

# Cartridge Based Pyrogen Filtration System (1 membrane)

## Operator Manual



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**TABLE OF CONTENTS**

Our Company ..... 01

- Contact Us ..... 01
- Technical Phone Support ..... 01
- Technical Support Info Online ..... 01
- Specific Contacts ..... 02

Introduction ..... 02

Warnings & Cautions ..... 03

General Requirements & Specifications ..... 04

Product Description ..... 05

Detailed View of Models ..... 05

Operation

- General System Operation ..... 06
- Initial Start-Up of .03 Micron Filter ..... 06
- Daily Operation ..... 06
- Monitoring Procedures ..... 07
- Daily Shutdown ..... 07
- Valves Legend and Operation ..... 07

Disinfecting

- Disinfecting Overview ..... 08
- Disinfecting Procedure ..... 08

Sanitizing the Sanitary Sample Ports ..... 09

System Maintenance

- General ..... 10
- Changing the Filter ..... 11

Service Help

- 30" .03 micron Filter Housing ..... 12
- 20" .03 micron Filter Housing ..... 13

Trouble-Shooting Guide ..... 14

Limited Warranty Terms and Conditions ..... 15

Appendix A, Calculations & Conversions ..... 17

- Bleach Disinfecting Dilutions ..... 17
- Conversion of Ounces to Milliliters ..... 17
- Calculation for Area of Pipe Volume ..... 18
- 3 Feet per Second Flow Velocity Rates ..... 18

Visit our website to see our complete product line of water purification products!

[www.betterwater.com](http://www.betterwater.com)



## Our Company

Better Water LLC is a leading integrated manufacturer of water treatment equipment and components for the industrial, commercial and institutional markets.



Located in Smyrna, Tennessee, Better Water LLC continues its history of manufacturing and distribution of equipment specifically designed for the renal dialysis market.

Founded in 1971, Better Water LLC has built a reputation for solving our customers' toughest problems with high quality products and unmatched service.

## Contact Us

**Better Water LLC**  
698 Swan Dr  
Smyrna, TN 37167

**Phone (615) 355-6063**  
**Fax (615) 355-6065**

**Technical Support:**  
Phone (615) 355-6063, press "1"  
Email [support@betterwater.com](mailto:support@betterwater.com)

**Customer Service:**  
Phone (615) 355-6063, press "3"  
Email [customerservice@betterwater.com](mailto:customerservice@betterwater.com)

## Technical Phone Support

Support is available regarding all Better Water LLC systems, **24 hours a day, 7 days a week.**

- Normal business hours are [Monday through Friday](#) from **8:00 am until 3:30 pm, Central Standard Time** (*excluding holidays*)

**Call (615) 355-6063, press "1" for Technical Support**

**Emergency assistance** is available after normal business hours (*including holidays*) by calling **(615) 708-8627**.

**BEFORE calling for emergency assistance:**

- Check the Troubleshooting guide in this manual
- Check the electrical-power connections, fuses/circuit breakers (*if applicable*)
- Check all valves to ensure each is in the correct position (*if applicable*)

## Technical Support Info Online

Our website, [www.betterwater.com](http://www.betterwater.com), which is updated frequently, contains a wealth of technical support information on the **SUPPORT** tab and includes:

- Operator and Service Manuals
- Interactive Frequently Asked Questions for Troubleshooting
- Consumables and Accessories Lists
- Technical Service Bulletins

For your convenience there are also online forms for placing **Orders** and requesting **Returned Goods Authorization**. These are Adobe forms that can be downloaded and either faxed or emailed to us.



**Specific Contacts**

Technical Support	Phone (615) 355-6063, option "1"
	Email <a href="mailto:support@betterwater.com">support@betterwater.com</a>
To Place an Order (purchase orders)	Fax (615) 355-6065
	Email <a href="mailto:orders@betterwater.com">orders@betterwater.com</a>
	Phone (615) 355-6063
Customer Service (returns)	Phone (615) 355-6063, option "2"
	Fax (615) 355-6065
	Email <a href="mailto:customerservice@betterwater.com">customerservice@betterwater.com</a>

**Website** [www.betterwater.com](http://www.betterwater.com)

Helpful information and forms that can be found on our website:

- Operator & Service Manuals
- Technical Service Bulletins
- Consumables and Replacement Parts List
- Brochures
- Order Form
- Return Goods Authorization Request Form

**Introduction**

Your Better Water LLC Cartridge Based Pyrogen Filtration System was designed and built for your water treatment system, and it is of the utmost quality. With proper operation, maintenance and care, this device should give you years of reliable service.

**Before you start using this device**, you must read and understand this manual in its entirety. This Operator Manual describes in detail the steps and procedures required to safely operate this device. It is also **unsafe** to operate this device without a basic understanding of water treatment.

This device was designed and built with consideration for the information that has been provided to us on the current product water requirements at your site of operation.

This device was designed and built to filter RO/DI product water. This device is not intended for any other application.

Once the device has been delivered to you, it is the **responsibility** of the **Medical Director and Staff** to ensure that the [device] is operated, monitored, and maintained in such a manner so as to satisfy all applicable standards for which the water may be used. Guidelines for such procedures and other related information are available from:

- Food and Drug Administration (FDA)
- National Association of Nephrology Technicians/Technologists (NANT)
- Association for the Advancement of Medical Instrumentation (AAMI)



## WARNINGS



1. It is unsafe to operate or service this device without first reading and understanding the **entire** Operator's Manual. Keep this manual and other associated documentation for future reference.
2. Misuse, improper operation, and/or improper monitoring of this system could result in serious injury, death, or other serious reactions to patients undergoing hemodialysis treatment.
3. Misuse, improper use or handling of disinfectants and chemical cleaning solutions could result in serious injury or even death. You must comply with the information contained in the Material Safety Data Sheet (MSDS) for the chemical being used.

## CAUTIONS



1. When used as a medical device, federal law restricts this device to sale by or on the authority of a physician. Per CFR 801.109 (b)(1).
2. Improper operation of this device could result in a low or no-flow alarm on the dialysis machines.
3. Misuse or improper operation of this device will void any warranty.
4. Where water is mentioned, unless otherwise noted, it must be AAMI standard quality water.
5. Electrical and plumbing connections must adhere to local statutes and any facility codes.
6. Do not remove any Caution, Warning or any other descriptive labels from the device.
7. Do not operate this device in an explosive environment or in the presence of flammable materials. Do not use this device to store, mix, or transfer flammable liquids.
8. Movement or vibrations during shipment may cause connections to loosen.
9. Do not operate this unit in an environment where temperatures may be below 50° F or above 90° F.
10. This device should not be used for purposes outside the device's stated applications, specifications, or limitations.

## GENERAL REQUIREMENTS & SPECIFICATIONS

### Feed Water Supply Requirements:

A properly pretreated water supply consisting of RO/DI product water. Better Water recommends 1.2 megohms as the minimum for DI water (*AAMI standard is 1 megohm*), but these minimums are set by the Medical Director.

- Pressure 30 psi (*minimum*) to 100 psi (*maximum*)

### Electrical requirements:

- None

### Drain requirements:

- This equipment does not require a drain.

### Floor Space:

- This unit is normally assembled at Better Water LLC and mounted to the wall surface.
- 30" Housing Height 54" x Width 22" x Depth 7"
- 20" Housing Height 44" x Width 22" x Depth 7"

### Empty Weight:

- 30" Housing 30 lbs
- 20" Housing 25 lbs

## MODELS

There are four models of the 1 Membrane Pyrogen Filter with the difference being the material used in the header construction, and what size of filter housing is used. The operation and service for these models are basically the same with only a slight physical difference between them.

Model	Header Construction	Filter Housing
<a href="#">EQASSY1.030.03</a>	Poly-Pro	30", Stainless-Steel
<a href="#">EQASSY1.030.03PVC</a>	PVC	30", Big-Blue
<a href="#">EQASSY1.020.03</a>	Poly-Pro	20", Stainless-Steel
<a href="#">EQASSY1.020.03PVC</a>	PVC	20", Big-Blue



## PRODUCT DESCRIPTION

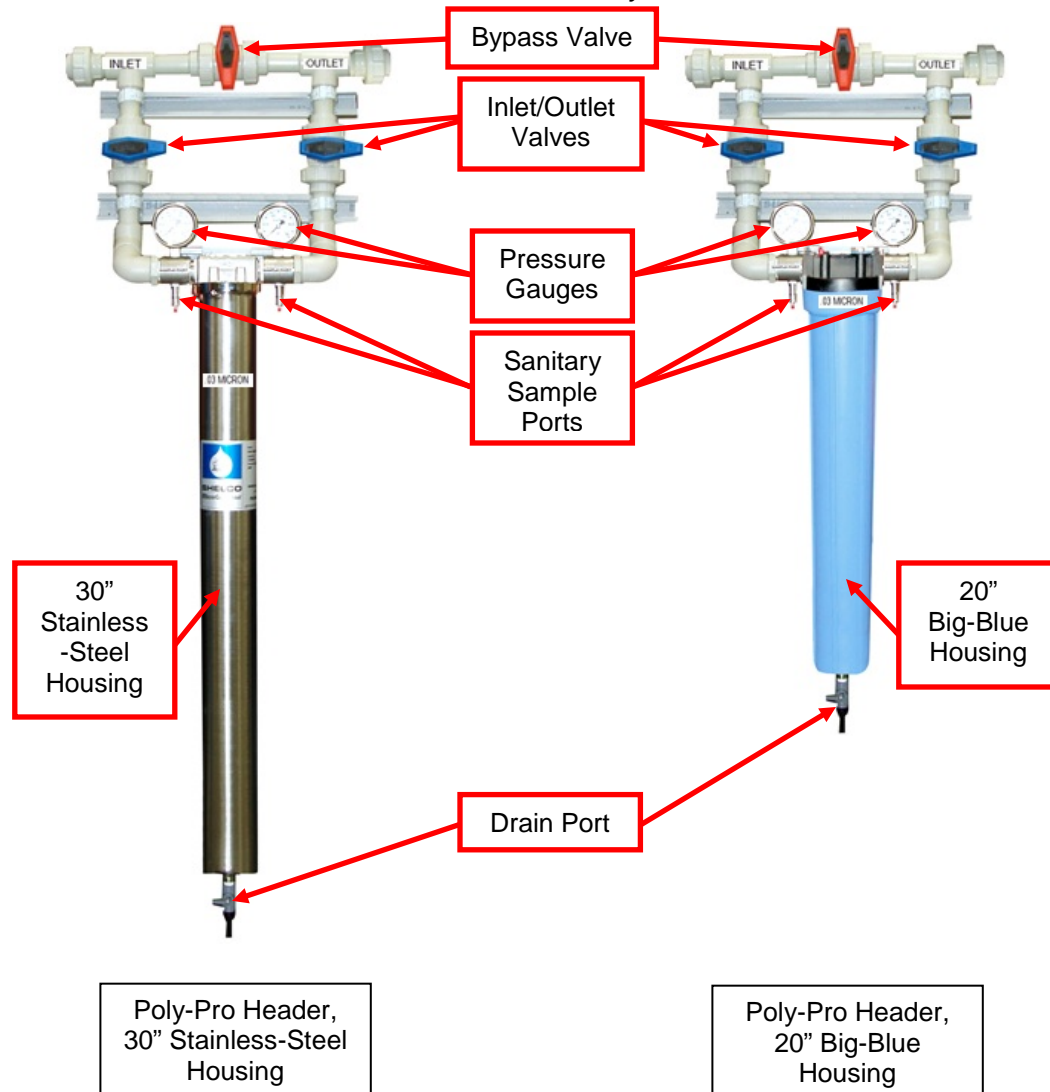
The Cartridge Based Pyrogen Filtration System uses a replaceable filter that is enclosed in a special vessel to process RO/DI product water. The models will vary based on the header construction which can be of either PVC or Poly-Pro, and the size and type of the filter housing which can be either a 30" stainless-steel or a 20" big-blue.

The Filtration system works from system water pressure. The output (product) water from the filtration system is affected by other components in the water treatment system; namely, pressure, temperature and flow-rate.

Pyrogen filters are a consumable product. The life of the filter is directly related to the monitoring and routine care programs that you maintain in your facility. A Pyrogen Filtration system, in conjunction with good disinfecting programs, is a very effective means of controlling bacteria and endotoxins in the post treatment and distribution segments of a water purification system.

## DETAILED VIEW of MODELS

\* NOTE: Details of the PVC model are the same as the Poly-Pro models shown below.



## GENERAL SYSTEM OPERATION

**Before you start using this device**, operators must read and understand this manual in its entirety. This manual of Operator's Instructions describes in considerable detail all of the steps and procedures required to **safely** operate this device. With proper operation, maintenance, and care, this device should give you years of reliable service.

It is **unsafe** to operate this device without a basic understanding of water treatment and a thorough understanding of the contents of this manual. Inadequately treated water for hemodialysis poses a severe threat to the health and safety of hemodialysis patients. Education and training of the staff in these facilities is critical given the technically complex subject of water treatment. Guidelines and other related information are available from:

- Food and Drug Administration (FDA)
- National Association of Nephrology Technicians/Technologists (NANT)
- Association for the Advancement of Medical Instrumentation (AAMI)

Incoming tap water contaminants, temperature, pH, pressure, and flow-rates have a direct impact on the quality and quantity of the device's output. The operator must be aware of changing tap water conditions. This can be easily accomplished with good, two-way communications with the local municipal water supplier and with routine testing of the tap water.

## INITIAL START-UP of .03 MICRON FILTER

1. Verify the filter is installed (*if not see section Changing Filters*).
2. Start with all valves, sample ports, and drains closed.
3. Slowly open the inlet valve to allow water to begin filling the housing.
4. Partially open the outlet sanitary sample port to allow air to be purged from the device.
5. When steady stream of water flows from the sanitary sample port, signaling that the air has been purged from the device, close the sanitary sample port.
6. Let the filter soak for 10 minutes at 45 psi (minimum).
7. Slowly open the outlet valve fully to allow water to flow through the device.
8. The filter is now on-line and ready for use.

## DAILY OPERATION

1. This device does not require any specific daily operation procedures, other than that the valves are in the proper position for normal operations.

## MONITORING PROCEDURES

The Cartridge Based Pyrogen Filtration System **must be monitored** on a **daily** basis by a **qualified technician** recording the items listed below on a **Quality Assurance Checklist**.

1. The filter gauges should be checked with water flowing, when there is **NO** demand for purified water.

### 2. Monitoring Requirements: (record on the Quality Assurance Checklist)

- a. Filter system Inlet Pressure
- b. Filter system Outlet Pressure
- c. Bacteria/Endotoxins (*check at least monthly; more often if necessary*) must meet established standards

## DAILY SHUTDOWN

1. This device does not require any daily shutdown.

## VALVES LEGEND and OPERATION

\* NOTE: Valve legend and operation the same for all models, no matter the header construction or filter housing size.

\* NOTE: Inlet and Outlet valves may be reversed if the device requires Right-to-Left flow configuration. Reference labeling for proper valve identification.

### 1. Bypass Valve

Open to prevent water from entering the device, and closed to allow water into the device to be filtered.

\* CLOSED during normal operation

### 2. Inlet Valve

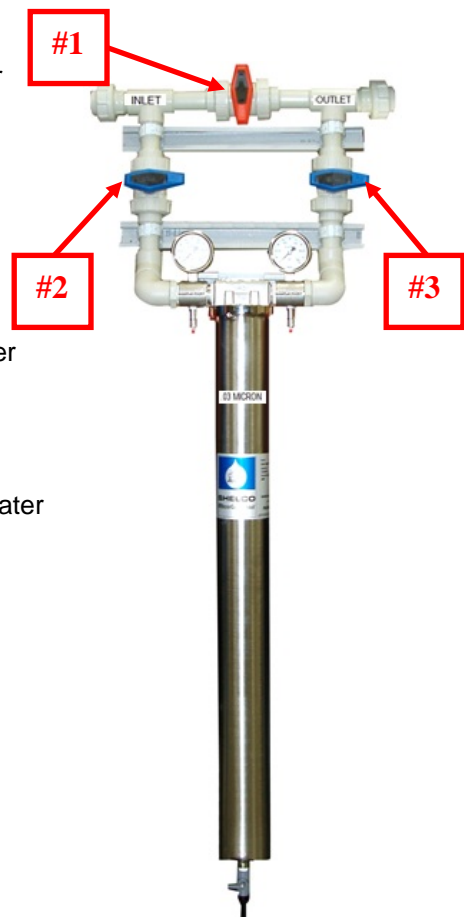
Open to allow water into the device, and closed to prevent water from entering the device.

\* OPEN during normal operation

### 3. Outlet Valve

Open to allow water to exit the device, and closed to prevent water from exiting the device.

\* OPEN during normal operation



## DISINFECTING OVERVIEW

The Cartridge Based Pyrogen Filtration System is disinfected as a component of the Post-Treatment and/or Distribution Segment of the water treatment system. The disinfecting schedule is determined by the Medical Director and the results of bacteria and endotoxins test, but Better Water LLC recommends disinfecting monthly.

The use of typical household bleach (5.25%) is common for use in disinfecting water treatment systems for hemodialysis. Bleach is a cost effective disinfectant and generally produces satisfactory results. Varying concentrations of Sodium Hypochlorite (bleach) are used among dialysis facilities for disinfection.

- a. 5.25% household bleach is 50,000 ppm Sodium Hypochlorite
- b. 6% household bleach is 60,000 ppm Sodium Hypochlorite

Better Water LLC recommends using IRON FREE bleach. Care should be taken to select iron free bleach because many discount or generic brands will have high iron content. Iron will be harmful to the equipment and shorten its lifespan.

**\* WARNING: DO NOT USE "SPASH-LESS" BLEACH. The content of "splash-less" bleach may damage the equipment, and will create foam.**

**\* WARNING: Ozone should not be used as a disinfectant on the .03 micron Cartridge Based Pyrogen Filter System, because the filters will be damaged.**

## BLEACH SOLUTION FOR TANK FEED SYSTEMS

**- NOTE: Bleach will only be used on Tank Feed Systems**

- a. 500 ppm solution of sodium hypochlorite (*bleach*)

This is 1 gallon (128 ounces) of bleach per 100 gallons of water or a **1:100 dilution**

5.25% = 500 ppm dilution      Water Gallons x 1.28 = ounces of bleach 5.25%

6% = 600 ppm dilution      Water Gallons x 0.96 = ounces of bleach 6%

**\* Total water gallons should include gallons in the tank as well as the loop.**

- b. Recommended dwell time is **30-60 minutes**

**\* See Appendix A for other bleach dilution ratios and pipe volume calculations, and 3 feet per second flow velocity rates if needed.**

## RENALIN / MINNCARE SOLUTION FOR DIRECT FEED or TANK FEED SYSTEMS

**- NOTE: Renalin / Minncare can be used on Direct Feed or Tank Feed Systems**

- a. 1% Renalin / Minncare solution at a 1:25 dilution

This is 750 ml (25.36 ounces) of Renalin / Minncare per 25 gallons of water or **1:25 dilution**

**\* Total water gallons should include gallons in the tank as well as the loop.**

- b. Recommended dwell time is **2-4 hours**

## DISINFECTING PROCEDURE

1. The .03 micron Cartridge Based Pyrogen Filter System is disinfected as a component of the Post-Treatment and/or Distribution Segment of the water treatment system. Better Water LLC recommends that this filter assembly be disinfected monthly or more often if necessary.
2. Slowly open and close the bypass valve a few times during the disinfect process to allow the bypass ball valve and associated piping to be disinfected.
3. Slowly open and close the sanitary sample ports a few times during the disinfect process to allow these ports to be disinfected.

4. Slowly open and close the bypass valve a few times during the disinfect rinse process to allow the bypass ball valve and associated piping to be rinsed.
5. Slowly open and close the sanitary sample ports a few times during the disinfect rinse process to allow these ports to be rinsed.

## **SANITIZING THE SANITARY SAMPLE PORTS**

Sanitize the sanitary sample ports immediately BEFORE each sampling operation.

1. Turn the port stem to the left to open and allow a full flow of liquid to pass out of the port for 1-2 minutes. Then close the port by turning the stem to the right.
2. Fill a 20 ml plastic polypropylene syringe with at least 10 ml of 70% ethanol, 90% isopropyl alcohol, or 3% hydrogen peroxide solution. Attach the port-needle to the syringe.
3. Insert the needle all the way into the port through the stem opening, and express most of the sanitant into the port. Allow a few milliliters to flow out of the port outlet.
4. As the needle is removed from the opening, squirt the remaining few milliliters of sanitant over the outer surface of the stem.
5. When ready to sample, open the port for 1 to 2 minutes to allow product water to rinse the residuals and any endotoxins from the sample port before sampling.

**SYSTEM MAINTENANCE, General**

<b>Maintenance Task</b>	<b>Frequency (more often if needed)</b>	<b>Notes</b>
Check the system for leaks	Daily	Visual Inspection
Clean external surfaces	Weekly	Use a soft, damp towel or sponge. <b>(DO NOT USE BLEACH)</b>
Record operational values, pressures	Daily or more often as required by the facility	Record on a Daily Checklist
Change particulate filter cartridges	Every 6 months or if there is a pressure drop across the device greater than 15 psi while the RO is running	See Changing Filter section
Perform chemical, microbial, and endotoxin testing on feed and product water as per AAMI requirements	Schedule established by the Medical Director	Submit samples to a qualified testing laboratory

## SYSTEM MAINTENANCE, Changing the Filter

Better Water LLC, recommends that the .03 micron Pyrogen filter be changed **every 6 months**, unless otherwise dictated by, bacteria/endotoxin testing, and/or higher Delta-P pressure across the system.

1. Start with all valves, sample ports, and drain ports closed.
2. Open the drain port on the bottom of the housing to allow the water to drain completely from the system. Close drain port when water flow stops.
3. Unscrew the filter housing to remove it from the device.
4. Remove the old filter, and replace with the new filter.
5. Verify the o-ring in the top of the housing is properly seated, then turn and lock into place.
6. Screw the filter housing back into place, and hand-tighten.
7. Slowly open the inlet valve to allow water to begin filling the housing.
8. Partially open the outlet sanitary sample port to allow air to be purged from the device.
9. When water flows from the sanitary sample port, signaling that the air has been purged from the device, close the sanitary sample port.
10. Let the filter soak for 10 minutes at a minimum of 45 psi and check for leaks.
11. Slowly open the outlet valve fully to allow water to flow through the device.
12. Perform a disinfect.
13. The filter is now on-line and ready for use.



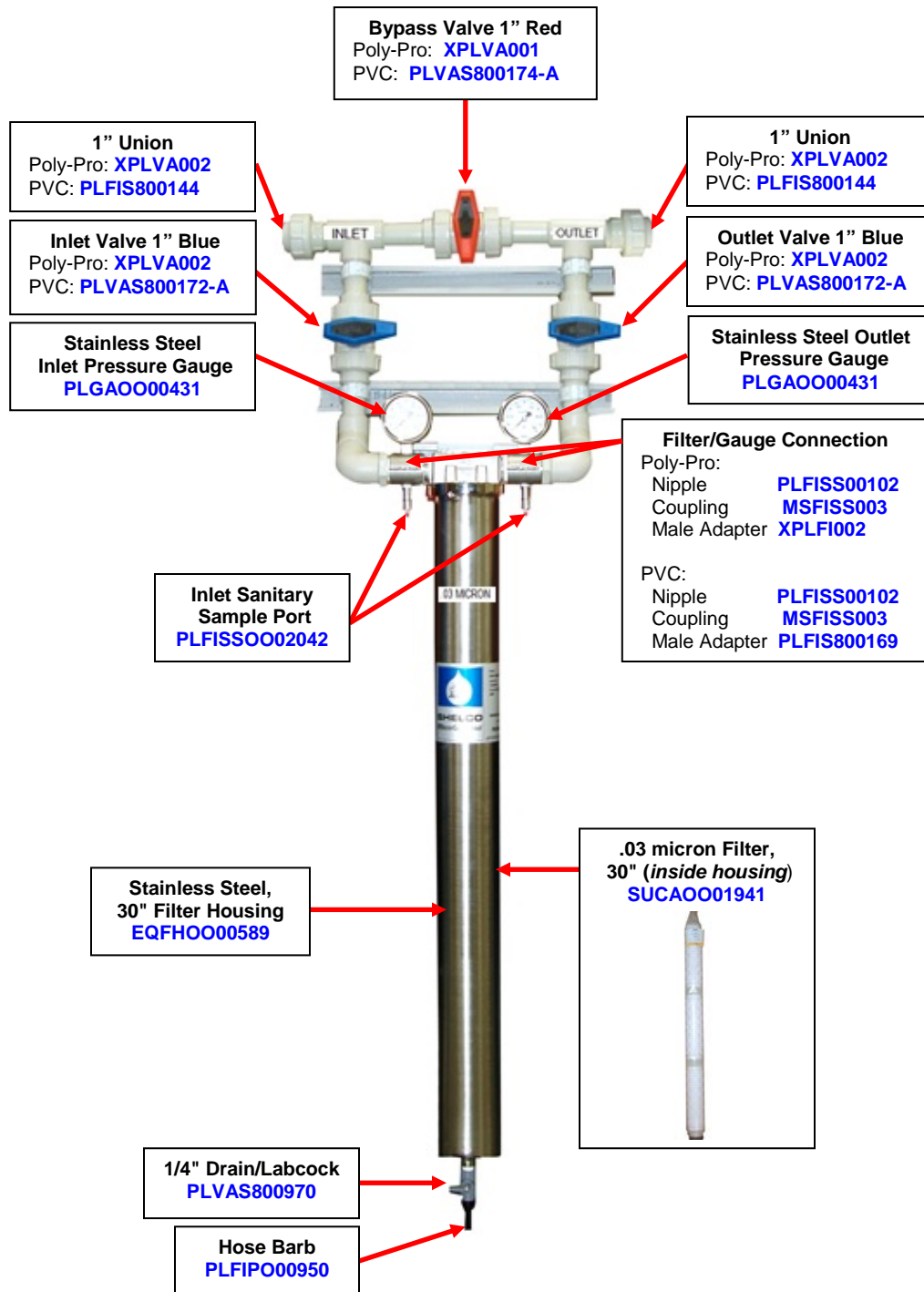
part#  
**SUCAO01941**  
30", .03 Micron Filter



part#  
**SUCAPE00575**  
20", .03 Micron Filter

## SERVICE HELP: 30" .03 micron Filter Housing

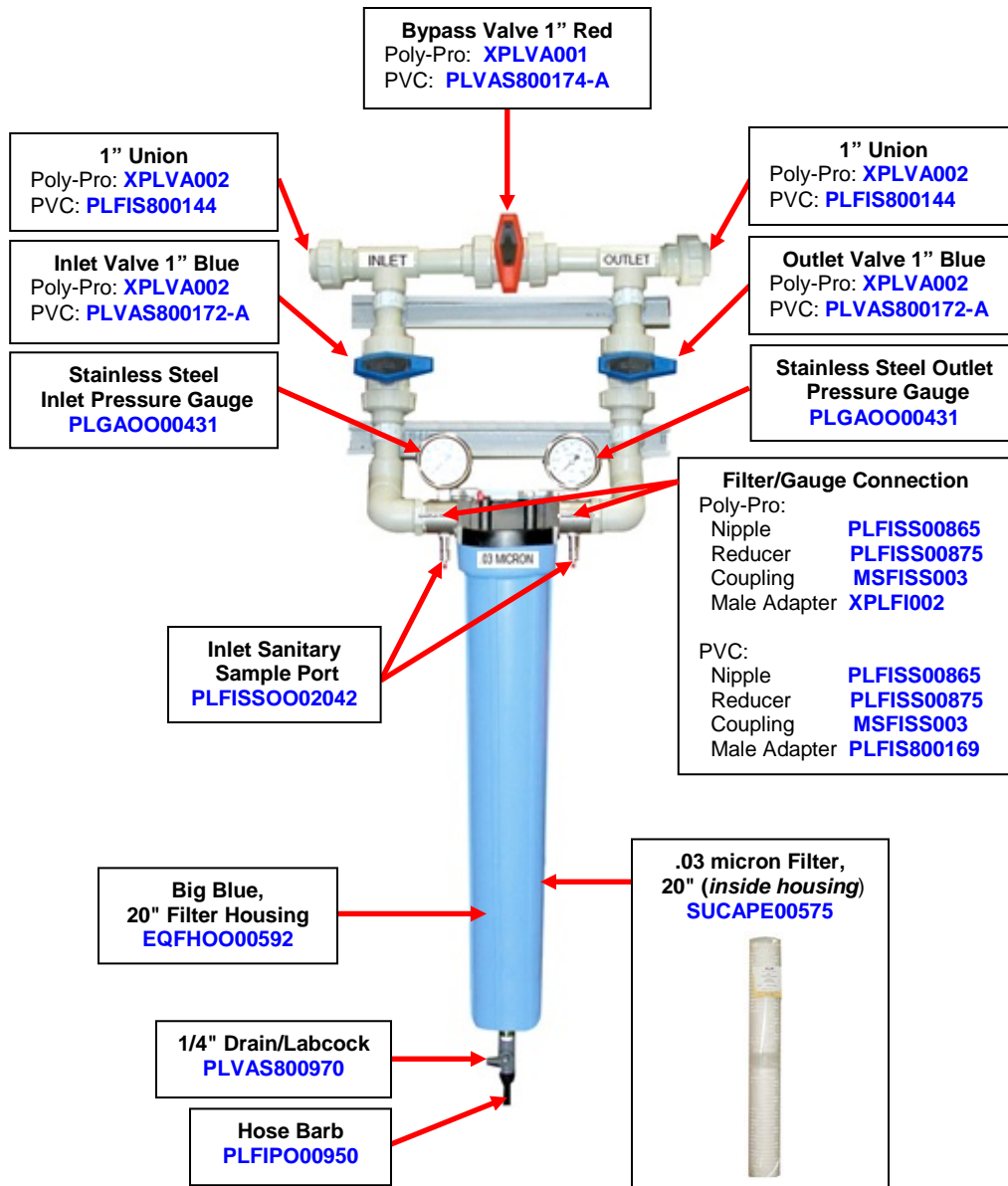
\* NOTE: Poly-Pro model shown, but PVC part numbers specified as well where different.





**SERVICE HELP: 20" .03 micron Filter Housing**

\* NOTE: Poly-Pro model shown, but PVC part numbers specified as well where different.



## TROUBLE-SHOOTING GUIDE

The information in this document is intended to serve as a guide only for qualified operators. It is not all inclusive of the problems that may be encountered. This guide should aid operators with reminders and routine trouble-shooting tasks.

For any problem outside the confines of this guide, call for technical assistance.

<b>Problem</b>	<b>Possible Causes</b>	<b>Possible Solutions</b>
<b>The product (permeate) pressure has decreased</b>	<ol style="list-style-type: none"> <li>1. Filter is fouled</li> <li>2. Filter exceeds recommended change out time</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the inlet pressure to the filter system.                             <ul style="list-style-type: none"> <li>- If the inlet pressure has decreased below design specification (<b>30-100 psi</b>); adjust the pressure regulator at the loop return at the reservoir to increase the inlet pressure.</li> </ul> </li> <li>2. Perform a disinfect</li> <li>3. If disinfection does not correct the problem, the Pyrogen filter must be replaced.</li> </ol>
<b>The product (permeate) water is contaminated with microbiological contaminants (bacteria and/or endotoxins)</b>	<ol style="list-style-type: none"> <li>1. Filter ruptured</li> <li>2. Missing or damaged o-ring</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the filter system inlet pressure.                             <ul style="list-style-type: none"> <li>- If the <math>\Delta P</math> is lower than normal there is the possibility that the filter has ruptured or an o-ring is missing or damaged. Replace the filter and/or o-ring.</li> </ul> </li> </ol>
<b>The product (permeate) water is contaminated with microbiological contaminants (bacteria and/or endotoxins)</b>	<ol style="list-style-type: none"> <li>1. Filter is fouled</li> <li>2. Filter exceeds recommended change out time</li> <li>3. Improper disinfection</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform a disinfect</li> <li>2. If disinfection does not correct the problem, the Pyrogen filter must be replaced.</li> </ol>
<b>The pressure drop is greater than 15 psi</b>	<ol style="list-style-type: none"> <li>1. Filter is fouled</li> <li>2. Filter exceeds recommended change out time</li> </ol>	<ol style="list-style-type: none"> <li>1. Perform a disinfect</li> <li>2. If disinfection does not correct the problem, the Pyrogen filter must be replaced</li> </ol>

## LIMITED WARRANTY TERMS and CONDITIONS

- a. This limited warranty is given only to the original buyer and covers the equipment delivered with this limited warranty.
- b. The buyer shall be barred from any recovery on this limited warranty or otherwise for damages due in whole or in part to...
  - ... unreasonable use
  - ... improper operation
  - ... use beyond normal fashion
  - ... failure to follow instructions
  - ... failure to maintain the product in good condition and repair
  - ... or the like.
- c. If the buyer discovers or should have discovered a defect in which it is reasonable to conclude that damage, either personal, property, or economic, may result, the buyer's continued use of the product shall constitute any assumption of risk by the buyer and a bar to any recovery for breach of this limited warranty or otherwise.
- d. No oral or written representation, information, or advice given by Better Water LLC or any of its representatives shall create a warranty or in any way increase the scope of this express limited warranty and shall not form a part of the basis for bargain.

## WHAT IS WARRANTED AND FOR HOW LONG?

- a. All equipment, excluding ion exchange and filtration media and cartridges, are warranted to be free from factory defects in materials, and workmanship under normal use for a period of one (1) year from the date of shipment.
- b. It is a condition precedent to recovery on this limited warranty that the buyer strictly comply with all operating and maintenance guidelines established by Better Water LLC and that the serial number (*if applicable*) is intact and legible on the equipment.
- c. It is a condition precedent to recovery on this limited warranty for damage to the external finish of the equipment that the buyer notifies Better Water LLC at the time of the installation that the finish is damaged.

## WHAT IS REMEDY FOR BREACH OF THIS LIMITED WARRANTY or NEGLIGENCE BY BETTER WATER LLC

- a. Buyer's sole and exclusive remedy for any breach of this limited warranty or negligence by Better Water LLC shall be repair or replacement of the defective part, at the option of Better Water LLC, provided such defective part is returned to Better Water LLC for inspection.
- b. Better Water LLC shall not be obligated to supply an exact replacement of the defective part and reserves the right to substitute new and improved parts.
- c. Better Water LLC shall provide at no cost to buyer, labor to remove and/or replace defective parts covered by this limited warranty for a period of ninety (90) days from the date of installation by Better Water LLC of the equipment.
- d. After such ninety (90) day period, buyer shall be responsible for any labor or service charge for the removal and/or replacement of any defective parts.
- e. Buyer shall be responsible for all travel expenses and freight charges at all times.
- f. Better Water LLC shall have no obligation to repair or replace any defective part if buyer fails to follow the procedure set forth in "HOW TO OBTAIN A REPLACEMENT PART UNDER LIMITED WARRANTY".

***IN NO EVENT SHALL THIS LIMITED WARRANTY BE CONSTRUED TO COVER, NOR SHALL BETTER WATER LLC BE LIABLE TO BUYER AS ANY OTHER PERSON FOR, ANY CONSEQUENTIAL, INCIDENTAL, ECONOMIC, DIRECT, INDIRECT, GENERAL OR SPECIAL DAMAGES, WHICH ARE HEREBY EXPRESSLY DISCLAIMED.***

## HOW TO OBTAIN A REPLACEMENT PART UNDER LIMITED WARRANTY

- a. Buyer should contact the Customer Service or Technical Support Departments and request a Return Goods Authorization.

- b. Described part(s) will be sent with a purchase order.
- c. The returned part(s) will be returned to the factory for limited warranty consideration. If part(s) are not covered under the limited warranty, part(s) will be considered billable against the purchase order supplied.

**WHAT IS NOT COVERED BY THIS LIMITED WARRANTY:**

By way of example and not limitation, this limited warranty does not cover:

- Damage to or replacement of any ion exchange resin or filter media
- Labor or service charges for the removal and/or replacement of any defective parts after the ninety (90) day period from the date of installation or sale by Better Water LLC
- Freight charges and travel expenses
- Damage from inadequate or defective wiring, improper voltage, improper connections or electrical service, inadequate or defective plumbing, water supply, or water pressure, or in violation of applicable building, plumbing or electrical codes, laws, ordinances or regulations.
- Damage from improper installation or operation, including but not limited to, abuse, accident, neglect, improper maintenance, freezing and fires, or abnormal use.
- Damage caused by contaminants in Buyer's water supply, including hardness, chlorine, chloramines, sulfur, bacterial iron, tannin, algae, oil, organic matter or other unusual substances, if special equipment has not been installed by Better Water LLC to remove such contaminants
- Damage to or caused by filters/membranes or other replacement parts not purchased from Better Water LLC or damage caused by modification, alteration, repair or service of the equipment or any of its parts by anyone other than Better Water LLC or its expressly authorized representatives.

## APPENDIX A: CALCULATIONS & CONVERSIONS

### BLEACH DISINFECTING DILUTIONS

a. 5.25% household bleach is 50,000 ppm Sodium Hypochlorite

b. 6% household bleach is 60,000 ppm Sodium Hypochlorite

#### 1:50 Dilution

5.25% = 1000 ppm

6% = 1200 ppm

Tank Gallons x 2.56 = ounces of bleach 5.25%

Tank Gallons x 1.92 = ounces of bleach 6%

#### 1:100 Dilution

5.25% = 500 ppm

6% = 600 ppm

Tank Gallons x 1.28 = ounces of bleach 5.25%

Tank Gallons x 0.96 = ounces of bleach 6%

#### 1:500 Dilution

5.25% = 100 ppm

6% = 120 ppm

Tank Gallons x 0.64 = ounces of bleach 5.25%

Tank Gallons x 0.48 = ounces of bleach 6%

#### 1:1000 Dilution

5.25% = 50 ppm

6% = 60 ppm

Tank Gallons x 0.128 = ounces of bleach 5.25%

Tank Gallons x 0.096 = ounces of bleach 6%

## CONVERSION FORMULAS

### OUNCES to MILLILITERS

Formula: **Fluid Ounces x 29.6 = Milliliters**

*Example: 128 oz x 29.6 = 3790 milliliters*

### MILLILITERS to OUNCES

Formula: **Milliliters / 29.6 = Ounces**

*Example: 750 ml / 29.6 = 25.34 ounces*

### GALLONS to OUNCES

Formula: **Gallon \* 128 = Ounces**

*Example: 1 gal \* 128 = 128 ounces*

### OUNCES to GALLONS

Formula: **Ounces / 128 = Gallons**

*Example: 128 ounces / 128 = 1 Gallon*

## CALCULATION for AREA of PIPE VOLUME

To calculate the cross sectional area of pipe, use the following formula:  $\text{Area} = \pi \times r^2$

-  $\pi = 3.14$

-  $r$  = radius (which is  $\frac{1}{2}$  the diameter)

**The following calculation uses a 1" diameter pipe as an example:**

Calculate the cross sectional area of the pipe using the formula above:

- |   |  |
|---|--|
| 1. divide the diameter by 2 to get the radius in inches   | $1" \text{ diameter} / 2 = 0.5 \text{ inches}$ |
| 2. divide the radius by 12 to convert from inches to feet | $0.5 / 12 = 0.0417 \text{ feet}$               |
| 3. square the radius                                      | $0.0417^2 = .00174 \text{ sq ft}$              |
| 4. Multiply by pi   | $0.00174 \times 3.14 = .00546 \text{ sq ft}$   |

**Answer:** the area of a 1" diameter pipe is 0.00546 ft<sup>2</sup>

## 3 FEET per SECOND FLOW VELOCITY RATES

### Nominal Loop Pipe Inner Diameter

3/4" Teflon id	=	0.60in.
3/4" schedule 80 pvc id	=	0.74in
1" Teflon id	=	0.88in
1" schedule 80 id	=	0.96in
1 1/2" schedule 80 id	=	1.48 in
3/4" (25mm) polypropylene id	=	0.80in
1" (32mm) polypropylene id	=	1.03in
1 1/2" (50mm) polypropylene id	=	1.61 in

### Nominal Flow Rates at 3 Feet per Second

3/4" Teflon	=	2.64 gpm @ 3ft/sec (Nominal)
3/4" schedule 80 pvc	=	4.02 gpm @ 3ft/sec (Nominal)
1" Teflon	=	5.69 gpm @ 3ft/sec (Nominal)
1" schedule 80	=	6.77 gpm @ 3ft/sec (Nominal)
1 1/2" schedule 80	=	16.1 gpm @ 3ft/sec (Nominal)
3/4" (25mm) polypropylene	=	4.70 gpm @ 3ft/sec (Nominal)
1" (32mm) polypropylene	=	7.79 gpm @ 3ft/sec (Nominal)
1 1/2" (50mm) polypropylene	=	19.0 gpm @ 3ft/sec (Nominal)

**a.** All 3ft/sec flow rates at the loop return flow meter are calculated for the loop inner diameter only.

**b.** The above flow rates should be set with all dialysis machines running.

**c.** If bicarb or acid makeup water is required, both should have the proper flow controls to maintain flow velocity.

