DEFENDER® REGENERATIVE MEDIA FILTER MANUAL

DEFENDER® RMF SYSTEM

OPERATION & MAINTENANCE MANUAL

evoqua WATER TECHNOLOGIES

Revised 10/2022

PREFACE

Disclaimer Statement

This operation and maintenance manual (O&M) references component manufacturers' manuals. Along with this O&M, these manuals (OEMs) should provide complete and accurate information to meet operating and/or service requirements based on the information available at the time of publication. However, Evoqua Water Technologies assumes no responsibility for the technical content of the component manufacturers' OEM manual.

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EVOQUA WATER TECHNOLOGIES, LLC.

www.evoqua.com

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GENERAL INFORMATION

Introduction

Established in 1956, Neptune Benson has proudly served the commercial aquatics industry for over six decades. Our Defender® line of regenerative media filters has become synonymous with the term “RMF” in the industry. With over 20,000 installations in 45 countries, we have the filtration and disinfection experience to help meet your water quality needs, while keeping sustainability and safety of your guests top of mind.

The Neptune Benson Defender Regenerative Media Filter System has been specifically developed to provide aquatics venues with the clearest, cleanest and safest water possible. The Defender RMF System will be one of the following configurations:

- Defender SP in 27”, 33”, 41”, 49” and 55” Models
- Defender SP Reduced Height in 27”, 33”, 41”, 49” and 55” Models
- Defender SP Assero in the 29” Model

This manual describes the basic steps to install, operate, and maintain this system and supplies project drawings and documents, and any details that are specific to this project.

Read this manual completely before installing, operating, or maintaining the system to learn about the system. If questions arise that this manual does not specifically answer, contact Technical Support for assistance at the information provided below:

Evoqua Water Technologies, LLC - Neptune Benson, Inc.

Technical and Aftermarket Parts Support: +1-800-832-8002 (toll-free) +1-401-821-2200 (toll)

E-mail: nbtechsupport@evoqua.com

Standards and Regulations

The Defender filter conforms to the following standards and regulations:

1. NSF50
2. CE

The Defender filter controller conforms to the following standards and regulations:

1. UL
2. CE
3. IEC

Terms and Definitions

Agitation – Mechanical or manual movement to dislodge filter aid and dirt from the filter element.

Bump – The process which removes the filter aid. See Agitation.

Diatomite-type Filter – A pressure or vacuum type device designed to filter water through a thin layer of filter aid.

Differential pressure – Effluent pressure subtracted from the influent pressure of the filter.

Effluent – The treated water stream emerging from a unit, system, or process.

Filter Aid – Finely divided medium used to coat a flextube of a diatomite-type filter.

Flextube – The filter element on which the filter aid is deposited.

Head Loss – Total Pressure drop in psi or feet of water between the inlet and outlet of a component.

Influent – The untreated water stream entering a unit, system, or process.

Precoat – Layer of filter aid on flextube of a diatomite-type filter at the beginning of a filter cycle

Regen – The cycle which applies the filtration media to the flextubes.

RMF – Regenerative Media Filter. See Diatomite-type Filter.

Working Pressure – Maximum operating pressure recommended by manufacturer.

Health and Safety

Safety Guidelines

Safety precautions protect against accidents such as personal injury. They may also prevent damage to equipment and facilities, as well as undesirable process occurrences. These measures may also maximize operational efficiency by minimizing downtime, maximizing productivity, or improving overall operating effectiveness.

Warning labels have been placed on the equipment to remind the operator of certain hazards. Specific personal and product safety notification are also provided within the procedures of this manual. For more information about these messages, see the Cautions and Warnings section in the Appendix.

However, the notifications in this manual and the warning labels do not replace the need to be alert and use common sense when using the equipment.

All personnel should be thoroughly familiar with the procedures contained in this manual. It is the responsibility of the owner to ensure that the equipment is used properly and safely, strictly following the instructions contained in the manual.

Safety Notices

Safety notices are located throughout this manual at the point where the risk is encountered. The notices employ the latest ISO style format for personal risk notifications and typical “technical manual” style notices for product notifications. See the Cautions and Warnings section in the for further information.

System Safety Precautions

The following safety precautions are relevant to the installing and operating the Defender® RMF system as described in this manual.

⚠ WARNING

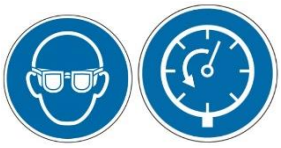
POTENTIAL ELECTRICAL HAZARDS EXISTS WHEN SERVICING THE LOCAL CONTROL PANELS, PUMPS, MIXERS, AS WELL AS SKID-MOUNTED AND TANK-MOUNTED INSTRUMENTATION.

ALWAYS ISOLATE ELECTRICAL POWER SUPPLIES BEFORE SERVICING POWERED EQUIPMENT AND DEVICES. AFTER ISOLATING, ALLOW AT LEAST 30 SECONDS FOR POWER TO DISSIPATE.

⚠ CAUTION

Potential moving parts hazard exists when servicing or inspecting centrifugal pumps, motors, and/or bump mechanism.

Turn off control to pumps, motors before servicing. Do not operate without guards in place.

⚠ CAUTION		
	Potential high-pressure hazards exist while servicing high-pressure air supply lines and disconnecting any compressed air tubing leading to the pneumatically actuated control valves. Wear eye protection and ensure pressures are relieved before servicing high-pressure air lines and equipment.	

⚠ CAUTION		
	This system may use chemicals that may be highly corrosive. Severe burns or blindness may occur upon contact, or prolonged inhalation may result in severe irritation to mucous membranes. And contact with metals may become corrosive. Wear the proper Personal Protective Equipment (PPE) when handling these chemicals—see the SDS supplied with each chemical for exact risks and precautions to take.	

Safety Data Sheets

A description of any chemicals that may be used for operating and cleaning, as well as guidelines for handling, care and other pertinent topics are included in the Safety Data Sheets that are available upon request.

Delivery Safety Precautions

⚠ WARNING		
	*ALWAYS INSPECT LIFTING EQUIPMENT PRIOR TO USE.* *OUT OF SERVICE AND DAMAGED EQUIPMENT CAN FAIL IN SERVICE AND CAN CAUSE SEVERE PERSONAL INJURY AND/OR DAMAGE THE EQUIPMENT.*	

⚠ WARNING		
	*LIFT LOADS ONLY AS HIGH AS NECESSARY TO MOVE FROM ONE SURFACE TO ANOTHER.* *TOP HEAVY EQUIPMENT SKIDS MAY TIP-OVER AND FALL OFF OF LIFTING EQUIPMENT AND CAUSE SEVERE PERSONAL INJURY AND/OR DAMAGE THE EQUIPMENT.*	

CAUTION	DO NOT LIFT A SKID ATTACHING LIFTING DEVICES TO PIPING OR OTHER COMPONENTS. USE DEFINED LIFTING POINTS, LUGS OR EYELETS. FAILURE TO USE DEFINED LIFTING POINTS WILL DAMAGE THE FILTER WHICH MAY VOID THE WARRANTY AND CAN RESULT IN COSTLY DELAYS AND REPAIRS.

CAUTION	DO NOT SUBJECT VESSEL LEGS AND OTHER LIFT POINTS TO SIDE LOADS. DO NOT LIFT SKIDS UNEVENLY. SIDE LOADS MAY CAUSE DAMAGE TO THE EQUIPMENT FRAME AND HARM SYSTEM OPERATION WHICH MAY VOID THE WARRANTY AND CAN RESULT IN COSTLY DELAYS AND REPAIRS.

CAUTION	CAREFULLY UNLOAD AND MOVE FILTER, CONTROL PANEL AND EQUIPMENT CRATES. FAILURE TO DO SO MAY DAMAGE THE DELICATE INSTRUMENTS IN THE CONTROL PANEL OR SHIPPING CRATES WHICH MAY VOID THE WARRANTY AND CAN RESULT IN COSTLY DELAYS, REPAIRS OR REPLACEMENT.

Important	*Report shipping damage promptly to both Neptune Benson and the carrier to ensure repair or replacement. Avoid releasing equipment for installation until all damage claims and/or shortage problems have been resolved.*

Installation Safety Precautions

⚠ CAUTION

The weight of the skid presents a crush hazard.

Keep hands and feet from underneath skids and pallets during installation.

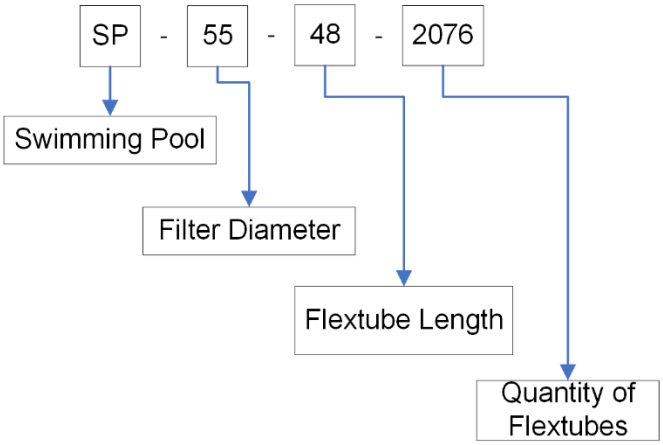
CAUTION	ALL EQUIPMENT MUST BE SECURELY ANCHORED TO THE FOUNDATION. UNANCHORED OR POORLY ANCHORED EQUIPMENT IS SUBJECT TO VIBRATION INDUCED MOVEMENT THAT CAN RESULT IN MISALIGNMENT AND DAMAGE TO PIPING COMPONENTS.

⚠ WARNING

VERIFY THAT ALL SUPPLIES OF SERVICE ELECTRICITY ARE DISCONNECTED OR SHUT OFF, AND ARE LOCKED-OUT BEFORE INSTALLING SERVICE TO THE SYSTEM.

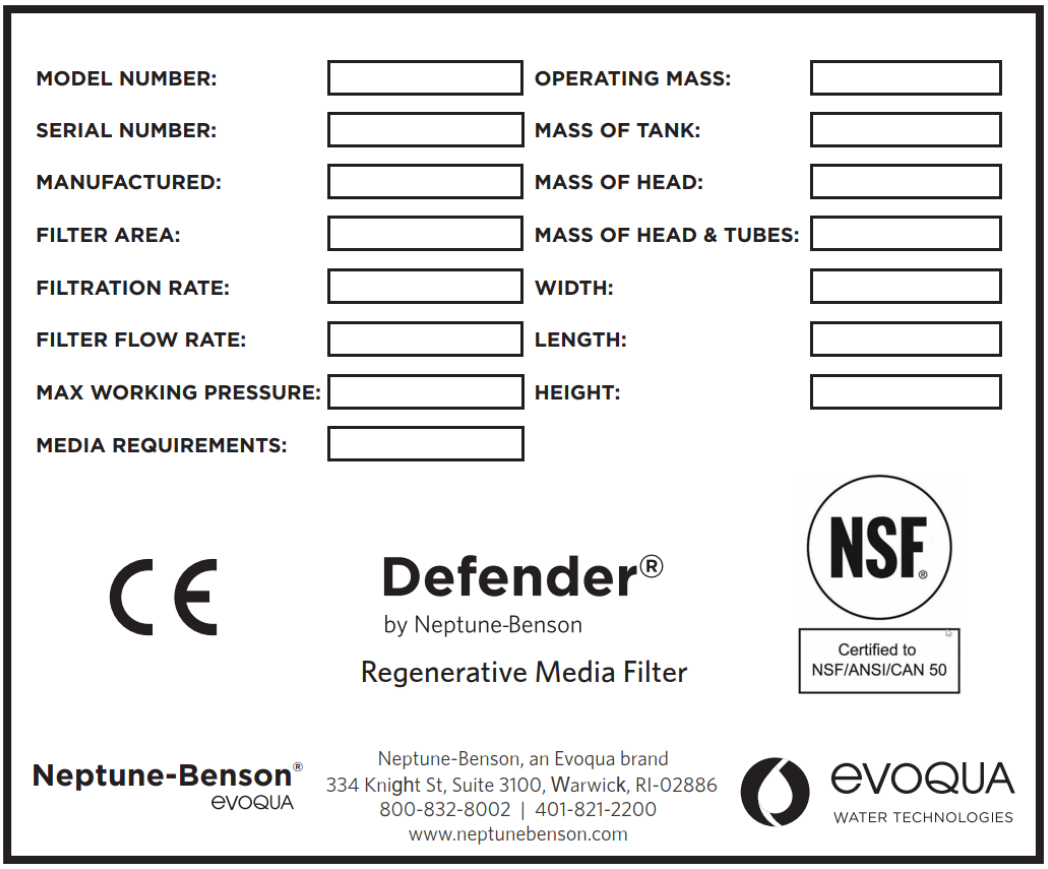
Labels and Data Plates

Model number guide:



Data Plate:

Every Defender will have its own unique data plate. The data plate contains critical information regarding the installation and operation of the filter. Removal of this data plate will void the filter's warranty.



Operating Limits

Filter Rate: 0.5 – 2 GPM/SF

Working Pressure: 50 psi

Maximum Differential Pressure: 15 psi

Storage Temperature: -25 to 120 degrees Fahrenheit, -31 to 48 degrees Celsius

Operating Temperature: 0 to 120 degrees Fahrenheit, -17 to 48 degrees Celsius

Maximum Chlorine Concentration: Do not exceed more than 5 ppm for continuous immersion. Do not exceed 25 ppm for greater than 24 hours.

pH: 7.2 - 7.8

Written evidence of ongoing daily compliance to the accepted Langlier saturation index and chemical levels appropriate for the Defenders intended use with recreational water is required.

Handling and Lifting

When receiving delivery of a Defender, a suitable method of lifting the filter will be required. Once the Defender is offloaded, it should be inspected for any obvious damage to the protective packaging. The packaging includes indicators which will tell if the Defender has fallen over. If this indicator has been tripped, please contact Neptune Benson.

The Defender filter is capable of being lifted in two ways.

1. Lifted from the top, by the lifting eyes.
2. Lifted from the bottom, via a pallet or special shipping legs on units too large for a pallet.

Defender filters are packaged so that damage from shipping is avoided. The protective wrapping and padding should be left in place until the Defender is ready for installation.

Long Term Storage

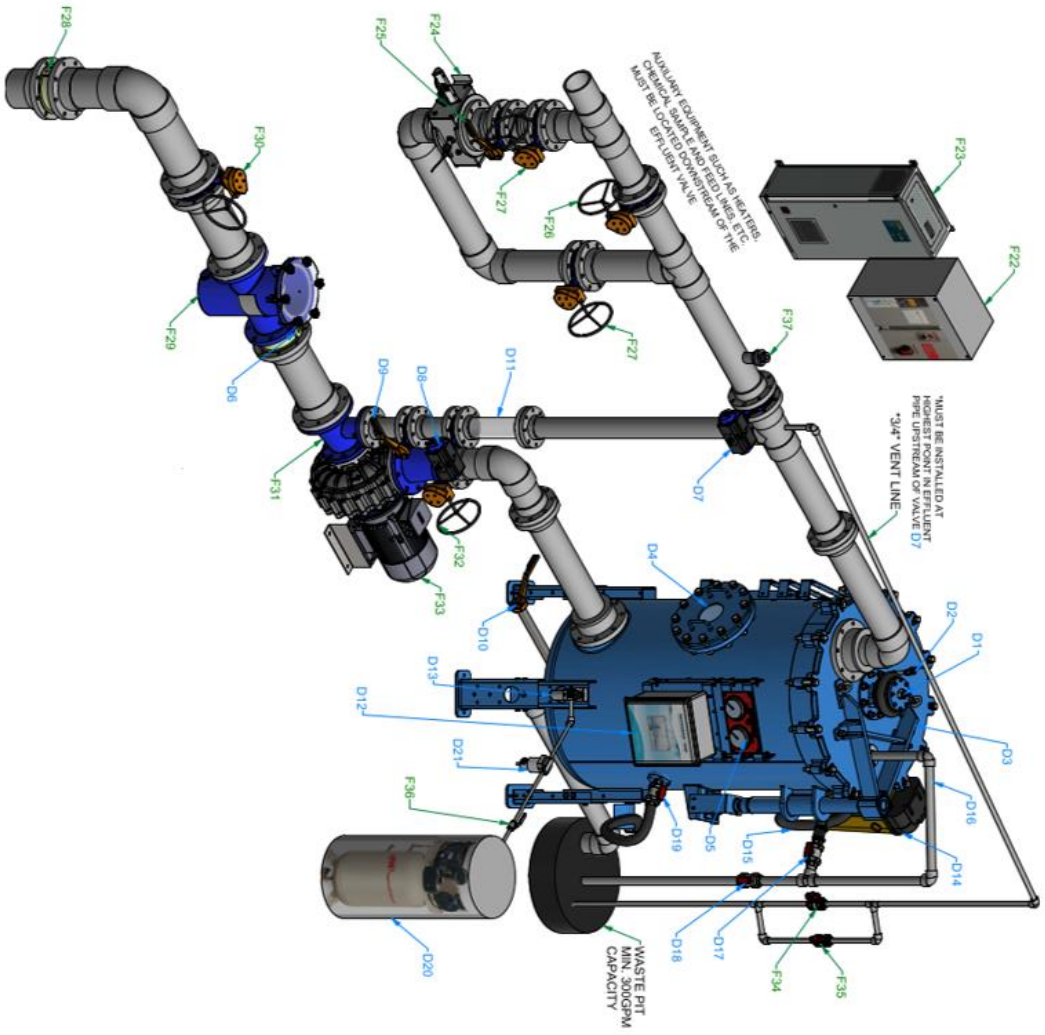
Defender filters may arrive on-site months before they are ready to be installed and long-term storage may be required. The following recommendations will ensure the Defender Filter is protected.

1. The protective wrapping should be left on the Defender until it is ready for installation.
2. Ambient temperature should not exceed -25 to 120 degrees Fahrenheit.
3. Defender should be placed on a firm foundation to ensure it will not tip over.

Before installation, the Defender should be unwrapped and inspected for any damage that may have occurred during transport or storage. It is important that the Bump tire be fully pressurized (70-90psi) before moving the Defender to its final position.

General Installation Schematic

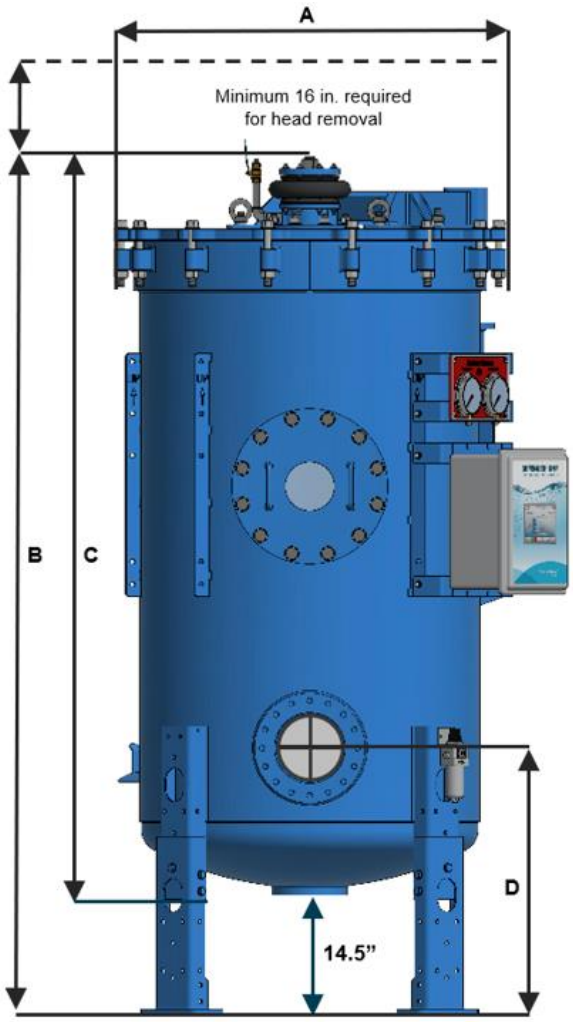
Mark	Reference	Notes
DEFENDER® FILTER COMPONENTS – INCLUDED IN DEFENDER® PACKAGE		
D1	Pneumatic Bump Assembly	
D2	Quick Exhaust Valve	
D3	Lifting Davit	
D4	Viewing Window	
D5	Gauge Panel	
D6	Influent Check Valve	Install directly on precoat line tee. Locate where valve position can be easily viewed
D7	Pneumatic Effluent Valve	
D8	Pneumatic Precoat Valve	Install as close as possible to pump suction piping. Precoat piping should be 2 pipe diameters smaller than effluent piping (no less than 2")
D9	System Fill Valve	Manually operated, normally open valve.
D10	Tank Drain Valve	Manually operated, normally closed valve. Extension is bolted directly to tank bottom. Must be plumbed independently to waste. Automated option available.
D11	In-line Sight Glass	Install on precoat line so it can be viewed while standing at filter control panel.
D12	RMF Control Panel	
D13	Filter Regulator	Set to 90 psi
D14	Vacuum Transfer Unit	Pre-wiring provided to RMF Control Panel.
D15	Vacuum Transfer Hose	
D16	Vacuum Transfer Piping & Fittings	SCH80 PVC fittings and pipe 1.5"
D17	Vacuum Transfer Valve	True union ball valve 1.5", normally closed
D18	Vacuum Vent Valve	True union ball valve 1.5", normally closed. Vacuum drain line must be plumbed independently to waste.
D19	Vacuum Hose Valve with Hose	True union ball valve 1.5", normally closed.
D20	Air Compressor	Optional
D21	Water Separator	
OPTIONAL FILTER ACCESSORIES - AVAILABLE UPON REQUEST		
Mark	**Reference**	**Notes**
F22	greenDrive™ VFD	Available in NEMA4X or with bypass
F23	Wafer™ UV Generator	Package includes control cabinet and treatment chamber.
F24	Wafer™ UV Chamber	Installed in vertical section of piping.
F25	EZ Clean Strainer	Installed on the effluent side of the UV chamber.
F26	UV System Bypass Loop	
F27	UV Isolation Valves	Gear or lever operated valves, normally open.
F28	Check Valve	For self-priming pumps, check valve must be installed on the suction pipe below water level.
F29	Guardian Strainer	Hair and lint strainer.
F30	Strainer Isolation Valve	Gear or lever operated valve, normally open.
F31	Precoat Reducing Tee	
F32	Pump Throttling Valve	Gear or lever operated valve, normally open.
F33	Recirculating Pump	
F34	3/4" Precoat Line Vent Valve	Ball Valve, normally closed. Must be plumbed independently to waste.
F35	3/4 Precoat Line Vent Auto Valve	Shown with automated option.
F36	1/2" Shut Off Valve	
F37	Flow Meter	4-20 mA Output



Equipment shown for schematic purposes only. Refer to project proposal and submittal for equipment supplied by Neptune Benson. Pneumatic tubing or wiring not shown for clarity.

DIMENSIONAL REFERENCE

Standard Defender



CAPACITIES & RATINGS

	Filter Area (ft²)	Flow Range (gpm)	Volume (gal)
SP-27-48-487	381	191 ↔ 762	159
SP-33-48-732	572	286 ↔ 1,144	250
SP-41-48-1038	812	406 ↔ 1,624	441
SP-49-48-1548	1,211	606 ↔ 2,422	615
SP-55-48-2076	1,625	813 ↔ 3,250	841

CONNECTION SIZES & FOOTPRINT

	Inlet/Outlet (in)	Drain (in)	Footprint (ft²)	Perlite (lbs)
SP-27-48-487	6.0	3.0	27.0	30.0
SP-33-48-732	8.0	3.0	33.0	45.0
SP-41-48-1038	8.0	4.0	44.0	64.0
SP-49-48-1548	10.0	4.0	58.0	96.0
SP-55-48-2076	12.0	4.0	72.0	128.0

DIMENSIONS

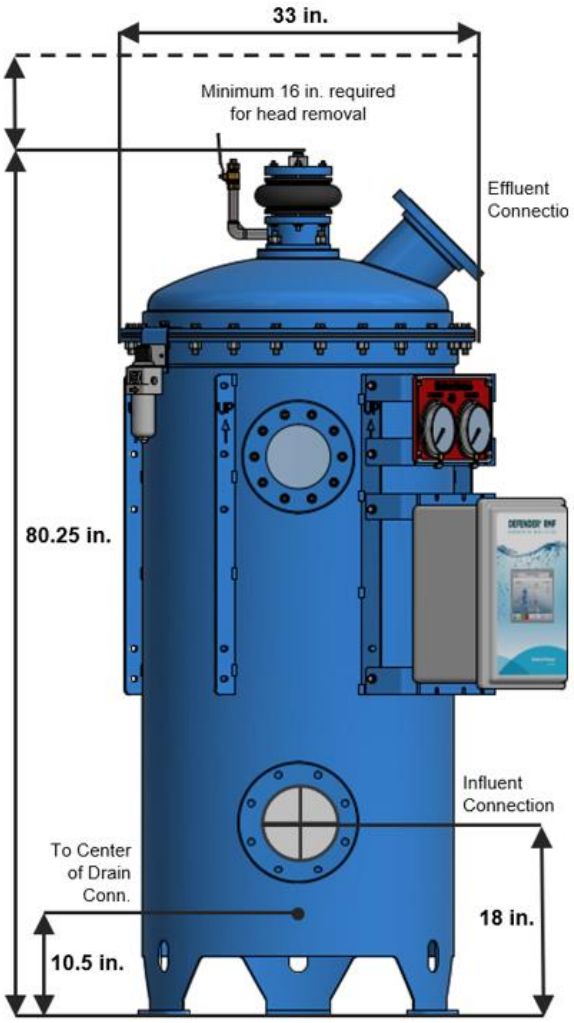
	A (in)	B (in)	C (in)	D (in)
SP-27-48-487	33.25	97.00	83.50	28.00
SP-33-48-732	38.50	103.25	89.75	31.00
SP-41-48-1038	47.00	104.75	91.25	32.50
SP-49-48-1548	54.00	109.25	95.75	35.00
SP-55-48-2076	61.25	110.50	97.00	36.00

WEIGHTS

	Head (lbs)	Head & Tubes (lbs)	Shipping (lbs)	Operating (lbs)
SP-27-48-487	350	680	1,650	2,970
SP-33-48-732	475	790	1,800	3,880
SP-41-48-1038	750	1,265	2,350	6,019
SP-49-48-1548	1,085	1,920	3,320	8,437
SP-55-48-2076	1,385	2,300	3,850	10,847

Note 1: Installed height (Dimension B) | Drain connection centerline (Dimension D)
Note 2: All standard and reduced-height models are NSF listed up to 2.0 gpm/ft²
Note 3: Flow rate range calculated based on filtration rate of 0.5 - 2.0 gpm/ft²
Note 4: Optimum performance achieved at filtration rate of 0.5 - 1.4 gpm/ft²
Note 5: Consult Neptune Benson for applications outside recommended range
Note 6: Inlet & outlet connection sizes based on 10.0 fps max pipe velocity
Note 7: Perlite media volume produces 1/8" cake for optimal performance
Note 8: Reduced height models with fixed position drain valve also available

Assero Defender



CAPACITIES & RATINGS

	Filter Area (ft²)	Flow Range (gpm)	Volume (gal)
SP-29-36-200	117	59 ↔ 234	181
SP-29-36-250	146	73 ↔ 292	181
SP-29-36-300	175	88 ↔ 350	181
SP-29-36-350	204	102 ↔ 408	181
SP-29-36-400	234	117 ↔ 468	181
SP-29-36-450	263	132 ↔ 526	181
SP-29-36-500	294	147 ↔ 588	181

CONNECTION SIZES & FOOTPRINT

	Inlet/Outlet (in)	Drain (in)	Footprint (ft²)	Perlite (lbs)
SP-29-36-200	3.0	3.0	9.5	9.0
SP-29-36-250	4.0	3.0	9.5	11.0
SP-29-36-300	4.0	3.0	9.5	13.0
SP-29-36-350	4.0	3.0	9.5	16.0
SP-29-36-400	6.0	3.0	9.5	18.0
SP-29-36-450	6.0	3.0	9.5	20.0
SP-29-36-500	6.0	3.0	9.5	22.0

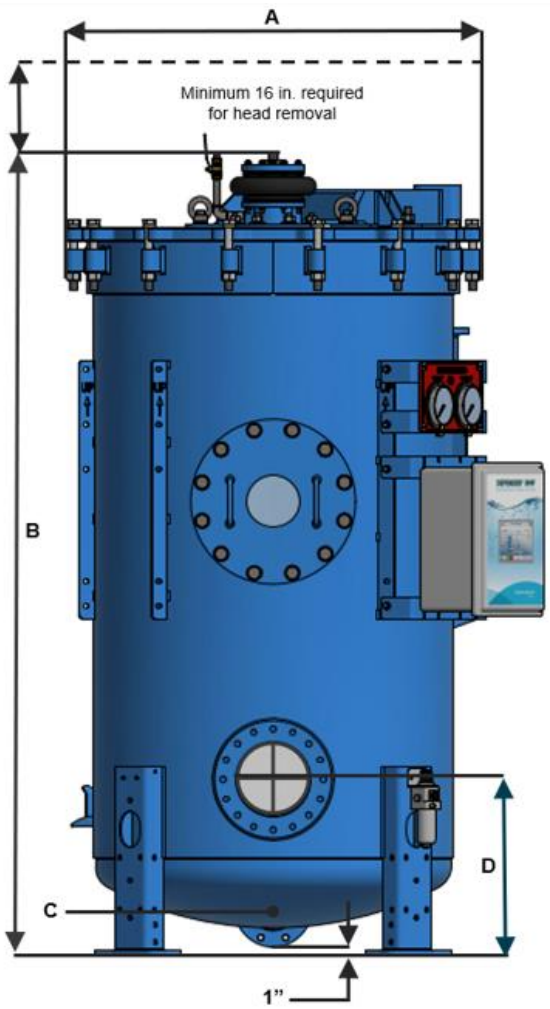
WEIGHTS

	Head (lbs)	Head & Tubes (lbs)	Shipping (lbs)	Operating (lbs)
SP-29-36-200	170	350	735	2,250
SP-29-36-250	170	365	750	2,265
SP-29-36-300	170	380	765	2,280
SP-29-36-350	170	395	780	2,295
SP-29-36-400	170	410	795	2,310
SP-29-36-450	170	425	810	2,325
SP-29-36-500	170	440	825	2,340

Note 1: Installed height 82" | Drain connection centerline 10.5"
Note 2: All Defender Assero models NSF listed up to 2.0 gpm/ft²
Note 3: Flow rate range calculated based on filtration rate of 0.5 - 2.0 gpm/ft²
Note 4: Optimum performance achieved at filtration rate of 0.5 - 1.4 gpm/ft²
Note 5: Consult Neptune Benson for applications outside recommended range
Note 6: Inlet & outlet connection sizes based on 10.0 fps max pipe velocity
Note 7: Perlite media volume produces 1/8" cake for optimal performance
Note 8: Additional sizes of Defender® filters available in standard or reduced height

Reduced Height Defender

Reduced Height Defender



CAPACITIES & RATINGS

	Filter Area (ft²)	Flow Range (gpm)	Volume (gal)
SP-27-48-487-R	381	191 ↔ 762	159
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	Head (lbs)	Head & Tubes (lbs)	Shipping (lbs)	Operating (lbs)
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Note 1: Installed height (Dimension B) | Drain connection centerline (Dimension D)
Note 2: All standard and reduced-height models are NSF listed up to 2.0 gpm/ft²
Note 3: Flow rate range calculated based on filtration rate of 0.5 - 2.0 gpm/ft²
Note 4: Optimum performance achieved at filtration rate of 0.5 - 1.4 gpm/ft²
Note 5: Consult Neptune Benson for applications outside recommended range
Note 6: Inlet & outlet connection sizes based on 10.0 fps max pipe velocity
Note 7: Perlite media volume produces 1/8" cake for optimal performance
Note 8: Standard height models with multi-position drain valve also available

Installation

The filter contains internal parts that are vertically deployed. Always transport and handle the filter in an upright position.

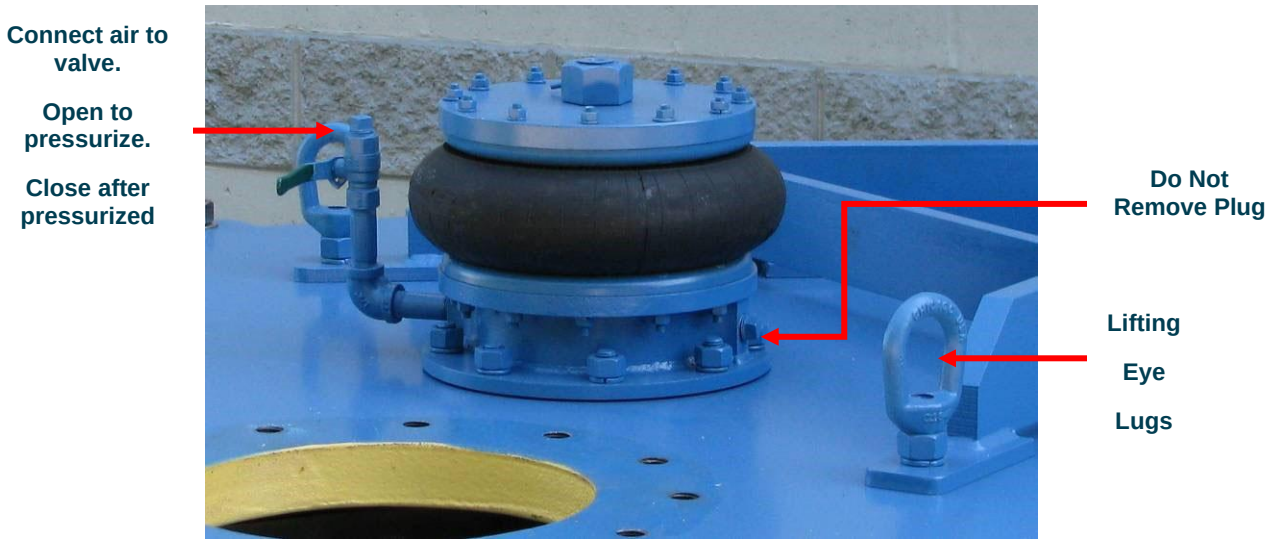


Figure 1: Positioning and Erection of Tanks

If the filter needs to be positioned horizontally for access reasons, the bump mechanism must be pressurized to a minimum of 75 PSI prior to tilting the tank.

CAUTION	FAILURE TO PRESSURIZE THE BUMP MECHANISM CAN DAMAGE THE LIFT SHAFT AND RENDER THE FILTER INOPERABLE. RETURN THE FILTER TO THE VERTICAL POSITION AS SOON AS POSSIBLE. DO NOT LEAVE OR STORE THE FILTER IN THE HORIZONTAL POSITION. AFTER THE TANK IS SET IN ITS FINAL VERTICAL POSITION, BUMP THE UNIT FIVE TO SIX TIMES TO VERIFY PROPER OPERATION.

Hoist the filter only by the lifting pad eye lugs located on the top of the filter vessel.

Keeping the vessel in the vertical position on the hoist, extend the legs from the collapsed position to the extended position. If you are positioning an SP-49-48-1548 or SP-55-48-2076, once the tank is in the final position, remove the shipping tabs, and then attach the regular legs. For reduced-height filters, the legs are welded.

Install the filter so that the head is level. The level of the filter should be checked with a bubble level. Shim and grout the leg base pads as required to level the filter. Using the holes in the pads, anchor each leg to the concrete floor.

Grounding lug mounting locations are available on each leg of the filter, each location is indicated by a sticker. Proper grounding is essential to help slow corrosion that can be caused by stray current. Refer to the *Vacuum Transfer System Diagram* for more information on the grounding lug locations.

Tank Leg Anchor Installation

WARNING	THE FILTER IS PROVIDED WITH MOUNTING ANCHORS TO SECURE IT TO THE FLOOR. ANCHORS MUST BE INSTALLED PER THE MANUFACTURER'S INSTRUCTIONS BEFORE ATTEMPTING TO LIFT THE FILTER HEAD (TOP PLATE). FAILURE TO PROPERLY ANCHOR THE FILTER TO THE FLOOR CAN RESULT IN BODILY INJURY AND EQUIPMENT DAMAGE.

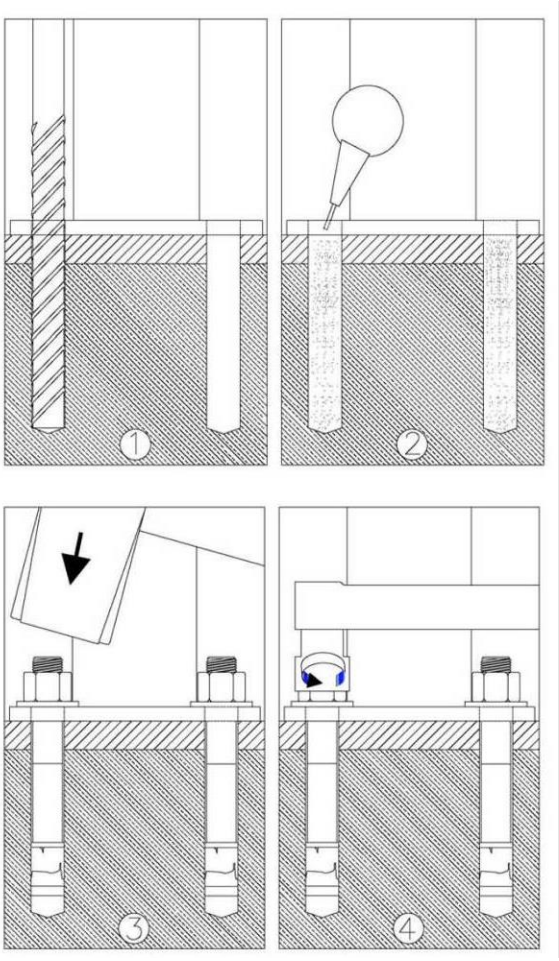


Figure 2: Tank Leg Anchor Installation

1. With the filter tank in its installed location, use a 1/2 inch carbide drill bit and drill a 6 inch-deep hole in the floor. There should be a total of 6 1/2 inches depth from the top of leg plate.
2. Remove all debris from the holes.
3. Assemble washer and nut, leaving top of the stud exposed above the nut. Drive anchor into the hole until the washer is flush.
4. Expand the anchor by tightening nut 3-5 turns past the hand tight position, or torque to 55 ft-lbs.

Auxiliary Equipment Installation

Gauge Panel

Bolt the gauge panel to mounting plate with four 1/4 x 1 inch screws, washer, and nuts (included).

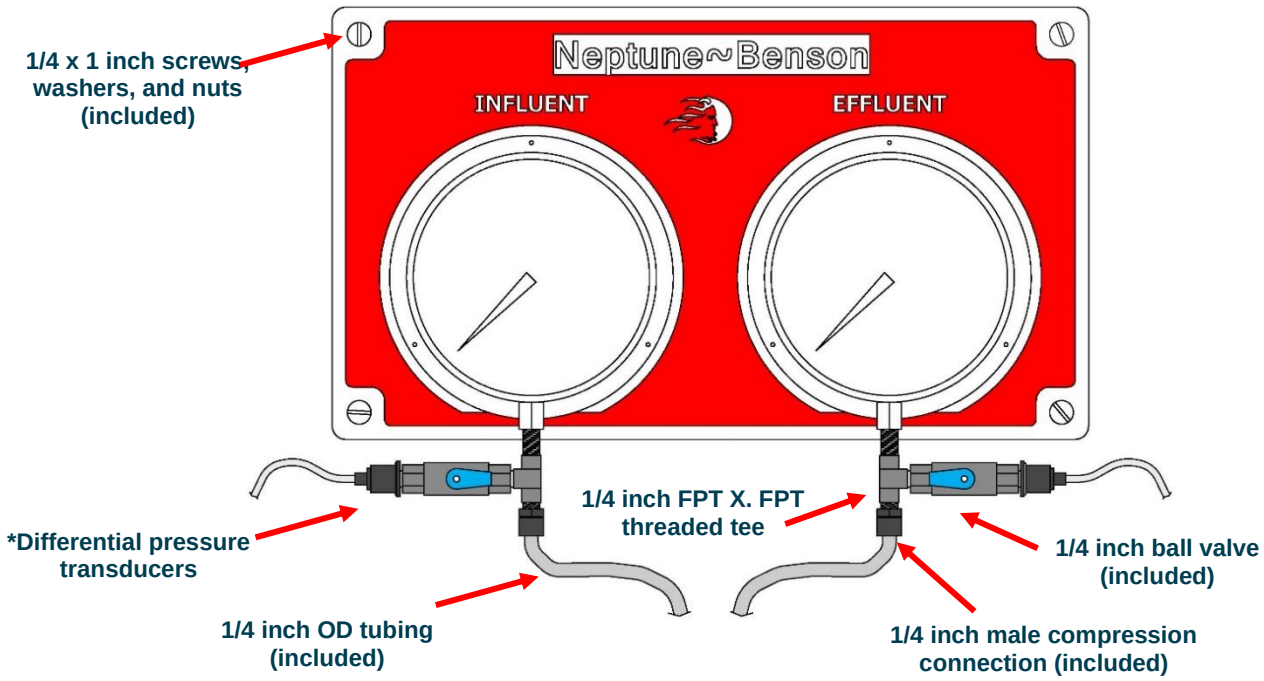


Figure 3: Gauge Panel

Pressure Gauges

All gauges supplied by Neptune-Benson™ are designed with dampening orifice openings to minimize damage due to surges or quick changes in pressure. The small opening is subject to clogging, especially on gauges that are located before the filter.

If a gauge reacts slowly to changes in pressure or tends to remain at an elevated pressure while the system is shut down, remove the gauge for inspection. The opening or orifice is located

within the center inside the nozzle connection. If you cannot observe an opening somewhat smaller than a pinhead, clean or replace the gauge.

Switch the positions of gauges to verify the operation of a gauge. Doing so indicates whether a gauge requires repair or replacement. All gauges are provided with 1/4 inch male national pipe thread (NPT) connections. It is recommended that a gauge cock be installed at each gauge.

The gauges in your system provide you with the best data relative to the operation and efficiency of items of equipment. If you keep them in good order, they will help make your daily chores less troublesome.

Do not disregard the gauges when they break down. Replacement gauges are inexpensive and easy to replace.

Pipe Installation

Support Spacing for PVC

Support and spacing requirements for PVC pipe, fittings, and valves should be designed into the installation to allow for increased temperature. As temperature increases, the tensile strength of PVC decreases, so the pipe and associated fixtures must be well supported.

Horizontal piping systems should be supported on uniform centers, which are determined by maximum operating temperature. These spacings apply to uninsulated lines, either in a building or exposed to the atmosphere. The formula used to determine the spacing data takes into account the heating effect of the sun on low-temperature lines. For insulated lines, it is necessary to reduce spans by 30% to allow for the additional weight of the insulation.

Adjustable clevis, ring, or roll hangers and roll stands with broad support surfaces are best for use with PVC pipe. Other suitable types include pipe clamps, straps, and riser clamps. A broader and flatter support surface is preferred. The support components should be filed smooth, taped, or padded to avoid the possibility of damaging the pipe. Remove sharp edges or burrs from the clamps, anchors, or any other support components that could frequently come in contact with the pipe. Anchor the pipe so that it is held absolutely rigid or constricted. Some slight axial movement is necessary.

For vertical lines, it is recommended that you band the pipe at the intervals determined by the vertical load. Riser clamps are best utilized if they are supported on spring hangers. Short risers should include a saddle at the bottom and might require an additional hanger at the top. Longer risers might require oversized U-bolts or similar devices to prevent lateral motion.

All valves and points of concentrated loads such as tees and flanges should have support that is independent of the normal span support. Metallic or lined valves should be fully supported because of the increased weight. At higher temperatures or when the line is transporting hazardous liquids, it might be more economically practical to use a continuous support system.

When pipe clamps are used, they should not force the pipe and fitting into position. To remedy this, each section of the pipeline should be laid out and all connections – whether solvent

cemented, screwed, or flanged – should be made while the pipe is held in a temporary support. Once the joints have been completed, the final clamping can be completed. When correctly installed, a clamp, holder, or pipe connection can be loosened or removed without the pipeline shifting position.

Recommended Support Spacing (In Feet)

Nominal Pipe Size (inches)	PVC Pipe								CPVC Pipe			
	Schedule 40				Schedule 80				Schedule 80			
	Temperature (°F)				Temperature (°F)				Temperature (°F)			
	60	80	100	120	60	80	100	120	60	80	100	120
	Recommended Support Spacing (feet)											
1	5.5	5	4.5	3	6	5.5	5	3.5	6.5	6.5	6	5
2	6	5.5	5	3.5	7	6.5	6	4	7.5	7.5	7	6
3	7	7	6	4	8	7.5	7	4.5	8.5	8	7.5	4.5
4	7.5	7	6.5	4.5	9	8.5	7.5	5	9.5	8	8	5
6	8.5	8	7.5	5	10	9.5	9	6	10.5	10	9.5	9
8	9	8.5	8	5	11	10.5	9.5	6.5	11	10.5	10	9.5
10	10	9	8.5	5.5	12	11	10	7	11.5	11.5	11	10.5
12	11.5	10.5	9.5	6.5	12	11	10	7	12.5	12.5	12.5	11
14	12	11	10	7	13.5	13	11	8				
16	12.5	11.5	10.5	7.5	14	13.5	11.5	8.5				

PVC Flange Installation Data

1. Follow the illustrated bolt-tightening sequence.
2. Recommended gaskets are full face, 1/8 inch thick, elastomeric, 50–70 Shore A hardness.
3. Fully lubricate the bolt threads.
4. Always use full size flat washers with bolts and nuts.
5. Always use primer and heavy-bodied PVC cement.

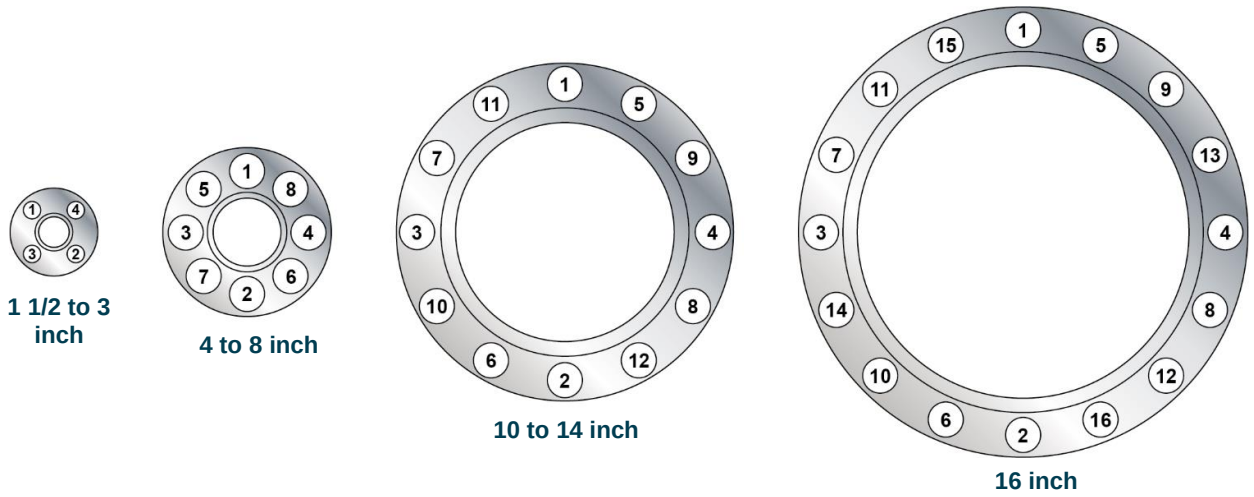


Figure 4: PVC Flange Installation

Piping Size*	Bolt Circle Diameter	Bolt Size	Recommended Torque (lbf·ft)
1/2	2 3/8	1/2–13 UNC	15–20
3/4	2 3/4	1/2–13 UNC	15–20
1	3 1/8	1/2–13 UNC	15–20
1 1/4	3 1/2	1/2–13 UNC	15–20
1 1/2	3 7/8	1/2–13 UNC	15–20
2	4 3/4	5/8–11 UNC	20–30
2 1/2	5 1/2	5/8–11 UNC	20–30
3	6	5/8–11 UNC	20–30
4	7 1/2	5/8–11 UNC	20–30
5	8 1/2	5/8–11 UNC	25–35
6	9 1/2	3/4–10 UNC	33–50
8	11 3/4	3/4–10 UNC	33–50
10	14 1/4	7/8–9 UNC	53–75
12	17	7/8–9 UNC	53–75
14	18 3/4	1–8 UNC	100–110
16	21 1/4	1–8 UNC	100–110

* All dimensions are in inches.

NOTE *FLANGES CONFORM TO ANSI B16.5, CLASS 150.*

Valve Installation

Butterfly Valves

Dominion™ Butterfly Valves have nylon-coated cast aluminum bodies and nylon-coated ductile iron discs with stainless steel stems.

The valves have bushings around the handle shaft to keep the water from leaking out of the shaft. As the valve ages, these bushings tend to dry out. The dryness, combined with dust and dirt, inhibits valve operation which increases the force required to turn the valve handle. This is not a serious problem when the valves are operated individually – until the problem gets progressively worse and excessive force is required to turn the valve handle. If the valve resistance becomes too high, the actuator can develop enough torque to shear the valve stem.

Routine preventive maintenance for these valves, without removing them, is to lubricate the stem and bushing with a food grade, silicone base, penetrating lubricant. The pneumatic operator must be removed to expose the shaft and bushing.

The valves are highly corrosion resistant and should provide satisfactory service for many years; however, it is possible for them to become coated with foreign material due to an imbalance of the water chemistry or the build-up of hair, lint, or other material that can wrap itself around the valve stems.

If you are inspecting a valve, it is necessary to remove most of the securing bolts at that valve. The resilient lining provides the seal between the valve and the flanges so that no gaskets are required. The flanges must be opened or spread slightly so the valve can slide out of position. Ensure that the valve disc is in the closed position before attempting removal.

The valve shaft is square with a scribe mark. If the scribe marks run in the same direction as the piping (parallel) the disc is in the open position. If the scribe marks are perpendicular to the piping, the disc is closed. The disc does not have to be 100% closed for shut-off purposes.

The resilient lining of the valve provides a seal between the process water and the stainless steel shaft. If the position of the lining is altered due to coating or buildup of scale, etc., this seal could be broken. If the valve resists turning after cleaning, lubricate the shaft ends from the inside and outside. If your service schedule includes removal of the valves for inspection, the resilient lining should be coated with the same lubricant.

If the valve disc does not move freely with normal pressure after treating it with the lubricant, consider replacing the valve. Replacement valves are not expensive and usually cost less than the labor and replacement parts required to repair an existing valve.

Installation of Butterfly Valves

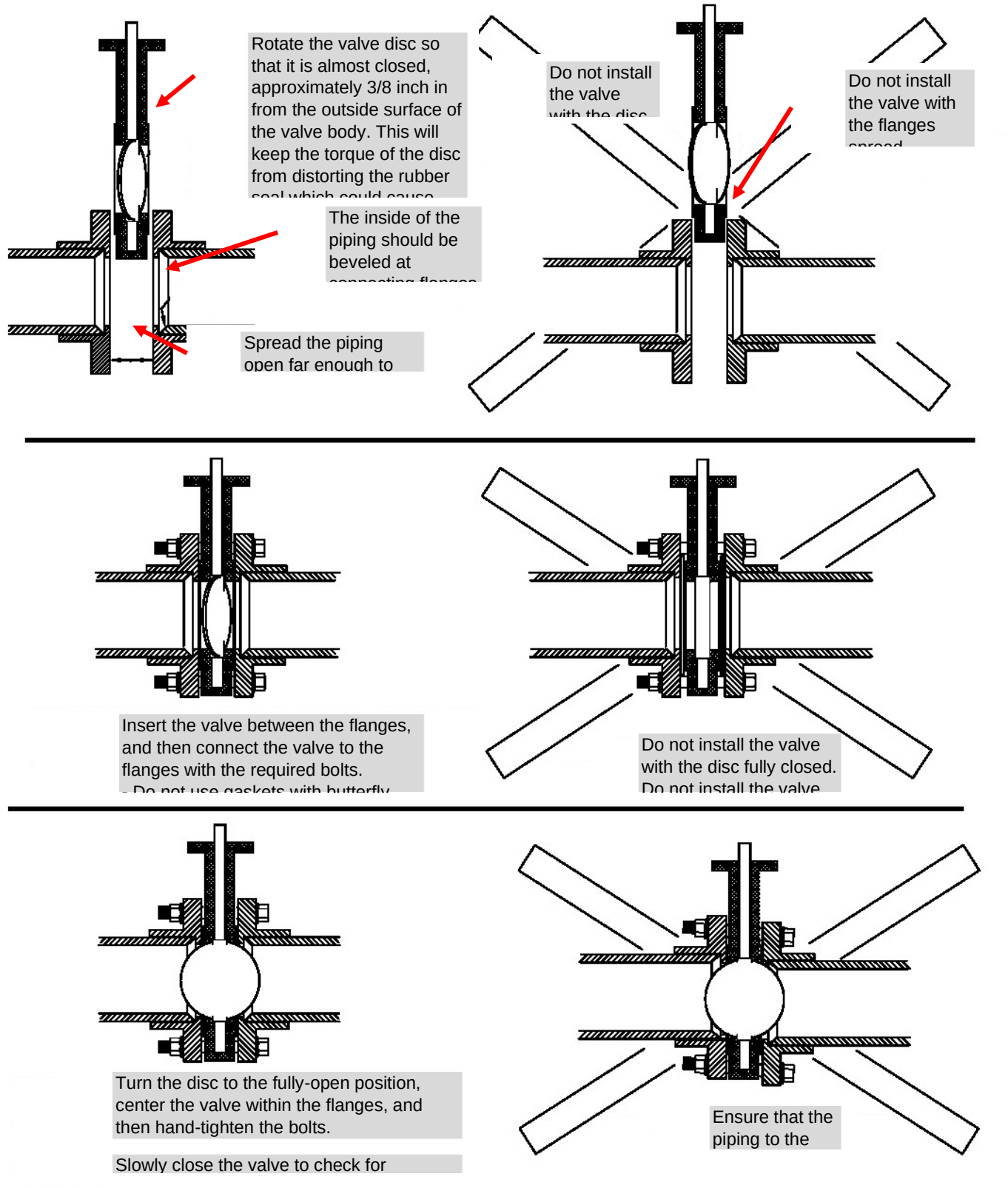


Figure 5: Butterfly Valve Installation

Controller Installation

Figure 6: Control Enclosure

Mount the control enclosure to the bracket with four #10-32 x 3/4 inch hex head bolts and washers (included).

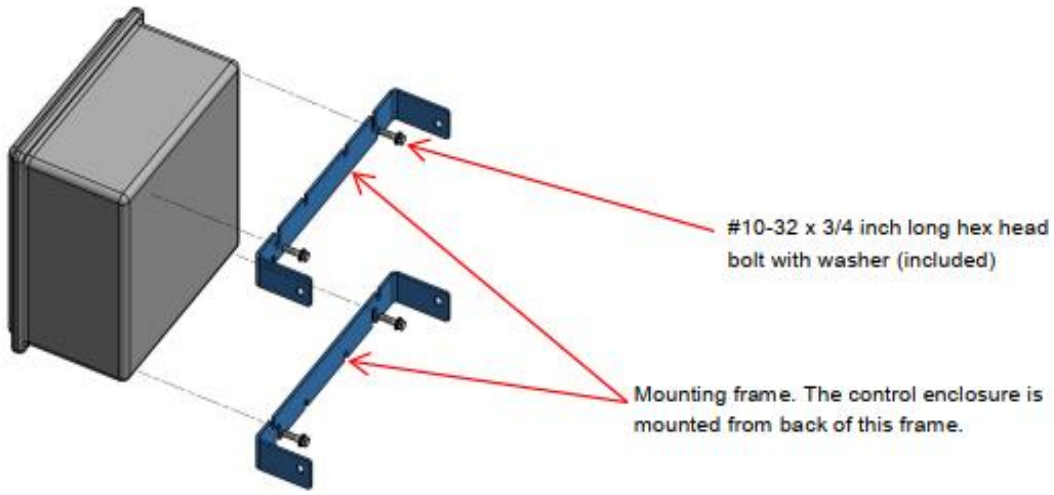


Figure 7: Control Enclosure Mounting

Please refer to important safety notes on the following page:

NOTE	*Electrical Requirements: Disconnect with GFCI and overcurrent protection is required. Recommended protection: 120/230 VAC, 15/10 A. Power wiring is to be 12AWG 90°C and control wiring is to be 16AWG 90°C*

NOTE	*Service Conditions:* *The ambient air temperature does not exceed +40°C (104*F) and its average over a period of 24 hours does not exceed +35°C (95°F). The lower limit of the ambient air temperature is –5°C (23°F).* *The air is clean, and its relative humidity does not exceed 50% at a maximum temperature of +40°C (104°F). Higher relative humidity may be permitted at lower temperatures, for example 90% at +20°C (68°F). Moderate condensation is taken care of, which may occasionally occur due to variations in temperature.* *The altitude of the site of installation does not exceed 2,000 m.* *Panel assemblies are intended for Pollution Degree 3 (PD 3).*

NOTE	*Basic protection: Enclosures are provided with a cover and lockable tabs. It is advised for operators to install a lock to prevent ease of access.*

NOTE	*Terminals for external conductors: Terminals are suitable for connection of copper or aluminum conductors, or both as applicable to the construction.*

PNEUMATIC CONNECTIONS

Control Enclosure

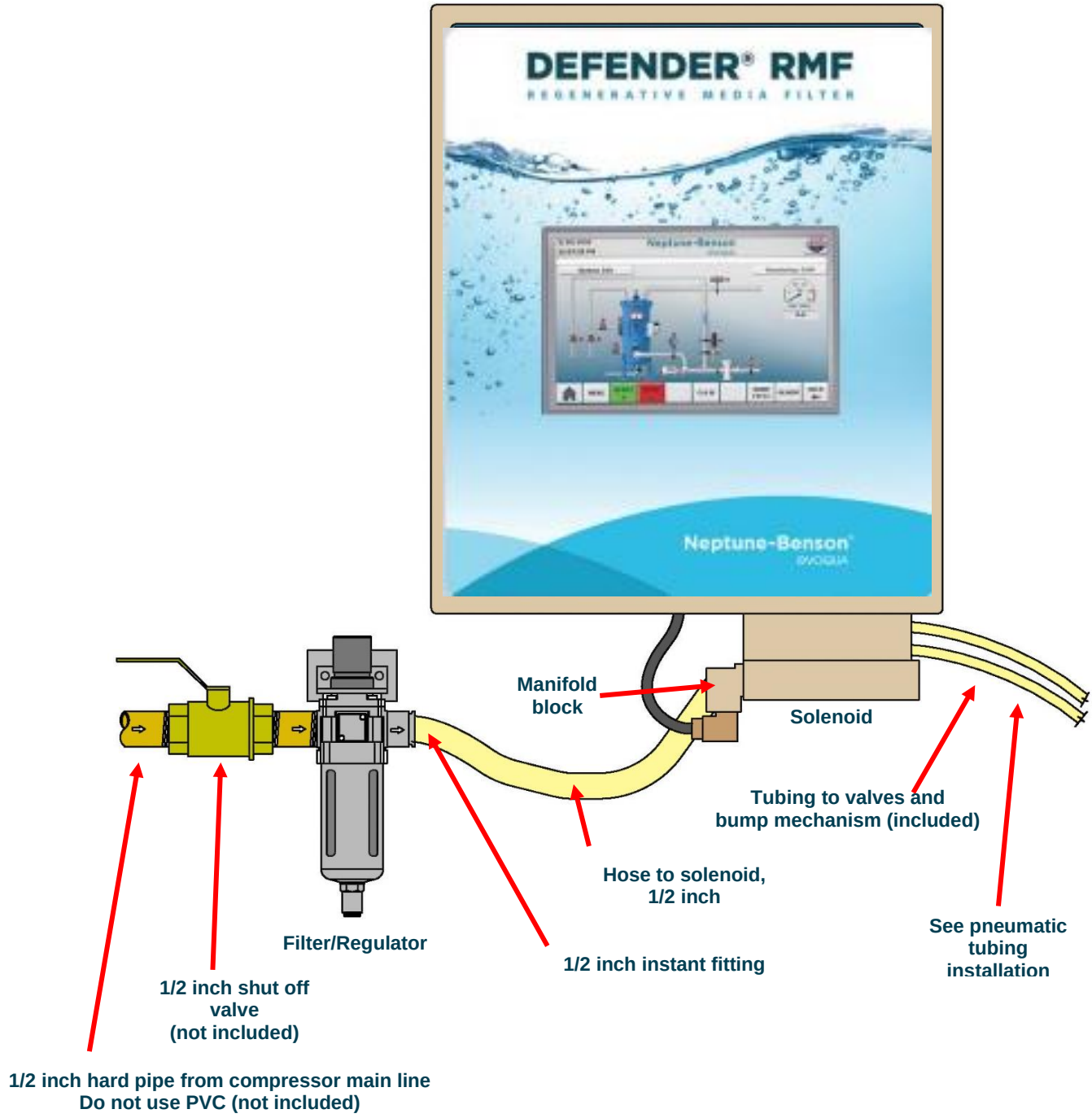


Figure 8: Control Enclosure and Filter/Regulator

Filter/Regulator

Connect the line from the compressor to the filter/regulator.

Connect the filter/regulator to the Defender leg as pictured in 7-A.

Attach the filter/regulator using two 1/4 x 1 inch screws, washers, and nuts (included).

For Assero models attach the regulator to mounting tab on desired Defender head bolt pictured in 7-B.

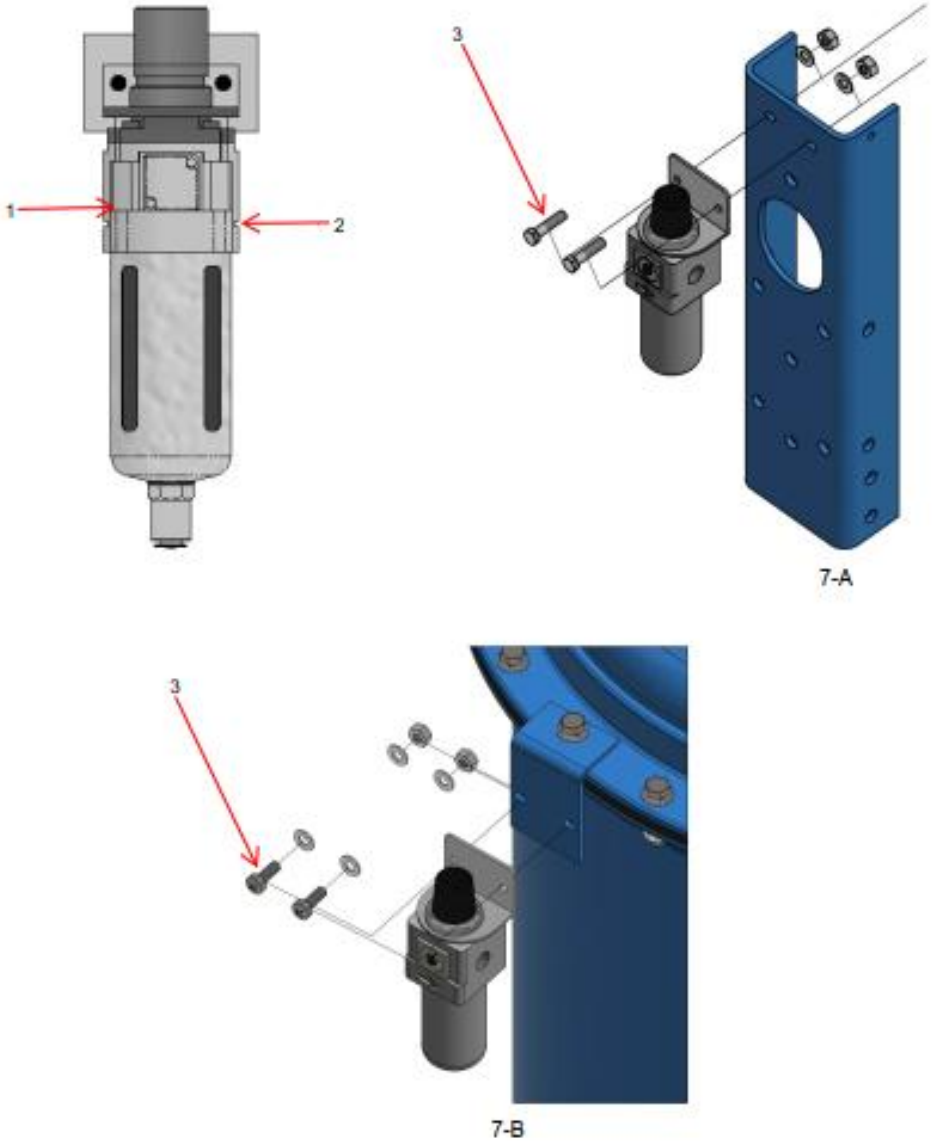


Figure 9: Filter/Regulator

Pneumatic Solenoid Valves

Using 1/2 inch poly tubing, connect the manifold block of the pneumatic solenoid valve to the filter/regulator.

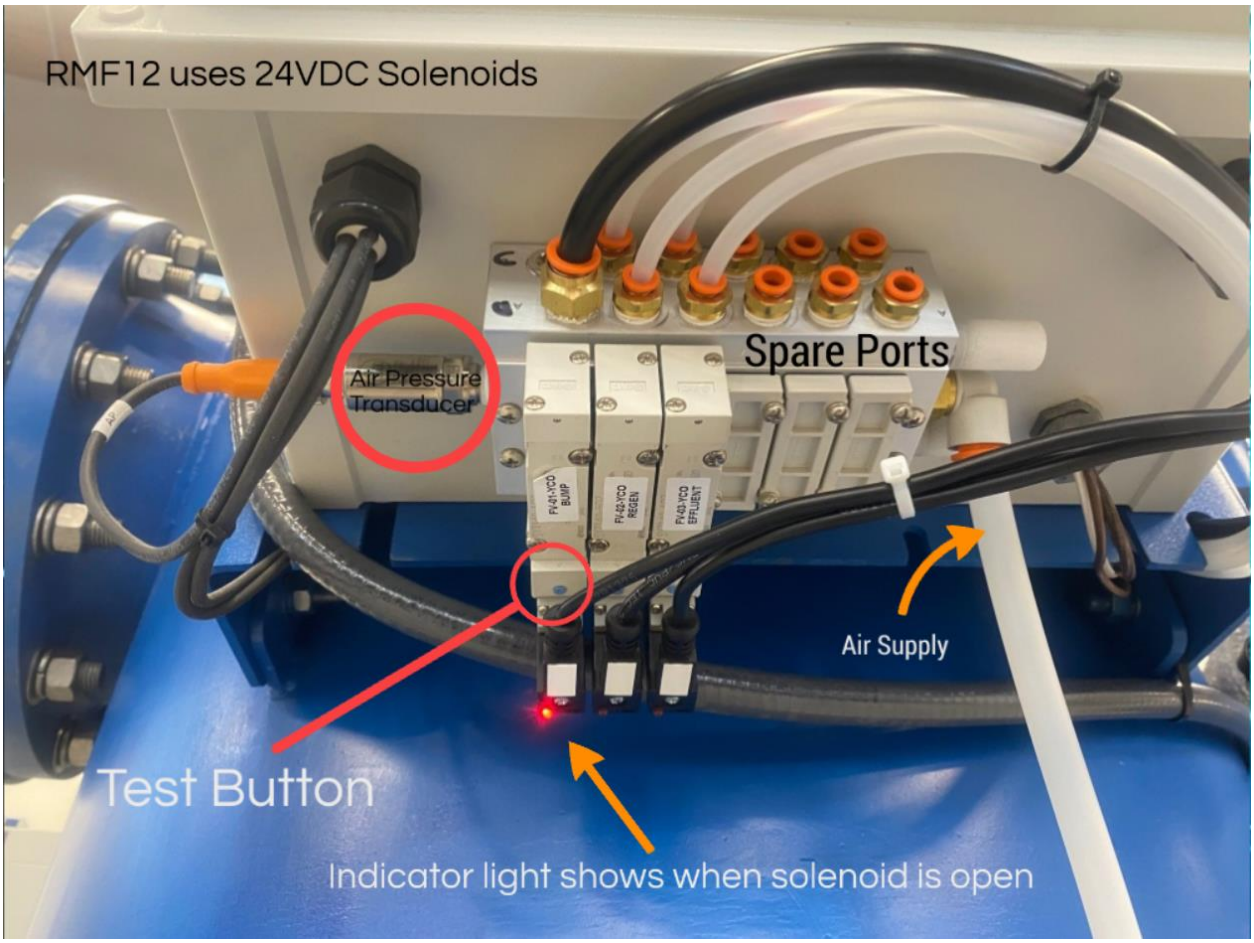


Figure 10: Pneumatic Solenoid Valves (Bottom View)

Pneumatic Tubing Installation

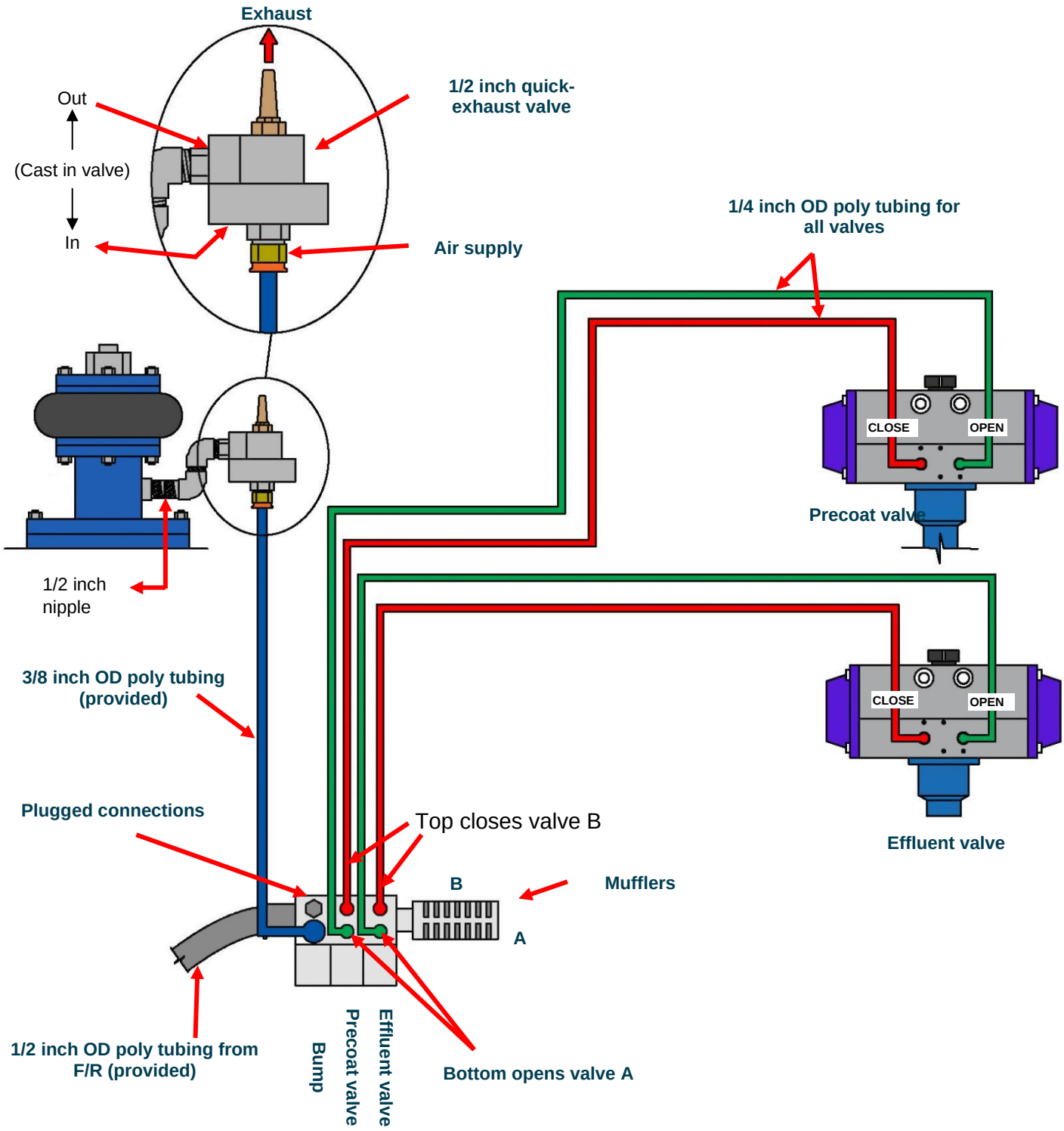


Figure 11: Solenoid Tubing Connections

Pneumatic Actuator Tubing Connections

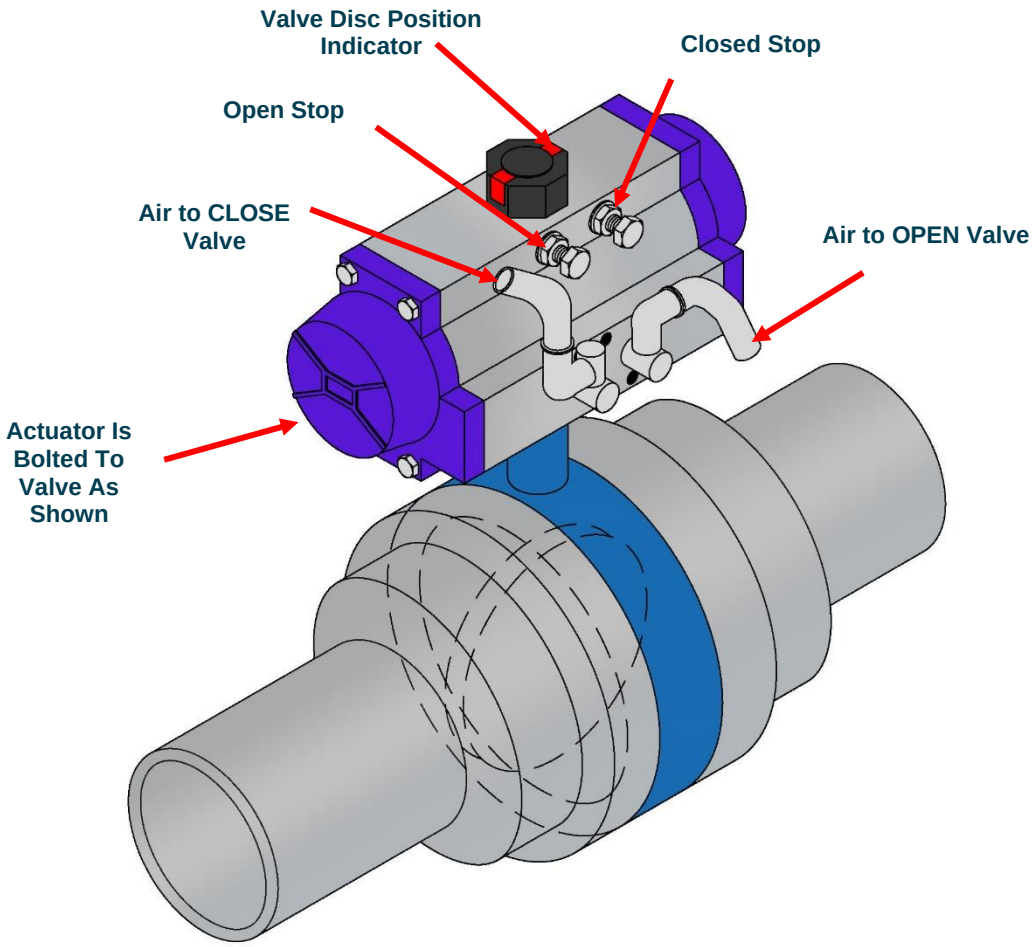


Figure 12: Pneumatic Actuator Setup

Actuator Installation and Adjustment

Flow (Speed) Control Valves

Pneumatic actuators are provided with the flow control valves. The flow control valves connected to the pneumatic actuators are used to regulate the speed of the butterfly valve operation.

1. Shut off the air supply.
2. Remove the tubing from the closed port of the pneumatic actuator. Refer to *Pneumatic Actuator Tubing Connections* to determine which port is the closed port. Connect it to the air supply in on the air switch.
3. Remove the tubing from the open port of the pneumatic actuator.
4. Connect the tubing from the air switch to both ports of the pneumatic actuator.
5. Open the air supply.
6. Move the switch back and forth to check the open and closed operation of the valve.
7. If necessary, adjust the valves:
    a. Loosen the lock nut, and then close the control valves by turning them clockwise.
    b. Open the valves 1.5 turns each by turning them counterclockwise.
    c. If necessary, adjust the valves to allow for smooth operation:

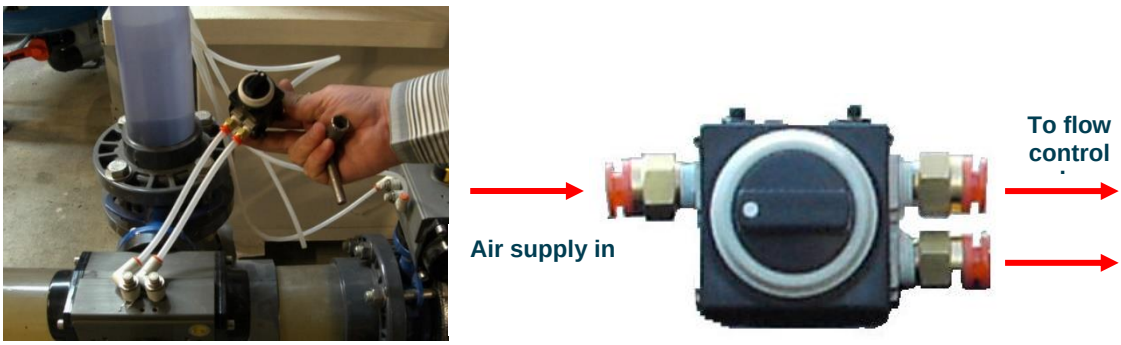


Figure 13: Flow Control Valves

NOTE

While facing the pneumatic actuator with flow control valves, the air in on right opens the valve; the air in on left closes the valve. See Figure 9.

The control valve on the CLOSED PORT regulates the butterfly valve's opening speed.

The control valve on the OPEN PORT regulates the butterfly valve's closing speed.

Closing the valves slows the speed of the butterfly valve.

Opening the valves increases the speed of the butterfly valve.

It is recommended that the actuator be mounted parallel with the piping.

Vacuum Transfer Unit

Vacuum Transfer System Diagram:

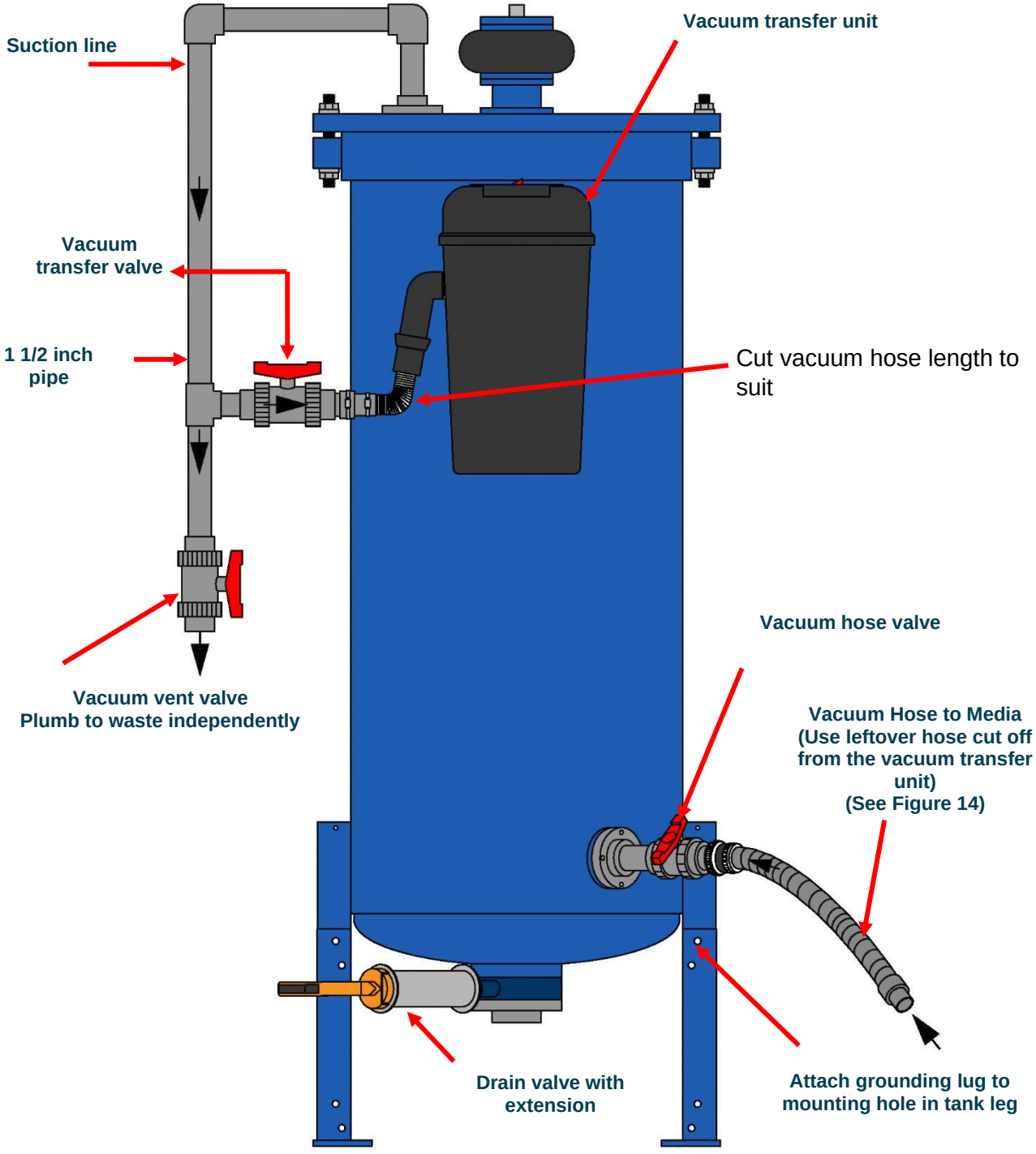


Figure 14: Vacuum Transfer System

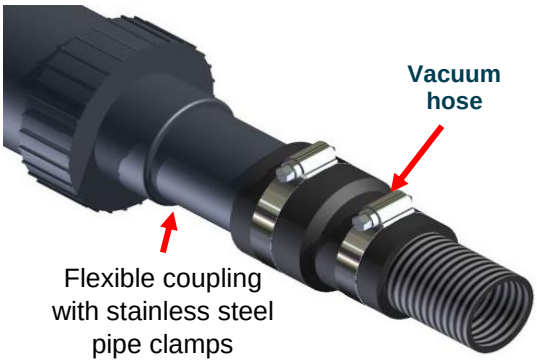


Figure 15: Vacuum Hose Connection Detail

NOTE	ALL FITTINGS, VALVES, AND HARDWARE AS SHOWN ARE SCHEDULE (SCH) 80 POLYVINYL CHLORIDE (PVC) AND ARE SUPPLIED BY NEPTUNE-BENSON™.

NOTE	THE FILTER AND MOST OF ITS ACCESSORIES ARE ACCEPTABLE FOR UNPROTECTED INSTALLATIONS THAT ARE EXPOSED TO THE ELEMENTS. IF INSTALLED IN AN UNENCLOSED ENVIRONMENT, THE VACUUM TRANSFER UNIT AND THE COMPRESSOR REQUIRE SUPPLEMENTARY COVERS TO PROTECT THESE UNITS FROM THE ELEMENTS. NEPTUNE-BENSON™ RECOMMENDS A MINIMUM ENCLOSURE OF AN OPEN SHELTER WITH A ROOF TO PROVIDE PROTECTION FROM DIRECT EXPOSURE TO RAIN AND SNOW.

Vacuum Hose Bracket:

Bolt the vacuum hose bracket to the Defender leg as pictured in 15-A. ½" hardware included.

For Assero models bolt to the vacuum transfer bracket as pictured in 15-B.

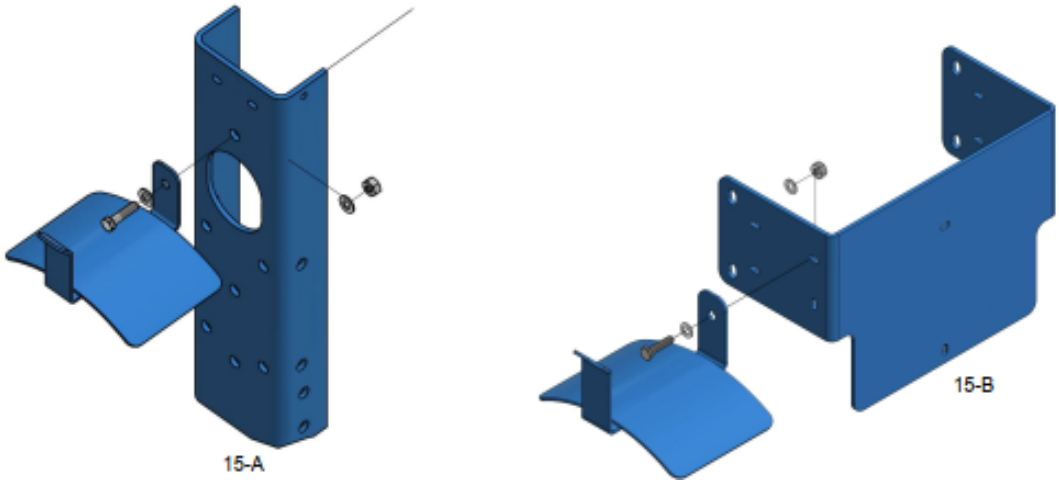


Figure 16: Vacuum Hose Bracket

Vacuum Transfer Unit Wiring:

NOTE	ALL ELECTRICAL CONNECTIONS ARE FOR SCHEMATIC REFERENCE ONLY. THEY DO NOT INDICATE EXACT LOCATIONS.

1. Mount the pre-wired junction box to the vacuum transfer bracket, as shown.
2. Cut the plug end from the vacuum.
3. Wire the vacuum power cable into the junction box with wire nuts.

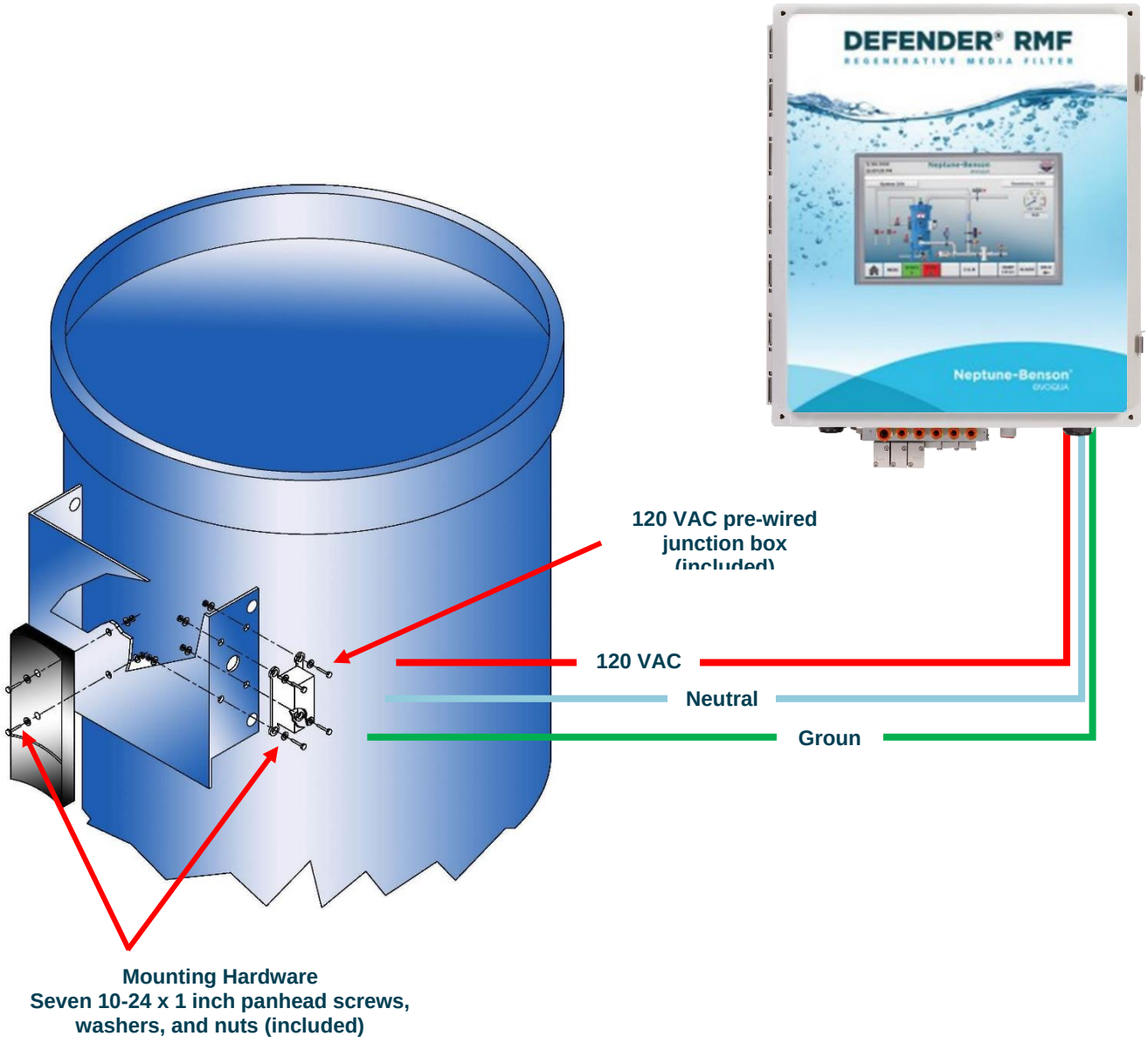


Figure 17: Vacuum Transfer Unit

NOTE	THE FILTER AND MOST OF ITS ACCESSORIES ARE ACCEPTABLE FOR UNPROTECTED INSTALLATIONS THAT ARE EXPOSED TO THE ELEMENTS. THE VACUUM TRANSFER UNIT AND THE COMPRESSOR MANUFACTURER PROHIBIT EXPOSURE TO THE ELEMENTS. NEPTUNE-BENSON™ RECOMMENDS A MINIMUM ENCLOSURE OF AN OPEN SHELTER WITH A ROOF TO PROVIDE PROTECTION FROM DIRECT EXPOSURE TO RAIN AND SNOW.

Grounding Requirements

Grounding lug is not supplied. To effectively ground the system, you will need to grind down or scrape the paint to expose the metal portion of the designated grounding location on either leg of the system. Only grind/scrape the paint on the surface area where the lugs will be installed.

NOTE	THE FILTER MUST BE GROUNDED TO HELP SLOW CORROSION THAT CAN BE CAUSED BY STRAY CURRENT.

Touchup Paint

Each Defender is shipped with a can of touch up paint. This should be utilized anytime there is damage done to the exterior coating of the Defender. This will ensure the exterior of the Defender does not begin to corrode.

Initial Startup

Pre-Startup Check

1. Use iron or galvanized piping (not PVC) from the compressor up to the filter/regulator mounted on the filter tank. Add a valve for isolating just before the filter/regulator.
2. All plumbing and valving must be installed per the appropriate *Defender® Regenerative Media Filter Schematic and Parts List*. A water separator with automatic drain must be installed as shown on the schematic. An SMC® AMG350-N04D is recommended.
3. Check critical items prior to scheduling the startup:
    a. Power up all system components:
        i. Compressor
        ii. Control enclosure
        iii. Vacuum transfer unit
    b. Set the filter pressure regulator between 80 and 90 PSI.

NOTE	THE RMF CONTROLLER WILL FAULT IF THE AIR PRESSURE TO THE MANIFOLD EXCEEDS 100 PSI OR IS BELOW 50 PSI.

4. Check for air leaks at tubing connections. If leaks occur shut off the compressor. Remove the tubing to verify that it is cut square. Correct any tube defects. Reinsert the tubing, ensuring that it is fully engaged. Pull on the tubing to verify that it is connected securely. If leaks still occur, the tubing might be the incorrect OD (outer diameter). All tubing is to be imperial and either 1/4, 3/8, or 1/2 inch OD, as shown on the appropriate *Defender® Regenerative Media Filter Schematic and Parts List*.

Controller Parameters/Setup

Setup Instructions

The Defender® RMF12 has several selections available for programming to your specific facility needs.

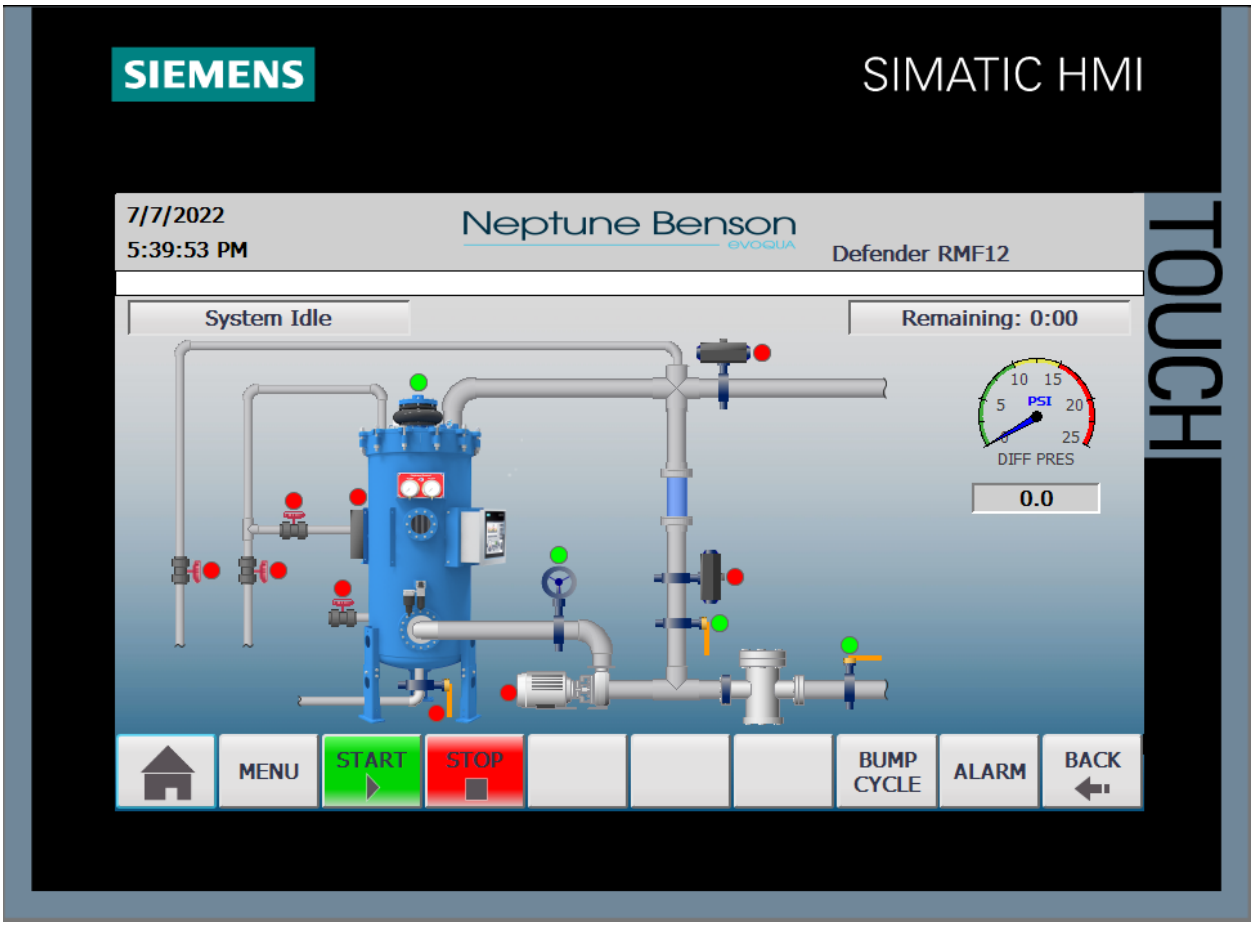


Figure 18: System Idle Screen

1. From the **System Idle** screen, press **MENU**.

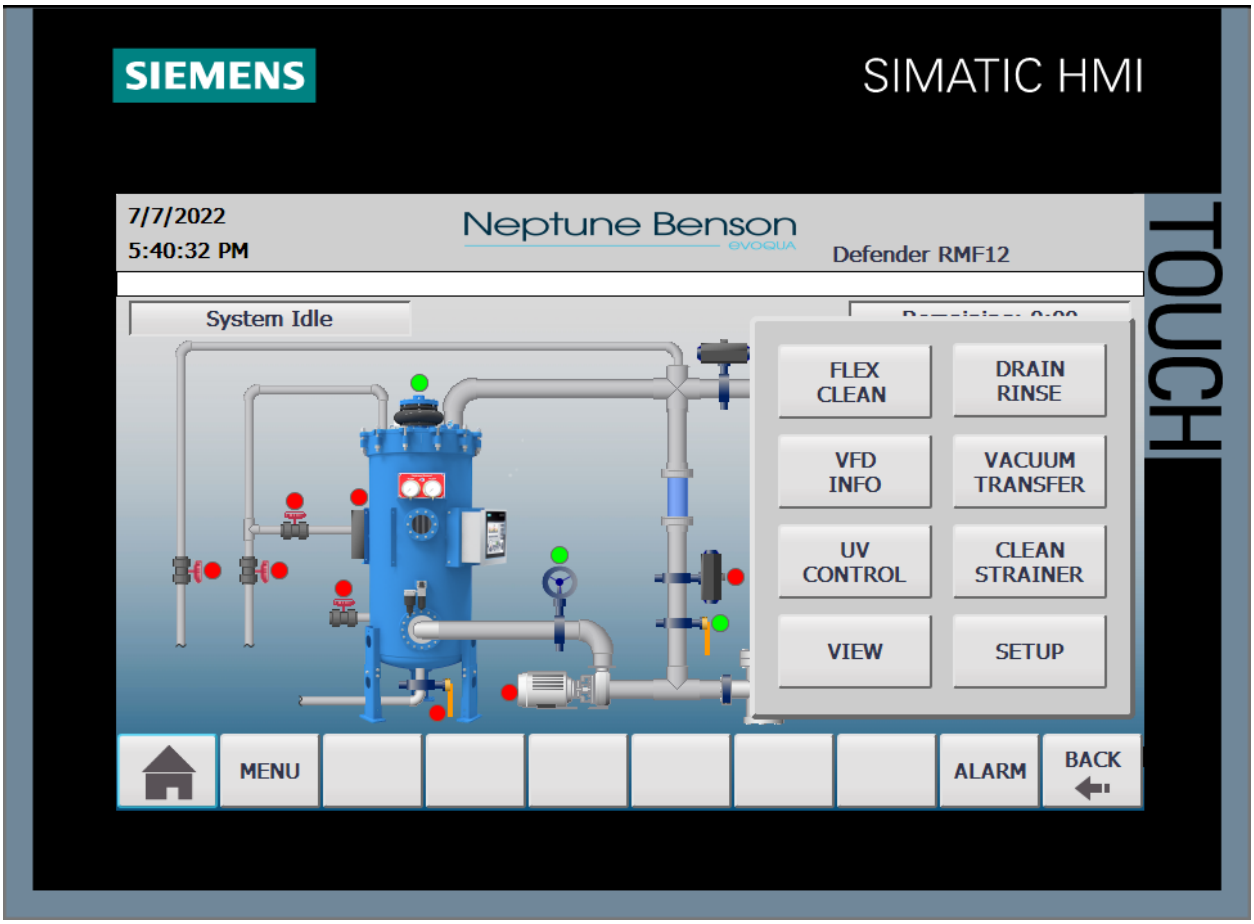


Figure 19: Menu Screen

2. Press **SETUP**.
3. From the **Login** pop-up window, press the **Password** field, and then enter the password using the pop-up keyboard. The default password is 22222.
4. Press **OK** to confirm the password and close the pop-up window.

The **Setup Submenu** screen contains several options detailed in the sections below. Press **BACK** from any of the submenu screens to return to the previous screen. Press the home button at the bottom left to return to the **System Idle** screen.

PARAMETERS

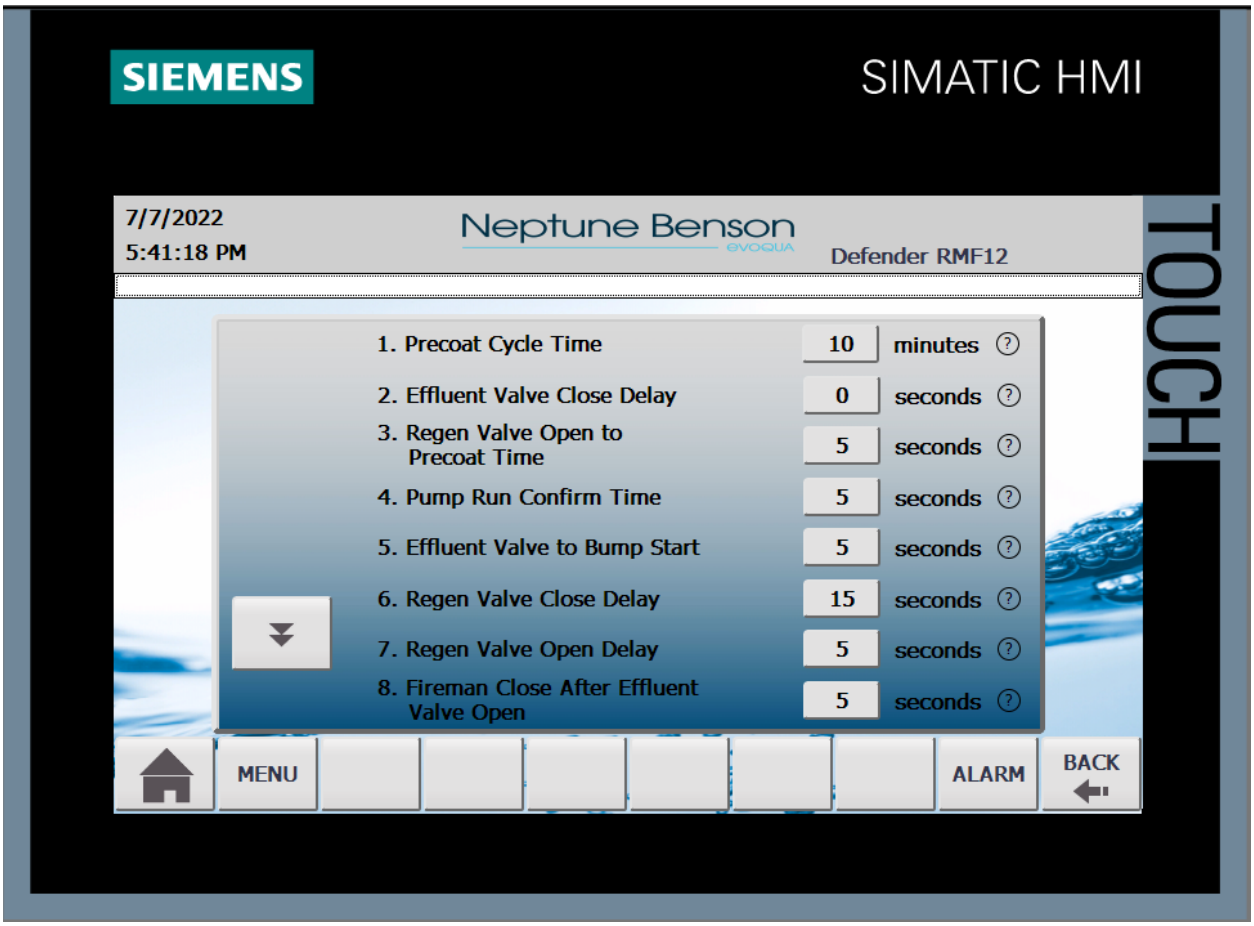


Figure 20: Parameters Screen

The field to the right of each parameter contains a default value. These parameters should be reviewed and modified as required for each filter. Press the **?** to right of the parameter value to display a description of the parameter.

From the **Menu** screen, the **VIEW** option allows you to view the parameters; however, you cannot edit the parameters from that screen.

Parameters and their default values (factory setting):

Parameter		Default	Notes
1.	**Precoat Cycle Time**	**10 minutes**	Time system is in the closed precoat loop.
2.	**Effluent Valve Close Delay**	**0 seconds**	Time after bump is initiated to close the effluent valve.
3.	**Regen Valve Open to Precoat Time**	**5 seconds**	Time display on the screen prior Opening Precoat Valve to start of Precoat Timing.
4.	**Pump Run Confirm Time**	**5 seconds**	Time the control enclosure waits for a closed contact from the pump motor starter. If the closed contact signal is not received, the system shuts down.
5.	**Effluent Valve to Bump Start Time**	**5 seconds**	Delay to start bump after the effluent valve closes.
6.	**Regen Valve Close Delay**	**15 seconds**	Delay time between the effluent relay energizing to effluent valve opening after the precoat cycle and the regen relay de-energizes to close the regen valve.
7.	**Regen Valve Open Delay**	**5 seconds**	Delay time for the regen valve relay to energize to open the regen valve once the start button is pressed.
8.	**Fireman Off Before Effluent Valve Open**	**0 seconds**	Delay time after precoat before the effluent valve opens.
9.	**Fireman On to Effluent Valve Close Time**	**0 seconds**	Set to the desired delay, if used. Relay energizes when an automatic or manual bump is initiated and shutoff auxiliary equipment. System does not bump until the delay times out.
10.	**Bump Set Off Time**	**5 seconds**	Time bump solenoid de-energizes when **Bump Set** is pressed.
11.	**Bump Set On Time**	**2 seconds**	Time bump solenoid energizes when **Bump Set** is pressed.
12.	**Bump Auto/Man Off Time**	**5 seconds**	Time bump solenoid de-energizes when an automatic or manual bump is initiated.
13.	**Bump Auto/Man On Time**	**2 seconds**	Time bump solenoid is energized.
14.	**Flex Clean (Flexible Tube Chemical Cleaning) Loop Time**	**120 seconds**	Time that the pump is on in precoat mode during chemical cleaning. Set to **0** if using Neptune-Benson Chem Clean Express.
15.	**Flex Clean (Flexible Tube Chemical Cleaning) Loop Delay**	**15 minutes**	Delay time between system idle to bumping and precoating, as in Parameter 14.
16.	**Auto Bump Loops**	**10**	Number of bumps, when initiated.
17.	**Required Bump Passcode**	**OFF**	When set to **ON**, bump cannot be initiated without a passcode.

18.	**Tank Drain Option (Auto Drain Valve Open to flush tank bottom)**	**OFF**	
19.	**Tank Drain On Time**	**5 Seconds**	Time that the valve is open.
20.	**Precoat Line Option (Auto Valve to allow make up water for TDS control)**	**OFF**	
21.	**Precoat Line On Time**	**5 seconds**	Time that the valve is open.
22.	**UV Screen Cycle Option (Automatic UV Screen)**	**OFF**	Set to **ON** if the option is used.
23.	**UV Screen Cycle Time**	**0 hours**	If on, set to the desired time for self-cleaning.
24.	**Water Level Enable**	**OFF**	If set to **ON**, probes and sensing chamber are required for water level control.
25.	**Water Level Fill Delay**	**0 seconds**	Set to the required time from when the water level reaches the hi level probe to the desired optimum water level.
26.	**Level Stabilize Delay**	**5 seconds**	
27.	**Level Valve Max Open Time**	**50 seconds**	To prevent overfilling the pool, this is the maximum time that the solenoid valve is open during fill.
28.	**VFD Display Enable**	**OFF**	To utilize this feature, interlock wiring is required from VFD to D7.
29.	**VFD Units**	**GPM**	Other available units of measurement include **m^3/hour** and **l/second**.
30.	**Low Pressure Cutoff**	**50 PSI**	Low air pressure limit. Never operate the filter with this parameter disabled.
31.	**Delta-P Difference Value**	**12 PSI**	If enabled, the filter automatically bumps when a pressure differential reaches 12 PSI, unless the bump block is scheduled.
32.	**Flow Rate Enable**	**OFF**	Use this for a 4–20 mA flow sensor when you do not have a VFD.
33.	**Flow Units**	**GPM**	Other available units of measurement include **m^3/hour** and **l/second**.
34.	**Output Log Frequency (minutes)**	**OFF**	
35.	**Precoat Pump Enable**	**OFF**	Set to **ON** when a separate precoat pump is used.
36.	**Main Pump On to Effluent Open Delay**	**6 seconds**	Time that the main filtration pump is on before the effluent valve opens.
37.	**Precoat Pump Off after Regen Close Delay**	**5 seconds**	Time that the precoat pump is on before the valve closes.
38.	**Dual Mode Option**	**OFF**	This parameter is for industrial use where two filters alternate filtration.
39.	**Main Drain Delay - Dual D4**	**0 seconds**	
40.	**Language**	**English**	Other available languages include **German**, **Chinese**, **Spanish**, and **French**.
41.	**Pressure Units**	**PSI**	Other available units of measurement include **BAR** and **KPI**.

42.	**Auto Restart after Power Fail**	**ON**	When set to **ON**, the system restarts automatically after a power failure.
43.	**Remote ON/OFF Control**	**OFF**	When set to **ON**, the system can be controlled via remote access.
44.	**Alarm Relay Output**	**OFF**	When set to **ON**, turns on the relay when any alarm is active, and turns it off when the alarm is cleared.
45.	**Optional Relay 1 Control**	**NA**	OPT 1 = relay open in idle and filter mode; OPT 2 = relay open in idle and pre-coat mode; OPT 3 = relay open in precoat and filter mode.
46.	**Start Fill Level**	0%	Filling can be started at this setting.
47.	**Pool Name**	Defender RMF12	A name can be entered in this field that displays on the header of the HMI.

DELTA-P BUMP

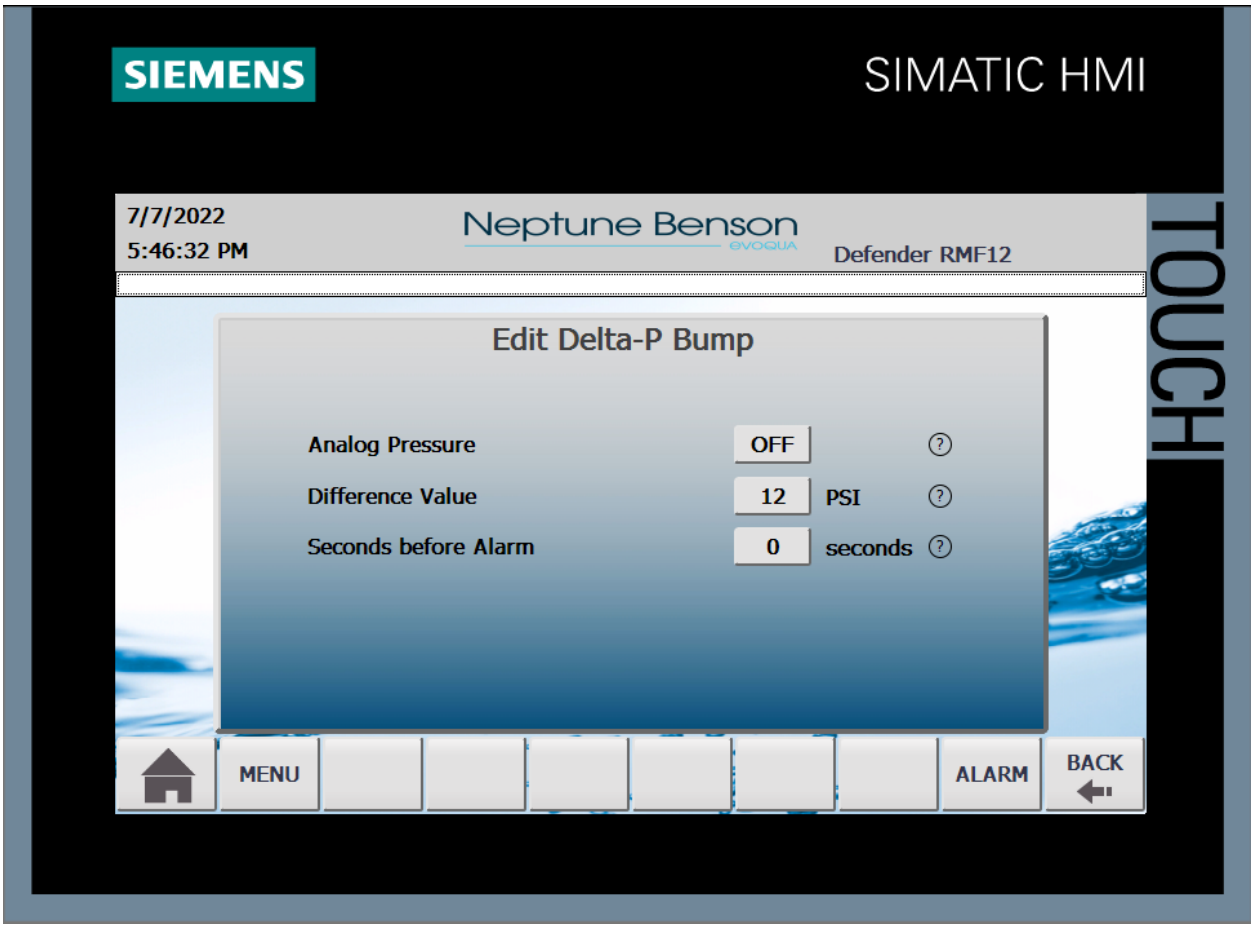


Figure 21: Edit Delta-P Bump Screen

On this screen, you can enable the filter to automatically bump when a preset pressure differential is reached by using the following settings:

Analog Pressure Enable: **ON**. Never operate the system with this set to **OFF**.
Difference Value: **12 PSI** (factory default)
Seconds before Alarm: **0 seconds** (factory default)

PRESSURE INPUT

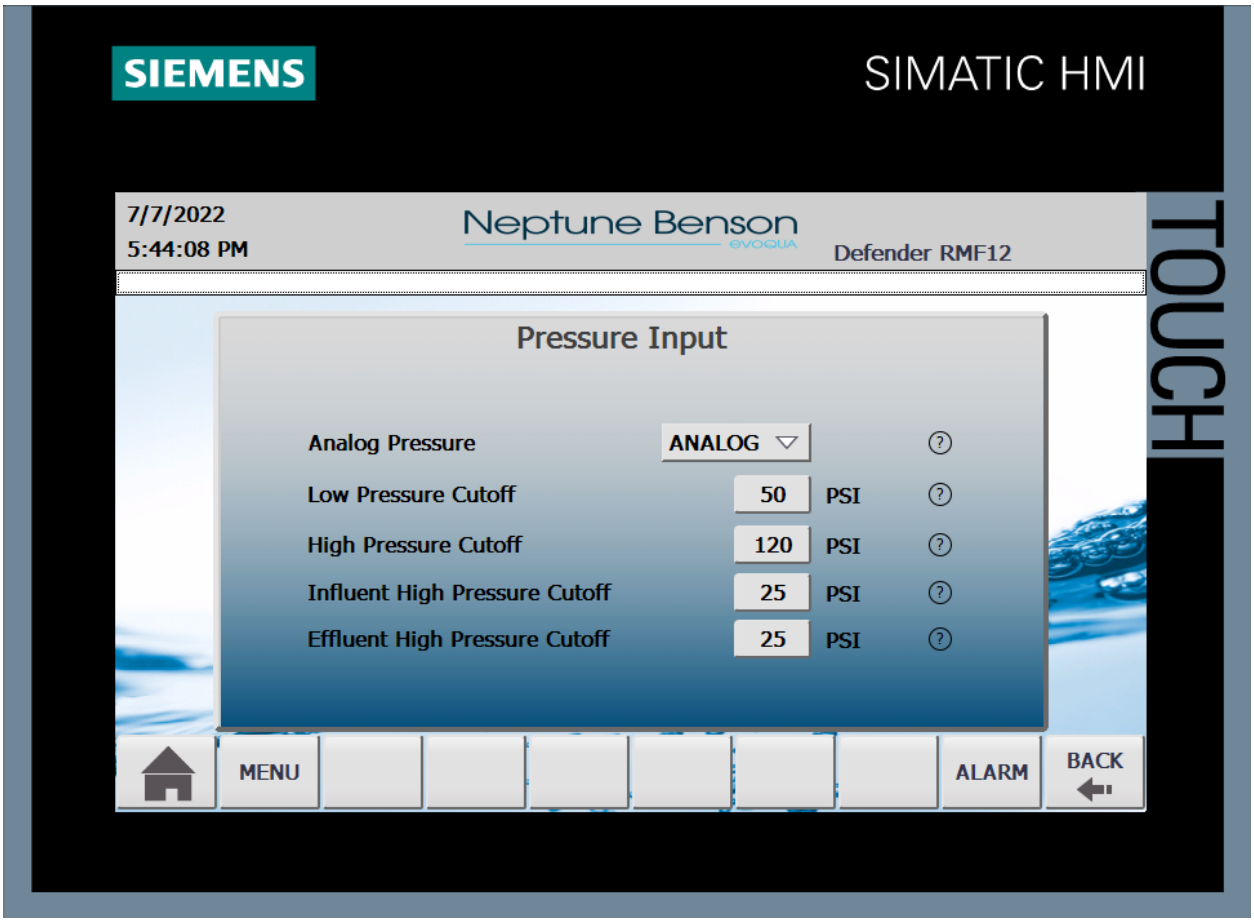


Figure 22: Pressure Input Screen

On this screen, you can configure the filter to monitor the available air pressure and shut down the system if the value falls below the preset value:

Analog Pressure: **Analog**
Low Pressure Cutoff: **50 PSI**
High Pressure Cutoff: **120 PSI**
Influent High-Pressure Cutoff: **25 PSI**
Effluent High-Pressure Cutoff: **25 PSI**

ANALOG SCALING

On this screen, you can view each transducer scale and value. Transducers are scaled from the factory and do not require adjustment during startup.

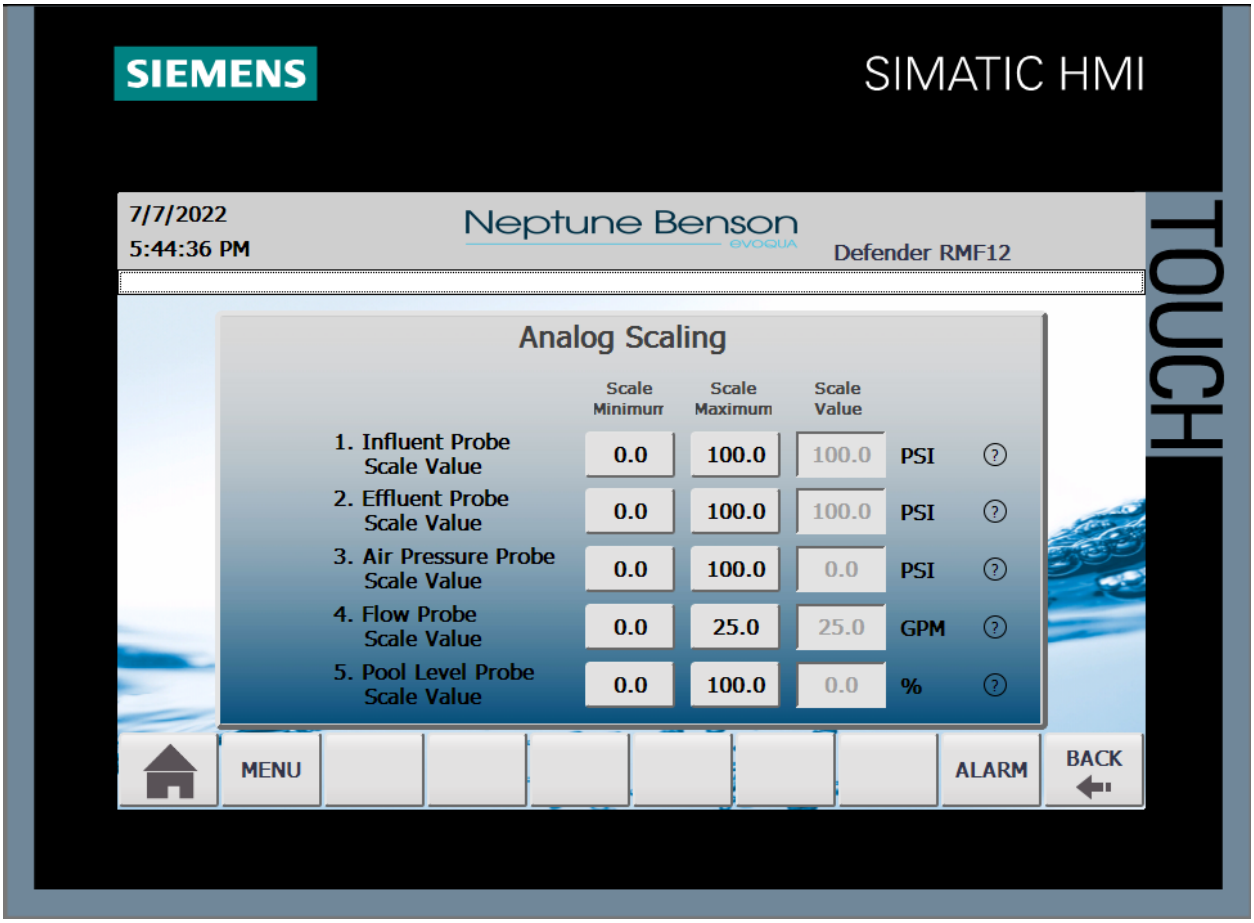


Figure 23: Analog Scaling Screen

SCHEDULE TYPES

This screen contains four submenus. All the screens on these submenus contain seven sets of selections representing the seven days of the week and a time schedule, allowing you to program the event for specific days and times.

BUMP SCHEDULE
BUMP BLOCK SCHEDULE
DRAIN SCHEDULE (optional, to periodically flush bottom of the tank)
PRECOAT SCHEDULE (optional, to allow for makeup water for pool water TDS control)

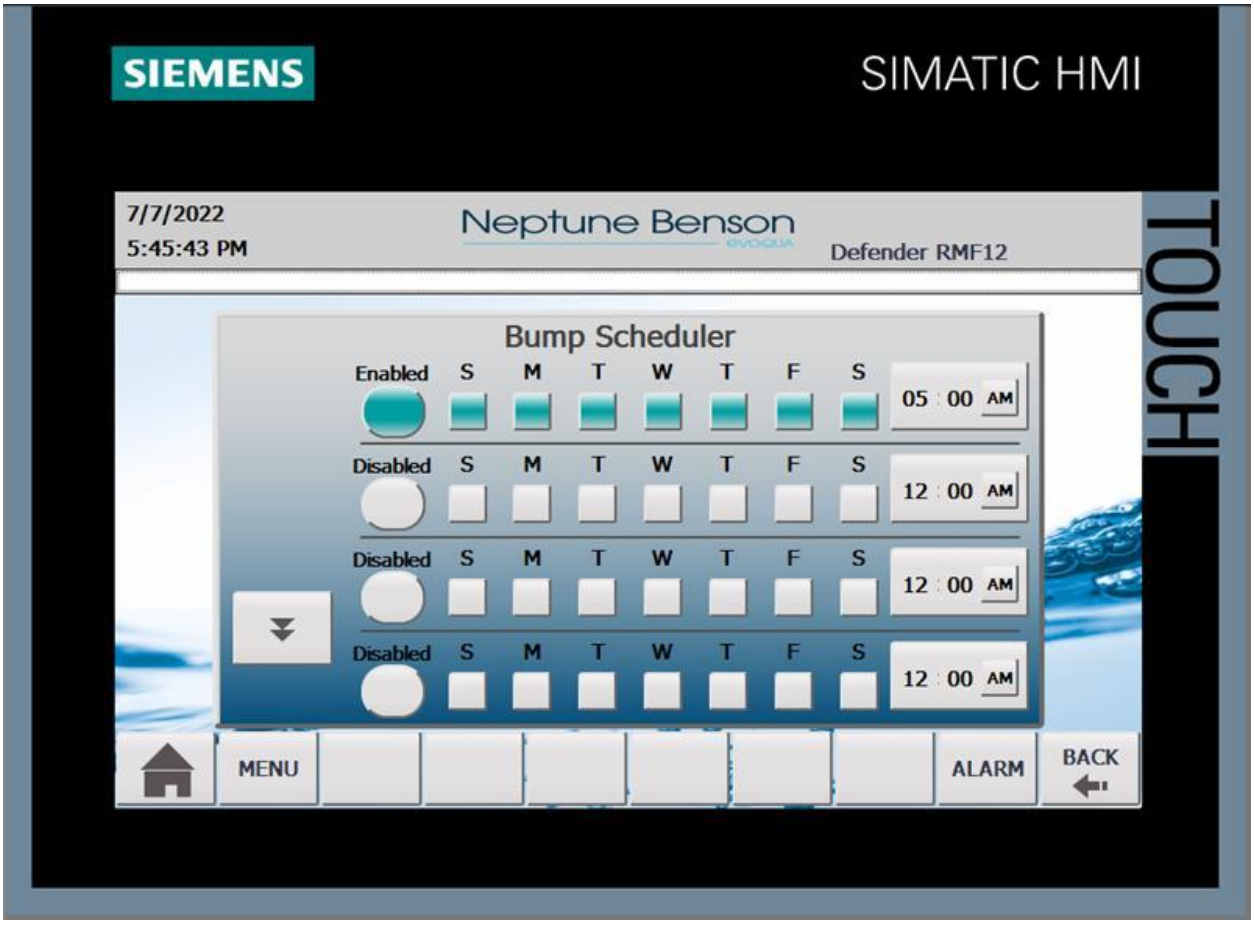


Figure 24: Bump Scheduler Screen

Bump Scheduler: Set the schedule for the automatic bumping function. Typically, one bump per day, seven days a week is sufficient. The RMF12 has the capacity to program up to seven bumps per day.

There are two screens for the bump scheduler. The down arrow opens the second screen.

1. Press **Disabled** to toggle it to **Enabled**. The green color confirms that schedule is enabled.
2. Select the appropriate days of the week. The selected days turn green.

3. Enter the time at which you want the bump to automatically start.

Bump Block Scheduler: Set a window of time to block a bump from occurring. This is used if you want to prevent a bump from occurring during hours when the pool is open. For this you need to select a start and end window schedule.

1. In the **Block # Start** row, press **Disabled** to toggle it to **Enabled**. The green color confirms that schedule is enabled.
2. Select the appropriate days of the week. Selected days turn green.
3. Enter the time at which you want the bump block to start.
4. In the **Block # End** row, press **Disabled** to toggle it to **Enabled**. The green color confirms that schedule is enabled.
5. Select the appropriate days of the week. The selected days turn green.
6. Enter the time at which you want the bump block to end.

NOTE	BOTH AUTOMATIC AND MANUAL BUMPS ARE BLOCKED DURING THE SCHEDULED BUMP BLOCK. TO PERFORM A MANUAL BUMP DURING THE SCHEDULED BUMP BLOCK, TURN THE APPROPRIATE BUMP BLOCK SCHEDULE OFF BY PRESSING THE ENABLED BUTTONS TO TOGGLE THEM TO DISABLED.

Drain Valve Scheduler: Set the schedule for the optional auto drain valve to open and close to flush the tank bottom if Parameter 18 from the **Parameter** menu is set to **ON**.

There are two screens for the drain valve scheduler. The down arrow opens the second screen.

1. Press **Disabled** to toggle it to **Enabled**. The green color confirms that schedule is enabled.
2. Select the appropriate days of the week. The selected days turn green.
3. Enter the time at which you want the drain schedule to automatically start.

Precoat Vent Valve Scheduler: Set the schedule for the optional automatic operation of the precoat valve to allow for makeup water if Parameter 20 from the **Parameter** menu is set to **ON**.

There are two screens for the precoat vent valve scheduler. The down arrow opens the second screen.

1. Press **Disabled** to toggle it to **Enabled**. The green color confirms that schedule is enabled.
2. Select the appropriate days of the week. The selected days turn green.
3. Enter the time at which you want the precoat valve to automatically start.

ADVANCED SETTINGS

The **Advanced Settings** screen has five submenus:

1. **ELECTRICAL SCHEMATIC**: Opens electrical drawings.
2. **REBOOT SYSTEM**: Reboots the operator panel.
3. **CONTROLLER DIAGNOSTICS**: Displays the diagnostic information of the controller.
4. **PANEL SETUP**: Provides Operator Panel setup options. Refer to *Advanced Topics*.
5. **IO DIAGNOSTICS**: Allows individual manual testing of all relays. Used for dry testing.

Once you have completed your initial preparation you are ready to start your Defender® Regenerative Media Filter.

ADMIN

On this screen, you can add new users or edit existing user details and other administrative functions.

Add a User:

1. Press the empty **User** field, and then enter a username using the pop-up keyboard.
2. Enter the required **Password**, as described in the following procedure.
3. Select a suitable user **Group** (Administrator, User, etc.) from the drop-down list.
4. Enter a **Logoff time**.

Change a User's Password:

1. Press the **Password** field of the user whose password you want to change.
2. In the **Change password** pop-up window, press the **New Password** field, and then enter the new password using the pop-up keyboard.
3. Re-enter the password in the **Confirmation** fields.
4. Press **OK** to confirm the change and close the pop-up window.

LOGOFF/LOGON: Use these buttons to log-off the existing user or log in with a different username.

Exit Runtime: Press the power button to exit the panel runtime.

Dry Test Guide

IO Diagnostics

This feature allows for testing the pneumatics, pumps, vacuums, and relays prior to starting the filter.

1. In System Idle mode, press **MENU**.
2. Press **SETUP**.
3. In the **Log-in** pop-up box, enter the passcode **22222** (factory default), and then press **OK**.
4. Press **ADVANCE**.
5. Press **IO DIAGNOSTICS**.

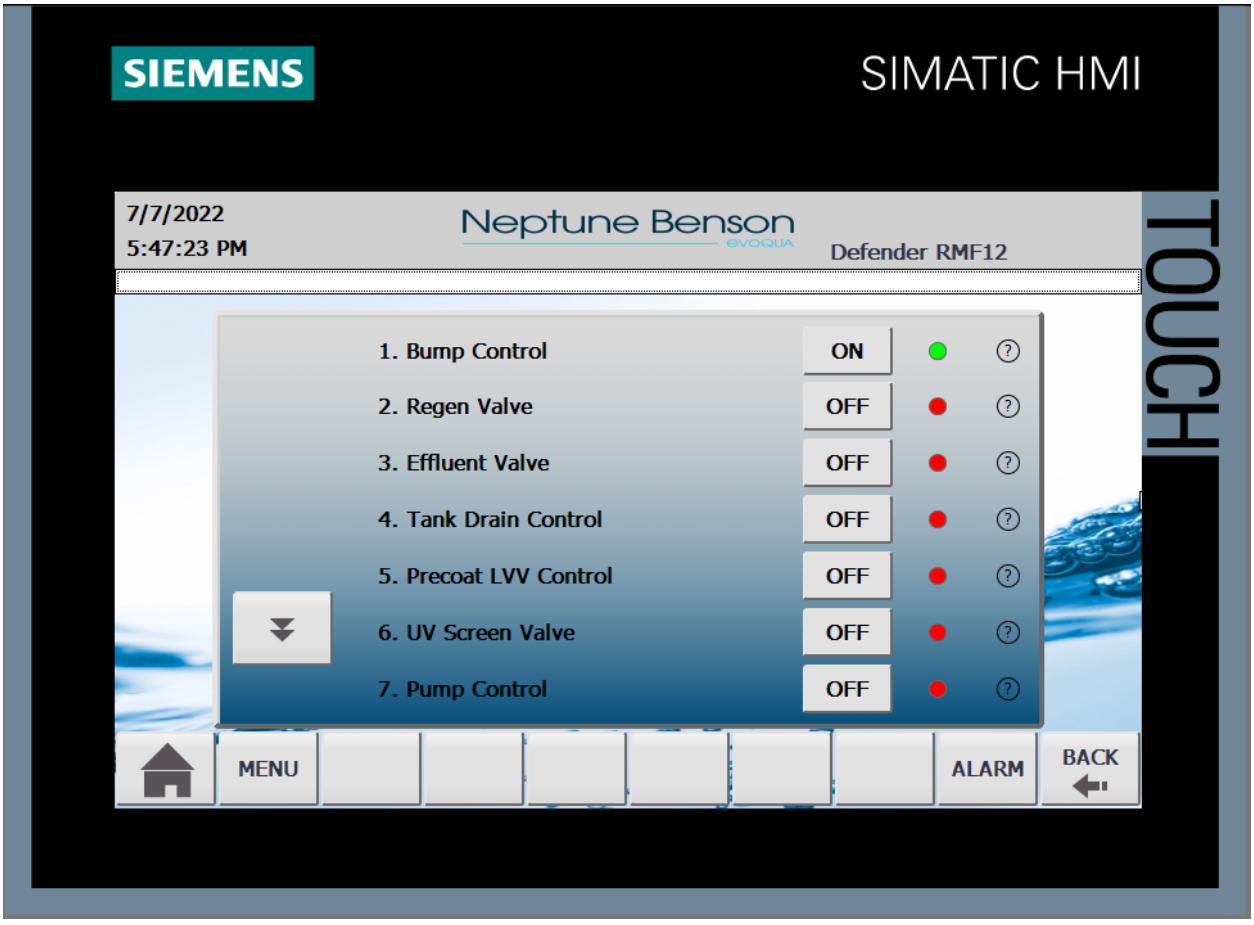


Figure 25: IO Diagnostics Screen

The **IO Diagnostics** screen allows you to test each function by pressing the corresponding button; for example, press **Bump Control** to toggle it to **OFF** and deflate the bump tire. Press the up and down arrows to scroll through the list of diagnostics.

Media Requirements

NSF Standard 50 approved perlite is required. Load amounts are specified by the NSF Standard 50 Certified media packaging of the manufacture’s recommendation.

Loading Perlite-Vacuum Transfer

The Defender filter should never be allowed to run without the approved media. When it is time to begin recirculating water follow the instructions in section “Recharging Perlite (Drain/Rinse)”. During initial startup frequent bumping and media changes are to be expected.

Operational Overview

View Information

From the **System Idle** screen, press **MENU**, and then **VIEW** to open the **VIEW INFORMATION** screen.

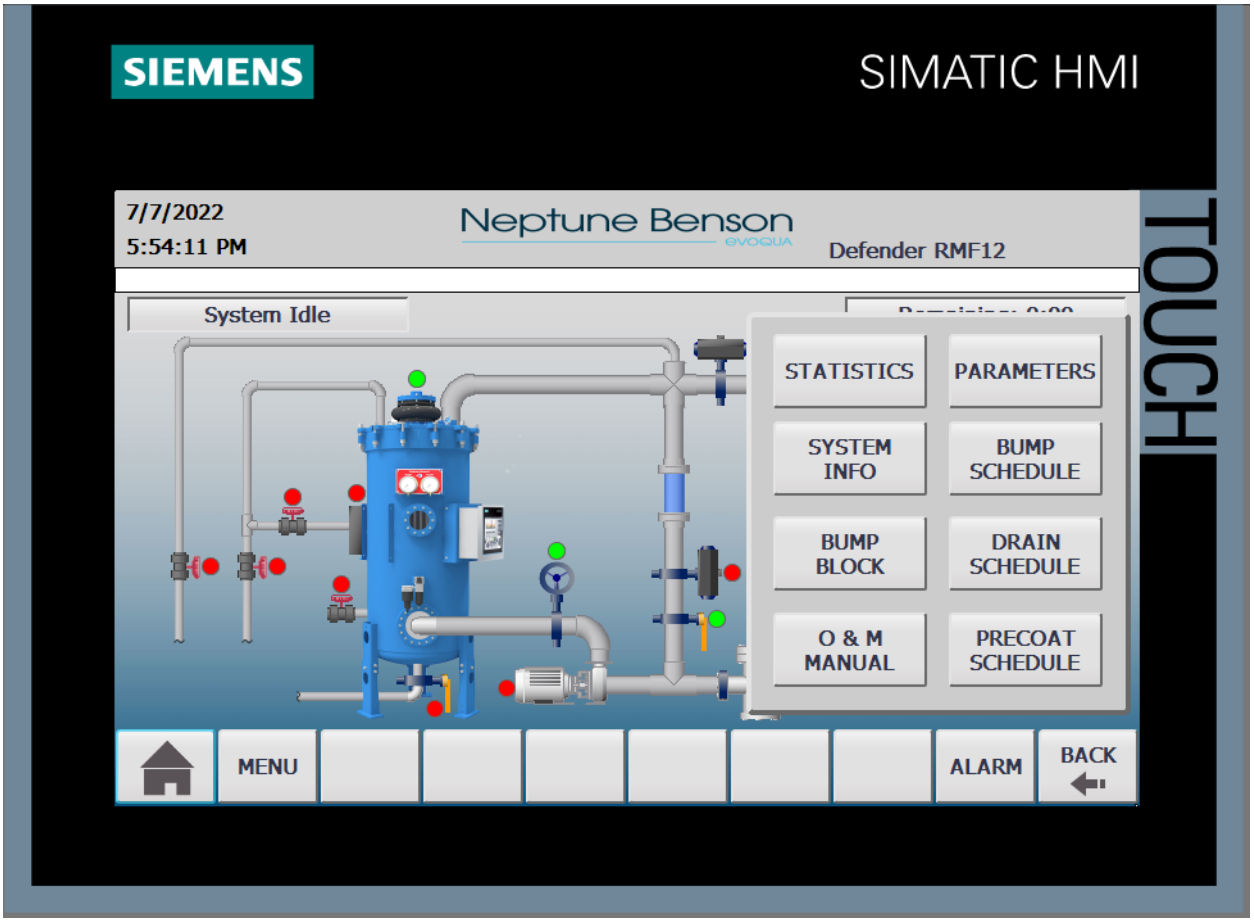


Figure 26: View Information Screen

This screen contains eight sub-menus:

1. **STATISTICS**
2. **SYSTEM INFO**
3. **BUMP BLOCK**: View the bump block schedule.
4. **O & M MANUAL**: View Operator and Maintenance manual.
5. **PARAMETERS**: View parameter settings.
6. **BUMP SCHEDULE**: View the bump schedule.
7. **DRAIN SCHEDULE**: View the drain valve schedule.
8. **PRECOAT SCHEDULE**: View the precoat vent valve schedule.

STATISTICS

The **Statistics** screen displays a 30-day history of:

Filter Stats

Bump Stats

Automatic: By pressure differential or time schedule.

Manual: By pressing the BUMP.

Basket Clean Stats

Drain/Rinse Stats

SYSTEM INFO

The **System Information** screen contains the following information:

Current Info: Controller last download date:

Controller Mode/Serial #: The model and serial number of the filter.

Build: Hardware and firmware versions.

Network: IP addresses of the operator panel and controller.

Controller Status

Bump Required Status: This status displays when the bump is required automatically or planned manually but blocked by a scheduled bump block.

Bump Block Active: This status displays during a scheduled bump block.

Close when Water Exits Vacuum Drain Valve: This status displays while performing **DRAIN RINSE** or **VACUUM TRANSFER**, and during the Close Vacuum Drain Valve step to inform the operator to close the drain valve when the water exits the drain line.

General
It is recommended that a bump be performed at least once every day. When a bump occurs, the pump stops, the effluent valve closes, and then the bump mechanism activates. The bump mechanism depressurizes, and then pressurizes (bumps) 10 times. This action separates media and dirt from the tubes. The RMF controller goes into the **Precoat/Regen** and **Filter Mode**, as described above.

Last Bump Time: The time a bump last occurred is shown in hour and minutes.

Recharging Perlite (Drain/Rinse)

There are several factors such as bather load, water chemistry, organic loading, indoor/outdoor pool, etc. that influence the service life of the media. Perlite may need to be changed every 2 – 12 weeks depending on the factors listed above.

Media recharge is required when:

The pressure differential reaches 10–12 PSI shortly after bumping.
The required system recirculation flow rate cannot be maintained.
The media does not coat well or does not readily release from the flex tubes and into the suspension. See Tubewash Procedure.

Before pressing **STOP**, partially open the drain valve to clear any debris in the piping.

Press **STOP**. The pump stops, the effluent valve closes, and the **System Idle** screen displays.

1. Press **MENU**.
2. Press **DRAIN RINSE**.
3. Close Pump Discharge Valve. Press next.
4. Press **BUMP CYCLE**. The filter bumps for the preprogrammed number of times (10). Press Next.
5. Open Drain Valve. Press next.
6. Open Vacuum Drain Valve. Press next.
7. Once the tank is completely empty, Close Drain Valve. Press next.
8. Open Pump Discharge Valve. Press next.
9. Fill Tank. Press **PUMP ON**, and then wait a couple of seconds after the water passes the viewing window. Tank is full when water is flowing out if the Vacuum drain valve
10. Press **PUMP OFF**. Press next.
11. Press **REPEAT** and follow the steps on the controller to rinse the tank again and remove as much residual media and debris as possible.
12. Close pump discharge valve. Press next.
13. Open drain valve. Once the tank is completely empty, Press next.
14. Close drain valve. Press next.
15. Close vacuum drain valve. Press next.
16. Open vacuum transfer valve. Press next.
17. Open vacuum hose valve. Press next.
18. Insert vacuum hose into bag of media.
19. Press **Vacuum On** to vacuum media into the tank. Continue until the required amount of media has been loaded.
20. Press **Vacuum Off.** Press next.
21. Close vacuum hose valve. Press next.
22. Close vacuum transfer valve. Press next.
23. Open precoat vent line valve. Press next.
24. Open pump discharge valve. Press next.
25. Open vacuum drain valve. Press next.
26. Fill Tank. Press **PUMP ON**, and then wait a couple of seconds after the water passes the viewing window. Tank is full when water is flowing out if the Vacuum drain valve. System is full when water is flowing out of the precoat vent line.
27. Press **PUMP OFF**. Press next.
28. Close vacuum drain valve. Press next.
29. Close precoat vent line valve. Press next.
30. System will automatically begin a 10 minute precoat cycle, and then return to filter mode.

NOTE	ONCE THE TANK HAS BEEN DRAINED AND RINSED SATISFACTORILY, THE D7 AUTOMATICALLY PROMPTS YOU TO PERFORM A VACUUM TRANSFER AS INSTRUCTED IN LOADING PERLITE/VACUUM TRANSFER STEPS 3–11 AND FILL TANK STEPS 1–3. IF YOU STOP THE PROCESS FOR ANY REASON, PRESS MENU, PRESS VACUUM TRANSFER, AND PERFORM STEPS 3–11 ABOVE .

Cleaning the Strainer

1. Press **STOP**.
2. Press **MENU**.
3. Press **Clean Hair Strainer**.
4. Close Strainer Influent Valve. Press next.
5. Remove Strainer Basket and replace it with a clean basket. Press next.
6. Open Strainer Influent Valve. Press next.
7. Press **NEXT** to start the bump.

*The filter bumps, and then goes into the **Precoat/Regen** and returns to **Filter Mode**.*

Maintenance

General

1-Year Maintenance Schedule

The following preventative maintenance schedule should be followed annually to ensure proper performance.

- Filter Tank: Visually inspect the finish and touch up any blemishes with the supplied touch up paint.
- Head Bolts: Verify torque and retighten hardware as required. Refer to Figure 88: Head Torque.
- Flanged Connections: Verify torque and retighten hardware as required. Refer to PVC Flange Installation Data.
- Tank Leg Anchors: Verify torque and retighten hardware as required. Refer to Tank Leg Anchor Installation.
- Vacuum Transfer Unit: Refer to the vacuum transfer unit owner's manual.
- Filter/Regulator: Refer to the filter/regulator manual.
- Air Pressure Regulator Filter Element: Replace with SMC Corporation Part Number AF40P-060S.
- Pneumatic Tubing and Fittings: Inspect for signs of wear and/or leaks. Replace as required.
- Flextubes:
    - Visually inspect and manually clean Flextubes. Refer to Tubewash Procedure.
    - Perform a chemical clean of the Flextubes. Refer to Chemical Clean Procedure.
    - Replace flextubes if tube presents visual damage.

5-Year Maintenance Schedule

In addition to the 1-Year Maintenance Schedule, the following preventative maintenance schedule should be followed every 5 years to ensure proper performance.

- Bump Assembly: Visually inspect the bump assembly for signs of wear and/or leaks and replace all seals.
    - Inspect the bump mechanism tire.
    - Inspect quick exhaust valve and muffler.
    - Replace the two bump bushing O-rings.
    - Replace the three lift shaft O-rings.
    - Replace the bump bushing.
- Tubesheet Assembly: Visually inspect the tubesheet and clean as required.
    - Inspect the felt gasket to ensure an adequate seal around the perimeter of the tubesheet.
    - Verify torque and retighten hardware as required. Hold down plate bolts should be torqued between 20 and 30ft-lbs.
- Tank Lining: The interior of the tank should be visually inspected for any signs of corrosion.

Contact Neptune-Benson for the parts kits required for this maintenance.

10-Year Maintenance Schedule

In addition to the 1-Year and 5-Year Maintenance Schedules, the following preventative maintenance schedule should be followed every 10 years to ensure proper performance.

- Felt Gasket: Visually inspect the felt gasket and replace as required.
    - If gasket does not require replacement. It should be inspected annually until it is replaced.

Contact Neptune-Benson for the parts kits required for this maintenance.

Tube Wash Procedure

This procedure is required whenever the Flextubes become fouled and/or when a media change does not return the filter to its clean pressure differential. Fouled flex tubes will have an uneven, spotty precoat.

1. Bump and perform a drain and rinse to remove debris from the tank
2. At the upper right-hand corner of the control enclosure, shut the breaker off.
3. Remove the viewing window.
4. Using a garden hose, thoroughly rinse the full length of the Flextubes that are accessible through the viewing window.
5. Reach into the viewing window, grasp several tubes with your hand, and pull radially **from left to right** to rotate the tube sheet and allow access to additional flexible tube elements. Continue until all flexible tube elements have been thoroughly rinsed.
6. Reinstall the viewing window, turn on the breaker, and then recharge the media.

Chemical Clean Procedure

This procedure is required whenever the flex tubes become fouled and/or when a media change does not return the filter to its clean pressure differential. To optimize the chemical clean, it is best to perform a Tube wash prior to performing a chemical clean. Chem-Clean Express™ is a multi-purpose granular formulation that cleans and unclogs filters from grease, oils, and scale.

Procedure:

1. Remove the viewing window, and then manually wash off tube elements. Refer to *Tube Wash Procedure*.
2. Reinstall the viewing window.
3. Drain tank.
4. In the menu, select Vacuum Transfer.
5. Close pump discharge valve. Press next.
6. Open vacuum transfer valve. Press next.
7. Open vacuum hose valve. Press next.
8. Insert hose into the bucket of ChemClean. Press next.
9. Press vacuum on and transfer the required amount of cleaner into the tank.
10. Press vacuum off. Press next.
11. Close vacuum hose valve. Press next.
12. Close vacuum transfer valve. Press next.
13. Open precoat vent line valve. Press next.
14. Open pump discharge valve. Press next.
15. Open vacuum drain valve. Press next.
16. Fill Tank. Press **PUMP ON**, and then wait a couple of seconds after the water passes the viewing window. Tank is full when water is flowing out if the Vacuum drain valve. System is full when water is flowing out of the precoat vent line.
17. Press **PUMP OFF**. Press next.
18. Close vacuum drain valve. Press next.

19. Close precoat vent line valve. Press next.
20. Allow the system to precoat for two minutes, then press stop.
21. Open the precoat vent line to dissipate pressure build up.

NOTE	Failure to vent the tank will result in pressurization of the recirculation system that may result in catastrophic failure. See note below.

22. Press **MENU**.
23. Press **Flex-tube Clean**. The filter automatically bumps 10 times every 15 minutes.
24. Soak for 1–5 hours.
25. Drain and fill the tank twice to remove all cleaner residue.
26. Recharge with perlite. Refer to *Recharging Perlite (Drain/Rinse)*.

NOTE	Parameter 14: Flex Clean Loop Time must be set to 0 seconds.

Figure 27: Chem-Clean Express

Size: 25-lb pail (Part Number 1000-5865) and 55-lb pail (Part Number 1000-5866).

Flexible Tube Element Chemical Cleaning

Refer to *Indoor Pools* and *Outdoor Pools* for the recommended cleaning frequency.

Defender Model #	Volume (gal)	Volume (M3)	Suggested Pounds (lbs) of Cleaner	Suggested Kilograms (kg) of Cleaner
SP-27-48-487	159	.60	22	10
SP-29-36-200 through SP-29-36-500	181	.70	25	11
SP-33-48-732	250	.95	34	15
SP-41-48-1038	441	1.70	61	28
SP-49-48-1548	615	2.33	85	39
SP-55-48-2076	841	3.20	116	53

Lowering the Tubesheet into Maintenance Position

Procedure:

1. Turn off the main breaker inside the controller and isolate the filter from the main power and air pressure. The bump tire must be completely deflated before continuing.
2. Remove the ½" bolt and associated hardware from the top of the lift shaft. This will need to be reinstalled once maintenance is complete.
3. The Bump Removal Jig will need to be assembled as shown in Figure 28.
4. Place the Bump Removal Jig (Mark 1) on top of the bump assembly so that it stands unsupported and the hole in the horizontal cross member is aligned with the threaded hole in the shaft.
5. Thread the ½-13 threaded rod (Mark 3) into the top of the lift shaft until it is bottomed out.
6. Thread the ½" nut (Mark 2) down the threaded rod until it contacts the lift shaft. Tighten nut another ¼ turn. This will restrain the tubesheet from rotating while it is being lowered into the tank.
7. Thread the ½" nut (Mark 4) (Mark 4) down the threaded rod until it contacts the thrust bearing (Mark 5).
8. Continue tightening the ½" nut (Mark 4) until the large nut on the shaft can be removed. Once removed, the full weight of the tubesheet has been transferred to the Bump Removal Jig.
9. Loosen the ½" nut (Mark 4) so that the threaded rod, lift shaft, and tubesheet are lowered into the tank. The assembly will need to be lowered approximately 14" until it comes to rest on tabs inside the tank.

10. Once there is no longer any weight on the Bump Removal Jig, the threaded rod will need to be removed from the lift shaft. Carefully use channel locks to loosen the threaded rod. This can also be done by using a jam nut against the nut (Mark 4).

Raising the Tubesheet into Operating Position

Procedure:

1. Place the Bump Removal Jig (Mark 1) on top of the bump assembly so that it stands unsupported and the hole in the horizontal cross member is aligned with the hole in the shaft.
2. Thread the ½-13 threaded rod (Mark 3) into the top of the lift shaft until it is bottomed out. Note: The large nut for the lift shaft must be placed on the bump assembly with the threaded rod through it so that it can be reinstalled when the lift shaft is pulled up.
3. Thread the ½" nut (Mark 2) down the threaded rod until it contacts the lift shaft. Tighten nut another ¼ turn. This will restrain the tubesheet from rotating while it is being lowered into the tank.
4. Thread the ½" nut (Mark 4) down the threaded rod until it contacts the thrust bearing (Mark 5).
5. Continue tightening the ½" nut (Mark 4) until the large nut can be installed on the shaft. Note: The large nut must be threaded on the lift shaft until it bottoms out on a shoulder machined into the lift shaft.
6. Remove the Bump Removal Jig
7. Reinstall all hardware and pneumatic tubing.

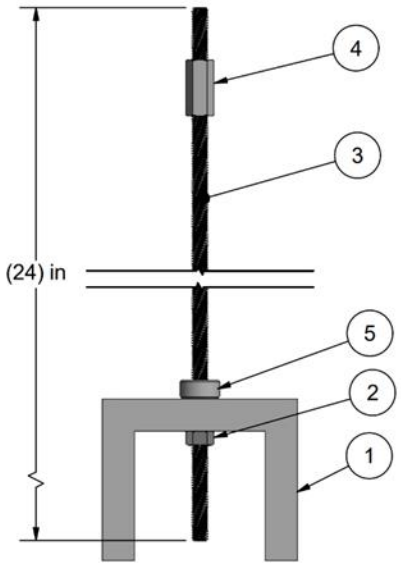


Figure 28: Bump Removal Jig

Bump Assembly Maintenance

Lift Shaft Maintenance Procedure:

1. Complete the procedure for *Lowering the Tubesheet into Maintenance Position*.
2. Remove any pneumatic tubing from the bump assembly
3. Remove the nuts bolting the bump assembly to the filter head. The Bump assembly can now be removed.
4. With the bump assembly removed, inspect the lift shaft and shaft seals for any signs of damage.
5. Remove and replace the three O-rings on the lift shaft. It is important that the O-rings be liberally lubricated with Dupont Molykote® 55 O-Ring Grease.

Bump Assembly Maintenance Procedure:

1. Remove the nuts holding the tire to the steel air chamber.
2. Remove the internal retaining ring inside the air chamber with a pair of retaining ring pliers.
3. Flip the air chamber over and carefully drive the bushing out using a mallet.
4. Install the new O-rings on the bushing. It is important that the O-rings be liberally lubricated with Dupont Molykote® 55 O-Ring Grease.
5. Carefully press the new bushing into the air chamber until the retaining ring groove is accessible. If this is done incorrectly, it can result in damaged O-rings.
6. Install the new retaining ring in the air chamber.
7. Insert the bolts into the bead ring. The bolts will be pulled into place by the action of tightening the nuts. The bolt heads must be oriented so that they sit flush with the bead ring.
8. Slip all the bolts (which are protruding through the bead ring) into the mating holes of the mounting plate and attach the lock washers and nuts. FINGER TIGHTEN all nuts to produce a uniform gap between the bead ring and mounting plate all the way around.
9. At this point, make certain that the bellows bead is properly seated under the bead ring. PLEASE NOTE THAT UNIFORM SUCCESSIVE TIGHTENING OF THE NUTS IS IMPORTANT TO SEAT THE RUBBER BEAD PROPERLY TO THE MOUNTING PLATE FOR ITS FULL CIRCUMFERENCE.
10. Tighten all nuts one turn each, moving around the circle until continuous contact is made between the bead ring and mounting plate.
11. Torque all nuts to 17-22 ft-lbs, going at least two complete turns around the bolt circle.
12. Place bump assembly over the studs and gasket on the head and reinstall the nuts.
13. Follow the procedure for “Raising the Tubesheet into Operating Position”

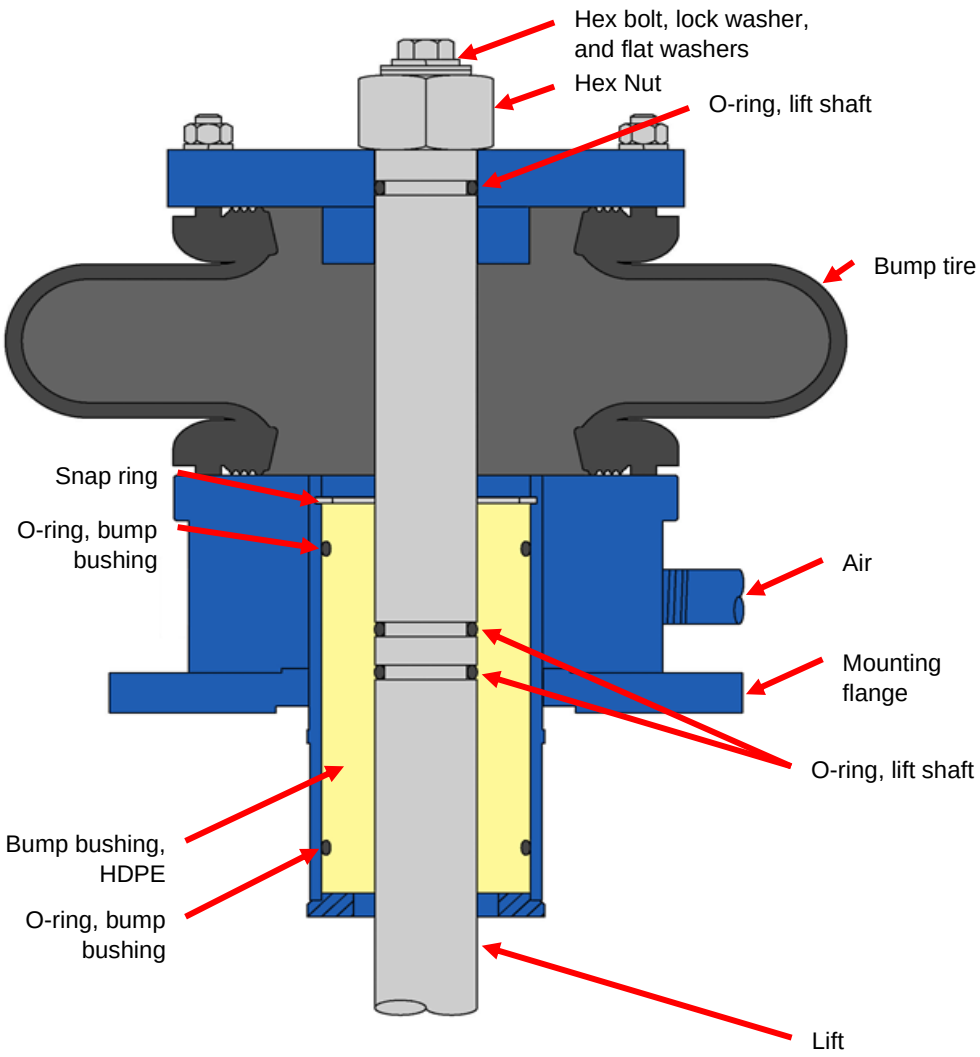


Figure 29: Bump Assembly

Head Removal

This procedure is to be followed when any kind of maintenance or repair is required inside the filter tank which cannot be accessed from the various open connections or manways.

All Defender filters are equipped with a davit head removal system, except for older domed-headed filters and the SP-18 and SP-29 Assero Defender filters. The tank-mounted bottle jack drives a shaft attached to the head of the tank. Due to the infrequent use of the davit, a lubricating penetrating oil for the davit must be applied before each operation.

The head gasket is required to be replaced whenever the head is removed. Be sure to have a new head gasket on hand before performing this procedure.

1. Bump and perform a drain and rinse to remove debris from the tank.

2. Shut off the air supply and vent the air out via the filter regulator.
3. Remove the pneumatic tubing from the bump mechanism.
4. Disconnect the effluent and vacuum piping that are bolted to the head.
5. Disconnect the tubing from the gauge panel, and then remove the gauge panel bracket by removing the nuts.
6. Follow the procedure for “Lowering the Tubesheet into Maintenance Position”
7. Inspect the support legs of the Defender and verify that the filter is properly anchored to the concrete.

CAUTION	ENSURE FILTER IS PROPERLY ANCHORED TO THE CONCRETE. IF NOT PROPERLY ANCHORED, FILTER CAN TIP AND POSES A CRUSH RISK.

8. Remove all hardware that fastens the head to the tank.
9. Using the supplied jack handle, insert it into the bottle jack, and raise the head until it can swing clear of the tank
10. Swing the head clear of the filter tank.

NOTE	THE SP-18, SP-29, AND ALL OTHER DOMED-HEADED FILTERS HAVE LIFTING LUGS, PAD EYE LUGS (SP-18 AND SP-24 WITHOUT THE DAVIT OPTION) OR EYE NUTS (SP-29) WILL REQUIRE A HOIST.

Head torque sequence is listed on next page. For filters other than the SP-29 domed head sequence, use a standard bolt pattern and torque recommendations for the specific bolt sizes.

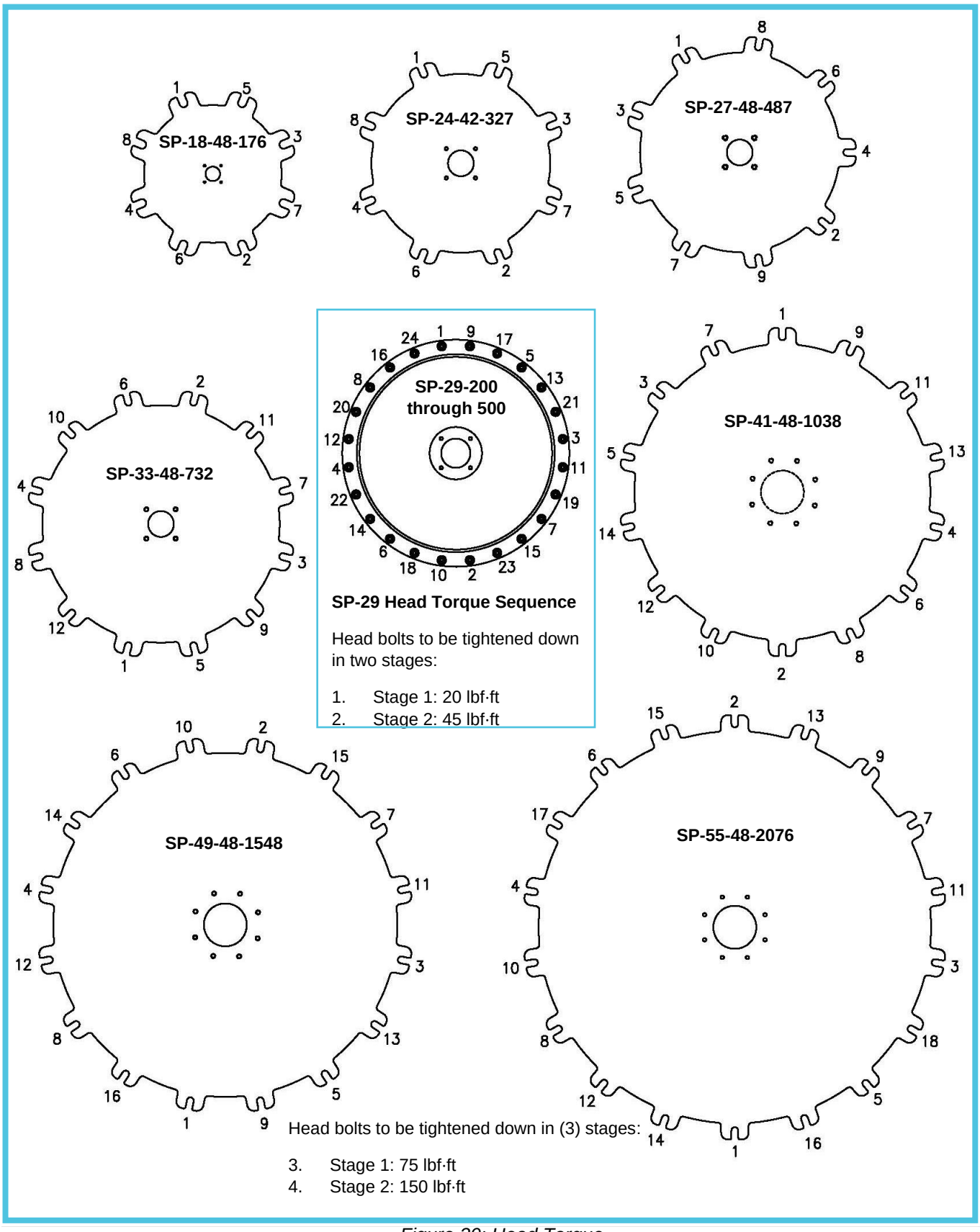


Figure 30: Head Torque

Felt Gasket Replacement Procedure

1. If filter is in operation, start by bumping and draining the filter, and then shut down the filter system. Isolate the filter, isolate the compressed air, deenergize the control panel and drain the tank. NOTE: If tubes still seem to be caked with residue, we recommend a Tubewash prior to shutting down the system. The tube elements will be removed from the tube-sheet and if they are covered with debris, they will be more difficult to remove.
2. Follow the procedure for “Lowering the Tubesheet into Maintenance Position”
3. Follow the procedure for “Head Removal”
4. Unbolt/Remove the hold down plate(s).
5. Remove/pull out the tube elements by hand.
6. Remove old tube-sheet felt gasket and replace with a new tube-sheet felt gasket.
7. Inspect and reinstall tube elements.

NOTE	*If damaged tubes are found, they should be replaced before final assembly.*

8. Re-install hold down plate(s). Torque bolts to 30 ft-lbs.
9. Re-install head and torque bolts following Figure 30: Head Torque, and all other associated pipe, pneumatic tubing, and hardware.

Troubleshooting

Errors and Alarms

The RMF Controller requires two critical inputs to operate effectively and safely. Without a minimum of 50 PSI of air pressure and a positive signal from the motor starter that the pump is running, the RMF Controller will return to idle mode and display an alarm in red at the top of the screen. When the cause of the alarm is identified and corrected press the ALARM icon to display active alarms, and then press the RESET ALARM icon to clear all active alarms. Normal operation of filter can now resume.

Alarm	Probable Cause	Solution
Air pressure low or out of range	Air pressure is below 50 PSI.	Verify that air pressure is between 80-90 PSI.
Main pump failed. The system will not operate without it	Run confirm signal was not received.	Confirm motor starter shows no faults/alarms. Confirm wiring between the RMF controller and the motor starter.

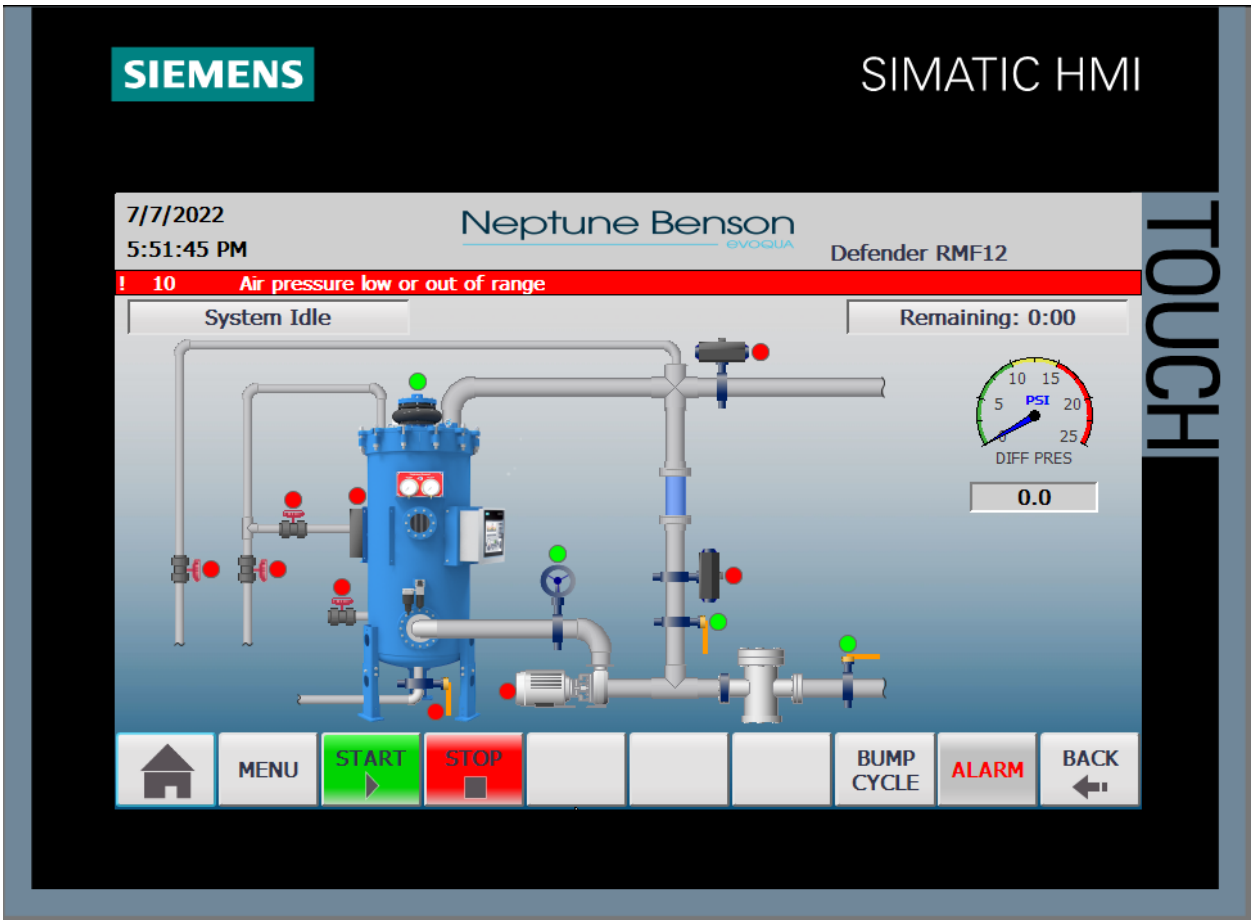


Figure 31: Example Alarm

When any predefined alarm condition occurs, it is indicated on the top alarm banner in the panel screen. The **ALARM** button blinks. Press **ALARM** to open the **Active Alarm** screen.

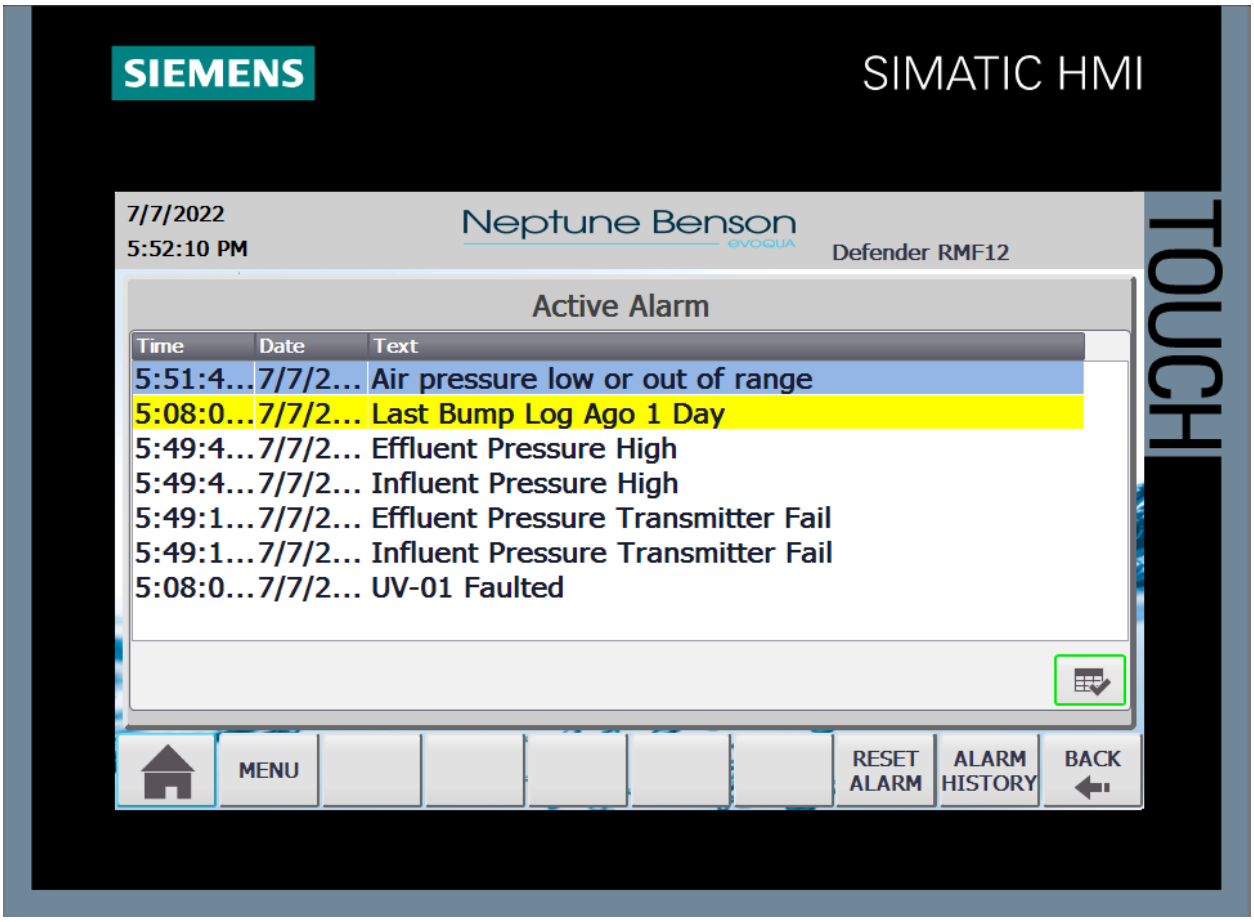


Figure 32: Example Active Alarm Screen

This **Active Alarm** screen example indicates a loss of air pressure. Press the acknowledge button (check mark icon) to acknowledge the current alarm.

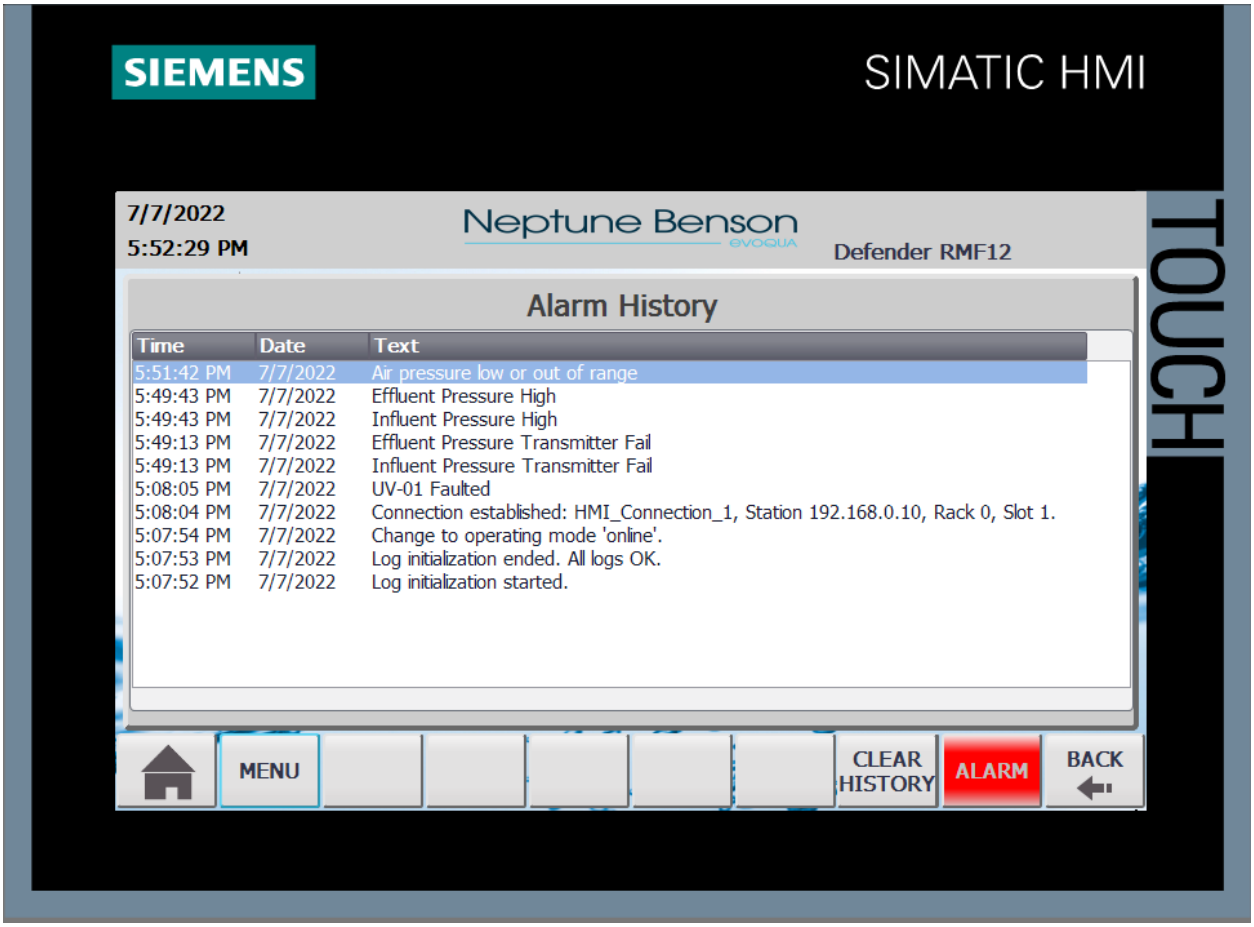


Figure 33: Alarm History Screen

CLEAR HISTORY: Clears all alarm and warning messages from the system.

Troubleshooting Guide

Component	Problem	Probable Cause	Solution
Vacuum Transfer System	Vacuum does not turn on when activated on control panel.	Vacuum unit is not turned on at the device.	Toggle on/off switch while vacuum is active on control panel.
		Vacuum is not getting power.	Verify wiring is correct and power is present at the control panel.
	No suction at hose end while vacuum is running.	Vacuum hose or port is clogged.	Disconnect hose and ensure there is no blockage in the hose or port.
		Vacuum filter is clogged or full of water.	Inspect vacuum canister and ensure everything is clean.
		Valves are not configured properly.	Verify that ball valves are in the correct orientation.
			Ensure the precoat and effluent valves are closed.
Valves with Pneumatic Actuators	Actuator is not operating.	No air is getting to or from the actuator.	Check system air pressure. Confirm at 80-90 PSI.
			Check air line tubing is properly attached.
			Check for leaks in the air lines and fittings.
		Air flow is restricted due to needle valves being closed.	Confirm the needle valves are open to allow air flow and are properly adjusted.
	Actuator is moving too quickly or slowly.	Air flow needs to be adjusted at the needle valves on the actuator.	Turn knobs counterclockwise to increase actuator speed. Turn knobs clockwise to decrease actuator speed.
	Valve disk is sticking closed and then slamming open.	Valve stops are out of adjustment.	Adjust the actuator limit stops so that the valve closes, but does not stick closed.
		No air is getting to the actuator.	Check system air pressure. Confirm at 80-90 PSI.
			Check air line tubing is properly attached.
			Check for leaks in the air lines and fittings.
	Precoat valve did not open or close when it was supposed to.	No air is getting to the actuator.	Inspect pneumatic solenoid operation.
	Effluent valve did not open or close when it was supposed to.	No air is getting to the actuator.	Inspect pneumatic solenoid operation.

Filter Tank	Head is leaking.	Bolts around perimeter of tank are loose.	Re-torque bolts to specification.
	Tank is draining slowly.	Tank drain port is blocked with dirt and debris.	While pump is running, slowly open the drain valve to purge the drain port.
		Vacuum is preventing the tank from draining quickly.	Open tank vent valve to relieve vacuum.
	Pressure gauge not reading correctly.	Perlite may have impacted the tubing or gauge neck.	Service and/or replace faulty gauge and associated tubing.
	Media is getting back to the pool.	Effluent valve is not closed.	Adjust the actuator limit stops so that the valve closes, but does not stick closed.
		Tubes are not fully precoating prior to filter going into filter mode.	Verify the precoat flow rate is at least .5 gpm/sf based on filter size.
			Complete tube wash to ensure tubes are not fouled.
			Confirm the system has been purged of any air.
			Inspect condition of felt tubesheet gasket and replace if necessary.
		The incorrect grade of media is being used.	Contact Neptune Benson for media recommendations.
		The tube elements are fouled.	Complete tube wash procedure to ensure tubes are not fouled.
			Use ChemClean Express to de-grease the tube elements if needed.
Bump Mechanism	Bump tire did not inflate.	No air is getting to the bump tire.	Check system air pressure. Confirm at 80-90 PSI.
			Inspect and service the quick exhaust valve and muffler.
			Inspect pneumatic solenoid operation.
	Bump tire did not deflate.	The quick exhaust valve is not opening.	Inspect and service the quick exhaust valve and muffler.
		The solenoid is not switching state.	Inspect pneumatic solenoid operation.
	Bump is weak.	The quick exhaust valve is not opening.	Inspect and service the quick exhaust valve and muffler.
	Water is leaking from the quick exhaust valve muffler.	Bump O-rings and bushing are worn.	Replace bump O-rings and bushing.

RMF 12 Controller	Menu Passcode		Operator: 22222 Admin: EWT
	Screen is blank.	24V power is not being supplied to HMI.	Verify the 24V power supply has green LED indicator and that 24V is supplied to the HMI connector.
	HMI works for a while and then locks up, requiring cycling power to reset.	Inconsistent incoming power or electrical interference causing the HMI to lock up.	A line power filter could be installed to eliminate electrical interference.
		Pressure transducer out of range.	Check system air pressure. Confirm at 80-90 PSI. Exceeding 100 PSI will result in an alarm, which needs to be reset in the alarm screen.
	Nothing happens when start is pressed and menu is not accessible.	Program update may be necessary.	There may be a program issue that requires an update.
		Pressure transducer out of range.	Check system air pressure. Confirm at 80-90 PSI. Exceeding 100 PSI will result in an alarm, which needs to be reset in the alarm screen.
	Pump did not start.	Pump run command not recognized on VFD or motor starter.	Verify that terminals 39/40 are closing when pump run is desired.
	Air pressure alarm present.	Air pressure is below 50 PSI.	Verify that air pressure is between 80-90 PSI.
	Pump run confirm not working (Pump is Offline alarm)	Contact closure in VFD or motor starter are not making contact.	Ensure contact closure when pump is running with no warnings.
	##### are present on main screen values.	The PLC and HMI have lost communication.	Verify that ethernet cables are properly connected.
			Verify indicator lights are green on the PLC modules and ensure they are properly seated.
			There may be a program issue that requires an update.
	Bump schedule does not return after a power failure.	The schedules are not being retained.	There may be a program issue that requires an update.

Optional Features

Automated Drain Option

This is a nonstandard option available for a periodic flush of the tank bottom of large debris without the need to replace the media. For further details please contact Neptune Benson.

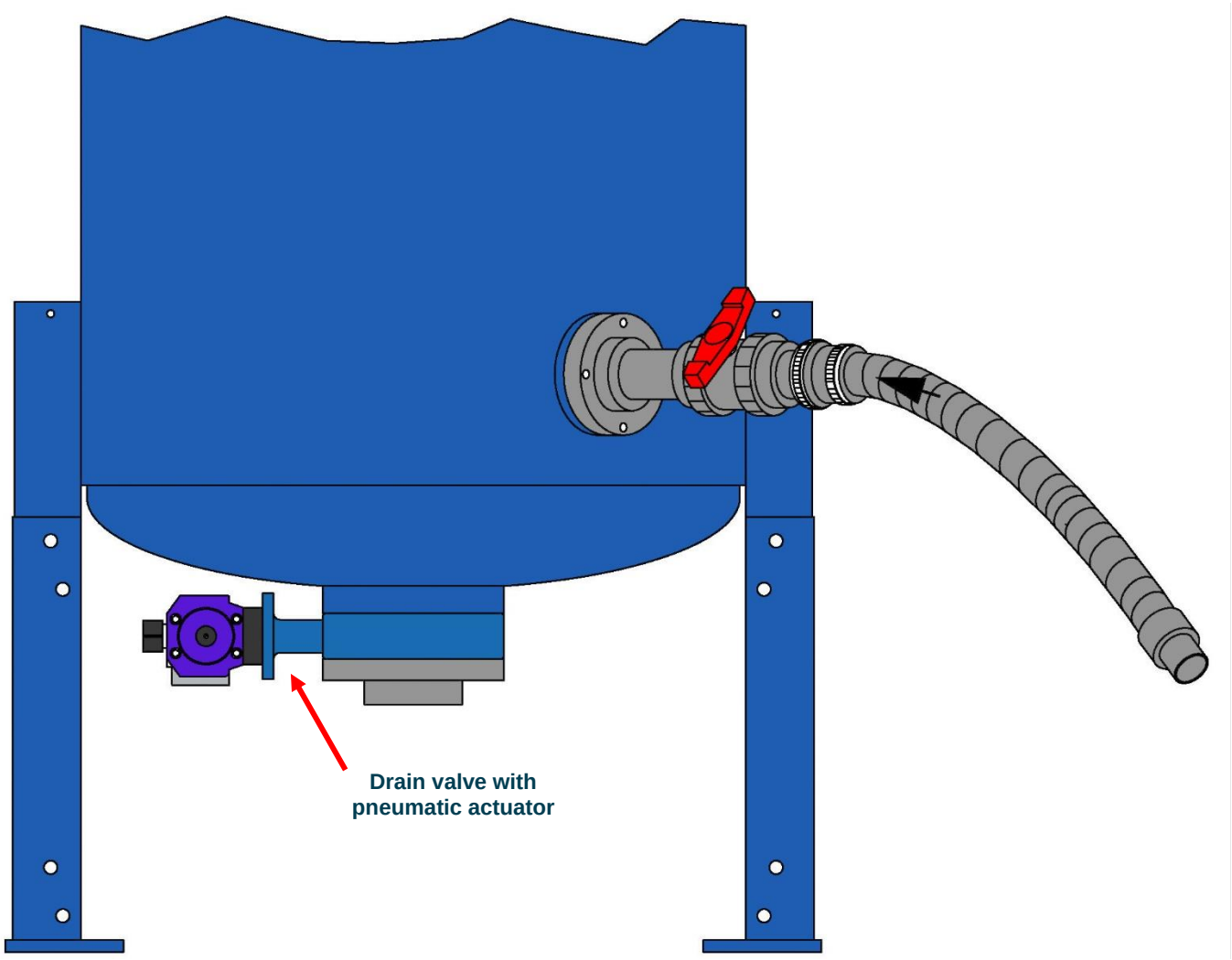


Figure 34: Automated Drain Option

APPENDIX

Neptune Benson
evoqua

Defender RMF12 Field Wiring Guide

Pump Run Confirm[1] (relay closure at VFD or Motor Starter when pump is ready/running with no faults)

UV Healthy[1] (relay closure at UV system) – will require a jumper if UV system status is not integrated

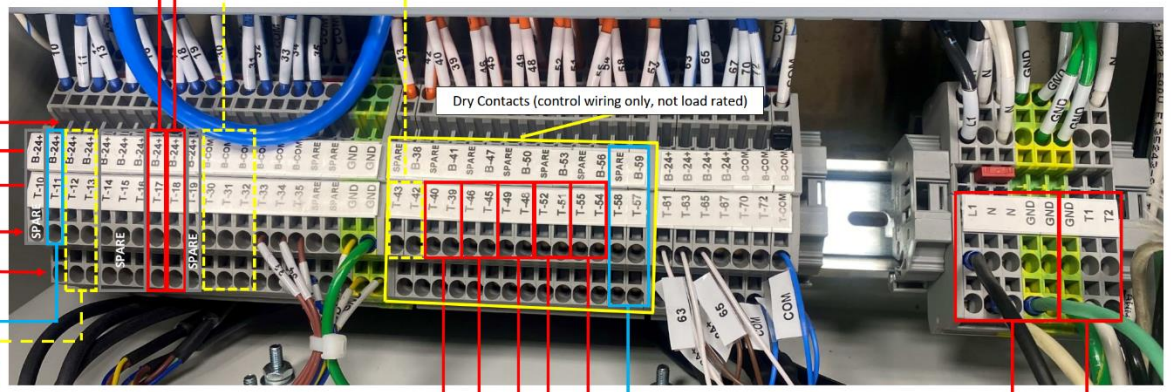
Secondary Functions[2] (additional pneumatic solenoids could be wired here)

Secondary Pump Start/Stop (contact closes to start pump)

Bottom Row Terminal #

Top Row Terminal #

Use small flat head screwdriver to open spring-loaded contact



Row not used

T = Top Row

B = Bottom Row

Digital Air Pressure Input[2]
Not commonly used
(programmable in setup menu)

Secondary Functions[2]
Remote Start/Stop – if programmed

Primary Pump Start/Stop[1] (contact closes to start pump)

Filter Mode Contacts – provides interlocking for auxiliary equipment
(contacts are closed during filter mode)

Fireman Switch Contacts[2] – provides interlocking for heater or heat exchanger
(contacts are closed during filter mode)
Linked to parameters 8 &9 in setup menu

Programmable Relay[2] – open or closed based on selection in setup menu
(T58Common, T57NO, B59NC)
Linked to parameter 45 in the setup menu
Select OP2 for closed contacts during pre-coat mode – could be used for VFD Jog Speed

Incoming Line Power, Neutral & Ground[1]

Vacuum Transfer System[3]

[1] Required for system to run
[2] Programmable in the setup menu
[3] Pre-wired from factory

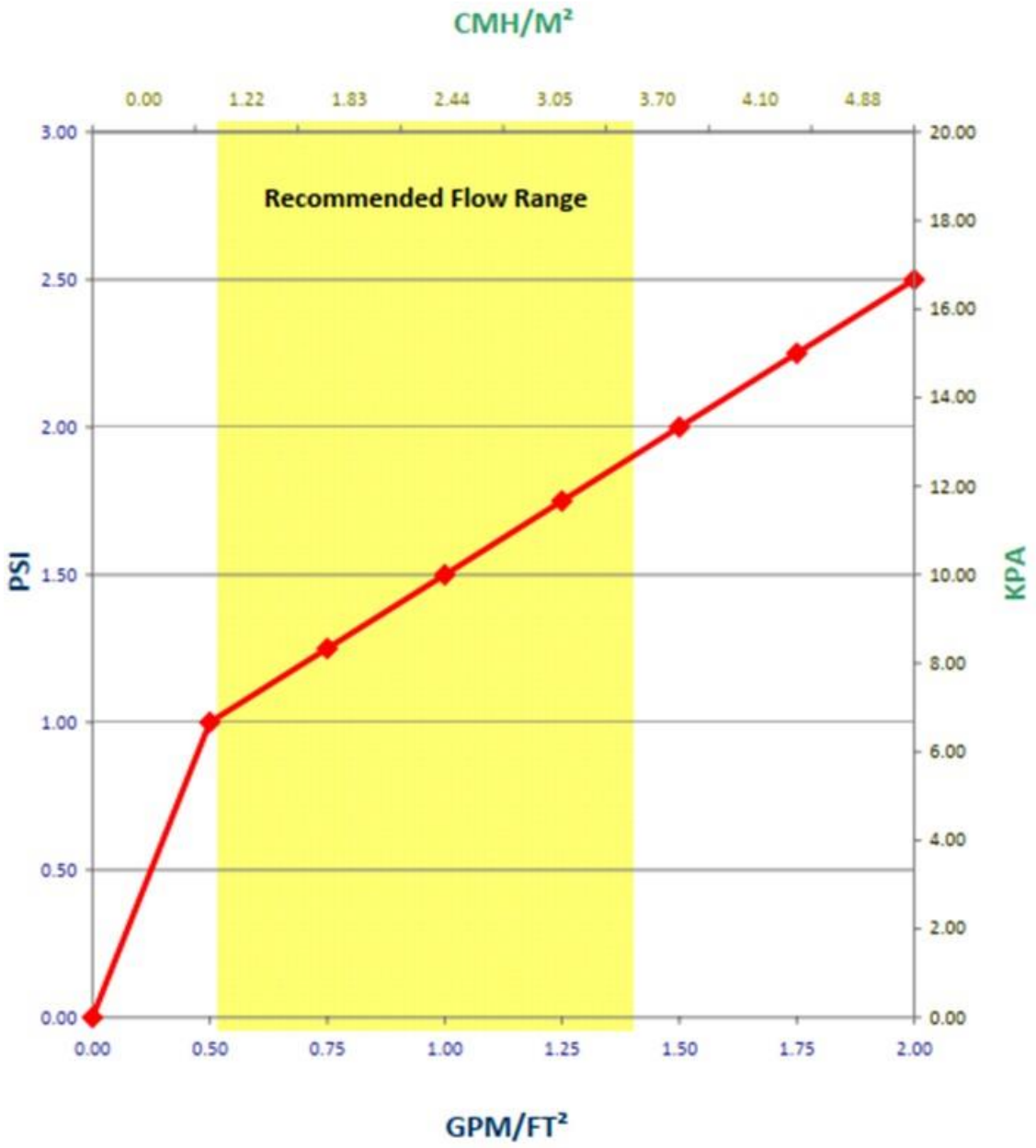
Notes: 90psi air pressure needed for system to operate
Menu passcode: 22222
Advanced passcode: ewt

Reference page 95 in the O&M for additional information.

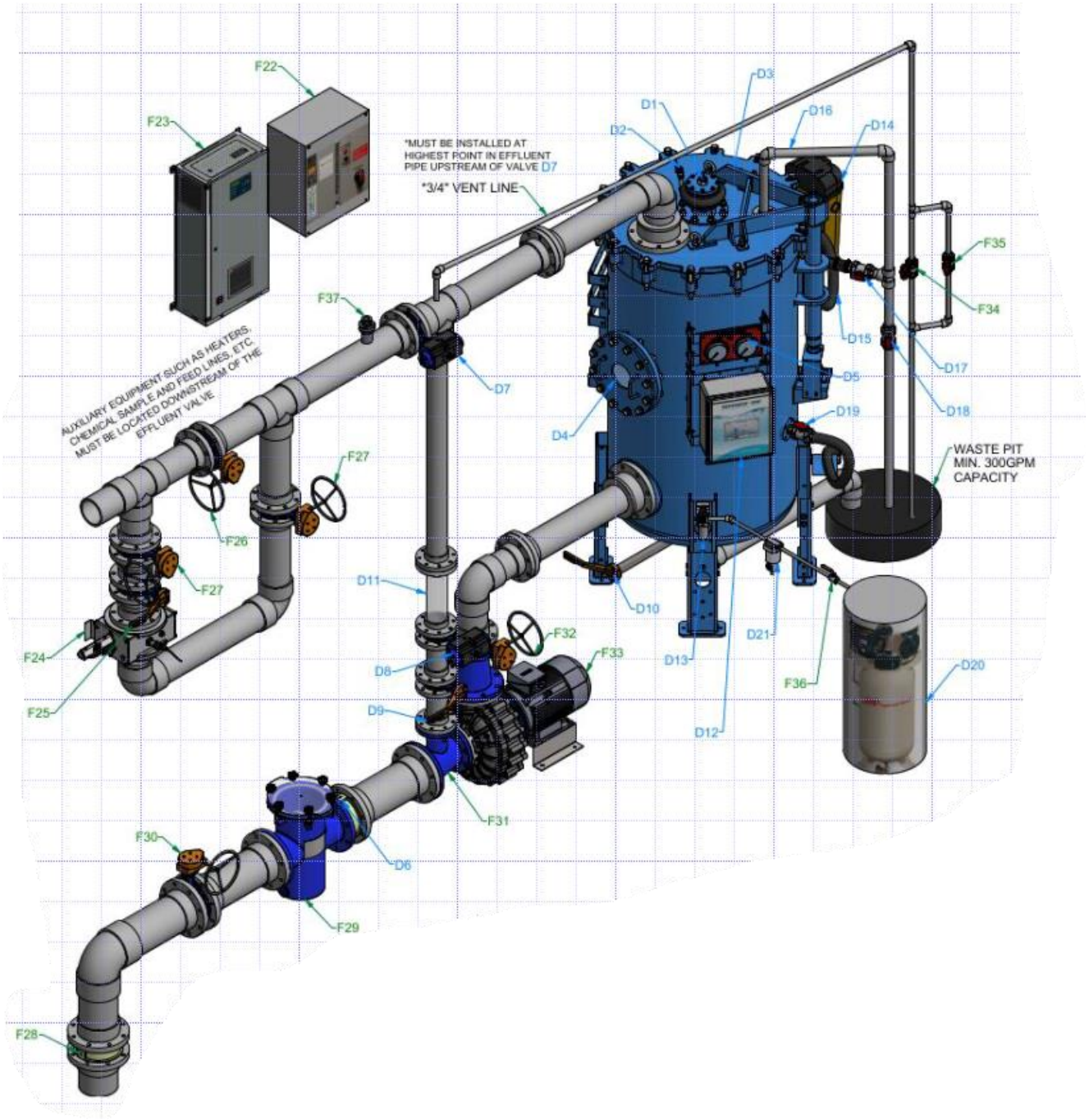
09/20/22

Evoqua Water Technologies LLC 334 Knight St Ste 3100 Warwick, RI 02886 (401) 821-2200 nbtechsupport@evoqua.com

Head Loss Curve



Defender® RMF Schematic and Parts List



NOTE	*EQUIPMENT IS SHOWN FOR SCHEMATIC PURPOSES ONLY. REFER TO THE PROJECT PROPOSAL AND SUBMITTALS FOR A LIST OF EQUIPMENT SUPPLIED BY NEPTUNE-BENSON™.* *PNEUMATIC TUBING OR WIRING NOT SHOWN FOR CLARITY.*

Filter Components – Included in Package

Mark	Reference	Notes
D1	Pneumatic bumping assembly	
D2	Quick exhaust valve	
D3	Lifting davit	
D4	Viewing window	
D5	Gauge panel	
D6	Influent check valve	
D7	Effluent valve	Air-operated butterfly valve, normally open. Install the effluent valve directly on the precoat tee. Locate the actuator where the valve position can be viewed from the floor.
D8	Precoat valve	Air-operated butterfly valve, normally closed. Install the precoat valve as close as possible to the pump suction piping. Precoat the line two pipe diameters smaller than effluent pipe diameter. (No less than 2 inches).
D9	System fill	Manually-operated butterfly valve, normally open.
D10	Drain valve	Manually-operated butterfly valve, normally closed, with extension. Bolted directly to the tank bottom (media dump/rinse). Drain line must be plumbed independently to waste. (Automated option available).
D11	In-line sight glass	Install in-line sight glass on the precoat line so that it can be viewed while standing at the filter control panel.
D12	Control enclosure	
D13	Filter regulator	
D14	Vacuum transfer unit	
D15	Vacuum transfer hose	
D16	Vacuum transfer piping and fittings	SCH 80 PVC fittings and pipe, 1 1/2 inch.
D17	Vacuum transfer valve	Ball valve, 1 1/2 inch, true union, normally closed.
D18	Vacuum vent valve	Ball valve, 1 1/2 inch, true union, normally closed. The vacuum drain line must be plumbed independently to waste.
D19	Vacuum hose valve with hose	Ball valve, 1 1/2 inch, true union, normally closed.
D20	Air compressor	Optional.
D21	Water separator	

Filter Accessory Components – Available Upon Request

Mark	Reference	Notes
F22	Green drive VFD	With by-pass.
F23	ETS UV treatment system controller	This is a package.
F24	ETS UV chamber	
F25	ETS UV EZ strainer	Shown with automated option.
F26	ETS UV bypass	Gear-operated butterfly valve, normally closed.
F27	ETS UV isolation	Gear- or lever-operated butterfly valve, normally open. Two required.
F28	Check valve	For self-priming pumps, the check valve must be installed on the suction pipe below the water level.
F29	Guardian™ strainer	Hair and lint strainer.
F30	Strainer isolation	Lever- or gear-operated butterfly valve, normally open.
F31	Precoat reducing tee	None.
F32	Pump throttle valve	Gear-operated butterfly valve, normally open.
F33	Recirculating pump	
F34	Pump base	
F35	3/4 inch precoat line vent valve	Normally closed, precoat line must be plumbed independently to waste.
F36	3/4 inch precoat line vent valve	Shown with automated option.
F37	3/4 inch shut off valve	
F38	Flow meter	4–20 MA output.

Filter Components – Included in Package

Mark	Reference	Notes
D1	Pneumatic bumping assembly	
D2	Quick exhaust valve	
D3	Viewing window	
D4	Gauge panel	
D5	Influent check valve	
D6	Effluent valve	Air-operated butterfly valve, normally open. Install the effluent valve directly on the precoat tee. Locate the actuator where the valve position can be viewed from the floor.
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D11	Control enclosure	
D12	Filter regulator	
D13	Vacuum transfer unit	
D14	Vacuum transfer hose	
D15	Vacuum transfer piping and fittings	SCH 80 PVC fittings and pipe, 1 1/2 inch.
D16	Vacuum transfer valve	Ball valve, 1 1/2 inch, true union, normally closed.
D17	Vacuum vent valve	Ball valve, 1 1/2 inch, true union, normally closed. The vacuum drain line must be plumbed independently to waste.
D18	Vacuum hose valve with hose	Ball valve, 1 1/2 inch, true union, normally closed.
D19	Air compressor	Optional.
D20	Water separator	

•

Filter Accessory Components – Available Upon Request

Mark	Reference	Notes
F21	Green drive VFD	With by-pass.
F22	ETS UV treatment system controller	This is a package.
F23	ETS UV treatment system	
F24	ETS UV EZ strainer	Shown with automated option.
F25	ETS UV bypass	Gear-operated butterfly valve, normally closed.
F26	ETS UV isolation	Gear- or lever-operated butterfly valve, normally open. Two required.
F27	Check valve	For self-priming pumps, the check valve must be installed on the suction pipe below the water level.
F28	Guardian™ strainer	Hair and lint strainer.
F29	Strainer isolation	Lever- or gear-operated butterfly valve, normally open.
F30	Precoat reducing tee	None.
F31	Pump throttle valve	Gear-operated butterfly valve, normally open.
F32	Recirculating pump	
F33	Pump base	
F34	3/4 inch precoat line vent valve	Normally closed, precoat line must be plumbed independently to waste.
F35	3/4 inch precoat line vent valve	Shown with automated option.
F36	1/2 inch shut off valve	
F37	Flow meter	4–20 MA output.

CAUTION

DO NOT STORE OR INSTALL FILTER PIPING OR INTERNALS IN LOCATIONS THAT ARE SUBJECT TO TEMPERATURES BEYOND THE SPECIFIED LIMITS OF THEIR COMPOSITE MATERIALS. FOR OUTDOOR INSTALLATIONS, TEMPERATURES INSIDE THE FILTER CAN VARY WIDELY FROM THE OUTSIDE TEMPERATURE. DO NOT EXPOSE THE FILTER TANKS TO DIRECT SUNLIGHT OR HEAT BEYOND AMBIENT TEMPERATURES DURING STORAGE OR WHEN THE SYSTEM IS SHUT DOWN FOR EXTENDED PERIODS. CONTACT NEPTUNE-BENSON™ FOR QUESTIONS REGARDING THE STORAGE OR INSTALLATION PROCEDURES FOR TANKS AND PIPING.

Health and Safety

Cautions and Warnings

Prior to operating or servicing this filter system, read and understand the information provided in this manual. If anything is not clear, before proceeding contact Neptune Benson Technical Support at the phone number provided on the cover of this manual for assistance. Keep this and other associated manuals for future reference and for new operators or qualified service personnel.

Warnings, Cautions, and information notices are used to attract attention to essential, critical, or beneficial information. Warnings and Cautions will appear before the text associated with them, and informational notices can appear either before or after associated text. Notices found in this manual are utilized for either personal safety or product performance.

Personal Safety

Personal safety notices are patterned after ANSI/ISO label standards. The notices are categorized by “signal words” that indicate the severity of the risk involved, symbols that convey the appropriate action to take in response to the risk level, and a message that describes the hazard.

DANGER	*INDICATES A HAZARDOUS SITUATION WILL RESULT IN DEATH OR SERIOUS INJURY IF NOT AVOIDED. USE IS LIMITED TO THE MOST EXTREME SITUATIONS.*
WARNING	*INDICATES A HAZARDOUS SITUATION THAT COULD RESULT IN DEATH OR SERIOUS INJURY IF NOT AVOIDED.*
CAUTION	*INDICATES A HAZARDOUS SITUATION THAT COULD RESULT IN MINOR OR MODERATE INJURY IF NOT AVOIDED.*

Hazard Alerting Symbols

The triangular, yellow safety symbol provides a visual identification of a hazardous situation.

Electrical Shock

Foot Crush

Sharp Element

Loud Noise

Pinch Point

Inhalation

Chemical Burn

Moving Parts

Prohibited Action Symbols

The circular safety symbol with red border communicates action that should not be taken.

Do Not Change Position of Switch

Do Not Step On

No Climbing

Do Not Tilt

Mandatory Action Symbols

These blue, circular safety symbols communicate actions that should be taken to avoid hazardous situations.

Pay Attention
This is Mandatory

Refer to Instruction
Manual

Verify Guard
is in Place

Disconnect Mains
Plug from Outlet

Disconect Before
Performing Maintainance
or Repair

The complete safety notice will identify the hazard, describe the consequence of not avoiding the hazard and how to avoid the hazard.

Product Safety

The following notices apply to product/equipment operation and performance without affecting personal safety.

CAUTION	CAUTIONS INDICATE A SITUATION THAT MAY CAUSE DAMAGE OR DESTRUCTION OF EQUIPMENT, OR OTHERWISE VOID PRODUCT WARRANTY.

Important	*Provides reminder, preparatory or qualifying information important for successfully understanding content or performing instructions. Failure to incorporate does not compromise comprehension or task completion but may result in minor setbacks.*

Notes are used to add information, state exceptions, and point out areas that is of greater interest or significance. Ignoring a note does not affect comprehension or task completion.

Tip:	*Provides time saving or helpful hints to complete a task more quickly, intending to improve user product experience. Ignoring a tip does not affect the task completion.*