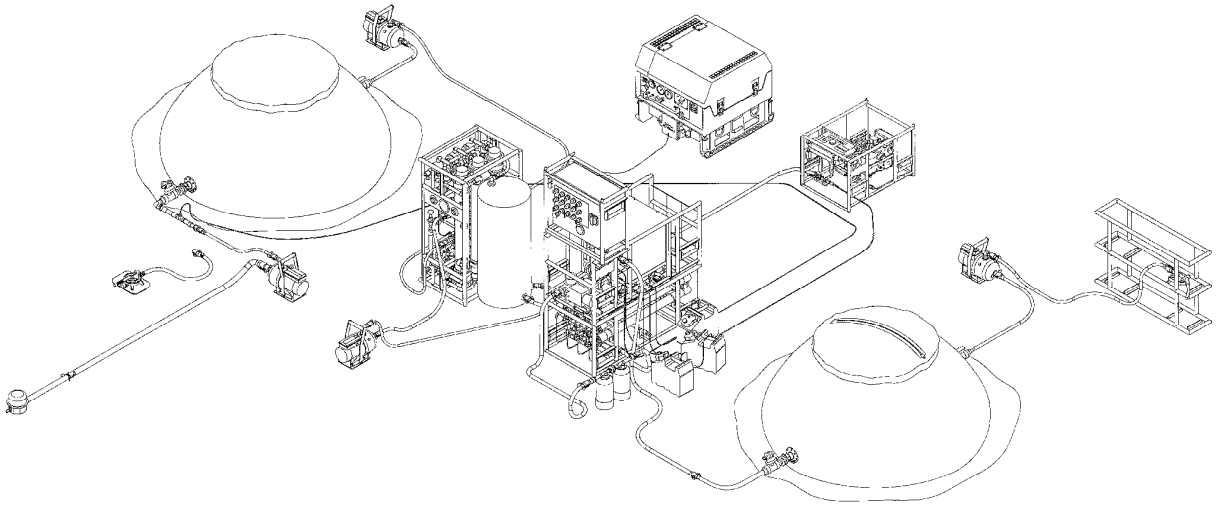
*TM 10-4610-310-13

TECHNICAL MANUAL

OPERATOR AND FIELD MAINTENANCE MANUAL

FOR

LIGHTWEIGHT WATER PURIFIER
PART NUMBER 7859MFG
NSN 4610-01-495-0046



*Supersedes TM 10 4610-310-14, 01 May 2005, including all changes.

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

HEADQUARTERS, DEPARTMENT OF THE ARMY
October 2009

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.

FIRST AID

FIRST AID instructions are given in FM 4-25.11, First Aid.

EXPLANATION OF SAFETY WARNING ICONS

HEAVY OBJECT - human figure stooping over heavy object shows physical injury potential from improper lifting technique.

HEAVY PARTS - heavy object pinning human figure against wall shows that heavy, moving parts present a danger to life or limb.

EAR PROTECTION – headphones over ears shows that noise level will harm ears.

ELECTRICAL – electrical wire to arm with electricity symbol running through body shows that shock hazard is present.

EYE PROTECTION – person with goggles shows that the material will injure the eye.

FIRE – flame shows that a material may ignite and cause burns.

HOT AREA – hand over object radiating heat shows that part is hot and can Burn.

EXPLANATION OF SAFETY WARNING ICONS – CONT'D

SLICK FLOOR – wavy line on floor with legs prone shows that slick floor presents a danger for falling.

VAPOR – human figure in a cloud shows that material vapors present a danger to health.

CHEMICAL – drops of liquid on hand shows that the material will cause burns or irritation to human skin or tissue.

POISON - skull and crossbones shows that a material is poisonous or is a danger to life.

EXPLOSION - rapidly expanding symbol shows that the material may explode if subjected to high temperatures, sources of ignition or high pressure.

SHARP OBJECT - pointed object in hand shows that a sharp object presents a danger to limb.

GENERAL SAFETY WARNING DESCRIPTION

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.

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.

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.

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.

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.

Two personnel are required to remove the diesel engine from the module frame. Serious injury to personnel could result.

The High Pressure pump is to be lifted by four personnel. Do not attempt to lift the HP pump with less than four personnel. Serious injury to personnel could result.

WARNING

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

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

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

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.

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

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.

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

All oil spills must be thoroughly wiped up. Oil spills present a possibility of slips and /or fall hazard to personnel. Serious injury to personnel could occur.

All diesel fuel spills must be thoroughly wiped up. Fuel spills present a possibility of slips and /or fall hazard to personnel. Serious injury to personnel could occur.

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.

Never attempt to start the generator if it isn't properly grounded. Consult the TQG technical manual for proper grounding procedures. Failure to observe this warning could result in personnel injury and/or death and damage to the equipment.

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 could result in severe burns or injury.

WARNING

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

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

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

WARNING

Use protective gloves for remaining steps in the instruction. Personal injury may result.

EXPLANATION OF HAZARDOUS MATERIALS ICONS

POISON - skull and crossbones shows that a material is poisonous or is a danger to life.

CHEMICAL – drops of liquid on hand shows that the material will cause burns or irritation to human skin or tissue.

EYE PROTECTION – person with goggles shows that the material will injure the eyes.

FIRE – flame shows that a material may ignite and cause burns.

VAPOR – human figure in a cloud shows that material vapors present a danger to health.

HAZARDOUS MATERIALS DESCRIPTION

WARNING

FUEL

Avoid prolonged contact with skin, eyes and clothing, do not use in enclosed spaces. Always wear goggles and gloves when handling fuel. Fuel is flammable and should not be used near open flame or heat source. No Smoking signs should be posted within 100 feet of the fuel drum. Fire extinguishers should be readily available at all times. All petroleum products contain additives that may be harmful to personnel and the environment. All leaks must be corrected as soon as possible. Wash fuel or oil from skin immediately. Remove and wash contaminated clothing immediately. Spills of fuel or oil must be cleaned up in accordance with local area direction to prevent harm to personnel or damage to the environment. Never operate the equipment with any Class of fuel leak. Serious injury or death may occur.

WARNING

SODIUM HYDROXIDE

Is very corrosive and can cause severe skin burns, permanent eye damage, and is harmful if ingested. All personnel safety equipment must be worn when handling this chemical. Use only in adequately ventilated areas, wear gloves, and eye protection when handling sodium hydroxide. Serious injury or death may occur.

CALCIUM HYPOCHLORITE

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

LIST OF EFFECTIVE PAGES/WORK PACKAGES

NOTE: Supersedes TM 10-4610-310-14, 01 May 2005. Zero in the “Change No.” column indicates an original page or work package.

Original 15 October 2009

TOTAL NUMBER OF PAGES FOR FRONT AND REAR MATTER IS 52 AND TOTAL NUMBER OF WORK PACKAGES IS 141 CONSISTING OF THE FOLLOWING:

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

LIST OF EFFECTIVE PAGES/WORK PACKAGES – continued

- Zero in this column indicates an original page.

Page/WP No.	*Change No.
WP 0075 (2)	0
WP 0076 (2)	0
WP 0077 (2)	0
WP 0078 (4)	0
WP 0079 (4)	0
WP 0080 (4)	0
WP 0081 (4)	0
WP 0082 (4)	0
WP 0083 (2)	0
WP 0084 (2)	0
WP 0085 (2)	0
WP 0086 (2)	0
WP 0087 (2)	0
Chapter 6 Title Page	
WP 0088 (4)	0
WP 0089 (2)	0
WP 0090 (2)	0
WP 0091 (12)	0
WP 0092 (2)	0
WP 0093 (4)	0
WP 0094 (4)	0
WP 0095 (6)	0
WP 0096 (8)	0
WP 0097 (4)	0
WP 0098 (2)	0
WP 0099 (4)	0
WP 0100 (6)	0
WP 0101 (4)	0
WP 0102 (6)	0
WP 0103 (2)	0
WP 0104 (4)	0
WP 0105 (2)	0
WP 0106 (2)	0
WP 0107 (2)	0
WP 0108 (20)	0
WP 0109 (4)	0
WP 0110 (10)	0
WP 0111 (2)	0
WP 0112 (4)	0
WP 0113 (2)	0
WP 0114 (2)	0
WP 0115 (2)	0
WP 0116 (4)	0
WP 0117 (2)	0
WP 0118 (6)	0
WP 0119 (4)	0
WP 0120 (2)	0
WP 0121 (4)	0
WP 0122 (8)	0
WP 0123 (6)	0
WP 0124 (4)	0
WP 0125 (2)	0
WP 0126 (8)	0
WP 0127 (10)	0
WP 0128 (2)	0
WP 0129 (4)	0
WP 0130 (4)	0
WP 0131 (2)	0
WP 0132 (8)	0
WP 0133 (4)	0
WP 0134 (2)	0
Chapter 7 Title Page	
WP 0135 (2)	0
WP 0136 (4)	0
WP 0137 (12)	0
WP 0138 (26)	0
WP 0139 (4)	0
WP 0140 (2)	0
WP 0141 (2)	0

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 15 October 2009

TECHNICAL MANUAL

OPERATOR AND FIELD MAINTENANCE MANUAL

FOR

LIGHTWEIGHT WATER PURIFIER
PART NUMBER 7859MFG
NSN 4610-01-495-0046

REPORTING ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find any errors, or if you would like to recommend any improvements to the procedures in this publication, please let us know. The preferred method is to 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 https://aeps.ria.army.mil. The DA Form 2028 is located under the Public Applications section on the AEPS public home page. Fill out the form and click on SUBMIT. Using this form on the AEPS site will enable us to respond to your comments quicker and to manage the DA Form 2028 program better. You may also mail, email, or fax your comments or DA Form 2028 directly to the U.S. Army TACOM Life Cycle Management Command. The postal address is U.S. Army TACOM Life Cycle Management Command, ATTN: AMSTA-LCL-MPP/ TECH PUBS, 1 Rock Island Arsenal, Rock Island, IL 61299-7630. The email address is tacomlcmc.daform2028@us.army.mil. The fax number is DSN 793-0726 or Commercial (309) 782-0726.

*Supersedes TM 10 4610-310-14, 01 May 2005, including all changes.

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

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

Chapter 2 OPERATOR INSTRUCTIONS –continued

WP Sequence No.

Chapter 3 TROUBLESHOOTING (OPERATOR)

Chapter 4 OPERATOR MAINTENANCE INSTRUCTIONS

TABLE OF CONTENTS - continued

Chapter 5 TROUBLESHOOTING (FIELD)

WP Sequence No.

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS

TABLE OF CONTENTS - continued

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS –continued

Chapter 7 SUPPORTING INFORMATION

LIST OF ILLUSTRATIONS

Chapter 1 INTRODUCTION

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS - continued

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS - continued

LIST OF ILLUSTRATIONS - continued

Chapter 2 OPERATOR INSTRUCTIONS - continued

Chapter 4 OPERATOR MAINTENANCE INSTRUCTIONS

LIST OF ILLUSTRATIONS - continued

Chapter 4 OPERATOR MAINTENANCE INSTRUCTIONS - continued

LIST OF ILLUSTRATIONS - continued

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS

LIST OF ILLUSTRATIONS - continued

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS - continued

LIST OF ILLUSTRATIONS - continued

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS - continued

Figure No. Title **WP Sequence No./Page No.**

LIST OF ILLUSTRATIONS - continued

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS - continued

LIST OF ILLUSTRATIONS - continued

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS - continued

LIST OF TABLES

Chapter 2 OPERATOR INSTRUCTIONS

LIST OF TABLES- continued

Chapter 2 OPERATOR INSTRUCTIONS

Chapter 4 OPERATOR MAINTENANCE INSTRUCTIONS

Chapter 5 TROUBLESHOOTING (FIELD)

Chapter 6 FIELD MAINTENANCE INSTRUCTIONS

LIST OF TABLES- continued

Chapter 7 SUPPORTING INFORMATION

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 7 essential chapters. They are organized as follows:

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

Operator Level Procedures
Chapter 2 Operator Instructions (WP 0004-WP 0022)
Chapter 3 Troubleshooting Procedures (WP 0023-WP 0036)
Chapter 4 Maintenance Instructions (WP 0037-WP 0052)

FIELD Level Procedures
Chapter 5 Troubleshooting Procedures (WP 0053-WP 0086)
Chapter 6 Maintenance Instructions (WP 0087-WP 0131)

Supporting Information
Chapter 7 Supporting Information (WP 0132-WP 0138)

NOTE

All work packages are sets of instructions covering a particular task. Work package 0011 and 0012 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 0011) and complete set up of the remaining components (WP 0012). This is done to ensure the most efficient use of set up time. Upon completion of set up in WP 0011, the settling tank will be filling up. In the mean time, the information in WP 0012 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.

HOW TO REPAIR THE LWP - continued

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 10-4610-310-23P (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 10-4610-310-23P 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

GENERAL INFORMATION, EQUIPMENT DESCRIPTION AND THEORY OF OPERATION FOR LIGHTWEIGHT WATER PURIFIER

OPERATOR AND FIELD 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 and Field 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 750-8, 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 750-8, 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 750-8.

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 DEPLETEING 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/ΔP	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
kg	Kilogram
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
M	Meter
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
TMP	Trans-Membrane Pressure
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 0039.

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 10-4610-310-23P. 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 (Field). The specialist should communicate what the problem is and the part or parts involved. See DA PAM 750-8, 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.

COPYRIGHT 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 AND FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
EQUIPMENT DESCRIPTION AND DATA

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 -25º F (-32º C) and 120º F (49ºC). At freezing temperatures, a cold weather kit is necessary (See WP 0015). At temperature higher than 120º F (49º C). The LWP may not function properly due to possible decrease in power output from the 3 kW TQG.

Lightweight Water Purifier

- Complete LWP unit weighs less than 1833 lbs. (831.45 kg) without cold weather kit, 1995 lbs. (904.93 kg) 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.

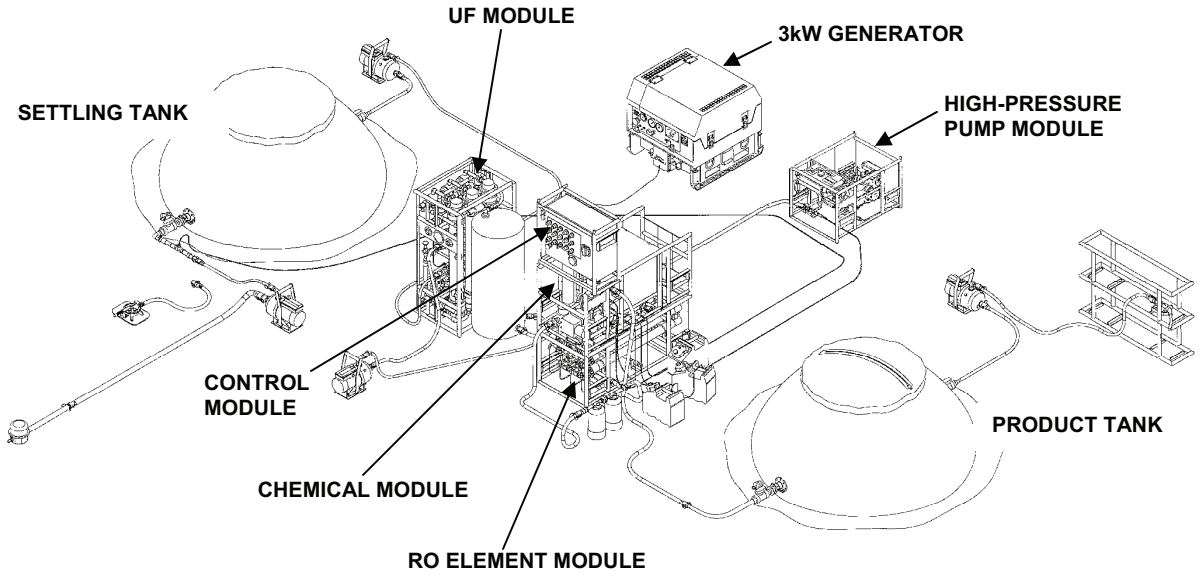


Figure 1. Lightweight Water Purifier Field Setup.

- Automated, backwash cycles every 15 minutes, 30 seconds each UF cartridge
- Produces 125 gph (473.13 l/h) from freshwater and 75 gph from saltwater 20,000 mg/l.
- Treats raw water to 60,000 milligrams per Liter (mg/l or ppm) at a reduced flow rate
- Uses titanium pressure vessels on RO element module
- Overall power requirements are 240 volts/60 Hertz and 120 volts/60 Hertz

Collapsible Fabric Tank

- 1000 gal (3780 l) 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 Pumps Co
Model	CHI2-30
Service	Water

HIGH-PRESSURE PLUNGER PUMP

Manufacturer	Cat Pumps
Model	3CP1211G
Service	Water
Rated Output	3.8 gpm(14.38 l/m)
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

LTRAFILTRATION CARTRIDGES

Manufacturer	Koch Corporation
Model	HF82-35-PM
Type	Hollow Fiber
Size	5 in. x 45 in. (12.7 cm x114.3 cm)
Membrane surface	75 sq ft. (6.97 sq m)

REVERSE OSMOSIS ELEMENTS

Manufacturer	FilmTec
Model	SW30-2540
Type	Spiral Wound
Size	2.5 in. x 40 in. (6.36 cm x 102.6 cm)
Membrane surface	30 sq ft. (2.79 sq m)

ELECTRONIC METERING PUMPS (CHEMICAL INJECTION)

Manufacturer	LMI Milton Roy
Model	LMI A 141-352SI
Current	230 VAC
Maximum gph	0.58 gph (2.20 l/h)
Maximum psi	250 psi (17.2 bar)

COLLAPSIBLE FABRIC TANKS

Manufacturer	Bell Avon Inc.
Model	BA02-452
Capacity	1000 gal (3785 l)
Fittings	2 @ 2 in. (5.08 cm)

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 ULTRAFILTRAQTION MODULE

The LWP UF module is a welded aluminum pipe frame that houses the three membrane cartridges. There are seven solenoid valves (two configurations), holes are drilled in the top bank of valves to allow a small amount of reject through the cartridges, 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 in. (1.3 m) High
28 in. (.71 m) Long
36 in. (.92 m) Wide
Weight: 198.4 lbs. (89.9 kg)

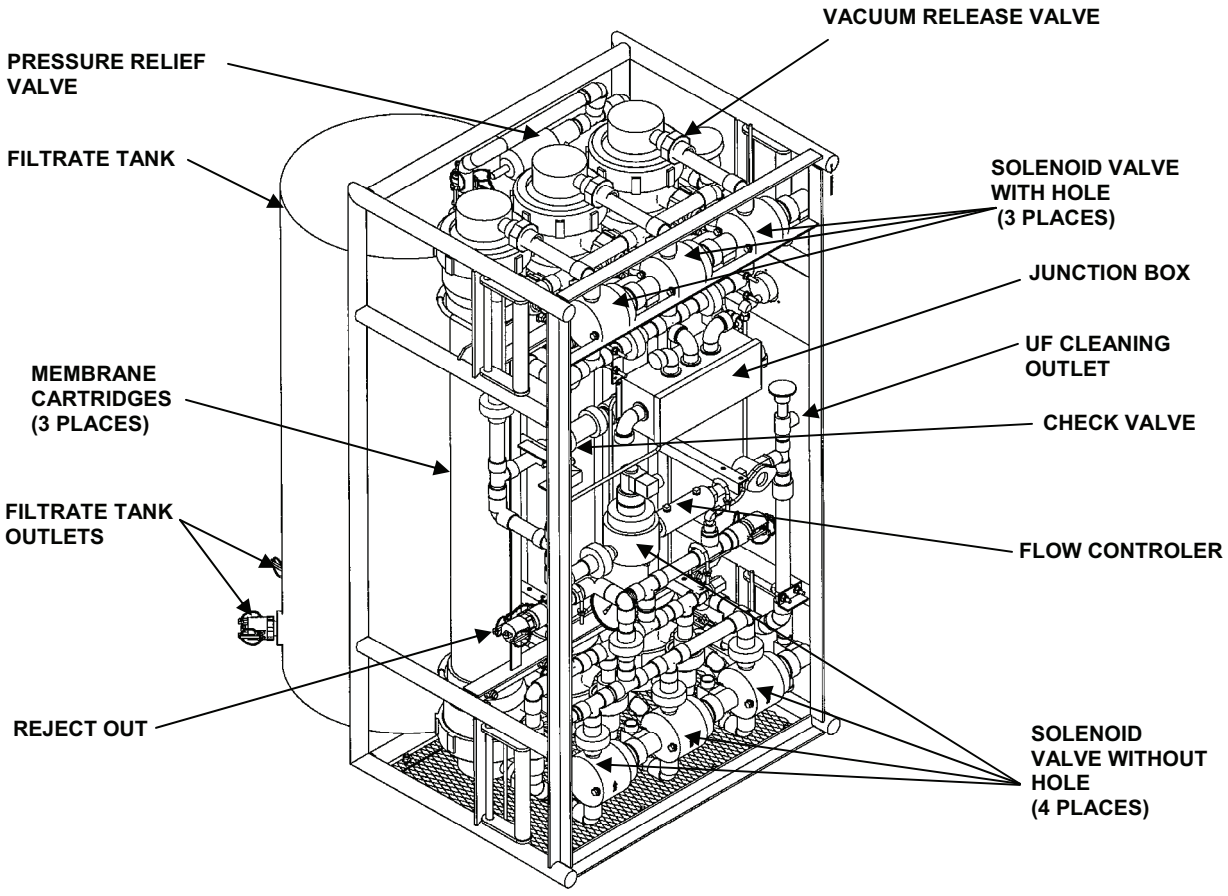


Figure 2. Ultrafiltration Module (Back and Left Side).

LWP ULTRAFILTRATION MODULE – continued

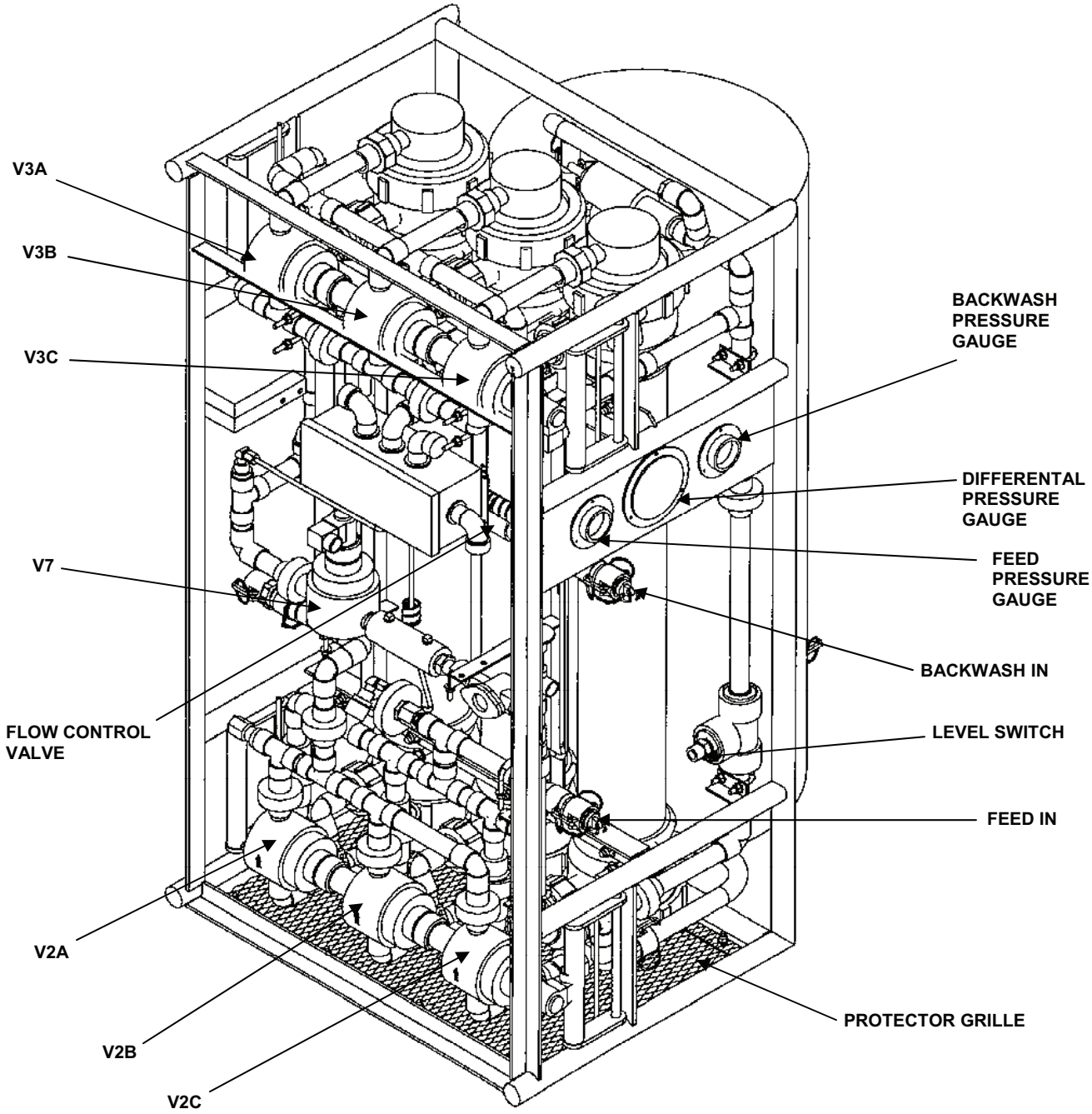


Figure 3. Ultrafiltration Module (Front and Left Side).

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 gal. (13.25 l) 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 psi (151.72 bars). A flow meter 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 in. (.64 m) High
38 in. (.96 m) Long
28 in. (.71 m) Wide
Weight: 181.7 lbs. (82.4 kg)

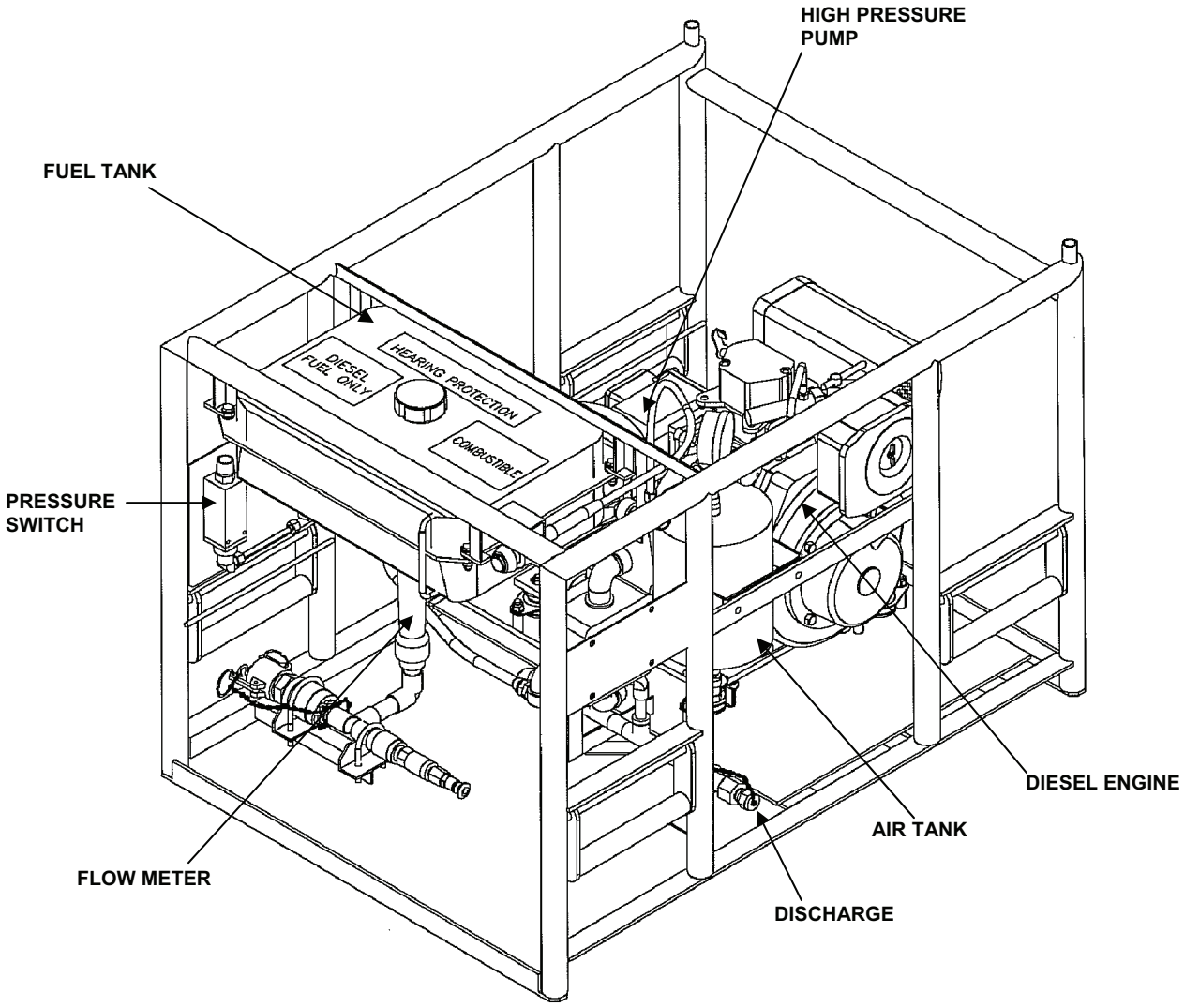


Figure 4. High – Pressure Pump Module (Rear).

LWP HIGH – PRESSURE PUMP MODULE – continued

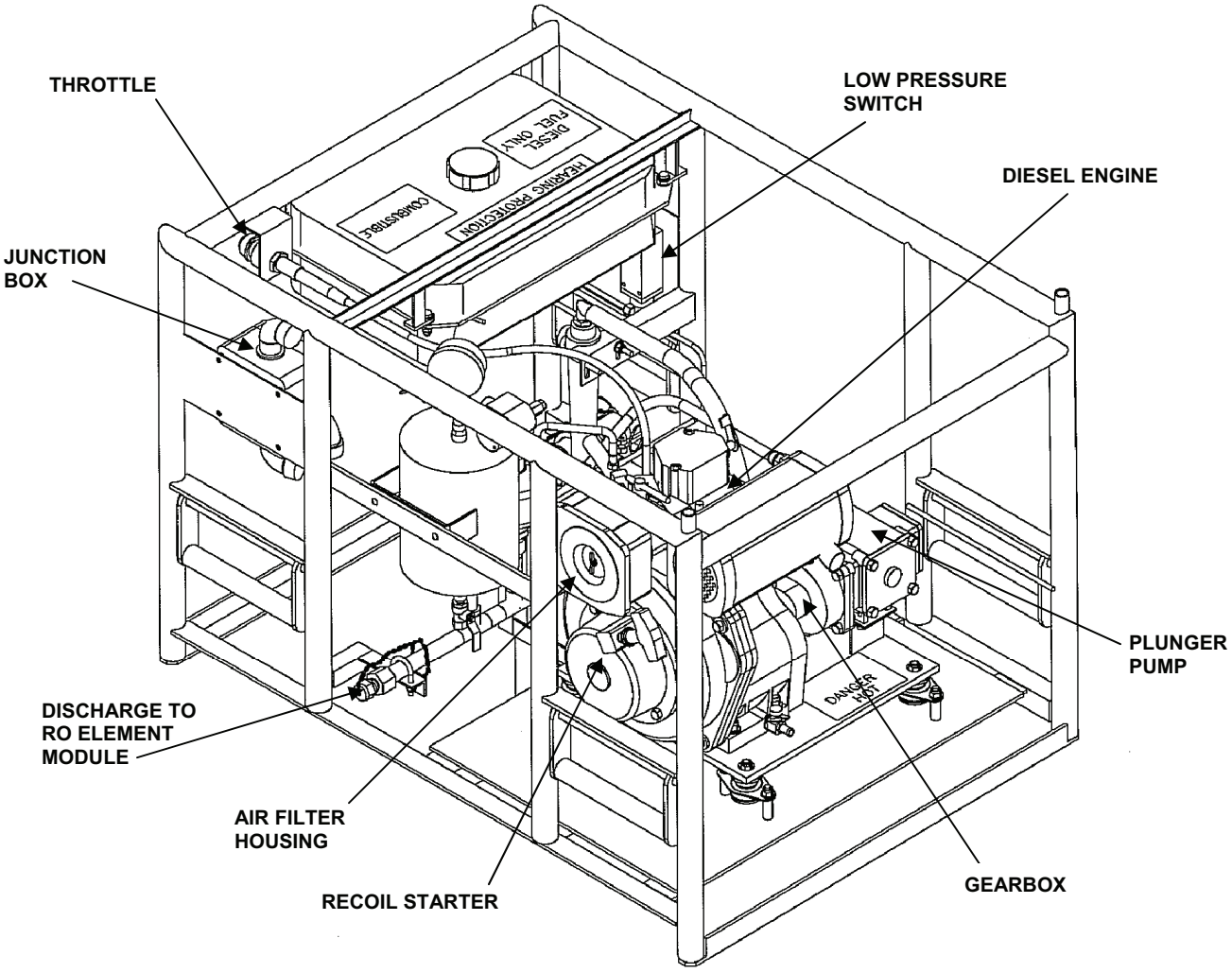


Figure 5. High – Pressure Pump Module (Front).

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 (HEAMP) 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 in. (.66 m) High
13 3/16 in. (.33 m) Long
28 in. (.71 m) Wide
Weight: 79 lbs. (35 kg)

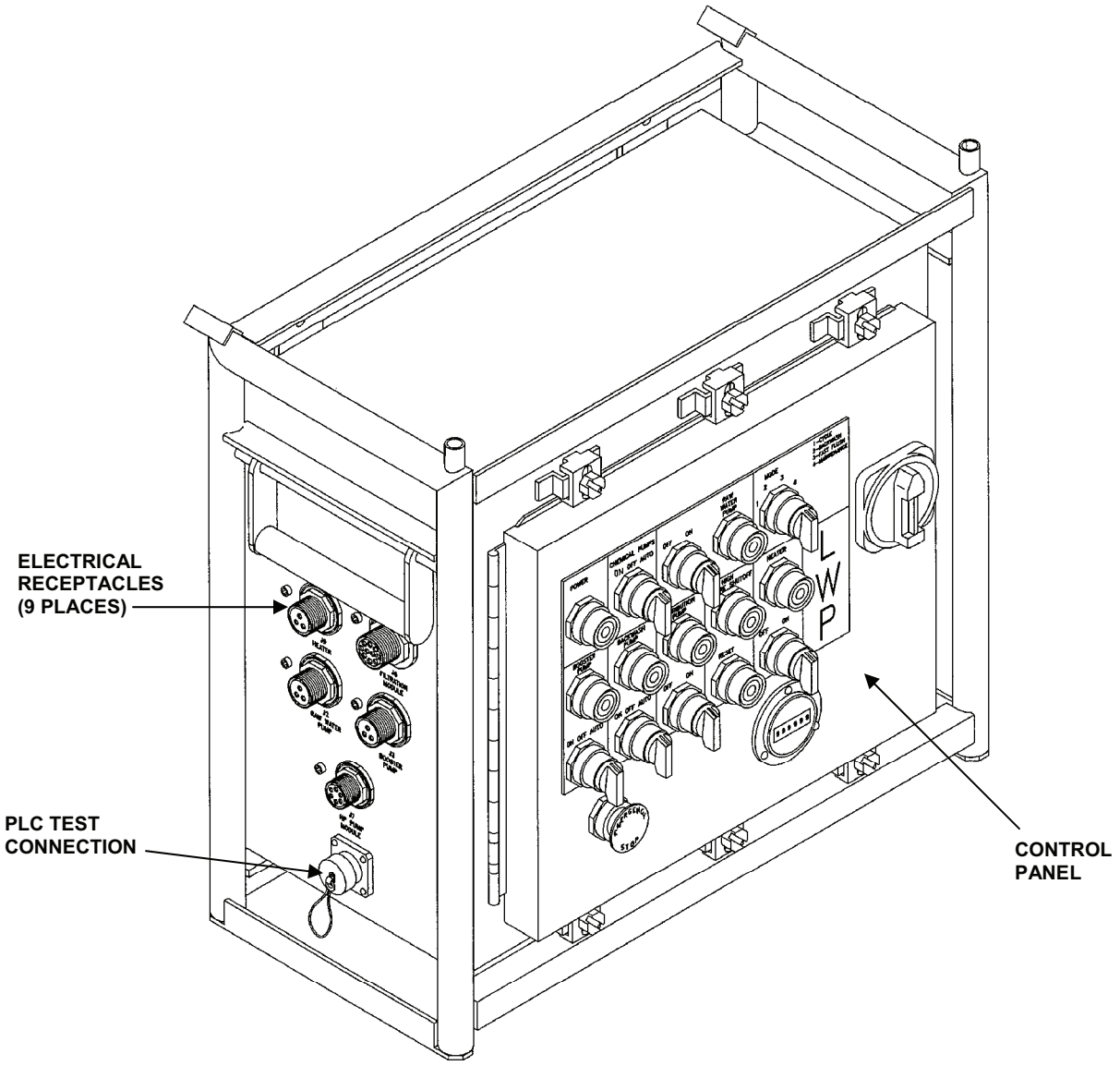


Figure 6. Control Module.

LWP CONTROL MODULE – continued

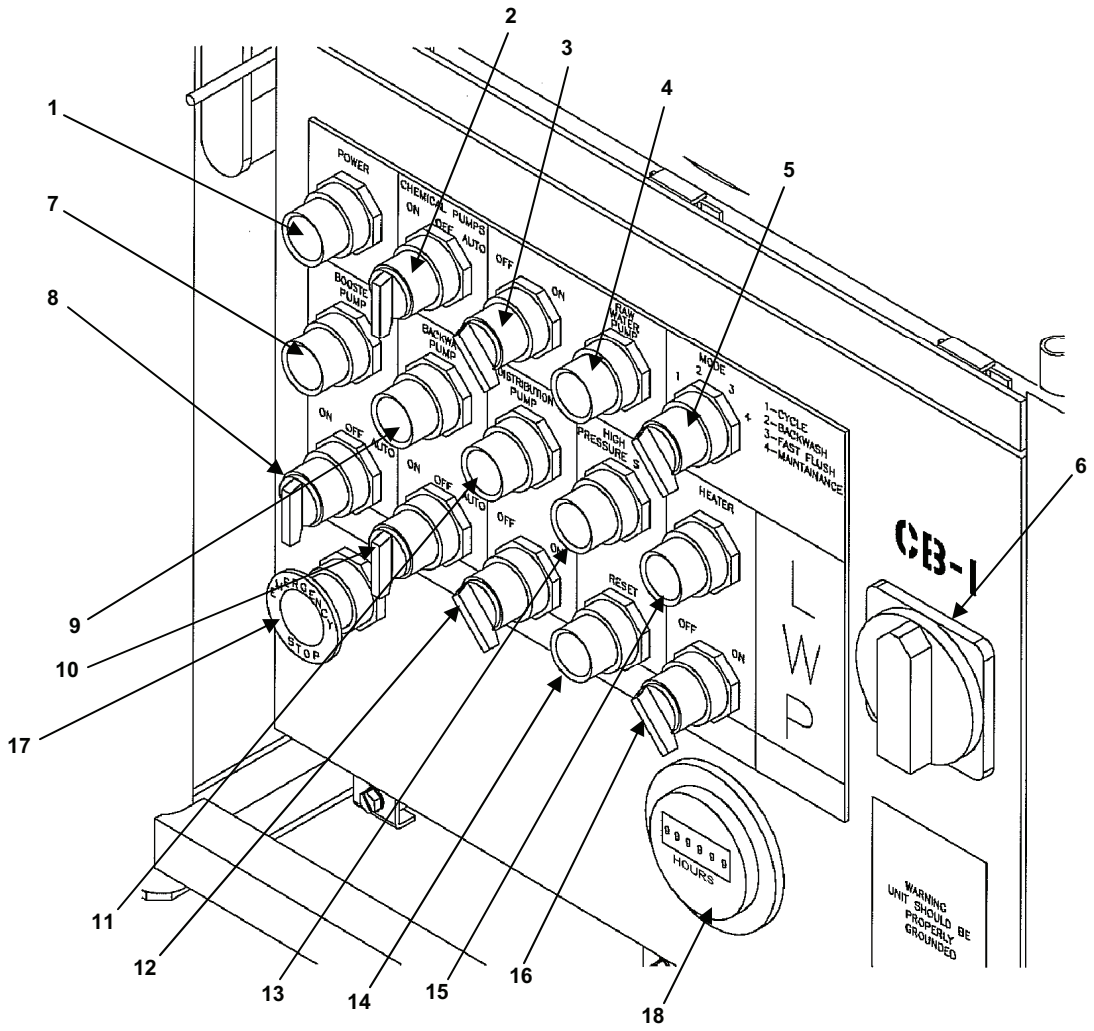


Figure 7. Electrical Control Panel on Control Module.

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

REVERSE OSMOSIS ELEMENT MODULE

The RO element module is a welded aluminum pipe frame that houses seven seawater RO elements in titanium pressure vessel 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 in. (.65 m) High
51 ¼ in. (1.30 m) Long
24 in. (.61 m) Wide
Weight: 197.6 lbs (89.63 kg) with membranes installed

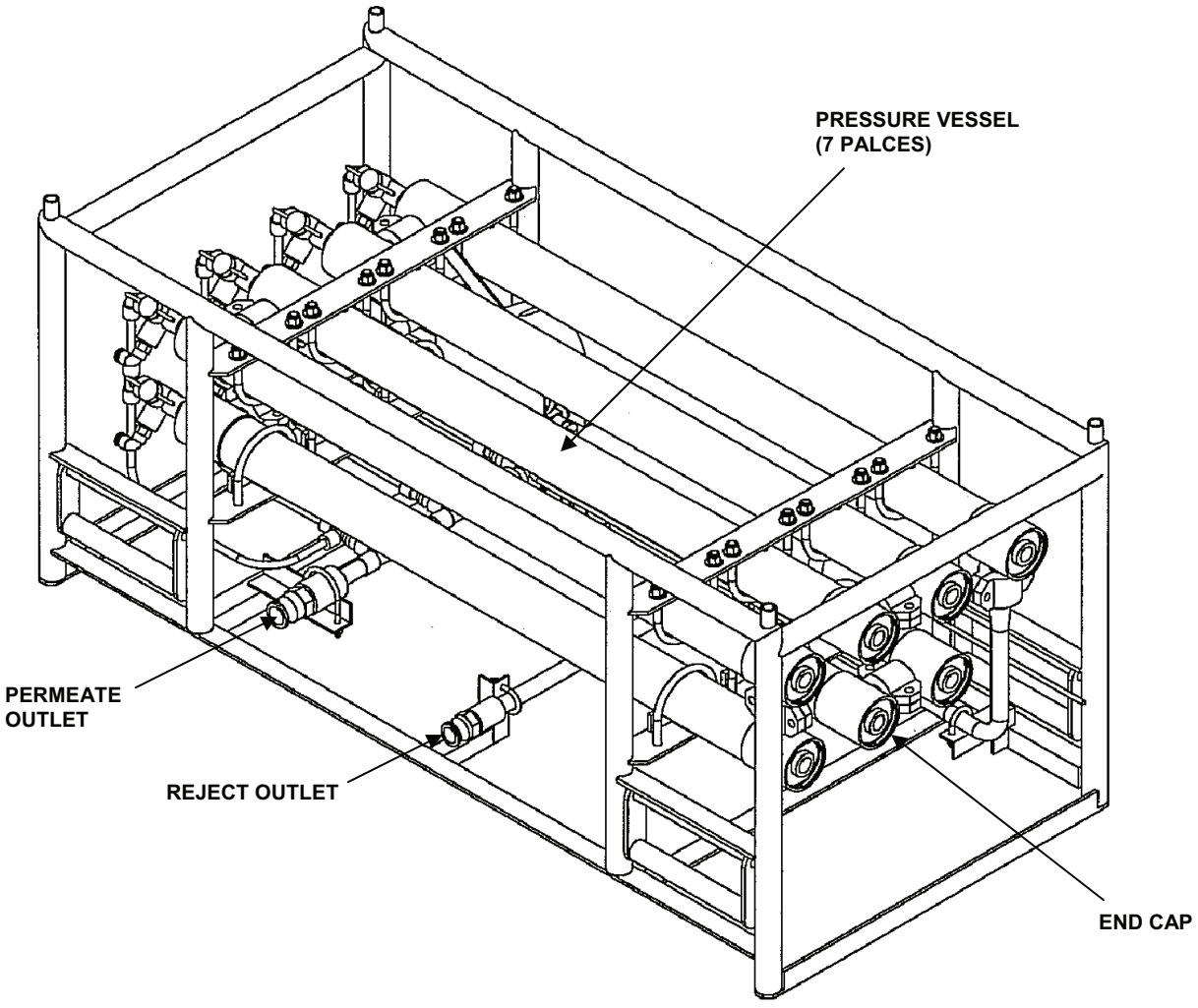


Figure 8. Reverse Osmosis Element Module (Back and Left Side).

REVERSE OSMOSIS ELEMENT MODULE – continued

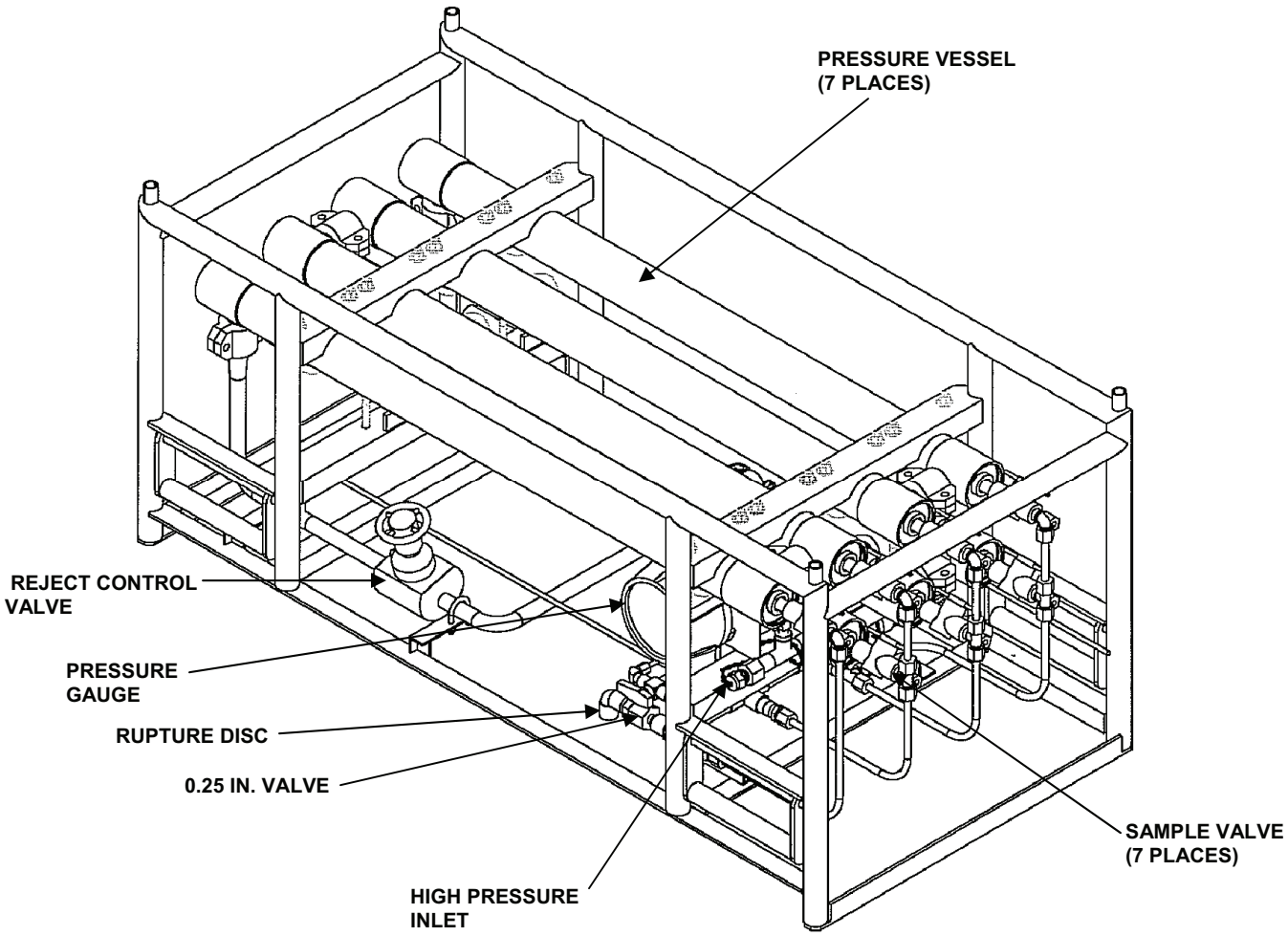


Figure 9. Reverse Osmosis Element Module (Front and Left Side).

LWP CHEMICAL INJECTION/CLEANING MODULE

The chemical injection/cleaning module is a welded aluminum pipe frame that houses a 20 gal. (75.7 l) Cleaning 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 gal (9.46 l) tanks for the chemicals that are placed adjacent to the module. The 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 in. (.66 m) High
51 ¼ in. (1.30 m) Long
24 in. (.61 m) Wide
Weight: 117.2 lbs. (53.16 kg)

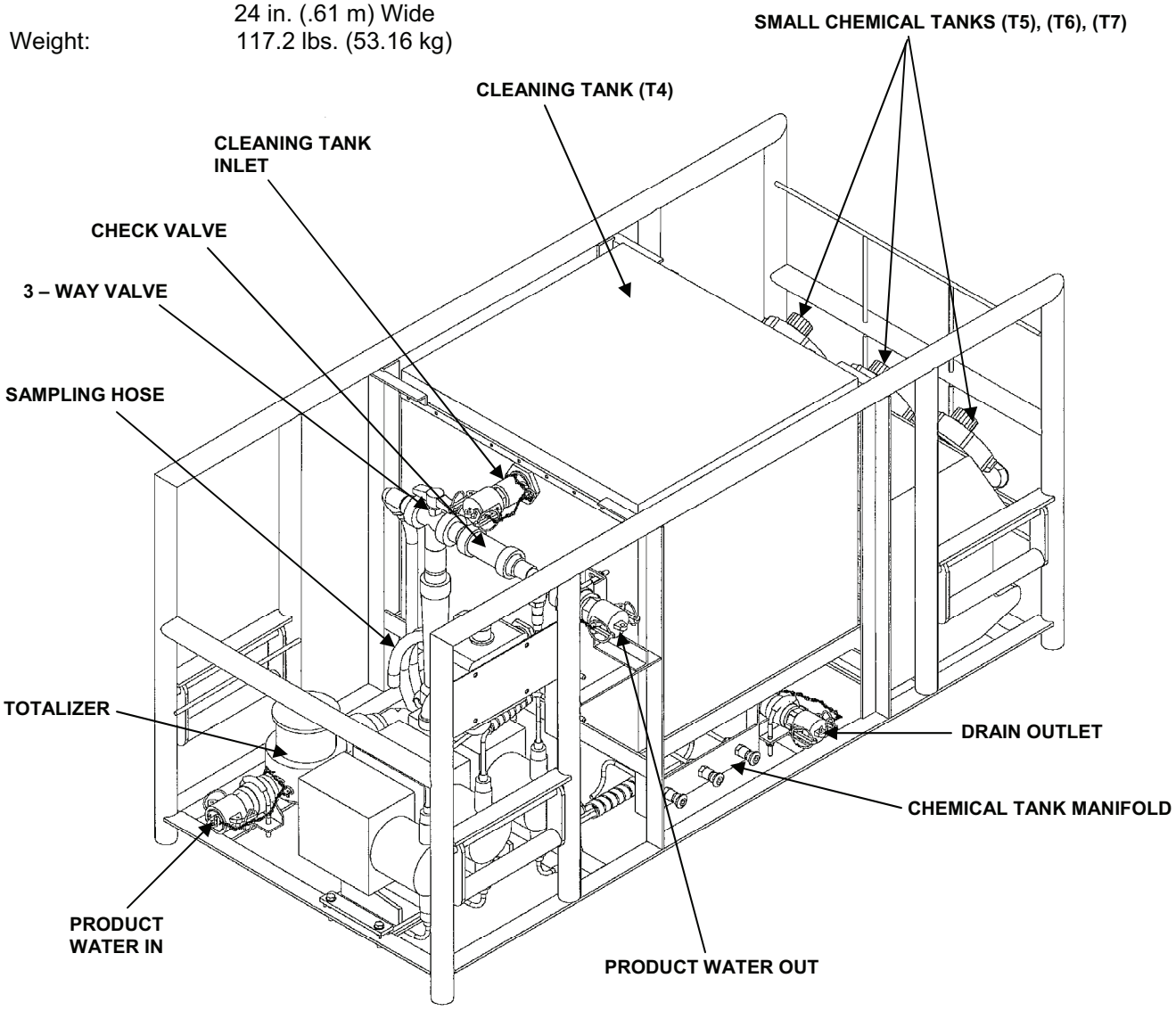


Figure 10. LWP Chemical Injection/Cleaning Module (Front and Right Side).

LWP CHEMICAL INJECTION/CLEANING MODULE – continued

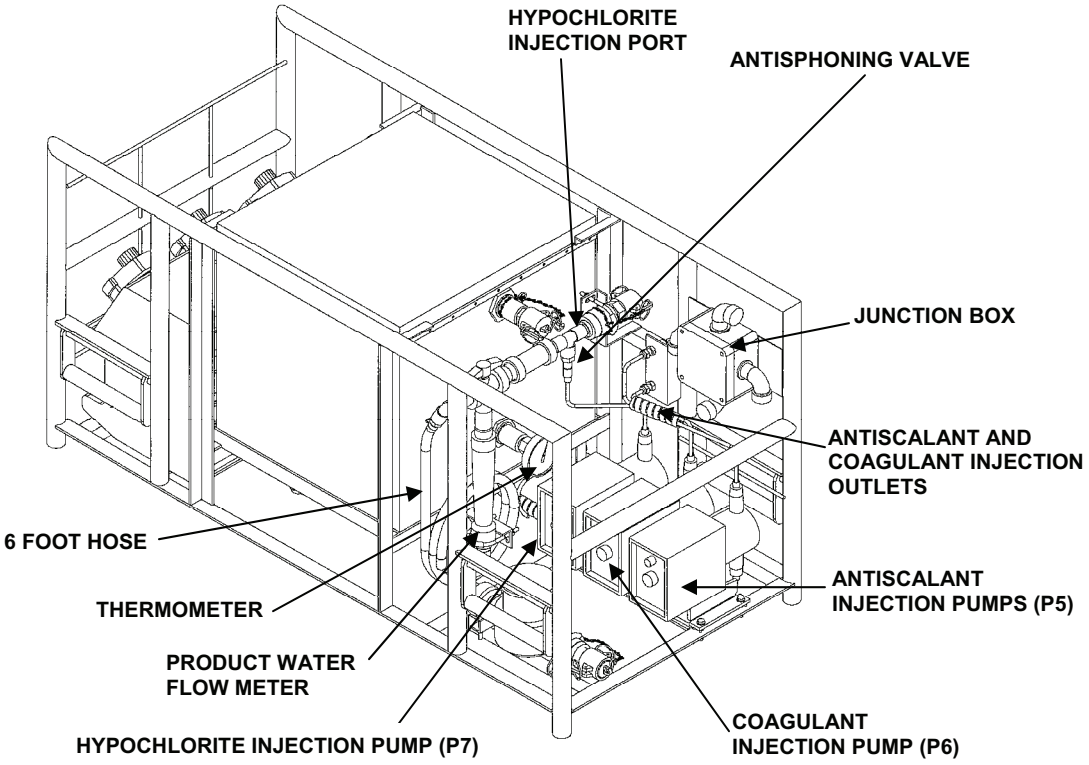


Figure 11. LWP Chemical injection/Cleaning Module (Front and Left Side).

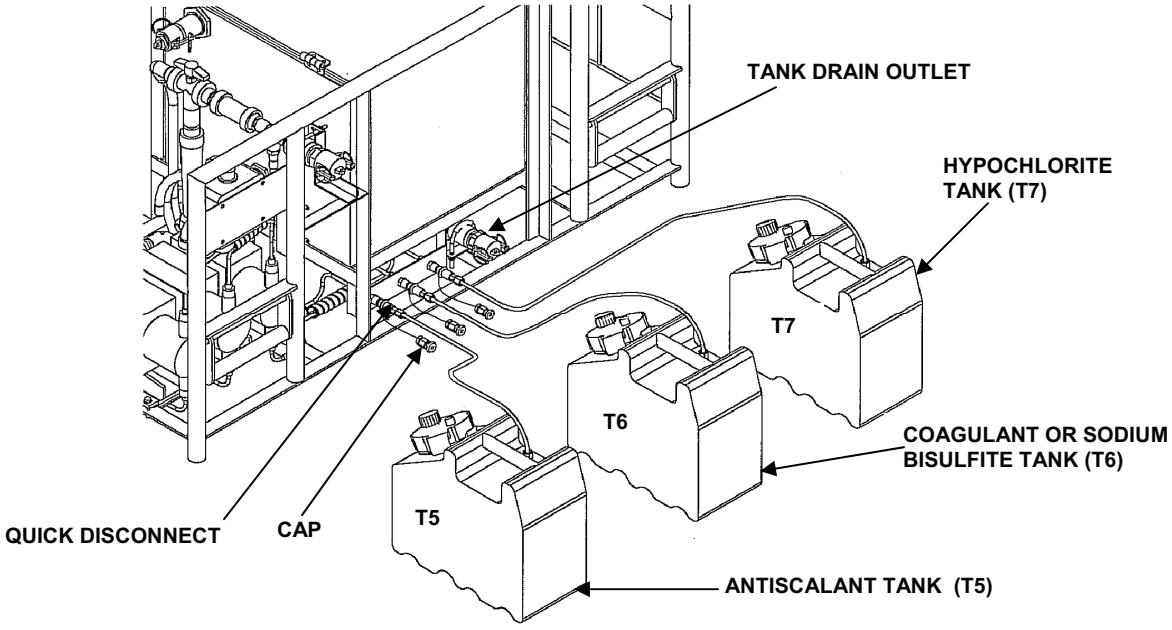


Figure 12. Chemical Injection/Cleaning Module Chemical Tanks.

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 in (.67 m) High
34.8 in. (.87 m) Long
27.8 in. (.70 m) Wide
Weight: 334 lbs. (151.5 kg)

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

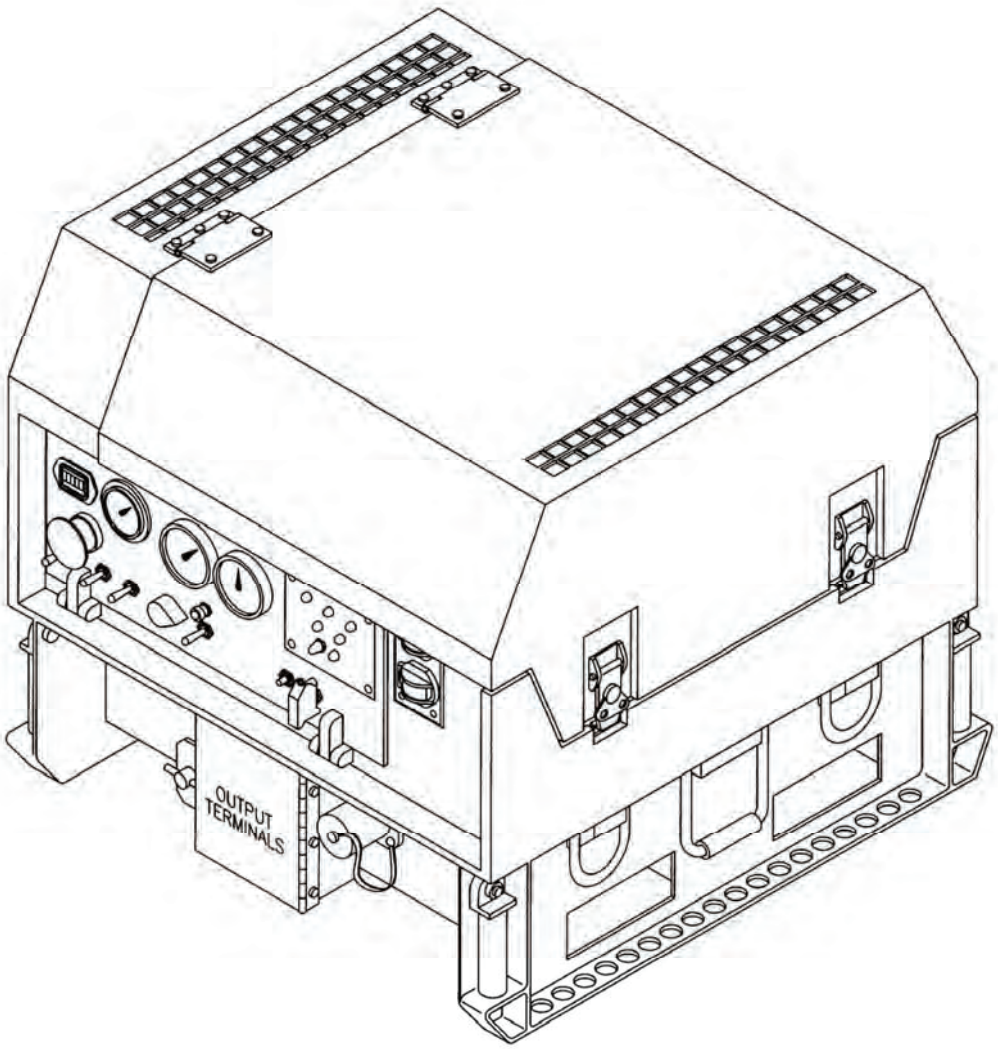


Figure 13. 3kW Tactical Quiet Generator (TQG) Set.

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 (10 bar). See Figure 14 and Figure 15.

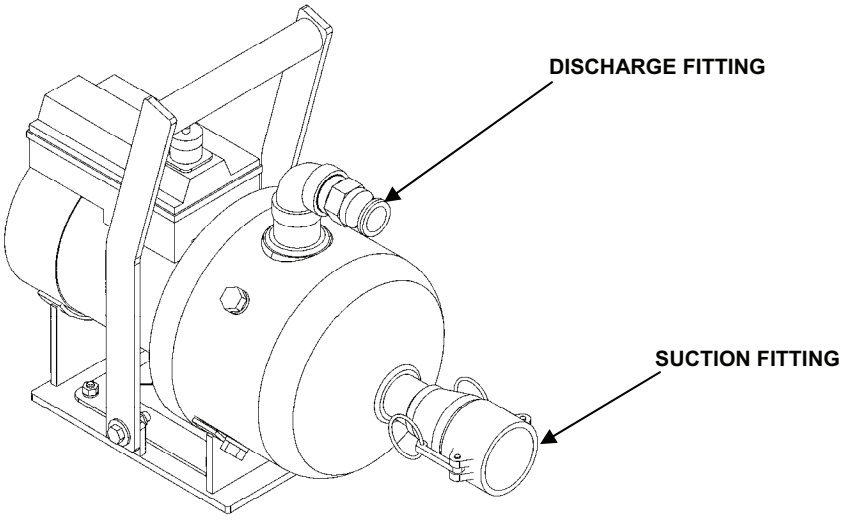


Figure 14. Service Pump (Raw Water).

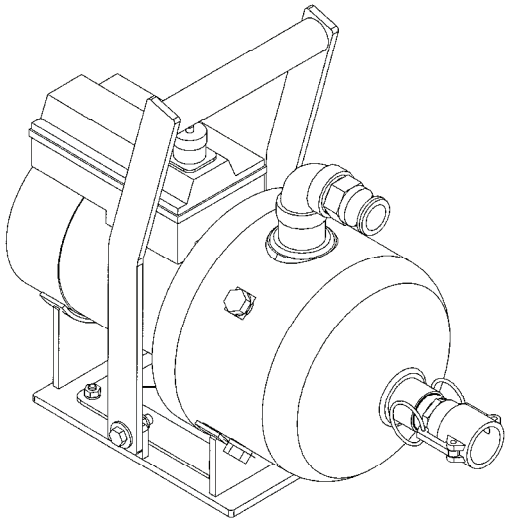


Figure 15. Service Pump (Booster, Backwash, and Distribution).

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/Durable Items, and one box that holds the Basic Issue Items (BII) required for 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 0135.

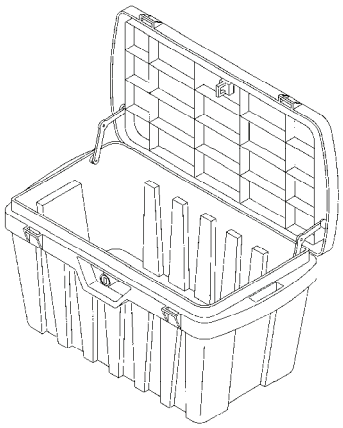


Figure 16. Basic Issue Items/Components of End Item/Cold Weather Kit Boxes.

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.

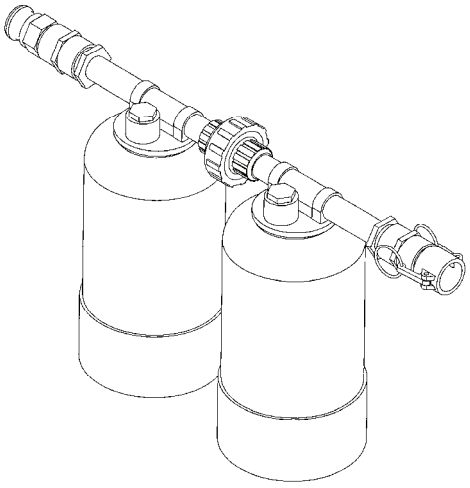


Figure 17. Nuclear, Biological, and Chemical (NBC) Canister.

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.

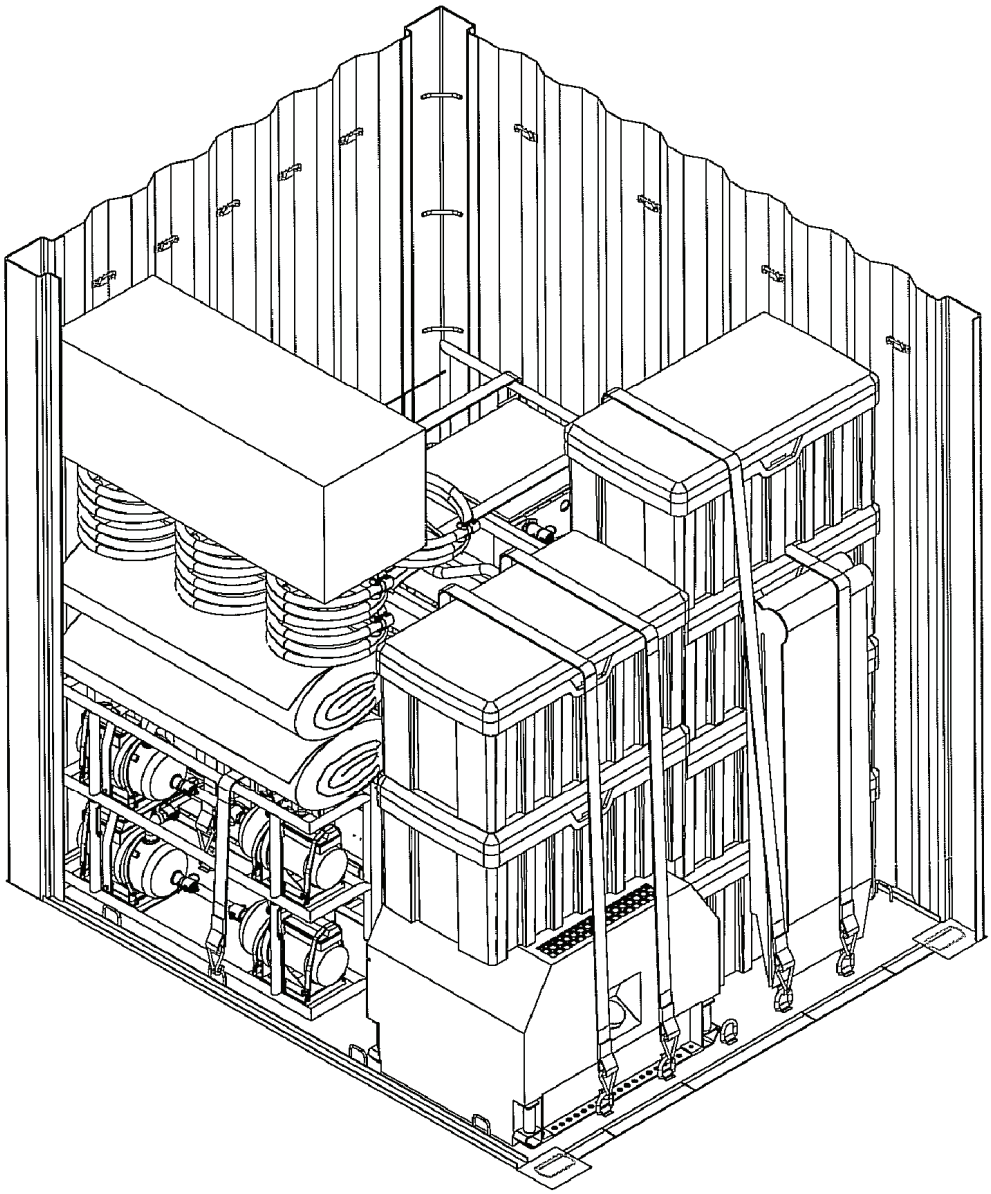


Figure 18. TRICON

ADDITIONAL EQUIPMENT – continued

Contamination Avoidance Covers (CAC)

The fabric (CACs) are placed on the modules to prevent NBC contamination of equipment and eliminate airborne contaminates. 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.

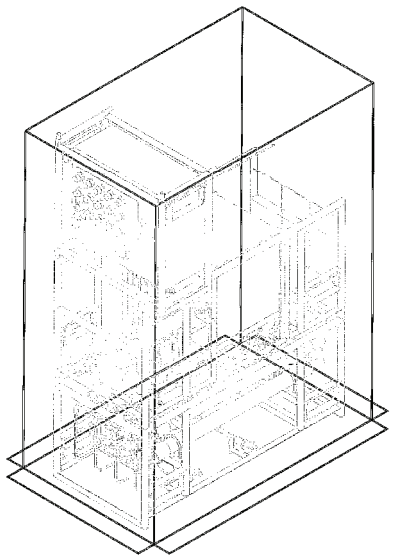


Figure 19. Contamination Avoidance Cover (Control Module/Chemical Module/RO Module).

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 gal. (3785 l) 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

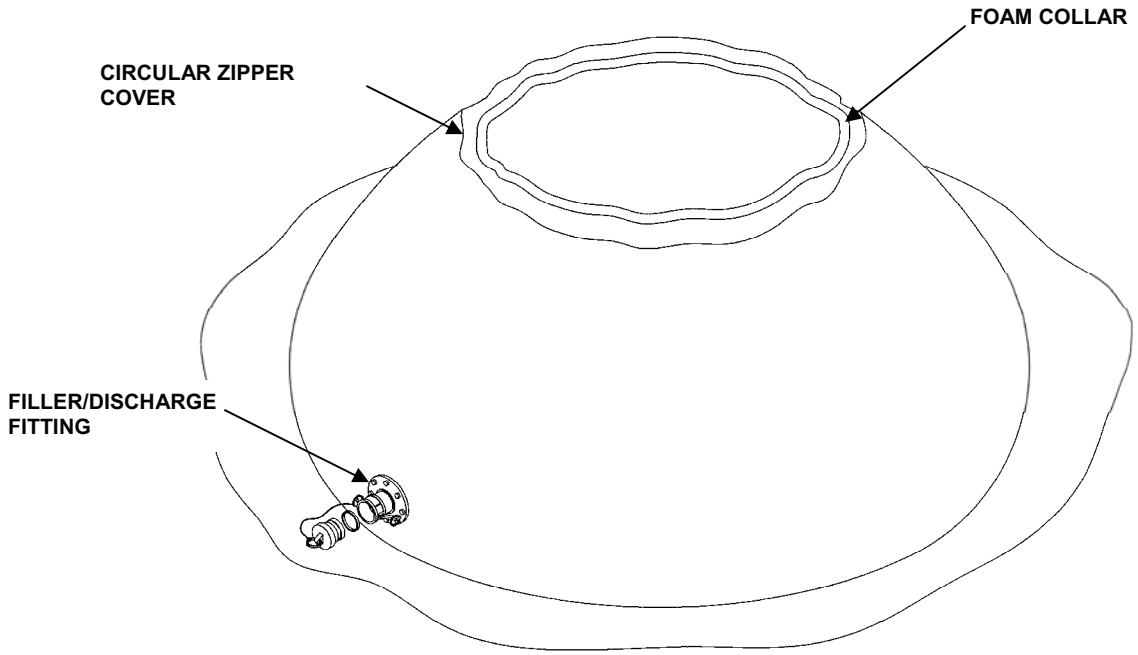


Figure 20. Settling Collapsible Fabric Tank.

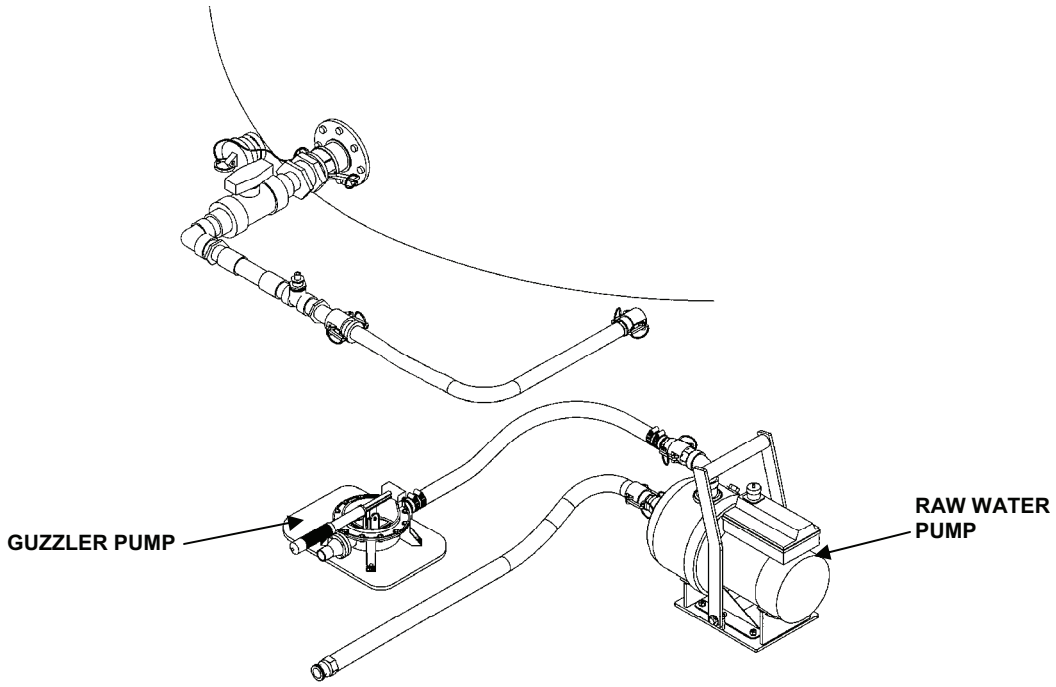


Figure 21. Settling Tank Inlet Fitting Field Setup.

ADDITIONAL EQUIPMENT – continued

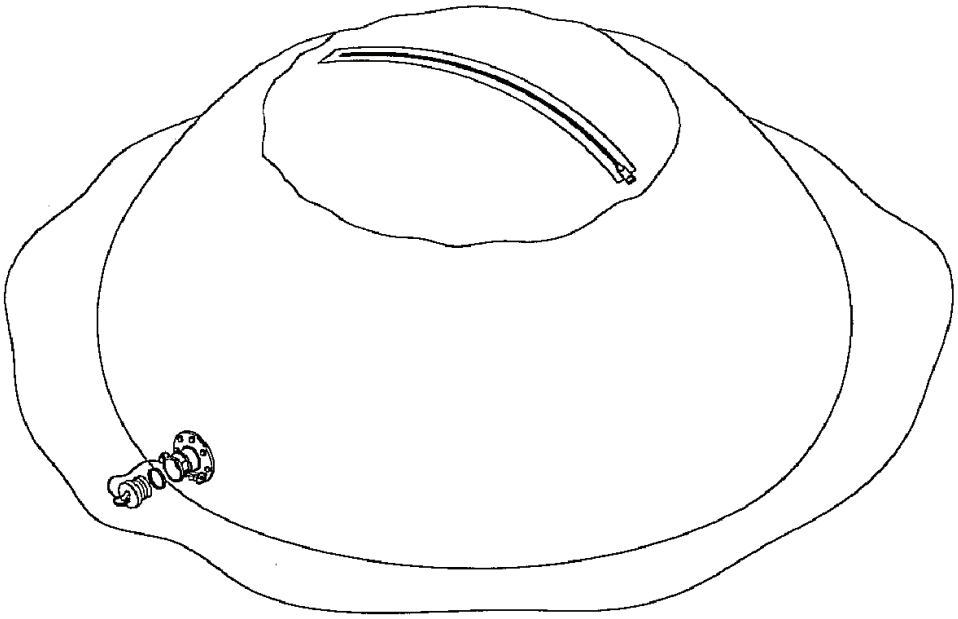


Figure 22. Product Collapsible Fabric Tank.

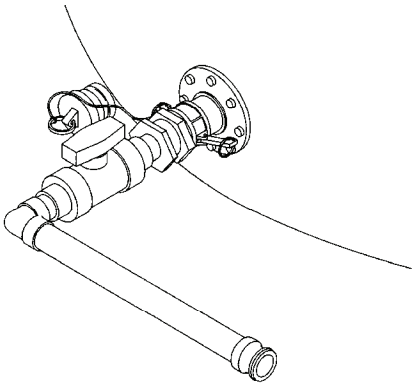


Figure 23. Inlet (Filler) Fitting.

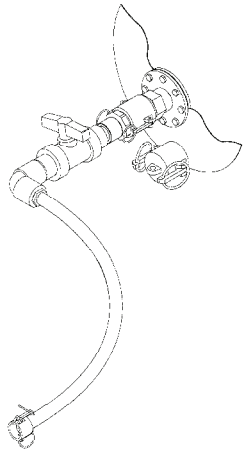


Figure 24. Outlet (Discharge) Fitting.

ADDITIONAL EQUIPMENT – continued

Cold Weather Kit (CWK)

The cold weather kit is used when the ambient temperature is expected to be 32º F (0º 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 ft. (7.62 m) 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 ft. (15.24 m) 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 ft. (7.62 m) 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 ft. (5..22 m) 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.

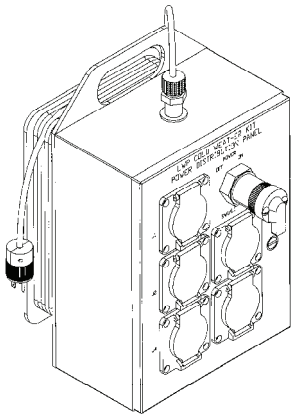


Figure 25. Power Distribution Panel.

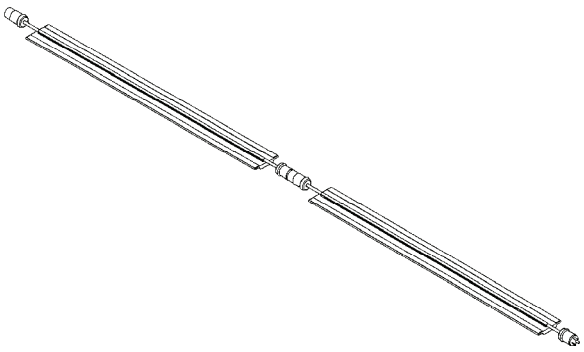


Figure 26. Electric Thermal Blankets.

ADDITIONAL EQUIPMENT – continued

Hand Truck

A four – wheeled hand truck capable of handling 500 lbs. (226.8 kg) 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 ¾ ton, 4X4 High Mobility Multipurpose Wheeled Vehicle (HMMWV) in conjunction with a foldable ramp. See Figure 27.

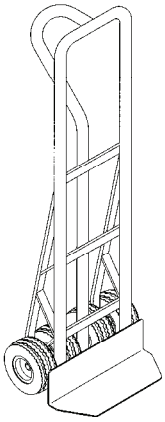


Figure 27. Hand Truck.

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 600lb. (272.16 kg).

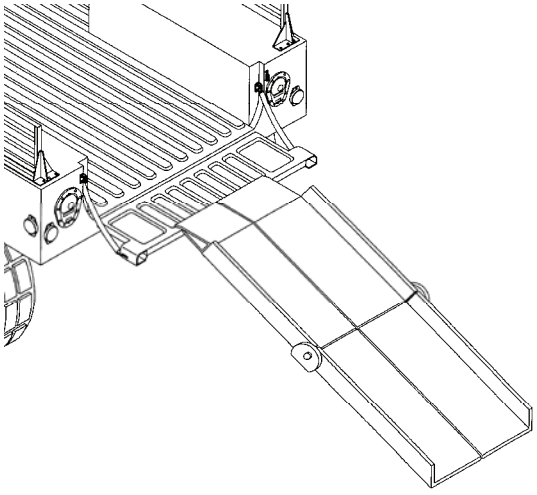


Figure 28. Foldable Ramp.

ADDITIONAL EQUIPMENT – continued

Turbidity Meter

A battery operated turbidity meter is provided for measuring the turbidity of the source water. The covers a 0 to 1000 Formazine Turbity 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.

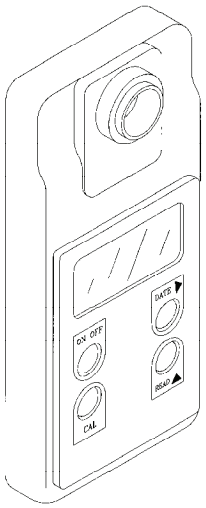


Figure 29. Turbidity Meter.

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 ± 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.

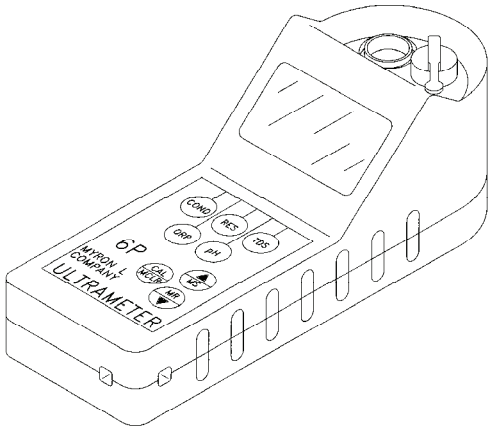


Figure 30. Conductivity, pH, and TDS Meter.

END OF WORK PACKAGE

OPERATOR AND FIELD 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 gph (473.13 l/h) from a fresh water (less than 20,000 ppm source water) and 75 gph 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 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**

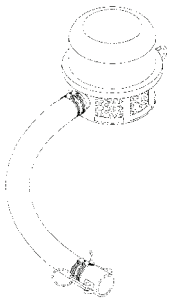


Figure 1. Raw water strainer.

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 in. (3.18 cm) diameter, 25 ft. (7.62 m) 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 in. (3.18 cm) 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.

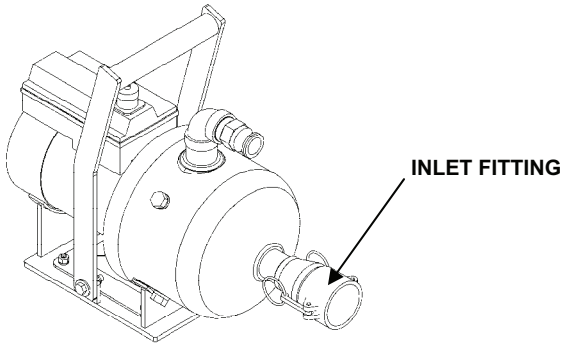


Figure 2. Raw water pump.

4. Settling Tank

The 1000 gal (3785 l) 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 gal (3785 l) 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 serves as a second pass reservoir when treating contaminated water source. See WP 0020.

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 ¾ in. (1.91 cm) polypropylene fittings.

NOTE

For a complete listing of hoses used, refer to Table 1 in WP 0012.

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 gal (151.4 l) (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). Sodium Meta 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 gal (3785 l) 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 (6.308 l/sec) 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 gal (3785 l) 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.

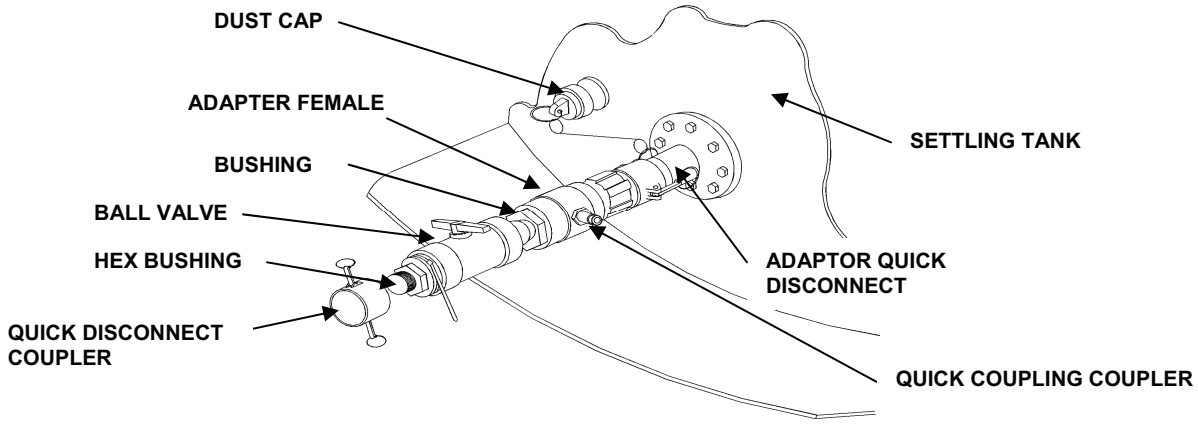


Figure 4. Settling tank inlet spool piece.

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.

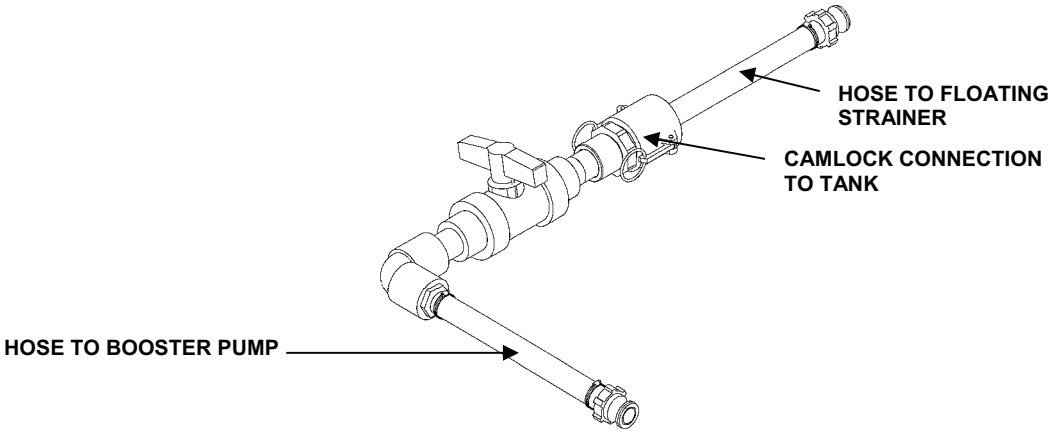


Figure 5. Settling tank outlet spool piece.

b. Product tank inlet spool piece

This is the shortest spool piece. See Figure 6.

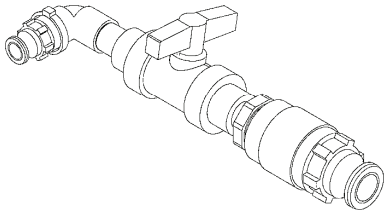


Figure 6. Product tank inlet spool piece.

c. Product tank outlet spool piece

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

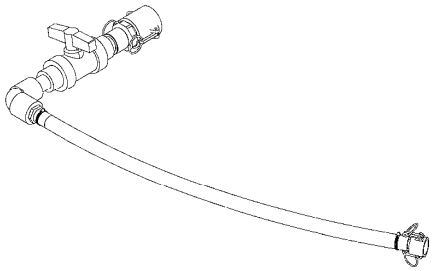


Figure 7. Product tank outlet spool piece.

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.

Vessels 1 through 3 are backwashed for 30 seconds each for a total of 3 pulses. See Figure 12.

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.

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 filtrate 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 run dry.

MODES

1 – CYCLE

This is a normal cycle consisting of 15 minutes of filtration operation, followed by 1-1/2 minutes of backwashing and 1-1/2 minutes of fast flushing. It starts out with three backwash ups and follows with one backwash down. In other words, once the unit is turned on at this mode, it will take 69 minutes before the first backwash down initiates. After which it goes back to backwash ups all over again.

2 - BACKWASH

At this cycle, the UF module will start with a backwash up and then alternate with a backwash down to accommodate easier troubleshooting of the solenoid valves, especially the bottom ones (V2 - A, B, C). This cycle can also be used as an expedient method to clean the UF membranes and also to drain the filtrate tank quickly.

3 – FAST FLUSH

This cycle can be used as an expedient method cleaning the UF membranes or to flush the UF module of chlorine etc.

4 – MAINTENANCE

This cycle can be used to troubleshoot or clean the UF module. At this cycle, proper valves and pumps will be activated to go through normal filtration process without doing any backwashes.

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 0102.

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 240 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.

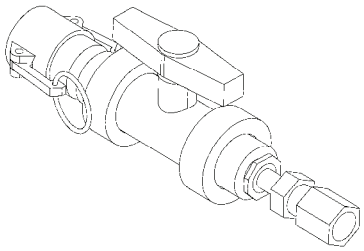


Figure 8. Cleaning Adapter.

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 in. (3.81 cm) hose to the discharge of the distribution pump, which has a ¾ in (1.91 cm) connection.

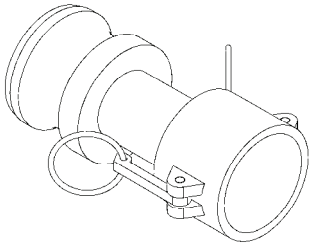


Figure 9. Flushing Adapter.

Cleaning Outlet

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

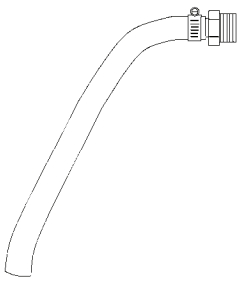


Figure 10. Cleaning Outlet.

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 0011.

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 filled, the diesel engine can be started to initiate potable water production. These procedures are covered in WP 0012.

The table containing the hoses and their differentiating features can be found in WP 0012, Table 1. The table listing the cables can be found also in WP 0012, 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.

HOSE DESCRIPTIONS

Raw Water Hoses

These hoses have the largest diameter at 1.5 inch (3.81 cm) by 25 ft long 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) by 25 ft. long. 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) by 12 ft. long. 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.

CABLE DESCRIPTIONS

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.

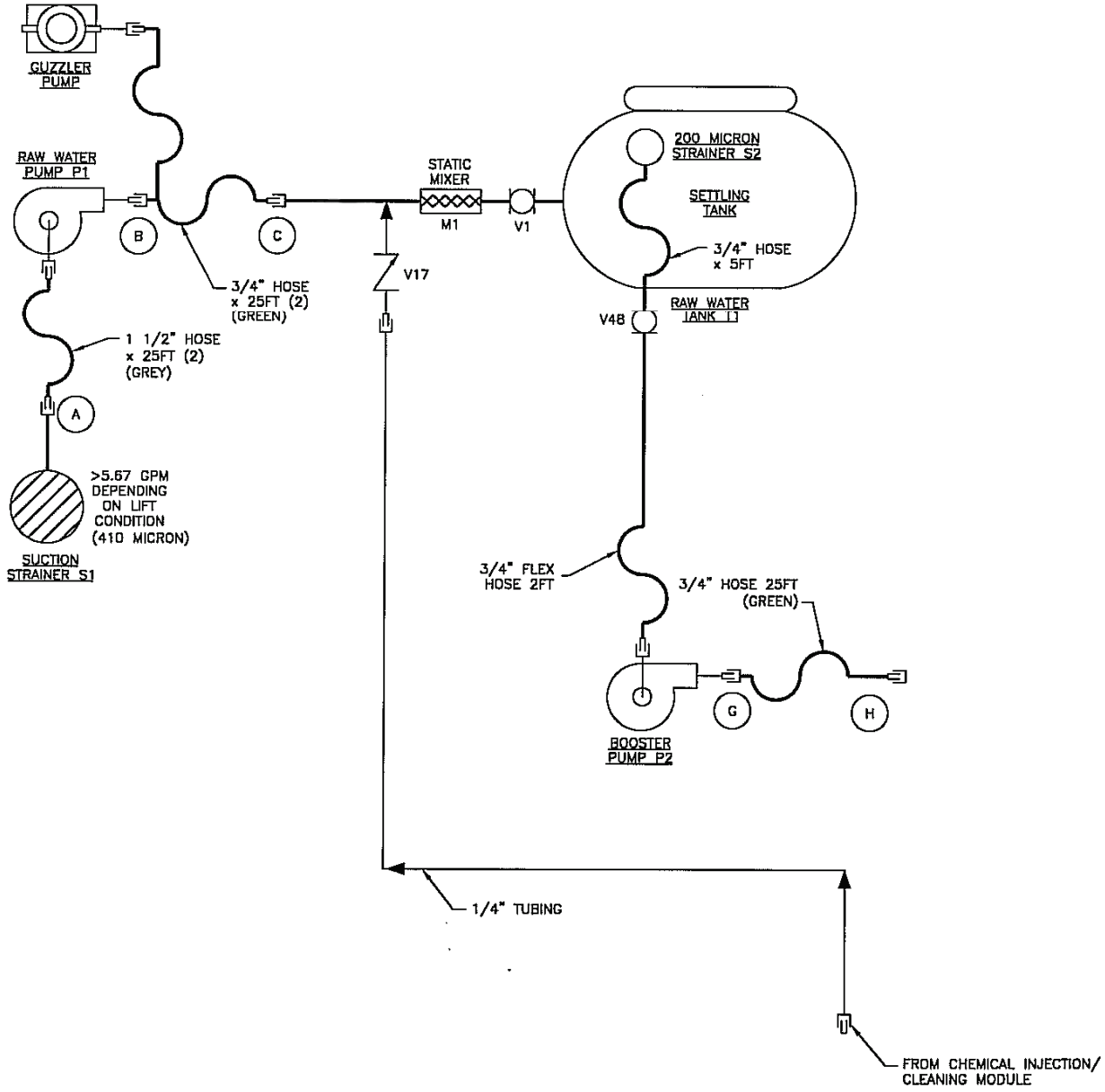


Figure 11. Water Source to Ultrafiltration Module Piping Diagram.

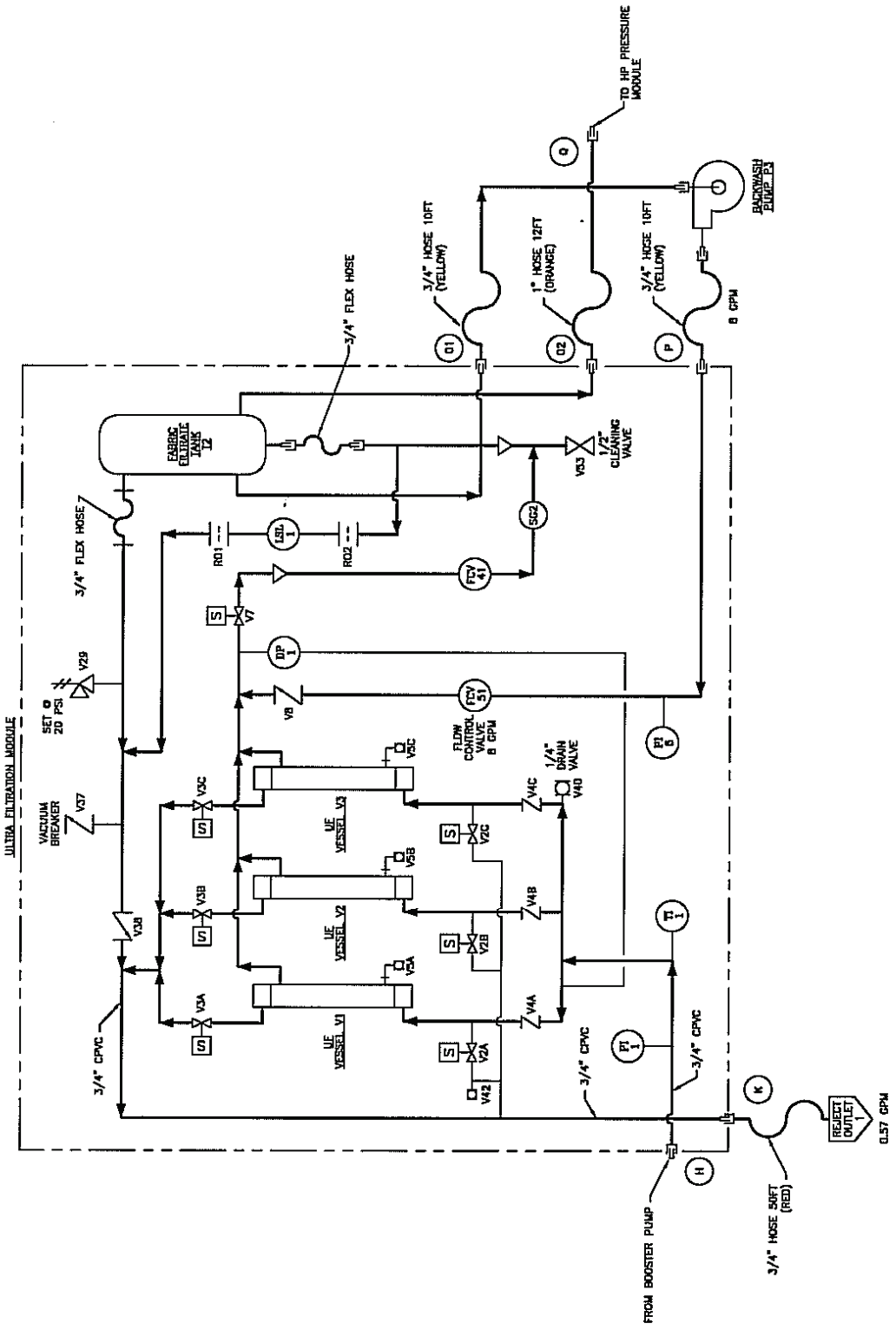


Figure 12. Ultrafiltration Module to High-Pressure Pump Module Piping Diagram.

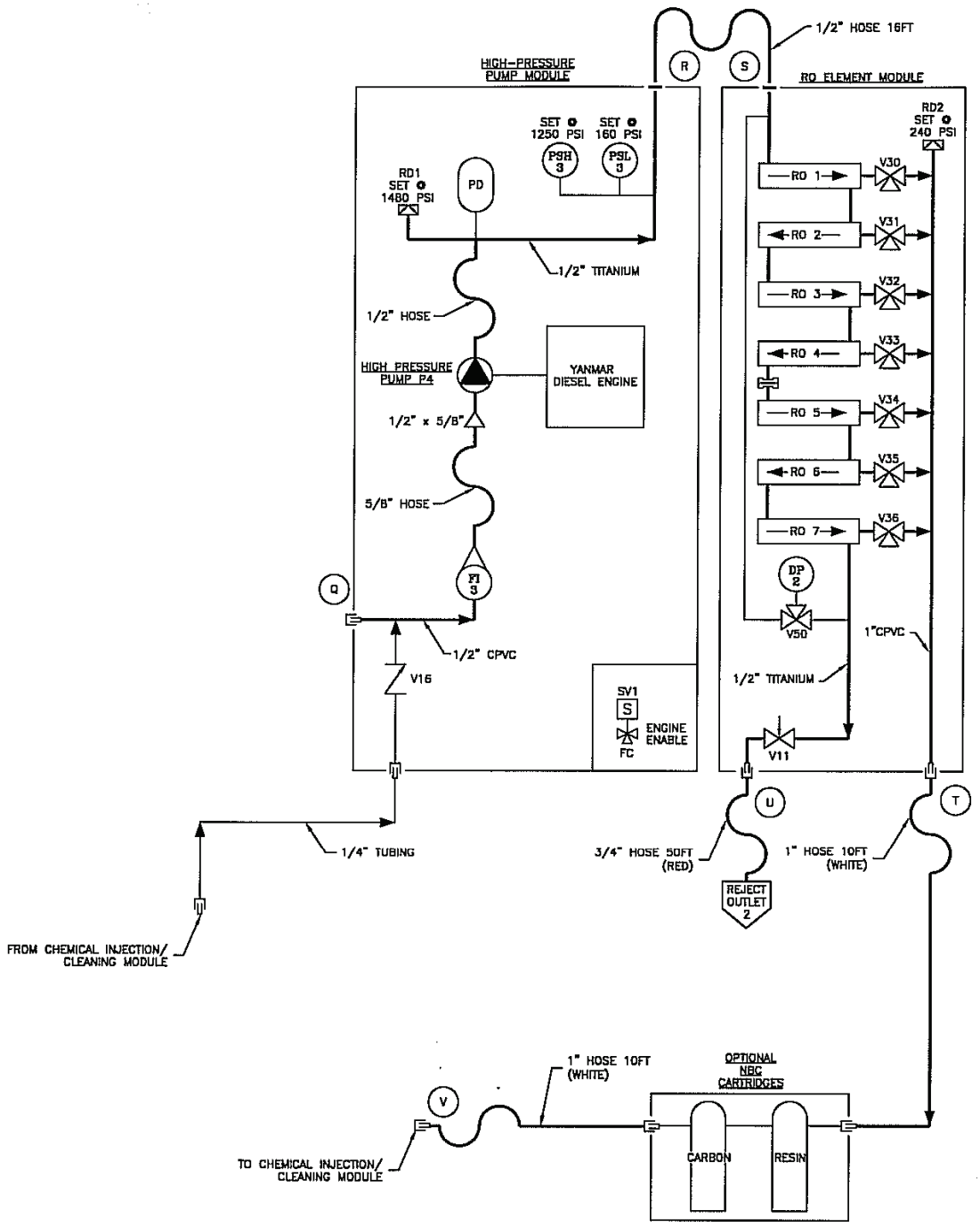


Figure 13. High-Pressure Pump Module to Chemical Injection/Cleaning Module Piping Diagram.

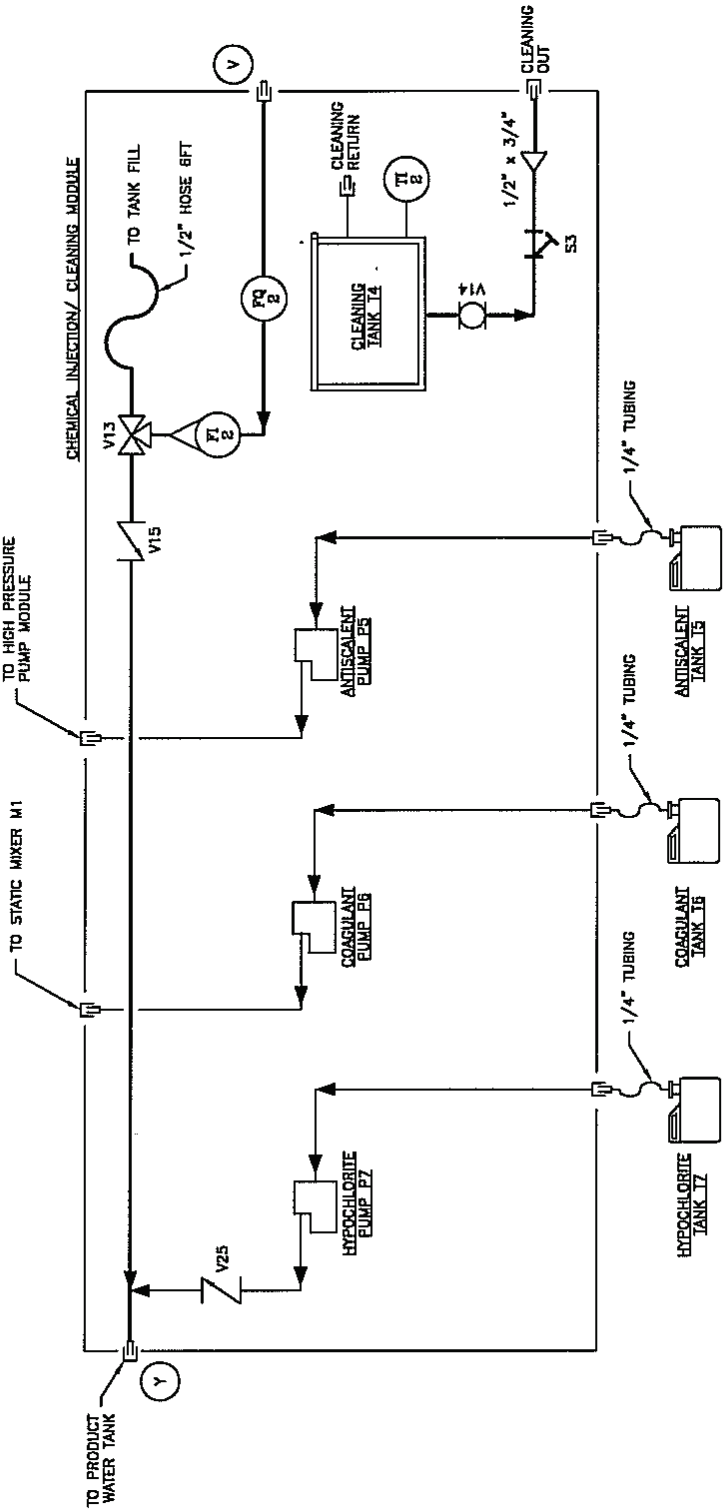


Figure 14. Chemical Injection/Cleaning Module Piping Diagram.

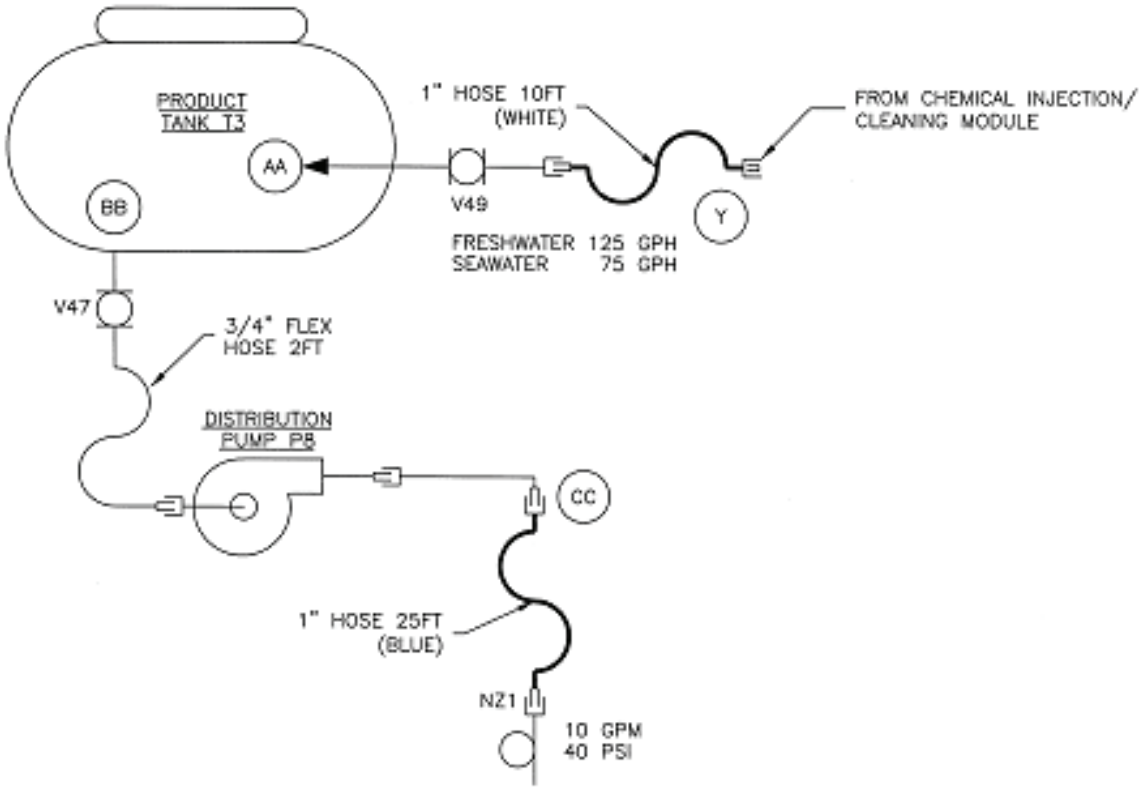


Figure 15. Chemical Injection/Cleaning Module to Distribution Nozzle Piping Diagram.

FIELD SETUP

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

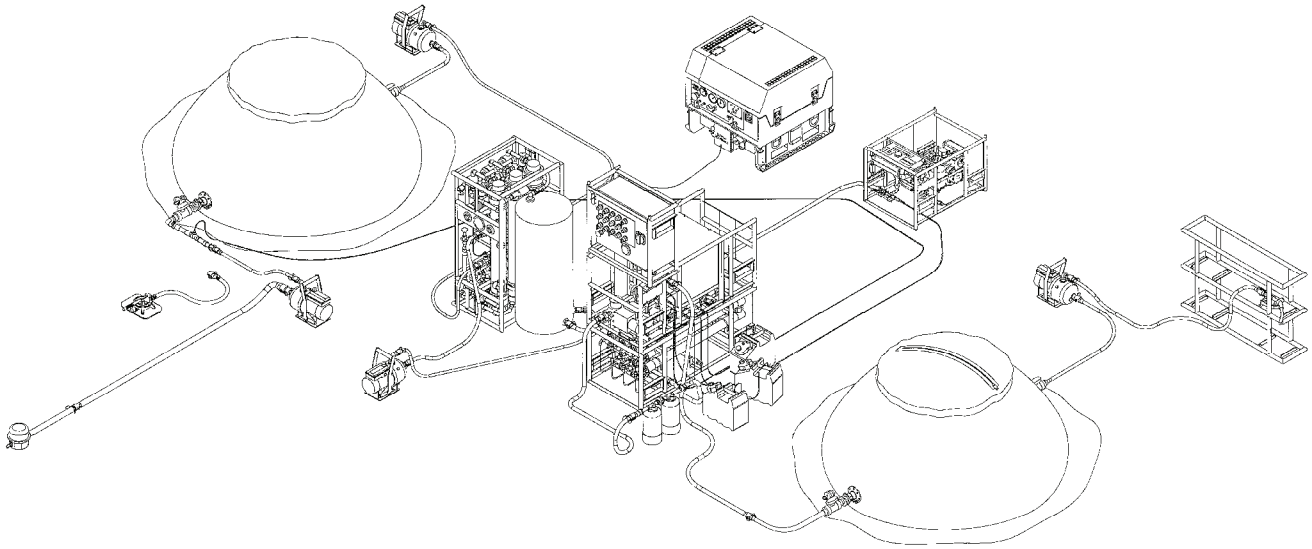


Figure 16. Lightweight Water Purifier Field Setup.

Electro Magnetic Interference (EMI) Mitigation

General

The LWP may cause interference to radio receivers when operated within 50 Ft. (15 m) 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.

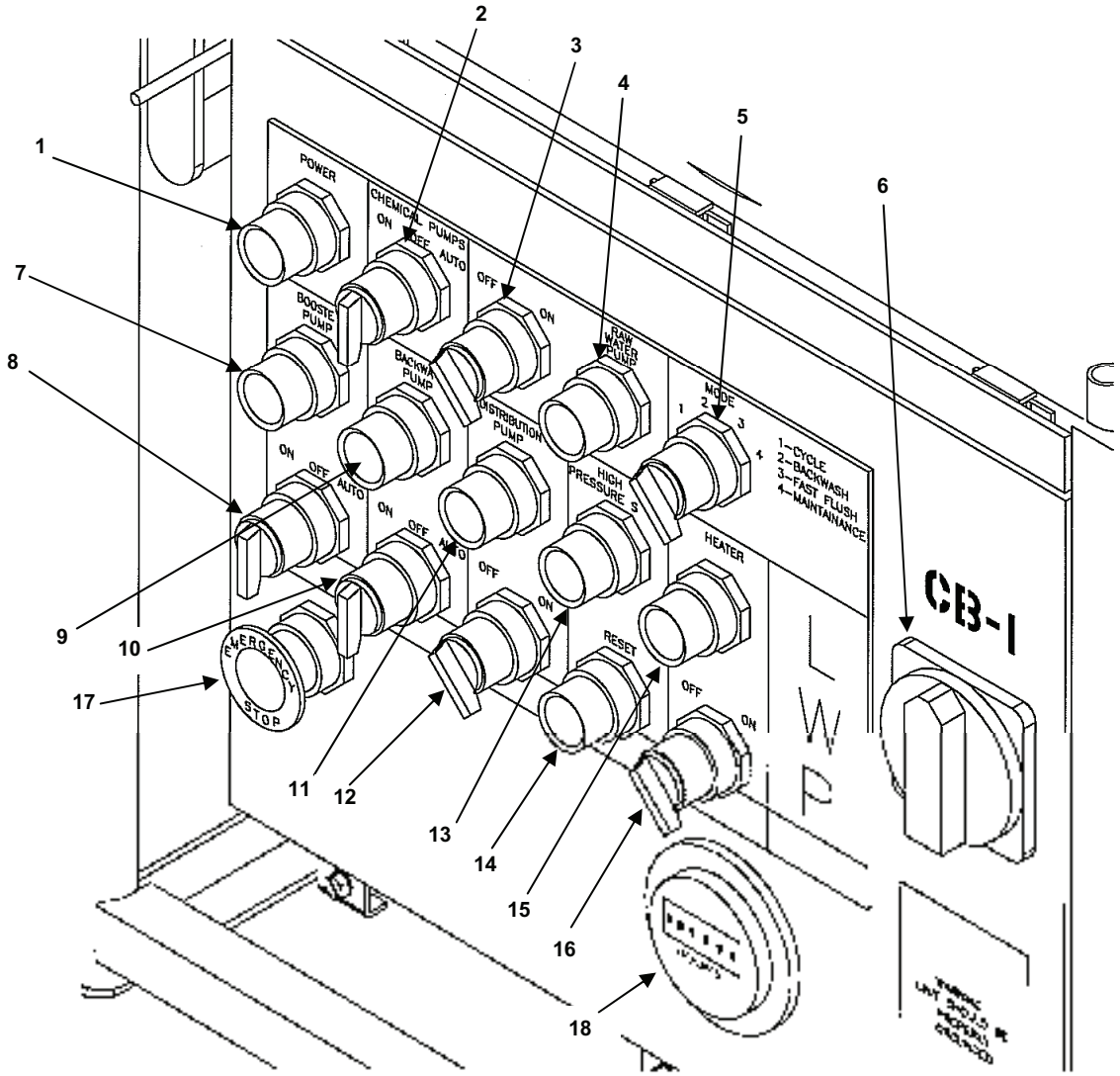


Figure 1. Control Module Controls and Indicators.

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 ON/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 1250 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

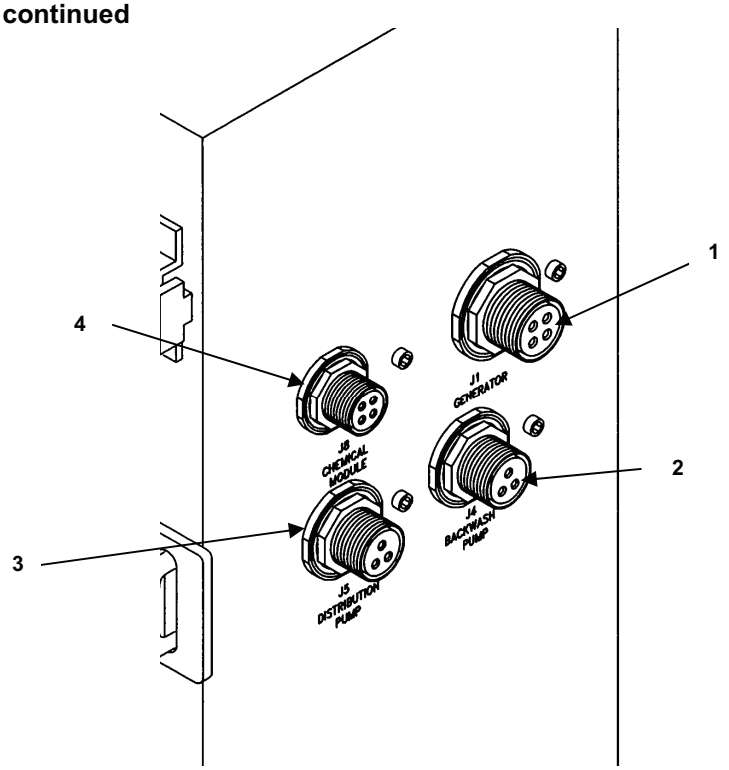


Figure 2. Control Module Power Receptacles (Right Side).

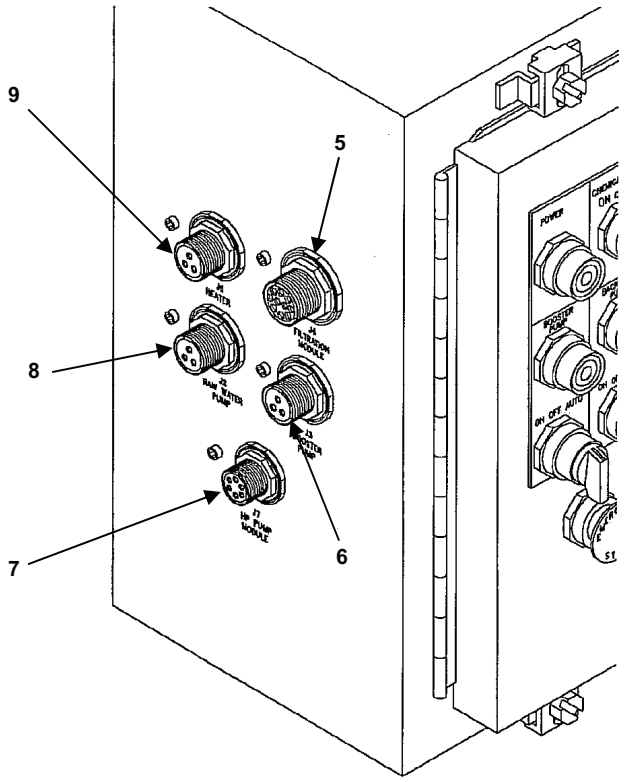


Figure 3. Control Module Power Receptacles (Left Side).

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

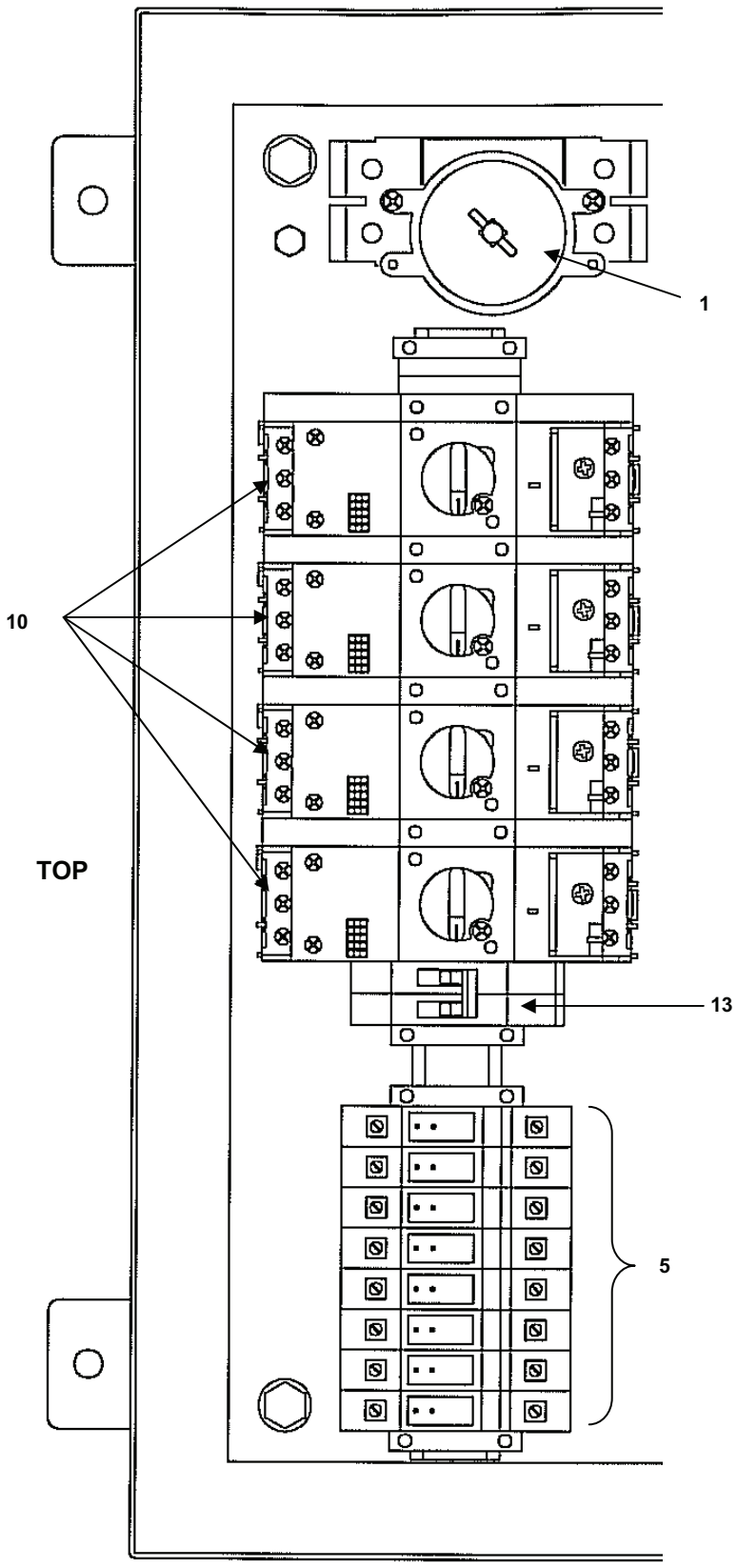


Figure 4. Control Module Internal Components (Top Half).

CONTROL MODULE - continued

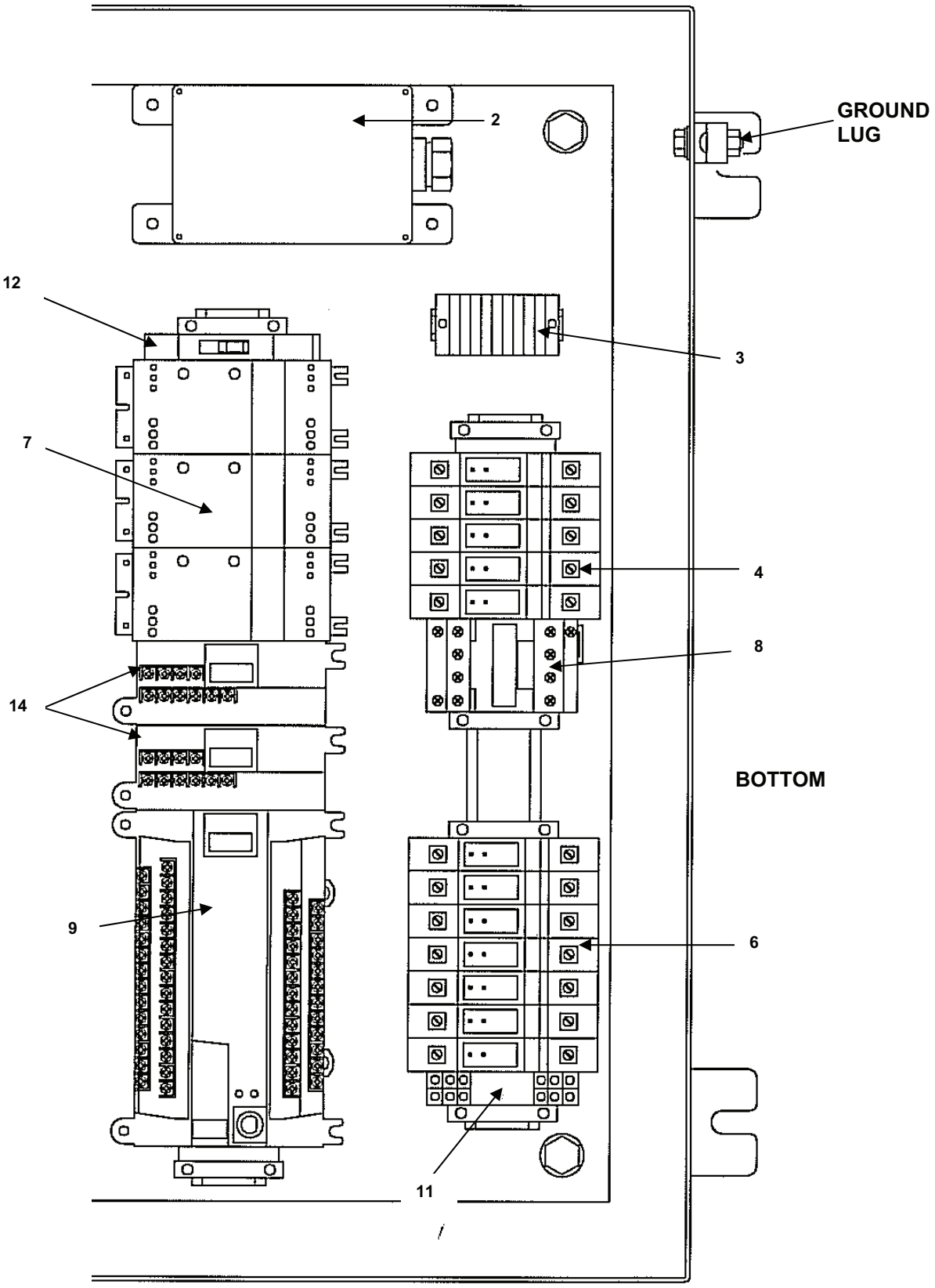


Figure 5. Control Module Internal Components (Bottom Half).

CONTROL MODULE – continued

Table 3. Control Module 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	240 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 0047.

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.

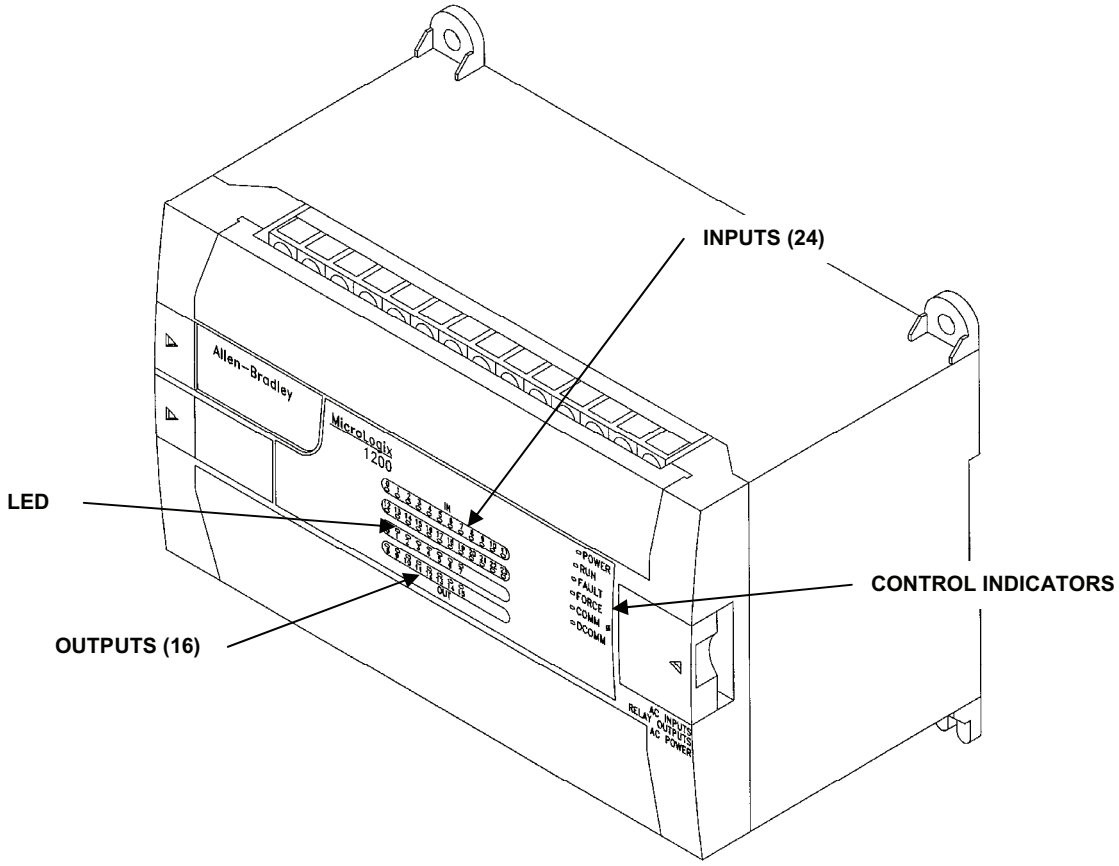


Figure 6. Programmable Logic Controller Controls and Indicators.

NOTE

For a complete listing of inputs and outputs on the (PLC) see WP 0070.

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.

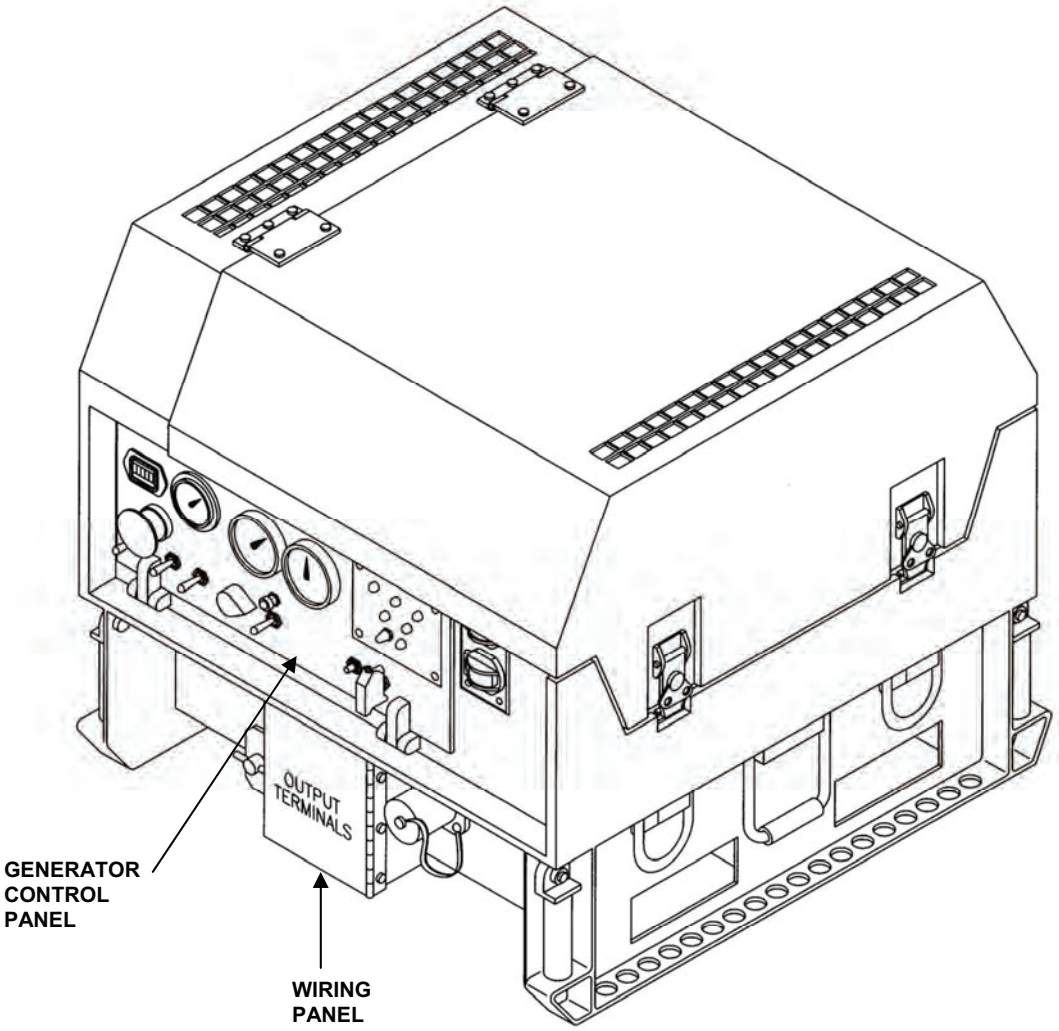


Figure 7. 3kW Tactical Quiet Generator Set.

ULTRAFILTRATION MODULE

Controls and indicators on the UF module are identified on Figure 8 and described in Table 4.

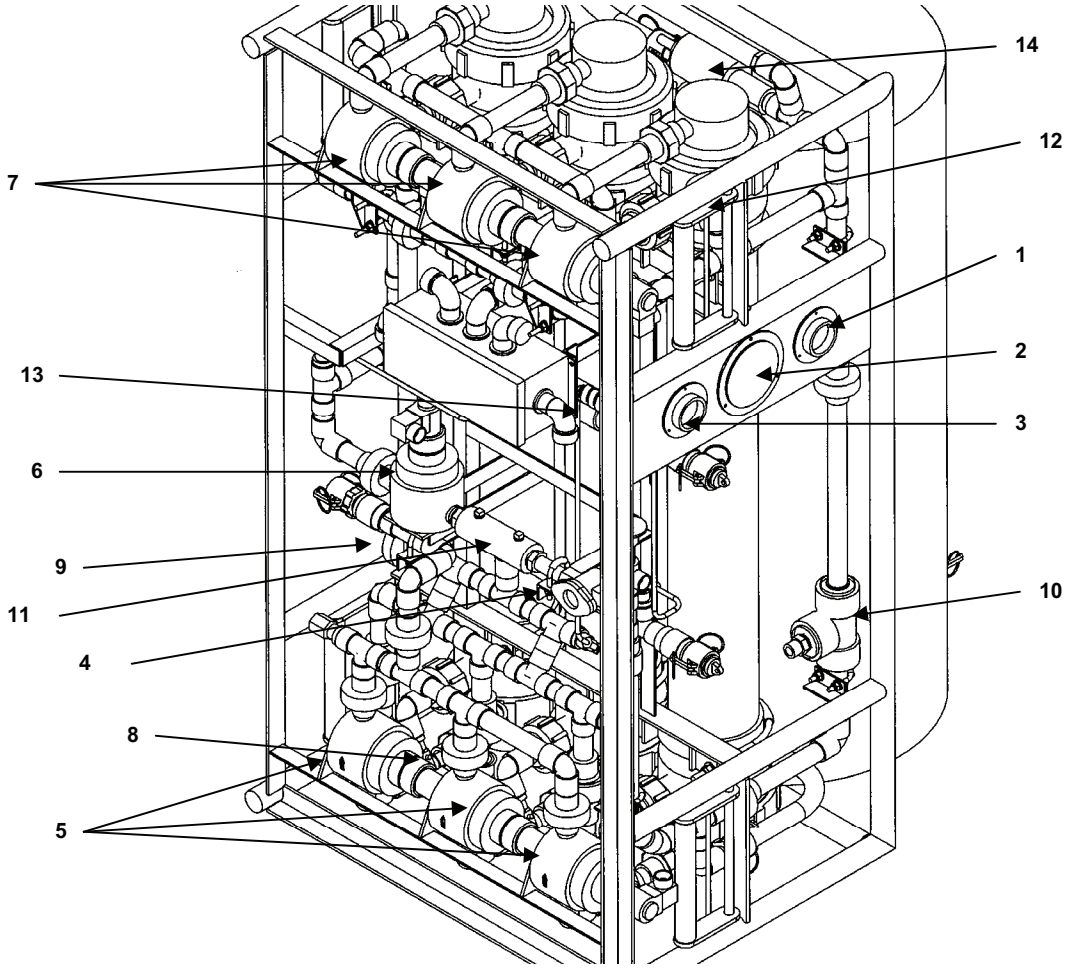


Figure 8. Ultrafiltration Module Controls and Indicators.

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 in. (12.7 mm), SG-2	Indicates water flow during operation through the UF module
5	Solenoid valve V2A, V2B, V2C	Controls flow of fast flush and back wash water cartridges, interfaces w/PLC
6	Solenoid valve V7	Controls filtrate water in the reject out piping, interfaces with PLC
7	Solenoid valve V3A, V3B, V3C	Controls flow of fast flush and back wash water cartridges, interfaces w/PLC
8	0.25 in. (6.35 mm) drain valves V5A, V5B, V5C (on bottom of each UF vessel assembly)	Manually opened to drain fluid from the vessel assemblies for maintenance

Table 4. Ultrafiltration Module Controls and Indicators - continued

KEY	CONTROL OR INDICATOR	FUNCTION
9	Temperature gauge -20° to 120°F (-28.88º to 48.88º C)	Measures the temperature of feed to UF water
10	Level switch LSL-1	Shuts down high-pressure pump for low level, interfaces with PLC
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 in. (12.7 mm), 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, 20 psi, 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 5.

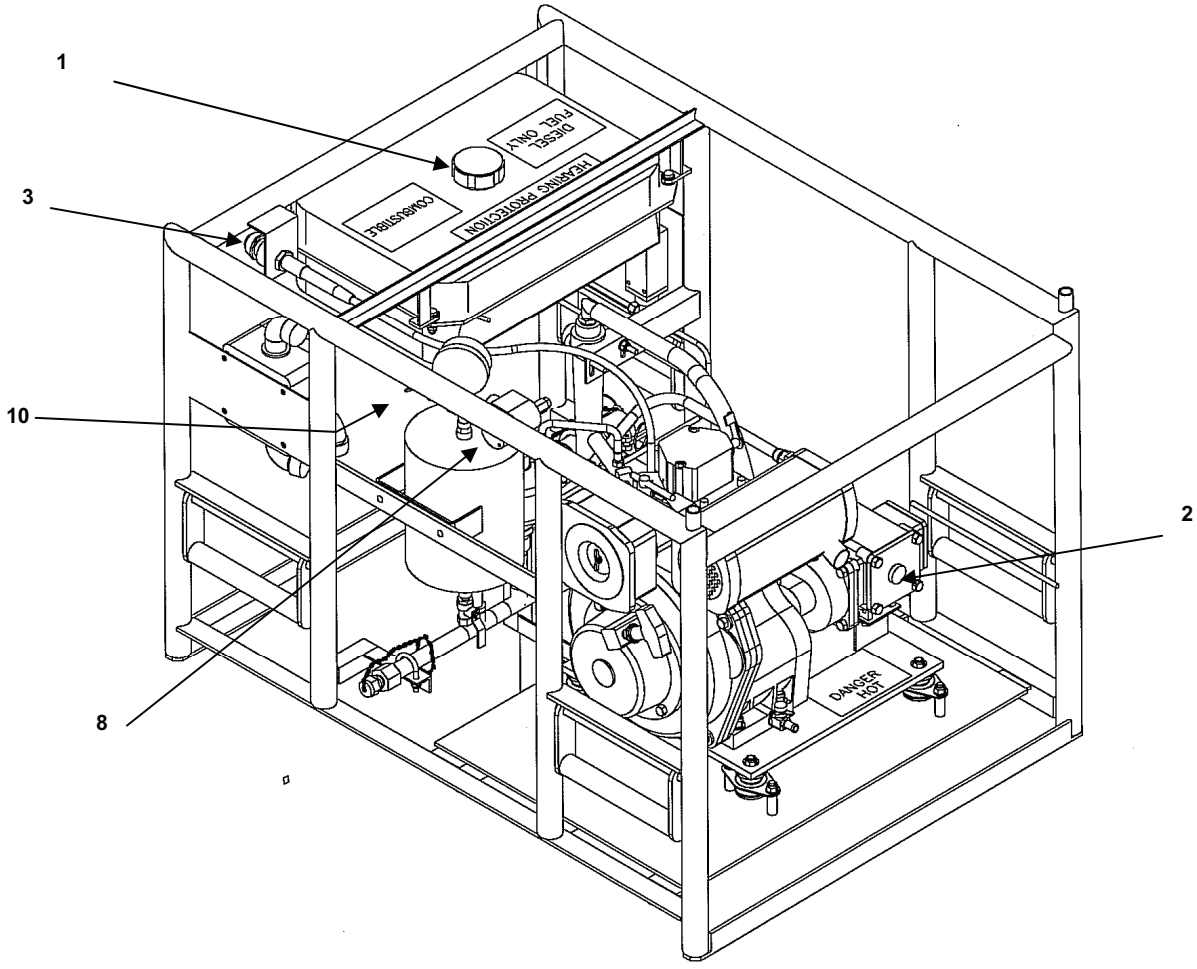


Figure 9. High-Pressure Pump Module.

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

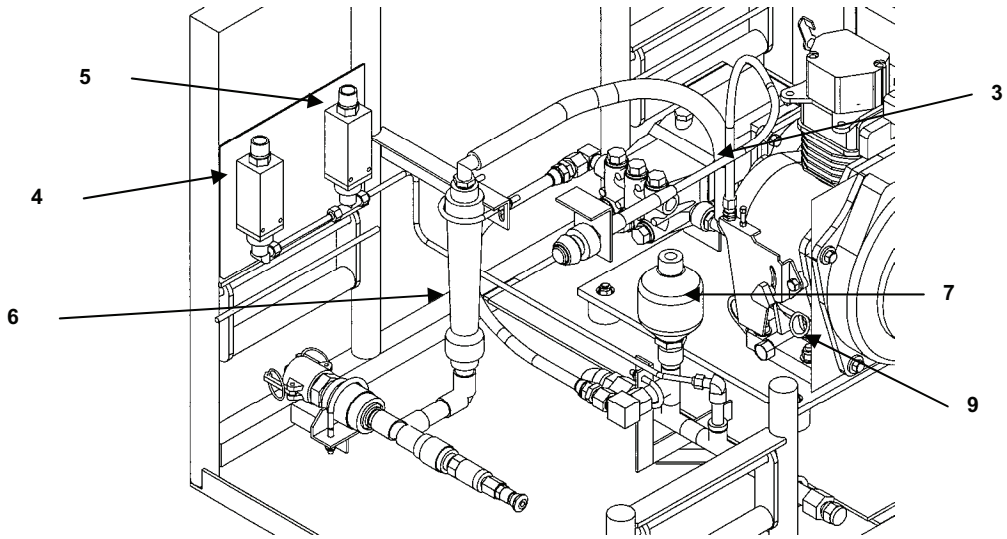


Figure 10. Switches, Meter, Dampener, and Throttle on High-Pressure Pump Module.

REVERSE OSMOSIS ELEMENT MODULE

Controls and indicators on the Reverse Osmosis (RO) module are identified on Figure 11, Figure 12, and described in Table 6.

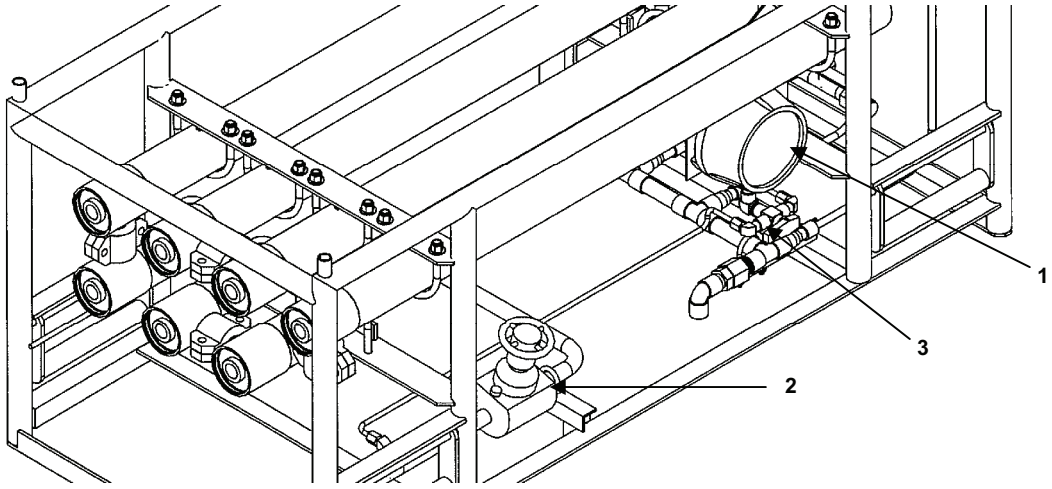


Figure 11. Reverse Osmosis Element Module.

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 in. (12.7 mm), V11	Control reject valve
3	3-way ball valve, 0.25 in. (6.25 mm), V50	Use as a differential pressure diverter valve
4	3-way ball valve, 0.375 in. (9.53 mm), V30 through V36	Used to drain and take samples of the water in the pressure vessels

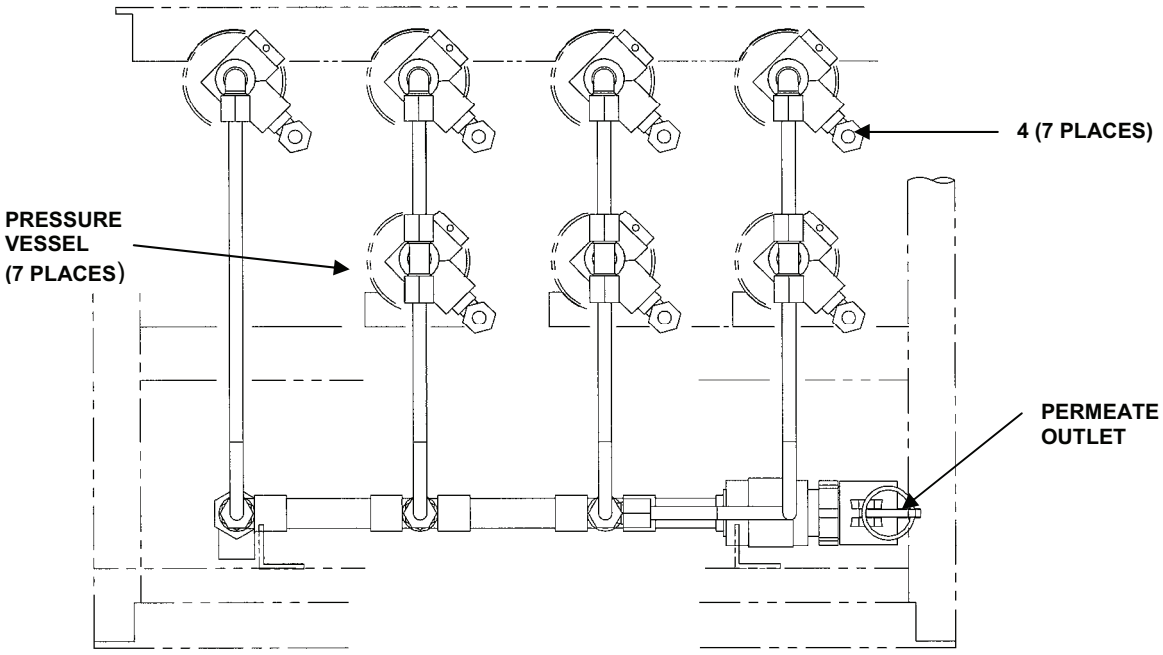


Figure 12. Sampling Ball Valves and Pressure Vessel Assemblies.

CHEMICAL INJECTION/CLEANING MODULE

Controls and indicators on the chemical injection/cleaning module are identified on Figure 13, Figure 12, and described in Table 7.

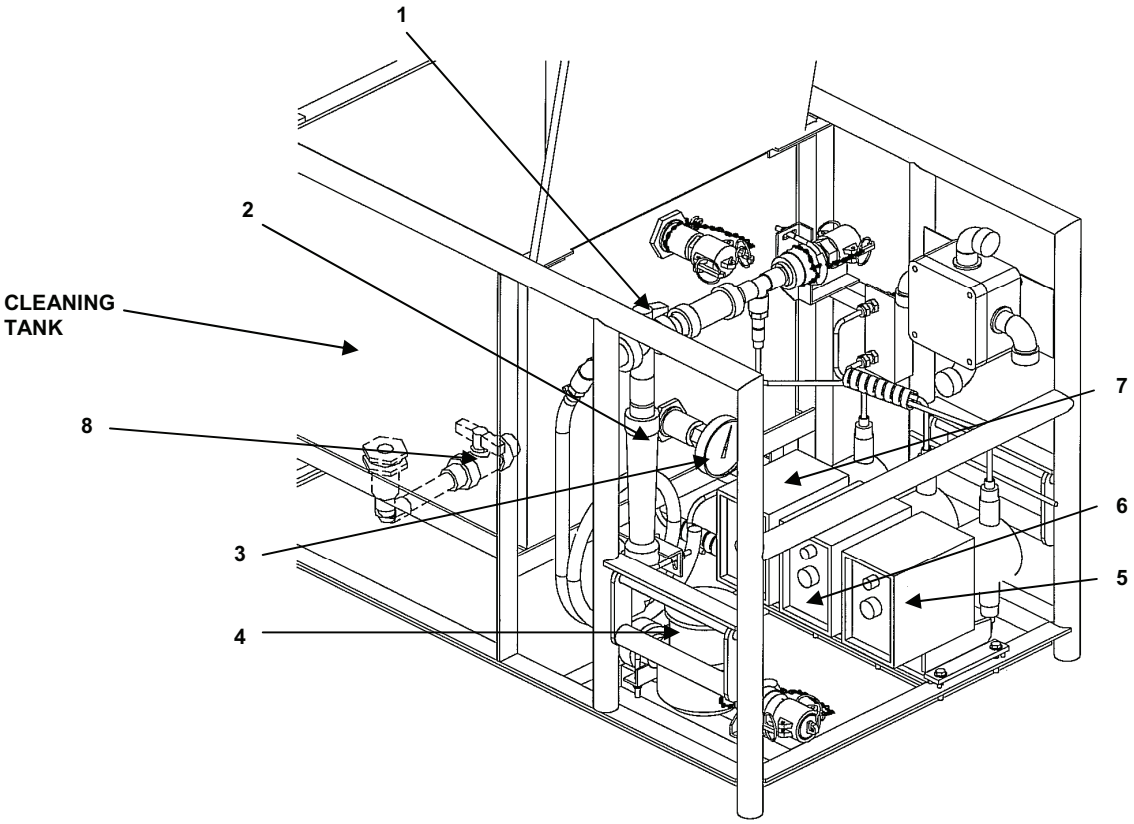


Figure 13. Chemical Injection/Cleaning Module.

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 FT. (1.8 m) 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 8.
6	Chemical injection pump, P6	Injects coagulant into raw water before the settling tank T1. See Table 8.
7	Chemical injection pump, P7	Injects hypochlorite into product water just before going into the product tank T3. See Table 8.
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 8 for a description.

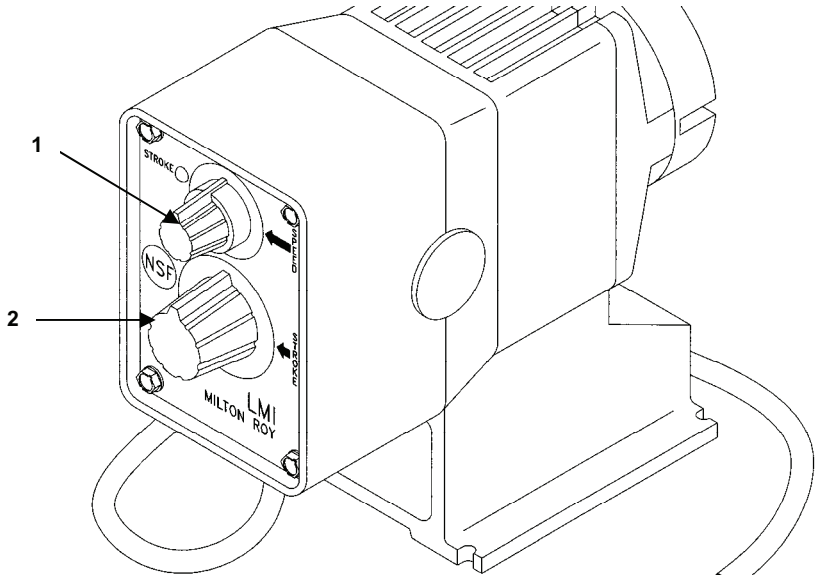


Figure 14. Chemical Injection Pump.

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 0013
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 0013

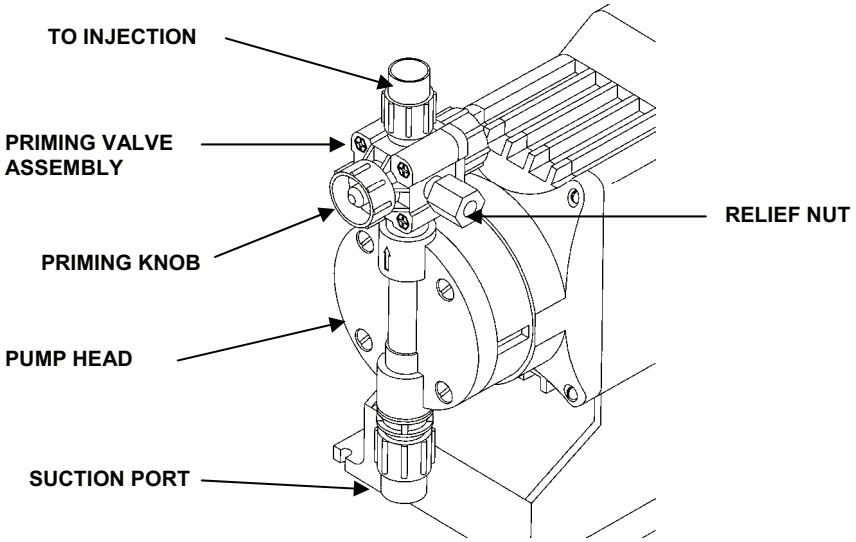


Figure 15. Chemical Injection Pump Priming Valve.

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.

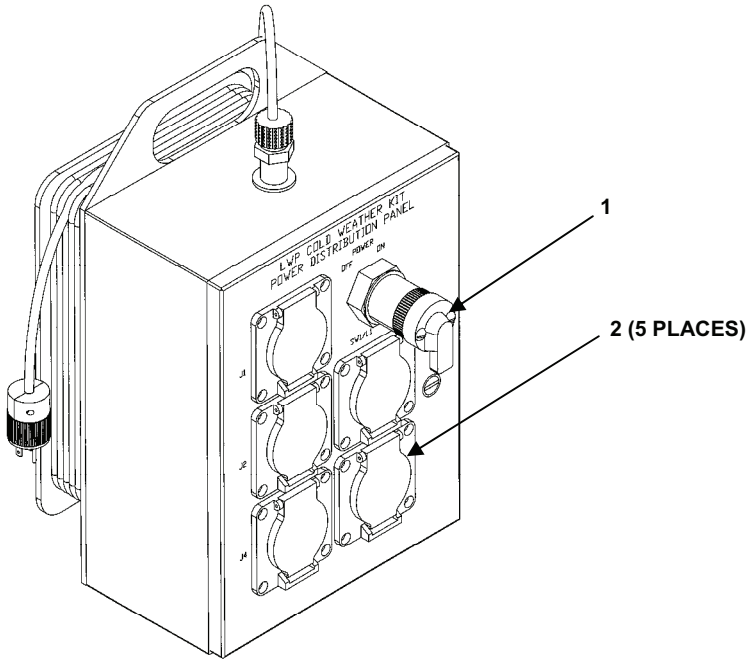


Figure 16. Cold Weather Kit Power Distribution Panel.

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 ft. (15.24 m) RO reject outlet 2 hose, 50 ft. (15.24 m) UF reject outlet 1 hose, and raw water service pump

END OF WORK PACKAGE

OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
TURBIDITY METER
OPERATION UNDER USUAL CONDITIONS

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 0008 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 0049 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.

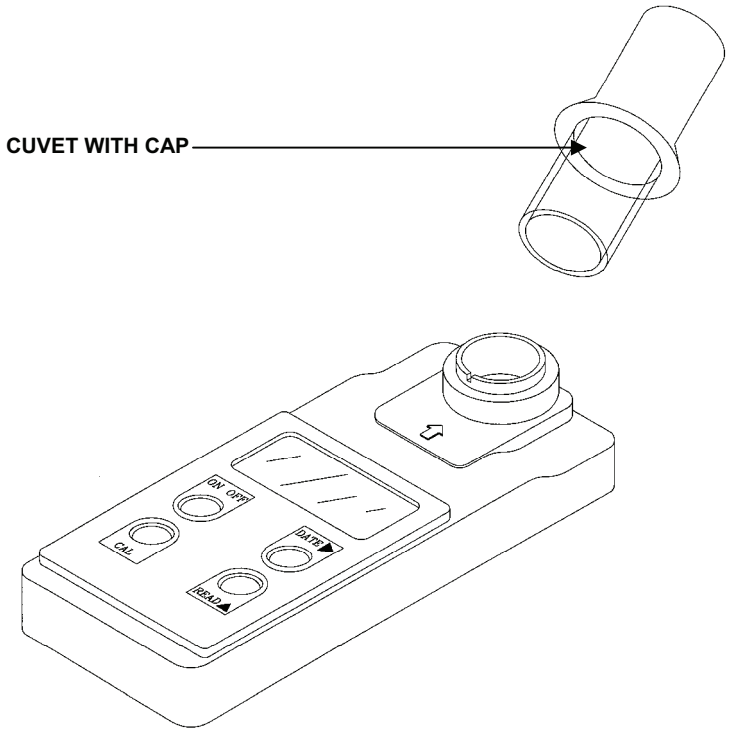


Figure 1. Turbidity Meter.

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 in. (0.64 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 in. (2.54 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.

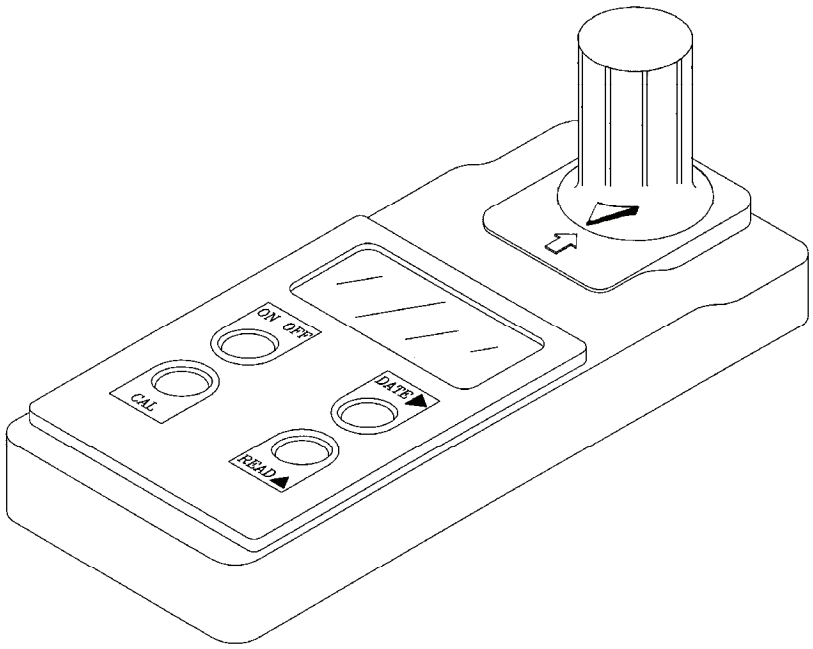


Figure 2. Turbidity Meter Cuvet Installation.

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 mL - 15 mL = 85 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 x 100 (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 FTU x 100 mL/15mL = 180 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 0049 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 cuvets.

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.

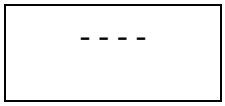
NOTE

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

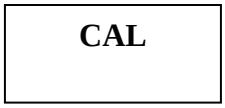
3. Calibrate the turbidity meter according to WP 0049.

CODES

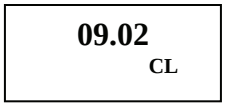
Meter HI 93703 will display several different LCD codes in different situations to help the user to operate the meter. The following data illustrates the display on the LCD:



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



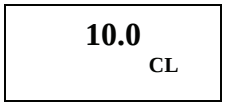
This indicates that the Calibration Mode is active. If the CAL key is not pressed within 6 seconds, the meter will automatically switch to the Measurement Mode.



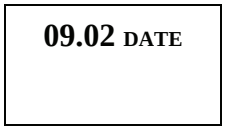
This indicates that the Calibration Date Setting Mode is active. The format is MM.DD.

This indicates a 0 FTU standard calibration is required.

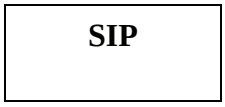
This indicates that calibration is performed.



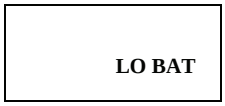
This indicates a 10 FTU standard calibration is required.



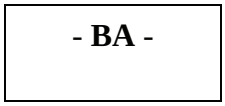
This indicates the last calibration date (MM.DD).



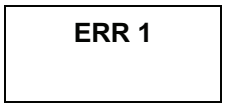
This indicates that measurement is performed.



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.



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



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
OPERATION UNDER USUAL CONDITIONS

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	0-9999µS or 10-200 mS	0-9999 ppm or 10-200 ppt
ACCURACY	±0.01	±1% of reading	±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 0050.

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.

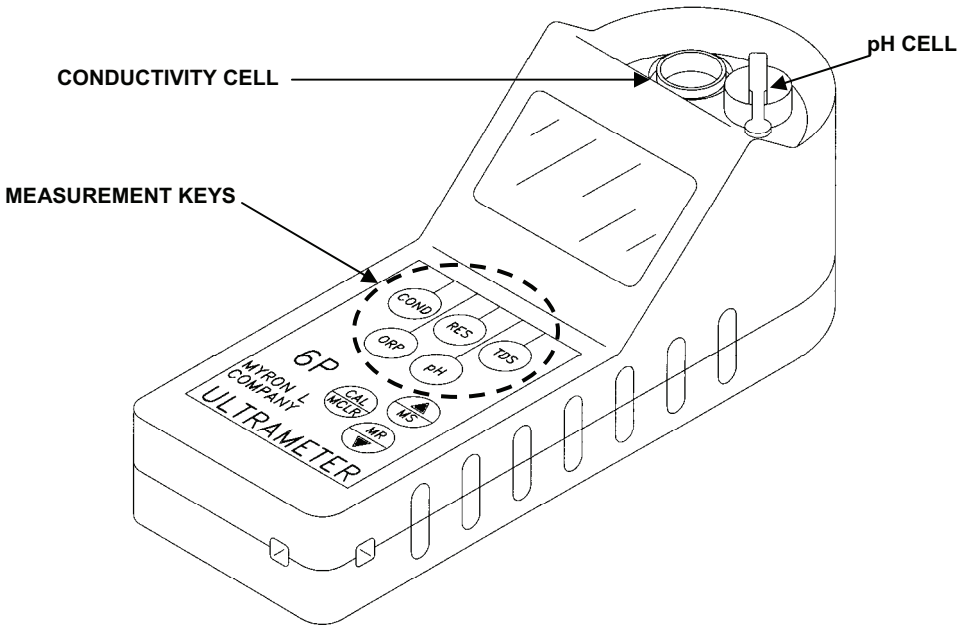


Figure 1. Ultrameter.

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 Storage Solution NSN 6810-01-528-3706, , or equal. The protective cap is installed securely.
3. A press of the pH key displays pH readings. No units are displayed.

Description of ($\frac{\text{CAL}}{\text{MCLR}}$) Key

1. Press the **($\frac{\text{CAL}}{\text{MCLR}}$)** 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 **($\frac{\text{CAL}}{\text{MCLR}}$)** key is held down (pressed) for about 3 seconds, the CAL mode is not entered, but SEL appears to allow solution selection with the **($\frac{\Delta}{\text{MS}}$)** or **($\frac{\text{MR}}{\nabla}$)** keys. As in calibration, the **($\frac{\text{CAL}}{\text{MCLR}}$)** key is now an “accept” key.
3. While reviewing stored records, the MCLR key is active, to allow clearing records.

Description of ($\frac{\Delta}{\text{MS}}$) Or ($\frac{\text{MR}}{\nabla}$) Keys

1. While measuring in any parameter, the **($\frac{\Delta}{\text{MS}}$)** or **($\frac{\text{MR}}{\nabla}$)** 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 30,000 ppm solution NSN 6810-01-399-1289. 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 CLr 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 0050.

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
OPERATION UNDER USUAL CONDITIONS

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.

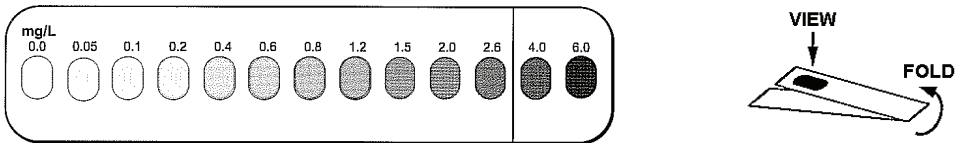


Figure1. Color Scale and Viewing the Indicator Pad.

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
WATER ANALYSIS
OPERATION UNDER USUAL CONDITIONS

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 gph (283.88 l/h) of product water from any seawater source containing 20,001 to 45,000 ppm and 125 gph (473.13 l/h) 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° (0º C) to 95°F (35º C).

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 0013 for instructions.
   a. Coagulant injection should be made when turbidity is higher than 150 NTU.
   b. If chlorine is present is 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 0013 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 0049.
3. Calibrate the conductivity meter before use. See WP 0050.

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.

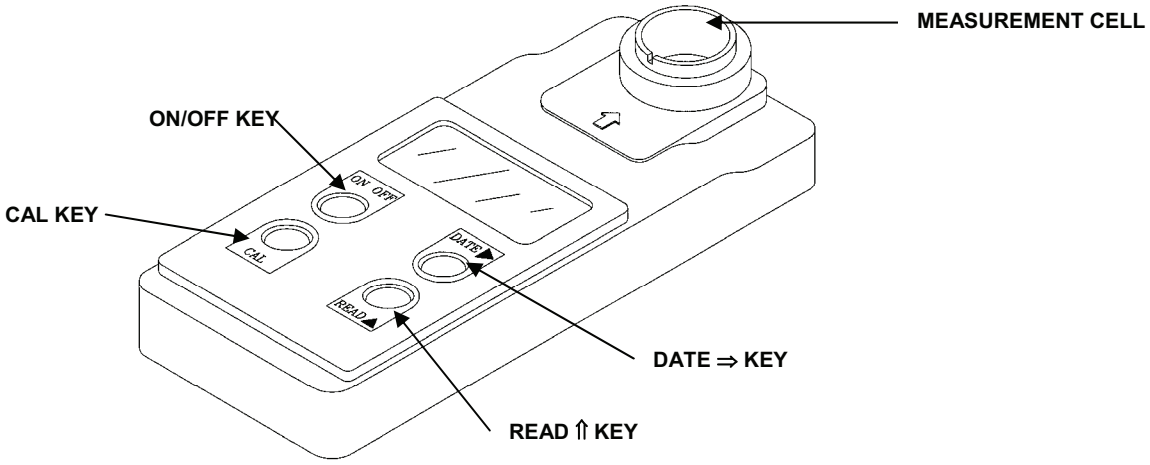


Figure 1. Portable Microprocessor Turbidity Meter

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 in. (0.65 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 in. (2.54 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:

    Vos = 3000/T

    Where Vos = 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 mL (Vos)

    15 ml (Vos) + 85 mL (HI 90703-0) = 100 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 x 100 mL/Vos = T_n

    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 FTU x 100 mL/15mL = 180 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 standards 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 in. (2.54 cm) from the bottom of the cuvet.

Sources of Interference

The following instructions should prevent any interference in accurate measurements:

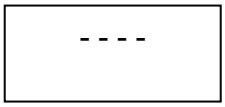
1. Presence of floating debris and coarse sediment that settle out rapidly will give false readings.

TURBIDITY METER OPERATION - continued

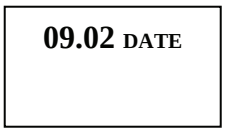
2. The infrared light source used for the HI 93703 turbidity meter, or equal, according to International Standard Organization (ISO) 7027, can effectively minimize errors due to colored dissolved substances. This effect, called “true color”, is a common interference for most commercially available instruments 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 cuvets.

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.

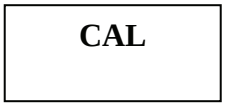
Two indications on the turbidity meter will inform the operator that the batteries require replacement:

- **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

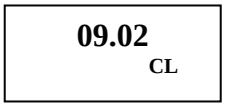
Turbidity meter HI 93703 will display several different LCD codes in different situations to help the user to operate the meter. The following data illustrates the display on the LCD:

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



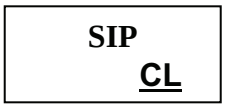
TURBIDITY METER OPERATION – continued

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.

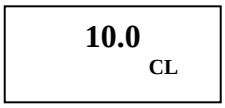


This indicates that the Calibration Date Setting Mode is active. The format is MM.DD.

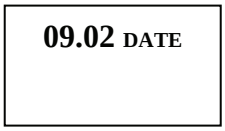
This indicates a 0 FTU standard calibration is required.



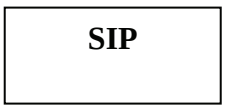
This indicates that calibration is performed.



This indicates a 10 FTU standard calibration is required.

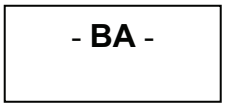


This indicates the last calibration date (MM.DD).



This indicates that measurement is performed.

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.



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.

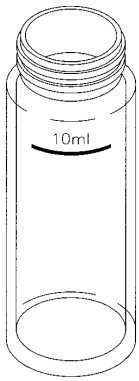


Figure 2. Cuvet

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 in. (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.

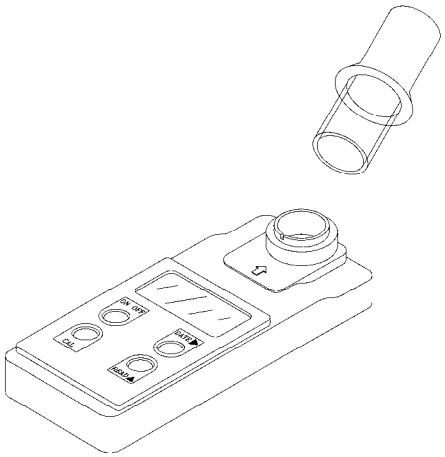


Figure 3. Correct Position of Cuvet Cap in Turbidity Meter

SOURCE WATER TURBIDITY MEASUREMENT - continued

10. Press the READ key and the LCD will display a blinking “SIP” (Sampling in Process). The turbidity value will appear after approximately 25 seconds.
11. Record the information on a copy of the Data Sheet. See Chapter 7 Supporting Information.
12. Coagulant will be needed if the source water is greater than 150 NTUs (FTUs). See WP 0013.
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 0007.

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 to77°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.

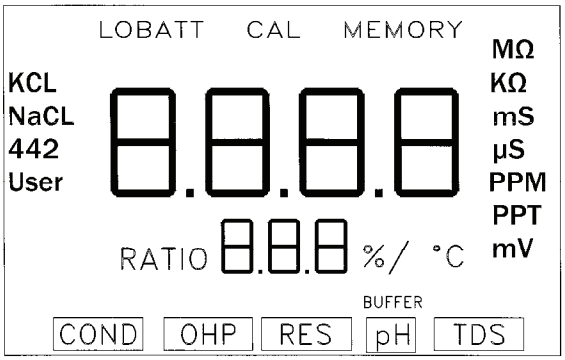


Figure 4. Conductivity Meter Liquid Crystal Display.

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 NaCI 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.

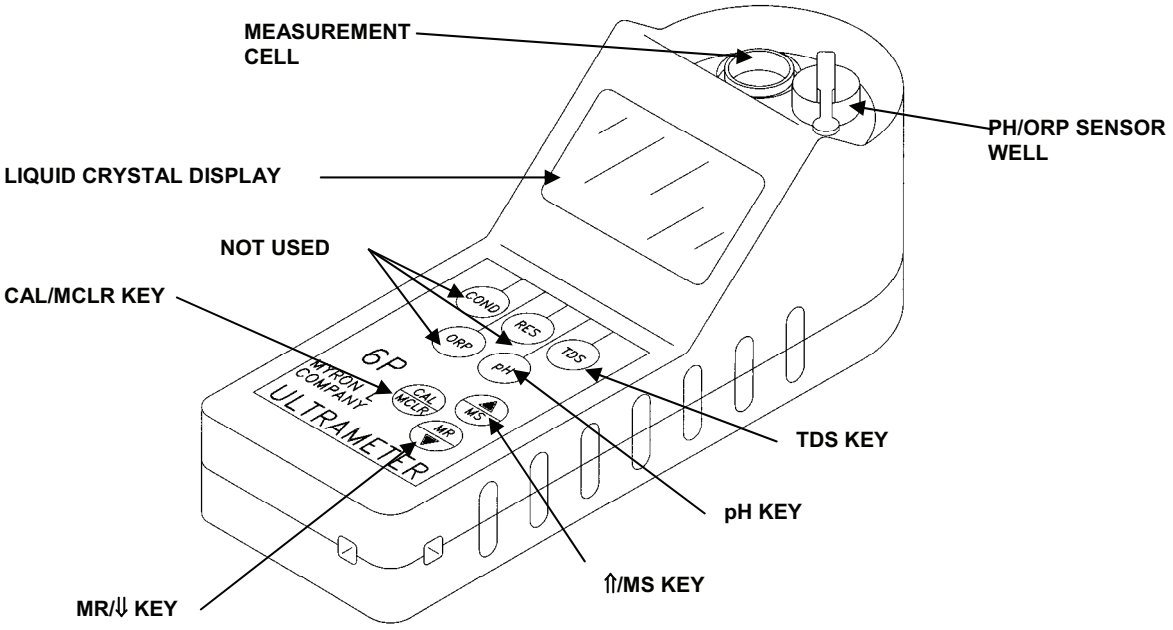


Figure 5. Conductivity Meter.

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 Storage Solution NSN 6810-01-528-3706, 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 ∆/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.

∆/MS (UP) or MR/∇ (DOWN) Keys

1. While measuring in any parameter, the ∆/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 ∆/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.
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 NaCI 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 Chapter 7 Supporting Information.
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 Chapter 7 Supporting Information.
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
OFFLOADING THE LWP
OPERATION UNDER USUAL CONDITIONS

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.

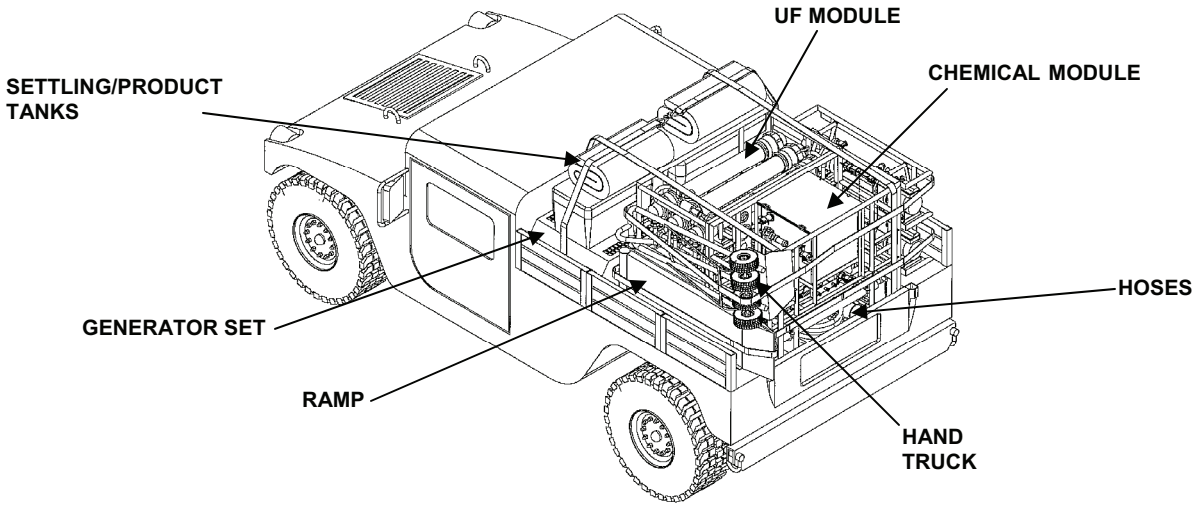


Figure 1. Lightweight Water Purifier Transport and Packing Configuration.

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

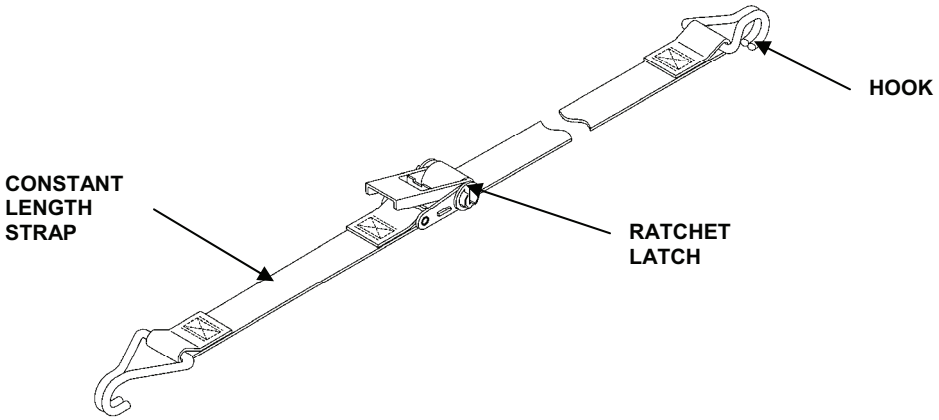


Figure 2. Tie Down Strap.

UNLOADING FOLDABLE RAMP

WARNING

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

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.

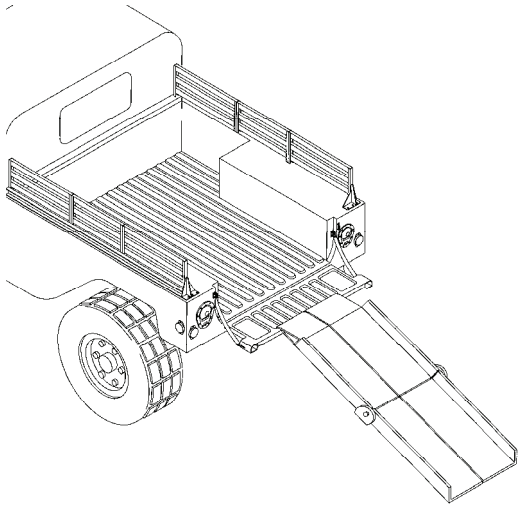


Figure 3. Positioning Ramp on HMMWV Tailgate.

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.

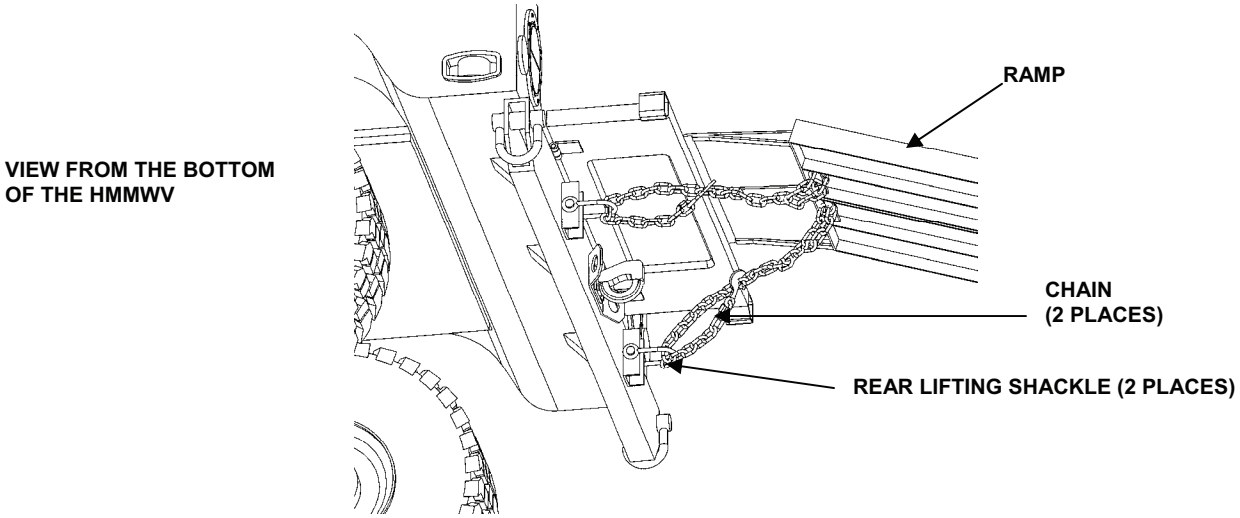


Figure 4. Securing Ramp to Vehicle.

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.

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 0011 and WP 0012. Place the hoses in a suitable location neatly.

OFFLOADING THE LWP - continued

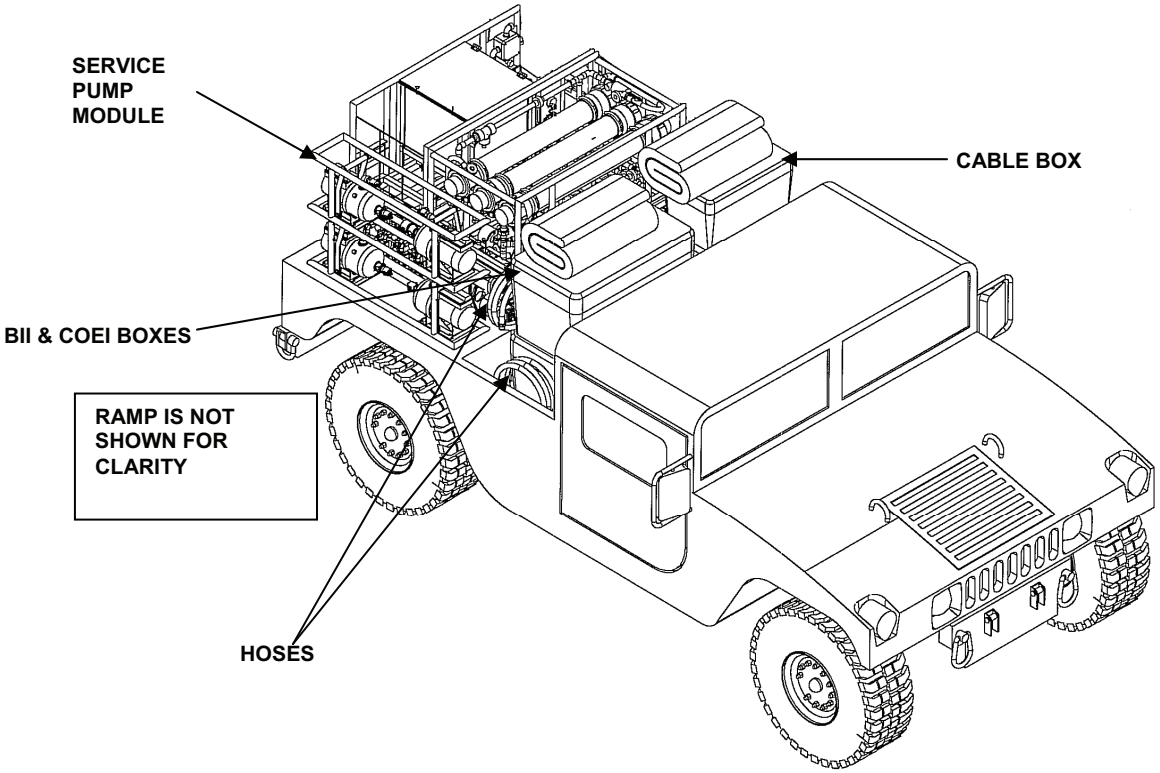


Figure 5. Offloading Lightweight Water Purifier Hoses and Tanks.

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.

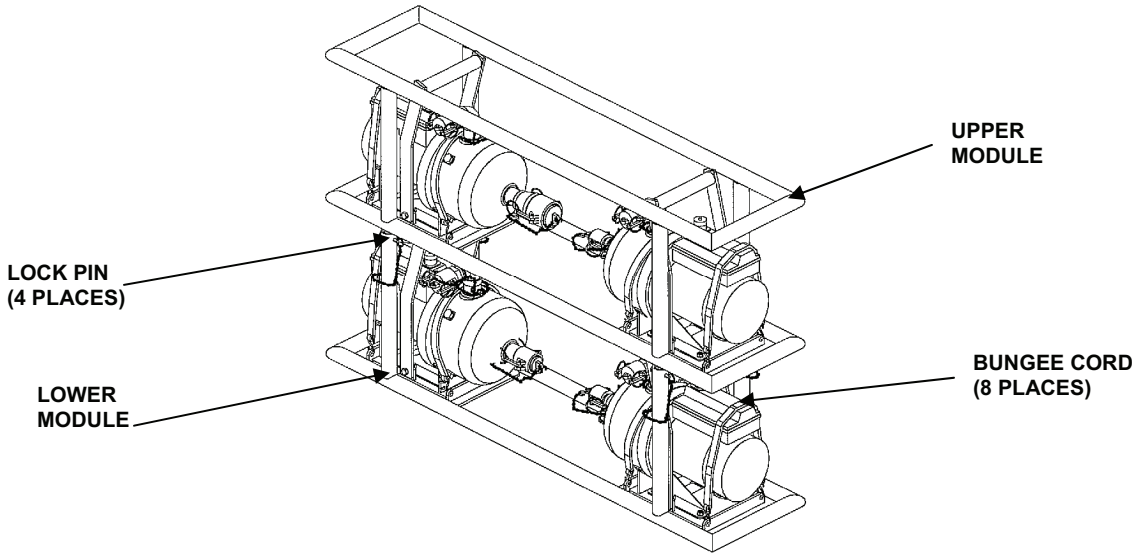


Figure 6. Service Pump Upper and Lower Modules.

OFFLOADING THE LWP - continued

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

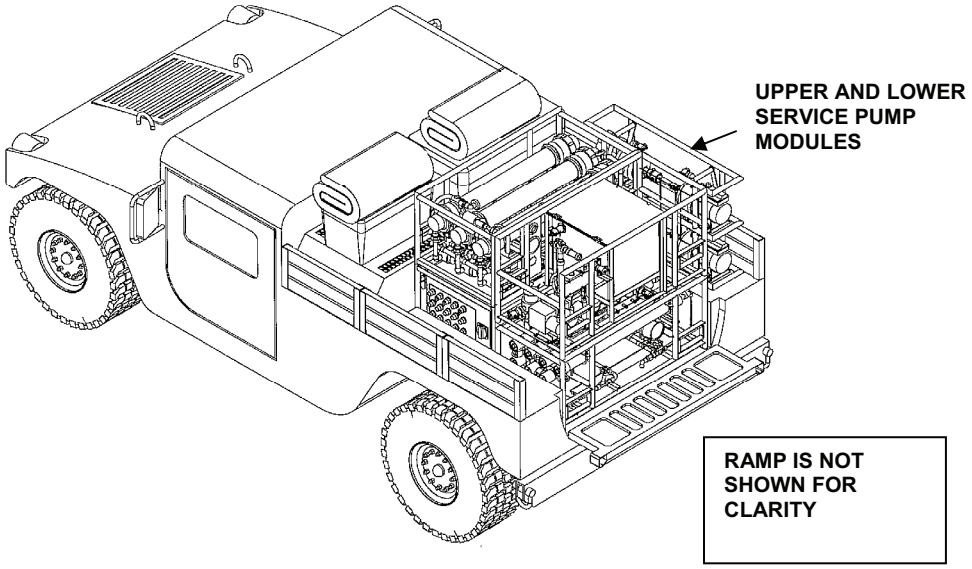


Figure 7. Offloading Service Pump Skids.

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.

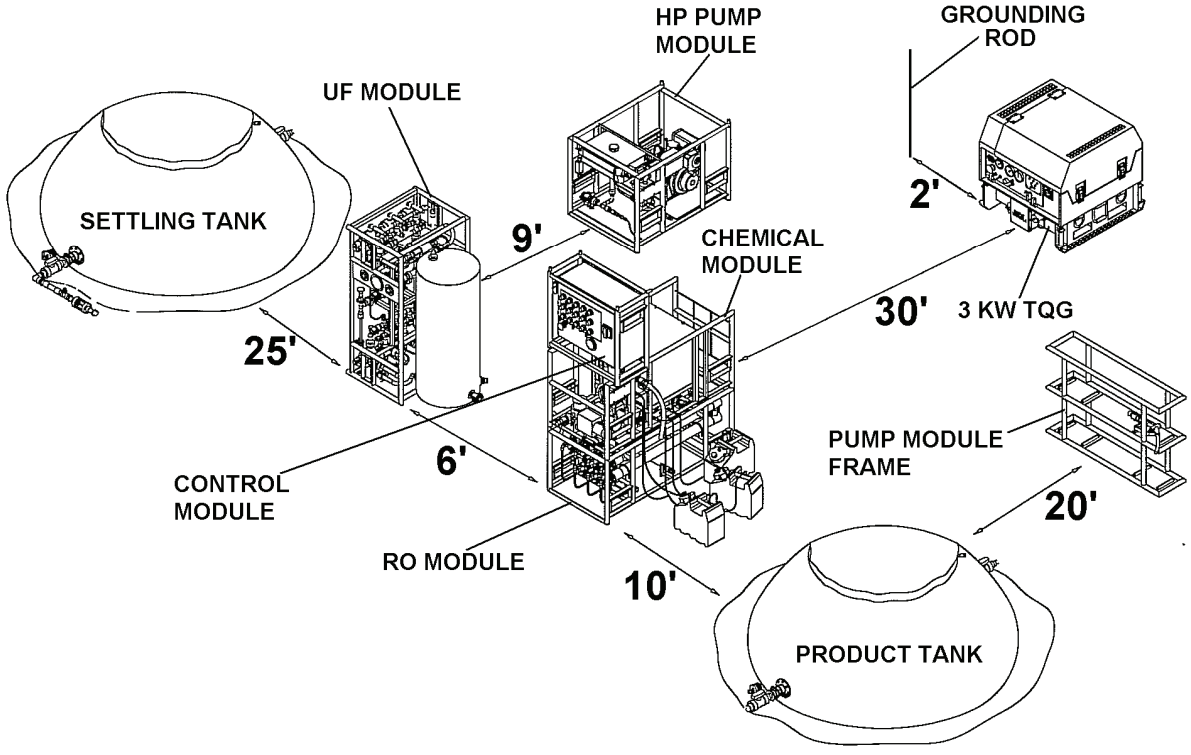


Figure 8. Recommended Distances Between the Components.

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.

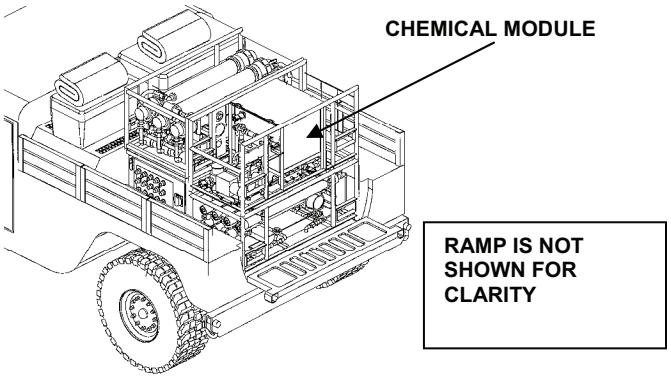


Figure 9. Offloading Chemical Module.

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.

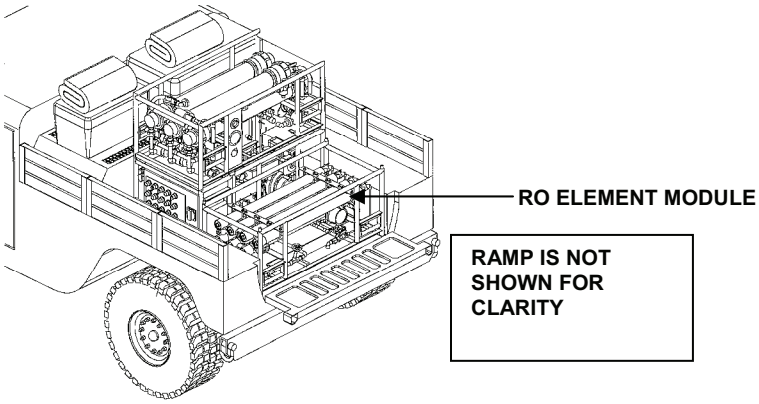


Figure 10. Offloading Reverse Osmosis Element Module.

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.

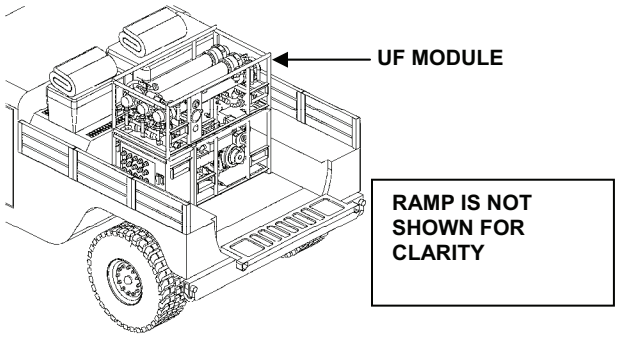


Figure 11. Offloading Ultrafiltration Module.

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.

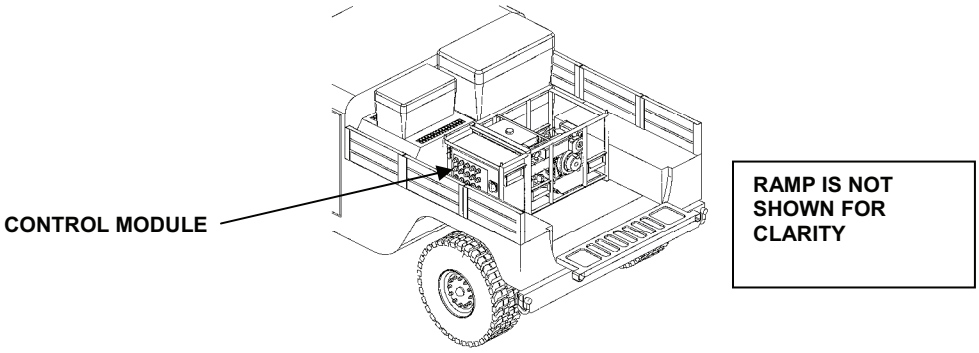


Figure 12. Offloading Control Module.

OFFLOADING THE LWP - continued

16. Stack the control module on top of the chemical module at least 3 in. (7.5 cm) 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.

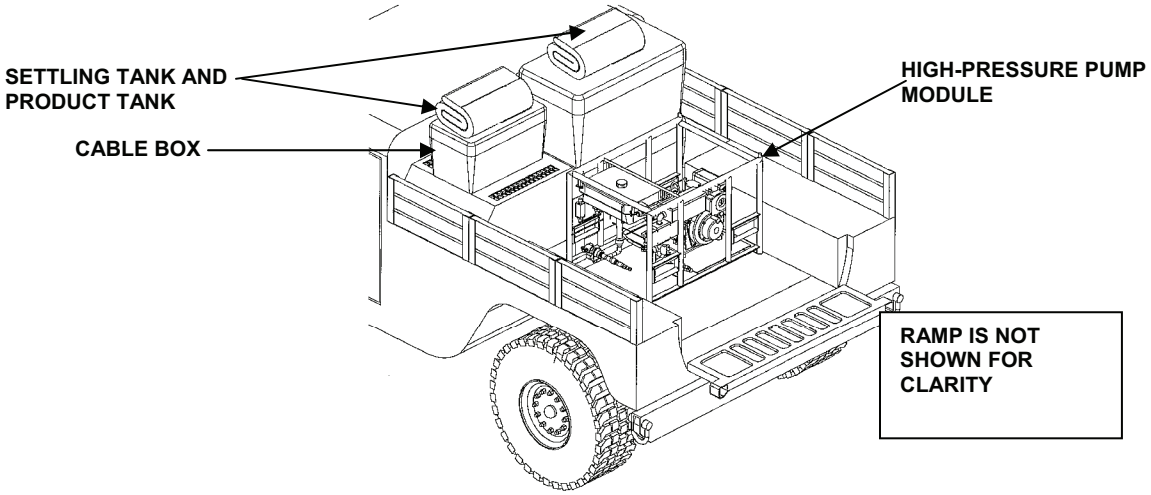


Figure 13. Offloading High-Pressure Pump Module.

20. Place the high-pressure pump module to the rear of the UF module, approximately 10 ft (3.05 m). (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 ft. (1.83 m).

24. Position the product water tank downstream of the stack of the control module, chemical module, and RO modules approximately 6 ft. (1.83 m) See Figure 8.

25. Unload the cable box.

OFFLOADING THE LWP - continued

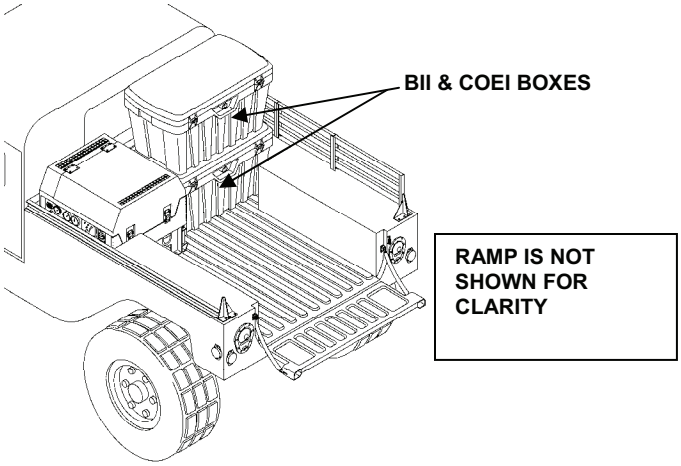


Figure 14. Offloading Basic Issue Items and Components of the End Item Boxes.

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 0138.

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

FUEL
Avoid prolonged contact with skin, eyes and clothing, do not use in enclosed spaces. Always Wear goggles and gloves when handling fuel. Fuel is flammable and should not be used near open flame or heat source. No Smoking signs should be posted within 100 feet of the fuel drum. Fire extinguishers should be readily available at all times. All petroleum products contain additives that may be harmful to personnel and the environment. All leaks must be corrected as soon as possible. Wash fuel or oil from skin immediately. Remove and wash contaminated clothing immediately. Spills of fuel or oil must be cleaned up in accordance with local area direction to prevent harm to personnel or damage to the environment. Never operate the equipment with any Class of fuel leak. Serious injury or death may occur.

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

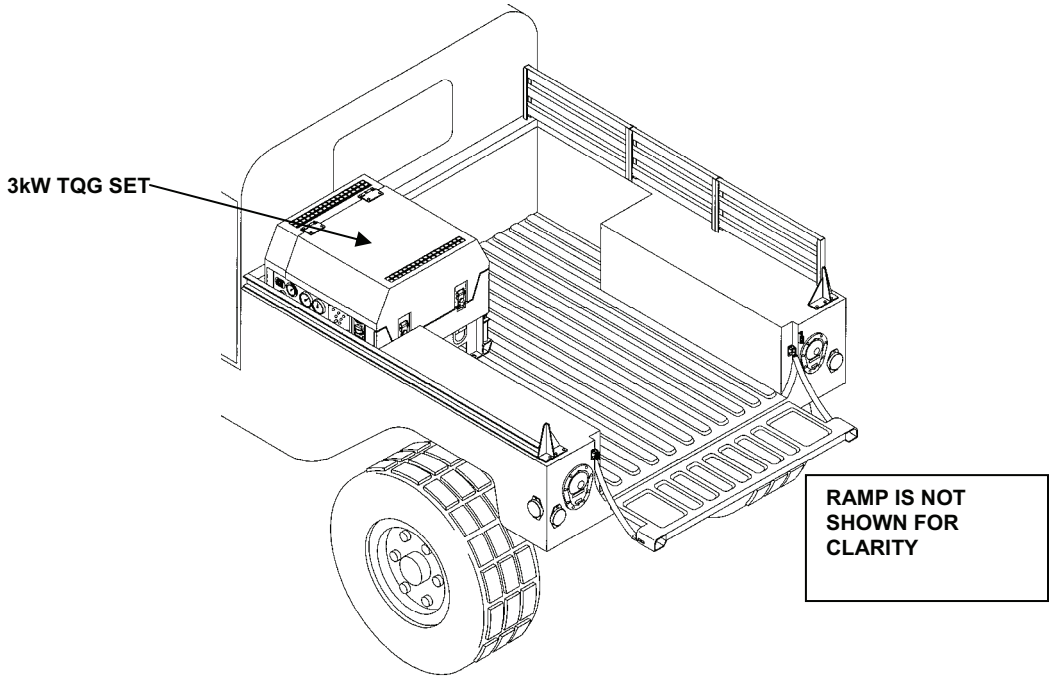


Figure 15. Offloading 3kW Tactical Quiet Generator Set.

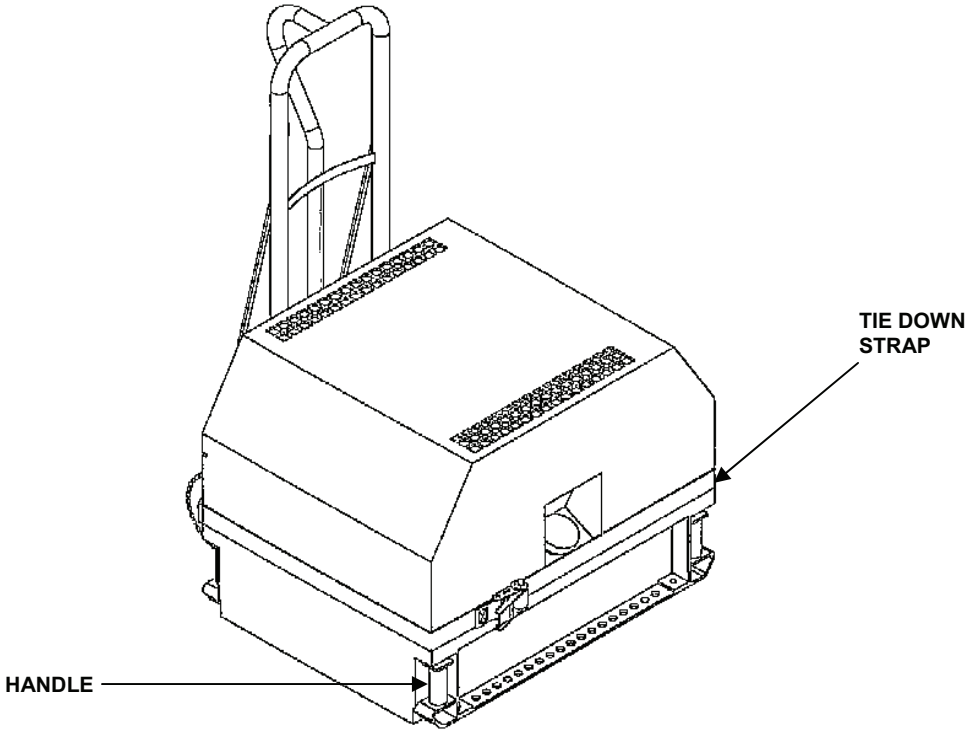


Figure 16. 3kW TQG Set Secured to Hand Truck

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
OPERATION UNDER USUAL CONDITIONS

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

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 0022 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 0022.
5. Preserve and Drain the LWP. See WP 0016.
6. If transporting during cold weather follow the cold weather drain procedures. See WP 0018.
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, and T7).
9. Make sure the cleaning tank on the chemical injection/cleaning module is completely dry. No moisture is allowed.
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
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 0103.

PREPARING THE LWP FOR TRANSPORTATION – Continued.

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. Inventory and stow all the Basic Issue Items (BII) and COEI boxes. See WP 0138 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 drain procedure. See WP 0018.
3. Ensure that all drains are closed.
4. Ensure that the fittings have the dust plugs and dust caps 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 0100.
    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 0099.
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.

PREPARING THE CHEMICALS FOR SHIPPING – Continued.

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.

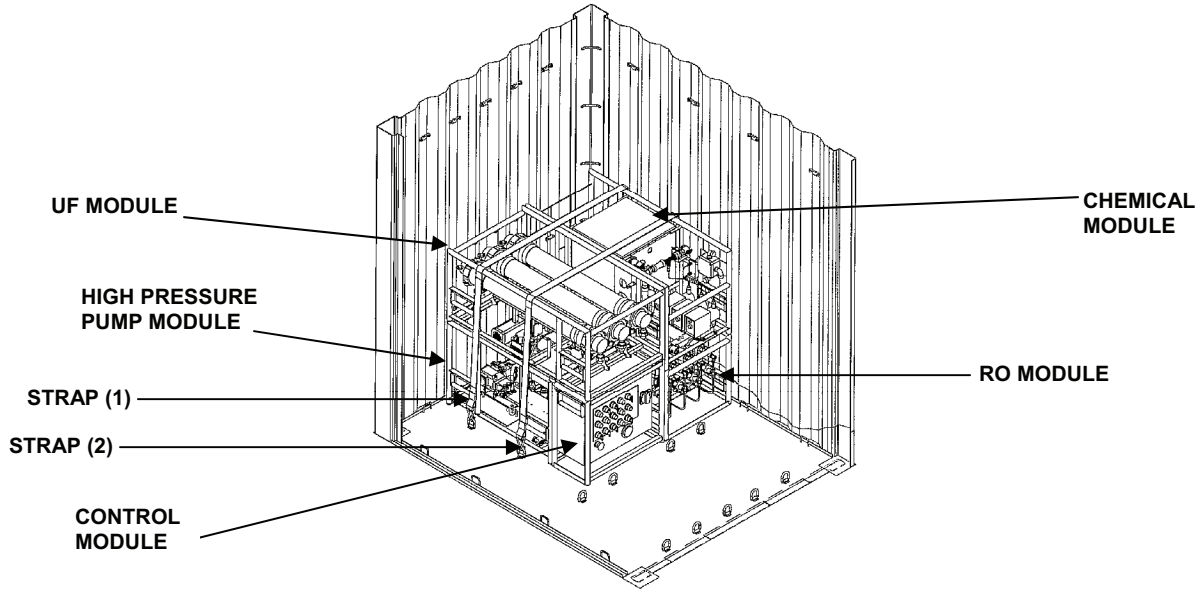


Figure 1. Loading TRICON (First Phase).

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.

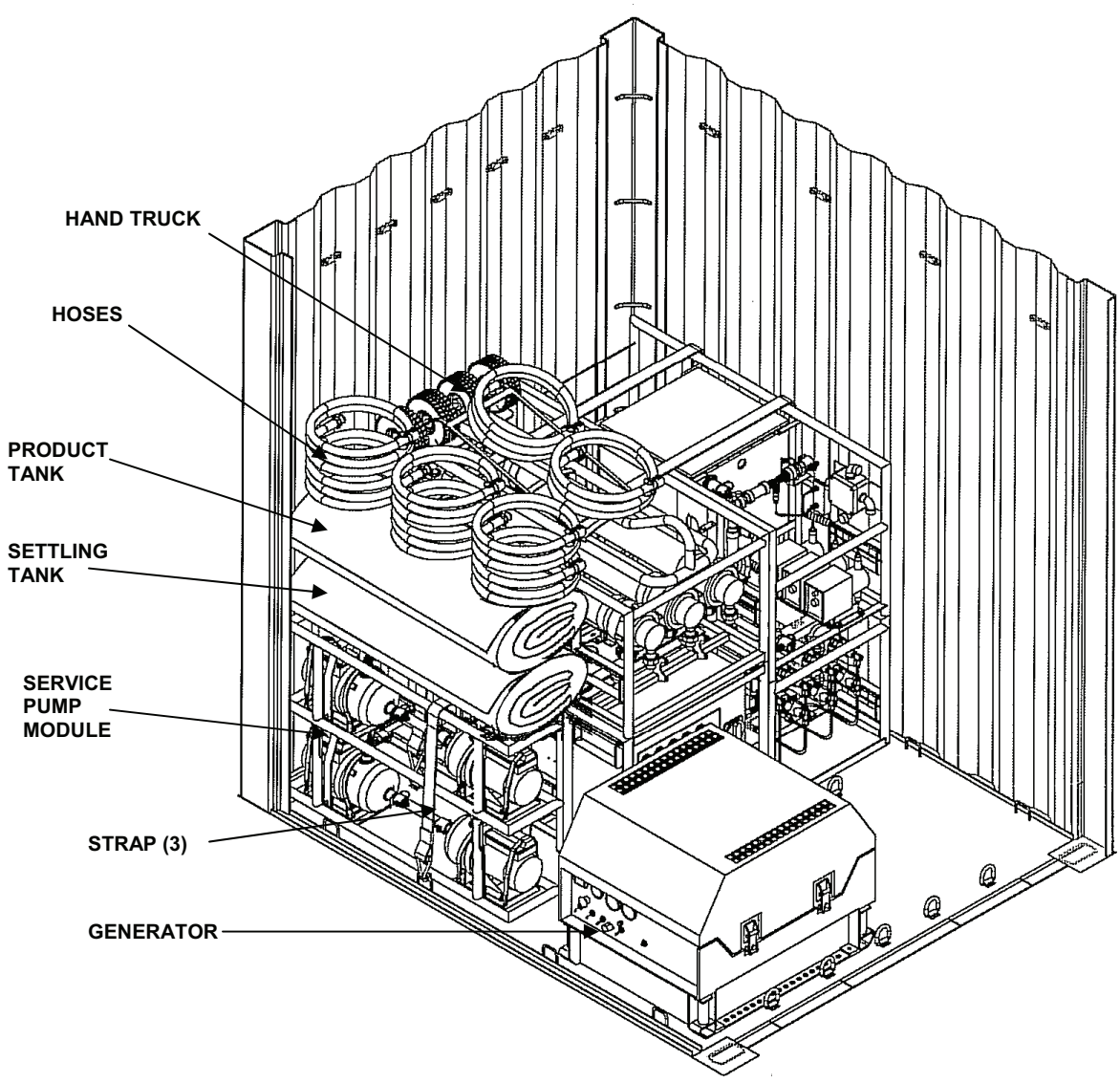


Figure 2. Loading TRICON (Second Phase).

LOADING THE TRICON – continued

WARNING

The 3kW TQG set weighs 334 lbs. (151.50 kg). At least six personnel are required to move the 3kW TQG set. Serious injury to personnel and/or damage to equipment could result.

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.
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.

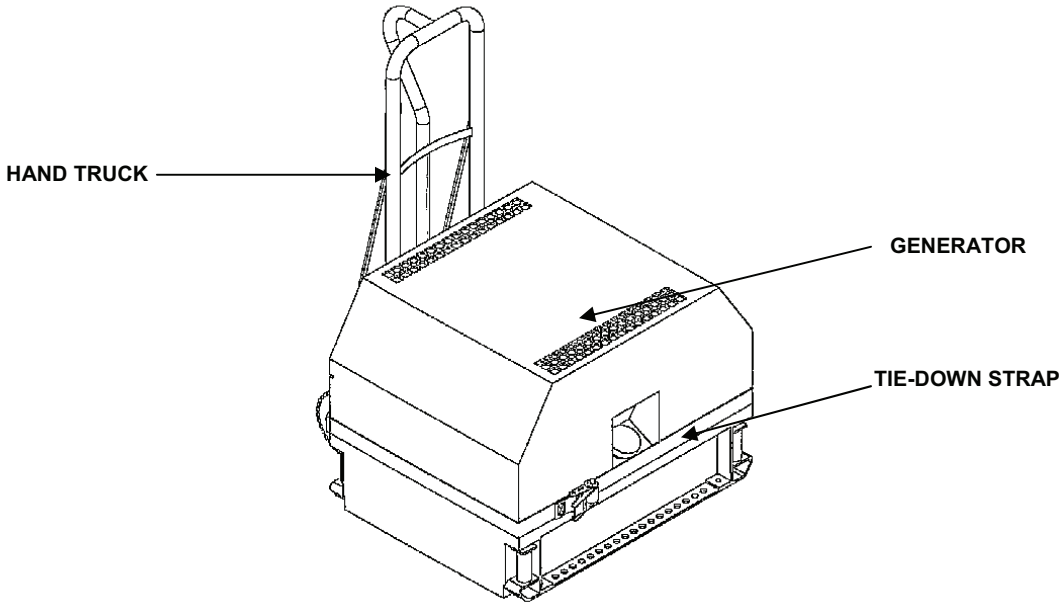


Figure 3. Loading 3kW Tactical Quiet Generator Set on Hand Truck.

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).

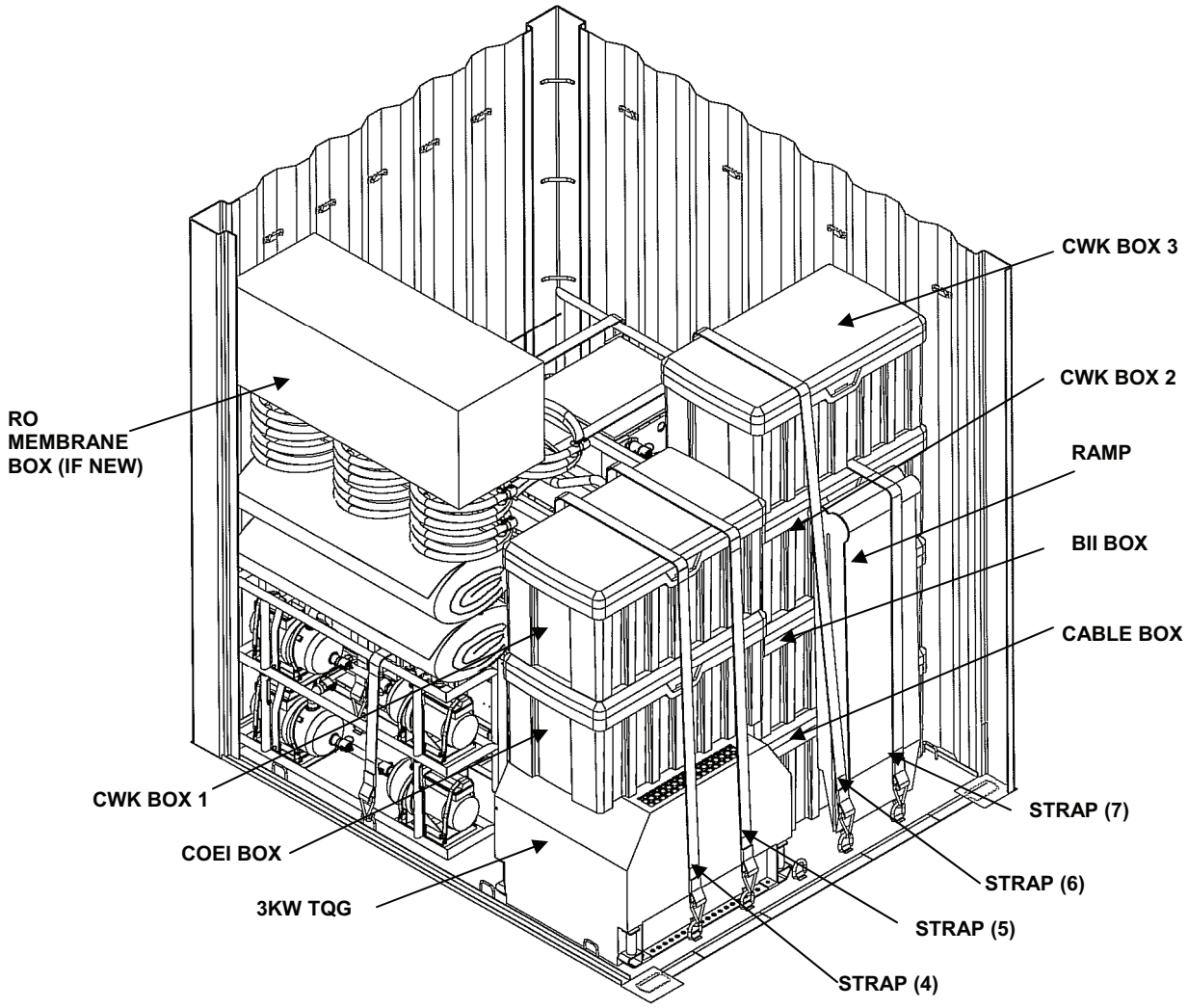


Figure 4. Loading TRICON (Third Phase).

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.

LOADING THE TRICON – continued

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).
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 FM 55-80 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. Remove hoses and hand truck from TRICON. Never throw the hoses.
7. Load the 3kW TQG set on the hand truck. Secure with tie-down strap. See Figure 3.
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 0009.
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
OPERATION UNDER USUAL CONDITIONS

INITIAL SETUP

Tools

Wrench, adjustable (WP 0138, Item 61)
Wrench set, combination (WP 0138, Item 60)
Rags, wiping, cotton (WP 0139, Item 24)
Device, floatation (WP 0139, Item 17)
Bag, sand 14 x 26 (WP 00139, Item 4)

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 0012 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 0009, and WP 0010. Perform Preventive Maintenance Checks and Services (PMCS). See WP 0038.

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.

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.

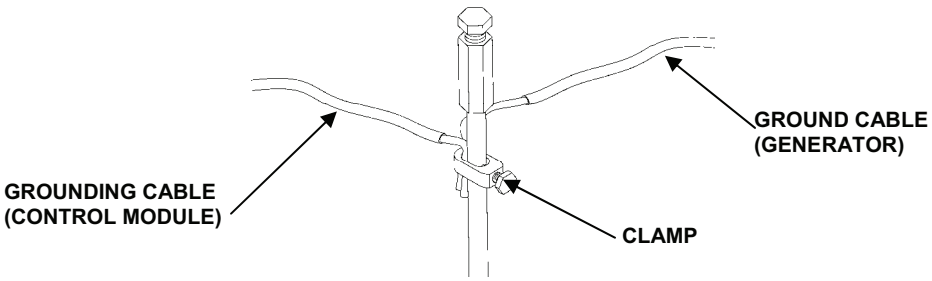


Figure 1. Grounding Rod.

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. Damage to equipment could occur.

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

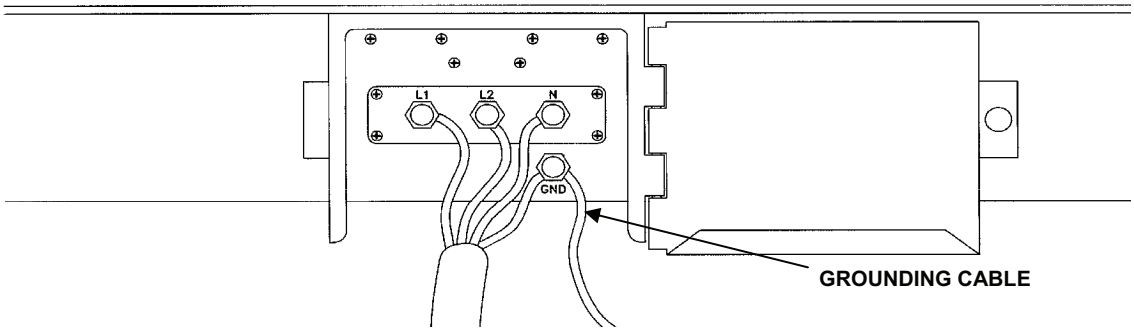


Figure 2. 3kW TQG Set Connections.

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

FUEL

Avoid prolonged contact with skin, eyes and clothing, do not use in enclosed spaces. Always wear goggles and gloves when handling fuel. Fuel is flammable and should not be used near open flame or heat source. No Smoking signs should be posted within 100 feet of the fuel drum. Fire extinguishers should be readily available at all times. All petroleum products contain additives that may be harmful to personnel and the environment. All leaks must be corrected as soon as possible. Wash fuel or oil from skin immediately. Remove and wash contaminated clothing immediately. Spills of fuel or oil must be cleaned up in accordance with local area direction to prevent harm to personnel or damage to the environment. Never operate the equipment with any Class of fuel leak. Serious injury or death may occur.

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 0038.
2. Place the settling tank in a suitable, level location where it will not roll or move as it fills up with water.

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 ft. (0.3 m) rise in 10 ft. (3 m) run] is exceeded.

3. Position the settling tank within 50 ft. (15.24 m) from raw water source and within 25 ft. (7.62 m) 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.

1. Unfasten the two buckles on the tank protective cover closure straps. See Figure 3.

CAUTION

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

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

2. Place the protective ground cover in the desired location
3. Unfold the protective ground 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 WP0038.
8. Remove the dust plug from the filler fitting or the dust cap from the discharge fitting. See Figure 5.

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

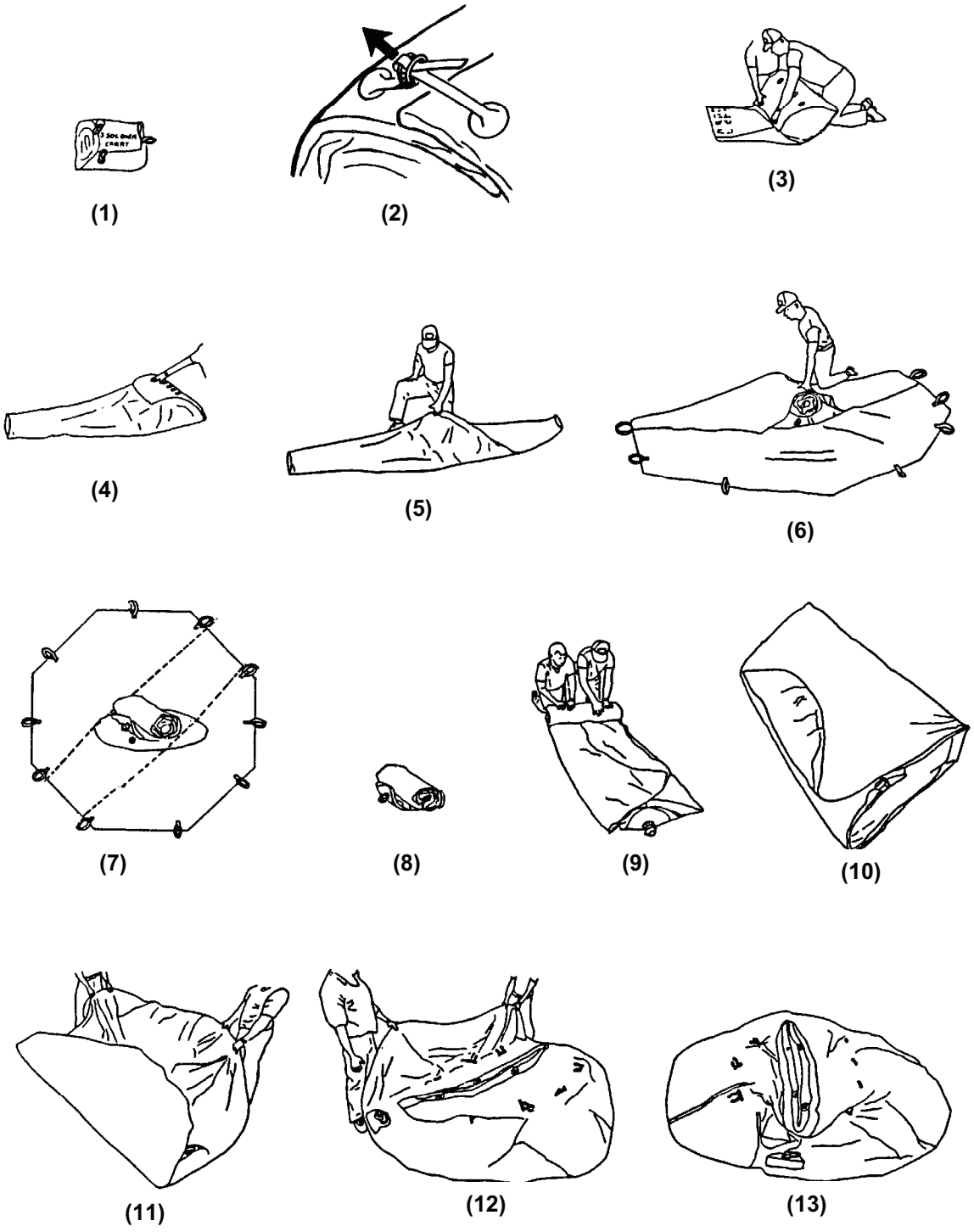


Figure 3. Unpacking Collapsible Fabric Tank.

SETTLING TANK SETUP – continued

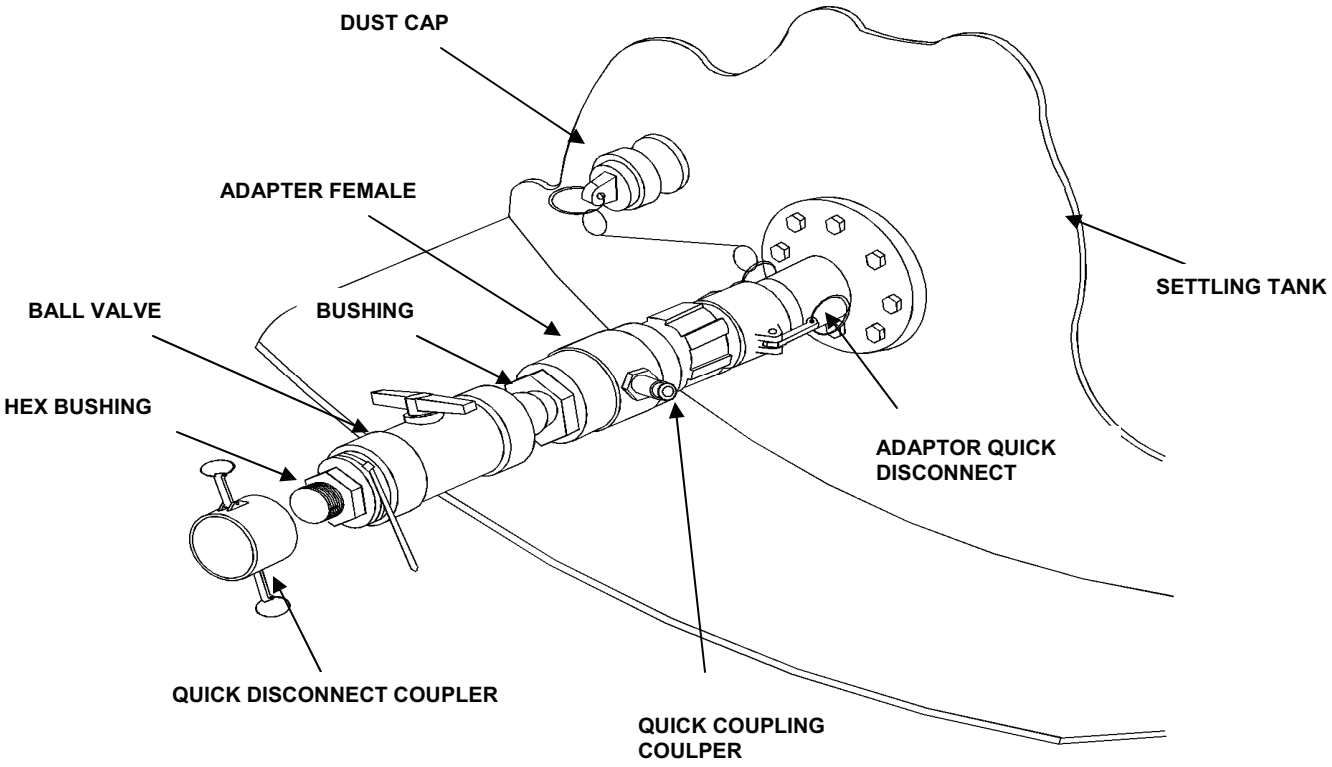


Figure 4. Settling Tank Inlet Spool Piece.

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. (Ball Valve V1)
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. (Ball Valve V48)

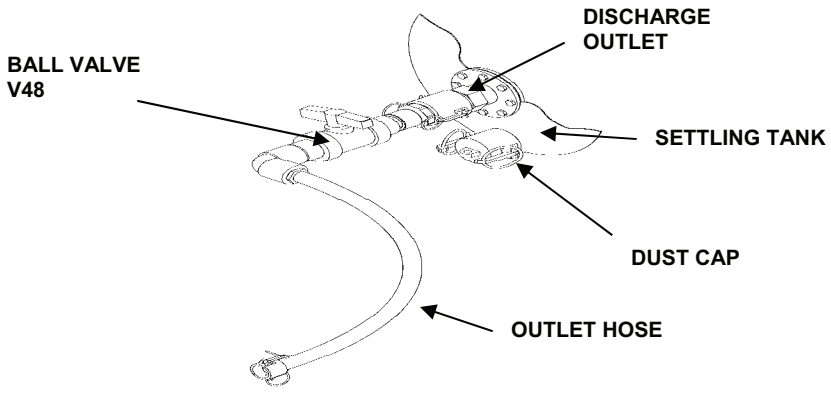


Figure 5. Settling Tank Outlet Spool Piece.

SETTLING TANK SETUP – continued

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

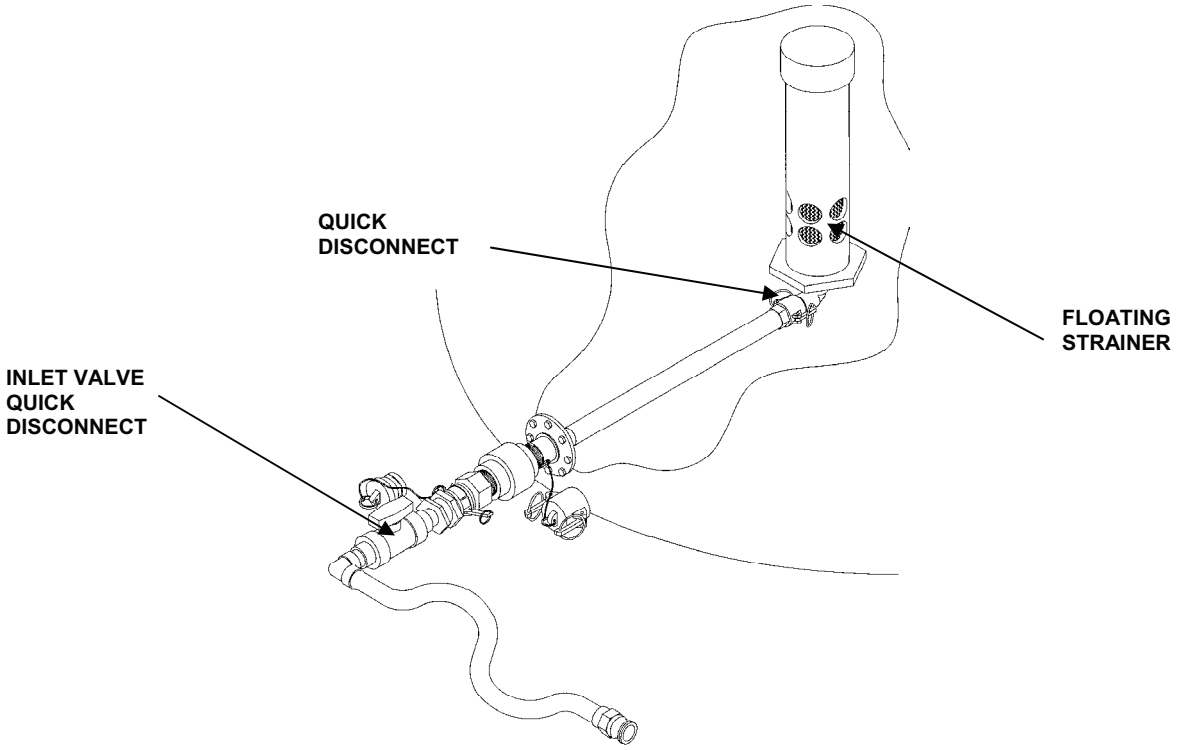


Figure 6. Settling Tank Strainer.

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

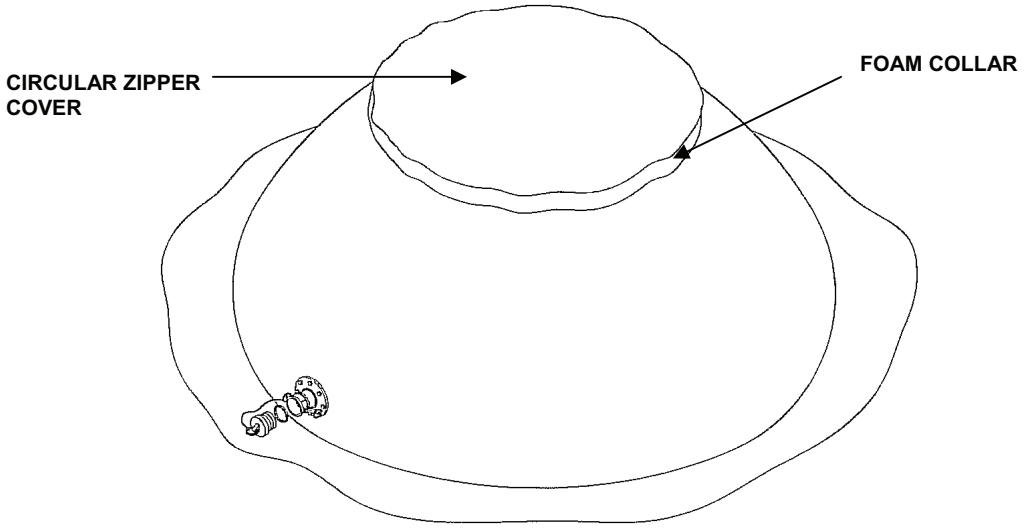


Figure 7. Settling Tank.

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.

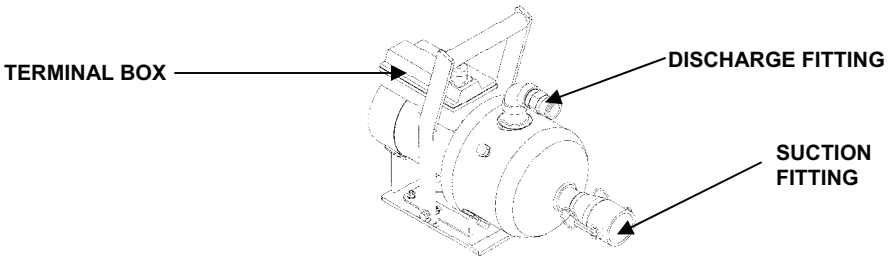


Figure 8. Raw Water Service Pump.

GUZZLER PRIMING PUMP SETUP

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

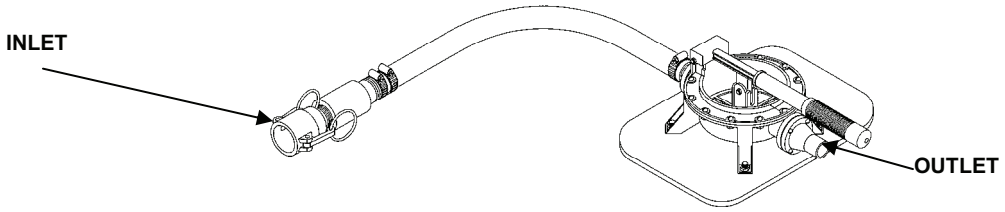


Figure 9. Hand-Powered Priming Pump.

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.

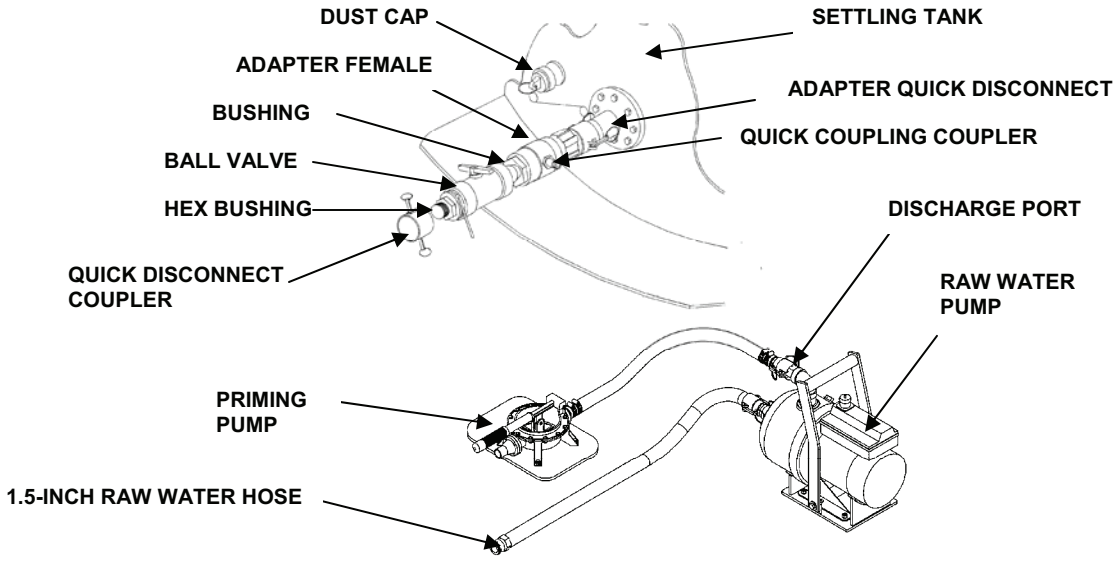


Figure 10. Priming Pump/Raw Water Service Pump Connection.

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.

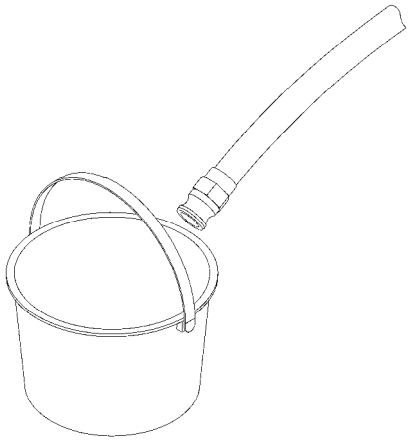


Figure 11. Cleaning Hose Connections.

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.

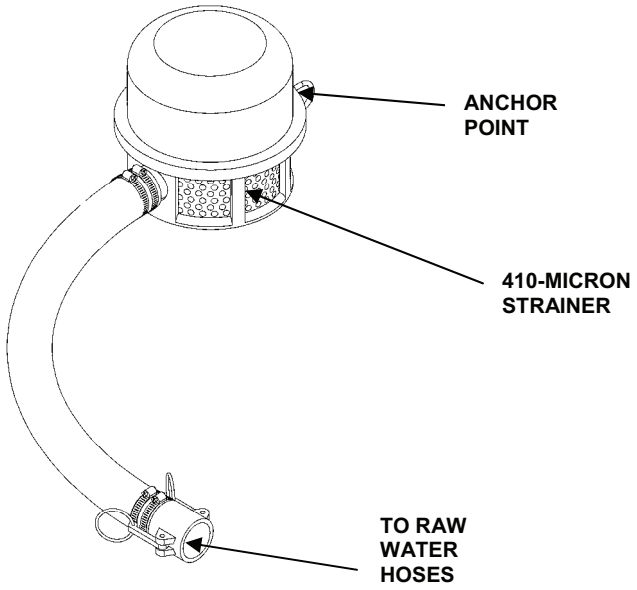


Figure 12. Raw Water Intake Strainer.

RAW WATER PUMP SETUP – continued

4. Fill sand bag from expendable durable items list, with sand, rocks, or other heavy material that will sink.
5. Cinch the bag closed and tie it shut with the string on the bag. Loop the string through the snap hook. The snap hook is located in the BII box.
6. Loop the rope from the BII box through the carabineer and tie it to the anchor point on the raw water strainer.
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 snap hook 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. A minimal depth of 3ft is desired.

INITIAL START

WARNING

Hearing protection must be worn at all times when operating within 17 Ft. (5.18 m) 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.
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.

INITIAL START – continued

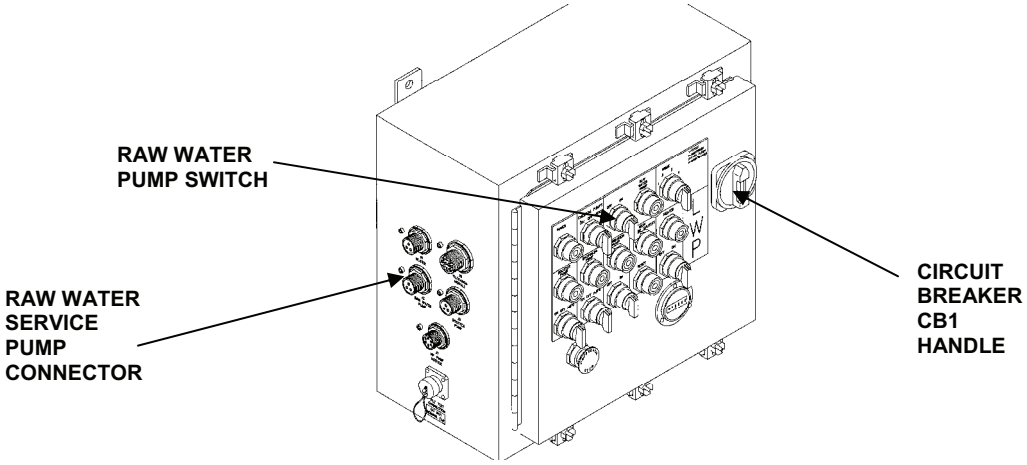


Figure 13. Control Module.

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 gal (3785 l).

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 0046.

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. Attach to LWP framework where possible.

END OF WORK PACKAGE

OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
LWP SETUP AND STARTUP PROCEDURES
OPERATION UNDER USUAL CONDITIONS

INITIAL SETUP

Tools
Wrench, adjustable (WP 0138, Item 61)

Materials/ Parts
Rags, wiping, cotton (WP 0139, Item 24,)

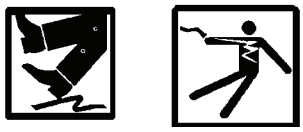
General Safety Considerations
Observe all CAUTIONs and WARNINGs

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 0011.

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.

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.

PURIFICATION AND DISTRIBUTION SYSTEM SETUP- continued

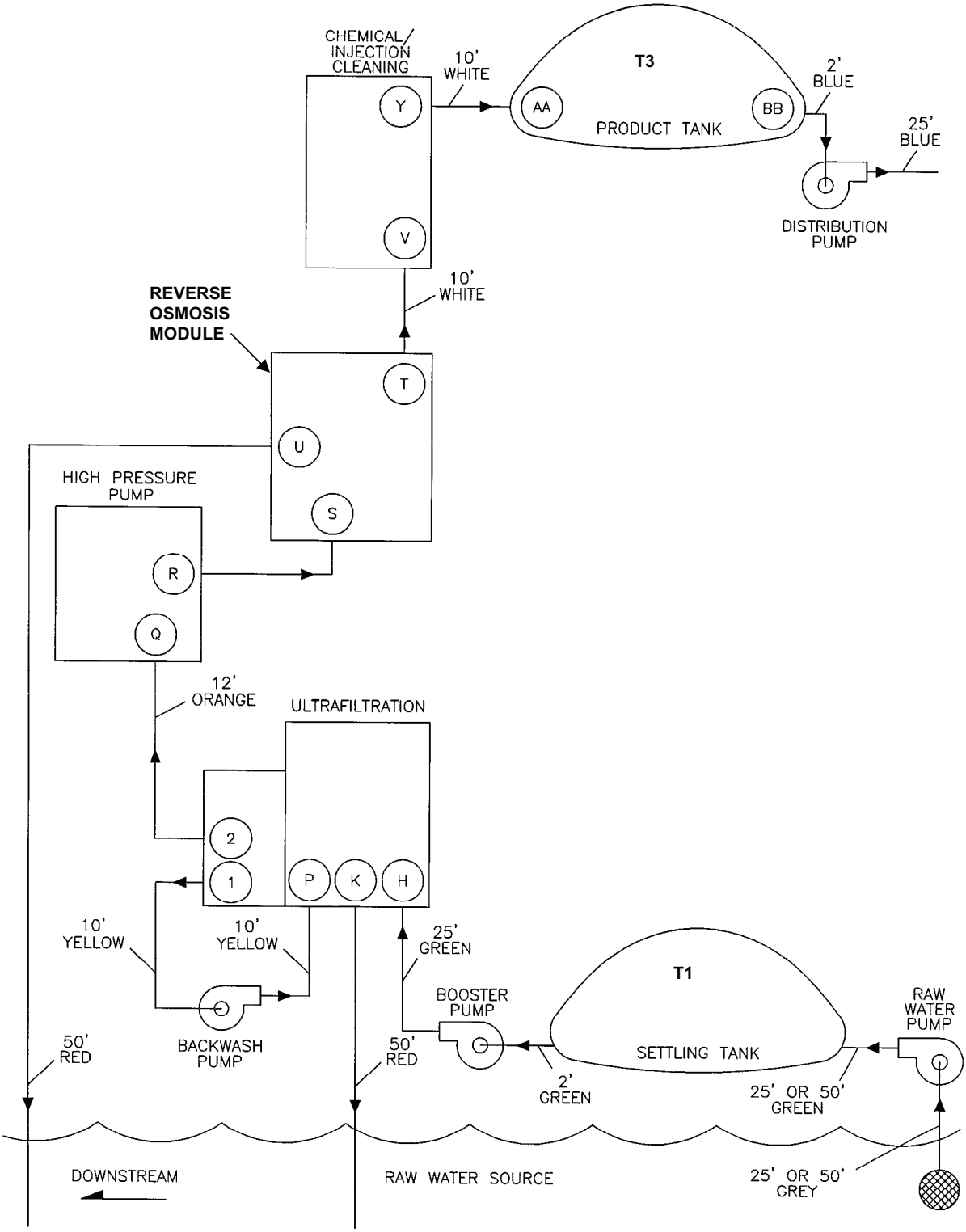


Figure 1. Normal Operation Piping Layout.

PURIFICATION AND DISTRIBUTION SYSTEM SETUP - continued

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

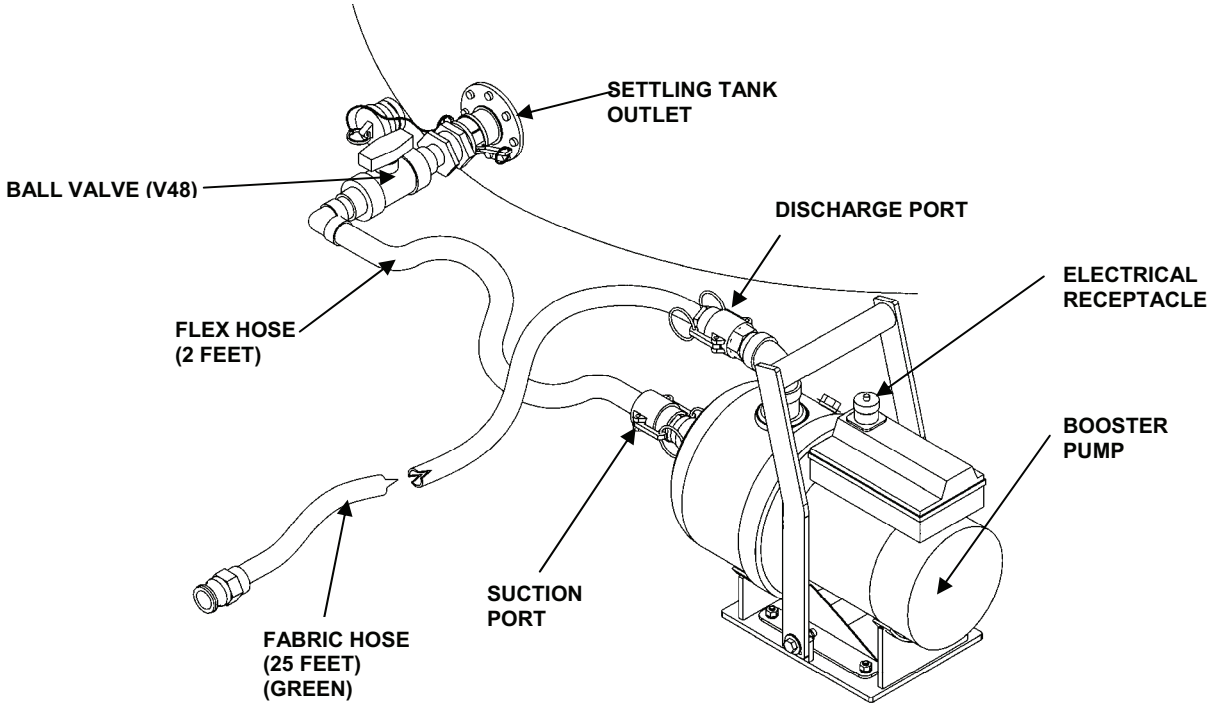


Figure 2. Booster Pump Hose Connections.

CAUTION

All hose connections must be clean. Dirt or debris maybe 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.

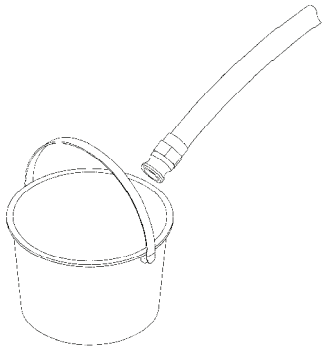


Figure 3. Cleaning Hose Connections.

PURIFICATION AND DISTRIBUTION SYSTEM SETUP – continued

CAUTION

All hose connections must be clean. Dirt or debris maybe 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.

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.

PURIFICATION AND DISTRIBUTION SYSTEM 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 (H). 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.

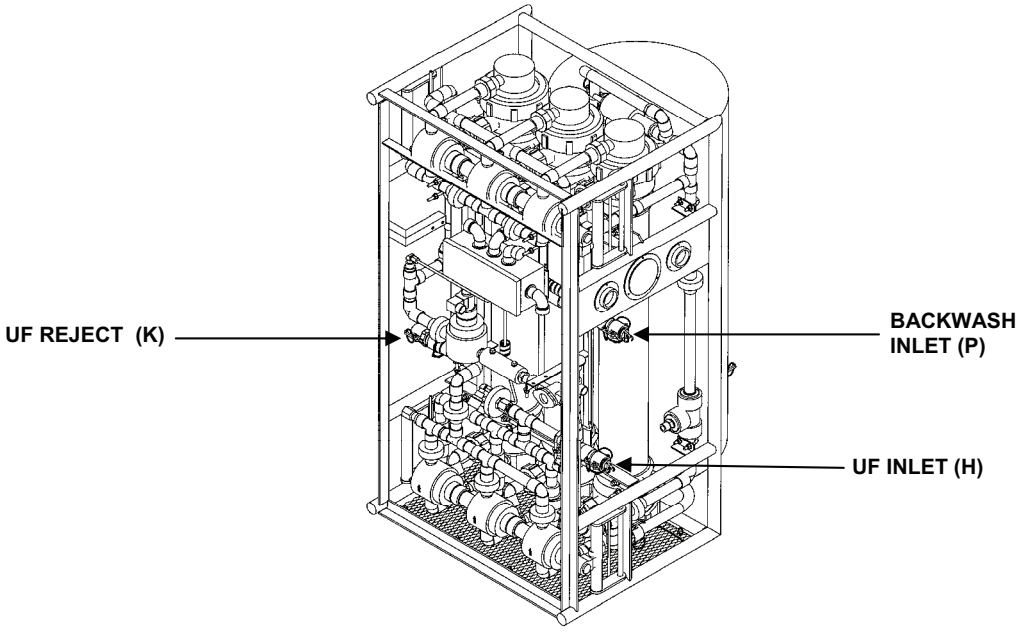


Figure 4. UF Module Connection.

PURIFICATION AND DISTRIBUTION SYSTEM 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.

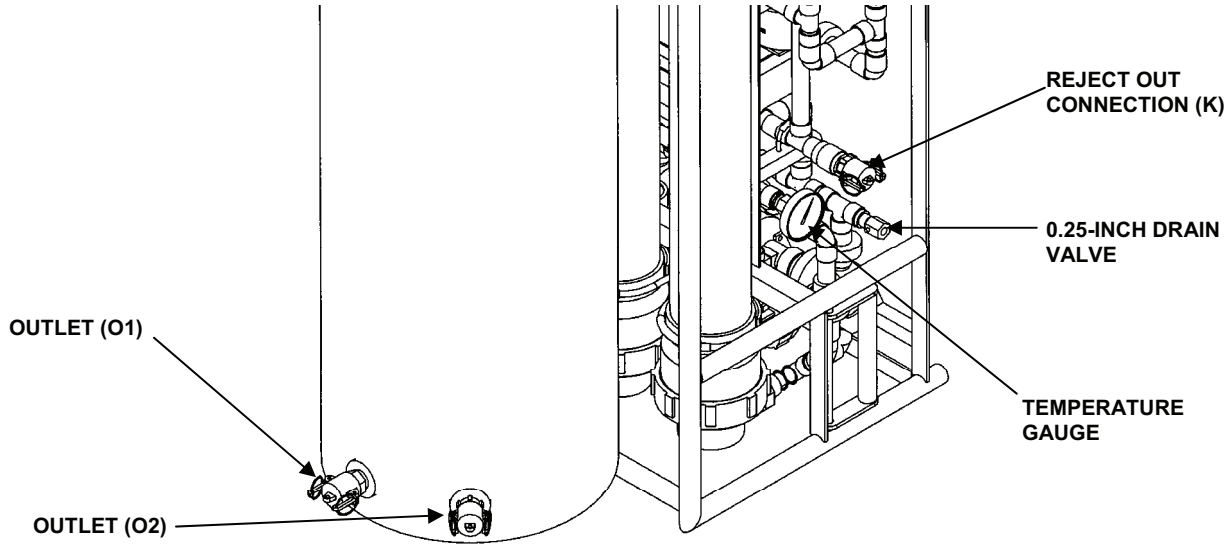


Figure 5. Filtrate Tank Outlet Connections.

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

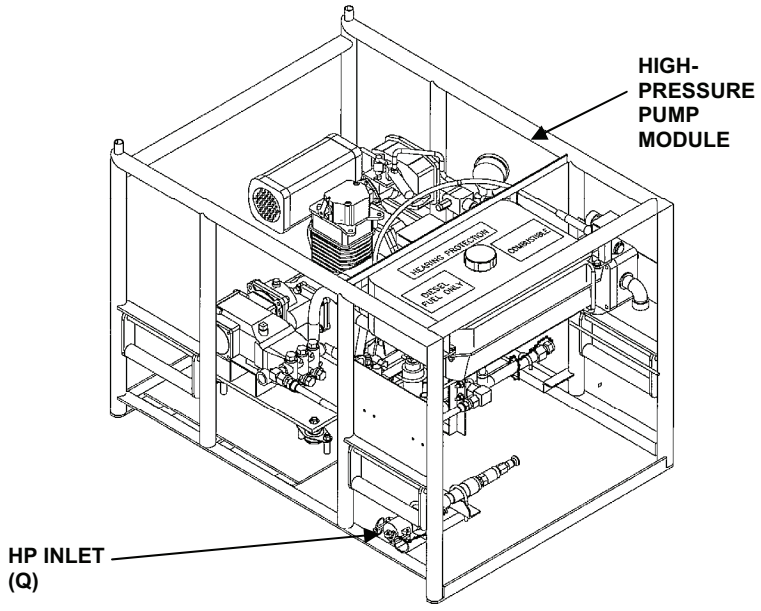


Figure 6. High Pressure Pump Module Inlet Connection.

PURIFICATION AND DISTRIBUTION SYSTEM SETUP - continued

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

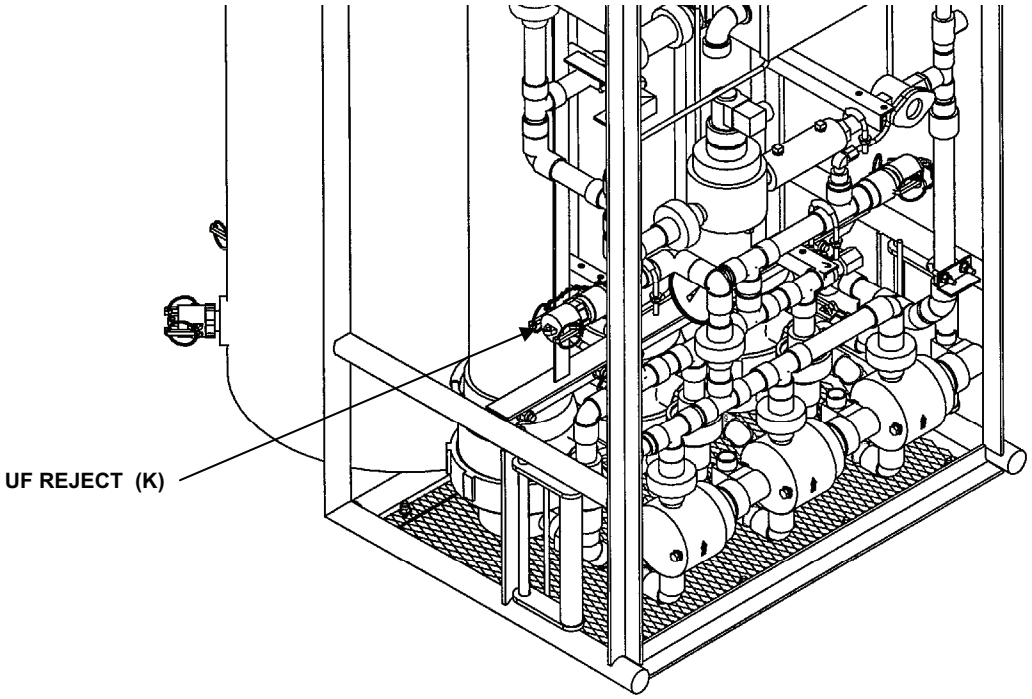


Figure 7. Raw Water Reject Outlet Connection.

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.

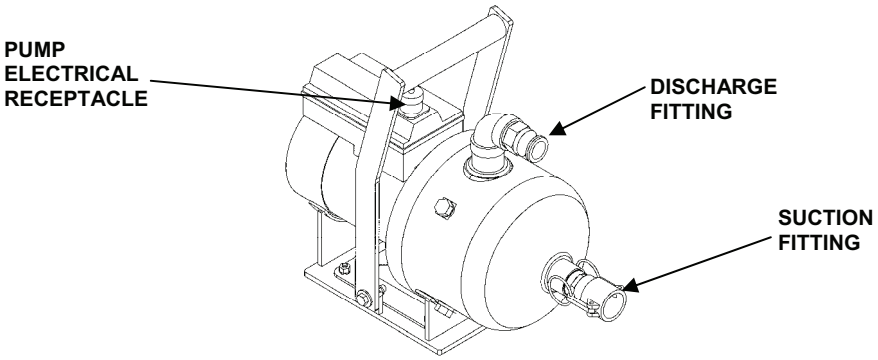


Figure 8. Backwash Service Pump.

PURIFICATION AND DISTRIBUTION SYSTEM 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 (P) 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 (R). Tighten securely. See Figure 1 and Figure 9.

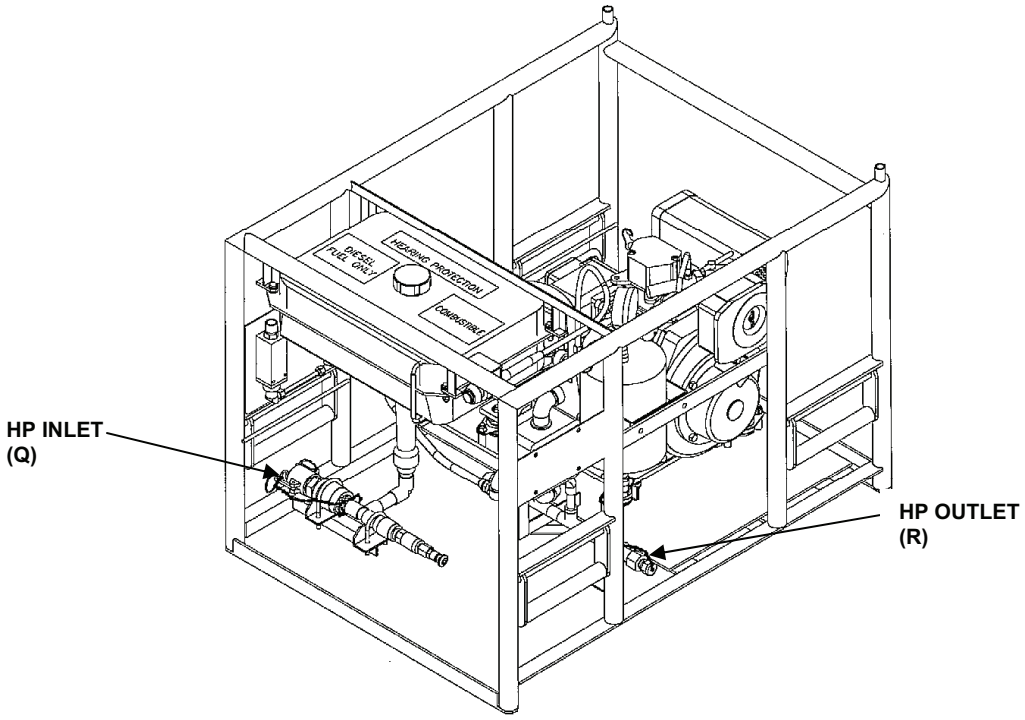


Figure 9. High-Pressure Pump Module Outlet Connection.

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

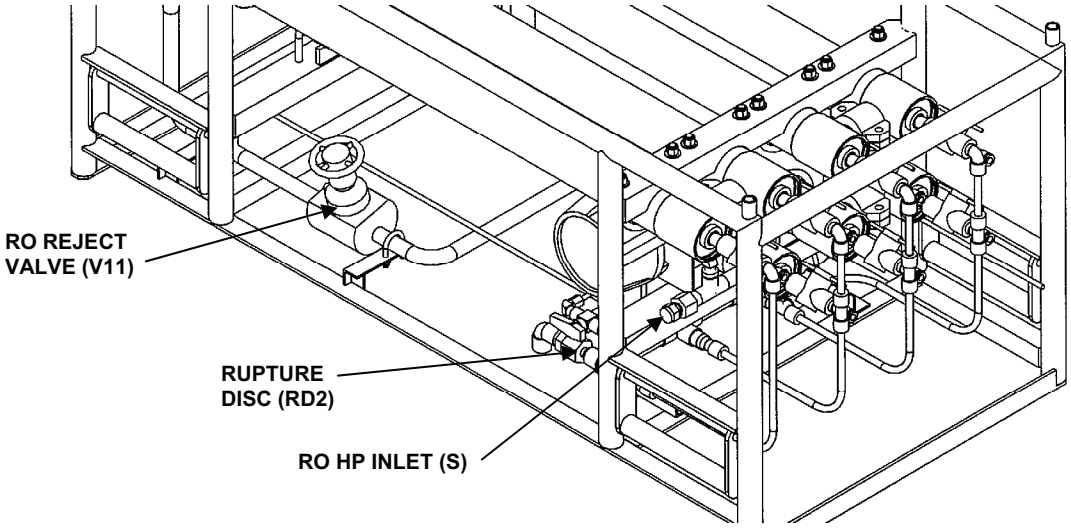


Figure 10. RO Module High-Pressure Inlet Hose Connection.

PURIFICATION AND DISTRIBUTION SYSTEM 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 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 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 (U). See Figure 10 and Figure 11.

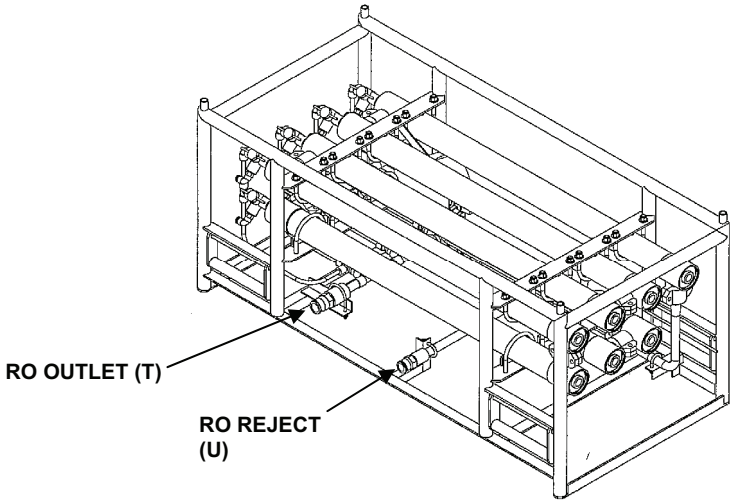


Figure 11. RO Reject and Product Hose Connection.

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 0013 for description of other chemicals stored inside the cable box.

PURIFICATION AND DISTRIBUTION SYSTEM SETUP – continued

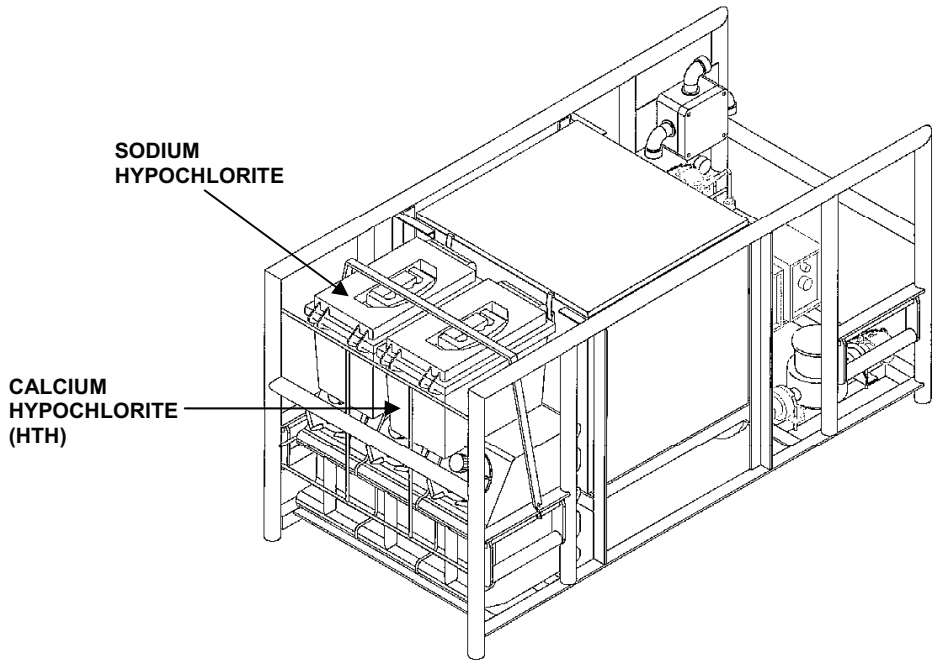


Figure 12. Chemical Module with Operational Chemical Boxes.

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

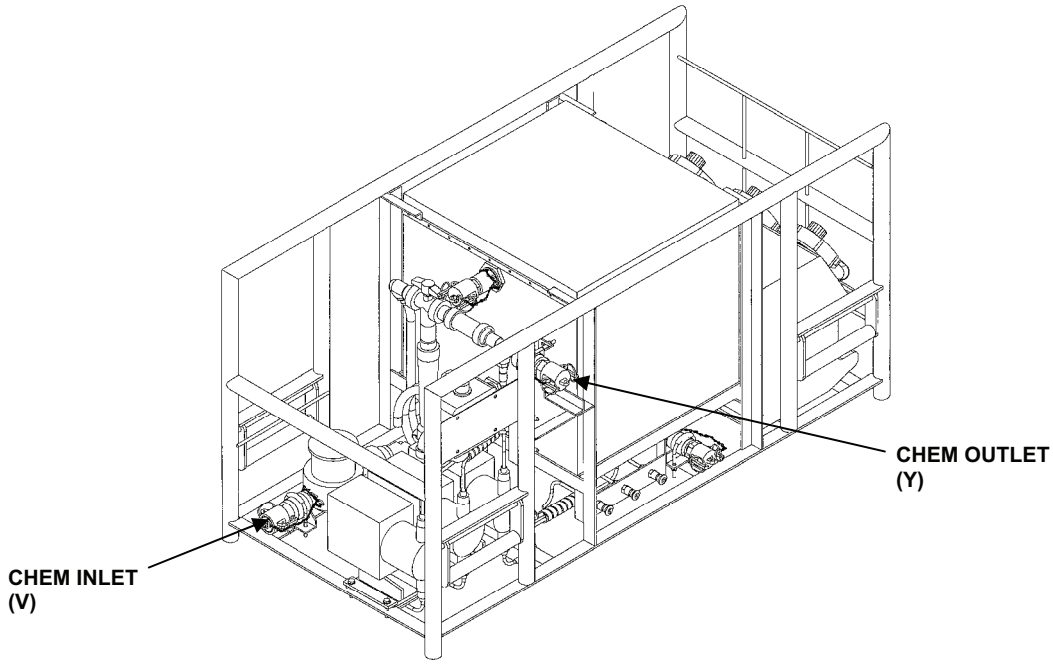


Figure 13. Chemical Module Product Water Hose Connections.

PURIFICATION AND DISTRIBUTION SYSTEM 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 (Y). See Figure 1 and Figure 13.
29. The other end of these two potable water hoses (white) will be connected to the product tank (AA) 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 the settling tank. See WP 0011.
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.

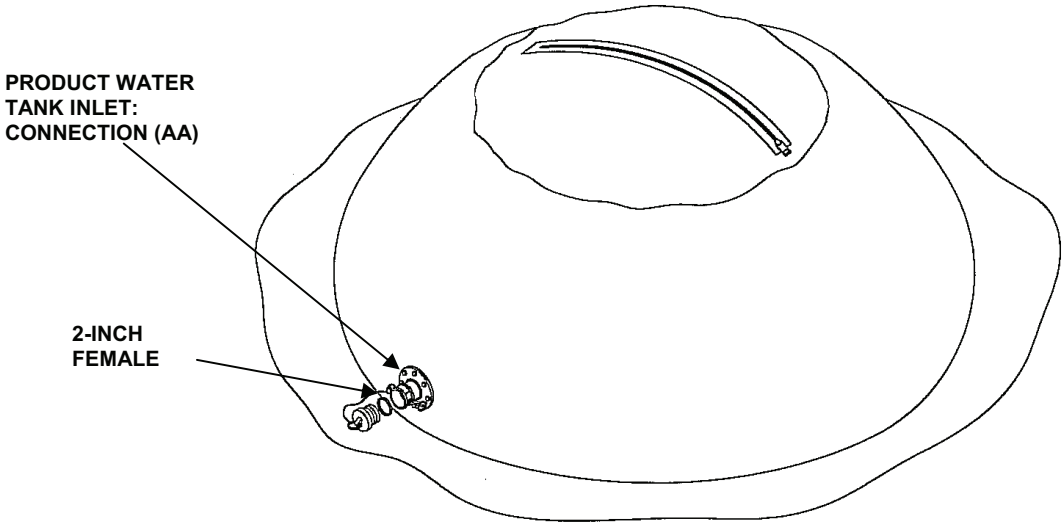


Figure 14. 1000-Gallon Collapsible Fabric Product Tank.

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.

PURIFICATION AND DISTRIBUTION SYSTEM SETUP - continued

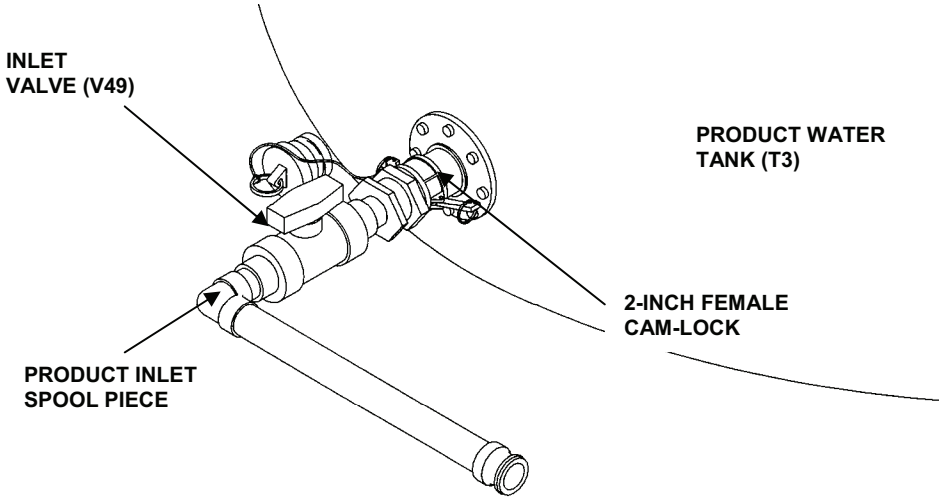


Figure 15. Product Tank Inlet Connection.

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.

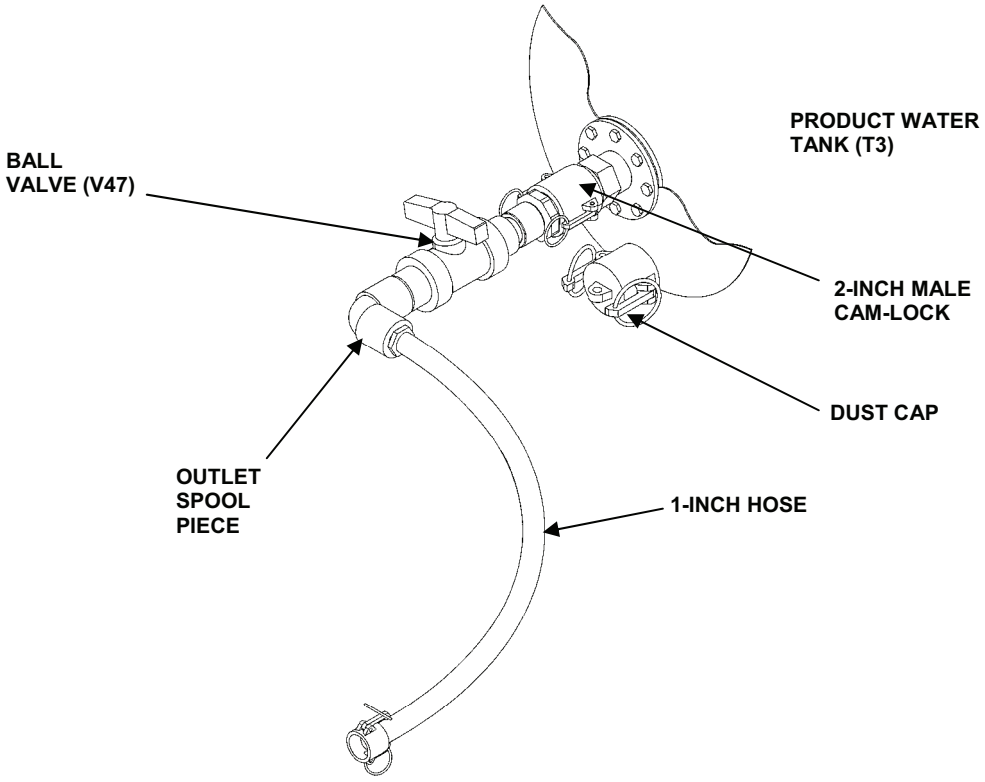


Figure 16. Product Tank Outlet Connection.

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.

PURIFICATION AND DISTRIBUTION SYSTEM 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.

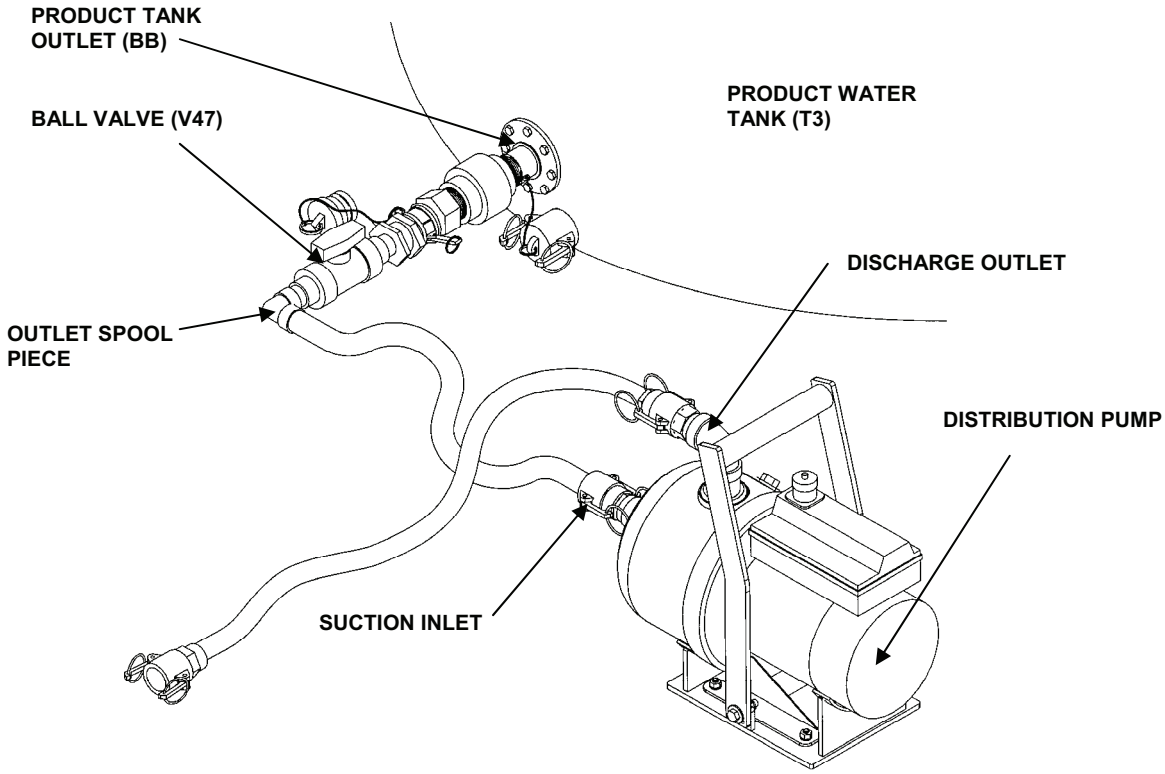


Figure 17. Product Tank Outlet to Distribution Pump Connection.

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

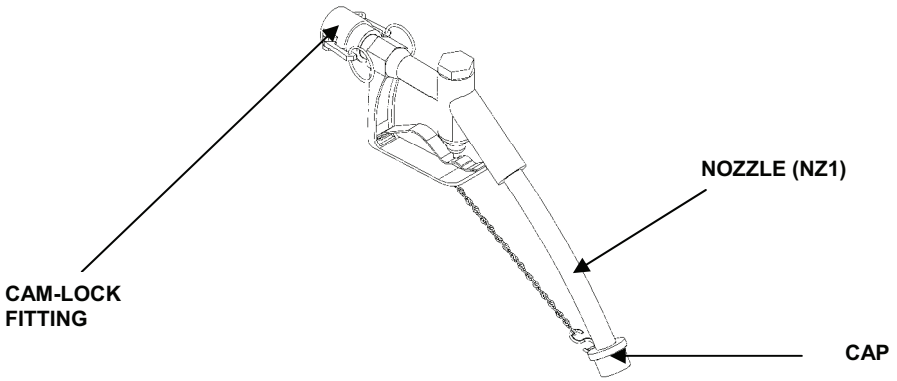


Figure 18. Product Water Nozzle.

PURIFICATION AND DISTRIBUTION SYSTEM 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 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 0038.

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.

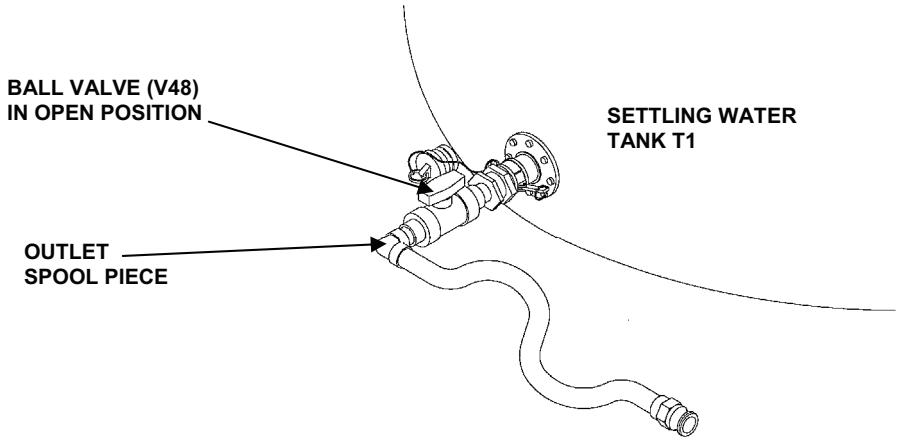


Figure 19. Settling Tank Outlet Valve in OPEN Position.

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

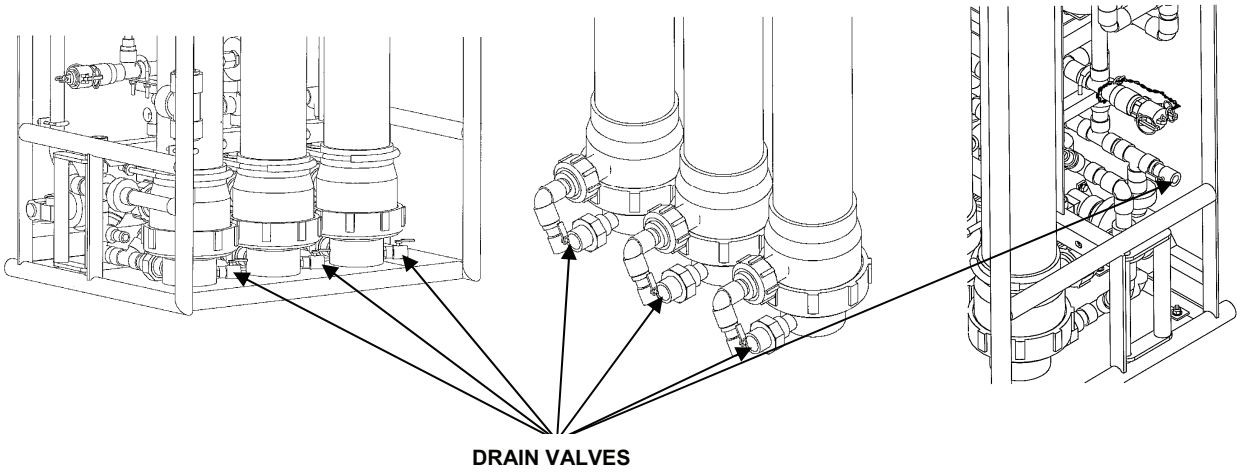


Figure 20. UF Module Drain Valves.

PURIFICATION AND DISTRIBUTION SYSTEM STARTUP – continued

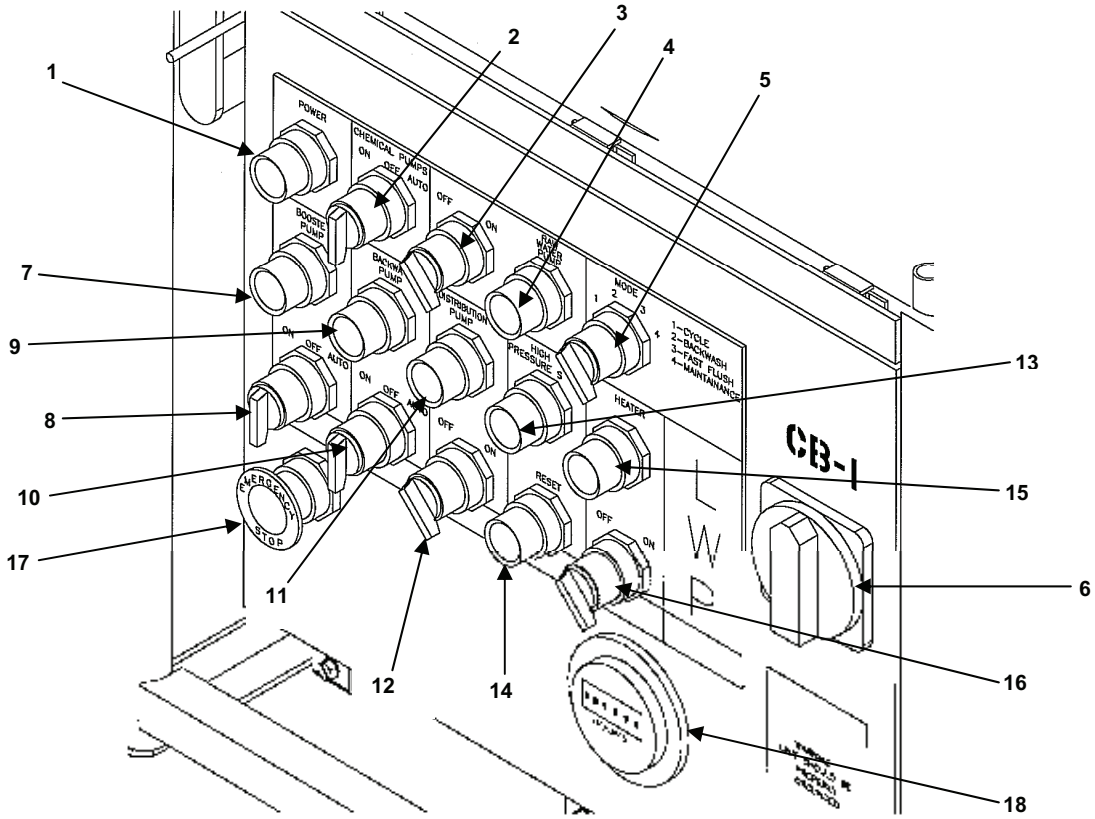


Figure 21. Control Module.

6. Disconnect the fabric hose (green) from the inlet (H) 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 (Figure 21, Item 8) and BACKWASH PUMP selector switch (Figure 21, Item 10) in the AUTO position on the control module. Green pilot light (Figure 21, Item 7) will light up. Green pilot light (Figure 21, Item 9) will only light up during backwash cycle.
8. It may be necessary to prime the booster pump. If so follow the steps to priming the raw water pump. See WP 0011.
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 (P).
    c. Place BACKWASH PUMP selector switch (Figure 21, Item 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 (P) 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 directed.
5. To shut down the diesel engine, pull the manual override handle out completely and the shutoff valve will snap close.

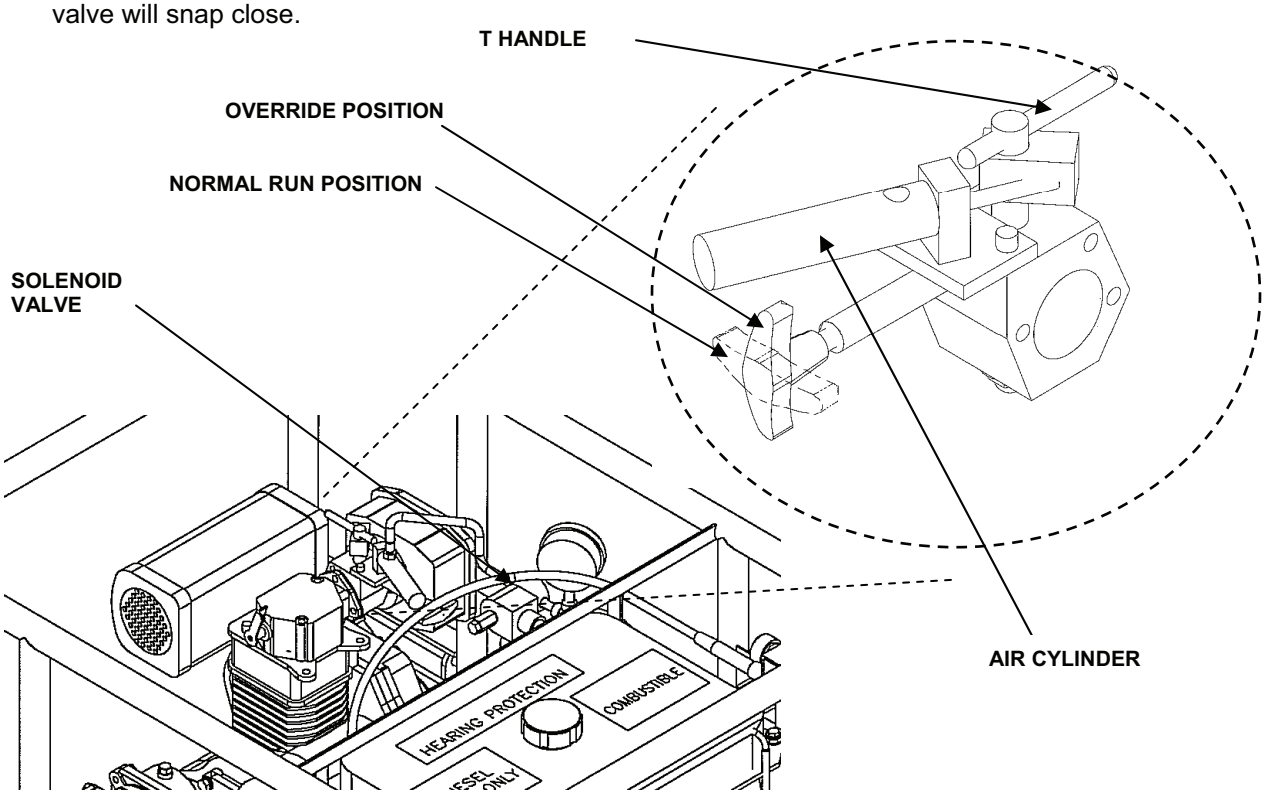


Figure 22. Operation of the Air Tank.

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.)

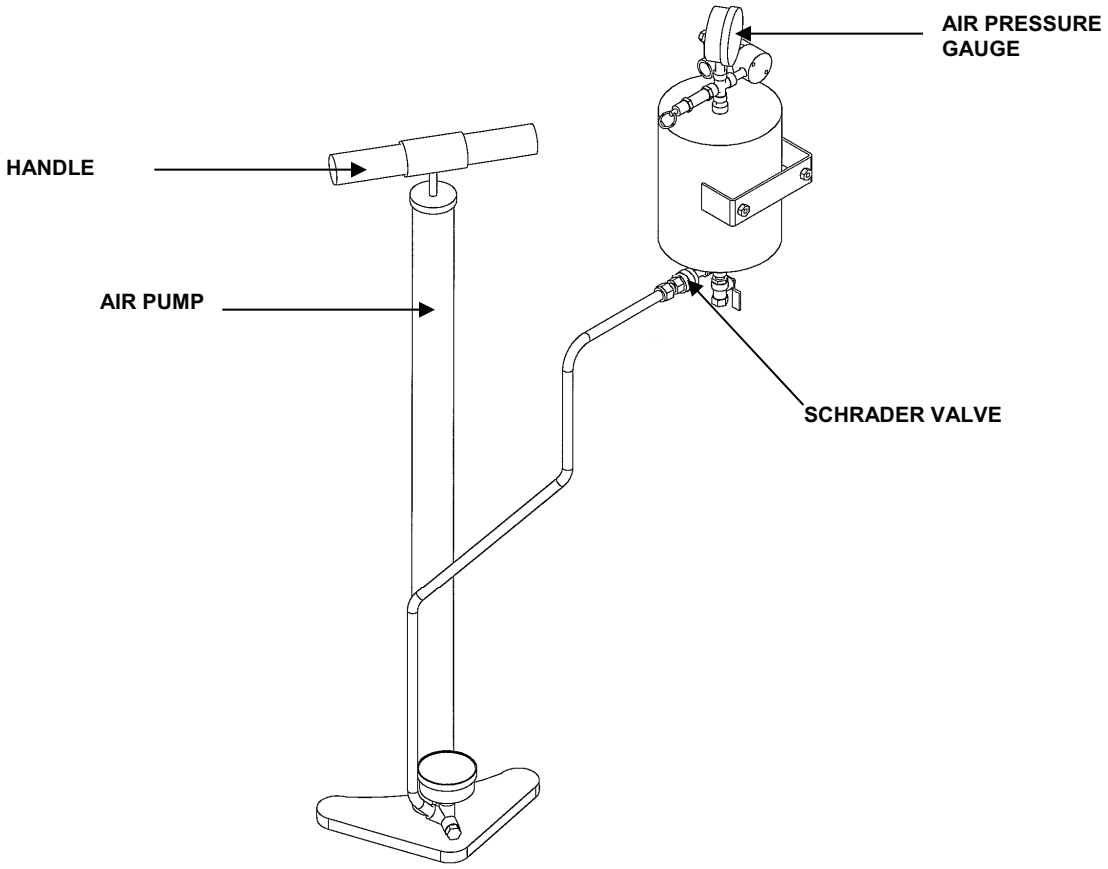


Figure 23. Filling up the Air Tank.

STARTING DIESEL ENGINE- 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. To operate throttle cable, red button must be pushed. Pull out completely. See Figure 27.

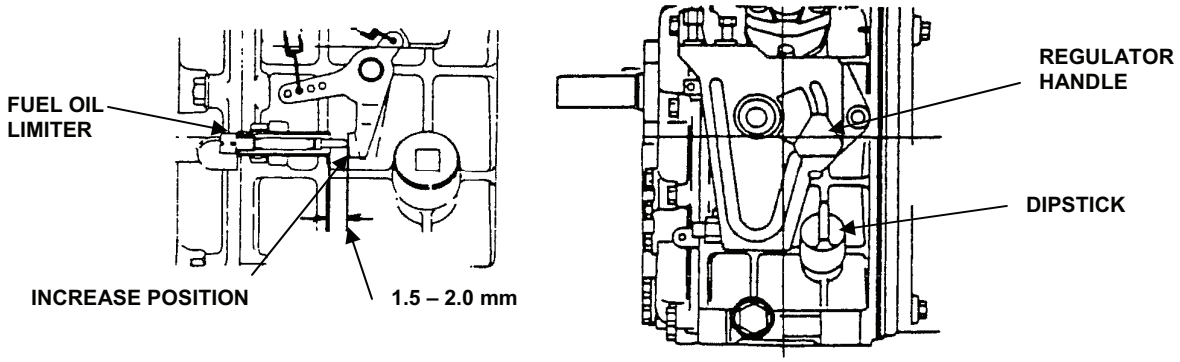


Figure 24. Regulator Handle.

6. Push and hold down on the decompression lever on the diesel engine. See Figure 25.

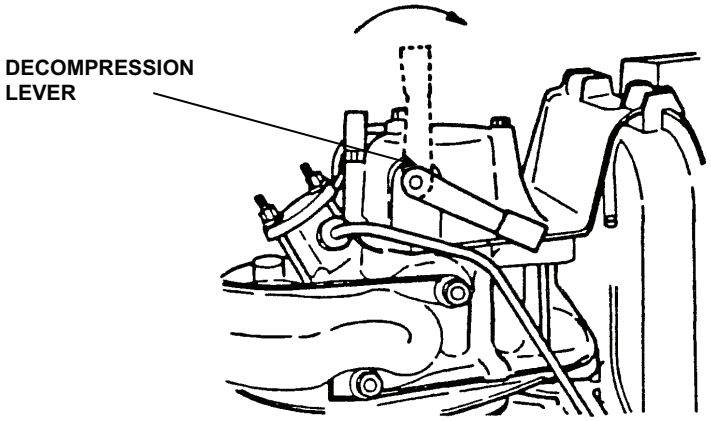


Figure 25. Decompression Lever.

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.

STARTING DIESEL ENGINE- 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 26.

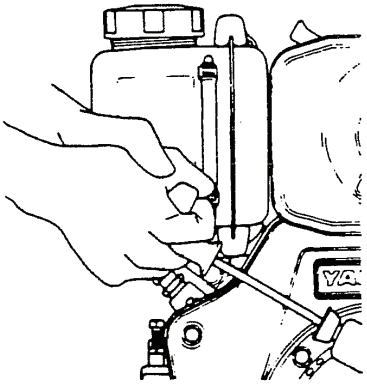


Figure 26. Recoil Starter Handle.

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 27.

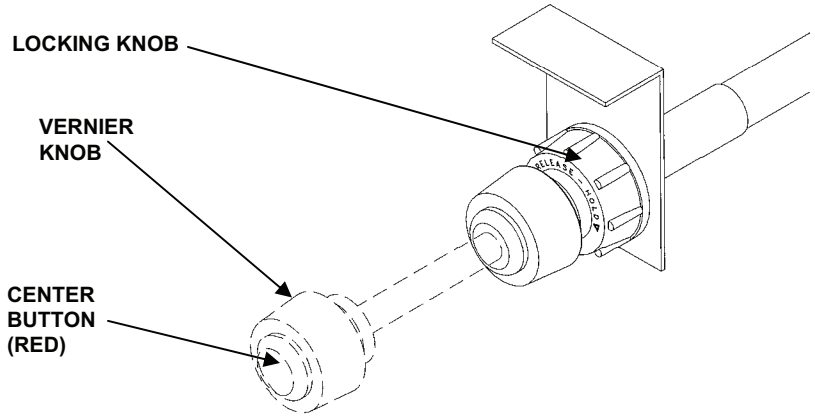


Figure 27. Diesel Engine Throttle.

    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.

STARTING DIESEL ENGINE- continued

12. Flow is read at the top of the float on the flow meter on the high-pressure pump module. See Figure 28.

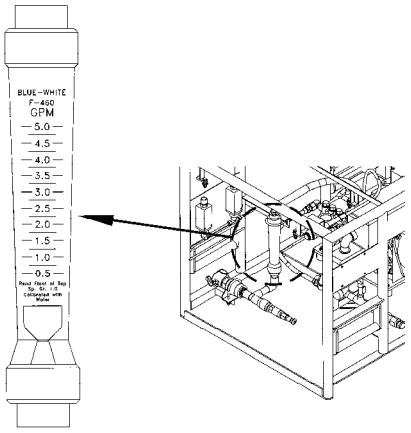


Figure 28. High-Pressure Pump Module Flow Meter.

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 0021.

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 29.

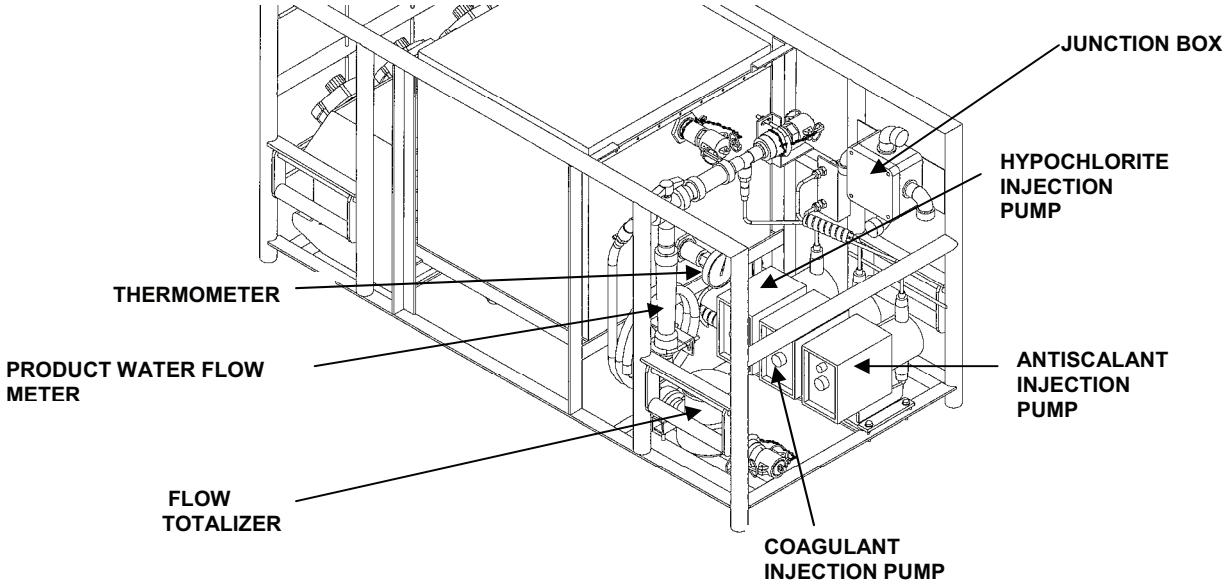


Figure 29. Chemical Injection/Cleaning Module.

STARTING DIESEL ENGINE- 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 30.

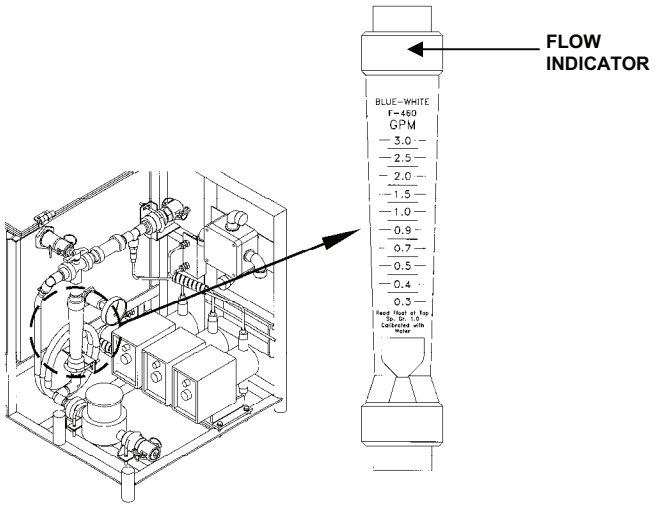


Figure 30. Product Water Flow Meter.

WARNING

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

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 31.

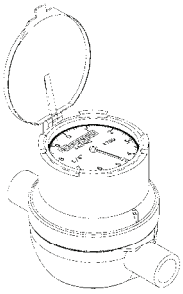


Figure 31. Flow Totalizer.

19. See WP 0013 for chemical injection instructions and WP 0015 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 27.

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. Injury could occur. Once the unit is operational, use the Velcro wraps provided in the BII box to strap down coiled hoses and cables. Injury could occur.

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.
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 32.
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.

3. Hold down the decompression lever and pull the starter rope repeatedly until all the air is purged from the fuel delivery lines.

4. Start the engine using the normal starting procedure.

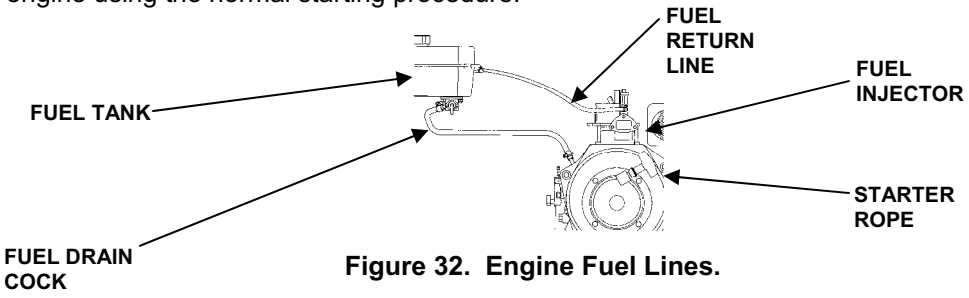


Figure 32. Engine Fuel Lines.

END OF WORK PACKAGE

OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
CHEMICAL INJECTION
OPERATION UNDER USUAL CONDITIONS

GENERAL

This work package contains information and instructions on injecting chemical solutions into the Lightweight Water Purifier (LWP). The bisulfite (M323) or coagulant (M322) is injected into the raw water input line before entering the settling tank if the source water contains chlorine. The antiscalant (M321) 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.

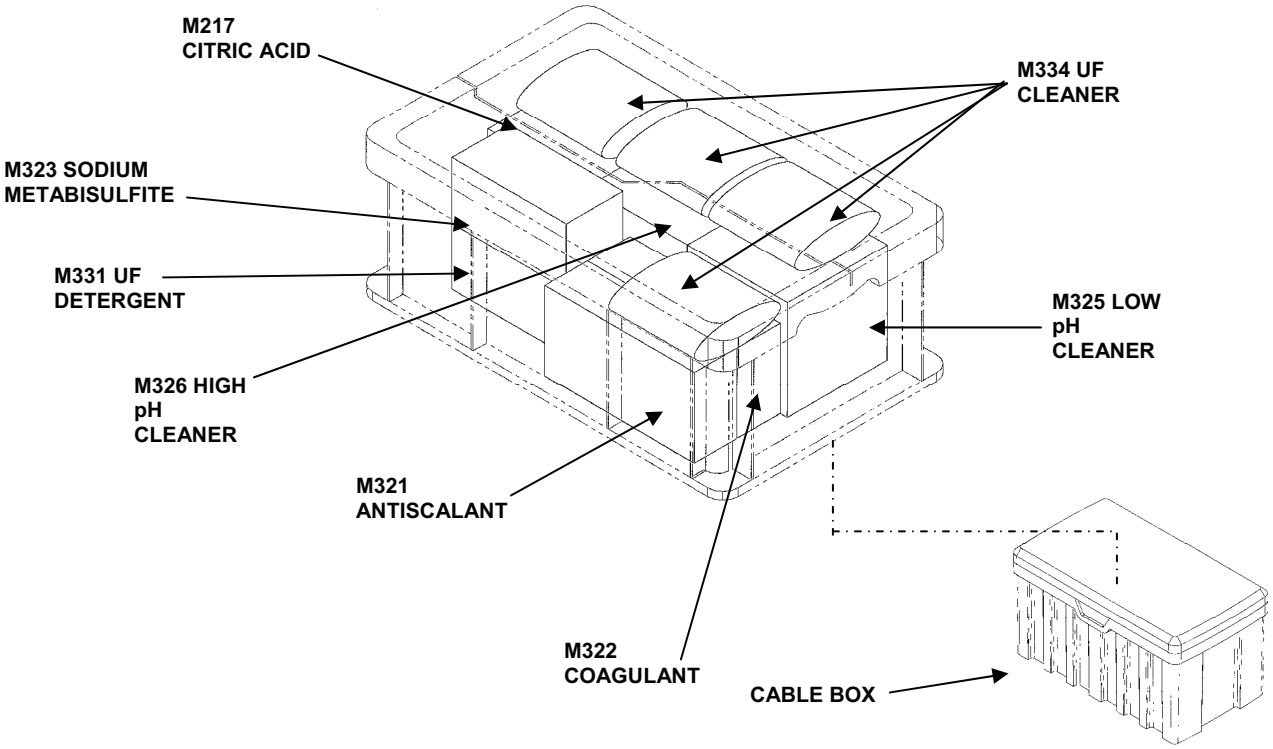


Figure 1. Chemical Storage In Cable Box.

CHEMICAL STORAGE - continued

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

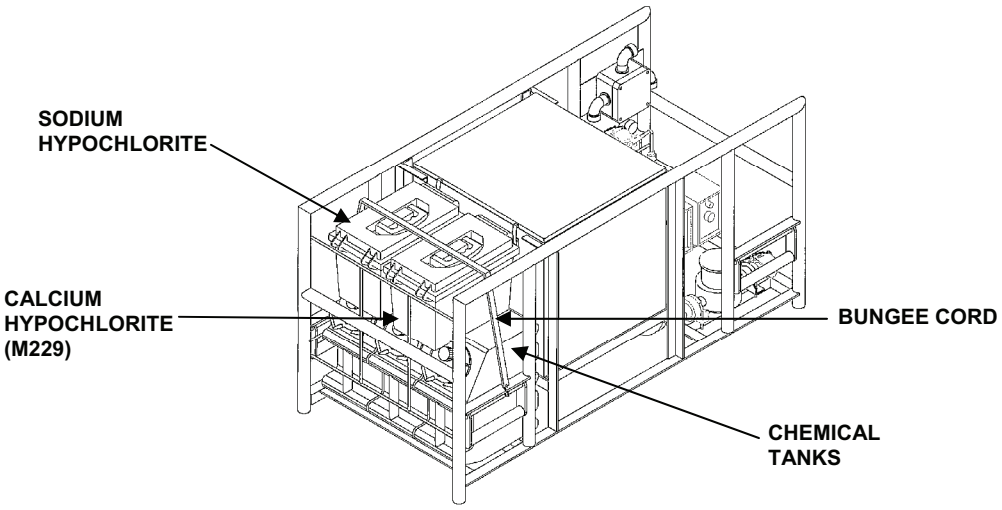


Figure 2. Chemical Storage Inside The Chemical Module.

WARNING

See each chemical Material Data Safety Sheet for information regarding the specific hazards associated with each chemical. Death or injury to personnel may 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.

CHEMICAL INJECTION – continued

WARNING

To avoid injury from contact with the cleaning chemicals, be sure to wear the personnel protective equipment. Death or injury to personnel may result.

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.

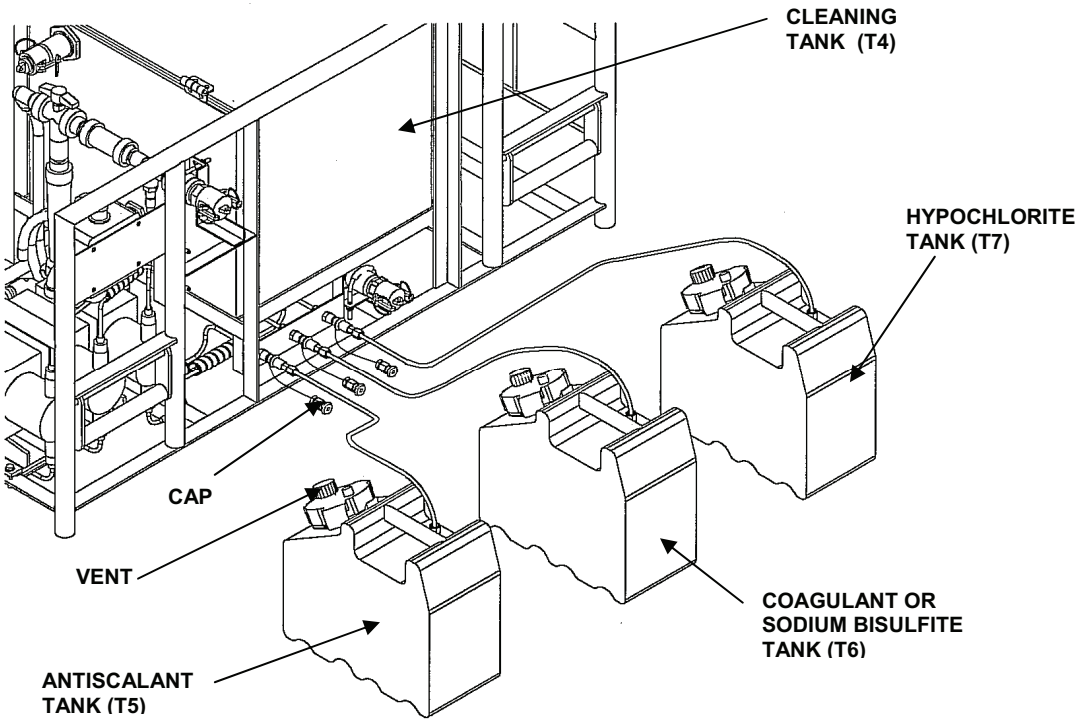


Figure 3. Chemical Module.

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.

CHEMICAL INJECTION – continued

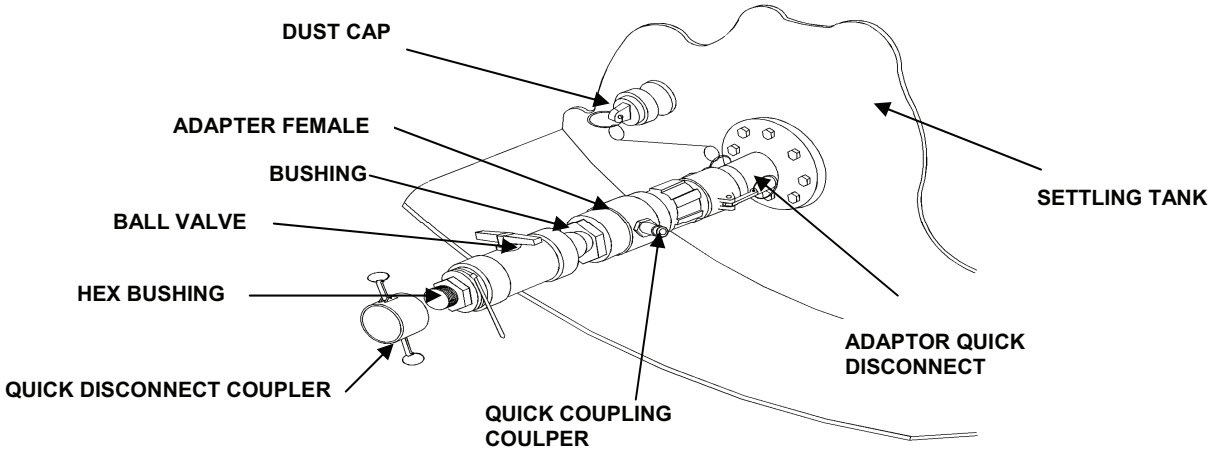


Figure 4. Sodium Bisulfite/Coagulant Injection Port on Raw Water Inlet Spool Piece.

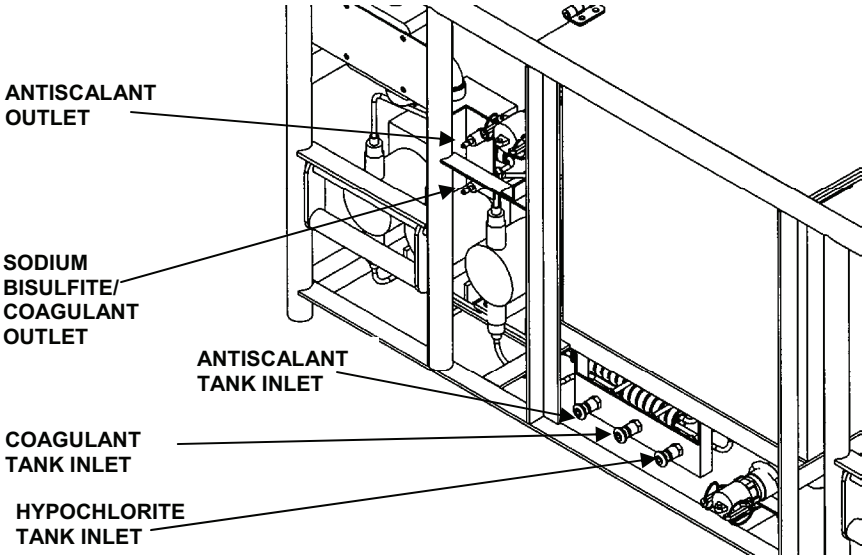


Figure 5. Chemical Injection Quick Disconnects.

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.

COAGULANT MIXING INSTRUCTION - Continued

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).
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.

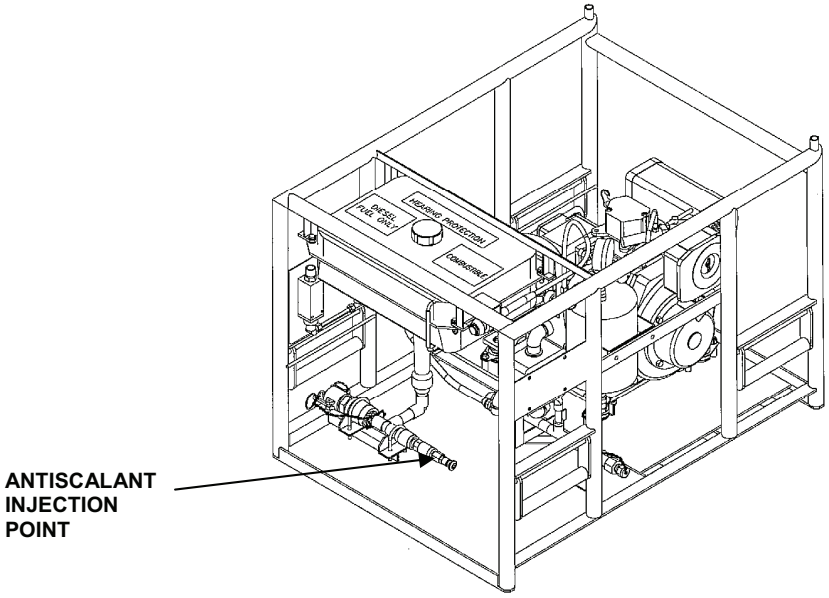


Figure 6. Antiscalant Chemical Injection Point on High-Pressure Pump Module.

CHEMICAL INJECTION – continued

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 (four, 2mL scopes) (9 grams (1 two, 2ml scoops) 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 (T7) half way with product water.
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.
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
10. Figure 7.

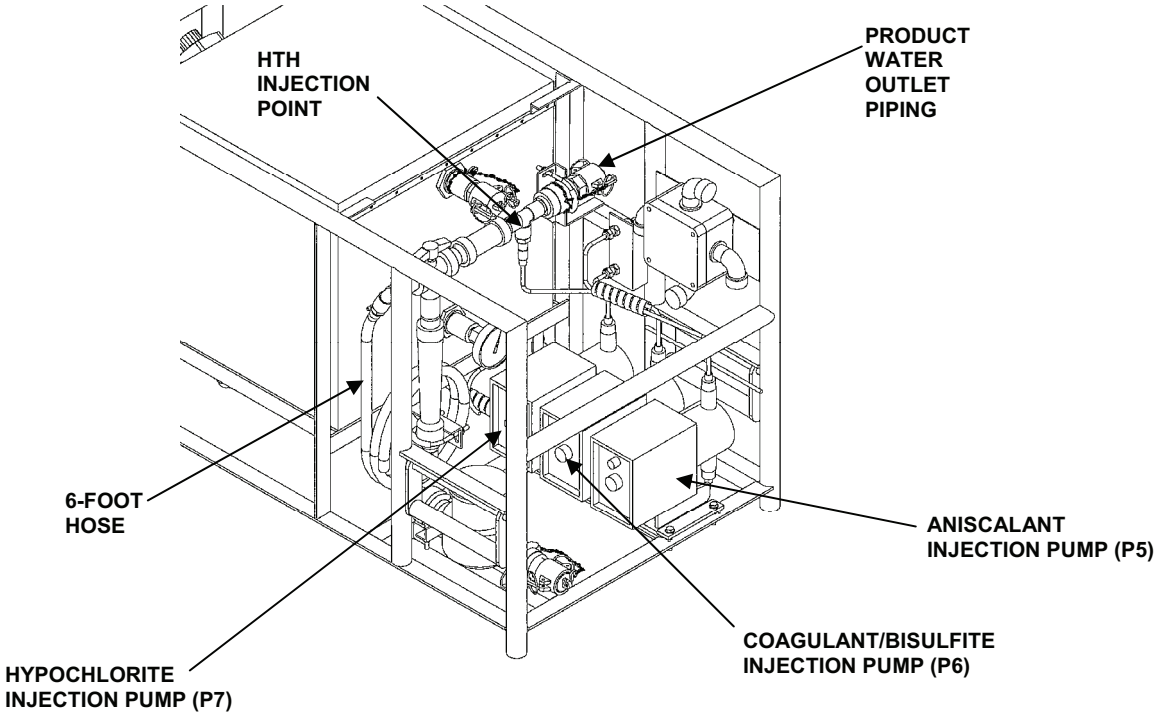


Figure 7. Hypochlorite Injection Port on Chemical Module.

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 ON position.
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.

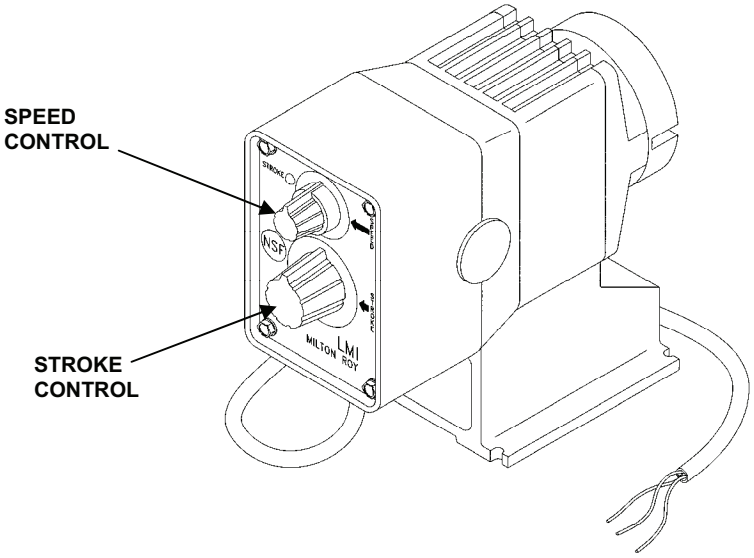


Figure 8. Chemical Injection Pump Front.

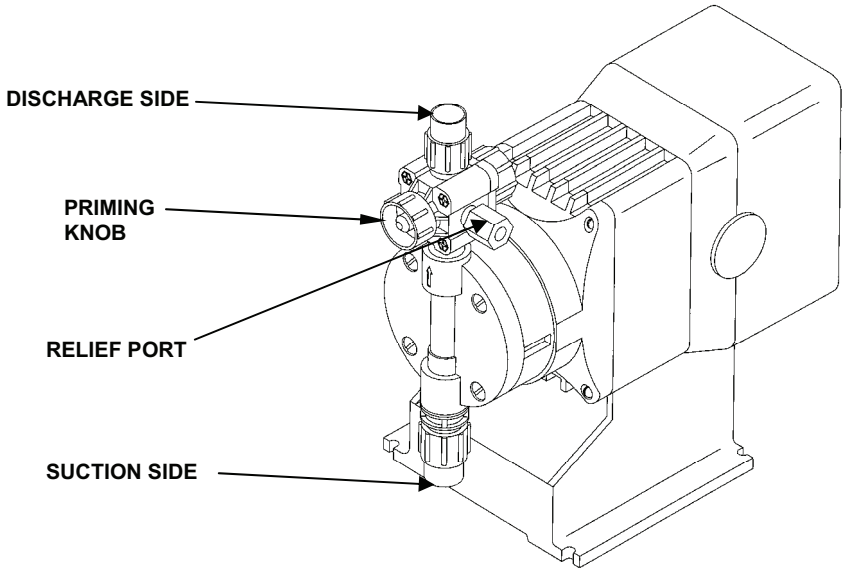


Figure 9. Chemical Injection Pump Rear.

CHEMICAL INJECTION PUMP OPERATION - continued

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.
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	Coagulant	Sodium Metabisulfite	Antiscalant	Hypochlorite
(gal)	(ml)	(small scoop)	(ml)	(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 tubing and connections are free of blockage and kinks. Ensure air is not being sucked in through loose connections.
4. Ensure all tubing 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.

CHEMICAL INJECTION PUMP PRIMING - continued

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 0112.
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
OPERATION UNDER USUAL CONDITIONS

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	3.4 – 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 50 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 0021 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.

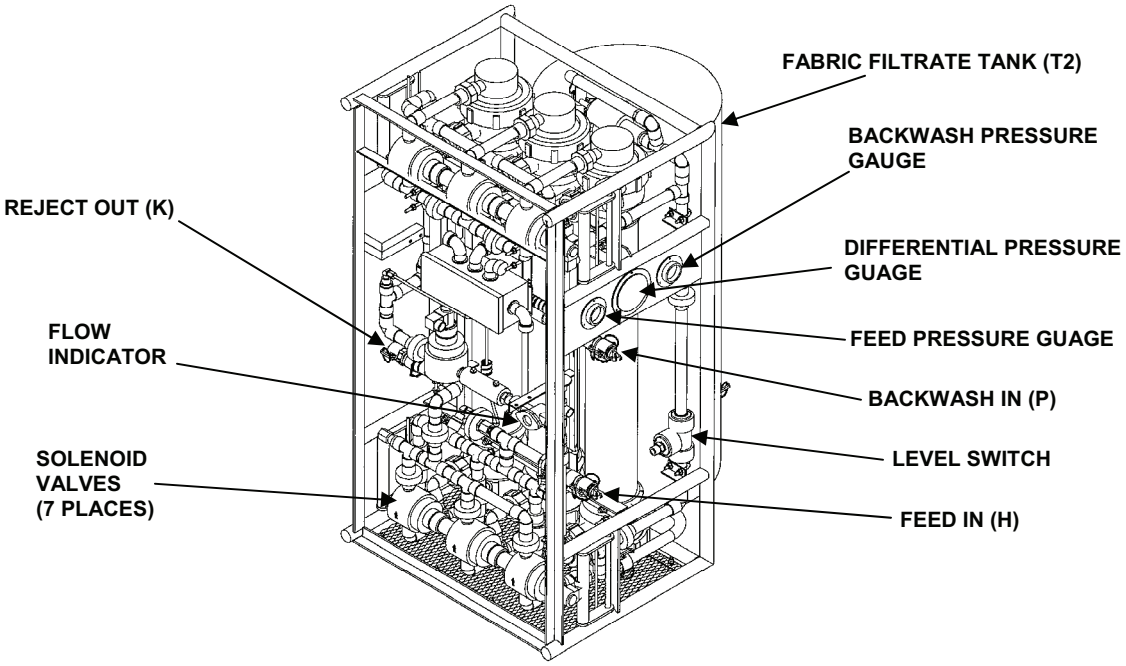


Figure 1. Ultrafiltration Module.

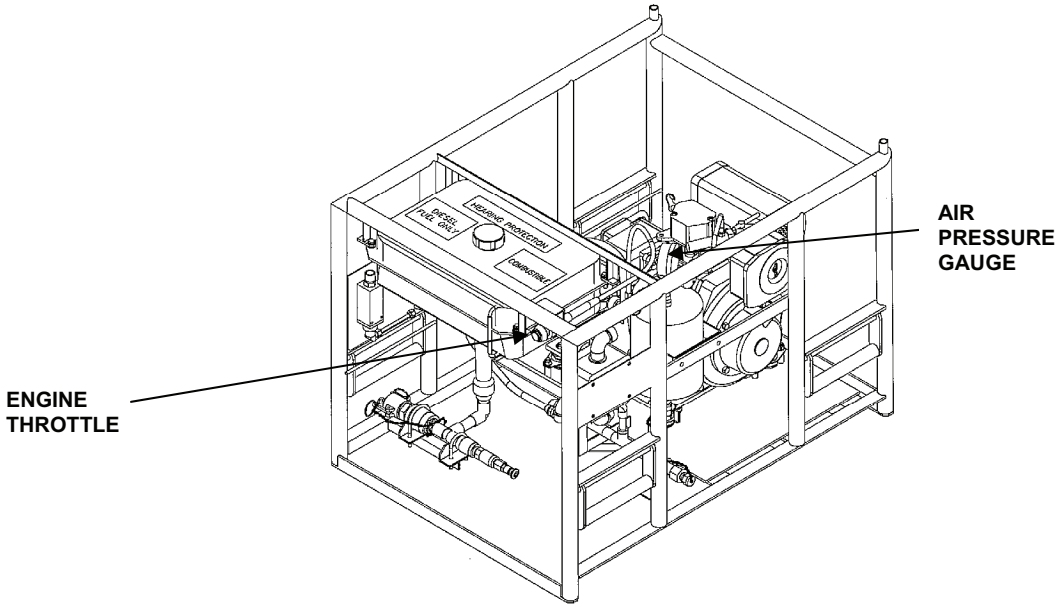


Figure 2. High-Pressure Pump Module.

NORMAL OPERATING READINGS – continued

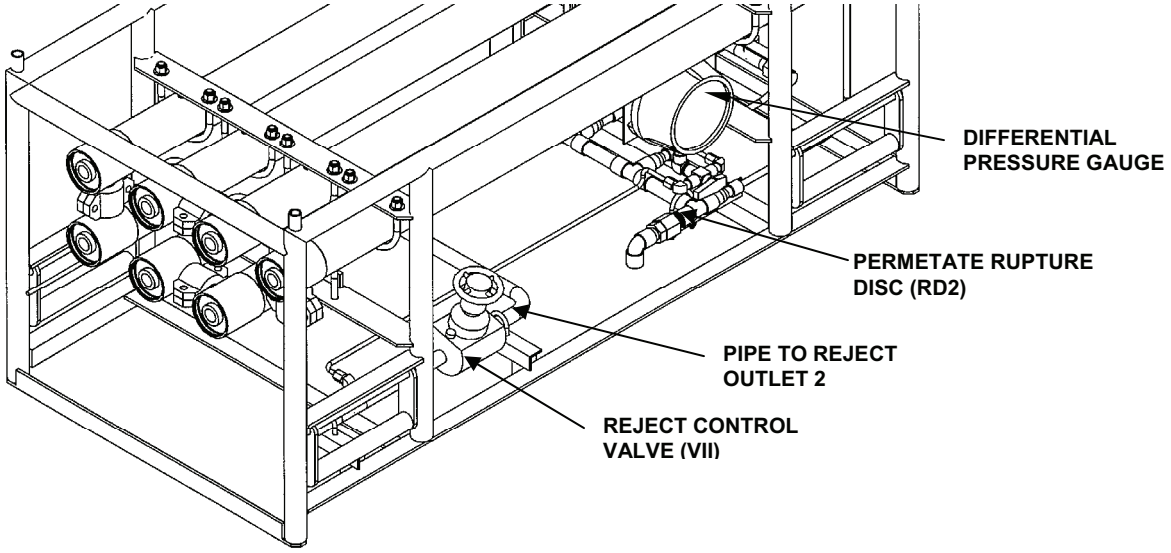


Figure 3. Reverse Osmosis (RO) Element Module.

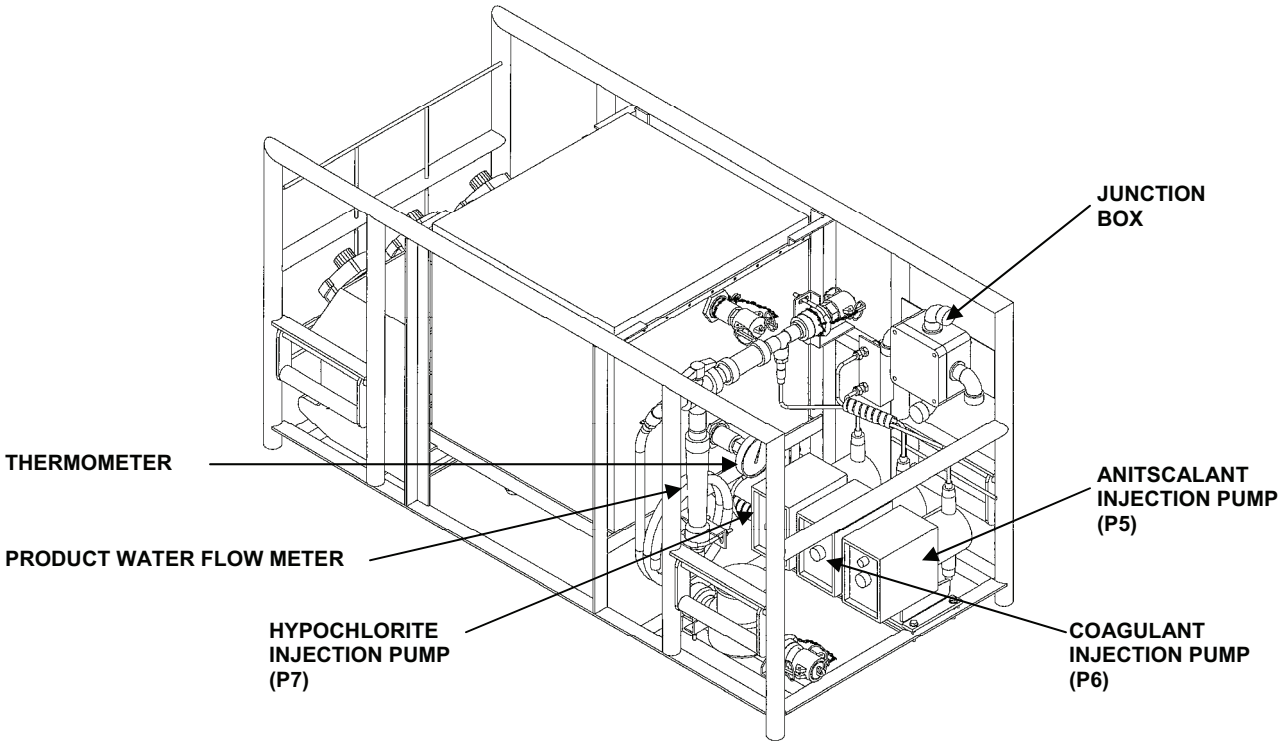


Figure 4. Chemical Injection/Cleaning Module.

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.

NOTE

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.

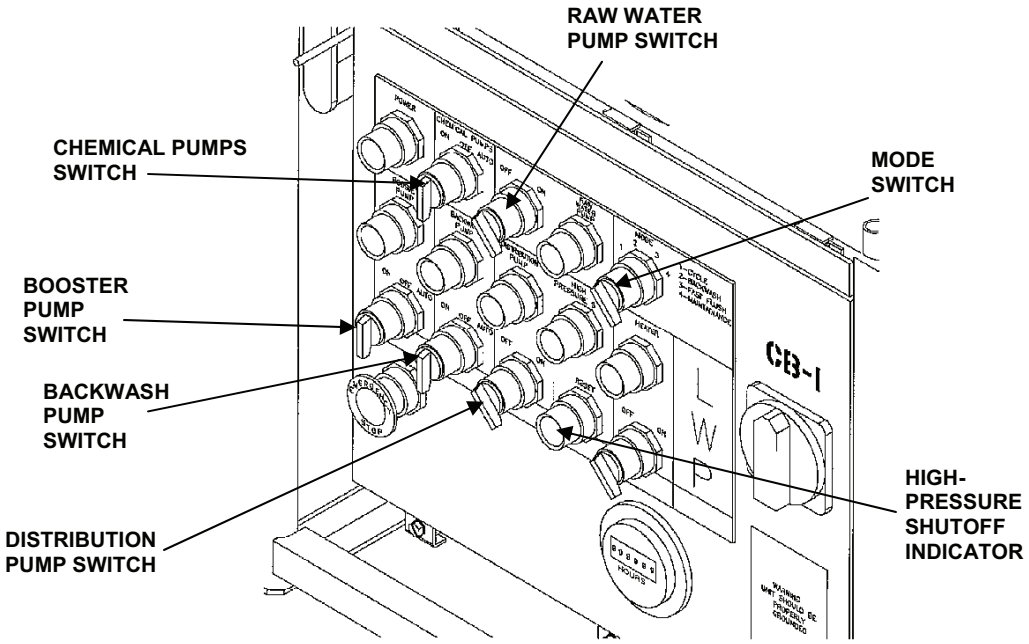


Figure 5. Control Module.

END OF WORK PACKAGE

OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
PRODUCT WATER DISTRIBUTION
OPERATION UNDER USUAL CONDITIONS

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.

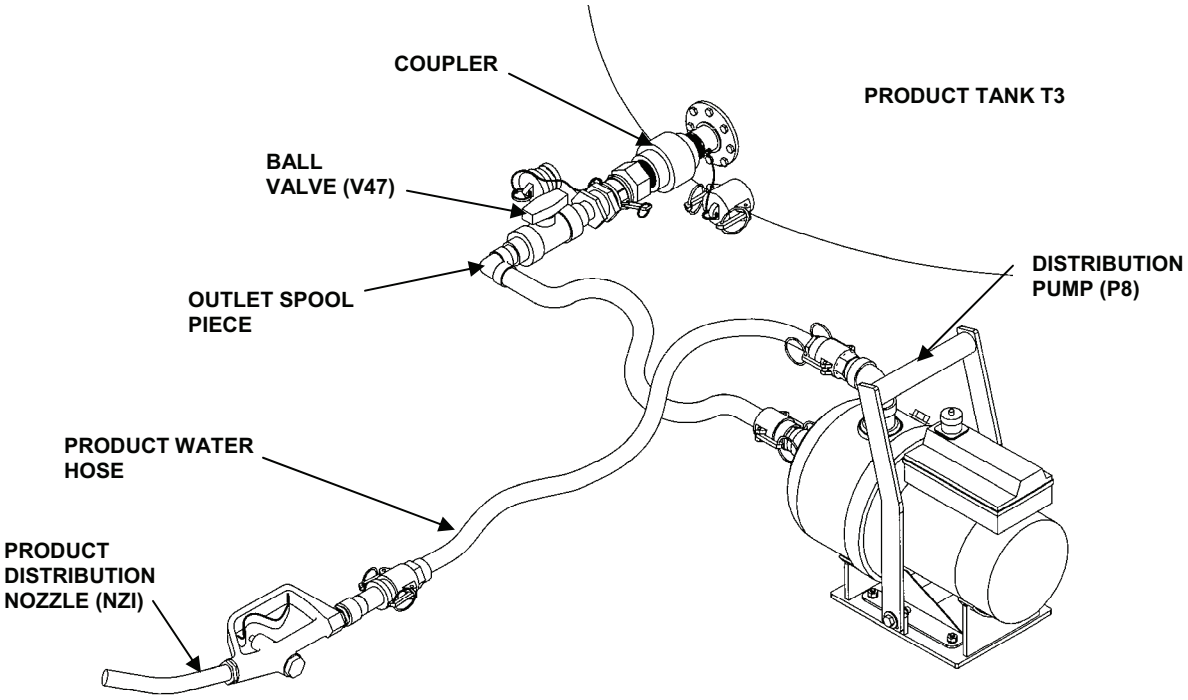


Figure 1. Product Tank Distribution Setup.

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 (NZI). 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

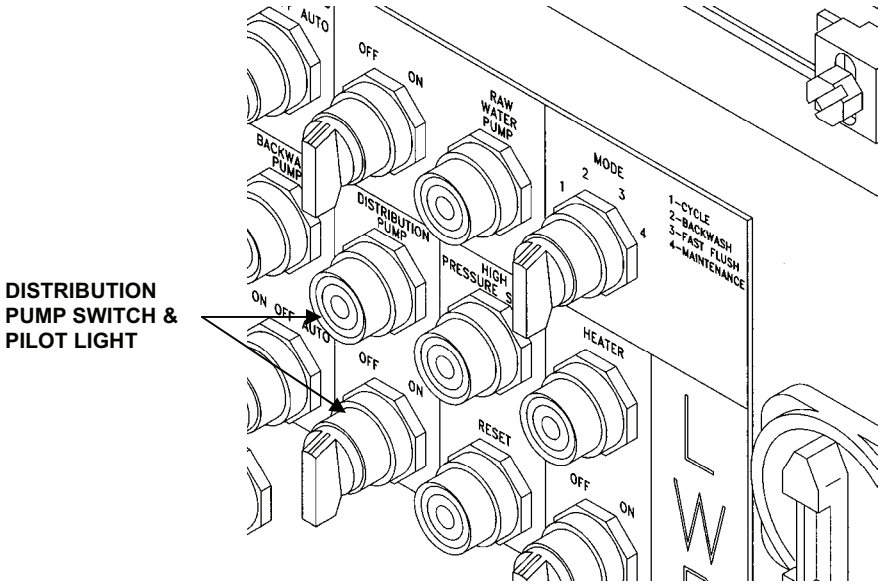


Figure 2. Control Module.

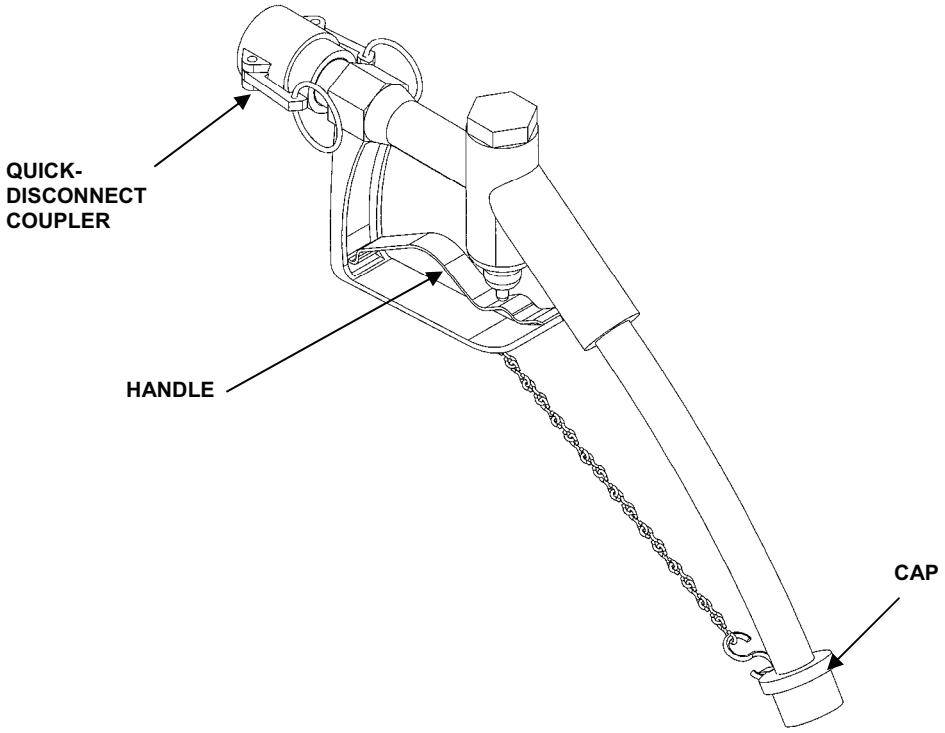


Figure 3. Product Distribution Nozzle (NZI).

END OF WORK PACKAGE

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

INITIAL SETUP

Tools

Wrench, adjustable (WP 0138, Table 2, Item 61)

Equipment Condition Required

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

Material/Parts

Apron, rubber coated (WP 0138, Table 2, Item 4)
Gloves, Neoprene (WP 0138, Table 2, Item 21)
Goggles, safety, clear (WP 0138, Table 2, Item 22)
Sodium Meta Bisulfite (M323) (WP 0139, Item 9)

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 (0º C) 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 0012.
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.

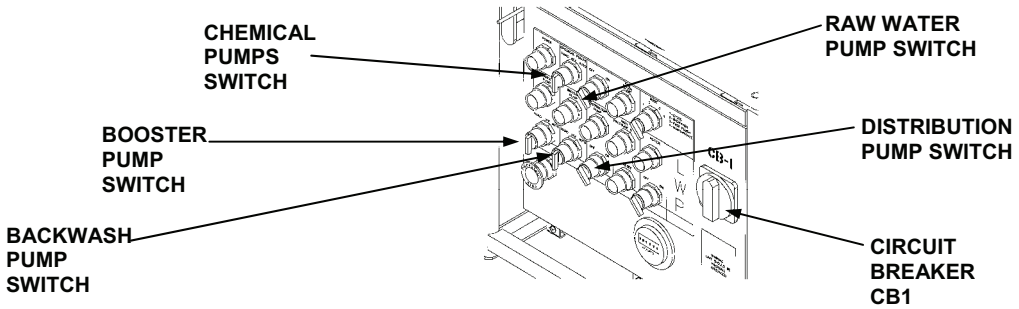


Figure 1. Control Module.

PRODUCT FLUSH

1. Turn chemical pumps and raw water pump OFF.

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. Close ball valve (V49) on product tank inlet spool piece, and disconnect the hose (white) from spool pieces.

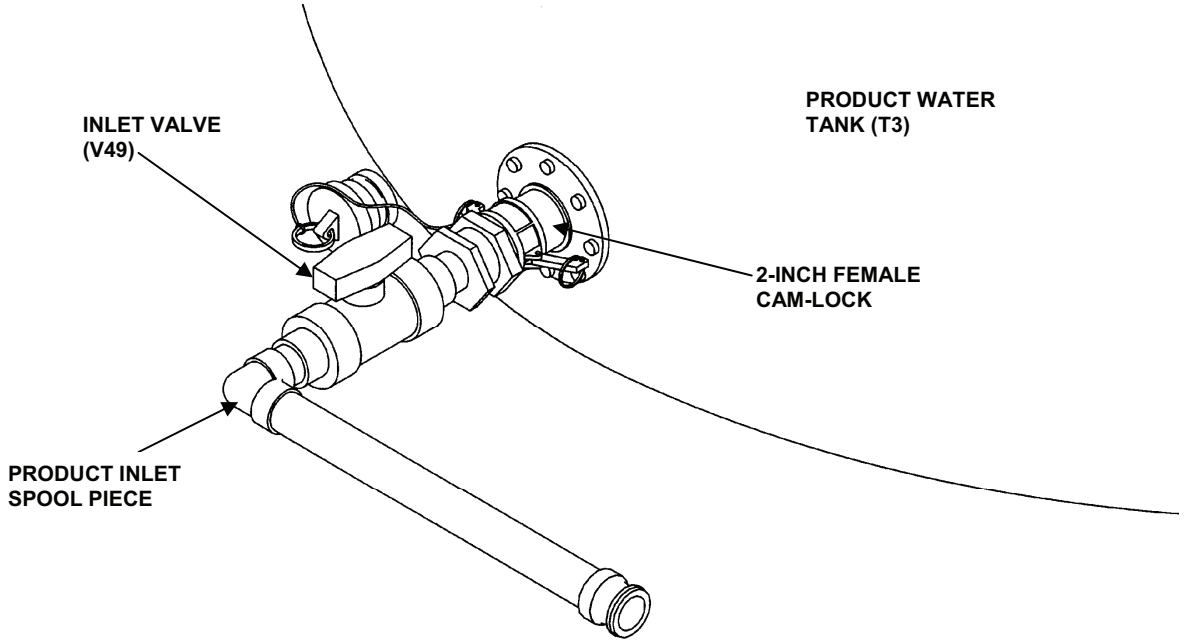


Figure 2. Product Tank Inlet Connection.

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 (V47) 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.

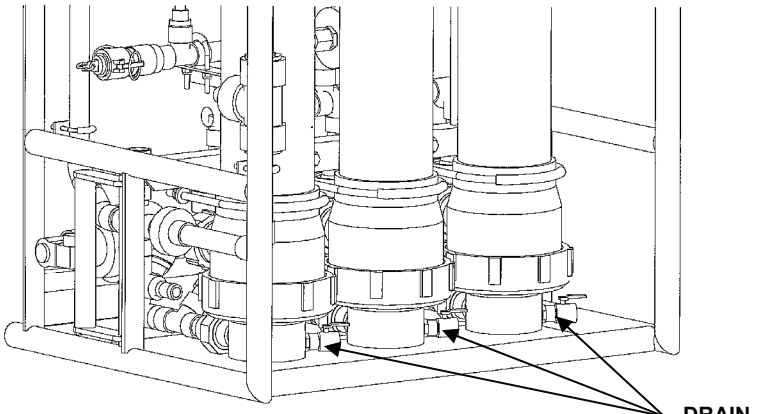


Figure 3. UF Drain Valve Locations.

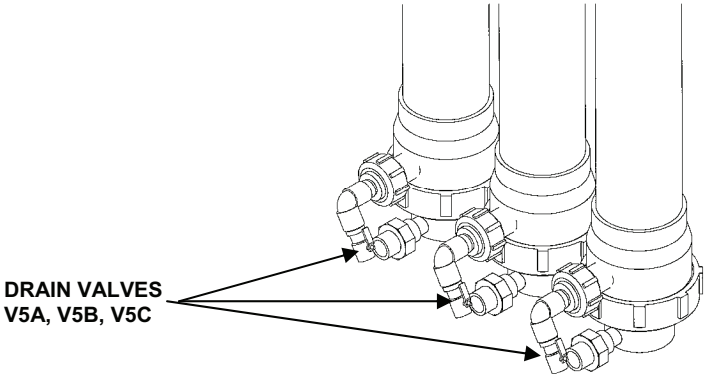


Figure 4. UF Cartridge Drain Valves.

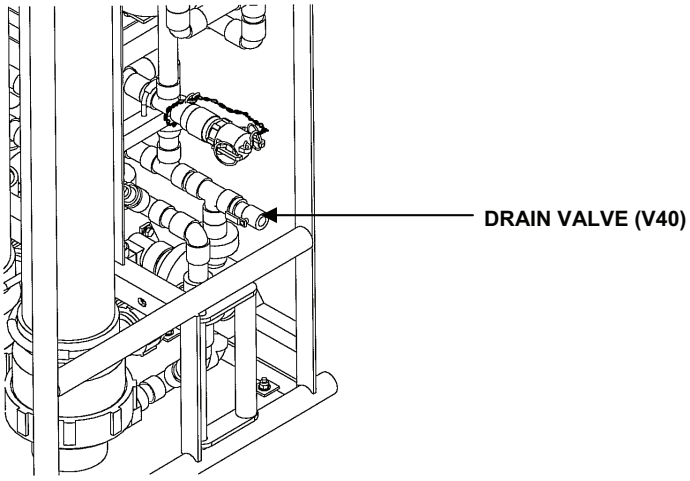


Figure 5. UF Drain Valve.

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, protective clothing and gloves. Failure to follow this warning may result in injury or death to personnel.

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 0013, 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).

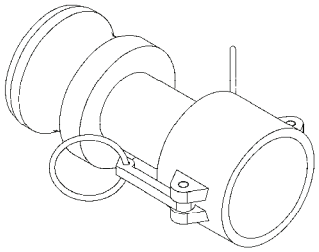


Figure 6. Flushing Adapter.

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. (V49)
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. See Figure 7.
22. Close seven 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.

PRODUCT FLUSH - continued

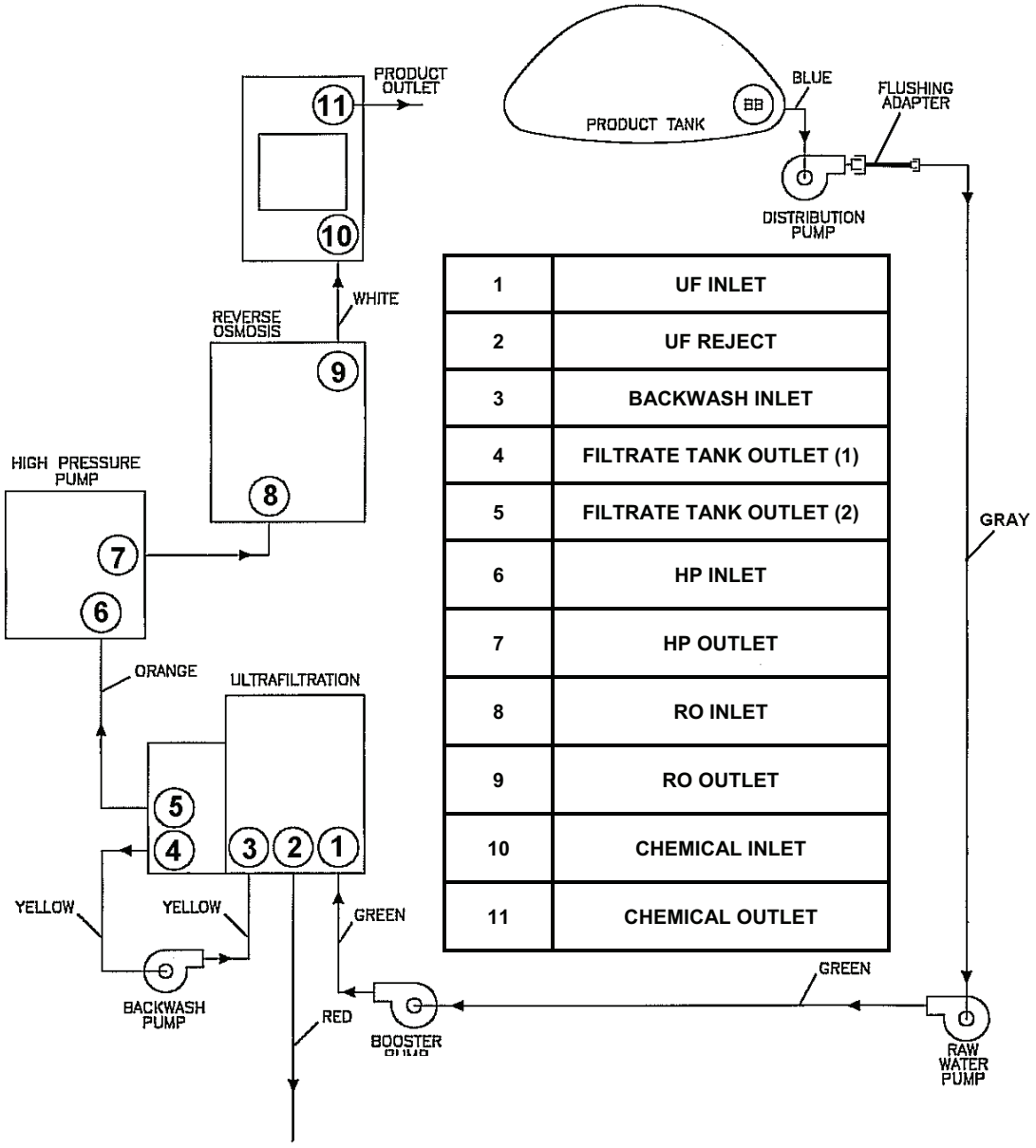
WARNING

Failure to place CB1 circuit breaker handle in the OFF position could result in personnel injury and/or death and damage to the equipment.

24. Place circuit breaker handle (CB1) in the OFF position on the control module.
25. Disconnect booster pump and backwash pump cables from the control panel and cap them. Cap all unused connections.
26. Place circuit breaker handle (CB1) in the ON position on the control module. Blue light will come on. Place the DISTRIBUTION PUMP switch on control module to the ON position. Green pilot light will come on.
27. Place the MODE switch on control module into position 4 – MAINTENANCE.
28. Place the BACKWASH PUMP and BOOSTER PUMP switches on the control module in the AUTO position.
29. Flush the LWP system with product water through the UF module and fill the filtrate tank.
30. If water is not flowing through pumps, bleed air by disconnection hose at discharge of the pump.
31. Make sure reject valve on the RO module is completely open.
32. When the filtrate tank is full, start the diesel engine of the HP pump.
33. Adjust the water flow to 3.4 to 3.8 GPM by turning the throttle handle. Lock into position.
34. Let the system operate for 15 minutes starting at this point to flush the system.
35. Place the DISTRIBUTION PUMP, BACKWASH PUMP, and BOOSTER PUMP switches on the control module in the OFF position. Green pilot lights will turn off.
36. Stop the diesel engine. Push the throttle handle on the engine all the way in.

PRODUCT FLUSH - continued

37. Place circuit breaker (CB1) on the control module in the OFF position. Blue light will go off.
38. Return the LWP to normal set up.



1	UF INLET
2	UF REJECT
3	BACKWASH INLET
4	FILTRATE TANK OUTLET (1)
5	FILTRATE TANK OUTLET (2)
6	HP INLET
7	HP OUTLET
8	RO INLET
9	RO OUTLET
10	CHEMICAL INLET
11	CHEMICAL OUTLET

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 0018.
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 0022.

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 and WP 0043. 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.

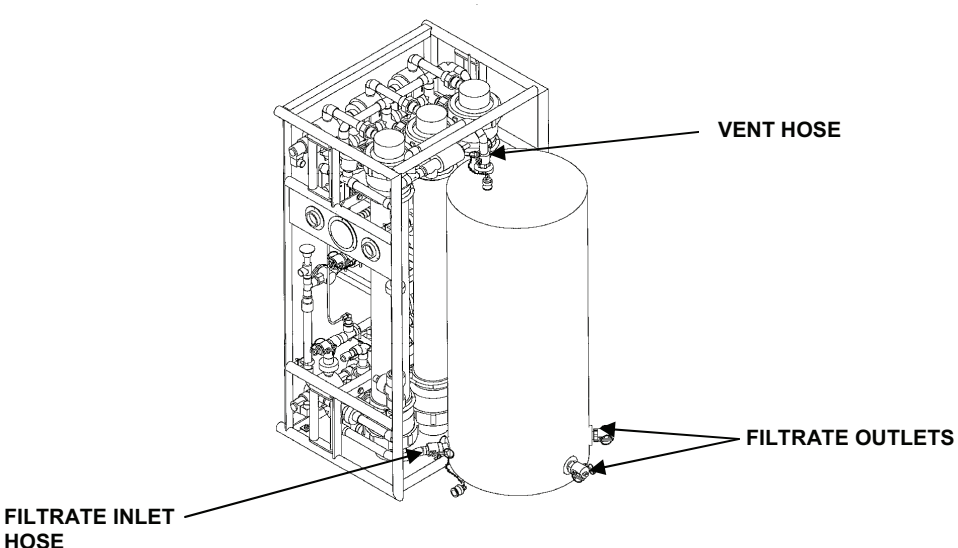


Figure 8. Inlet and Outlet Locations of the Filtrate Tank.

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.

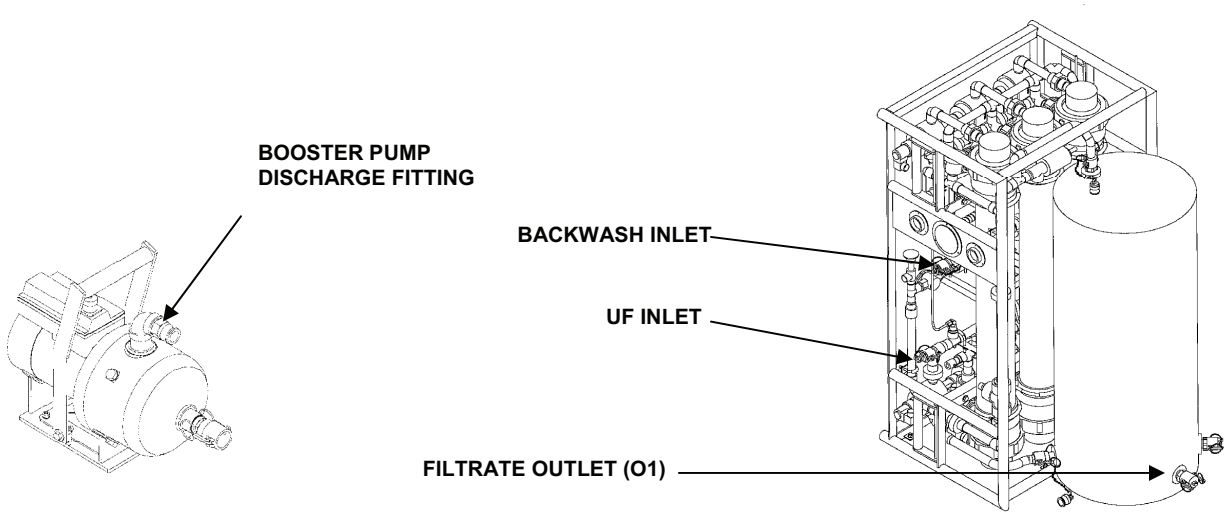


Figure 9. UF Hose Connection.

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.

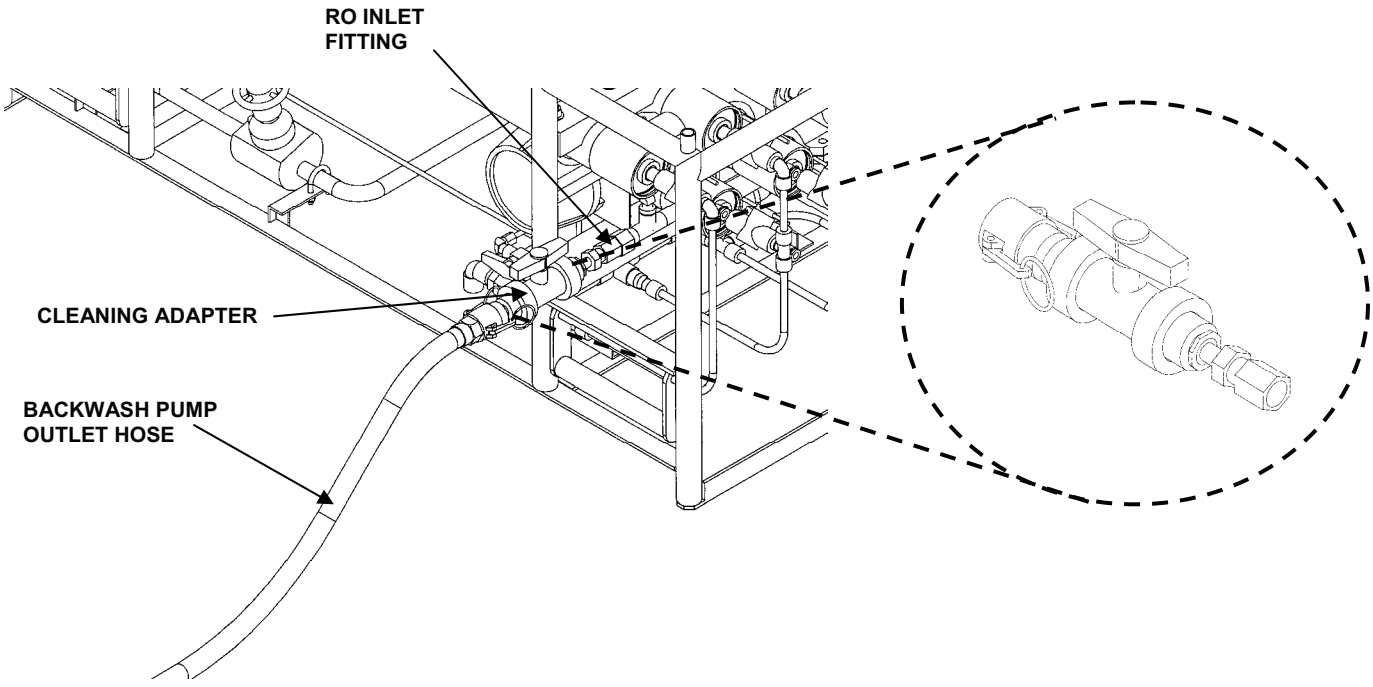
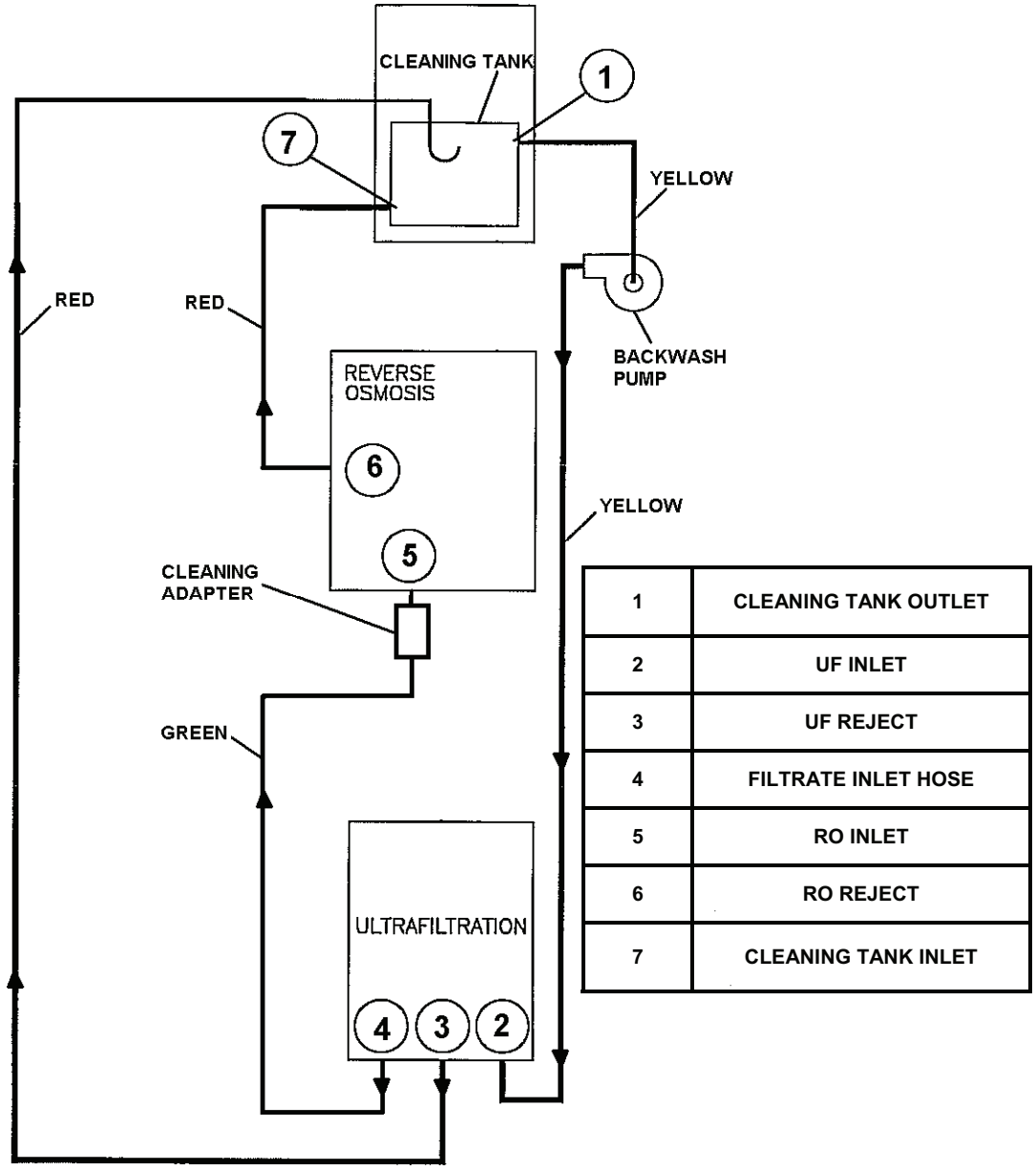


Figure 10. Cleaning Adapter Connection.

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.



1	CLEANING TANK OUTLET
2	UF INLET
3	UF REJECT
4	FILTRATE INLET HOSE
5	RO INLET
6	RO REJECT
7	CLEANING TANK INLET

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 0022.

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
COLLAPSIBLE FABRIC TANKS
OPERATION UNDER UNUSUAL CONDITIONS

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.

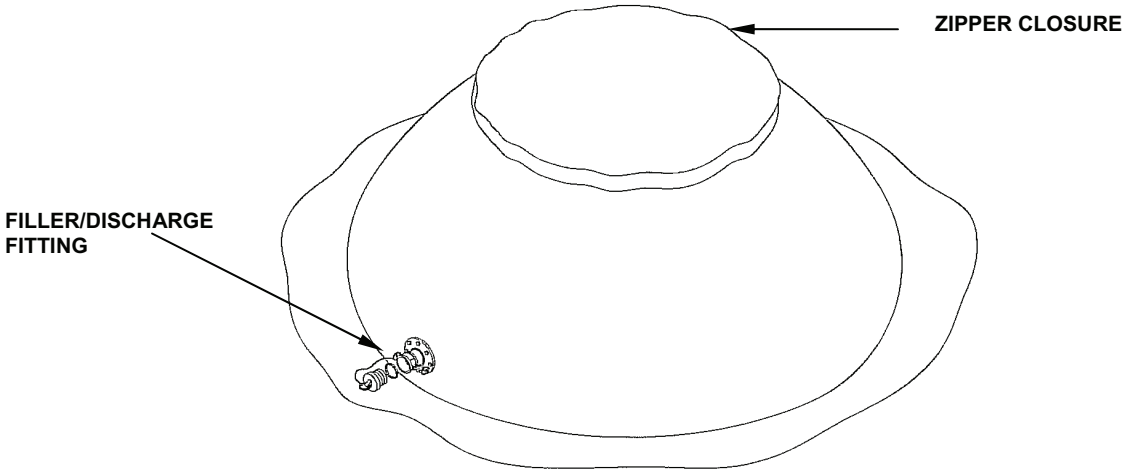


Figure 1. Collapsible Fabric Product Tank.

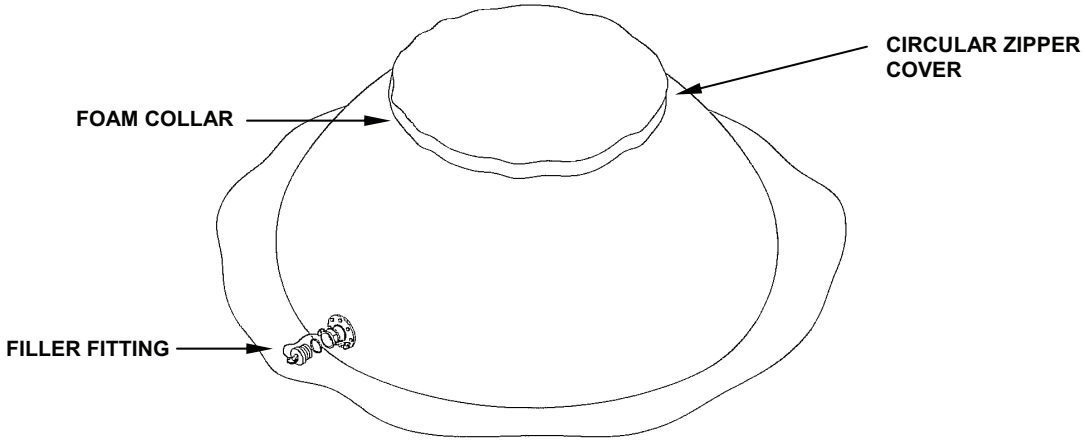


Figure 2. Collapsible Fabric Settling Tank.

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 0018.

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
COLD WEATHER OPERATION AND STORAGE
OPERATION UNDER UNUSUAL CONDITIONS

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 (0º C) 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 of 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 raw water pump to the settling tank and the two reject hoses outside the tent.
4. Connect all the hoses and cables. See WP 0011 and 0012.

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.

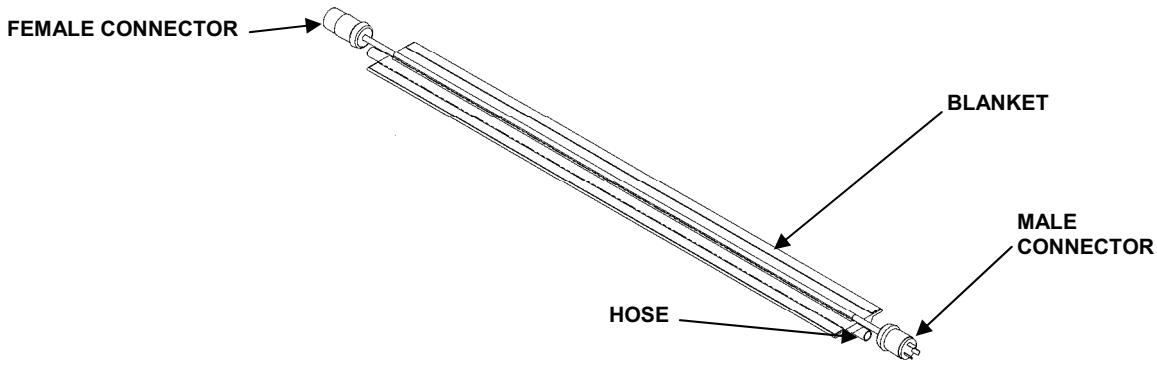


Figure 1. Electric Thermal Blanket.

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.

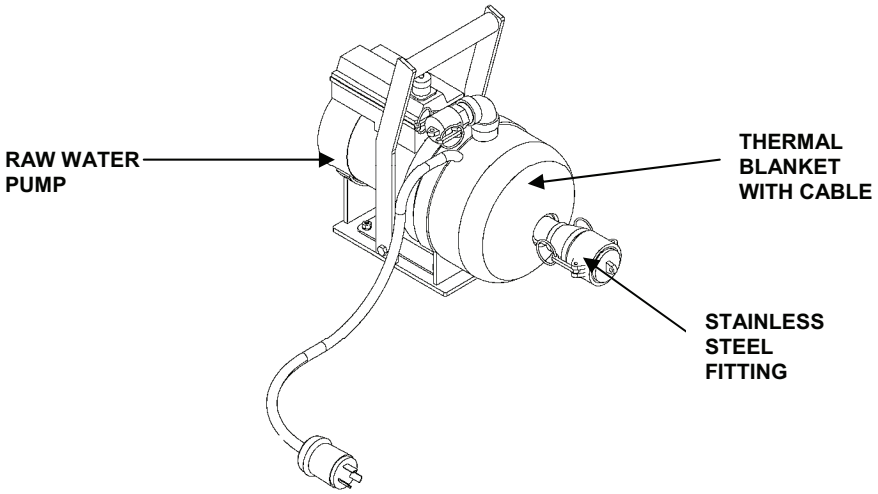


Figure 2. Raw Water Service Pump Electric Thermal Blanket.

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.

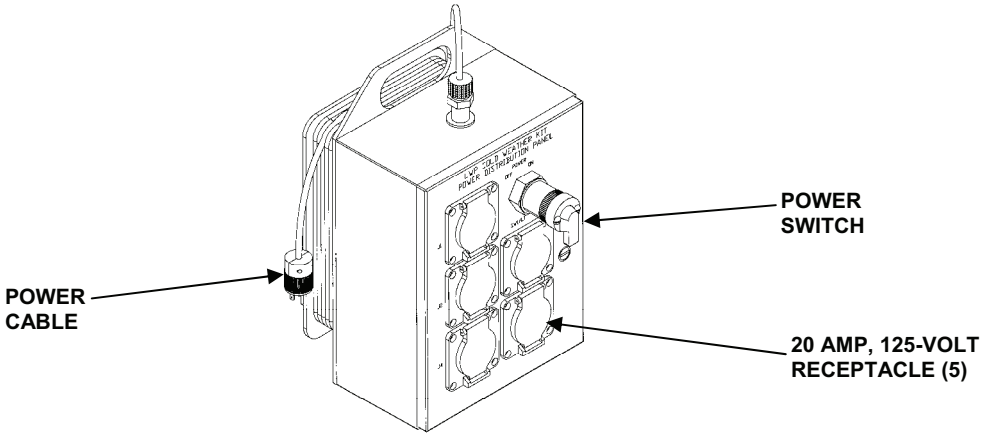


Figure 3. Power Distribution Panel.

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.

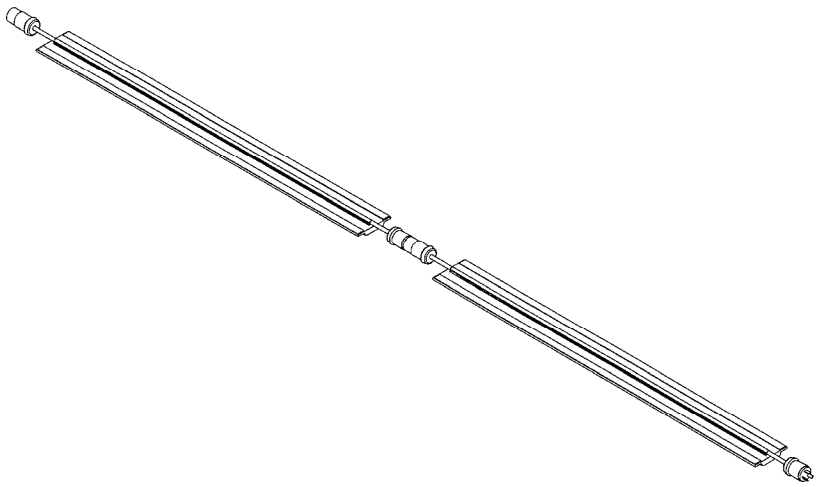


Figure 4. Combined Electric Thermal Blankets.

6. Prepare the following hoses:
   a. 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.
   b. Wrap the RO reject hose with one 10-foot and two 20-foot electric thermal blankets.
   c. 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.

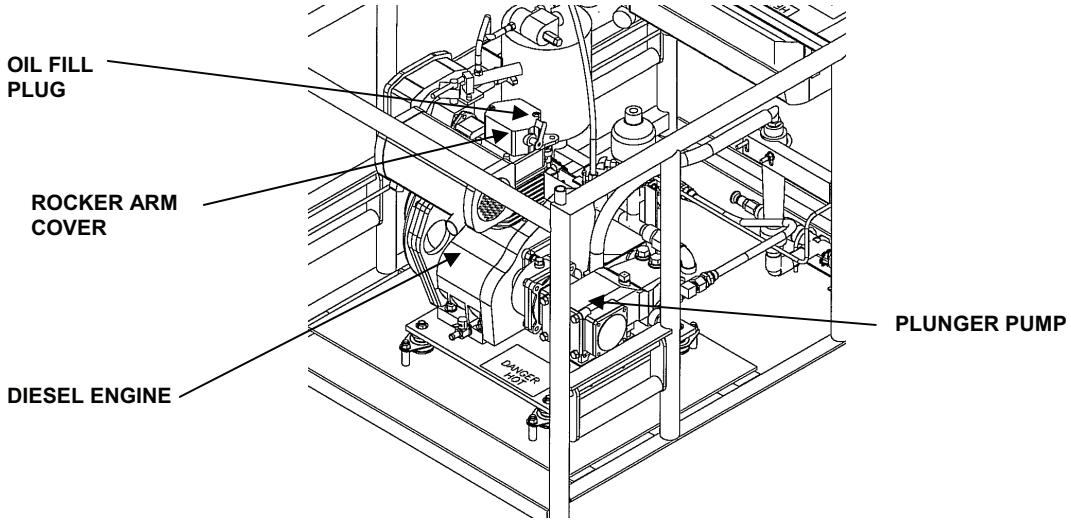


Figure 5. High-Pressure Pump Module Diesel Engine.

2. Add 0.067 fluid ounce (2 cc) or (3-4 drops) of 15W40 (MIL-PRF 2104) 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:

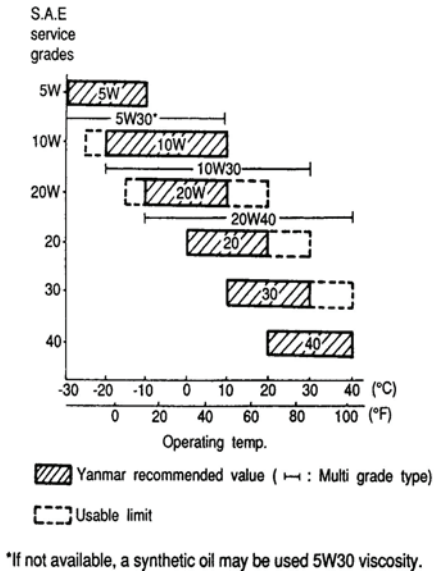


Figure 6. Diesel Engine Oil Chart.

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.

5. Place adapter portion of 12 ft. hose assembly over engine exhaust pipe. See Figure 7.

6. Secure with the hose clamp.

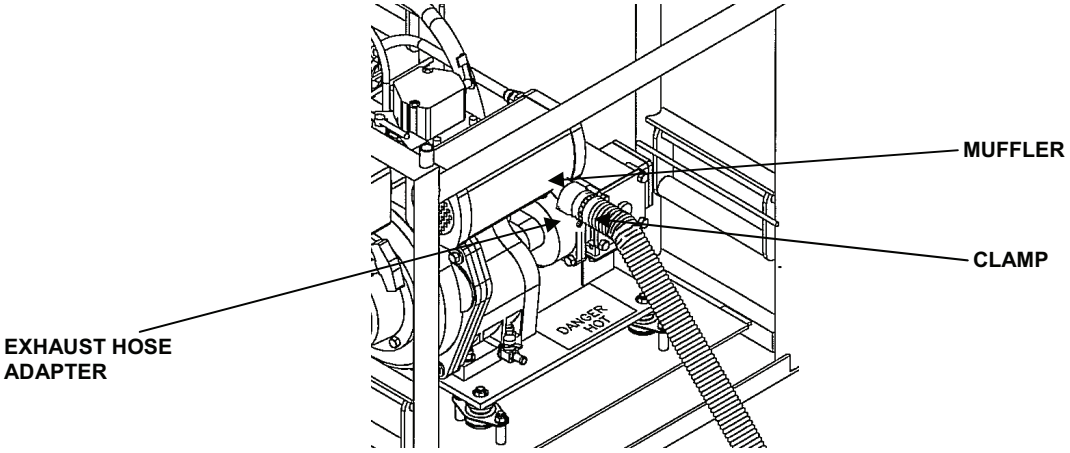


Figure 7. Diesel Engine Exhaust Hose Installation.

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.

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.

7. Route the exhaust hose to the outside of the heated enclosure, away from personnel, equipment, and dry grass and brush.
8. Install battery in the carbon monoxide detector and test for operation.
9. Mount carbon monoxide detector above the high-pressure pump module diesel engine at least 6 foot high.
10. Start up the LWP according to WP 0011 and WP 0012.

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 0016.
2. Drain all liquid that is remaining in the hoses, membranes, piping, tubing, tanks, service pumps and high-pressure pump. Particularly the RO Pressure Vessels.
    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. Thoroughly drain the system. The module can be tilted slightly to aid in draining. See WP 0016 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.

COLD WEATHER DRAIN PROCEDURE– continued

CAUTION

Make sure you drain all water from the reverse osmosis (RO) module before the temperature drops below freezing. Failure to follow this caution may result in damage to equipment.

3. Drain all water from the Reverse Osmosis (RO) Module.
    a. Uncap the module's inlet, outlet and reject connections and open the reject valve.
    b. Tilt the module on its side with the inlet port pointing down.
    c. Place the module back to its upright position and wait for any water to drain from the module's rejection connection.
    d. Stand the module on its end with the sample ports pointing up. Wait for any water to settle.
    e. Stand the module on its other end with the sample ports facing down. Wait for the water to settle. Drain water from the sample ports and the membrane filters when they're installed.
4. Drain the diesel engine fuel tank. (See WP 0099).
5. 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.

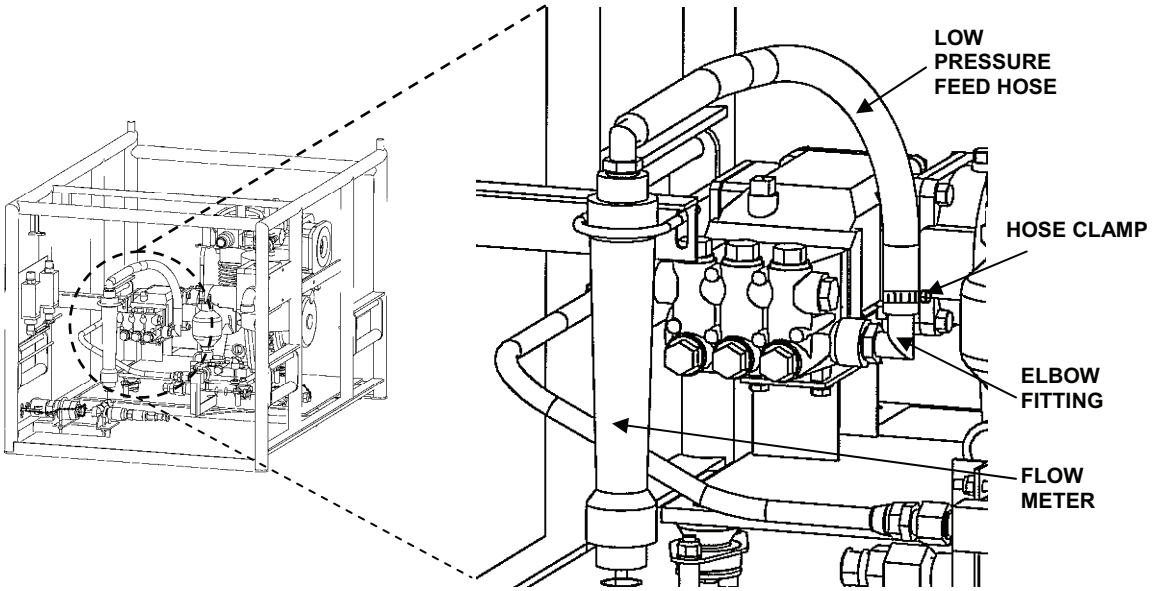


Figure 8. High-Pressure Pump Draining.

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 0016) 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.

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

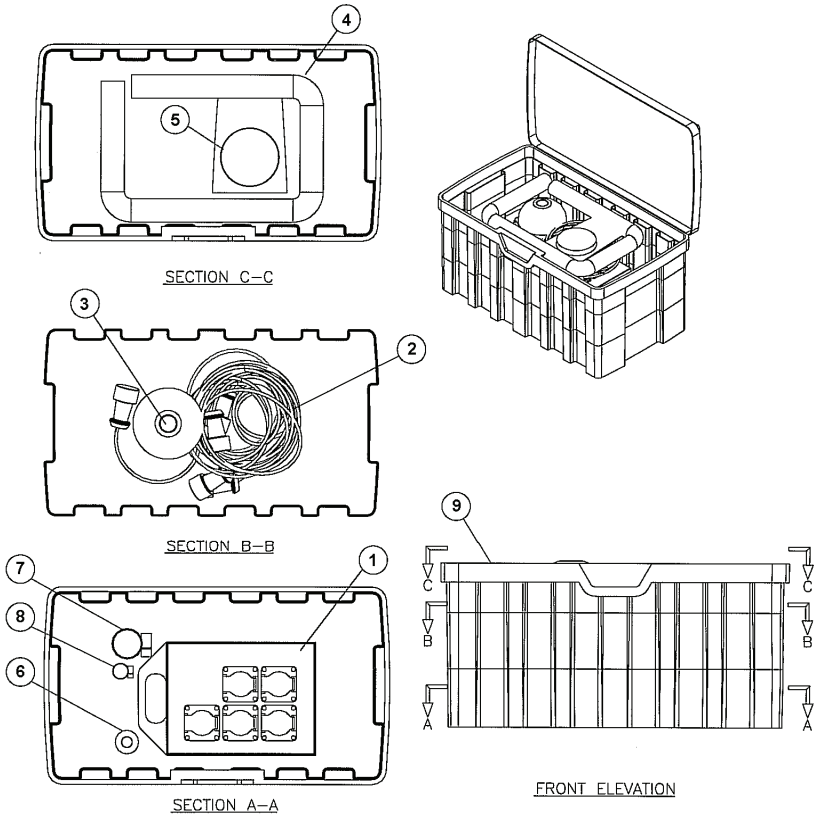


Figure 9. Cold Weather Kit Box 1.

PACKING COLD WEATHER KIT – continued

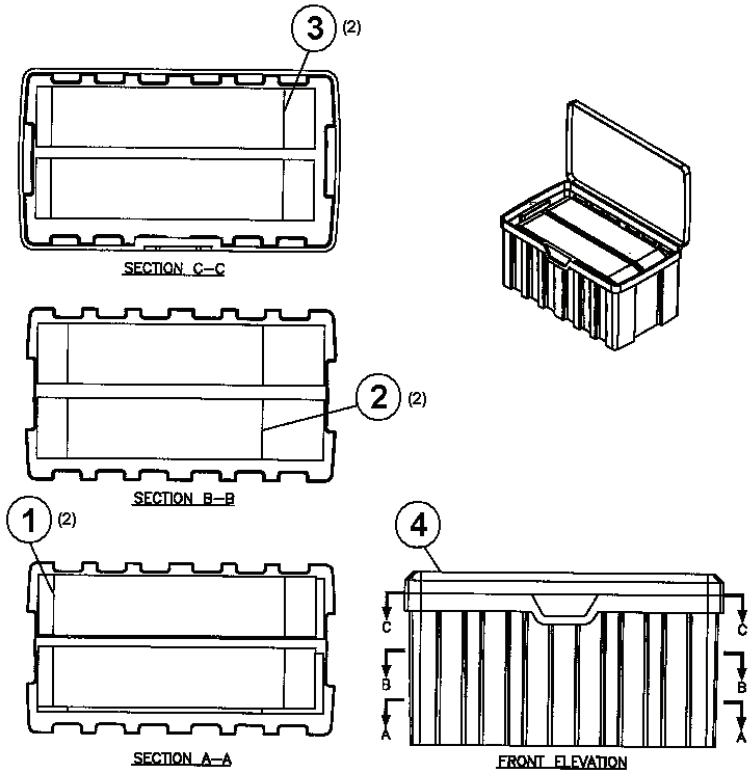


Figure 10. Cold Weather Kit Box 2.

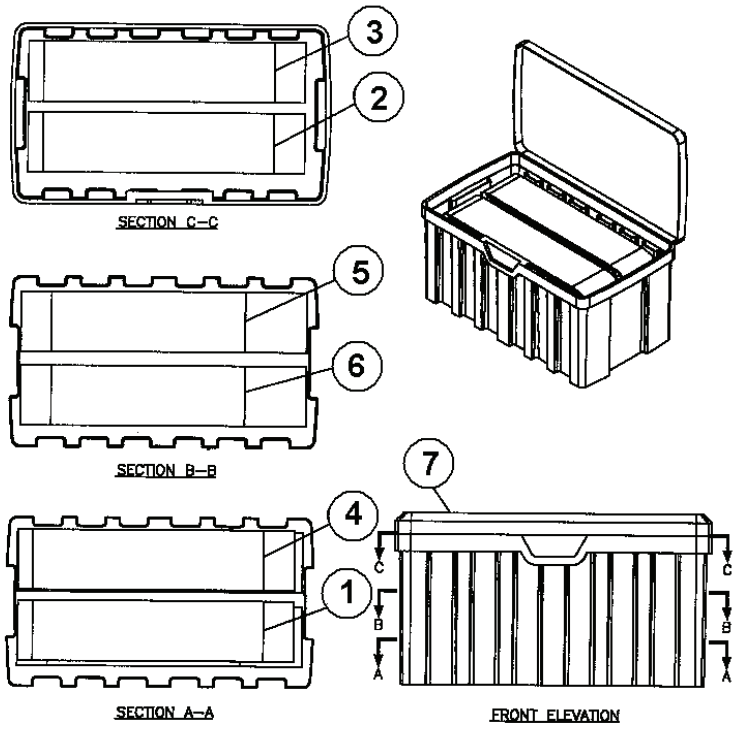


Figure 11. Cold Weather Kit Box 3.

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
NUCLEAR, BIOLOGICAL, AND CHEMICAL DECONTAMINATION
OPERATION UNDER UNUSUAL CONDITIONS

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 0020) 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 Contamination Avoidance Covers (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.

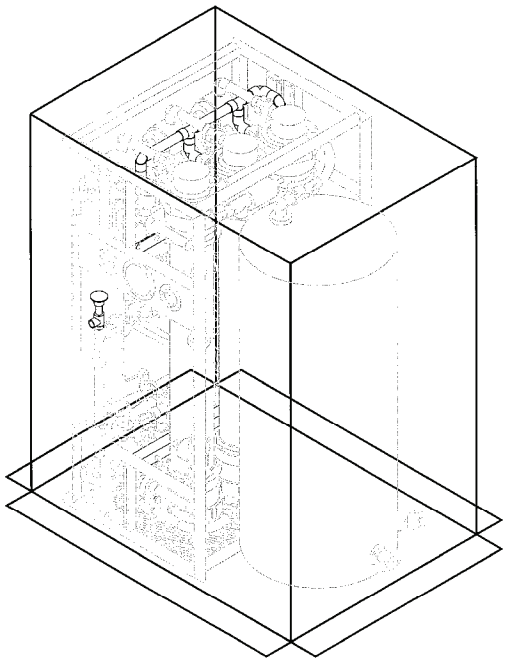


Figure 1. UF Module with Contamination Avoidance Cover (CAC).

SECURING THE LWP FOR NBC ATTACK - continued

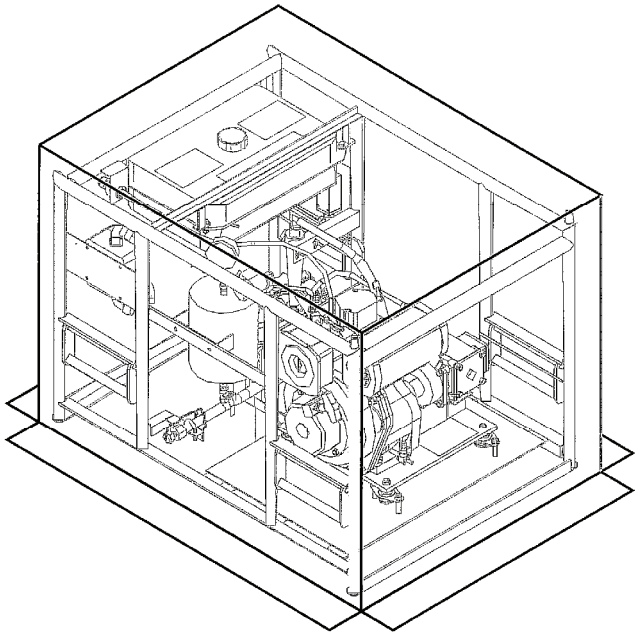


Figure 2. High-Pressure Pump Module with Contamination Avoidance Cover.

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

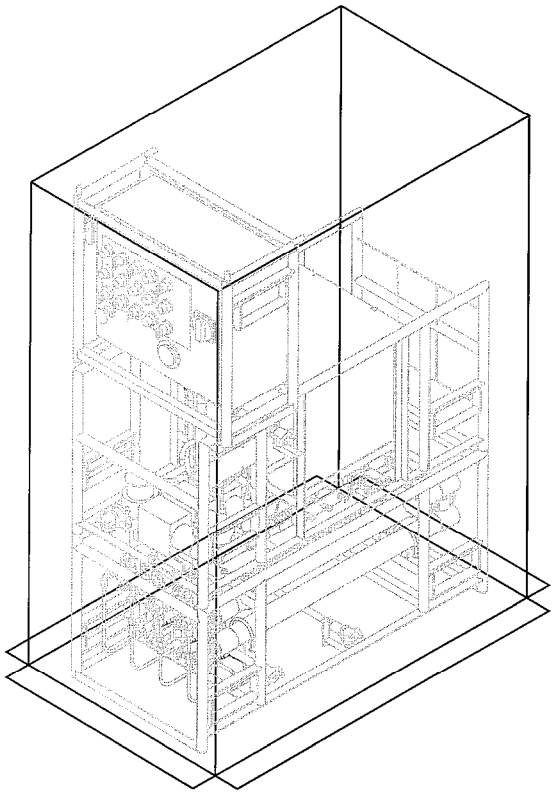


Figure 3. Control, Chemical Injection, and RO Modules with Contamination Avoidance Cover.

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.

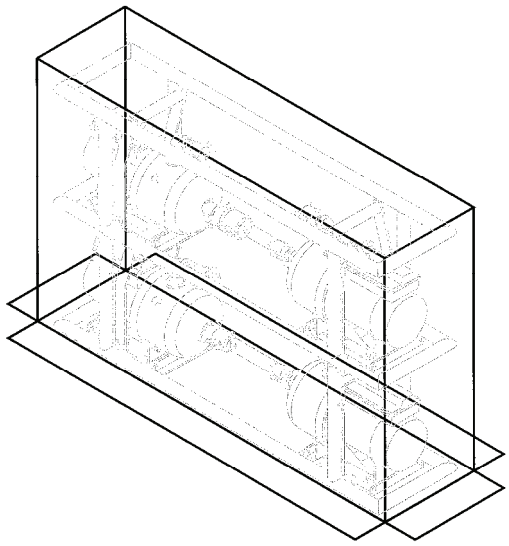


Figure 4. Service Pumps with a Contamination Avoidance Cover.

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 contaminates, 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 0011 and WP 0012).

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 and remove 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 0012).
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.

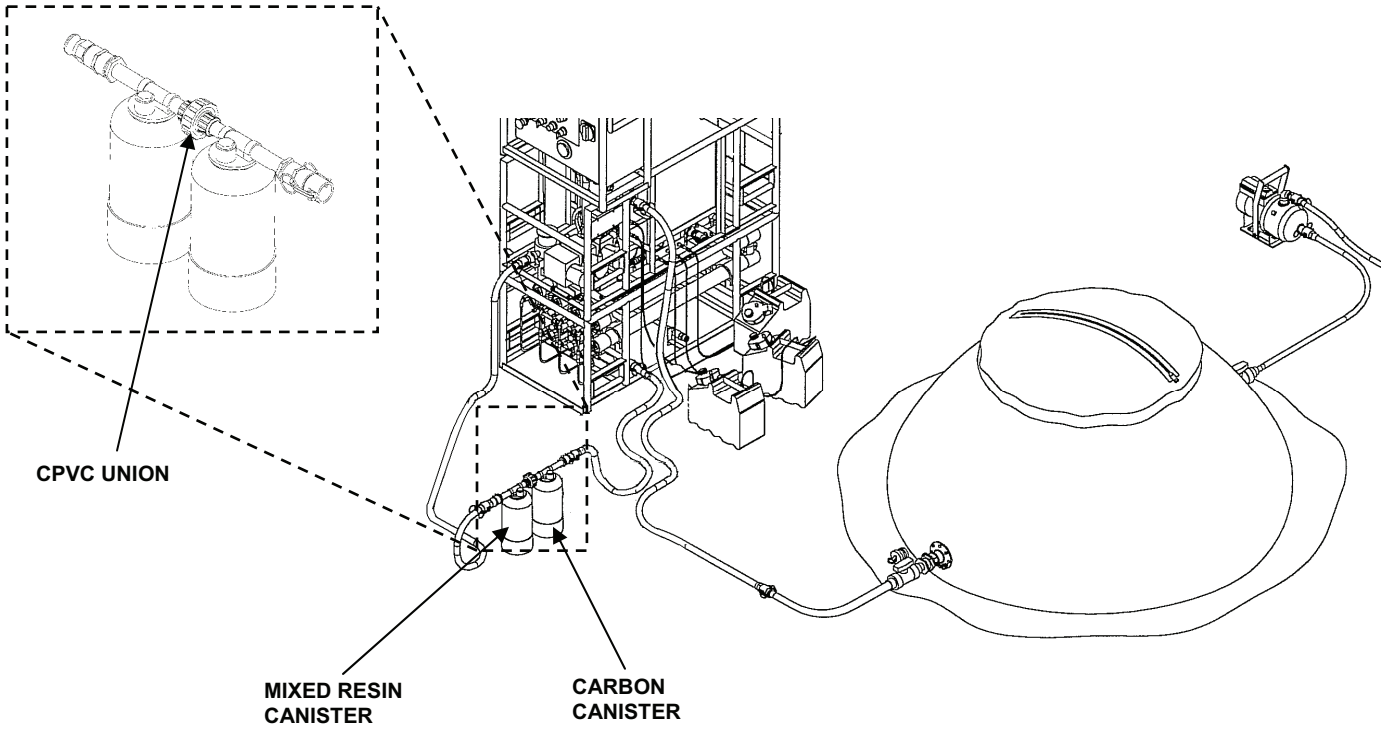


Figure 5. NBC Carbon and Mixed Resin Canisters.

END OF WORK PACKAGE

OPERATOR INSTRUCTIONS
LIGHTWEIGHT WATER PURIFIER
CYANIDE REMOVAL
OPERATION UNDER UNUSUAL CONDITIONS

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 0019) 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 0019), 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 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, 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.

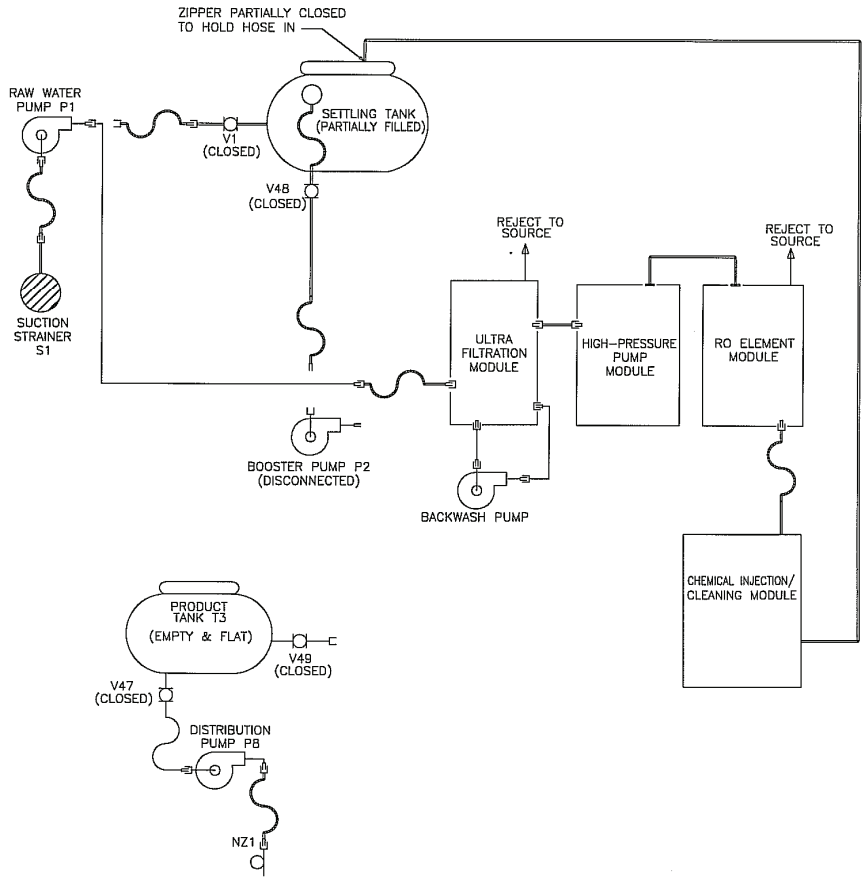


Figure 1. Layout for the First Pass.

2. Ensure that the circuit breaker (CB1) is at the OFF position.

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.

FIRST PASS SETUP AND OPERATING PROCEDURE - continued

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

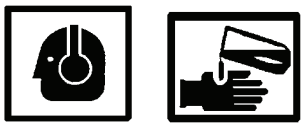
Do not add Hypochlorite to the first pass product water or damage may occur to the reverse osmosis elements during second pass operation.

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 0011, and 0012). 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 0013).

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.

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.

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. I 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).

FIRST PASS SETUP AND OPERATING PROCEDURE - continued

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 0019.

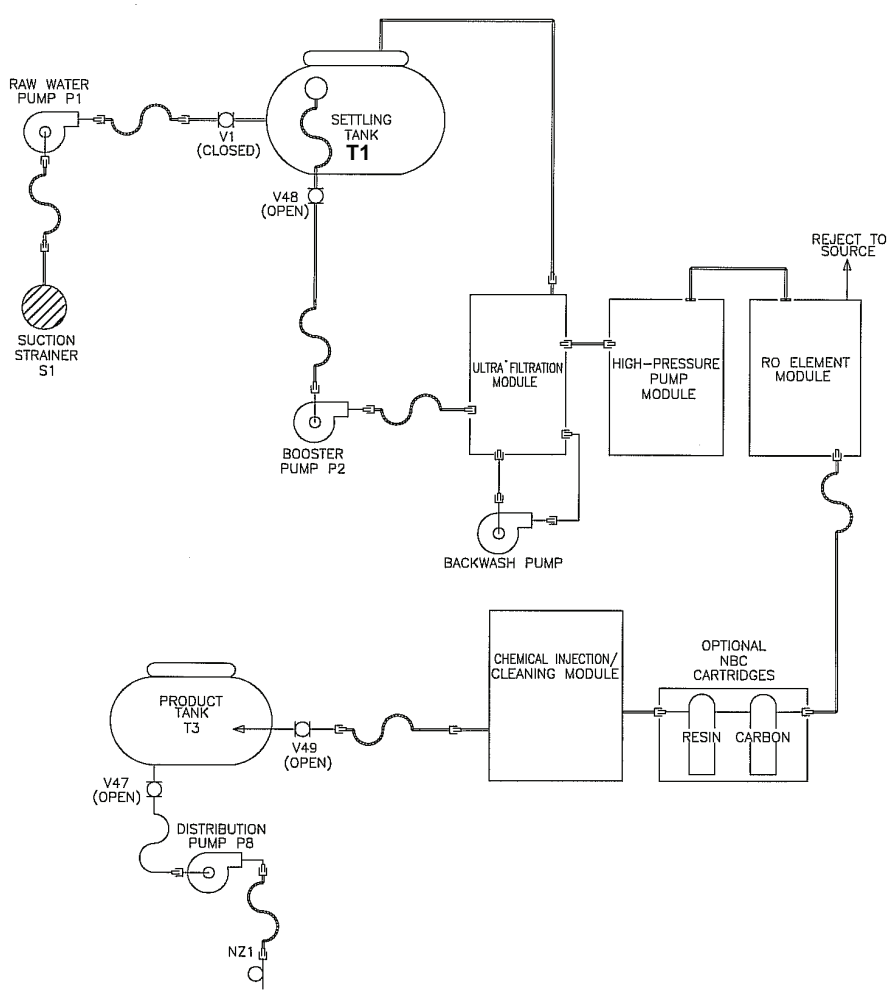


Figure 2. Layout for the Second Pass.

SECOND PASS SETUP AND OPERATING PROCEDURE - continued

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 Total Dissolved (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.

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 Trans Membrane Pressure TMP increases (greater than 4 psi in 4 hrs) during second pass operation a manual backwash or fast flush can be initiated. See (WP 0040)

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 0011 and 0012). 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 0013).

CAUTION

The water level in the settling tank must be constantly monitored. Shutdown operations when it is almost empty. Damage to equipment may result.

NOTE

During operation of the second pass, the product flow rate will always be adjusted to 2.25 gpm.

10. Adjust the RO feed pressure with reject control valve (V11) to a product water flow rate of (2.25 gpm).

11. Check to ensure contaminates are no longer detected. 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.

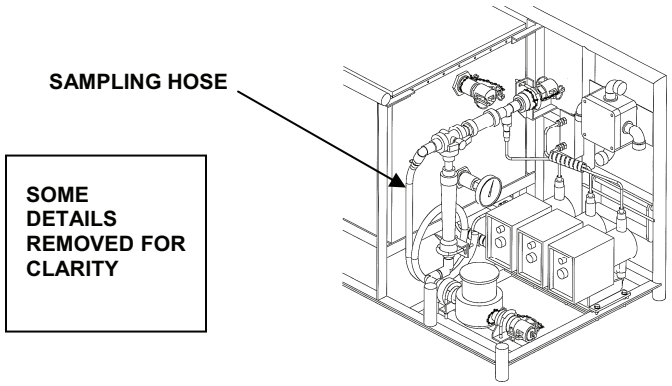


Figure 3. Chemical Module Sampling Hose.

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 0019) and FM 3-5 for additional decontamination instructions and guidance.

END OF WORK PACKAGE

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

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 slightly 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 120°F (49°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

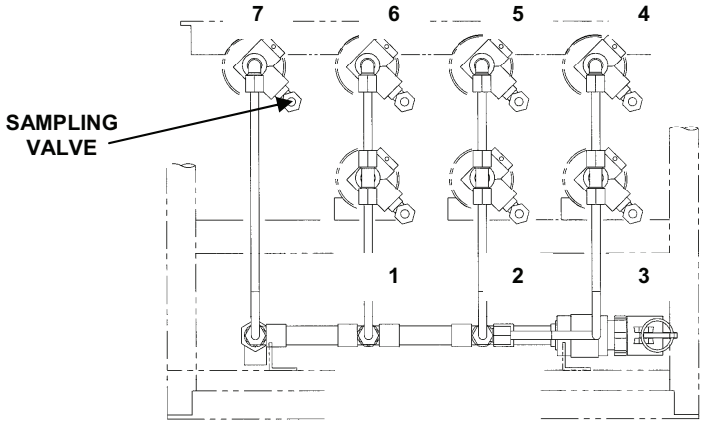


Figure 1. RO Vessel Layout.

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 0031 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 RO 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 completely. 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 0013 and WP 0010) 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 0099).
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

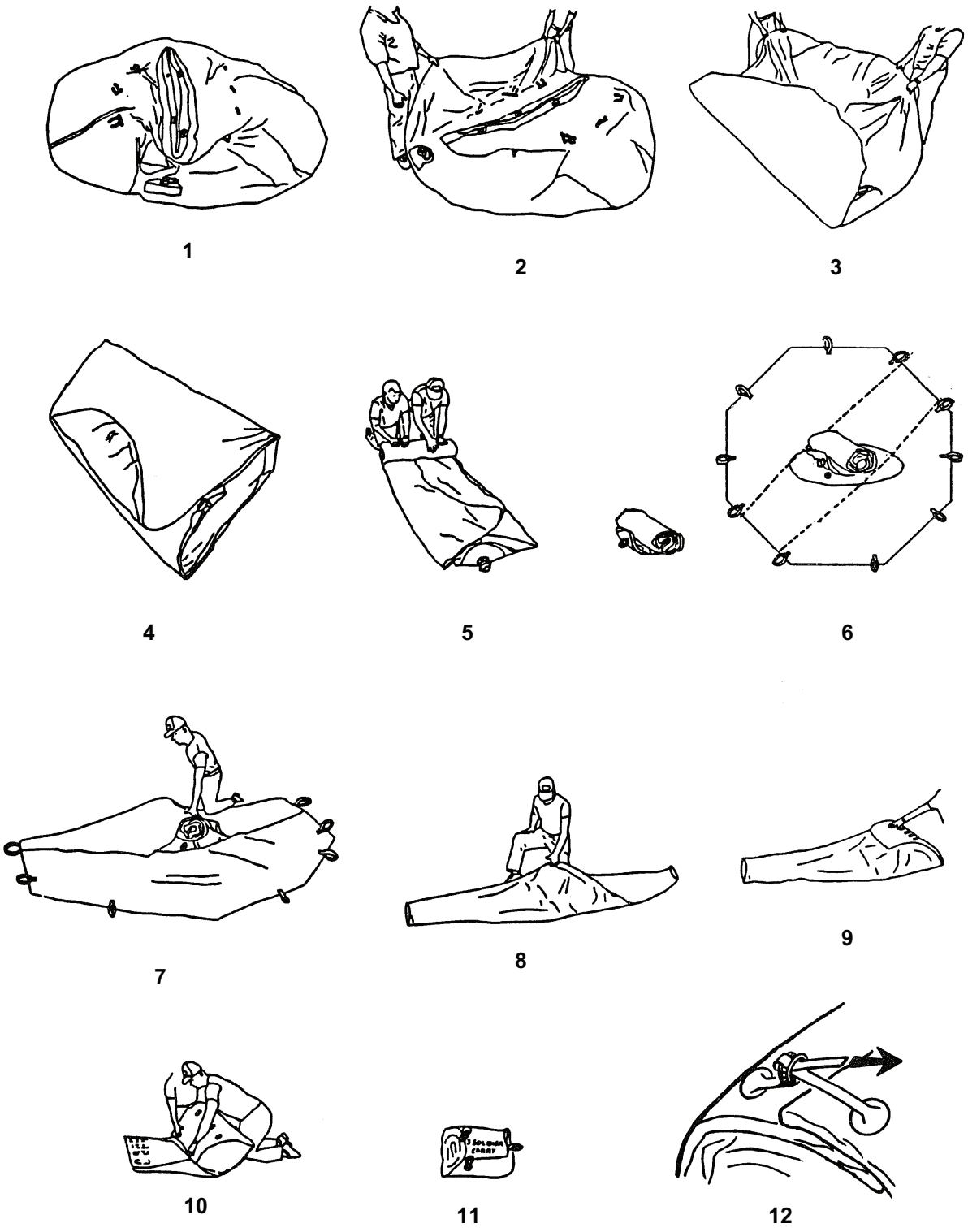
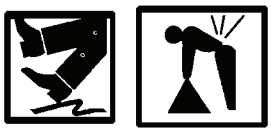


Figure 1. Packing Collapsible Fabric Tank.

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.

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.

CAUTION

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

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.

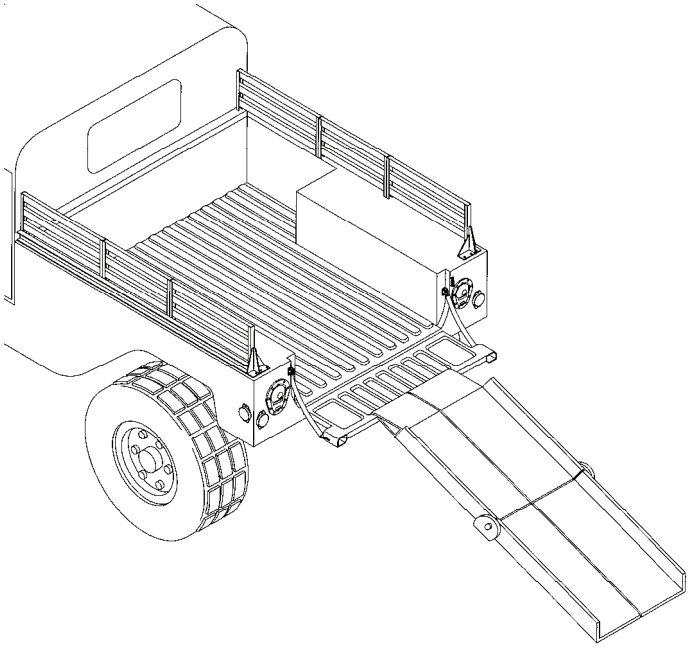


Figure 2. Foldable Ramp Installation.

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.

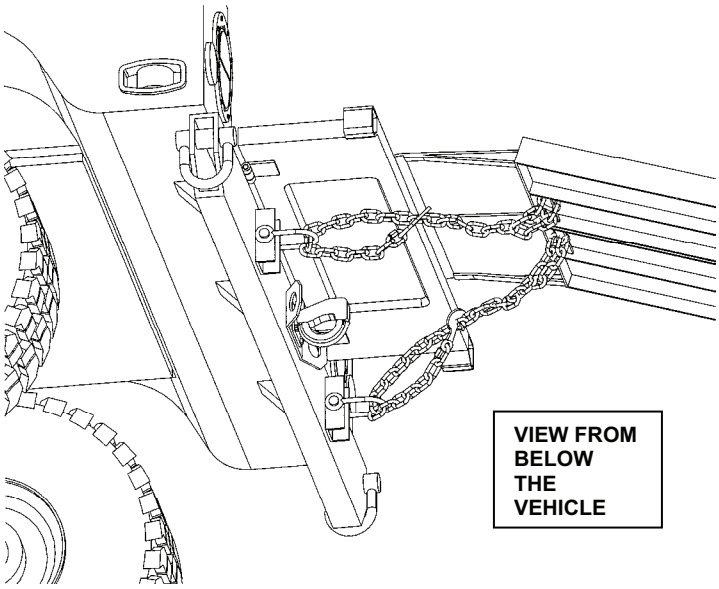


Figure 3. Securing Ramp to Vehicle.

6. Install one of the hooks of tie-down ratchet straps (Figure 4, Item 1) and (Figure 4, Item 2) in the rings behind the cab and lay the straps out over the cab.

7. Lay down the tie down strap (Figure 4, Item 3) across the bed closest to the cab.

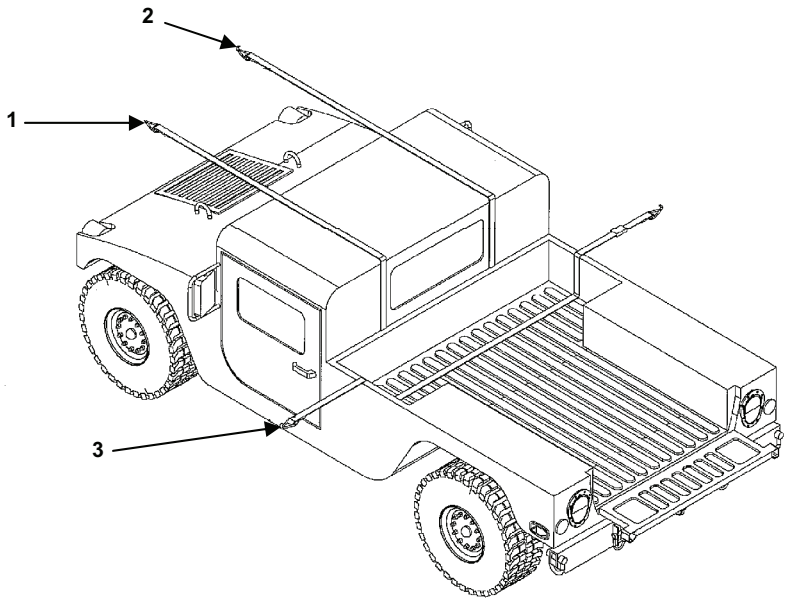


Figure 4. Tie Down Strap Layout.

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.

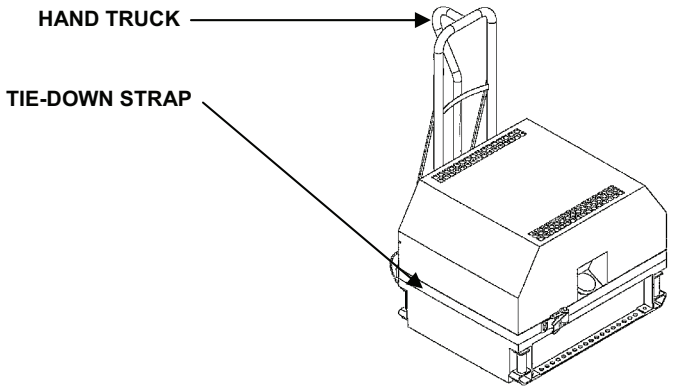
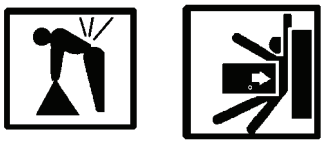


Figure 5. Loading Generator Set on Hand Truck.

WARNING



The 3kW TQG set weighs 334 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.

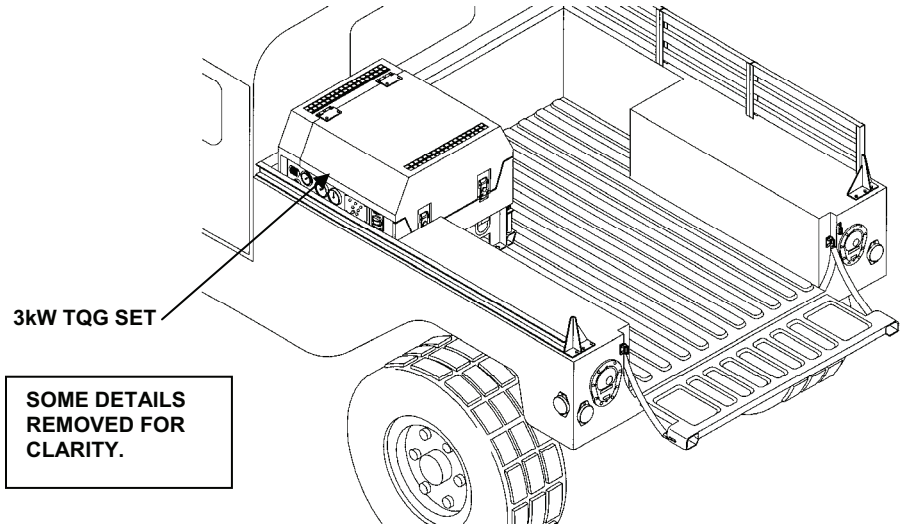


Figure 6. Loading Generator Set.

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.

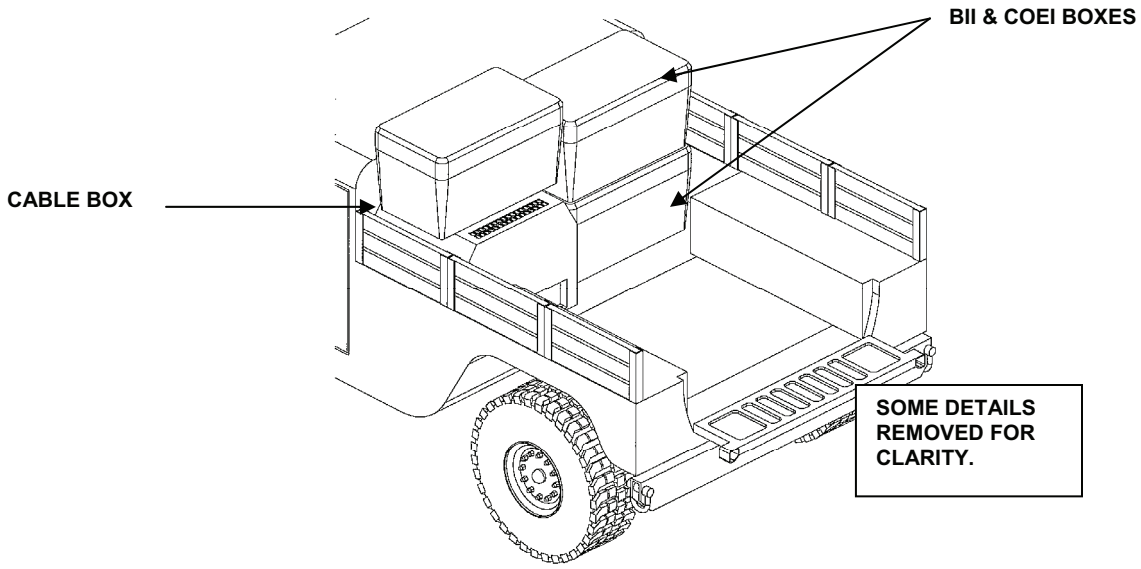


Figure 7. Loading COEI and BII Boxes.

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 protrudes 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.

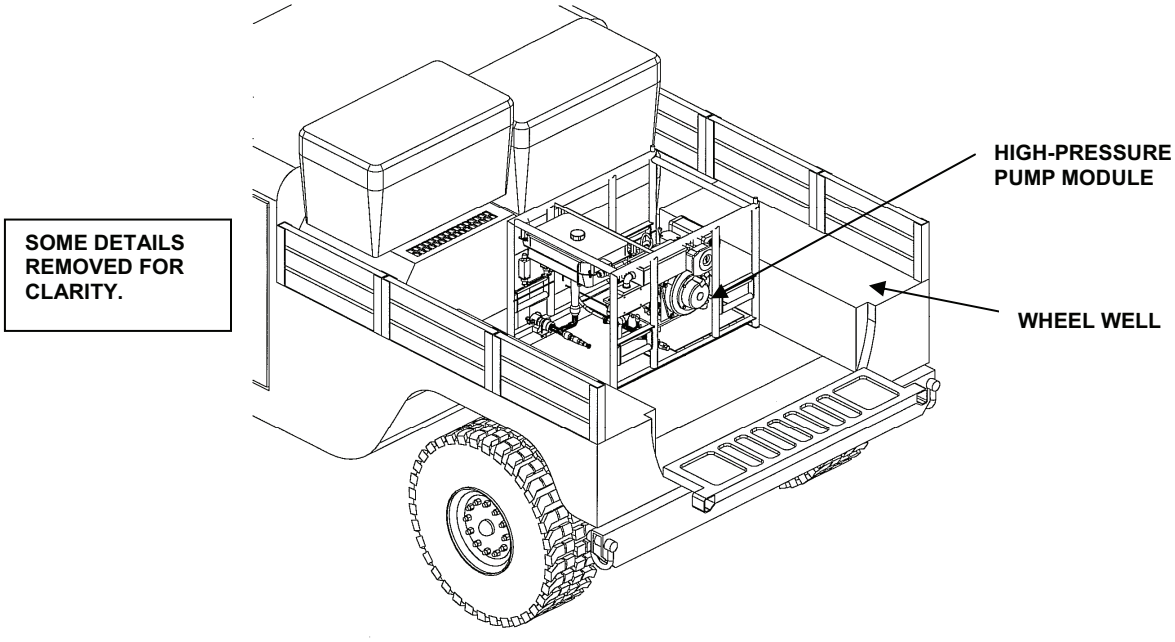


Figure 8. Loading High-Pressure Pump Module.

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.

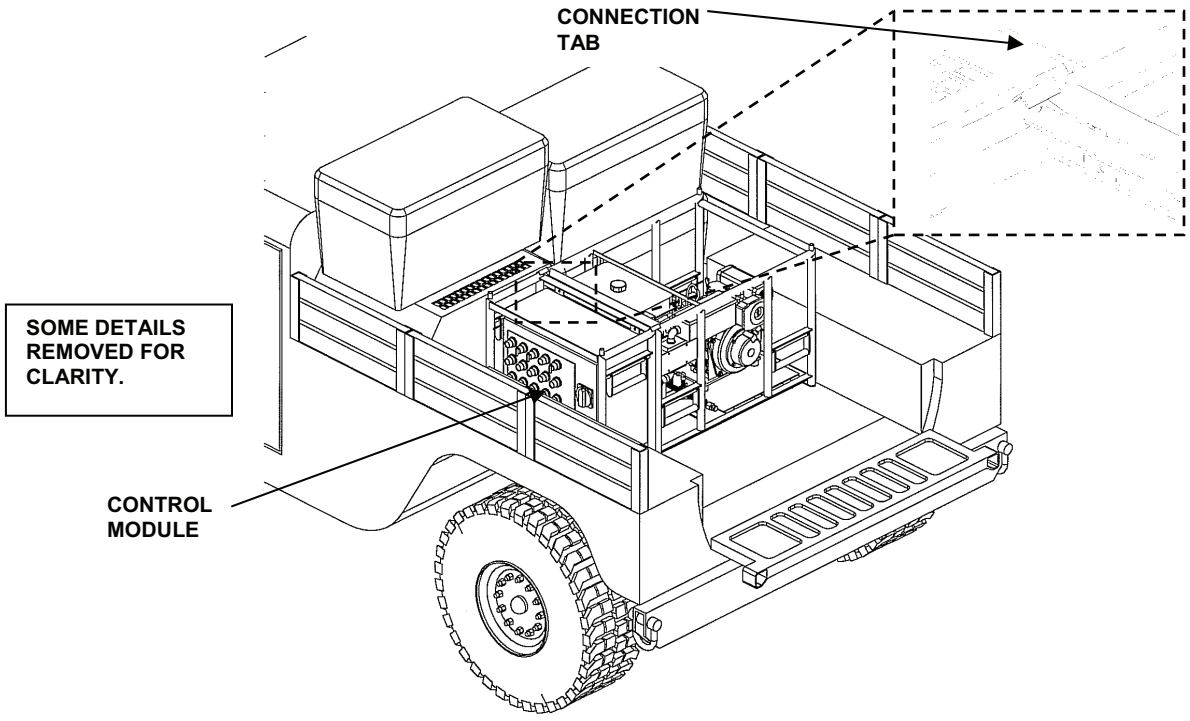


Figure 9. Loading Control Module.

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.

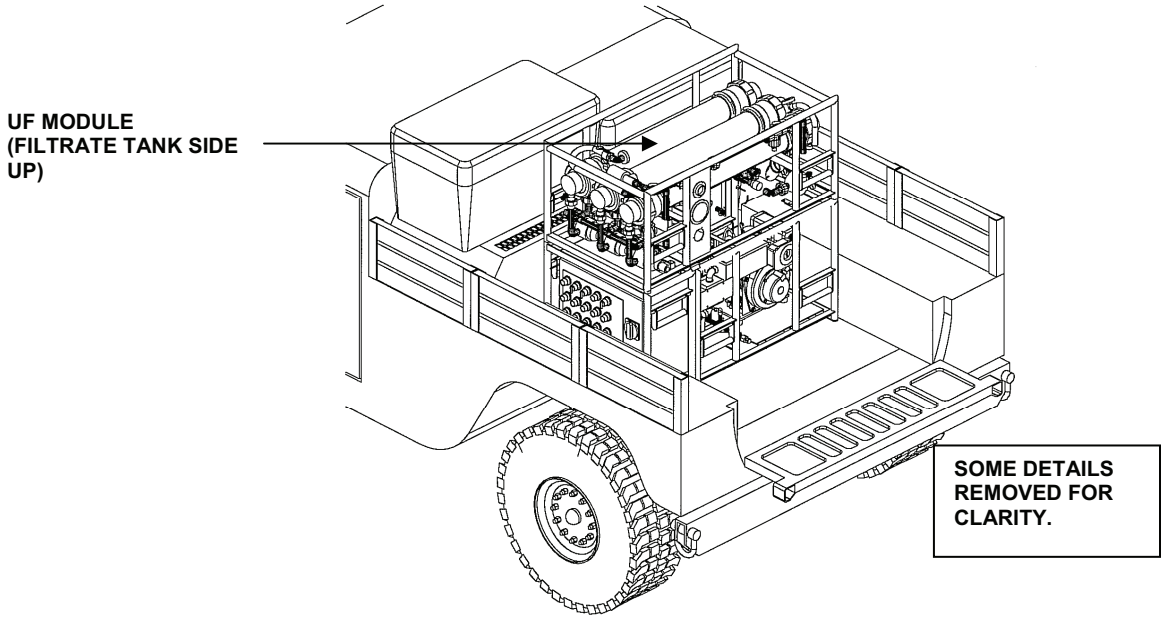


Figure 10. Loading UF Module.

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.

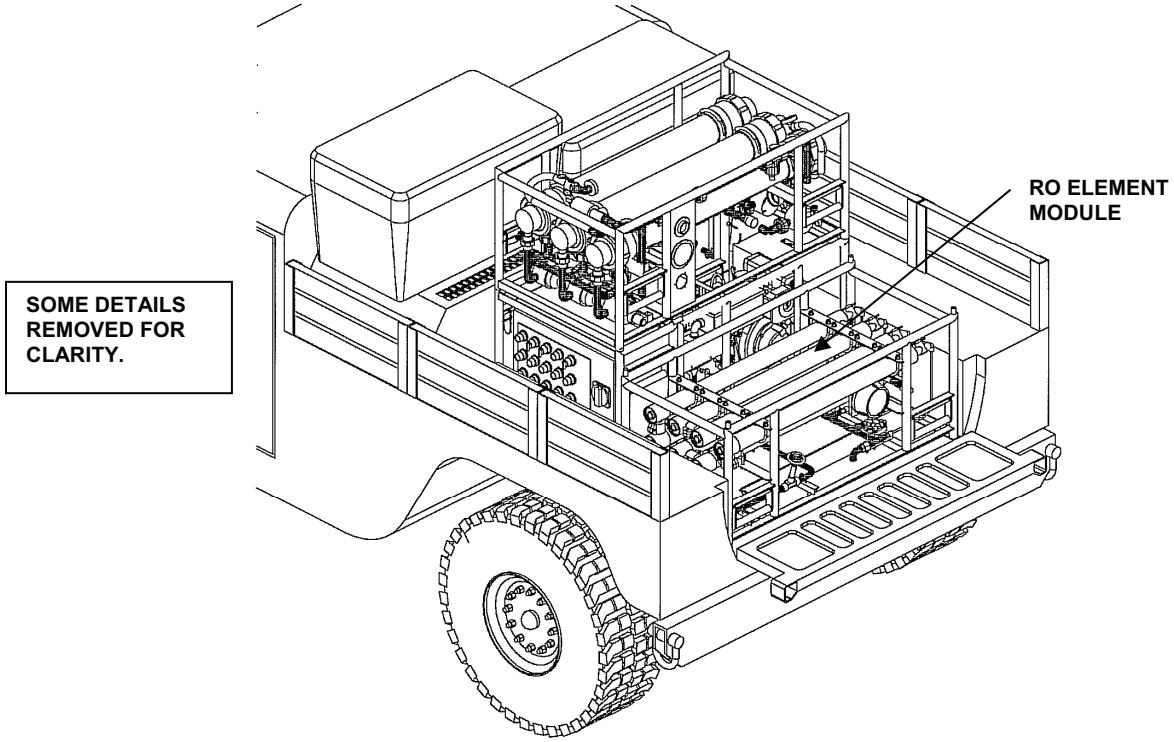


Figure 11. Loading RO Element Module.

LOADING THE HMMWV – continued

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

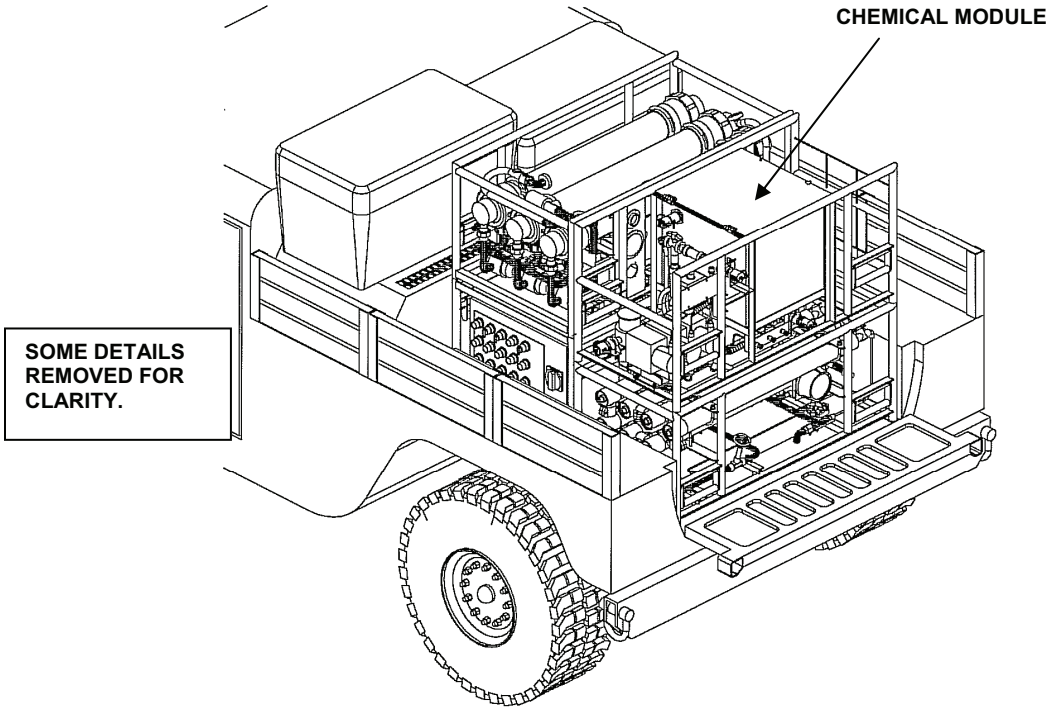


Figure 12. Loading Chemical Injection/Cleaning Module.

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.

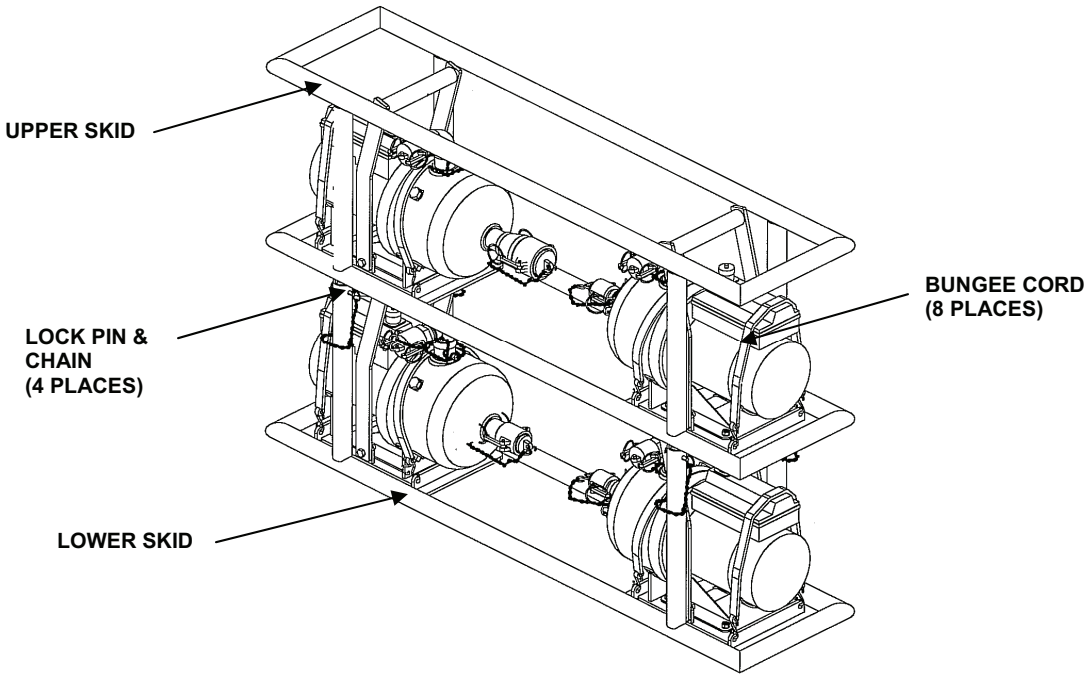


Figure 13. Service Pump Skids.

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.

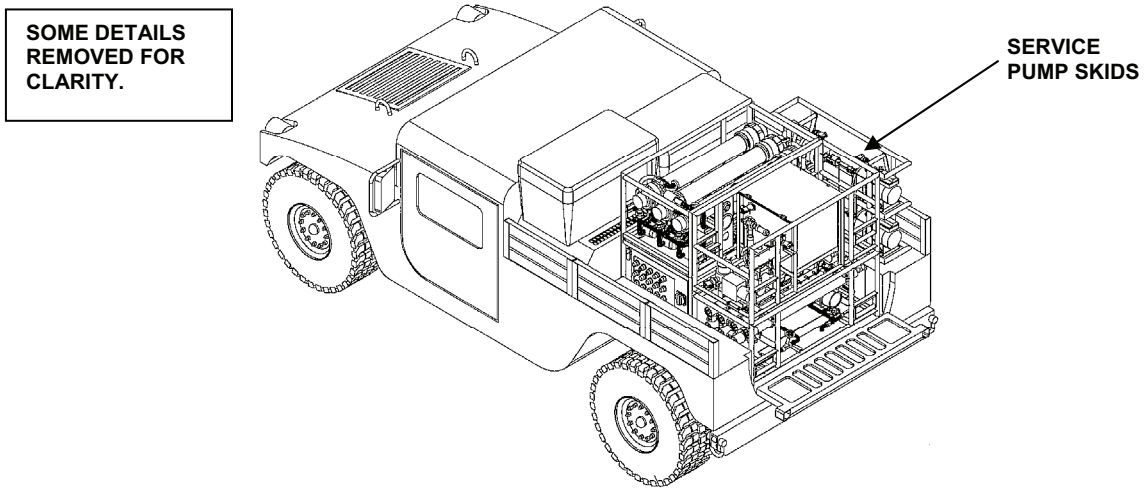


Figure 14. Loading Service Pumps Skids.

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 (Figure 15, Item 3) over the fabric tanks and ratchet them down.
26. Bring the straps (Figure 15, Item 1) and (Figure 15, Item 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 (Figure 15, Item 4) and (Figure 15, Item 5). Loop the ends of the straps around the module frames and onto itself.

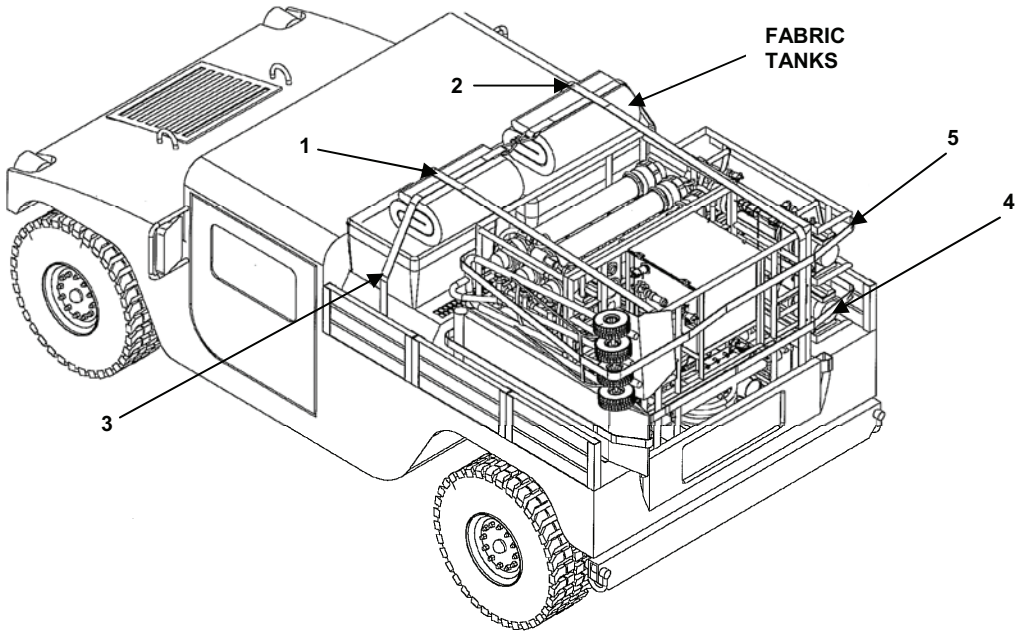


Figure 15. HMMWV Loaded with LWP.

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

CHAPTER 3

OPERATOR TROUBLESHOOTING PROCEDURES FOR LIGHTWEIGHT WATER PURIFIER

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING INDEX

Malfunction/Symptom - continued	Troubleshooting Procedure
Control Module	
1. No power to the module	WP 0030
2. Pilot light does not illuminate	WP 0030
Reverse Osmosis Element Module	
1. Total Dissolved Solids (TDS) too high	WP 0031
2. Operating pressure increasing	WP 0031
3. Blown Rupture Disc	WP 0031
Chemical Injection/Cleaning Module	
1. Improper chemical dosing	WP 0032
2. Totalizer not functioning properly	WP 0032
3. Flow meter not functioning properly	WP 0032
4. No flow to product water tank	WP 0032
Collapsible Fabric Tank	
1. Tanks drain down during shutdown periods	WP 0033
2. Tank overfills	WP 0033
3. Tank leaks	WP 0033
4. Fittings and spool pieces leak	WP 0033
Chemical Injection Pump	
1. Chemical pumps are not running – pilot light is off	WP 0034
2. Antiscalant and Coagulant pump are not running	WP 0034
3. Chemical pump is not running – pilot light is on	WP 0034
4. Chemical pump running but no flow	WP 0034
Total Dissolved Solids, Alkalinity, Conductivity Meter	
1. No display	WP 0035
2. Inability to adjust to calibration solution	WP 0035
3. Erratic display	WP 0035
Cold Weather Kit	
1. Short or electrical problem	WP 0036
2. No power	WP 0036
3. Switch malfunction	WP 0036
4. Receptacle malfunction	WP 0036
5. Electrical cord not plugged in	WP 0036
6. Blankets not heating hose	WP 0036

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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108). Notify field maintenance
	Reset the motor starter module and all circuit breakers (WP 0047).	Notify field 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 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 field maintenance See (WP 0079) for field level troubleshooting.
	Open control panel and check for tripped motor controller (M1)	Reset if tripped
3. Pump operates but produces little or no water	Loss of prime	Prime the pump. See (WP 0011).
	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 0116)	Clean the 10 mesh screen or replace from BII if damaged (WP 0138)
	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 and gaskets.(WP 0116). Notify field 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
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).
	Test pump light (WP 0046).	Replace light bulb (WP 0102). Notify field maintenance
	Reset the motor starter module and all circuit breakers (WP 0046).	Notify field 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 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 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 field maintenance See (WP 0079) for field level troubleshooting.
	Check ball valve compression rings on settling tank outlet spool piece for tightness	Tighten if loose
	Open control panel and check for tripped motor controller (M2)	Reset if tripped
3. Pump operates but produces no water	Loss of prime	Prime the pump. See (WP 0011).
	Kink or blockage in the hose	Remove blockage or kink
4. Leaks in fittings	Tighten connections. Check camlock gasket for damage.	Reapply thread tape. Replace damaged fittings and gaskets. (WP 0116). Notify field 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
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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108). Notify field maintenance
	Reset the motor starter module and all circuit breakers (WP 0047).	Notify field 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 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 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 field maintenance See (WP 0079) for field level troubleshooting.
	Open control panel and check for tripped motor controller (M3)	Reset if tripped
3. Pump operates but produces no water	Loss of prime	Prime the pump. See (WP 0011).
	Kink or blockage in the hose	Remove blockage or kink
4. Leaks in fittings	Tighten connections. Check camlock gasket for damage.	Reapply thread tape. Replace damaged fittings and gaskets. (WP 0116). Notify field 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
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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108). Notify field maintenance
	Reset the motor starter module and all circuit breakers (WP 0047).	Notify field 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 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 field maintenance See (WP 0079) for field level troubleshooting.
	Open control panel and check for tripped motor controller (M4)	Reset if tripped
3. Pump operates but produces no water	Loss of prime	Prime the pump. See (WP 0011).
	Kink or blockage in the hose	Remove blockage or kink
4. Leaks in fittings	Tighten connections. Check camlock gasket for damage.	Reapply thread tape. Replace damaged fittings and gaskets. (WP 0116). Notify field maintenance.

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE

GENERAL

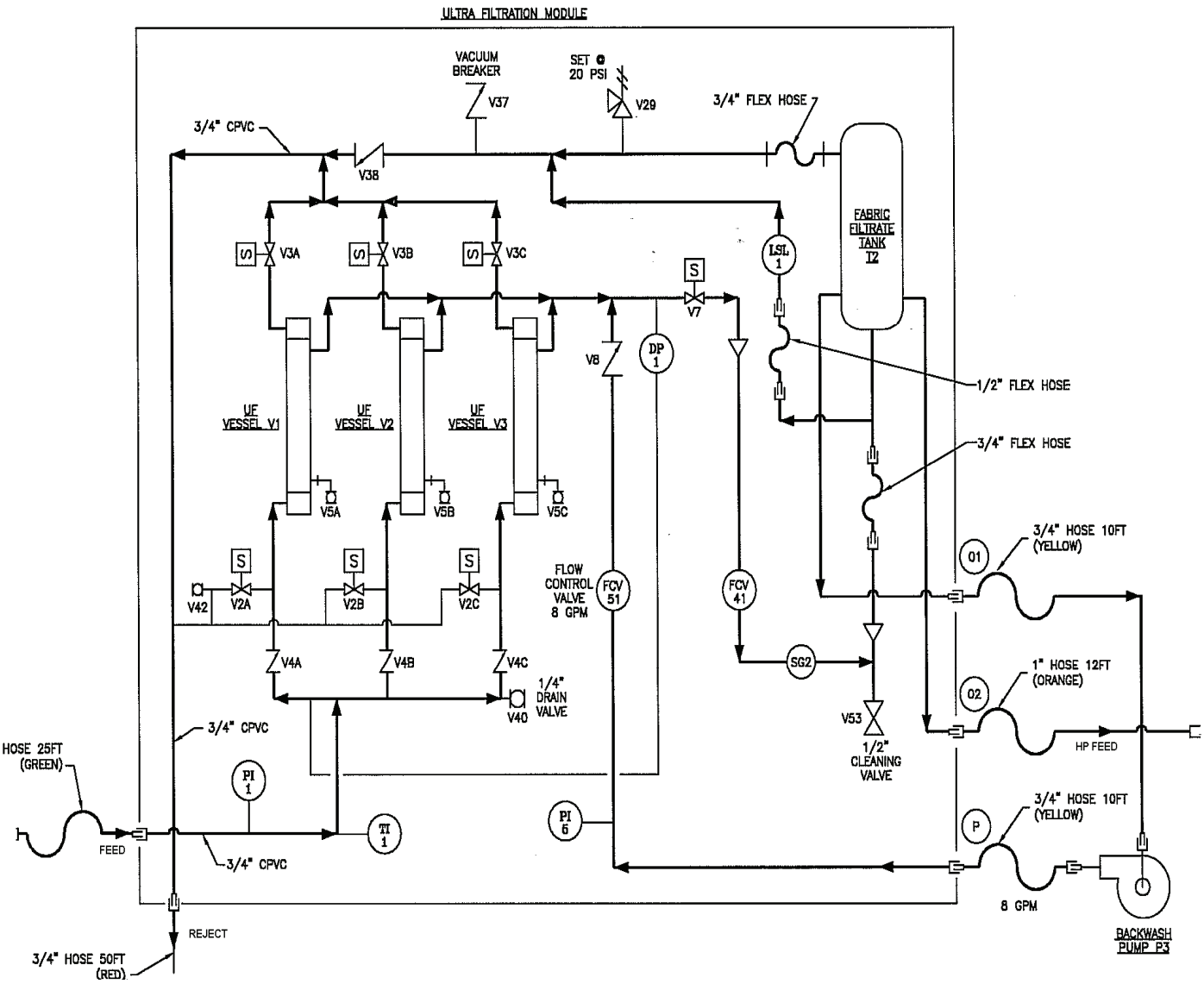
The table lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) Ultrafiltration (UF) module. You should perform the tests/inspections and corrective actions in the order listed.

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 0011)
	Inspect hoses and connections for good connections, kinks, breaks, debris, trash	Repair of replace any leaking fittings. Remove blockage.
	Check settling tank strainer	Clean strainer. (WP 0051)
	Inspect booster pump. Ensure booster **and** backwash switches in AUTO position.	See (WP 0025) 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 of 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 field maintenance. (WP 0096)
	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 field maintenance. (WP 0096)
	Inspect flow control valve (FCV 41) for proper orientation and blockage.	Notify field maintenance. (WP 0096)
	Inspect solenoid valves (V3 A,B,C and V7). 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 field maintenance. See (WP 0058– WP 0061) for field troubleshooting procedure

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
	Inspect check valve (V8) Remove the check valve and shake it back and forth to ensure that the ball is moving freely.	Notify field maintenance. (WP 0096)
4. Backwash pressure too high or not pulsing during backwash	Inspect hoses and connections for good connections, kinks, breaks, debris, trash	Repair of replace any leaking fittings. Remove blockage. Notify field maintenance.
	Inspect check valve (V8) Remove the check valve and shake it back and forth to ensure that the ball is moving freely. Notify field maintenance.	Notify field maintenance. (WP 0096)
	Inspect check valve (V4 A-C) Ensure that the arrow on the body of the check valve is in the direction of the flow.	Notify field maintenance. (WP 0096)
	Inspect flow control valve (FCV 41) Ensure that the arrow on the body of the check valve is in the direction of the flow. 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.)	Notify field maintenance. (WP 0096) Determine the problematic cycle. 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. Notify field maintenance. See (WP 0058 – WP 0061 for backwash up and WP 0055 – WP 0057 for backwash down) for field troubleshooting procedure
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 field maintenance. See (WP 0055 – WP 0057) for field troubleshooting procedure

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
6. Solenoid valves are not functioning correctly	Inspect PLC	Notify field maintenance (WP 0070)
7. Backwash pressure too low	Inspect the backwash pump for loss of prime.	Prime backwash pump (WP 0012)
	Inspect hoses and connections for good connections, kinks, breaks, debris, trash	Repair of replace any leaking fittings. Remove blockage.
	Troubleshoot backwash pump	See (WP 0026)
	Inspect the 30-mesh screens in the inlet camlock of the backwash piping. (WP 0091)	Clean the screens of any debris. Replace damaged screens (WP 0091).
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. Notify field maintenance See (WP 0055 – WP 0057 for backwash up and WP 0058 – WP 0061 for backwash down) for field troubleshooting procedure
	Check for dirty membranes	Perform manual backwash (WP 0041)
	Check for dirty membranes	Perform maintenance clean (WP 0039), proceed to next step if problem persists.
		Perform full chemical clean (WP 0040)
	Check for unserviceable membranes	Replace membrane cartridges (WP 0093). Notify field maintenance.
9. Filtrate tank over pressured	Inspect hoses and connections for good connections, kinks, breaks, debris, trash	Repair of 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 0091)
	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 0091).
	Unserviceable pressure relief valve?	Replace the pressure relief valve (WP 0091). Notify field maintenance.
10. Feed pressure too low	Inspect the 30-mesh screens on the inlet camlock of the UF feed piping. (WP 0091)	Clean the screens of any debris. Replace damaged screens (WP 0091).
	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 field maintenance. See (WP 0055 – WP 0057) for field troubleshooting procedure
11. Filtrate tank level dropping	Inspect the piping and fittings for blockage	Remove blockage

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
11. Filtrate tank level dropping-continued	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 field in manual backwash (WP 0041). 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 – page 6)	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 field 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 field maintenance. (WP 0099) Inspect fuel filter.	Ensure correct fuel. Refill if necessary (diesel, JP8). Clean the fuel strainer. Replace fuel filter if necessary (WP 0099)
	Check if emergency shutoff valve is open. (WP 0012)	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 0043)
	Ensure that the engine is primed. (WP 0012)	Prime the engine. (WP 0012)
	Inspect throttle cable for loose connections, binding and general operation.	Ensure throttle cable is pulled out. Tighten loose connections. Replace if faulty. (WP 0012). Notify field maintenance.
2. Air shutoff valve will not open automatically **NOTE** The air shutoff valve is equipped with a manual override feature to enable continued operations during emergency (WP 0012).	Inspect the air pressure gauge for proper charge. Inspect for air leaks if necessary.	Fill to 30 psi. Tighten connections (WP 0012).
	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 0063). Notify field 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 0068).
	Inspect the shutoff assembly for binding and corrosion	Rotate the T-handle to check for binding and corrosion. Clean and lubricate if necessary.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
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 0106).
4. Excessive engine noise.	Inspect engine oil level	Fill with oil if necessary (WP 0100)
	Inspect the muffler for corrosion or damage	Replace damaged muffler (WP 0107). Notify field maintenance.
	Inspect vibration mounts	Tighten nuts. If damaged, remove and replace vibration mounts. Notify field maintenance. (WP 0097)
5. Unusual gear box noise	Inspect for proper oil level in the HP pump	Fill HP pump with oil (WP 00412)
	Inspect for loose mounting screws	Tighten connections
	Inspect the gear box for damage	Notify field maintenance. (WP 0104)
6. High-pressure pump leaks (WATER)	Inspect the high-pressure pump for damage, corrosion or worn seals.	Notify field maintenance. (WP 0127)
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 0042)
8. High-pressure pump not building up pressure	Inspect the high-pressure pump for damage, corrosion or worn seals.	Notify field maintenance. (WP 0127)
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 0098).
11. Engine low rpm	Check (WP 0038) for maintenance intervals	Ensure all scheduled maintenances are completed as required. Notify field 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 field maintenance WP 0068)	Replace if faulty (WP 0102). Notify field 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 0011)
	Troubleshoot the generator	See (TM 9-6115-639-13).
	Inspect Circuit breakers	Reset circuit breakers. (WP0047)
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 0108). If the bulb comes on but the switch is not operable see (WP 0071). Notify field 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 0044).	Clean membranes (WP 0044)
	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 0046)
	Inspect the O-rings from the high (TDS) vessel	Check when replacing membranes (WP 0046) and replace if needed.
2. Operating pressure increasing	Inspect the operating parameters and compare to the limits in (WP 0044).	Clean membranes (WP 0044)
	Inspect all hoses for kinks or blockage	Remove blockage
	Check flow rates	Verify (WP 0014)
3. Blown rupture disc	Verify product tank Inlet Spool Piece Valve is in open position.	Open Valve
	Inspect for kinks or blockage in product water hose.	Remove the blockage

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 0013.
2. Totalizer not functioning properly	Check piping connections	Tighten connections. Remove and replace if damaged (WP 0111)
	Inspect check valve Remove the check valve and shake it back and forth to ensure that the ball is moving freely. Notify field maintenance.	Notify field maintenance. (WP 0091)
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 0110)
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 0052)
4. Fittings and spool pieces leak	Check fittings and spool pieces for damage or looseness	Tighten fittings (WP 0110)
	Check gasket, installed in both filler/discharge fittings for damage	Replace gasket, if required. (WP 0114). Notify field maintenance.

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION ELECTRONIC METERING 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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108). Notify field 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 field maintenance (WP 0102)
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 0013).
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 0110)
	Inspect chemical tanks	Refill if necessary

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
TOTAL DISSOLVED SOLIDS (TDS), ALKALINITY (pH), CONDUCTIVITY METER

INITIAL SETUP

Material/Parts
Battery, 9-volt, alkaline (WP 0139, Item 5)
Rag, wiping, cotton (WP 0139, Item 24)

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. 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 0006)
	Inspect meter for water intrusion.	Remove the back cover and allow meter to dry. Replace meter if unserviceable.
2. Inability to adjust to calibration solution.	Check expiration date of the solution.	Replace solution.
	Inspect solution for contamination.	Replace solution.
	Inspect electrode for damage or corrosion.	Clean electrode or replace the meter.
	Inspect salt solution from pH well contaminating the TDS well.	Close rubber cap tightly. Clean out the TDS well and flush remnants three times.
3. Erratic display.	Inspect meter for water intrusion.	Remove the back cover and allow meter to dry. Replace meter if unserviceable.

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
COLD WEATHER KIT

INTIAL SETUP

Material/Parts

Blanket, 10 foot, PN 12511618-1, 12511618-4
Blanket, 20-foot, PN 12511618-2, 12511618-3, 12511618-5, 12511618-6
Cable assembly, extension, PN 12497077

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 connnections	Plug blanket electrical connnection 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

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 the order listed will make sure the LWP meets its mission objective.

The PMCS table is arranged in five 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.

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 field 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 field maintenance. For further information on how to use this form, refer to (DA PAM 750-8).

If special tools required to perform PMCS are not listed in TM 10-4610-310-23P, notify field 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 field maintenance.

WARNING

Never operate the LWP with any Class of fuel leak. Serious injury or death may occur.

CAUTION

Equipment should not be operated with a Class III leak of any fluid. 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 field 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 field 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 field 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 field 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 field 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 at scheduled intervals for the engines.
5. Maintain surfaces and fittings free of trash and contaminates 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 any Operator 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 (WP 0038).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

- B – Before, D – During, A – After, W - Weekly

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
PREVENTATIVE MAINTENANCE CHECKS AND SERVICES TABLE

Table 1. Operator Maintenance Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	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 (BII) 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 field 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 field maintenance.	
6.	Before	UF cartridges /RO pressure vessels	Inspect for leaky gaskets and loose mountings. Notify field 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.

Table 1. Operator Maintenance Preventive Maintenance Checks and Services. - continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
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.
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 circuit breaker (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

Table 1. Operator Maintenance Preventive Maintenance Checks and Services. - continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
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 0052)
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 field 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. See (TM 9-6115-639-13)	
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. Notify Field Maintenance.	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 –Solenoid air vent	Inspect the vent fitting to ensure it is not clogged.	
28.	Before	Engine shut off-air drain valve	Inspect the drain valve for serviceability	

Table 1. Operator Maintenance Preventive Maintenance Checks and Services. - continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
29.	Before	Engine shut off- air 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 conduit is in place and there is no visual damage	
31.	Before	Engine shut off – air lines and fittings	Inspect for damaged hoses and fittings. Inspect for clogged hoses and fittings	
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. Notify Field Maintenance of leaks.	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	

Table 1. Operator Maintenance Preventive Maintenance Checks and Services. - continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
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.	
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 field 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

Table 1. Operator Maintenance Preventive Maintenance Checks and Services. - continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
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.	
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 diesel engine lines and engine	Check for fuel and oil leaks	Fuel leak, large oil leak
70.	During	Engine shut off – air pressure	Check and refill so that the pressure in the air tank is above 30 psi.	
71.	During	High – pressure pump engine fuel tank	Check fuel level and refill as necessary. **Do not remove the fuel strainer to refill.**	
72.	During	Cleaning tank	Check level and refill as necessary. Inspect for leaks, cracks, and punctures. Inspect for loose connections.	Damage that would prevent operation
73.	During	Chemical injection tanks	Check chemical levels. Check connections for leaks	Damage that would prevent operation
74.	During	Chemical injection tanks (3)	Inspect for cracks, breaks, and loose fittings.	Leaky tanks.
75.	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
76.	During	Product shutoff valve	Inspect for leakage and damaged control	Damage that would prevent operation
77.	During	Distribution nozzle	Check for leaks and proper operation, cap missing	Damage that would prevent operation
78.	During	Distribution hoses	Check for leaks	Class III leaks
79.	During	Raw water hoses	Check for leaks	Class III leaks
80.	During	RO pressure gauge	Inspect for function, connections, broken glass.	

Table 1. Operator Maintenance Preventive Maintenance Checks and Services. - continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
81.	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.
82.	During	Air shut off assembly	Inspect for leaks and loose equipment. Ensure the pressure gauge reads between 30-100 psi.	
83.	After	UF membranes	Perform product flush (WP 0013)	
84.	After	Collapsible fabric water tanks	Check for cuts, tears, punctures, damaged zipper, leaking filler/discharge fittings	Damage is observed
85.	After	Diesel engine oil level	Visually inspect oil level and condition of oil	Oil level is low
86.	After	Electrical cables and connections	Check for cuts, loose connections, and damaged connections	Damage that would prevent operation
87.	After	Air shut off assembly	Drain the air tank if shutdown is longer than 48 hrs.	
88.	After	Chemical tanks	Drain and clean chemical tanks and tubing	
89.	After	Chemical injection tanks (3)	Inspect for cracks, breaks, and loose fittings.	Class III leaks
90.	After	LWP unit and tools	Rinse unit and tools the with clean fresh water to prevent corrosion	
91.	Weekly	LWP (Corrosion)	Inspect the LWP for signs of corrosion. Remove corrosion or replace corroding part.	Corrosion that may prevent operations
92.	Weekly	High-pressure pump plumbing	Inspect for looseness, damage, cuts, leaks	Damage that would prevent operation
93.	Weekly	Contamination Avoidance Covers	Inspect for rips, tears, or other damage. Report damage to field maintenance.	
94.	Weekly	Paint	Inspect the paint on LWP. Touch up any area with damaged paint.	
95.	Beginning of deployment, or as required	Water quality meters	Calibrate meters (WP 0048 and 0049)	
96.	50 hours*	Diesel engine	Initial oil change, notify field maintenance (WP 0093)	
97.	50 hours	High-pressure pump oil	Perform initial oil change, (WP 0041)	
98.	The first 50 hours	Valve clearance	Adjust initial valve clearance (WP 0119)	
99.	100 hours	Diesel engine air filter	Inspect and change as needed (WP 0042)	

Table 1. Operator Maintenance Preventive Maintenance Checks and Services. - continued

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
100.	500 hours	Diesel engine air filter element	Change air filter element (WP 0042)	
101.	Annual	Rupture discs	Replace both rupture discs. Ensure that the rupture disc holder is free of corrosion.	
102.	As required	UF membrane cartridges	Clean when ΔP is greater than 30 psi (WP 0040)	
103.	As required	RO membrane elements	Clean if the criteria presented in (WP 0044) are not met.	

Lubrication Instructions:

See 3kw TQG TM 9-6115-639-13 for maintaining the diesel engine oil level Before check and service, (Item 18) Operator Maintenance Preventive Maintenance Checks and Services.

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MEMBRANE
MAINTENANACE CLEANING PROCEDURE

INITIAL SETUP:

Materials/Parts
Stop watch (WP 00138, Table 2, Item 50)
Test Strips Chlorine (WP 0138, Table 2, Item 35)
Hypochlorite Sodium (WP 0139, Item 20)

References
LWP Shut down (WP 0016)
Chlorine Test Strips (WP 0007)

Special Environmental Conditions
Follow local regulations for discharge

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 0016.

CAUTION

To avoid damage, use care when removing screen.

4. Ensure cleaning tank drain valve is closed. See Figure 1. Remove plug from Y-strainer. Remove mesh screen. See Figure 2.

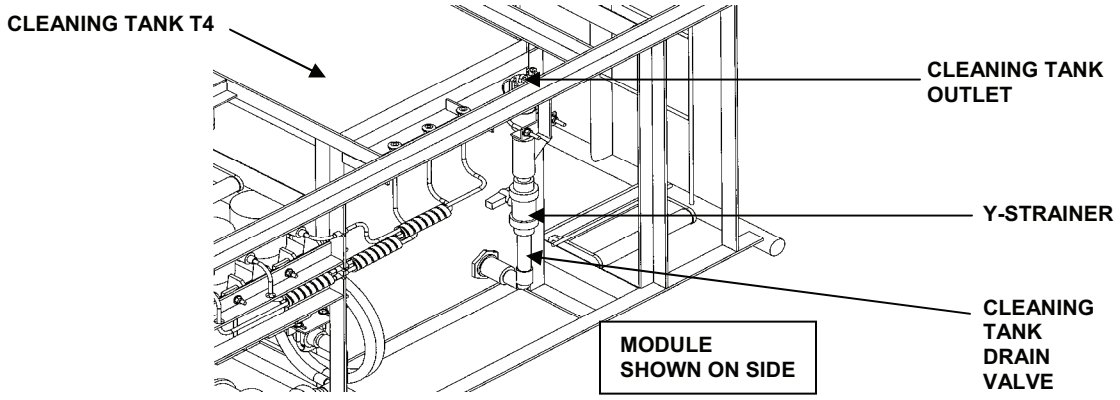


Figure 1. Y-Strainer Location.

PROCEDURE - continued

5. Clean the strainer screen in the Y-strainer with clean water. Observe for debris. Install mesh screen and plug into Y-strainer. See Figure 2.

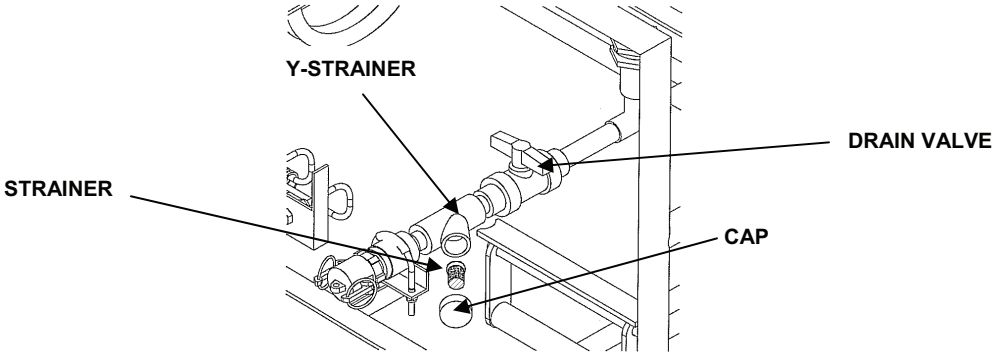


Figure 2. Y-Strainer.

6. Disconnect the UF filtrate inlet hose from the filtrate tank and cap tank inlet.

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.

7. Allow the filtrate tank to drain.
8. Disconnect the backwash pump suction hose from the filtrate tank and cap tank outlet. See Figure 3.

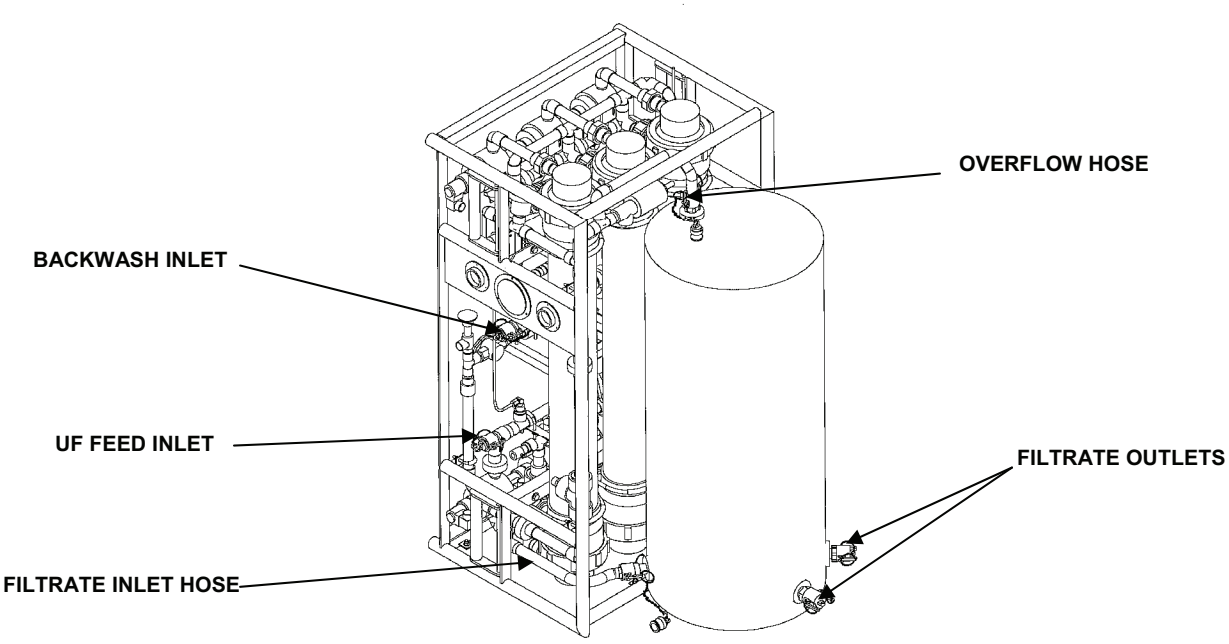


Figure 3. Filtrate Tank Connections.

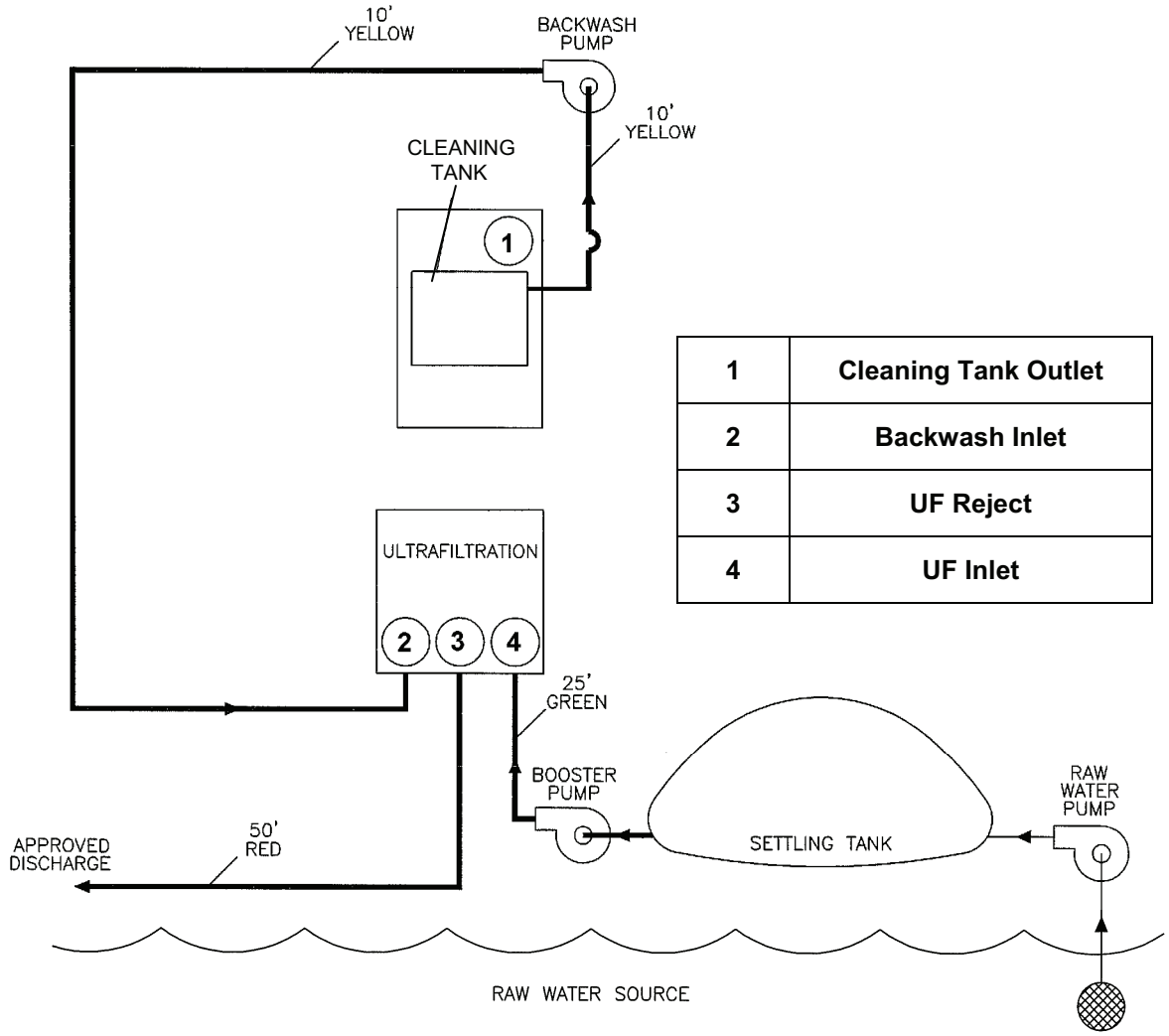
9. Connect the backwash pump suction hose to the cleaning tank outlet. See Figure 1.

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.

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. Turn circuit breaker (CB1) to ON position.
14. Drape the backwash inlet hose over the cleaning tank and turn the backwash pump ON. When the cleaning solution flows from the cleaning tank through the backwash service pump, turn the backwash pump OFF.
15. Reconnect the backwash inlet hose to the UF module. See Figure 4 for cleaning diagram.



1	Cleaning Tank Outlet
2	Backwash Inlet
3	UF Reject
4	UF Inlet

Figure 4. Maintenance Cleaning Diagram.

PROCEDURE - continued

16. Place the UF reject hose (red) so that the maintenance backwash discharge will be disposed of properly.
17. Route discharge to a container where it can be neutralized with sodium metabisulfite or allowed to dissipate naturally.
18. Place the BACKWASH PUMP switch on the control module in the AUTO position.
19. 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.
20. After manual backwash, place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the OFF position.
21. Allow the LWP to soak for 60 minutes.
22. Place the MODE switch in position 3 – (FAST FLUSH).
23. Place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the AUTO position.
24. The LWP will manually fast flush for 3 minutes. Use stopwatch from instrument case to time procedure.
25. Place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the OFF position.
26. Disconnect the backwash service pump suction hose from the cleaning tank outlet. See Figure 1.
27. Reconnect the backwash service pump suction hose to the fabric filtrate tank outlet connection.
28. Drain cleaning tank until empty. Close the cleaning tank drain valve when done.
29. Disconnect the RO reject hose and connect it to the UF filtrate tank inlet hose in order to direct the flushing water to disposal area.
30. Place the MODE switch in position 1 (CYCLE).
31. Place the BOOSTER PUMP and BACKWASH PUMP switches on the control module in the AUTO position.
32. 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 RO reject hose (Connected to the UF filtrate inlet hose).
33. Use the chlorine test strip to determine chlorine content. See WP 0007.
34. When there is no chlorine in the filtrate water, turn the BOOSTER PUMP and BACKWASH PUMP off.
35. Disconnect the RO reject hose from the UF filtrate tank inlet hose and connect it back to the RO reject outlet.
36. Reconnect UF filtrate tank inlet hose to the filtrate tank.
37. Turn the BOOSTER and BACKWASH pumps to AUTO and fill filtrate tank to full.
38. Turn Mode Switch to Position 2 (backwash) and backwash until filtrate tank is empty (to ensure chlorine is flushed from backwash pump and hoses).
39. When the tank is empty, turn the mode switch to position 1 (CYCLE) and LWP can now be operated in the normal mode.
40. 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
Detergent, M334, (WP 0139, Item 17)
Detergent, M331, (WP 0139, Item 18)
Acid, Citric (WP 0139, Item 1)

Tools
Paddle, stirring, (WP 0138,Table 2, Item 32)
Pail, utility, 5-quart, (WP 0138, Table 2, item 33)
Immersion heater, 2000-watt, (WP 0138, Table 1, Item 25)
Stop watch (WP 0138, Table 2, Item 50)
Test Strip Chlorine (WP 0138, Table 2, Item 35)
Ultrameter (WP 0138, Table 2, Item 30)

Special Environmental Conditions
Do not allow drainage to be contaminated.

Equipment Status
LWP set up for normal operations (WP 0012)
Water in product tank is needed. (WP 0016)

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 25 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.

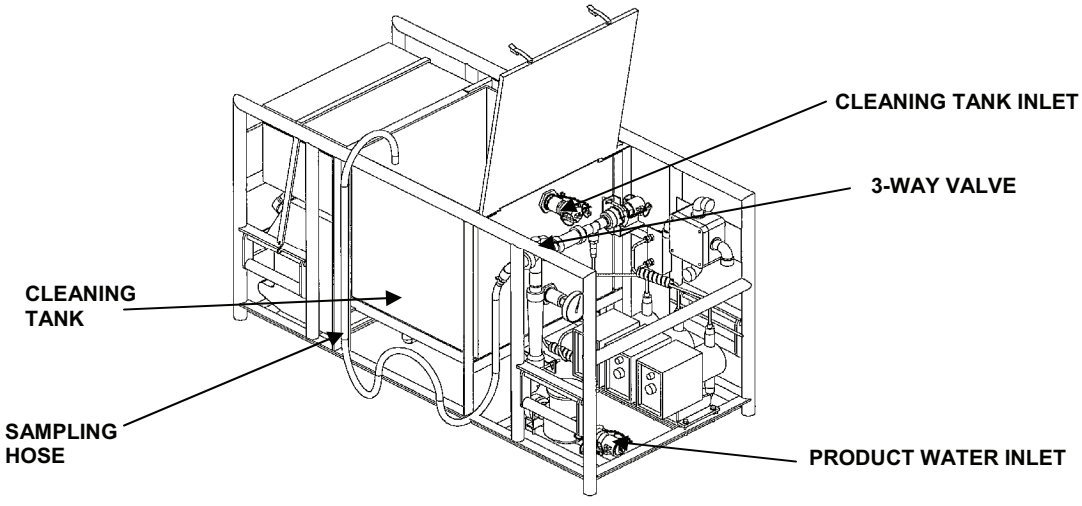


Figure 1. Filling Cleaning Tank.

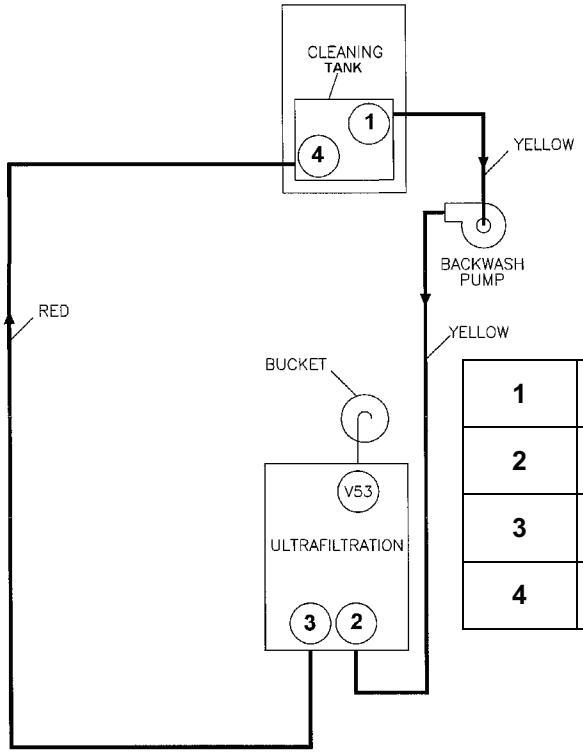
CHEMICAL CLEANING PROCEDURE - continued

2. Perform product water flush procedure. See WP 0016.

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).



1	Cleaning Tank Outlet
2	UF Inlet
3	UF Reject
4	Cleaning Tank Inlet

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 seven (7) 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

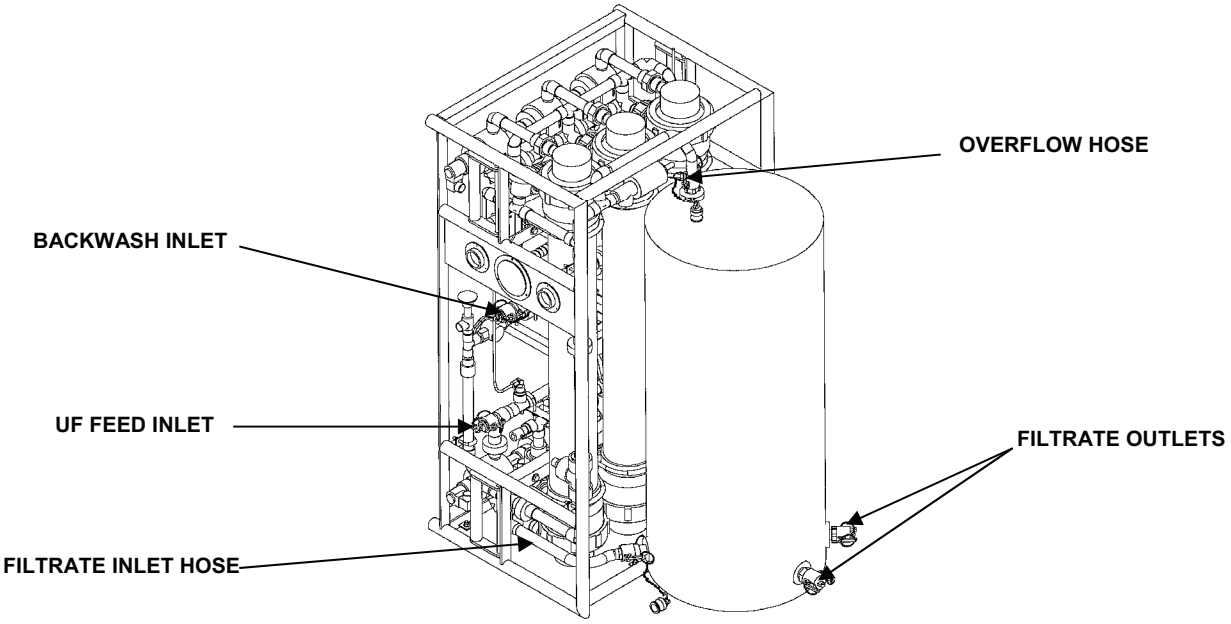


Figure 3. Inlet and Outlet Locations of the Filtrate Tank.

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.

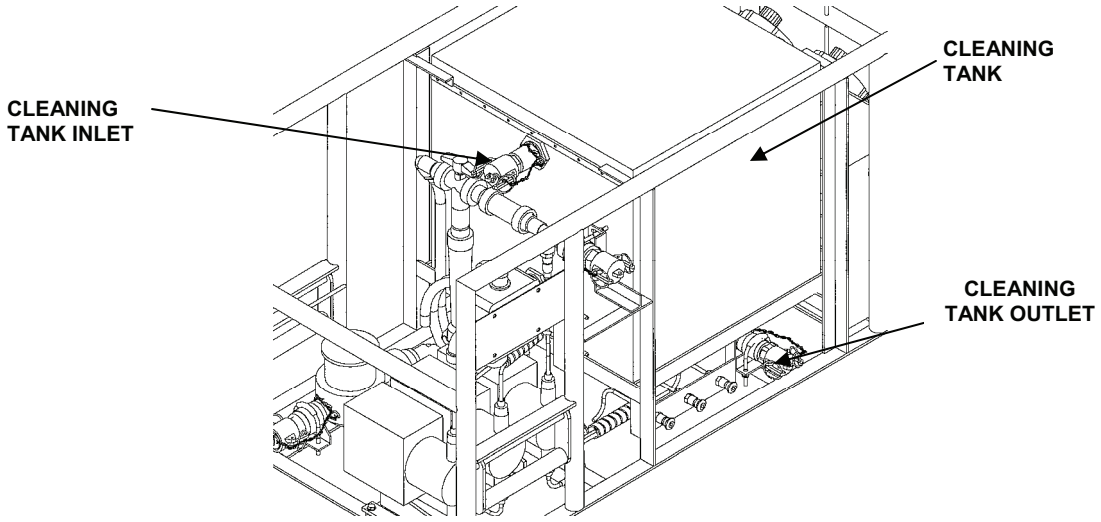


Figure 4. Cleaning Tank Clean Out Connection.

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.

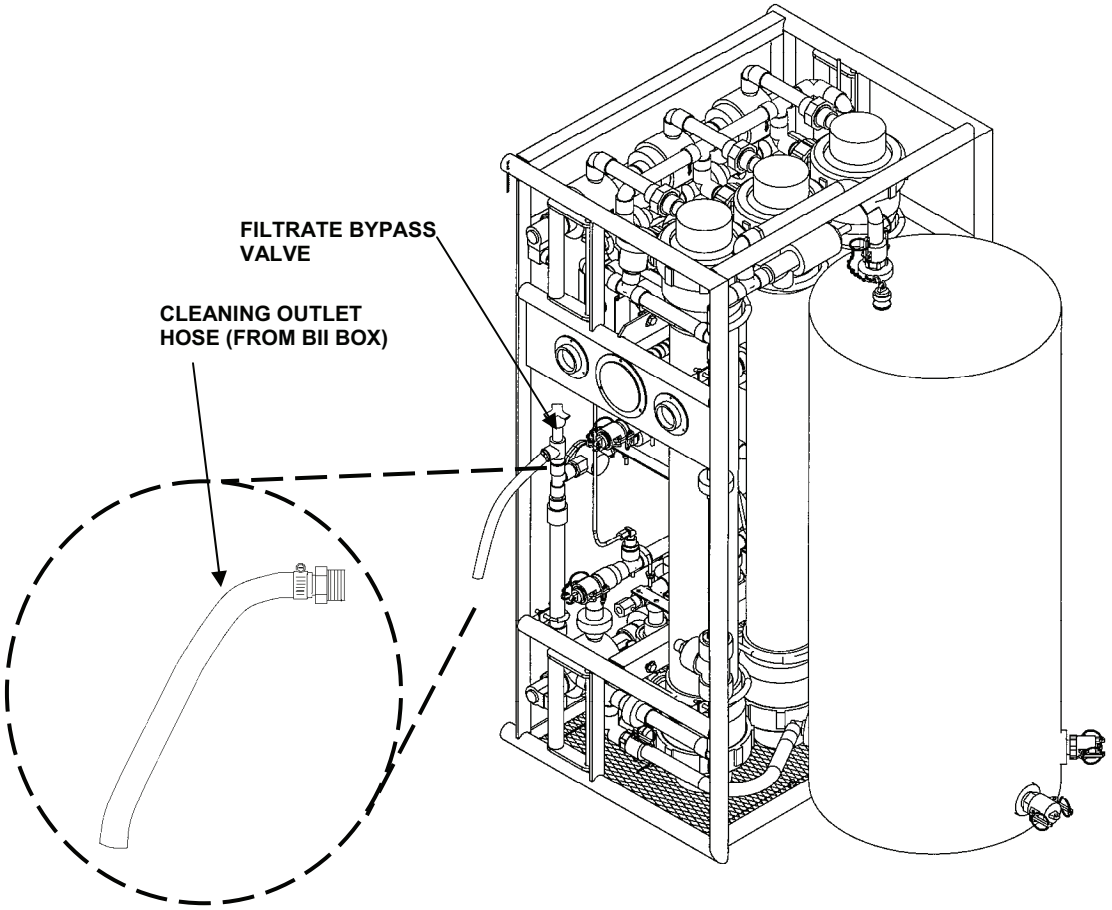


Figure 5. Ultrafiltration Module.

5. Ensure that Circuit Breaker (CB1) 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 (CB1) 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.

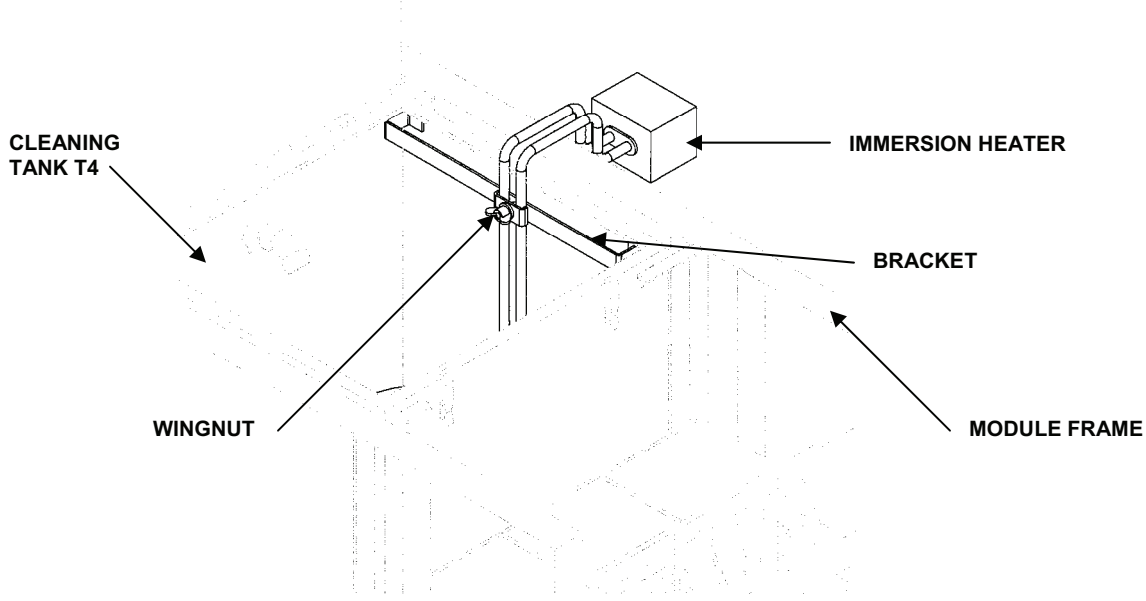


Figure 6. Immersion Heater with Bracket.

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.

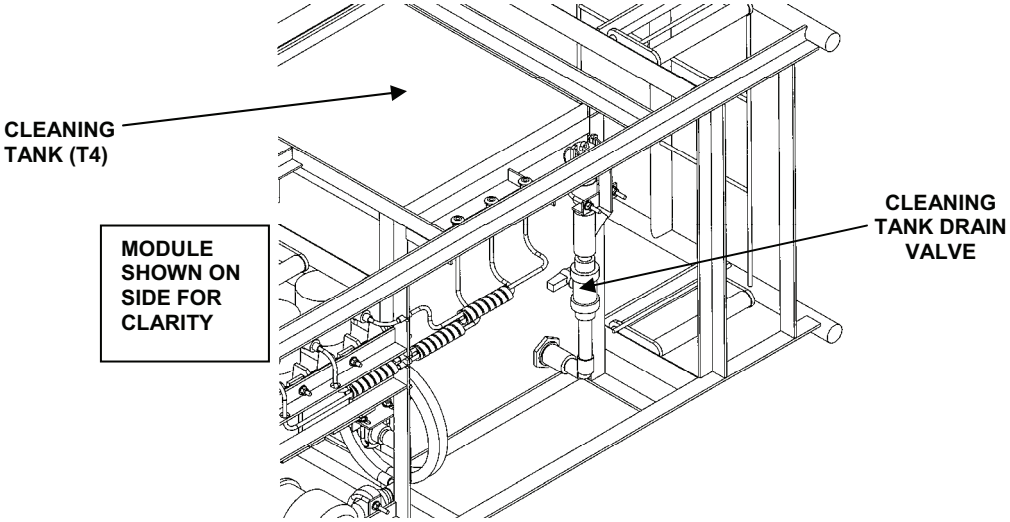


Figure 7. Cleaning Tank Drain Valve.

18. Place Booster pump and Backwash pump switches in AUTO position.

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 (9) 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 the ON position. 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. See Figure 7.

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. Measure 295 ml of (M331) detergent instead of (M334), (use graduated cylinder from BII to measure detergent).

41. Turn off circuit breaker (CB1).

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 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 Trans Membrane Pressure (TMP). If TMP is less than 8 psi, resume normal operations.

CHEMICAL CLEANING PROCEDURE – continued

46. If TMP is above 8 psi, repeat steps 1 through 39, this time, use graduated cylinder from BII and measure 340 ml of citric acid for cleaning.

47. If after using (M331, M334), and citric acid wash TMP does not return to less than 8 psi, repeat complete cleaning procedure.

48. If after repeating cleaning procedure, TMP does not return to less 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 (WP 0138 Table 2, Item 50)

Equipment Status
High-pressure pump module is shutdown (WP 0012)
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 cycles each cartridge for 30 seconds, 7 seconds on and 3 seconds off.

NOTE

Perform manual 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 0012.

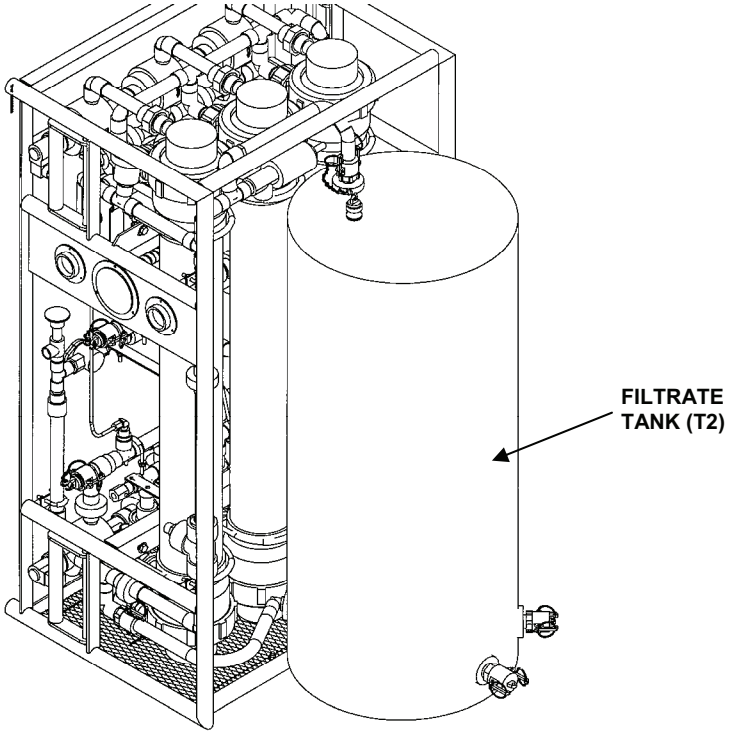


Figure 1. Fabric Filtrate Tank T2.

MANUAL BACKWASH/FAST FLUSH PROCEDURE - continued

2. Place the BOOSTER PUMP and BACKWASH PUMP selector switches on the control module in the OFF position. See Figure 2.

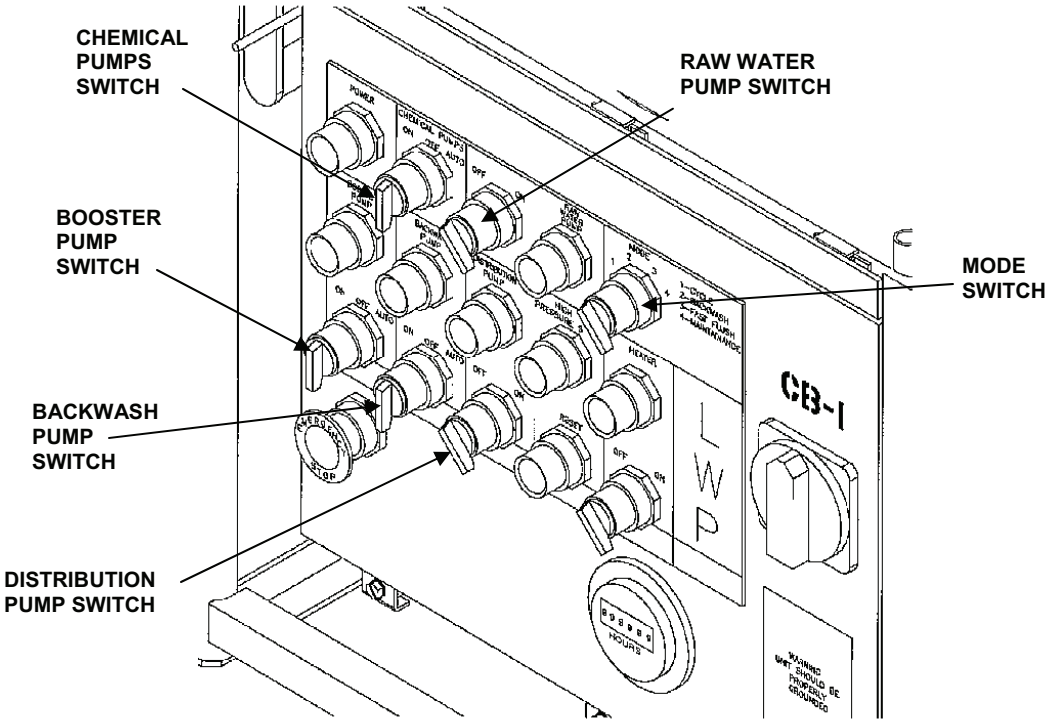


Figure 2. Control Module.

NOTE

Any delay in performing the backwash or fast flush procedures will cause the filtrate tank level to decrease too low.

3. Turn service MODE selector switch to position 2 (BACKWASH). See Figure 2.
4. Place the BACKWASH PUMP and BOOSTER PUMP selector switches in the AUTO position.
5. Run the manual backwash until the filtrate bag is empty.
6. After the manual backwash, place the service MODE selector switch in position 3 (FAST FLUSH). See Figure 2.
7. Run fast flush for approximately 5 minutes.
8. 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
(WP 0137, Table 2, Item 2)

Material/Parts

Container to drain oil
Rags, wiping, cotton (WP 0139, Item 24)
Oil, Pump (WP 0139, Item 23)

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.

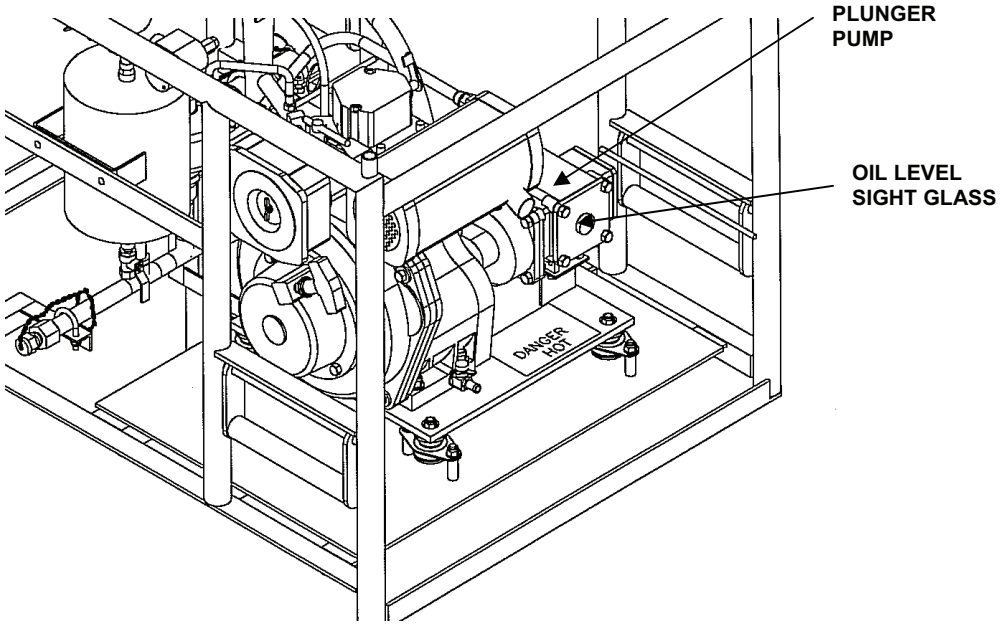


Figure 1. Plunger Pump Oil Level Sight Glass.

3. If oil is required, remove the fill cap. Refer to Figure 2.

OIL LEVEL INSTRUCTION - continued

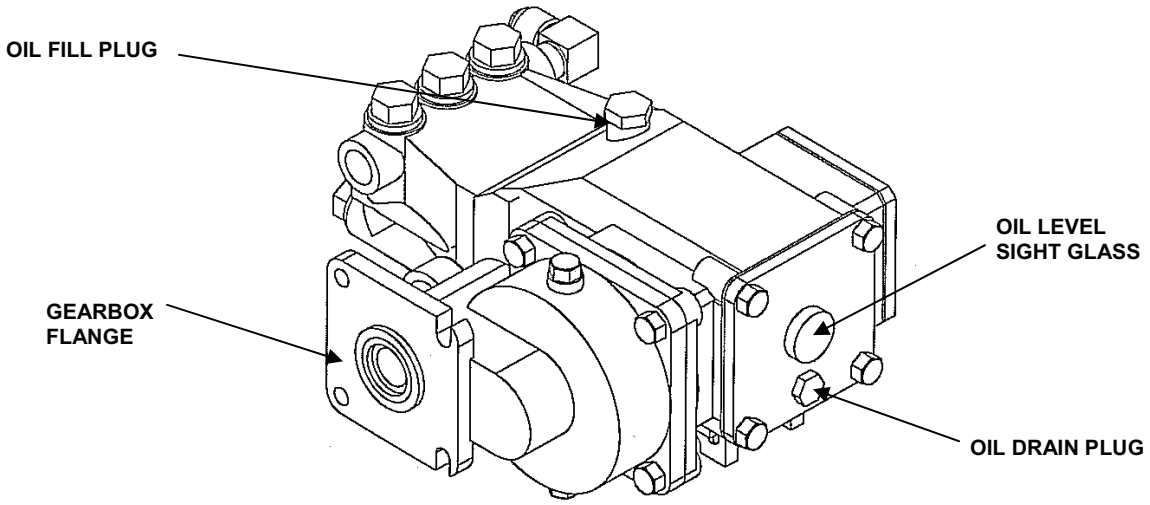


Figure 2. Plunger Pump Oil Fill Cap.

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 (SAE 30, Non-detergent).
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, 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, (WP 0139, Item 24)

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.

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.

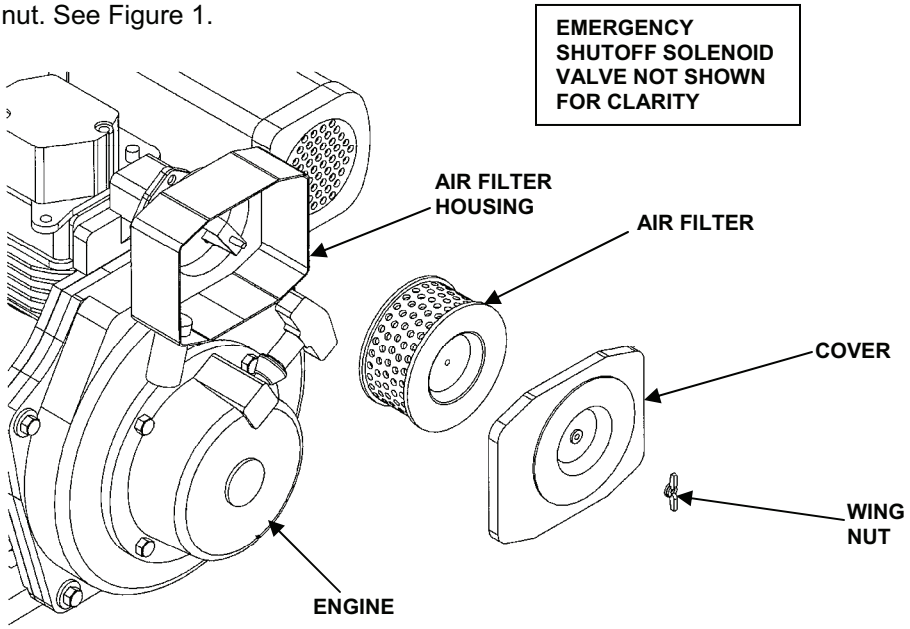


Figure 1. Diesel Engine Air Filter.

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, (7920-00-205-1711).

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
ELEMENT CLEANING

INITIAL SETUP

Materials/Parts

Cleaner, RO Membrane (M326) High pH (WP 0139, Item 11)
Cleaner, RO Membrane (M325) Low pH (WP 0139, Item 12)

Tools

Paddle, stirring, (PN 3485K14) (WP 0138, Table 2, Item 32)
Immersion heater, 2000-watt, (WP 0138, Table 1, Item 25)
Tool Kit (PN 3600486000)
Adapter, cleaning, (PN 12497102) (WP 0138, Table 2, Item 1)
Stop watch (WP 0138, Table 2, Item 50)

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, (read by subtracting the pressure out from the pressure in). increases by 15% from the mission start.
- The differential pressure is more than 50 psi.
- 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)	Feed temp.	Permeate flow	Operating pressure	LIMIT
ppm	(F)	(gpm)	(psi)	(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.

HIGH pH CLEANING PROCEDURE

1. Make sure cleaning tank drain valve is closed on the chemical module. See Figure 1.

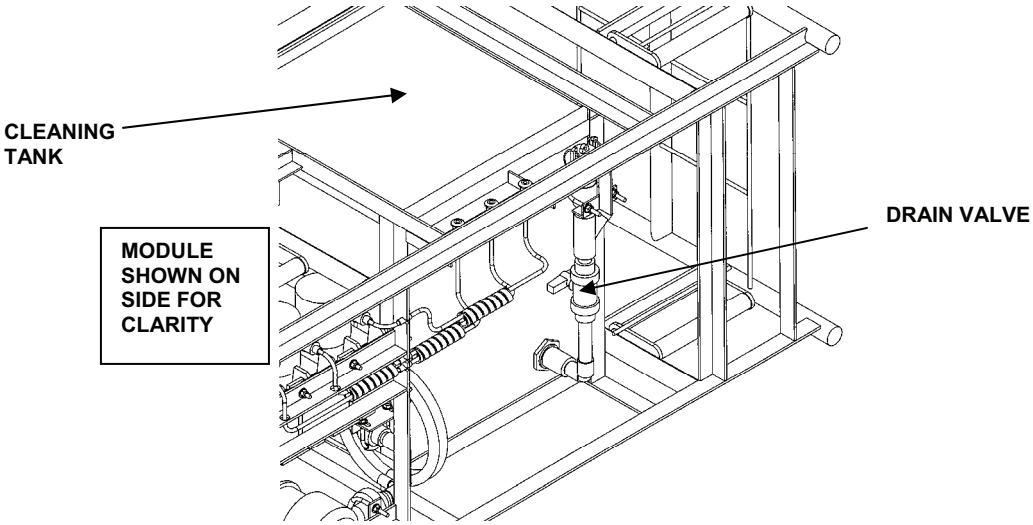


Figure 1. Cleaning Tank Drain Valve.

2. Open cleaning tank cover. Support lid as needed. See Figure 2.
3. Place the sampling valve hose 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.

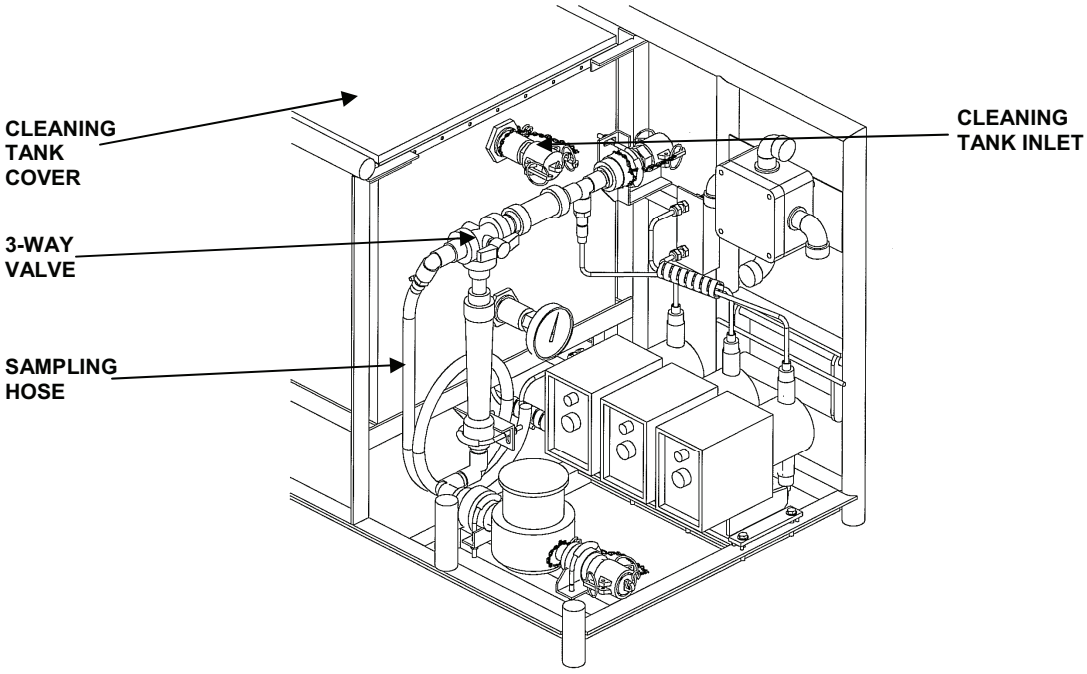


Figure 2. Filling Cleaning Tank.

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.

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.

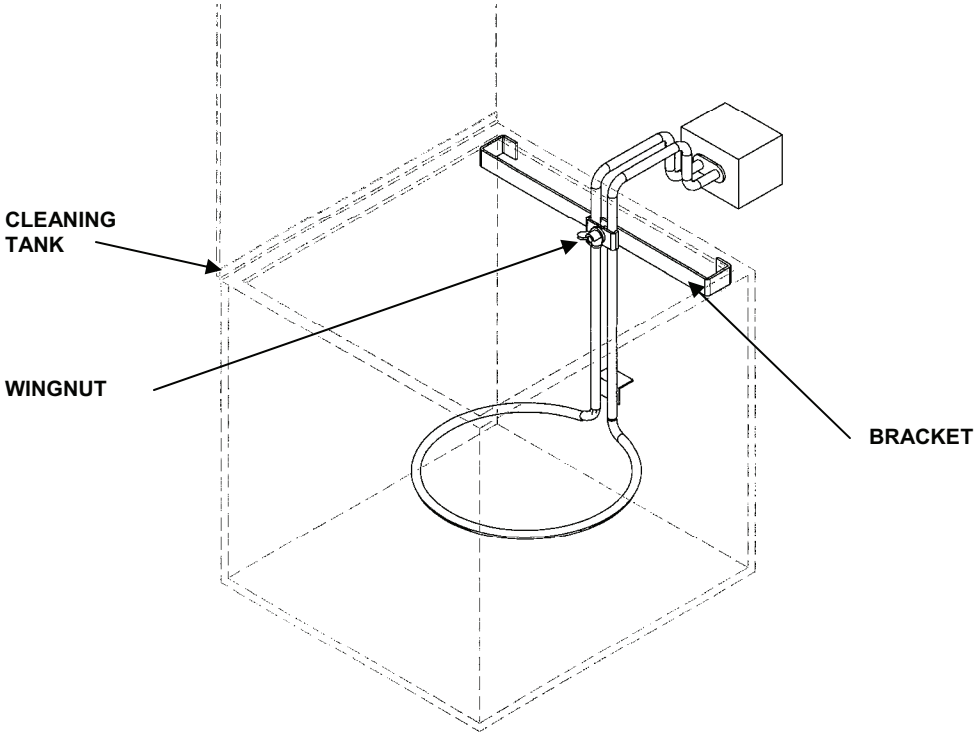


Figure 3. Immersion Heater Installed in Cleaning Tank.

HIGH pH CLEANING PROCEDURE – continued

10. Shut the LWP down. See WP 0016 00.
11. Attach immersion heater cable to receptacle (J9) on control module. Turn (CB1) on.

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.

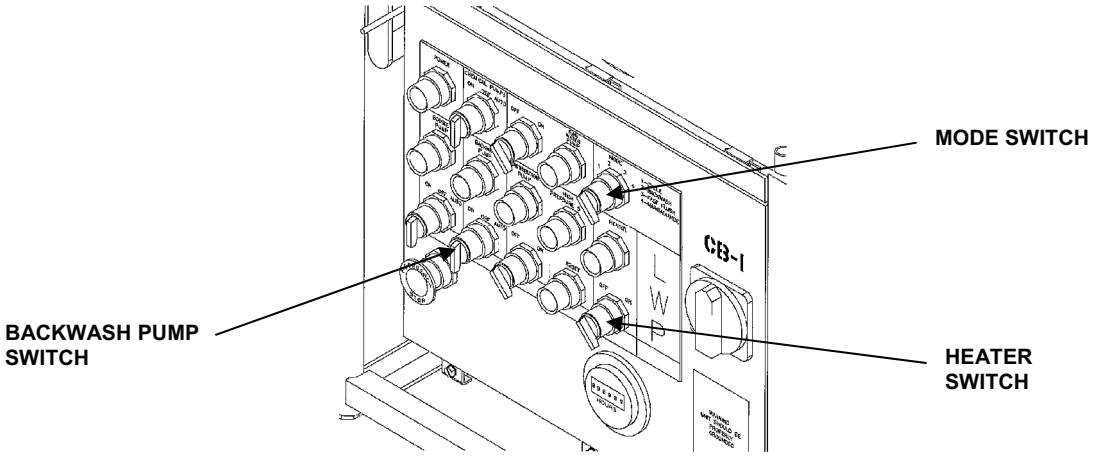


Figure 4. Control Module.

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.

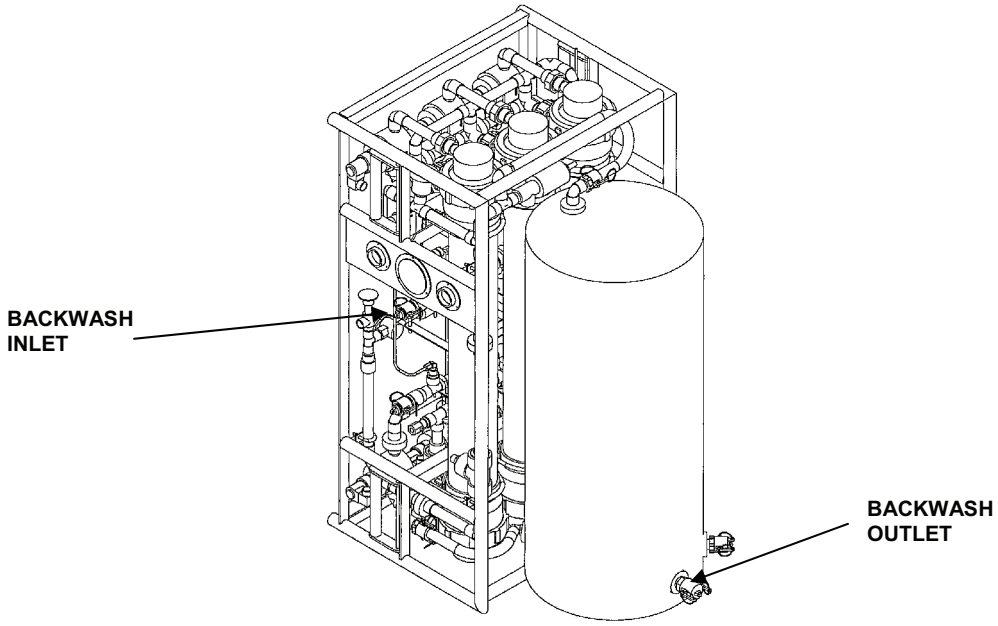


Figure 5. UF Module Connections.

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.

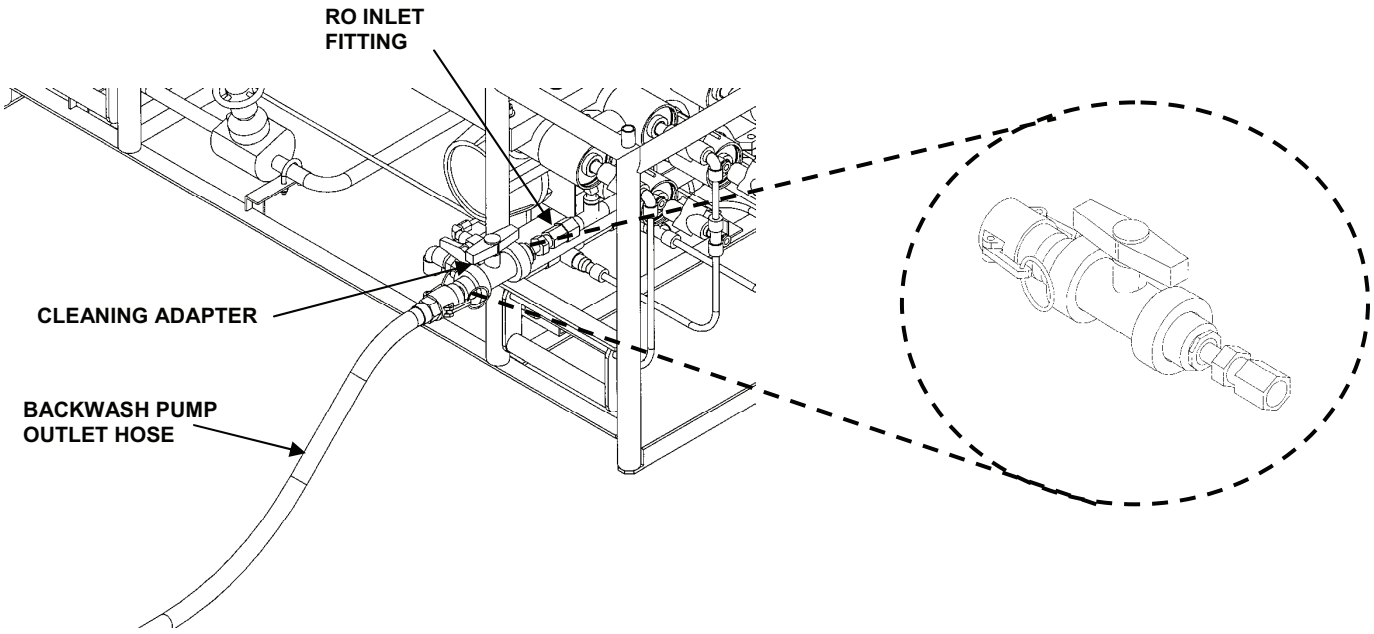


Figure 6. Cleaning Adapter Connection.

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.

HIGH pH CLEANING PROCEDURE – continued

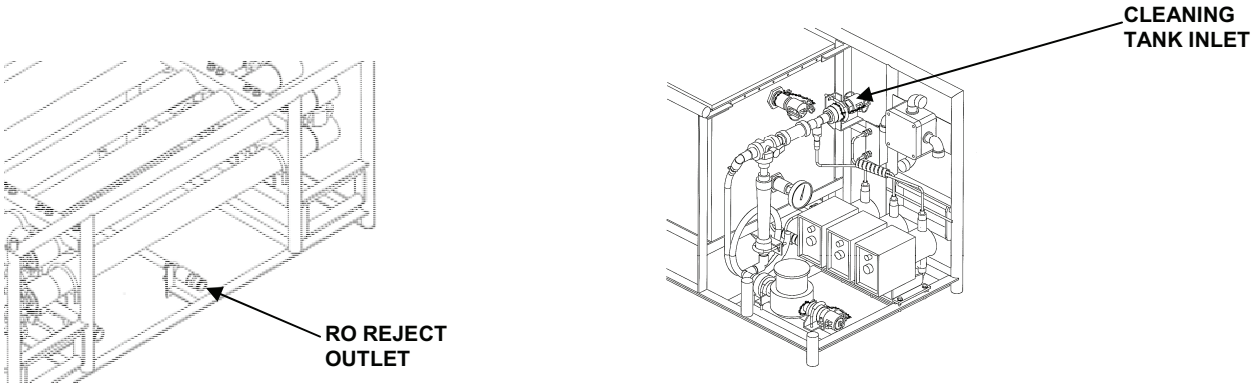


Figure 7. RO Module Reject Circulation Connections.

22. Disconnect the product hose (white) at inlet on chemical module. Drape it into cleaning tank. See Figure 8.

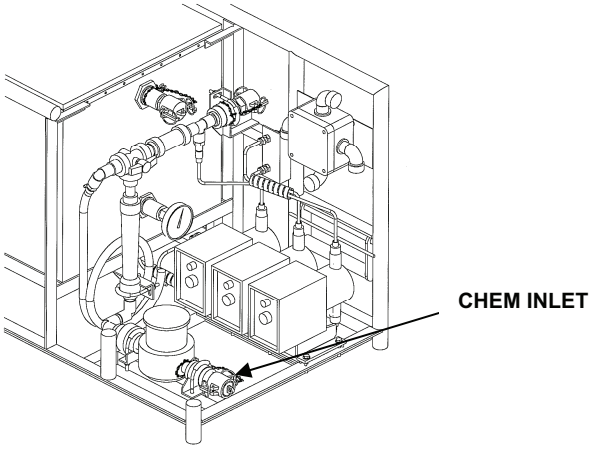


Figure 8. Chemical Module Product Inlet.

23. The RO cleaning solution is ready to be circulated. See Figure 9.

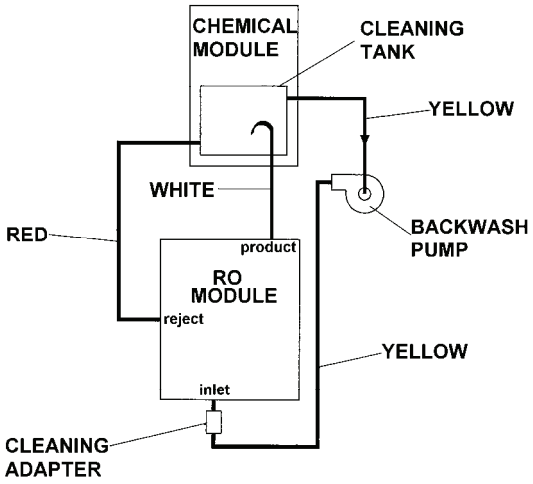


Figure 9. RO Element Cleaning Piping Diagram.

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 0011, WP 0012).
2. The product water hose from the chemical module should be left disconnected at the product tank inlet spool piece.
3. Start LWP up.
4. Allow the RO module to flush for fifteen (15) minutes and reconnect the product hose (white) to the product tank inlet spool piece.

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE RUPTURE DISC
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

Equipment Condition Required

All equipment de-energized, throttle set to minimum, and diesel engine off.

Material/Parts

Rags, wiping,cotton (WP 0139, Item 24)
Tape, anti-seize (WP 0139, Item 32)
Disc, rupture, 1480 PSI (WP 0138, Table 2, Item 17a)

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 (Figure 1, Item 3) of the rupture disc holder and elbow (Figure 1, Item 4) from product piping. It is not necessary to separate the elbow (Figure 1, Item 4) from the outlet half (Figure 1, Item 3). Remove rupture disc (Figure 1, Item 2).

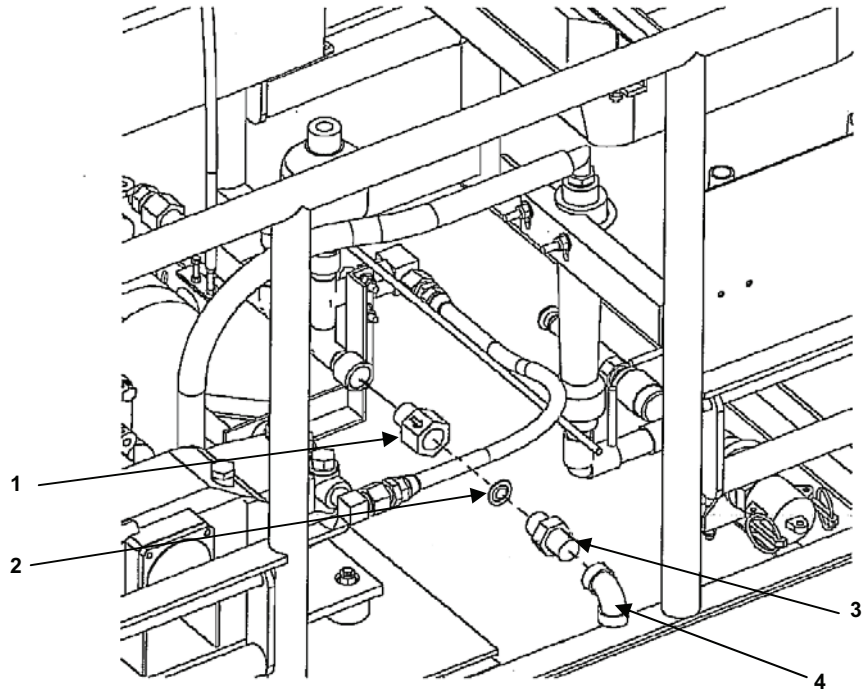


Figure 1. Rupture Disc Holder.

2. Remove inlet half (Figure 1, Item 1) of the holder from piping only if necessary. **Note the direction of the arrow on the holder**.

INSPECTION

3. Inspect rupture disc holders for corrosion or damage.
4. 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.

5. If removed, install inlet half (Figure 1, Item 1) of the rupture disc holder into the piping.
6. Install rupture disc (Figure 1, Item 2) into inlet half (Figure 1, Item 1): the rupture disc should be bulging into the water side.
7. Install outlet half (Figure 1, Item 3) of the holder and elbow (Figure 1, Item 4).
8. 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 (WP 0137, Table 2, Item 5)
Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

Equipment Condition Required
All equipment de-energized

Materials/Parts
O-ring(s), end cap, (PN AS29513-331 or MS29513-210)
Lubricant, O-ring (WP 0139, Item 15)
Tape, anti-seize, (WP 0139, Item 32)
Rags, wiping, cotton (WP 0139, Item 24)
Element, Reverse Osmosis, (PN 12497000)

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 lose the ferrules inside the nuts. Equipment may be rendered inoperable.

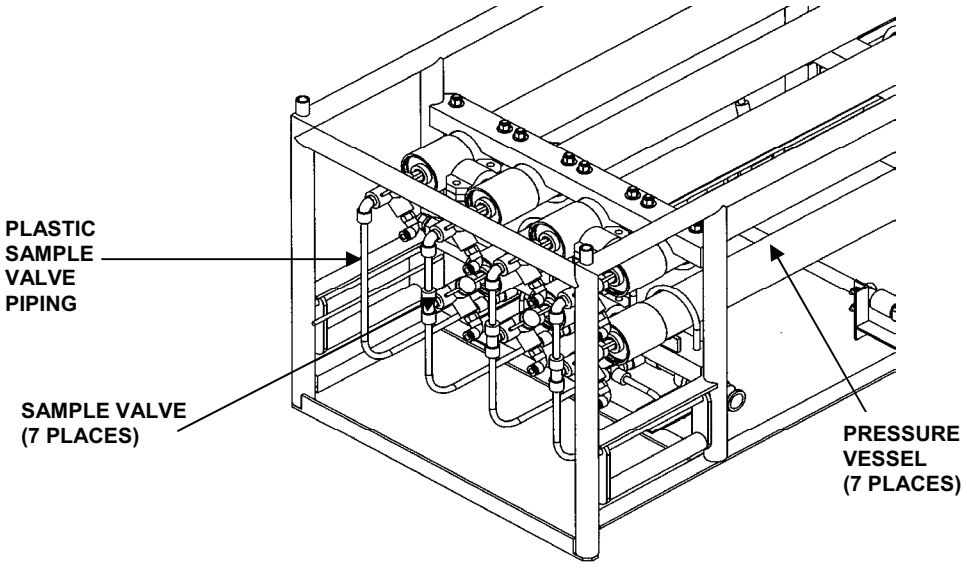


Figure 1. Removing Sample Valve Tubing (Left Side).

SAMPLE VALVE REMOVAL – continued

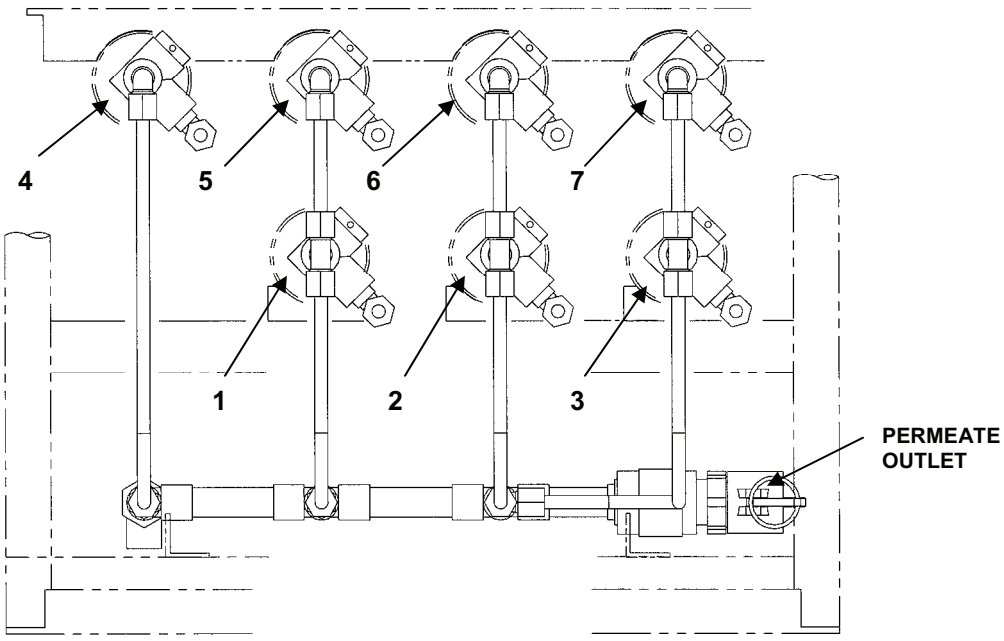


Figure 2. RO Element Piping Layout.

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).

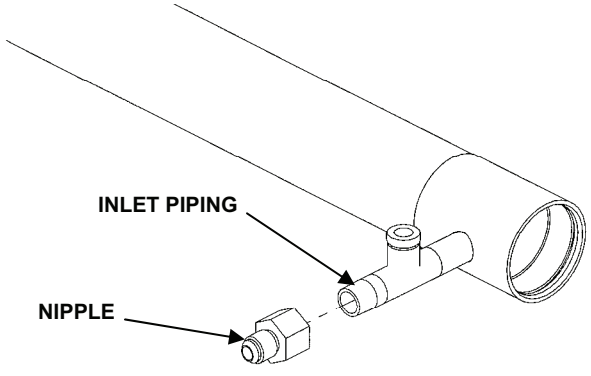


Figure 3. Pressure Vessel RO1.

RO ELEMENT REMOVAL - continued

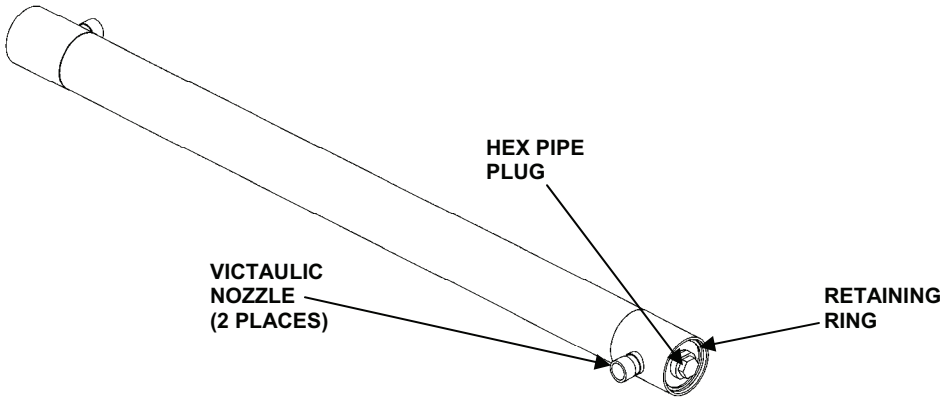


Figure 4. Pressure Vessels RO2 through RO7.

1. Remove the retaining ring and hex pipe plug from the end cap.
2. Remove anti-seize tape.
3. Thread the brass adapter (Figure 5, Item 3) into the end cap. Tighten as far as possible. Hand tighten only.

NOTE

Thread slide hammer into vessels as far as possible to prevent damage to threads.

4. Thread the slide rod (Figure 5, Item 1) onto the adapter (Figure 5, Item 3).
5. Use the slide hammer (Figure 5, Item 2) to hammer against the stopper (Figure 5, Item 4) to remove the end cap.

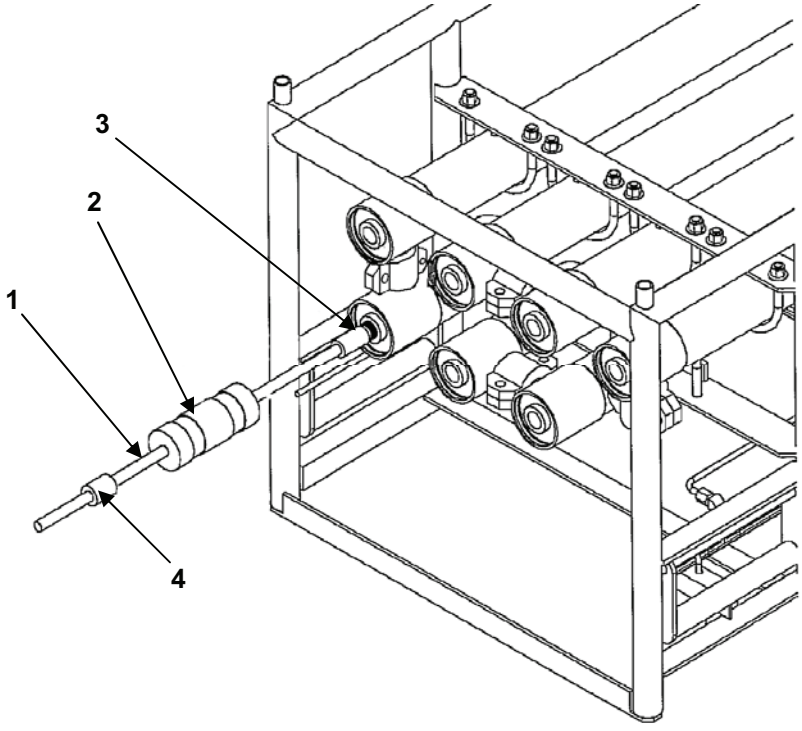


Figure 5. End Cap Removal Tool.

RO ELEMENT REMOVAL - continued

6. The RO membrane (Figure 6, Item 2) is now visible and ready for removal.

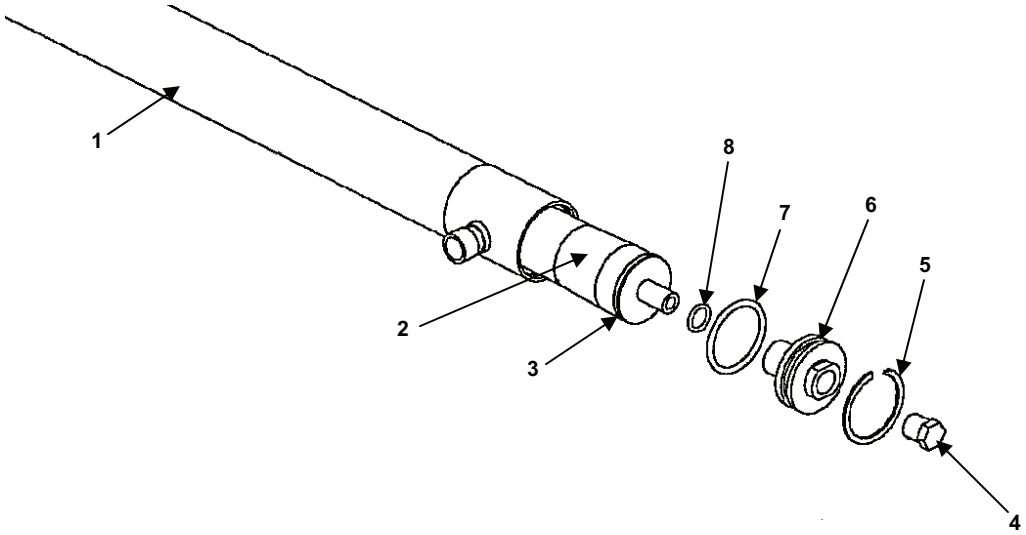


Figure 6. Membrane Removal/Installation.

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 (Figure 6, Item 2) from the pressure vessel (Figure 6, Item 1).
8. Remove large O-ring (Figure 6, Item 7) from outer groove on end cap (Figure 6, Item 6). Remove small O-ring (Figure 6, Item 8) from inner groove in end cap (Figure 6, Item 6).

INSPECTION

Inspect the O-rings (Figure 6, Item 3, 7 and 8) for any sign of damage, deterioration, cuts, etc. Replace if unserviceable.

CLEANING AND LUBRICATION

1. Lubricate the O-rings (Figure 6, Item 7, 8, 3) with Dow Corning 111 Lubricant, to facilitate assembly.
2. Install large O-rings (Figure 6, Item 7) on end caps (Figure 6, Item 6). Install small O-rings (Figure 6, Item 8) inside the end caps (Figure 6, Item 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.

RO ELEMENT INSTALLATION- continued

2. Insert the end without the O-ring in first.

3. Install RO membrane (Figure 6, Item 2) in the direction of flow. Observe arrows on both ends of the pressure vessel.

4. Insert the RO membrane (Figure 6, Item 2) into the pressure vessel (Figure 6, Item 1) from the end marked “Load membrane this end”.

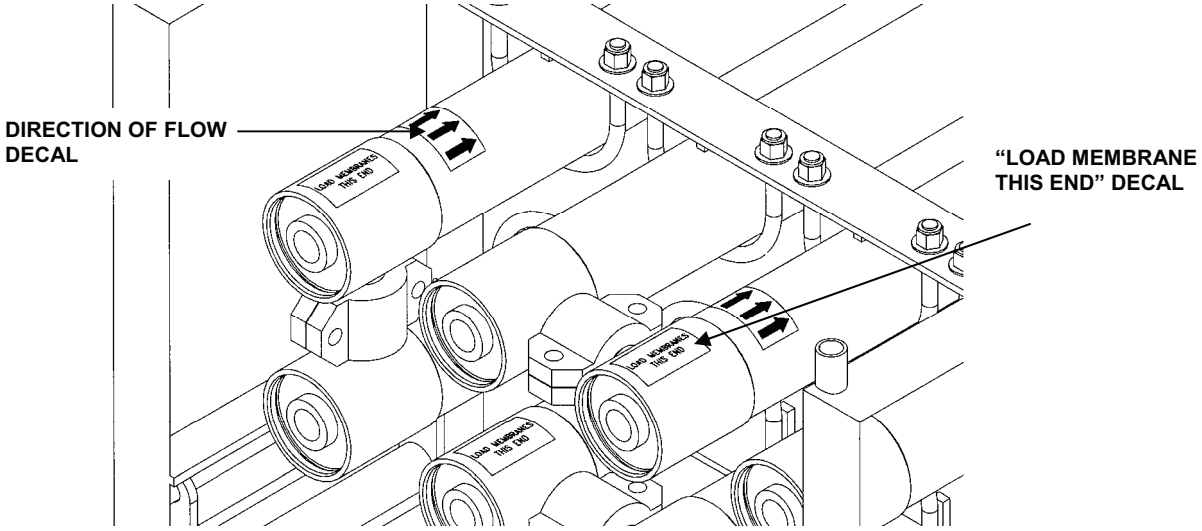


Figure 7. Pressure Vessel Flow and Load Decals.

END CAP INSTALLATION

1. Refer to Figure 5 for this procedure section.
2. Apply a liberal amount of lubrication in and around the retaining 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 of slide hammer (Figure 5, Item 3) as far as possible in the end cap. Tighten as much as possible. **Hand tighten only**. See Figure 5.

5. Thread the slide rod (Figure 5, Item 1) on the brass adapter (Figure 5, Item 3).
6. Use the slide hammer (Figure 5, Item 2) to hammer against the brass adapter (Figure 5, Item 3). Stop when end cap bottoms out and retaining ring groove is visable.

7. Install retaining ring to secure the end cap (Figure 6, Item 5). Ensure there retaining ring is seated inside the groove.

8. Install the hex pipe plug (Figure 6, Item 4) 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.

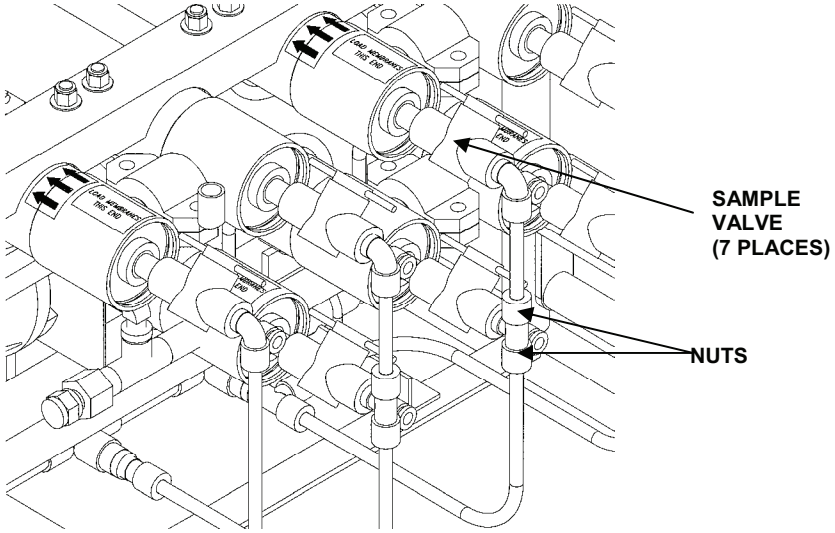


Figure 8. Sample Valve Installation.

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 0011 00, WP 0012.
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.

SIMULATORS

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 (2) types; five (5) with a drilled hole and two (2) without.

REMOVAL

1. Pressure vessel numbers (1-5) should contain the simulators with a hole. See Figure 9.

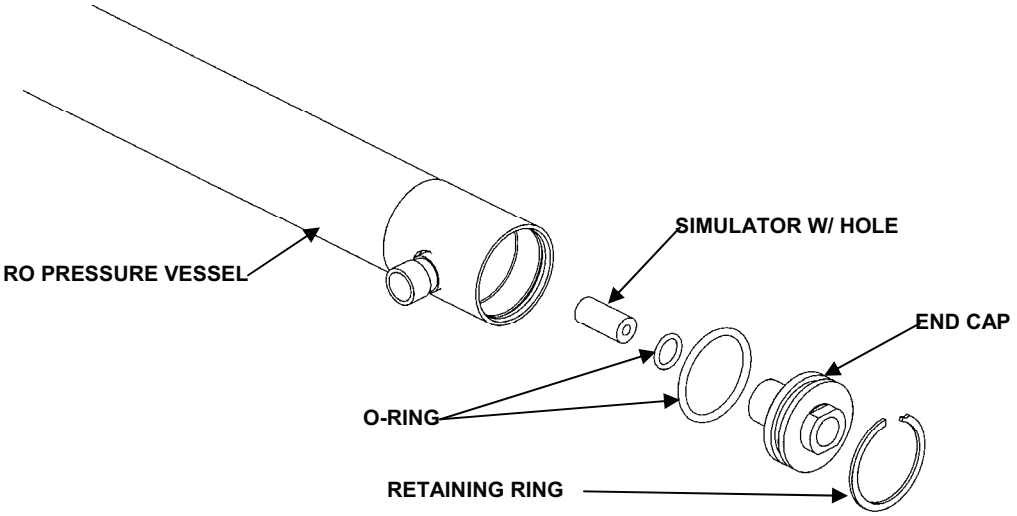


Figure 9. Pressure Vessel 1 With Simulator.

2. Pressure vessel numbers (6 and 7) should contain simulators without a hole. Figure 10.

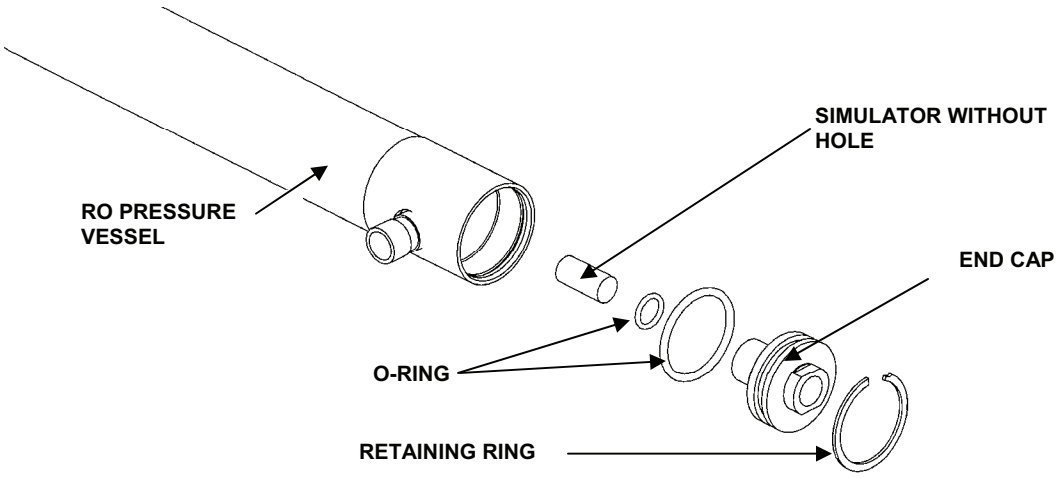


Figure 10. Pressure Vessels 2-7 With Simulator.

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 0046.

INSTALLATION

1. Remove sampling valves and end caps on RO vessels. See WP 0046.
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 (4).
4. Install the sampling valves. See WP 0046.

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CONTROL MODULE
CHECKS AND SERVICES

INITIAL SETUP

Equipment condition

Diesel engine shut off (TQG)
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 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 0108. Test the pilot light again.
4. Replace the light assembly if unserviceable. See WP 0108.

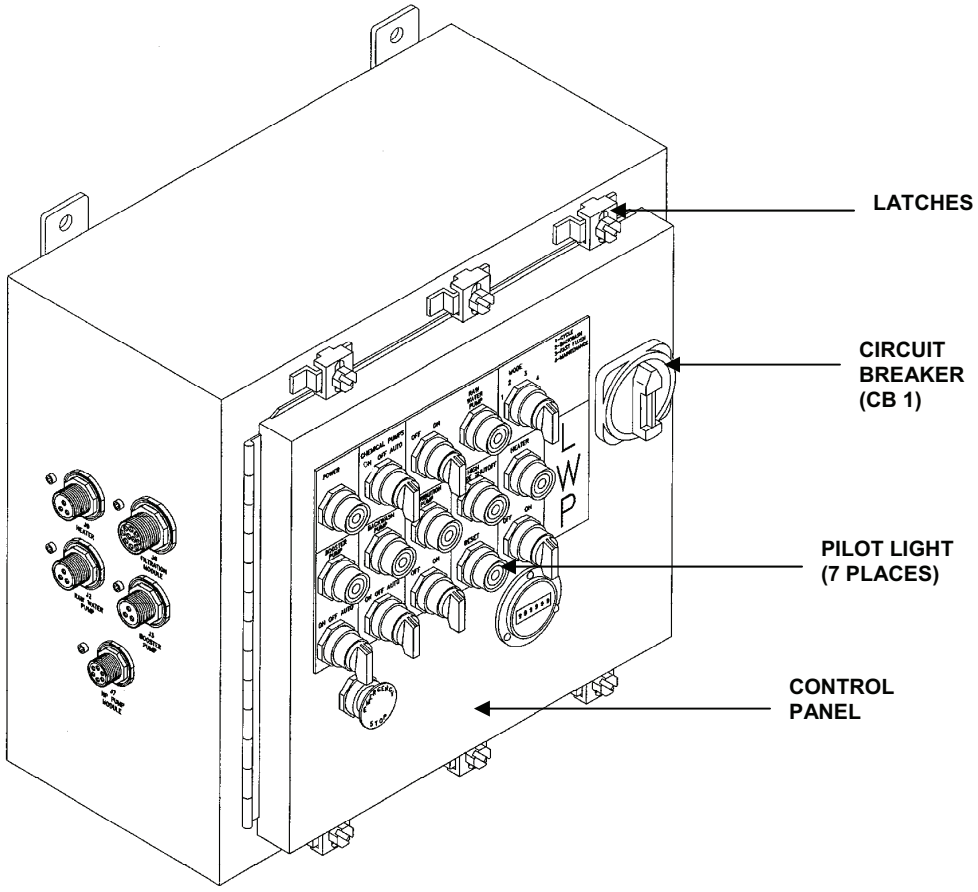


Figure 1. Control Module.

CONTROL PANEL

WARNING

When checking for voltage on an energized component, extreme care must be taken. Only a 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 (Figure 2, Item 2) to OFF position.
2. Loosen and slide the eight (8) Latches off the control panel. See Figure 1.
3. Hold the panel closed with one hand to allow the switch (Figure 2, Item 2) to rotate. Keep the hand on the panel.
4. Turn the safety tab (Figure 2, Item 1) clockwise with the other hand. Do not let go of the safety tab (Figure 2, Item 1).
5. Turn the switch (Figure 2, Item 2) counter-clockwise. The safety tab (Figure 2, Item 1) and the switch (Figure 2, Item 2) should be squeezed together.
6. Open the control panel. Ensure that none of the latches slid back into position.

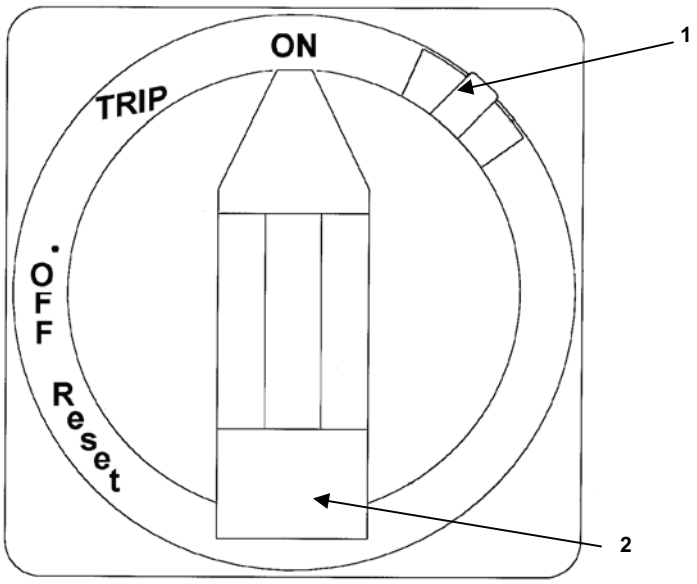


Figure 2. Circuit Breaker.

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.

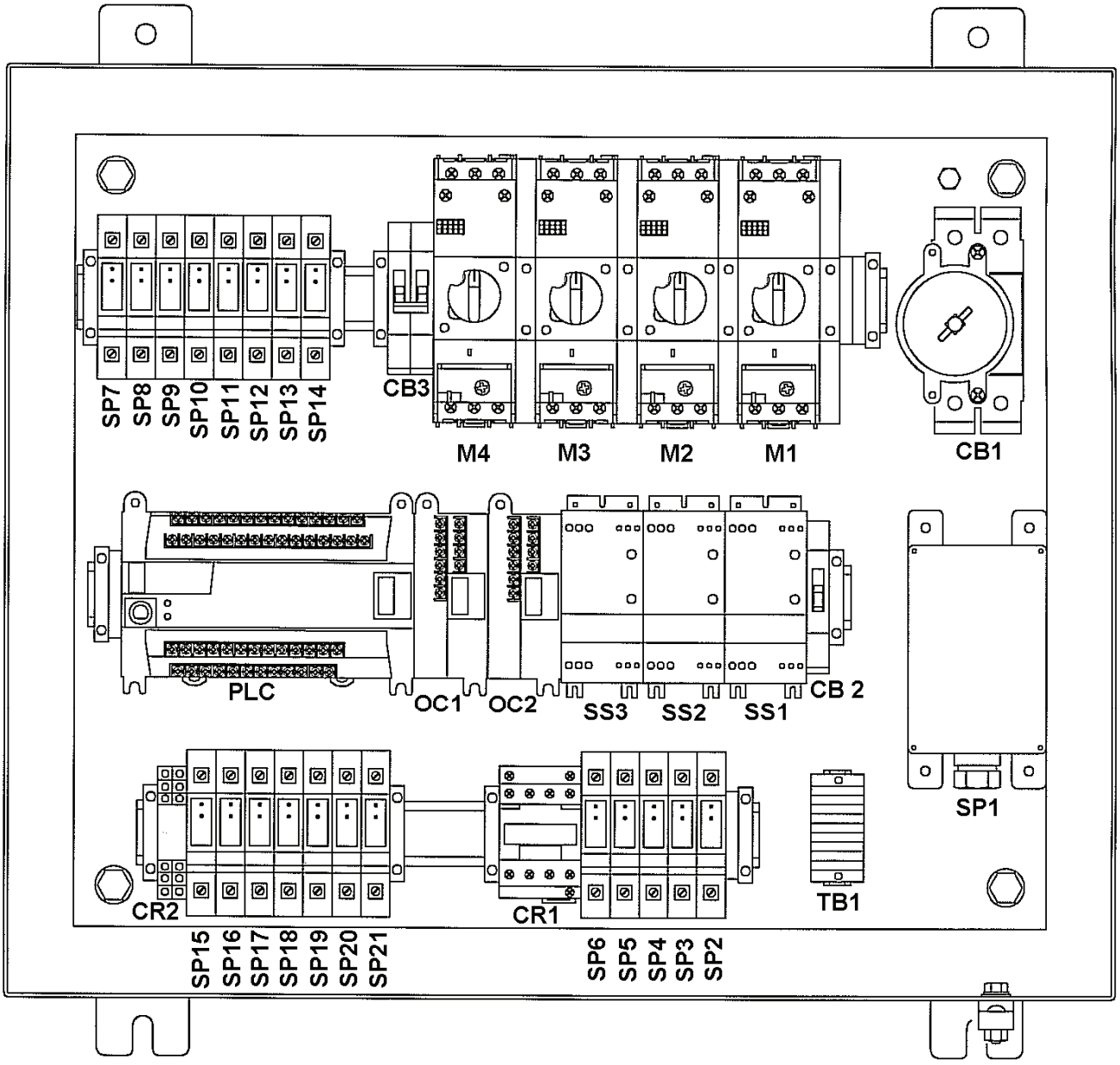


Figure 3. Control Module Electrical Components.

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)
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)

TABLE 1. DESCRIPTION OF CONTROL MODULE ELECTRICAL COMPONENTS-continued		
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 (Figure 4, Item 1). In the event of a short circuit, a flag can be visible through window (Figure 4, Item 4) and the switch (Figure 4, Item 2) will be rotated to TRIP location. The switch should never be at OFF.

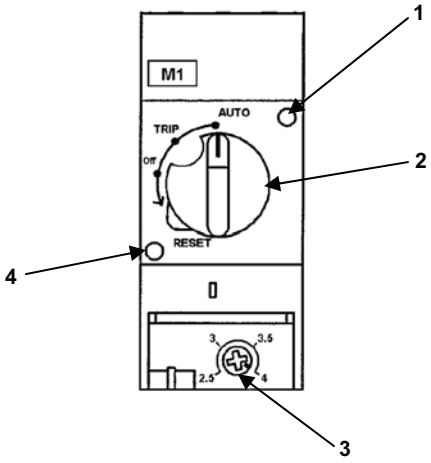


Figure 4. Motor Controller (raw water pump).

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 (Figure 4, Item 2) it should be set to AUTO.

MOTOR CONTROLLER – continued

2. Reset the switch if it is pointing to TRIP.
    a. Rotate the switch (Figure 4, Item 2) counter-clockwise to RESET.
    b. Rotate the switch (Figure 4, Item 2) back to AUTO.
3. Ensure that the overload screw (Figure 4, Item 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

CAUTION

Move circuit breaker (CB1) back and forth until slot engages. Do not force or slam door as damage to switch will occur.

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 (Figure 4, Item 1) clockwise with the other hand. Do not let go of the safety tab (Figure 4, Item 1).
5. Turn the switch (Figure 4, Item 2) counter-clockwise. The safety tab (Figure 4, Item 1) and the switch (Figure 4, Item 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, General Mechanics (WP 0137, Table 2, Item 3)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize, (WP 0139, Item 32)
Disc, rupture, 240 psi (WP 0138, Table 2, Item 17b)

Equipment Condition Required

All equipment de-energized.

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 (Figure 1, Item 5) of the rupture disc holder and elbow (Figure 1, Item 6) from product piping. It is not necessary to separate the elbow from the outlet half. See Figure 2.
2. Remove retaining ring (Figure 1, Item 4) and rupture disc (Figure 1, Item 3).

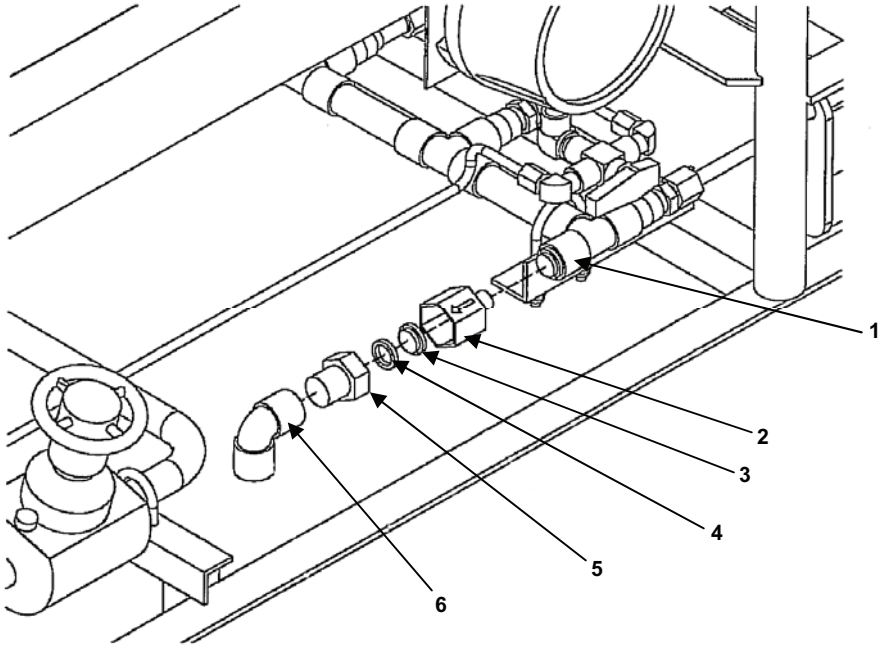


Figure 1. Rupture Disc Holder.

3. Remove inlet half (Figure 1, Item 2) of the holder from piping (Figure 1, Item 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 (Figure 1, Item 2) of the rupture disc holder into the piping (Figure 1, Item 1).
2. Install rupture disc (Figure 1, Item 3) into inlet half (Figure 1, Item 2): the rupture disc should be bulging into the airside.
3. Install retaining ring (Figure 1, Item 4) onto the rupture disc (Figure 1, Item 3).
4. Install outlet half (Figure 1, Item 5) of the holder and elbow (Figure 1, Item 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, (WP 0139, Item 28)
Solution, calibration, (WP 0139, Item 29)
Solution, cleaning, (WP 0139, Item 30)
Rags, wiping, cotton, (WP 0139, Item 24)

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 0005 for operation instructions.

CALIBRATION PROCEDURE

To the 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.

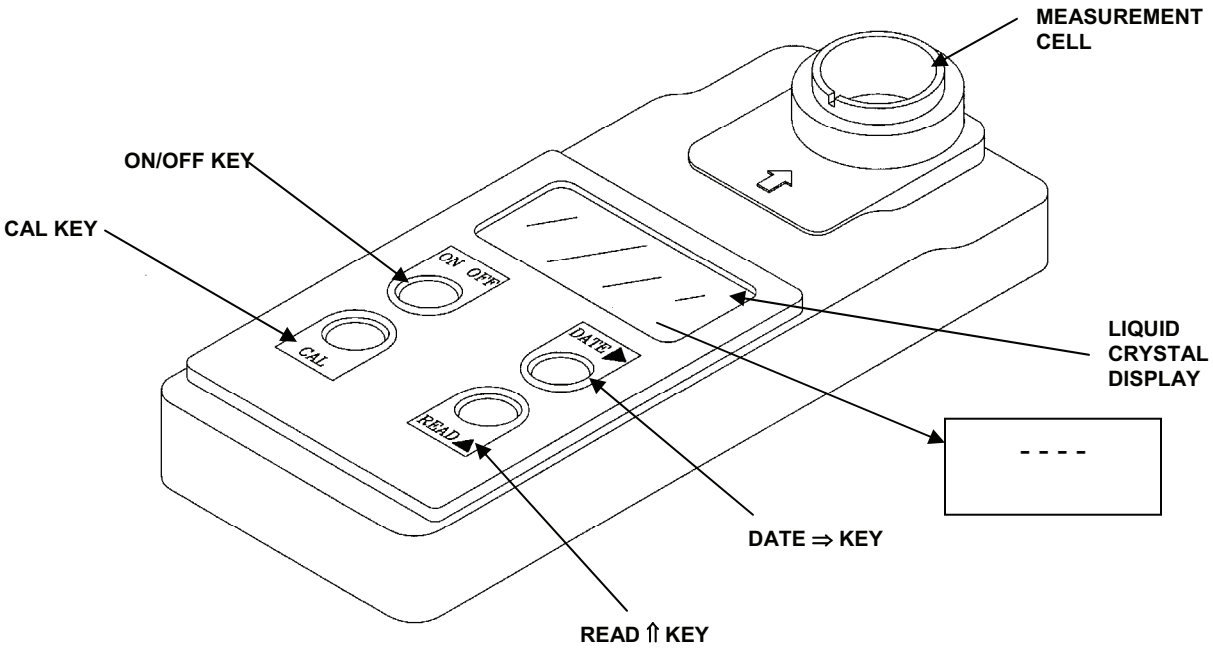


Figure 1. Turbidity Meter.

2. Press the CAL key once. The "CAL" message will blink on the LCD for about 6 seconds, then the calibration mode stops.

CAL

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.

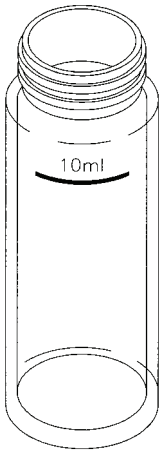


Figure 2. Measurement Cuvet.

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

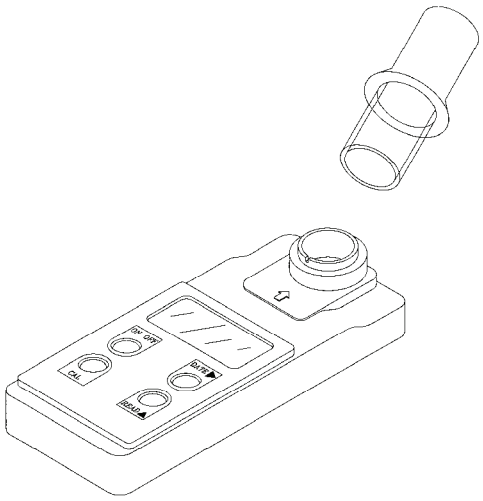
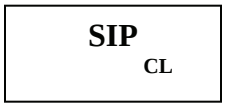
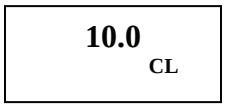


Figure 3. Turbidity Meter with Cuvet.

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 “500”. Press the “READ” key. The LCD will display “----“.

13. The meter is calibrated and ready for use.

ACCURATE CALIBRATION

The following instructions will ensure accurate calibration:

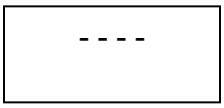
1. All glassware that contacts with the standards should be maintained clean. Wash with cleaning solution, HI 937803-50, or equal. Rinse glassware with calibration solution, HI 93703-0, or equal, or turbidity-free water.
2. Rinse the vial twice with 5 milliliter (mL) of the liquid to be tested. This 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

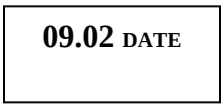
4. Before inserting the vial into the meter, wipe it with a soft, lint-free cloth, HI 93703-70, or equal. Handle vials so that no fingerprints can get on the areas where light passes [approximately 1 inch (2 cm) from the bottom of the vial].

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

Cleaner, RO membrane, (M326) (WP 0139, item 12)
Storage solution, pH cell, (WP 0139, Item 31)
Detergent, (WP 0139, Item 16)
Buffer solution, (WP 0139, Item 26, 27)

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.

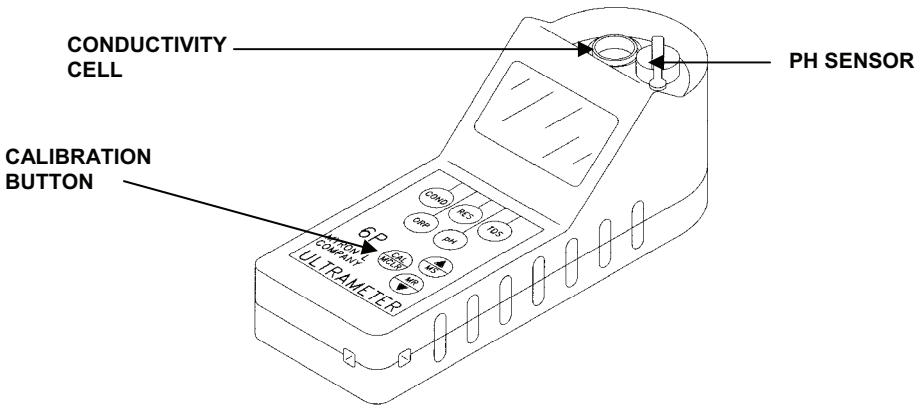


Figure 1. Ultrameter

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 ± 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, General Mechanics (WP 0138, Table 2, Item 3)

Material/Parts
Rags, wiping, cotton (WP 0139, item 24)
Tape, anti-seize (WP 0139, item 32)
Wire Cloth (WP 0138, Table 2, Item 58)

Equipment Condition Required
LWP shut down and UF filtrate tank full.

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.

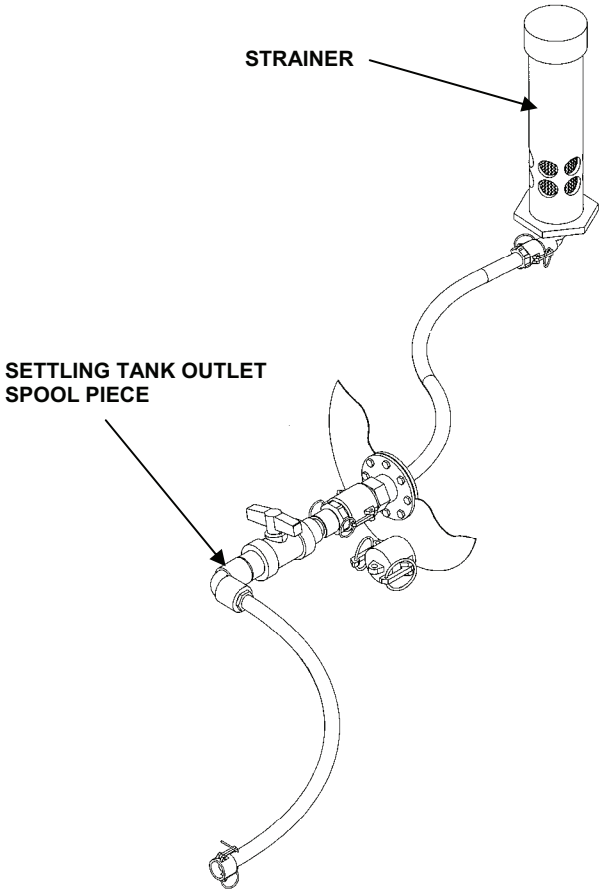


Figure 1. Settling Tank Strainer Installed.

BACKWASHING-CONTINUED

2. Ensure that the filtrate tank on the UF module is full. Remove strainer assembly from the settling tank. See Figure 2.

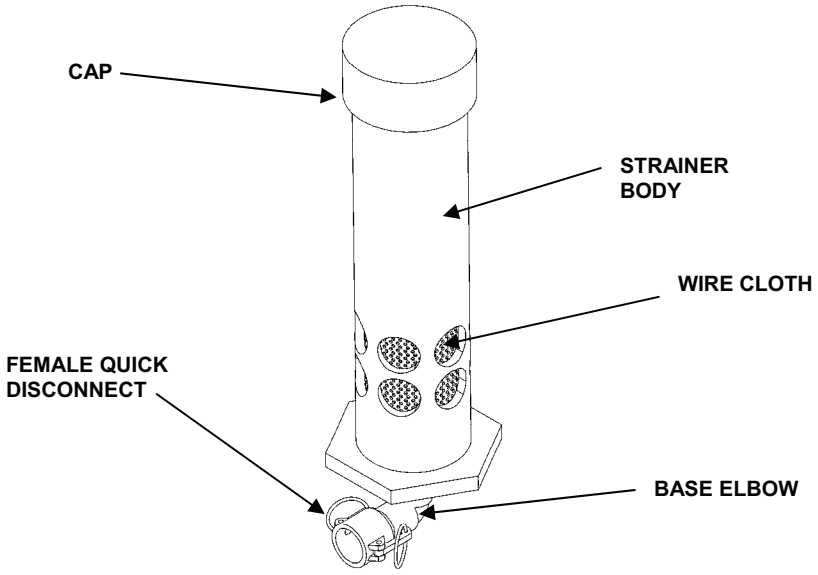


Figure 2. Settling Tank Strainer Assembly.

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 ON 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.
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.

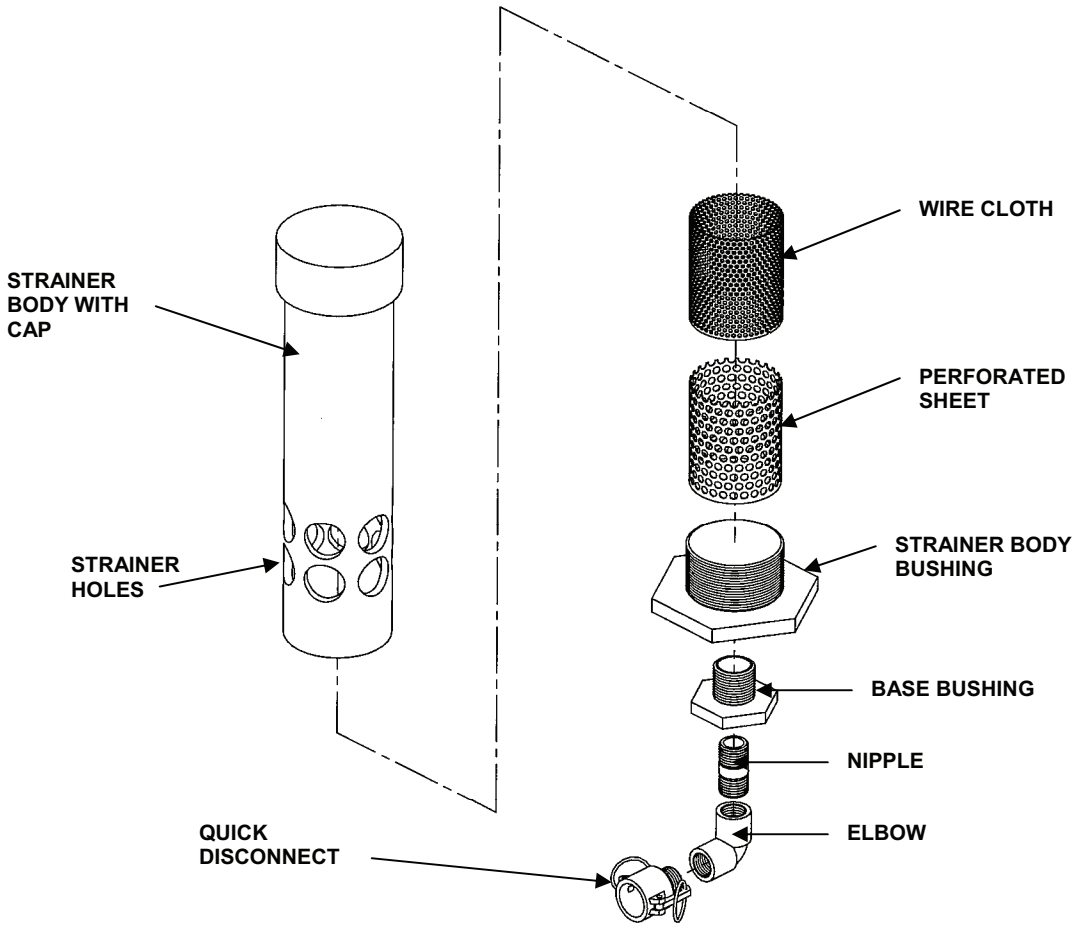


Figure 3. Strainer Assembly (Exploded View).

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 the settling tank outlet spool piece 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 (WP 0138, Table 2, Item 41)

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 (2) sizes of wood plugs and three (3) 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.

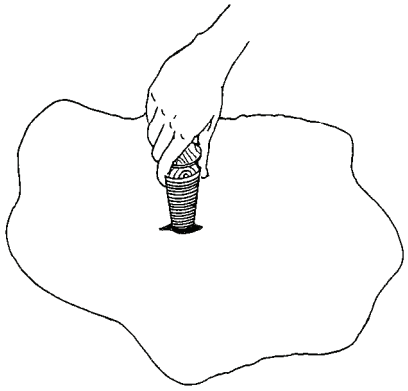


Figure 1. Wood Plug Repair of Collapsible Fabric Tank.

   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 maybe 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.

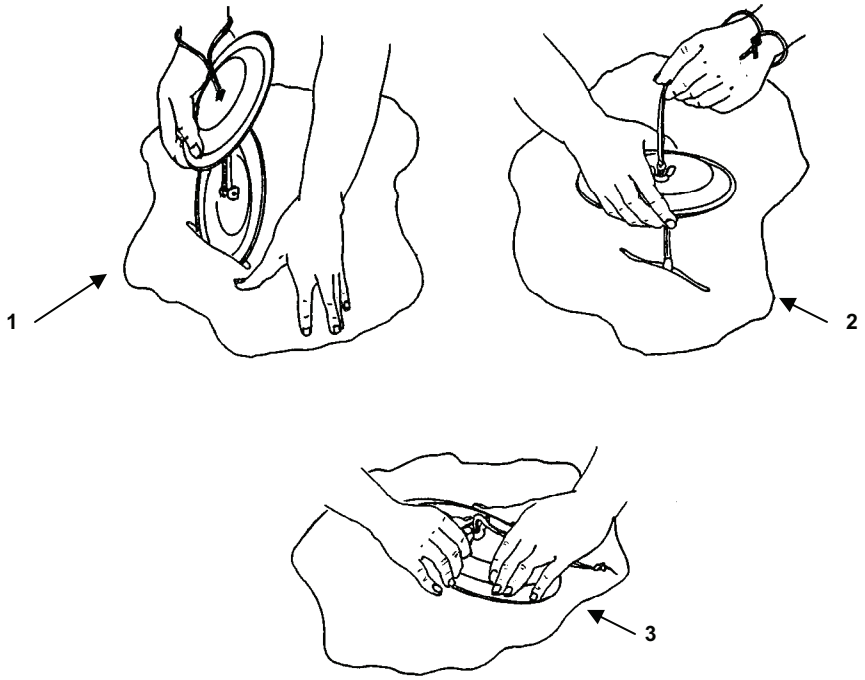


Figure 2. Repair of Collapsible Fabric Tank with Sealing Clamps.

END OF WORK PACKAGE

OPERATOR MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CPVC PIPING REPAIR

INITIAL SETUP

Tools
Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

General Safety Instructions
Observe all WARNINGS and CAUTIONS.

Materials/Parts
Repair Kit, Pipe (WP 0138, Table 2, Item 42)
Gloves, Neoprene (WP 0138, Table 2, Item 21)
Goggles, Safety, Clear (WP 0138, Table 2, Item 22)
Paper, Sand (WP 0138, Table 2, Item 34)

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.

REPAIR INSTRUCTIONS - continued

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

FIELD LEVEL TROUBLESHOOTING PROCEDURES FOR LIGHTWEIGHT WATER PURIFIER

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING INDEX

Malfunction/Symptom	Troubleshooting Procedure
UF Module Cable	
1. No power	WP 0064
2. Level Switch Malfunction	WP 0064
3. Solenoid Valve V2A malfunction	WP 0064
4. Solenoid Valve V2B malfunction	WP 0064
5. Solenoid Valve V2C malfunction	WP 0064
6. Solenoid Valve V3A malfunction	WP 0064
7. Solenoid Valve V3B malfunction	WP 0064
8. Solenoid Valve V3C malfunction	WP 0064
9. Solenoid Valve V7 malfunction	WP 0064
Diesel Engine (High-Pressure Pump Module)	
1. Engine will not or is difficult to start	WP 0065
2. Engine shuts down undirected	WP 0065
3. Engine speed racing or irregular	WP 0065
4. Black or bluish white exhaust smoke	WP 0065
High-Pressure Pump (High-Pressure Pump Module)	
1. Low pressure	WP 0066
2. Pulsation	WP 0066
3. Oil leak	WP 0066
4. Premature seal failure	WP 0066
5. Water leak	WP 0066
6. Knocking noise	WP 0066
7. Pump runs rough	WP 0066
Emergency Air Shutoff Valve (Diesel Engine)	
1. Undirected shutdown	WP 0067
2. Alarm light is blinking at control module	WP 0067
3. Alarm light is on at control module	WP 0067
4. Engine shuts down slowly	WP 0067
5. Solenoid valve is not functioning	WP 0067
6. Moisture inside the pressure gauge	WP 0067
7. Shutoff assembly malfunctioning – no spare parts	WP 0067
Pressure Switch (High/Low) (High-Pressure Pump Module)	
1. Engine shuts down at higher or lower than 1250 psi	WP 0068
2. Engine does not shut down – HP switch	WP 0068
3. Low-pressure switch fails to shut down the hour meter, antiscalant and hypochlorite pumps at lower than 160 psi.	WP 0068
4. Low-pressure switch fails to shut down the hour meter, antiscalant and hypochlorite pumps.	WP 0068
Control Module	
1. UF filtrate tank is not filling up (solenoid valve V7 malfunction)	WP 0069
2. Air shutoff solenoid valve (SV1)	WP 0069
3. Backwash Cycle components	WP 0069
4. Backwash down 1st UF vessel	WP 0069
5. Backwash down 2nd UF vessel	WP 0069
6. Backwash down 3rd UF vessel	WP 0069
7. Backwash up 1st UF vessel	WP 0069
8. Backwash up 2nd UF vessel	WP 0069
9. Backwash up 3rd UF vessel	WP 0069

Malfunction/Symptom	Troubleshooting Procedure
Control Module-continued	
10. Fast flush cycle components	WP 0069
11. Fast flush 1st UF vessel	WP 0069
12. Fast flush 2nd UF vessel	WP 0069
13. Fast flush 3rd UF vessel	WP 0069
14. Distribution pump malfunction	WP 0069
15. Raw water pump malfunction	WP 0069
16. High-pressure shutdown pilot light not functioning	WP 0069
Programmable Logic Controller	
1. PLC power light	WP 0070
2. PLC RUN light.	WP 0070
3. PLC FAULT light.	WP 0070
4. PLC RUN, FORCE, AND FAULT light flashing.	WP 0070
Control Module Switches	
1. Any malfunctioning switches	WP 0071
2. Mode selector switch (backwash mode malfunction)	WP 0071
3. Mode selector switch (fast flush mode malfunction)	WP 0071
4. Mode selector switch (maintenance mode malfunction)	WP 0071
5. Raw water pump switch	WP 0071
6. Chemical pump switch	WP 0071
7. Heater switch	WP 0071
8. Distribution pump switch	WP 0071
9. Backwash pump switch	WP 0071
10. Booster pump switch	WP 0071
11. Emergency stop switch	WP 0071
High-Pressure Pump Module Cable	
1. High-pressure shutdown pilot light not functioning – light bulb faulty	WP 0072
2. High-pressure shutdown pilot light not functioning – wiring faulty	WP 0072
3. High-pressure shutdown pilot light not functioning – surge suppressor faulty	WP 0072
4. High-pressure shutdown pilot light not functioning – PLC faulty	WP 0072
5. High-pressure shutdown pilot light not functioning – reset button faulty	WP 0072
6. High-pressure shutdown pilot light not functioning – faulty pilot light	WP 0072
7. High-pressure shutdown pilot light not functioning – faulty high-pressure switch PSH –3	WP 0072
Surge Protector	
Fault light is on – any surge protector	WP 0073
Surge protector – SP 6	WP 0073
Surge protector – SP 6	WP 0073
Hour Meter	
1. Hour meter malfunction	WP 0074
Chemical Injection Electronic Metering Pump (Antiscalant)	
1. Pump malfunctions	WP 0075
Chemical Injection Electronic Metering Pump (Coagulant)	
1. Pump malfunctions	WP 0076
Chemical Injection Electronic Metering Pump (Hypochlorite)	
1. Pump malfunctions	WP 0077

Malfunction/Symptom	Troubleshooting Procedure
Immersion Heater	
1. Immersion heater not working – heater	WP 0078
2. Immersion heater not working – control module	WP 0078
Raw Water Service Pump	
1. Pump light is not coming on at the control panel	WP 0079
2. Pump light is on but pump is not operating	WP 0079
Booster Service Pump	
1. Pump light is not coming on at the control panel	WP 0080
2. Pump light is on but pump is not operating	WP 0080
Backwash Service Pump	
1. Pump light is not coming on at the control panel	WP 0081
2. Pump light is on but pump is not operating	WP 0081
Distribution Service Pump	
1. Pump light is not coming on at the control panel	WP 0082
2. Pump light is on but pump is not operating	WP 0082
Cold Weather Kit	
1. Receptacle does not work	WP 0083
2. Power cord not working	WP 0083
3. Switch not working on power distribution panel	WP 0083
4. Blankets not providing heat to hoses	WP 0083
Chemical Module Cable	
1. No display, even though measurement key is pressed	WP 0084
2. Inaccurate pH readings	WP 0084
3. No response to pH changes	WP 0084
4. Will not adjust down to pH7	WP 0084
5. pH readings drift or respond slowly to changes in buffers/samples or FAC is displayed repeatedly	WP 0084
6. Unstable TDS readings	WP 0084
7. Unable to calibrate TDS	WP 0084
Diesel Engine	
1. Engine will not start	WP 0085
2. Engine shuts down undirected	WP 0085
3. Engine speed racing or irregular	WP 0085
4. Oil leaks	WP 0085
Service Pumps	
1. Pump leaks or corroded	WP 0086
High-Pressure Pump	
1. Low pressure	WP 0087
2. Pulsation	WP 0087
3. Water leak	WP 0087
4. Knocking noise	WP 0087
5. Pump runs rough	WP 0087
6. Premature seal failure	WP 0087

END OF WORK PACKAGE

FIELD 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.

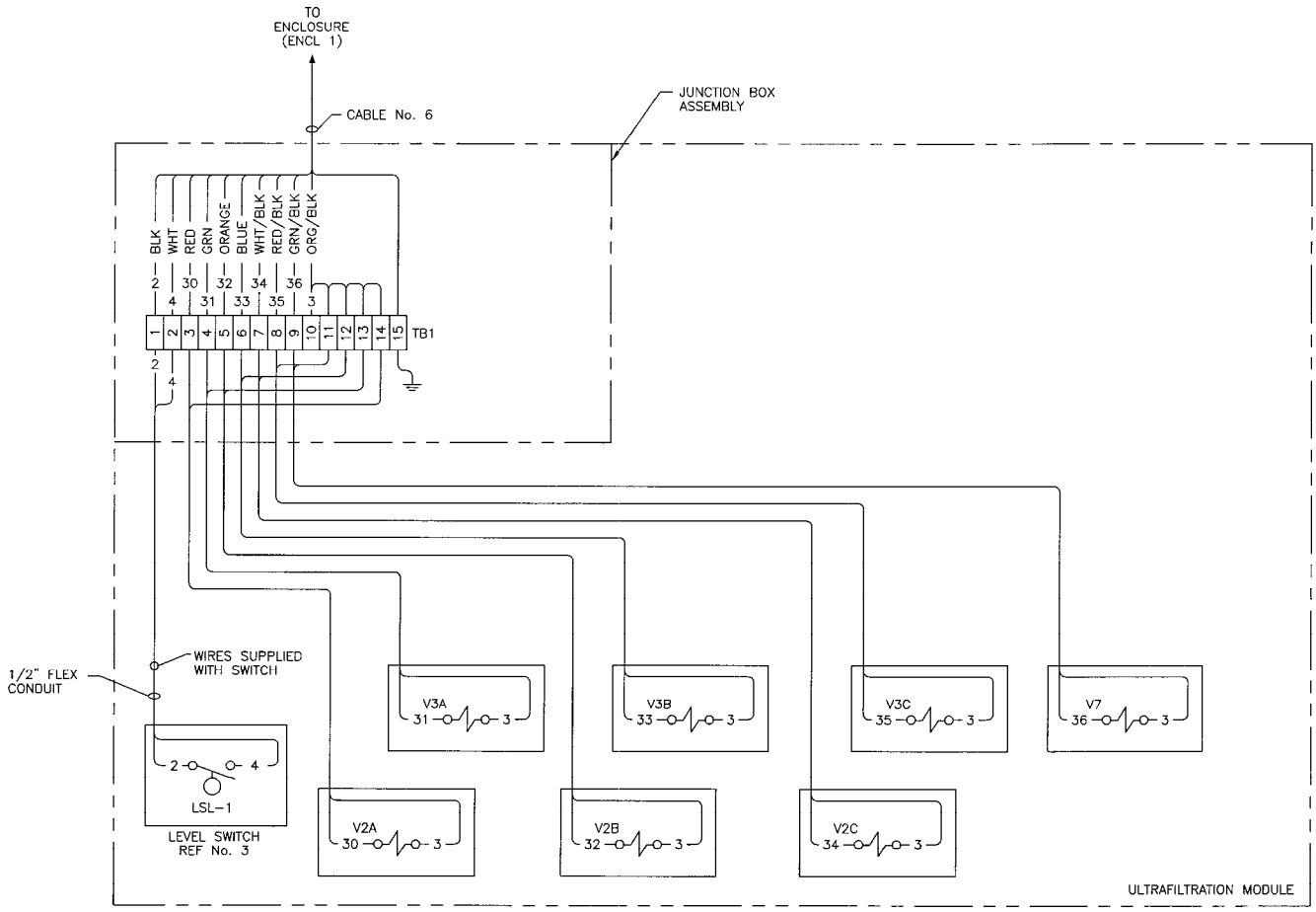
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

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 preceed 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 0120)	Replace coil if resistance is not within spec. (WP 0120)
	Test for operation.	Replace valve top if still inoperable. (WP 0094) (Spare in BII)
2. Valve will not open – voltage is not available.	If the voltage is not avilable 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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	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.
	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 0073).
	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 0070)
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0094)	Replace O-rings (WP 0094)
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 diaphgram from the valve and check for cleanliness. Ensure that all the pores in the diaphgram are free of deposits.	(WP 0094)



END OF WORK PACKAGE

FIELD 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.

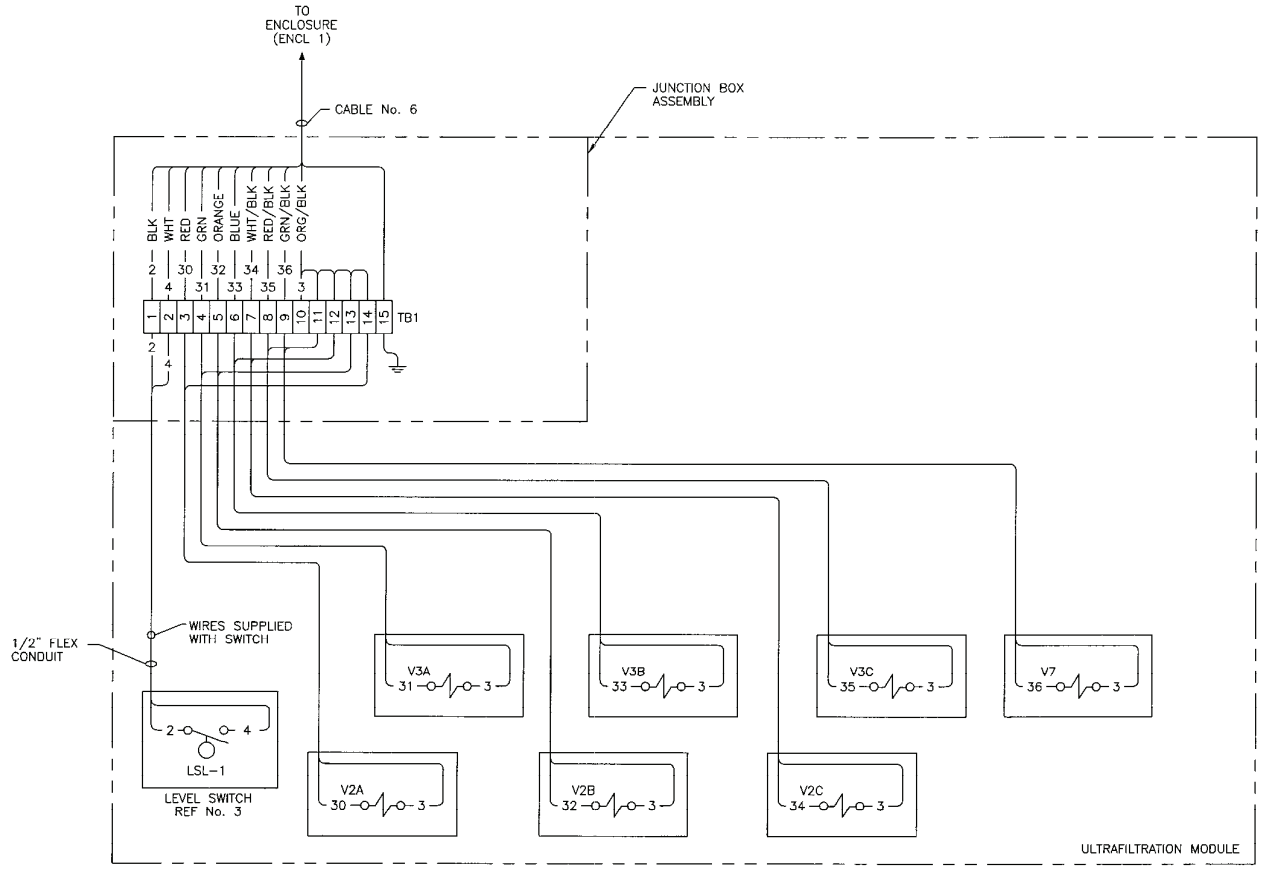
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

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 preceed 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 0120)	Replace coil if resistance is not within spec. (WP 0120)
	Test for operation.	Replace valve top if still inoperable. (WP 0094) spare in BII
2. Valve will not open – voltage is not available.	If the voltage is not avilable 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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	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.
	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 0073).
	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 0070)
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0094)	Replace O-rings (WP 0120)
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 diaphgram from the valve and check for cleanliness. Ensure that all the pores in the diaphgram are free of deposits.	(WP 0094)



END OF WORK PACKAGE

FIELD 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.

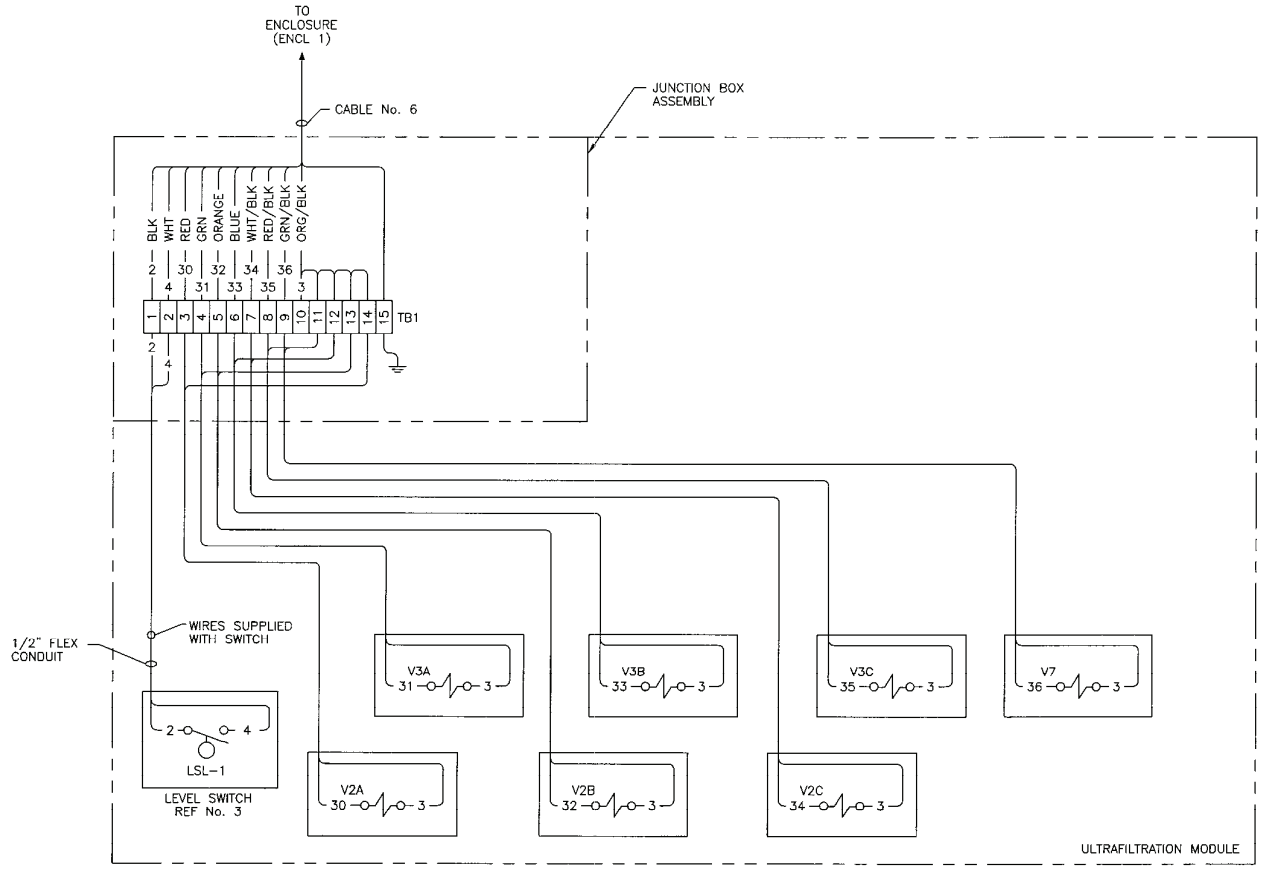
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

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 preceed 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 0120)	Replace coil if resistance is not within spec. (WP 0120)
	Test for operation.	Replace valve top if still inoperable. (WP 0094) spare in BII
2. Valve will not open – voltage is not available.	If the voltage is not avilable 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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	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.
	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 0073).
	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 0070)
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0094)	Replace O-rings (WP 0120)
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 diaphgram from the valve and check for cleanliness. Ensure that all the pores in the diaphgram are free of deposits.	(WP 0094)



END OF WORK PACKAGE

FIELD 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.

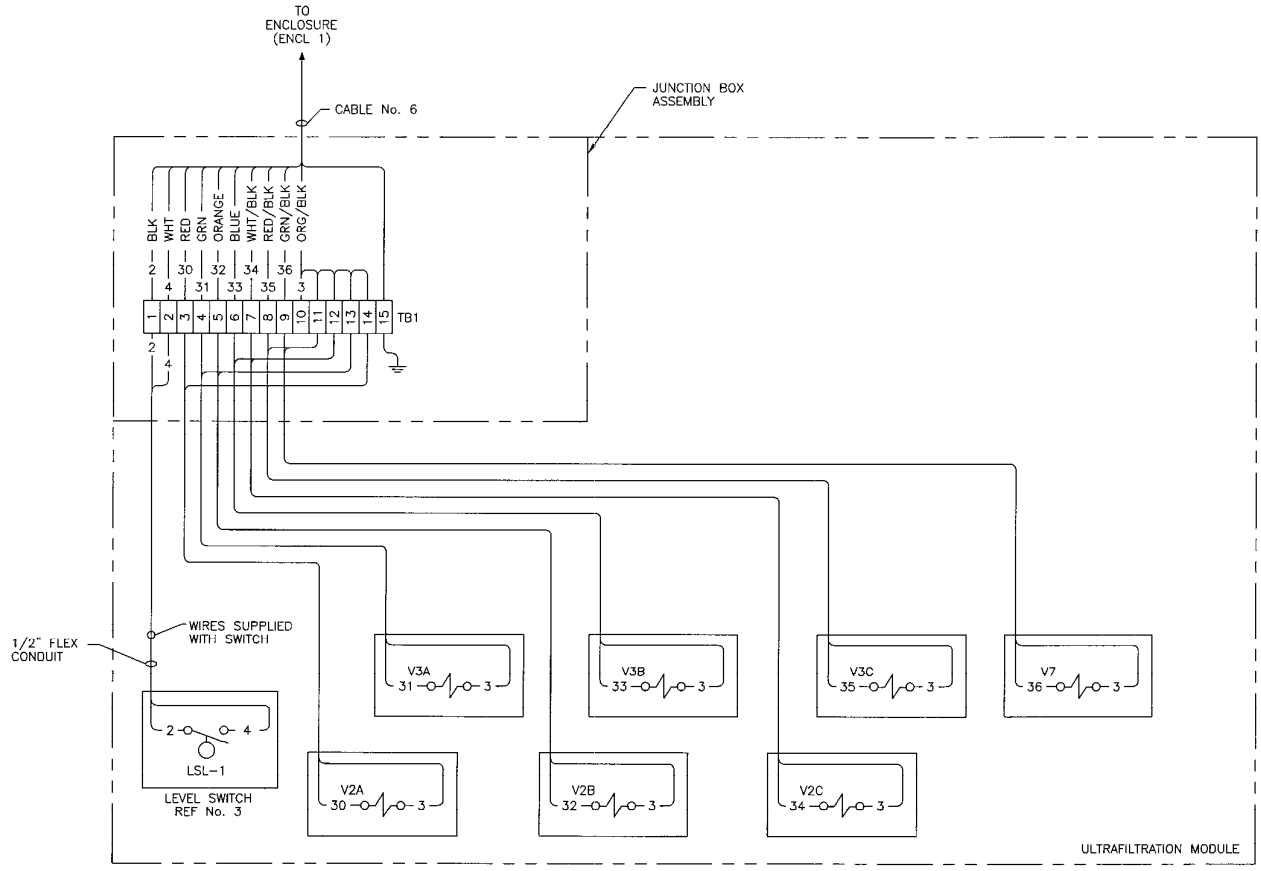
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

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 preceed 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 0120)	Replace coil if resistance is not within spec. (WP 0120)
	Test for operation.	Replace valve if still inoperable. (WP 0094)
2. Valve will not open – voltage is not available.	If the voltage is not avilable 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 0073).
	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 0070)
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0094)	Replace O-rings (WP 0120)
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 diaphgram from the valve and check for cleanliness. Ensure that all the pores in the diaphgram are free of deposits.	(WP 0094)



END OF WORK PACKAGE

FIELD 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.

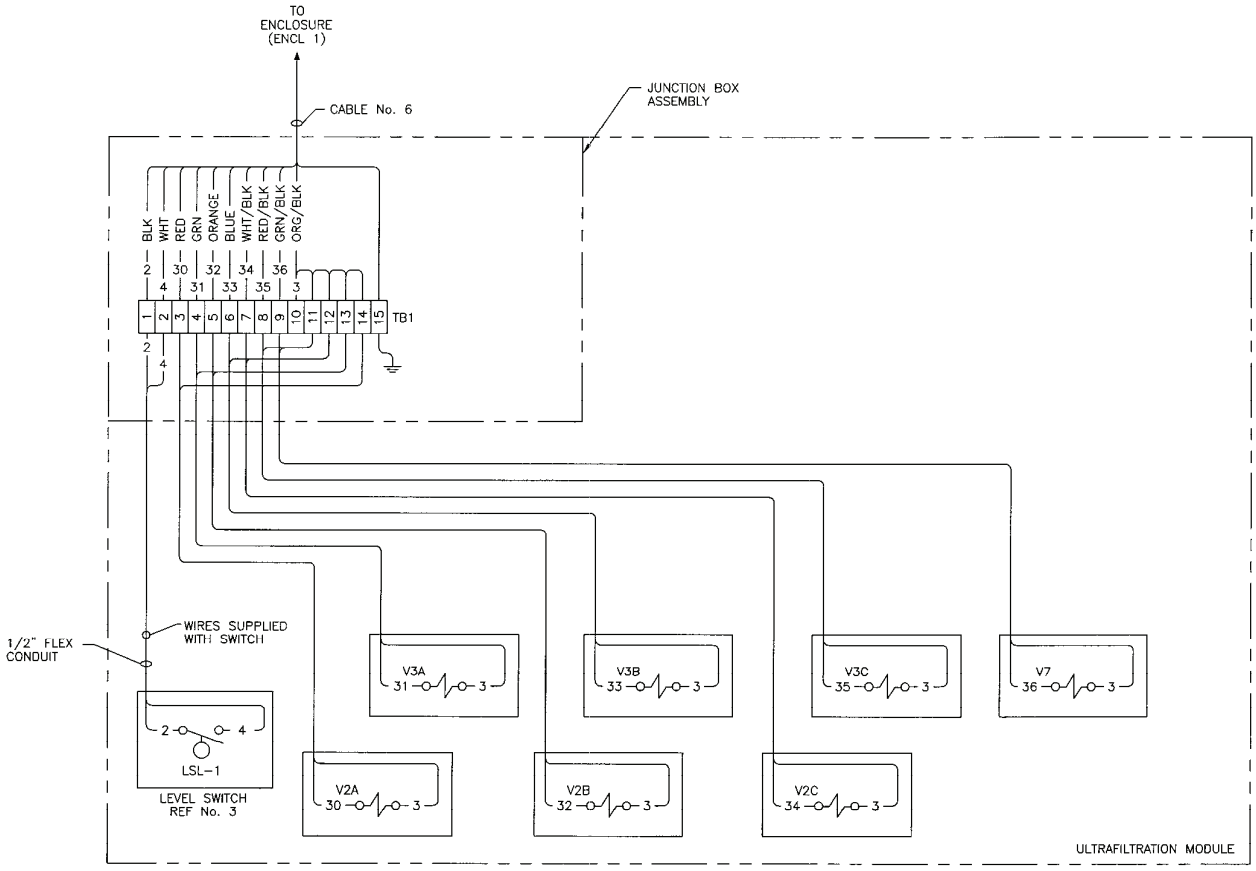
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

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 preceed 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 0120)	Replace coil if resistance is not within spec. (WP 0120)
	Test for operation.	Replace valve top if still inoperable. (WP 0094) spare in BII
2. Valve will not open – voltage is not available.	If the voltage is not avilable 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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	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.
	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 0073).
	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 0070)
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0094)	Replace O-rings (WP 0120)
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 diaphgram from the valve and check for cleanliness. Ensure that all the pores in the diaphgram are free of deposits.	(WP 0094)



END OF WORK PACKAGE

FIELD 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.

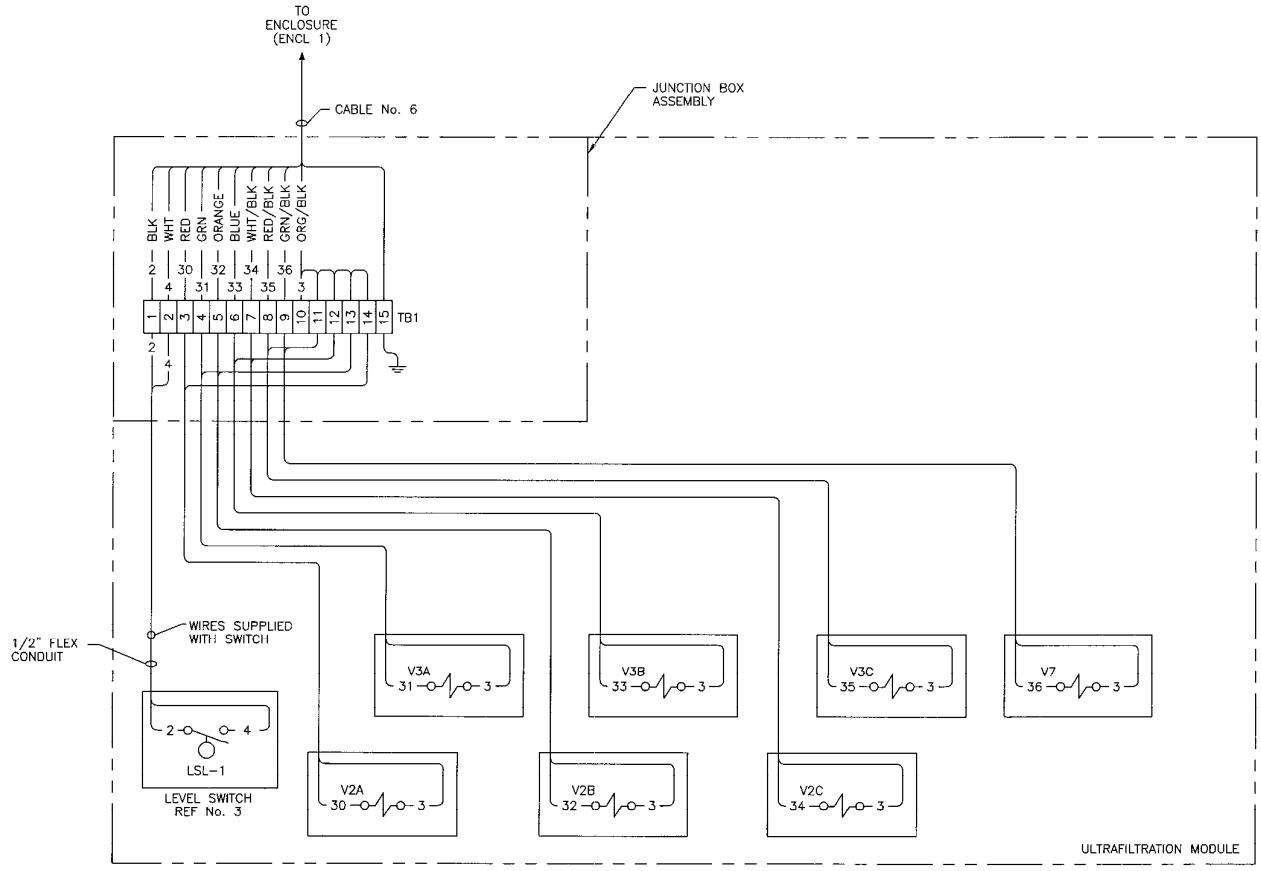
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

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 preceed 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 0120)	Replace coil if resistance is not within spec. (WP 0120)
	Test for operation.	Replace valve top if still inoperable. (WP 0094) spare in BII
2. Valve will not open – voltage is not available.	If the voltage is not avilable 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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	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.
	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 0073).
	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 0070)
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0094)	Replace O-rings (WP 0120)
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 diaphgram from the valve and check for cleanliness. Ensure that all the pores in the diaphgram are free of deposits.	(WP 0094)



END OF WORK PACKAGE

FIELD 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.

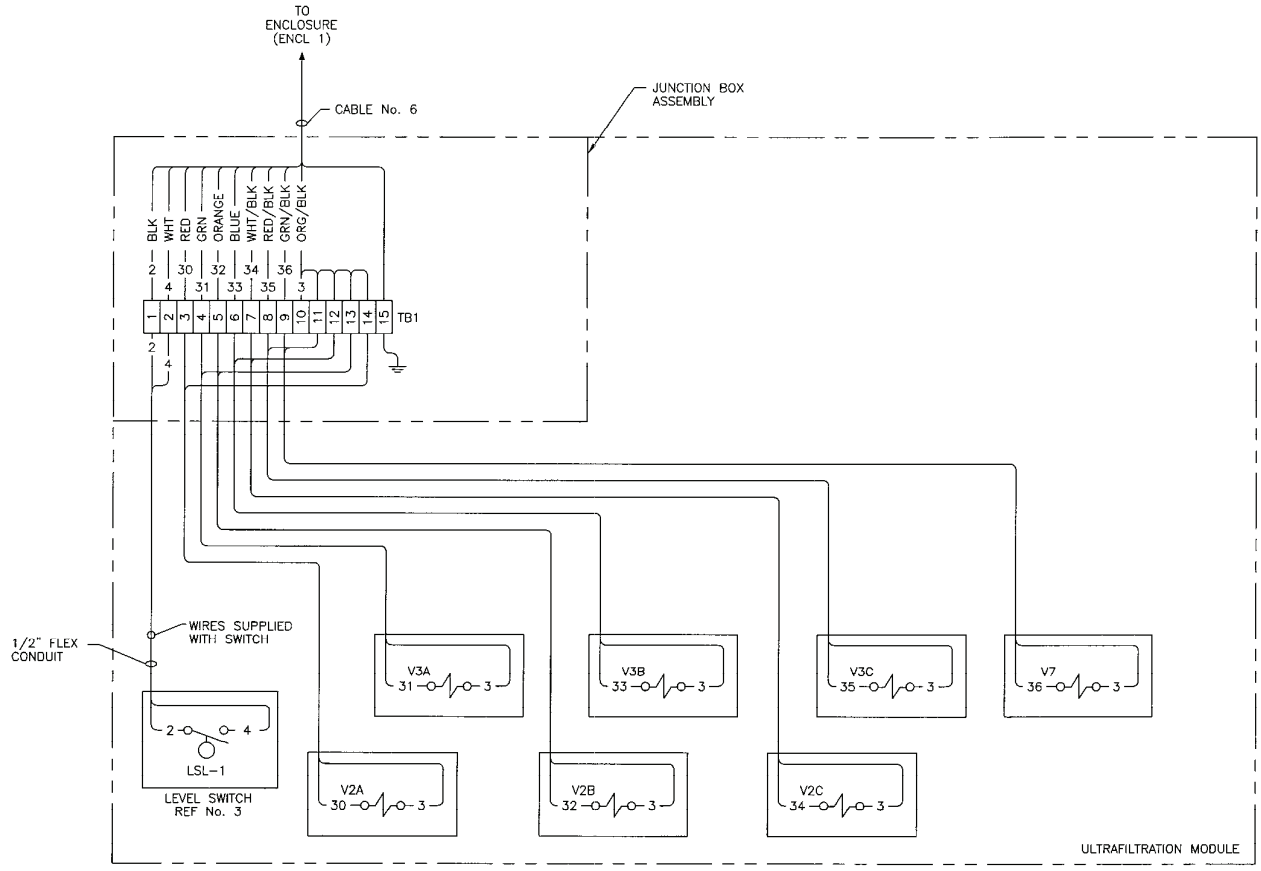
This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

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 preceed 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 0120)	Replace coil if resistance is not within spec. (WP 0120)
	Test for operation.	Replace valve top if still inoperable. (WP 0094) spare in BII
2. Valve will not open – voltage is not available.	If the voltage is not avilable 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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Valve will not open – voltage is not available. (continued)	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.
	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 0073).
	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 0070)
3. Leaking	Check for loose or missing bolts in body	Tighten bolts
	Check O-rings for damage (WP 0094)	Replace O-rings (WP 0094)
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 diaphgram from the valve and check for cleanliness. Ensure that all the pores in the diaphgram are free of deposits.	(WP 0094)



END OF WORK PACKAGE

FIELD 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).
2. No flow	Installed backwards	Check direction of arrow on housing indicating direction of flow (WP 0096).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
ULTRAFILTRATION MODULE
LEVEL SWITCH

GENERAL

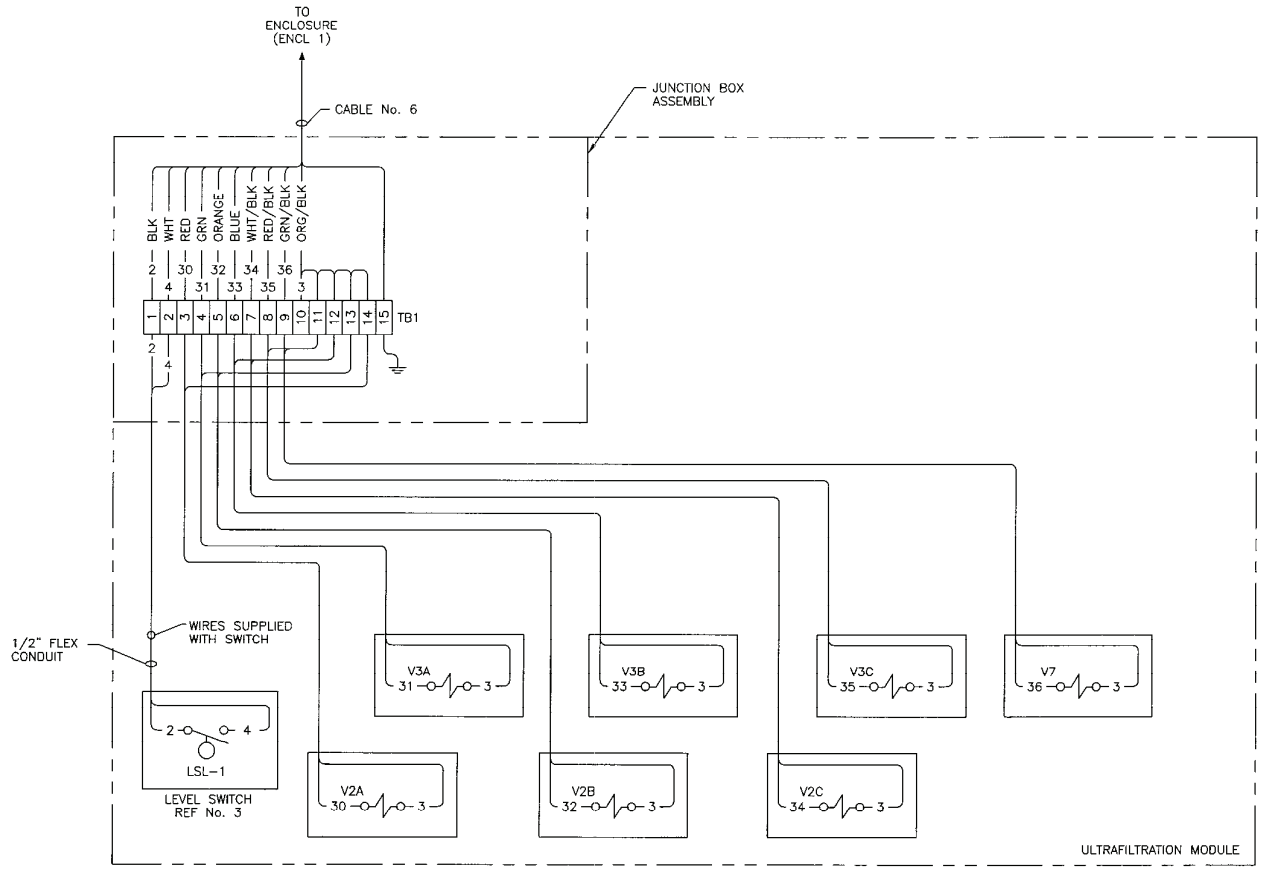
This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) 30-watt level switch on the Ultrafiltration (UF) module. You should perform the tests/inspections and corrective action in the order listed. The level switch mounts 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 0096)	If the unit shuts down, replace vacuum relief (WP 0096)
	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 0108)
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 0096)
	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 0096)
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)



END OF WORK PACKAGE

FIELD 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 0063).
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

FIELD 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 0121)
	Improper fuel injection timing	Adjust injection timing (WP 0126)
	Unserviceable fuel injector	Inspect fuel injector. Replace if faulty. (WP 0126)
	Inspect engine for low compression	
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.
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 0105).
	Ensure that the fuel pump is aligned with the governor lever.	Realign governor lever. (WP 0126).
	Inspect governor assembly for proper installation	(WP 0125).
4. Black or bluish-white exhaust smoke	Follow procedures in step (1)	Follow procedures in step (1)

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
HIGH-PRESSURE PUMP

INTIAL SETUP

Material/Parts

Seal kit, PN 33985
Valve kit, PN 30982
O-rings, PN 17547, 43893, 26089, 44001
Plunger, PN 48807

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 (WP 0104)
	Worn seals	Install new seal kit. (WP 0127)
	Worn or dirty inlet/discharge valves	Clean inlet/discharge valves or install new valve kit (WP 0127)
2. Pulsation	Faulty pulsation dampener	Install new pulsation dampener (WP 0098)
	Debris trapped in inlet/discharge valves	Clean inlet/discharge valves or install new valve kit (WP 0127)
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 0127)
	Loose drain plug or worn drain plug O-ring	Replace O-ring (WP 0127)
	Worn internal seals	Replace or rebuild pump (WP 0127)
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 0127).
	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 0127).

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
6. Knocking noise	Broken or worn bearing.	Replace bearing (WP 0127)
	Loose crankshaft	Check the key on the shaft (WP 0104)
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 0127).
	Leaking hi-pressure or lo-pressure seals	Install new seal kit. (WP 0127).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
DIESEL ENGINE AIR SHUTOFF

GENERAL

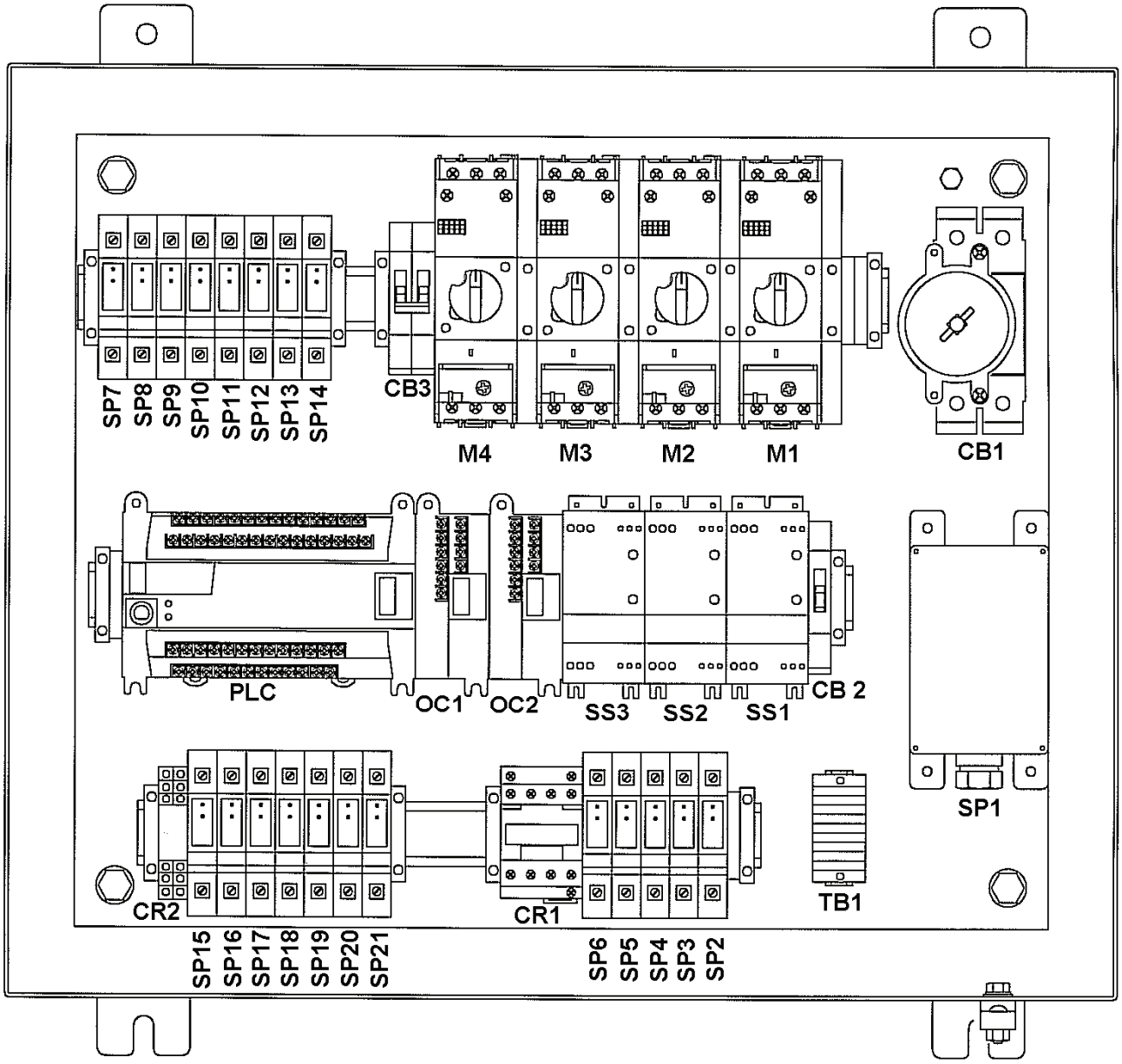
This work package lists the common malfunctions that you may find during the operation or maintenance of the Lightweight Water Purifier (LWP) air shutoff assembly on the high-pressure pump module. You should perform the tests/inspections and corrective action in the order listed. This valve is solenoid 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 shutsdown 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 0101).
2. Alarm light is blinking at control module	Ensure that the UF filtrate tank is full	If full, troubleshoot low level switch. (WP 0063).
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 0068).
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 0101).
	Inspect the vent plug (WP 0093)	Clean the vent plug if clogged. (WP 0099).
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. – continued, solenoid valve is not functioning (not allowing the pressureized air to enter the air cylinder)	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 0073)
	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 0070)
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. See (WP 0012).



END OF WORK PACKAGE

FIELD 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 0102).
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.

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
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 0102).
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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CONTROL MODULE

INTIAL 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 exists 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 exists in the wire.
	Check surge protector (SP19) fault light	(WP 0073).
	Check PLC.	(WP 0070).

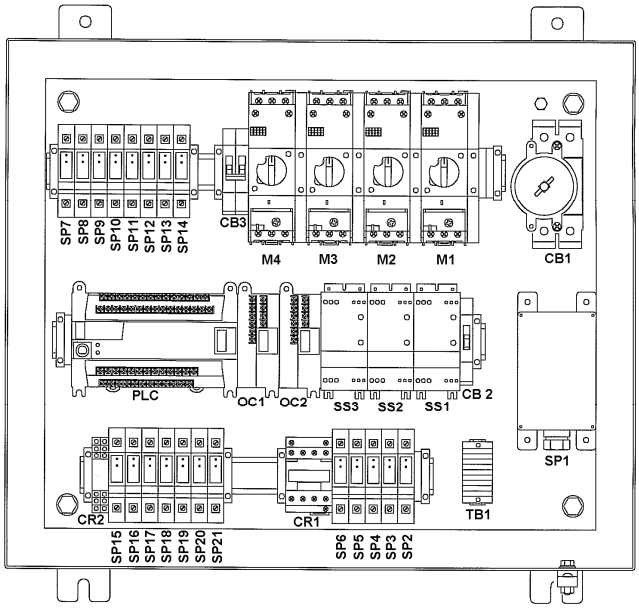
MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
2. Air shutoff solenoid valve (SV1)	With power off, Check connections of wire 22 on output 0 of the PLC from the PLC to the control relay (CR2), and check for continuity of wire number 22 from the PLC to the control relay.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	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 0073).
	Check PLC.	(WP 0070).
	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 0108)
3. Backwash Cycle components	Troubleshoot BACKWASH pump switch (SW3).	(WP 0071).
	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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
3. Backwash Cycle components - continued	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.
	Check surge protector (SP14) fault light to see if it is on.	(WP 0073)
	Check surge protector (SP21) fault light to see if it is on.	(WP 0073)
	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 0070)
	Check high-pressure shutdown switch	WP 0072 00
4. Backwash down 1st UF vessel	Troubleshoot solenoid valve V3A	(WP 0058)
5. Backwash down 2nd UF vessel	Troubleshoot solenoid valve V3B	(WP 0059)
6. Backwash down 3rd UF vessel	Troubleshoot solenoid valve V3C	(WP 0060)
7. Backwash up 1st UF vessel	Troubleshoot solenoid valve V2A	(WP 0055)
8. Backwash up 2nd UF vessel	Troubleshoot solenoid valve V2B	(WP 0056)
9. Backwash up 3rd UF vessel	Troubleshoot solenoid valve V2C	(WP 0057)
10. Fast flush cycle components	Troubleshoot BOOSTER pump switch (SW2).	(WP 0071).
	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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
10. Fast flush cycle components - continued	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 0073)
	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 surge protector (SP21) fault light to see if it is on.	(WP 0073)
	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 0070)
11. Fast flush 1st UF vessel	Troubleshoot solenoid valve V2A	(WP 0055)
12. Fast flush 2nd UF vessel	Troubleshoot solenoid valve V2B	(WP 0056)
13. Fast flush 3rd UF vessel	Troubleshoot solenoid valve V2C	(WP 0057)
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.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
14. Distribution pump malfunction- continued	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 0070)
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 0071)
	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 0070)
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 0108)
	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 0073)

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
16. High-pressure shutdown pilot light not functioning - continued	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 0108)
	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.	Replace switch SW7 if faulty. (WP 0108)
	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.	
	Remove wires 29 and 3 from pilot light. Check continuity between terminals on light where wires 29 and 3 were connected. Continuity should exist.	Replace pilot light L7. (WP 0108)
	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.	Replace high-pressure switch. (WP 0102) Check wiring inside high-pressure pump module junction box for loose connections.



END OF WORK PACKAGE

FIELD 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 card 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 0108)
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 0108)
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 0108)
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 0108)
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.

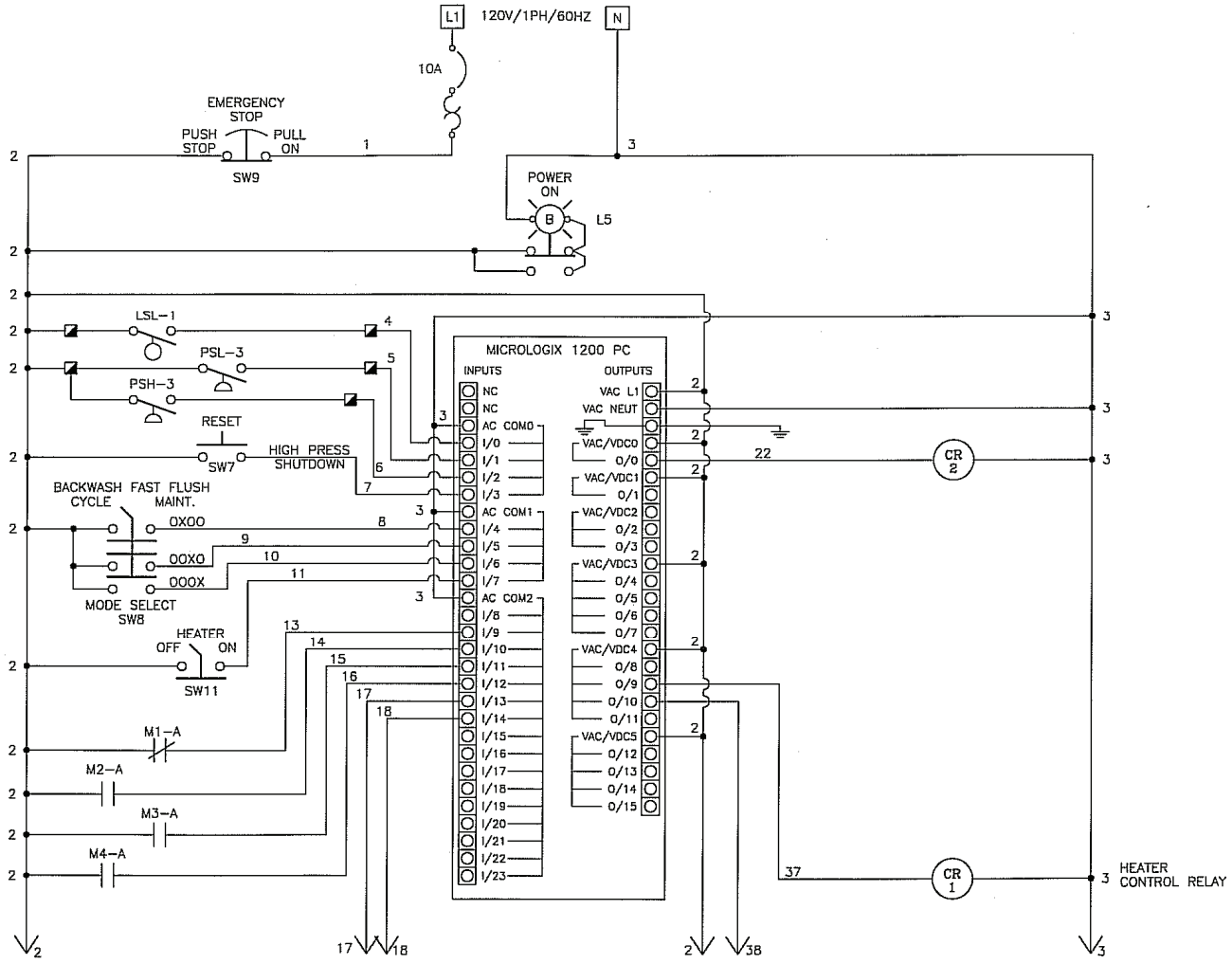
OUTPUT	DESCRIPTION
(0)	To high-pressure pump enable relay CR2 (when output is energized, the relay is energized and solenoid SV1 (air shutoff solenoid) is energized).
(9)	To heater control relay CR1 (when output is energized, relay is energized, and 240 VAC is supplied to heater).
(10)	To hour meter, 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

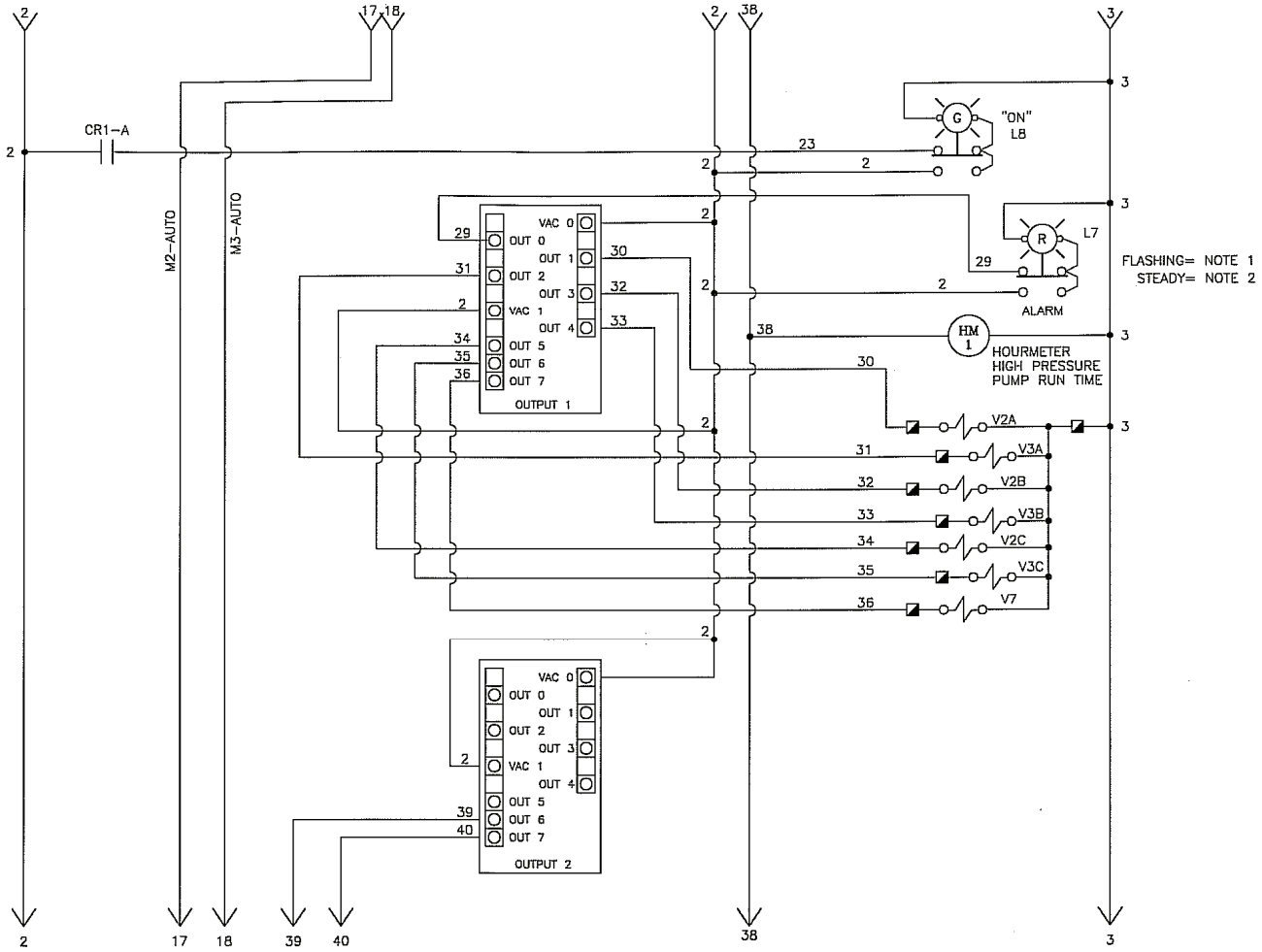
Table 3. PLC Output Card (1) Output Descriptions.

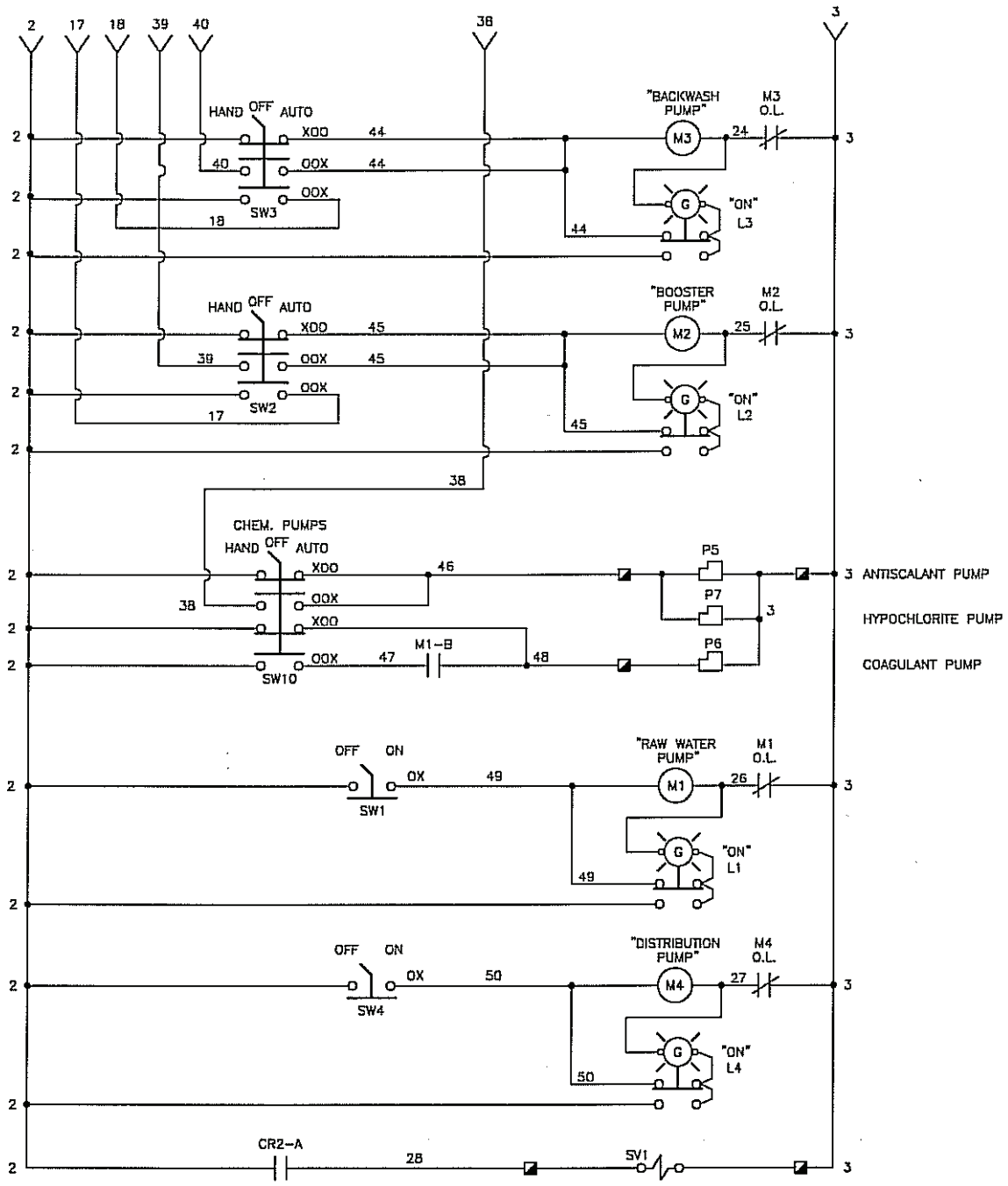
OUTPUT	DESCRIPTION
(0)	To high-pressure shutdown light (L7) (when output is energized, a high-pressure shutdown has occurred) (when output is flashing the UF filtrate tank level is low).
(1)	To valve V2a (when output is energized, valve V2a is open (120 VAC supplied to valve)).
(2)	To valve V3a (when 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).




CR1-A
M2-AUTO
M3-AUTO
"ON" LB
L7
ALARM
FLASHING= NOTE 1
STEADY= NOTE 2
HM 1
HOURMETER HIGH PRESSURE PUMP RUN TIME
V2A
V3A
V2B
V3B
V2C
V3C
V7
OUTPUT 1
OUTPUT 2
VAC 0
OUT 0
OUT 1
OUT 2
OUT 3
VAC 1
OUT 4
OUT 5
OUT 6
OUT 7



END OF WORK PACKAGE

FIELD 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)
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 0108). 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 0108). 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 0108). 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 0108). If present, the switch is OK.
6. Chemical pump switch	Place the switch to ON. 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 0108)
	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 0108).
	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 0108)
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 0108). 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 0108). If present, the switch is OK.

MALFUNCTION	TEST / INSPECTION	CORRECTIVE ACTION
9. Backwash pump switch	Place the switch to ON. Test for 120 VAC across wire 44 and ground at the switch.	If not present; replace the switch. (WP 0108).
	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 0108).
10. Booster pump switch	Place the switch to ON. Test for 120 VAC across wire 45 and ground.	If not present; replace the switch. (WP 0108).
	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 0108).
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 0108). If present, the switch is OK.

END OF WORK PACKAGE

FIELD 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

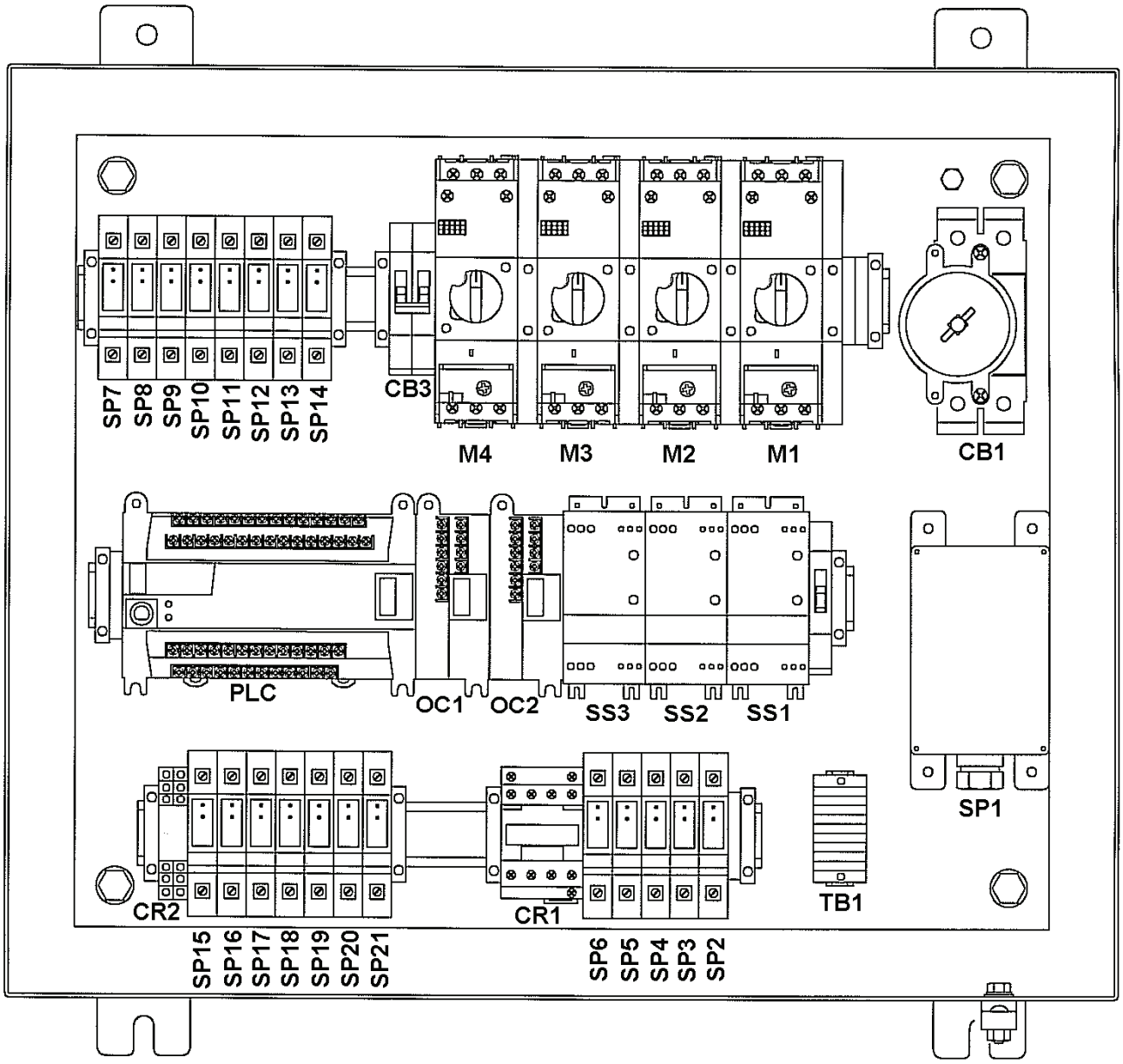
FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CONTROL MODULE
SURGE PROTECTORS

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
1. 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.
2. 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.
3. 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 0108).



END OF WORK PACKAGE

FIELD 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 HM1on 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 0070).
	Inspect low-pressure switch	(WP 0068).

END OF WORK PACKAGE

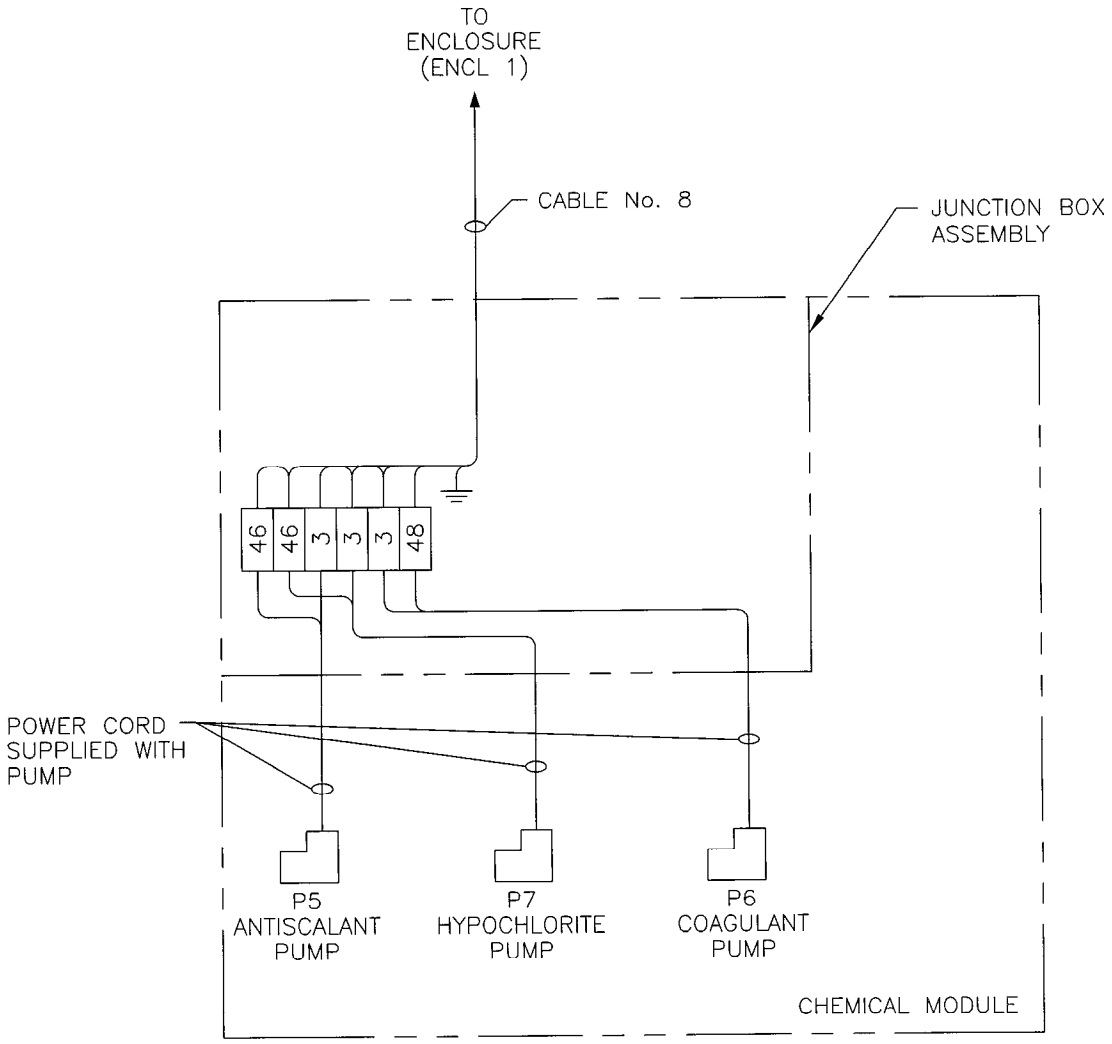
FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION PUMP (ANTISCALANT)

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 0068).
	Inspect chemical pump switch (SW10)	(WP 0071).
	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 0073).
	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 0070).



END OF WORK PACKAGE

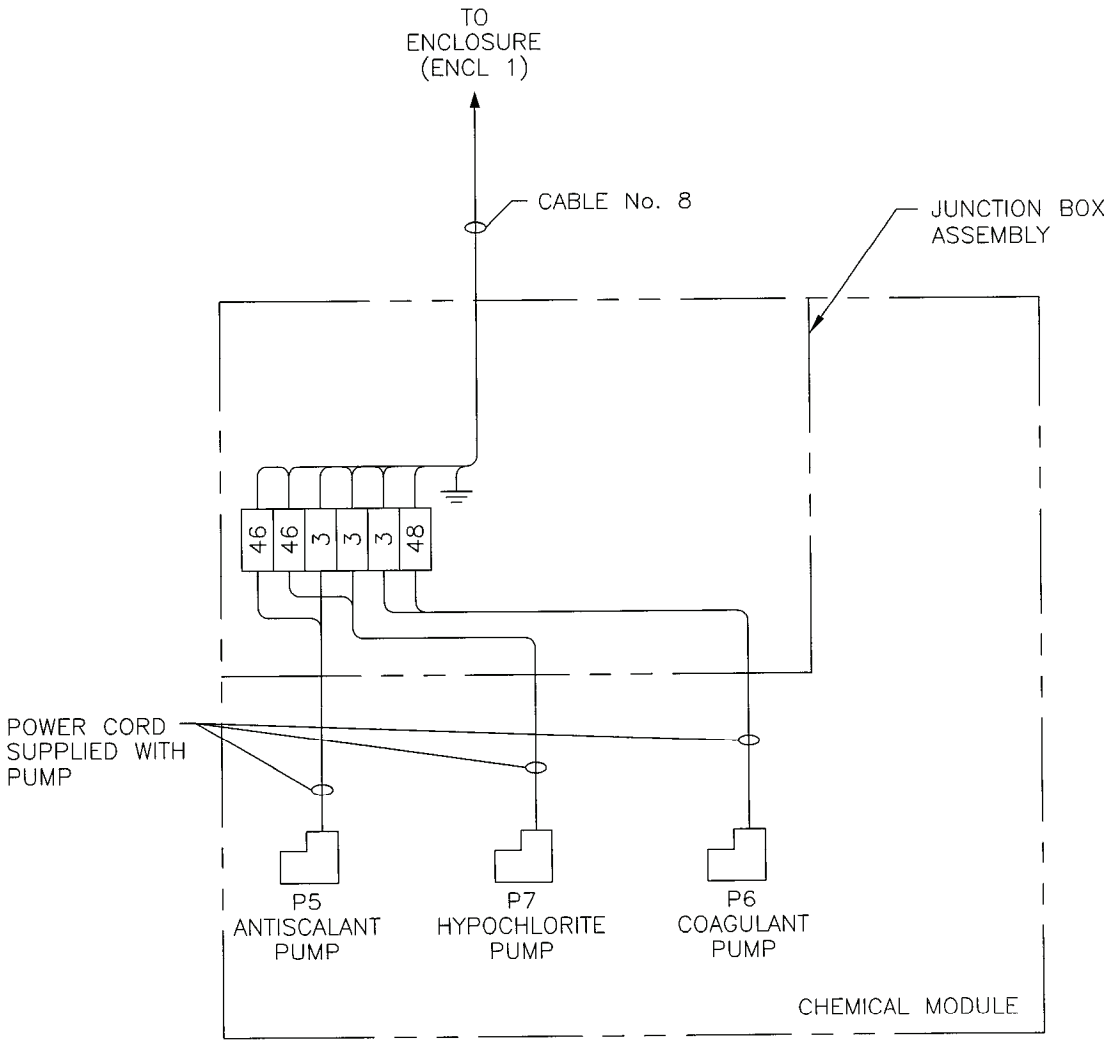
FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION PUMP (COAGULANT)

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 0071).
	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 exists 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 exists in the wire.
	Check PLC	(WP 0070).



END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL INJECTION PUMP (HYPOCHLORITE)

Chemical Injection Pump (Hypochlorite)

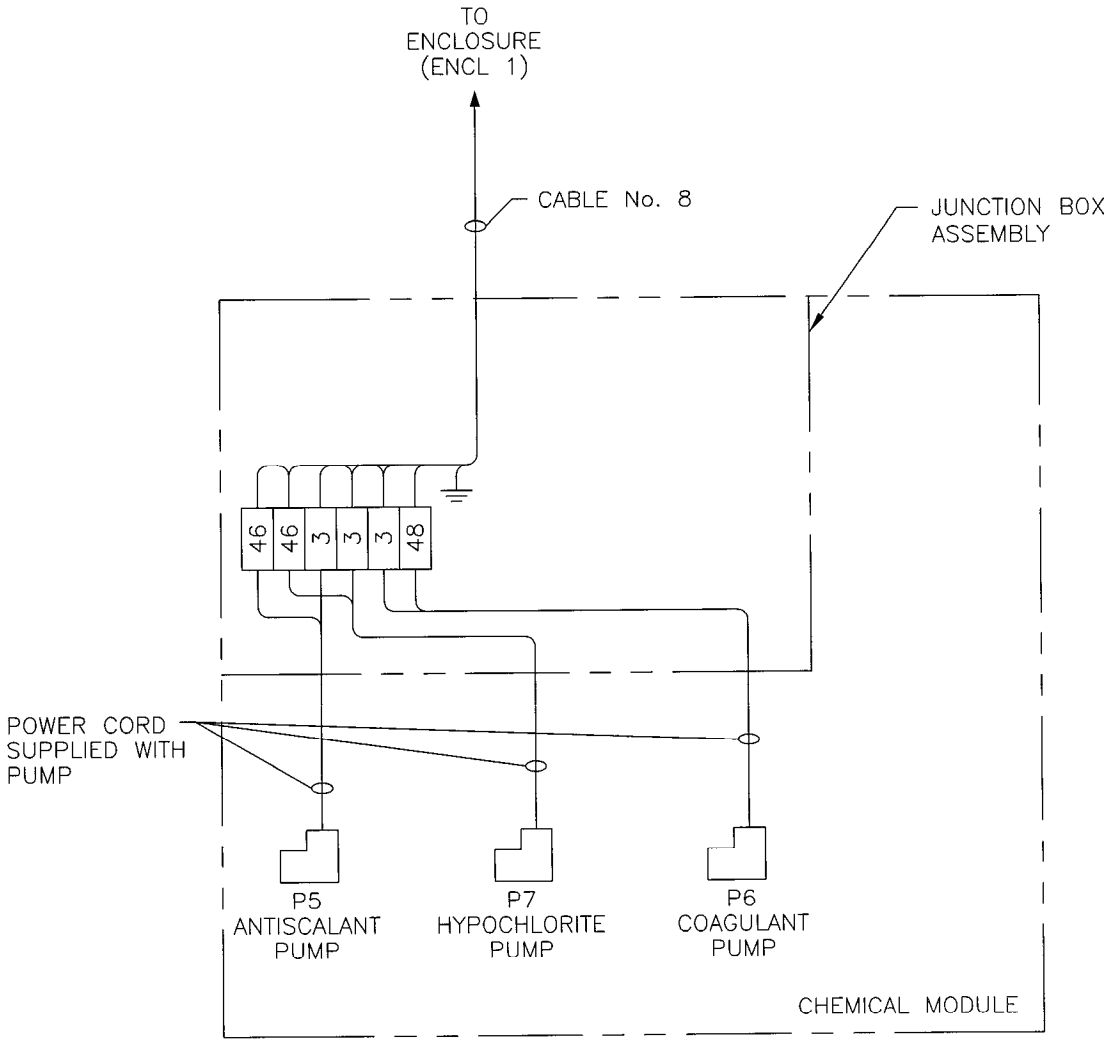
The table lists the common malfunctions that you may find during the operation or maintenance of the Hypochlorite chemical injection pump assembly (P7) in the chemical injection/cleaning module used in Lightweight Water Purifier (LWP). You should perform the tests/inspections and corrective actions in 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 0068).
	Inspect chemical pump switch (SW10)	(WP 0071).
	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 0073).
	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 0070).



END OF WORK PACKAGE

FIELD 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.

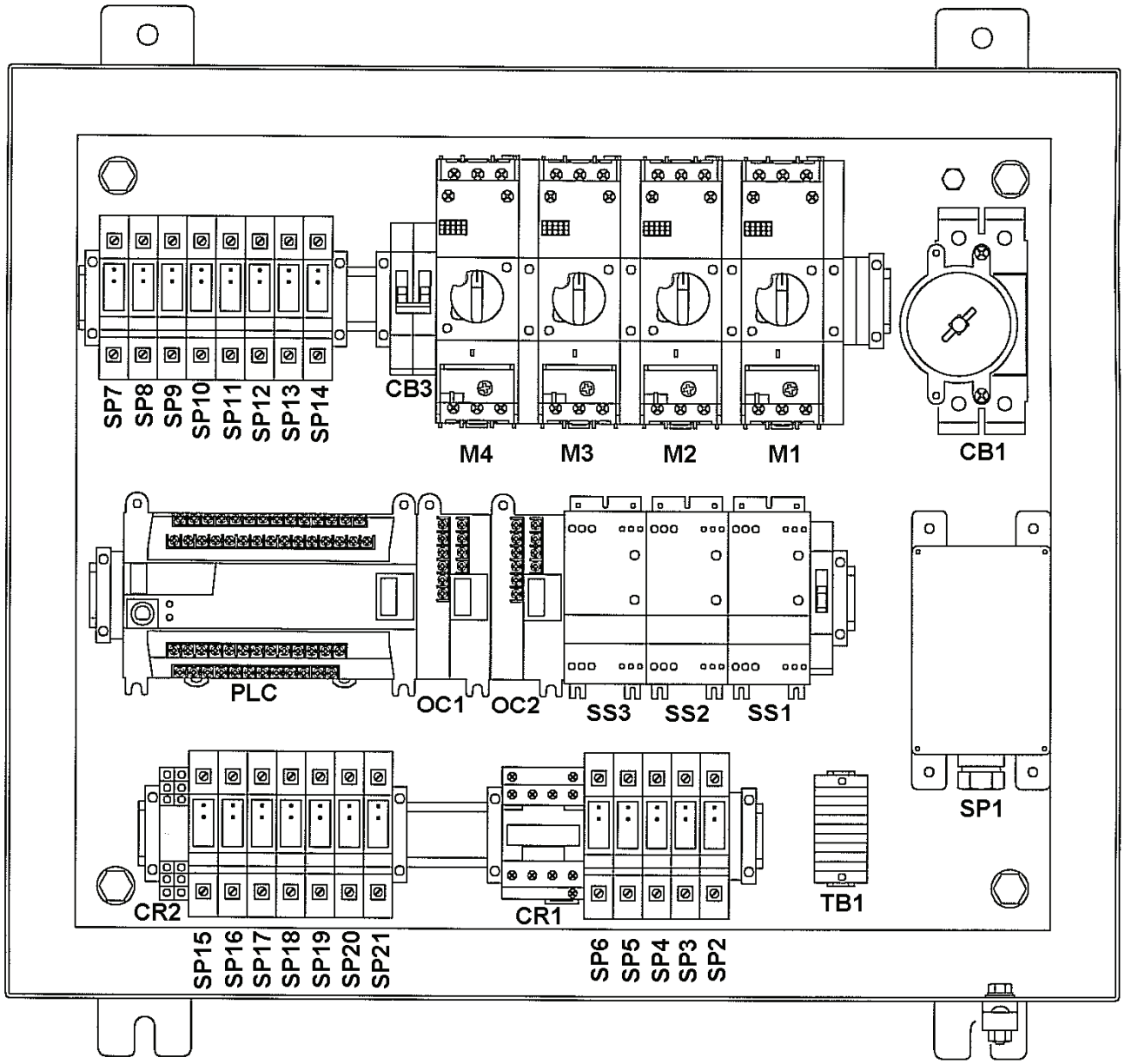
WARNING

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 0071)
	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 exists in the wire.
	With power on, check surge protector (SP11) fault light.	(WP 0073)
	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 exists in the wire.
	With power on, check surge protector (SP20) fault light	(WP 0073)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Immersion Heater not working – control module - continued	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 exists in the wire.
	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.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check PLC.	(WP 0070)
	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.	Replace control relay if unserviceable.
	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.	Replace control relay if the voltage is present on the inlet side but not on the outlet side.
	Check to see if circuit breaker (CB3) is off or tripped.	Reset the circuit breaker.
	With power off, check the connections and continuity of wire 62 and 63 from the circuit breaker (CB3) to the control relay (CR1).	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 the connections and continuity of wire 60 and 61 at the line side of the circuit breaker (CB3).	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
2. Immersion Heater not working – control module - continued	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.	Replace circuit breaker if faulty.
	With power off, check continuity between the terminals with wire 77 and wire 100 (Terminals 3 and 1, respectively) on surge protector (SP 6).	Tighten any loose connections. Replace (SP 6) if continuity doesn't exists in the wire.
	With power off, check the connections and the continuity of wire 98, 99, and 100 from the surge protector to the cable connector.	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 the connections and continuity of wire 76 and 77 from the control relay (CR1) to the surge protector (SP6).	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	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.	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.
	Check surge protector (SP6) fault light.	(WP 0073)
	Check continuity between the (SP 6) terminals with wire 76 and wire 98 (Terminals 4 and 2, respectively).	Tighten any loose connections. Repair and replace any broken or burnt wires. Replace if continuity doesn't exists in the wire.



END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
RAW WATER SERVICE PUMP

GENERAL

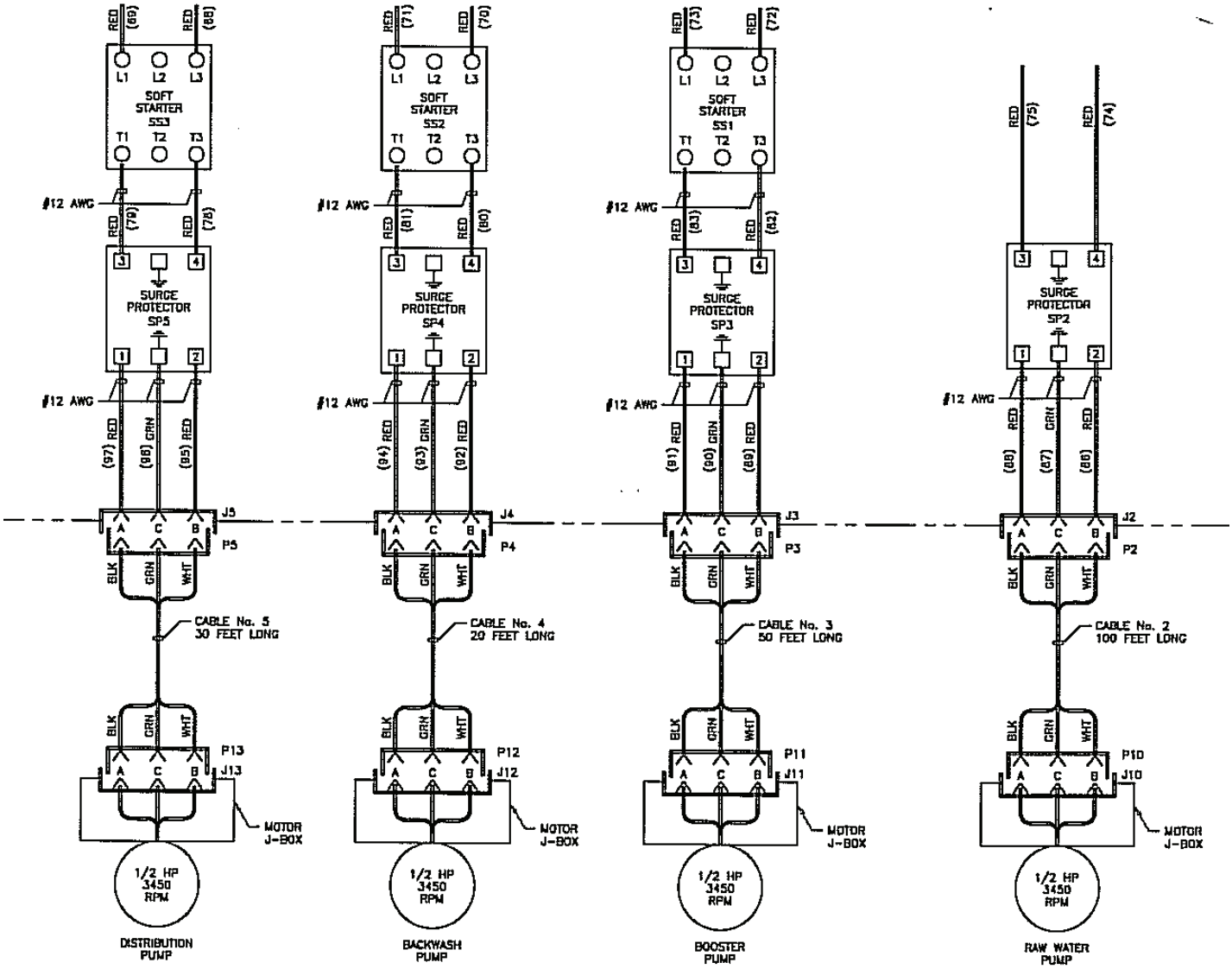
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the raw water pump (P1) or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

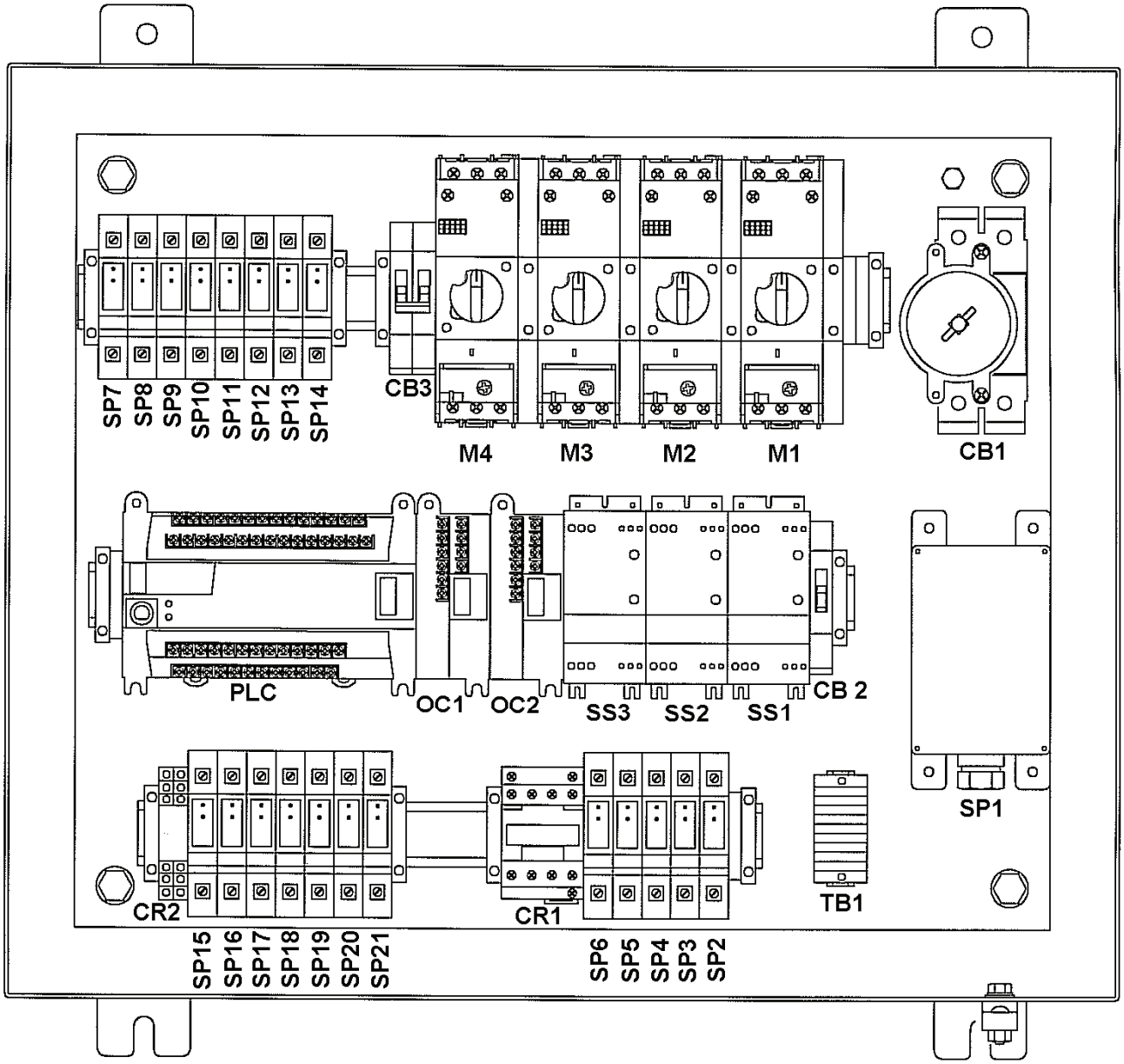
WARNING

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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108).
	Inspect and reset the motor starter module and overload screw (WP 0047).	Replace motor starter module if faulty (WP 0108).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0117)	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 0115)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Pump light is on but pump is not operating - continued	If voltage is present and no fault is found at receptacle assembly, 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 0071)
	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 0108).
	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 0108).
	Inspect the generator cable for proper wire connections.	Remove the generator cable wires from the generator and reconnect them securely.


SOFT STARTER SS3
SOFT STARTER SS2
SOFT STARTER SS1
SURGE PROTECTOR SP5
SURGE PROTECTOR SP4
SURGE PROTECTOR SP3
SURGE PROTECTOR SP2
#12 AWG
CABLE No. 5 30 FEET LONG
CABLE No. 4 20 FEET LONG
CABLE No. 3 50 FEET LONG
CABLE No. 2 100 FEET LONG
MOTOR J-BOX
1/2 HP 3450 RPM
DISTRIBUTION PUMP
BACKWASH PUMP
BOOSTER PUMP
RAW WATER PUMP



END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
BOOSTER SERVICE PUMP

GENERAL

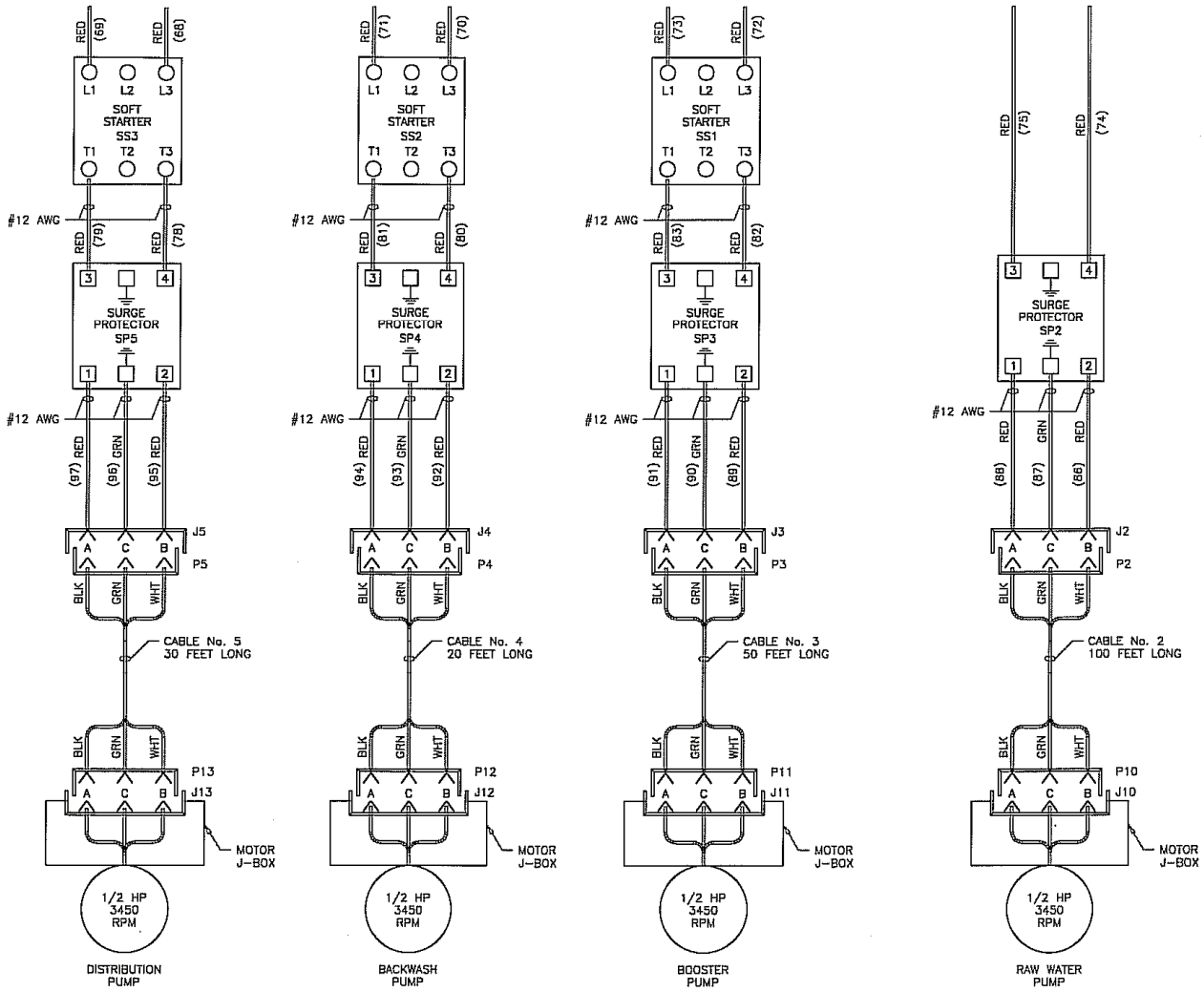
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the booster pump (P2) or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

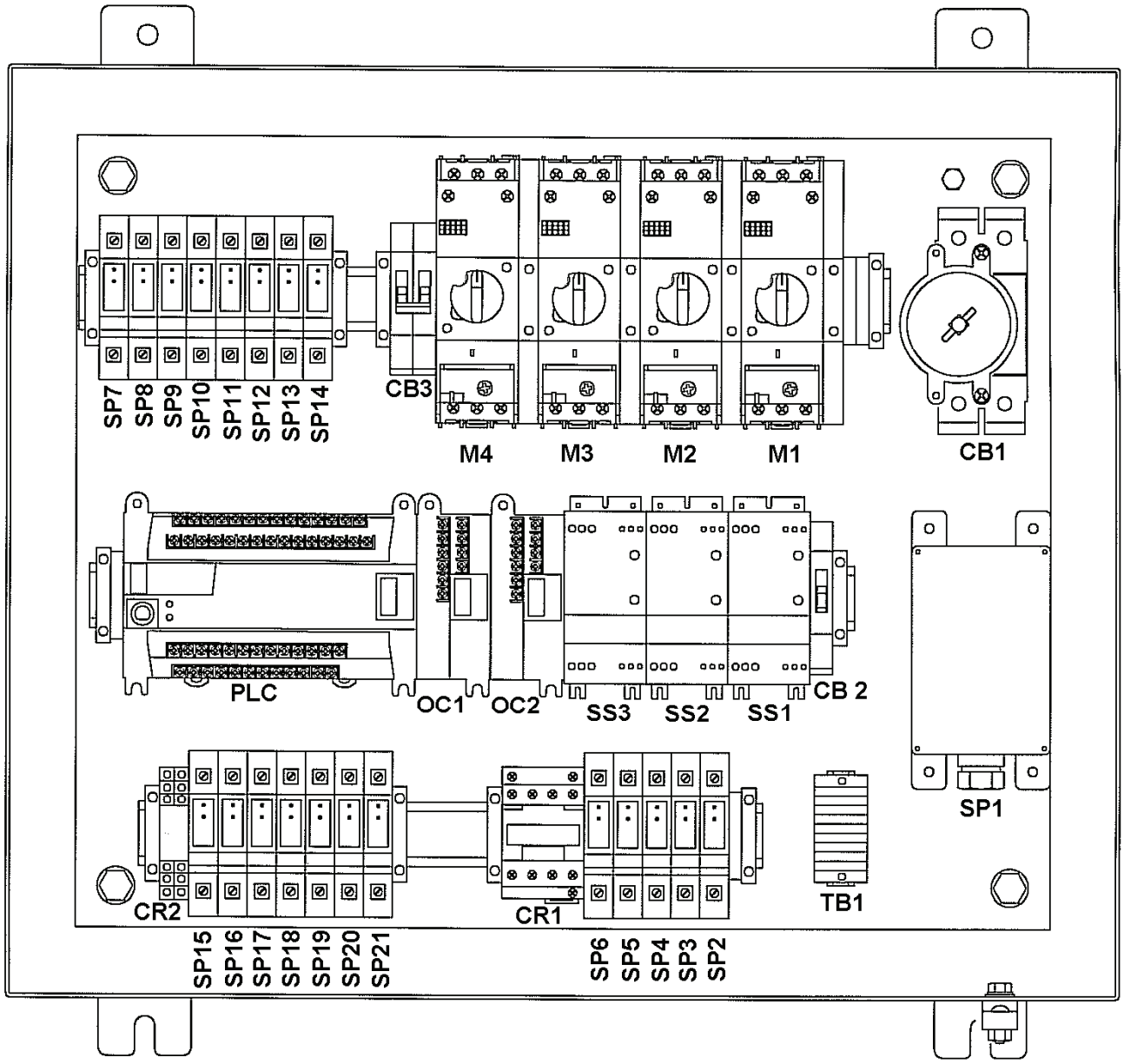
WARNING

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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108).
	Inspect and reset the motor starter module and overload screw (WP 0047 00).	Replace motor starter module if faulty (WP 0108).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0117)	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 0115)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Pump light is on but pump is not operating – continued	If voltage is present and no fault is found at receptacle assembly, 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	Replace booster pump if motor starter module for the distribution pump (M4) trips
	Inspect pump switch.	(WP 0071)
	Inspect surge protector (SP 3) Check for 240 VAC at the input (between wires 83 and 82) and output (between wires 91 and 89).	Replace if voltage is present at the input and not at the output (WP 0108).
	Inspect soft starter SS1 With power on, check for 240 VAC at the input (between wires 73 and 72) and output (between wires 83and 82).	Replace if voltage is present at the input and not at the output (WP 0108).
	Inspect motor controller module M2 With power on, check for 240 VAC at the input (between wires 60 and 61) and output (between wires 73and 72).	Replace if voltage is present at the input and not at the output (WP 0108).
	Inspect continuity of wire 39 from the output 6 of the PLC output card 2 (OC2) to booster switch (SW 2).	Tighten loose connection. Replace or repair broken wires and connections.
	Inspect the generator cable for proper wire connections.	Remove the generator cable wires from the generator and reconnect them securely.


RED (69)
RED (68)
L1 L2 L3
SOFT STARTER SS3
T1 T2 T3
#12 AWG
RED (79)
RED (78)
3 4
SURGE PROTECTOR SP5
1 2
#12 AWG
RED (97)
GRN (96)
RED (95)
J5
A C B
P5
BLK GRN WHT
CABLE No. 5
30 FEET LONG
BLK GRN WHT
P13
A C B
J13
MOTOR J-BOX
1/2 HP 3450 RPM
DISTRIBUTION PUMP
RED (71)
RED (70)
L1 L2 L3
SOFT STARTER SS2
T1 T2 T3
#12 AWG
RED (81)
RED (80)
3 4
SURGE PROTECTOR SP4
1 2
#12 AWG
RED (94)
GRN (93)
RED (92)
J4
A C B
P4
BLK GRN WHT
CABLE No. 4
20 FEET LONG
BLK GRN WHT
P12
A C B
J12
MOTOR J-BOX
1/2 HP 3450 RPM
BACKWASH PUMP
RED (73)
RED (72)
L1 L2 L3
SOFT STARTER SS1
T1 T2 T3
#12 AWG
RED (83)
RED (82)
3 4
SURGE PROTECTOR SP3
1 2
#12 AWG
RED (91)
GRN (90)
RED (89)
J3
A C B
P3
BLK GRN WHT
CABLE No. 3
50 FEET LONG
BLK GRN WHT
P11
A C B
J11
MOTOR J-BOX
1/2 HP 3450 RPM
BOOSTER PUMP
RED (75)
RED (74)
3 4
SURGE PROTECTOR SP2
1 2
#12 AWG
RED (88)
GRN (87)
RED (86)
J2
A C B
P2
BLK GRN WHT
CABLE No. 2
100 FEET LONG
BLK GRN WHT
P10
A C B
J10
MOTOR J-BOX
1/2 HP 3450 RPM
RAW WATER PUMP



END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
BACKWASH SERVICE PUMP

GENERAL

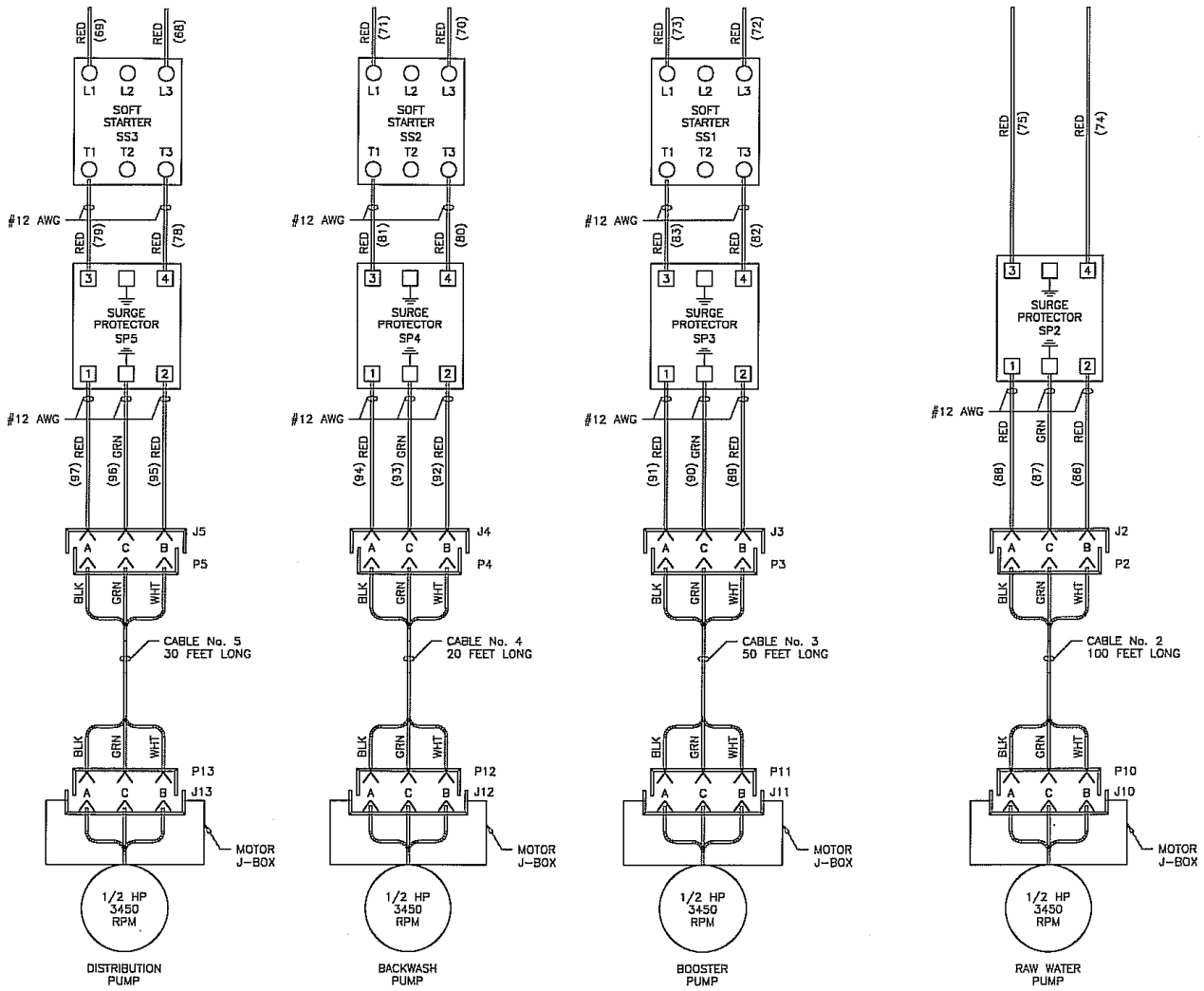
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the Backwash pump (P3) or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

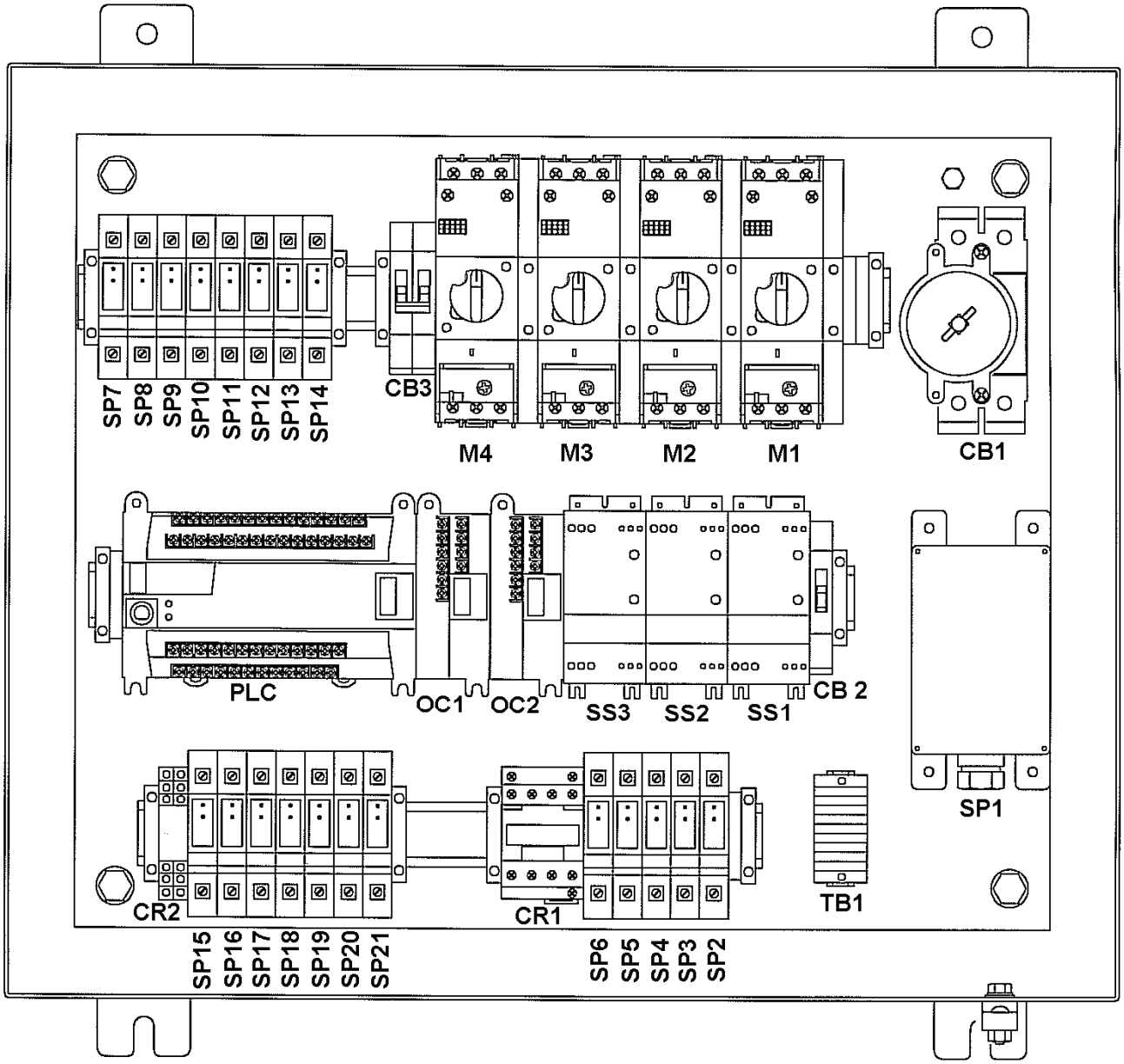
WARNING

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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108).
	Inspect and reset the motor starter module and overload screw (WP 0047).	Replace motor starter module if faulty (WP 0108).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0117)	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 0115)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Pump light is on but pump is not operating – - continued	If voltage is present and no fault is found at receptacle assembly, 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	Replace Backwash pump if motor starter module for the distribution pump (M4) trips
	Inspect pump switch.	(WP 0071)
	Inspect surge protector (SP 4) Check for 240 VAC at the input (between wires 80and 81) and output (between wires 92 and 94).	Replace if voltage is present at the input and not at the output (WP 0108).
	Inspect soft starter (SS2) With power on, check for 240 VAC at the input (between wires 70 and 71) and output (between wires 80 and 81).	Replace if voltage is present at the input and not at the output (WP 0108).
	Inspect motor controller module (M3) With power on, check for 240 VAC at the input (between wires 60 and 61) and output (between wires 70 and 71).	Replace if voltage is present at the input and not at the output (WP 0108).
	Inspect continuity of wire 39 from the output 7 of the PLC output card 2 (OC2) to the backwash pump switch (SW 3).	Tighten loose connection. Replace or repair broken wires and connections.
	Inspect the generator cable for proper wire connections.	Remove the generator cable wires from the generator and reconnect them securely.
3. Pump malfunctions – Backwash cycle electrical components	Troubleshoot control module	(WP 0069).


RED (69)
RED (68)
L1 L2 L3
SOFT STARTER SS3
T1 T2 T3
#12 AWG
RED (79)
RED (78)
3 4
SURGE PROTECTOR SP5
1 2
#12 AWG
(97) RED
(96) GRN
(95) RED
J5
A C B
P5
BLK GRN WHT
CABLE No. 5
30 FEET LONG
BLK GRN WHT
P13
A C B
J13
MOTOR J-BOX
1/2 HP 3450 RPM
DISTRIBUTION PUMP
RED (71)
RED (70)
L1 L2 L3
SOFT STARTER SS2
T1 T2 T3
#12 AWG
RED (81)
RED (80)
3 4
SURGE PROTECTOR SP4
1 2
#12 AWG
(94) RED
(93) GRN
(92) RED
J4
A C B
P4
BLK GRN WHT
CABLE No. 4
20 FEET LONG
BLK GRN WHT
P12
A C B
J12
MOTOR J-BOX
1/2 HP 3450 RPM
BACKWASH PUMP
RED (73)
RED (72)
L1 L2 L3
SOFT STARTER SS1
T1 T2 T3
#12 AWG
RED (83)
RED (82)
3 4
SURGE PROTECTOR SP3
1 2
#12 AWG
(91) RED
(90) GRN
(89) RED
J3
A C B
P3
BLK GRN WHT
CABLE No. 3
50 FEET LONG
BLK GRN WHT
P11
A C B
J11
MOTOR J-BOX
1/2 HP 3450 RPM
BOOSTER PUMP
RED (75)
RED (74)
3 4
SURGE PROTECTOR SP2
1 2
#12 AWG
(88) RED
(87) GRN
(86) RED
J2
A C B
P2
BLK GRN WHT
CABLE No. 2
100 FEET LONG
BLK GRN WHT
P10
A C B
J10
MOTOR J-BOX
1/2 HP 3450 RPM
RAW WATER PUMP



END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
DISTRIBUTION SERVICE PUMP

GENERAL

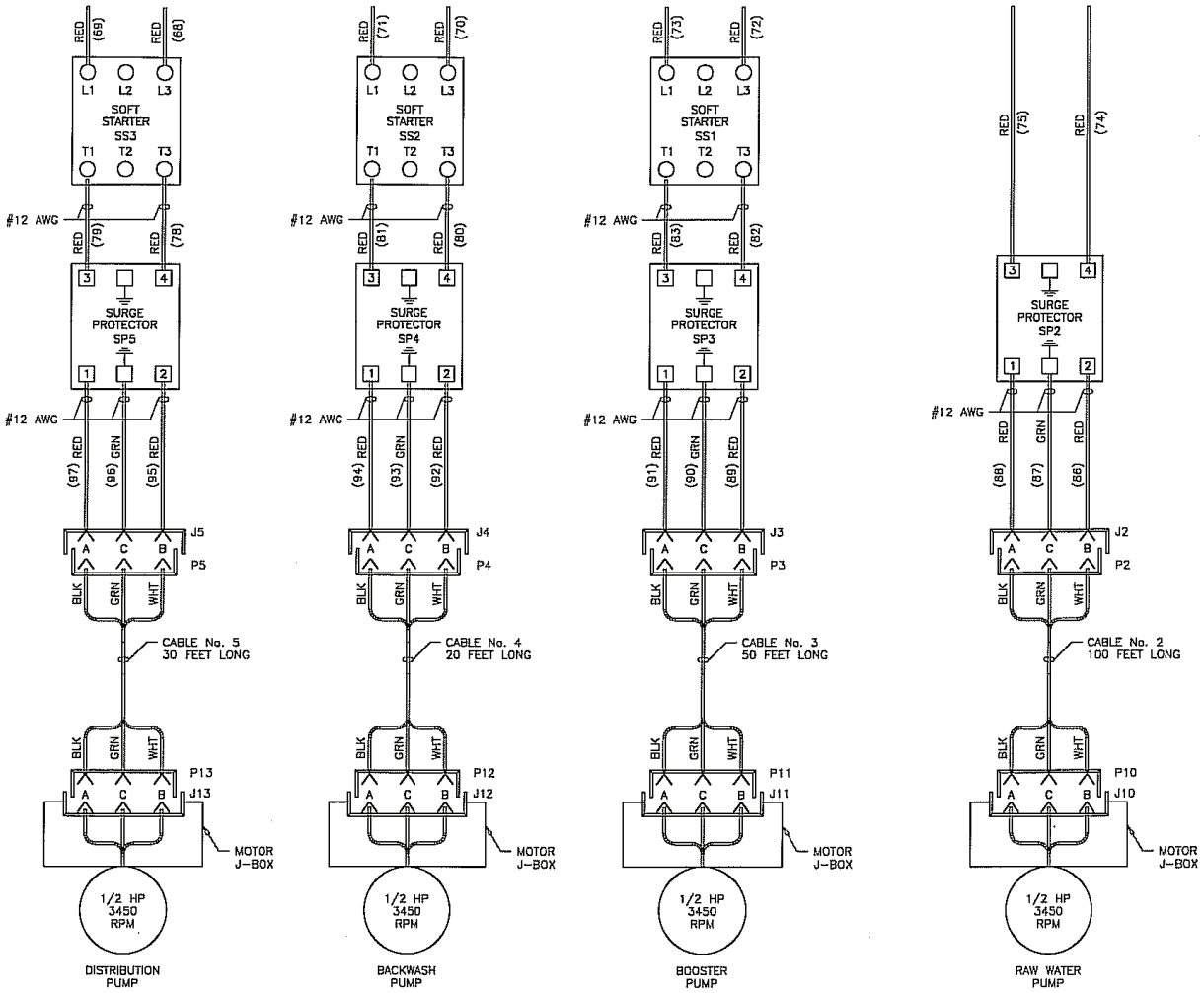
This work package lists the common electrical malfunctions that you may find during the operation or maintenance of the Distribution pump (P4) or its components used in the Lightweight Water Purifier (LWP). You should perform the electrical measurements in the order listed.

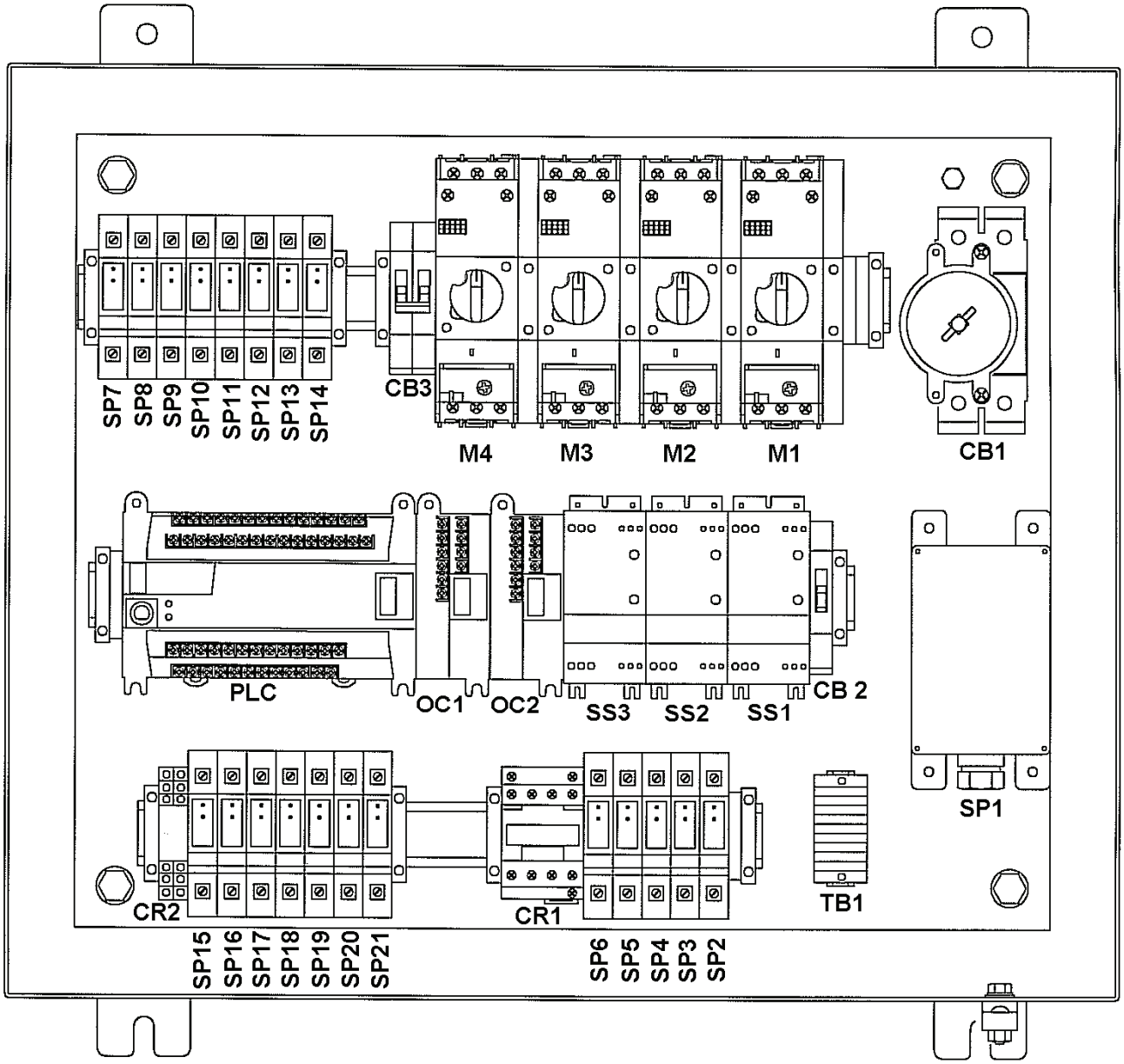
WARNING

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).
	Test pump light (WP 0047).	Replace light bulb (WP 0108).
	Inspect and reset the motor starter module and overload screw (WP 0047).	Replace motor starter module if faulty (WP 0108).
2. Pump light is on but pump is not operating	Disassemble and inspect the pump for debris. (WP 0117)	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 0115)

MALFUNCTION	TEST/INSPECTION	CORRECTIVE ACTION
2. Pump light is on but pump is not operating – - continued	If voltage is present and no fault is found at receptacle assembly, 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
	Inspect pump switch.	(WP 0071)
	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 0108).
	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 0108).
	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 0108).
	Inspect the generator cable for proper wire connections.	Remove the generator cable wires from the generator and reconnect them securely.


RED (69)
RED (68)
L1 L2 L3
SOFT STARTER SS3
T1 T2 T3
#12 AWG
RED (79)
RED (78)
3 4
SURGE PROTECTOR SP5
1 2
#12 AWG
(97) RED
(96) GRN
(95) RED
J5
A C B
P5
BLK GRN WHT
CABLE No. 5
30 FEET LONG
BLK GRN WHT
P13
A C B
J13
MOTOR J-BOX
1/2 HP 3450 RPM
DISTRIBUTION PUMP
RED (71)
RED (70)
L1 L2 L3
SOFT STARTER SS2
T1 T2 T3
#12 AWG
RED (81)
RED (80)
3 4
SURGE PROTECTOR SP4
1 2
#12 AWG
(94) RED
(93) GRN
(92) RED
J4
A C B
P4
BLK GRN WHT
CABLE No. 4
20 FEET LONG
BLK GRN WHT
P12
A C B
J12
MOTOR J-BOX
1/2 HP 3450 RPM
BACKWASH PUMP
RED (73)
RED (72)
L1 L2 L3
SOFT STARTER SS1
T1 T2 T3
#12 AWG
RED (83)
RED (82)
3 4
SURGE PROTECTOR SP3
1 2
#12 AWG
(91) RED
(90) GRN
(89) RED
J3
A C B
P3
BLK GRN WHT
CABLE No. 3
50 FEET LONG
BLK GRN WHT
P11
A C B
J11
MOTOR J-BOX
1/2 HP 3450 RPM
BOOSTER PUMP
RED (75)
RED (74)
3 4
SURGE PROTECTOR SP2
1 2
#12 AWG
(88) RED
(87) GRN
(86) RED
J2
A C B
P2
BLK GRN WHT
CABLE No. 2
100 FEET LONG
BLK GRN WHT
P10
A C B
J10
MOTOR J-BOX
1/2 HP 3450 RPM
RAW WATER PUMP



END OF WORK PACKAGE

FIELD 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.

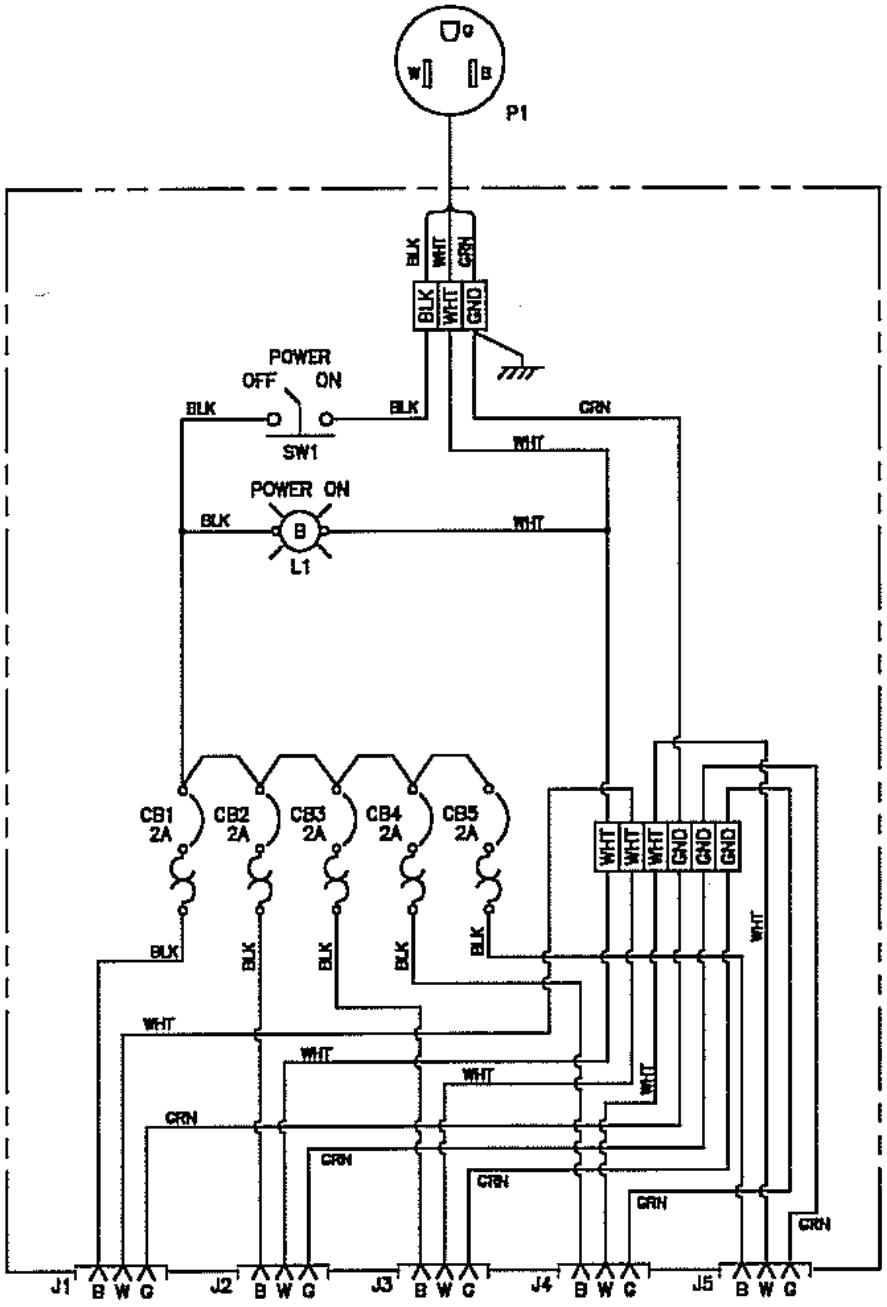
WARNING

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 continity 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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
CHEMICAL 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

FIELD 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 (HP) 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 (figure 1, item 2) from the fuel pump (figure 1, item 1). No need to remove the pipe on injector end (figure 1, item 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 0126).
	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 0123).
2. Engine shuts down undirected	Inspect the engine for seized bearings and excessively worn parts. (WP 0122).	Replace seized or damaged parts. (WP 0122).
3. Engine speed racing or irregular	Inspect the speed governor for damage or improper installation.	Install properly. Replace if damaged. (WP 0128).
4. Oil leaks	Head gasket	Replace. (WP 0121).
	Valve stem seal	Replace. (WP 0122).
	Fuel pump	Replace. (WP 0126).
	Crankcase cover	Replace. (WP 0124).
	Crank shaft oil seal	Replace. (WP 0122).

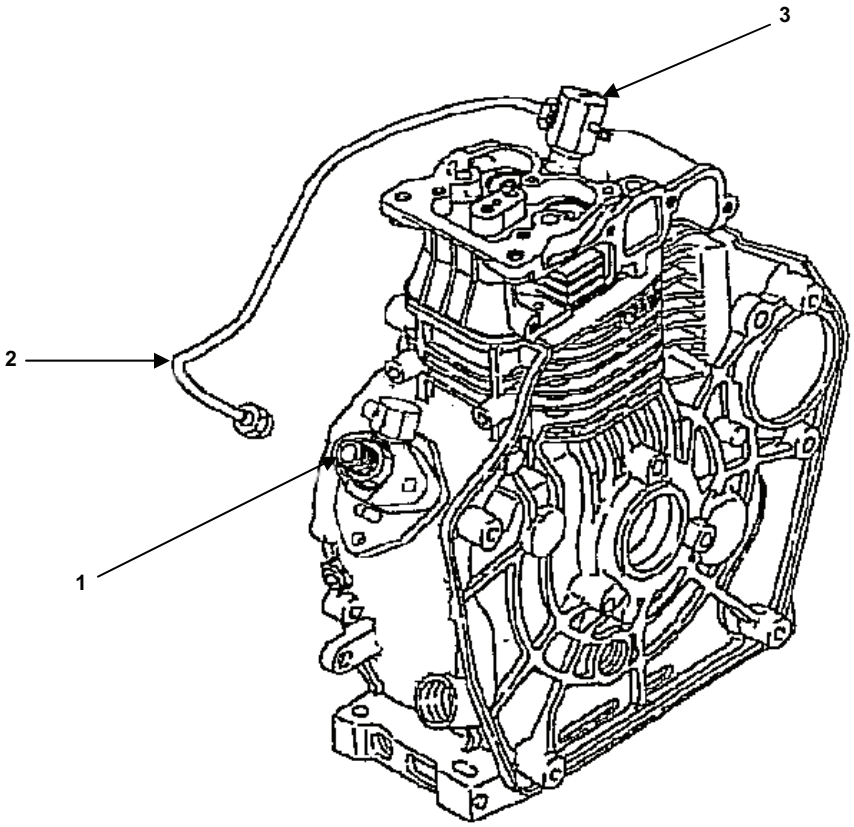


Figure 1. Diesel Engine.

END OF WORK PACKAGE

FIELD 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 0132).	Replace the corroded or damaged part. (WP 0132).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
TROUBLESHOOTING PROCEDURES
HIGH-PRESSURE PUMP

GENERAL

This work package lists the common malfunctions that you may find during the field maintenance 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 0127).	Replace if worn or corroded (WP 0127)
	Severe cavitation	Check inlet condtions
2. Pulsation	Foreign material trapped in inlet/discharge valves	Clean inlet/discharge valves. Install new valve kit (WP 0127)
3. Water leak a. Manifold	Worn high-pressure or low pressure seals	Install new seal kit. Increase frequency of service (WP 0127)
b. Into the crankcase	Excessive wear to seals	Install new seal kit. Increase frequency of service (WP 0127)
4. Knocking noise	Broken or worn bearing	Replace bearing (WP 0127)
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 0127)
6. Premature seal failure	Scored plungers	Replace plungers (WP 0127))
	Excessive pressure and/or temperature of pumped liquid	Check pressure and inlet pressure temperature
	Eroded manifold	Replace manifold. (WP 0127)

END OF WORK PACKAGE

CHAPTER 6

FIELD LEVEL MAINTENANCE INSTRUCTIONS FOR LIGHTWEIGHT WATER PURIFIER

FIELD 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 10-4610-310-23P).

Support equipment is listed in the Components of the End Item (COEI) and Basic Issue Items (BII). See (WP 0138).

Repair Parts

Repair parts are listed and illustrated in TM 10-4610-310-23P.

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 0011).

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 0009 and WP 0010. See Figure 1 and Figure 2.

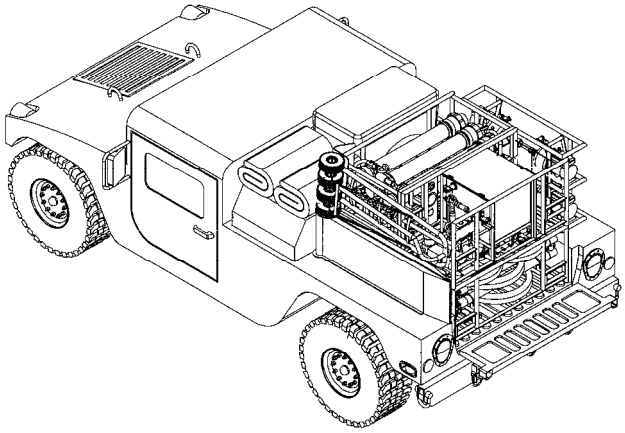


Figure 1. High Mobility Multipurpose Wheeled Vehicle (HMMWV).

SERVICE UPON RECEIPT - continued

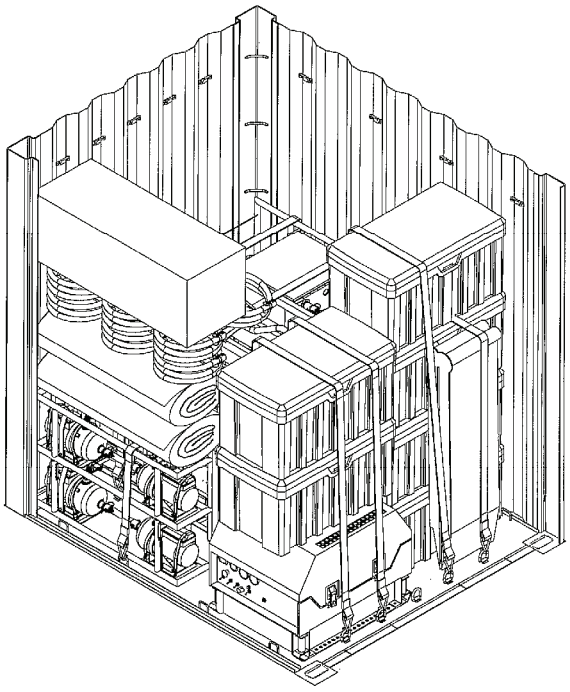


Figure 2. Triple Shipping and Storage Container (TRICON).

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 750-8).

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 750-8).

Setup Instructions

Setup the LWP according to (WP 0011 and WP 0012).

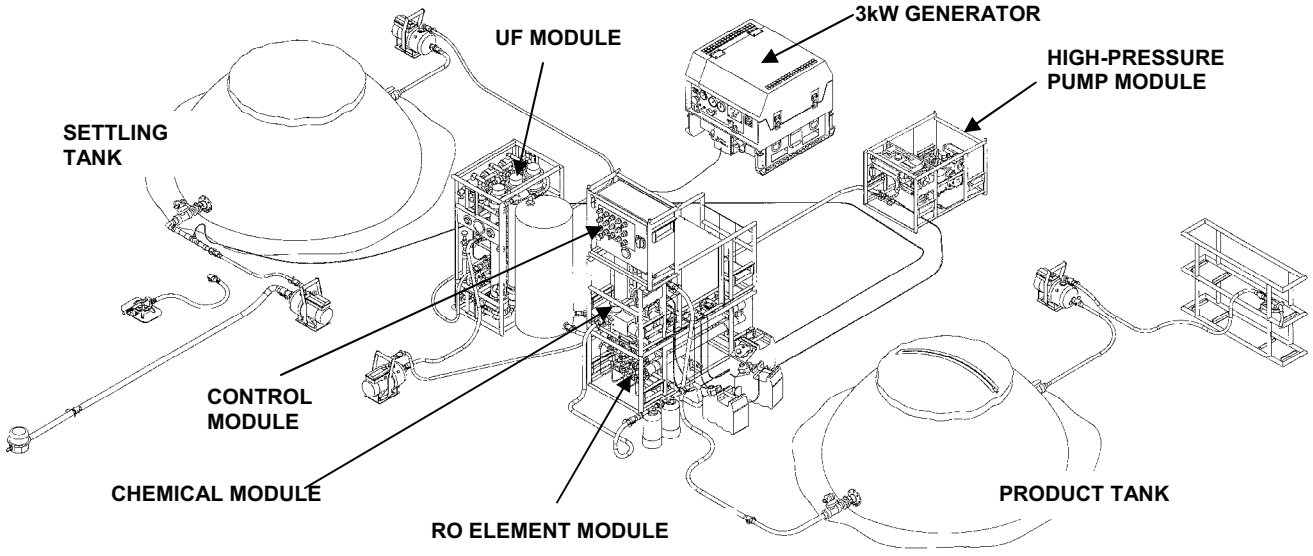


Figure 3. Field Setup.

SERVICE UPON RECEIPT - continued

Preliminary Servicing and Adjustment of Equipment

Remove RO simulators. See (WP 0046).

Draw the chemicals necessary for the mission and store them on the system. See (WP 0013).

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 0038 00 for Preventive Maintenance Checks and Services (PMCS).

TROUBLESHOOTING

Troubleshooting Procedures

See Chapter 3 for operator troubleshooting procedures, Chapter 5 for field 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 10-4610-310-23P).

END OF WORK PACKAGE

FIELD 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. Field Maintenance personnel are to do the PMCS tasks as shown in the PMCS table. Perform PMCS at the intervals stated in the PMCS table.

PMCS Procedures

Performing the PMCS procedures at the intervals listed will make sure the LWP meets its mission objective.

The PMCS table is arranged in five 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.

ITEM TO BE CHECKED OR SERVICES – what should be inspected or serviced.

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:

- Hours - Hours of equipment usage.
- Monthly - Do Monthly PMCS once a month.

If you find something wrong when performing PMCS, fix it if you can, using the troubleshooting procedures and/or maintenance procedures. 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 field maintenance. For further information on how to use (DA Form 2404), refer to (DA PAM 750-8).

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.

The LWP will require extra service and care when operated 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. Reduce interval as required in a rainy climate. Do not stow CACs when wet.
2. 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.
3. Refer to (TM 10-6116-639-13) for lubrication instructions and PMCS procedures for the 3kW TQG set.

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
PREVENTATIVE MAINTENANCE CHECKS AND SERVICES

Table 1. Field Maintenance Preventive Maintenance Checks and Services.

ITEM NO.	INTERVAL	ITEM TO BE CHECKED OR SERVICED	PROCEDURE	EQUIPMENT NOT READY/ AVAILABLE IF
1.	Weekly	Air shut off assembly	Lubricate (WP 0099)	
2.	100 hours*	Diesel engine - oil	Change oil (WP 0099)	
3.	100 hours	Diesel engine fuel strainer	Remove and clean. (WP 0099).	
4.	100 hours	Diesel engine air shutoff - vent plug	Remove and clean. (WP 0101).	
5.	Monthly*	Diesel engine fuel tank	Drain fuel, (WP 0103)	
6.	500 hours*	High-pressure pump oil	Perform oil change, (WP 0042)	
7.	1500 hours*	High-pressure pump seal	Change seals, (WP 0127)	
8.	500 hours*	Diesel engine head bolts	Check the torque on all head bolts and nuts, (WP 0122)	
9.	500 hours *	Diesel engine fuel filter	Change fuel filter, (WP 0099)	
10.	500 hours *	Diesel engine injection nozzle	Check injection nozzle, (WP 0126)	
11.	500 hours *	Diesel engine injection pump	Check injection pump, (WP 00126)	
12.	500 hours *	Diesel engine intake and exhaust valve clearance	Adjust intake and exhaust valve clearance (WP 0121)	
13.	500 hours*	Diesel engine fuel piping	Check fuel piping. Replace as required, (No specific WP for engine fuel piping)	
14.	1000 hours	Diesel engine oil filter	Change engine oil filter (WP 0099)	
15.	1000 hours*	Diesel engine intake and exhaust valve stem seals	Inspect and if necessary, reface intake and exhaust valve stem seals, (WP 0121)	
16.	1000 hours*	Diesel engine piston rings	Replace piston ring, (WP 0123)	
17.	As required	Diesel engine fuel filter	Clean 50 hours after switching to JP-8 fuel	

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE PIPING
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

Materials/Parts
Tape, anti-seize (WP 0139, Item 32)

Equipment Condition Required
All equipment de-energized, hoses disconnected

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. Locations are shown in Figure 1.

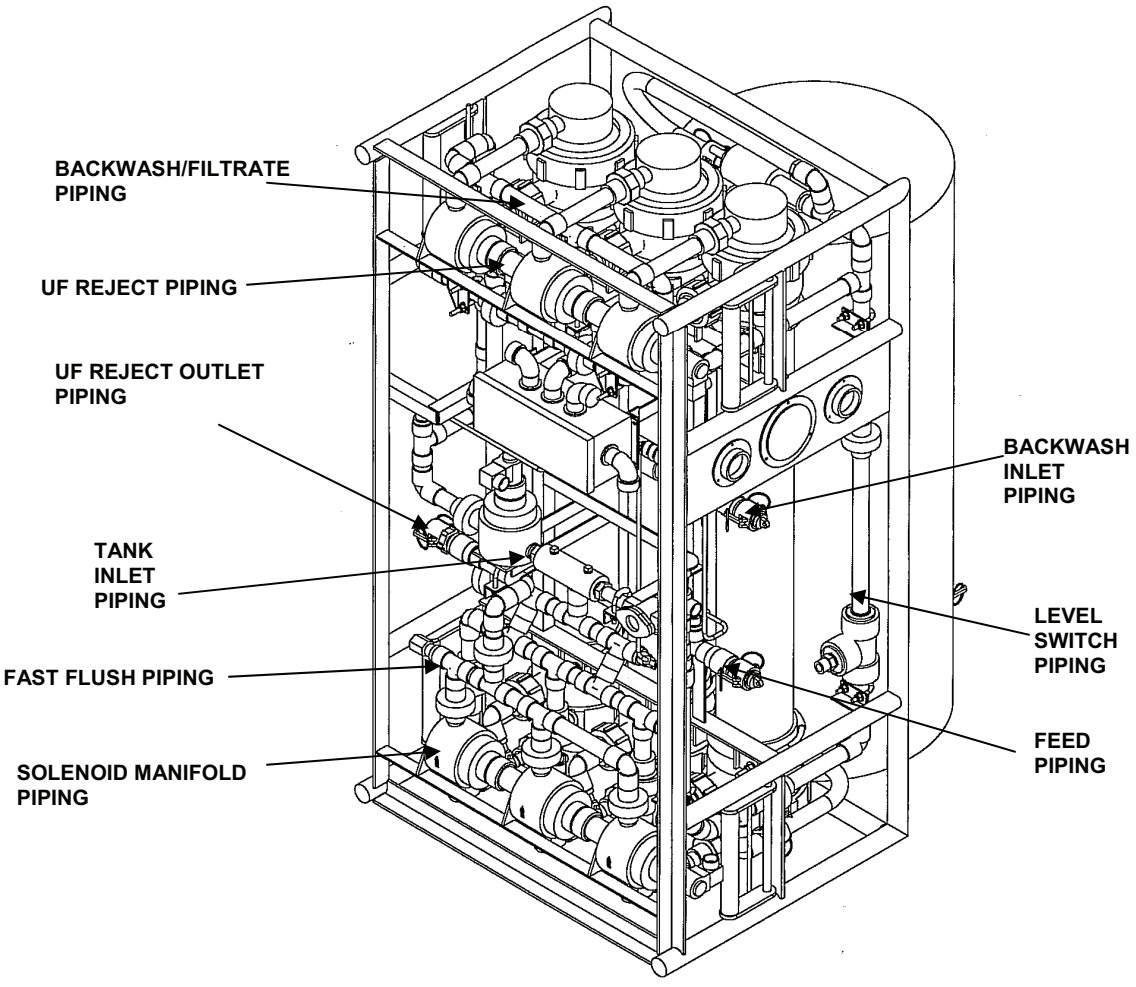


Figure 1. Ultrafiltration Module Piping.

REMOVAL

UF FEED PIPING

1. Loosen the three (3) unions (Figure 2, Item 1). Remove the lock nuts (Figure 2, Item 7) and lockwashers (Figure 2, Item 6) from U-bolt (Figure 2, Item 4).

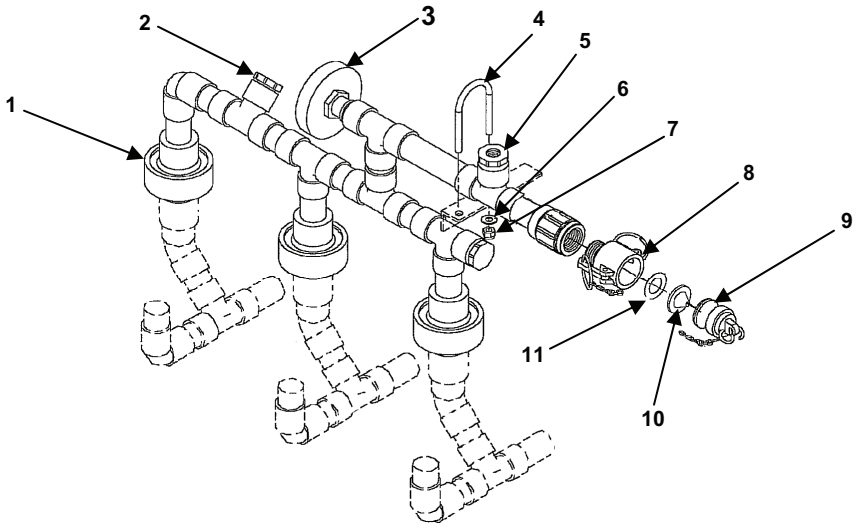


Figure 2. UF Feed Piping.

2. Remove the differential pressure gauge tubing from the tee fitting (Figure 2, Item 2).

3. Remove the temperature gauge (Figure 2, Item 3), unthread female camlock (Figure 2, Item 8) and dust plug (Figure 2, Item 9) if necessary.

4. Remove support washer (Figure 2, Item 11) and 30-mesh screen (Figure 2, Item 10) if necessary. Discard 30-mesh screen (Figure 2, Item 10).

5. Remove the feed pressure gauge tubing from tee fitting (Figure 2, Item 5).

UF TANK INLET PIPING REMOVAL

1. Remove nuts (Figure 3, Item 8) and washers (Figure 3, Item 9) from U-bolts (Figure 3, Item 7). Remove U-bolts.

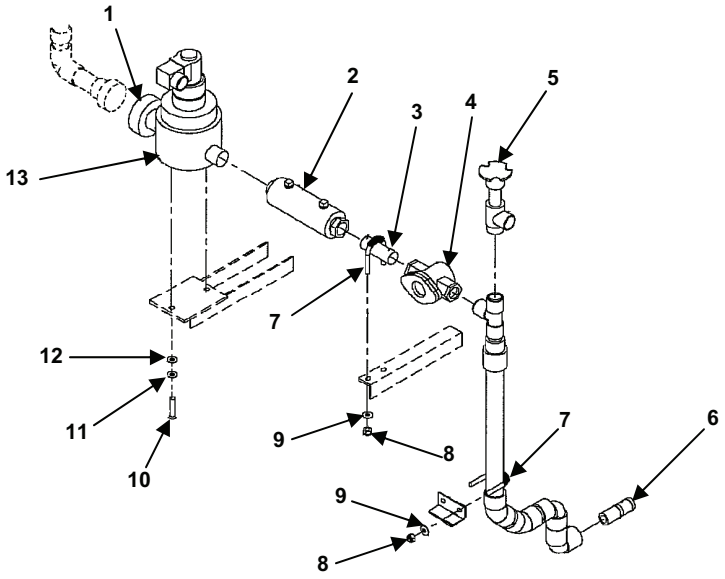


Figure 3. UF Tank Inlet Piping.

2. Remove the coil from the solenoid valve (Figure 3, Item 13). See (WP 0094).

3. Loosen union (Figure 3, Item 1) and remove screws (Figure 3, Item 10), lockwashers (Figure 3, Item 11) and washers (Figure 3, Item 12) from solenoid valve (Figure 3, Item 13).

UF TANK INLET PIPING REMOVAL- continued

4. Disconnect the hose from the fitting (Figure 3, Item 6).

5. Remove flow controller (Figure 3, Item 2), nipple (Figure 3, Item 3), flow indicator (Figure 3, Item 4), filtrate valve (Figure 3, Item 5) and fitting (Figure 3, Item 6) from piping only if necessary.

LEVEL SWITCH PIPING REMOVAL

1. Loosen the union (Figure 4, Item 1). Remove nuts (Figure 4, Item 6) and washers (Figure 4, Item 5) from the U-bolt (Figure 4, Item 3).

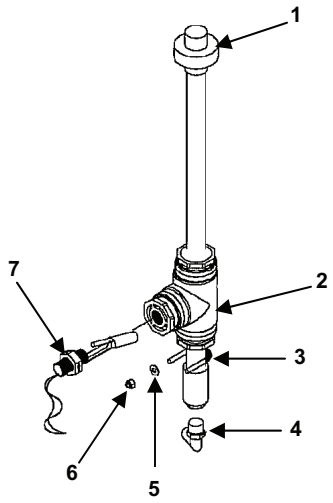


Figure 4. Level Switch Piping.

2. Remove hose from the elbow (Figure 4, Item 4). Remove level switch (Figure 4, Item 7) from the holder (Figure 4, Item 2) only if necessary.

BACKWASH INLET PIPING REMOVAL

1. Loosen unions (3) (Figure 5, Item 1, 2 and 3). Remove tubing from tee fitting (Figure 5, Item 7).

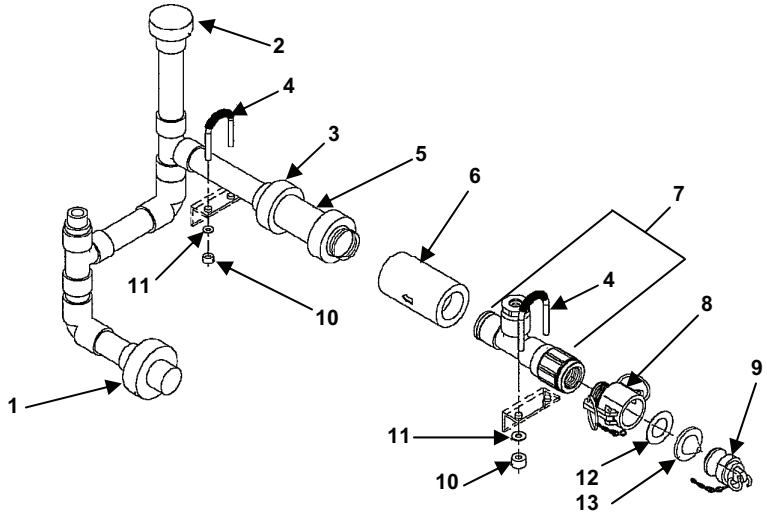


Figure 5. Backwash Inlet Piping.

2. Remove nuts (Figure 5, Item 10) and washers (Figure 5, Item 11) from the U-bolts. Remove the U-bolts.

BACKWASH INLET PIPING REMOVAL-continued

3. Remove check valve (Figure 5, Item 5), flow control valve (Figure 5, Item 6), female camlock (Figure 5, Item 8) and dust plug (Figure 5, Item 9) only if necessary.

4. Remove support washer (Figure 5, Item 12) and 30-mesh screen (Figure 5, Item 13) if necessary. Discard screen (Figure 5, Item 13).

BACKWASH/FILTRATE PIPING

1. Loosen the unions 3 ea. (Figure 6, Item 5) and at (Figure 6, Item 1).

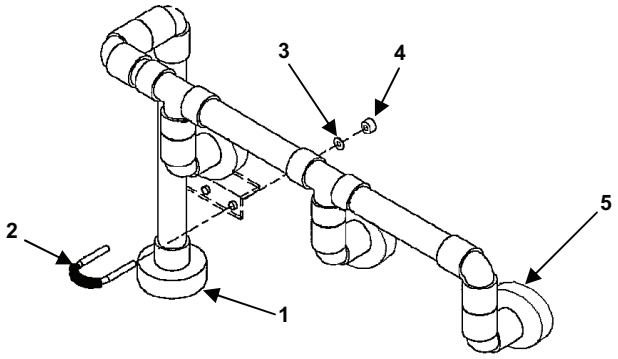


Figure 6. Backwash/ Filtrate Piping.

2. Remove the nuts (Figure 6, Item 4), washers (Figure 6, Item 3) from U-bolt (Figure 6, Item 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 3 ea.(Figure 7, Item 1) connect the entire spool piece to the UF cartridges, (Figure 7, Item 2) inter connects the three (3) valve spool pieces and (Figure 7, Item 3,4) connects to the rest of the piping.

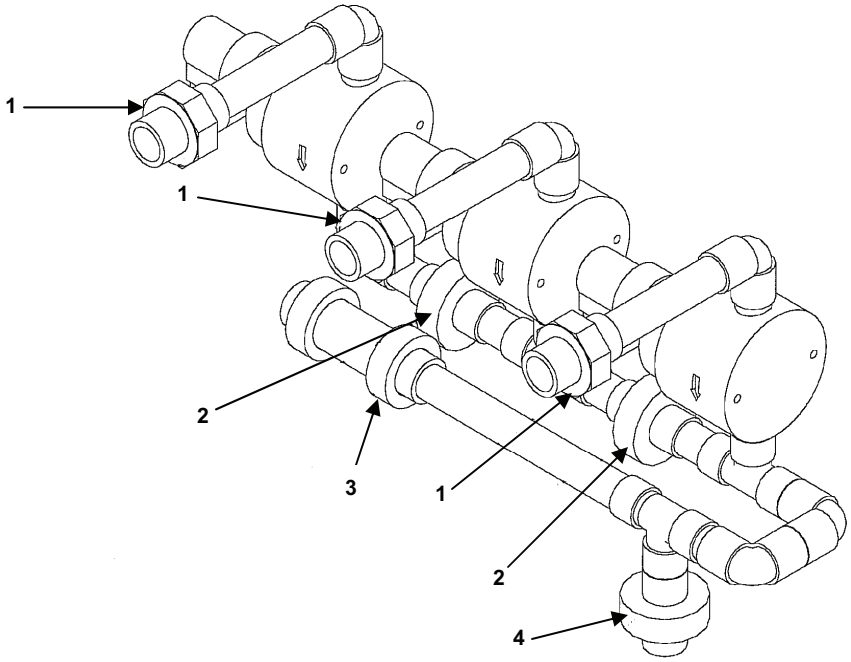


Figure 7. UF Reject Piping Unions.

UF REJECT PIPING - continued

1. Remove nuts (Figure 8, Item 2), washers (Figure 8, Item 3) from U-bolts (Figure 8, Item 1). Remove U-bolts.

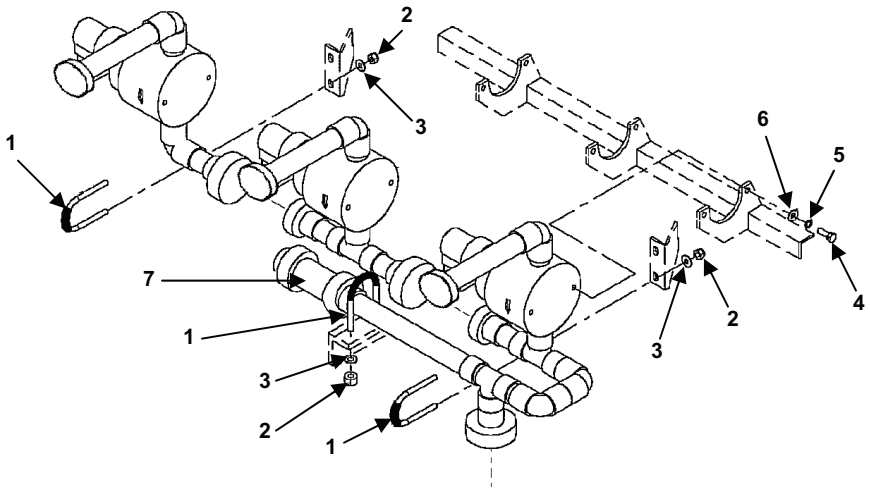


Figure 8. UF Reject Piping Assembly.

2. Remove screws (Figure 8, Item 4), lock washers (Figure 8, Item 5), and washers (Figure 8, Item 6) from valve supports.

3. Remove the coil from the solenoid valve. See (WP 0094).

4. Remove the unions as needed to remove the spool pieces. See Figure 7.

5. Remove check valve (Figure 8, Item 7) if needed.

UF REJECT OUTLET PIPING REMOVAL

1. Loosen the unions 2 ea. (Figure 9, Item 2 and 7). Remove nuts (Figure 9, Item 4), washers (Figure 9, Item 3) and remove U-bolt (Figure 9, Item 1).

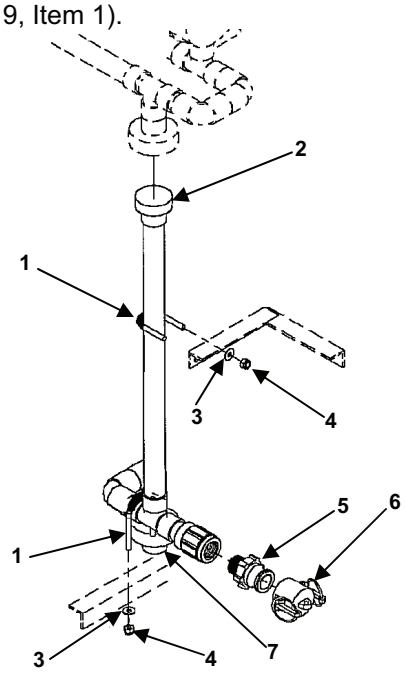


Figure 9. UF Reject Outlet Piping.

UF REJECT OUTLET PIPING REMOVAL- continued

2. Remove male camlock (Figure 9, Item 5) and dust cover (Figure 9, Item 6) only if necessary.

FAST FLUSH MANIFOLD PIPING REMOVAL

1. Loosen the unions 3 ea. (Figure 10, Item 3) and (Figure 10, Item 2) to remove this piping. Remove drain valve (Figure 10, Item 1) only if necessary.

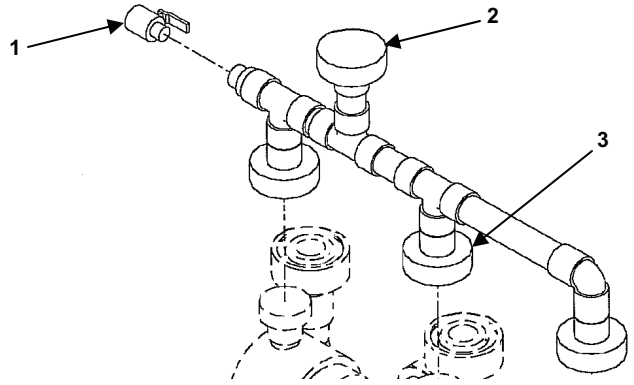


Figure 10. Fast Flush Manifold Piping.

FAST FLUSH PIPING REMOVAL

All three fast flush piping are interchangeable.

1. Remove the coil from the solenoid valve. See (WP 0094).

2. Loosen the unions (Figure 11, Item 1,2,6). Remove the coil from the solenoid valve. See (WP 0094).

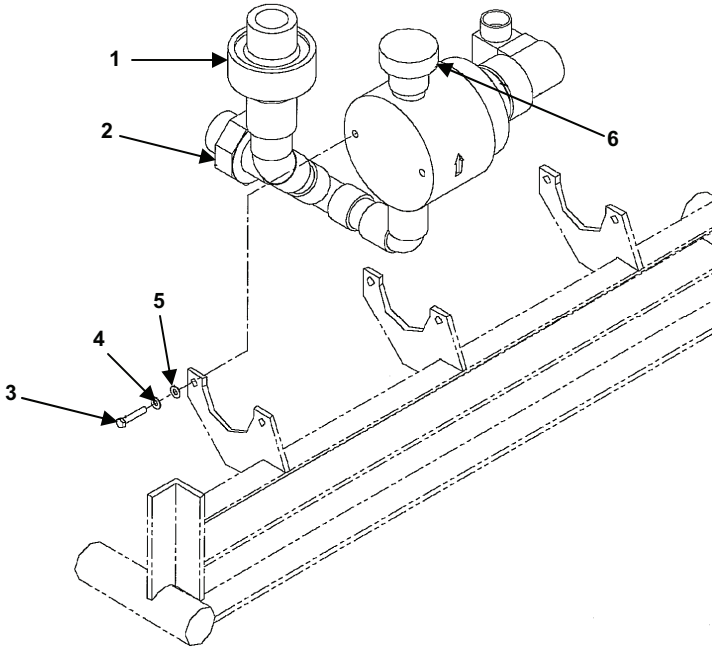


Figure 11. Fast Flush Piping.

3. Remove screws (Figure 11, Item 3), lock washers (Figure 11, Item 4) and washers (Figure 11, Item 5) from solenoid valve support.

TANK VENT PIPING REMOVAL

1. Loosen unions (Figure 12, Item 1) and (Figure 12, Item 9).

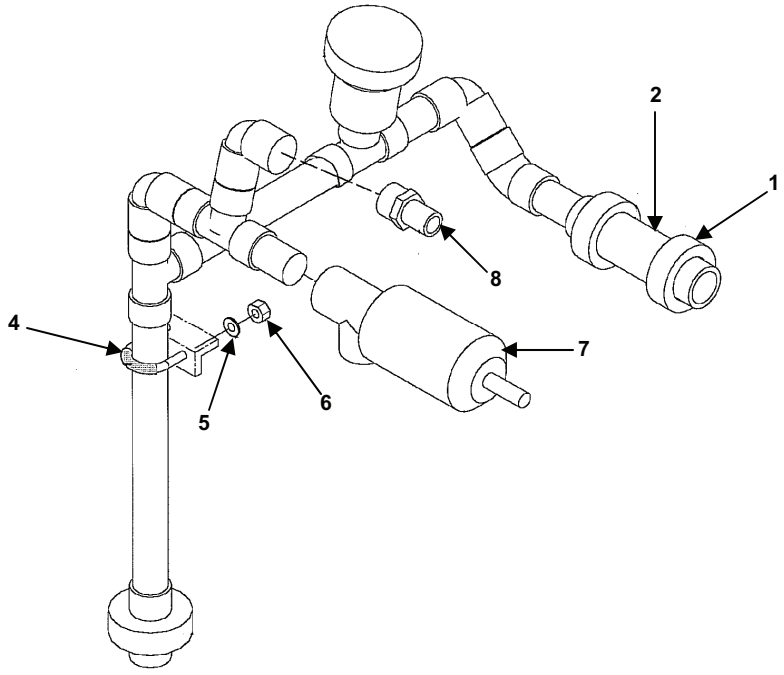


Figure 12. Tank Vent Piping.

2. Remove nuts (Figure 12, Item 6), washers (Figure 12, Item 5) and remove U-bolt (Figure 12, Item 4).

3. Remove check valve (Figure 12, Item 2), vacuum breaker (Figure 12, Item 3), hose adapter (Figure 12, Item 8), and pressure relief valve (Figure 12, Item 7) only if necessary.

UF CARTRIDGE DRAIN PIPING REMOVAL

1. Loosen the unions one (1) per cartridge bottom and top (Figure 13, Item 1) and remove the drain piping.

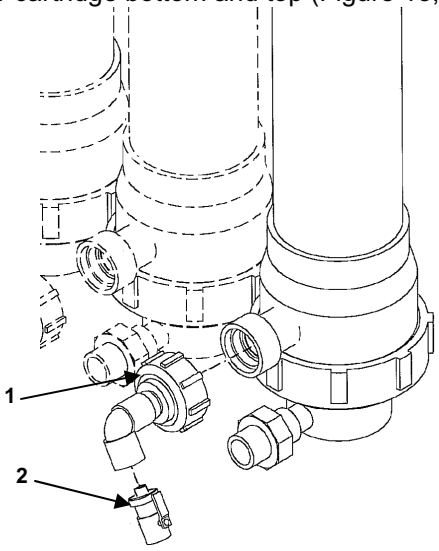


Figure 13. UF Cartridge Drain Piping.

2. Remove drain valve (Figure 13, Item 2) only if necessary.

INSPECTION

1. Inspect all threads for damage.
2. Inspect all O-rings for serviceability.
3. Inspect check valve by removing the union (Figure 11, Item 1) and checking the rubber diaphragm inside.
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 overtighten. 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 INSTALLATION

1. Refer to Figure 2 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (Figure 2, Item 1).
4. Install the U-bolt (Figure 2, Item 4) and fasten the lock nuts (Figure 2, Item 1) washers (Figure 2, Item 6) to the U-bolt (Figure 2, Item 4).
5. Install the differential pressure gauge tubing to tee fitting (Figure 2, Item 2).
6. Install the feed pressure gauge tubing to tee fitting (Figure 2, Item 5).
7. Install the temperature gauge (Figure 2, Item 3) if necessary.
8. Install support washer (Figure 2, Item 11) and a new 30-mesh screen (Figure 2, Item 10) if removed.

UF TANK INLET PIPING INSTALLATION

1. Refer to Figure 3 for this piping.
2. Mount the piping in its location.
3. Tighten the union (Figure 3, Item 1).
4. Install the U-bolt (Figure 3, Item 7) and fasten the lock nuts (Figure 3, Item 8) washers (Figure 3, Item 9) to the U-bolt (Figure 3, Item 7).
5. Fasten the solenoid valve with screws (Figure 3, Item 10), lock washers (Figure 3, Item 11) and washers (Figure 3, Item 12).
6. Install the solenoid valve coil.

UF TANK INLET PIPING INSTALLATION - continued

7. Install flow controller (Figure 3, Item 2), nipple (Figure 3, Item 3), flow indicator (Figure 3, Item 4), filtrate valve (Figure 3, Item 5) and fitting (Figure 3, Item 6) on piping as necessary.

LEVEL SWITCH PIPING INSTALLATION

1. Refer to Figure 4 for this piping.
2. Mount the piping in its location.
3. Tighten the union (Figure 4, Item 1).
4. Install the U-bolt (Figure 4, Item 3) and fasten the lock nuts (Figure 4, Item 6) washers (Figure 4, Item 5) to the U-bolt (Figure 4, Item 3).

BACKWASH INLET PIPING INSTALLATION

1. Refer to Figure 5 for this piping.
2. Mount the piping in its location.
3. Tighten unions (Figure 5, Item 1, 2, and 3).
4. Install tubing on tee fitting (Figure 5, Item 7).
5. Install the U-bolt (Figure 5, Item 4) and fasten the lock nuts (Figure 5, Item 10) washers (Figure 5, Item 11) to the U-bolt (Figure 5, Item 4).
6. Install the check valve (Figure 5, Item 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 (Figure 5, Item 6) if necessary.
8. Install support washer (Figure 5, Item 12) and a new 30-mesh screen (Figure 5, Item 13) if removed.

BACKWASH/FILTRATE PIPING INSTALLATION

1. Refer to Figure 6 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (Figure 6, Item 5 and 1).
4. Install the U-bolt (Figure 6, Item 2) and fasten the lock nuts (Figure 6, Item 4) washers (Figure 6, Item 3) to the U-bolt (Figure 6, Item 2).

UF REJECT PIPING INSTALLATION

1. Refer to Figure 7 and Figure 8 for this piping.
2. Mount the piping in its location.
3. Install check valve (Figure 8, Item 7). Ensure arrow on body of the check valve is in line with the direction of the flow.
4. Tighten unions (Figure 7, Item 1, 2, 3 and 4) as required.

UF REJECT PIPING INSTALLATION- continued

5. Install the U-bolt (Figure 8, Item 1) and fasten the lock nuts (Figure 8, Item 2) washers (Figure 8, Item 3) to the U-bolt (Figure 8, Item 1).

6. Fasten the solenoid valves with screws (Figure 8, Item 4), lock washers (Figure 8, Item 5) and washers (Figure 8, Item 6).

7. Connect the coils to the solenoid valves.

UF REJECT OUTLET PIPING INSTALLATION

1. Refer to Figure 9 for this piping.

2. Mount the piping in its location.

3. Tighten unions (Figure 9, Item 2 and 7).

4. Install the U-bolt (Figure 9, Item 1) and fasten the lock nuts (Figure 9, Item 4) washers (Figure 9, Item 3) to the U-bolt (Figure 9, Item 1).

FAST FLUSH MANIFOLD PIPING INSTALLATION

1. Refer to Figure 10 for this piping.

2. Mount the piping in its location.

3. Tighten the unions (Figure 10, Item 3 and 2).

4. Install the drain valve (Figure 10, Item 1) if necessary.

FAST FLUSH PIPING INSTALLATION

1. Refer to Figure 11 for this piping.

2. Mount the piping in its location.

3. Tighten the unions (Figure 11, Item 1, 2 and 6).

4. Fasten the solenoid valves with screws (Figure 11, Item 3), lock washers (Figure 11, Item 4) and washers (Figure 11, Item 5).

5. Install the coil on the solenoid.

TANK VENT PIPING INSTALLATION

1. Refer to Figure 12 for this piping.

2. Mount the piping in its location.

3. Tighten the unions (Figure 12, Item 1 and 9).

4. Install the U-bolt (Figure 12, Item 4) and fasten the lock nuts (Figure 12, Item 6) washers (Figure 12, Item 5) to the U-bolt (Figure 12, Item 4).

5. Install the check valve (Figure 12, Item 2) if necessary. Ensure that the arrow on the body of the check valve is in line with the direction of the flow.

TANK VENT PIPING INSTALLATION-continued

6. Install the vacuum breaker (Figure 12, Item 3), hose adapter (Figure 12, Item 8), and pressure relief valve (Figure 12, Item 7) if necessary.

UF CARTRIDGE DRAIN PIPING INSTALLATION

1. Refer to Figure 13 for this piping.
2. Mount the piping in its location.
3. Tighten the unions (Figure 13, Item 1).
4. Install the drain valve (Figure 13, Item 2) if necessary.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
FILTRATE TANK
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

Personnel Required

2

Material/Parts

Rags, cotton, wiping (WP 0139, Item 24)

Tank, Filtrate (PN 12511538)

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 (Figure 1, Item 1) is drained. Remove the straps from the module frame.

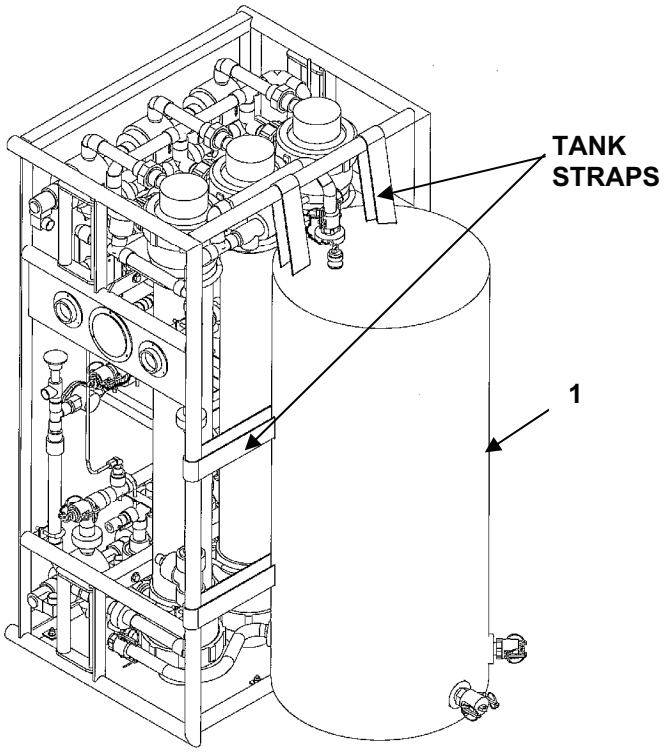


Figure 1. UF Filtrate Tank.

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 (Figure 2, Item1), level switch hose (Figure 2, Item 4) and inlet hose (Figure 2, Item 5).

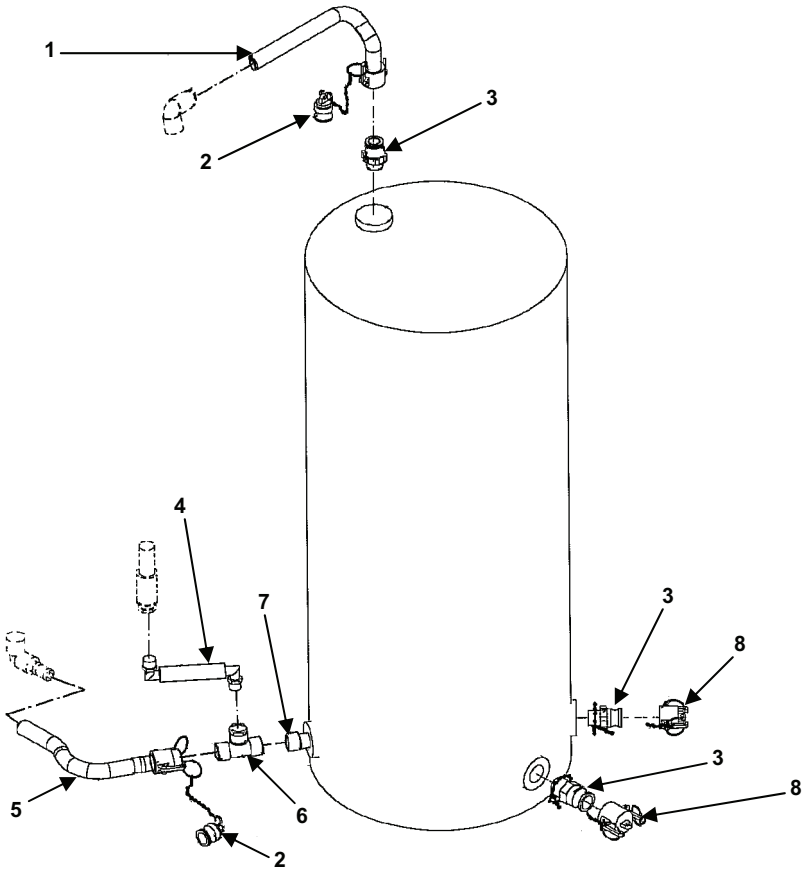


Figure 2. Filtrate Tank Piping.

2. Remove male camlock fittings (Figure 2, Item 3), tee fitting (Figure 2, Item 6), and adapter (Figure 2, Item 7) only if necessary.
3. Remove dust plugs (Figure 2, Item 2) and dust caps (Figure 2, Item 8) only if necessary.

INSTALLATION

Before installation, ensure all hoses and fittings are clean and serviceable.

1. Install the adapter (Figure 2, Item 7), and tee fitting (Figure 2, Item 6) and male camlock fittings (Figure 2, Item 3) on the filtrate tank if necessary.
2. Connect the inlet hose (Figure 2, Item 5), level switch hose (Figure 2, Item 4), and vent hose (Figure 2, Item 1).
3. Install the dust plugs (Figure 2, Item 2) and dust caps (Figure 2, Item 8) if necessary.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION CARTRIDGE
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

Personnel Required
2

Materials/Parts
Gasket, port, (PN 12497120)
Cartridge, 5-inch, (PN 12489136)
O-ring, (PN 12497121)

General Safety Instructions
Observe all Cautions.

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 0092).
2. Drain the Ultrafiltration module thoroughly. See (WP 0016).

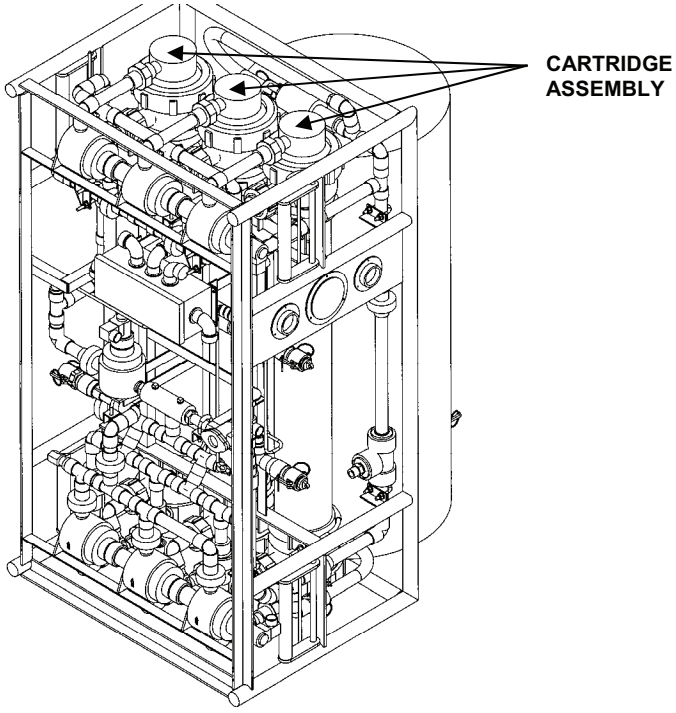


Figure 1. Ultrafiltration Module.

REMOVAL - continued

3. Disconnect piping attached to the cartridge. See (WP 0091).
    a. Disconnect UF cartridge drain piping.
    b. Disconnect fast flush piping.
    c. Disconnect filtrate/backwash piping
    d. Disconnect UF reject piping.
4. Remove nuts (Figure 2, Item 7), washers (Figure 2, Item 8) and U-bolts (Figure 2, Item 9).
5. Remove the UF cartridge from the module.
6. Remove the end caps (Figure 2, Item 1) by unthreading the nuts (Figure 2, Item 2).

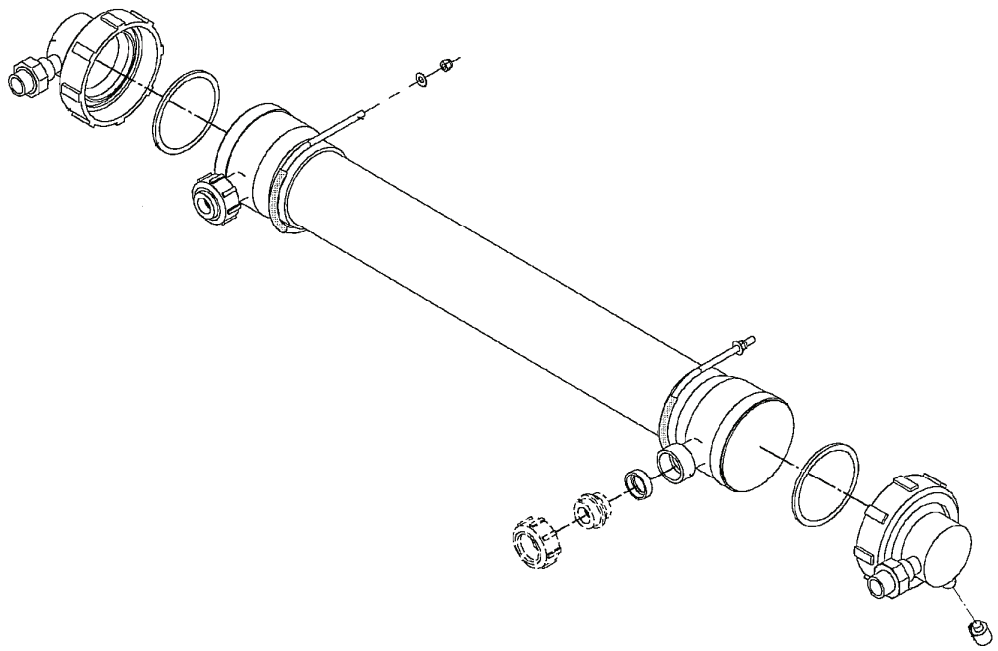


Figure 2. Cartridge Mounting Hardware.

7. Remove the O-rings (Figure 2, Item 3). Replace if damaged.
8. Remove the gasket (Figure 2, Item 4) from the filtrate port (Figure 2, Item 5). Replace if damaged.
9. Remove low point drain valve (Figure 2, Item 6) only if necessary.

INSTALLATION

1. Ensure that all O-rings and gaskets are serviceable.
2. Install gasket (Figure 2, Item 4) in the filtrate port (Figure 2, Item 5).
3. Install O-rings (Figure 2, Item 3).
4. Install end caps (Figure 2, Item 1) by tightening the nut (Figure 2, Item 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 (Figure 2, Item 9) and fasten with nuts (Figure 2, Item 7) and washers (Figure 2, Item 8).
7. Connect piping to the cartridge. (See WP 0091).
    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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
SOLENOID VALVE REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

Equipment Condition Required

Discontinue fluid and electrical service.

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize (WP 0139, Item 32)
Valve, solenoid, PN 12497012(with hole)
Valve, solenoid, PN 12511399 (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 0055 through WP 0061). See Figure 1.

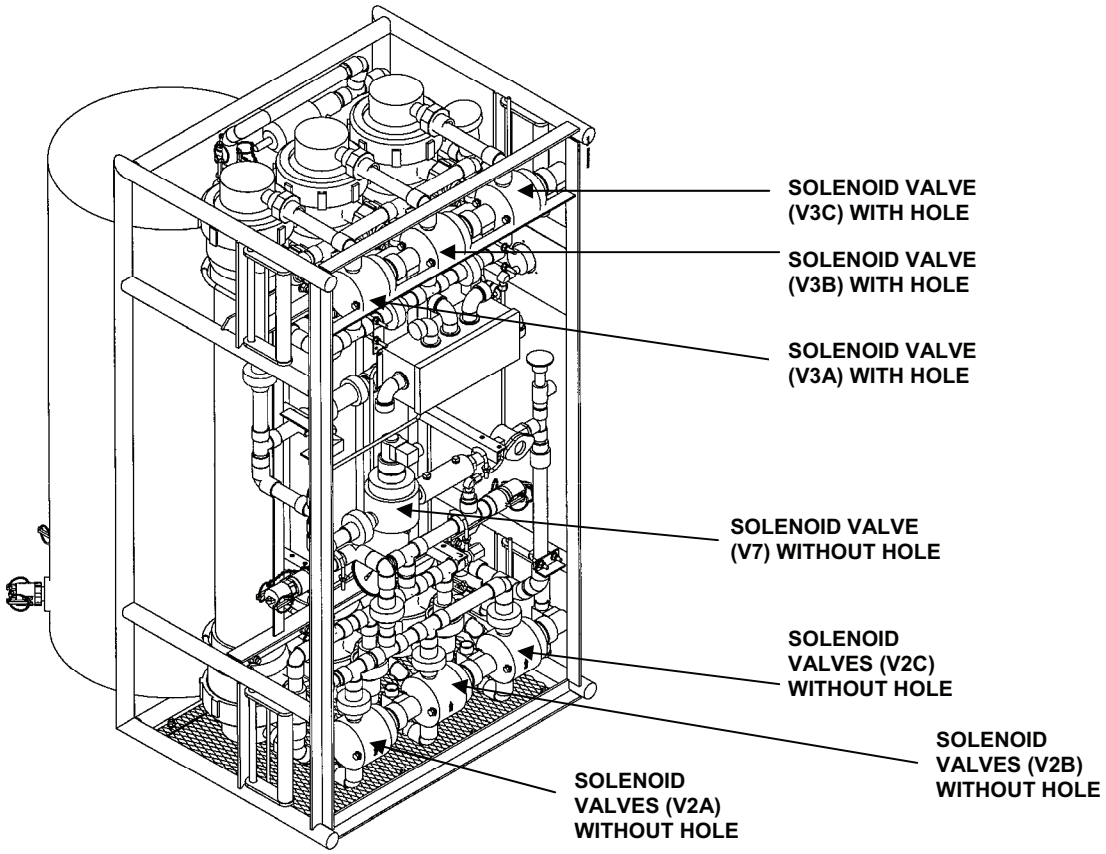


Figure 1. Ultrafiltration Module.

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. Only replace the top parts. If the valve needs complete repair, see WP 0120 00.

2. Remove cap nut (Figure 2, item 1), O-ring (Figure 2, item 2) and screw (Figure 2, item 7).

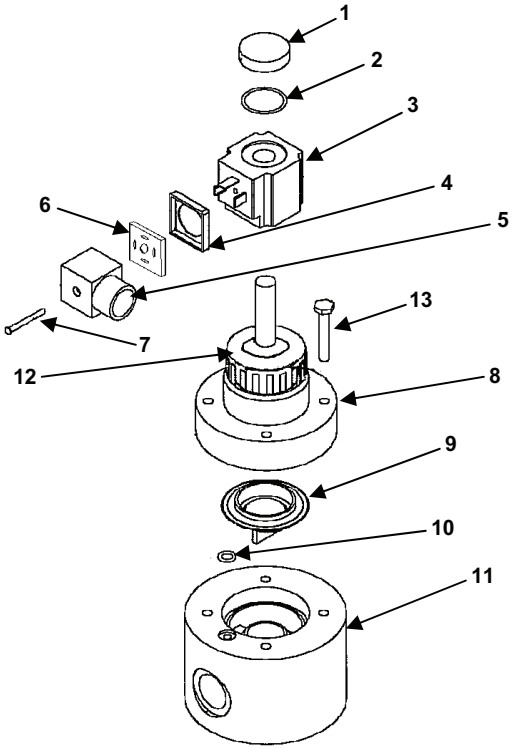


Figure 2. Solenoid Valve Assembly.

3. Remove the electrical connector (Figure 2, item 5) and gasket (Figure 2, item 4), lighted wafer (Figure2, item 6).
4. Remove coil (Figure 2, item 3) and four screws (Figure 2, item 12).
5. Remove valve top (Figure 2, item 8), diaphragm (Figure 2, item 9) and O-ring (Figure 2, item 10) from socket body (Figure 2, item 11). It is not necessary to remove union nut (Figure 2, item 12).

REMOVING THE COMPLETE VALVE FROM PIPING

If any of the solenoid valves need to be removed from the piping, see (WP 0091).

INSPECTION

1. Inspect the O-rings (Figure 2, item 2 and 10) and gasket (Figure 2, item 4) for damage or deformity.
2. Inspect diaphragm (Figure 2, item 9) and lighted wafer (Figure 2, item 6) for damage or clogged pores.
3. Inspect the socket body for debris, deposits or damage.

INSTALLATION

1. Install O-ring (Figure 2, item 10) on socket body (Figure 2, item 11).
2. Install diaphragm (Figure 2, item 9) into socket body (Figure 2, item 11). Ensure fin is on the bottom and parallel with the flow.

INSTALLATION – continued

3. Install valve top (Figure 2, item 8) and secure with screws (Figure 2, item 13).
4. Install coil (Figure 2, item 3) O-ring (Figure 2, item 2) and cap nut (Figure 2, item 1).
5. Install gasket (Figure 2, item 4), electrical connector (Figure 2, item 5), and secure with screw (Figure 2, item 7).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
GAUGES REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

Equipment Condition Required

All equipment de-energized.

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize (WP 0139, Item 32)
Gauge, pressure, differential, (PN 12497126)
Gauges, pressure Feed and Backwash, (PN 12497125)
Gauge, temperature, (PN 12497129)

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.

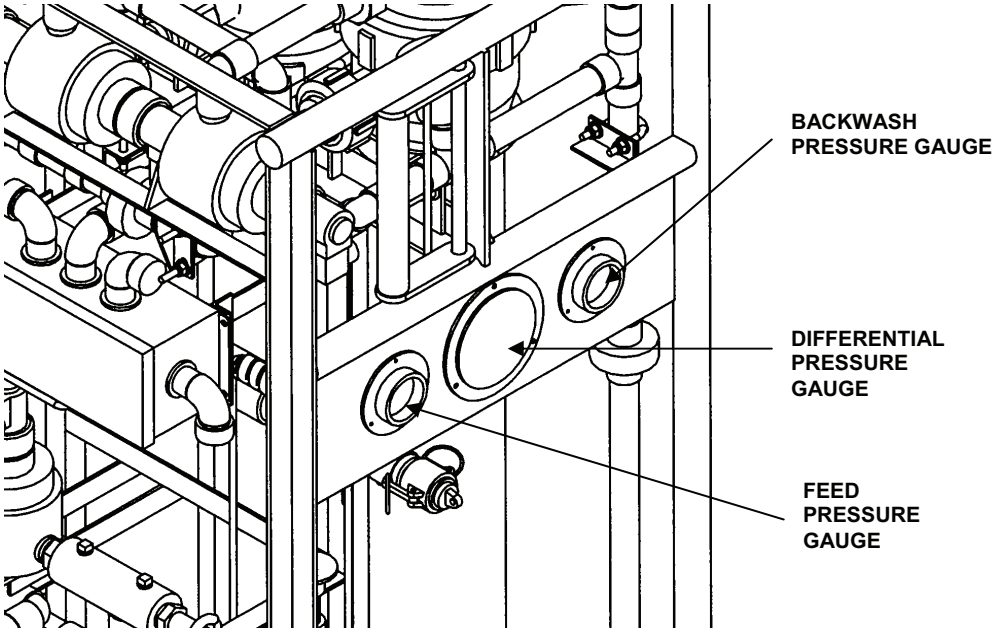


Figure 1. Ultrafiltration Module.

Differential Pressure Gauge

1. Remove screws (Figure 2, item 3), nuts (Figure 2, item 1) and washers (Figure 2, item 2) from gauge (Figure 2, item 4).
2. Disconnect tubing (Figure 2, item 5 and 6) from gauge.

REMOVAL - continued

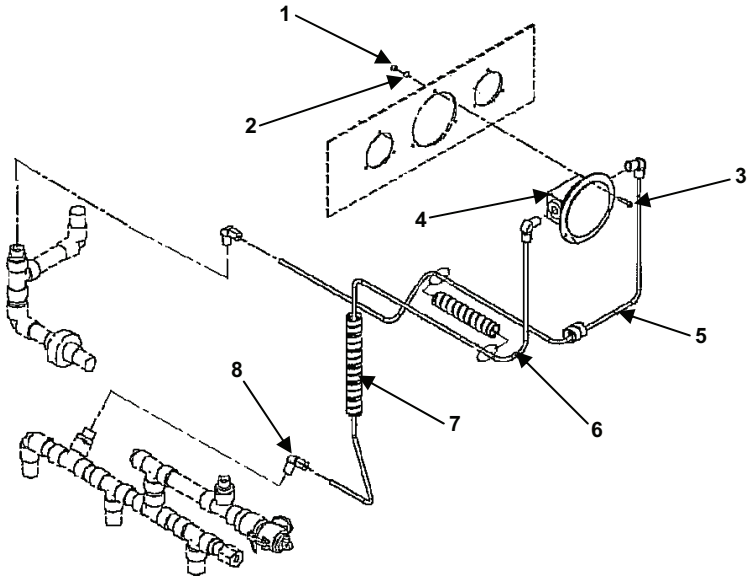


Figure 2. Differential Pressure Gauge.

3. Remove spiral wrap (Figure 2, item 7) only if necessary.
4. Remove elbows (Figure 2, item 8) only if necessary.

Feed Pressure Gauge

1. Remove screws (Figure 3, item 4), nuts (Figure 3, item 1) and washers (Figure 3, item 2) from gauge (Figure 3, item 3).

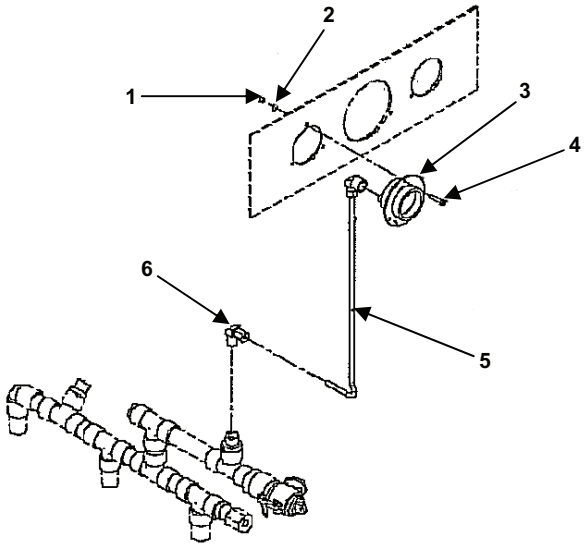


Figure 3. Feed Pressure Gauge.

2. Remove tubing (Figure 3, item 5) from gauge (Figure 3, item 3).
3. Remove gauge from the panel.
4. Remove elbows (Figure 3, item 6) only if necessary.

Backwash Pressure Gauge

1. Remove screws (Figure 4, item 6), nuts (Figure 4, item 3), and washers (Figure 4, item 4).

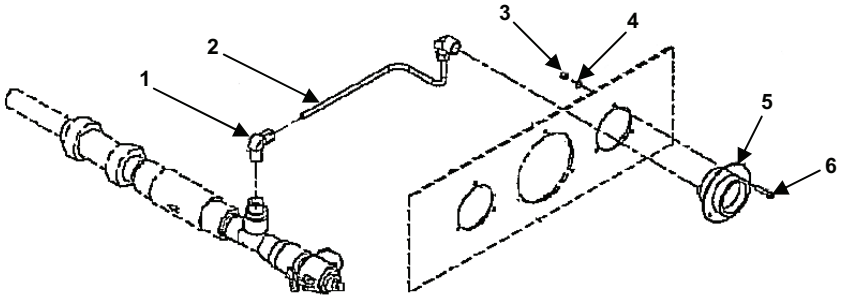


Figure 4. Backwash Pressure Gauge.

2. Remove tubing (Figure 4, item 2) from gauge (Figure 4, item 5).
3. Remove gauge (Figure 4, item 5) from the panel. Remove elbows (Figure 4, item 1) only if necessary.

Temperature Gauge

1. Temperature gauge is located below the reject outlet. See Figure 5.

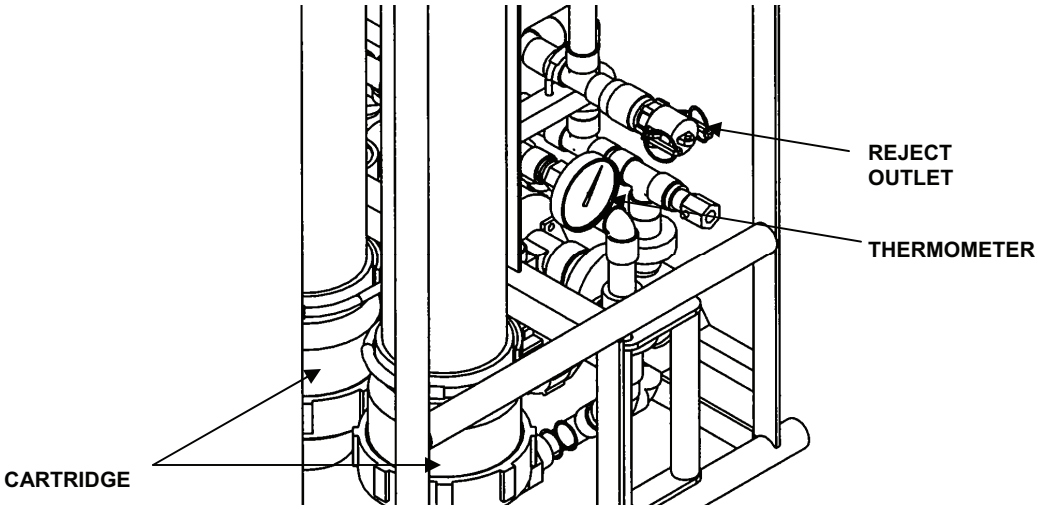


Figure 5. Ultrafiltration Module Temperature Gauge.

2. Remove the temperature gauge (Figure 6, item 1) from the thermowell fitting (Figure 6, item 2).
3. Remove the thermowell (Figure 6, item 2) from the piping (Figure 6, item 3) only if necessary.

Temperature Gauge - continued

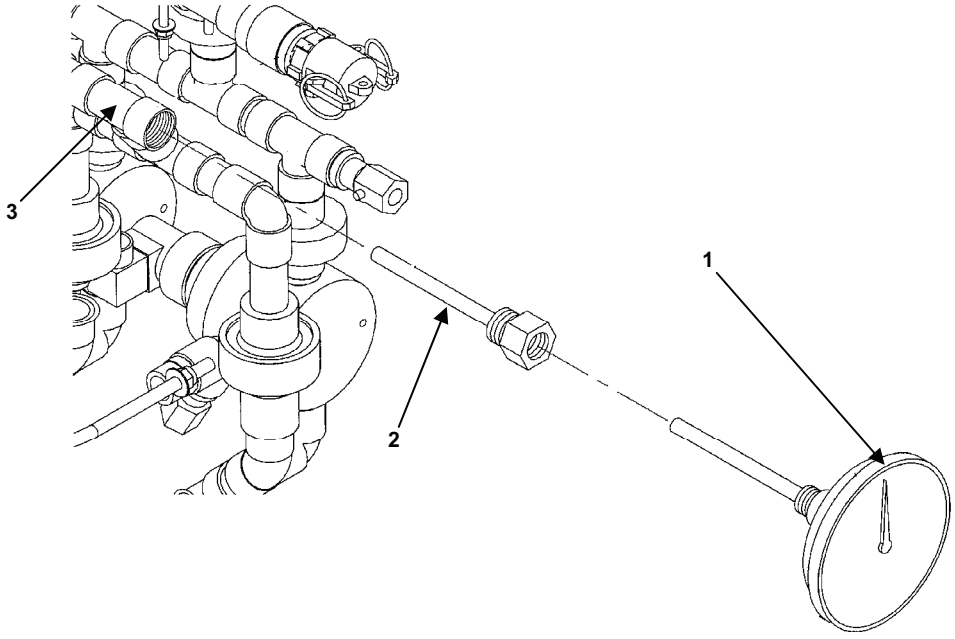


Figure 6. Temperature Gauge.

INSTALLATION

Differential Pressure Gauge

1. Refer to Figure 2 for this procedure section.
2. Install elbows (Figure 2, item 6) if necessary.
3. Install gauge in the panel.
4. Install tubing (Figure 2, item 5).
5. Install screws (Figure 2, item 3), washers (Figure 2, item 2), and nuts (Figure 2, item 1).

Feed Pressure Gauge

1. Refer to Figure 3 for this procedure section.
2. Install elbows (Figure 3, item 6) if necessary.
3. Install gauge (Figure 3, item 3) in the panel.
   a. Install tubing (Figure 3, item 5) on the gauge.
   b. Install screws (Figure 3, item 4), washers (Figure 3, item 2), and nuts (Figure 3, item 1).

Backwash Pressure Gauge

1. Refer to Figure 4 for this procedure section.
2. Install elbows (Figure 4, item 1) if necessary.
3. Install gauge (Figure 4, item 5) in the panel.
4. Install tubing (Figure 4, item 2).
5. Install screws (Figure 4, item 6), washers (Figure 4, item 4), and nuts (Figure 4, item 3).

Temperature Gauge

1. Refer to Figure 6 for this procedure section.
2. Install temperature gauge (Figure 6, item 1) onto the thermowell fitting (Figure 6, item 2).
3. Install thermowell fitting (Figure 6, item 2) into piping (Figure 6, item 3) if necessary.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
PIPING COMPONENTS
REMOVAL/INSTALLATION

INITIAL SETUP

TOOLS
Tool Kit, General Mechanics, Automotive
(WP 0137, Table 2, Item 2)

EQUIPMENT CONDITION REQUIRED
All equipment de-energized.

MATERIALS/PARTS
Rags, wiping, cotton (WP 0139, Item 24)
Compound, O-ring lubricant (WP 0139, Item 15)
Tape, anti-seize, (WP 0139, Item 32)
Controller, flow, 5 GPM, (PN 12511392)
Valve, control, flow, 8 GPM, (12511391)

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.

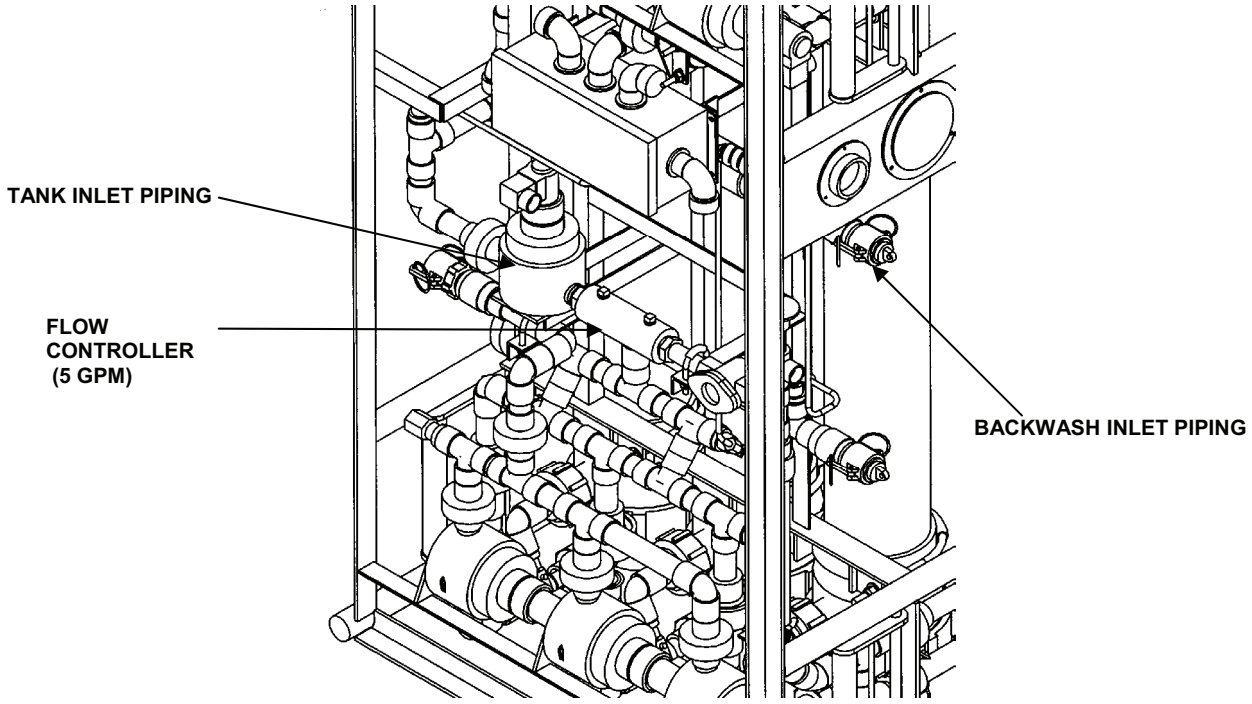


Figure 1. Ultrafiltration Module (Front/Left View).

REMOVAL – CONTINUED

1. Remove tank inlet piping. See (WP 0091).

2. Remove flow controller (Figure 2, item 2) from the solenoid valve (Figure 2, item 1) and adapter (Figure 2, item 3).

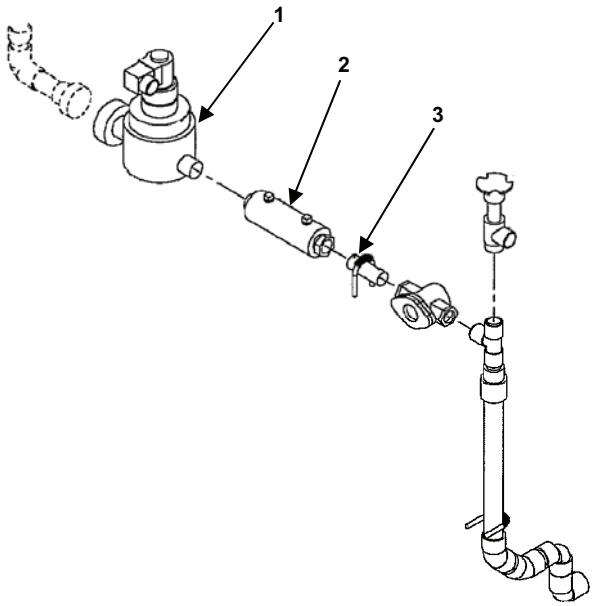


Figure 2. Flow Controller (5 GPM).

Flow Controller (8 GPM)

The flow controller (8 GPM) is located in the backwash inlet piping. See Figure 3.

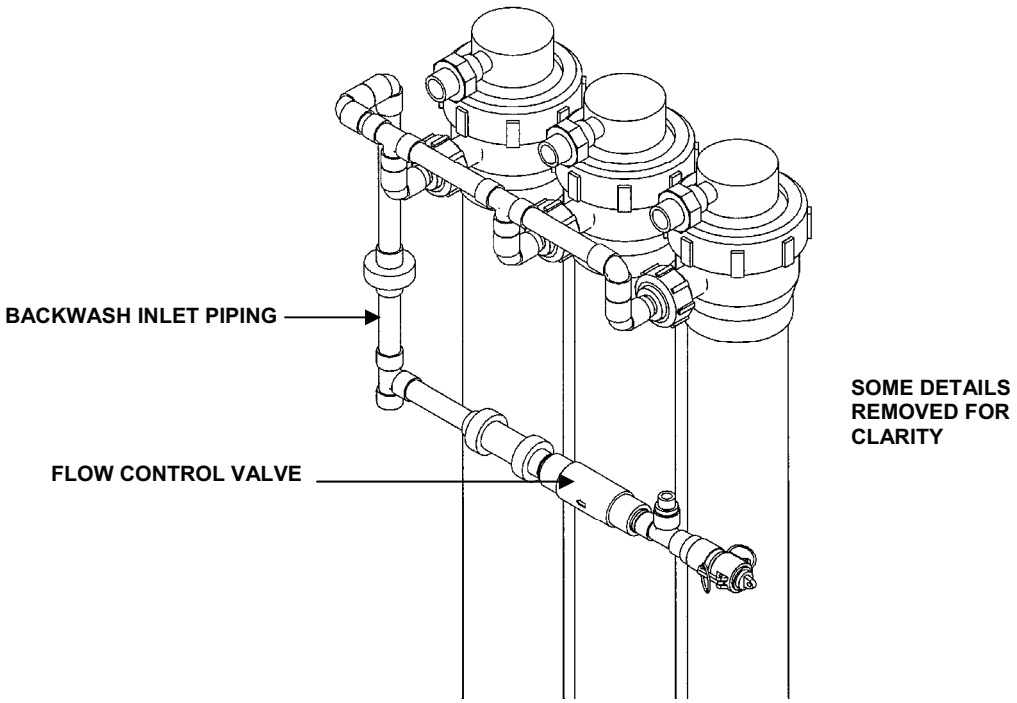


Figure 3. Backwash Inlet Piping.

REMOVAL - continued

1. Remove dust plug (Figure 4, item 1) and female camlock (Figure 4, item 3).

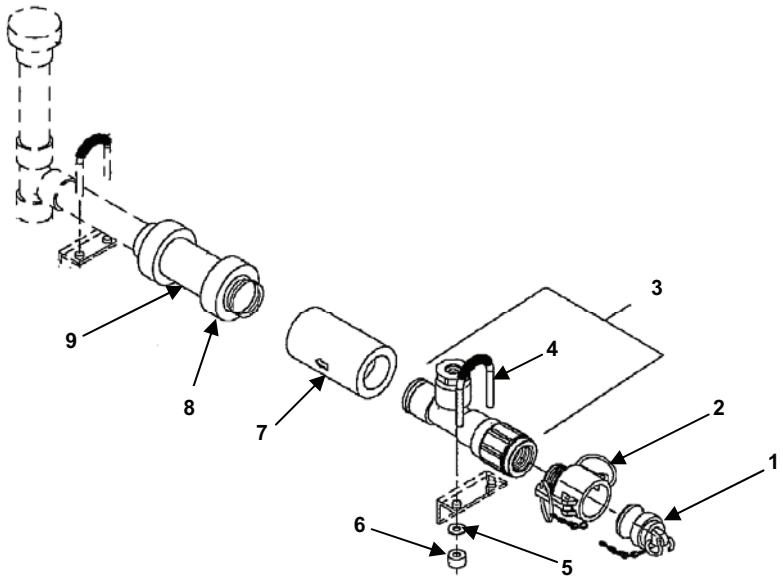


Figure 4. Flow Controller (8 GPM).

2. Remove nuts (Figure 3, item 6), washers (Figure 3, item 5), and U-bolt (Figure 3, item 4).

3. Remove pressure indicator tubing from the top branch of the tee fitting (Figure 3, item 3). Remove tee fitting (Figure 3, item 3).

4. Remove flow controller (Figure 3, item 7) from the check valve (Figure 3, item 9) by loosening at the union (Figure 3, item 8).

Level Switch

1. Level switch is located in the level switch piping. See Figure 5.

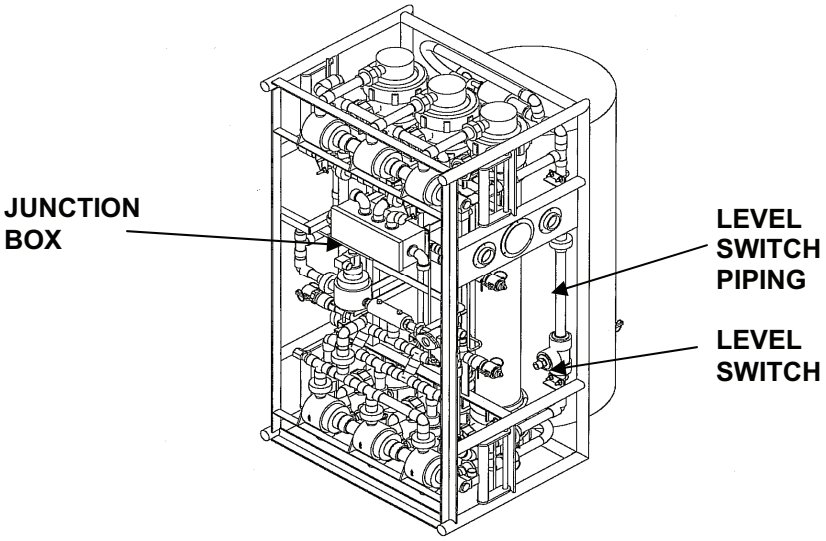


Figure 5. Level Switch Location.

REMOVAL - continued

2. Remove the four screws from the cover on the UF junction box. Remove the cover.
3. Disconnect wires (Figure 6, item 2) and (Figure 6, item 4) from the terminal block (TB 1).

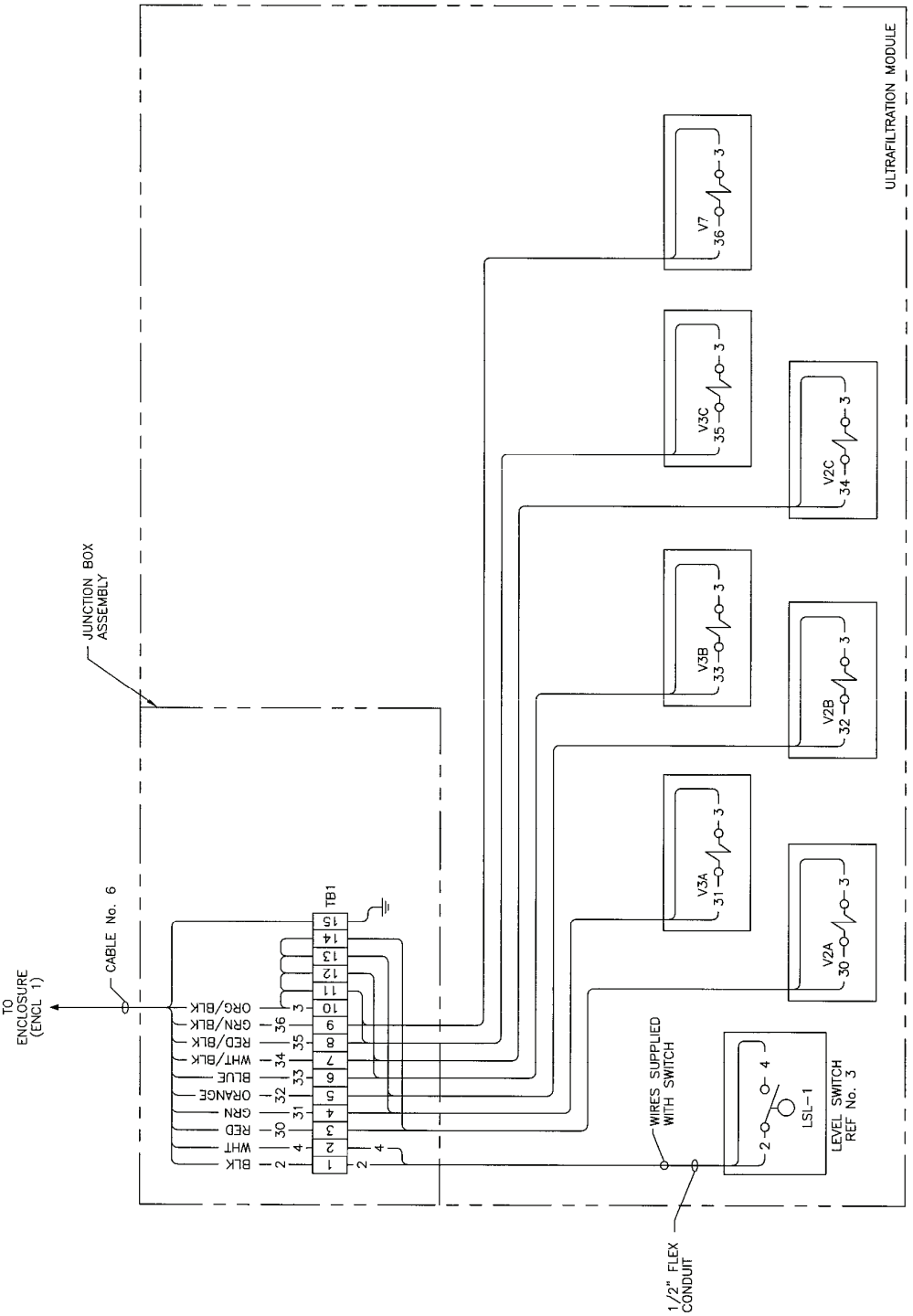


Figure 6. UF Wiring Diagram.

REMOVAL – continued

4. Remove the conduit from the threaded end (Figure 7, item 3) of the level switch (Figure 7, item 2) and from the junction box.

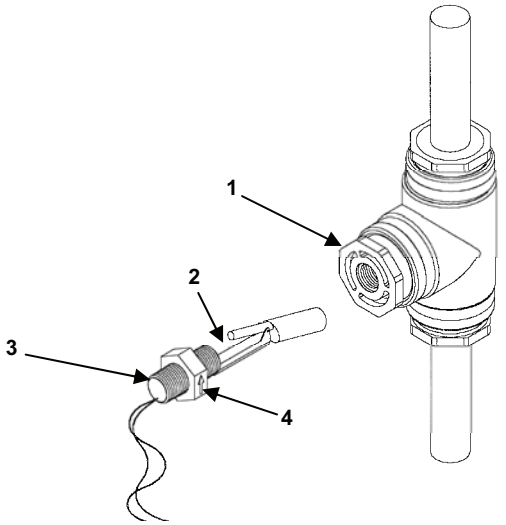


Figure 7. Level Switch Removal.

5. Remove the level switch (Figure 7, item 2) from holder (Figure 7, item 1).

6. Note the direction of the arrow (Figure 7, item 4) for installation.

7. Pull the wires (Figure 7, item 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.

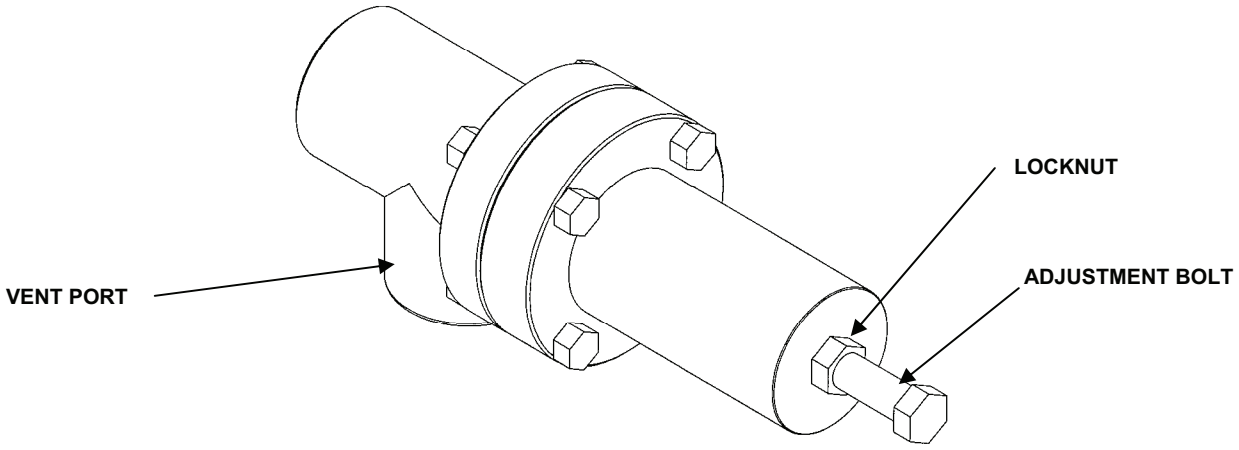


Figure 8. Pressure Relief Valve.

REMOVAL – continued

Unthread the pressure relief valve from the tank vent piping. See Figure 9.

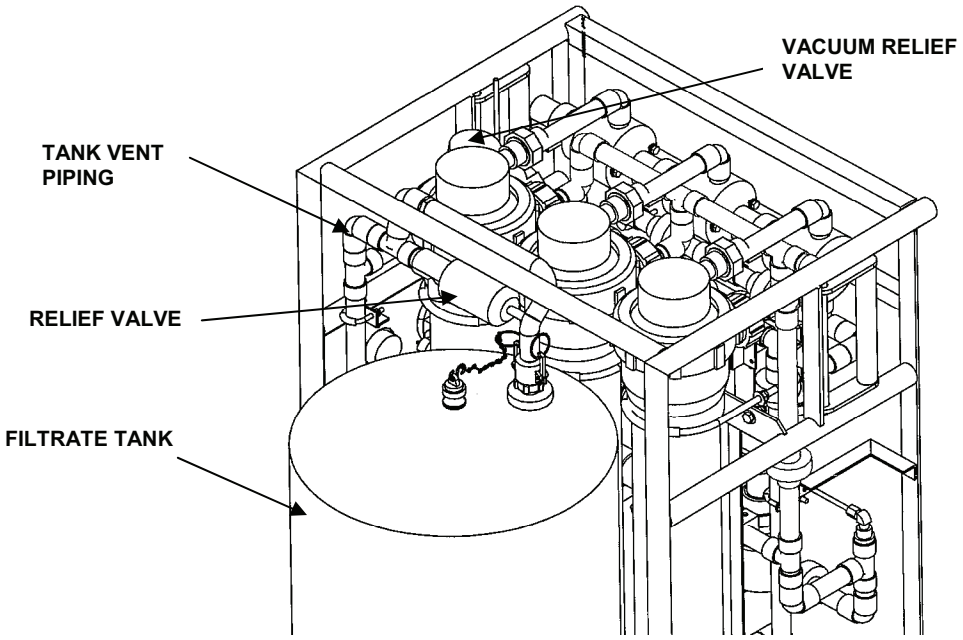


Figure 9. Pressure Relief Valve Location.

Vacuum Relief Valve

1. Vacuum relief valve is located on the tank vent piping. See Figure 9.
2. Remove vacuum relief valve (Figure 10, item 1) by unthreading it from the piping (Figure 10, item 2).
3. Clean the inside of the vacuum release of deposits.

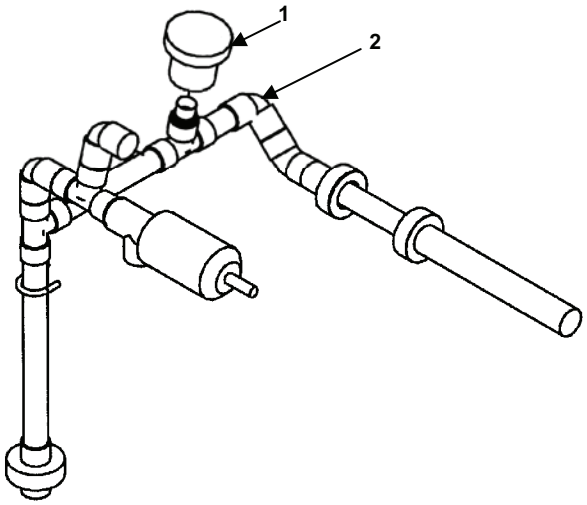


Figure 10. Vacuum Relief Valve.

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 (Figure 2, item 2) onto the solenoid valve (Figure 2, item 1) and adapter (Figure 2, item 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 0091).

Flow Controller (8 GPM)

1. Install the flow controller (Figure 11, item 7) on to the check valve (Figure 11, item 9). Ensure that the arrow on the flow control valve is pointing in the direction of the flow.

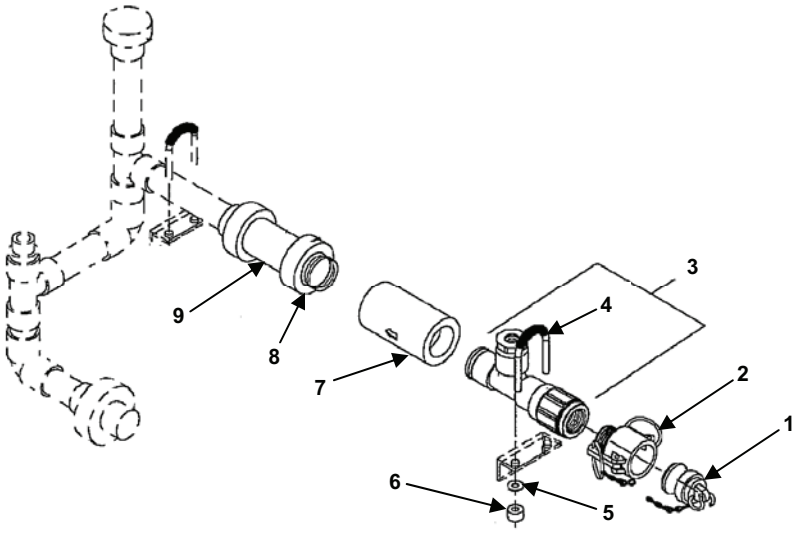


Figure 11. Flow Controller (8 GPM).

2. Install the tee fitting (Figure 11, item 3) onto the flow controller (Figure 11, item 7).
3. Install the pressure gauge tubing onto the top branch of the tee fitting (Figure 11, item 3).
   a. Install U-bolt (Figure 11, item 4) on the mount and secure with nuts (Figure 11, item 6) and washers (Figure 11, item 5).
   b. Install female camlock (Figure 11, item 2) and dust plug (Figure 11, item 1) on the tee fitting (Figure 11, item 2).

Level Switch

1. Refer to Figure 7 for this procedure section.
2. Thread the level switch (Figure 7, item 2) into the holder (Figure 7, item 1).
3. Ensure the arrow (Figure 7, item 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.

INSTALLATION – continued

6. Screw the conduit on both ends.

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 (Figure 10, item 1) onto the tank vent piping (Figure 10, item 2).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
PROTECTIVE GRILL
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool Kit, General Mechanics (WP 0137, Table 2, Item 3)

General Safety Instructions
Observe all CAUTIONS

Materials/Parts
Grille, protective, (PN 12511507)

Personnel required
2

Equipment Condition Required
All equipment shutdown and de-energized

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).

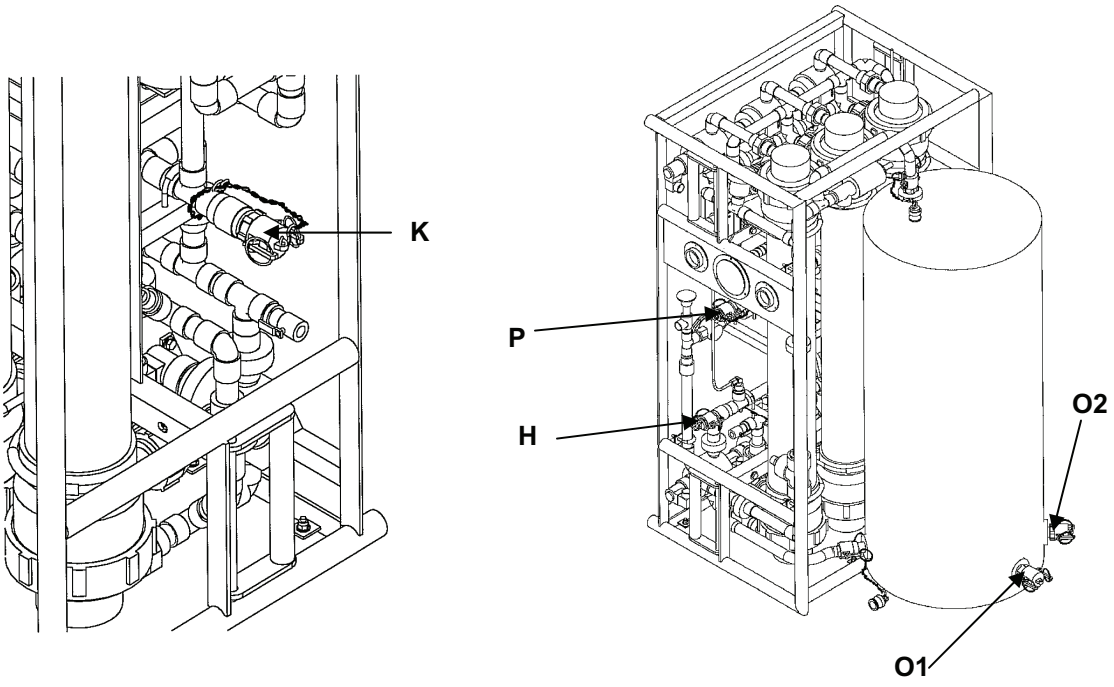


Figure 1. Hose Connection Locations On UF Module.

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.

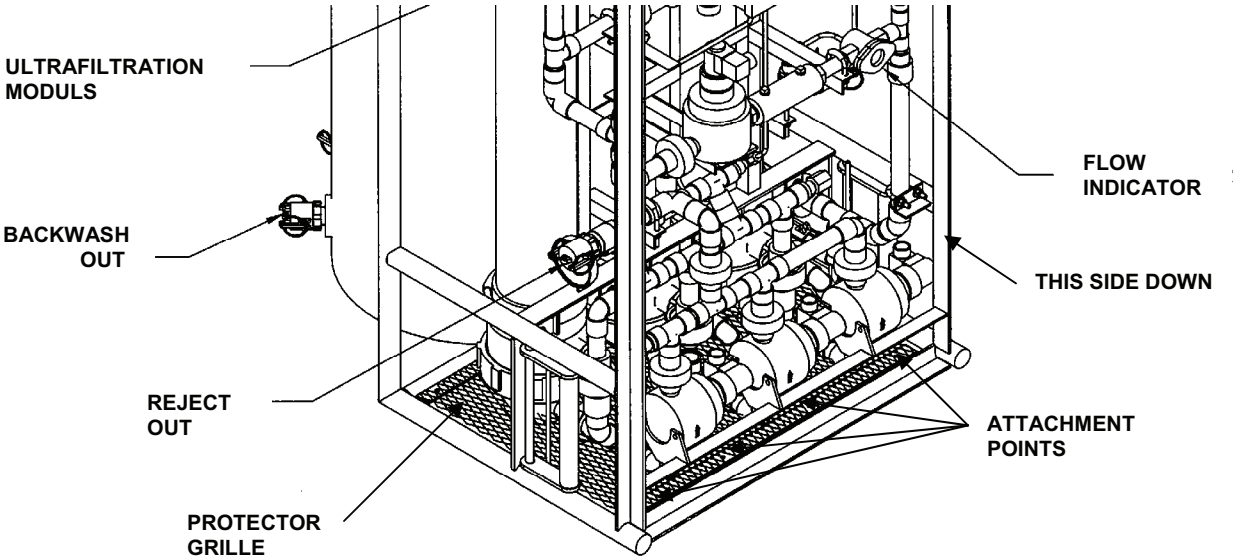


Figure 2. Protective Grille.

2. Remove eight machine screws, flat washers, and hex lock nuts from eight brackets on base of UF module. See Figure 3.

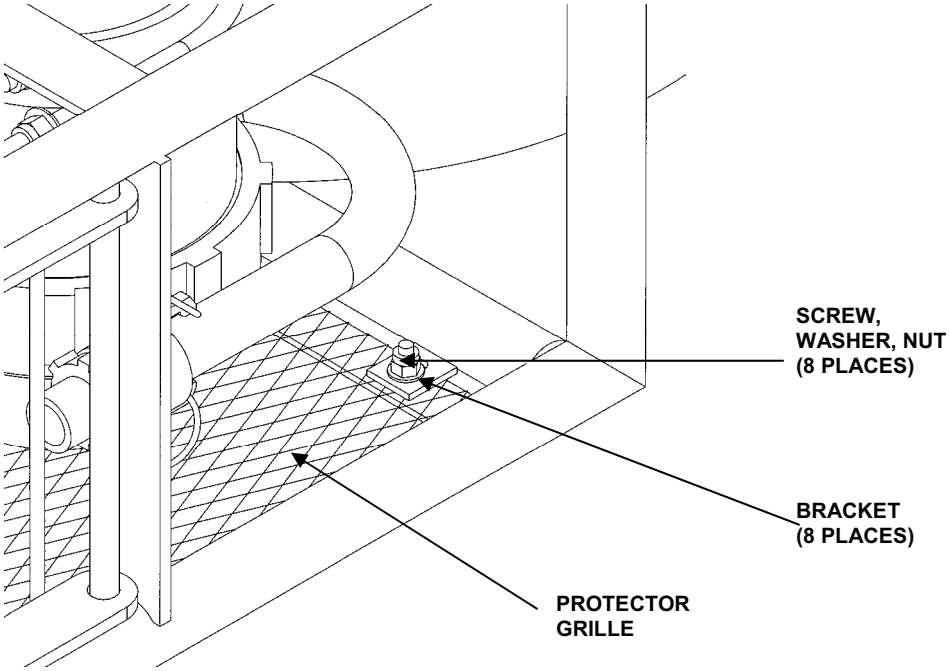


Figure 3. Protective Grille Attachment.

REMOVAL-continued

3. Remove protective grille from eight brackets on bottom of UF module.

INSTALLATION

1. 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).
2. Align eight holes in protective grille with brackets.
3. Install eight machine screws, flat washers, and hex nuts through protective grille and brackets. See Figure 3.
4. 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.

5. Place the UF module in the upright operational position. See Figure 2.
6. 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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE
PIPING COMPONENTS
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts
Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize, (WP 0139, Item 32)
Flow meter, (PN 12511536)
Pulsation Dampener (PN 12511354)

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 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 (Figure 1, item 2) on feed hose (Figure 1, item 1).

SOME DETAILS REMOVED FOR CLARITY

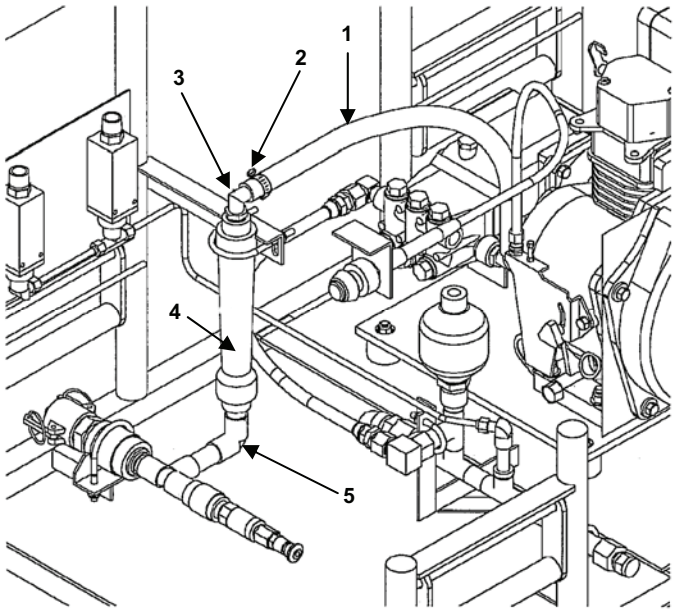


Figure 1. Flow meter on High-Pressure Pump Module.

2. Remove feed hose (Figure 1, item 1) from elbow fitting (Figure 1, item 3).
3. Remove elbow fitting (Figure 1, item 3) from flow meter (Figure 1, item 4).
4. Remove flow meter (Figure 1, item 4) from adapter (Figure 1, item 5).

REMOVAL – continued

Pulsation Dampener

Remove pulsation dampener (Figure 2, item 1) by unthreading from tee fitting (Figure 2, item 2).

SOME DETAILS REMOVED FOR CLARITY

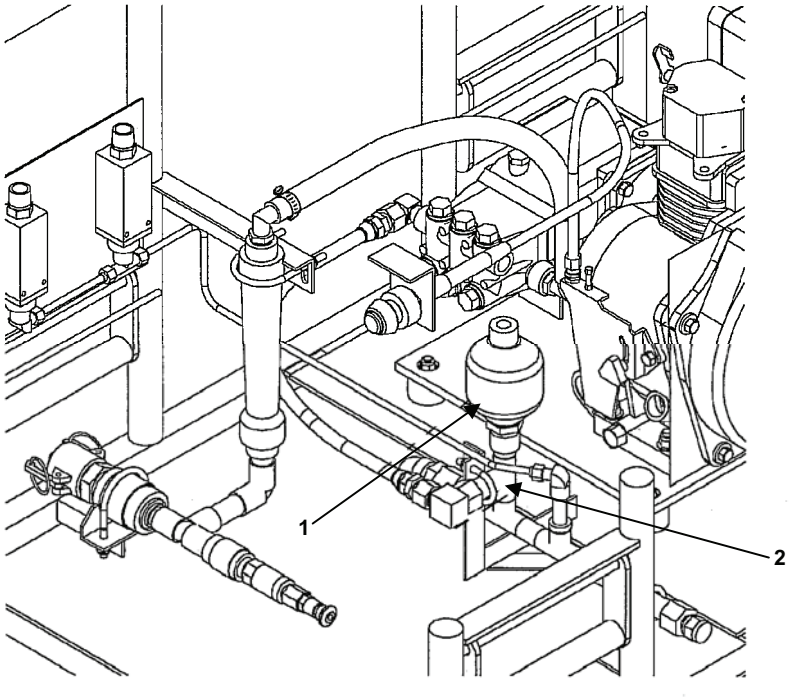


Figure 2. Pulsation Dampener.

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 (Figure 1, item 4) onto the adapter (Figure 1, item 5). Ensure that the flow scale faces out to read.
3. Install the elbow fitting (Figure 1, item 3) onto the flow meter.
4. Install the hose (Figure 1, item 1) on the elbow fitting and tighten hose clamp (Figure 1, item 2).

Pulsation Dampener

1. Refer to Figure 2 for this procedure section.
2. Thread pulsation dampener (Figure 2, item 1) securely onto the tee fitting (Figure 2, item 2).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
ROUTINE MAINTENANCE

INITIAL SETUP

Materials/Parts
Filter, Oil (NSN 2815-01-353-7523)
Hose, fuel (PNs 5155-5)
Filter, fuel (PN 12512194)
Oil, lubricating, (WP 0139, Item 22)
Oil, fuel (diesel No.1, No.2, JP8)
Rags, wiping, cotton (WP 139, Item 24)
Detergent (WP 139, Item 16)

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 0099) 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 0099) or as needed.

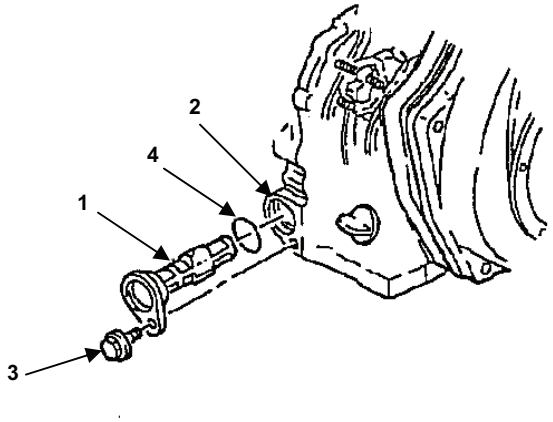


Figure 1. Oil Filter.

2. Drain engine oil. See (WP 0100).
3. Remove oil filter (Figure 1, item 1) from the engine block (Figure 1, item 2) by removing bolt (Figure 1, item 3).
4. Remove O-ring (Figure 1, item 4) and discard.

FUEL STRAINER

1. The fuel strainer is cleaned as prescribed in (WP 0038) or as needed. Replace if damaged.

FUEL STRAINER – continued

2. Remove the fuel cap (Figure 2, item 1), cap gasket (Figure 2, item 2) and fuel strainer (Figure 2, item 3) from the tank (Figure 2, item 4).

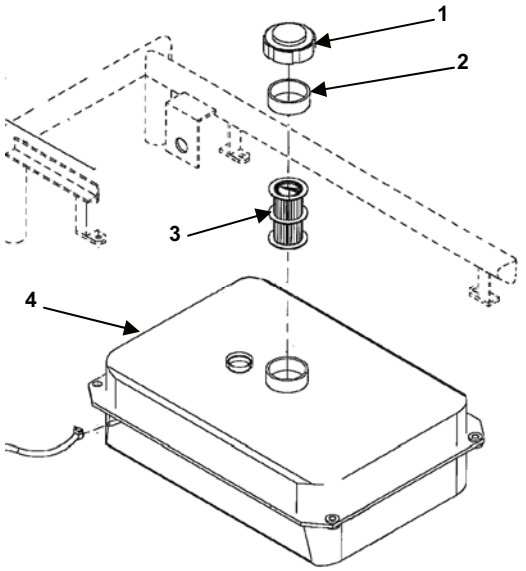


Figure 2. Fuel Strainer.

3. Replace the cap (Figure 2, item 1) once the strainer is removed to avoid contaminants from entering the fuel tank (Figure 2, item 4).
4. Clean fuel strainer (Figure 2, item 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 (Figure 3, item 2) and washer seal (Figure 3, item 1).

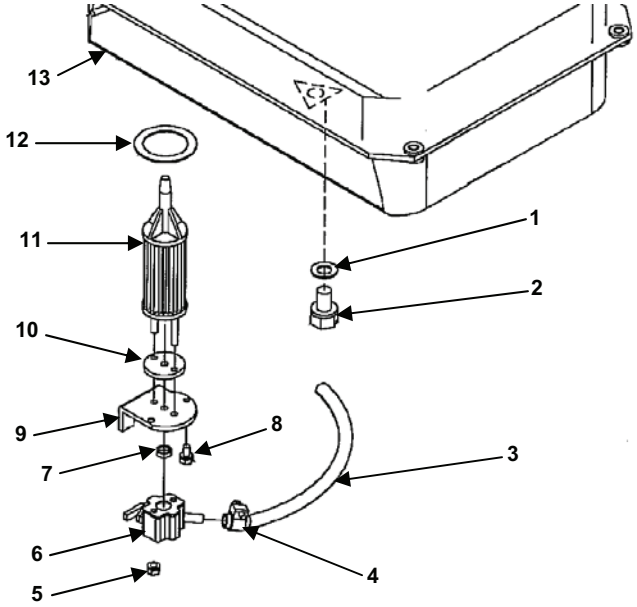


Figure 3. Fuel Filter Assembly.

FUEL FILTER - continued

2. Install the plug (Figure 3, item 2), and washer seal (Figure 3, item 1) once the fuel tank is drained to avoid contaminants from getting inside the tank.
3. Remove fuel hose (Figure 3, item 3) from the fuel cock (Figure 3, item 6) by loosening the clamp (Figure 3, item 4).
4. Remove lock nut (Figure 3, item 5), remove fuel cock (Figure 3, item 6), and seal (Figure 3, item 7).
5. Remove screws (Figure 3, item 8), plate (Figure 3, item 9), and gasket (Figure 3, item 10).
6. Remove fuel filter (Figure 3, item 11), O-ring (Figure 3, item 12), from fuel tank (Figure 3, item 13).

AIR SHUTOFF VALVE VENT PLUG

1. Remove vent plug (Figure 4, item 1) from adapter (Figure 4, item 2) on the 3-way solenoid valve (Figure 4, item 3).

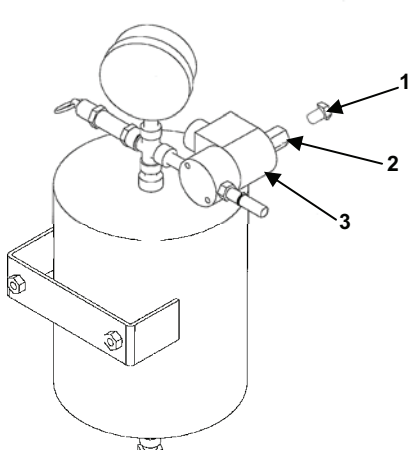


Figure 4. Air Shutoff Valve Vent Plug.

2. Clean the vent plug (Figure 4, item 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 (Figure 5, item 1).

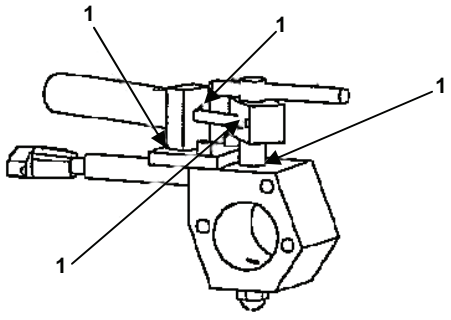


Figure 5. Air Shutoff Valve Lubrication.

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 (Figure 1, item 4) and install on the new oil filter (Figure 1, item 1).
3. Slide oil filter into the engine block (Figure 1, item 2) and secure using bolt (Figure 1, item 3).
4. Refill engine oil. See (WP 0100).

Fuel Strainer

1. Refer to Figure 2 for this procedure section.
2. Remove the fuel cap (Figure 2, item 1) and place the strainer (Figure 2, item 3) inside the fuel tank (Figure 2, item 4).
3. Install the fuel cap (Figure 2, item 1) and gasket (Figure 2, item 2).

Fuel Filter

1. Install the gasket (Figure 6, item 10) onto the fuel filter (Figure 6, item 11).

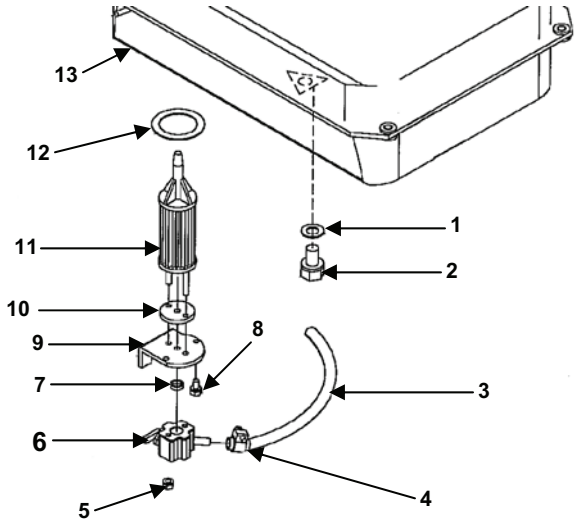


Figure 6. Fuel Filter Assembly.

2. Install the fuel filter onto the plate (Figure 6, item 9).
3. Install the O-ring (Figure 6, item 12), fuel filter (Figure 6, item 11), gasket (Figure 6, item 10), and plate (Figure 6, item 9) into the fuel tank (Figure 6, item 13). Secure with screws (Figure 6, item 8).
4. Install the seal (Figure 6, item 7) on the fuel cock (Figure 6, item 6).
5. Install the fuel cock (Figure 6, item 6) on the plate (Figure 6, item 9) and secure with locknut (Figure 6, item 5).
6. Install the fuel hose (Figure 6, item 3) on the fuel cock (Figure 6, item 6).
7. Tighten hose clamp (Figure 6, item 4).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE ASSEMBLY REMOVAL AND INSTALLATION

INITIAL SETUP

Tools
Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Personnel Required
2

Material/Parts
Container to drain oil
Hose, engine oil drain (WP 0138, table 2, Item 24)
Rags, wiping, cotton, (WP 0139, Item 24)
Lubricating oil, 10W30 (WP 0139, Item 22)

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.

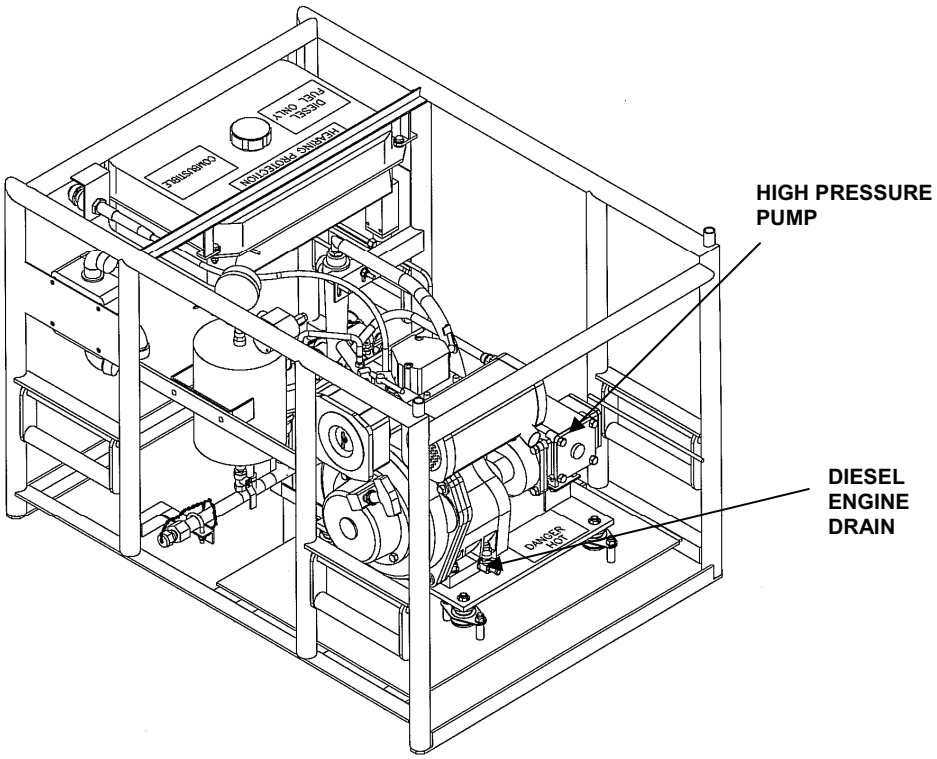


Figure 1. High-Pressure Pump Module (Front).

LUBRICATION – continued

WARNING

All oil spills must be thoroughly wiped up. Oil spills present a fire and safety hazard to personnel and slip and fall hazard. Failure to observe this warning could result in personnel injury and /or death could occur.

2. Retrieve hose from Basic Issue Items (BII) box. Install oil drain hose on drain valve. See Figure 2.

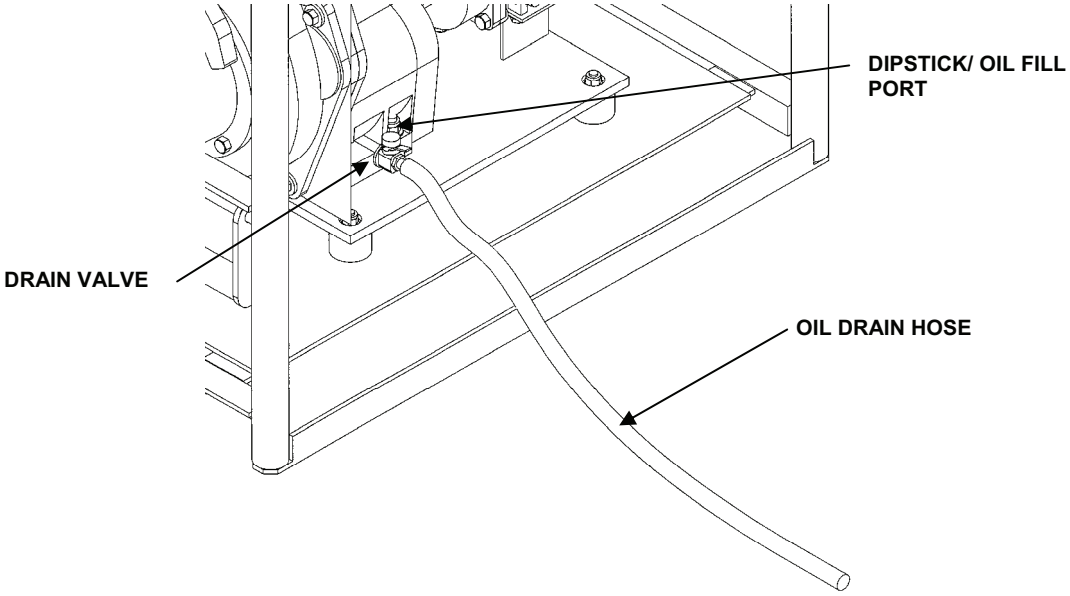


Figure 2. Draining Oil From Diesel Engine.

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 15W40 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.

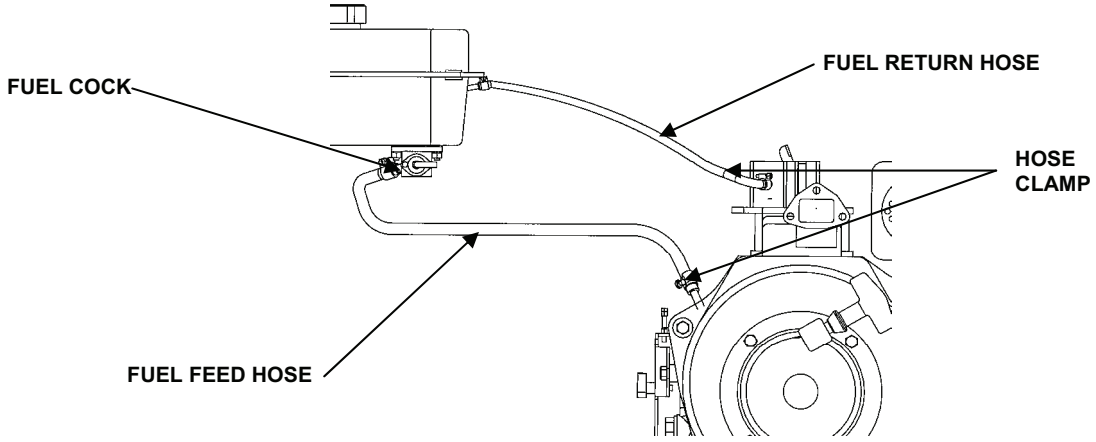


Figure 3. Fuel Tank and Hoses.

WARNING

All diesel fuel spills must be thoroughly cleaned up. Fuel spills present a fire and safety hazard to personnel. Failure to observe this warning could result in personnel injury and /or death could occur.

2. Disconnect fuel return hose and fuel feed hose from the engine by loosening hose clamps. See Figure 3.

3. Remove outlet hose (Figure 4, item 1) and inlet hose (Figure 4, item 2) from the high-pressure pump (Figure 4, item 3).

SOME DETAILS REMOVED FOR CLARITY

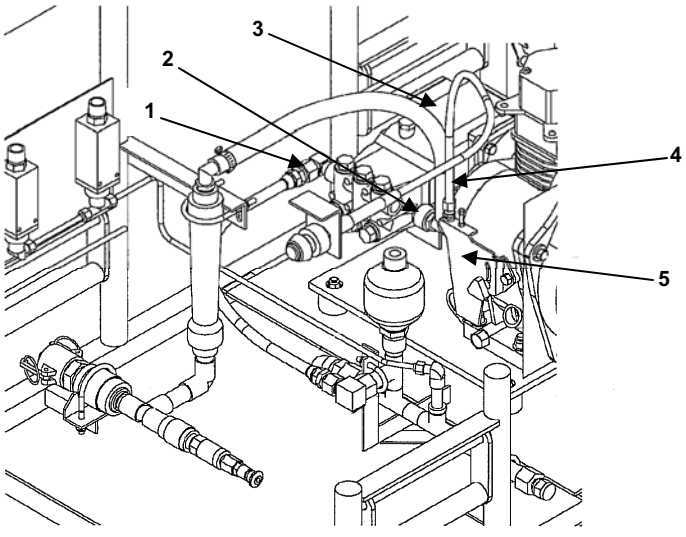


Figure 4. High and Low-Pressure Hoses/Throttle.

REMOVAL – continued

4. Remove throttle cable (Figure 4, item 4) from the throttle plate (Figure 4, item 5). See (WP 0105).

5. Remove air cleaner assembly. See (WP 0043).

6. Remove engine air shutoff assembly from the engine. See (WP 0101).

7. Remove four nuts (Figure 5, item 5) and secure the center bolt (Figure 5, item 6) and rebound washer (Figure 5, item 7).

SOME DETAILS REMOVED FOR CLARITY

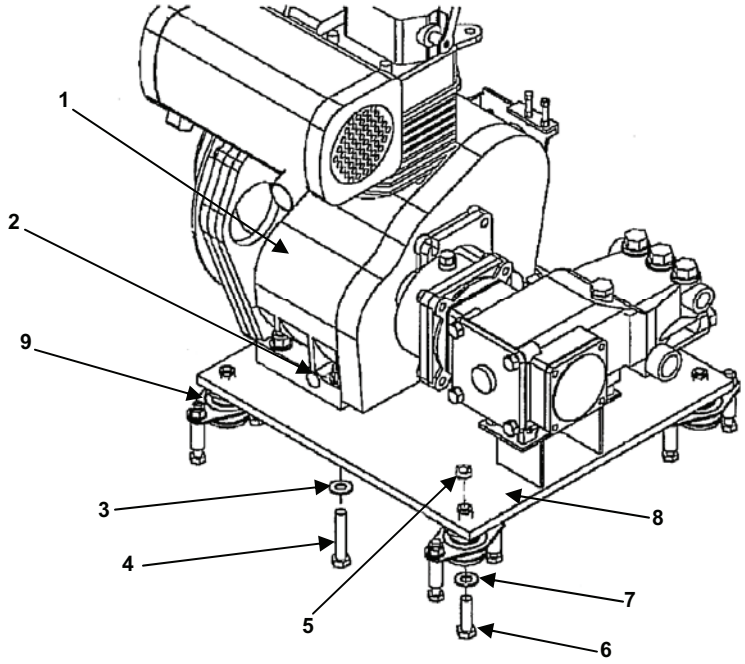


Figure 5. Diesel Engine Assembly.

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 0104).

10. Remove four nuts (Figure 5, item 2), washers (Figure 5, item 3), and bolts (Figure 5, item 4) securing diesel engine (Figure 5, item 1) to base plate (Figure 5, item 8).

11. Remove diesel engine (Figure 5, item 1) from base plate (Figure 5, item 8).

Vibration Mounts

1. Remove two nuts (Figure 6, item 2), bolts (Figure 6, item 4), and center bolt (Figure 6, item 6).

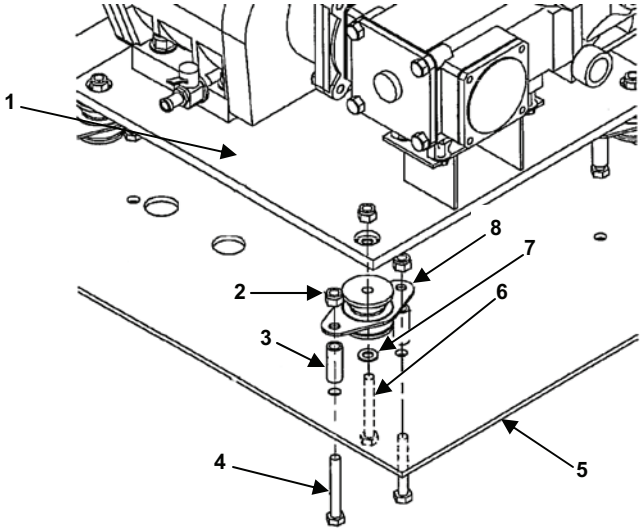


Figure 6. Vibration Mount Assembly.

2. Remove rebound washer (Figure 6, item 7), support tubes (Figure 6, item 3) and vibration isolator (Figure 6, item 8).

INSTALLATION

Vibration Mounts

1. Place vibration isolator (Figure 6, item 8) and support tubes (Figure 6, item 3) on the mounting plate (Figure 6, item 5).

2. Slide the bolts (Figure 6, item 4) through the mounting plate, support tubes (Figure 6, item 3) and vibration isolator (Figure 6, item 8). Secure with nuts (Figure 6, item 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 (Figure 5, item 1) onto base plate (Figure 5, item 8). Secure engine to base plate with four nuts (Figure 5, item 2), washers (Figure 5, item 3), and bolts (Figure 5, item 4).

2. Install diesel engine assembly (Figure 5, item 1) and mounting plate (Figure 5, item 8) onto vibration isolators (9).

3. Secure the base plate (Figure 5, item 8) to the vibration isolators (Figure 5, item 9) with bolts (Figure 5, item 6), washers (Figure 5, item 7) and four nuts (Figure 5, item 5).

4. Install high-pressure pump and gearbox. See (WP 0104).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE SHUTOFF ASSEMBLY
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Valve, air shutoff, (PN 12511585)

Equipment Condition Required

All equipment de-energized, throttle set to minimum, and diesel engine off. Allow equipment to cool down.

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.
Wear eye protection or Serious injury may occur.

1. Drain the air tank by opening the drain valve completely. See Figure 1.

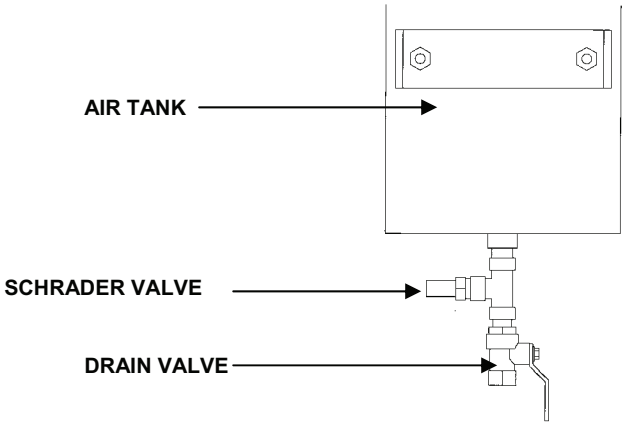


Figure 1. Air Tank (Rear View).

AIR FILTER ASSEMBLY REMOVAL

2. Disconnect air filter assembly (Figure 2, item 1). Remove the wing nut (Figure 2, item 7), cover (Figure 2, item 8), and filter element (Figure 2, item 6) from the filter housing (Figure 2, item 9). Washer (Figure 2, item 10) is affixed to cover (Figure 2, item 8).

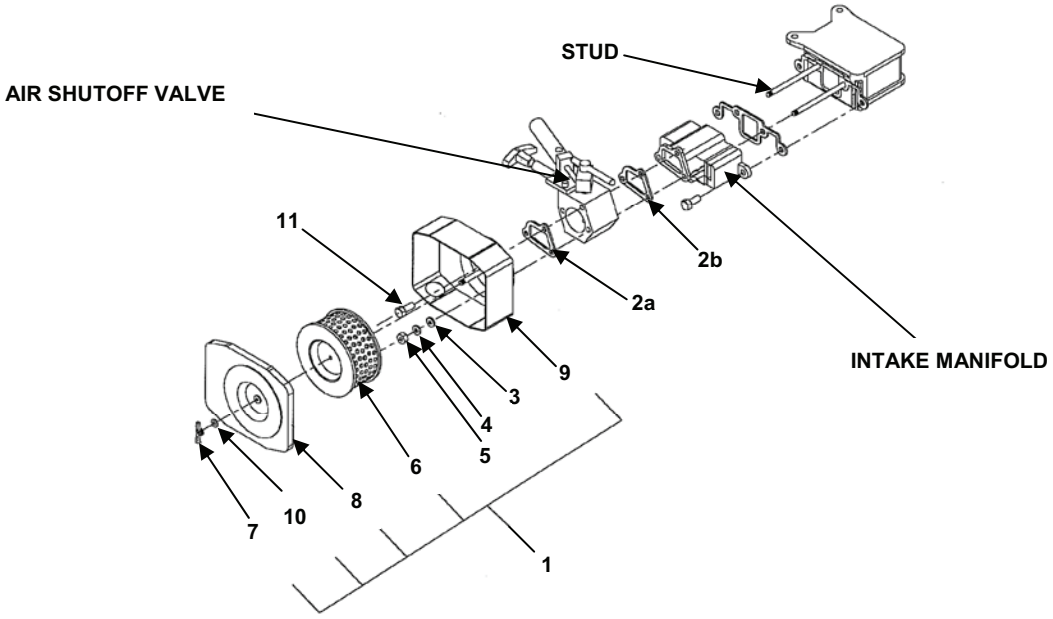


Figure 2. Air Cleaner Assembly.

3. Remove two nuts (Figure 2, item 5), two washers (Figure 2, item 4), two lock washers (Figure 2, item 3) and one bolt (Figure 2, item 11) from the filter housing.
4. Remove filter housing (Figure 2, item 9) from the shut off valve.
5. Remove the gasket (Figure 2, item 2 a). Replace if damaged.
6. Slide the air shutoff valve from the studs.
7. Remove the gasket (Figure 2, item 2 b). Replace if damaged.

AIR TANK SOLENOID COIL REMOVAL

1. Remove vent assembly (Figure 3, item 5) from solenoid valve (Figure 3, item 1). See Figure 3.

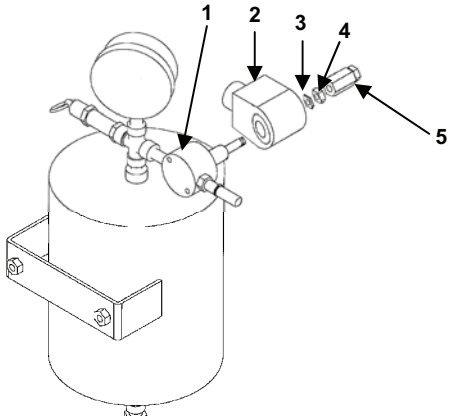


Figure 3. Air Tank Solenoid Coil Removal

2. Remove nut (Figure 3, item 4) spring washer (Figure 3, item 3) and slide off the coil (Figure 3, item 2) from the solenoid valve (Figure 3, item 1).
3. Unthread the electrical conduit from solenoid coil (Figure 3, item 2).

AIR TANK SOLENOID COIL REMOVAL - continued

4. Open the high-pressure pump module junction box cover. See (WP 0102).
5. Disconnect wire number (28 and 3) from the junction box terminal block. See (WP 0102).

AIR SHUTOFF ASSEMBLY REMOVAL

1. Disconnect the air hose (Figure 4, item 10) from hose adapters (Figure 4, item 8) by loosening clamps (Figure 4, item 9).

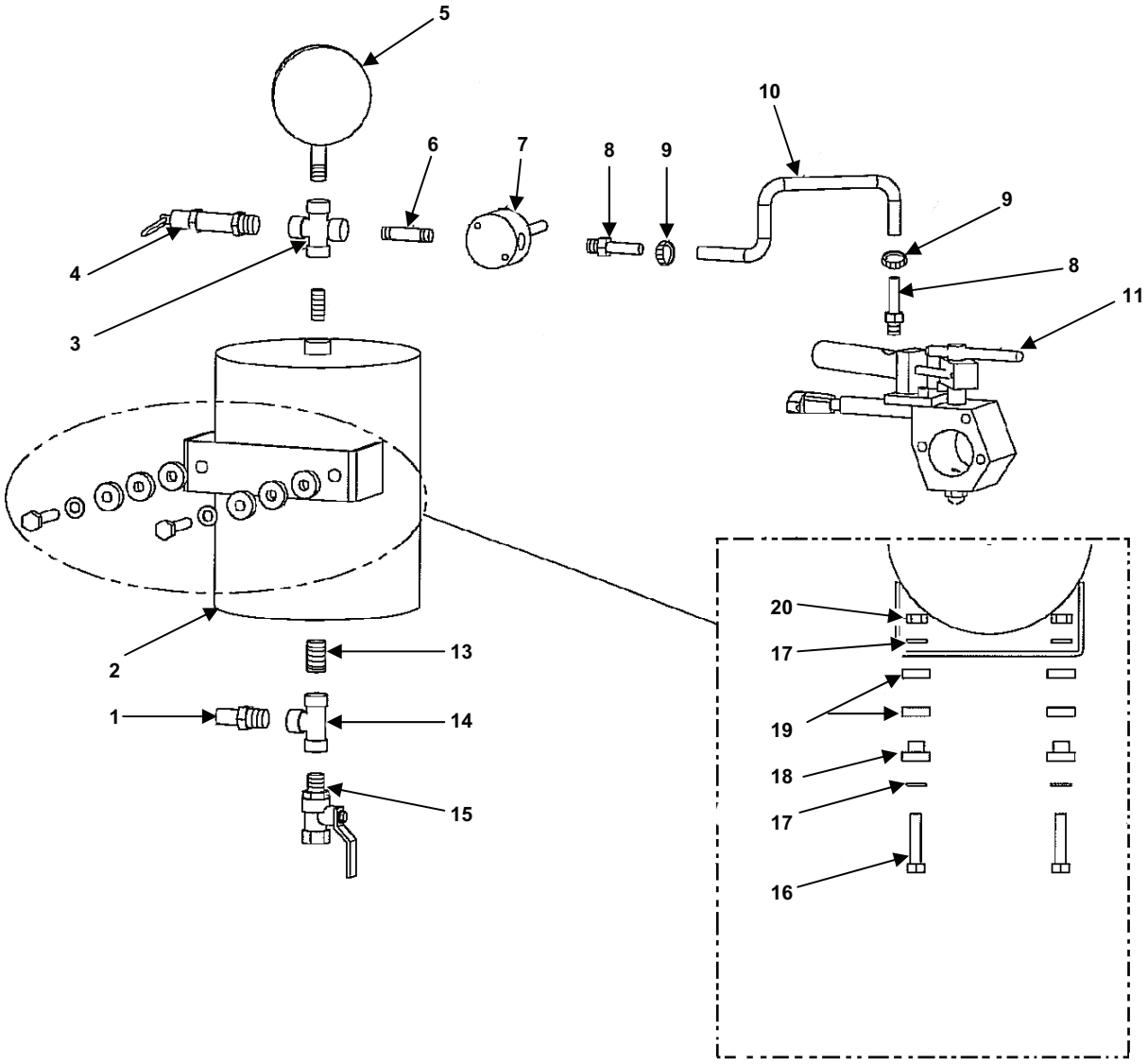


Figure 4. Air Tank Assembly Removal

2. Unthread the solenoid valve (Figure 4, item 7) from the threaded nipple (Figure 4, item 6) to remove.
3. Remove the threaded nipples (Figure 4, item 6) from solenoid valve (Figure 4, item 7) and shutoff valve (Figure 4, item 11), if necessary.
4. Remove the threaded nipple (Figure 4, item 6), gauge (Figure 4, item 5), safety pop valve (Figure 4, item 4), cross (Figure 4, item 3), and nipple (Figure 4, item 12), if necessary, by unthreading them counter-clockwise.

AIR SHUTOFF ASSEMBLY REMOVAL - continued

1. Unthread the Schrader valve (Figure 4, item 1), drain valve (Figure 4, item 15), tee (Figure 4, item 14) and nipple (Figure 4, item 13), if necessary, by unthreading them counter clockwise.
2. Remove the air tank from the module by removing bolts (Figure 4, item 16), washers (Figure 4, item 17), bushing (Figure 4, item 18), rubber rings (Figure 4, item 19) and nuts (Figure 4, item 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 (Figure 4, item 16), washers (Figure 4, item 17), bushing (Figure 4, item 18), rubber rings (Figure 4, item 19) and nuts (Figure 4, item 20).
3. Install the Schrader valve (Figure 4, item 1), drain valve (Figure 4, item 15), tee (Figure 4, item 14) and nipple (Figure 4, item 13), if necessary, by threading them clockwise.
4. Install the threaded nipple (Figure 4, item 6), gauge (Figure 4, item 5), safety pop valve (Figure 4, item 4), cross (Figure 4, item 3), and nipple (Figure 4, item 12), if necessary, by threading them clockwise.
5. Install the threaded nipples (Figure 4, item 6) to solenoid valve (Figure 4, item 7) and shutoff valve (Figure 4, item 11), if necessary.
6. Install the solenoid valve (Figure 4, item 7) to the threaded nipple (Figure 4, item 6).

AIR TANK SOLENOID COIL INSTALLATION

1. Refer to Figure 3 for this procedure section.
2. Slide the coil (Figure 3, item 2) on the solenoid valve (Figure 3, item 1) and secure with spring washer (Figure 3, item 3) and nut (Figure 3, item 4).
3. Install vent assembly (Figure 3, item 5) on the solenoid valve (Figure 3, item 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 (Figure 2, item 2 b) on the intake manifold.
3. Slide the shutoff valve on the studs.
4. Install the gasket (Figure 2, item 2 a).
5. Install the filter housing (Figure 2, item 9) on the studs and secure with bolt (Figure 2, item 11), nuts (Figure 2, item 5), lock washers (Figure 2, item 4) and washers (Figure 2, item 3).
6. Install the filter element (Figure 2, item 6) and cover (Figure 2, item 8) and secure with wing nut (Figure 2, item 7).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE
HIGH AND LOW PRESSURE SWITCHES
REMOVAL/INSTALLATION

INITIAL SETUP:

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize (WP 0139, Item 32)
Switch, high-pressure (PN 12511454)
Switch, low-pressure (PN 12511453)

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 looks 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.

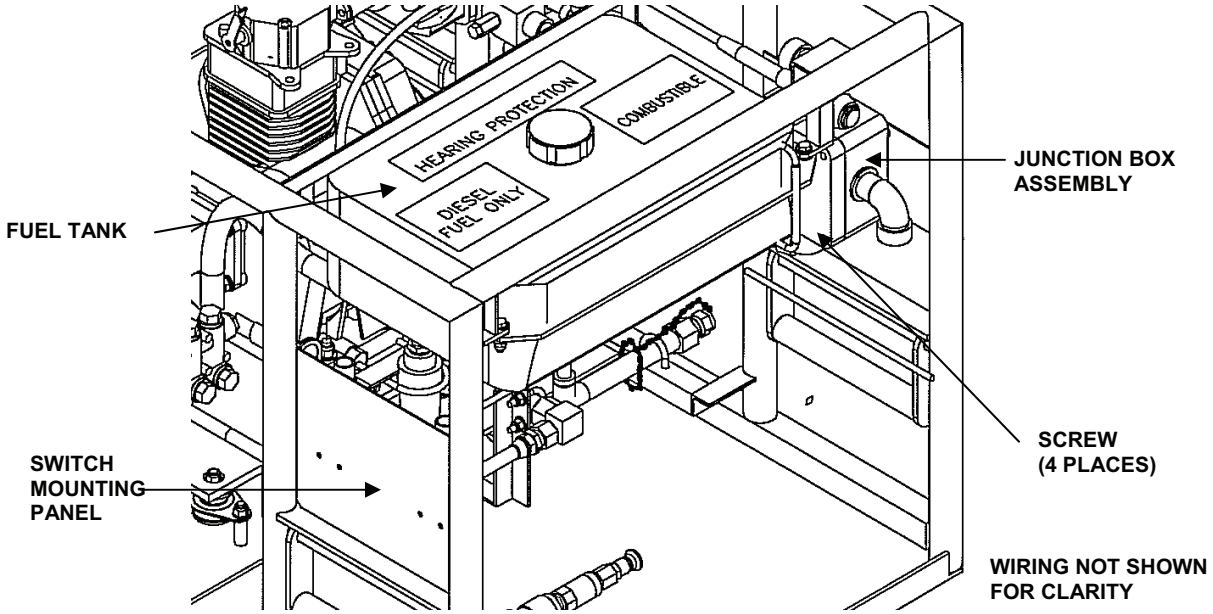


Figure 1. Junction Box Assembly.

REMOVAL - continued

3. Remove two wires numbers 2 and 6 from terminal block.

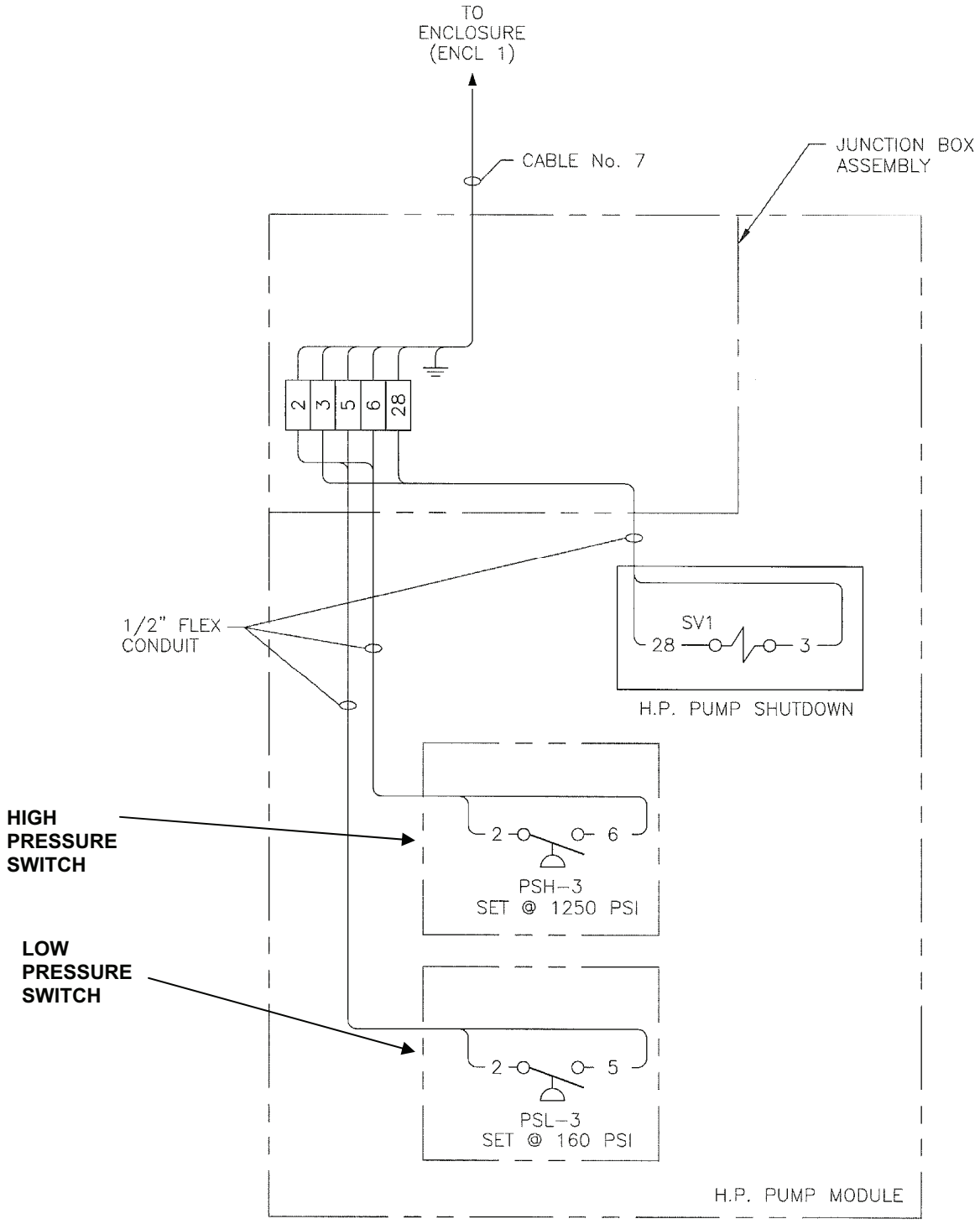


Figure 2. Wiring Diagram.

REMOVAL – continued

4. Remove and retain wire tags.
5. Remove the conduit (Figure 3, item 8) from the junction box (Figure 3, item 9).
6. Remove the conduit (Figure 3, item 8) from the high-pressure switch (Figure 3, item 6) at the top nut (Figure 3, item 5). Pull wires out from the conduit (Figure 3, item 8).

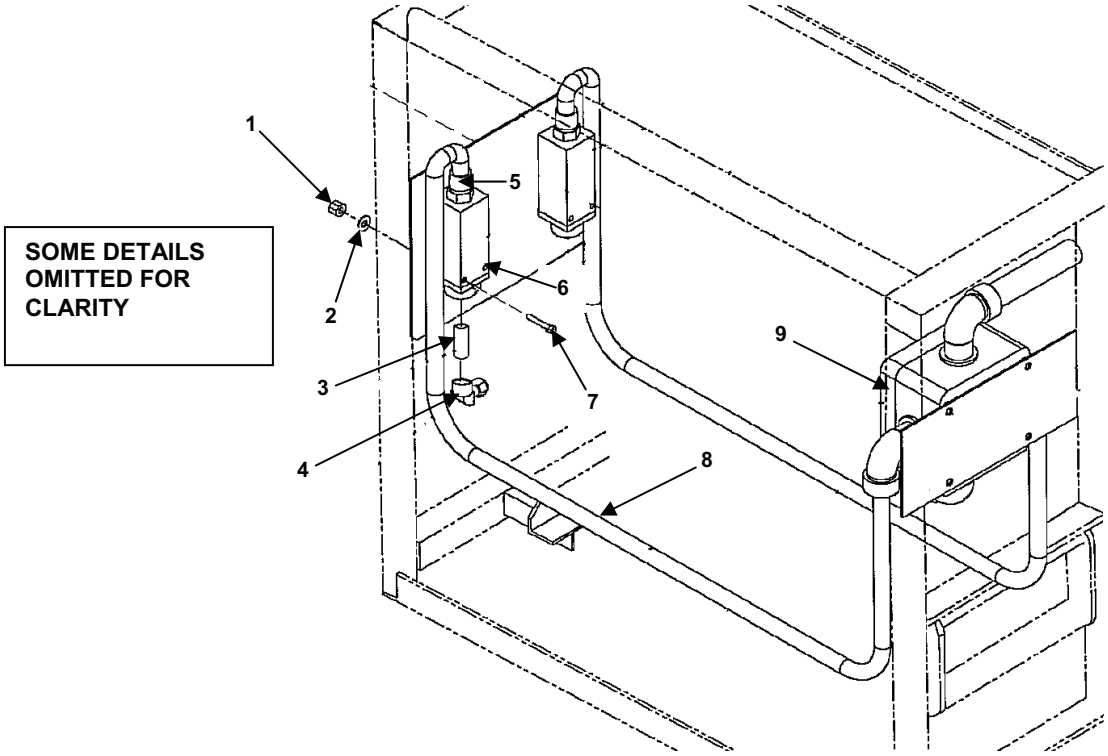


Figure 3. High-Pressure Switch Removal.

7. Remove tubing from elbow fitting (Figure 3, item 4).
8. Remove screws (Figure 3, item 7), nuts (Figure 3, item 1) and washers (Figure 3, item 2).
9. Remove elbow fitting (Figure 3, item 4) and adapter (Figure 3, item 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.
5. Remove the conduit (Figure 4, item 9) from the junction box (Figure 4, item 8).

REMOVAL - continued

6. Remove the conduit (Figure 4, item 9) from the low-pressure switch (Figure 4, item 4) at the top nut (Figure 4, item 3). Pull wires out from conduit (Figure 4, item 9).

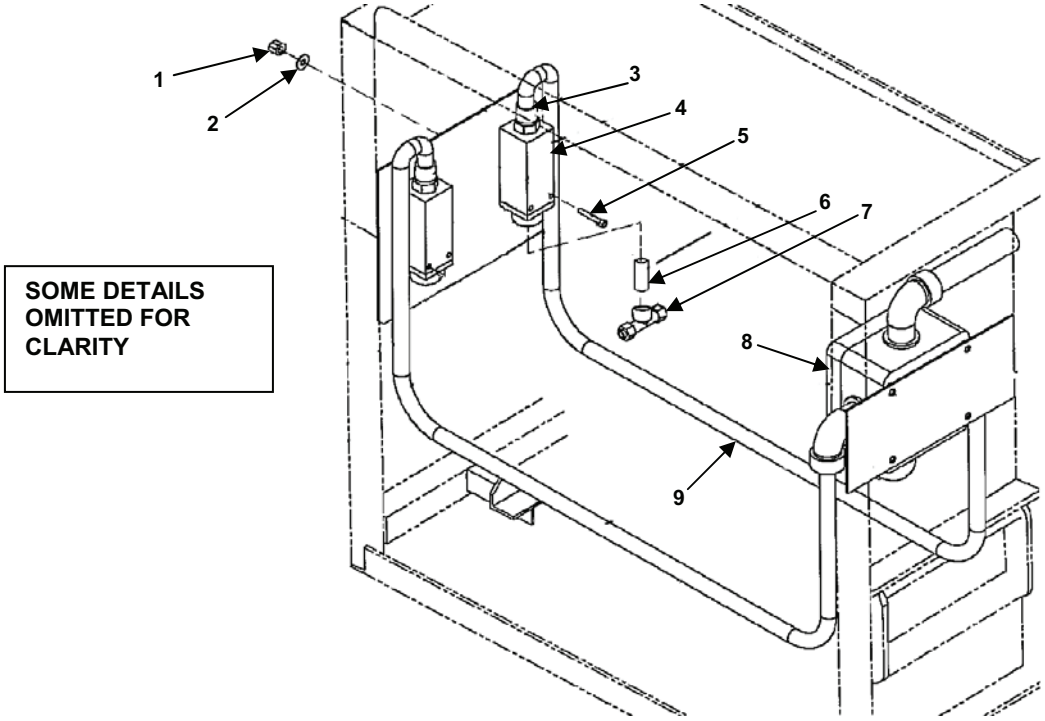


Figure 4. Low-Pressure Switch Removal.

7. Remove tubing from tee fitting (Figure 4, item 7).
8. Remove screws (Figure 4, item 5), nuts (Figure 4, item 1) and washers (Figure 4, item 2) from low-pressure switch.
9. Remove tee fitting (Figure 4, item 7) and adapter (Figure 4, item 6).

NOTE

Tee fitting cannot be removed from the switch until the switch is removed from mounting panel.

INSTALLATION

High-Pressure Switch

Install the adapter (Figure 4, item 3) and elbow fitting (Figure 4, item 4) on the high-pressure switch (Figure 4, item 6).

1. Install high-pressure switch (Figure 3, item 6) and secure with screws (Figure 3, item 5), nuts (Figure 3, item 1), and washers (Figure 3, item 2).
2. Feed the wire through the conduit (Figure 3, item 8) and into the junction box (Figure 3, item 9).
3. Connect wires (Figure 2, items 2 and 6) on the terminal block (TB1).
4. Secure the conduit (Figure 2, item 8) on the high-pressure switch (Figure 2, item 6) and on the junction box (Figure 2, item 9).
5. Install the tubing onto the elbow fitting (Figure 2, item 4).

INSTALLATION - continued

Low-Pressure Switch

1. Install the adapter (Figure 2, item 6) and tee fitting (Figure 2, item 7) on the low-pressure switch (Figure 2, item 4).
2. Install low-pressure switch (Figure 4, item 4) and secure with screws (Figure 4, item 5), nuts (Figure 4, item 1), and washers (Figure 4, item 2).
3. Feed the wire through the conduit (9) and into the junction box (Figure 4, item 8).
4. Connect wires 2 and 5 on the terminal block (TB1). See Figure 2.
5. Secure the conduit (Figure 2, item 9) on the low-pressure switch (Figure 2, item 4) and on the junction box (Figure 2, item 8).
6. Install the tubing onto the tee fitting (Figure 2, item 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, .05 in pipe plugs may be used in place of the RO sample valves. Pipe plugs should be installed one at a time to achieve required pressure.
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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
FUEL TANK
REMOVAL / INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Container, 5-gallon (18.9-liter) (to drain fuel)
Tank, fuel, (PN 12511636)
Indicator, Liquid, Quantity (PN 105092-55150)

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 0099).
2. Remove fuel strainer. See (WP 0099).
3. Remove fuel filter. See (WP 0099).
4. Remove the fuel cap from the tank.
5. Remove fuel gauge (Figure 1, item 9) from the fuel tank (Figure 1, item 1) by reaching into the tank and pushing the gauge up and out of the tank.
6. Remove fuel return line (Figure 1, item 6) from the fuel tank (Figure 1, item 1) by loosening the clamp (Figure 1, item 5).

REMOVAL - continued

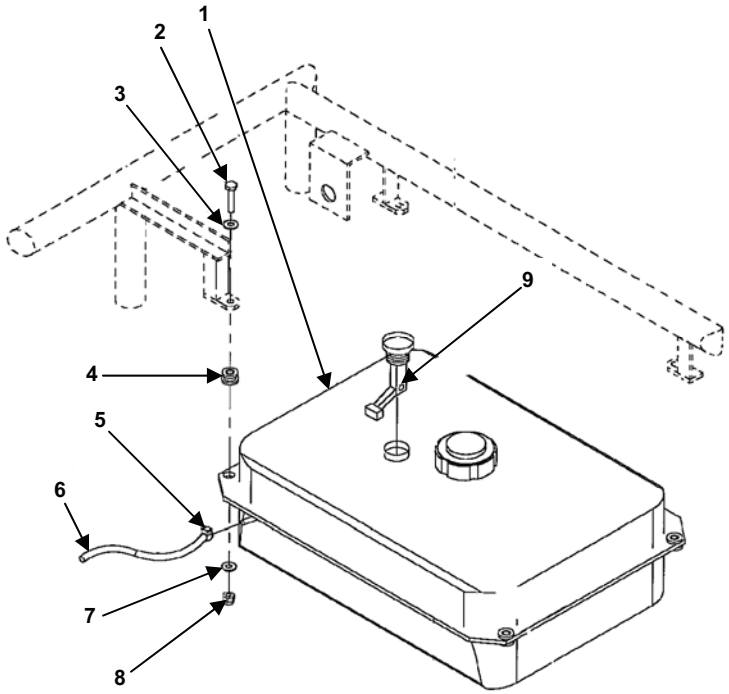


Figure 1. Fuel Tank and Fuel Gauge.

7. Support the tank from underneath.
8. Remove bolts (Figure 1, item 2), washers (Figure 1, item 3), nuts (Figure 1, item 8) and washers (Figure 1, item 7).
9. Remove rubber bushings (Figure 1, item 4) only if necessary.
10. Remove the tank (Figure 1, item 1) from the module.

INSTALLATION

1. Install the rubber bushings (Figure 1, item 4) if necessary.
2. Place the tank on the module. Support the tank from the bottom if necessary.
3. Secure the tank with bolts (Figure 1, item 2), washers Figure 1, item (3), nuts (Figure 1, item 8) and washers (Figure 1, item 7).
4. Install fuel return line (Figure 1, item 6) on the tank (Figure 1, item 1) and tighten clamp (Figure 1, item 5).
5. Install fuel gauge (Figure 1, item 9) on tank (Figure 1, item 1) by firmly pushing the gauge into the hole until seated.
6. Install fuel filter. See (WP 0099).
7. Install fuel strainer. See (WP 0099).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP/GEARBOX
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Drain pan
Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize, (WP 0139, item 32)
Pump, High-pressure, (PN 12511627)
Gearbox, (PN 12511632)
Oil, Pump (WP 0139, item 23)

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 (Figure 1, item 3) and outlet hose (Figure 1, item 1) from the high-pressure pump.
    a. Disconnect the inlet hose (Figure 1, item 3) from the elbow (Figure 1, item 4).
    b. Disconnect the outlet hose (Figure 1, item 1) by unthreading nut (Figure 1, item 2).

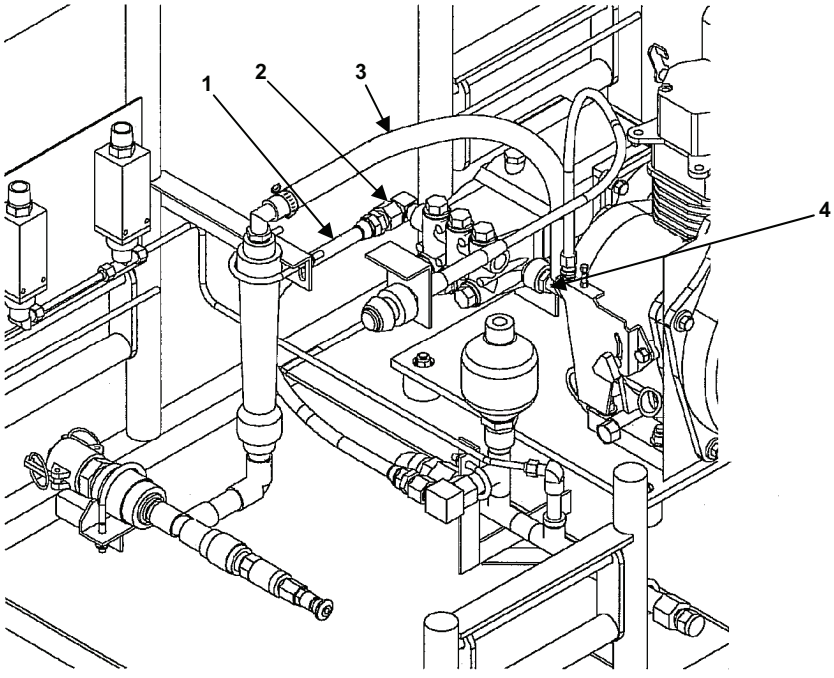


Figure 1. High-Pressure Pump Hose Removal.

REMOVAL - continue

2. Drain the oil from the high-pressure pump. See (WP 0042).
3. Separate the high-pressure pump (Figure 2, item 5) from mounting base (Figure 2, item 6). Remove bolts (Figure 2, item 9), lock washers (Figure 2. item 8), and washers (Figure 2, item 7).

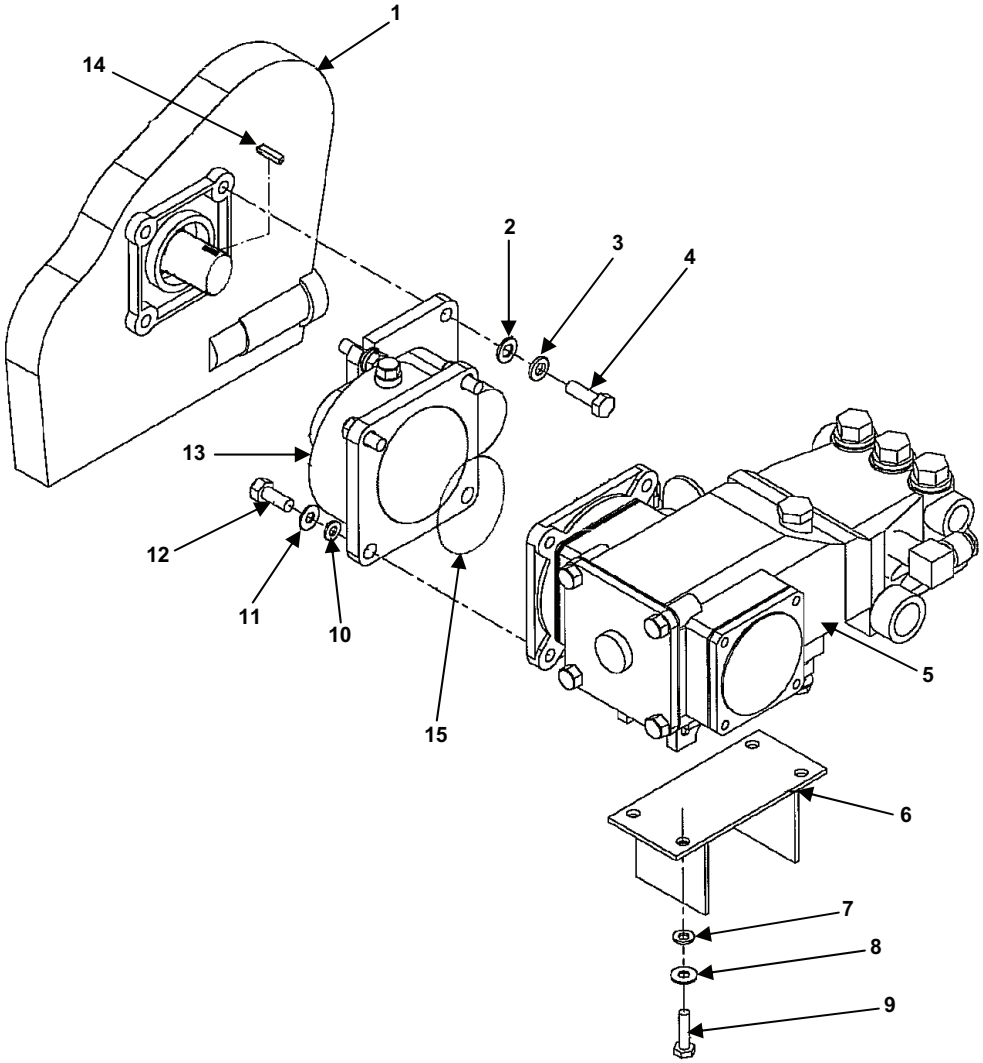


Figure 2. Gearbox/High-Pressure Pump Removal.

4. Remove bolts (Figure 2, item 4), lock washers (Figure 2, item 3), and washers (Figure 2, item 2).
5. Remove the gearbox (Figure 2, item 13) and high-pressure pump (Figure 2, item 5) from the engine (Figure 2, item 1).
6. Remove the key (Figure 2, item 14).
7. Separate the gearbox from (Figure 2, item 13) from the high-pressure pump (Figure 2, item 5). Remove bolt (Figure 2, item 12), lock washers (Figure 2, item 11), and washers (Figure 2, item 10)

REMOVAL - continue

High-Pressure Pump Flange

1. Remove bolt (Figure 3, item 2), lock washer (Figure 3, item 12), washer (Figure 3, item 3), and key (Figure 3, item 11).

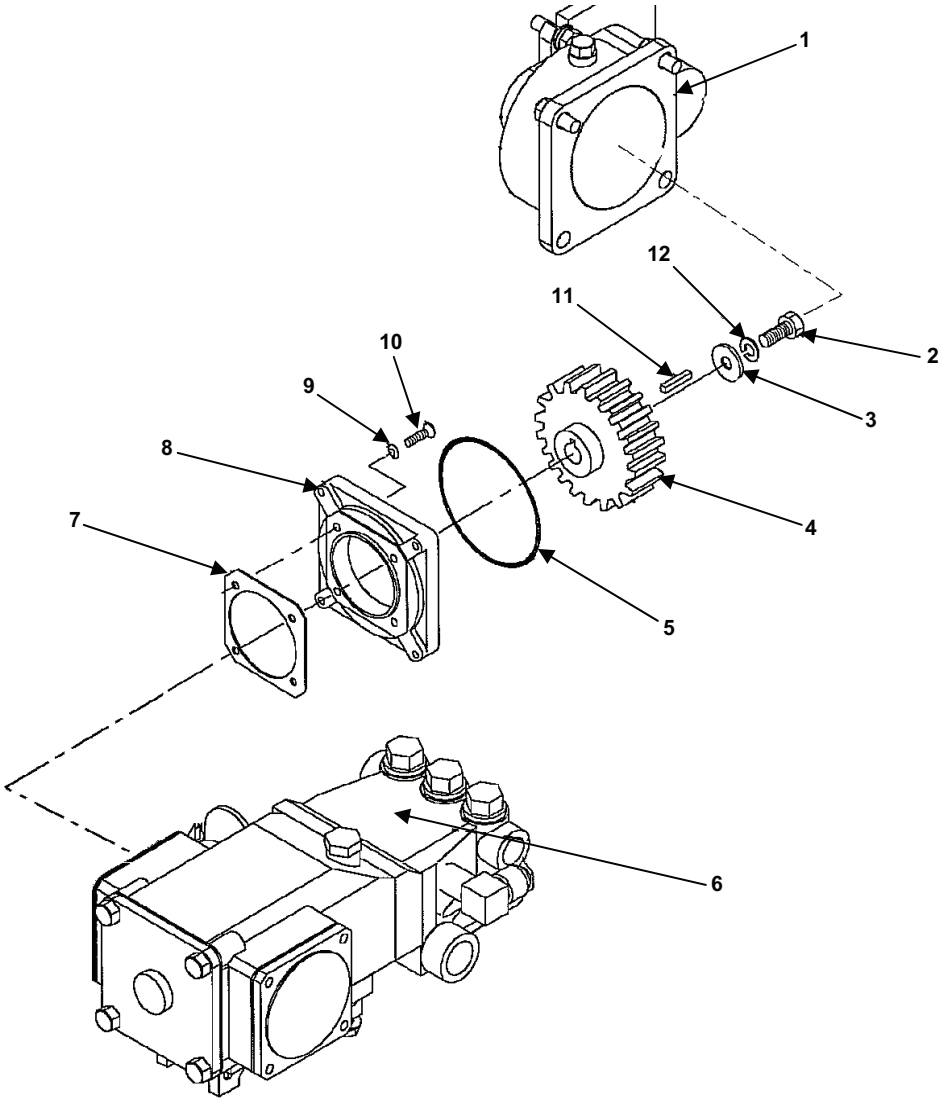


Figure 3. High-Pressure pump Flange.

2. Slide the spur gear (Figure 3, item 4) from the high-pressure pump (Figure 3, item 6).
3. Remove O-ring (Figure 3, item 5), screws (Figure 3, item 10), and lock washers (Figure 3, item 9) from the flange (8).
4. Remove flange (Figure 3, item 8) from the high-pressure pump (Figure 3, item 6). Remove the gasket (Figure 3, item 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 (Figure 3, item 6), gasket (Figure 3, item 7), and flange (Figure 3, item 8). Fasten with screws (Figure 3, item 10) and washers (Figure 3, item 9).
3. Rub a light coat of clean lubricating oil on the O-ring (Figure 3, item 5) and place it in the groove on the flange (Figure 3, item 8).
4. Place the key (Figure 3, item 11) in the recess in the spur gear (Figure 3, item 4) and slide the gear on the pump shaft.
5. Secure the gear with washer (Figure 3, item 3), lock washer (Figure 3, item 12), and bolt (Figure 3, item 2).

Gearbox

1. Refer to Figure 2 for this procedure section.
2. Mate the gearbox (Figure 2, item 13) to the high-pressure pump flange. Secure with bolts (Figure 2, item 12), lock washers (Figure 2, item 11), and washers (Figure 2, item 10).
3. Install the key (Figure 2, item 14) on the engine shaft.
4. Place the pump and gearbox assembly on the mounting base (Figure 2, item 6) and align the engine shaft into the gearbox (Figure 2, item 13).
5. Secure the gearbox (Figure 2, item 13) to the engine (Figure 2, item 1) with bolts (Figure 2, item 4), lock washers (Figure 2, item 3), and washers (Figure 2, item 2).
6. Secure the high-pressure pump (Figure 2, item 5) to the mounting base (Figure 2, item 6) with bolts (Figure 2, item 9), lock washers (Figure 2, item 8), and washers (Figure 2, item 7).
7. Refill with oil. See (WP 0042).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
THROTTLE ASSEMBLY
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2 Item 2)

Materials/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Throttle cable, (12489056)

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.
2. Remove cable sleeve retaining nut (Figure 1, item 2) from throttle cable.

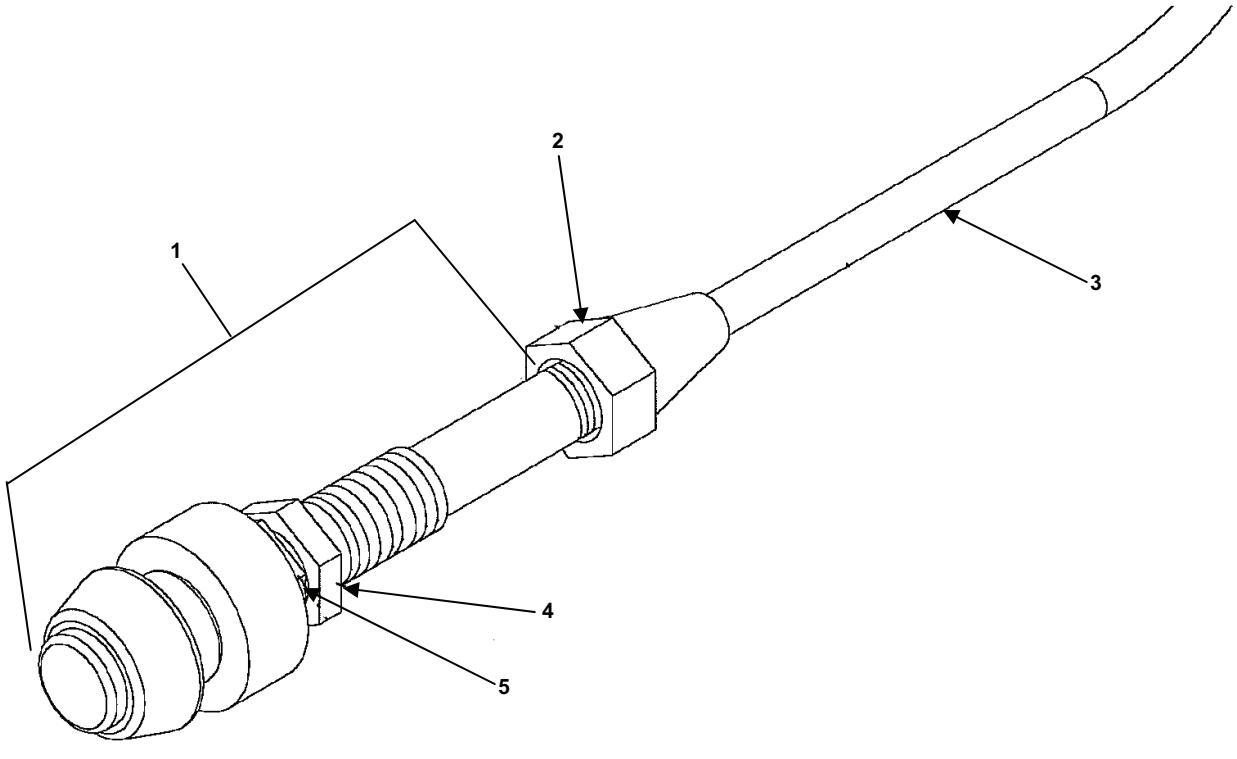


Figure 1. Throttle Cable Assembly.

REMOVAL- continued

3. Pull the cable out from the sleeve (Figure 1, item 3) and disconnect from the adjusting mechanism (Figure 1, item 1).
4. Remove the adjustment mechanism (Figure 1, item 1) by removing retaining nut (Figure 1, item 4) and washer (Figure 1, item 5).
5. Loosen the setscrew (Figure 2, item 2) on the throttle arm (Figure 2, item 1).
6. Remove cable by loosening lower lock nut (Figure 2, item 4) on throttle plate (Figure 2, item 3) and rotating outer sleeve (Figure 2, item 5) counter-clockwise.

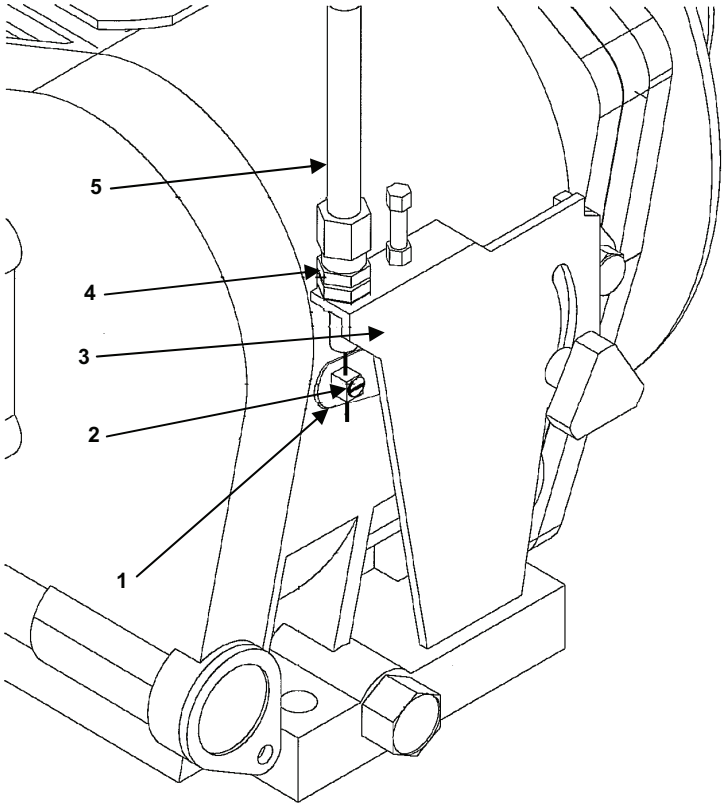


Figure 2. High-Pressure Pump Module Throttle Location.

INSTALLATION

1. Push the throttle cable through the throttle plate (Figure 2, item 3) and set screw (Figure 2, item 2).
2. Screw the throttle cable outer sleeve (Figure 2, item 5) into the throttle plate (Figure 2, item 3).
3. Tighten the lower lock nut (Figure 2, item 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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
RECOIL STARTER AND STARTER ROPE
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Starter Rope (PN 160260-76630-01)

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 (Figure 1, item 1), and remove the recoil starter assembly (Figure 1, item 2) from flywheel housing (Figure 1, item 3).

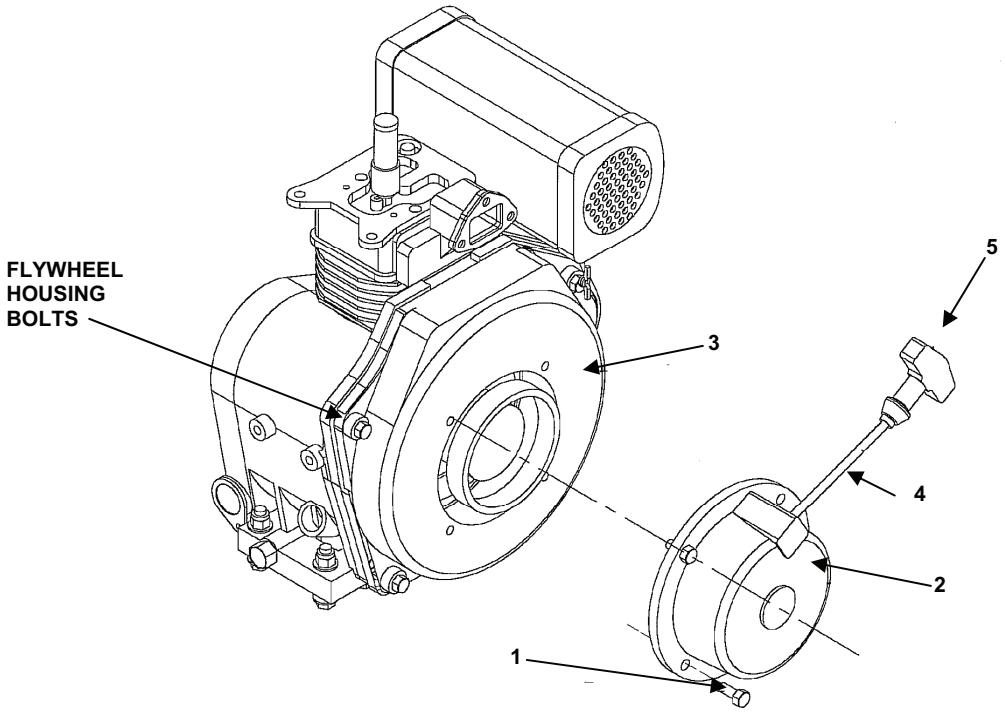


Figure 1. Recoil Starter Removal.

Flywheel Housing

Remove flywheel housing (Figure 1, item 3) by removing bolts.

Starter Rope

1. Note how and where the rope is anchored on the recoil assembly (Figure 1, item 2).
2. Remove the starter rope from the recoil starter assembly (Figure 1, item 2) and handle (Figure 1, item 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.

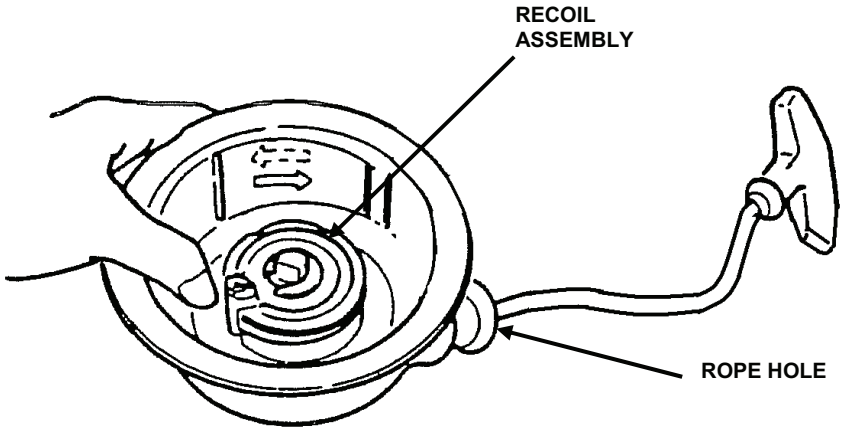


Figure 2. Starter Rope Installation.

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 (Figure 1, item 3) by installing bolts.

Recoil Starter

Install the recoil starter (Figure 1, item 2) on the engine (Figure 1, item 3) and secure with four bolts (Figure 1, item 1).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
MUFFLER ASSEMBLY
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Muffler, (PN 114250-13521)

GENERAL

This work package contains information and instructions for removal and installation of the muffler assembly on the diesel engine.

REMOVAL

1. Remove the bolts (Figure 1, item 6), nuts (Figure 1, item 3) and remove the muffler assembly (Figure 1, item 7) from the engine.

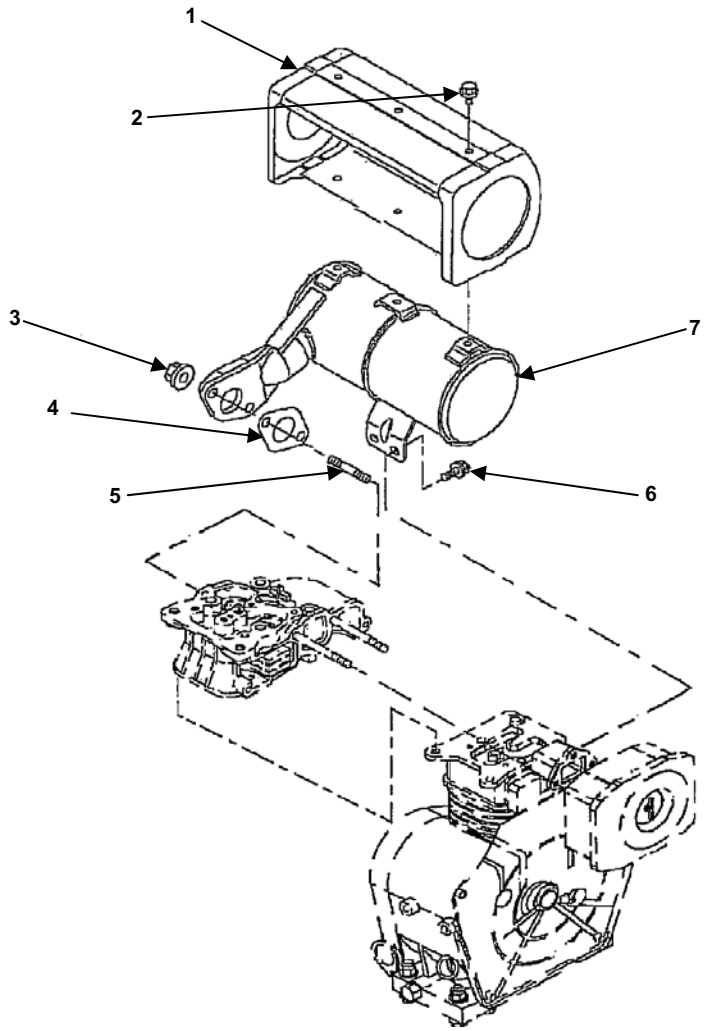


Figure 1. Muffler Removal.

REMOVAL - continue

2. Remove gasket (Figure 1, item 4).
3. Remove screws (Figure 1, item 2) and muffler cover (Figure 1, item 1) only if necessary.
4. Removing mounting studs (Figure 1, item 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 (Figure 1, item 5) if necessary.
3. Install muffler cover (Figure 1, item 1) on the muffler (Figure 1, item 7) and secure with screws (Figure 1, item 2) if necessary.
4. Slide the gasket (Figure 1, item 4) on the mounting studs.
5. Install the muffler (Figure 1, item 7) and secure with nuts (Figure 1, item 3) and bolts (Figure 1, item 6)

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CONTROL MODULE COMPONENTS
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts
Rags, wiping, cotton (WP 0139, Item 24)
Switch, 2-position, (PN 12497070)
Switch, 3-position, (PN 12511441)
Switch, 4-position, (PN 12511443)
Hour meter, 0-99999.9 hours, (PN 12511425)
Breaker, circuit, 20 amp, (PN 12511430)
Light, pilot, (PN 12511439)
Bulb, pilot light (WP 0139, item 10)
Block, circuit breaker, (PN12511434)
Button, push-pull, emergency stop (PN 12511438)
Button, push, (PN 12511411)
Block, terminal, 600 V, (PN 12511423)
Block, circuit breaker, 10 amp, (PN 12511495)
Suppressor, surge, 120 V, (PN UAK 2/2-120AC-ST)
Suppressor, surge, 230 VAC, (PN UAK 2/2-230AC-ST)

Equipment Condition Required
All equipment de-energized and shut off.

Material/Parts - continued
Relay, control, SPDT, (PN 12511426)
Module, start, 18-amp, (PN 12511435)
Module, start, 2.5-4 amp, (PN 12511418)
Module, start, auxiliary, (PN 12511419)
Suppressor, surge, (PN 12511436)
Controller, motor, (PN 12511442)
Board, terminal, 600V, (PN 12511415)
Handle, mechanism, (PN 12511431)
Module, starter, (PN 12511449)
Block, terminal, 600V, (12511523)
Wire, Nonelectrical (WP 00139, Item 42)
Tie Wraps, gray (WP 0139, item 34)

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 (8) 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 (18) 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.
4. Loosen lock nut on front of switch.

SWITCH, 2-POSITION/3-POSITION/4-POSITION - continued

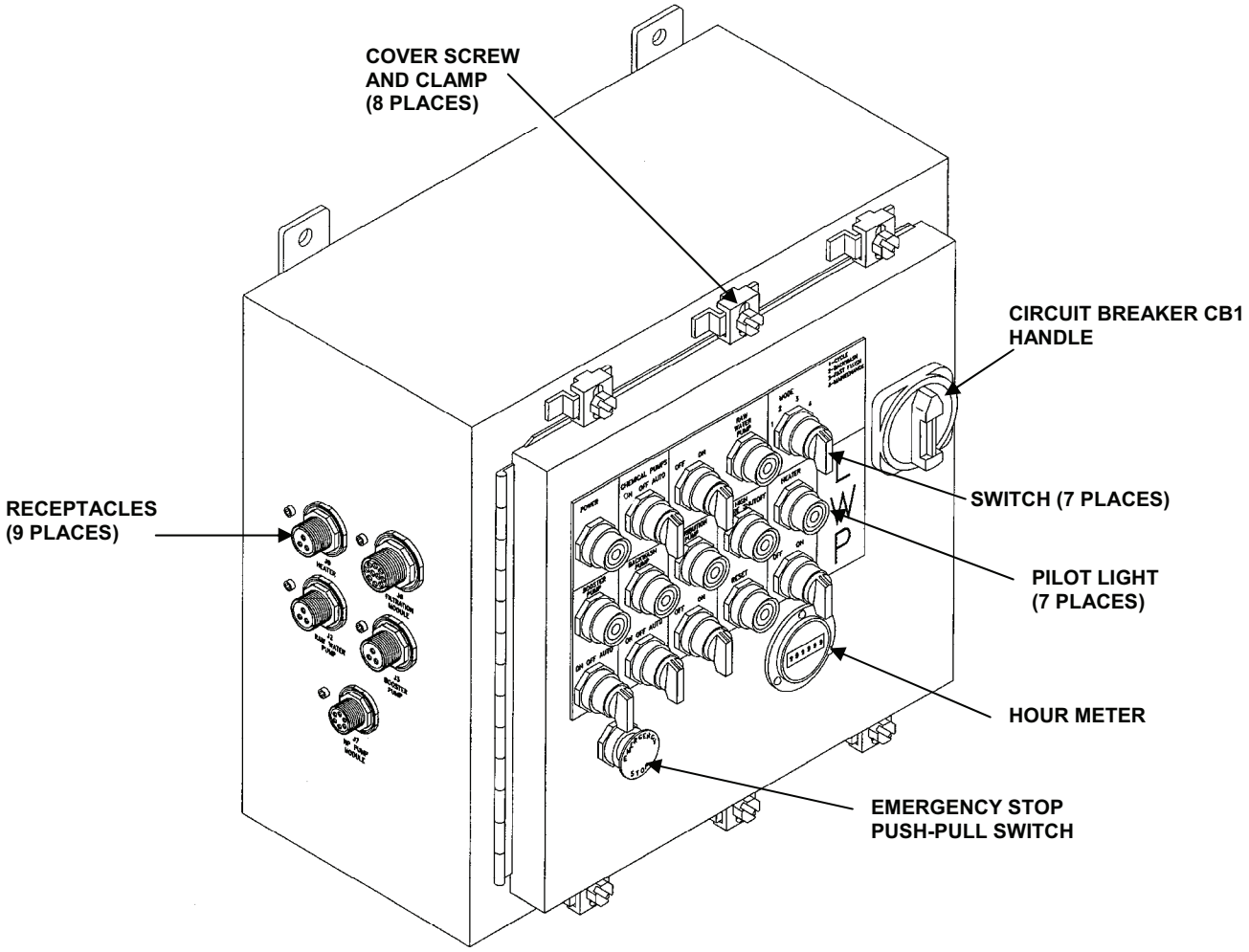


Figure 1. Control Module.

NOTE

Number varies depending on switch, two to eight wires.

5. Pull through cover. Remove from cutout in panel.

Installation

1. Insert switch through cutout in panel.
2. Install lock nut on front of switch.
3. Connect wiring on the back of the switch. Observe number tags and prior note for proper connection.
4. Install inner panel over hour meter wiring. Install eighteen screws. Tighten securely.

HOUR METER

Removal

1. Remove eighteen (18) screws. Remove inner panel for access to hour meter wiring and mounting.
2. Make note of the two (2) wire numbers on rear of meter for ease of reinstallation.

HOUR METER - continued

3. Disconnect two (2) wires on back of hour meter
4. Remove three (3) 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 (3) screws and nuts to secure hour meter to panel.
3. Connect two (2) 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 (18) screws. Tighten securely.

PILOT LIGHT (INDICATOR)

Removal

1. Remove eighteen (18) 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 (18) 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 (18) 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 (2) 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 (2) 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 (2) 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 (2) screws and O-rings from rear of handle mechanism. See Figure 2.

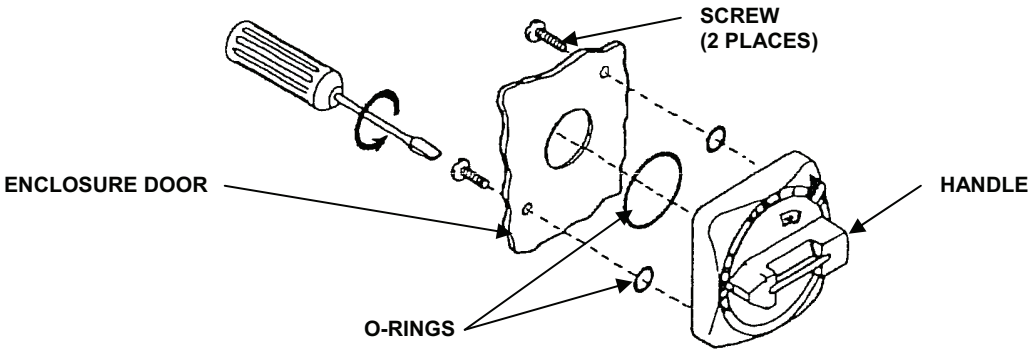


Figure 2. Handle Mechanism.

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 (2) slotted screws from circuit breaker.
4. Remove circuit breaker from mounting panel.
5. Remove depth shaft assembly from circuit breaker by removing the two (2) mounting screws.

CIRCUIT BREAKER (CB1) - continued

Installation

1. Place circuit breaker on mounting plate. See Figure 3.
2. Install the two (2) 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 (2) 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.

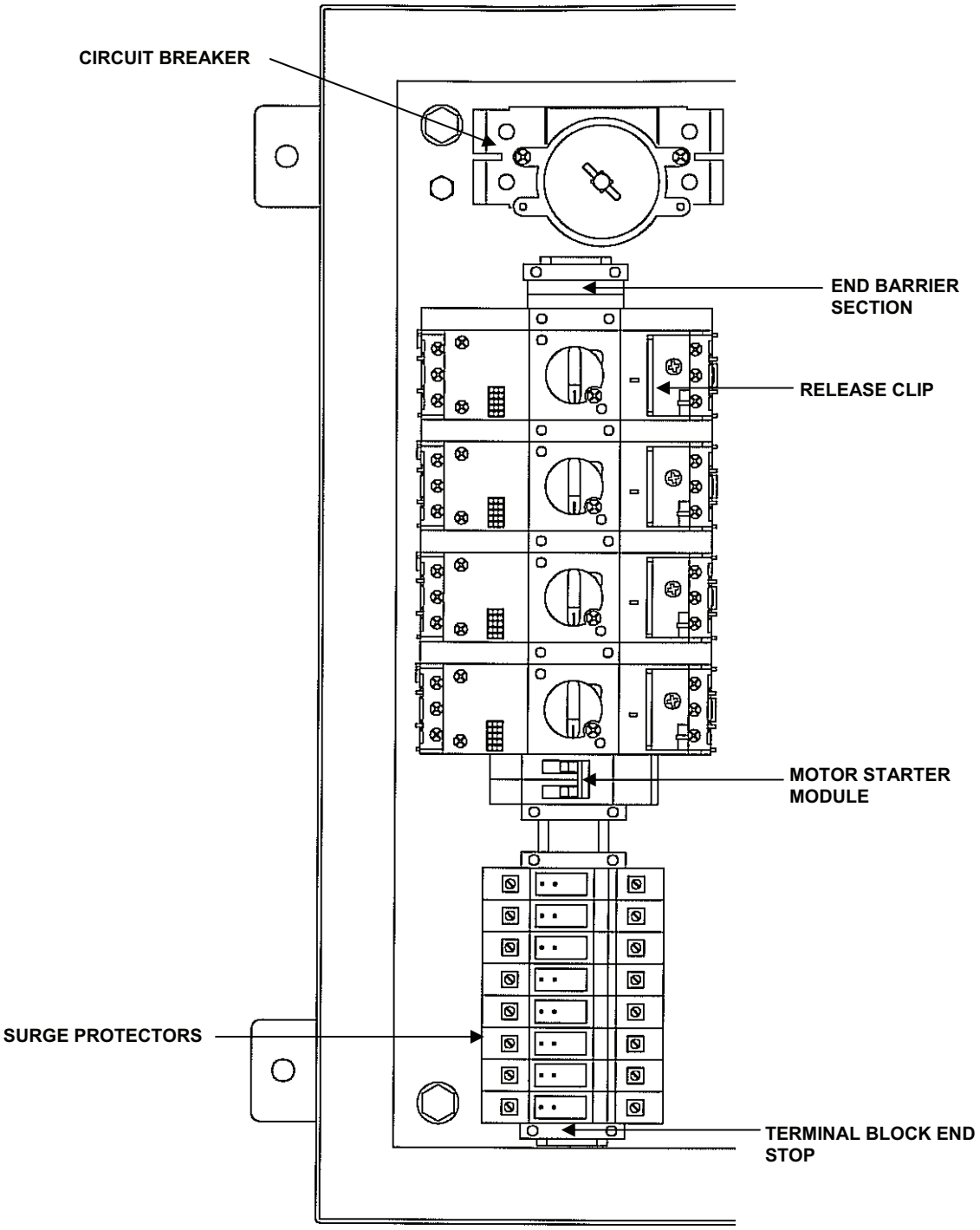


Figure 3. Control Module Internal Components (Top).

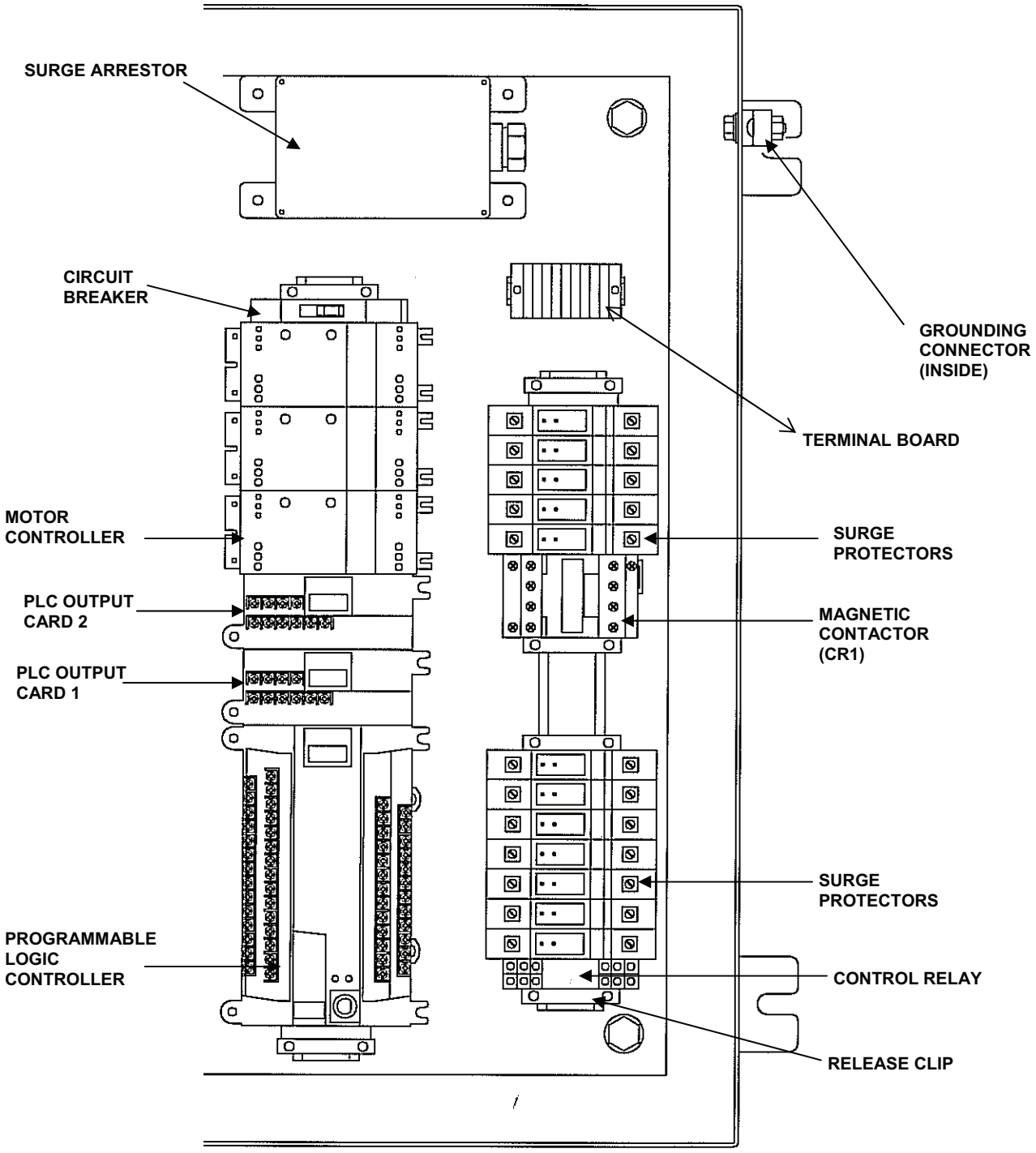


Figure 4. Control Module Internal Components (Bottom).

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 (4) wires on motor controller. See Figure 4.
2. Remove four (4) 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 (4) 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 (2) wires from circuit breaker.
3. Press release clip with screwdriver.
4. Pull up and remove circuit breaker.

Installation

1. Connect two (2) 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 (4) 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 (4) 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 (2)screws from each input or output terminal strip on sides of PLC.

Removal - continued

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 (4) screws from PLC base.
8. Remove PLC from mounting plate. The PLC is not repairable.
9. See (WP 0070) for troubleshooting on PLC.

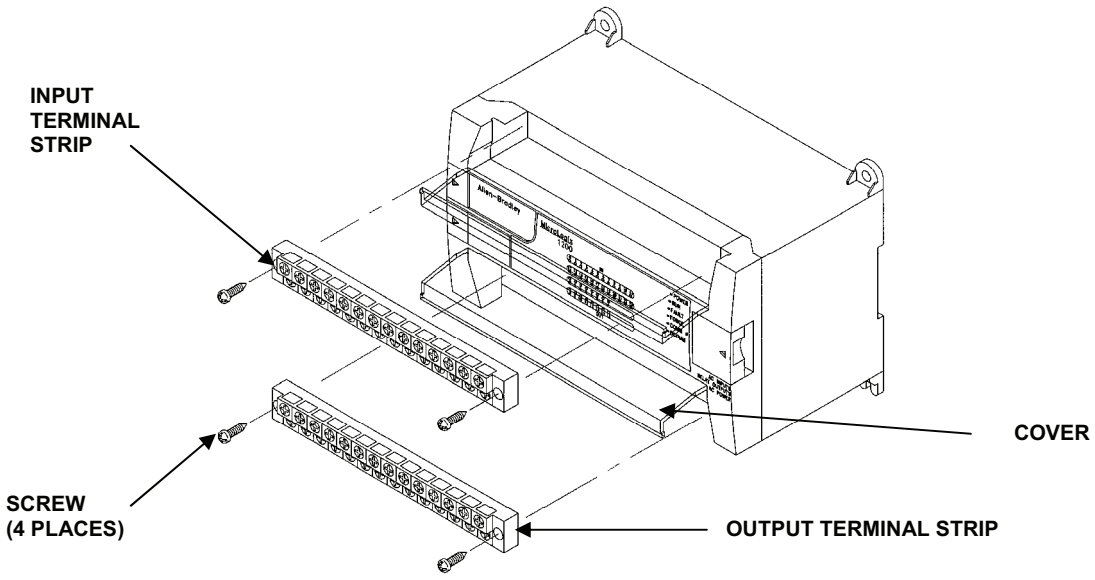


Figure 5. Programmable Logic Controller.

Installation

1. Place PLC on mounting plate.
2. Install four (4) screws through PLC base into mounting plate. Tighten securely.
3. Install two (2) terminal strips (input and output) on PLC.
4. Install two (2) 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.

Removal - continued

3. Unplug the ribbon connector from the adjacent module.

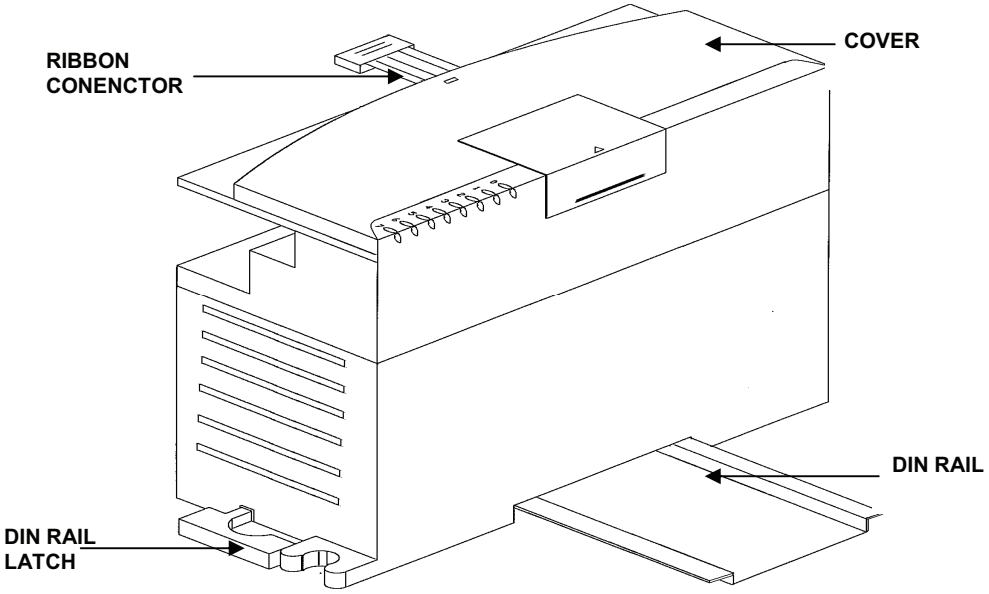


Figure 6. PLC Output Card.

4. Pull out the DIN rail latch.
5. Tilt the output card towards the top and remove it from the DIN rail.

Installation

1. Push the DIN rail latch in.
2. Press the output card onto the DIN rail.
3. Connect all wires. Observe the tags and prior note for installation.

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 (4) 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 (9) 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 (9) 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 (5) 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 (2) capscrews, four (4)flat washers, two (2) lock washers, and two (2) 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.

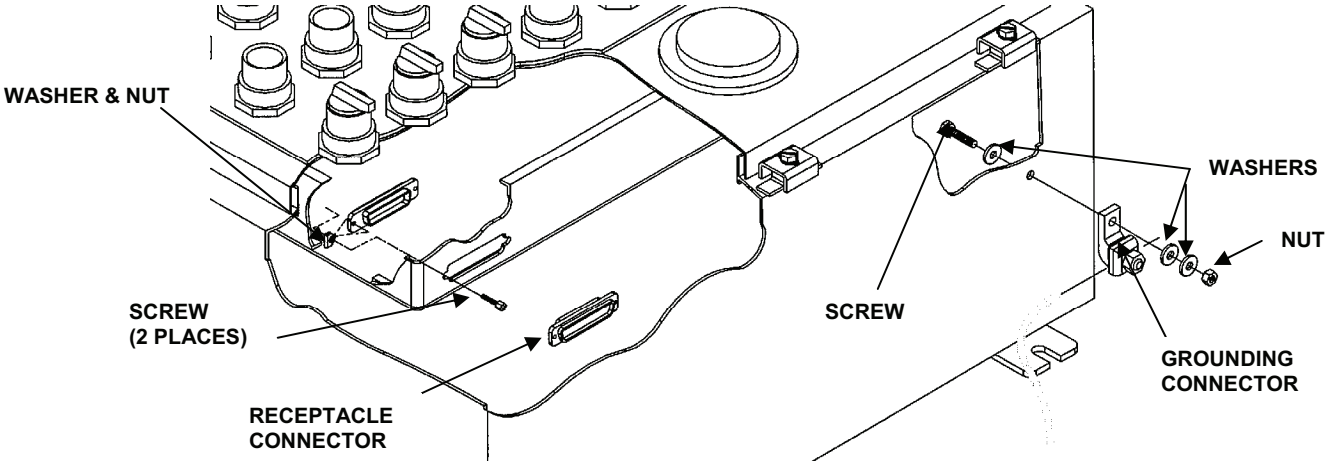


Figure 7. Ground Connector/Receptacle Connector.

Installation

1. Install cable connector on bottom of control module.
2. Install two (2) capscrews, four (4) flat washers, two (2) lock washers, and two (2) 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 (2) 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 (2) 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) 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.

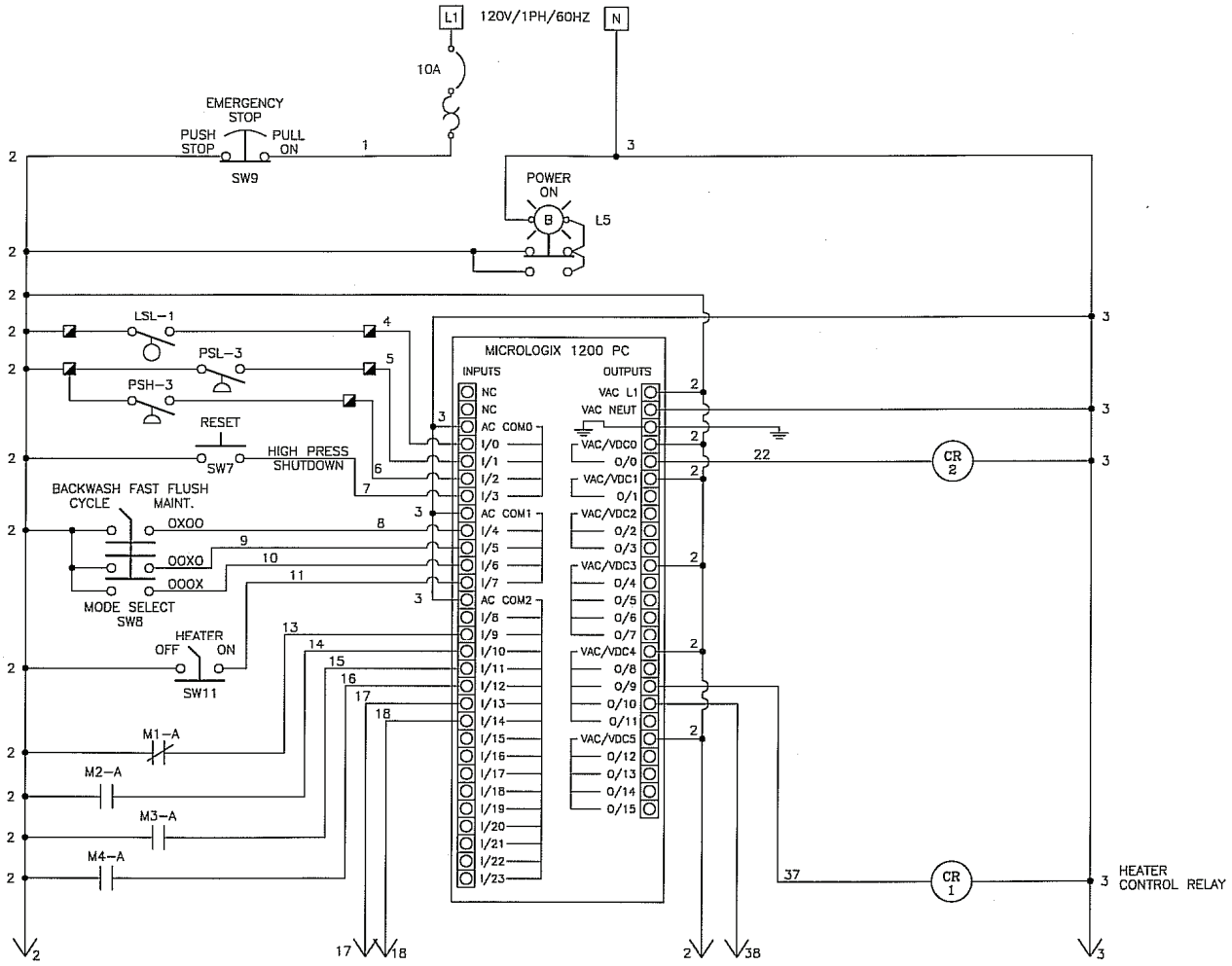


Figure 8. Control Module Circuit (PLC).

WIRING DIAGRAMS - continued

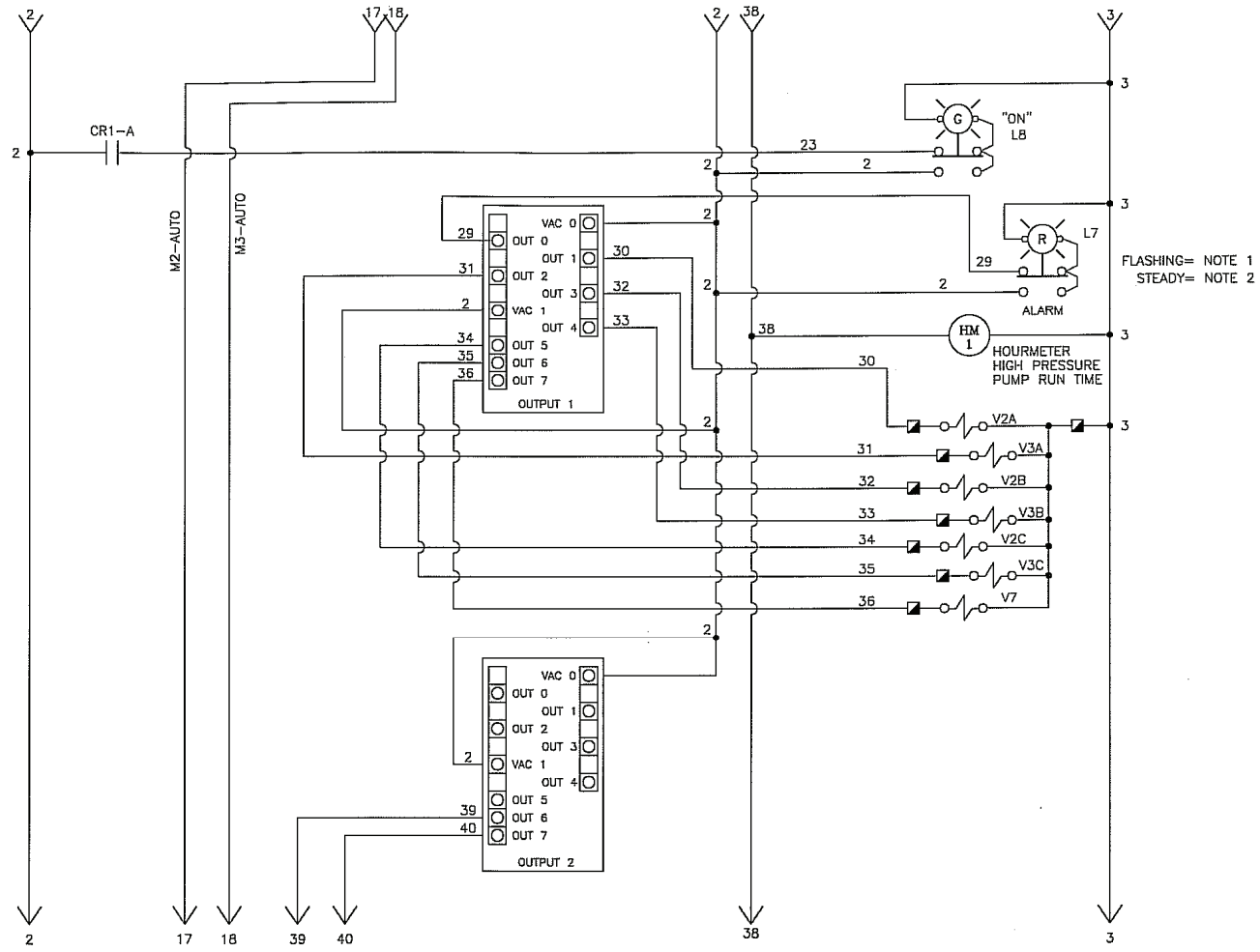


Figure 9. Control Module Circuit (Pumps/Hour Meter).

WIRING DIAGRAMS - continued

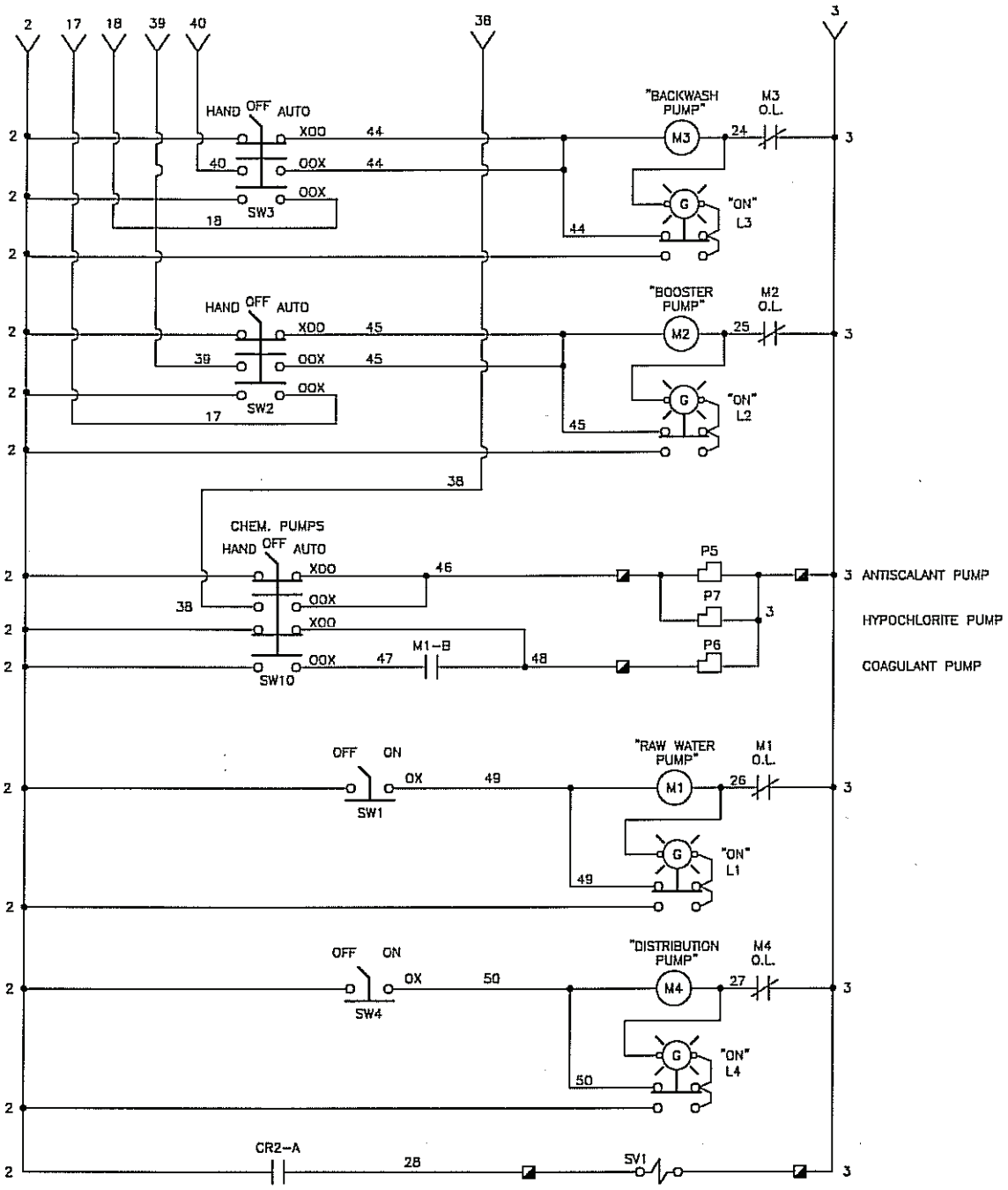


Figure 10. Control Module Circuit (Chemical Pumps/Pumps).

WIRING DIAGRAMS - continued

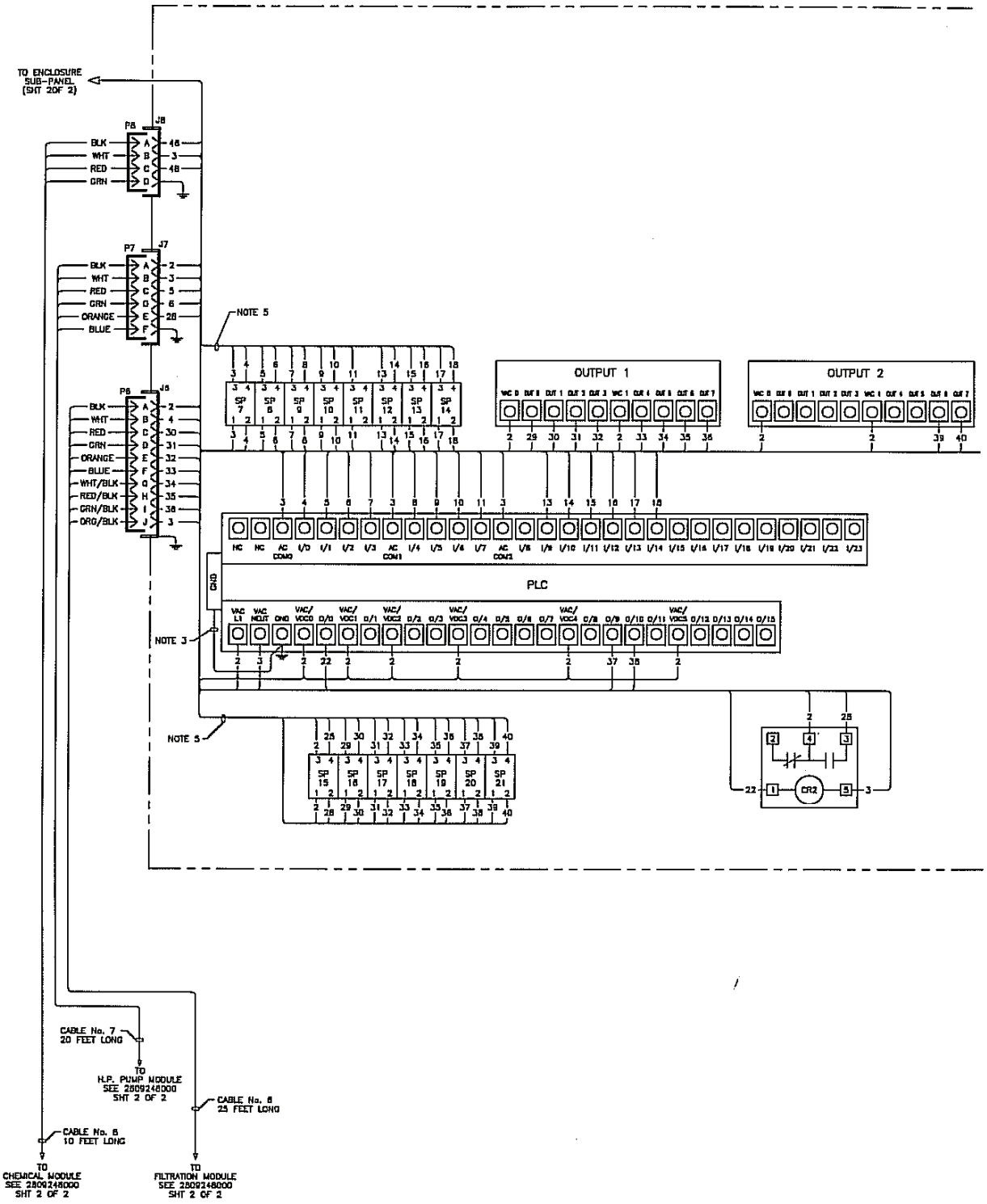


Figure 11. Control Module Wiring Diagram (PLC/Cables).

WIRING DIAGRAMS - continued

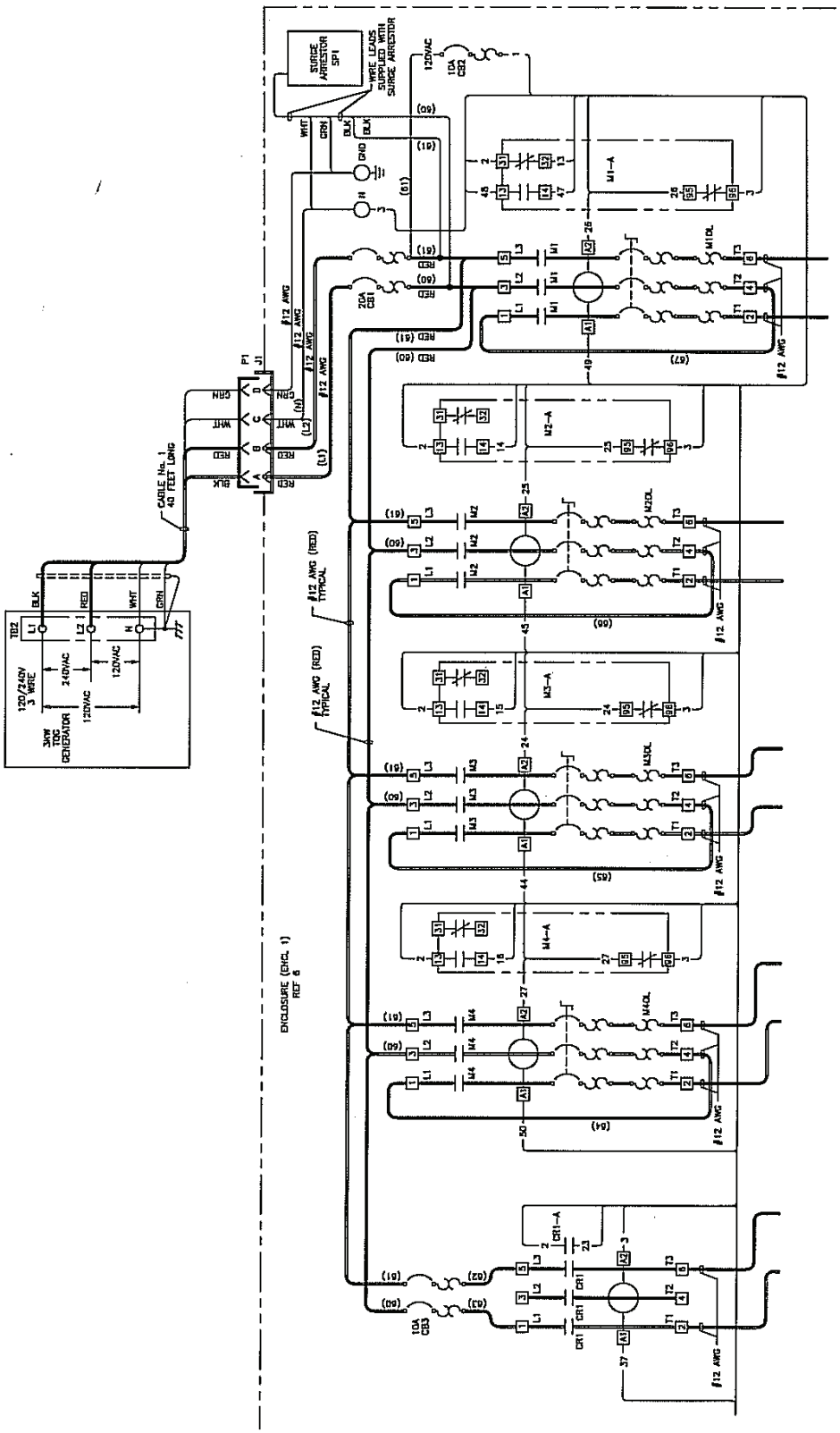


Figure 12. Control Module Wiring Diagram (3kW TQG Set/Motor Starters).

WIRING DIAGRAMS - continued

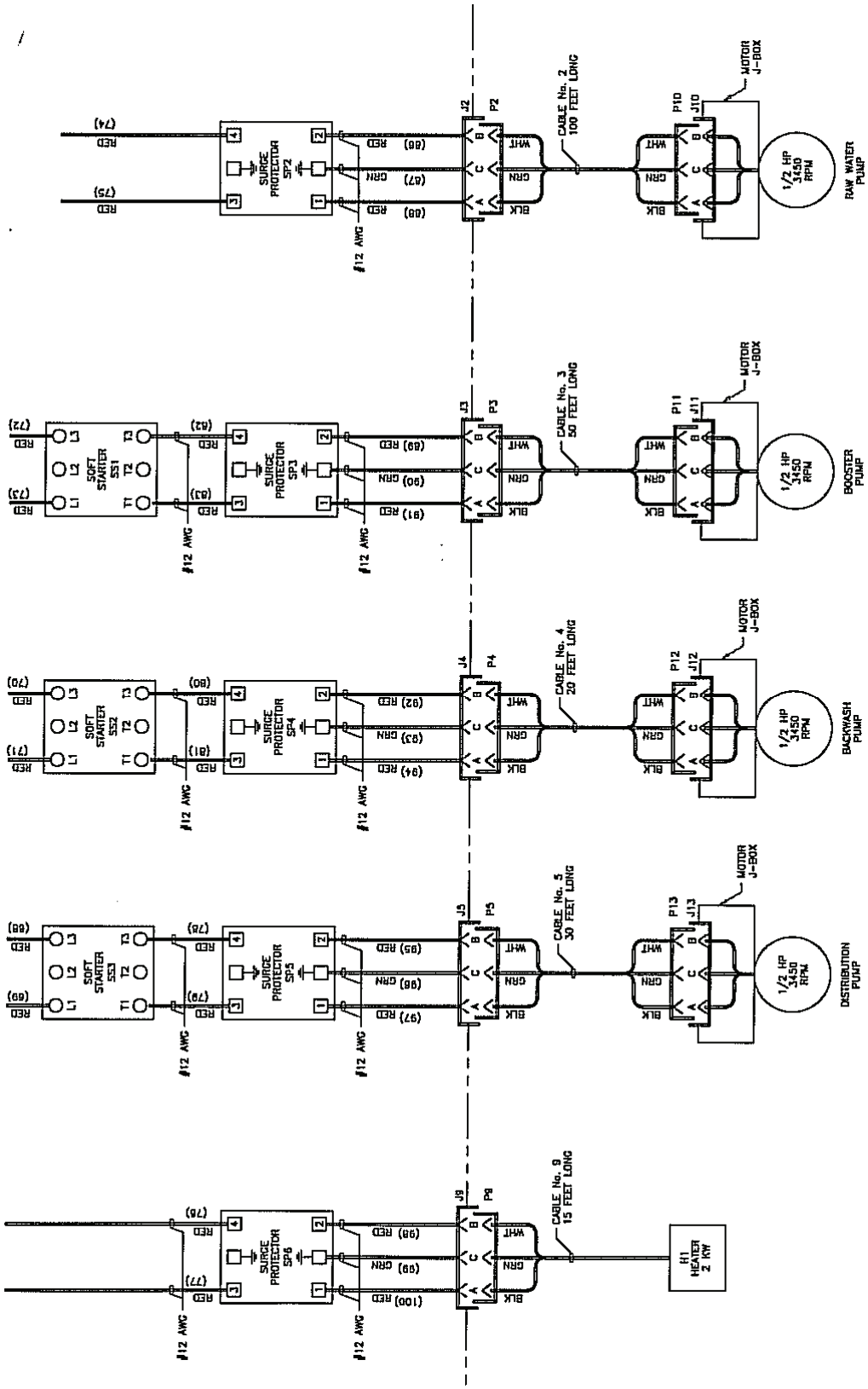


Figure 13. Control Module Wiring Diagram (Pumps/Soft Starters).

WIRING DIAGRAMS - continued

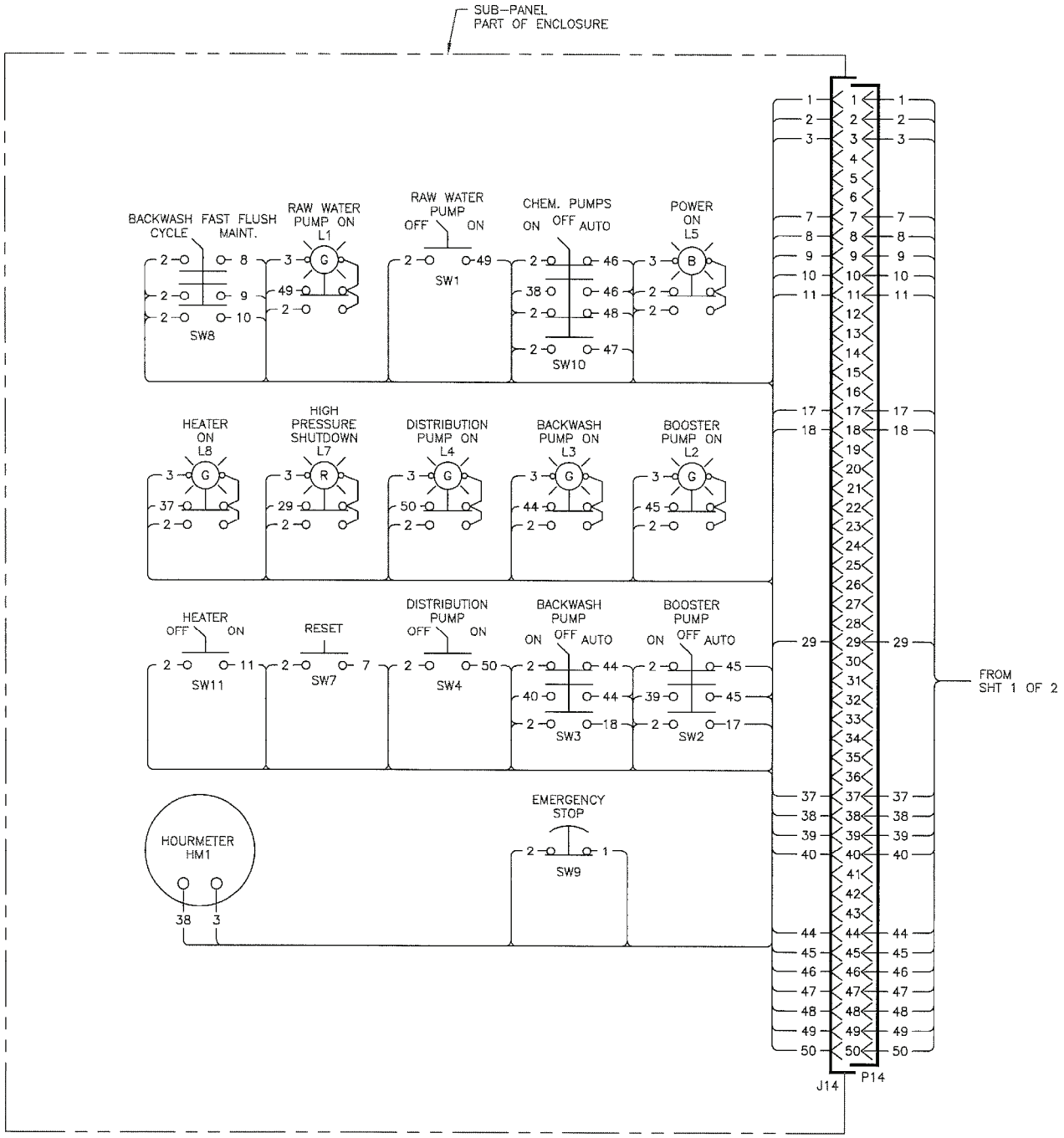


Figure 14. Control Module Wiring Diagram (Switches/Pilot Lights/Hour Meter).

WIRING DIAGRAMS – continued

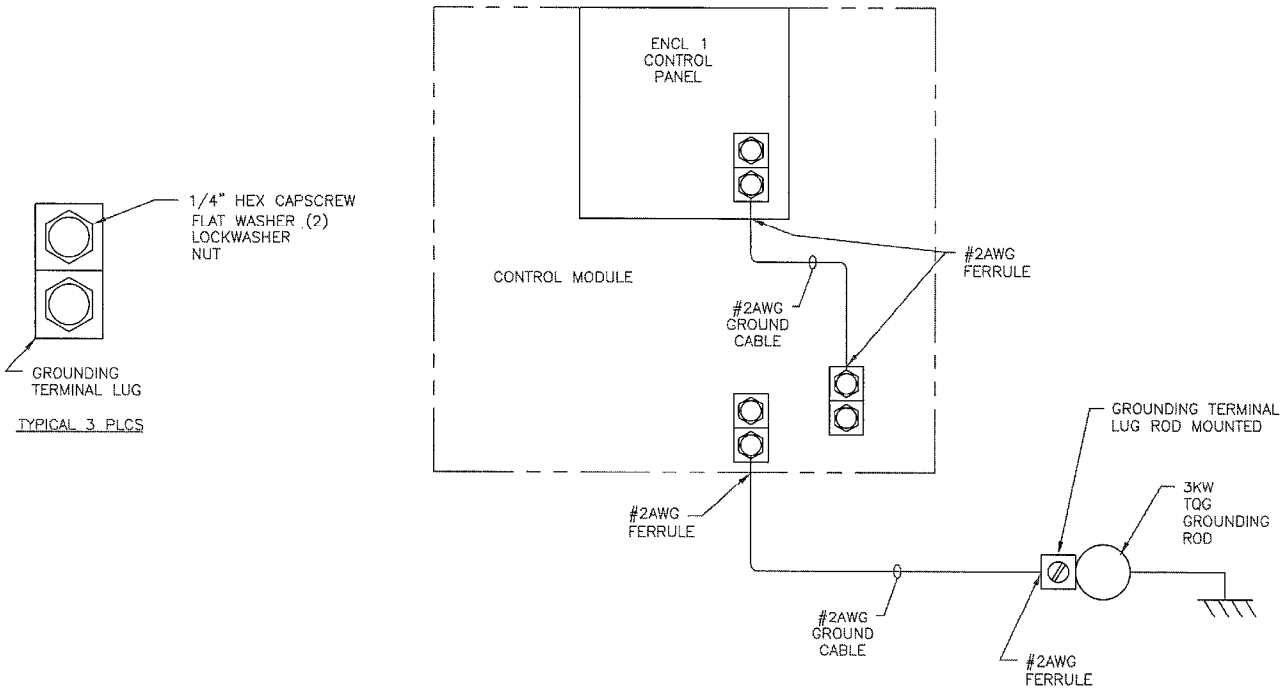


Figure 15. Control Module Wiring Diagram (Grounding).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL PUMPS
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Pump, injection, (PN 1002696001)

Personnel Required

2

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 0110).
3. Loosen four (4) screws on chemical module junction box cover and remove the cover.

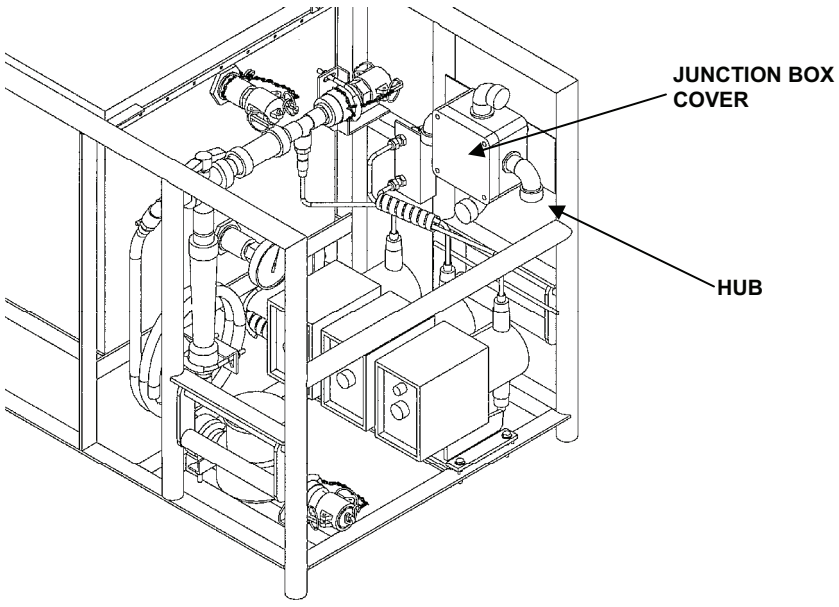


Figure 1. Junction Box Cover.

REMOVAL-continued

4. Note the location and the number of the wires. See Figure 2.
5. Disconnect two power wires and ground wire.

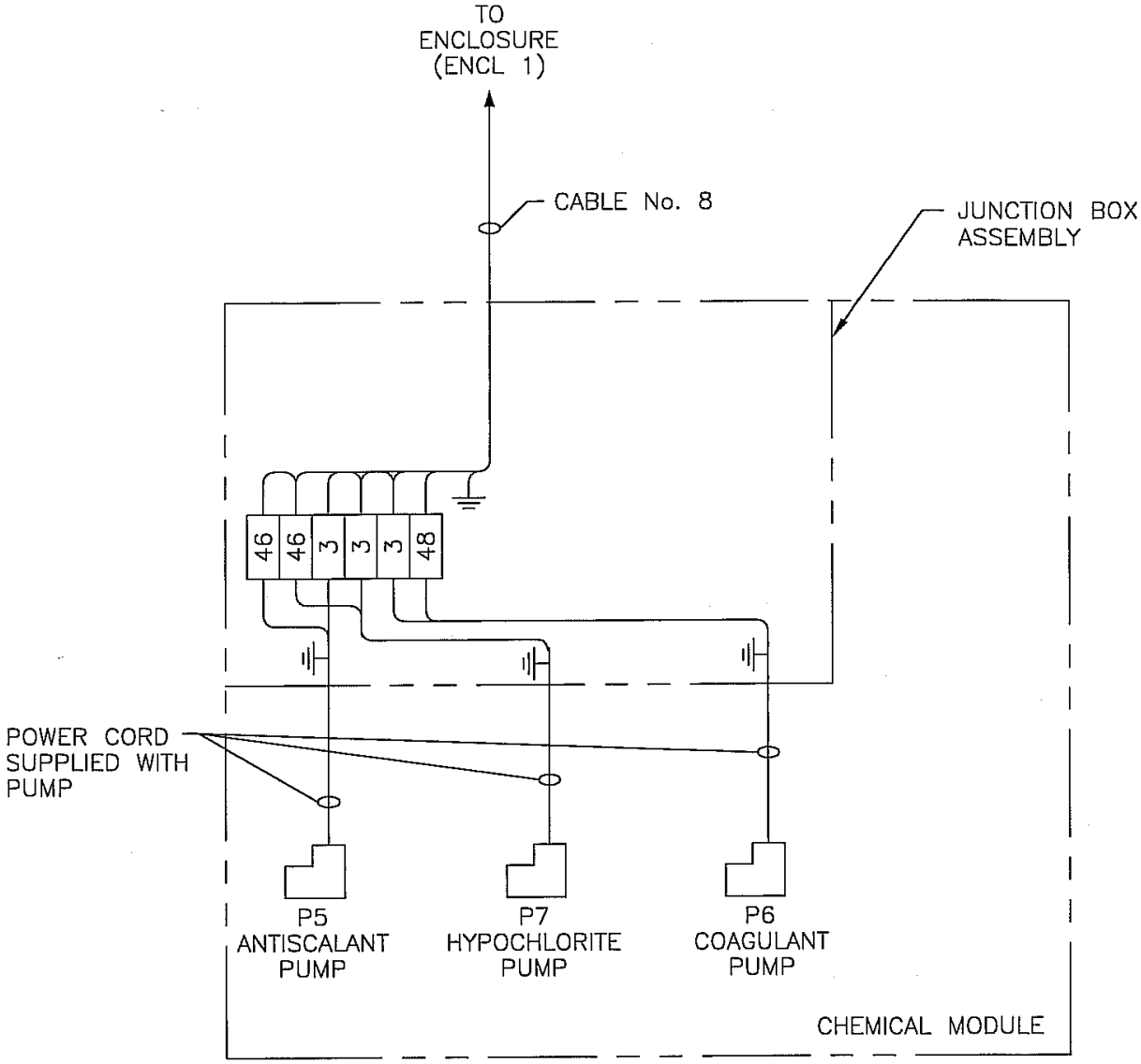


Figure 2. Wiring Diagram.

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 (4) nuts, bolts, and washers, and two (2) 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.

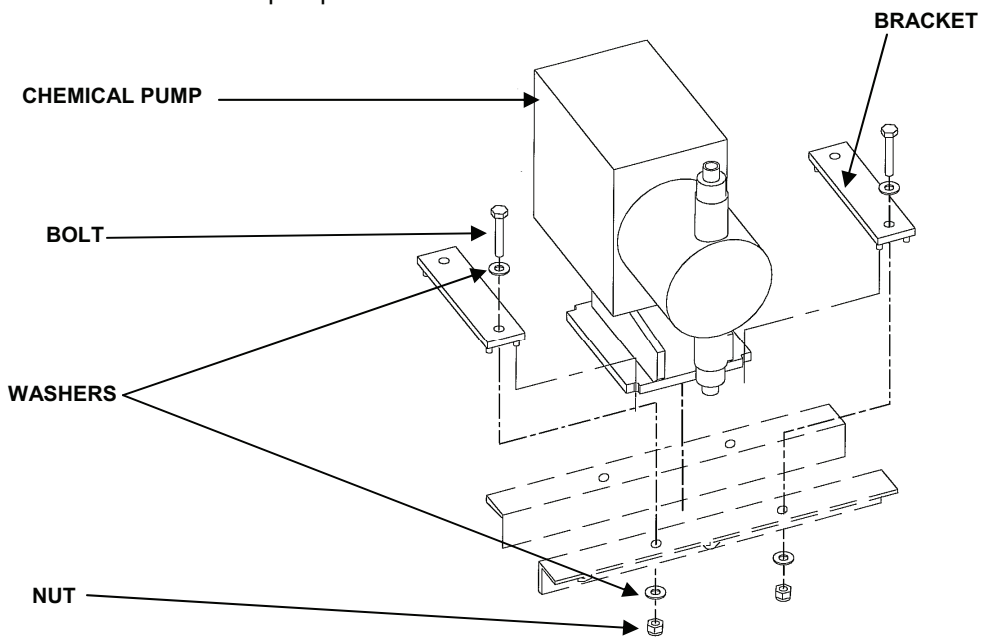


Figure 3. Chemical Pump Mounting Brackets.

INSTALLATION

1. Install chemical pump onto the chemical module.
2. Install mounting brackets.
3. Secure chemical pump and brackets with four (4) 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 (4) screws.
8. Install injection discharge tubing. See (WP 0110).
9. Install suction tubing to pump. See (WP 0110).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL MODULE PIPING
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Flowmeter, (PN 12511536)

Equipment Condition Required

All equipment de-energized.
All switches in off position.

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 0016).
2. Remove sampling hose (Figure 1, item 3) by loosening hose clamp (Figure 1, item 2).
3. Note the location of product outlet spool piece (Figure 1, item 1) and product inlet spool piece (Figure 1, item 4).

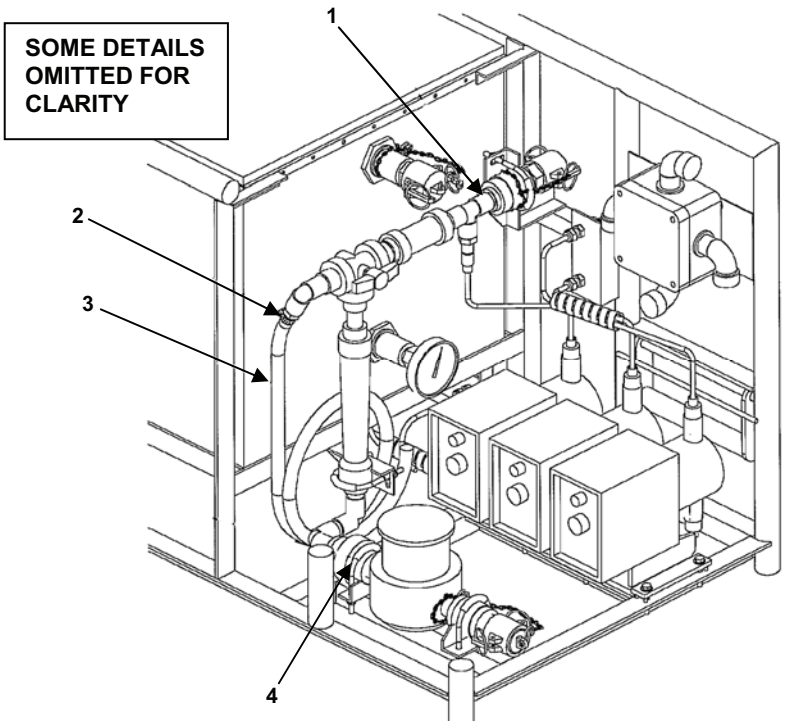


Figure 1. Product Water Sampling Hose.

Product Inlet Spool Piece

1. Loosen the union (Figure 2, item 7) on the 3-way ball valve (Figure 2, item 6).
2. Remove U-bolts (Figure 2, item 3) by removing nuts (Figure 2, item 12) and washers (Figure 2, item 13).
3. Remove piping from the module.

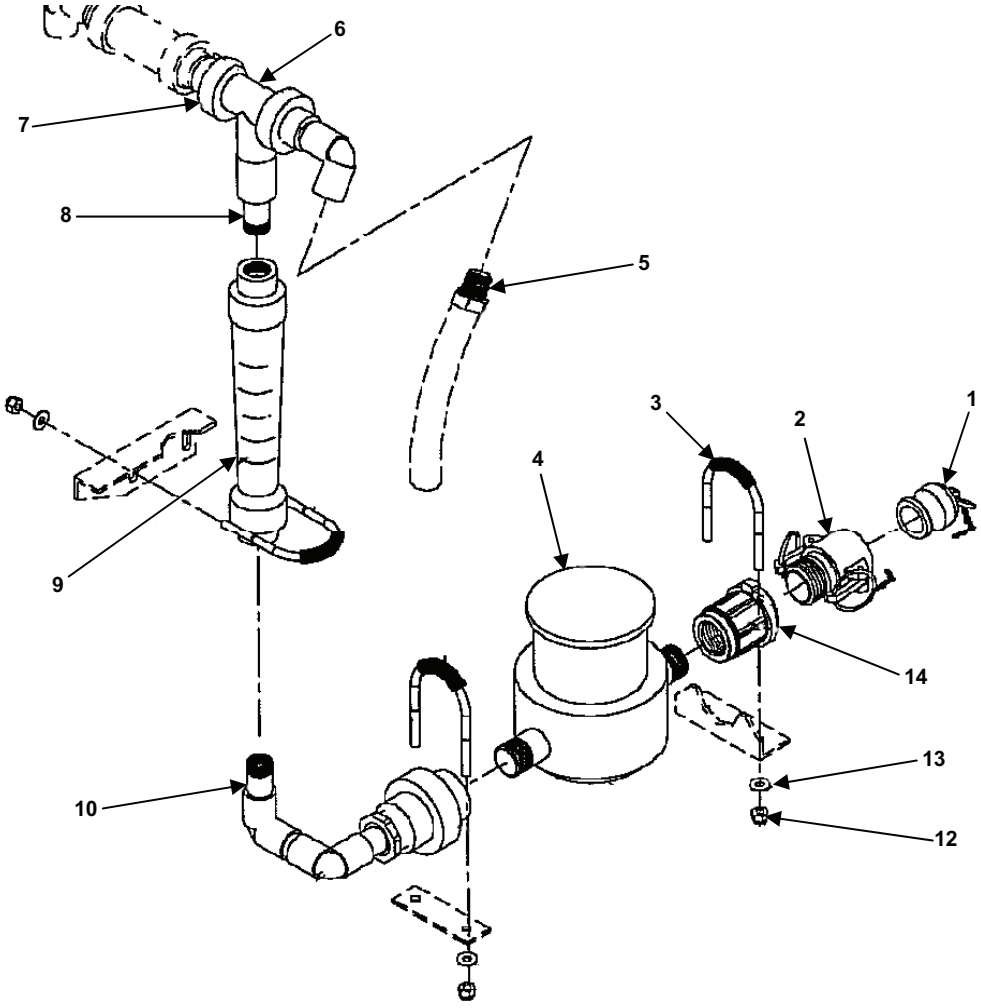


Figure 2. Product Inlet Piping.

4. Remove flow meter (Figure 2, item 9), if necessary, by unthreading from adapters (Figure 2, item 8) and (Figure 2, item 10).
5. Remove dust plug (Figure 2, item 1), female camlock (Figure 2, item 2), female adapter (Figure 2, item 14), 3-way valve (Figure 2, item 6), and totalizer (Figure 2, item 4) only if necessary.

Product Outlet Spool Piece

1. Loosen union (Figure 3, item 5) on the 3-way valve (Figure 3, item 6).
2. Remove U-bolt (Figure 3, item 3) by removing nuts (Figure 3, item 9) and washers (Figure 3, item 10).
3. Remove anti-siphon valve (Figure 3, item 7) from tee fitting (Figure 3, item 8).
4. Remove piping from module.
5. Remove dust cap (Figure 3, item 1) and male camlock (Figure 3, item 2) and check valve (Figure 3, item 4) if necessary.

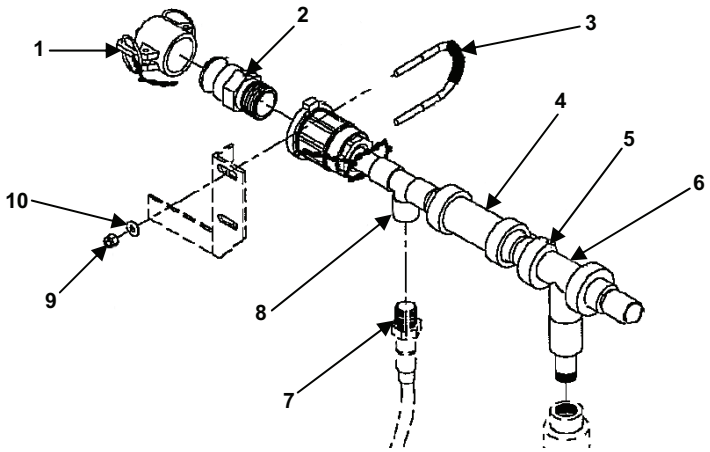


Figure 3. Product Outlet Piping.

Cleaning Tank Outlet Piping

1. The cleaning tank outlet piping is located beneath the cleaning tank (Figure 4, item 8).
2. Loosen union (Figure 4, item 9) on the valve (Figure 4, item 4).

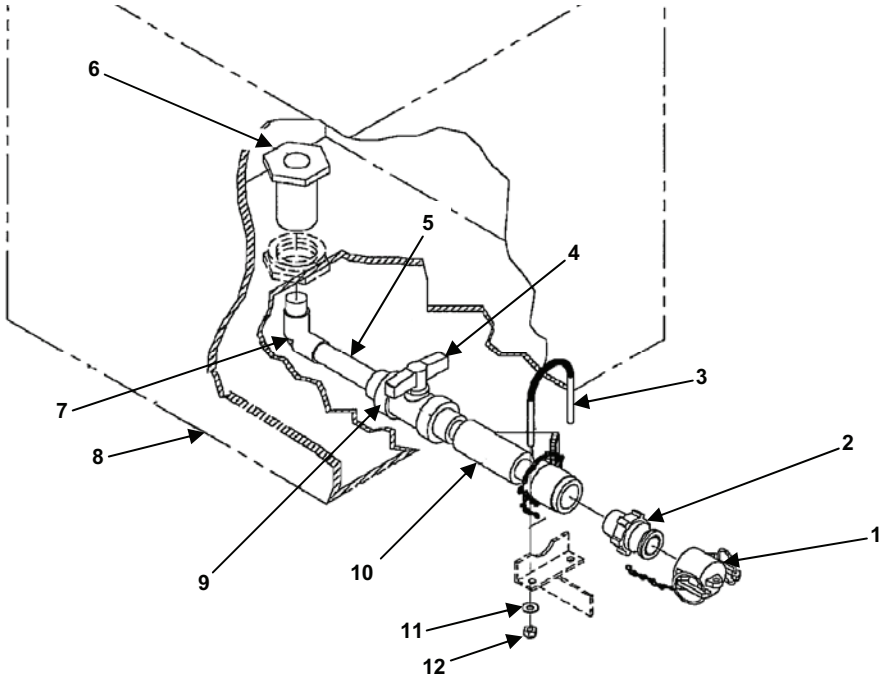


Figure 4. Cleaning Tank Outlet Piping.

3. Remove nuts (Figure 4, item 12), washers (Figure 4, item 11) and remove the U-bolt (Figure 4, item 3).
4. Remove all components up to valve (Figure 4, item 4) from the module.
5. Remove the piping (Figure 4, item 5), if necessary, by unthreading the bulkhead fitting (Figure 4, item 6) from the adapter (Figure 4, item 7).
6. Remove Y-strainer (Figure 4, item 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.

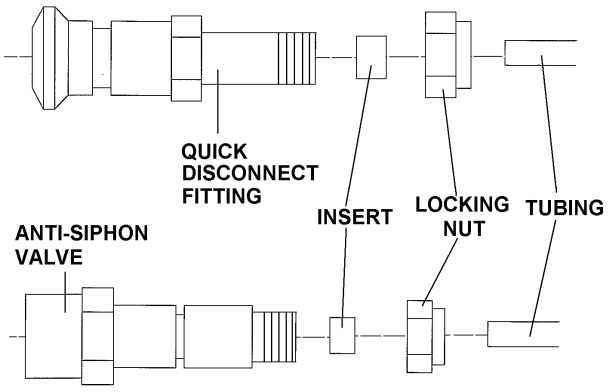


Figure 5. Tubing Connections.

Chlorine Tubing

1. Disconnect chlorine discharge tubing at nuts (Figure 6, item 2) and at (Figure 6, item 4) at chlorine pump (P7) (Figure 6, item 12).

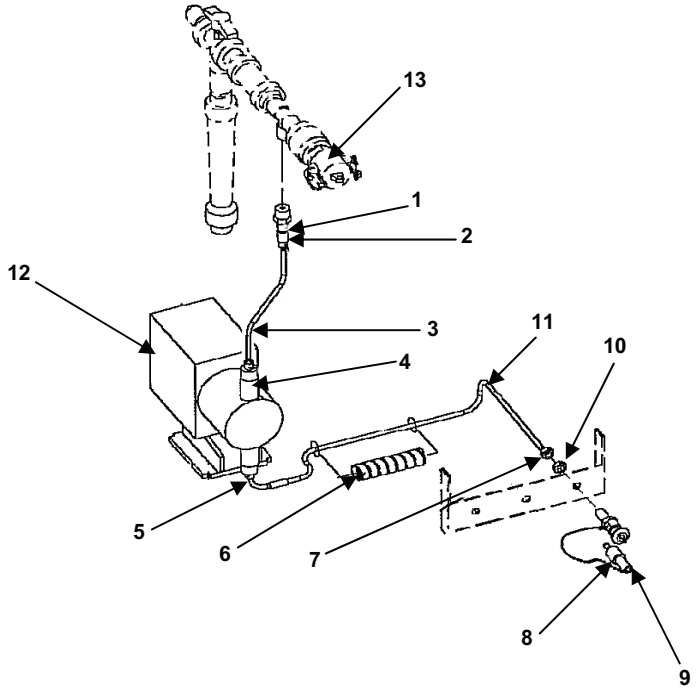


Figure 6. Chlorine Tubing.

2. Remove the insert (Figure 6, item 10) from the tubing.
3. Disconnect chlorine suction tubing (Figure 6, item 11) at nut (Figure 6, item 5) and (Figure 6, item 7).
4. Remove anti-siphon valve (Figure 6, item 1) from piping (Figure 6, item 13) if necessary.
5. Remove the spiral wrap (Figure 6, item 6), quick disconnect (Figure 6, item 8) and plug (Figure 6, item 9) only if necessary.

Coagulant/Bisulfite Tubing

1. Disconnect discharge tubing at nut (Figure 7, item 1) and (Figure 7, item 7).
2. Remove inserts (Figure 7, item 8) from the tubing.
3. Disconnect suction tubing at nut (Figure 7, item 3) and (Figure 7, item 5).

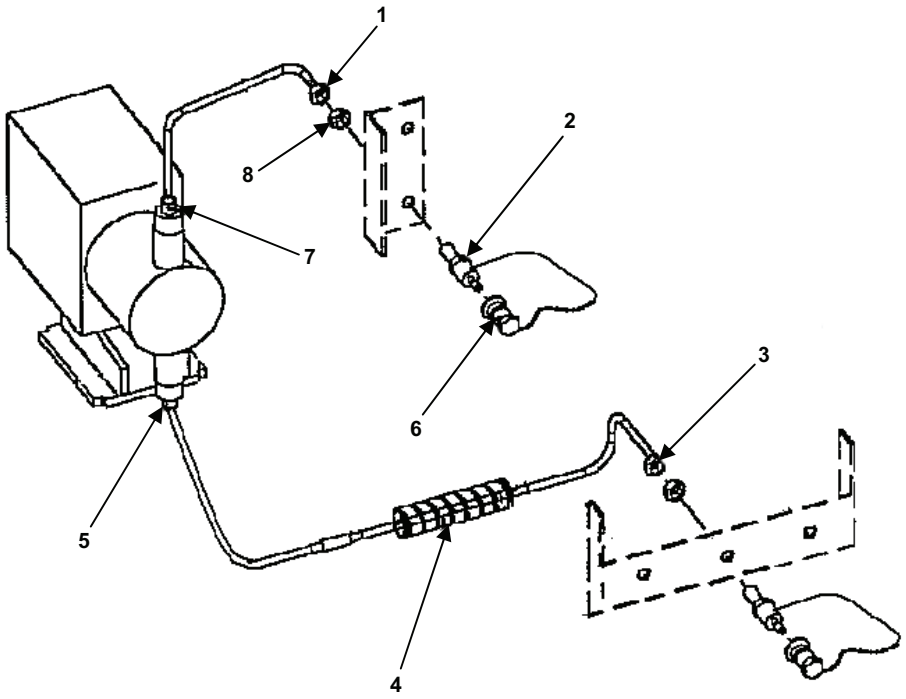


Figure 7. Coagulant/Bisulfite Tubing.

4. Remove quick disconnect (Figure 7, item 2), dust plug (Figure 7, item 6) and spiral wrap (Figure 7, item 4) if necessary.

Antiscalant Tubing

1. Disconnect discharge tubing at nuts (Figure 8, item 1) and (Figure 8, item 7).
2. Remove nut (Figure 8, item 2) from tubing.

Antiscalant Tubing - continued

3. Disconnect suction tubing at nuts (Figure 8, item 3) and (Figure 8, item 6).

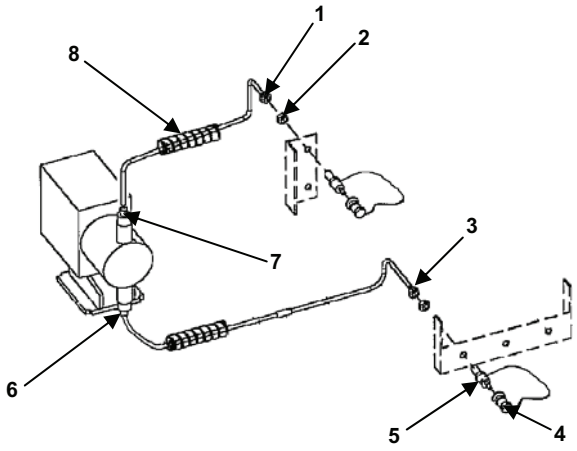


Figure 8. Antiscalant Tubing.

4. Remove spiral wraps (Figure 8, item 8), quick disconnect (Figure 8, item 5), and dust plug (Figure 8, item 4) if necessary.

Chemical Tank Tubing

1. Remove the tubing by loosening the nut (Figure 9, item 4).
2. Remove the quick disconnect (Figure 9, item 1) from tubing by loosening nut (Figure 9, item 2) if necessary.

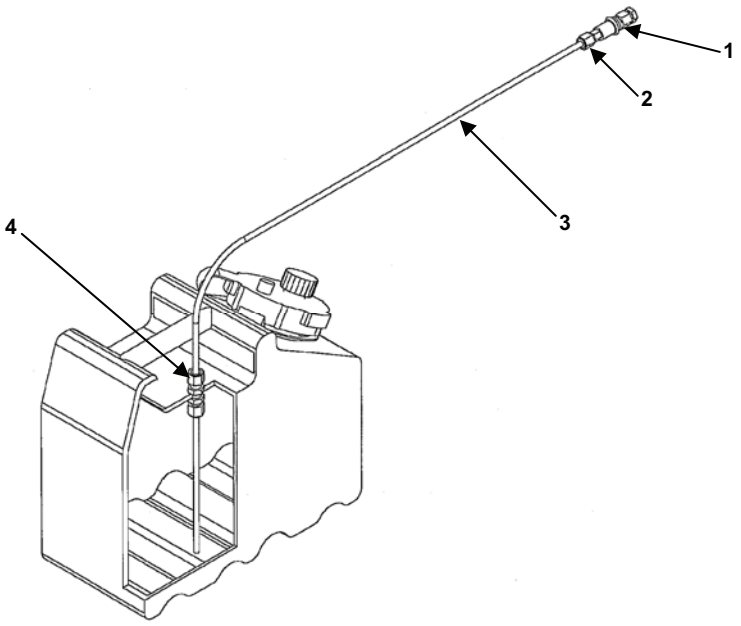


Figure 9. Chemical Tank Tubing.

INSPECTION

Check Valve

1. Inspect the check valve (Figure 3, item 2) 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.

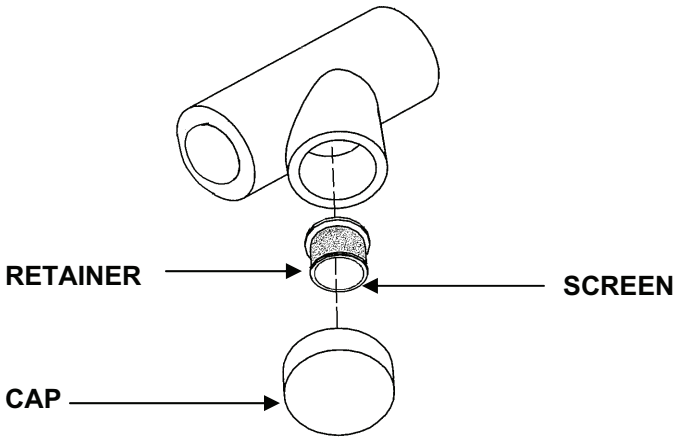


Figure 10. Y-Strainer.

INSTALLATION

Before installation, the following tasks must be completed.

1. Clean all threads of 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.

Sampling Hose

1. Refer to Figure 1 for this procedure section.
2. Install the sampling hose (Figure 1, item 3) on the piping (Figure 1, item 1) and tighten clamp (Figure 1, item 2).

Product Inlet Spool Piece

1. Assemble the spool piece into one unit if taken apart. See Figure 11. Install 3-way ball valve (Figure 11, item 6), flow meter (Figure 11, item 9), totalizer (Figure 11, item 4), adapter (Figure 11, item 14).
2. Place the spool piece in the module.
3. Tighten union (Figure 11, item 7).

INSTALLATION - continued

4. Install U-bolts (Figure 11, item 3), and secure with nuts (Figure 11, item 12) and washers (Figure 11, item 13).
5. Install female camlock (Figure 11, item 2) and dust plug (Figure 11, item 1) if removed.

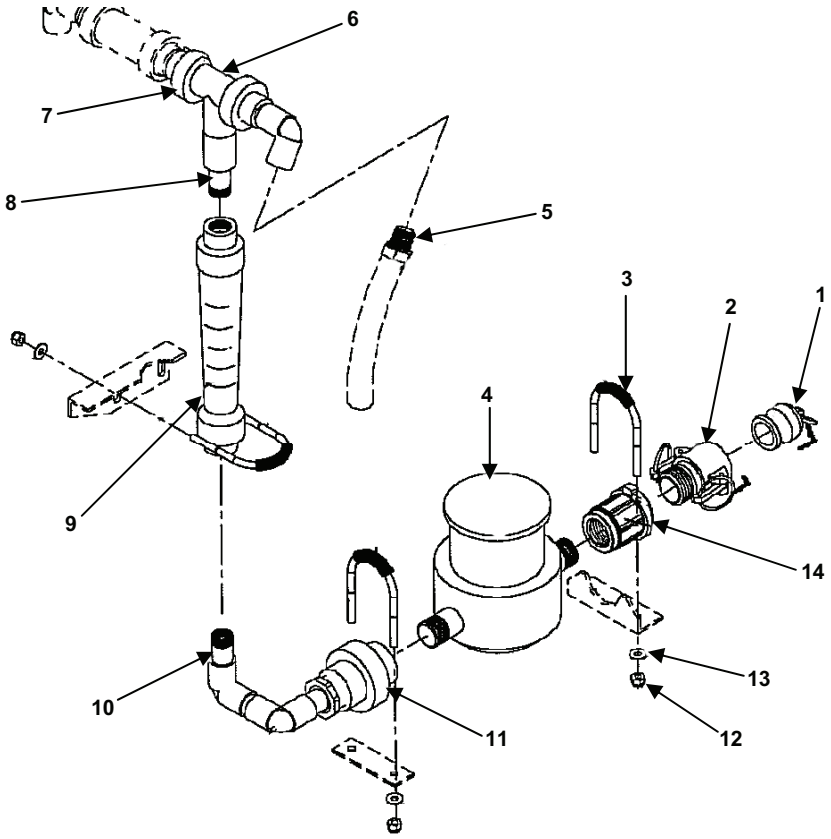


Figure 11. Product Inlet Piping.

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 (Figure 3, item 4) on the 3-way valve (Figure 3, item 6). Tighten union (Figure 3, item 5). **Ensure that the arrow on the check valve body is in line with the flow.**
3. Install tee fitting (Figure 3, item 8) on the piping.
4. Install chlorine tubing (Figure 3, item 7) on the tee fitting (Figure 3, item 8).
5. Install U-bolt (Figure 3, item 3) and secure with nuts (Figure 3, item 9) and washers (Figure 3, item 10).
6. Install male camlock (Figure 3, item 2) and dust cap (Figure 3, item 1) if removed.

Chemical Tank Piping

1. Refer to Figure 4 for this procedure section.
2. Install piping (Figure 4, item 5) on bulkhead fitting (Figure 4, item 6).

INSTALLATION – continued

3. Install valve (Figure 4, item 4) on the piping (Figure 4, item 5). Tighten union (Figure 4, item 9).

CAUTION

Install the retainer end of the Y strainer first. Damage to the strainer may result if installed backwards.

4. Install Y-strainer (Figure 4, item 10) if removed.
5. Install U-bolt (Figure 4, item 3) and secure with nuts (Figure 4, item 12) and washers (Figure 4, item 11).
6. Install male camlock (Figure 4, item 2) and dust cap (Figure 4, item 1) if removed.

Chlorine Tubing

Refer to Figure 6 for this procedure section.

1. Ensure that the inserts (Figure 6, item 10) are present on all the tubing ends.
2. Install anti-siphon valve (Figure 6, item 1) and if removed.
3. Install discharge tubing by connecting nuts (Figure 6, item 2) and (Figure 6, item 4).
4. Install suction tubing by connecting nuts (Figure 6, item 5) and (Figure 6, item 7).
5. Install spiral wrap (Figure 6, item 6) if removed.

Coagulant/Bisulfite Tubing

Refer to Figure 7 for this procedure section.

1. Ensure that the inserts (Figure 7, item 8) are present on all the tubing ends.
2. Install discharge tubing by connecting nuts (Figure 7, item 1) and (Figure 7, item 7).
3. Install suction tubing by connecting nuts (Figure 7, item 5) and (Figure 7, item 3).
4. Install spiral wrap (Figure 7, item 4) if removed.

Antiscalant Tubing

Refer to Figure 8 for this procedure section.

1. Ensure that the inserts (Figure 8, item 2) are present on all the tubing ends.
2. Install discharge tubing by connecting nuts (Figure 8, item 2) and (Figure 8, item 7).
3. Install suction tubing by connecting nuts (Figure 8, item 6) and (Figure 8, item 3).
4. Install spiral wrap (Figure 8, item 8) if removed.

Chemical Tank Tubing

Refer to Figure 9 for this procedure section.

1. Slide the tubing inside the tank. Ensure that the tubing is almost touching the bottom of the tank.
2. Secure tubing by tightening nuts (Figure 9, item 2) and (Figure 9, item 4).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL MODULE
GAUGES
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize, (WP 0139 Item 32)
Thermometer, 2-inch (PN 12497130)

Equipment Condition Required

All equipment de-energized. Hoses disconnected from chemical module. All switches in off position.

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 (Figure 1, item 2) is located on the side of the cleaning tank.

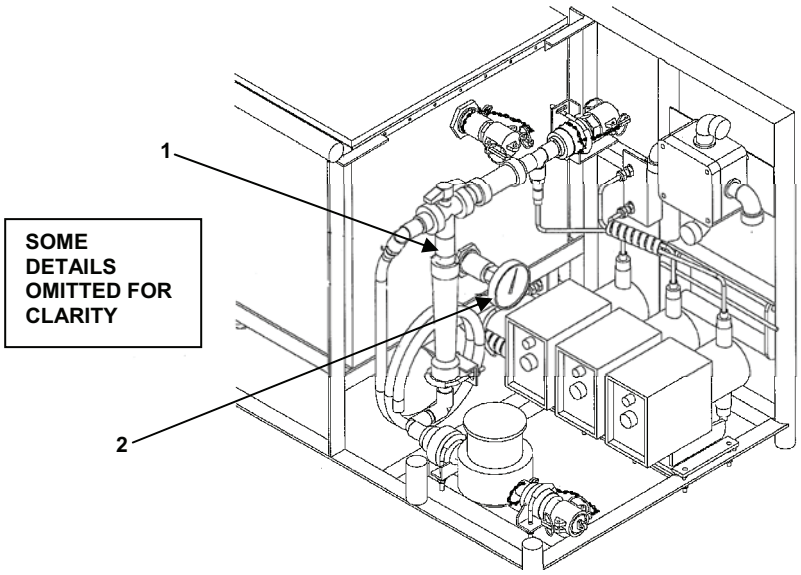


Figure 1. Cleaning Tank Thermometer.

2. Unthread the temperature gauge (Figure 1, item 2) from thermowell fitting (Figure 1, item 1).
3. Remove thermowell fitting (Figure 1, item 2) only if necessary.

REMOVAL- continued

Totalizer

1. Remove nuts (Figure 2, item 6) and washers (Figure 2, item 7) and remove U-bolts (3).
2. Loosen union (Figure 2, item 5) all the way.
3. Remove the totalizer (Figure 2, item 4). Remove union (Figure 2, item 5) from totalizer (Figure 2, item 4) if necessary.
4. Remove dust plug (Figure 2, item 1), female camlock (Figure 2, item 2), and adapter (Figure 2, item 8) if necessary.

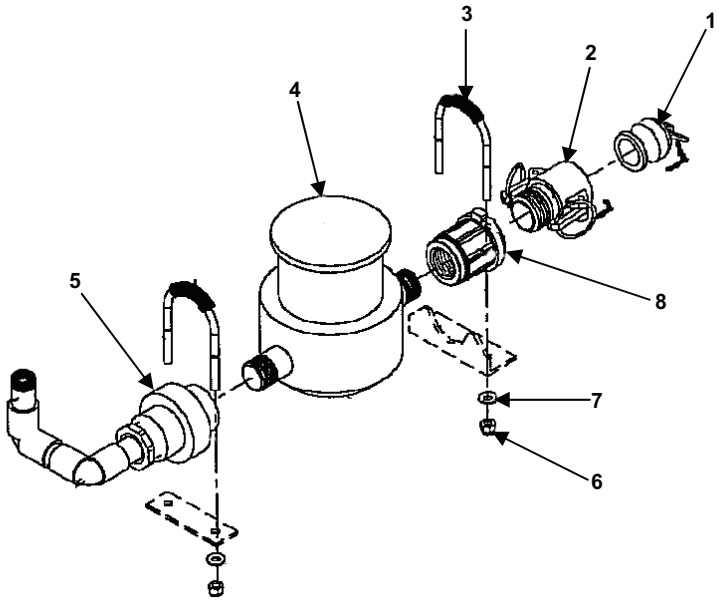


Figure 2. Totalizer.

INSTALLATION

Thermometer

1. Apply anti-seize tape to thermometer threads.
2. Install thermometer (Figure 1, item 2) onto thermowell fitting (Figure 1, item 1).
3. Install thermowell fitting (Figure 1, item 1) in the cleaning tank if necessary.

Totalizer

1. Apply anti-seize tape to all threaded connection.
2. Install adapter (Figure 1, item 8), female camlock (Figure 1, item 2) and dust plug (Figure 1, item 1).
3. Install union (Figure 1, item 5) on the totalizer (Figure 1, item 4) if necessary.
4. Install totalizer (Figure 1, item 4) on the module. Tighten union (Figure 1, item 5).
5. Install U-bolt (Figure 1, item 3) and secure with nuts (Figure 1, item 6) and washers (Figure 1, item 7).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
REVERSE OSMOSIS MODULE
PRESSURE VESSELS AND PIPING
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Shop equip., automotive (WP 0137 Item 1)
Removal tool, retaining ring (WP 0137, Item 5)

Material/Parts

Tape, anti-seize (WP 0139, Item 32)
Rags, wiping, cotton (WP 0139, Item 24)
Vessel assy., pressure (PN 12489090-1) (RO2, RO5, RO6)
Vessel assy., pressure (PN 12489090-2) (RO3)
Vessel assy., pressure (PN 12489090-3) (RO4)
Vessel assy., pressure (PN 12489090-4) (RO1)
Vessel assy., pressure (PN 12489090-5) (RO7)
Compound, O-ring, lubricant (WP 0139, Item 15)
O-rings, (PN AS29513-331 or MS29513-210)

Equipment Condition Required

All equipment de-energized. Hoses disconnected from RO element module.

Personnel Required

2

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 0046).
2. Remove retaining ring, end cap, plug, membrane and O-ring from pressure vessel assy. See (WP 0046).
3. Remove two (2) nuts and bolts on Victaulic clamp. See Figure 1.

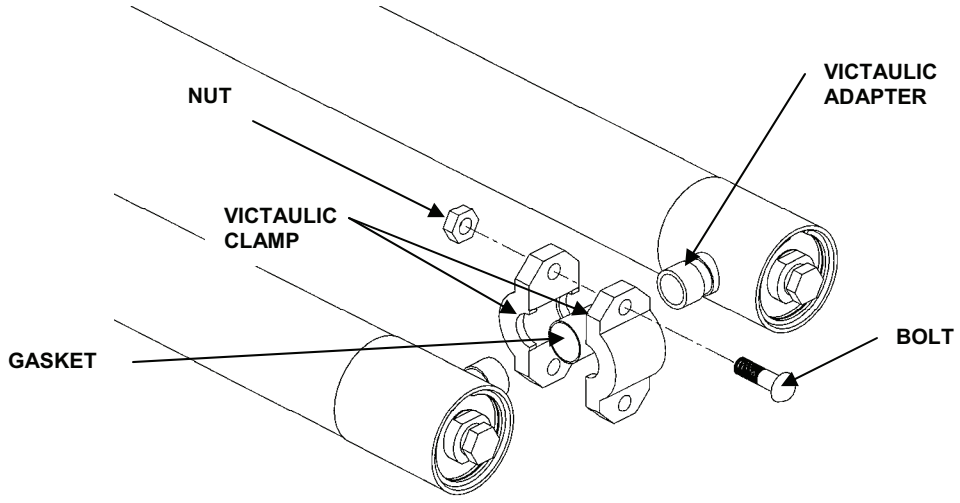


Figure 1. Pressure Vessel Clamp Arrangement.

4. Remove Victaulic clamp from victaulic adapter on end of the pressure vessel assembly. Slide gasket onto opposite victaulic adapter.

REMOVAL- continued

5. Support pressure vessel assembly at both ends.
6. Remove two nuts and washers from U-bolt and remove the U-bolt. See Figure 2.
7. Remove pressure vessel assembly from RO element module.

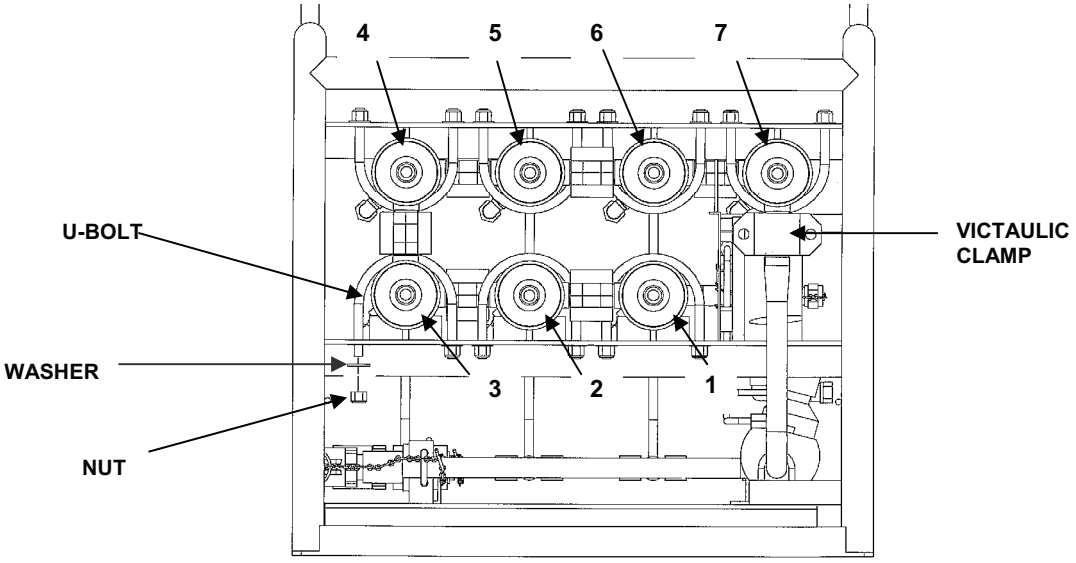


Figure 2. Pressure Vessel Mounting Hardware.

RO REJECT PIPING

1. Remove the victaulic clamp from the tail end of vessel number (Figure 3, item 7).
2. Loosen tubing nut (Figure 3, item 9) from elbow (Figure 3, item 10).

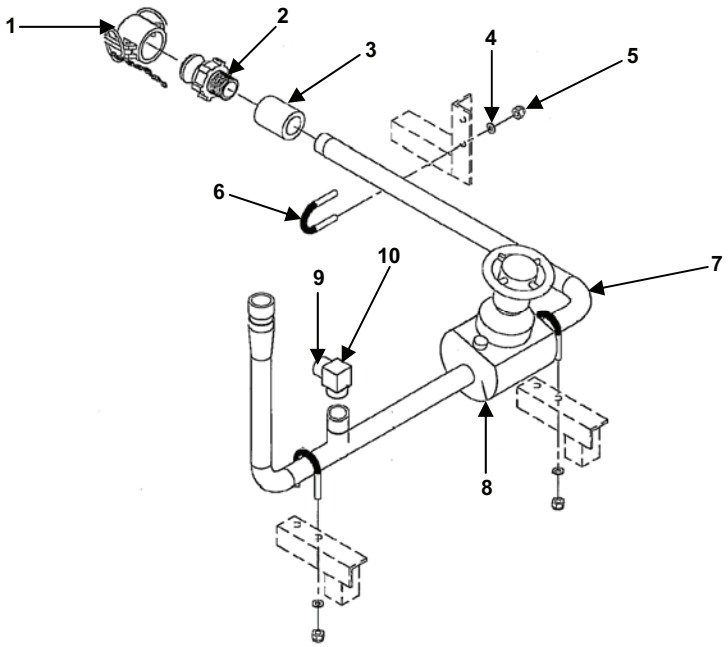


Figure 3. Reject Piping Assembly.

REMOVAL- continued

3. Remove the nuts (Figure 3, item 5), washers (Figure 3, item 4) and U-bolts (Figure 3, item 6). Remove the piping from the module.
4. Remove adapter (Figure 3, item 3), male camlock (Figure 3, item 2) and dust cap (Figure 3, item 1) if necessary.
5. Disassemble RO reject valve (Figure 3, item 8) if necessary. See (WP 0131).

INSTALLATION

RO PRESSURE VESSEL

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 0046).
8. Install front and rear end caps with plugs and O-rings. Secure in place with retaining ring. See (WP 0046).
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

1. Refer to Figure 3 for this procedure section.
2. Reassemble RO reject valve (Figure 3, item 8) if necessary. See (WP 0131).
3. Install adapter (Figure 3, item 3), male camlock (Figure 3, item 2) and dust cap (Figure 3, item 1) if necessary.
4. Install the U-bolts (Figure 3, item 6) and secure with nuts (Figure 3, item 5) and washers (Figure 3, item 4). Place the piping on the module.
5. Install tubing on the elbow (Figure 3, item 9).
6. Install the victaulic clamp to attach the reject piping to the tail end of vessel number (Figure 3, item 7).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
PRIMING PUMP
REMOVAL/INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Equipment Condition Required

Hoses disconnected.

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Pump Assy, priming, (WP 0138, Table 1, Item 29)
Base, guzzler pump (PN 12497053)
Hose, discharge, 3 ft. (0.9 meter) (PN 12511604)

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 use 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.

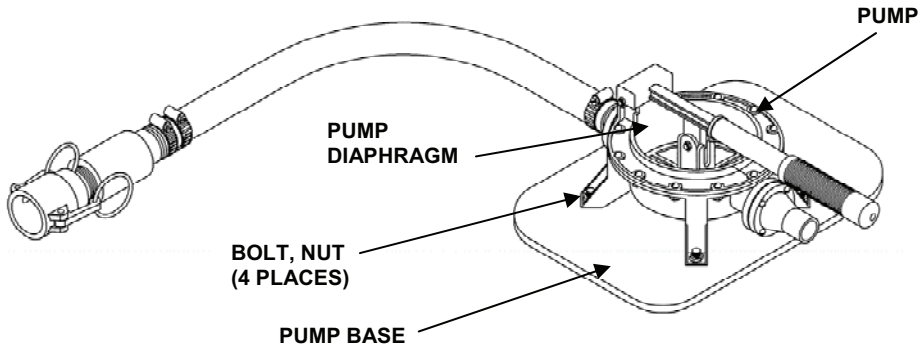


Figure 1. Priming Pump.

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

FIELD 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 compound, solvent (WP 0139, Item 13)
Rags, wiping, cotton, (WP 0139, Item 24)
Coupling, filler, female, 2-inch, (PN 01000385)
Plug, dust, (PN 01000381)
Coupling, discharge, male, 2-inch, (PN 01000384)
Cap, dust, (PN 01000382)
Flanges, Internal and External (PN 01000722)

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 (8) bolts and remove the bulkhead fitting from the tank if necessary.

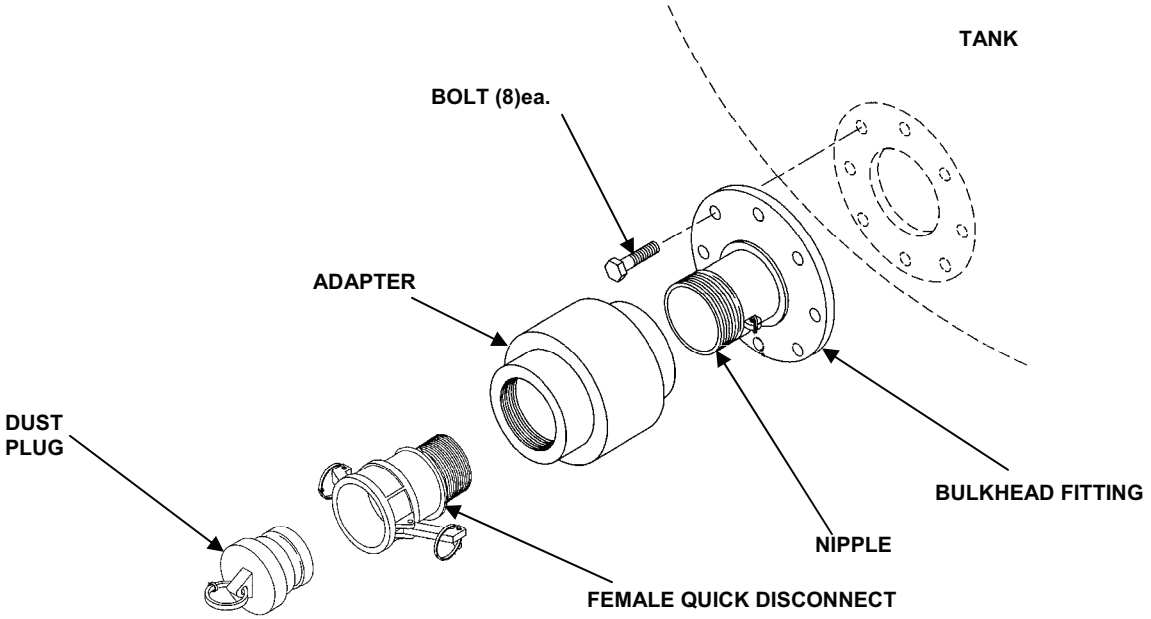


Figure 1. Settling and Product Tank Filler Fitting.

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 (8) bolts and remove the bulkhead fitting from the tank if necessary. See Figure 2.

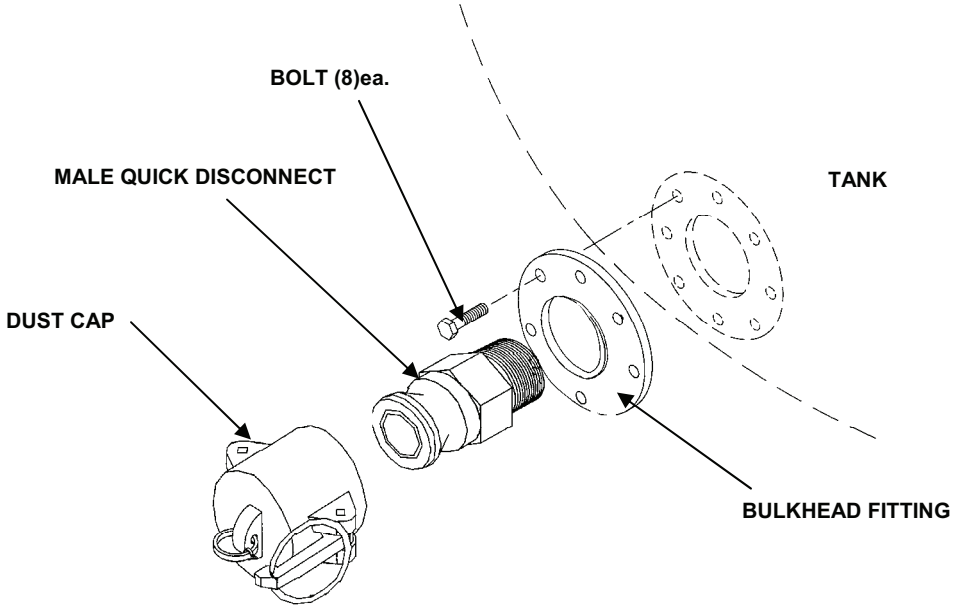


Figure 2. Settling and Product Tank Discharge Fitting.

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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP RECEPTACLE
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Equipment Condition Required
Equipment de-energized.

Materials/Parts
Rags, wiping, cotton (WP 0139, Item 24)
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 (2) bolts on mounting plate.
3. Push handle forward to clear receptacle. See Figure 1.

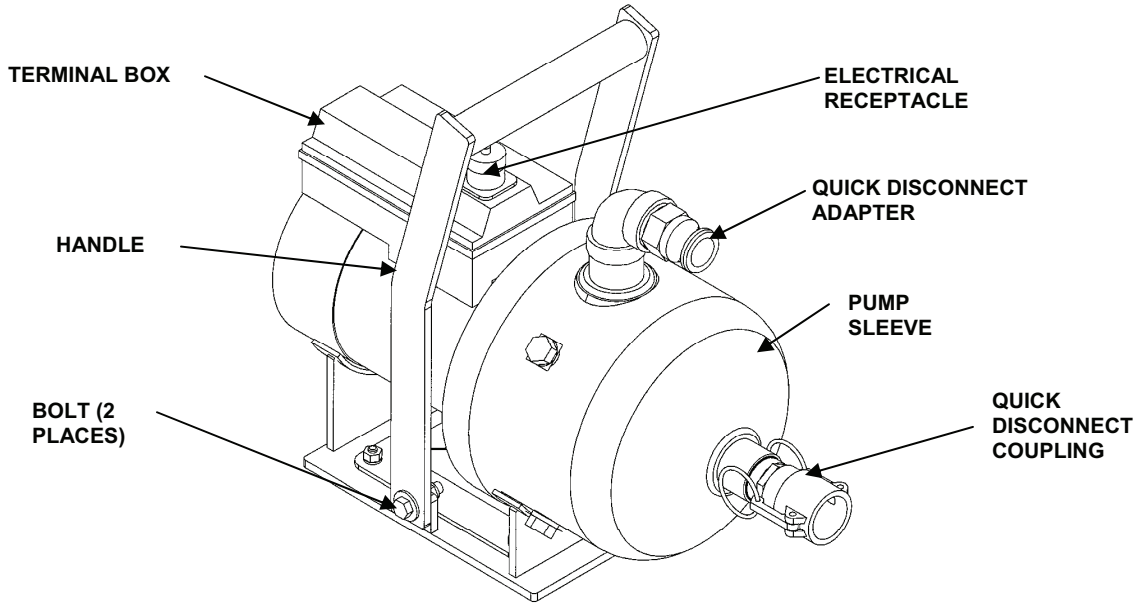


Figure 1. Service Pump.

DISASSEMBLY - continued

4. Remove four (4) screws (Figure 2, item 4) from terminal box cover (Figure 2, item 6).
5. Remove receptacle cap (Figure 2, item 2) with lanyard (Figure 2, item 7) from receptacle (Figure 2, item 3).
6. Remove terminal box cover (Figure 2, item 6) from terminal box with gasket (Figure 2, item 5).
7. Tag wires from receptacle (Figure 2, item 3) to assist during installation.

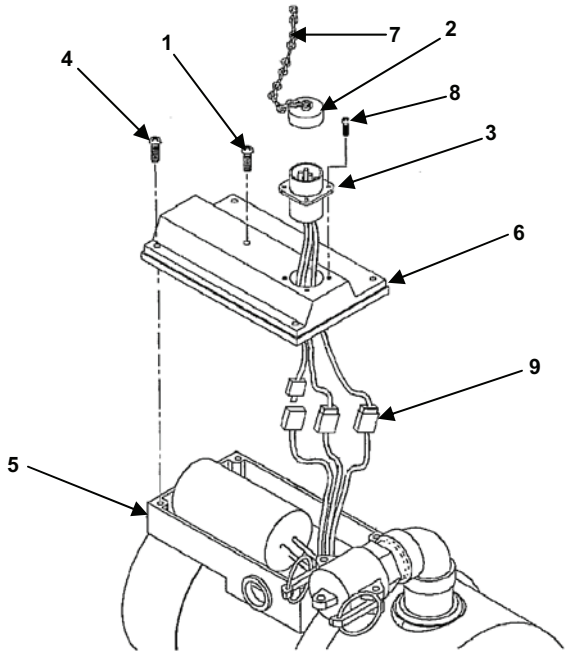


Figure 2. Service Pump Terminal Box (Exploded View).

8. Remove four (4) screws (Figure 2, item 8) from receptacle (Figure 2, item 3) on terminal box cover (Figure 2, item 6).
9. Disconnect the quick connectors (Figure 2, item 9) from three (3) wires (black, green, white) from the pump (Figure 2, item 5).
10. Remove receptacle (Figure 2, item 3).
11. Remove screw (Figure 2, item 1) and lanyard (Figure 2, item 7) in terminal box cover (Figure 2, item 6).

INSTALLATION

1. Connect three (3) wires (black, green, white) to the pump by fitting the quick connectors (Figure 2, item 9) together.
2. Observe tags for correct wiring connections.
3. Install receptacle (Figure 2, item 3) on terminal box cover (Figure 2, item 6). Secure with four (4) screws (Figure 2, item 8). Tighten securely.
4. Install terminal box cover (Figure 2, item 6) on pump (Figure 2, item 5). Secure with four (4) screws (Figure 2, item 4). Tighten securely.
5. Install screw (Figure 2, item 1) to secure lanyard (Figure 2, item 7) in terminal box cover (Figure 2, item 6). Tighten securely.
6. Reposition handle on base plate. Tighten two (2) bolts securely. See Figure 1.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP COUPLING
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

Materials/Parts
Tape, anti-seize, (WP 0139, Item 32)
Rags, wiping, cotton (WP 0139, Item 24)
Cap, dust, 0.75, (PN 2771107-07V)
Adapter, quick disconnect, 0.75, (WP 0138, Table 2, Item 3)
Elbow, 90, 1-inch, (PN 16SESS)
Bushing, hex, 1-inch, (PN 2502738000)
Coupler, quick disconnect, 0.75, (WP 0138, Item 15)
Cap, dust, 1-inch, (PN 2771110SG-10V)
Cam, 1-inch, (PN 2770610SG-10F)
Coupler, quick disconnect, 1-inch, (PN 2770210SG-10B)
Plug, dust, quick disconnect, 1-inch, (PN 2771210SG-10W)

Equipment Condition Required
All equipment de-energized, hoses removed, electrical cables removed.

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 0039) for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

REMOVAL

Raw Water Pump

1. Remove male camlock (Figure 1, item 3) and dust cap (Figure 1, item 4).
2. Remove bushing (Figure 1, item 2) and elbow (Figure 1, item 1) from the pump.

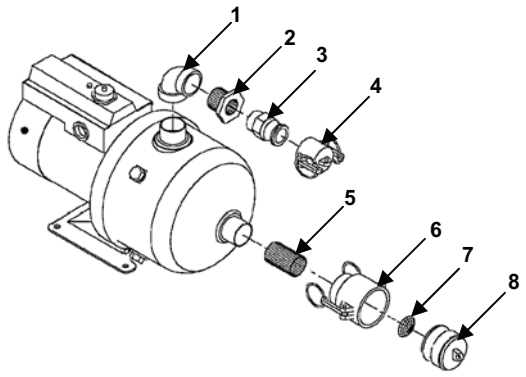


Figure 1. Raw Water Service Pump.

3. Unthread female camlock (Figure 1, item 7) and dust plug (Figure 1, item 8).
4. Remove reducing female camlock (Figure 1, item 6) from adapter (Figure 1, item 5).
5. Remove 10-mesh screen (Figure 1, item 7) and dust plug (Figure 1, item 8) if necessary. Inspect the screen and replace if necessary.

REMOVAL-continued

Distribution Pump

1. Remove male camlock (Figure 2, item 2) and dust cap (Figure 2, item 3).
2. Remove elbow (Figure 2, item 1) from the pump.
3. Unthread female camlock (Figure 2, item 4) and dust plug (Figure 2, item 5).

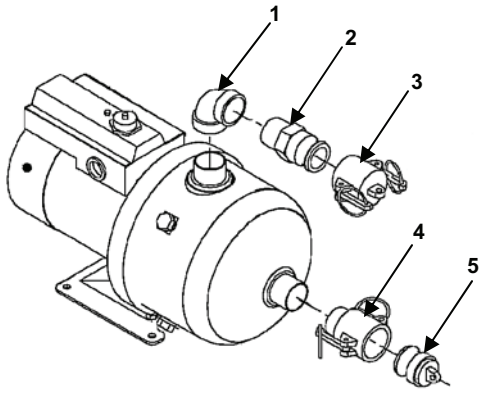


Figure 2. Distribution Service Pump.

Booster and Backwash Pump

1. Remove male camlock (Figure 3, item 3) and dust cap (Figure 3, item 4).
2. Remove bushing (Figure 3, item 2) and elbow (1) from the pump
3. Unthread female camlock (Figure 3, item 6) and dust plug (Figure 3, item 7).
4. Remove bushing (Figure 3, item 5) from pump.

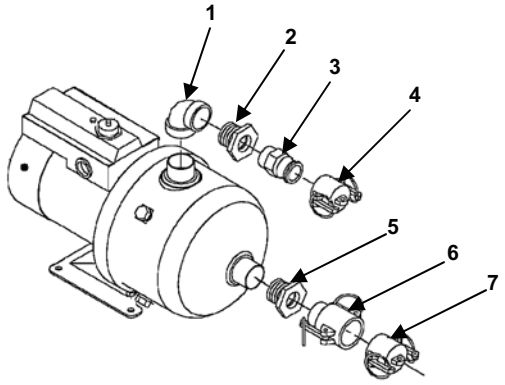


Figure 3. Booster and Backwash Service Pump.

INSTALLATION

Raw Water Pump

1. Refer to Figure 1 for this procedure section.
2. Install elbow (Figure 1, item 1) on the pump and bushing (Figure 1, item 2) on the elbow (Figure 1, item 1).
3. Install male camlock (Figure 1, item 3) and dust cap (Figure 1, item 4) on the bushing (Figure 1, item 2).
4. Install adapter (Figure 1, item 5) on the pump.
5. Install reducing female camlock (Figure 1, item 6) on the adapter (Figure 1, item 5).
6. Install 10-mesh screen (Figure 1, item 7) and dust plug (Figure 1, item 8) if removed.

INSTALLATION- continued

Distribution Pump

1. Refer to Figure 2 for this procedure section.
2. Install elbow (Figure 2, item 1) on the pump.
3. Install male camlock (Figure 2, item 2) and dust cap (Figure 2, item 3).
4. Install female camlock (Figure 2, item 4) and dust cap (Figure 2, item 5).

Booster and Backwash Service Pumps

1. Refer to Figure 3 for this procedure section.
2. Install elbow (Figure 3, item 1) on the pump.
3. Install bushing (Figure 3, item 2) on the elbow (Figure 3, item 1).
4. Install male camlock (Figure 3, item 3) and dust cap (Figure 3, item 4).
5. Install bushing (Figure 3, item 5) on the pump.
6. Install female camlock (Figure 3, item 6) and dust cap (Figure 3, item 7).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP SLEEVE
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Tool Kit, Gen. Mech., Automotive (WP 0137, Table 2, Item 2)

General Safety Instructions
Observe all CAUTIONS.

Materials/Parts
Tape, anti-seize, (WP 0139, Item 32)
Rags, wiping, cotton (WP 0139, Item 24)
O-ring, (PN 00ID6873 (2))
Seal, shaft, (PN 004H1422)
O-ring, (PN 00ID6874)
O-ring, (PN 00ID9917)
Compound, O-ring, lubricant (WP 0139, Item 15)

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.

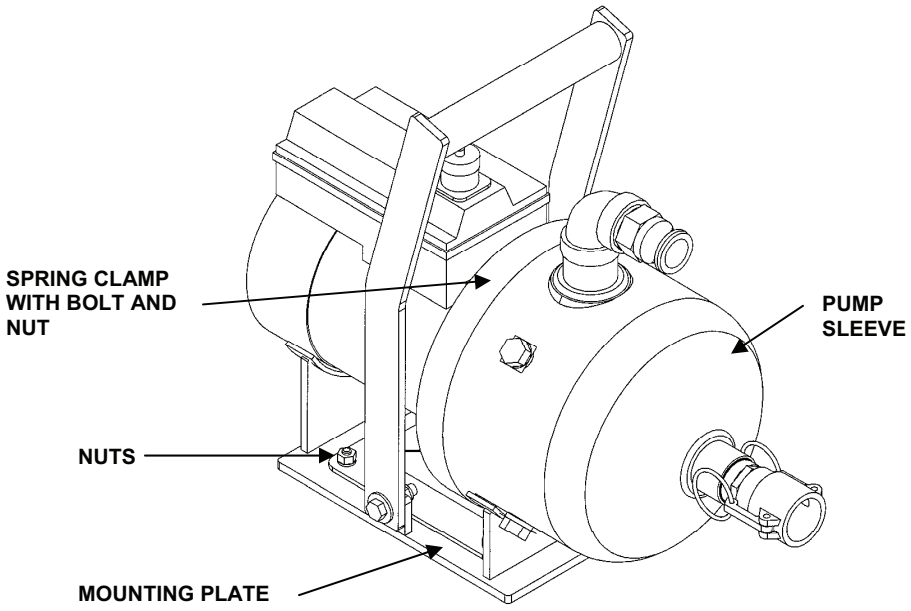


Figure 1. Service Pump.

2. Remove the pump from the mounting plate by removing four (4) 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 0132).

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 (4) nuts.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
COLD WEATHER KIT COMPONENT
REMOVAL/ INSTALLATION

INITIAL SETUP

Tools

Tool Kit, Gen. Mech., Auto. (WP 0137, Table 2, Item 2)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Receptacle, panel (PN 1297065)
Switch, selector, 2-position (PN 12497070)
Lamp, incandescent (PN 755)
Block, terminal, 600V (PN 12511523, 12511423, 12511422)
Block, circuit breaker, 2 amp (PN 12511420)
Tie wraps, gray (WP 0139, Item 34)

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.

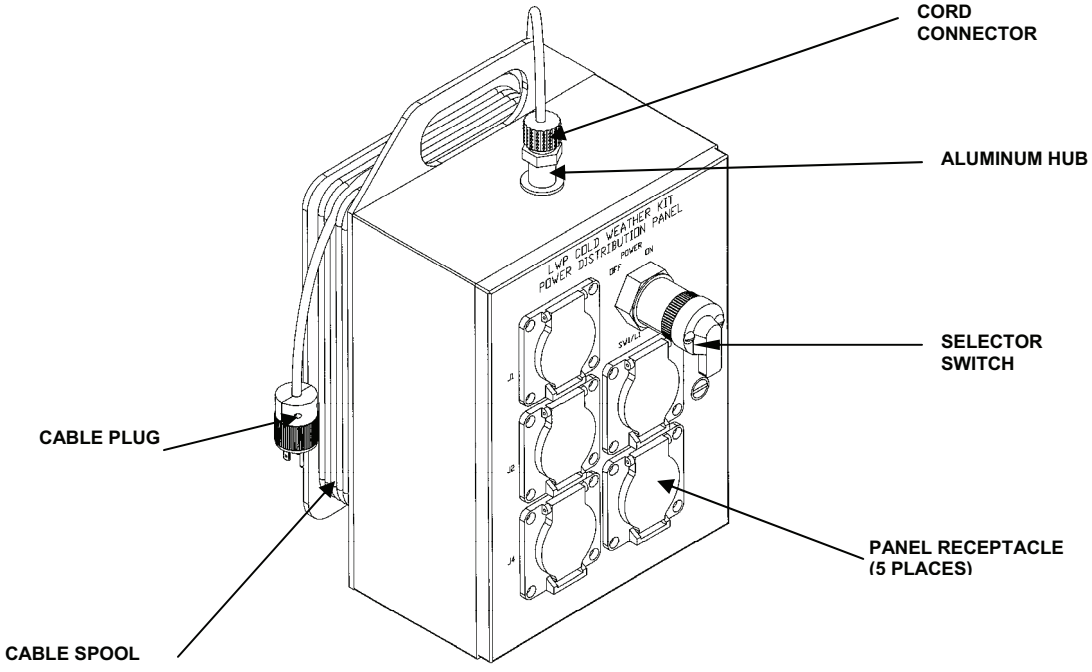


Figure 1. Power Distribution Panel.

3. Turn access lock counter clockwise to open panel cover.

SWITCH, SELECTOR, 2-POSITION (SW1)

Removal

1. Remove two (2) screws from switch handle. See Figure 2.

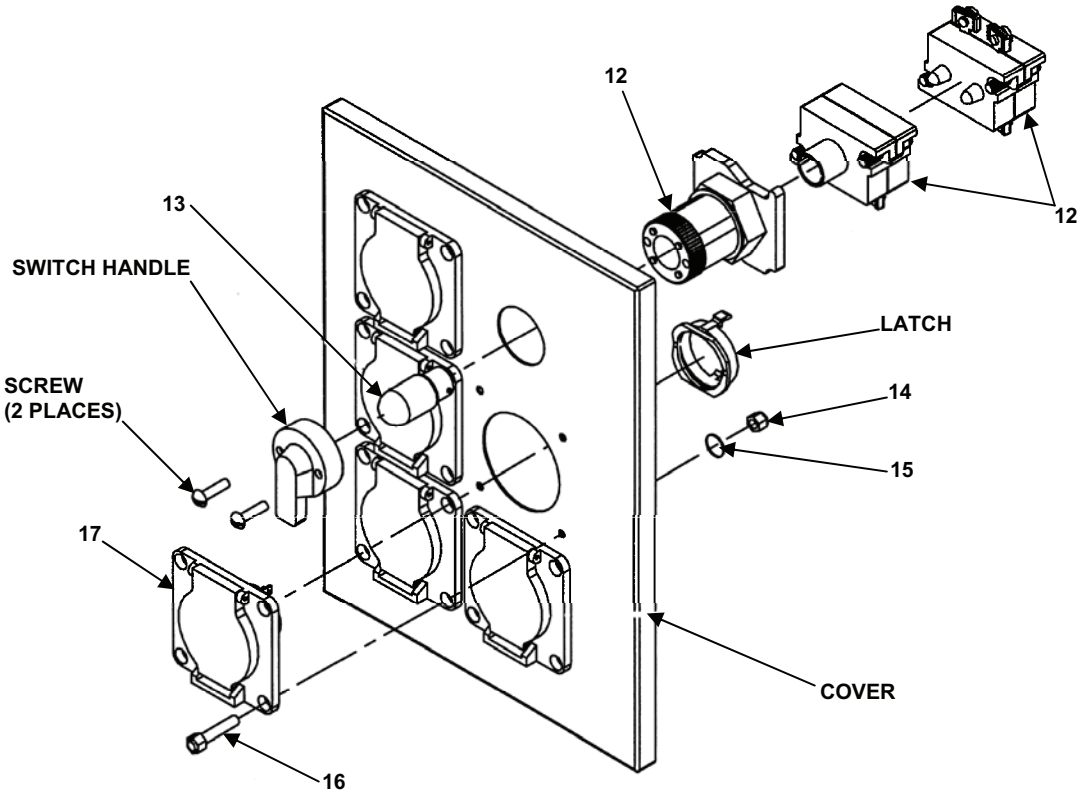


Figure 2. External Components.

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 (Figure 2, item 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

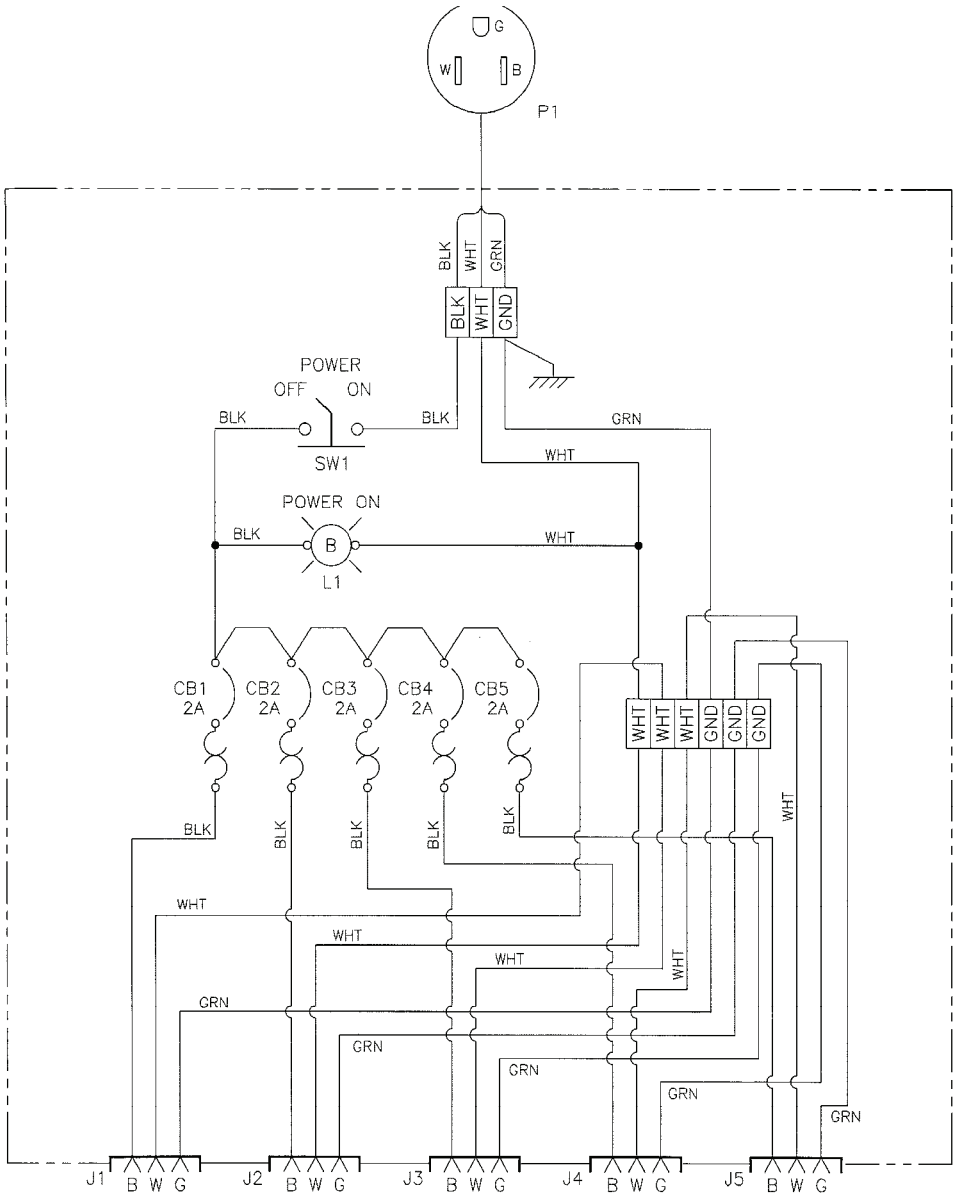


Figure 3. Power Distribution Panel Wiring Diagram.

PANEL RECEPTACLE (J1, J2, J3, J4, J5)

Removal

1. Remove four (4) screws (Figure 2, item 16), flat washers (Figure 2, item 15), and nuts (Figure 2, item 14) from panel receptacle (Figure 2, item 17).
2. Disconnect three (3) 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 (3) wires (green, black, white) to rear of receptacle as previously noted. See Figure 3.
4. Install four (4) screws (Figure 2, item 16), flat washers (Figure 2, item 15), and nuts (Figure 2, item 14) into panel receptacle (Figure 2, item 17).

CIRCUIT BREAKER BLOCK (CR1 THROUGH CR5)

Removal

1. Remove two (2) black electrical wires from terminal on circuit breaker block (Figure 4, item 25).
2. Use a flat tip screwdriver and insert into slot at bottom of circuit breaker.
3. Pry the appropriate circuit breaker (Figure 4, item 25) from mounting channel (Figure 4, item 23).

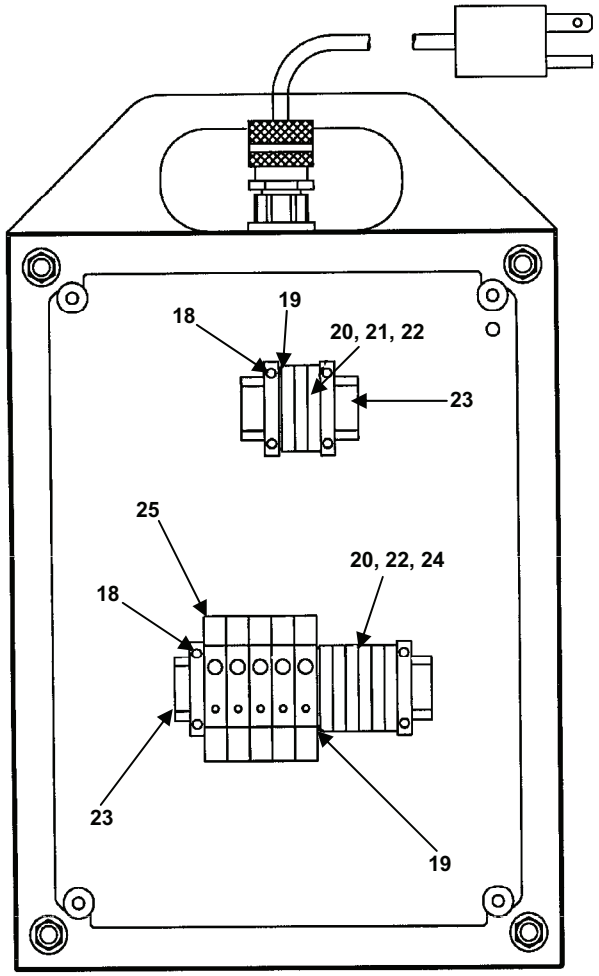


Figure 4. Internal Components.

4. Discard circuit breaker.

Installation

1. Position circuit breaker (Figure 4, item 25) into appropriate slot on mounting channel (Figure 4, item 23).
2. Snap circuit breaker (Figure 4, item 25) into position.
3. Connect two (2) black wires to terminals on circuit breaker (Figure 4, item 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 (2) 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 (Figure 4, item 23).
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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
JUNCTION BOX
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Shop Equipment, (SATS) (WP 0137, Item 1)

Equipment Condition Required
All equipment de-energized.

Materials/Parts
Box assembly, junction, (PN 12489137)
Block, terminal, 15-circuit, (PN 12511519)
Jumper, terminal strip, (PN 12511520)

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.

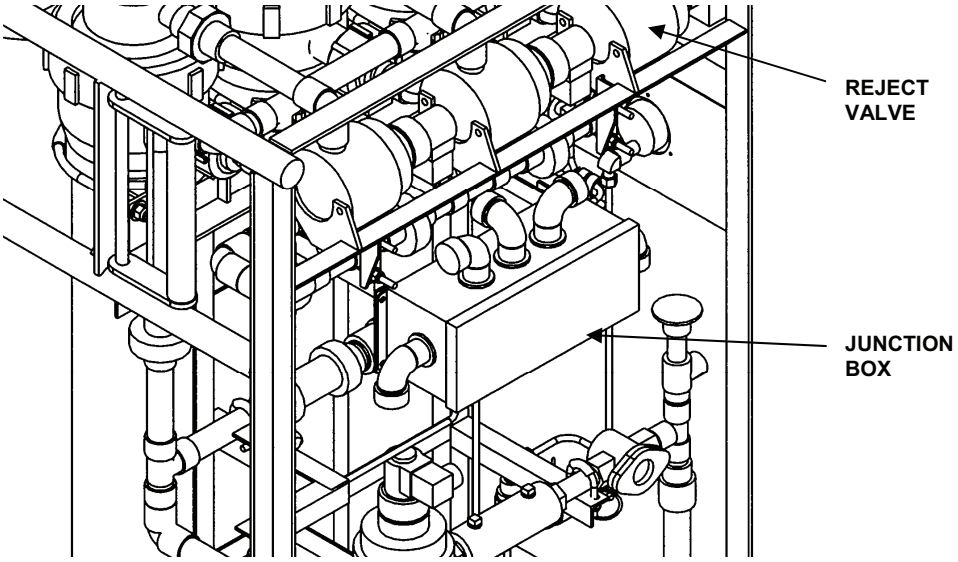


Figure 1. Ultrafiltration Module Junction Box Assembly Location.

3. Loosen four (4) screws (Figure 2, item 8) and remove junction box cover (Figure 2, item 1).
4. Remove all ground wires.
5. Remove all wiring from terminal block (Figure 3, item 6). Note location of the wires and their numbers.

REMOVAL - continued

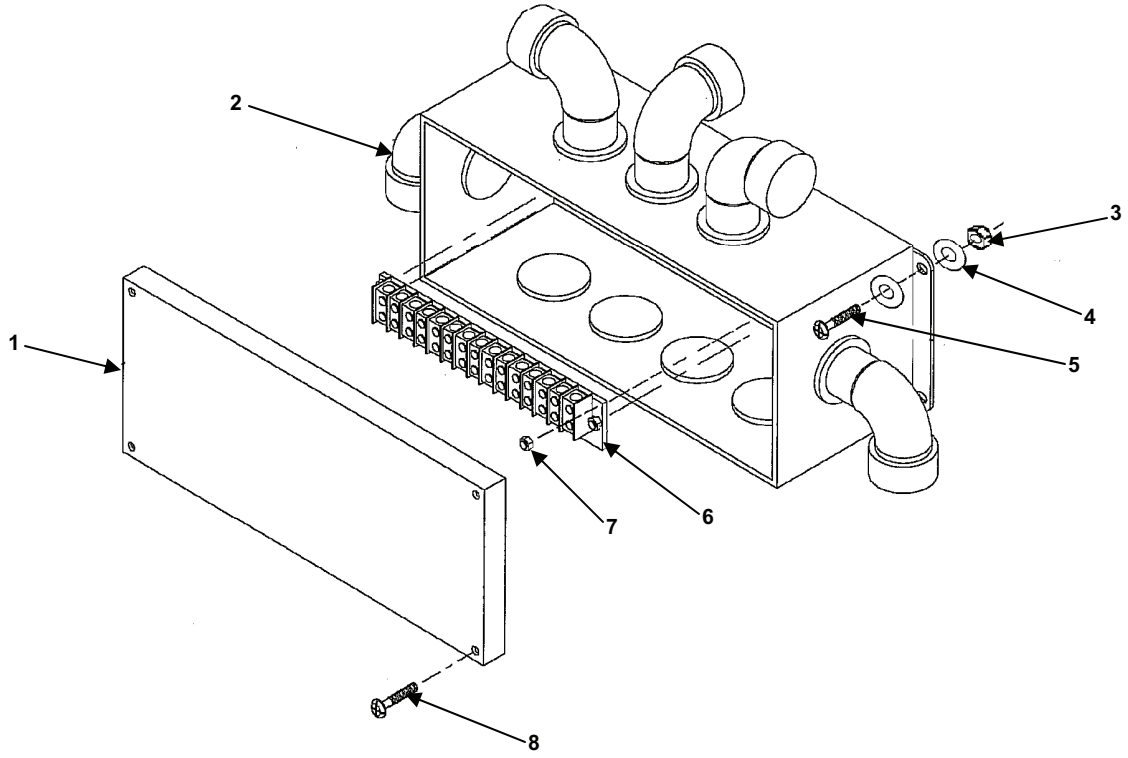


Figure 2. Junction Box Assembly.

6. Remove all the conduits from the nine (9) hubs (Figure 2, item 2). Note the locations of the hubs.

7. Remove the jumper strips between terminals 10 through 14. See Figure 3.

8. Remove four (4) lock nuts (Figure 2, item 7) from the terminal block (Figure 2, item 8) and remove the terminal block (Figure 2, item 8).

9. Remove four screws (Figure 2, item 5), eight (8) washers (Figure 2, item 4) and four (4) lock nuts (Figure 2, item 3). Remove junction box from module.

INSTALLATION

1. Mount the junction box on the module and secure with four screws (Figure 2, item 5), eight washers (Figure 2, item 4) and four lock nuts (Figure 2, item 3).
2. Mount the terminal block on the junction box and secure with four (4) lock nuts (Figure 2, item 7).

3. Connect jumper strip between terminal 10 and 11 and all wiring on the terminal block (Figure 2, item 6). See Figure 3.

4. Reconnect all the conduits from the nine (9) 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 (4) screws (Figure 2, item 8).

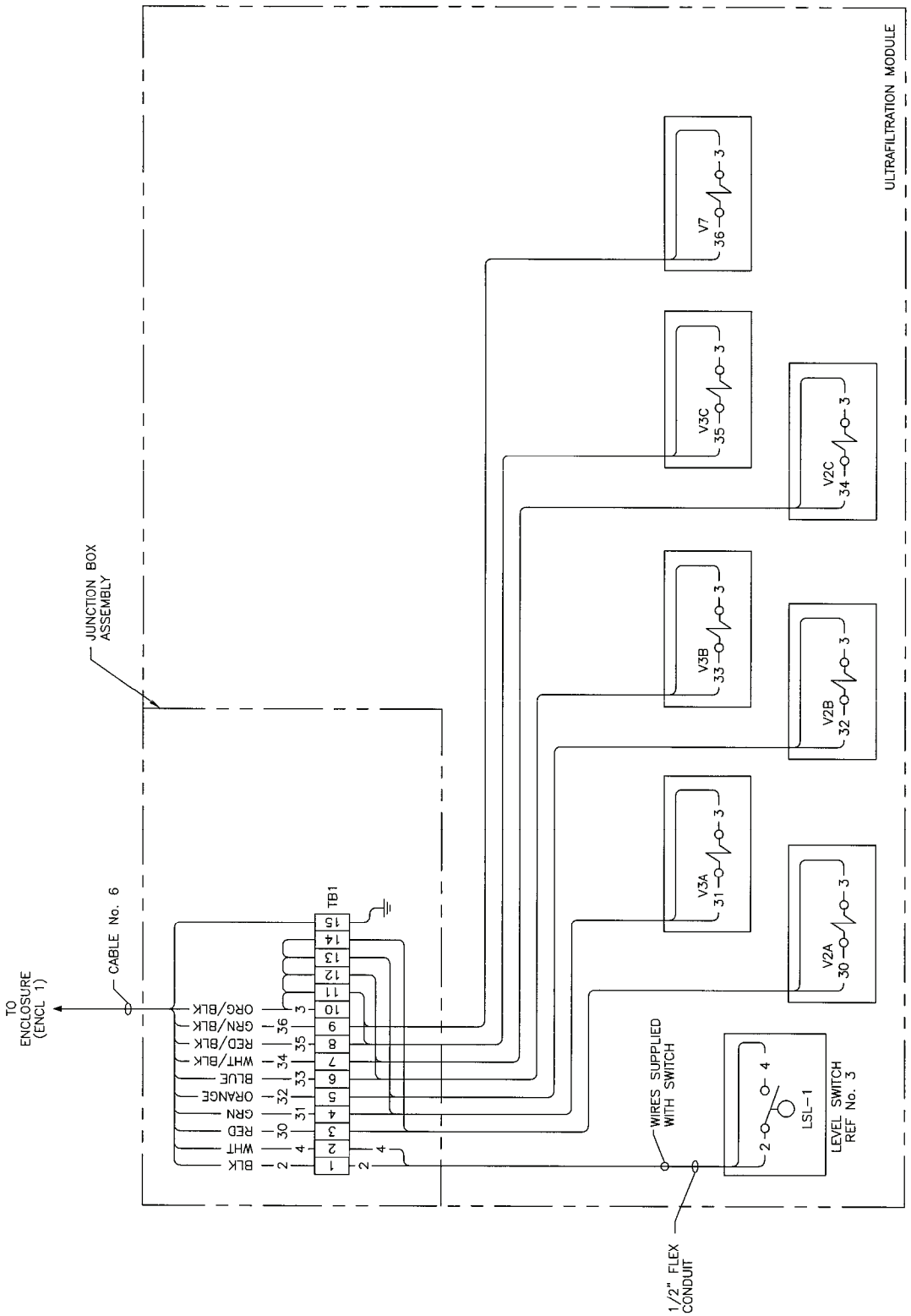


Figure 3. Ultrafiltration Module Wiring Diagram.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ULTRAFILTRATION MODULE
SOLENOID VALVE
REPAIR

INITIAL SETUP

Tools

Shop Equipment,(SATS) Vehicle (WP 0137, Item 1)

Material/Parts

Rags, wiping, cotton (WP 0139, Item 24)
Tape, anti-seize, (WP 0139, Item 32)
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 0094 for instructions on replacing the top works of the solenoid valve.

DISASSEMBLY

1. Remove the cap nut (Figure 1, item1) and O-ring (Figure 1, item 2) and slide the coil (Figure 1, item 3) off from the valve (Figure 1, item 7).
2. Remove the screw (Figure 1, item 7) from the electrical connector (Figure 1, item 5), and lighted wafer (Figure 5, item 6)
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 (Figure 1, item 5) from the coil (Figure 1, item 3).

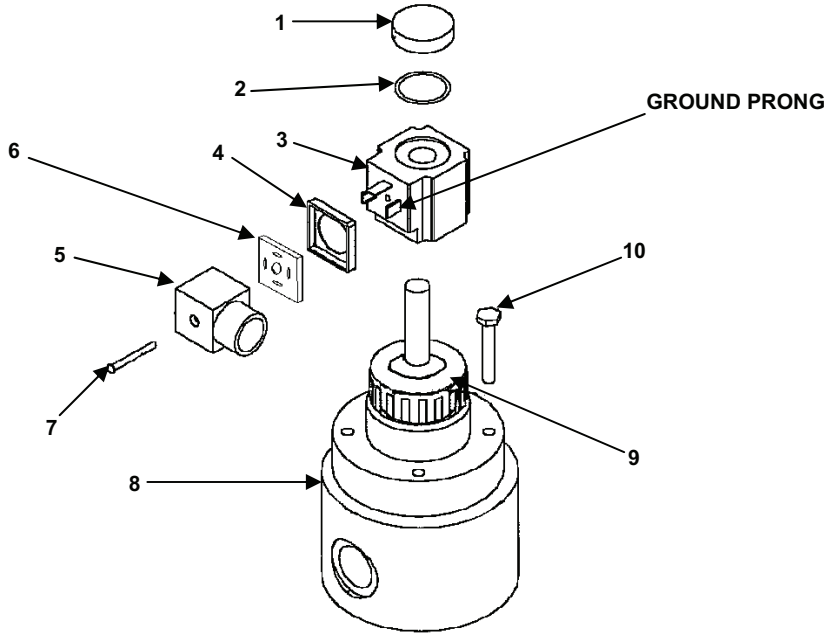


Figure 1. Solenoid Valve (Exploded View).

INSPECTION

1. Inspect the O-ring (Figure 1, item 2) and the gasket (Figure 1, item 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 other wise.
    c. Visually inspect lighted wafer for damage.

ASSEMBLY

1. Refer to Figure 1 for this procedure section.
2. Connect the wires to the electrical connector (Figure 1, item 5) if needed.
3. Connect the electrical connector (Figure 1, item 5) to lighted wafer (Figure1, item 6) and gasket (Figure 1, item 4) to the coil (Figure 1, item 3).
4. Slide the coil (Figure 1, item 3) on to the shaft on the valve (Figure 1, item 8).
5. Secure the coil with cap nut (Figure 1, item 1) and O-ring (Figure 1, item 2).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
CYLINDER HEAD
DISASSEMBLY/ASSEMBLY

INITIAL SETUP

Tools
Shop Equipment, (SATS) (WP 0137, Table 2, item 4)

Materials/Parts
Seals, valve stem (PN 114250-11340)
Oil, lubrication, 10W30 (WP 0139, item 22)

Equipment Condition Required
Engine air filter housing removed (WP 0044)
Engine shutoff removed (WP 0101)
Exhaust muffler removed (WP 0107)
Fuel injector removed (WP 0126)
Fuel line removed (WP 0126)

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 0039) for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

CYLINDER HEAD REMOVAL

1. Remove valve cover (Figure 1, item 15), gasket (Figure 1, item 14) and three (3) bolts (Figure 1, item 16).
2. Remove rocker arm assembly and cylinder head. See (WP 0122).
3. Store the wear caps (1).

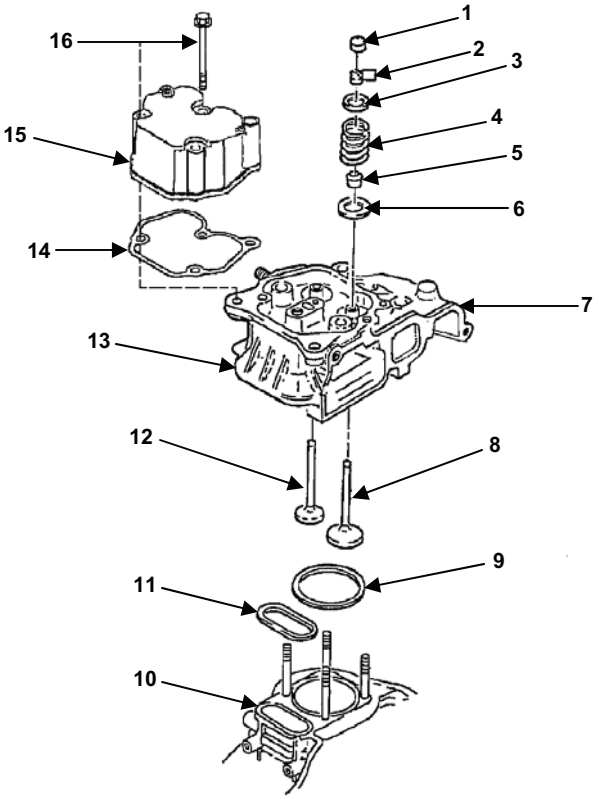


Figure 1. Cylinder Head Assembly.

CYLINDER HEAD REMOVAL – CONTINUED

4. Discard Head gasket (Figure 1, item 9) and O-ring (Figure 1, item 11).

5. Slide intake valve (Figure 1, item 8) and exhaust valve (Figure 1, item 12) out of the cylinder head. Do not mix them.

6. Remove cotter assembly (Figure 1, item 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 injures.

7. Compress spring (Figure 1, item 4) using spring compressing tool and carefully remove spring retainer (Figure 1, item 11).

8. Carefully remove the spring (Figure 1, item 4).

9. Remove stem seal (Figure 1, item 5) and washer (Figure 1, item 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.

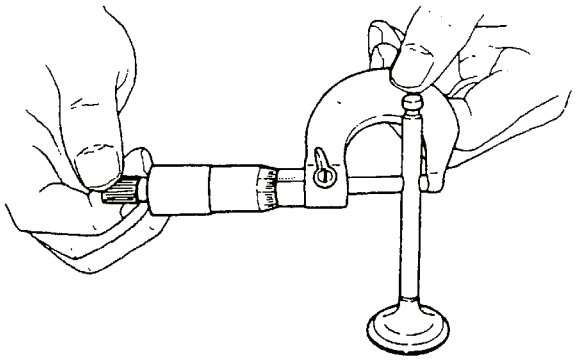


Figure 2. Valve Stem Measurement.

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.

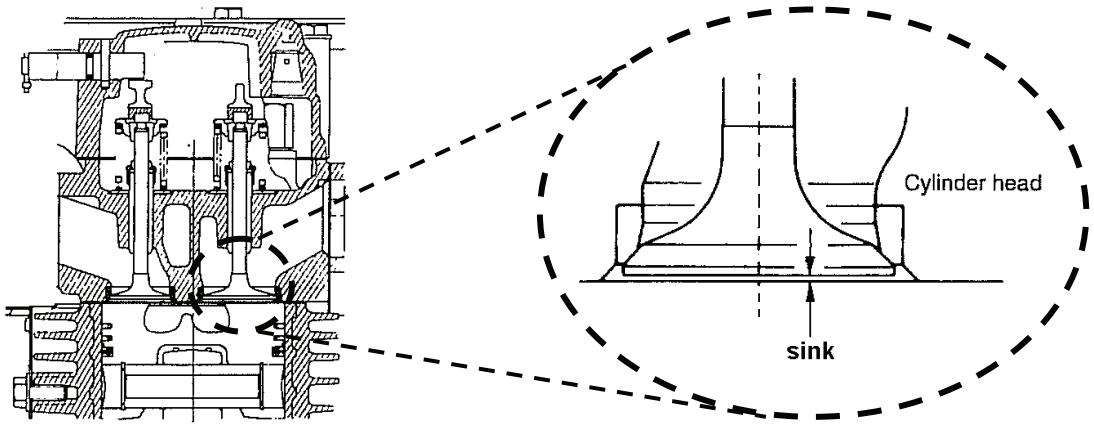


Figure 3. Valve Sink Measurement.

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 stems seals or damage to diesel engine may result.

2. Install valve stem seal (Figure 1, item 5) and washer (Figure 1, item 6) onto intake valve.
3. Install and compress valve spring (Figure 1, item 4). Carefully install spring retainer (Figure 1, item 3). Release hold on spring slowly.
4. Repeat steps 2-3 for the exhaust valve.
5. Choose the cylinder head gasket (Figure 1, item 9). See (WP 0122).
6. Install cylinder head gasket (Figure 1, item 9).
7. Install new O-ring (Figure 1, item 11).
8. Install the cylinder head. See (WP 0122).
9. Install the rocker arm assembly. See (WP 0122).

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).
3. Loosen the lock nut. Rotate the adjusting screw in either direction to achieve proper clearance. See Figure 4.

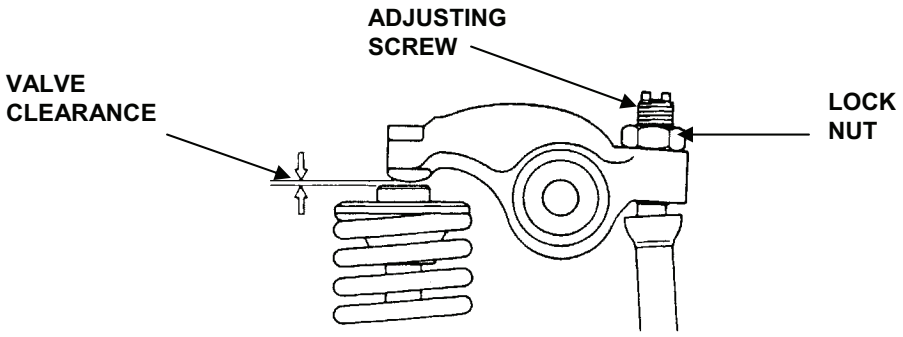


Figure 4. Valve Clearance Adjustment.

4. Tighten the lock nut. Recheck the clearance. Readjust if necessary.
5. Install valve cover, gasket and three bolts.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGH WATER PURIFIER
DIESEL ENGINE
DISASSEMBLY/ASSEMBLY

INITIAL SETUP

Tools
Shop Equip. Automotive Maint. & Repair (WP 0137, Item 1)
Workbench, Parts trays/containers
Container, waste oil

Materials/Parts
Parts (See TM 10-4610-310-24P)
Sealing Compound (Thread locking) (WP 0139, Item 25)
Cleaning Compound, Solvent, (WP 0139, Item 13)
Anti-seize Compound (WP 0139, Item 3)
Lubricating oil, 10W30 (WP 0139, Item 22)

Equipment Condition Required
Engine removed from module (WP 0100)
Throttle plate removed (WP 0128)
Valve cover removed (WP 0121)
Recoil starter removed (WP 0106)
Flywheel housing removed (WP 0106)
Fuel injector removed (WP 0126)

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 0039) for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

DISASSEMBLY

Rocker Arm Assembly Removal

1. Remove rocker arm support (Figure 1, item 5) from cylinder head (Figure 1, item 1) by removing two screws (Figure 1, item 4).

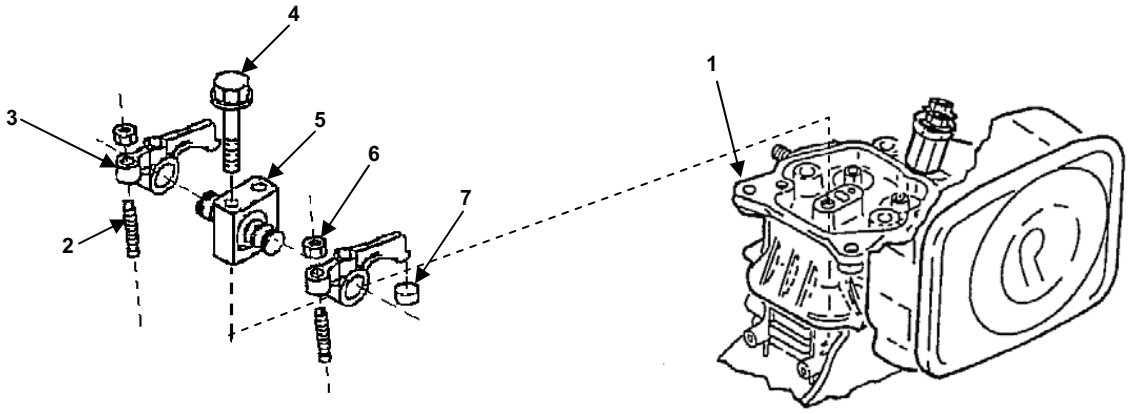


Figure 1. Rocker Arm Assembly Removal.

2. Remove lock nut (Figure 1, item 6) from the adjustment screw (Figure 1, item 2).
3. Remove adjustment screw (Figure 1, item 2) only if necessary.
4. Remove rocker arm (Figure 1, item 3) and wear cap (Figure 1, item 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.

DISASSEMBLY - continued

Cylinder Head

1. Remove two cap nuts (Figure 2, item 1) from cylinder head and two (2) nuts ((Figure 2, item 2). See Figure 2.
2. Remove four (4) washers ((Figure 2, item 3).
3. Remove the cylinder head ((Figure 2, item 7) from the engine block ((Figure 2, item 6).
4. Pull up over four (4) mounting studs ((Figure 2, item 4).
5. Remove head gasket ((Figure 2, item 5).

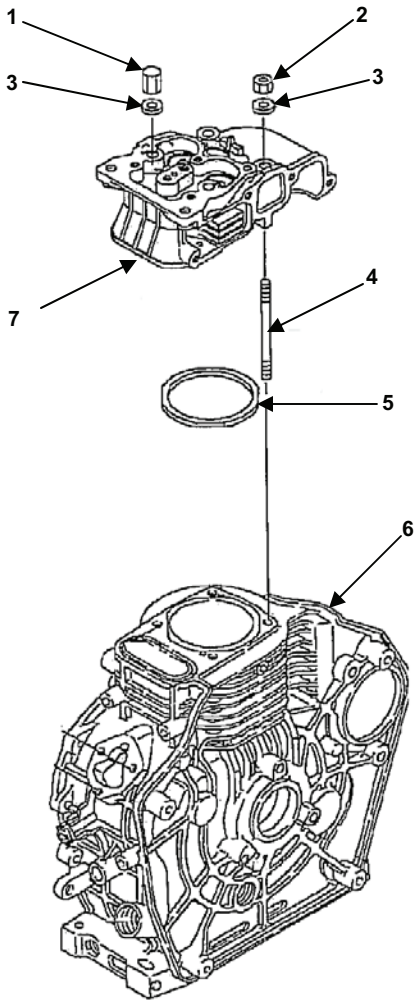


Figure 2. Removing Cylinder Head.

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 0126).

Crankcase Cover

Remove crankcase cover. See (WP 0124).

DISASSEMBLY – continued

Camshaft

1. Ensure that the push rods (Figure 3, item 2) are removed.
2. Rotate the camshaft (Figure 3, item 4) and note the alignment dots on the camshaft gear teeth (Figure 3, item 5) for assembly.
3. Push up the tappets (Figure 3, item 3) and pull out the camshaft (Figure 3, item 4) from the engine block.
4. Remove the tappets (Figure 3, item 3).

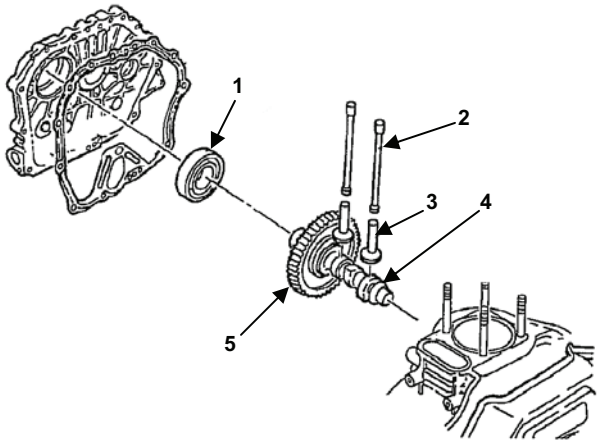


Figure 3. Camshaft.

5. Identify exhaust and intake tappets for reassembly.
6. Remove the oil seal (Figure 3, item 1) only if necessary.

Balancer Shaft

1. Rotate the balancer shaft and note the alignment dots on the gear teeth (Figure 4, item 3) for assembly.
2. Pull out balancer shaft (Figure 4, item 2) from the engine block.

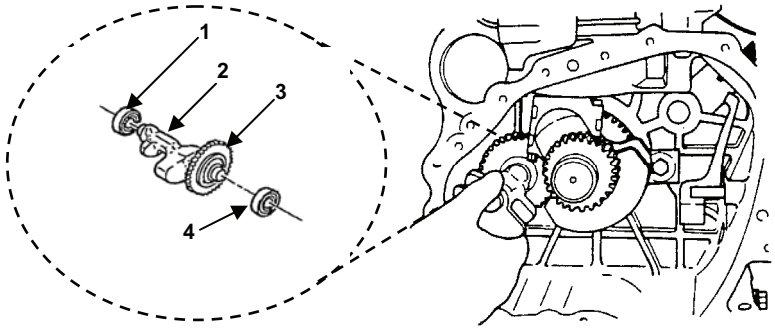


Figure 4. Balancer Shaft.

3. Remove the balancer shaft oil seals (Figure 4, item 1,4) only if necessary.

Piston and Connecting Rod Assembly

Remove Piston and connecting rod assembly. See WP (0123).

Flywheel

1. Loosen the lock nut (Figure 5, item 5) and washer (Figure 5, item 4) from flywheel (Figure 5, item 3) and crankshaft (Figure 5, item 2).

DISASSEMBLY – continued

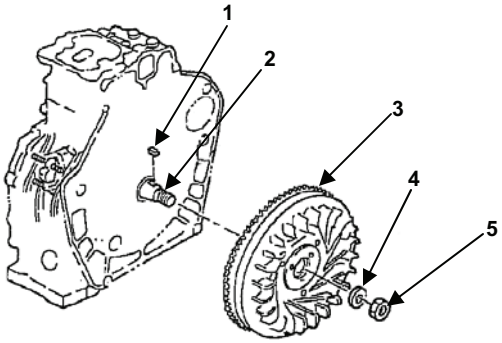


Figure 5. Flywheel.

2. Remove the flywheel (Figure 5, item 3).
3. Remove the key (Figure 5, item 1) from the crankshaft (Figure 5, item 2).

Crankshaft

1. Remove screw (Figure 6, item 1) and retainer (Figure 6, item 2).

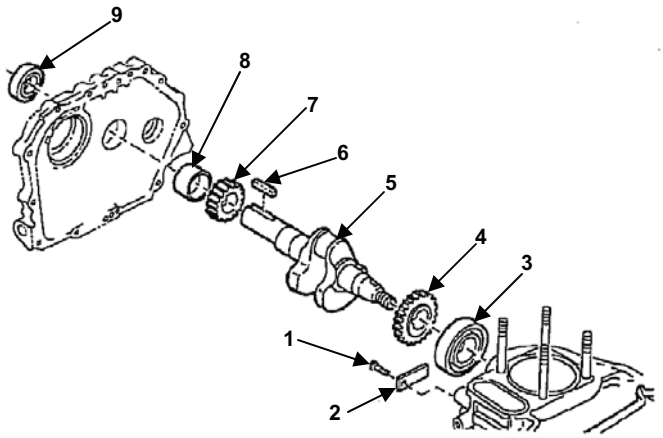


Figure 6. Crankshaft removal.

2. Remove crankshaft (Figure 6, item 5) and gears (Figure 6, item 4,7) taking care not to damage the oil seals (Figure 6, item 3, 9).
3. Remove key (Figure 6, item 6).
4. Remove oil seals (Figure 6, item 3,9) and bearing (Figure 6, item 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 (Figure 7, item 3) is facing up and oil hole (Figure 7, item 2) on the bearing is lined up with the oil passage (Figure 7, item 1).
3. Ensure that the bearing is sunk 0.0394 inch (1 mm) below the face of the crankcase cover (Figure 7, item 4).

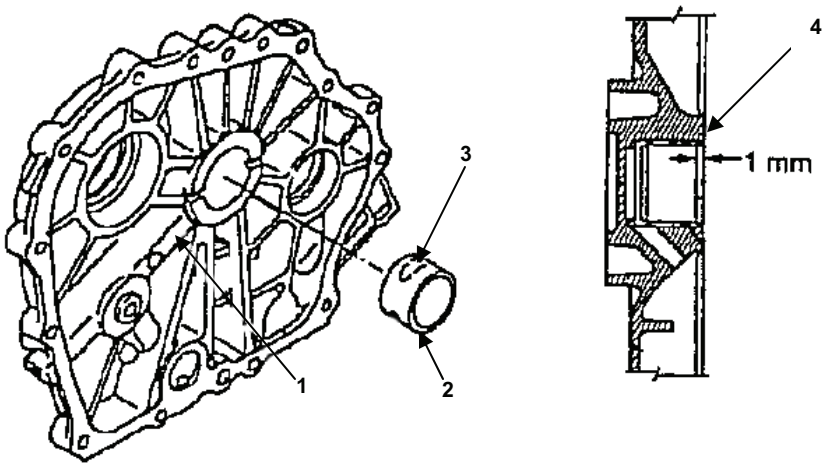


Figure 7. Crankshaft Bearing Installation.

4. Install the crankshaft with gears into the engine block and attach screw (Figure 6, item 1) and retainer (Figure 6, item 2).
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 (Figure 5, item 5) and washer (Figure 5, item 4).
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 0123.

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.

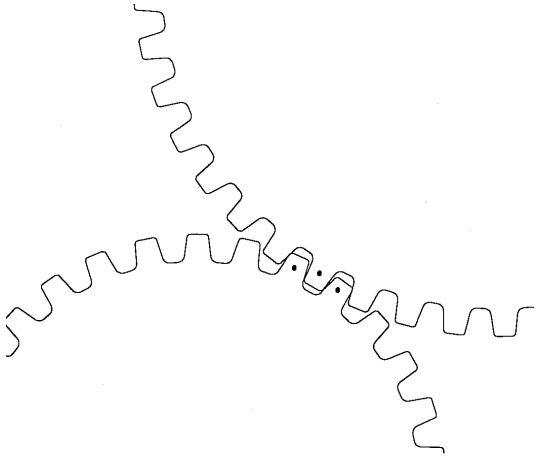


Figure 8. Aligning gear teeth.

Camshaft

1. Install the tappets.
2. 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.

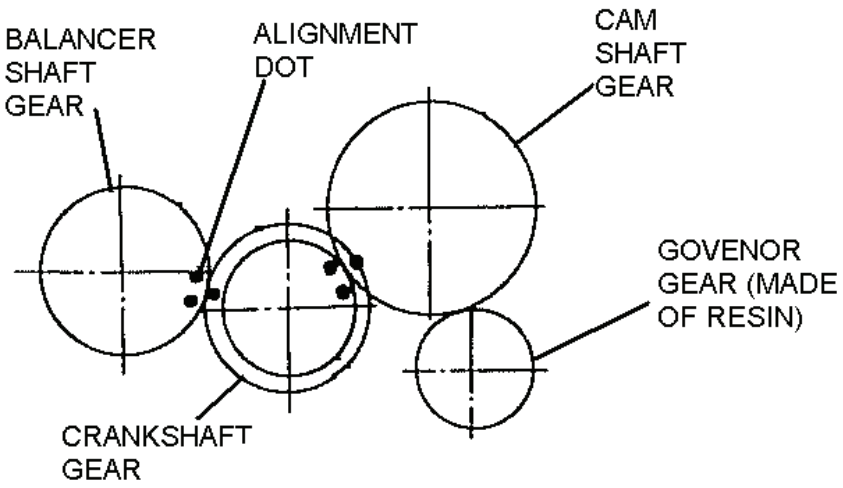


Figure 9. Gear Train Alignment.

Cylinder head

1. Measure the clearance of the cylinder head.
    a. Rotate the crankshaft until the piston is Top Dead Center (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.

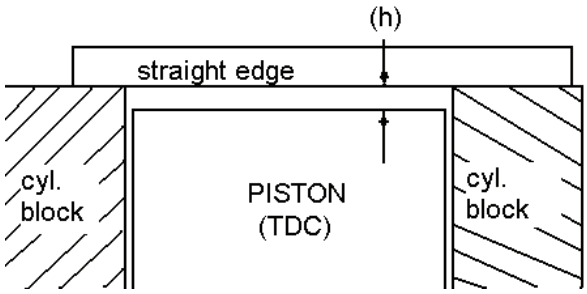


Figure 10. Cylinder Head Clearance.

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 mm – (h) and maximum 0.596 mm – (h)

    (or)

    Minimum = 0.215 inch – (h) and maximum 0.235 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 (Figure 2, item 7) onto mounting studs (Figure 2, item 4).
5. Install the washers (Figure 2, item 3), cap nuts (Figure 2, item 1), and nuts (Figure 2, item 2).
6. Torque all four (4) 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 (Figure 11, item 4) on the cylinder head (Figure 11, item 1).
2. Place the wear caps (Figure 11, item 7) on the end of the valve stem.
3. Torque the screws (Figure 11, item 4) between 14 – 16 ft-lb (1960 – 2256 N-cm).
4. Adjust valve clearance. See (WP 0121).

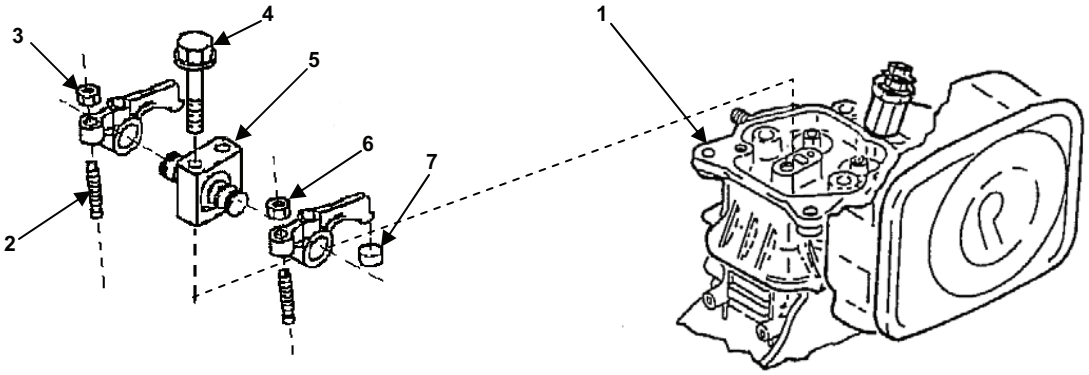


Figure 11. Rocker Arm Assembly Installation.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
PISTON AND PISTON RING
CHECKS AND SERVICES

INITIAL SETUP

Tools
Shop Equipment, (SATS) (WP 0137, Table 2, Item 4)

Equipment Condition Required
Engine disassembled. (WP 0122)

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 0122).
2. Rotate the crankshaft so the connecting rod bolts (Figure 1, item 7) are accessible and remove them.

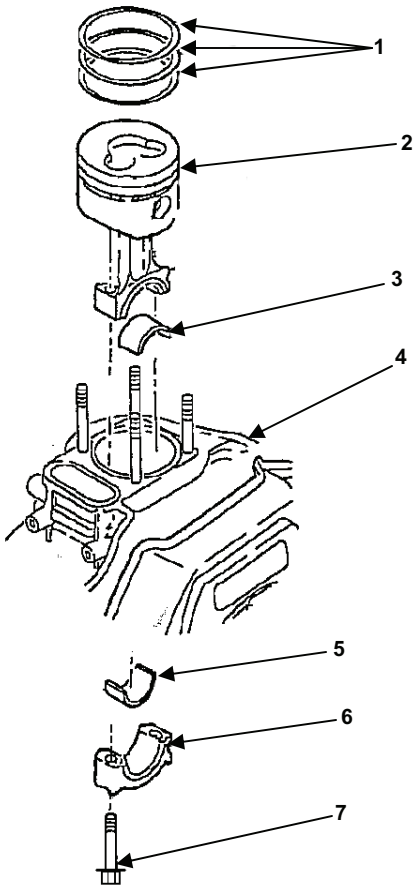


Figure 1. Connecting Rod Removal.

REMOVAL – continued

3. Remove the piston (Figure 1, item 2) from the engine block (Figure 1, item 4).
4. Remove the upper (Figure 1, item 3) and lower (Figure 1, item 5) journal bearings only if necessary.
5. Remove the piston rings (Figure 1, item 1) if necessary.

INSPECTION

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.

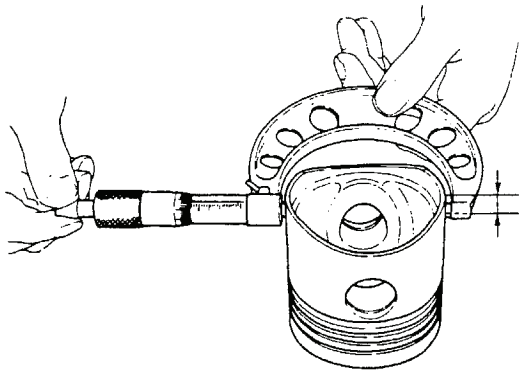


Figure 2. Piston Outside Dimension Measurement.

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.

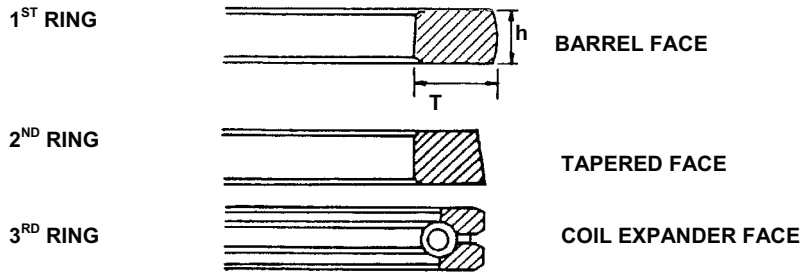


Figure 3. Piston Rings Measurement.

PISTON RINGS - continued

2. Measure the dimensions according to Table 1.

Table 1. Piston Rings Measurements

	1st Ring		2nd Ring		Oil Ring	
Measurement	**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)

3. Replace the piston ring if any of the measurements are less than the service limit.
4. Insert a serviceable piston ring into the piston ring groove
5. Measure the piston ring side clearance according to Figure 4 and Table 2. Replace the piston if the clearance exceeds the service limit.

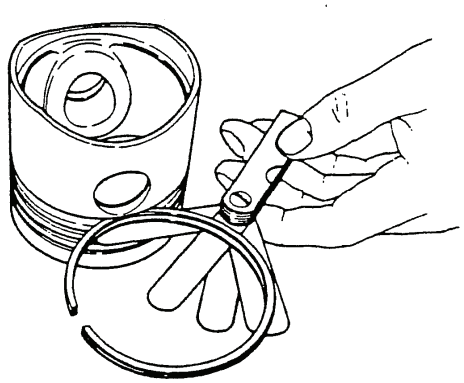


Figure 4. Piston Ring and Groove Clearance Measurement.

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.

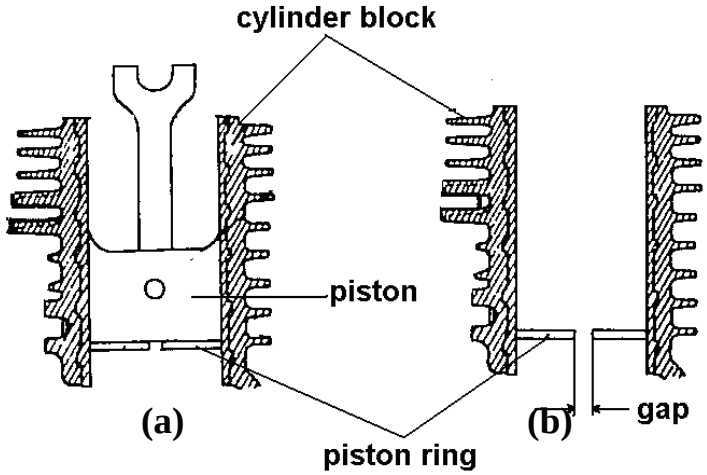


Figure 5. Ring End Gap Measurement.

   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 rings, the manufacturer marker should face up. See Figure 6.

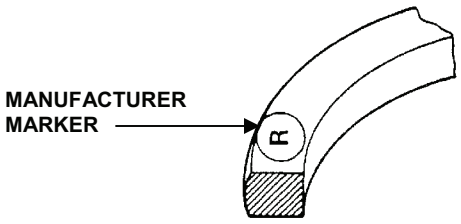


Figure 6. Piston Ring Marker.

ASSEMBLY – continued

d. Ensure piston ring gaps are 120° apart. See Figure 7.

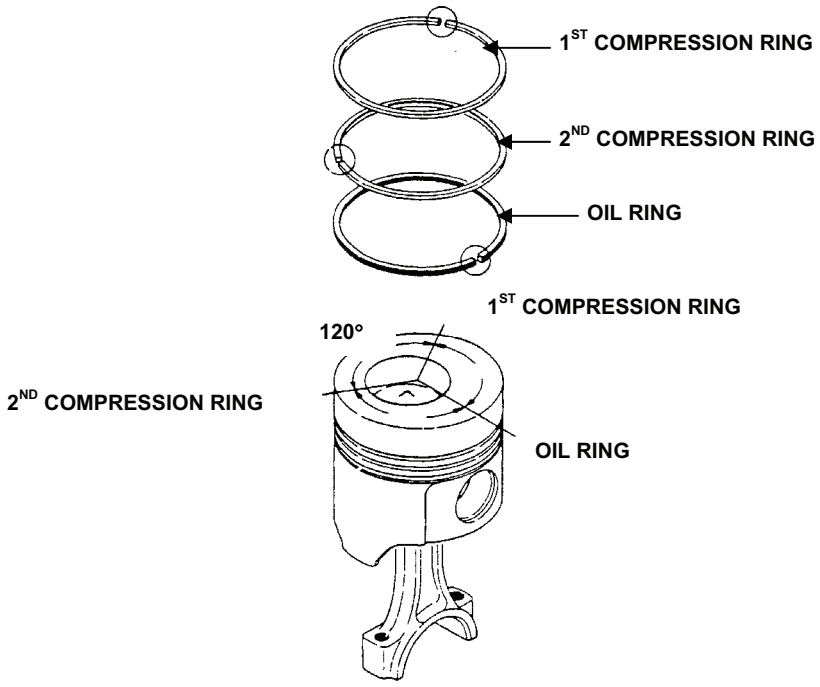


Figure 7. Piston Ring Orientation.

1. Compress the piston rings using a ring compressor and insert the piston into the cylinder.
2. Ensure the marking on the piston is on the same side as the marking on the cylinder block. See Figure 8.

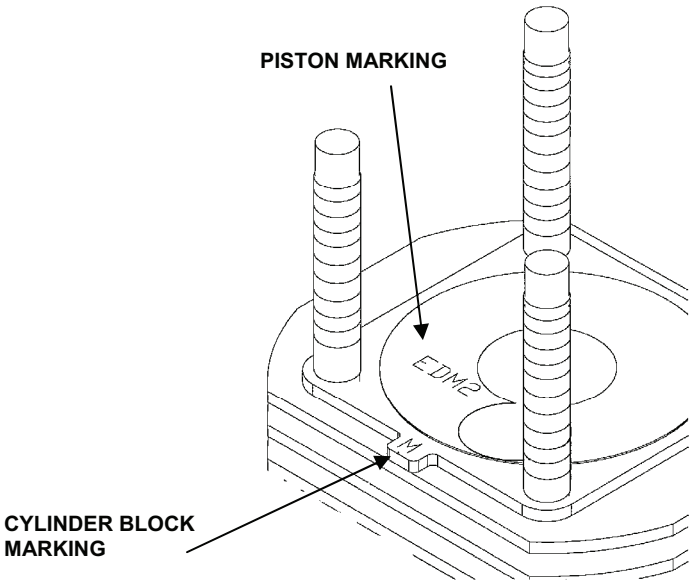


Figure 8. Piston Orientation.

ASSEMBLY -continued

3. Reinstall the upper (Figure 1, item 3) and lower (Figure 1, item 5) journal bearings if removed.
4. Mate the connecting rod cap (Figure 9, item 6) to the connecting rod. Ensure to match up the markings.

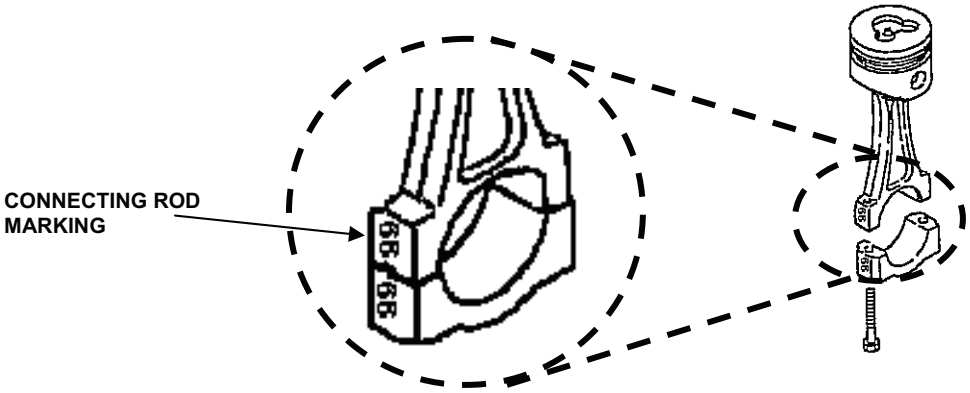


Figure 9. Connecting Rod Orientation.

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.
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 0122).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
CRANKCASE COVER
CHECKS AND SERVICES

INITIAL SETUP

Tools
Shop Equipment, (SATS) (WP 0137, Table 2, Item 4)

Materials/Parts
Cleaning Compound Solvent, (WP 0139, Item 13)
Rags, wiping, cotton, (WP 0139, Item 24)
Seal, oil, crankshaft, (PN 160210-02220)

Equipment Condition Required
Engine oil drained. (WP 0100)
Engine separated from gearbox (WP 0100)
Engine removed from module (WP 0100)

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 crankcase cover (Figure 1, item 4) from the engine by removing fourteen (14) screws (Figure 1, item 2) and stiffener bolt (Figure 1, item 11).

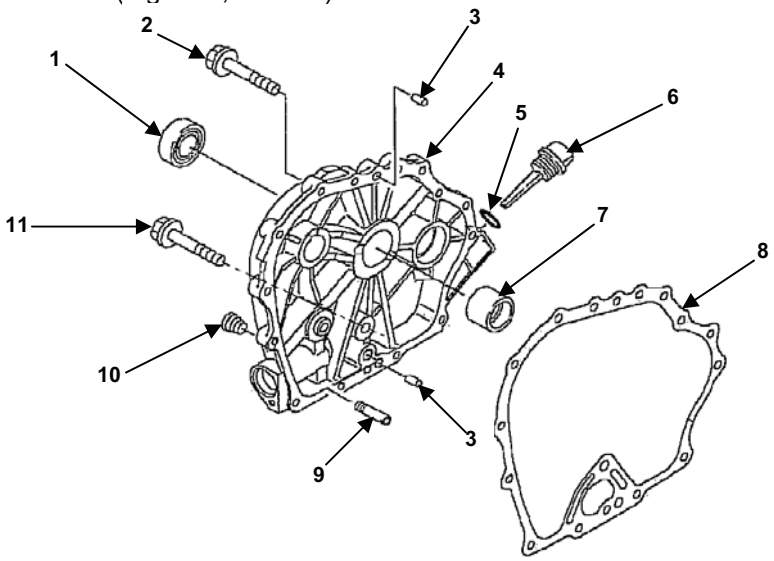


Figure 1. Crankcase Cover.

3. Remove cover gasket (Figure 1, item 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 (Figure 1, item 1), parallel pins (Figure 1, item 3), O-ring (Figure 1, item 5), oil dipstick (Figure 1, item 6), main bearing (Figure 1, item 7), oil tube (Figure 1, item 9), and oil plug (Figure 1, item 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.

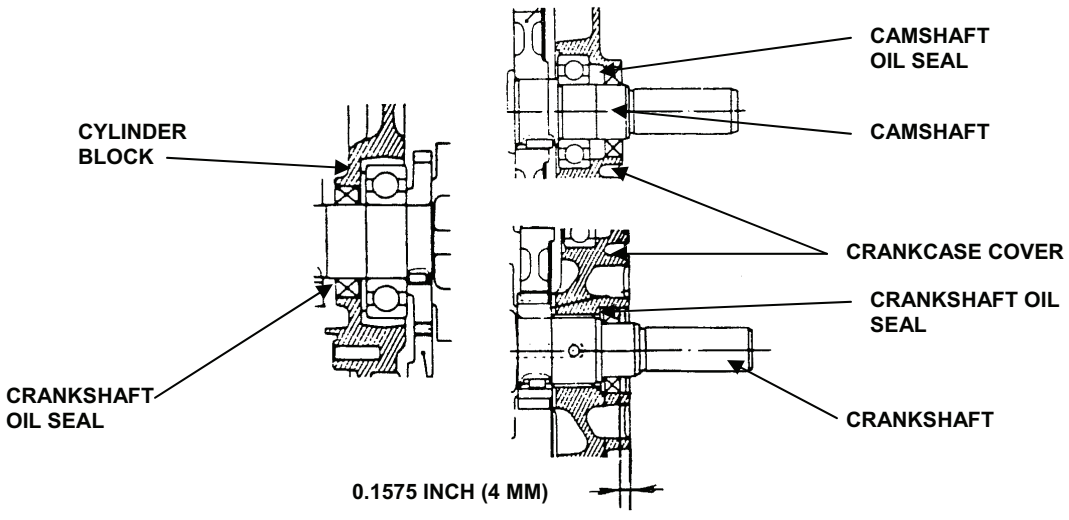


Figure 2. Crankcase Cover Oil Seals.

Camshaft Oil Seal Replacement

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.

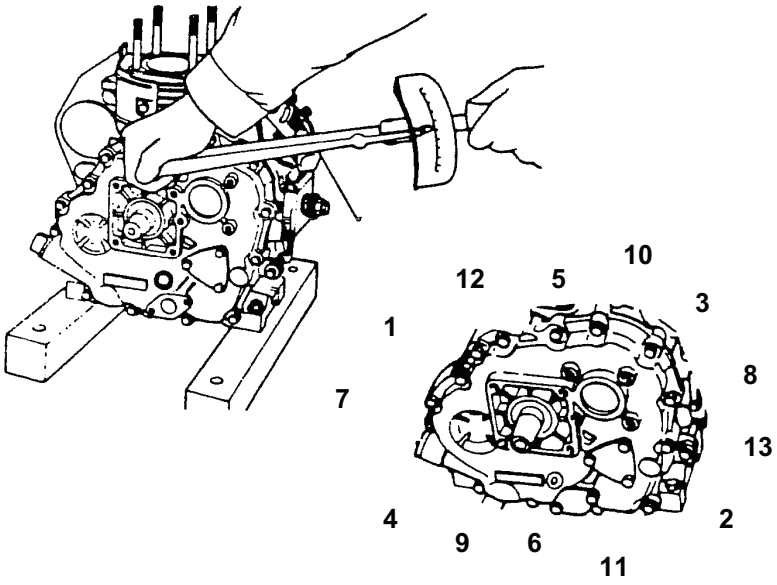


Figure 3. Tightening Crankcase Cover.

6. Tighten stiffener bolt (Figure 1, item 11) between 1960 to 2256 N-cm (14.5 to 16.6 lb-ft).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
LUBRICATION SYSTEM
CHECKS AND SERVICES

INITIAL SETUP

Tools
Shop Equipment, (SATS) (WP 0137, Table 2, Item 4)

Equipment Condition Required
Crankcase cover removed. (WP 0124)

Materials/Parts
Oil, lubricating, SAE 10W30 (WP 0139, Item 22)
Pump, oil, (WP 0139, Item 23)

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) 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 (Figure 1, item 6) from crankcase cover (Figure 1, item 1) by removing three (3) screws (Figure 1, item 7).
2. Remove and discard O-ring (Figure 1, item 4).
3. Remove parallel pin (Figure 1, item 2) and slide oil pump out of the crankcase cover.
4. Remove outer rotor assembly (Figure 1, item 4) from inner rotor (Figure 1, item 3).
5. Remove governor assembly (Figure 1, item 10) and pin (Figure 1, item 9).

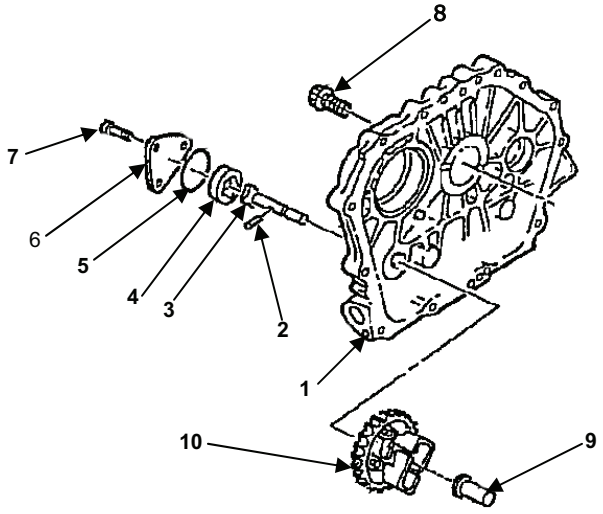


Figure 1. Oil Pump Maintenance.

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.

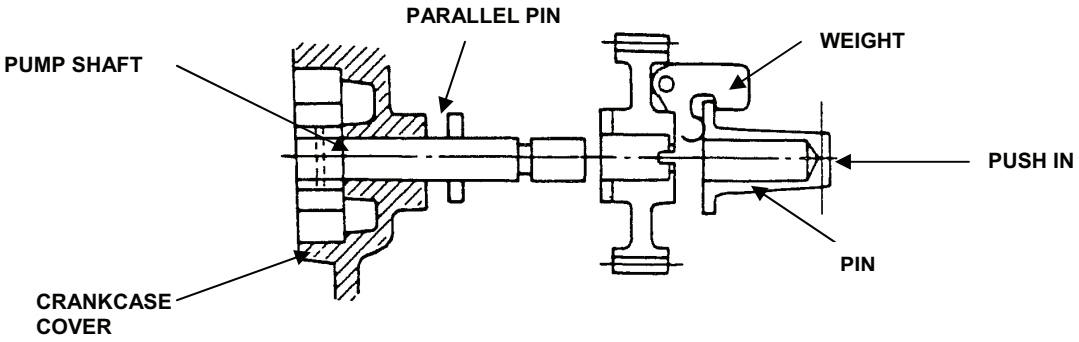


Figure 2. Lubricating Oil Pump Installation.

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 (3) 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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
FUEL PUMP AND INJECTOR
CHECKS AND SERVICES

INITIAL SETUP

Tools
Shop Equipment, (SATS) (WP 0137, Table 2, Item 4)

Materials/Parts
Valve, fuel injection, (PN 714771-53100)
Rags, wiping, cotton, (WP 0139, Item 24)
Bolt, stud, M8 or M9, (PN 26106-080452)
Shim set, (PN 114250-018000)
Filter, fuel oil, (PN 114250-55121)
Gasket, nozzle, (PN 124550-51350)

Equipment Condition Required
Flywheel housing removed. (WP 0106)

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) for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

FUEL PUMP REMOVAL

1. Disconnect fuel pipe (Figure 1, item 1) from the fuel pump (Figure 1, item 2). See Figure 1.

2. Remove nut (Figure 1, item 4), inspection cover (Figure 1, item 5) and gasket (Figure 1, item 6) from the lower pump stud.

3. Remove fuel pump (Figure 1, item 2) from pump studs by removing two nuts (Figure 1, item 3). Remove shim(s) (Figure 1, item 7). Note number of shims utilized.

4. Remove fuel tappet (Figure 1, item 9) from the engine.

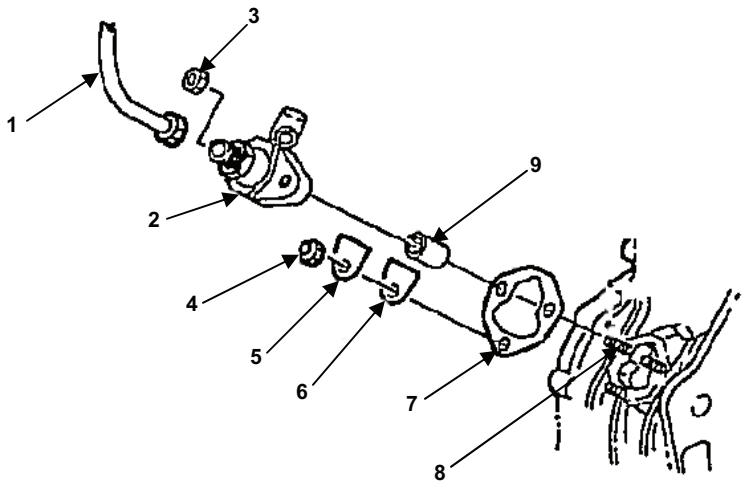


Figure 1. Fuel Pump Removal.

FUEL PUMP REMOVAL - continued

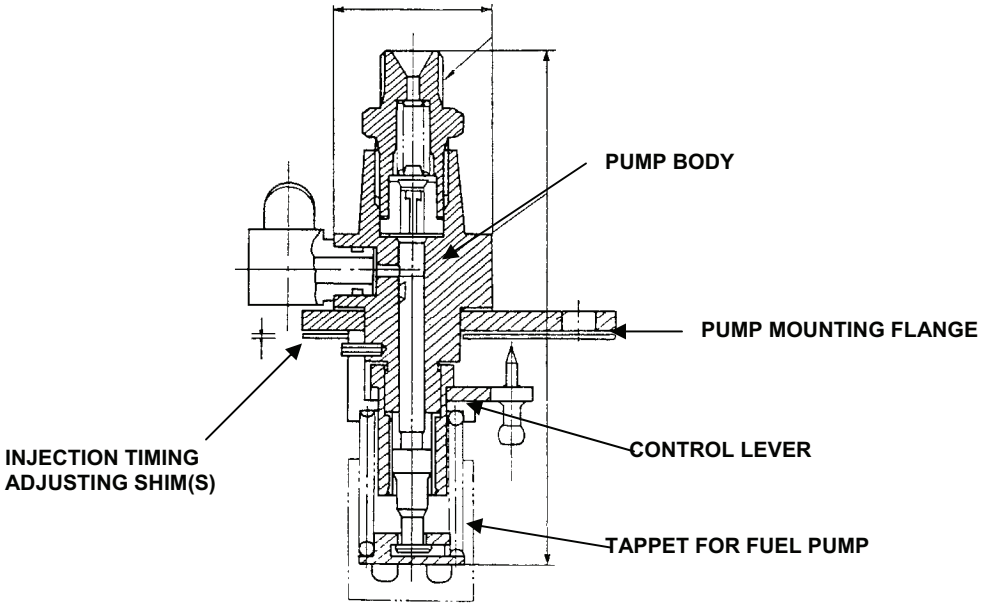


Figure 2. Fuel Pump Configuration.

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 REMOVAL - continued

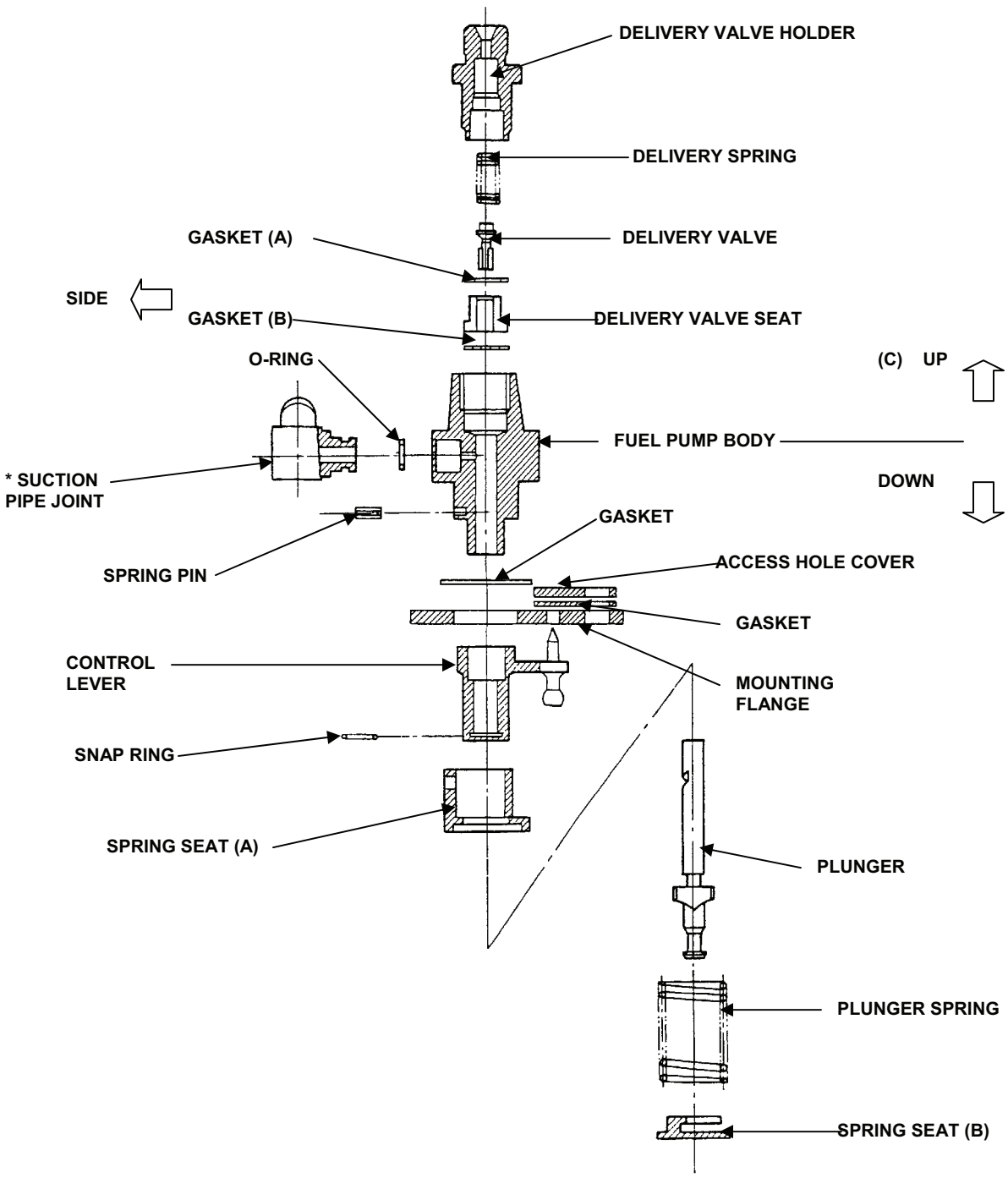


Figure 3. Fuel Pump Disassembly/Assembly.

FUEL PUMP REMOVAL - 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 (Figure 4, item 9) into the engine crankcase. See figure 4.

2. Install shim(s) onto injection pump studs (Figure 4, item 8). Install gasket (Figure 4, item 6), cover (Figure 4, item 5, and nut (Figure 4, item 4).

3. Install injection pump (Figure 4, item 2) onto studs (Figure 4, item 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 (Figure 4, item 3) and tighten to 7.2 to 8.7 lbs. (100 to 120 kg-cm).

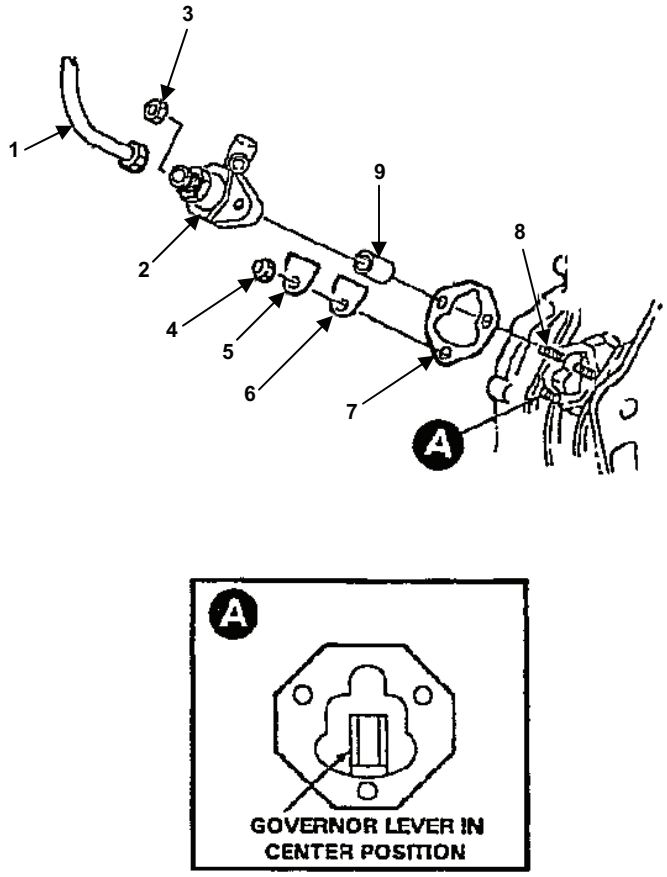


Figure 4. Fuel Pump Installation.

FUEL INJECTION TIMING ADJUSTMENT

Adjust fuel injection timing before connecting fuel pipe (Figure 4, item 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.

FUEL INJECTION TIMING ADJUSTMENT- continued

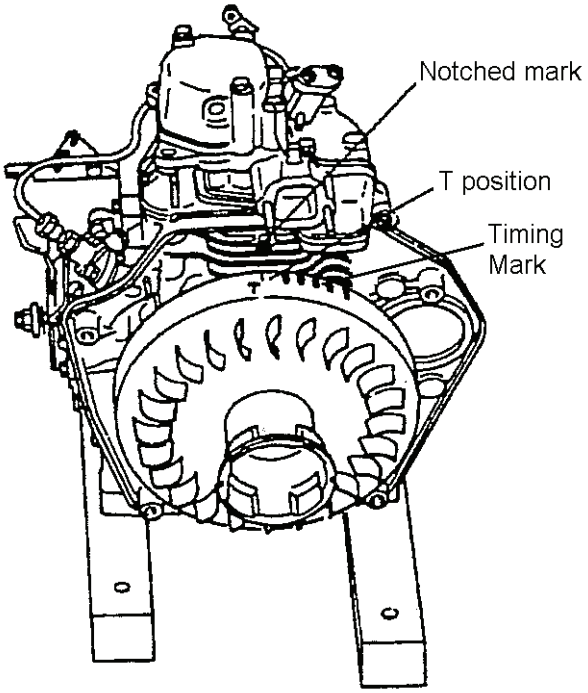


Figure 5. Fuel Injection Timing.

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 (Figure 6, item 3) and fuel return line (Figure 6, item 6) from the fuel injector (Figure 6, item 2).

2. Remove mounting nuts (Figure 6, item 5) and retaining plate (Figure 6, item 4) from studs (Figure 6, item 1).

3. Remove fuel injector (Figure 6, item 2).

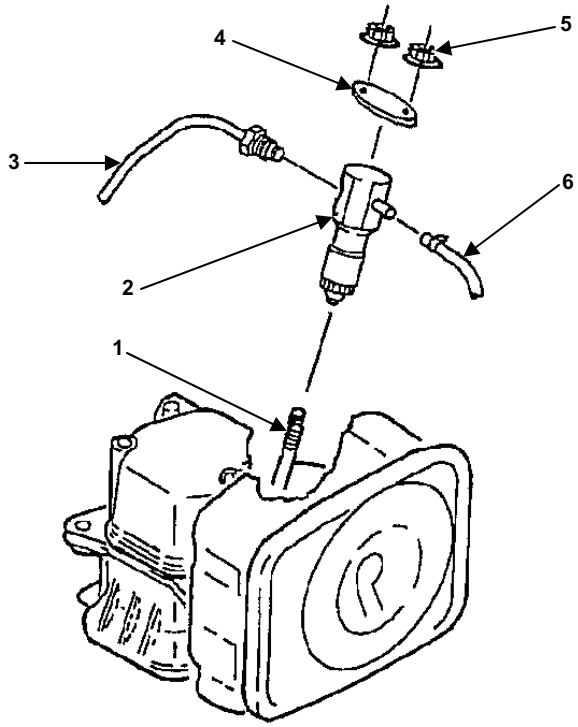


Figure 6. Fuel Injector Assembly.

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 (Figure 6, item 3) and fuel return line to the fuel injector (Figure 6, item 2).
3. Place the fuel injector in a suitable container.
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

1. Place fuel injector (Figure 6, item 2) in the engine block and secure with retaining plate (Figure 6, item 4) and nuts (Figure 6, item 5).
2. Install fuel delivery line (Figure 6, item 3) and fuel return line (Figure 6, item 6) on the fuel injector (Figure 6, item 2).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP
DISASSEMBLY/REPAIR/ASSEMBLY

INITIAL SETUP

Tools
Shop Equipment, (SATS) (WP 0137, Table 2, Item 4)

Equipment Condition Required
Pump removed from module. (WP 0104)

Materials/Parts
Kit, valve, (PN 26089)
O-rings, (PNs 17547, 43893, 26089, 44001)
Gasket, liquid, (PN 6104)
Kit, seal, (PN 46730)
Retainers, (spring, PN 44055)
Compound, O-ring, Lubricant (WP 0139, Item 15)
Seats, (PN 44058)
Springs, (PN 44056)

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 (2) Hex Socket Head screws, four (4) screws, and six (6) lock washers from the discharge manifold. Refer to Figure 1.

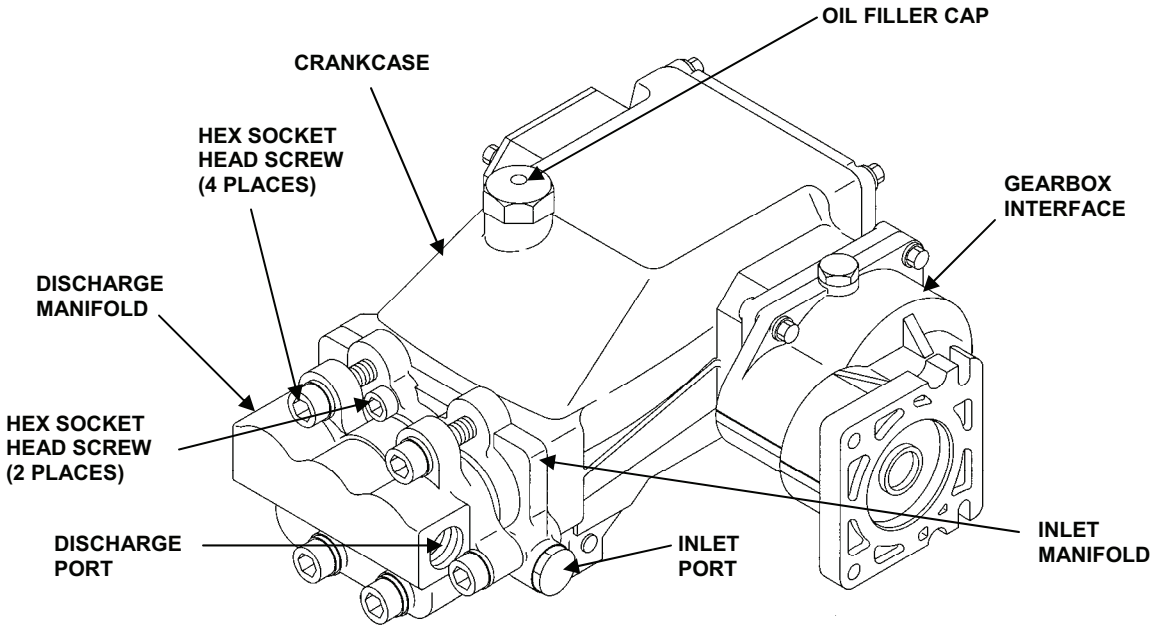


Figure 1. High-Pressure Plunger Pump.

SERVICING VALVES – continued

2. Support the discharge manifold from the underside.

3. Tap the backside of the discharge manifold with a rubber or leather mallet to gradually separate from the inlet manifold (Figure 2, item 27).

NOTE

Use care in handling plunger pump. Water may remain in manifold.

4. Carefully place discharge manifold (Figure 2, item 41) on work surface with the crankcase (Figure 2, item 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 (Figure 2, item 32) with inner (Figure 2, item 31) and outer (Figure 2, item 34) O-rings from the three small diameter and shallow inlet chambers in the discharge manifold (Figure 2, item 41).

NOTE

These adapters are not held securely in position and may fall out as the discharge manifold is removed.

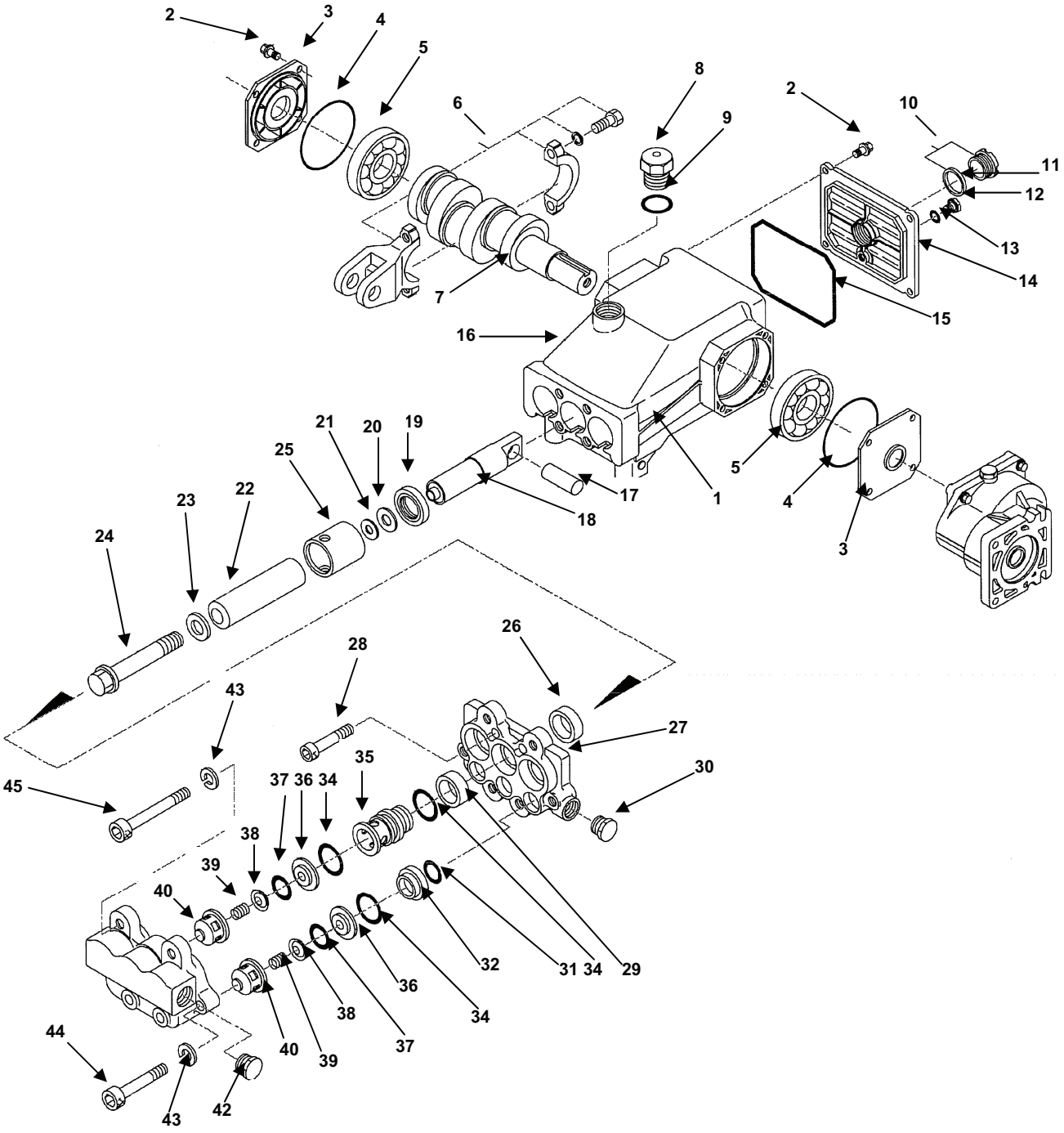


Figure 2. High-Pressure Plunger Pump (Exploded View).

6. Remove seat (Figure 2, item 36), O-ring (Figure 2, item 37), valve (Figure 2, item 38), spring (Figure 2, item 39), and spring retainer (Figure 2, item 40) from each inlet valve chamber in the discharge manifold (Figure 2, item 41). Place removed parts in parts tray. Account for all parts.

7. Remove three discharge valve adapters (Figure 2, item 35) with two inner and outer O-rings (Figure 2, item 34) from the three large diameter and deeper discharge valve chambers in the discharge manifold (Figure 2, item 41).

SERVICING VALVES - continued

8. Seals (Figure 2, item 29) generally remain with the inlet manifold (Figure 2, item 27) as it is removed.
9. If seals (Figure 2, item 29) remain in inlet manifold (Figure 2, item 27), insert two screwdrivers under the lip of the seals. Pry the seals from the inlet valve chamber if necessary.
10. Remove seat (Figure 2, item 36), O-ring (Figure 2, item 37), valve (Figure 2, item 38), spring (Figure 2, item 39), and spring retainer (Figure 2, item 40) from each discharge valve chamber in discharge manifold (Figure 2, item 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. (EPDM) elastomers require silicone-base lubricant.

1. Examine spring retainers (Figure 2, item 40) for internal wear or breaks in the structure. Replace as needed.
2. Examine springs (Figure 2, item 39) for fatigue or breaks. Replace as needed.
3. Examine valves (Figure 2, item 38) for grooves, pitting, or wear. Replace as needed.
4. Position spring retainer (Figure 2, item 40) in each deep discharge valve chamber in discharge manifold (Figure 2, item 41). Push in until spring retainer rests on the machined ridge in each chamber.
5. Insert spring (Figure 2, item 39) into the spring retainer (Figure 2, item 40) over the plastic center guide.
6. Place valve (Figure 2, item 38) over spring (Figure 2, item 39) with concave side down.
7. Examine seat O-rings (Figure 2, item 34) for cuts or wear. Replace as needed.
8. Lubricate O-ring (Figure 2, item 34) with Glycerin. Insert into groove on outside of each seal (Figure 2, item 29).
9. Place O-ring (Figure 2, item 34) on lip of spring retainer (Figure 2, item 40).
10. Carefully square O-ring (Figure 2, item 34) in each valve chamber to avoid cutting O-ring when seat (Figure 2, item 36) is installed.
11. Examine seats (Figure 2, item 36) for grooves, pitting, or wear. Replace as needed.
12. Install seat (Figure 2, item 36) with concave side down in each discharge valve chamber. Make sure O-ring (Figure 2, item 34) fits snugly into each groove in seat.
13. Examine both inner and outer O-rings (Figure 2, item 34) on the discharge valve adapter (Figure 2, item 35) for cuts or wear. Replace as needed.
14. Carefully press discharge valve adapter (Figure 2, item 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 (Figure 2, item 40) for internal wear or breaks in the structure. Replace as needed.
2. Examine springs (Figure 2, item 39) for fatigue or breaks Replace as needed.
3. Examine valves (Figure 2, item 38) for grooves, pitting, or wear. Replace as needed.
4. Position spring retainer (Figure 2, item 40) in each shallow inlet valve chamber in discharge manifold (Figure 2, item 41). Push in until spring retainer rests on the machined ridge in each inlet chamber.
5. Place valve (Figure 2, item 38) over spring (Figure 2, item 39) with concave side down.
6. Examine seat O-rings (Figure 2, item 34) for cuts or wear. Replace as needed.
7. Place seat O-ring (Figure 2, item 34) on lip of spring retainer (Figure 2, item 40).
8. Carefully square seat O-ring (Figure 2, item 34) in each inlet valve chamber to avoid cutting when seat (Figure 2, item 36) is installed.

SERVICING VALVES - continued

9. Examine seats (Figure 2, item 36) for grooves, pitting, or wear. Replace as needed.
10. Install seats (Figure 2, item 36) with concave side down in each inlet valve chamber. Make sure O-ring (Figure 2, item 34) fits snugly in groove in seat (Figure 2, item 36).
11. Examine both inner (Figure 2, item 31) and outer (Figure 2, item 34) O-rings on the inlet valve adapter (Figure 2, item 32) for cuts and wear. Replace as needed.
12. Lubricate O-rings with Glycerin. Insert into grooves on outside of each inlet valve adapter (Figure 2, item 32).
13. Carefully press inlet valve adapter (Figure 2, item 32) with small diameter down into each lower valve chamber until inlet valve adapter snaps tightly into place.
14. Slide discharge manifold (Figure 2, item 41) over ceramic plunger (Figure 2, item 22) ends. Align exposed discharge valve adapters (Figure 2, item 35) with inlet valve chambers in inlet manifold (Figure 2, item 27).
15. Tap discharge manifold (Figure 2, item 41) with rubber or leather mallet until inlet (Figure 2, item 27) and discharge (Figure 2, item 41) manifolds are flush.
16. Place six (6) lock washers (Figure 2, item 43) on two (2) screws (Figure 2, item 44) and four (4) screws (Figure 2, item 45).
17. Apply anti-seize compound to screw threads.
18. Install two screws (Figure 2, item 44) and four screws (Figure 2, item 45) through discharge manifold (Figure 2, item 41) into inlet manifold (Figure 2, item 27). Tighten hand tight.
19. Torque six (6) screws 12 foot-pounds (16.3 N m) in **cross pattern sequence**.

SERVICING SEALS

Disassembly

It is necessary to remove both the discharge manifold (Figure 2, item 41) and inlet manifold (Figure 2, item 27) from the pump crankcase (Figure 2, item 16) to service the seals.

1. Remove two (2) screws (Figure 2, item 44), four (4) screws (Figure 2, item 45), and six (6) lock washers (Figure 2, item 43) from the discharge manifold (Figure 2, item 41).
2. Support the discharge manifold (Figure 2, item 41) from the underside. Tap the backside of the discharge manifold with a rubber or leather mallet to gradually separate from the inlet manifold (Figure 2, item 27).
3. Carefully place discharge manifold (Figure 2, item 41) on work surface with the crankcase (Figure 2, item 16) up.
4. Remove four (4) screws (Figure 2, item 28) from inlet manifold (Figure 2, item 27) and pump crankcase (Figure 2, item 16).
5. Rotate crankshaft (Figure 2, item 7) to loosen inlet manifold (Figure 2, item 27).
6. Support inlet manifold (Figure 2, item 27) from the underside. Tap the backside of the inlet manifold with a leather or rubber mallet to separate inlet manifold (Figure 2, item 27) from the pump crankcase (Figure 2, item 16).
7. Place inlet manifold (Figure 2, item 27) on a suitable work surface with crankcase (Figure 2, item 16) side down.

CAUTION

Exercise caution as the screwdriver may damage sealing surface in inlet manifold.

1. Remove Hi-Pressure Seal (HPS) (Figure 2, item 29) from each seal chamber in inlet manifold (Figure 2, item 27).
2. Invert inlet manifold (Figure 2, item 27) with crankcase (Figure 2, item 16) side up.
3. Remove Lo-Pressure Seal (LPS) (Figure 2, item 26) from each seal chamber in inlet manifold (Figure 2, item 27).

SERVICING SEALS - continued
Assembly

NOTE

For certain applications, apply liquid gasket to o-ring crevices and seal surfaces. EPDM elastomers require silicone-base lubricant.

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 (Figure 2, item 26) for wear to the internal ridges, outer surfaces, or for broken springs. Replace as needed.
2. Make sure to invert inlet manifold (Figure 2, item 27) with crankcase (Figure 2, item 16) side up.
3. Apply liquid gasket to the manifold bores where the LPS (Figure 2, item 26) will make contact when installed.
4. Press LPS (Figure 2, item 26) into each seal chamber of the inlet manifold (Figure 2, item 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 (Figure 2, item 29) for wear to the internal ridges or outer surfaces. Replace as needed.
7. Invert the inlet manifold (Figure 2, item 27) with crankcase (Figure 2, item 16) side down.
8. Apply liquid gasket to the manifold bores where the HPS (Figure 2, item 29) will make contact when installed.
9. Press HPS (Figure 2, item 29) into each seal chamber with metal backing down until completely seated.
10. Examine inlet valve adapters (Figure 2, item 32) and discharge valve adapters (Figure 2, item 35) for scale build-up and wear. Replace as needed.
11. Examine spacer O-rings (Figure 2, item 34) on the discharge valve adapter (Figure 2, item 35) for cuts and deterioration. Replace as needed.
12. Examine inner and outer adapter O-rings (Figure 2, item 31, 34) on the inlet valve adapter (Figure 2, item 32) for cuts and deterioration. Replace as needed.
13. Apply liquid gasket to O-ring grooves on inlet valve adapter (Figure 2, item 32) and discharge valve adapter (Figure 2, item 35).
14. Apply liquid gasket to the manifold bores where the adapters (Figure 2, item 32, 35) will make contact when installed.
15. Carefully press discharge valve adapter (Figure 2, item 35) into each discharge valve chamber in discharge manifold (Figure 2, item 185) with small diameter side down until adapter snaps tightly into position.
16. Carefully press inlet valve adapter (Figure 2, item 32) into each inlet valve chamber in discharge manifold (Figure 2, item 41) with small diameter side down until adapter snaps tightly into position.
17. Rotate crankshaft (Figure 2, item 7) by hand so the two outside plungers (Figure 2, item 22) are extended equally.
18. Lightly lubricate three ceramic plungers (Figure 2, item 22) with Glycerin to assist in installing the inlet manifold (Figure 2, item 27).
19. Position inlet manifold (Figure 2, item 27) over ceramic plungers (Figure 2, item 22).
20. Apply Locktite-242 to four (4) screw (Figure 2, item 28) threads.

SERVICING SEALS - continued

21. Torque four (4) screws 9.4 foot-pounds (13 Nm) in **cross pattern sequence**.
22. Position discharge manifold (Figure 2, item 41) over ceramic plunger (Figure 2, item 22) ends. Align exposed discharge valve adapters (Figure 2, item 35) with inlet manifold (Figure 2, item 27) chambers. Press into position.
23. Tap with a leather or rubber mallet until inlet and discharge manifolds are flush.
24. Place six (6) lock washers (Figure 2, item 43) on two (2) screws (Figure 2, item 44) and four (4) screws (Figure 2, item 45).
25. Apply anti-seize compound to screw threads.
26. Install two (2) screws (Figure 2, item 44) and four (4) screws (Figure 2, item 45) through discharge manifold (Figure 2, item 41) into inlet manifold (Figure 2, item 27). Tighten hand tight.
27. Torque six (6) screws 12 foot-pounds (16.3 N m) in **cross pattern sequence.**

SERVICING PLUNGERS

Disassembly

1. Remove two (2) screws (Figure 2, item 44), four (4) screws (Figure 2, item 45), and six (6) lock washers (Figure 2, item 43) from the discharge manifold (Figure 2, item 41).
2. Support the discharge manifold (Figure 2, item 41) from the underside. Tap the backside of the discharge manifold with a rubber or leather mallet to gradually separate from the inlet manifold (Figure 2, item 27).
3. Carefully place discharge manifold (Figure 2, item 41) on work surface with the crankcase (Figure 2, item 16) up.
4. Remove four (4) screws (Figure 2, item 28) from inlet manifold (Figure 2, item 27) and pump crankcase (Figure 2, item 16).
5. Rotate dual end crankshaft (Figure 2, item 7) to loosen inlet manifold (Figure 2, item 27).
6. Support inlet manifold (Figure 2, item 27) from the underside. Tap the backside of the inlet manifold with a leather or rubber mallet to separate inlet manifold (Figure 2, item 27) from the pump crankcase (Figure 2, item 16).
7. Place inlet manifold (Figure 2, item 27) on a suitable work surface with crankcase (Figure 2, item 16) side down.
8. Remove seal retainer (Figure 2, item 25) from each plunger rod (Figure 2, item 18).
9. Loosen plunger retainers (Figure 2, item 24) approximately three to four turns.
10. Push ceramic plunger (Figure 2, item 22) back towards crankcase (Figure 2, item 16). Separate plungers (Figure 2, item 22) from plunger retainers (Figure 2, item 24).
11. Complete unthreading plunger retainers (Figure 2, item 24) by hand.
12. Remove plunger retainers (Figure 2, item 24) and seal washers (Figure 2, item 23).
13. Remove ceramic plungers (Figure 2, item 22), keyhole washers (Figure 2, item 21), and barrier slingers (Figure 2, item 20) from each plunger rod (Figure 2, item 18).

Assembly

1. Visually inspect three crankcase oil seals (Figure 2, item 19) for deterioration or leaks. Replace as needed.
2. Examine three plunger retainers (Figure 2, item 24), keyhole washers (Figure 2, item 21), and barrier slingers (Figure 2, item 20) for wear. Replace as needed.
3. Examine seal washers (Figure 2, item 23) for cuts or wear. Replace as needed.
4. Examine ceramic plungers (Figure 2, item 22) for scoring, scale build-up, chips, or cracks. Replace as needed.

SERVICING PLUNGERS – continued

NOTE

Generally the ceramic plungers do not need to be replaced.

5. Install seal washer (Figure 2, item 23) over each plunger retainer (Figure 2, item 24).

Install plunger retainer (Figure 2, item 24) with seal washer (Figure 2, item 23) into flat end of ceramic plunger (Figure 2, item 22).

CAUTION

Ceramic plunger can only be installed in one direction. Counter bore end of ceramic plunger fits over plunger rod shoulder.

6. Install barrier slinger (Figure 2, item 20) over each plunger rod (Figure 2, item 18) with concave side away from crankcase (Figure 2, item 16).
7. Install keyhole washer (Figure 2, item 21) over each plunger rod (Figure 2, item 18) with split ends facing downward.
8. Apply Locktite-242 to exposed threads of plunger retainer (Figure 2, item 24).
9. Thread plunger retainer (Figure 2, item 24) into plunger rod (Figure 2, item 18). Tighten hand tight.
10. Torque plunger retainer 4.4 foot-pounds (6 N m).
11. Install seal retainers (Figure 2, item 25) with the holes to the top and bottom, and small tabs facing downward over each plunger rod (Figure 2, item 18).
12. Examine inlet valve adapters (Figure 2, item 32) and discharge valve adapters (Figure 2, item 35) for scale build-up and wear. Replace as needed.
13. Examine spacer O-rings (Figure 2, item 34) on the discharge valve adapter (Figure 2, item 35) for cuts and deterioration. Replace as needed.
14. Examine inner and outer adapter O-rings (Figure 2, item 31, 34) on the inlet valve adapter (Figure 2, item 32) for cuts and deterioration. Replace as needed.
15. Carefully press discharge valve adapter (Figure 2, item 32) into each discharge valve chamber in discharge manifold (Figure 2, item 41) with small diameter side down until adapter snaps tightly into position.
16. Carefully press inlet valve adapter (Figure 2, item 32) into each inlet valve chamber in discharge manifold (Figure 2, item 41) with small diameter side down until adapter snaps tightly into position.
17. Rotate crankshaft (Figure 2, item 7) by hand so the two outside plungers (Figure 2, item 22) are extended equally.
18. Lightly lubricate three ceramic plungers (Figure 2, item 22) with Glycerin to assist in installing the inlet manifold (Figure 2, item 27).
19. Position inlet manifold (Figure 2, item 27) over ceramic plungers (Figure 2, item 22).
20. Apply Locktite-242 to four screw (Figure 2, item 28) threads.
21. Install four (4) screws (Figure 2, item 28) through inlet manifold (Figure 2, item 27) into crankcase (Figure 2, item 16). Tighten hand tight.
22. Torque four (4) screws 9.4 foot-pounds (12.7 N m) in **cross pattern sequence**.
23. Position discharge manifold (Figure 2, item 41) over ceramic plunger (Figure 2, item 22) ends. Align exposed discharge valve adapters (Figure 2, item 35) with inlet manifold (Figure 2, item 27) chambers. Press into position.
24. Tap with a leather or rubber mallet until inlet and discharge manifolds are flush.
25. Place six (6) lock washers (Figure 2, item 43) on two (2) screws (Figure 2, item 44) and four (4)screws (Figure 2, item 45).
26. Apply antiseize compound to screw threads.

SERVICING PLUNGERS – continued

27. Install two (2) screws (Figure 2, item 44) and four (4) screws (Figure 2, item 45) through discharge manifold (Figure 2, item 41) into inlet manifold (Figure 2, item 27). Tighten hand tight. Torque six (6) screws 12 foot-pounds (16.3 Nm) in **cross pattern sequence.**

SERVICING CRANKCASE SECTION

1. While inlet and discharge manifolds (Figure 2, item 27, 41), plungers (Figure 2, item 22), and seal retainers (Figure 2, item 25) are removed, examine crankcase oil seals for leaking and wear.
2. Check for any signs of leaking at rear cover (Figure 2, item 14), drain plug (Figure 2, item 12), and bubble oil gauge (Figure 2, item 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 (Figure 2, item 7) by hand to feel for smooth bearing movement.
5. Examine crankshaft oil seal (Figure 2, item 19) externally for drying, cracking, or leaking. Replace as needed.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
DIESEL ENGINE
THROTTLE PLATE
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Shop Equipment, Automotive Vehicle (WP 0137, Table 2, Item 4)

Equipment Condition Required
Throttle cable removed. (WP 0105)

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) for Preventive Maintenance Checks and Services (PMCS) scheduled intervals for these items.

REMOVAL

1. Remove adjusting screw (Figure 1, item 1) and washer (Figure 1, item 2) from the assembly (Figure 1, item 3).
2. Note the location of the spring attachments (Figure 1, item 4,5, and 12) on the control handle (Figure 1, item 6).
3. Remove assembly (Figure 1, item 3) from the engine block by removing screw (Figure 1, item 8).
4. Remove screw (Figure 1, item 9), knob (Figure 1, item 10), and nut (Figure 1, item 11). Remove screw (Figure 1, item 13) and spring (Figure 1, item 12).

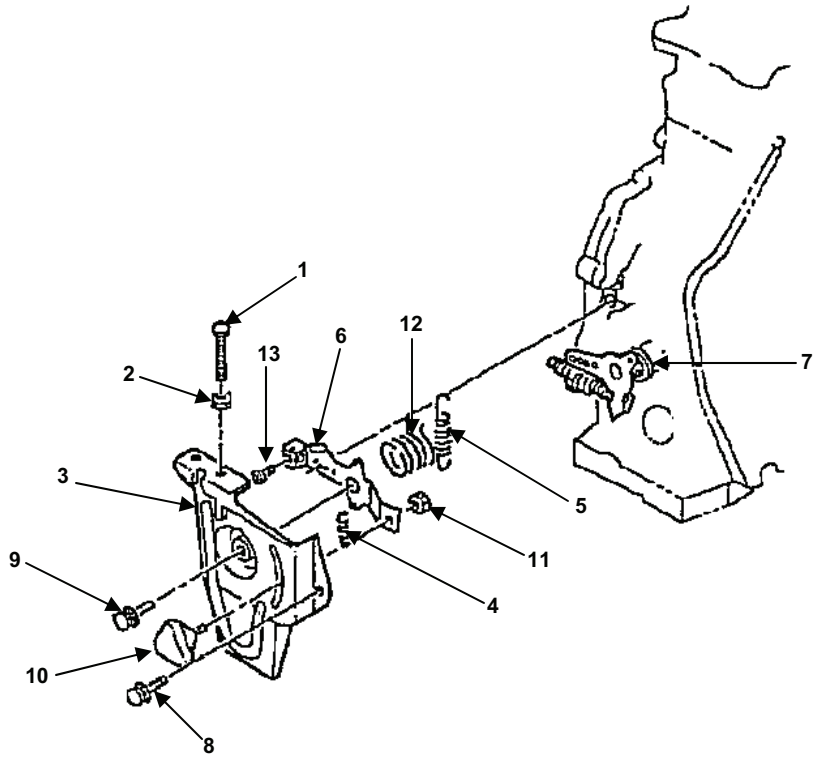


Figure 1. Throttle Plate.

INSPECTION

Inspect all the components for damage or deformity. Replace if needed.

ASSEMBLY

1. Install screw (Figure 1, item 13) onto control handle (Figure 1, item 6). See Figure 1.
2. Install handle to the assembly (Figure 1, item 3) and install screw (Figure 1, item 9), knob (Figure 1, item 10), nut (Figure 1, item 11), and spring (Figure 1, item 12).
3. Install assembly (Figure 1, item 3) to the engine block and install screw (Figure 1, item 8).
4. Connect springs (Figure 1, item 4 and 5) to handle (Figure 1, item 6) and lever (Figure 1, item 7).
5. Install screw (Figure 1, item 1) and washer (Figure 1, item 2).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
GEARBOX
DISASSEMBLY/ ASSEMBLY

INITIAL SETUP

Tools
Shop Equipment, Automotive Vehicle (WP 0137, Table 2, Item 4)

Materials/Parts
Lubricating oil, (WP 0139, Item 22)
O-ring, (PN 44558, 23170)
Seal, oil, pinion, (PN 45089)
Gasket, flange, (PN 48262)
Anti-seize compound, (WP 0139, Item 3)

Equipment Condition Required
LWP shut down and all equipment de-energized.

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 0104).
2. Remove items (Figure 1, item 9) through (Figure 1, item15). See (WP 0104).
3. Remove lower drain plug (Figure 1, item 21) with drain plug O-ring (Figure 1, item 22) from gearbox housing (Figure 1, item 2).

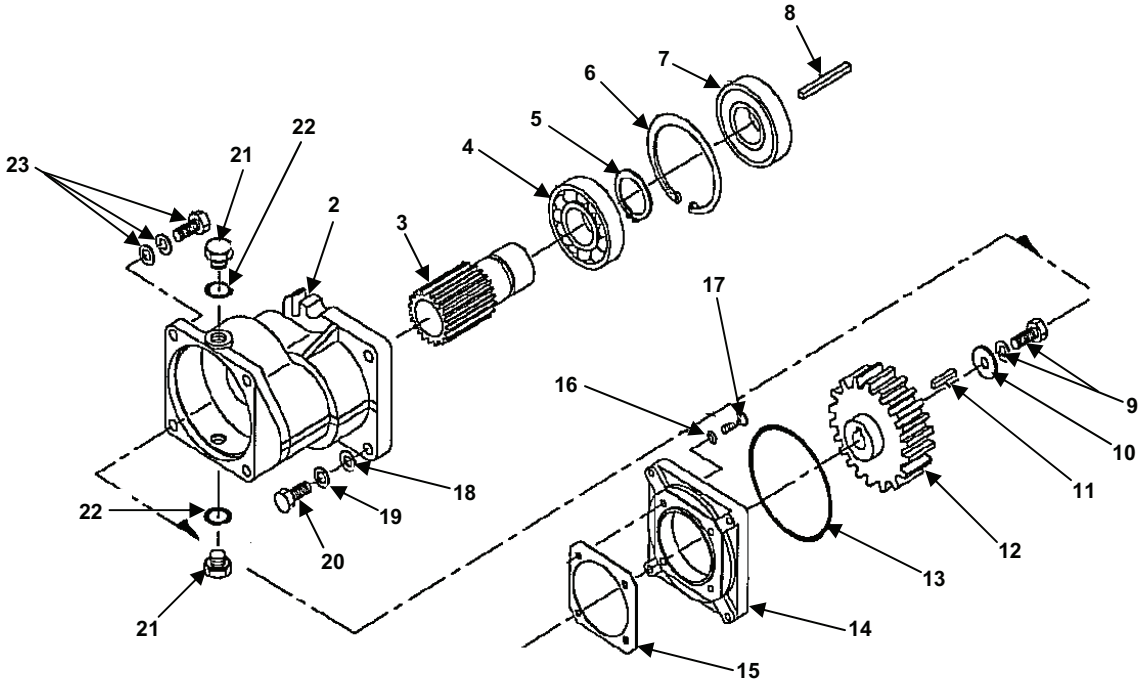


Figure 1. High-Pressure Pump Module Gearbox (Exploded View).

DISASSEMBLY-REMOVED

1. Completely drain the oil from the gearbox crankcase into a suitable container. See Figure 1.
2. Place gearbox (Figure 1, item 1) on work surface with pinion oil seal (Figure 1, item 7) facing up.
3. Remove pinion oil seal (Figure 1, item 7).
4. Remove outer retaining ring (Figure 1, item 6) in groove below pinion oil seal (Figure 1, item 7).
5. Remove pinion gear (Figure 1, item 3). Place gearbox on housing (Figure 1, item 2) flange. Press ball bearing (Figure 1, item 4) out from inside gearbox housing (Figure 1, item 2).
6. Remove ball bearing (Figure 1, item 4) from pinion gear (Figure 1, item 3).
7. Remove inner retaining ring (Figure 1, item 5).
8. Set pinion gear (Figure 1, item 3), ball bearing (Figure 1, item 4), and inner retaining ring (Figure 1, item 5) aside for reassembly.
9. Remove retaining screw with lock washer (Figure 1, item 9) and flat retaining washer (Figure 1, item 10) from spur gear (Figure 1, item 12).

ASSEMBLY

Bearing Cover Flange

1. Align the four holes and mount gasket (Figure 1, item 15) on outside of bearing cover flange (Figure 1, item 14).
2. Replace O-ring (Figure 1, item 13) in outer groove of bearing cover flange (Figure 1, item 14).

CAUTION

Keep raise threaded mounting holes to front top and bottom rear. Proper assembly is necessary.

3. Install bearing cover flange (Figure 1, item 14) onto plunger pump flush with pump crankcase.
4. Install four socket Allen head screws (Figure 1, item 17) and toothed washers (Figure 1, item 16).
5. Torque screws 50 inch-pounds (5.6 N m).

Gearbox

1. Insert key (Figure 1, item 11) into pump crankshaft keyway.
2. Examine spur gear (Figure 1, item 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 (Figure 1, item 12) with key (Figure 1, item 11) in pump shaft.
4. Install flat washer (Figure 1, item 10) and retaining screw with lock washer (Figure 1, item 9) onto shaft.
5. Torque the retaining screw 110 inch-pounds (12.3 N m).
6. Examine two gearbox crankcase housing (Figure 1, item 2) oil drain plugs (Figure 1, item 21) for any evidence of leaking.
7. Replace two (2) O-rings (Figure 1, item 22) if necessary.
8. Examine pinion gear (Figure 1, item 3) teeth for wear. Replace pinion gear if necessary.
9. Press ball bearing (Figure 1, item 4) over pinion gear (Figure 1, item 3) until seated on shoulder.
10. Install inner retaining ring (Figure 1, item 5) on pinion gear (Figure 1, item 3). Snap ring into groove.

ASSEMBLY – continued

11. Install pinion gear (Figure 1, item 3) and gear assembly into gearbox housing (Figure 1, item 2). Press into position until seated on shoulder.

NOTE

Groove for outer retaining ring must be visible.

12. Insert large retaining ring (Figure 1, item 6) into pinion bearing housing (Figure 1, item 2). Snap ring into groove.
13. Lubricate inside and outside diameters of new pinion oil seal (Figure 1, item 7) with CAT PUMP oil, or equal.
14. Place pinion oil seal (Figure 1, item 7) at mouth of pinion bearing housing (Figure 1, item 2).

CAUTION

Keep seal square in position to avoid inner lip hanging up on pinion gear edge.

15. Carefully press pinion oil seal (Figure 1, item 7) into position until seated on retaining ring (Figure 1, item 5 and 6).
16. Rotate pinion gear (Figure 1, item 3) so keyway is up.
17. Mount assembled gearbox housing (Figure 1, item 2) onto plunger pump (Figure 1, item 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 (Figure 1, item 20) with washers (Figure 1, item 19, 18) to fasten gearbox (Figure 1, item 1) to plunger pump (Figure 1, item 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 (Figure 1, item 13).
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 (Figure 1, item 9) onto engine shaft until flush with diesel engine face.
5. Install four hex head screws (Figure 1, item 10), flat washers (Figure 1, item 11), and lock washers (Figure 1, item 12) through gearbox (Figure 1, item 9) housing into engine mounting flange.
6. Torque screws 110 inch-pounds (12.3 N m).

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
HIGH-PRESSURE PUMP MODULE
JUNCTION BOX
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Shop Equipment, Automotive Vehicle (WP 0137, Table 2, Item 4)

Materials/Parts
Box assembly, junction, (PN 12489052)
Block, terminal, 15-circuit, (PN 12511457)

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 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 (4) screws from junction box cover. Remove cover. Refer to Figure 1.
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 (Figure 2, item 6).

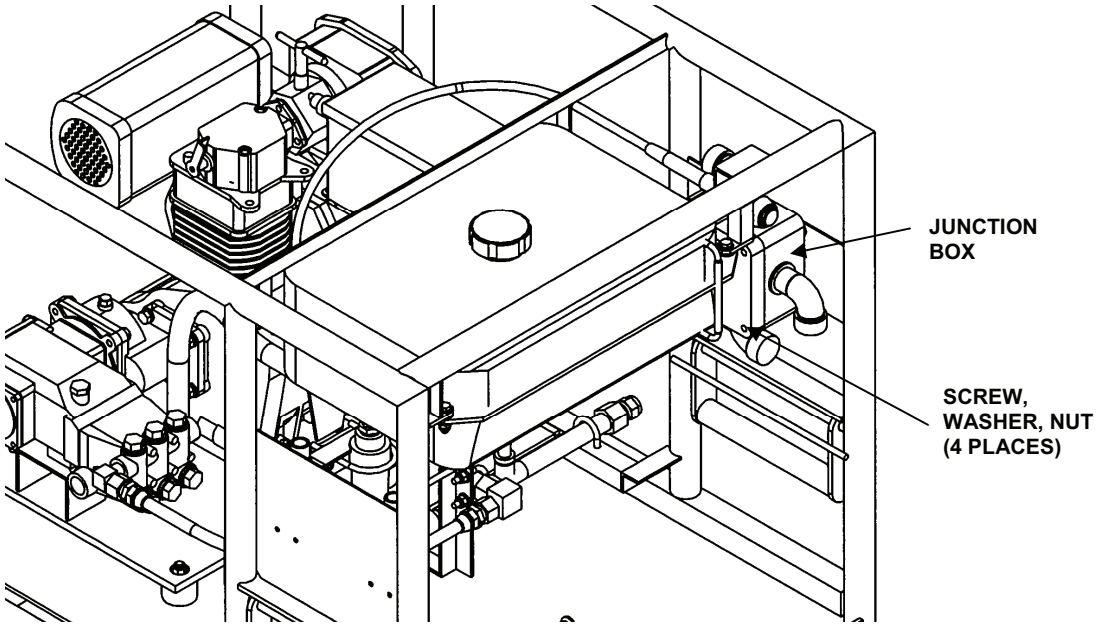


Figure 1. HP Module Junction Box Location.

REMOVAL – continued

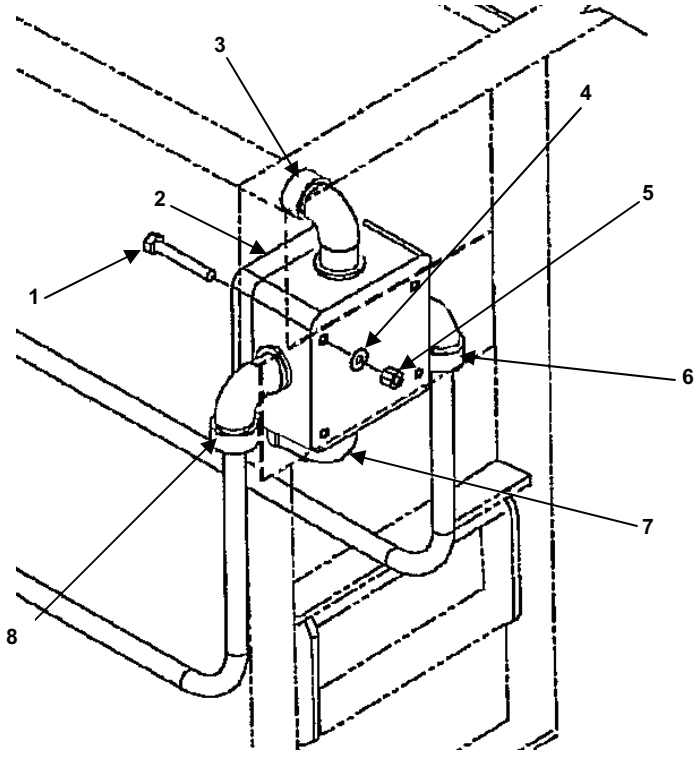


Figure 2. HP Module Junction Box Assembly.

5. Remove low-pressure switch conduit from hub (Figure 2, item 3).
6. Remove emergency shutoff switch conduit from hub (Figure 2, item 7).
7. Remove control panel cable from hub (Figure 2, item 8).
8. Remove four (4) screws (Figure 2, item 1), nuts (Figure 2, item 5), and washers (Figure 2, item 4) from junction box (Figure 2, item 2).
9. Remove end stops on the mounting rail and pry off the terminal block from the mounting rail. See Figure 3.

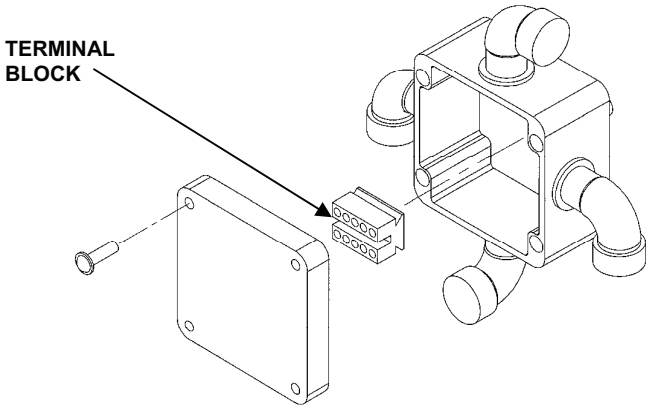


Figure 3. Terminal Block.

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 (4)ea 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 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.

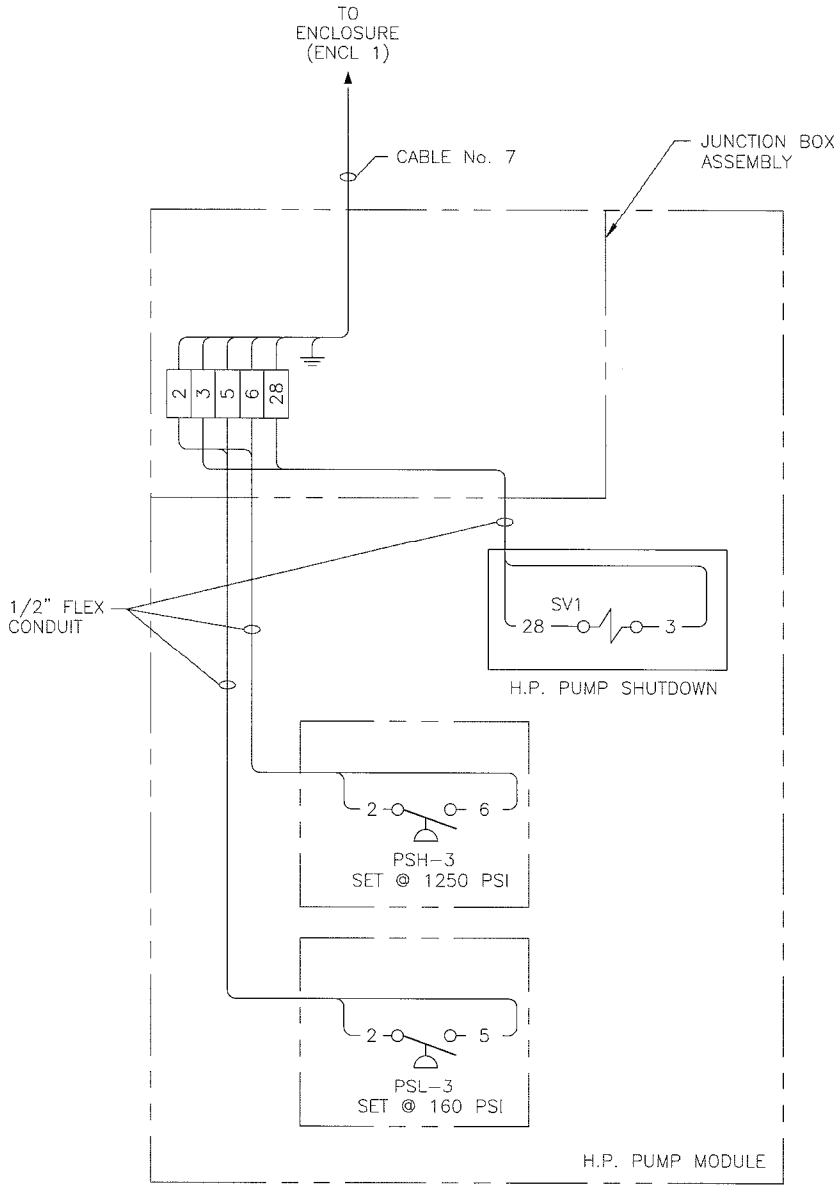


Figure 4. HP Module Wiring Diagram.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
REVERSE OSMOSIS ELEMENT MODULE
NEEDLE VALVE ASSEMBLY
DISASSEMBLY/REPAIR/ASSEMBLY

INITIAL SETUP

Tools
Shop Equipment, Automotive Vehicle (WP 0137, Table 2, Item 4)
Vise, bench mounted
Wrench, strap (WP 0138, Item 63)
Removal/installation tool, valve seat

Materials/Parts
Seat, needle valve, (PN 12511387)
O-rings, (PN 80014, 80011, 80110, 80131)
Compound, O-ring, lubricant (WP 0139, Item 15)

General Safety Instructions
Observe all CAUTIONS.

Equipment Condition Required
All equipment shut down.
Circuit breaker (CB1) in OFF position.

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 (Figure 1, item 2) and washer (Figure 1, item 3) from handle (Figure 1, item 4).

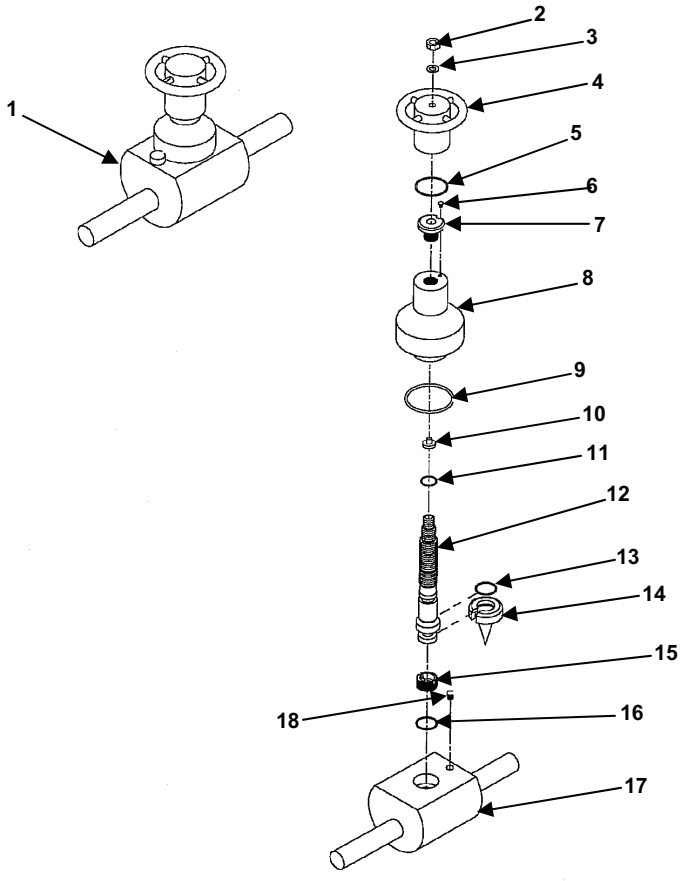


Figure 1. Reject Control Needle Valve.

DISASSEMBLY - continued

2. Remove capscrew (Figure 1, item 18) from body (Figure 1, item 17) on 0.5-inch needle valve (Figure 1, item 1).
3. Use strap wrench to remove bonnet (Figure 1, item 8) from body (Figure 1, item 17).
4. Remove O-ring (Figure 1, item 9) from bonnet (Figure 1, item 8).
5. Remove O-ring (Figure 1, item 5) from base of handle (Figure 1, item 4). Discard o-ring.
6. Remove capscrew (Figure 1, item 6) from stem nut (Figure 1, item 7).
7. Remove stem nut (Figure 1, item 7) from bonnet (Figure 1, item 8).
8. Remove needle (Figure 1, item 14) from stem (Figure 1, item 12) and body (Figure 1, item 17).
9. Remove stem (Figure 1, item 12) from bonnet (Figure 1, item 8).
10. Remove backup ring (Figure 1, item 10) and O-ring (Figure 1, item 11) from stem (Figure 1, item 12).
11. Remove seat (Figure 1, item 15) from body (Figure 1, item 17) if necessary with a seat removal tool.
12. Remove O-ring (Figure 1, item 16) from seat (Figure 1, item 15) if necessary.

REPAIR

1. Inspect the tip of the stem (Figure 1, item 12) for damage, burrs, or wear. Replace if damaged.
2. Inspect the seat (Figure 1, item 15) for damage, burrs, or wear. Replace if damaged.
3. Replace all damaged parts as necessary.
4. Replace all O-rings (Figure 1, item 5, 9, 10, 11, 13, 16).

ASSEMBLY

1. Lubricate O-rings (Figure 1, item 5, 9, 10, 11, 13, 16) with silicone lubricant.
2. Install new O-ring (Figure 1, item 16) on seat (Figure 1, item 15).
3. Install seat (Figure 1, item 15) into body (Figure 1, item 17).
4. Install backup ring (Figure 1, item 10) on stem (Figure 1, item 12).
5. Install new O-rings (Figure 1, item 9, 13) on stem (Figure 1, item 12).
6. Insert stem (Figure 1, item 12) into bonnet (Figure 1, item 8).
7. Install stem nut (Figure 1, item 7) on stem (Figure 1, item 12). Insert into bonnet (Figure 1, item 8). Tighten securely.
8. Install capscrew (Figure 1, item 6) to secure stem nut (Figure 1, item 7) to bonnet (Figure 1, item 8).
9. Install O-ring (Figure 1, item 9) on bonnet (Figure 1, item 8).
10. Install bonnet (Figure 1, item 8) into body (Figure 1, item 17). Tighten securely.
11. Install locking capscrew (Figure 1, item 18) into body (Figure 1, item 17) to secure bonnet (Figure 1, item 8).
12. Install O-ring (Figure 1, item 5) onto handle (Figure 1, item 4).
13. Install hex head nut (Figure 1, item 2) and flat washer (Figure 1, item 3) on handle (Figure 1, item 4). Tighten securely.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SERVICE PUMP
DISASSEMBLY/REPAIR/ASSEMBLY

INITIAL SETUP

Tools
Shop Equipment, Automotive Vehicle (WP 0137, Table 2, Item 4)

Materials/Parts
O-rings, (PN 00ID6875, 00ID6873, 00ID6874, 00ID9917, 00ID9928)
Compound, O-ring lubricant (WP 0139, Item 15)

General Safety Instructions
Observe all CAUTIONS.

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 0038) 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.

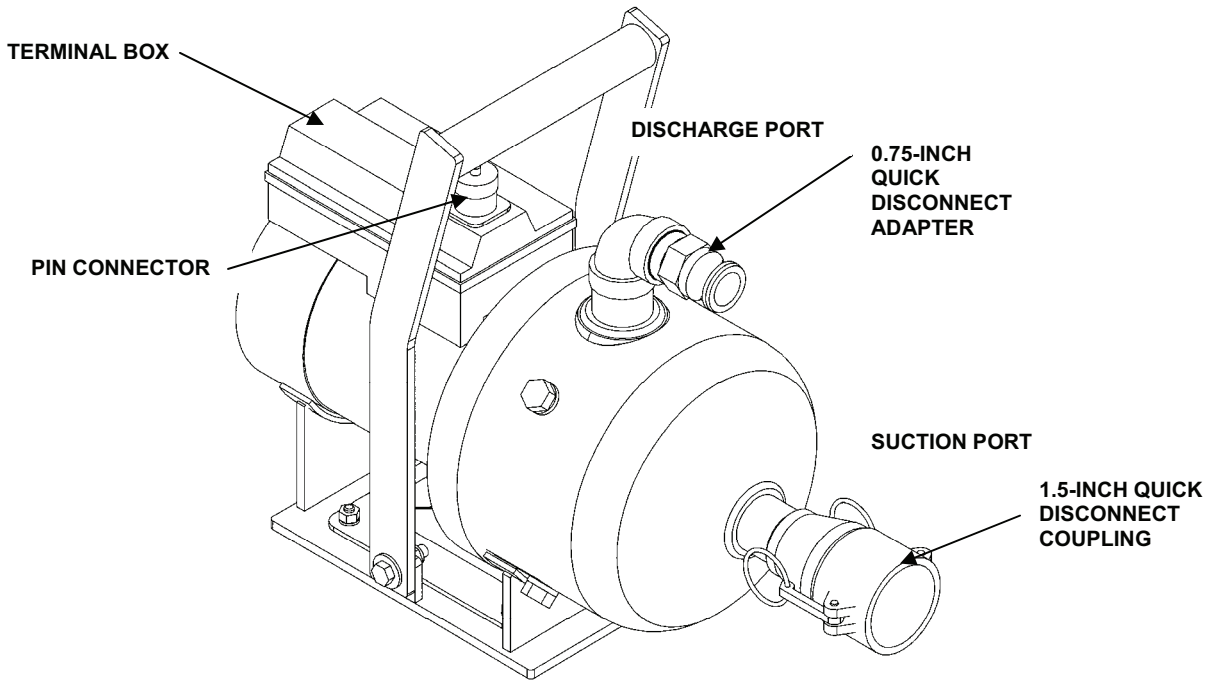


Figure 1. Raw Water Service Pump.

DISASSEMBLY - continued

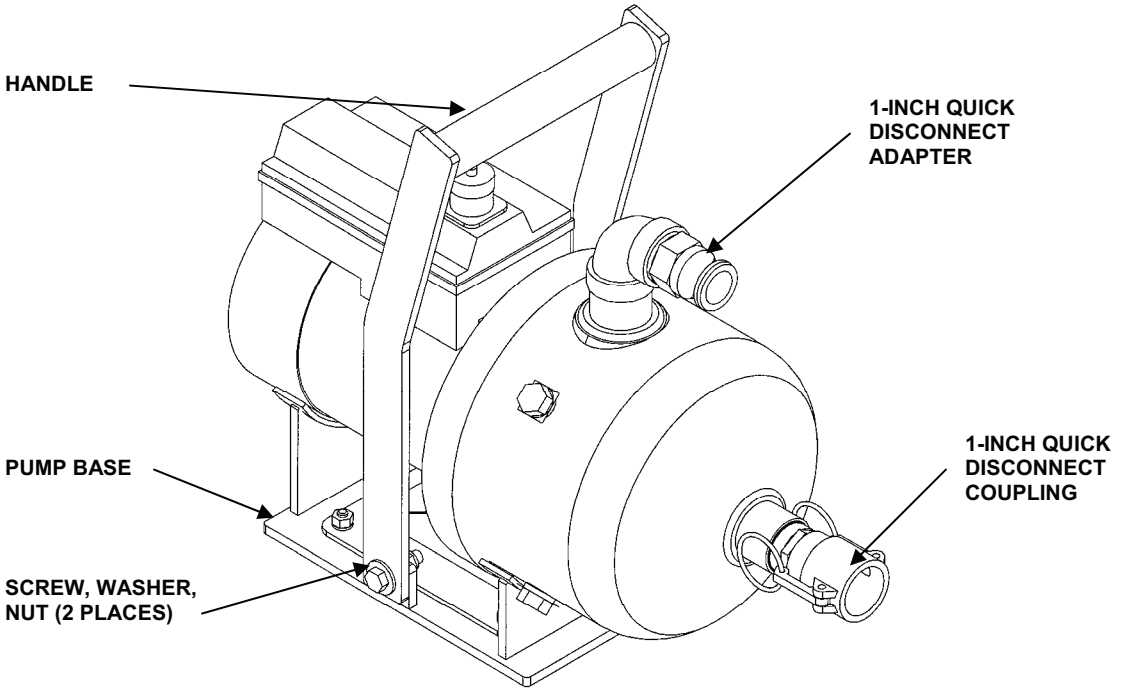


Figure 2. Distribution Service Pump.

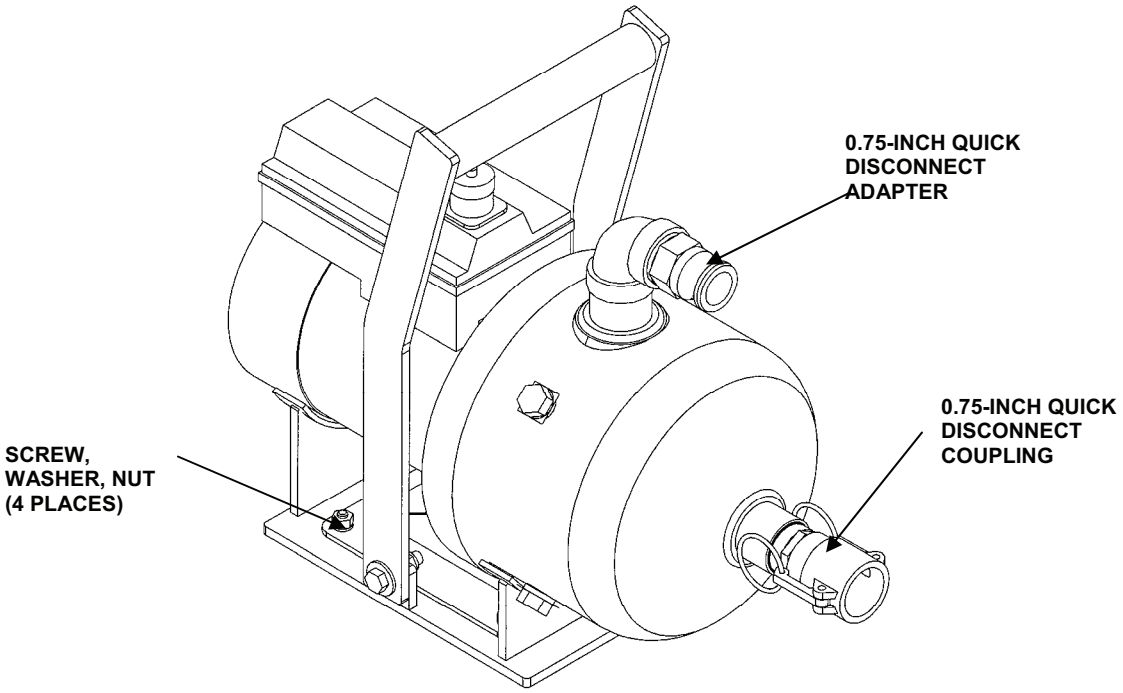


Figure 3. Booster and Backwash Service Pump.

2. Remove suction and discharge hose connections. See (WP 0116).
3. Remove the suction coupling and discharge adapter, if necessary. See (WP 0116).

DISASSEMBLY - continued

Pump

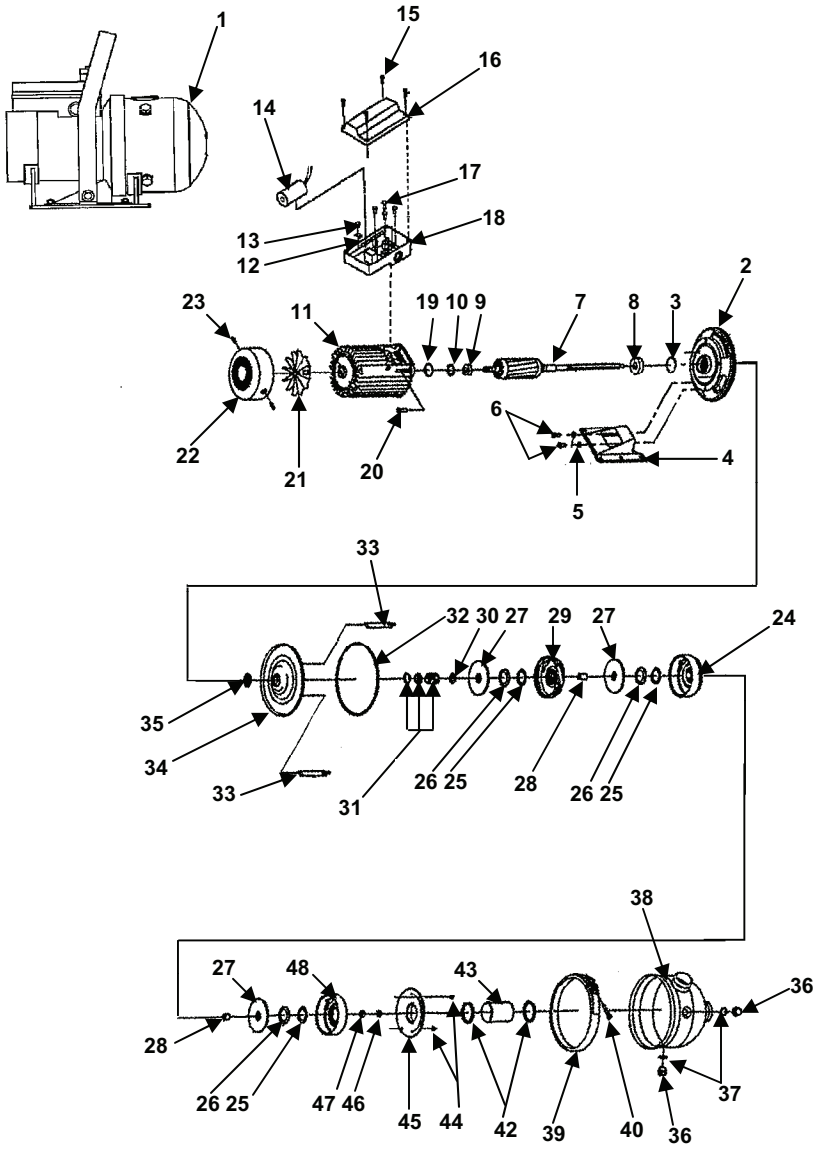


Figure 4. Service Pump (Exploded View)

1. Remove intermediate chamber (Figure 4, item 24), impeller, (Figure 4, item 27), and spacing pipe (Figure 4, item 28) from rotor (Figure 4, item 7) shaft.
2. Remove top intermediate chamber (Figure 4, item 29), impeller (Figure 4, item 27), and spacing pipe (Figure 4, item 28) from rotor (Figure 4, item 7) shaft.
3. Remove top intermediate chamber (Figure 4, item 29) by inserting a screwdriver in a slot on the side of top intermediate chamber (Figure 4, item 29).

DISASSEMBLY – continued

4. Remove top intermediate chamber (Figure 4, item 29) from the rotor (Figure 4, item 7) shaft by pushing the shaft of the screwdriver back against cover plate (Figure 4, item 34).
5. Remove rotating shaft seal (Figure 4, item 31) from the rotor (Figure 4, item 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 (Figure 4, item 32), cover plate (Figure 4, item 34), and diverting disc (Figure 4, item 35) from the rotor (Figure 4, item 7) shaft. Discard O-ring (Figure 4, item 32).

Neck Ring

1. Position the special puller on neck ring (Figure 4, item 25).
2. Free neck ring (Figure 4, item 25) by pushing the retainer (Figure 4, item 26) free of the intermediate chamber/suction interconnector.
3. Remove neck ring (Figure 4, item 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 (Figure 4, item 31) part way out of the cover plate (Figure 4, item 34) from the motor side.

Spacing Pipe

1. Remove the spacing pipe (Figure 4, item 43).
2. Remove two O-rings (Figure 4, item 42) from pump sleeve (Figure 4, item 38) and suction interconnector (Figure 4, item 45). Discard O-rings (Figure 4, item 42).

Stator with Housing

1. Remove screws (Figure 4, item 20).
2. Loosen the stator with housing (Figure 4, item 11) with a light blow from a rubber mallet.
3. Remove stator with housing (Figure 4, item 11) from the pump.
4. Determine if O-ring (Figure 4, item 10), capacitor, (Figure 4, item 14), terminal box cover with gasket (Figure 4, item 16), terminal box with gasket (Figure 4, item 18), four screws (Figure 4, item 15), screw (Figure 4, item 13), square washer (Figure 4, item 12) and four terminal box screws (Figure 4, item 17) require disassembly. Discard O-ring (Figure 4, item 10).
5. Observe for corrugated spring (Figure 4, item 19) if installed in this model.
6. Remove two screws (Figure 4, item 6) from base plate (Figure 4, item 4) and motor stool (Figure 4, item 2).
7. Remove base plate (Figure 4, item 4) from stator with housing (Figure 4, item 11). Retain plugs in motor stool (Figure 4, item 2).
8. Retain base plate (Figure 4, item 4) for assembly.
9. Remove O-ring (Figure 4, item 16) from motor stool (Figure 4, item 2). Discard O-ring (Figure 4, item 16).
10. Observe ball bearings (Figure 4, item 8, 9) and rotor (Figure 4, item 7) shaft for damage and discolor. Discard if defective.

ASSEMBLY

1. Always replace shaft locknut (Figure 4, item 31), and all O-rings (Figure 4, item 37, 42, 32, 3, 10)
2. Clean and inspect all parts. Replace possible defective parts.

Shaft Seal

1. Install shaft seal (Figure 4, item 31) on rotor (Figure 4, item 7) shaft.

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 (Figure 4, item 25) on intermediate chamber (Figure 4, item 24).
2. Insert neck ring (Figure 4, item 25) on suction interconnector (Figure 4, item 45).
3. Push seal ring retainer (Figure 4, item 26) over neck ring (Figure 4, item 25) so that it engages with intermediate chamber (Figure 4, item 24) and suction interconnector (Figure 4, item 45).
4. Make sure that it is possible to move neck ring (Figure 4, item 25) freely (sideways) between the seal ring retainer (Figure 4, item 26) and the intermediate chamber (Figure 4, item 24) and suction interconnector (Figure 4, item 45).

Stator with Housing

1. Position stator with housing (Figure 4, item 11) upright, with opening facing upward. The rotor/housing assembly (Figure 4, item 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 (Figure 4, item 2).
2. Press O-ring (Figure 4, item 24) into the recess of the stator. Install corrugated spring (Figure 4, item 19).
3. Slide the stator with housing (Figure 4, item 11) over rotor (Figure 4, item 7) shaft.
4. Position terminal box with gasket (Figure 4, item 18) relative to the discharge port before disassembly.
5. Install four screws (Figure 4, item 20) into stator with housing (Figure 4, item 11) and motor stool (Figure 4, item 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 (Figure 4, item 21) on the rotor (Figure 4, item 7) shaft.
7. Make sure fan (Figure 4, item 21) rotates freely.
8. Place the fan cover (Figure 4, item 22) on stator with housing (Figure 4, item 11). Align screw holes.
9. Install two cheese-head screws (Figure 4, item 23) through fan cover (Figure 4, item 22) into stator with housing (Figure 4, item 11). Tighten securely.
10. Install terminal box with gasket (Figure 4, item 18), if removed. Secure with four screws (Figure 4, item 17). Tighten securely.

Pump

1. Place the shaft holder in the vice. Tighten securely.
2. Place rotor (Figure 4, item 7) with pump shaft and ball bearings (Figure 4, item 8, 9) into motor with housing (Figure 4, item 11) if necessary.
3. Place the rotor (Figure 4, item 7) pump shaft in the shaft holder. Make sure are installed. Tighten securely.
4. Fit the diverting disc (Figure 4, item 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 (Figure 4, item 31) with water.
6. Press the shaft seal (Figure 4, item 31) into the cover plate (Figure 4, item 34), O-ring first.
7. If seal face is dirty, wipe with a clean, nonabrasive cloth, A-A-531
8. Press the cover plate (Figure 4, item 34) onto motor stool (Figure 4, item 2).
9. Install O-ring (Figure 4, item 32) onto cover plate (Figure 4, item 34).
10. Moisten rotating shaft seal (Figure 4, item 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 (Figure 4, item 29), impeller (Figure 4, item 27), and spacing pipe (Figure 4, item 28) onto rotor (Figure 4, item 7) shaft.
13. Install intermediate chamber (Figure 4, item 24), impeller, (Figure 4, item 27), and spacing pipe (Figure 4, item 28) onto top intermediate chamber (Figure 4, item 29).
14. Seat top intermediate chamber (Figure 4, item 29) onto cover plate (Figure 4, item 34).
15. Place intermediate chamber (Figure 4, item 24) onto top intermediate chamber (Figure 4, item 29).
16. Press intermediate chamber (Figure 4, item 24) with your hands until top intermediate chamber (Figure 4, item 29) snaps into place.
17. Install bottom intermediate chamber (Figure 4, item 48) and impeller (Figure 4, item 28) onto intermediate chamber (Figure 4, item 24).
18. Press bottom intermediate chamber (Figure 4, item 48) with your hands until intermediate chamber (Figure 4, item 24) snaps into place.
19. Lubricate locknut (Figure 4, item 47) threads with oil.
20. Install locknut (Figure 4, item 47) on end of rotor (Figure 4, item 7) shaft. Tighten locknut 10 to 12 N m (1, 0 – 1, 2 kpm).
21. Turn the suction interconnector (Figure 4, item 45) so that the holes for two straps (Figure 4, item 33) are aligned with the dogs/holes of cover plate (Figure 4, item 18).
22. Make sure two straps (Figure 4, item 33) contact the intermediate chamber (Figure 4, item 24) when it is attached to the holder of the cover plate (Figure 4, item 18) and the holes in suction interconnector (Figure 4, item 45).
23. Lubricate nut (Figure 4, item 44) threads with oil..
24. Install two (2) nuts (Figure 4, item 44) onto ends of straps (Figure 4, item 33). Tighten nuts 0,7 - 1,0 N m (7 to 10 kp cm).
25. Moisten two (2) O-rings (Figure 4, item 42) with water.
26. Install O-ring (Figure 4, item 42) in pump sleeve (Figure 4, item 38). Install O-ring (Figure 4, item 42) in suction interconnector (45).
27. Press spacing p Figure 4, item ipe (Figure 4, item 43) into suction interconnector (Figure 4, item 45).
28. Apply a light coat of valve lubricant and sealant, Dow Corning 111 compound, or equal, to the inside lip of pump sleeve (Figure 4, item 38) where O-ring (Figure 4, item 32) will seat.

CAUTION

Use care not to crimp the O-ring. Damage to part may result.

29. Align pump sleeve (Figure 4, item 38) edge evenly against O-ring (Figure 4, item 32).
30. Firmly press pump sleeve (Figure 4, item 38) until it snaps into position over O-ring (Figure 4, item 32) against motor stool (Figure 4, item 2).
31. Make sure the discharge port is in the same direction before disassembly, preferably up.

ASSEMBLY – continued

32. Install clamp (Figure 4, item 39) around pump sleeve (Figure 4, item 38) and motor stool (Figure 4, item 2). Secure with screw (Figure 4, item 40) and nut (Figure 4, item 41).
33. Remove the service pump from the shaft holder.
34. Make sure the rotor (Figure 4, item 7) shaft rotates freely.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CHEMICAL MODULE
JUNCTION BOX ASSEMBLY
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Shop Equipment, Automotive Vehicle (WP 0137, Table 2, Item 4)

Materials/Parts
Box assembly, junction, (PN 12489111)
Block, terminal, 15-circuit, (PN 12511463)

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.

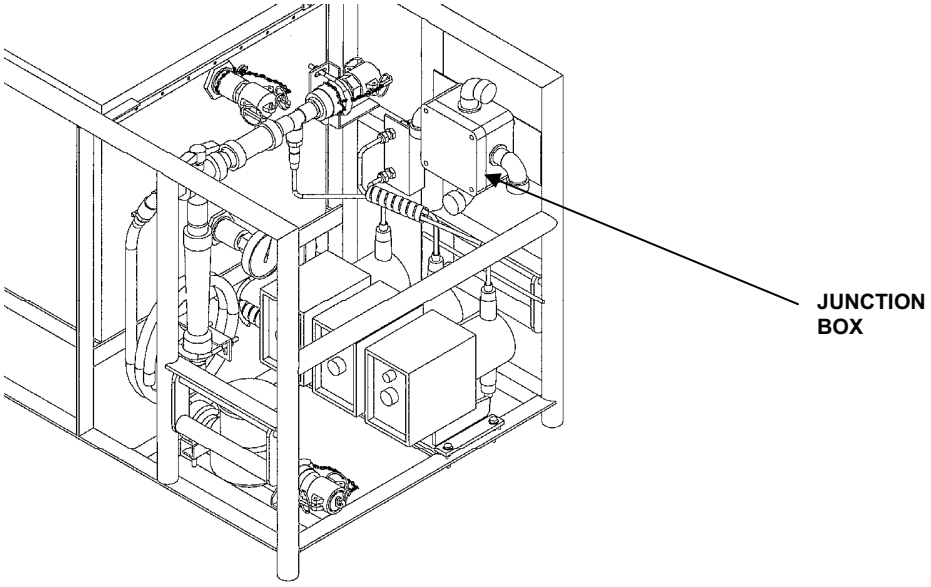


Figure 1. Chemical Module Junction Box Location.

REMOVAL - continued

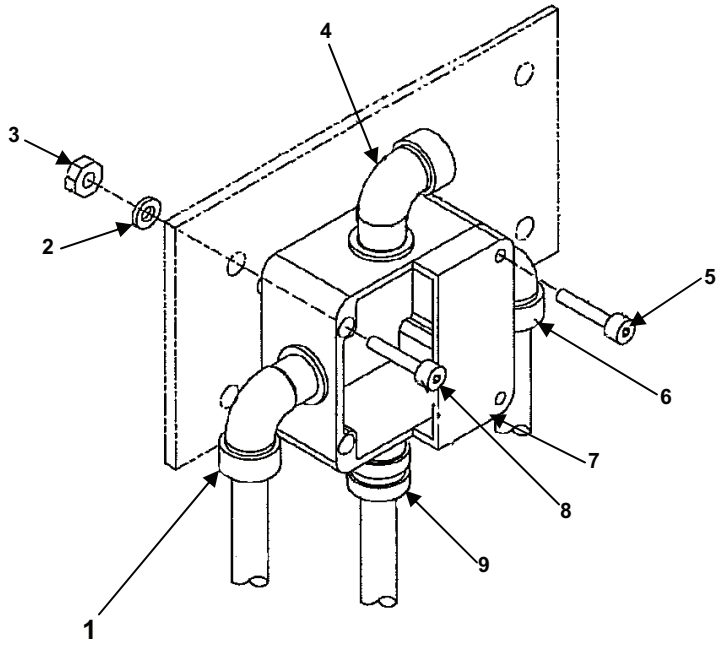


Figure 2. Chemical Module Junction Box Assembly.

1. Loosen four (4) screws (Figure 2, item 5) from the cover and remove the cover (Figure 2, item 7).
2. Remove 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 (Figure 2, item 1).
4. Remove control panel cable from hub (Figure 2, item 4).
5. Remove antiscalant pump conduit from hub (Figure 2, item 9).
6. Remove coagulant pump from hub (Figure 2, item 6).
7. Remove four (4) screws (Figure 2, item 8), nuts (Figure 2, item 3), and washers (Figure 2, item 2) from junction box. Remove the junction box.
8. Remove end stops from mounting rail. Pry off the terminal block from the mounting rail. See Figure 3.

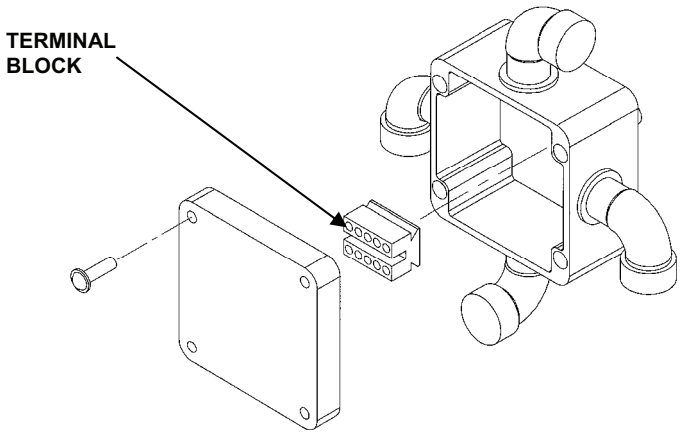


Figure 3. Terminal Block.

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 junction box assembly on module. Secure with four (4) 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 old wires. Refer to Figure 4.
5. Install cover on junction box assembly. Secure with four screws.

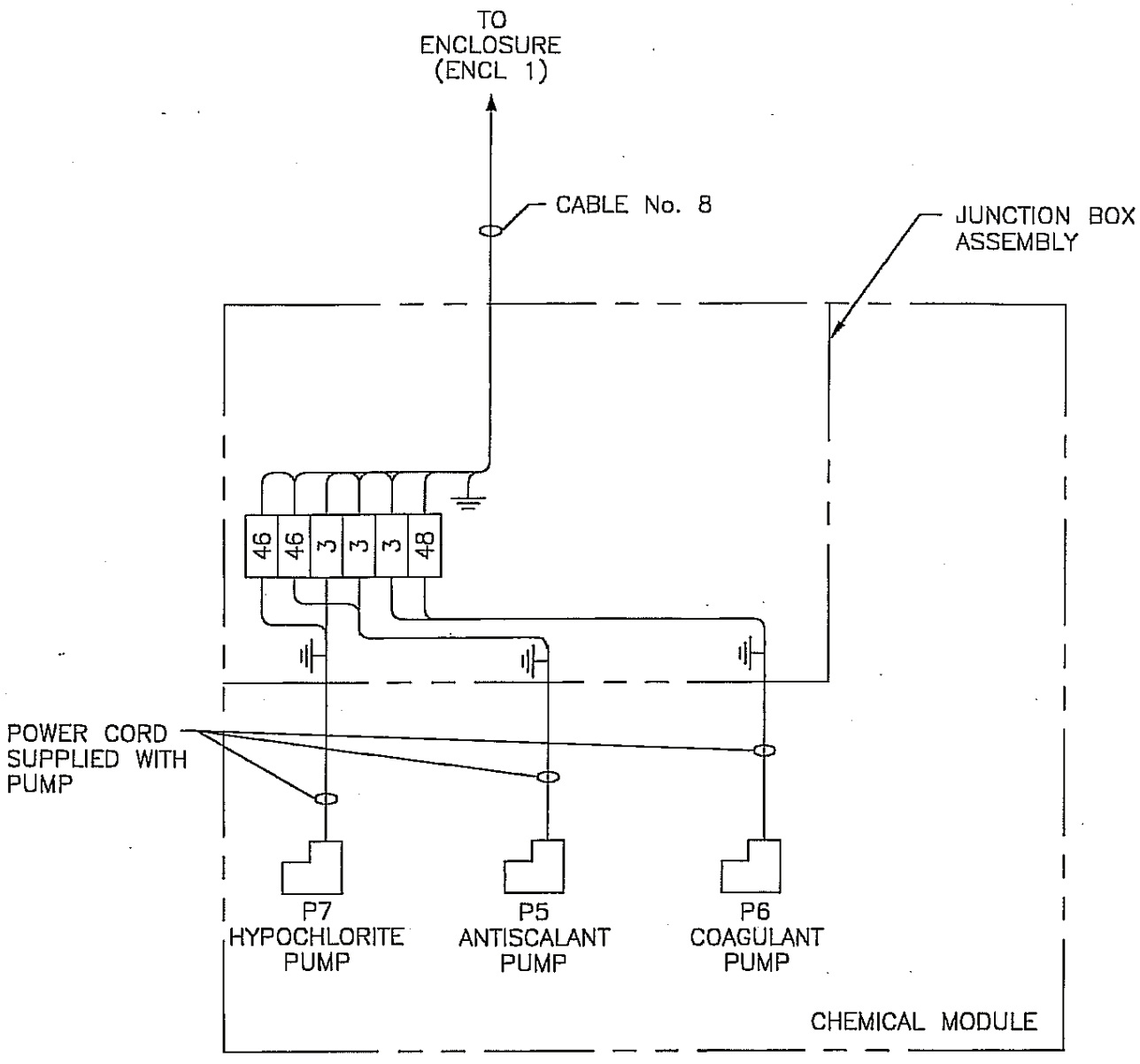


Figure 4. Chemical Module Wiring Diagram.

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
CONTROL MODULE
SURGE PROTECTOR (SP1)
REMOVAL/INSTALLATION

INITIAL SETUP

Tools
Shop Equipment, Automotive Vehicle (WP 0137, Table 2, Item 4)

Materials/Parts
Box assembly, junction, (PN 12489094)
Tie wraps, gray (WP 00139, Item 34)
Block, terminal, 15-circuit, (PN 12511463)

Equipment Condition Required
All equipment de-energized

GENERAL

This work package contains information and instructions for removal and installation of the surge protector (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 right of motor controller (M1). Make note of locations.
3. Remove all wire ties from the wires coming from the surge protector 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 protector connection with wire ties.

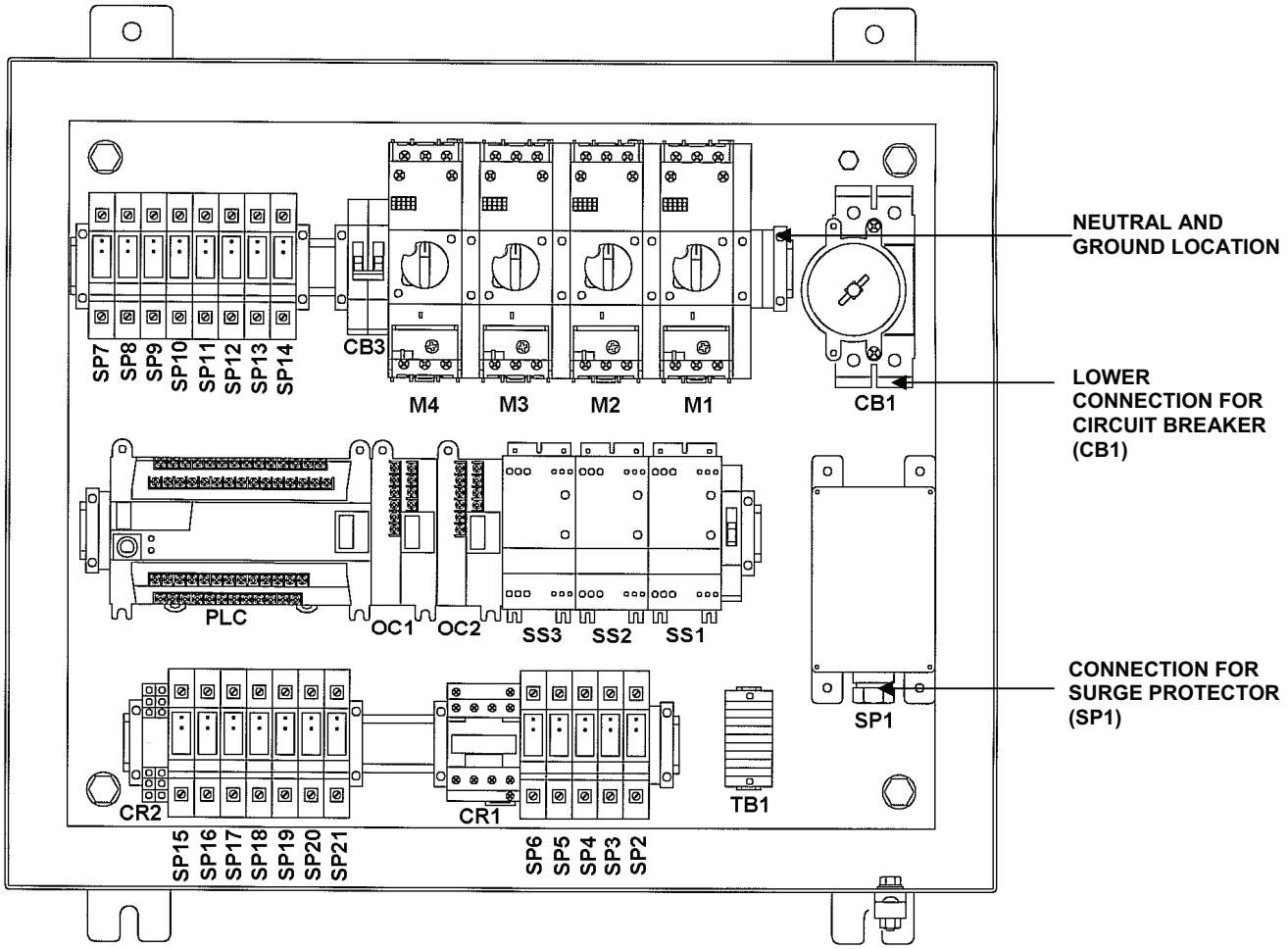


Figure 1. Control Module Diagram.

END OF WORK PACKAGE

CHAPTER 7
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
FM 55-80, Army Container Operation

FORMS

DA Form 2404, Maintenance Worksheet
DA Form 2408-9, Equipment Control Record
DD Form 836, Dangerous goods shipping Paper/Declaration and Emergency Response Information for Hazardous Materials Transport by Government Vehicles

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 10-4610-310-23P, Repair Parts and Special Tool Lists, Lightweight Water Purifier
TM 10-8340-211-13, Operator, Unit and Direct Support Maintenance Manual, General Purpose Tent
TM 38-250, Preparing Hazardous Materials for Military Air shipments-2001

MISCELLANEOUS PUBLICATIONS

DA PAM 750-8, The Army Maintenance Management System (TAMMS)
DOD 4500.9-R, Defense Transportation Regulation (DTR)
CFR 49, Transportation
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 AND FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
SUPPORTING INFORMATION
MAINTENANCE ALLOCATION CHART (MAC) INTRODUCTION

INTRODUCTION

The Army Maintenance System MAC

This introduction provides a general explanation of all maintenance and repair functions authorized at the two maintenance levels under the Two-Level Maintenance (TLM) System concept.

The MAC (immediately following the introduction) 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 levels, which are shown on the MAC in column (4) as:

Field - includes two subcolumns, Crew (C) and Maintainer (F).

Sustainment - includes two subcolumns, Below Depot (H) and Depot (D).

The maintenance to be performed at Field and Sustainment levels is described as follows:

1. Crew maintenance. The responsibility of a using organization to perform maintenance on its assigned equipment. It normally consists of inspecting, servicing, lubricating, adjusting, and replacing parts, minor assemblies, and subassemblies. The replace function for this level of maintenance is indicated by the letter “C” in the third position of the SMR code. A “C” appearing in the fourth position of the SMR code indicates complete repair is possible at the crew maintenance level.

2. Maintainer maintenance. Maintenance accomplished on a component, accessory, subassembly, plug-in unit, or other portion either on the system or after it is removed. The replace function for this level of maintenance is indicated by the letter “F” appearing in the third position of the SMR code. An “F” appearing in the fourth position of the SMR code indicates complete repair is possible at the field maintenance level. Items are returned to the user after maintenance is performed at this level.

3. Below depot Sustainment. Maintenance accomplished on a component, accessory, assembly, subassembly, plug-in unit, or other portion either on the system or after it is removed. The replace function for this level of maintenance is indicated by the letter “H” appearing in the third position of the SMR code. An “H” appearing in the fourth position of the SMR code indicates complete repair is possible at the below depot Sustainment maintenance level. Items returned to the supply system after maintenance is performed at this level.

4. Depot Sustainment. Maintenance accomplished on a component, accessory, assembly, subassembly, plug-in unit, or other portion either on the system or after it is removed. The replace function for this level of maintenance is indicated by the letter “D” or “K” appearing in the third position of the SMR code. Depot Sustainment maintenance can be performed by either depot personnel or contractor personnel. A “D” or “K” appearing in the fourth position of the SMR code indicates complete repair is possible at the depot Sustainment maintenance level. Items are returned to the supply systems after maintenance is performed at this level.

The tools and test equipment requirements table (immediately following the MAC) lists the tools and test equipment (both special tools and common tool sets) required for each maintenance function as referenced from the MAC.

The remarks table (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 gagings 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 the proper functioning of equipment or a system.

8. Paint (ammunition only). To prepare and spray color coats of paint so that the ammunition can be identified and protected. The color indication 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.

Services. 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 breakdown (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. That maintenance effort (service/action) prescribed to restore an item to a completely serviceable/operational condition as required by maintenance standards in appropriate technical publications. 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

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).

Column (2) — Component/Assembly. Column (2) contains the item names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

Column (3) — Maintenance Function. Column (3) lists the functions to be performed on the item listed in column (2). (For detailed explanation of these functions, refer to “Maintenance Functions” outlined above.)

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 time 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 Crew maintenance

F maintainer maintenance

Sustainment:

L Specialized Repair Activity (SRA)

H Below depot 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.

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.

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

Column (1) — Tools or Test Equipment Reference Code. The tools or test equipment reference code correlates with a code used in column (5) of the MAC.

Column (2) — Maintenance Level. The lowest level of maintenance authorized to use the tool or test equipment.

Column (3) — Nomenclature. Name or identification of the tool or test equipment.

Column (4) — National Stock Number (NSN). The NSN of the tool or test equipment.

Column (5) — Tool Number. The manufacturer's part number.

Explanation of Columns in the Remarks

Column (1) — Remarks Code. The code recorded in column (6) of the MAC.

Column (2) — Remarks. This column lists information pertinent to the maintenance function being performed as indicated in the MAC.

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
MAINTENANCE ALLOCATION CHART (MAC) TABLES

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER.

(1)	(2)	(3)	(4) MAINTENANCE LEVEL				(5)	(6)
			FIELD		SUSTAINMENT			
GROUP NUMBER	COMPONENT/ ASSEMBLY	MAINTENANCE FUNCTION	CREW	MAINTAINER	BELOW DEPOT	DEPOT	TOOLS AND EQUIPMENT REFERENCE CODE	REMARKS CODE
			C	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	
		Removal/Install		0.5				
		Repair		1.0				
01010101	Assembly, Block, Cylinder	Inspect	0.1	0.1				A
		Removal/Install		1.1				
		Repair		2.8			1,2,3,4	E
0101010101	Assembly, Piston	Inspect		0.5			3,4	A
		Removal/Install		1.5			3,4	
		Repair		0.5			3,4	E
0101010102	Cylinder Head and Bonnet	Inspect		0.5				A
		Adjust		0.5			1,2	A
		Removal/Install		2.0			3,4	
		Repair		2.0			3,4	E
01010103	Assembly, Valve, Emergency Shut-Off	Inspect	0.1	0.1				
		Repair		0.5			1,2	
		Removal/Install		0.5			1,2	
		Replace		0.5			1,2	

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
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				
		Removal/Install		1.0			3,4	
		Replace		1.0			3,4	
01010106	Assembly, Pump, Fuel Injection	Inspect		0.2			3,4	
		Removal/Install		0.8			3,4	E
		Repair		1.0				
01010107	Assembly, Muffler	Inspect	0.1	0.1				
		Removal/Install		0.2			1,2	
		Replace		0.2			1,2	
010102	Mounting Plate, HP Pump	Inspect	0.1	0.1				A
		Replace		1.0			1,2	
0102	Reserved							
0103	Assembly, HP Pump w/ Associated Hardware	Inspect	0.2					A
		Service	0.1	0.4				A
		Removal/Install		1.3			1,2	
		Replace		1.3			1,2	
010301	Pump, Plunger	Inspect		0.1				
		Repair		2.0			3,4	D
		Removal/Install		1.0			1,2	
		Replace		1.0			1,2	
010302	Gearbox, HP Pump	Inspect		0.2				
		Repair		1.2			3,4	A, D, E
		Replace		1.0			3,4	
0104	Spool Piece, Suction, HP Pump	Inspect	0.1	0.1				
		Replace		1.0			1,2	
		Repair		0.3			3,4	

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
0105	Spool Piece, Discharge, HP Pump	Inspect	0.1	0.1				A
		Replace		1.0			1,2	
		Repair		0.1			3,4	
010501	Dampener, Pulsation	Inspect	0.1	0.1				
		Replace		0.3			1,2	
010502	Disc, Rupture	Inspect	0.1	0.1				
		Replace		0.3			1,2	
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	Assy., Elect., HP Module	Inspect	0.1	0.1				
		Repair		1.0			1,2	
010701	Box, Junction, HP Pump	Inspect	0.1	0.1				
		Repair		1.0			1,2	
		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	
020101	Valve, 3-way Ball (Qty 7)	Inspect	0.1	0.1			2	
		Replace		0.2				

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
020102	Disc, Rupture	Inspect	0.1	0.1				A
		Replace	0.2				2	
0202	Piping, Reject, RO Element	Inspect	0.1	0.1				
		Replace		0.5			2	
0203	Vessels, RO Pressure	Inspect	0.2	0.2				
		Replace		2.0				
0204	Element, RO	Inspect	0.1				5	
		Replace	2.0					
03	Module, Ultrafiltration	Inspect	0.2	0.2				A
0301	Frame, Module, Ultrafiltration	Inspect	0.1	0.1				
		Repair		0.5				
		Replace		1.0			1,2	
0302	Assembly, UF Vessel (Qty 3)	Inspect	0.1	0.1				A
		Repair		0.5				E
		Replace		1.0			1,2	
0303	Assembly, Electrical	Inspect	0.1	0.2				
		Repair		0.5			3,4	
030301	Box, Junction	Inspect	0.1	0.2				
		Replace		0.5			3,4	
030302	Assembly, Cable	Inspect	0.1	0.2				B,C
		Replace		0.5			3,4	
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				
		Replace		0.5				A
030504	Switch, Level	Inspect	0.1	0.1				
		Replace		0.3				

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
0306	Piping, UF Feed	Inspect Repair	0.1	0.1 0.3				A
0307	Piping, UF Filtrate to Tank	Inspect Replace	0.1	0.1 0.5				A
030701	Solenoid Valves	Inspect Repair Replace	0.1	0.2 1.0 0.5				A E
0308	Piping, UF Filtrate/ Backwash	Inspect Replace	0.1	0.1 0.5				A
0309	Piping, UF Reject	Inspect Replace	0.1	0.1 0.5				A
030901	Solenoid Valves	Inspect Repair Replace	0.1	0.2 1.0 0.5				A E
0310	Piping, Manifold, UF Fast Flush	Inspect Replace	0.1	0.2 0.5				A
031001	Solenoid Valves	Inspect Repair Replace	0.1	0.2 1.0 0.5				A E
0311	Piping, Vent, UF Tank	Inspect Replace	0.1	0.1 0.3				A
0312	Piping, Drain, UF Vessel	Inspect Repair	0.1	0.1 0.3				A
04	Module, Chemical Inj./ Cleaning	Inspect	0.3					A
0401	Spool Piece, Product Piping	Inspect Repair	0.1	0.1 1.0				A
040101	Totalizer	Inspect Replace	0.1	0.1 0.4				
040102	Meter, Flow	Inspect Replace	0.1	0.1 0.4				
0402	Spool Piece, Tank Outlet	Inspect Repair	0.1	0.1 1.0				
040201	Valve, Ball, Cleaning Outlet	Inspect Replace	0.1	0.1 0.3				A

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
040202	Strainer	Inspect	0.1	0.1				A
		Replace		0.2				
0403	Assy.., Module, Chemical Inj./Cleaning	Inspect	0.1	0.2				A
		Repair		2.0				
0404	Assy., Pump, Chemical Injection	Inspect	0.2	0.2				
		Service		1.2			1,2	A
		Repair		1.2			1,2	
		Adjust		0.5				
		Replace		0.8			1,2	
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	
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	0.2				
		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							

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	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	0.4				
		Repair		2.5			3,4	
		Replace		.02				
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				
0702	Meter, Turbidity	Inspect	0.1	0.1				
		Repair		0.1				
08	Assemblies, Hose							
0801	Assembly, Hose, Raw Water	Inspect	0.1	0.1				
		Replace		0.2				
080101	Suction Hose, Raw Water	Inspect	0.1	0.1				
		Replace		0.2				
080102	Discharge Hose, Raw Water	Inspect	0.1	0.1				
		Replace		0.2				
0802	Assembly, Hose, Booster Pump	Inspect	0.1	0.1				
		Replace		0.2				
080201	Suction Hose, Booster Pump	Inspect	0.1	0.1				
		Replace		0.2				

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
080202	Discharge Hose, Booster Pump	Inspect	0.1	0.1				
		Replace		0.2				
0803	Assy., Hose, Backwash Pump	Inspect	0.1	0.1				
		Replace		0.2				
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				
0807	Assembly, Hose, Chemical Skid	Inspect	0.1	0.1				
		Replace						
		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	

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
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				
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				
11	Kit, Cold Weather	Inspect	0.2	0.2				A
		Repair		0.5				A
		Replace		0.2				

Table 1. MAC for LIGHTWEIGHT WATER PURIFIER. Cont'd

(1) GROUP NUMBER	(2) COMPONENT/ ASSEMBLY	(3) MAINTENANCE FUNCTION	(4) MAINTENANCE LEVEL				(5) TOOLS AND EQUIPMENT REFERENCE CODE	(6) REMARKS CODE
			FIELD		SUSTAINMENT			
			CREW	MAINTAINER	BELOW DEPOT	DEPOT		
			C	F	H	D		
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 for the Lightweight Water Purifier.

TOOLS OR TEST EQUIPMENT REF. CODE	MAINTENANCE LEVEL	NOMENCLATURE	NATIONAL STOCK NUMBER (NSN)	TOOL NUMBER
1	F	Shop Equipment, Automotive Maintenance and Repair	4910-00-754-0654	SC4910-95-CL-A74
2	F	Tool Kit, General Mechanics Automotive	5180-00-177-7033	SC5180-90-CL-N26
3	F	Tool Kit, General Mechanics	5180-00-699-5273	SC5180-90-CL-N05
4	F	Shop Equipment, Automotive Vehicle	4910-00-754-0705	SC4910-95-CL-A31
5	F	Tool, End Cap Removal	5120-01527-9172	

Table 3. Remark Codes for the Lightweight Water Purifier.

REMARKS 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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
COMPONENTS OF END ITEM (COEI) AND BASIC ISSUE ITEM (BII) LISTS

INTRODUCTION

Scope

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.

General

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, to 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.

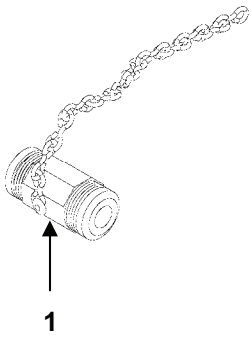
Column (3), Description, CAGEC and part number, identifies the Federal item name (in capital letters) followed by a minimum description when needed. The stowage location of COEI and BII is also included in this column. The last line below the description is the CAGEC (commercial and Government entity code) (in parentheses)and the part number.

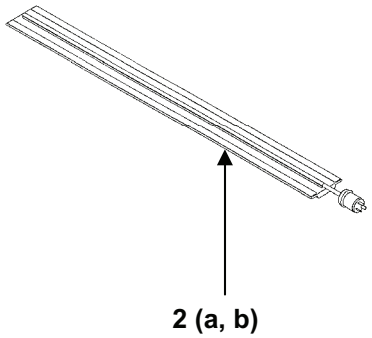
Column (4), Useable on Code, gives you a code if the item you need is not the same for different models of equipment. These codes are identified below:

Code	Used on
None	None

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, indicates the quantity required.





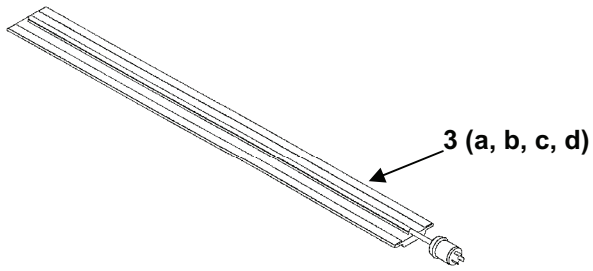


Table 1. Components of End Item.

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
1	4730-01-527-7638	ADAPTER, ASSY, UNION, 00.750”-16MPT, 316SST 12497049, (19207)		EA	1
2 (a)	4520-01-527-6305	BLANKET, THERMAL, 10 FT 12511618-1(19207)		EA	3
2 (b)	4520-01-527-6307	BLANKET, THERMAL, 10 FT 12511618-4(19207)		EA	1
3 (a)	4520-01-527-6316	BLANKET, THERMAL, 20 FT 12511618-2(19207)		EA	3
3 (b)	4520-01-527-6323	BLANKET, THERMAL, 20 FT 12511618-3(19207)		EA	3
3 (c)	4520-01-527-6464	BLANKET, THERMAL, 20 FT 12511618-5(19207)		EA	1
3 (d)	4520-01-527-6466	BLANKET, THERMAL, 20 FT 12511618-6(19207)		EA	1

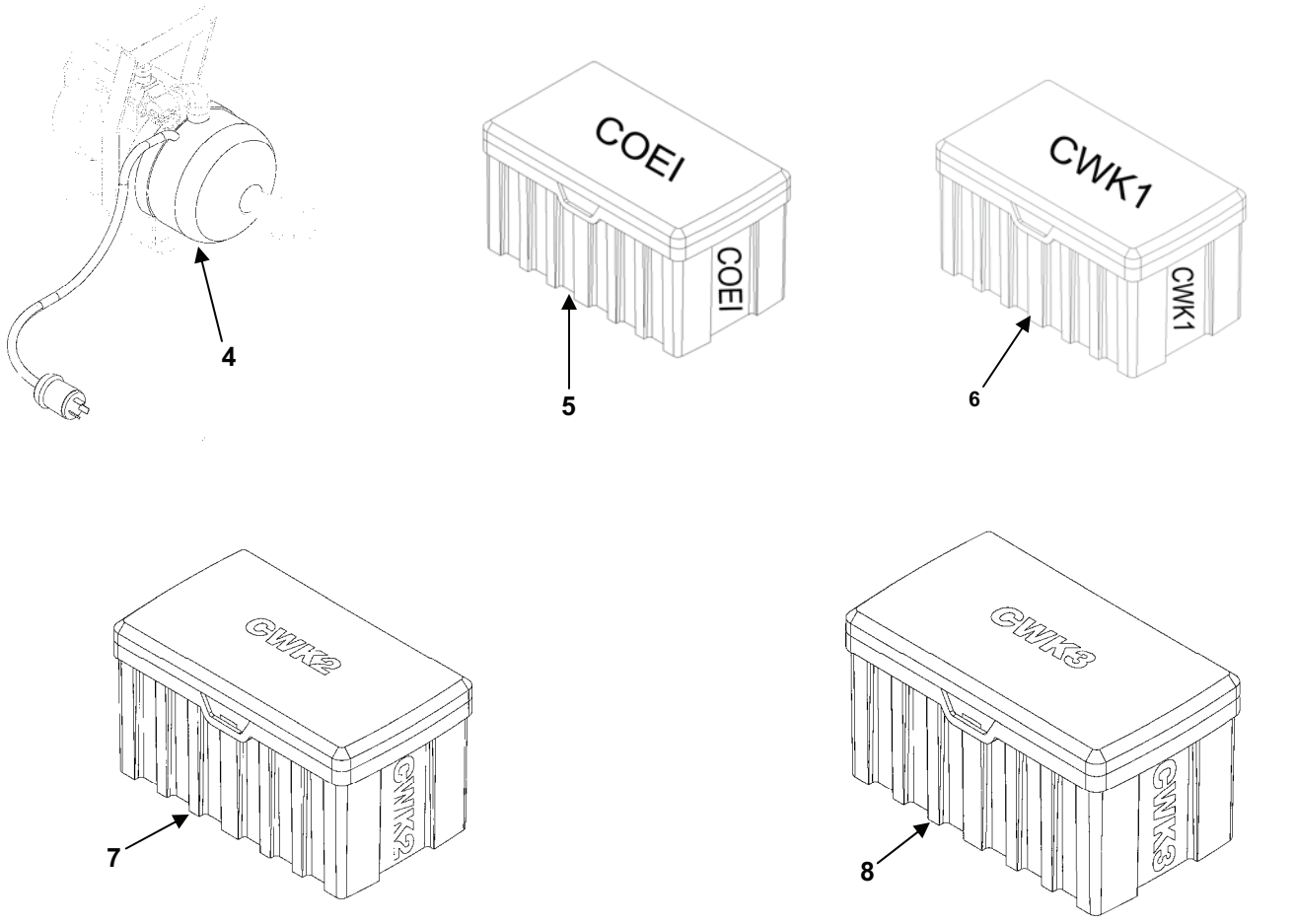
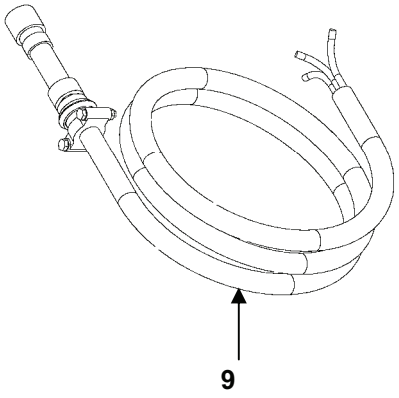
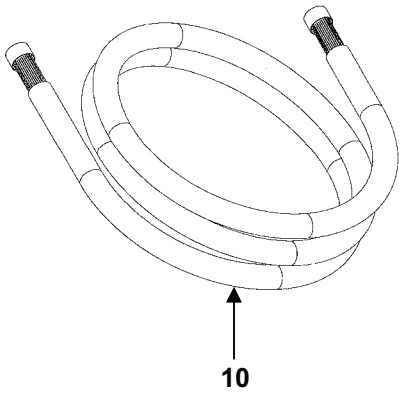


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
4	5640-01-527-4925	BLANKET, PUMP 12489126(19207)		EA	1
5	2540-01-527-6517	BOX, STORAGE, COEI 12497055(19207)		EA	1
6	2540-01-527-6533	BOX, STORAGE, CWK 1 12497062(19207)		EA	1
7	2540-01-527-0324	BOX, STORAGE, CWK 2 12497063(19207)		EA	1
8	2540-01-527-0321	BOX, STORAGE, CWK 3 12497064(19207)		EA	1





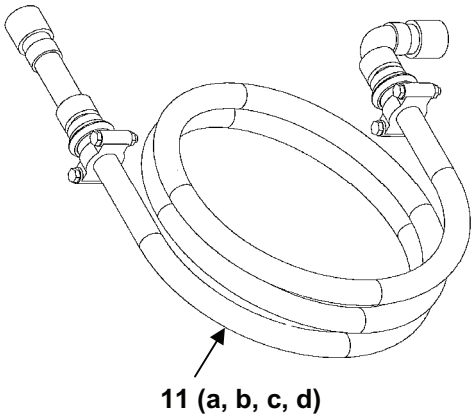


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
9	6150-01-526-8335	CABLE 1, 40 ft. (POWER) 12497072(19207)		EA	1
10	6150-01-526-8339	CABLE 11, 40 ft. (GROUND) 12497077(19207)		EA	1
11a	6150-01-526-8334	CABLE 2 (BLUE) 100 ft. (raw water pump) 12497073-1(19207)		EA	1
11b	6150-01-526-8336	CABLE 3 (GREEN) 50 ft. (booster pump) 12497073-2(19207)		EA	1
11c	6150-01-526-8337	CABLE 4 (YELLOW) 20 ft. (backwash) 12497073-3 (19207)		EA	1
11d	6150-01-526-8338	CABLE 5 (RED) 30 ft. (distribution pump) 12497073-4(19207)		EA	1

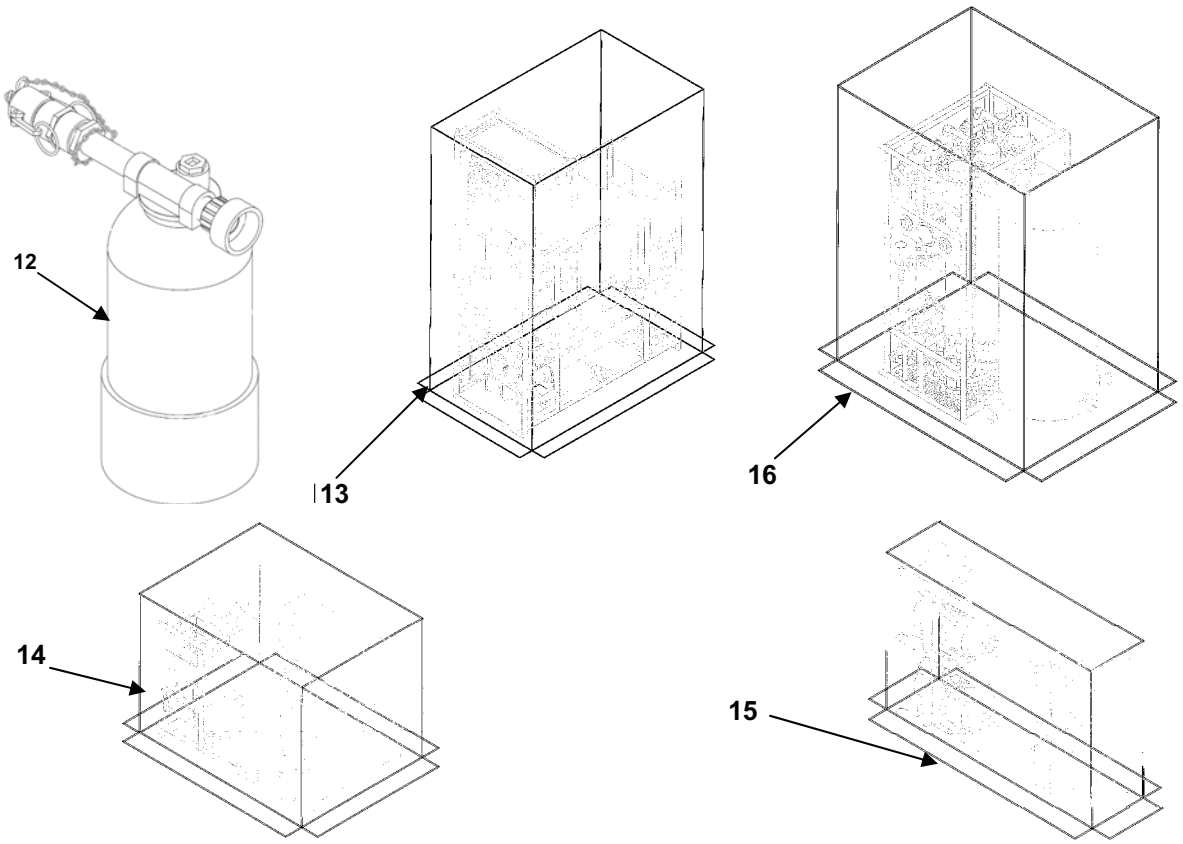


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
12	4610-01-526-8760	CARTRIDGE ASSY, NBC, CARBON,12490756 (19207)		EA	1
13	9390-01-527-6547	COVER, CONTAMINATION AVOIDANCE, CONTROL, RO, CHEMICAL 12497028-3(19207)		EA	1
14	9390-01-527-6573	COVER, CONTAMINATION AVOIDANCE, HP PUMP MODULE 12497028-2(19207)		EA	1
15	9390-01-527-6579	COVER, CONTAMINATION AVOIDANCE, SERVICE PUMP SKID 12497028-4(19207)		EA	1
16	9390-01-527-6582	COVER, CONTAMINATION AVOIDANCE, UF MODULE 12497028-1(19207)		EA	1

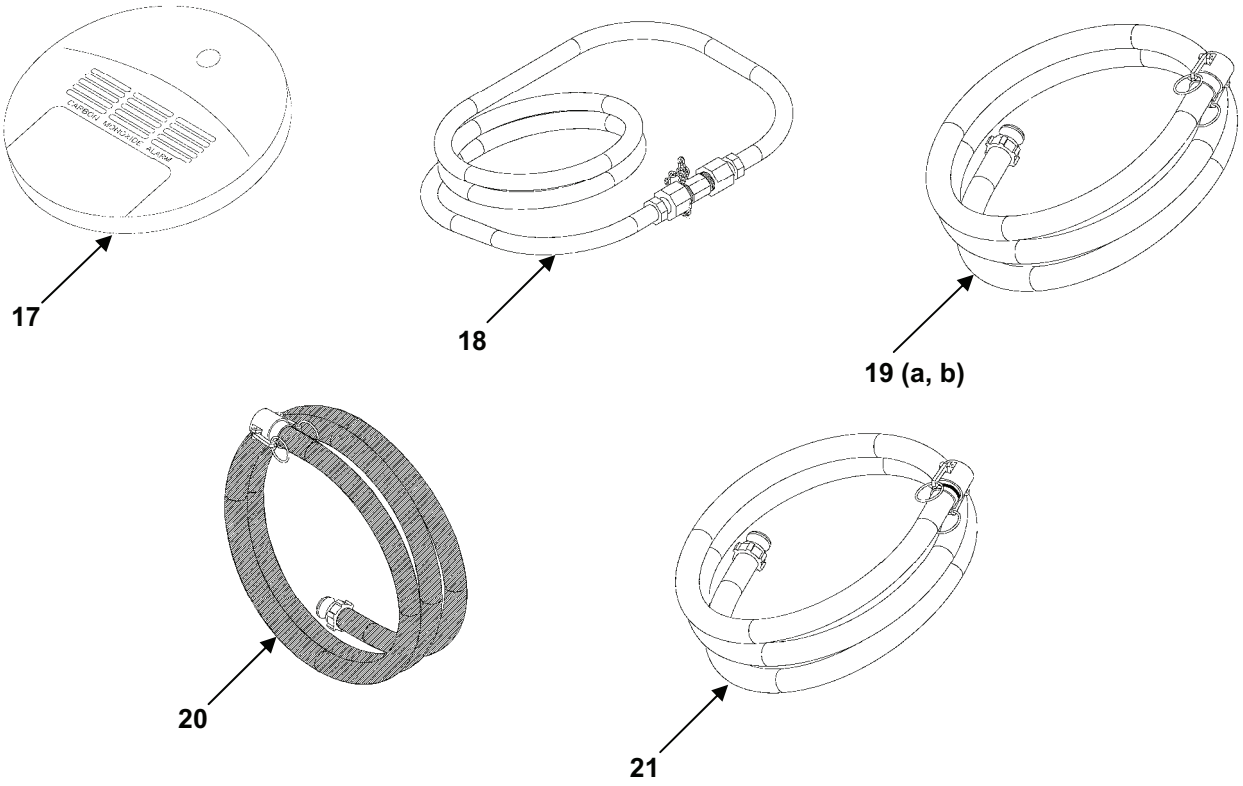


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
17	6665-01-527-7273	DETECTOR, CARBON MONOXIDE 12511559(19207)		EA	1
18	4720-01-527-4926	HOSE, HIGH PRESSURE 0.5” X 14’ 12497048 (19207)		EA	1
19a	4720-01-526-8345	HOSE ASSY, (YELLOW) (BACKWASH) 0.75” X 10’ 12512184(19207)		EA	2
19b	4720-01-526-8344	HOSE ASSY, (WHITE) (PRODUCT) 1” X 10’ 12512183(19207)		EA	3
20	4720-01-526-8343	HOSE, RUBBER (RED) (REJECT) 0.75” X 50’ 12512182(19207)		EA	2
21	4720-01-526-8342	HOSE ASSY, (GRAY) (RAW WATER) 1.5” X 25’ 12512181(19207)		EA	2

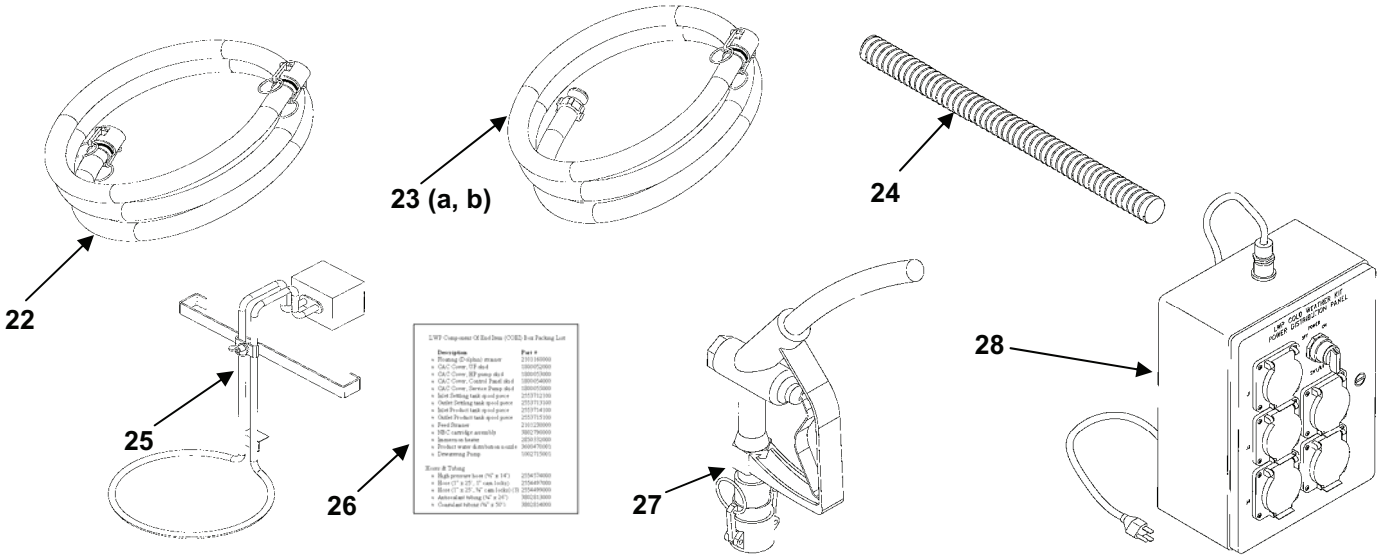


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
22	4720-01-526-8341	HOSE ASSY, (ORANGE) (HP FEED) 1” X 12’ 12512185(19207)		EA	1
23a	4720-01-527-1404	HOSE, FABRIC (BLUE) (DISTRIBUTION) 1” X 25’ 12497045-1(19207)		EA	1
23b	4720-01-527-1405	HOSE, FABRIC, (GREEN) (BOOSTER) 0.75” X 25’ 12497045-2(19207)		EA	3
24	4720-01-567-1009	HOSE ASSY, EXHAUST, 2.5 ID, 12’ L 12511605 (19207)		EA	1
25	4520-01-527-4928	IMMERSION HEATER ASSY, 2000 WATTS, WITH BRACKET 12497050(19207)		EA	1
26	N/A	LIST, COEI PACKING 12512188(19207)		EA	1
27	4730-01-527-7246	NOZZLE, WATER DISTRIBUTION 12497054(19207)		EA	1
28	6110-01-527-4932	PANEL, POWER DISTRIBUTION 12497065(19207)		EA	1

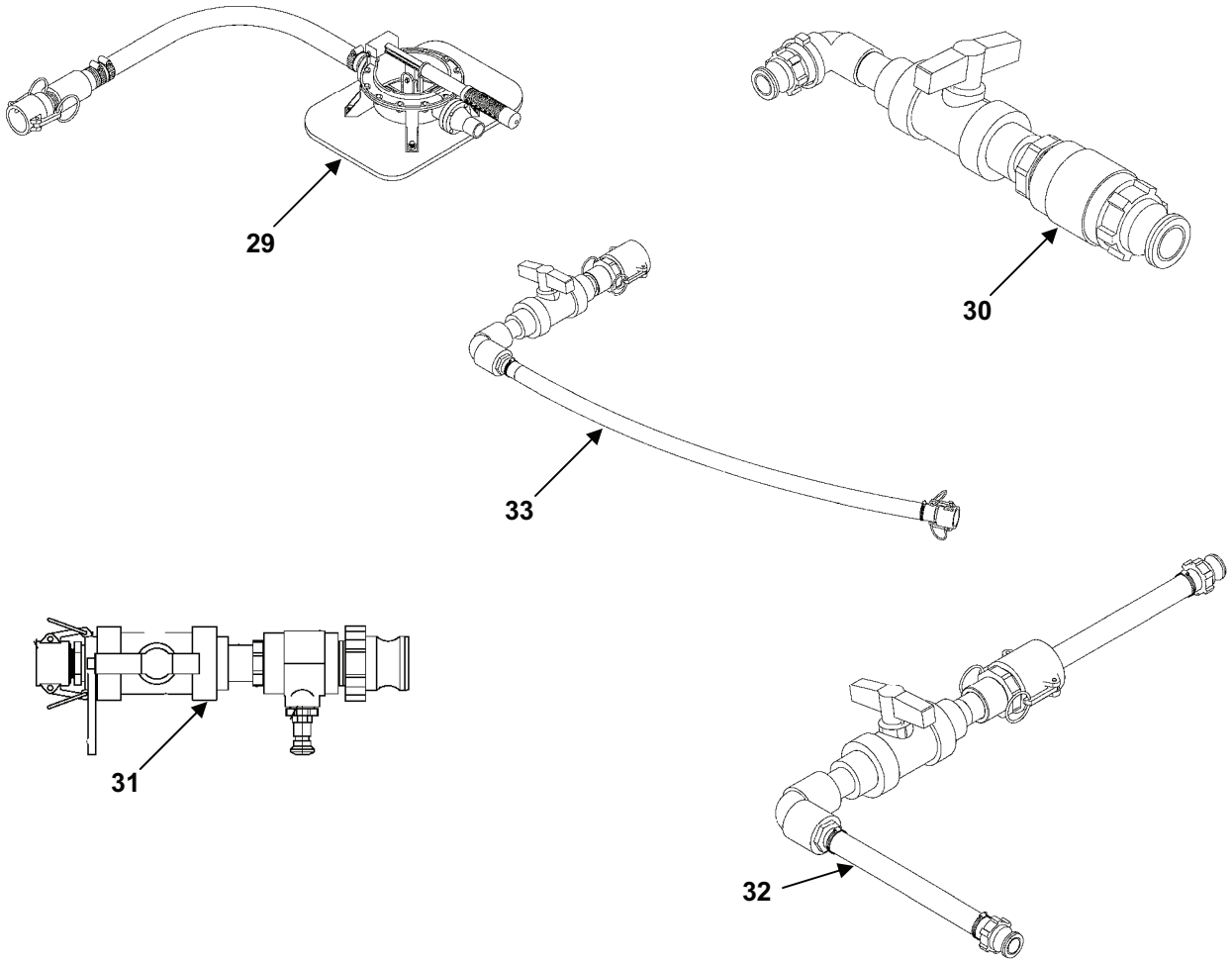


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
29	4320-01-527-7281	PUMP ASSY, PRIMING 12497023(19207)		EA	1
30	4730-01-527-7237	SPOOL PIECE ASSEMBLY, INLET, PRODUCT TANK 12497041(19207)		EA	1
31	4730-01-5277239	SPOOL PIECE ASSEMBLY, INLET, SETTLING TANK 12497035 (19207)		EA	1
32	4730-01-527-7241	SPOOL PIECE ASSEMBLY, OUTLET, PRODUCT TANK 12497043(19207)		EA	1
33	4730-01-527-7244	SPOOL PIECE ASSEMBLY, OUTLET, SETTLING TANK 12497039(19207)		EA	1

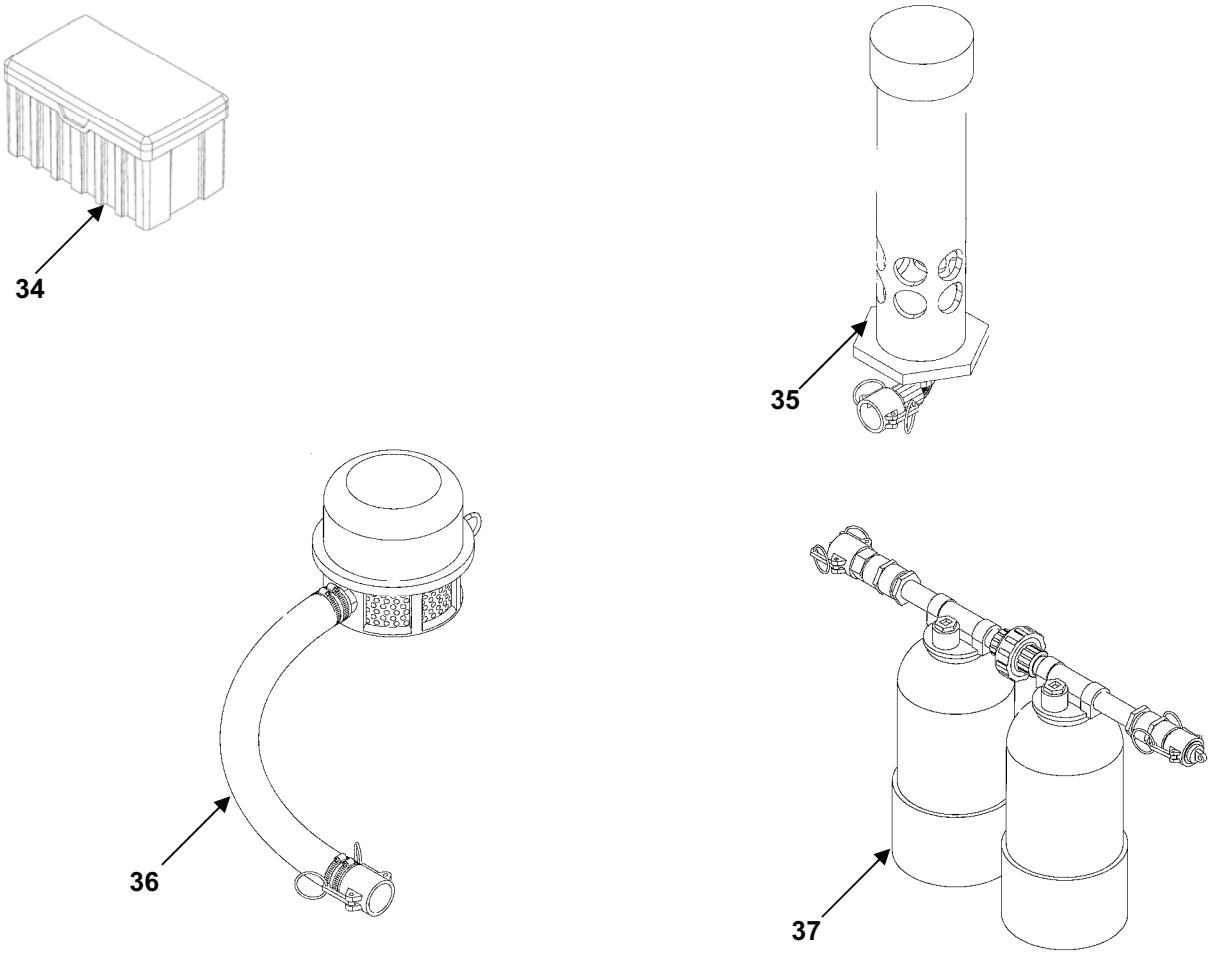


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) NationaL Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) QtyRqr
34	8145-01-508-1509	STORAGE CONTAINER, 24 GALLON 1172-04-38(13147)		EA	1
35	4730-01-526-8362	STRAINER, FEED, 200 MICRON 12497032(19207)		EA	1
36	4730-01-526-8946	STRAINER, RAW WATER, 410 MICRON 12497117(19207)		EA	1
37	4610-01-526-8759	TANK ASSEMBLY, NBC 12497056(19207)		EA	2

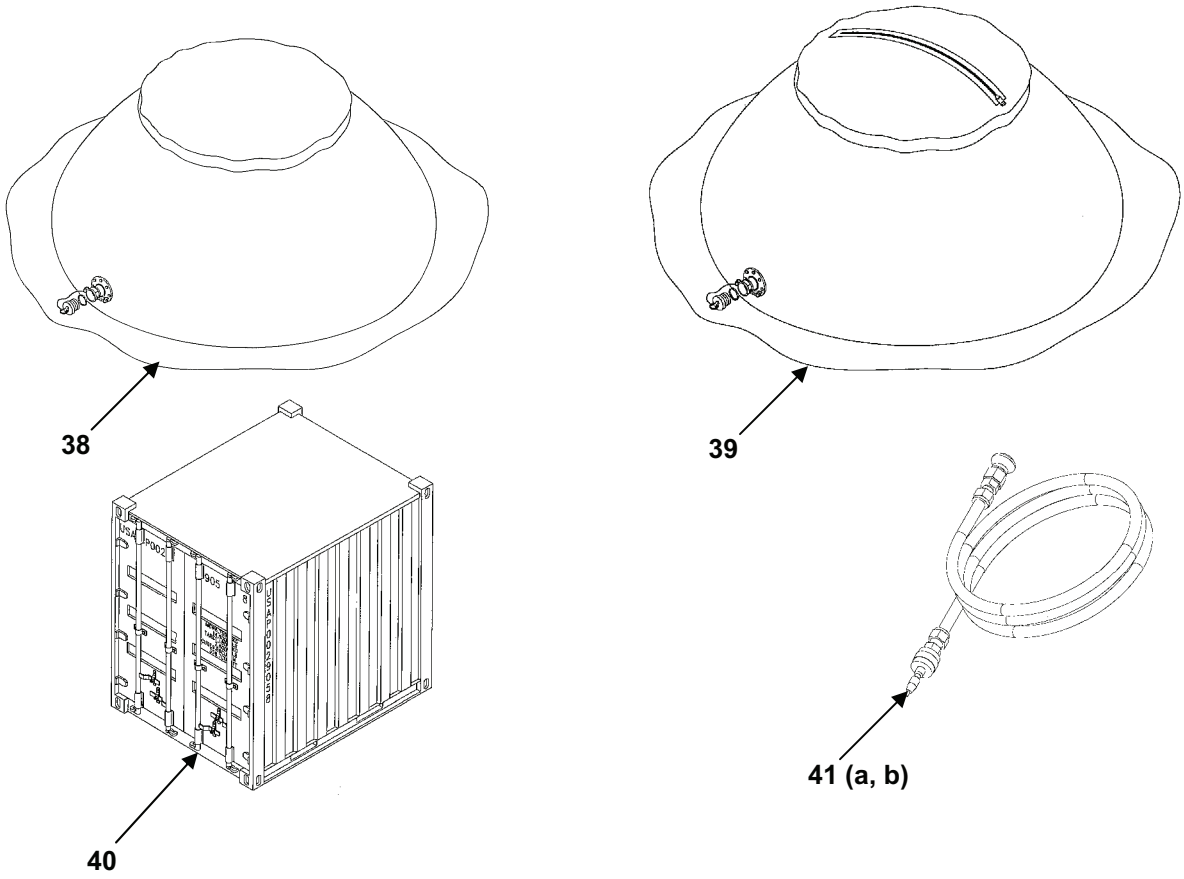


Table 1. Components of End Item. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
38	5430-01-526-8947	TANK, COLLAPSIBLE, 1000 GALLONS, PRODUCT 12511542(19207)		EA	1
39	5430-01-527-0337	TANK, COLLAPSIBLE, 1000 GALLONS, SETTLING, 12511541(19207)		EA	1
40	8415-01-527-1596	TRICON, MODEL 101 12497074(19207)		EA	1
41a	4710-01-527-1409	TUBING ASSEMBLY, ANTISCALANT, 0.25-INCH 12511509-1(19207)		EA	1
41b	4710-01-527-1411	TUBING ASSEMBLY, COAGULANT, 0.25-INCH 12511509-2(19207)		EA	1

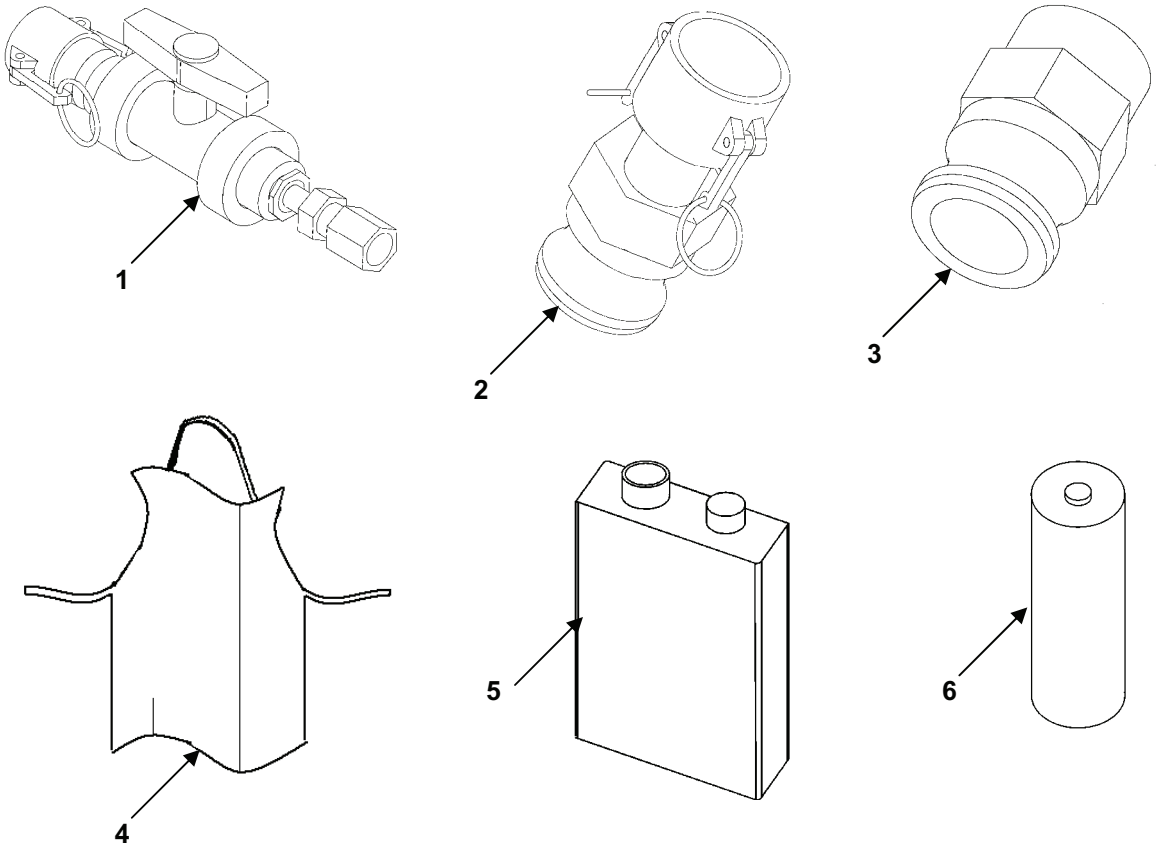


Table 2. Basic Issue Items.

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
1	4710-01-526-8761	ADAPTER, CLEANING 12497102(19207)		EA	1
2	4730-01-526-8356	ADAPTER, FLUSHING 12496995(19207)		EA	1
3	4730-01-526-7007	ADAPTER, QUICK DISCONNECT, 0.75” MQD X 0.75” MPT 2770607SG-07F(33813)		EA	1
4	8415-00-082-6108	APRON, RUBBER-COATED, CLOTH 12511514(19207)		EA	2
5	6135-00-900-2139	BATTERY, 9 VOLT MN1604(90303)		EA	1
6	6135-00-985-7845	BATTERY, AA 20-0571-1988 NEDA 15A(80204)		EA	4

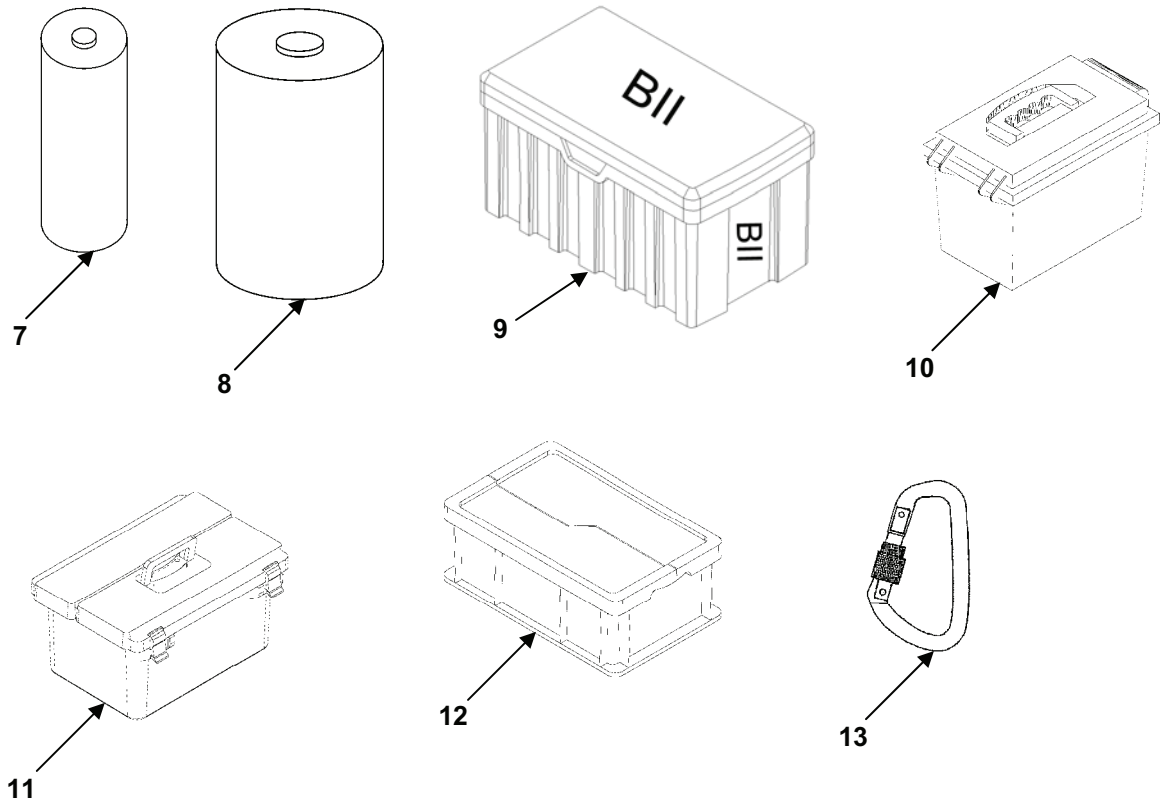
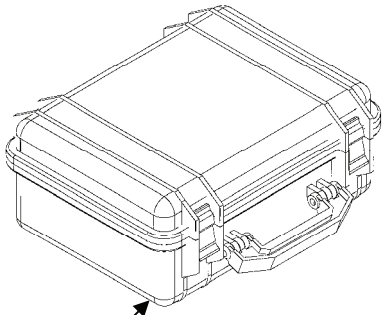
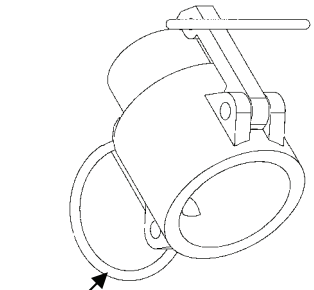


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
7	6135-00-826-4798	BATTERY, AAA 824(77542)		EA	4
8	6135-00-835-7210	BATTERY, D 813(77542)		EA	2
9	2540-01-527-1415	BOX, BII 1251554(19207)		EA	1
10	2540-01-527-1837	BOX, DRY SDB-0-11(3HDZ8)		EA	1
11	2540-01-527-1867	BOX, TOOL 12511552 (19207)		EA	1
12	2540-01-527-9324	BOX, STORAGE, CHEMICAL 12511565(19207)		EA	1
13	5340-01-526-8944	SNAP, HOOK S0181-K100(1CXX6)		EA	3





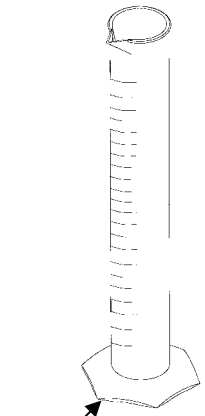


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
14	6760-01-491-2082	CASE, INSTRUMENT 12497017 (19207)		EA	1
15	4730-01-526-7188	COUPLER, QUICK DISCONNECT, 0.75” FQD X 0.75” MPT2770207SG-07B (33813)		EA	1
16	6640-01-527-9325	CYLINDER, GRADUATED, 250 ML 1475T14(39428)		EA	1
17a	4820-01-526-7417	DISK, RUPTURABLE, HIGH, 1480 PSI, 12511386(19207)		EA	6
17b	4820-01-526-8363	DISK, RUPTURABLE, LOW, 240 PSI, 12511361(19207)		EA	6

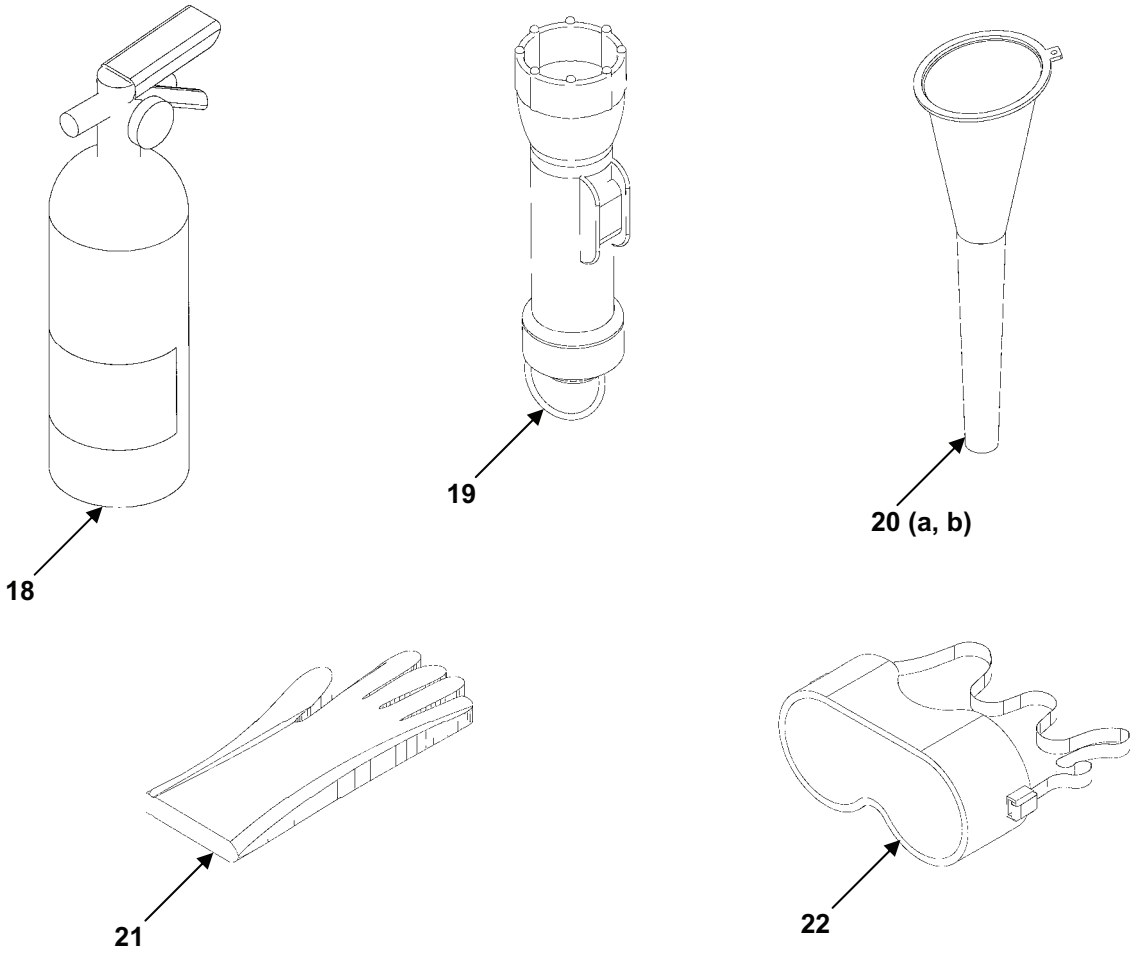
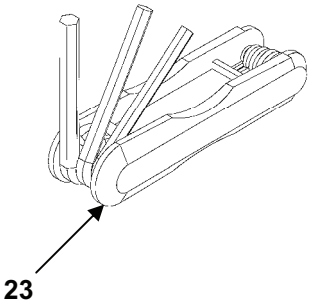
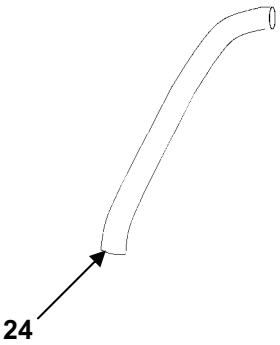
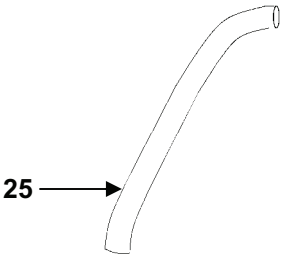


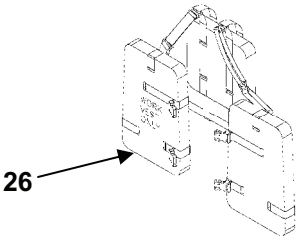
Table 2. Basic Issue Items. (cont.)

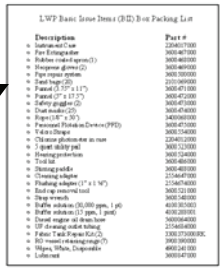
(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
18	4210-01-526-8956	EXTINGUISHER, FIRE 466227(0J0S5)		EA	1
19	6230-00-163-1856	FLASHLIGHT, WATERPROOF 6230-00-163-1856(64067)		EA	1
20a	7240-01-527-9304	FUNNEL, 1 GALLON 05032(76371)		EA	1
20b	7240-01-527-9302	FUNNEL, 1 PINT 05090(1FUL5)		EA	1
21	8415-01-526-8501	GLOVES, NEOPRENE 12511515(19207)		EA	2
22	4240-00-052-3776	GOGGLES, SAFETY, CLEAR 12511516(19207)		EA	2











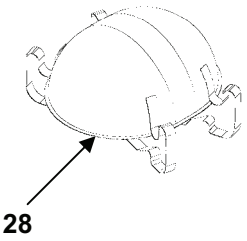


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
23	5120-01-430-9452	HEX KEY SET, FOLDING 20911(05253)		EA	1
24	4720-01-527-9272	HOSE, ENGINE OIL DRAIN, 3/8-INCH 560064000(76371)		EA	1
25	4720-01-527-9276	HOSE, LIGHT BULB REMOVAL, 3/8-INCH 2850622000(76371)		EA	1
26	4220-01-526-8310	LIFE PRESERVER, VEST 12511522 (19207		EA	1
27	N/A	LIST, BII PACKING 12512095(19207)		EA	1
28	4240-01-247-2348	MASK, DUST, DISPOSABLE 12511521(19207)		EA	25

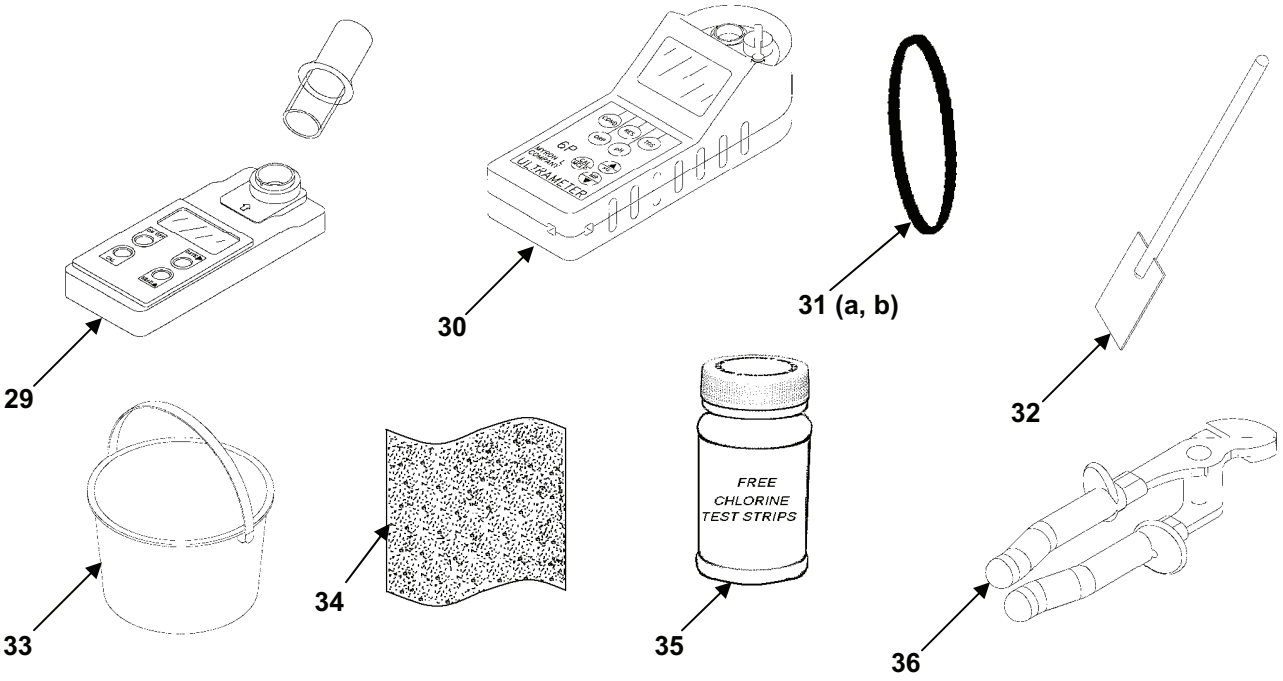


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
29	6760-01-490-7581	METER, TURBIDITY 12511535(19207)		EA	1
30	6630-01-491-2184	METER, ULTRA 12497124(19207)		EA	1
31a	5331-01-527-9805	O RING, FOR 3/4" UNIONS (E0603-70-2-214)(30781)		EA	6
31b	5331-01-527-9807	O RING, FOR 1" UNIONS (E0603-70-20215)(30781)		EA	6
32	6640-01-526-9861	PADDLE, STIRRING, 1” X 3’ 3485K14(39428)		EA	1
33	7240-00-061-1163	PAIL, UTILITY, 5-QT 7240-00-061-1163(0HFR0)		EA	1
34	5350-00-253-4393	PAPER, SAND, 60 GRIT 051144-02461(76381)		EA	1
35	6550-01-528-1046	TEST STRIPS, CHLORINE 12497133(19207)		EA	1
36	5120-01-437-5261	PLIERS, CHANNEL LOCK INPA10(55719)		EA	1

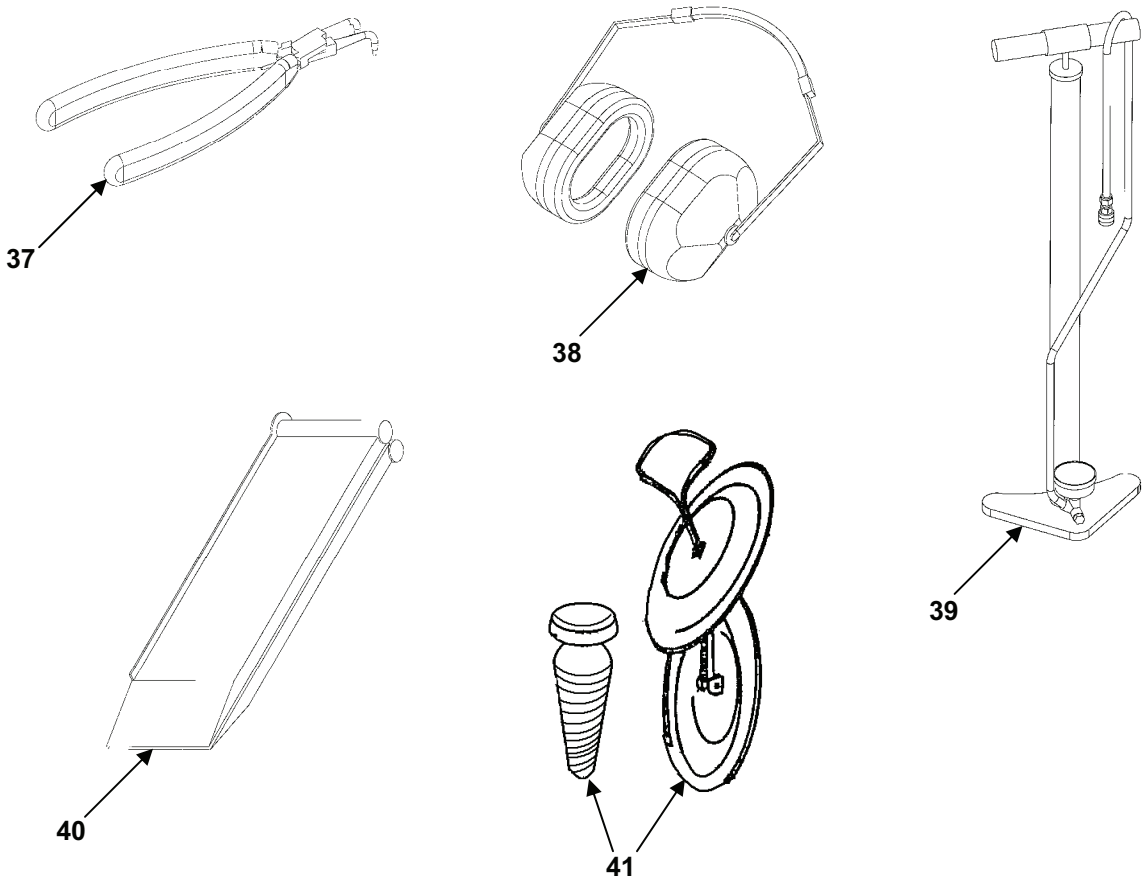
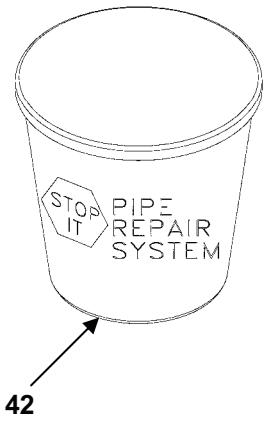
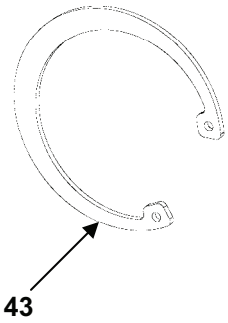
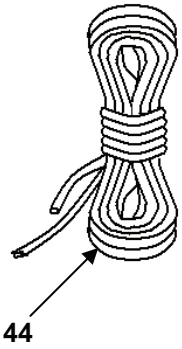


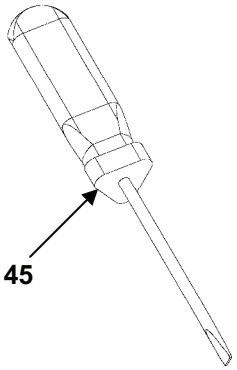
Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
37	5120-01-428-8381	PLIERS, SNAP RING, 90 DEG 3SRPC9045(55719)		EA	1
38	4240-00-022-2946	PROTECTION, HEARING 12511544(19207)		EA	1
39	4320-00-852-9036	PUMP, BICYCLE, 12511584(19207)		EA	1
40	3990-01-526-8351	RAMP, FOLDING, ALUMINUM, 10’ X 30” 12512186(19207)		EA	1
41	5430-01-527-9319	REPAIR KIT, COLLAPSIBLE FABRIC TANK 330037300RK(66618)		EA	1









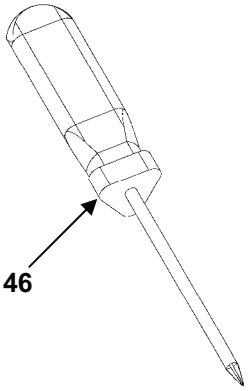


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
42	4730-01-301-3687	REPAIR KIT, PIPING 12551556(19207)		EA	1
43	5325-01-011-5681	RING, RETAINING 12511366(19207)		EA	7
44	4020-01-527-1483	ROPE, 0.188’ X 50’, FIBER S303(6X552)		EA	1
45	5120-00-222-8852	SCREWDRIVER, FLAT TIP SCC539502-2(80063)		EA	1
46	5120-00-234-8913	SCREWDRIVER, PHILLIPS, #2 BD122(75347)		EA	1

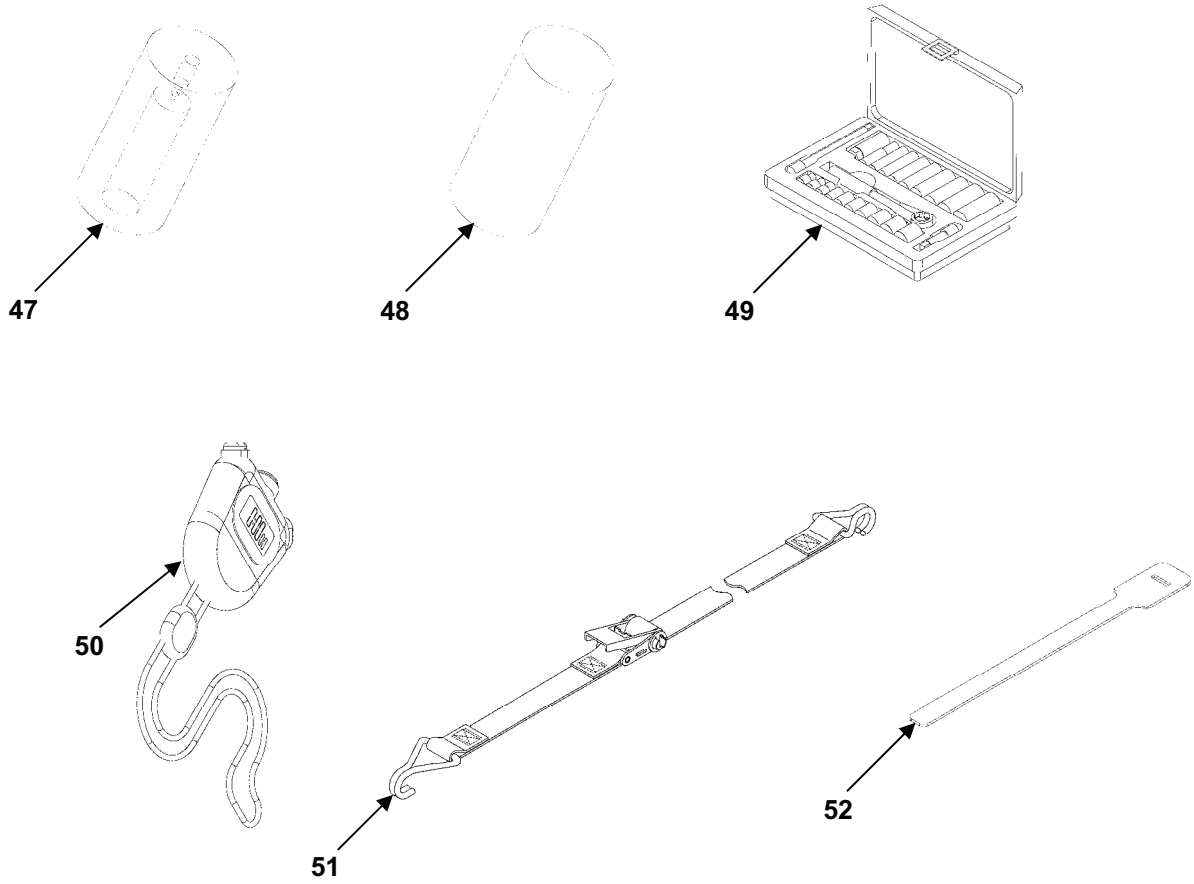


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
47	4610-01-527-3761	SIMULATOR, RO, W/HOLE 2554626001(76371)		EA	5
48	4610-01-527-3762	SIMULATOR, RO, W/O HOLE 2554626002(76371)		EA	2
49	5120-01-527-9576	SOCKET SET WITH RATCHET, 13 PIECES 5561A33(39428)		EA	1
50	6645-01-526-8717	STOPWATCH, DIGITAL, 12512174(19207)		EA	1
51	5340-01-527-0322	STRAP, TIE DOWN T-R5027WH(1X6W8)		EA	7
52	5340-01-527-0320	STRAP, VELCRO 12511563(19207)		EA	10

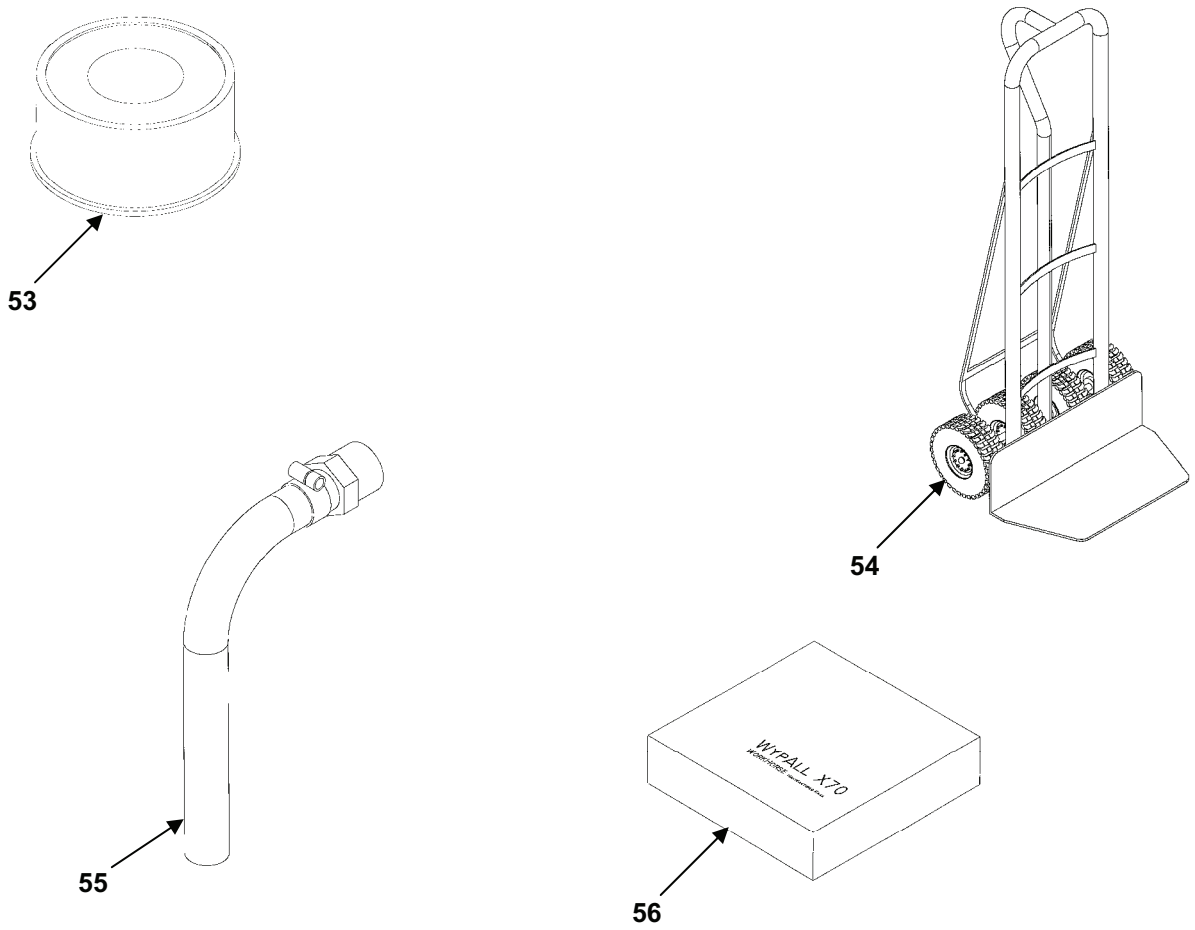


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
53	8030-00-889-3535	TAPE, ANTISEIZING 16030 A (84180)		EA	1
54	3920-01-526-7235	TRUCK, HAND 12512187(19207)		EA	1
55	4710-01-526-8364	ULTRAFILTRATION CLEANING OUTLET 12512109(19207)		EA	1
56	7920-00-543-6492	WIPES, DISPOSABLES A-A-1432(58536)		EA	1

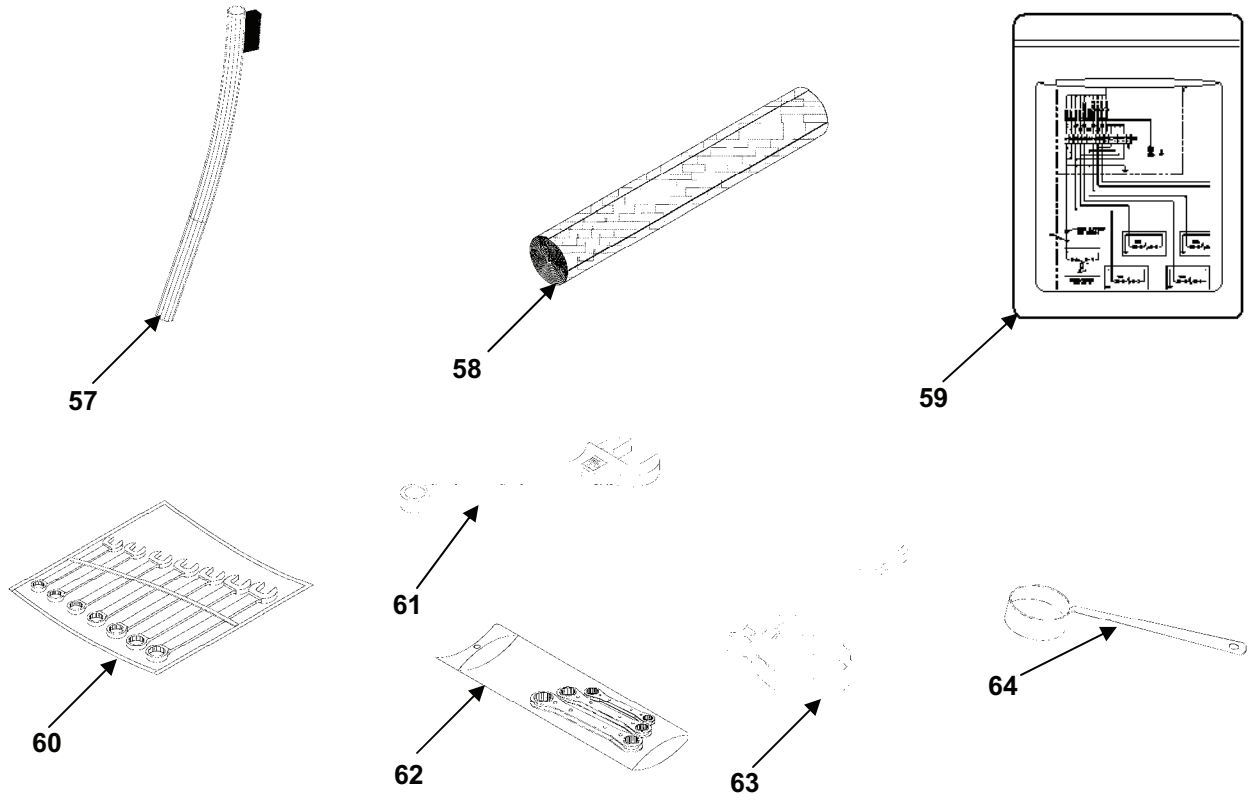


Table 2. Basic Issue Items. (cont.)

(1) Illus Number	(2) National Stock Number (NSN)	(3) Description, Part Number /(CAGEC)	(4) Usable On Code	(5) U/M	(6) Qty Rqr
57	7920-01-195-5355	WIRE BRUSH AC5A(55719)		EA	1
58	4730-01-527-2007	WIRE CLOTH 12511610(19207)		EA	1
59	N/A	WIRING DIAGRAMS 3701681DWGKIT(76371)		EA	1
60	5120-01-428-8054	WRENCH SET, COMBINATION GOEXS708K(55719)		EA	1
61	5120-01-399-9866	WRENCH, ADJUSTABLE, 10” 710SL(1CV05)		EA	1
62	5120-01-437-7863	WRENCH, RATCHET BOX (3) 29301(08292)		EA	1
63	5120-00-063-6502	WRENCH, STRAP S-24(37078)		EA	1
64	TBD	SCOOP MEASURING 2MI PP 14-379-304 (08889)		PK	1

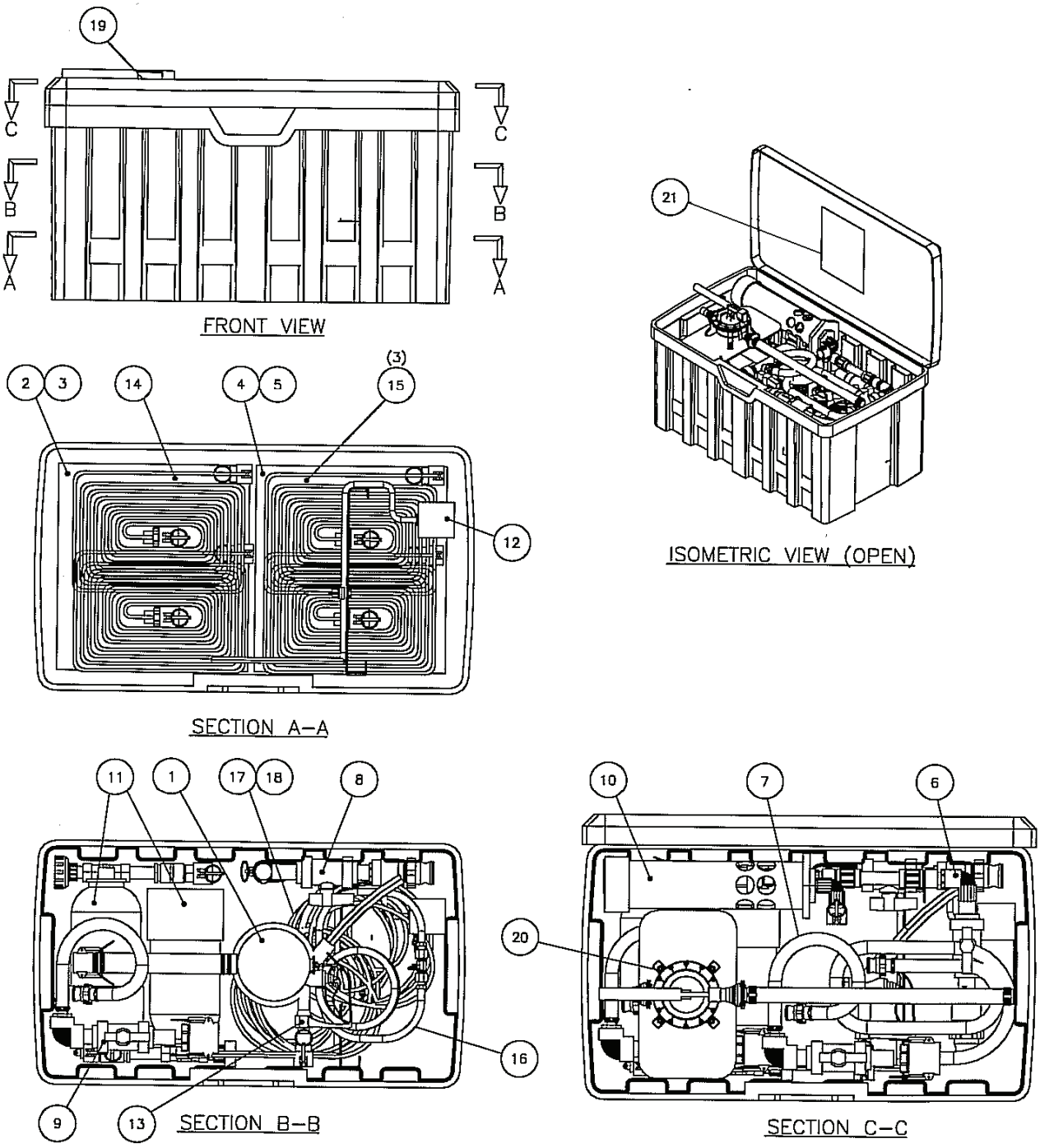


Figure 1. Components of End Item Box.

Table 3. 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 4. 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.

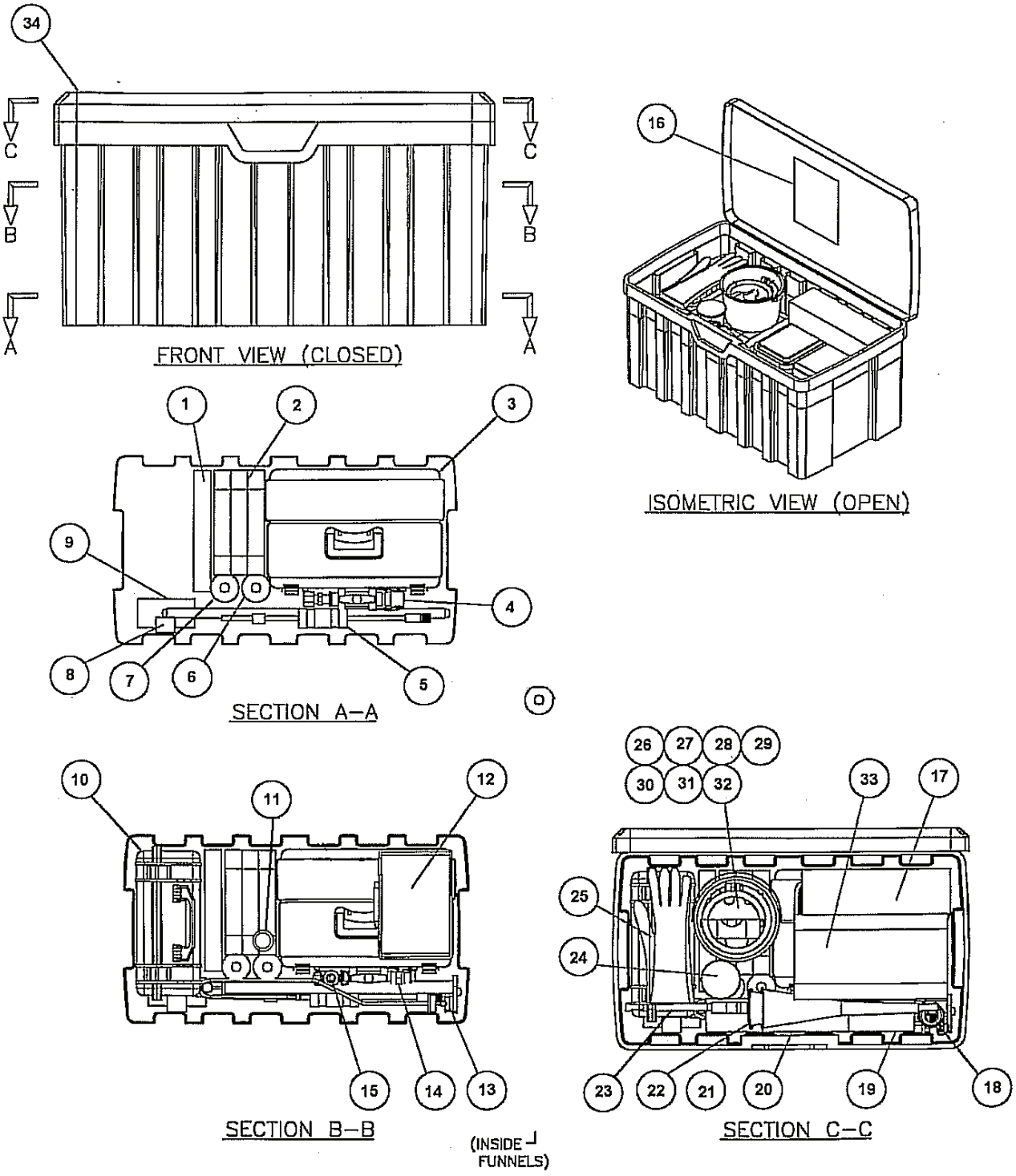


Figure 2. Basic Issue Items Box.

Table 5. Basic Issue Items Box Packing Index.

ITEM NUMBER	DESCRIPTION
1	Apron (2)
2	Personal Flotation Device (PDF)
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, BII 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

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
EXPENDABLE AND DURABLE ITEMS LIST

INFORMATION

Scope

This work package lists all expendable and durable material 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 (WP 0136 00, Item 20).”).

Column (2) – Level. This column includes the lowest level of maintenance that requires the listed item.

(C = Operator/Crew).

Column (3) – National Stock Number. This is the NSN assigned to the item which you can use to requisition.

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 Issue (U/I). This code shows the physical measurement or count of an item, such as gallon, dozen, gross, etc.

Table 1. Expendable and Durable Items List.

(1) Item No.	(2) Level	(3) National Stock Number (NSN)	(4) Item Name, Description, Part Number /(CAGEC)	(5) U/I
1	C	6810-01-527-4039	Acid Citric, (M217), powder form, 5.5 pounds box, 12511566 (19207)	BX
2	C	6850-01-527-4119	AntiScalant, (M321), liquid form, 32oz bottle, 12511570 (19207)	BT
3	C	8030-01-286-9536	Antiseize Compound 13655 ((07431)	CN
4	C	8105-00-142-9345	Bag, sand, 14x26, polypropylene A-A52140A-1, (58535)	HD
5	C	6135-00-900-2139	Battery, 9 volt MN1604, (90303)	PK
6	C	6135-00-985-7845	Battery, AA BA-3058, (0453B)	PK
7	C	6135-00-826-4798	Battery, AAA E92, (83740)	PK
8	C	6135-00-835-7210	Battery, D-cell E95, (83740)	PK
9	C	6810-01-527-4028	Bisulfite, sodium, (M323), 980 gram container, 12511572, (19207)	BX
10	O	6240-00-941-8487	Bulb, light, control panel, 755, (08806)	EA
11	C	6850-01-527-4116	Cleaner, RO membrane, (M326), high pH, 6 lb box, 12511574, (19207)	BX
12	C	6850-01-527-4111	Cleaner, RO membrane, (M325), low pH, 6 lb box, 12511573, (19207)	BX
13	C	6850-01-567-2511	Cleaning Compound, Solvent MIL-PRF-TYPEII, (81349)	GL

Table 1. Expendable and Durable Items List.

(1) Item No.	(2) Level	(3) National Stock Number (NSN)	(4) Item Name, Description, Part Number /(CAGEC)	(5) U/I
14	C	6850-01-527-4102	Coagulant (Flocculant), (M322), liquid form, 32 oz bottle, 12511571, (19207)	BT
15	C	6850-00-294-0860	Compound, O-ring, Lubricant, Dow Corning 111, DC 111, (71984)	TU
16	O	7930-00-880-4454	Detergent 7930-00-880-4454, (83421)	OZ
17	O	6850-01-527-4093	Detergent, M334, powder form, 1 lb packs, 12511576, (19207)	LB
18	O	6850-01-527-4086	Detergent, M331, 32 oz bottle, 12511575, (19207)	BT
19	O	6840-01-527-4069	Hypochlorite, Calcium (HTH) (M229), 12511567, (19207)	BT
20	C	6810-01-527-5777	Hypochlorite, Sodium (Bleach), 24 oz bottle, 12511577, (19207)	BT
21	C	5330-01-543-2135	Liquid Gasket 1854590 (11083)	CN
22	O	9150-01-227-8210	Oil, lubricating, 10W30, J2363, (81343)	QT
23	O	9150-01-527-3990	Oil, pump, 6107 PUMP OIL (SAE 30 non-detergent), (57783)	QT
24	O	7920-00-205-1711	Rags, wiping, cotton 7920-00-205-1711, (64067)	EA
25	C	8030-01-025-1692	Sealing Compound 24241 (05972)	BT
26	O	6810-01-527-4074	Solution, buffer, 15 ppm, 1 pint, 12511568, (19207)	PT
27	O	6810-01-399-1289	Solution, buffer, 30,000 ppm, 1 pint, 12511569, (19207)	PT
28	O	6850-01-487-8860	Solution, calibration, turbidity meter, HI 93703-0, (06EF2)	BT
29	O	6850-01-487-8875	Solution, calibration, turbidity meter, HI 93703-10, (06EF2)	BT
30	O	6850-01-487-8862	Solution, cleaning, turbidity meter, HI 93703-50, (06EF2)	BT
31	O	6810-01-528-3706	Solution, storage, pH cell SSQ, (30053)	QT
32	O	8030-00-889-3535	Tape, anti-seize 16030A, (84180)	RO
33	C	N/A	Tie wrap, blue, 71295K64-blue, (39428)	PK
34	C	N/A	Tie wrap, gray, 71295K64-gray, (39428)	PK
35	C	N/A	Tie wrap, green, 71295K64-green, (39428)	PK
36	C	N/A	Tie wrap, orange, 71295K64-orange, (39428)	PK
37	C	N/A	Tie wrap, red, 71295K64-red, (39428)	PK
38	C	5340-01-248-4747	Tie wrap, white, 7130K14, (39428)	PK

Table 2. Expendable and Durable Items List.

(1) Item No.	(2) Level	(3) National Stock Number (NSN)	(4) Item Name, Description, Part Number /(CAGEC)	(5) U/I
39	C	N/A	Tie wrap, yellow, 71295K64-yellow, (39428)	PK
40	O	N/A	Unit package, Chemical, for 140 hours of operations. 4100324000, (76371)	PK
41	O	7920-00-543-6492	Wipes, disposable, 7920-00-543-6492 , (80244)	BX
42	C	9505-00-293-4208	Wire, Nonelectrical MS20995C32 (80205)	LB

END OF WORK PACKAGE

FIELD MAINTENANCE
LIGHTWEIGHT WATER PURIFIER
ADDITIONAL AUTHORIZED LIST

INTRODUCTION

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 (in all capital letters) followed by a minimum description when needed. The last line below the description is the CAGEC Commercial and Government Entity Code) (in parentheses) and the part number.
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.

Table 1. Additional Authorized List Items

(1) National Stock Number (NSN)	(2) Description, Part Number /(CAGEC)	(3) Usable On Code	(4) U/M	(5) Qty Recom
6810-01-528-3879	Hydroxide, Sodium SH150, (1R9H9)		GM	1

FIELD MAINTENANCE
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 torque.

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

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is ODISC4.	Use Part II (reverse) for Repair Parts and Special Tool Lists (RPSTL) and Supply Catalogs/Supply Manuals (SC/SM).	DATE Date you filled out this form.
TO: *(Forward to proponent of publication or form) (Include ZIP Code)* U.S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	FROM: *(Activity and location) (Include ZIP Code)* Your mailing address	

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	Title
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).
	0019 00 1	3	1	1		Step No. 2 says to secure doors open with locking bar or hooks from where to what? The bars or hooks are not identified.
	0019 00 4	4	1	1		Step No. 19 states to remove locking bars, pins or hooks from where to what? The bars, pins or hooks are not identified. Where they stored?

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	Signature
Your Name		*Your Signature*

DA FORM 2028, FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00

TO: (Forward direct to addressee listed in publication)	FROM: (Activity and location) (Include ZIP Code)	DATE
U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	Your address	Date you filled out this form

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

PAGE NO.	COLM NO.	LINE NO.	NATIONAL STOCK NUMBER	REFERENCE NO.	FIGURE NO.	ITEM NO.	TOTAL NO. OF MAJOR ITEMS SUPPORTED	RECOMMENDED ACTION

SAMPLE

PART III – REMARKS **(Any general remarks or recommendations, or suggestions for improvement of publications and blank forms. Additional blank sheets may be used if more space is needed.)**

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE
Your Name		Your Signature

USAPPC V3.00

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is ODISC4.	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) U.S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	FROM: (Activity and location) (Include ZIP Code)	

PART I – ALL PUBLICATIONS (EXCEPT RPSTL AND SC/SM) AND BLANK FORMS

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

DA FORM 2028, FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00

TO: (Forward direct to addressee listed in publication)	FROM: (Activity and location) (Include ZIP Code)	DATE
U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630		

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

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 or 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

USAPPC V3.00

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is ODISC4.	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) U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	**FROM: (Activity and location) (Include ZIP Code)**	

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

DA FORM 2028, FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00

TO: (Forward direct to addressee listed in publication) U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	FROM: (Activity and location) (Include ZIP Code)	DATE

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

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 or 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

USAPPC V3.00

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is ODISC4.	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) U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	**FROM: (Activity and location) (Include ZIP Code)**	

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

DA FORM 2028, FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00

TO: (Forward direct to addressee listed in publication) U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	FROM: (Activity and location) (Include ZIP Code)	DATE

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

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 or 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

USAPPC V3.00

RECOMMENDED CHANGES TO PUBLICATIONS AND BLANK FORMS For use of this form, see AR 25-30; the proponent agency is ODISC4.	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) U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	**FROM: (Activity and location) (Include ZIP Code)**	

PUBLICATION/FORM NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

ITEM NO.	PAGE NO.	PARA-GRAPH	LINE NO. *	FIGURE NO.	TABLE NO.	RECOMMENDED CHANGES AND REASON (Provide exact wording of recommended changes, if possible).

**Reference to line numbers within the paragraph or subparagraph.*

TYPED NAME, GRADE OR TITLE	TELEPHONE EXCHANGE/AUTOVON, PLUS EXTENSION	SIGNATURE

DA FORM 2028, FEB 74 REPLACES DA FORM 2028, 1 DEC 68, WHICH WILL BE USED. USAPPC V3.00

TO: (Forward direct to addressee listed in publication) U. S. Army TACOM Life Cycle Management Command ATTN: AMSTA-LCL-MPP/TECH PUBS 1 Rock Island Arsenal, Rock Island, IL 61299-7630	FROM: (Activity and location) (Include ZIP Code)	DATE

PART II – REPAIR PARTS AND SPECIAL TOOL LISTS AND SUPPLY CATALOGS/SUPPLY MANUALS

PUBLICATION NUMBER	DATE	TITLE
TM 10-4610-310-13	15 Oct 09	Operator & Field Maintenance Manual for Lightweight Water Purifier

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 or 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

USAPPC V3.00

By Order of the Secretary of the Army:

GEORGE W. CASEY,JR.
General, United States Army
Chief of Staff

JOYCE E. MORROW
Administrative Assistant to the
Secretary of the Army
0927106

DISTRIBUTION: To be distributed in accordance with the Initial Distribution Number (IDN) 256794 requirements for TM 10-4610-310-13

LWP DATA SHEET									
PART I. OPERATING PARAMETER LOG									
LWP #	NCO IN CHARGE:							DATE:	
TIME	PRODUCT WATER FLOW	UF PRESSURE (TMP)	UF FEED (OR) BACKWASH PRESSURE	UF FEED TEMP.	ENGINE SHUTOFF AIR PRESSURE	HP PUMP FLOW	REVERSE OSMOSIS PRESSURE	FEED WATER TDS	PRODUCT WATER TDS
	(GPM)	(PSI)	(PSI)	°F	(PSI)	(GPM)	(PSI)	(PPM)	(PPM)

a

LWP DATA SHEET

PART II. CHEMICAL LOG

LWP #	NCO IN CHARGE:	DATE:

TIME	PRODUCT WATER CHLORINE RESIDUAL	CHEM. PUMP SETTINGS						REMARKS
		CHLOR. PUMP		COAG. PUMP		ANTISCAL. PUMP		
	(PPM)	SPEED	STROKE	SPEED	STROKE	SPEED	STROKE	

SIGNATURE OF OPERATOR:	TIME ON:	TIME OFF:
SIGNATURE OF NCO:		

The Metric System and Equivalents

Linear Measure

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

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 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. decimeter = 1000 cu. centimeters = 61.02 cu. lathes
1 cu. meter = 1000 cu. decimeters = 35.31 feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	newton-meters	1.356	metric tons	short tons	1.102
pound-inches	newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

PIN: 085905-000