

**VIRGINIA MILITARY INSTITUTE**

Lexington, Virginia 24450

PROCUREMENT SERVICES  
Phone 540-464-7323  
Fax 540-464-7669

**COMMONWEALTH OF VIRGINIA**  
**STANDARD CONTRACT**

Contract Number: V211-23-001

This contract entered into this 19<sup>th</sup> day of July, 2022 between Coastline, LTD, FIN # 54-1271662, hereinafter known as the "Contractor" and the Commonwealth of Virginia, Virginia Military Institute, hereinafter known as "VMI" henceforth.

**WITNESSETH** that the Contractor and VMI, in consideration of the mutual covenants, promises and agreements herein contained, agree as follows:

**SCOPE OF CONTRACT:** The Contractor shall provide a water treatment program at VMI to include all steam, steam condensate, heating hot water, chilled water, and cooling tower systems

**PERIOD OF PERFORMANCE:** The contract shall be from 19 July 2022 through 30 June 2023, with four (4) successive optional one-year renewals.

**COMPENSATION AND METHOD OF PAYMENT:** The Contractor shall be paid \$ 24,280.00 per year (Twenty-four thousand, two hundred eighty and 00/100 Dollars). In accordance with the Commonwealth of Virginia's *Prompt Payment Act* terms are Net 30 days from receipt of invoice.

**CONTRACT DOCUMENTS:** The contract documents shall consist of:

- (1) This signed form
- (2) The Contractor's Proposal/Bid and any modifications, if applicable.
- (3) The General Terms and Conditions
- (4) Special Terms and Conditions as required

**IN WITNESS WHEREOF**, the parties have caused this Contract to be duly executed intending to be bound thereby.

**CONTRACTOR:**

By: Michael Brown

For: Coastline, LTD

Title: Regional Sales Manager

**VMI:**

By: Lynn Carmack  
MAJ Lynn W. Carmack, CUPO, CPPO, CPSM, VCCO  
For: Virginia Military Institute

Title: Assistant Director, Procurement Services



**Request For Proposals (RFP)  
Project #V211-23-001  
Water Treatment Services**

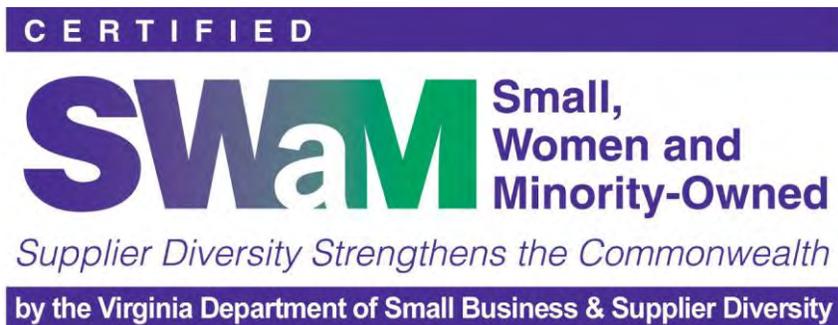
**VIRGINIA MILITARY INSTITUTE (VMI)  
Lexington, VA**

**14 June 2022**

**By**



**Alexandria, VA**



“This proposal or quotation includes data that shall not be disclosed outside the offices of The Virginia Military Institute (VMI) and shall not be duplicated, used, or disclosed—in whole or part—for any purpose other than to evaluate this proposal or quotation. If, however, a contract is awarded to this offeror or quoter as a result of—or in connection with—the submission of this data, The Virginia Military Institute shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit The Virginia Military Institute the right to use information contained in this data if it is obtained from another source without restriction.”

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- A. Pricing Schedule**
- B. Conflict of Interest Statement**
- C. Contractor Data Sheet**
- D. References**
- E. SWaM Certification**
- F. CWT Certificate**

## I. RFP Cover Sheet

**Virginia Military Institute  
Lexington, Virginia 24450-0304**

**RFP# V211-18-007**

Issue Date: 3 May 2022

Title: WATER TREATMENT SERVICES  
SET-ASIDE FOR SBSB CERTIFIED SWAM VENDORS ONLY

Bids Due: 14 June 2022 at 2:00 PM EST

Commodity Codes: 03124, 03127, 88500, 96223, 96896

Issuing Agency: Procurement Services  
314 Smith Hall, Lexington VA  
Virginia Military Institute  
314 Smith Hall  
Lexington, VA 24450

Period of Contract: **Date of Award** through **30 June 2023** Annually Renewable Thereafter for four (4) successive one (1) year renewals.

All Inquiries for Information should be directed to MAJ Lynn W. Carmack, VMI Procurement Services at [carmacklw@vmi.edu](mailto:carmacklw@vmi.edu). **Use of the Understanding of Requirement Form (Attachment A) must be submitted for questions concerning specifications or statement of needs.**

In compliance with this invitation for bid and to all the conditions imposed therein and hereby incorporated by reference, the undersigned offers and agrees to furnish the goods/services in accordance with the attached signed bid or as mutually agreed upon by subsequent negotiation.

Name And Address Of Firm:

Coastline, LTD. Date: 29 August 2017  
P.O. Box 1247  
Alexandria, VA 22313 By:   
(Signature In Ink)

EVA Vendor ID or DUNS number 077489128 Name: Michael Brown  
(Please Print)  
E-mail: Mbrown@CoastlineLTD.com Title: Regional Sales Manager  
Phone: (703) 461-0200  
Fax: (703) 461-0203

Minority Vendor: \_\_\_\_\_ Woman owned: \_\_\_\_\_ **Small Business**  SWaM Certificate #.: 656498

**ADDENDUM ACKNOWLEDGEMENT: Coastline has received and reviewed all the addendums to this RFP.**

## II. Full-Service Water Treatment Programs for Colleges and Universities



**Coastline, LTD provides Full-Service Water Treatment Programs to many Universities and Colleges in the Eastern US and Texas**

The Quality of our Programs directly affects the safety, health and comfort of the students, faculty and guests and impacts the efficiency, maintenance cost and useful life of the HVAC systems.

Our programs achieve the goals of:

- Minimizing water and energy consumption while extending the useful life of boilers, chillers.
- Providing sustainable and cost-effective water treatment solutions.
- Attracting students and improving retention through a positive campus experience.
- Protecting the community from harmful waterborne pathogens like *Legionella Pneumophila*

### List of Current Customers Include:



SWaM Certification # 656498



### III. Why Select Coastline Ltd.?

Water treatment has been our business since 1981. Our qualified, certified, and capable staff takes an active role in partnering with our customers to develop extensive knowledge of their systems and operations. We identify areas for improvement and waste no time in applying the latest technology to make changes that result in cost effectiveness and improved efficiencies.

Colleges and universities recognize the importance of quality performance. They are looking for an experienced contractor with quality, cost effective products and services, knowledgeable and skilled personnel with the singular business focus to meet or exceed customer's needs through mutually beneficial partnerships and mission dedication. Specifically, we offer the following advantages over our competition:

- **Quality** – Our past performance and longevity with our customers in the Eastern United states and Texas demonstrates our ability to follow through and provide products and services of the highest quality. As a small, woman-owned business, we believe our hard work and professional ethics allows us to successfully maintain our existing customers and gain new customers. We place a high value on our reputation, and we ensure that that our customers are satisfied.
- **Competitive Pricing/Cost Savings** – We work diligently to control product costs through partnerships with our material suppliers to provide programs that delivers results without sacrificing performance. As a small business with over 40 years of experience in this industry, our overhead and costs of operation remain lower than most other firms.
- **Responsiveness** – As a small company, we have built our reputation, and differentiate ourselves from the competition, through exceptional service – responsiveness to our customers' needs is the key. This philosophy is shared not only by the company officers, but the managers and employees as well.
- **Full-Service Offering** - In addition to chemical products and service, Coastline offers cleaning services for cooling towers and heat exchangers, sales and installation of chemical feed equipment and controls and analytical services to CDC-Elite testing for Legionella bacteria.

**FULL-SERVICE, WATER TREATMENT SOLUTIONS begin here.  
We look forward to solving your Water Treatment Challenges!**



<http://www.coastlineltd.com>

**Coastline Ltd.**  
P.O. Box 1247  
Alexandria, VA 22313

Phone: 703-461-0200  
Fax: 703-461-0203

## **IV. Plan and Methodology for Providing the Required Goods and Services**

**Statement of Needs** - We have thoroughly reviewed the Statement of Needs listed on pages 4 through 8 of the RFP and we believe our Full-Service Water Treatment Program complies with the requirement listed in the RFP.

### **A. General Requirement – Full Compliance**

1. Our intent is to continue providing a high-performance, comprehensive, water treatment programs consisting of water treatment chemicals, services, and technical support to minimize maintenance costs and extend system longevity and reliability. Our recommended products provide superior protection from corrosion and scale formation in the boiler and cooling systems and provide superior control of bacteria and algae in the cooling tower. Our Full-Service Water Treatment Program will provide the service and technical support to ensure the success of the water treatment program.

We understand that additional products and service requirements have been added to the RFP. We have extensive experience servicing the systems that are being added to the contract and have provided the same products and services for over 10 years for similar systems at the University of Mary Washington and at the College of William & Mary.

2. The existing metering equipment and pumps are adequate for the proposed treatment systems. We will continue to monitor this equipment during our normal service visits and make you aware of any issues that need to be addressed.
3. Coastline will continue to provide all labor, tools, chemicals, materials, equipment, supplies to deliver chemicals, maintain treatment systems and equipment, and perform the necessary testing and dosing required to meet the terms of the contract.
4. VMI will be responsible for all plumbing and electrical connections.
5. Coastline has over 40 years' experience in treating water treatment systems similar to the VMIs requirements.
6. Coastline has an excellent safety record, and we will continue to work in a safe manner.

**Items 7 through 20:** We have reviewed all the requirements for these items and our Water Treatment Programs meet all the needs listed.

**B. Initial Inspection and Report** – We will provide a complete report of the current condition of the treatment systems and equipment to include recommendations for improvements.

**C. Central Boiler Plant** – The current boiler treatment program is providing excellent results and the VMI boiler operators are very familiar with the products, tests, and control ranges. We propose continuing with our current program and complying with all the requirements listed for this section of this RFP, found on pages 6 and 7.

**D. Cooling Tower Systems** - The cooling tower treatment program is providing excellent results and the VMI boiler operators are very familiar with the products, tests, and control ranges. We propose continuing with our current program and complying with all the requirements listed on page 7 of this RFP.

- **Cooling Tower Scale/Corrosion Inhibitor:**

The **Coastline Cooline TI-120T Cooling Tower Scale and Corrosion Inhibitor** we are using is specifically designed for cooling systems with a high potential for scale formation. **TI-120T** has done an excellent job at inhibiting scale and corrosion in difficult to treat water. **TI-120T** contains a fluorescent dye (PTSA) that provides an easy and accurate way to control the product feed and measure the level of product in the cooling water.

- **Cooling Tower Biocides:**

We plan to continue to use BromMax 7.1 (Stabilized Bromine) and Aquacar DB20 (20% DBNPA) to control microbiological growth in the cooling towers. These two products have provided excellent control of bacteria and algae. There are lower cost products like Sodium Hypochlorite (Bleach), but they are not as effective as the products we are providing.

**E. Closed Loop Systems** - The Nitrite-based, Closed Loop treatment program we have implemented is providing excellent results. We propose continuing with our current program using Coastline Cooline CS-120 and complying with all the requirements listed on page 7 of this RFP.

**F. Maury Brooke Hall Laboratory RO/DI System** – We are very knowledgeable and experienced providing the required service for the RO/DI System described on page 8 of the RFP. We have been providing the same service for the laboratory RO/DI systems at the University of Mary Washington and at the College of William & Mary for over 10 years.

**G. Maury Brooke Hall and Crozet Hall (Water Softening Systems)** - We are very knowledgeable and experienced providing the quarterly service for the Softeners described on page 8 of the RFP.

## V. Coastline's Qualifications

Coastline has been in the water treatment business since 1981. Our qualified, certified, and capable staff takes an active role in partnering with our customers to develop extensive knowledge of their systems and operations. We identify areas for improvement and waste no time in applying the latest technology to make changes that result in cost effectiveness and improved efficiencies.

Colleges and universities recognize the importance of quality performance. They are looking for an experienced contractor with quality, cost effective products and services, knowledgeable and skilled personnel with the singular business focus to meet or exceed customer's needs through mutually beneficial partnerships and mission dedication. Specifically, we offer the following advantages over our competition:

- **Quality** – Our past performance and longevity with our customers in the Eastern United States and Texas demonstrates our ability to follow through and provide products and services of the highest quality. We believe our hard work and professional ethics allows us to successfully maintain our existing customers and gain new customers. We place a high value on our reputation, and we ensure that that our customers are satisfied.
- **Competitive Pricing/Cost Savings** – We work diligently to control product costs through partnerships with our material suppliers to provide programs that delivers results without sacrificing performance. As a small business with over 40 years of experience in this industry, our overhead and costs of operation remain lower than most other firms.
- **Responsiveness** – We have built our reputation through exceptional service and responsiveness to our customers' needs. This philosophy is shared by the company officers, managers and employees.
- **Full-Service Offering** - In addition to chemical products and service, Coastline offers cleaning services for cooling towers and heat exchangers, sales and installation of chemical feed equipment and controls and analytical services to CDC-Elite testing for Legionella bacteria.
- **Quality Assurance:** We believe in being proactive and routinely refine our treatment programs and services to meet the needs of our customer. We take advantage of new technologies and chemistries and partner with a manufacturing facility that is ISO 9001:2008 certified.
- **Training:** Coastline offers a series of training seminars covering a host of critical systems to include cooling towers, boilers, closed-loop systems and control of legionnaire's disease. We also provide training on the relative feed and control equipment and the corresponding testing methods.

## **A. Representative Experience**

Coastline uses a team approach for providing the required service of our water treatment programs on college campuses. The team that will be servicing the water treatment systems at UNCG Greensboro has extensive experience servicing college campuses to include:

1. Radford University
2. Roanoke College
3. UNC Greensboro
4. University of Richmond
5. College of William & Mary
6. University of Maryland, College Park
7. Norfolk State University
8. University of Mary Washington

The following are the Coastline employees that will be providing service at VMI:

### **Account Manager – Mike Brown:**

- Serves as the main point of contact and is responsible for the overall performance of the water treatment programs.
- Services the applications and is responsible for sending out service and test result reports
- Manages the commercial and administrative functions of the contract to ensure that the contractual requirements are being met.



- Mike has 30 years of experience in water treatment industry to include positions in sales management, field service, quality control and technical support management.
- Mike is recognized by the Association of Water Technologies (AWT) as a Certified Water Technologist (AWT) and has Bachelor of Science in Mechanical Engineering from Washington State University
- Mike has extensive background in boiler and cooling water treatment in industries to include Commercial HVAC, Hospitals and Food and Beverage.
- Mike lives in Central Virginia and his cell number is (434) 444-4283

### **Secondary Technical Representative - Wayne Mullins**



- Wayne has 25 years of experience in water treatment and has worked for Coastline managing the Central Virginia Area for the last 14 years.
- Wayne has a Bachelor of Science degree from the University of Mississippi, Oxford; and served in the US Air Force.
- Wayne has extensive experience in water treatment applications for a broad range of industries including institutional, commercial, light industrial and wastewater treatment.
- Wayne lives in Richmond, VA and his cell number is (757) 214-8979.

## **B. Quality Manufacturing**

The products for VMI are manufactured and shipped from a state-of-the-art, ISO 9001:2015 certified manufacturing facility in Salem, VA.

- Samples are taken from every manufacturing batch and stored for one-year to evaluate product quality and stability.
- Every product container has a barcoded label with the manufacturing date and batch number.
- Our manufacturing Quality Control is best in the industry and our manufacturing plant is available for tours and inspections.
- Our manufacturing plant is located 60 miles from the VMI campus and tours of our plant are available upon request.



## **C. Service Level and Response Time:**

- Coastline has (5) service technicians that can be on the VMI campus within 4-hours to respond to an emergency.
- Coastline's representatives will visit the VMI campus a minimum of once a month to perform the required service outlined in the RFP. We expect to provide two service visits per month to complete the required service.
- Coastline will not be using any subcontractors for this contract.
- Coastline agrees to not substitute key personnel assigned to the performance of the contract without prior written approval from VMI.

## **D. Quality Control:**

Coastline has a well-established quality control program that emphasizes:

1. **Customer Focus:** Determining and meeting the requirements of internal customers and external customers.
2. **Total Involvement:** Establishing policies, procedures and programs that encourage company-wide emphasis on achieving customer satisfaction.
3. **Continuous Improvement:** Reinforcing the need to continuously improve service.

### **Coastline's Quality Control Process**

Coastline Ltd. has organized its problem-solving process into a series of logical, orderly steps when attempting to determine the root cause(s) of a problem. We feel that this methodology is the best way to provide a structured process that helps us solve quality problems, since each step often reveals new information about the problem. These steps are:

1. Define the problem(s)
2. Plan the solution.
3. Implement the quick fix(s)
4. Identify the root cause(s)
5. Take corrective action.
6. Evaluate corrective action.
7. Follow up

The Coastline will collect and analyze appropriate data to evaluate where continual improvement of our water treatment programs can be made. Management review meetings will be held where Coastline and VMI personnel can review the Quality Control Process. In the event there is a deficiency in a program Coastline, will immediately inform VMI personnel to determine the actions required to eliminate the problem.

All members of the Coastline Service team have received training in Coastline's Quality Program.

## **E. Subcontractors:**

Coastline will not be using any subcontractors for this contract except for deliveries and for Legionella testing and analysis

Coastline uses Aerobiology Laboratory Associates, Inc. for Legionella analysis and testing. Aerobiology Laboratory Associates, Inc is a network of CDC-Elite certified testing facilities. An Aerobiology Legionella report is included in Attachment C.

## **F. Compliance with the RFP Requirements**

### **1. Statement of Needs**

We have reviewed the bid specifications and Addendum #1 and feel that our proposal meets the requirements. This includes all the requirement in:

- A. General Requirements
- B. Initial Inspection and Report
- C. Central Boiler Plant
- D. Cooling Tower Systems
- E. Closed Loop Systems
- F. Maury Brooke Hall Laboratory RO/DI System
- G. Maury Brooke Hall and Crozet Hall (Miscellaneous Water Softening Systems)

### **2. SWaM Participation**

Coastline Ltd. is a small, SWaM certified business headquartered in Alexandria, VA.

### **3. General Terms and Conditions**

Coastline takes no exceptions to the General Terms and Conditions

### **4. Special Terms and Conditions**

Coastline takes no exceptions to the Special Terms and Conditions

**ATTACHMENT A BID FORM**

**Pricing Summary:**

<b>Systems to be Treated</b>	<b>Initial Testing Mat'ls &amp; Labor</b>	<b>Monthly MATERIAL COST</b>	<b>Monthly LABOR COST</b>	<b>Total ANNUAL COST</b>
<b>Heat Plant – (3) Boilers and Boiler System Equipment</b>	No Charge	\$ 180.00	\$ 75.00	\$ 3,060.00/yr.
<b>Cooling Towers</b> Total of (9) Cooling Towers and CPTF1 PDD System	No Charge	\$ 720.00	\$ 190.00	\$ 10,920.00/yr.
<b>Closed Circuit Cooling Towers</b> Total of (2) Cooling Towers	No Charge	\$ 40.00	\$ 40.00	\$ 960.00/yr.
<b>Chiller and Chilled Water Loops</b> Closed Loops in (13) Buildings	No Charge	\$ 480.00 (Semi-Annual)	\$ 320.00 (Semi-Annual)	\$ 1,600.00/yr.
<b>Hydronic Closed Loops</b> Closed Loops in (20) Buildings	No Charge	\$ 630.00 (Semi-Annual)	\$ 420.00 (Semi-Annual)	\$ 2,100.00/yr.
<b>RO / DI / Softener Systems</b>	No Charge	\$ 300.00	\$ 100.00	\$ 4,800.00/yr.
<b>TOTAL ANNUAL COST FOR SYSTEMS LISTED IN THE BID SPECIFICATIONS</b>			<b>\$ 24,280.00 per year</b>	

**BOILER TREATMENT**

EQUIPMENT	MFGR.	CAPACITY (BHP)	TESTING SCHEDULE	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Mat'ls & Labor	Monthly MATERIAL COST	Monthly LABOR COST
BOILER B-1	CLEAVER-BROOKS	400	Monthly	Boiler Water: (P), (M), (OH) alkalinity, pH, phosphate or inhibitor, sulfite and hardness, neutralized TDS, silica and iron.	Sulfite oxygen inhibitor, phosphate scale inhibitor, dispersant, neutralizing amine	No Charge	\$ 40.00	\$ 25.00
BOILER B-2	CLEAVER-BROOKS	800	Monthly			No Charge	\$ 80.00	\$ 25.00
BOILER B-3	CLEAVER-BROOKS	600	Monthly			No Charge	\$ 60.00	\$ 25.00
Condensate Return (Surge Tank)	n/a	n/a	Monthly	pH, soluble and insoluble iron, hardness, percentage return, neutralized TDS	n/a	No Charge	Included in Price Above	Included in Price Above
Feedwater (Deaerator)	n/a	n/a	Monthly	Total hardness, pH, iron, and neutralized TDS, dissolved O2	n/a	No Charge	Included in Price Above	Included in Price Above
Makeup Water (City Water)	n/a	n/a	Monthly	Total hardness, iron, neutralized TDS, pH, P and M - alkalinity.	n/a	No Charge	Included in Price Above	Included in Price Above
Softened Water	n/a	n/a	Monthly	Hardness, TDS, total daily flow, salt used (mean), and number of regenerations.	n/a	No Charge	Included in Price Above	Included in Price Above
<b>MONTHLY TOTAL</b>							<b>\$ 180.00</b>	<b>\$ 75.00</b>

**COOLING TOWERS**

LOCATION	MFGR.	TONS	TESTING SCHEDULE	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Mat'ls & Labor	Monthly MATERIAL COST	Monthly LABOR COST	
CAMERON HALL ROOF	EVAPCO	510	MAR, APR, MAY, JUN, JULY, AUG, SEPT	pH Total dissolved solids, Tracer Visual inspection for algae, bacteria, fungi. Inspect equipment for proper function.	Corrosion and scale inhibitor. Biocide.	No Charge	\$ 120.00	\$ 30.00	
	EVAPCO	510							
	EVAPCO	240							
THIRD BARRACKS	EVAPCO	267	MAR, APR, MAY, JUN, JULY, AUG, SEPT			MONTHLY JAN-DEC	No Charge	\$ 30.00	\$ 30.00
CLARK KING HALL	EVAPCO	448	MONTHLY JAN-DEC				No Charge	\$ 90.00	\$ 30.00
	EVAPCO	448					No Charge	\$ 80.00	\$ 40.00
CPTF1	BAC	220	MAR, APR, MAY, JUN, JULY, AUG, SEPT	No Charge	\$ 80.00	\$ 40.00			
	BAC	220		No Charge	\$ 400.00	\$ 60.00			
	BAC	220		No Charge	\$ 400.00	\$ 60.00			
CPTF1	PDD	N/A	2X / Mon in Summer 1X / Mon in Winter	Legionella H202	H202 & Bellacide 355	No Charge	\$ 400.00	\$ 60.00	
						<b>MONTHLY TOTAL</b>	<b>\$ 720.00</b>	<b>\$ 190.00</b>	

**CLOSED CIRCUIT COOLING TOWERS**

LOCATION	MFGR.	TONS	TESTING SCHEDULE	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Mat'ls & Labor	Monthly MATERIAL COST	Monthly LABOR COST
COCKE HALL	BAC	180	MAR, APR, MAY, JUN, JULY, AUG, SEPT	pH, Total dissolved solids Visual inspection for algae, bacteria, fungi. Inspect equipment for proper function.	Corrosion and scale inhibitor. Biocide.	No Charge	\$ 20.00	\$ 20.00
CORMACK HALL	BAC	180	MAR, APR, MAY, JUN, JULY, AUG, SEPT			No Charge	\$ 20.00	\$ 20.00
						<b>MONTHLY TOTAL</b>	<b>\$ 40.00</b>	<b>\$ 40.00</b>

**CHILLERS AND CHILLED WATER LOOPS**

LOCATION	MFGR.	CAPACITY (TONS)	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Mat'ls & Labor	Semi-Annual MATERIAL COST	Semi-Annual LABOR COST
CARROLL HALL	TRANE	125 (100 TON ICE BACK UP)	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
CAMERON HALL	CARRIER	225	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
	CARRIER	225					
	CARRIER	150					
CLARKSON MCKENNA	YORK	60	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
CLARK KING HALL *	TRANE	250	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
	TRANE	250					
CROZET HALL	MCQUAY	200	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
KILBOURNE HALL	MCQUAY	160	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
MALLORY HALL	YORK	175	Nitrite Total Dissolved Solids pH	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
MARSHALL HALL	MCQUAY	275	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
MAURY BROOKE HALL	MCQUAY	350	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
MOODY HALL	TRANE	30	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
	TRANE	30					
	CARRIER	15					
PRESTON LIBRARY	TRANE	125 (100 TON ICE BACK UP)	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
SCOTT SHIPP HALL	TRANE	200	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
SMITH HALL	TRANE	60	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
THIRD BARRACKS	MULTISTACK	130	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
POST HOSPITAL	AIRSTACK	60	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
CPTF1 **	DAIKIN	325	Nitrite Total Dissolved Solids pH	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
	DAIKIN	325					
<b>SEMI-ANNUAL TOTAL</b>						<b>\$ 480.00</b>	<b>\$ 320.00</b>

HYDRONIC CLOSED LOOPS

LOCATION	INPUT BTUH	HEAT SOURCE	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Mat'ls & Labor	Semi-Annual MATERIAL COST	Semi-Annual LABOR COST
CARROLL HALL	470,000	HX	Nitrite Total Dissolved Solids pH	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
CLARKSON MCKENNA	2 boilers: 600,000 ea.	Boiler			No Charge	\$ 30.00	\$ 20.00
CLARK KING HALL	317,000	HX			No Charge	\$ 30.00	\$ 20.00
JACKSON MEMORIAL HALL	1,041,000	HX			No Charge	\$ 30.00	\$ 20.00
KILBOURNE HALL	2 boilers: 1,650,00 ea.	Boiler			No Charge	\$ 30.00	\$ 20.00
KILBOURNE HALL, QMD	2 boilers: 1,673,000 ea.	Boiler			No Charge	\$ 30.00	\$ 20.00
MALLORY HALL	2,177,000	HX			No Charge	\$ 30.00	\$ 20.00
MARSHALL HALL	2 boilers: 1,300,000 ea.	Boiler	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
SCOTT SHIPP HALL	2 HX: 1,580,000 ea.	HX	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
MAURY BROOKE HALL	2 HX: 2,900,000 ea.	HX w/Boiler	Nitrite, pH Total Dissolved Solids	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
MOODY HALL	2 boilers: 1,500,000 ea.	Boiler			No Charge	\$ 30.00	\$ 20.00
NICHOLS & MORGAN HALL	2,024,000	HX			No Charge	\$ 30.00	\$ 20.00
PRESTON LIBRARY	2,450,000	HX w/Boiler		No Charge	\$ 30.00	\$ 20.00	
SHELL & RICHARDSON HALL	1,570,000	HX		No Charge	\$ 30.00	\$ 20.00	
SMITH HALL	2 boilers: 700,000 ea.	Boiler		Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
STONEWALL JACKSON HOUSE	2 boilers: 212,000 ea	Boiler		No Charge	\$ 30.00	\$ 20.00	
BARRACKS Dual-Temp	4,915,000	HX			No Charge	\$ 30.00	\$ 20.00
OLD & NEW BARRACKS Admin	2,950,000	HX			No Charge	\$ 30.00	\$ 20.00
POST HOSPITAL	840,000	HX	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
CPTF1, Heating Loop	2 boilers: 2,500,000 ea.	Boiler	Nitrite, pH, TDS	Rust inhibitor	No Charge	\$ 30.00	\$ 20.00
CPTF1, Glycol Loop	2 HX: 2,500,000 ea.	Boiler	Glycol concentration, pH	Ethylene glycol	No Charge	\$ 30.00	\$ 20.00
<b>SEMI-ANNUAL TOTAL</b>						<b>\$ 630.00</b>	<b>\$ 420.00</b>

RO / DI SYSTEMS

Equipment	MFGR.	Capacity	Testing Schedule	Testing Required	CHEMICAL TREATMENT	Initial Testing Mat'ls & Labor	ANNUAL MATERIAL COST	ANNUAL LABOR COST
RO/DI/Softener Systems	Marlo	n/a	Monthly	Review Operators Log, Test Feedwater Chemistry, Perform RO System check	n/a	No Charge	\$ 0.00	\$ 480.00
			Quarterly	Replace Prefilter Cartridge	n/a	No Charge	\$ 300.00	\$ 160.00
			Semi-Annual	Replace system filter cartridge, Replace UV lamp, Service deionization, Service Carbon	n/a	No Charge	\$ 2800.00	\$ 300.00
			Annual	Replace UV Quartz sleeve, Service Vent Filter	n/a	No Charge	\$ 500.00	\$ 100.00
			Quarterly	Check the softeners in Maury Brooke and Crozet Hall for proper operation	n/a	No Charge	\$ 0.00	\$ 160.00
<b>ANNUAL TOTAL</b>							<b>\$ 3,600.00</b>	<b>\$ 1,200.00</b>

SUBMITTED BY:  \_\_\_\_\_

PRINTED NAME: Michael Brown

For: Coastline, LTD. (Company)

DATE: June 14, 2022

END BID FORM



CONTRACTOR DATA SHEET

QUALIFICATIONS OF OFFEROR: Offerors must have the capability and capacity in all respects to fully satisfy the contractual requirement.

Indicate the length of time you have been in business providing this type of service. 42 Years, 6 Months

Provide a list of current references, either college, Educational Institutions, and/or other companies that your firm is servicing. Include the length of service, dollar volume, year contract was entered into, and the name and address of the person the State has your permission to contact. Such listing shall be comprehensive of your firm’s customer base and can be formatted as follows:

CURRENT ACCOUNTS:

Account Name, Address & Phone #	Length of Service	\$ Volume/Year
<u>College of William Mary (757) 221-1256</u>	<u>13 Years</u>	<u>\$ 115k/yr</u>
<u>University of Richmond (804) 831-7712</u>	<u>6 Years</u>	<u>\$ 50k/yr</u>
<u>Radford University (540) 831-7712</u>	<u>4 Years</u>	<u>\$ 27k/yr</u>
<u>University of Mary Washington (540) 654-1047</u>	<u>9 Years</u>	<u>\$ 25k/yr</u>
<u>University of Maryland, College Park (301) 405-7075</u>	<u>6 Years</u>	<u>\$ 185k/yr</u>
<u>UNC Greensboro (336) 256-1073</u>	<u>1 Year</u>	<u>\$ 20k/yr</u>

LOST ACCOUNTS:

Account Name, Address & Phone #     

No Major Accounts Lost over the last 5 years

REFERENCES

Please list at least four references for whom you have performed each applicable category of service specified herein and within the past five years.

CLIENT: Radford University

ADDRESS: PO BOX 6906 Armstrong Complex Radford, VA 24142

CONTACT PERSON/PHONE#: Philip Hoover (540) 320-9506

APPROXIMATE DOLLAR VOLUME PER YEAR: \$27,574.00

PROJECTS/DATES/DESCRIPTION:

Full Service Water Treatment Contract to Include Cooling towers, Closed Loops, and Steam Boilers

CLIENT: The College of William and Mary

ADDRESS: PO BOX 8795 Williamsburg, VA 23187

CONTACT PERSON/PHONE#: Larry Jackson/ 757-221-1256

APPROXIMATE DOLLAR VOLUME PER YEAR: \$114,750.00

PROJECTS/DATES/DESCRIPTION:

Full Service Water Treatment Contract to Include Cooling towers, Closed Loops, and Steam Boilers

CLIENT: UNC Greensboro

ADDRESS: 800 Oakland Ave., Greensboro, NC

CONTACT PERSON/PHONE#: Gary Denny (336) 256-1073

APPROXIMATE DOLLAR VOLUME PER YEAR: \$20,000 per year

PROJECTS/DATES/DESCRIPTION:

Full Service Water Treatment Contract to Include Cooling towers, Closed Loops, and Steam Boilers

**SWaM (Small, Woman- and/or Minority-Owned Business Certification)**

**Small Business:** "Small business " means an independently owned and operated business which, together with affiliates, has 250 or fewer employees, or average annual gross receipts of \$10 million or less averaged over the previous three years. Note: This shall not exclude SBSB-certified women- and minority-owned businesses when they have received SBSB small business certification.

**Women-Owned Business:** Women-owned business means a business concern that is at least 51% owned by one or more women who are citizens of the United States or non-citizens who are in full compliance with United States immigration law, or in the case of a corporation, partnership or limited liability company or other entity, at least 51% of the equity ownership interest is owned by one or more women who are citizens of the United States or non-citizens who are in full compliance with United States immigration law, and both the management and daily business operations are controlled by one or more women who are citizens of the United States or non-citizens who are in full compliance with the United States immigration law.

**Minority-Owned Business:** Minority-owned business means a business concern that is at least 51% owned by one or more minority individuals or in the case of a corporation, partnership or limited liability company or other entity, at least 51% of the equity ownership interest in the corporation, partnership, or limited liability company or other entity is owned by one or more minority individuals and both the management and daily business operations are controlled by one or more minority individuals.

**All small businesses must be certified by the Commonwealth of Virginia Department of Small Business and Supplier Diversity (SBSB) by the due date of the solicitation to participate in the SWaM program. Certification applications are available online at [www.sbsd.virginia.gov](http://www.sbsd.virginia.gov).**

Offeror Name: Coastline Ltd.

Preparer Name: Mike Brown Date: \_\_\_\_\_

Instructions

- A. Businesses certified by the Department of Small Business and Supplier Diversity (SBSB) as a small business must complete Section A of this form.

Section A

CERTIFICATION TYPE (check only one below):

- Small Business
- Small and Women-owned Business
- Small and Minority-owned Business

Certification number: 656498 Certification Date: July 2, 2019

Expiration Date: July 2, 2024

NOTE: It is your responsibility to ensure that your certification is renewed and does not lapse. Should your certification expire, you will no longer be eligible to receive awards under this contract.

\* In September, 2021, Coastline LTD. became a Woman-owned Business. Coastline Ltd has submitted the application through SWaM, and currently waiting approval.

# COMMONWEALTH OF VIRGINIA



## DEPARTMENT OF SMALL BUSINESS & SUPPLIER DIVERSITY

101 N. 14th Street, 11th Floor  
Richmond, VA 23219

### COASTLINE LTD

is a certified Small

Business meeting all the requirements set forth under the Code of Virginia Section 2.2-16.1 et seq.  
and Administrative Code 7VAC 13-20 et seq.

Certification Number: 656498

Valid Through: Jul 2, 2024

Accordingly Certified

A handwritten signature in blue ink, appearing to read "Tracey G. Wiley".

Tracey G. Wiley, Director

CERTIFIED

**SWaM** Small,  
Women and  
Minority-Owned

Supplier Diversity Strengthens the Commonwealth  
by the Virginia Department of Small Business & Supplier Diversity



# CERTIFIED WATER TECHNOLOGIST

*This is to certify that pursuant to the provisions set forth by the Certification Committee of the Association of Water Technologies*

*is certified in the field of industrial water treatment technology and is entitled to all rights and privileges conferred by that designation.*

*Certificate Number:*

*Witness Our Hand*

*Michael L. Bourgeois*  
*President*

*Alid J. Ziri*  
*Executive Director*

*Recertification Date*



REQUEST FOR PROPOSALS  
PROJECT #V211-23-001

**Water Treatment Services**  
3 May 2022

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**Virginia Military Institute**  
Lexington, Virginia 24450-0304

REQUEST FOR PROPOSALS

RFP# V211-23-001

Issue Date: 3 May 2022

Title: Water Treatment Services  
SET-ASIDE FOR SBSO CERTIFIED SWAM VENDORS ONLY

Commodity Codes: 03124, 03127, 88500, 96223, 96896

Due Date: 1 June 2022 at 2:00 PM EST

Issuing Agency: Virginia Military Institute  
Procurement Services  
330 Parade Avenue, 314 Smith Hall  
Lexington, VA 24450

Period of Contract: **Date of Award** through **30 June 2023** (Annually Renewable Thereafter for four (4) successive one-year renewals.

**PRE-PROPOSAL CONFERENCE:** There is NO PRE-PROPOSAL CONFERENCE.

All Inquiries for Information should be directed to MAJ Lynn W. Carmack, VMI Procurement Services at [carmacklw@vmi.edu](mailto:carmacklw@vmi.edu). **Use of the Understanding of Requirement Form (Attachment A) must be submitted for questions concerning specifications or statement of needs.**

In Compliance With This Request For Proposal And To All The Conditions Imposed Therein And Hereby Incorporated By Reference, The Undersigned Offers And Agrees To Furnish The Goods/Services In Accordance With The Attached Signed Proposal Or As Mutually Agreed Upon By Subsequent Negotiation.

Name and Address of Firm:

_____	Date: _____
_____	By: _____
_____	(Signature In Ink)
_____	Name: _____
_____	(Please Print)
_____ Zip Code: _____	Title: _____
EVA Vendor ID or DUNS number _____	Phone: (____) _____
E-mail: _____	Fax: (____) _____

Minority Vendor: \_\_\_\_\_ Woman owned: \_\_\_\_\_ Small Business: \_\_\_\_\_ SWaM Certification Number: \_\_\_\_\_

**Note: This public body does not discriminate against faith-based organizations in accordance with the *Code of Virginia*, § 2.2-4343.1 or against a bidder or offeror because of race, religion, color, sex, national origin, age, disability, sexual orientation, gender identity, political affiliation, or veteran status or any other basis prohibited by state law relating to discrimination in employment. Faith based organizations may request that the issuing agency not include subparagraph 1.f in General Terms and Condition C. Such a request shall be made in writing and explain why an exception should be made in that invitation to bid or request for proposal.**

**REQUEST FOR PROPOSAL**  
**Water Treatment Services**  
V211-23-001

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- Attachment A: Understanding of Requirements
- Attachment B: Conflict of Interest Statement
- Attachment C: Contractor’s Data Sheet
- Attachment D: References
- Attachment E: SWaM Certification
- Attachment F: Price Form
- Attachment G: CPTF1 Drawings
- Attachment H: MARLO Water Treatment System

- I. **PURPOSE:** The intent and purpose of this Request for Proposals is to enter into a contract with one qualified contractor to provide Water Treatment Services for Virginia Military Institute (VMI), an Agency of the Commonwealth of Virginia.
- II. **BACKGROUND:** VMI's Heat Plant produces steam for most of the Post, including HVAC loads in most buildings and process loads for the Mess Hall and Laundry. Steam is produced at 100psi by three Cleaver-Brooks fire- tube boilers rated at 400 HP (13,800lb/hr.), 600 HP (20,700 lb/hr) and one rated at 800 HP (27,600lb/hr.)

**Typically, one 400 HP boiler is operated in the summer. In spring, fall and winter, one boiler will be selected as lead, with the other two in lag to meet steam demand.**

**Boiler feedwater is de-aerated, and the rate of condensate return is approximately 80%.**

**Makeup water is provide from the City of Lexington supply, which is softened at the Heat Plant.**

**The Cycles of concentration are estimated at 15 .**

**Current boiler water treatment consists of a concentrated sulfite, a liquid phosphate, a polymer/dispersant and a neutralizing amine which are mixed *in* a day tank and fed directly to the deaerator tank. Typically, a batch of chemicals will last 1-3 weeks depending on the time of year and the load.**

### III. **STATEMENT OF NEEDS**

#### A. **GENERAL REQUIREMENTS:**

- 1. The Contractor shall provide a water treatment program to include all steam, steam condensate, heating hot water, chilled water and cooling tower systems. The Contractor shall design a treatment approach to minimize scale, corrosion, fouling and microbiological growth, increase performance, reduce repairs and water consumption, and maximize heat transfer. Note that volumes for all these systems are not available and many must be estimated.
- 2. The Contractor shall review the existing metering equipment and pumps, and determine its adequacy for the proposed treatment system. Additional equipment that is required to meet the requirements of this contract shall be provided by the Contractor.
- 3. The Contractor shall provide all labor, tools, chemicals, materials, equipment, supplies to deliver chemicals, maintain treatment systems and equipment, and perform the necessary testing and dosing required to meet the terms of the contract.
- 4. The Institute will be responsible for all plumbing and electrical connections required for the treatment systems.
- 5. The Contractor shall have a minimum of 10 years' experience in treating water treatment systems similar to the Institute's requirements.
- 6. Contractor shall take necessary precautions in the use of chemicals for both water treatment and any chemical cleaning of machinery or equipment to obviate the possibility of accidents. The contractor shall be responsible for any hazardous waste created from the treatment or cleaning process.
- 7. Chemicals and other materials or devices used in the water treatment shall not be capable of damaging in any manner the internal workings of the equipment serviced.

8. Contractor shall fully utilize until depleted existing chemicals that are on site at each facility and may be responsible for removing containers when empty on a case-by-case basis.
9. The Contractor's personnel shall be safety trained and certified in all aspects of chemical handling associated with water treatment.
10. The Contractor shall provide materials and equipment required to handle accidental spills.
11. The Contractor shall be responsible for maintaining adequate backup chemical and supplies. The Institute will not provide storage room facilities for Contractor's excess inventory.
12. The Contractor shall provide Material Safety Data Sheets (MSDS) with all first time orders of chemicals and all chemical compounds utilized under this contract. These chemicals shall be suitable for the intended use and comply with requirements of the Virginia Department of Environmental Quality, the U. S. Environmental Protection Agency and the U. S. Department of Transportation. Chemicals shall be compatible with other chemicals used in the same area and be approved for use by the Institute's contract administrators. All chemicals that may be discharged into the sewer systems must meet local, state and federal requirements.
13. The Contractor must provide an emergency telephone number with 24-hour, 7- day per week access that can be reached for emergency information regarding chemical spills and/or accidents involving the Contractor's chemicals.
14. Service Level and Response Time:
  - a) The Contractor's representatives shall be able to respond by phone 2 hours after notification.
  - b) The Contractor's representative shall visit the site no less than once a month.
  - c) The Contractor's representatives shall be available 24-hours a day by telephone or email.
  - d) The Contractor shall be capable of having a technician on-site for an Emergency response within four (4) hours of notification.
15. The Contractor shall provide a (typed) monthly status report to the Institute's designated contract administrator(s). These reports will include testing summaries and significant issues that have been addressed by the contractor. All issues beyond the scope of this contract that need immediate attention shall be reported to the Institute's contract administrators.
16. The Contractor shall have the following laboratory abilities:
  - a) The Contractor should have laboratory facilities capable of performing a wide array of analytical work to facilitate monitoring, control, and troubleshooting of our systems. The following laboratory services should be available from the Contractor:
    - 1) Corrosion coupon analysis
    - 2) Water analysis
    - 3) Deposit analysis
    - 4) Microbiological analysis
    - 5) Ion exchange
    - 6) Resin analysis
    - 7) Metallurgical analysis
  - b) The Contractor shall provide all laboratory services and costs associated with these

services.

- c) Subcontracted work or use of independent laboratories is prohibited under this contract unless specifically authorized by the contract administrator.
- 17. The Contractor shall have the ability to determine organism levels for on-site testing of microbiological controls in cooling systems. The Contractor shall test on-site microbiological controls that may be required to adjust biocide feed so that system cleanliness is maintained without having to over feed biocide.
- 18. The Contractor shall make recommendations, as appropriate, for the improvement of this program and the operation of the affected mechanical systems.
- 19. The Institute will provide reasonable access to the mechanical systems during normal working hours.
- 20. The Contractor should work during the normal business hours of 7:30 AM - 4:30 PM, Monday through Friday.

#### B. INITIAL INSPECTION AND REPORT

- 1. Complete an initial detailed survey of all steam and condensate systems at the Heating Plant and all building HVAC systems where water treatment is required.
- 2. Provide a written report of the existing condition of all equipment and piping systems made available for inspection. Include recommendations for cleaning, flushing, and addition of chemical treatment in order to minimize scale, corrosion, fouling and microbiological growth, increase performance, reduce repairs and water consumption, and maximize heat transfer.

#### C. CENTRAL BOILER PLANT

- 1. Annual Boiler Treatment Testing Analysis
  - a) Scale forming rate in the steam boilers will be less than three grams per square foot heating surface per year, providing all recommended control limits are maintained.
  - b) There will be no oxygen corrosion in the boilers as evidenced by the absence of tuberculation of the boiler metal.
  - c) No carry-over problems will develop as the result of chemical treatment.
  - d) Performance of the feed water system will be checked by examining feed water temperature, deaerator pressure, and length of visible steam plume from the vent line. This evaluation will be supported by an annual survey for dissolved oxygen.
- 2. Heat Plant Monthly Analysis:
  - a) Boiler water - Phenolphthalein (P), methyl orange (M) and hydroxide (OH) alkalinity, pH, phosphate or inhibitor, sulfite and hardness, neutralized TDS, silica and iron, if they are limiting factors, as required.
  - b) Condensate - pH, soluble and insoluble iron, hardness, percentage return, neutralized TDS, and other tests required in the event of boiler priming or carryover. Tests will

be made on the condensate return at the plant.

c) Feed water- Total hardness, pH, iron, total daily flow, and neutralized TDS.

d) Raw Water Make-Up- total hardness, iron, neutralized TDS, silica as required, pH, and P and M alkalinity.

e) Softener Output - Hardness, TDS, total daily flow, salt used (mean), and number of regenerations.

f) Condensate and Feed water Temperature.

g) Analysis Report - Provide a monthly written report to include data on the above tests and cycles of concentration, including a section noting products used, inventory of products, present chemical dosage, recommended changes in control limits, performance evaluations, trending summaries, comments, and recommendations.

l) Test the deaerator for dissolved oxygen. The test results will be reported in cc per liter, included in the December monthly analysis report.

#### D. COOLING TOWER SYSTEMS

1. On a schedule as indicated on the attached list of cooling towers, contractor shall perform water testing on all cooling towers and submit a typed report to the VMI Physical Plant. Water testing for cooling towers is to include pH, total dissolved solids, and phosphate. Inspect visually for algae, bacteria, and fungi control monthly.
2. On a quarterly basis, contractor shall perform site inspection visits on cooling towers. Inspection services at each site will include but not limited to inspecting the equipment to assess proper functioning and perform all analysis required determining that the water treatment program is operating at optimum performance. Contractor shall submit service report to VMI Physical Plant.
3. Contractor shall provide a suitable amount of corrosion inhibitor material for one (1) year of treatment for the open side of the cooling towers/evaporative condenser for prevention of corrosion and mud fouling. This material shall contain no heavy metals, but should contain sequestrates, polymeric dispersants, and corrosion inhibitors for both ferrous and non-ferrous metals. The materials shall be capable of preventing accumulation of metal oxides, mineral scale and silt. The materials shall be stable to oxidizers.
4. Contractor shall provide a biocide material for prevention of biological fouling in cooling towers. This material shall be compatible with other chemicals used in the cooling tower and shall also be acceptable for discharge into municipal sanitary sewer.
5. The method for injecting chemicals shall be compatible with existing equipment at each site. In the event existing equipment is unsuitable for the purposes of this program, Contractor shall make recommendations to the Institute for required modifications to the equipment.

**E. Closed-Loop Systems**

1. On a biennial basis, contractor shall provide water testing samples of all closed loop piping systems and submit a report to the VMI Physical Plant. Water testing for closed loop systems is to include nitrite, total dissolved solids, and pH.
2. Contractor shall provide a treatment for the prevention of corrosion in the hot/chilled closed loop systems at each site. This material shall be nontoxic on exposure to air. No chemical with hydrazine shall be used in any treatment.
3. Contractor shall provide testing of all glycol systems to include concentration and pH, and provide recommendations.
4. The Institute will inform the contractor of any significant leaks in the closed loop systems. The Institute will reimburse the contractor for any additional chemicals required to achieve adequate residual levels due to significant leaks or repairs to the systems.
5. If necessary to drain and flush closed-loop systems at sites, the removal of treated water shall be done by the contractor in a manner that meets all Environmental Protection Agency (EPA) standards.

**F. Maury Brooke Hall Laboratory RO/DI System**

1. **System Description:** The laboratory RO/DI system consists of two skids. The first is a RO/pre-treat system that contains a carbon filter, water softener and media filter. The second skid contains UV sterilization, DI polishing, and final filtration.
2. The following maintenance schedule shall apply to the RO/DI system:

RO/DI Maintenance Schedule	
Review Operators Log Book	Monthly
System Feed Water Chemistry	Monthly
Reverse Osmosis System Check	Monthly
System Pre-filter Cartridge Replacement	Quarterly
System Filter Cartridge Replacement	Semi-Annually
UV Unit Lamp Replacement	Semi-Annually
UV Unit Quartz Sleeve	Annually
Service Vent Filter	Annually
Service Deionization	As Required (not to exceed 2x/year)
Service Carbon	As Required (not to exceed 2x/year)

**G. Maury Brooke Hall and Crozet Hall (Miscellaneous Water Softening Systems)**

On a quarterly basis, the two water softener systems located in Maury Brooke Hall and Crozet Hall shall be checked for proper operation. Softened water shall be tested for hardness and TDS. VMI staff shall be responsible for maintaining salt levels in the brine tanks. The contractor shall report if any malfunctions or resin degradation is found, as well as any recommendations for system improvements.

#### IV. CONTRACT PARTICIPATION

Under the authority of §6 of the Rules Governing Procurement of Goods, Services, Insurance and Construction by a Public Institution of Higher Education of the Commonwealth of Virginia (copy available at <https://vascupp.org/sites/vascupp/files/2020-05/vascapp-governing-rules.pdf>), it is the intent of this solicitation and resulting contracts to allow for cooperative procurement. Accordingly, any public, body, public or private health or educational institutions or lead issuing institution's affiliated corporations may access any resulting contract if authorized by the contractor. Participation in this cooperative procurement is strictly voluntary. If authorized by the Contractor(s), the resultant contract(s) may be extended to the entities indicated above to purchase at contract prices in accordance with the contract terms. The Contractor shall notify the lead issuing institution in writing of any such entities accessing the contract. No modification of this contract or execution of a separate contract is required to participate. The Contractor will provide semi-annual usage reports for all entities accessing the contract. Participating entities shall place their own orders directly with the Contractor and shall fully and independently administer their use of the contract(s) to include contractual disputes, invoicing and payments without direct administration from Virginia Military Institute. VMI shall not be held liable for any costs or damages incurred by any other participating entity as a result of any authorization by the Contractor to extend the contract. It is understood and agreed that VMI is not responsible for the acts or omissions of any entity and will not be considered in default of the contract no matter the circumstances. Use of this contract(s) does not preclude any participating entity from using other contracts or competitive processes as the need may be. Please contact the buyer for additional information.

#### V. PROPOSAL PREPARATION AND SUBMISSION

##### A. GENERAL REQUIREMENTS:

1. RFP Response: In order to be considered for selection, offeror must submit a complete response to this RFP. Response must be submitted electronically through [www.eva.virginia.gov](http://www.eva.virginia.gov).

No other distribution of the Responses shall be made by the offeror.

2. Proposal Preparation:
  - a. Proposals shall be signed by an authorized representative of the offeror. All information requested should be submitted. Failure to submit all information requested may result in the purchasing agency requiring prompt submissions of missing information and/or giving a lowered evaluation of the proposal. Proposals which are substantially incomplete or lack key information may be rejected by the purchasing agency. Mandatory requirements are those required by law or regulation or are such that they cannot be waived and are not subject to negotiation.
  - b. Proposals should be prepared simply and economically, providing a straightforward, concise description of capabilities to satisfy the requirements of the RFP. Emphasis should be placed on completeness and clarity of content.
  - c. Proposals should be organized in the order in which the requirements are presented in the RFP. All pages of the proposal should be numbered. Each paragraph in the proposal should reference the paragraph number of the corresponding section of the RFP. It is also helpful to cite the paragraph number, sub letter, and repeat the text of the requirement as it appears in the RFP. If a response covers more than one page, the paragraph number and sub letter should be repeated at the top of the next page. The proposal should contain a table of contents which cross references the RFP requirements. Information which the offeror desires to present that does not fall within

any of the requirements of the RFP should be inserted at the appropriate place or be attached at the end of the proposal and designated as additional material. Proposals that are not organized in this manner risk elimination from consideration if the evaluators are unable to find where the RFP requirements are specifically addressed.

- d. As used in this RFP, the terms “must”, “shall”, “should” and “may” identify the criticality of requirements. “Must” and “shall” identify requirements whose absence will have a major negative impact on the suitability of the proposed solution. Items labeled as “should” or “may” are highly desirable, although their absence will not have a large impact and would be useful, but are not necessary. Depending on the overall response to the RFP, some individual “must” and “shall” items may not be fully satisfied, but it is the intent to satisfy most, if not all, “must” and “shall” requirements. The inability of an offeror to satisfy a “must” or “shall” requirement does not automatically remove that offeror from consideration; however, it may seriously affect the overall rating of the offeror’ proposal.
  - e. Should the proposal contain **proprietary information**, provide **one (1) redacted copy** of the proposal and all attachments with **proprietary portions removed or blacked out**. This file should be clearly marked “*Redacted Copy*”. The classification of an entire proposal document, line item prices, and/or total proposal prices as proprietary or trade secrets is not acceptable. VMI shall not be responsible for the Offeror’s failure to exclude proprietary information from this redacted copy. See section f. below for additional information.
  - f. Ownership of all data, materials and documentation originated and prepared for the State pursuant to the RFP shall belong exclusively to the State and be subject to public inspection in accordance with the Virginia Freedom of Information Act. Trade secrets or proprietary information submitted by the offeror shall not be subject to public disclosure under the Virginia Freedom of Information Act; however, the offeror must invoke the protection of Section 2.2-4342F of the Code of Virginia, in writing, either before or at the time the data is submitted. The written notice must specifically identify the data or materials to be protected and state the reasons why protection is necessary. The proprietary or trade secret materials submitted must be identified by some distinct method such as highlighting or underlining and must indicate only the specific words, figures, or paragraphs that constitute trade secret or proprietary information. The classification of an entire proposal document, line item prices and/or total proposal prices as proprietary or trade secrets is not acceptable and will result in rejection and return of the proposal.
3. Oral Presentation: Offerors who submit a proposal in response to this RFP may be required to give an oral presentation of their proposal to the Virginia Military Institute. This provides an opportunity for the offeror to clarify or elaborate on the proposal. This is a fact finding and explanation session only and does not include negotiation. VMI will schedule the time and location of these presentations. Oral presentations are an option of the Institute and may or may not be conducted. Therefore, proposals should be complete.

B. SPECIFIC PROPOSAL INSTRUCTIONS:

Proposals should be as thorough and detailed as possible so that Virginia Military Institute may properly evaluate your capabilities to provide the required services. Offerors are required to submit the following items as a complete proposal:

1. Return RFP cover sheet and all addenda acknowledgments, if any, signed and filled out as required.
2. Plan and methodology for providing the goods/services as described in Section III. Statement of Needs for this Request for Proposal.

3. A written narrative to include, but not be limited to, the expertise, qualifications, and experience of the firm and resumes of specific personnel to be assigned to perform the work.
4. Offeror Data Sheet, included as Attachment A to the RFP, and other specific items or data requested in the RFP.
5. Small, Women-owned, Minority-owned or other SWaM Certified Business: This solicitation is SET-ASIDE for businesses certified by the Virginia Department of Small Business and Supplier Diversity.
6. Proposed Cost. See Section X. Pricing Schedule of this Request for Proposal.

**VI. EVALUATION and AWARD CRITERIA**

A. EVALUATION CRITERIA:

Proposals shall be evaluated by Virginia Military Institute using the following criteria:

<u>Points</u>	
1. Plan for providing Water Treatment Services to VMI	20
2. Qualifications and experience of Offeror	20
3. Price	20
4. Implementation, Planning and Services	20
5. References where similar goods and/or services have been provided	20
	100
TOTAL:	100

**VII. GENERAL TERMS AND CONDITIONS**

- A. **PURCHASING MANUAL:** This solicitation is subject to the provisions of the Commonwealth of Virginia’s Purchasing Manual for Institutions of Higher Education and Their Vendors and any revisions thereto, which are hereby incorporated into this contract in their entirety. A copy of the manual is available for review at the purchasing office. The manual may be accessed electronically at <https://vascupp.org/sites/vascupp/files/2020-09/hem.pdf>.
- B. **APPLICABLE LAWS AND COURTS:** This solicitation and any resulting contract shall be governed in all respects by the laws of the Commonwealth of Virginia and any litigation with respect thereto shall be brought in the courts of the Commonwealth. The agency and the contractor are encouraged to resolve any issues in controversy arising from the award of the contract or any contractual dispute using Alternative Dispute Resolution (ADR) procedures (*Code of Virginia, § 2.2-4366*). ADR procedures are described in Chapter 9 of the Commonwealth of Virginia Vendor’s Manual. The contractor shall comply with all applicable federal, state and local laws, rules and regulations.
- C. **ANTI-DISCRIMINATION:** By submitting their proposals, offerors certify to the Commonwealth that they will conform to the provisions of the Federal Civil Rights Act of 1964, as amended, as well as the Virginia Fair Employment Contracting Act of 1975, as amended, where applicable, the Virginians With Disabilities Act, the Americans With Disabilities Act and § 2.2-4311 of the Virginia Public Procurement Act (VPPA). If the award is made to a faith-based organization, the organization shall not discriminate against any recipient of goods, services, or disbursements made pursuant to the contract on the basis of the

recipient's religion, religious belief, refusal to participate in a religious practice, or on the basis of race, age, color, gender or national origin and shall be subject to the same rules as other organizations that contract with public bodies to account for the use of the funds provided; however, if the faith-based organization segregates public funds into separate accounts, only the accounts and programs funded with public funds shall be subject to audit by the public body. (*Code of Virginia*, § 2.2-4343.1E).

In every contract over \$10,000 the provisions in 1. and 2. below apply:

1. During the performance of this contract, the contractor agrees as follows:
    - a. The contractor will not discriminate against any employee or applicant for employment because of race, religion, color, sex, national origin, age, disability, or any other basis prohibited by state law relating to discrimination in employment, except
    - b. where there is a bona fide occupational qualification reasonably necessary to the normal operation of the contractor. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the provisions of this nondiscrimination clause.
    - c. The contractor, in all solicitations or advertisements for employees placed by or on behalf of the contractor, will state that such contractor is an equal opportunity employer.
    - d. Notices, advertisements and solicitations placed in accordance with federal law, rule or regulation shall be deemed sufficient for the purpose of meeting these requirements.
    - e. If the contractor employs more than five employees, the contractor shall (i) provide annual training on the contractor's sexual harassment policy to all supervisors and employees providing services in the Commonwealth, except such supervisors or employees that are required to complete sexual harassment training provided by the Department of Human Resource Management, and (ii) post the contractor's sexual harassment policy in (a) a conspicuous public place in each building located in the Commonwealth that the contractor owns or leases for business purposes and (b) the contractor's employee handbook.
    - f. The requirements of these provisions 1. and 2. are a material part of the contract. If the Contractor violates one of these provisions, the Commonwealth may terminate the affected part of this contract for breach, or at its option, the whole contract. Violation of one of these provisions may also result in debarment from State contracting regardless of whether the specific contract is terminated.
    - g. In accordance with Executive Order 61 (2017), a prohibition on discrimination by the contractor, in its employment practices, subcontracting practices, and delivery of goods or services, on the basis of race, sex, color, national origin, religion, sexual orientation, gender identity, age, political affiliation, disability, or veteran status, is hereby incorporated in this contract.
  2. The contractor will include the provisions of 1. above in every subcontract or purchase order over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.
- D. **ETHICS IN PUBLIC CONTRACTING:** By submitting their (bids/proposals), (bidders/offerors) certify that their (bids/proposals) are made without collusion or fraud and that they have not offered or received any kickbacks or inducements from any other (bidder/offeror), supplier, manufacturer or subcontractor in connection with their (bid/proposal), and that they have not conferred on any public employee having official responsibility for this procurement transaction any payment, loan, subscription, advance, deposit of money, services or anything of more than nominal value, present or promised, unless consideration of substantially equal or greater value was exchanged.
- E. **IMMIGRATION REFORM AND CONTROL ACT OF 1986:** Applicable for all contracts over \$10,000:

By entering into a written contract with the Commonwealth of Virginia, the Contractor certifies that the Contractor does not, and shall not during the performance of the contract for goods and services in the Commonwealth, knowingly employ an unauthorized alien as defined in the federal Immigration Reform and Control Act of 1986.

- F. **DEBARMENT STATUS:** By participating in this procurement, the vendor certifies that they are not currently debarred by the Commonwealth of Virginia from submitting a response for the type of goods and/or services covered by this solicitation. Vendor further certifies that they are not debarred from filling any order or accepting any resulting order, or that they are an agent of any person or entity that is currently debarred by the Commonwealth of Virginia.

If a vendor is created or used for the purpose of circumventing a debarment decision against another vendor, the non-debarred vendor will be debarred for the same time period as the debarred vendor.

- G. **ANTITRUST:** By entering into a contract, the contractor conveys, sells, assigns, and transfers to the Commonwealth of Virginia all rights, title and interest in and to all causes of action it may now have or hereafter acquire under the antitrust laws of the United States and the Commonwealth of Virginia, relating to the particular goods or services purchased or acquired by the Commonwealth of Virginia under said contract.

- H. **MANDATORY USE OF STATE FORM AND TERMS AND CONDITIONS FOR IFBs AND RFPs**

Failure to submit a proposal on the official state form provided for that purpose may be a cause for rejection of the proposal. Modification of or additions to the General Terms and Conditions of the solicitation may be cause for rejection of the proposal; however, the Commonwealth reserves the right to decide, on a case by case basis, in its sole discretion, whether to reject such a proposal.

- I. **CLARIFICATION OF TERMS:** If any prospective (bidder/offeror) has questions about the specifications or other solicitation documents, the prospective (bidder/offeror) should contact the buyer whose name appears on the face of the solicitation no later than five working days before the due date. Any revisions to the solicitation will be made only by addendum issued by the buyer.

- J. **PAYMENT:**

1. **To Prime Contractor:**

- a. Invoices for items ordered, delivered and accepted shall be submitted by the contractor directly to the payment address shown on the purchase order/contract. All invoices shall show the state contract number and/or purchase order number; social security number (for individual contractors) or the federal employer identification number (for proprietorships, partnerships, and corporations).
- b. Any payment terms requiring payment in less than 30 days will be regarded as requiring payment 30 days after invoice or delivery, whichever occurs last. This shall not affect offers of discounts for payment in less than 30 days, however.
- c. All goods or services provided under this contract or purchase order, that are to be paid for with public funds, shall be billed by the contractor at the contract price, regardless of which public agency is being billed.
- d. The following shall be deemed to be the date of payment: the date of postmark in all cases where payment is made by mail, or when offset proceedings have been instituted as authorized under the Virginia Debt Collection Act.
- e. **Unreasonable Charges.** Under certain emergency procurements and for most time and material purchases, final job costs cannot be accurately determined at the time orders are placed. In such cases, contractors should be put on notice that final payment in full is contingent on a determination of reasonableness with respect to all invoiced charges. Charges which appear to be unreasonable will be resolved in accordance with

*Code of Virginia*, § 2.2-4363 and -4364. Upon determining that invoiced charges are not reasonable, the Commonwealth shall notify the contractor of defects or improprieties in invoices within fifteen (15) days as required in *Code of Virginia*, § 2.2-4351.,. The provisions of this section do not relieve an agency of its prompt payment obligations with respect to those charges which are not in dispute (*Code of Virginia*, § 2.2-4363).

2. To Subcontractors:

- a. Within seven (7) days of the contractor's receipt of payment from the Commonwealth, a contractor awarded a contract under this solicitation is hereby obligated:
  - (1) To pay the subcontractor(s) for the proportionate share of the payment received for work performed by the subcontractor(s) under the contract; or
  - (2) To notify the agency and the subcontractor(s), in writing, of the contractor's intention to withhold payment and the reason.
- b. The contractor is obligated to pay the subcontractor(s) interest at the rate of one percent per month (unless otherwise provided under the terms of the contract) on all amounts owed by the contractor that remain unpaid seven (7) days following receipt of payment from the Commonwealth, except for amounts withheld as stated in (2) above. The date of mailing of any payment by U. S. Mail is deemed to be payment to the addressee. These provisions apply to each sub-tier contractor performing under the primary contract. A contractor's obligation to pay an interest charge to a subcontractor may not be construed to be an obligation of the Commonwealth.

3. Each prime contractor who wins an award in which provision of a SWaM procurement plan is a condition to the award, shall deliver to the contracting agency or institution, on or before request for final payment, evidence and certification of compliance (subject only to insubstantial shortfalls and to shortfalls arising from subcontractor default) with the SWaM procurement plan. Final payment under the contract in question may be withheld until such certification is delivered and, if necessary, confirmed by the agency or institution, or other appropriate penalties may be assessed in lieu of withholding such payment.

4. The Commonwealth of Virginia encourages contractors and subcontractors to accept electronic and credit card payments.

K. **PRECEDENCE OF TERMS:** The following General Terms and Conditions *COMMONWEALTH OF VIRGINIA PURCHASING MANUAL for INSTITUTIONS OF HIGHER EDUCATION and THEIR VENDORS*, APPLICABLE LAWS AND COURTS, ANTI-DISCRIMINATION, ETHICS IN PUBLIC CONTRACTING, IMMIGRATION REFORM AND CONTROL ACT OF 1986, DEBARMENT STATUS, ANTITRUST, MANDATORY USE OF STATE FORM AND TERMS AND CONDITIONS, CLARIFICATION OF TERMS, PAYMENT shall apply in all instances. In the event there is a conflict between any of the other General Terms and Conditions and any Special Terms and Conditions in this solicitation, the Special Terms and Conditions shall apply.

L. **QUALIFICATIONS OF (BIDDERS/OFFERORS):** The Commonwealth may make such reasonable investigations as deemed proper and necessary to determine the ability of the (bidder/offeror) to perform the services/furnish the goods and the (bidder/offeror) shall furnish to the Commonwealth all such information and data for this purpose as may be requested. The Commonwealth reserves the right to inspect (bidder's/offeror's) physical facilities prior to award to satisfy questions regarding the (bidder's/offeror's) capabilities. The Commonwealth further reserves the right to reject any (bid/proposal) if the evidence submitted by, or investigations of, such (bidder/offeror) fails to satisfy the Commonwealth that such (bidder/offeror) is properly qualified to carry out the obligations of the contract and to provide the services and/or furnish the goods contemplated therein.

M. **TESTING AND INSPECTION:** The Commonwealth reserves the right to conduct any test/inspection it may deem advisable to assure goods and services conform to the specifications.

- N. **ASSIGNMENT OF CONTRACT:** A contract shall not be assignable by the contractor in whole or in part without the written consent of the Commonwealth.
- O. **CHANGES TO THE CONTRACT:** Changes can be made to the contract in any of the following ways:
1. The parties may agree in writing to modify the terms, conditions, or scope of the contract. Any additional goods or services to be provided shall be of a sort that is ancillary to the contract goods or services, or within the same broad product or service categories as were included in the contract award. Any increase or decrease in the price of the contract resulting from such modification shall be agreed to by the parties as a part of their written agreement to modify the scope of the contract.
  2. The Purchasing Agency may order changes within the general scope of the contract at any time by written notice to the contractor. Changes within the scope of the contract include, but are not limited to, things such as services to be performed, the method of packing or shipment, and the place of delivery or installation. The contractor shall comply with the notice upon receipt, unless the contractor intends to claim an adjustment to compensation, schedule, or other contractual impact that would be caused by complying with such notice, in which case the contractor shall, in writing, promptly notify the Purchasing Agency of the adjustment to be sought, and before proceeding to comply with the notice, shall await the Purchasing Agency's written decision affirming, modifying, or revoking the prior written notice. If the Purchasing Agency decides to issue a notice that requires an adjustment to compensation, the contractor shall be compensated for any additional costs incurred as the result of such order and shall give the Purchasing Agency a credit for any savings. Said compensation shall be determined by one of the following methods:
    - a. By mutual agreement between the parties in writing; or
    - b. By agreeing upon a unit price or using a unit price set forth in the contract, if the work to be done can be expressed in units, and the contractor accounts for the number of units of work performed, subject to the Purchasing Agency's right to audit the contractor's records and/or to determine the correct number of units independently; or
    - c. By ordering the contractor to proceed with the work and keep a record of all costs incurred and savings realized. A markup for overhead and profit may be allowed if provided by the contract. The same markup shall be used for determining a decrease in price as the result of savings realized. The contractor shall present the Purchasing Agency with all vouchers and records of expenses incurred and savings realized. The Purchasing Agency shall have the right to audit the records of the contractor as it deems necessary to determine costs or savings. Any claim for an adjustment in price under this provision must be asserted by written notice to the Purchasing Agency within thirty (30) days from the date of receipt of the written order from the Purchasing Agency. If the parties fail to agree on an amount of adjustment, the question of an increase or decrease in the contract price or time for performance shall be resolved in accordance with the procedures for resolving disputes provided by the Disputes Clause of this contract or, if there is none, in accordance with the disputes provisions of the Commonwealth of Virginia *Vendors Manual*. Neither the existence of a claim nor a dispute resolution process, litigation or any other provision of this contract shall excuse the contractor from promptly complying with the changes ordered by the Purchasing Agency or with the performance of the contract generally.
- P. **ADDITIONAL GOODS AND SERVICES:** VMI may acquire other goods or services that the supplier provides than those specifically solicited. VMI reserves the right, subject to mutual agreement, for the Contractor to provide additional goods and/or services under the same pricing, terms, and conditions and to make modifications or enhancements to the existing goods and services. Such additional goods and services may include other products, components, accessories, subsystems, or related services that are newly introduced during the term of this Agreement. Such additional goods and services will be provided to VMI at favored nations pricing, terms and conditions.

- Q. **DEFAULT:** In case of failure to deliver goods or services in accordance with the contract terms and conditions, the Commonwealth, after due oral or written notice, may procure them from other sources and hold the contractor responsible for any resulting additional purchase and administrative costs. This remedy shall be in addition to any other remedies which the Commonwealth may have.
- R. **TAXES:** Sales to the Commonwealth of Virginia are normally exempt from State sales tax. State sales and use tax certificates of exemption, Form ST-12, will be issued upon request. Deliveries against this contract shall usually be free of Federal excise and transportation taxes. The Commonwealth's excise tax exemption registration number is 54-73-0076K.

If sales or deliveries against the contract are not exempt, the contractor shall be responsible for the payment of such taxes unless the tax law specifically imposes the tax upon the buying entity and prohibits the contractor from offering a tax-included price.

- S. **USE OF BRAND NAMES:** Unless otherwise provided in this solicitation, the name of a certain brand, make or manufacturer does not restrict (bidders/offerors) to the specific brand, make or manufacturer named, but conveys the general style, type, character, and quality of the article desired. Any article which the public body, in its sole discretion, determines to be the equivalent of that specified, considering quality, workmanship, economy of operation, and suitability for the purpose intended, shall be accepted. The (bidder/offeror) is responsible to clearly and specifically identify the product being offered and to provide sufficient descriptive literature, catalog cuts and technical detail to enable the Commonwealth to determine if the product offered meets the requirements of the solicitation. This is required even if offering the exact brand, make or manufacturer specified. Normally in competitive sealed bidding only the information furnished with the bid will be considered in the evaluation. Failure to furnish adequate data for evaluation purposes may result in declaring a bid nonresponsive. Unless the (bidder/offeror) clearly indicates in its (bid/proposal) that the product offered is an equivalent product, such (bid/proposal) will be considered to offer the brand name product referenced in the solicitation.
- T. **TRANSPORTATION AND PACKAGING:** By submitting their (bids/proposals), all (bidders/offerors) certify and warrant that the price offered for FOB destination includes only the actual freight rate costs at the lowest and best rate and is based upon the actual weight of the goods to be shipped. Except as otherwise specified herein, standard commercial packaging, packing and shipping containers shall be used. All shipping containers shall be legibly marked or labeled on the outside with purchase order number, commodity description, and quantity.
- U. **INSURANCE:** By signing and submitting a bid or proposal under this solicitation, the bidder or offeror certifies that if awarded the contract, it will have the following insurance coverage at the time the contract is awarded. For construction contracts, if any subcontractors are involved, the subcontractor will have workers' compensation insurance in accordance with §§ 2.2-4332 and 65.2-800 et seq. of the *Code of Virginia*. The bidder or offeror further certifies that the contractor and any subcontractors will maintain these insurance coverage during the entire term of the contract and that all insurance coverage will be provided by insurance companies authorized to sell insurance in Virginia by the Virginia State Corporation Commission.

**MINIMUM INSURANCE COVERAGES AND LIMITS:**

1. Workers' Compensation - Statutory requirements and benefits. Coverage is compulsory for employers of three or more employees, to include the employer. Contractors who fail to notify the Commonwealth of increases in the number of employees that change their workers' compensation requirements under the *Code of Virginia* during the course of the contract shall be in noncompliance with the contract.
2. Employer's Liability - \$100,000.
3. Commercial General Liability - \$1,000,000 per occurrence and \$2,000,000 in the aggregate. Commercial General Liability is to include bodily injury and property damage, personal injury and advertising injury, products and

completed operations coverage. The Commonwealth of Virginia shall be added as an additional insured to the policy by an endorsement.

- 4. Automobile Liability - \$1,000,000 combined single limit. (Required only if a motor vehicle not owned by the Commonwealth is to be used in the contract. Contractor must assure that the required coverage is maintained by the Contractor (or third party owner of such motor vehicle.)

<u>Profession/Service</u>	<u>Limits</u>
Accounting	\$1,000,000 per occurrence, \$3,000,000 aggregate
Architecture	\$2,000,000 per occurrence, \$6,000,000 aggregate
Asbestos Design, Inspection or Abatement Contractors	\$1,000,000 per occurrence, \$3,000,000 aggregate
Health Care Practitioner (to include Dentists, Licensed Dental Hygienists, Optometrists, Registered or Licensed Practical Nurses, Pharmacists, Physicians, Podiatrists, Chiropractors, Physical Therapists, Physical Therapist Assistants, Clinical Psychologists, Clinical Social Workers, Professional Counselors, Hospitals, or Health Maintenance Organizations.)	
	<i>Code of Virginia § 8.01-581.15</i>
	<a href="https://law.lis.virginia.gov/vacode/title8.01/chapter21.1/section8.01-581.15/">https://law.lis.virginia.gov/vacode/title8.01/chapter21.1/section8.01-581.15/</a>
Insurance/Risk Management	\$1,000,000 per occurrence, \$3,000,000 aggregate
Landscape/Architecture	\$1,000,000 per occurrence, \$1,000,000 aggregate
Legal	\$1,000,000 per occurrence, \$5,000,000 aggregate
Professional Engineer	\$2,000,000 per occurrence, \$6,000,000 aggregate
Surveying	\$1,000,000 per occurrence, \$1,000,000 aggregate

- U. **ANNOUNCEMENT OF AWARD:** Upon the award or the announcement of the decision to award a contract as a result of this solicitation, the purchasing agency will publicly post such notice on the DGS/DPS eVA VBO ([www.eva.virginia.gov](http://www.eva.virginia.gov)) for a minimum of 10 days.

- V. **DRUG-FREE WORKPLACE:** Applicable for all contracts over \$10,000:

During the performance of this contract, the contractor agrees to (i) provide a drug-free workplace for the contractor's employees; (ii) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (iii) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (iv) include the provisions of the foregoing clauses in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

For the purposes of this section, "*drug-free workplace*" means a site for the performance of work done in connection with a specific contract awarded to a contractor, the employees of whom are prohibited from engaging in the unlawful manufacture, sale, distribution, dispensation, possession or use of any controlled substance or marijuana during the performance of the contract.

- W. **NONDISCRIMINATION OF CONTRACTORS:** A bidder, offeror, or contractor shall not be discriminated against in the solicitation or award of this contract because of race, religion, color, sex, sexual orientation, gender identity, national origin, age, disability, faith-based organizational status, any other basis prohibited by state law relating to discrimination in employment or because the bidder or offeror employs ex-offenders unless the state agency, department or institution has made a written determination that employing ex-offenders on the specific contract is not in its best interest. If the award of this contract is made to a faith-based organization and an individual, who applies for or receives goods, services, or disbursements provided pursuant to this contract objects to the religious character of the faith-based

organization from which the individual receives or would receive the goods, services, or disbursements, the public body shall offer the individual, within a reasonable period of time after the date of his objection, access to equivalent goods, services, or disbursements from an alternative provider.

- X. **eVA BUSINESS-TO-GOVERNMENT VENDOR REGISTRATION, CONTRACTS, AND ORDERS:** The eVA Internet electronic procurement solution, web site portal [www.eVA.virginia.gov](http://www.eVA.virginia.gov), streamlines and automates government purchasing activities in the Commonwealth. The eVA portal is the gateway for vendors to conduct business with state agencies and public bodies. All vendors desiring to provide goods and/or services to the Commonwealth shall participate in the eVA Internet e-procurement solution by completing the free eVA Vendor Registration. All bidders or offerors must register in eVA and pay the Vendor Transaction Fees specified below; failure to register will result in the bid/proposal being rejected.

Vendor transaction fees are determined by the date the original purchase order is issued and the current fees are as follows:

- a. For orders issued July 1, 2014, and after, the Vendor Transaction Fee is:
  - (i) DSBSD-certified Small Businesses: 1%, capped at \$500 per order.
  - (ii) Businesses that are not DSBSD-certified Small Businesses: 1%, capped at \$1,500 per order.
- b. Refer to Special Term and Condition “eVA Orders and Contracts” to identify the number of purchase orders that will be issued as a result of this solicitation/contract with the eVA transaction fee specified above assessed for each order.

For orders issued prior to July 1, 2014, the vendor transaction fees can be found at [www.eVA.virginia.gov](http://www.eVA.virginia.gov).

The specified vendor transaction fee will be invoiced, by the Commonwealth of Virginia Department of General Services, typically within 60 days of the order issue date. Any adjustments (increases/decreases) will be handled through purchase order changes.

- Y. **AVAILABILITY OF FUNDS:** It is understood and agreed between the parties herein that the agency shall be bound hereunder only to the extent that the legislature has appropriated funds that are legally available or may hereafter become legally available for the purpose of this agreement.
- Z. **SET-ASIDES IN ACCORDANCE WITH THE SMALL BUSINESS ENHANCEMENT AWARD PRIORITY:** This solicitation is set-aside for award priority to DSBSD-certified micro businesses or small businesses when designated as “Micro Business Set-Aside Award Priority” or “Small Business Set-Aside Award Priority” accordingly in the solicitation. DSBSD-certified micro businesses or small businesses also includes DSBSD-certified women-owned and minority-owned businesses when they have received the DSBSD small business certification. For purposes of award, bidders/offerors shall be deemed micro businesses or small businesses if and only if they are certified as such by DSBSD on the due date for receipt of bids/proposals.
- AA. **BID PRICE CURRENCY:** Unless stated otherwise in the solicitation, bidders/offerors shall state bid/offer prices in US dollars.
- BB. **AUTHORIZATION TO CONDUCT BUSINESS IN THE COMMONWEALTH:** A contractor organized as a stock or nonstock corporation, limited liability company, business trust, or limited partnership or registered as a registered limited liability partnership shall be authorized to transact business in the Commonwealth as a domestic or foreign business entity if so required by Title 13.1 or Title 50 of the *Code of Virginia* or as otherwise required by law. Any business entity described above that enters into a contract with a public body pursuant to the *Virginia Public Procurement Act* shall not allow its existence to lapse or its certificate of authority or registration to transact business in the Commonwealth, if so required under Title 13.1 or Title 50, to be revoked or cancelled at any time during the term of the contract. A

public body may void any contract with a business entity if the business entity fails to remain in compliance with the provisions of this section.

- CC. **CIVILITY IN STATE WORKPLACES:** The contractor shall take all reasonable steps to ensure that no individual, while performing work on behalf of the contractor or any subcontractor in connection with this agreement (each, a “Contract Worker”), shall engage in 1) harassment (including sexual harassment), bullying, cyber-bullying, or threatening or violent conduct, or 2) discriminatory behavior on the basis of race, sex, color, national origin, religious belief, sexual orientation, gender identity or expression, age, political affiliation, veteran status, or disability.

The contractor shall provide each Contract Worker with a copy of this Section and will require Contract Workers to participate in agency training on civility in the State workplace if contractor’s (and any subcontractor’s) regular mandatory training programs do not already encompass equivalent or greater expectations. Upon request, the contractor shall provide documentation that each Contract Worker has received such training.

For purposes of this Section, “State workplace” includes any location, permanent or temporary, where a Commonwealth employee performs any work-related duty or is representing his or her agency, as well as surrounding perimeters, parking lots, outside meeting locations, and means of travel to and from these locations. Communications are deemed to occur in a State workplace if the Contract Worker reasonably should know that the phone number, email, or other method of communication is associated with a State workplace or is associated with a person who is a State employee.

The Commonwealth of Virginia may require, at its sole discretion, the removal and replacement of any Contract Worker who the Commonwealth reasonably believes to have violated this Section.

This Section creates obligations solely on the part of the contractor. Employees or other third parties may benefit incidentally from this Section and from training materials or other communications distributed on this topic, but the Parties to this agreement intend this Section to be enforceable solely by the Commonwealth and not by employees or other third parties.

## VIII. SPECIAL TERMS AND CONDITIONS

1. **ADDITIONAL USERS:** This procurement is being conducted on behalf of state agencies, institutions and other public bodies who may be added or deleted at any time during the period of the contract. The addition or deletion of authorized users not specifically named in the solicitation shall be made only by written contract modification issued by this agency or institution and upon mutual agreement of the contractor. Such modification shall name the specific agency added or deleted and the effective date. The contractor shall not honor an order citing the resulting contract unless the ordering entity has been added by written contract modification.
2. **AUDIT:** The contractor shall retain all books, records, and other documents relative to this contract for five (5) years after final payment, or until audited by the Commonwealth of Virginia, whichever is sooner. The agency, its authorized agents, and/or state auditors shall have full access to and the right to examine any of said materials during said period.
3. **AWARD OF CONTRACT:** Selection shall be made of two or more offerors deemed to be fully qualified and best suited among those submitting proposals on the basis of the evaluation factors included in the Request for Proposals, including price, if so stated in the Request for Proposals. Negotiations shall be conducted with the offerors so selected. Price shall be considered, but need not be the sole determining factor. After negotiations have been conducted with each offeror so selected, the agency shall select

the offeror which, in its opinion, has made the best proposal, and shall award the contract to that offeror. The Commonwealth may cancel this Request for Proposals or reject proposals at any time prior to an award, and is not required to furnish a statement of the reasons why a particular proposal was not deemed to be the most advantageous (Code of Virginia, § 2.2-4359D). Should the Commonwealth determine in writing and in its sole discretion that only one offeror is fully qualified, or that one offeror is clearly more highly qualified than the others under consideration, a contract may be negotiated and awarded to that offeror. The award\_document will be a contract incorporating by reference all the requirements, terms and conditions of the solicitation and the contractor's proposal as negotiated.

4. **CANCELLATION OF CONTRACT:** The purchasing agency reserves the right to cancel and terminate any resulting contract, in part or in whole, without penalty, upon 60 days written notice to the contractor. In the event the initial contract period is for more than 12 months, the resulting contract may also be terminated by the contractor, without penalty, after the initial 12 months of the contract period upon 60 days written notice to the other party. Any contract cancellation notice shall not relieve the contractor of the obligation to deliver and/or perform on all outstanding orders issued prior to the effective date of cancellation.
5. **CONFIDENTIALITY OF PERSONALLY IDENTIFIABLE INFORMATION:** The contractor assures that the information and data obtained as to personal facts and circumstances related to students or staff will be collected and held confidential, during and following the contract, and will not be divulged without the individual's and the University's written consent and only in accordance with federal law or Code of Virginia. Contractors who utilize, access, or store personally identifiable information as part of the performance of a contract are required to safeguard this information and immediately notify the agency of any breach or suspected breach in the security of such information. Contractors shall allow the agency to both participate in the investigation of incidents and exercise control over decisions regarding external reporting. Contractors and their employees working on this project may be required to sign a confidentiality statement.
6. **CONTINUITY OF SERVICES:**
  - A. The Contractor recognizes that the services under this contract are vital to the University and must be continued without interruption and that, upon contract expiration, a successor, either the University or another contractor, may continue them. The Contractor agrees:
    1. To exercise its best efforts and cooperation to effect an orderly and efficient transition to a successor;
    2. To make all University owned facilities, equipment, and data available to any successor at an appropriate time prior to the expiration of the contract to facilitate transition to successor; and
    3. That the University Contract Officer shall have final authority to resolve disputes related to the transition of the contract from the Contractor to its successor.
  - B. The Contractor shall, upon written notice from the Contract Office, furnish phase-in/phase-out services for up to ninety (90) days after this contract expires and shall negotiate in good faith a plan with the successor to execute the phase-in/phase-out services. This plan shall be subject to the Contractor Officer's approval.
  - C. The Contractor shall be reimbursed for all reasonable, pre-approved phase-in/phase-out costs (i.e., costs incurred within the agreed period after contract expiration that result from phase-in/phase-out operations) and a fee (profit) not to exceed a pro rata portion of the fee (profit) under this

contract. All phase-in/phase-out work fees must be approved by the Contract Officer in writing prior to commencement of said work.

7. **CONTRACT ADMINISTRATION:** VMI assigns “Contract Administrators” to each contract awarded. The Contract Administrator shall be the initial point of contact for the Contractor. Contract Administrators are charged with ensuring the terms and conditions of the contract are followed, payments are made in accordance to the contractual pricing schedule, and reporting noncompliance issues to the Procurement and Contracts Department at VMI. Contract Administrators **do not** have the authority to authorize changes and/or modifications to the contract. Should noncompliance issues exist and cannot be resolved at this level or changes/modifications to the contract are required, the assigned Contract Officer in the Procurement Services Department must be notified immediately by the Contract Administrator. The assigned Contract Administrator will be identified upon award.
8. **eVA ORDERS AND CONTRACTS:** The solicitation/contract will result in multiple purchase order(s) with the applicable eVA transaction fee assessed for each order.

Vendors desiring to provide goods and/or services to the Commonwealth shall participate in the eVA Internet e-procurement solution and agree to comply with the following: If this solicitation is for a term contract, failure to provide an electronic catalog (price list) or index page catalog for items awarded will be just cause for the Commonwealth to reject your bid/offer or terminate this contract for default. The format of this electronic catalog shall conform to the eVA Catalog Interchange Format (CIF) Specification that can be accessed and downloaded from [www.eVA.virginia.gov](http://www.eVA.virginia.gov). Contractors should email Catalog or Index Page information to [eVA-catalog-manager@dgs.virginia.gov](mailto:eVA-catalog-manager@dgs.virginia.gov).

9. **IDENTIFICATION OF PROPOSAL ENVELOPE:** If a special envelope is not furnished, or if return in the special envelope is not possible, the signed bid/proposal should be returned in a separate envelope or package, sealed and identified as follows:

<b>Name of Offeror:</b>	<b>RFP#</b>
<b>Address:</b>	<b>Due Date:</b> <span style="float: right;"><b>Time:</b></span>
	<b>RFP Title:</b>
<b>City, State, Zip:</b>	<b>Contract Officer:</b>

10. **INDEMNIFICATION:** Contractor agrees to indemnify the Commonwealth of Virginia, its officers, agents and employees for any loss, liability, cost , or reasonable settlement cost incurred as a result of any claims, damages and actions of any kind or nature, whether at law or in equity, arising from or caused by the use of any materials, goods, or equipment of any kind or nature furnished by the contractor/any services of any kind or nature furnished by the contractor, provided that such liability is not attributable to the sole negligence of the using agency or to failure of the using agency to use the materials, goods, or equipment in the manner already and permanently described by the contractor on the materials, goods or equipment delivered.
11. **LATE PROPOSALS:** To be considered for selection, proposals must be received by the Issuing Agency by the designated date and hour. The official time used in the receipt of proposal is that time on the

automatic time stamp machine in the Issuing Agency. **The Institute is not responsible for delays in the delivery of mail by the U.S. Post Office, private couriers, or the Institute's internal mail system. It is the sole responsibility of the Offeror to insure that its proposal reaches the issuing office by the designated date and hour.** \*Proposal receipt scheduled during a period of suspended state business operations will be rescheduled for processing at the same time on the next regularly scheduled business day.

12. **REFERENCES:** Bidders shall provide a list of at least three references where similar goods and/or services have been provided. Each reference shall include the name of the organization, the complete mailing address, the name of the contact person and telephone number.
13. **SUBCONTRACTS:** No portion of the work shall be subcontracted without prior written consent of the purchasing agency. In the event that the contractor desires to subcontract some part of the work specified herein, the contractor shall furnish the purchasing agency the names, qualifications and experience of their proposed subcontractors. The contractor shall, however, remain fully liable and responsible for the work to be done by its subcontractor(s) and shall assure compliance with all requirements of the contract.
14. **STATE CORPORATION COMMISSION IDENTIFICATION NUMBER:** Pursuant to Code of Virginia, §2.2-4311.2 subsection B, a bidder or offeror organized or authorized to transact business in the Commonwealth pursuant to Title 13.1 or Title 50 is required to include in its bid or proposal the identification number issued to it by the State Corporation Commission (SCC). Any bidder or offeror that is not required to be authorized to transact business in the Commonwealth as a foreign business entity under Title 13.1 or Title 50 or as otherwise required by law is required to include in its bid or proposal a statement describing why the bidder or offeror is not required to be so authorized. Indicate the above information on the SCC Form provided. Contractor agrees that the process by which compliance with Titles 13.1 and 50 is checked during the solicitation stage (including without limitation the SCC Form provided) is streamlined and not definitive, and the Commonwealth's use and acceptance of such form, or its acceptance of Contractor's statement describing why the bidder or offeror was not legally required to be authorized to transact business in the Commonwealth, shall not be conclusive of the issue and shall not be relied upon by the Contractor as demonstrating compliance.
15. **E-VERIFY PROGRAM:** EFFECTIVE 12/1/13. Pursuant to *Code of Virginia*, §2.2-4308.2., any employer with more than an average of 50 employees for the previous 12 months entering into a contract in excess of \$50,000 with any agency of the Commonwealth to perform work or provide services pursuant to such contract shall register and participate in the E-Verify program to verify information and work authorization of its newly hired employees performing work pursuant to such public contract. Any such employer who fails to comply with these provisions shall be debarred from contracting with any agency of the Commonwealth for a period up to one year. Such debarment shall cease upon the employer's registration and participation in the E-Verify program. If requested, the employer shall present a copy of their Maintain Company page from E-Verify to prove that they are enrolled in E-Verify.
16. **CERTIFICATION OF INTERNAL CONTROLS:** The contractor shall have clearly delineated processes and procedures for the internal control of sensitive data and processes, which are any data and processes of which the compromising of confidentiality, integrity, and/or availability could have a material adverse effect on Commonwealth of Virginia interests, the conduct of agency programs, or to the privacy of which individuals are entitled, when such sensitive data or processes are related to the goods and/or services provided pursuant to this agreement.

The contractor shall provide evidence of compliant and ongoing internal control of sensitive data and processes through a standard methodology, such as but without limitation the American Institute of Certified Public Accountant (AICPA) Service Organization Control (SOC) Reports. The evidence of compliance shall be contained in a report describing the effectiveness of the contractor's internal controls. The most recent version of the report shall be provided to the purchasing office upon request. Trade secrets or proprietary information contained within the report shall not be subject to public disclosure under the Virginia Freedom of Information Act; however, the contractor must invoke the protection of Code of Virginia, § 2.2-4342F, in writing, prior to or upon submission of the report, and must identify the data or other materials to be protected and state the reasons why protection is necessary.

If deficiencies in the contractor's internal control processes and procedures are described in the most recent version of the report, the contractor shall automatically submit the report to the purchasing office within a timely manner and shall describe the corrective actions to be put into place by the contractor to remedy the deficiencies. Failure to report and/or repair deficiencies in a timely manner shall be cause for the Commonwealth to make a determination of breach of contract.

The contractor's obligations for certification of internal controls shall survive and continue after completion of this agreement unless the contractor certifies the destruction of the sensitive data at the end of the contract term.

**14. FEDERALLY IMPOSED TARIFFS:** In the event that the President of the United States, the United States Congress, Customs and Border Protection, or any other federal entity authorized by law, imposes an import duty or tariff (a "tariff"), on an imported good that results in an increase in contractor's costs to a level that renders performance under the Agreement impracticable, the Commonwealth may agree to an increase to the purchase price for the affected good. No increase in purchase price may exceed 25% of the additional tariff imposed on the goods imported or purchased by the contractor that are provided to the Commonwealth under this Agreement.

Prior to the Commonwealth agreeing to a price increase pursuant to this Section, the contractor must provide to the Commonwealth, the following documentation, all of which must be satisfactory to the Commonwealth:

- evidence demonstrating: (i) the unit price paid by contractor as of the date of award for the good or raw material used to furnish the goods to the Commonwealth under this Agreement, (ii) the applicability of the tariff to the specific good or raw material, and (iii) contractor's payment of the increased import duty or tariff (either directly or through an increase to the cost paid for the good or raw material). The evidence submitted shall be sufficient in detail and content to allow the Commonwealth to verify that the tariff is the cause of the price change.
- a certification signed by contractor that it has made all reasonable efforts to obtain the good or the raw materials comprising the good procured by the Commonwealth at a lower cost from a different source located outside of the country against which the tariff has been imposed.
- a certification signed by contractor that the documentation, statements, and any other evidence it submits in support of its request for a price increase under this Section are true and correct, and that the contractor would otherwise be unable to perform under this Agreement without such price increase.

- as requested by the Commonwealth, written instructions authorizing the Commonwealth to request additional documentation from individuals or entities that provide the good or the raw materials to verify the information submitted by contractor.

If the Commonwealth agrees to a price increase pursuant to this Section, the parties further agree to add the following terms to this Agreement:

- During the Term and for five (5) years after the termination of this Agreement, contractor shall retain, and the Commonwealth and its authorized representatives shall have the right to audit, examine, and make copies of, all of contractor's books, accounts, and other records related to this Agreement and contractor's costs for providing goods to the Commonwealth, including, but not limited to those kept by the contractor's agents, assigns, successors, and subcontractors.
- Notwithstanding anything to the contrary in this Agreement, the Commonwealth shall have the right to terminate this Agreement for the Commonwealth's convenience upon 15 days' written notice to contractor.
- In the event the import duty or tariff is repealed or reduced prior to termination of this Agreement, the increase in the Commonwealth's contract price shall be reduced by the same amount and adjusted accordingly.
- Any material misrepresentation of fact by contractor relating in any way to the Commonwealth's payment of additional sums due to tariffs shall be fraud against the taxpayer's of the Commonwealth and subject contractor to treble damages pursuant to the Virginia Fraud Against Taxpayers Act.

**IX. METHOD OF PAYMENT**

The contractor will be paid on the basis of invoices submitted in accordance with the RFP and negotiations.

**X. PRICING SCHEDULE**

The contractor shall provide pricing for all products and services included in proposal indicating one-time and on-going costs

**XI. ATTACHMENTS**

Attachment A: Understanding of Requirements  
Attachment B: Conflict of Interest Statement  
Attachment C: Contractor's Data Sheet  
Attachment D: References  
Attachment E: SWaM Certification  
Attachment F: Price Form  
Attachment G: CPTF1 Drawings  
Attachment H: MARLO Water Treatment System

UNDERSTANDING OF REQUIREMENTS

OFFEROR: \_\_\_\_\_

RFP#: RFP #V211-23-001

Date: \_\_\_\_\_

The following question concerns specifications, Section (number) \_\_\_\_\_

Paragraph \_\_\_\_\_, page \_\_\_\_\_.

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All responses to questions will be made by Addendum and posted to [www.eVA.virginia.gov](http://www.eVA.virginia.gov)  
**Questions not submitted on this form WILL NOT BE ANSWERED.**

Questions Submitted by: \_\_\_\_\_

NAME

\_\_\_\_\_  
ORGANIZATION

\_\_\_\_\_  
PHONE

\_\_\_\_\_  
EMAIL

E-Mail to: [carmacklw@vmi.edu](mailto:carmacklw@vmi.edu), MAJ Lynn W. Carmack



CONTRACTOR DATA SHEET

QUALIFICATIONS OF OFFEROR: Offerors must have the capability and capacity in all respects to fully satisfy the contractual requirement.

Indicate the length of time you have been in business providing this type of service. \_\_\_\_\_ Years  
\_\_\_\_\_ Months

Provide a list of current references, either college, Educational Institutions, and/or other companies that your firm is servicing. Include the length of service, dollar volume, year contract was entered into, and the name and address of the person the State has your permission to contact. Such listing shall be comprehensive of your firm’s customer base and can be formatted as follows:

CURRENT ACCOUNTS:

Account Name, Address & Phone #	Length of Service	\$ Volume/Year
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

LOST ACCOUNTS:

Account Name, Address & Phone #	Length of Service	\$ Volume/Year
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

REFERENCES

Please list at least four references for whom you have performed each applicable category of service specified herein and within the past five years.

CLIENT: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CONTACT PERSON/PHONE#: \_\_\_\_\_

APPROXIMATE DOLLAR VOLUME PER YEAR: \_\_\_\_\_

PROJECTS/DATES/DESCRIPTION: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

CLIENT: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CONTACT PERSON/PHONE#: \_\_\_\_\_

APPROXIMATE DOLLAR VOLUME PER YEAR: \_\_\_\_\_

PROJECTS/DATES/DESCRIPTION: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

CLIENT: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

CONTACT PERSON/PHONE#: \_\_\_\_\_

APPROXIMATE DOLLAR VOLUME PER YEAR: \_\_\_\_\_

PROJECTS/DATES/DESCRIPTION: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Please use a separate sheet of paper for additional references.

**ATTACHMENT E:**

**SWaM (Small, Woman- and/or Minority-Owned Business Certification**

**Small Business:** "Small business " means an independently owned and operated business which, together with affiliates, has 250 or fewer employees, or average annual gross receipts of \$10 million or less averaged over the previous three years. Note: This shall not exclude SBSB-certified women- and minority-owned businesses when they have received SBSB small business certification.

**Women-Owned Business:** Women-owned business means a business concern that is at least 51% owned by one or more women who are citizens of the United States or non-citizens who are in full compliance with United States immigration law, or in the case of a corporation, partnership or limited liability company or other entity, at least 51% of the equity ownership interest is owned by one or more women who are citizens of the United States or non-citizens who are in full compliance with United States immigration law, and both the management and daily business operations are controlled by one or more women who are citizens of the United States or non-citizens who are in full compliance with the United States immigration law.

**Minority-Owned Business:** Minority-owned business means a business concern that is at least 51% owned by one or more minority individuals or in the case of a corporation, partnership or limited liability company or other entity, at least 51% of the equity ownership interest in the corporation, partnership, or limited liability company or other entity is owned by one or more minority individuals and both the management and daily business operations are controlled by one or more minority individuals.

**All small businesses must be certified by the Commonwealth of Virginia Department of Small Business and Supplier Diversity (SBSB) by the due date of the solicitation to participate in the SWaM program. Certification applications are available online at [www.sbsd.virginia.gov](http://www.sbsd.virginia.gov).**

Offeror Name: \_\_\_\_\_

Preparer Name: \_\_\_\_\_ Date: \_\_\_\_\_

**Instructions**

- A. Businesses certified by the Department of Small Business and Supplier Diversity (SBSB) as a small business must complete Section A of this form.

**Section A**

CERTIFICATION TYPE (check only one below):

\_\_\_\_\_ Small Business

\_\_\_\_\_ Small and Women-owned Business

\_\_\_\_\_ Small and Minority-owned Business

Certification number: \_\_\_\_\_ Certification Date: \_\_\_\_\_

Expiration Date: \_\_\_\_\_

**NOTE: It is your responsibility to ensure that your certification is renewed and does not lapse. Should your certification expire, you will no longer be eligible to receive awards under this contract.**

ATTACHMENT F PRICE FORM

EQUIPMENT	MFGR.	CAPACITY (BHP)	TESTING SCHEDULE	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Cost Mat'ls & Labor	Monthly <b>MATERIAL</b> COST	Monthly LABOR COST
BOILER <b>B-1</b>	CLEAVER- BROOKS	400	Monthly	Boiler Water: (P), (M), (OH) alkalinity, pH, phosphate or inhibitor, sulfite and hardness, neutralized TDS, silica and iron.	Sulfite oxygen inhibitor, phosphate scale inhibitor, dispersant, neutralizing amine	\$	\$	\$
BOILER <b>B-2</b>	CLEAVER- BROOKS	800	Monthly	Boiler Water: (P), (M), (OH) alkalinity, pH, phosphate or inhibitor, sulfite and hardness, neutralized TDS, silica and iron.		\$	\$	\$
BOILER <b>B-3</b>	CLEAVER- BROOKS	600	Monthly	Boiler Water: (P), (M), (OH) alkalinity, pH, phosphate or inhibitor, sulfite and hardness, neutralized TDS, <b>silica</b> and iron.		\$	\$	\$
Condensate Return (Surge Tank)	n/a	n/a	Monthly	pH, soluble and insoluble iron, hardness, percentage return, neutralized TDS	n/a	\$	\$	\$
Feedwater (Deaerator)	n/a	n/a	Monthly	Total hardness, pH, iron, and neutralized TDS, dissolved O <sub>2</sub>	n/a	\$	\$	\$
Makeup Water (City Water)	n/a	n/a	Monthly	Total hardness, iron, neutralized TDS, silica as required, pH, P and M alkalinity.	n/a	\$	\$	\$
Softened Water	n/a	n/a	Monthly	Hardness, TDS, total daily flow, salt used (mean), and number of regenerations.	n/a	\$	\$	\$

COOLING TOWERS								
LOCATION	MFGR.	TONS	TESTING SCHEDULE	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Cost Mafis & Labor	Monthly MATERIAL COST	Monthly LABOR COST
CAMERON HALL ROOF	EVAPCO	510	MAR, APR, MAY, JUN, JULY, AUG, SEPT	pH Total dissolved solids Phosphate Visual inspection for algae, bacteria, fungi. Inspect equipment for proper function.	Corrosion and scale inhibitor. Biocide.	\$	\$	\$
	EVAPCO	510						
	EVAPCO	240						
THIRD BARRACKS	EVAPCO	267	MAR, APR, MAY, JUN, JULY, AUG, SEPT			\$	\$	\$
CLARK KING HALL	EVAPCO	448	MONTHLY JAN-DEC					
	EVAPCO	448						
CPTF1	BAC	220	MAR, APR, MAY, JUN, JULY, AUG, SEPT			\$	\$	\$
	BAC	220						
	BAC	220						
CPTF 1	PDD	N/A	2X/MO in Summer 1X/MO in Winter	Legionella Residual/H2O2	H2O2 & Bellacide	\$	\$	\$
CLOSED CIRCUIT COOLING TOWERS								
LOCATION	MFGR.	TONS	TESTING SCHEDULE	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Cost Mafis & Labor	Monthly MATERIAL COST	Monthly LABOR COST
COCKE HALL	BAC	180	MAR, APR, MAY, JUN, JULY, AUG, SEPT	pH Total dissolved solids Phosphate Visual inspection for algae, bacteria, fungi. Inspect equipment for proper function.	Corrosion and scale inhibitor. Biocide.	\$	\$	\$
CORMACK HALL	BAC	180	MAR, APR, MAY, JUN, JULY, AUG, SEPT					
Notes: 1. Makeup water in Cormack Hall is softened. 2. Both buildings have closed water-source heat water loops.								

CHILLERS AND CHILLED WATER LOOPS

LOCATION	MFGR.	CAPACITY (TONS)	TESTING REQUIRED	CHEMICAL TREATMENT	Initial Testing Cost Mat1s&Labor	Semi-Annual MATERIAL COST	Semi-Annual LABOR COST
CARROLL HALL	TRANE	125 (100 TON ICE BACK UP)	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
CAMERON HALL	CARRIER	225	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
	CARRIER	225					
	CARRIER	150					
CLARKSON MCKENNA	YORK	60	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
CLARK KING HALL *	TRANE	250	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
	TRANE	250					
CROZET HALL	Daikin	200	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
KILBOURNE HALL	Daikin	160	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
MALLORY HALL	YORK	175	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
MARSHALL HALL	MCQUAY	275	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
MAURY BROOKE HALL	MCQUAY	350	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
MOODY HALL	TRANE	30	Nitrite Total Dissolved Solids PH,	Rust inhibitor	\$	\$	\$
	TRANE	30					
	CARRIER	15					
PRESTON LIBRARY	TRANE	180	Glycol concentration, pH	Propylene glycol	\$	\$	\$
SCOTT SHIPP HALL	TRANE	150	Glycol Concentration pH	Propylene glycol	\$	\$	\$
	TRANE	150					
SMITH HALL	TRANE	60	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
THIRD BARRACKS	MULTISTACK	130	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
POST HOSPITAL	DAIKIN	60	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
CPTF1 **	DAIKIN	325	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
	DAIKIN	325					

\* - Chiller plant serves Clark King, Nichols, Morgan, and JM Halls

\*\* - Building has 2 separate chilled water loops. Drawings for the system are included as Attachment H

**HYDRONIC CLOSED LOOPS**

<b>LOCATION</b>	<b>INPUT BTUH</b>	<b>HEAT SOURCE</b>	<b>TESTING REQUIRED</b>	<b>CHEMICAL TREATMENT</b>	<b>Initial Testing Cost Mat1s&amp;Labor</b>	<b>Semi-Annual MATERIAL COST</b>	<b>Semi-Annual LABOR COST</b>
CARROLL HALL	470,000	HX	Nitrite Total Dissolved Solids pH.	Rust inhibitor	\$	\$	\$
CLARKSON MCKENNA	2 boilers: 600,000 ea.	Boiler			\$	\$	\$
CLARK KING HALL	317,000	HX			\$	\$	\$
JACKSON MEMORIAL HALL	1,041,000	HX			\$	\$	\$
KILBOURNE HALL	no boiler tag info, 2 boilers: appx. 1,650,000 ea.	Boiler			\$	\$	\$
KILBOURNE HALL, QMD	2 boilers: 1,673,000 ea.	Boiler			\$	\$	\$
MALLORY HALL	2,177,000	HX			\$	\$	\$
MARSHALL HALL	2 boilers: 1,300,000 ea.	Boiler	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
SCOTT SHIPP HALL	2 HX: 1,580,000 ea.	HX	Glycol concentration, pH	Propylene Glycol	\$	\$	\$
MAURY BROOK HALL	2 HX: 2,900,000 ea.	HX w/Boiler	Nitrite Total Dissolved Solids pH	Rust inhibitor	\$	\$	\$
MOODY HALL	2 BOILERS; 1,500.00 EACH	Boiler			\$	\$	\$
NICHOLS & MORGAN HALL	2,024,000	HX			\$	\$	\$
PRESTON LIBRARY	2,450,000	HX w/Boiler			\$	\$	\$
SHELL & RICHARDSON HALL	1,570,000	HX			\$	\$	\$
SMITH HALL	2 boilers: 700,000 ea.	Boiler			\$	\$	\$
JACKSON HOUSE MUSEUM	2 boilers: 212,000 ea	Boiler			\$	\$	\$
BARRACKS Dual-Temp	4,915,000	HX			\$	\$	\$
OLD & NEW BARRACKS Admin	2,950,000	HX			\$	\$	\$
POST HOSPITAL	840,000	HX	Glycol concentration, pH	Ethylene glycol	\$	\$	\$
CPTF1, Heating Loop	2 boilers: 2,500,000 ea.	Boiler	Nitrite Total Dissolved Solids Ph	Rust inhibitor	\$	\$	\$
CPTF1, Glycol Loop	2 HX: 2,500,000 ea.	Boiler	Glycol concentration, pH	Ethylene glycol	\$	\$	\$

Price Sheet #5 RO/DI System								
Equipment	MFGR.	Capacity	Testing Schedule	Testing Required	Chemical Treatment	Initial Testing Cost Mat'l &	Monthly Marterial Cost	Monthly Labor Cost
RO/DI System	Marlo	n/a	Monthly	Review Operators Log, Test Feedwater Chemistry, Perform RO System check	n/a	\$	\$	\$
			Quarterly	Replace Prefilter Cartridge	n/a	\$	\$	\$
			Semi-Annual	Replace system filter cartridge, Replace UV lamp, Service deionization, Service Carbon	n/a	\$	\$	\$
			Annual	Replace UV Quartz sleeve, Service Vent Filter	n/a	\$	\$	\$

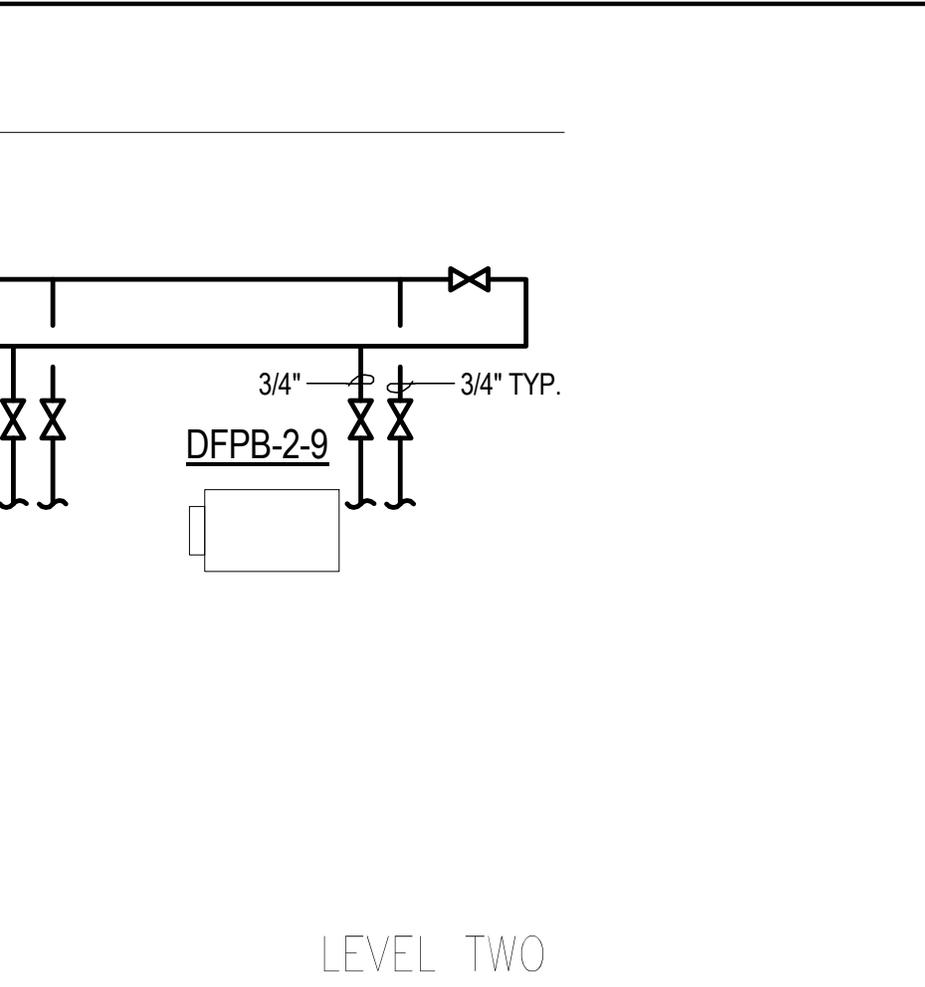
SUBMITTED BY: \_\_\_\_\_

PRINTED NAME: \_\_\_\_\_

For: \_\_\_\_\_ (Company)

DATE: \_\_\_\_\_

END PRICING FORM



# HKS

## ARCHITECT

HKS, INC.  
RICHMOND, VA 23223

## ASSOCIATE ARCHITECT

COMMONWEALTH ARCHITECTS  
RICHMOND, VA 23219

## STRUCTURAL

THORNTON-TOMASETTI  
WASHINGTON, DC 20036

## LANDSCAPE ARCHITECT

OCULUS  
CHARLOTTESVILLE, VA 22902

## CIVIL

DRAPER ADEN ASSOCIATES  
BLACKSBURG, VA 24060

## MEP

WSP-FLACK & KURTZ  
ARLINGTON, VA 22209

## TRACK AND FIELD DESIGNER

OLYMPVS INTERNATIONAL  
MIAMI, FL 33133

## GEOTECHNICAL

FROEHLING & ROBERTSON, INC  
ROANOKE, VA 24012

## FIRE PROTECTION

HOWE ENGINEERS  
NORWELL, MA 02061

## AV, IT, SECURITY, AND ACOUSTICS

ANTHONY JAMES PARTNERS  
RICHMOND, VA 23233

## LIGHTING

COVENTRY LIGHTING  
CHEVY CHASE, MD 20815

## OBSTACLE COURSE DESIGNER

CHALLENGE DESIGN INNOVATIONS, INC.  
PINEOLA, NC 28662

## SIGNAGE AND EXHIBIT DESIGNER

THE 1717 DESIGN GROUP  
RICHMOND, VA 23223

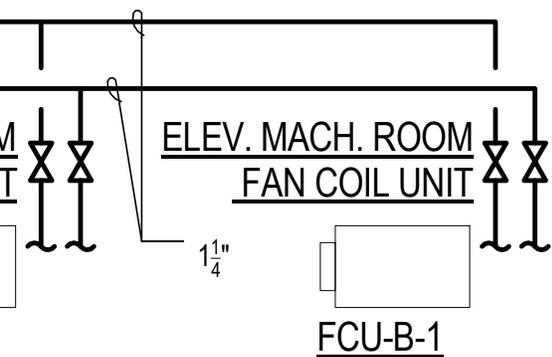
LOBBY  
ELEVATOR UNIT  
HU-2



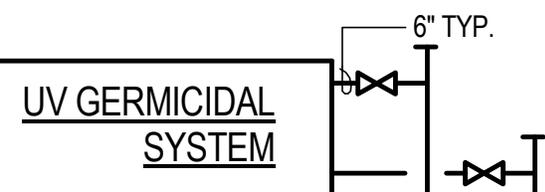
LEVEL ONE

CHILLED WATER SUPPLY TO  
BUOYANCY SPRAY  
SYSTEMS  
IN AIR INTAKE SHAFTS  
CONT.  
ON DWG M5.02

MECH PLENUM LEVEL



FIN



OWNER

VIRGINIA MILITARY INSTITUTE  
LEXINGTON, VA 24450



VIRGINIA MILITARY INSTITUTE

LEXINGTON, VA 24450

# CORPS PHYSICAL TRAINING FACILITY PHASE 1

## RECORD SET

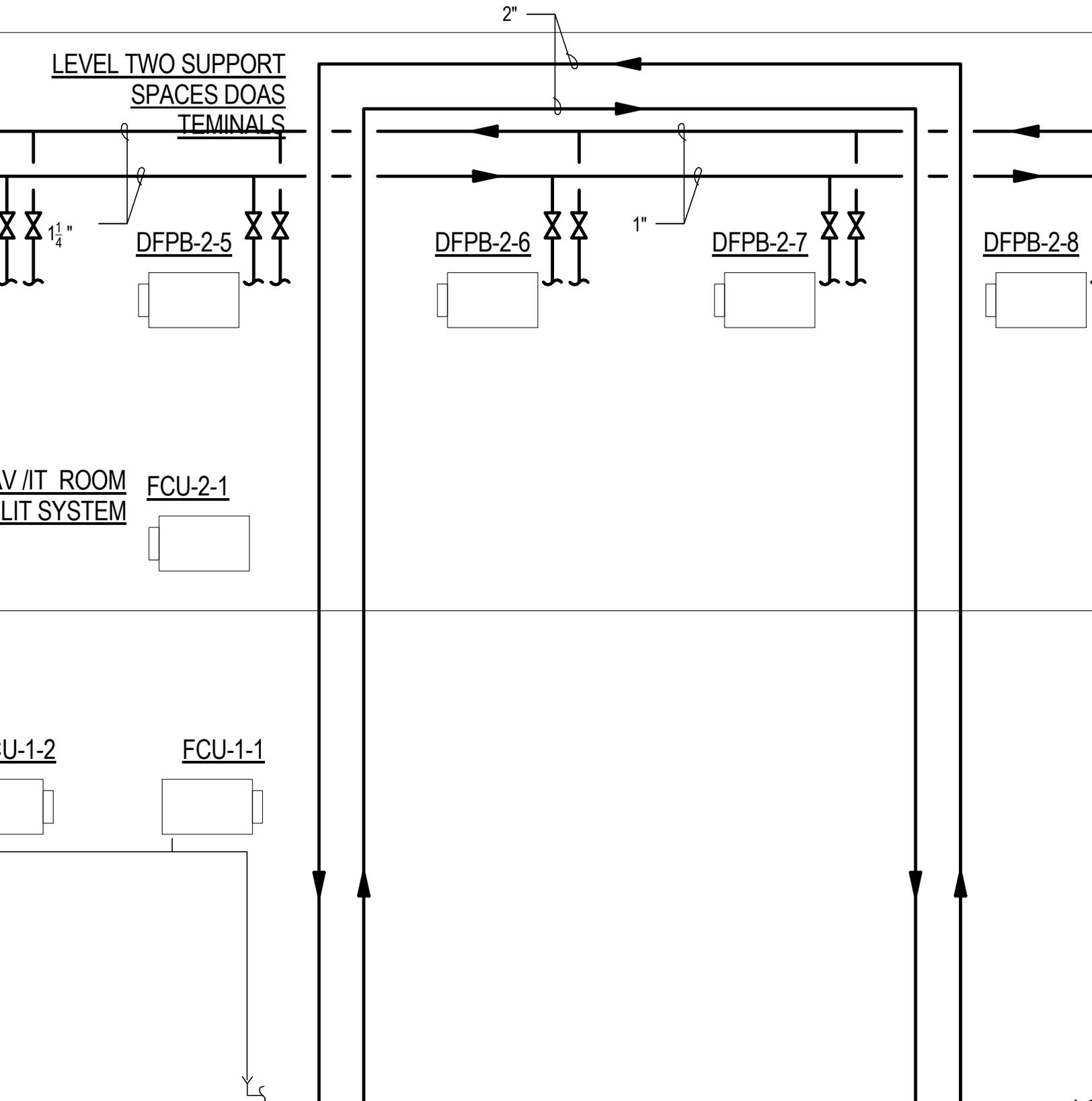
NOT FOR CONSTRUCTION

DATE: MARCH 24, 2017

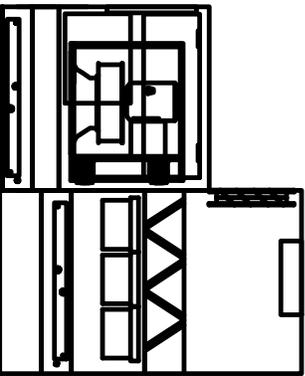
THE RECORD DRAWINGS REVISIONS  
CONTAINED HEREIN ARE BASED  
SOLELY UPON INFORMATION  
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NO REPRESENTATION IS MADE BY  
HKS, INC. OR ITS CONSULTANTS  
REGARDING THE ACCURACY OF  
THE INFORMATION SUPPLIED.

KEY PLAN

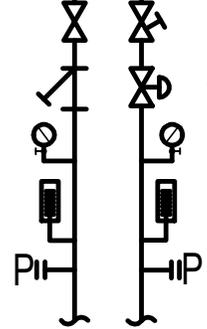
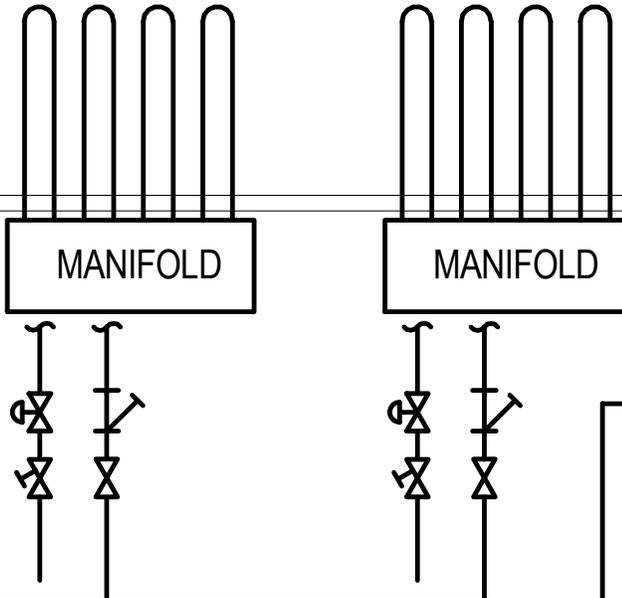




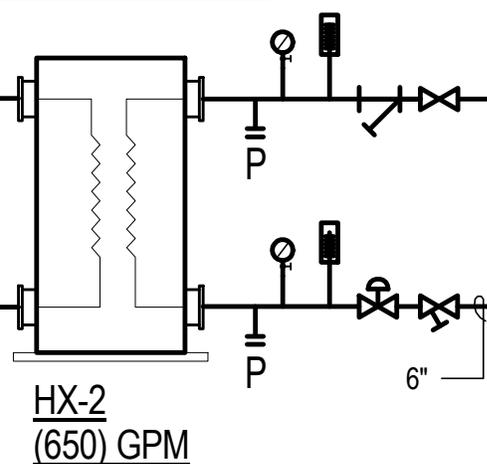
PORT SPACES  
R HANDLING  
UNITS  
AHU-1



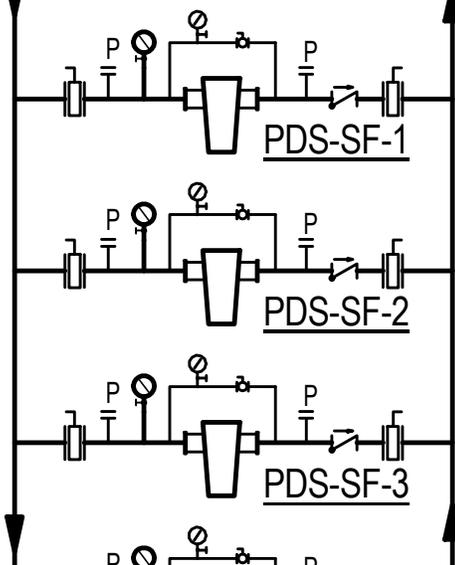
1ST FLOOR LOBBY  
RADIANT FLOOR SYSTEM



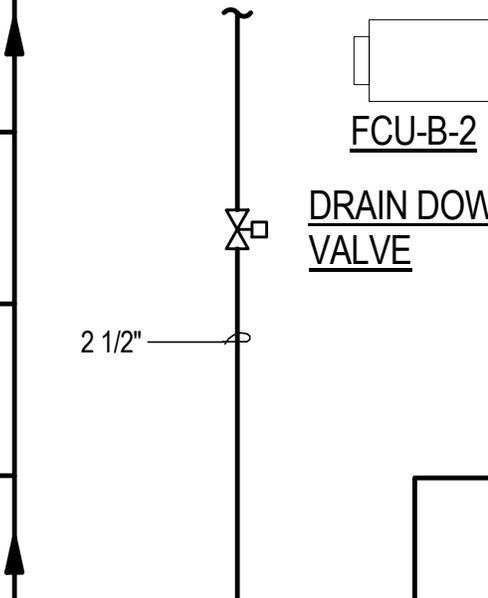
BUOYANCY SPRAY  
FILLED WATER  
HEAT EXCHANGER

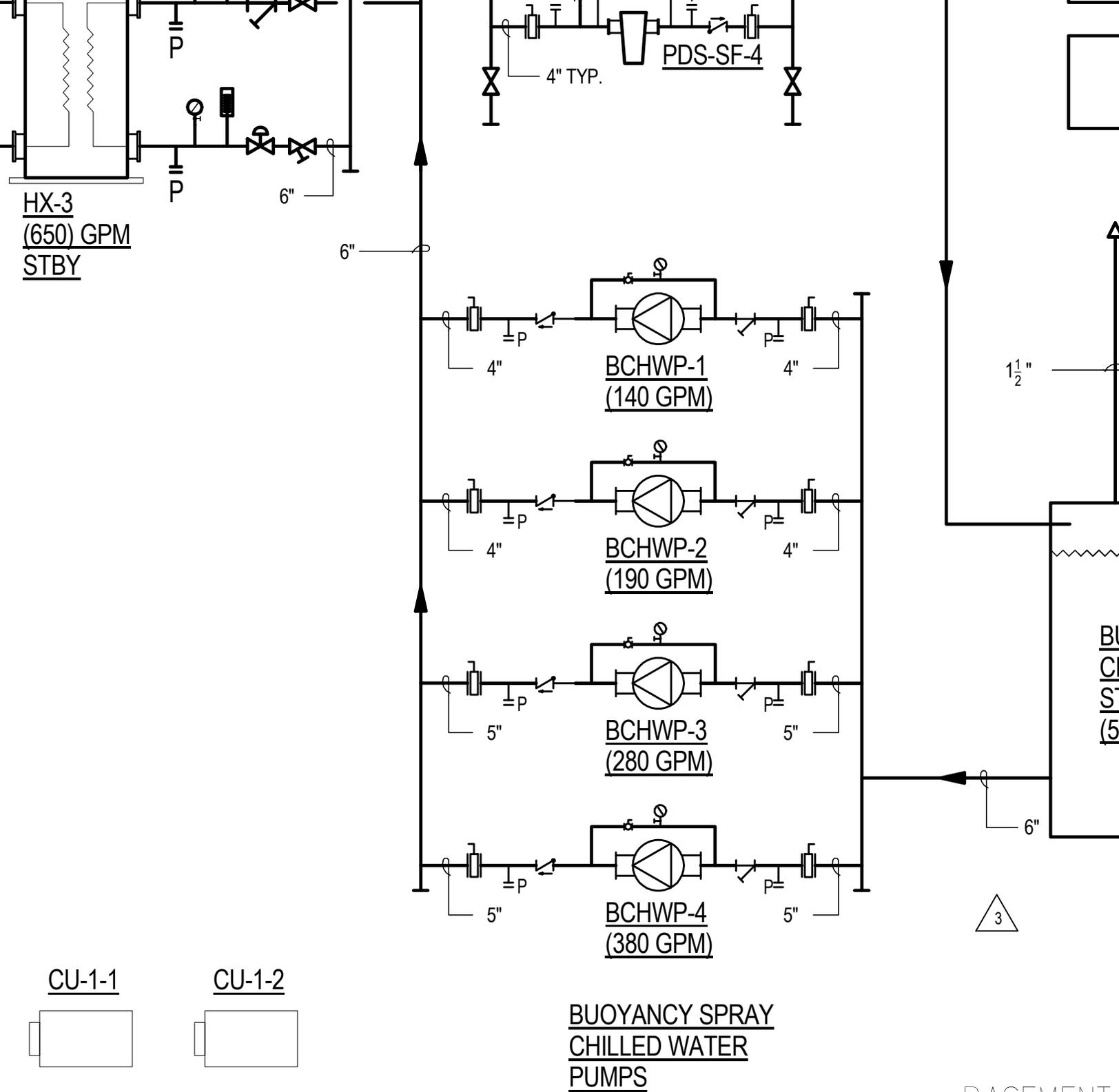


SPRAY NOZZLES  
LIQUID STRAINERS

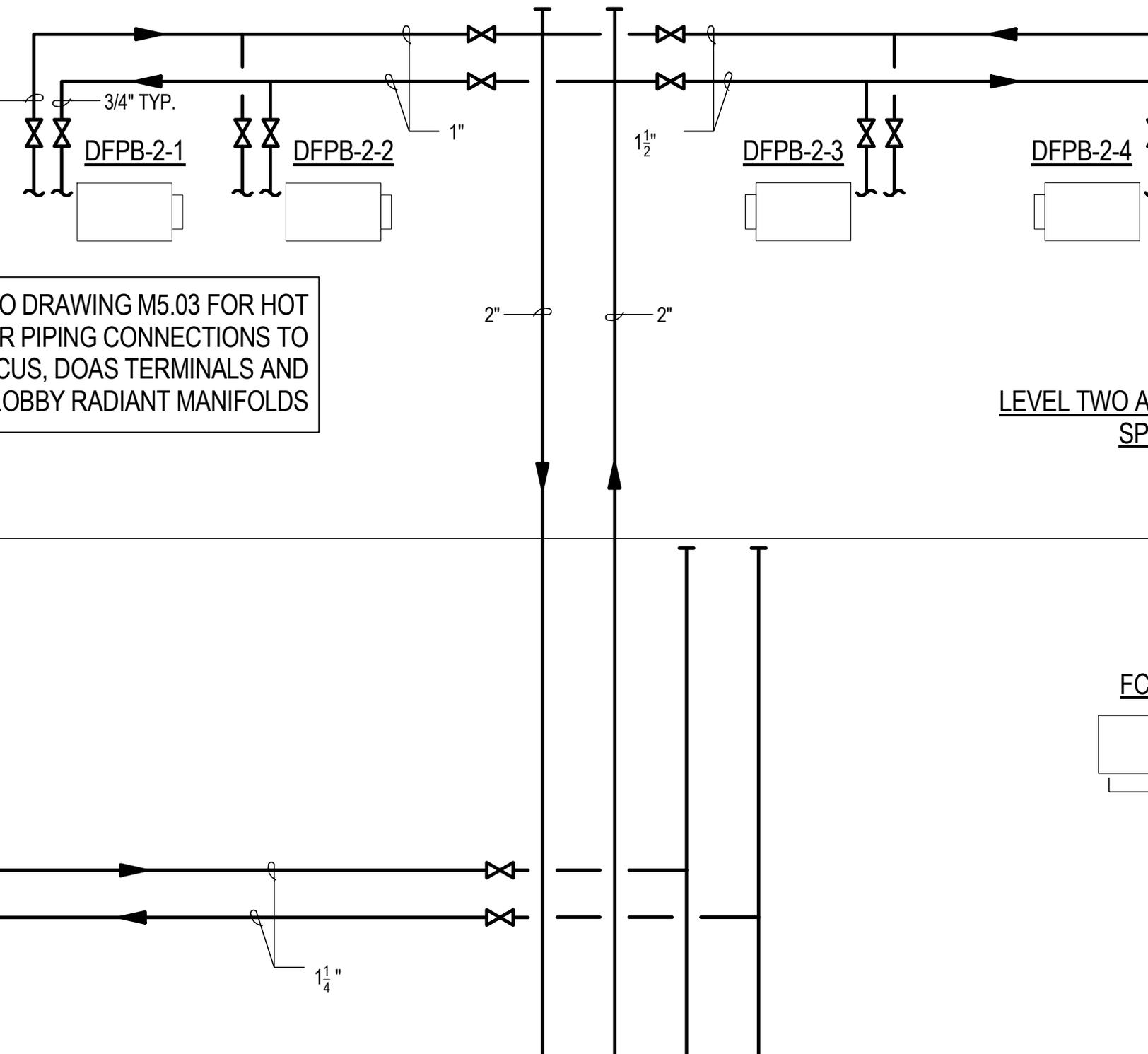


MAIN ELECTRIC ROOM  
FAN COIL UNIT





BASEMENT

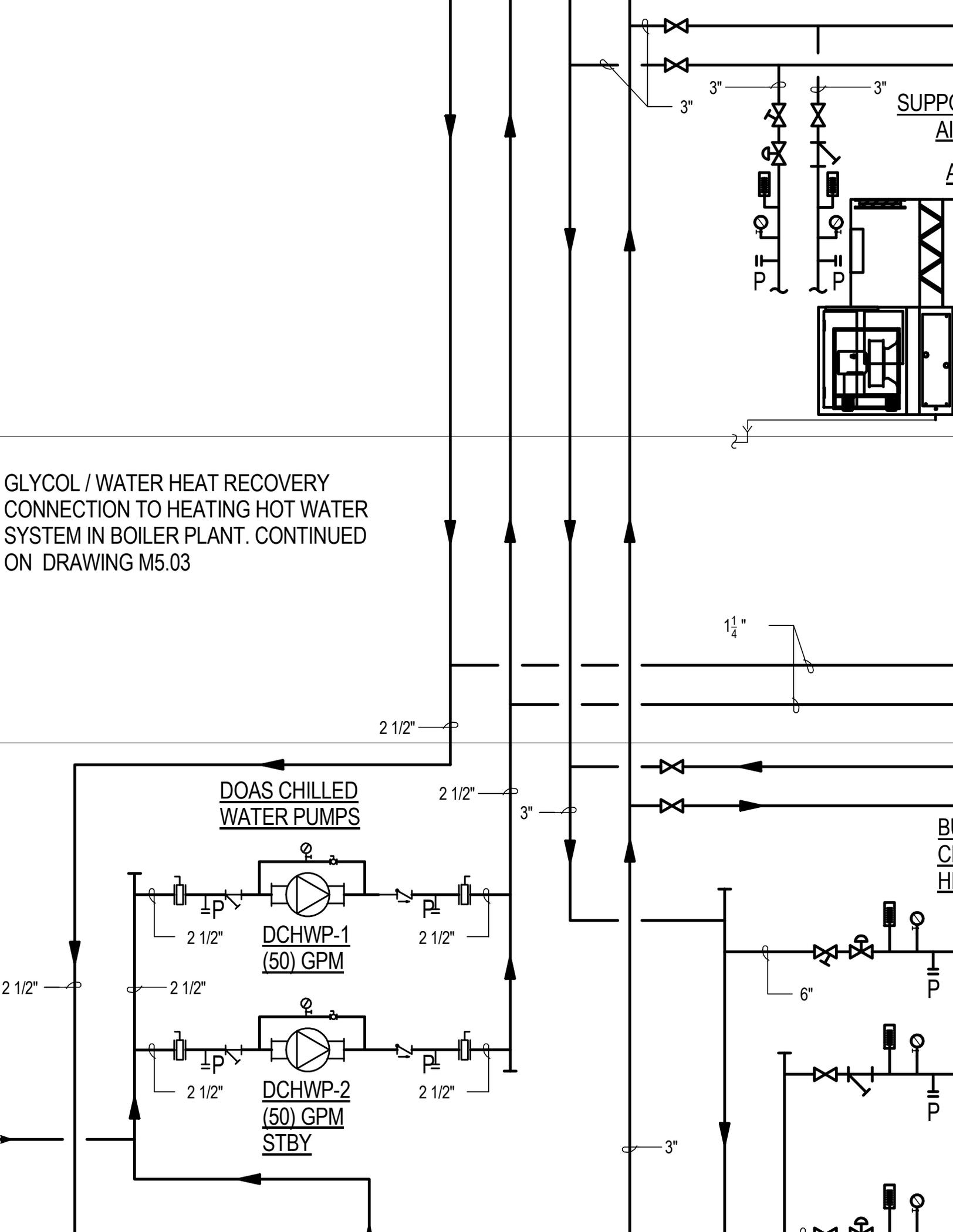


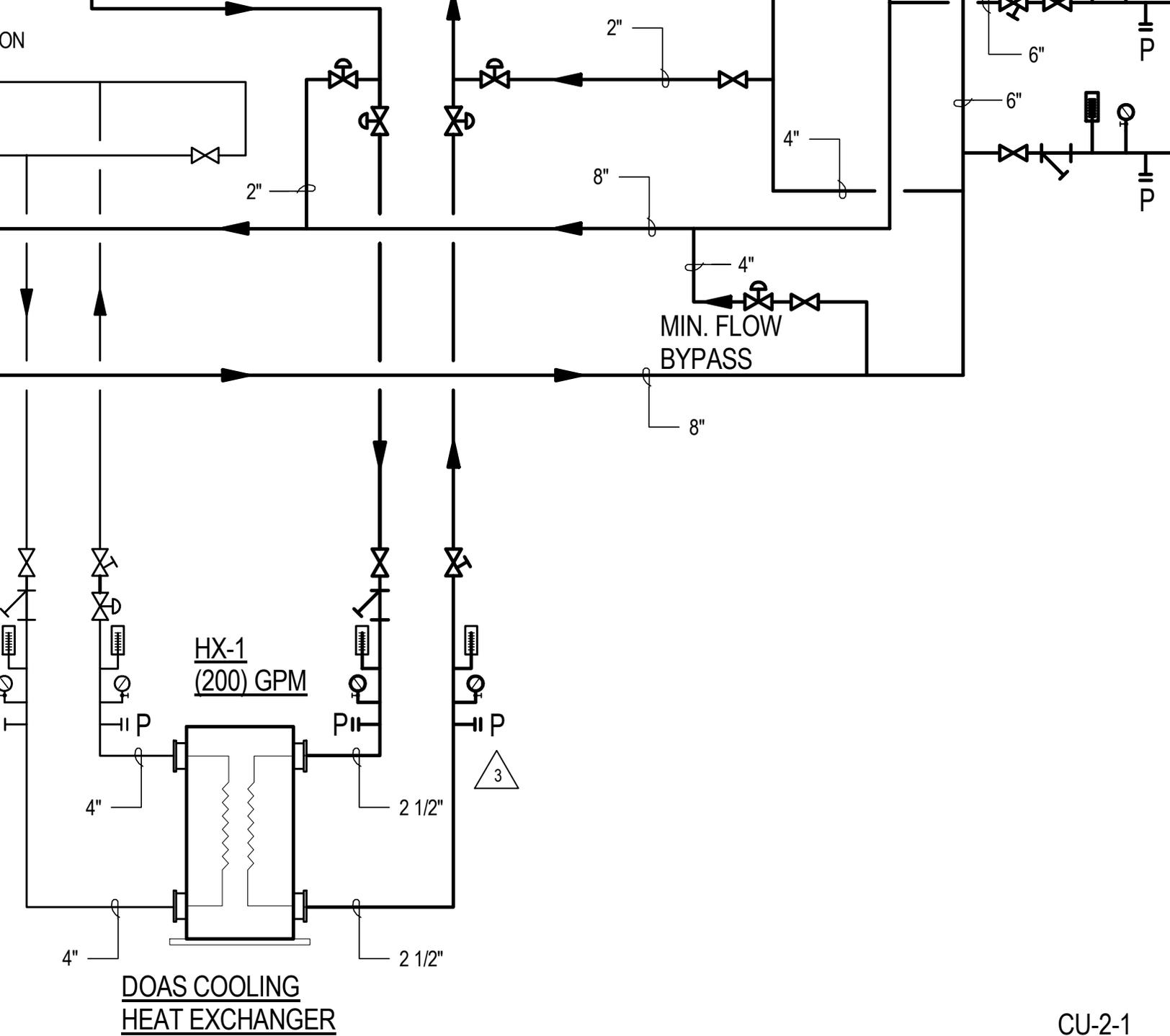
SEE DRAWING M5.03 FOR HOT  
 WATER PIPING CONNECTIONS TO  
 CHILLERS, DOAS TERMINALS AND  
 LOBBY RADIANT MANIFOLDS

LEVEL TWO A  
SP

FC  
 [ ]  
 [ ]

GLYCOL / WATER HEAT RECOVERY  
CONNECTION TO HEATING HOT WATER  
SYSTEM IN BOILER PLANT. CONTINUED  
ON DRAWING M5.03





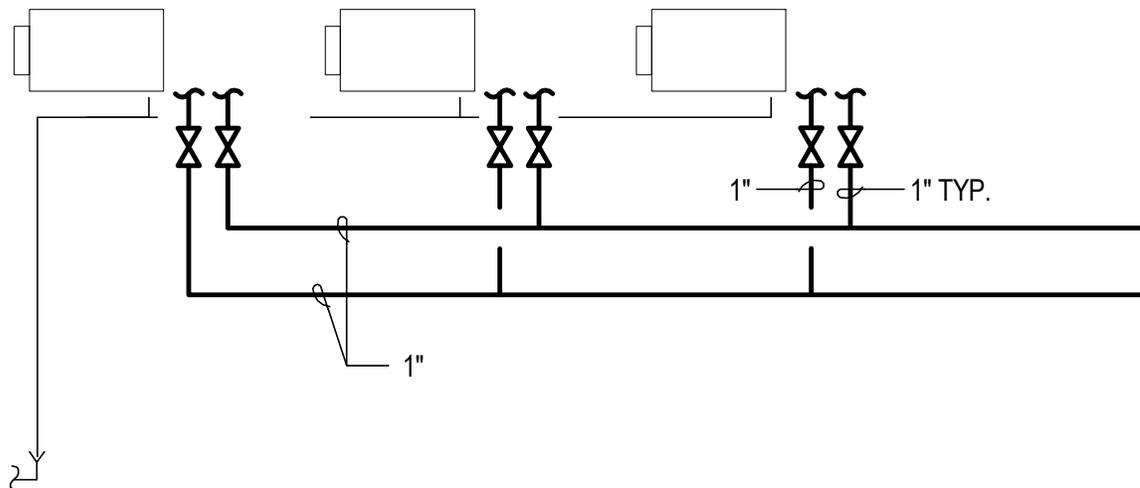
CHILLED AND CONDENSER WATER SYSTEM  
CENTRAL PLANT

3/4" -

REFER TO  
WATER  
AHUS, FC  
L

LEVEL ONE  
TELECOM  
ROOM FAN COIL  
FCU-1-5 UNIT

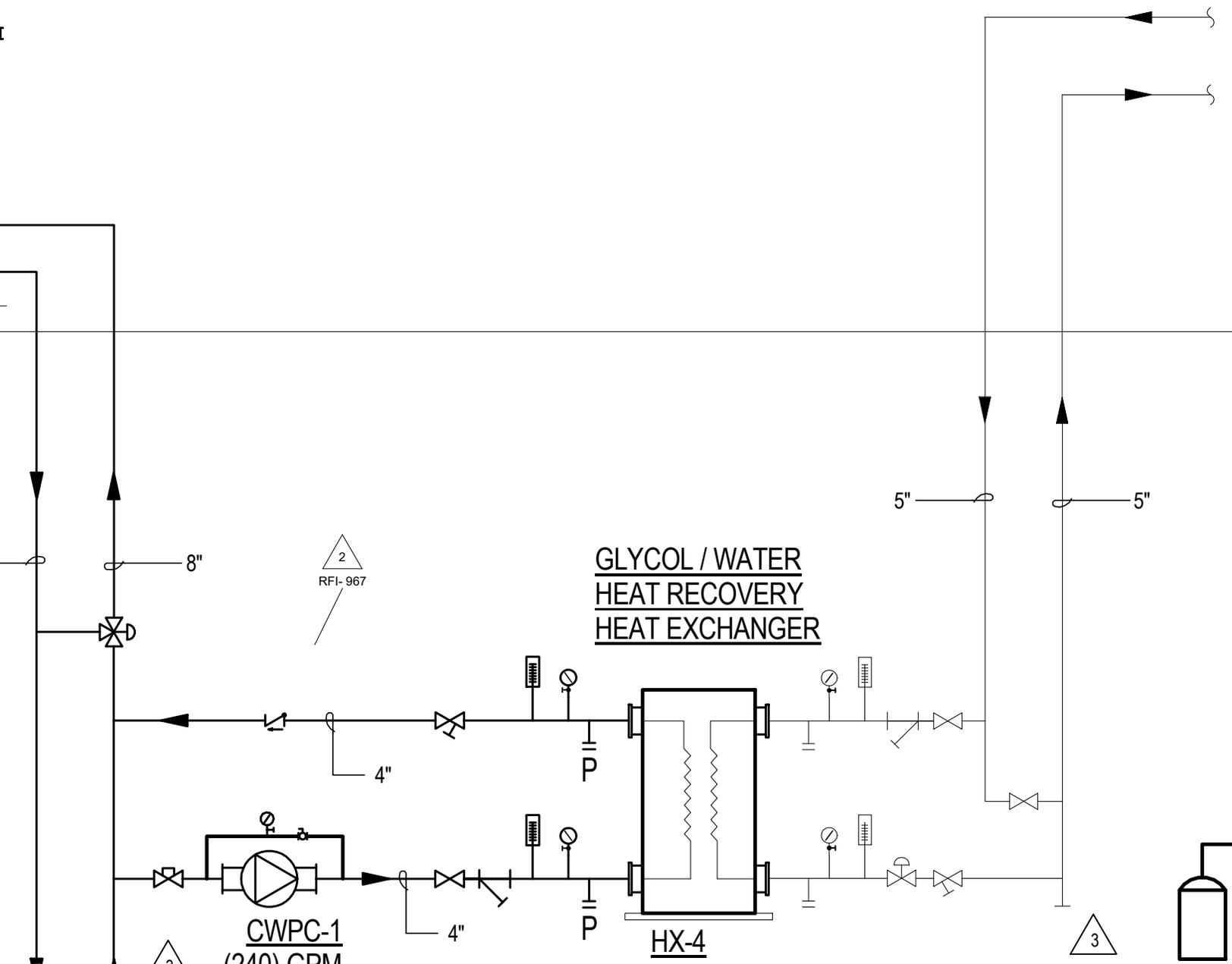
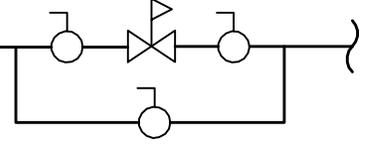
LEVEL ONE WEST  
STORAGE ROOMS FAN  
COIL UNITS  
FCU-1-4      FCU-1-3



1

DOMESTIC COLD  
WATER  
MAKE-UP

CW



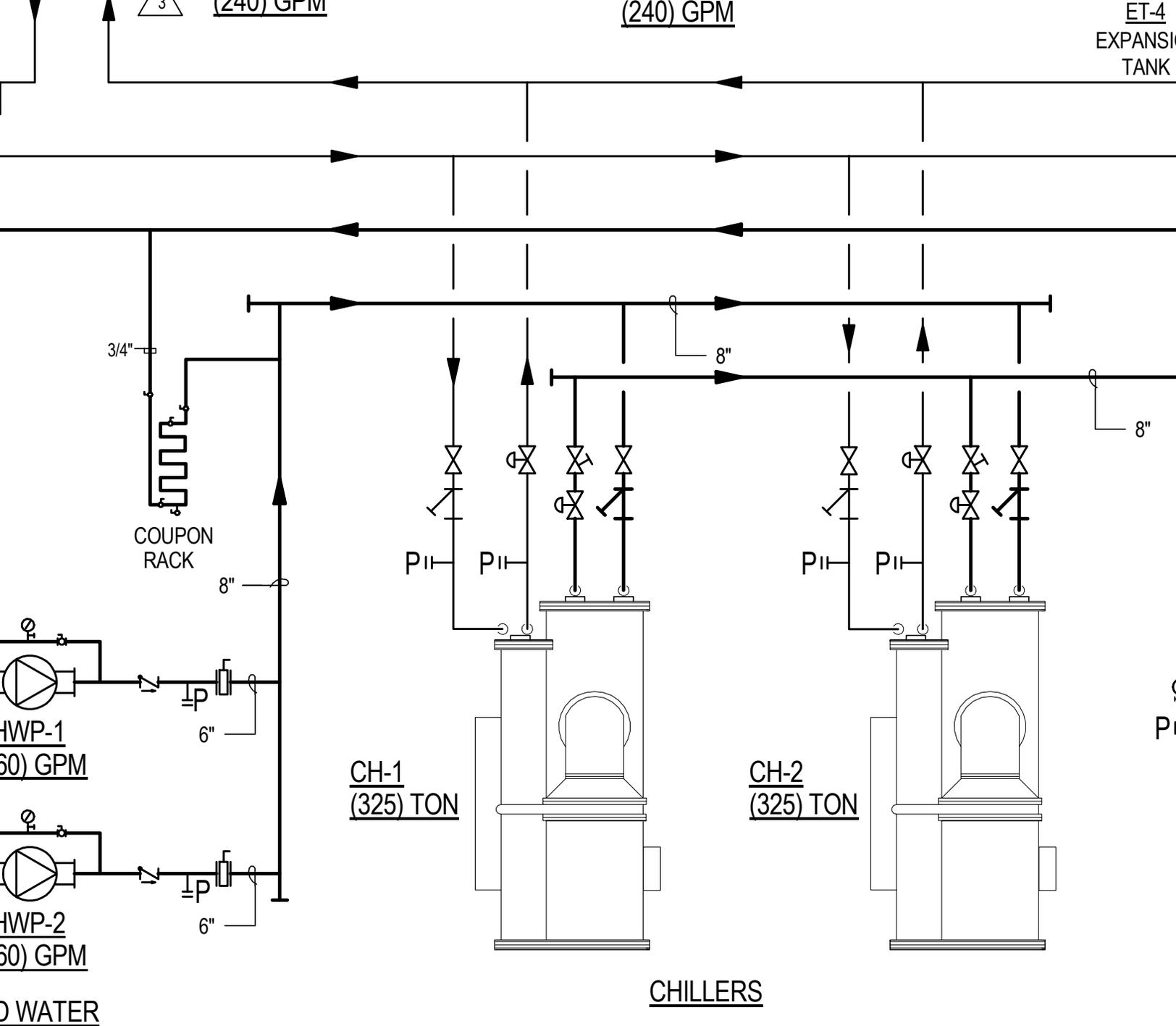
2  
RFI-967

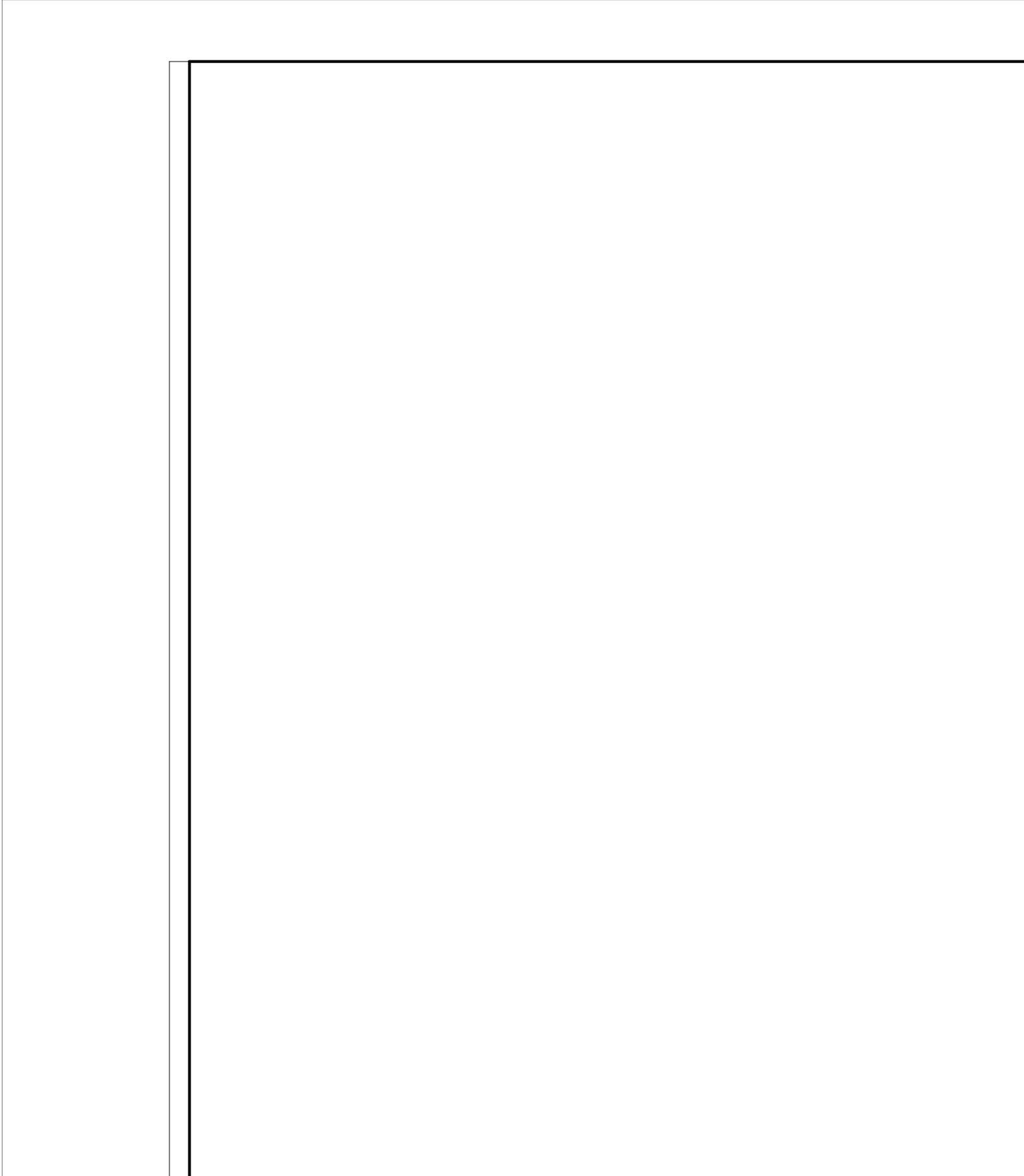
GLYCOL / WATER  
HEAT RECOVERY  
HEAT EXCHANGER

CWPC-1  
(210) GPM

HX-4

3



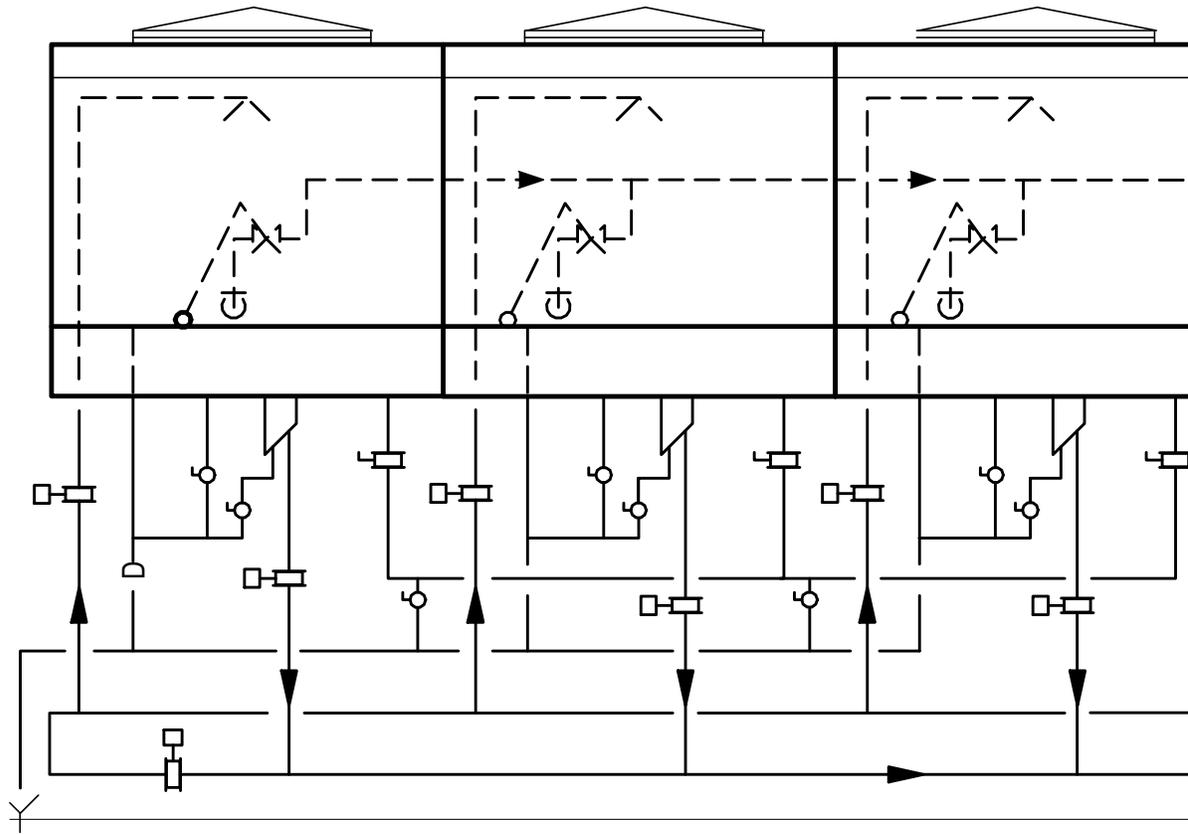


# COOLING TOWERS

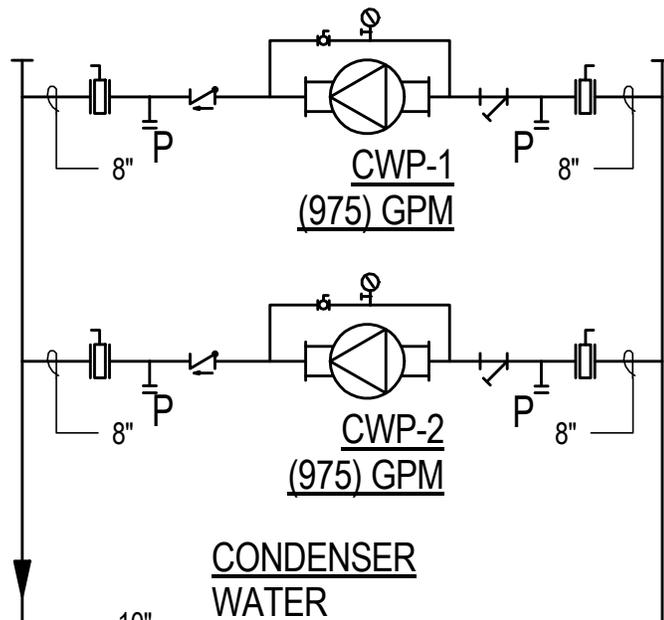
CT-1  
(220) TON

CT-2  
(220) TON

CT-3  
(220) TON

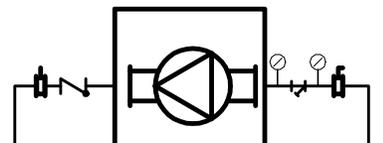


SOUTHWEST EXTERIOR  
GRADE LEVEL

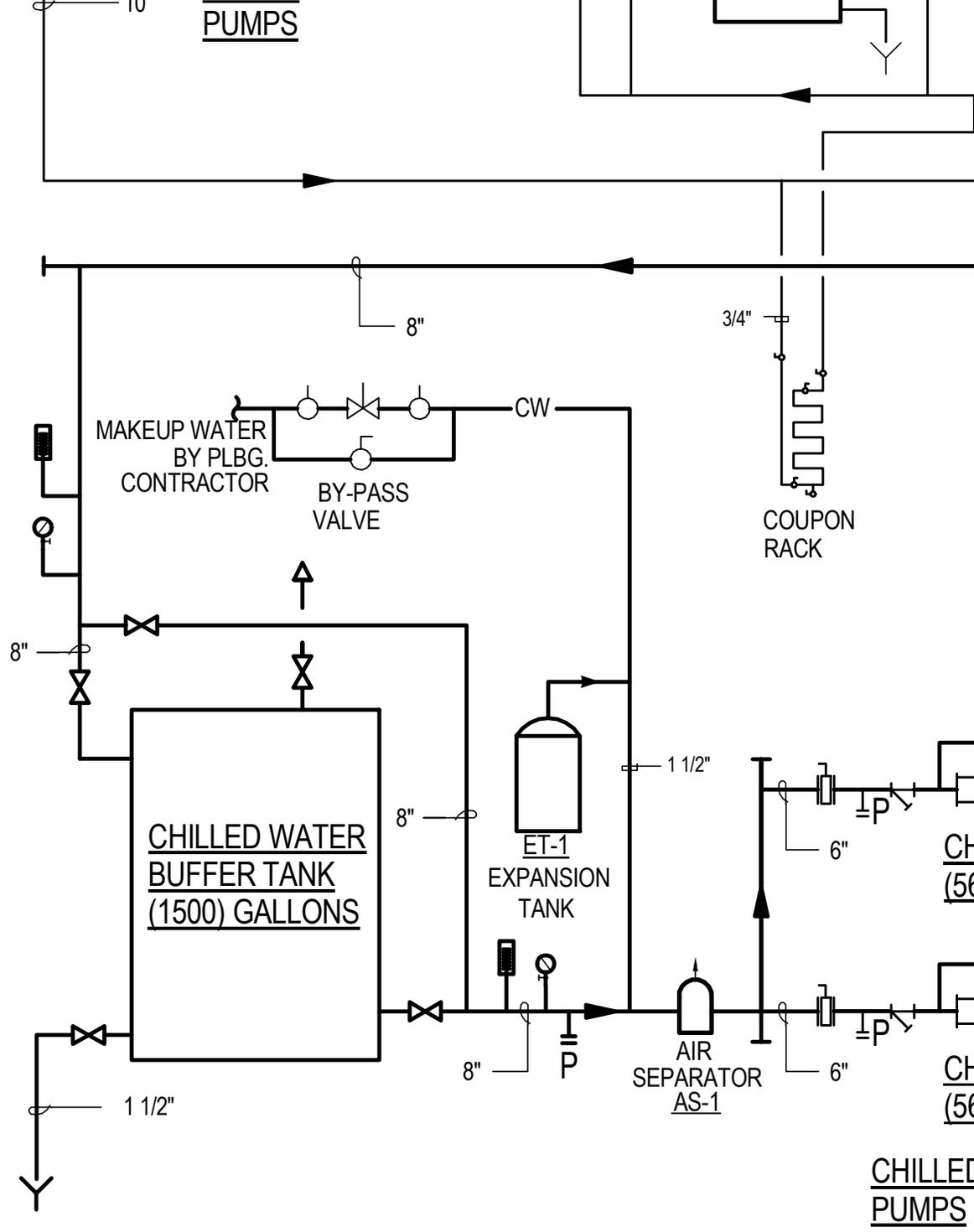


8"

CWF-1  
WATER FILTER



PUMPS



PLOT DATE: 3/24/2017 2:58:04 PM  
TEMPLATE VERSION:

CHILLED PUMPS

# HKS

## **ARCHITECT**

HKS, INC.  
RICHMOND, VA 23223

## **ASSOCIATE ARCHITECT**

COMMONWEALTH ARCHITECTS  
RICHMOND, VA 23219

## **STRUCTURAL**

THORNTON-TOMASETTI  
WASHINGTON, DC 20036

## **LANDSCAPE ARCHITECT**

OCULUS  
CHARLOTTESVILLE, VA 22902

## **CIVIL**

DRAPER ADEN ASSOCIATES  
BLACKSBURG, VA 24060

## **MEP**

WSP-FLACK & KURTZ  
ARLINGTON, VA 22209

## **TRACK AND FIELD DESIGNER**

OLYMPVS INTERNATIONAL  
MIAMI, FL 33133

## **GEOTECHNICAL**

FROEHLING & ROBERTSON, INC  
ROANOKE, VA 24012

## **FIRE PROTECTION**

HOWE ENGINEERS  
NORWELL, MA 02061

## **AV, IT, SECURITY, AND ACOUSTICS**

ANTHONY JAMES PARTNERS  
RICHMOND, VA 23233

## **LIGHTING**

COVENTRY LIGHTING  
CHEVY CHASE, MD 20815

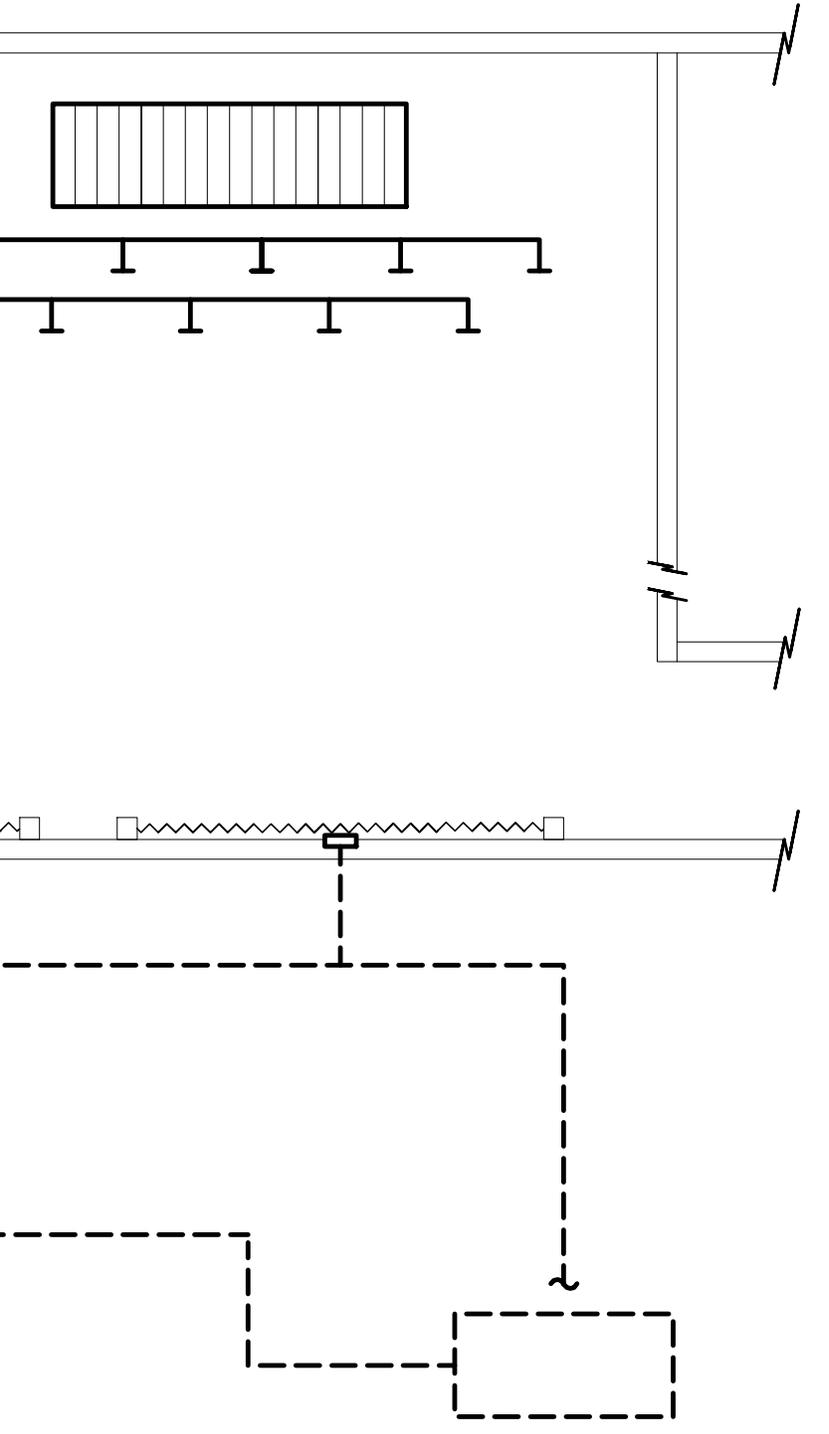
## **OBSTACLE COURSE DESIGNER**

CHALLENGE DESIGN INNOVATIONS, INC.  
PINEOLA, NC 28662

## **SIGNAGE AND EXHIBIT DESIGNER**

THE 1717 DESIGN GROUP  
RICHMOND, VA 23223

CA



SPRAY WATER RETURN DRAIN LINE,  
SUMP TANK AND TRANSFER PUMP REFER  
TO PLBG DRAWINGS FOR DETAILS

**OWNER**  
VIRGINIA MILITARY INSTITUTE  
LEXINGTON, VA 24450



VIRGINIA MILITARY INSTITUTE  
LEXINGTON, VA 24450

# CORPS PHYSICAL TRAINING FACILITY PHASE 1

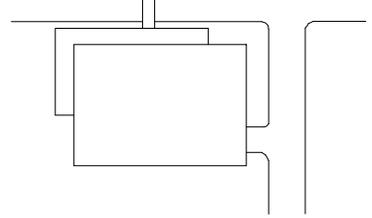
**RECORD SET**  
NOT FOR CONSTRUCTION  
DATE: MARCH 24, 2017  
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THE INFORMATION SUPPLIED.

KEY PLAN

CA

EXPA

AL SPRAY NOZZLE PIPING  
S SHALL BE ALIGNED WITH  
OM SILL OF INTAKE LOUVER  
OR (2).



REVISION

NO. DESCRIPTION DATE

1 ASI-005 12-18-2015

STATE PROJECT CODE #

**211-17996-001**

HKS PROJECT NUMBER

**15811.000**

DATE

**March 24, 2017**

ISSUE

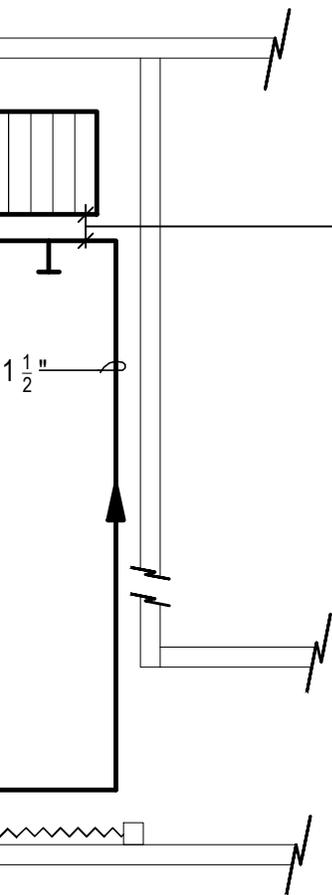
**RECORD DRAWINGS**

SHEET TITLE

**MECHANICAL WATER  
FLOW DIAGRAM NO.2**

SHEET NO.

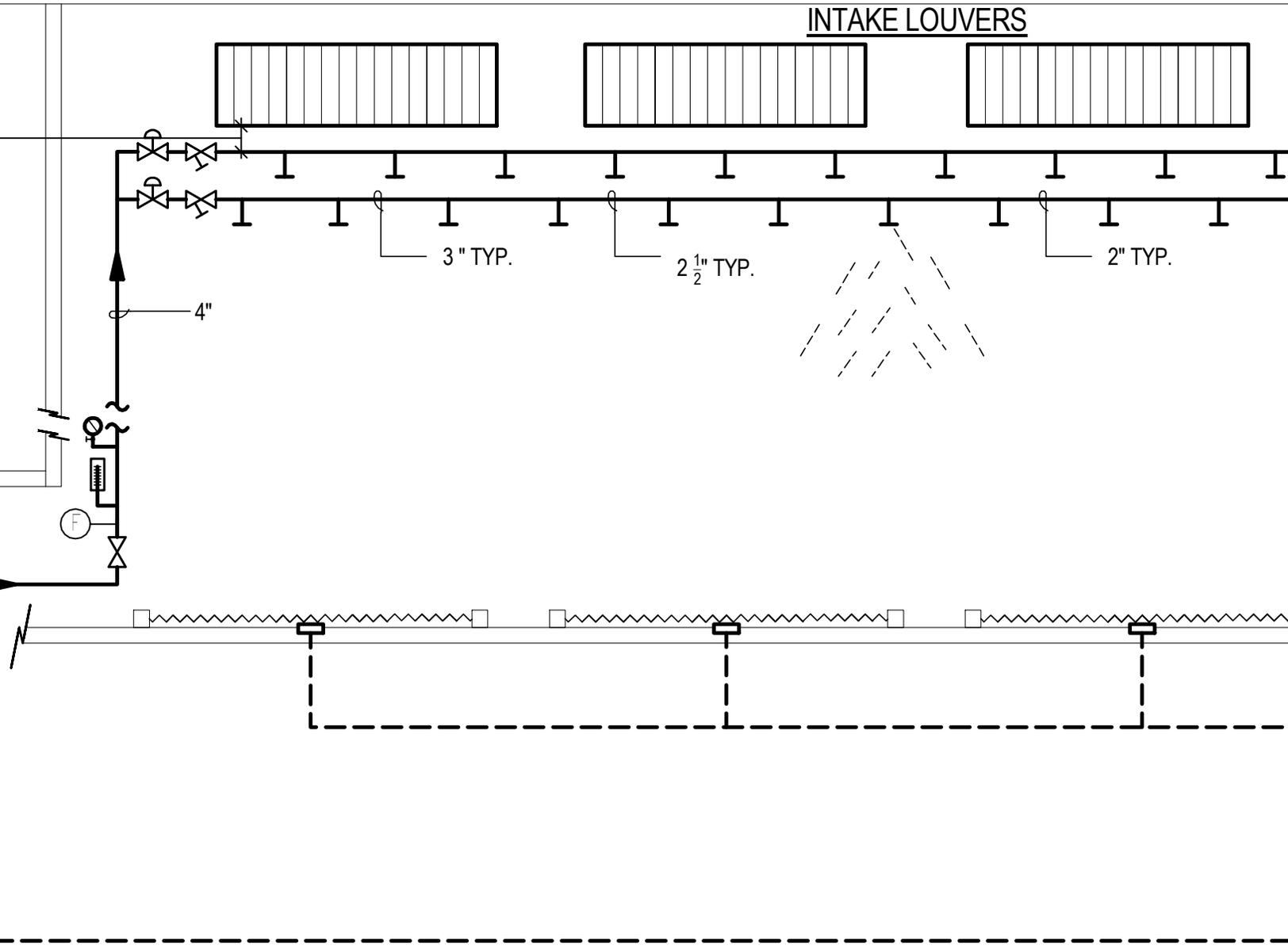
**M5.02**



HORIZONTAL SPRAY NOZZLE PIPING  
BRANCHES SHALL BE ALIGNED WITH  
THE BOTTOM SILL OF INTAKE LOUVER  
TYPICAL FOR (4).

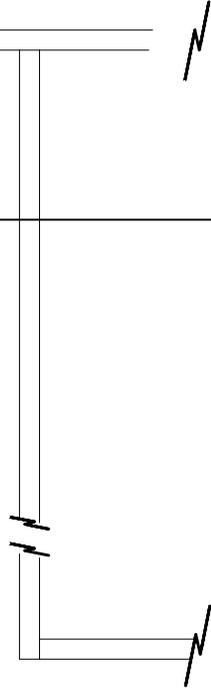
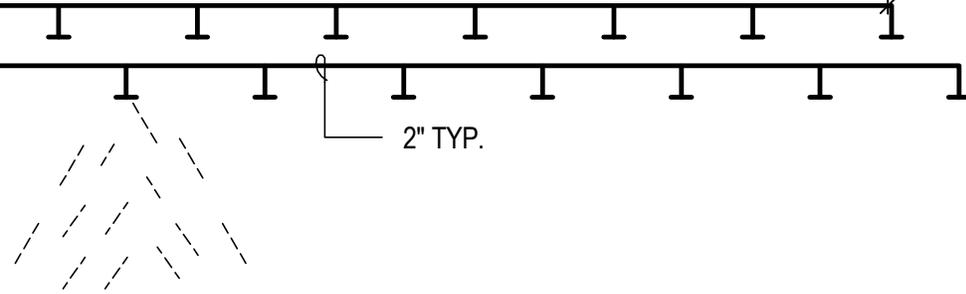
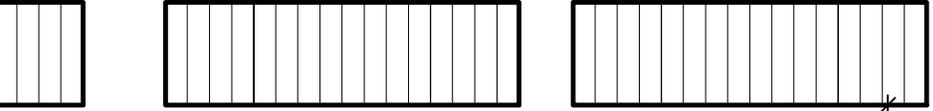


BUOYANCY SPRAY SYSTEM  
EAST AIR INTAKE SHAFT  
28 NOZZLES (188 GPM) TOTAL

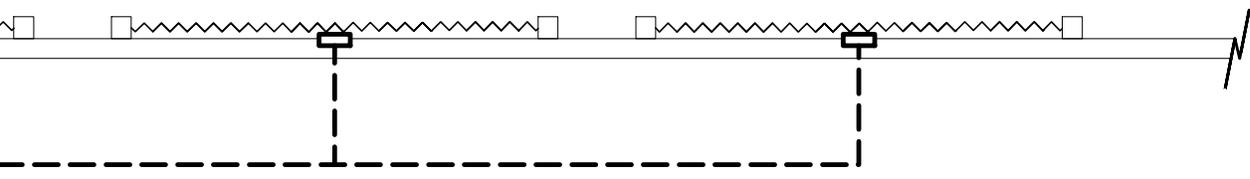


AIR INTAKE SHAFT  
NOZZLES (168 GPM) TOTAL

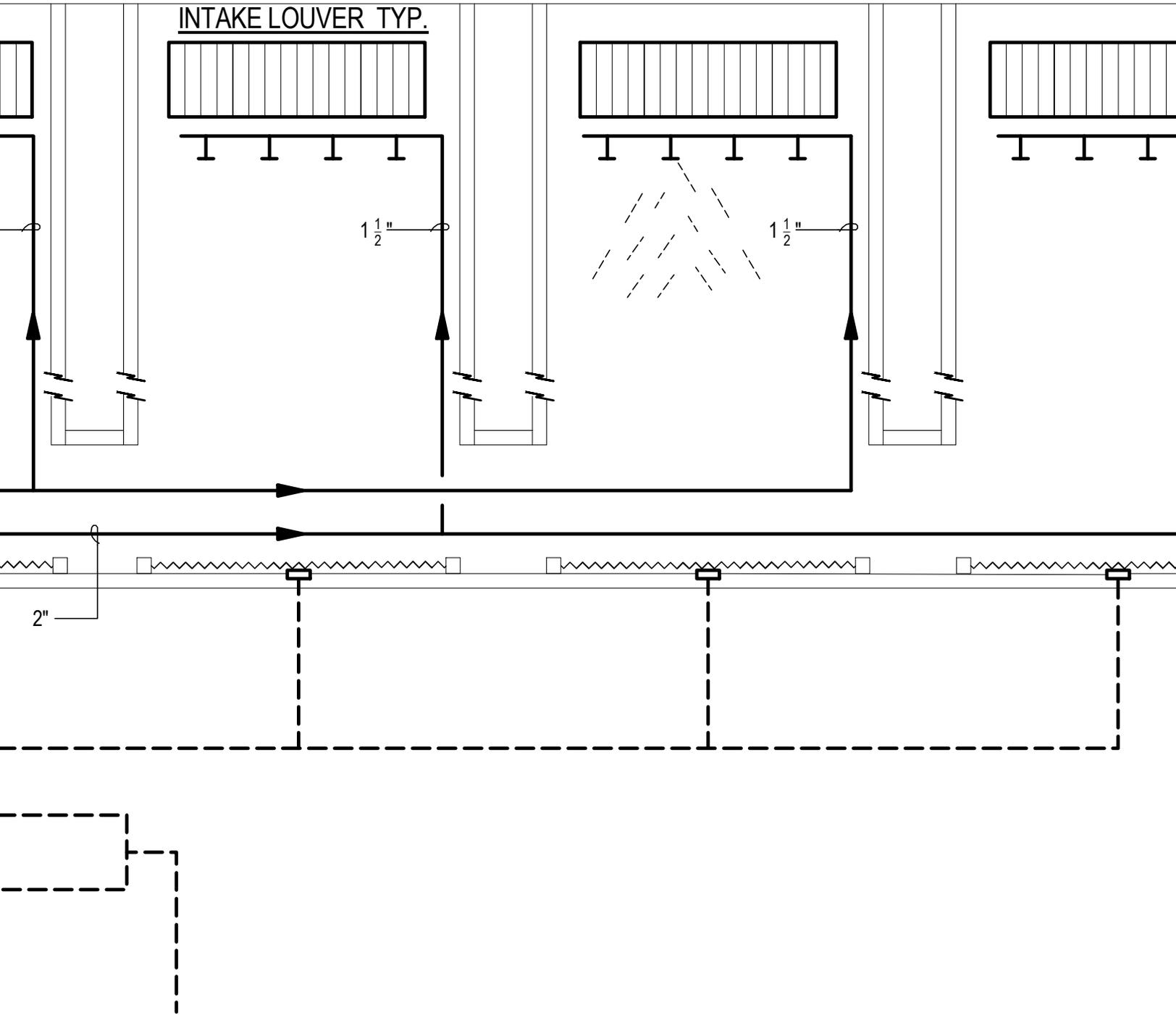
TAKE LOUVERS

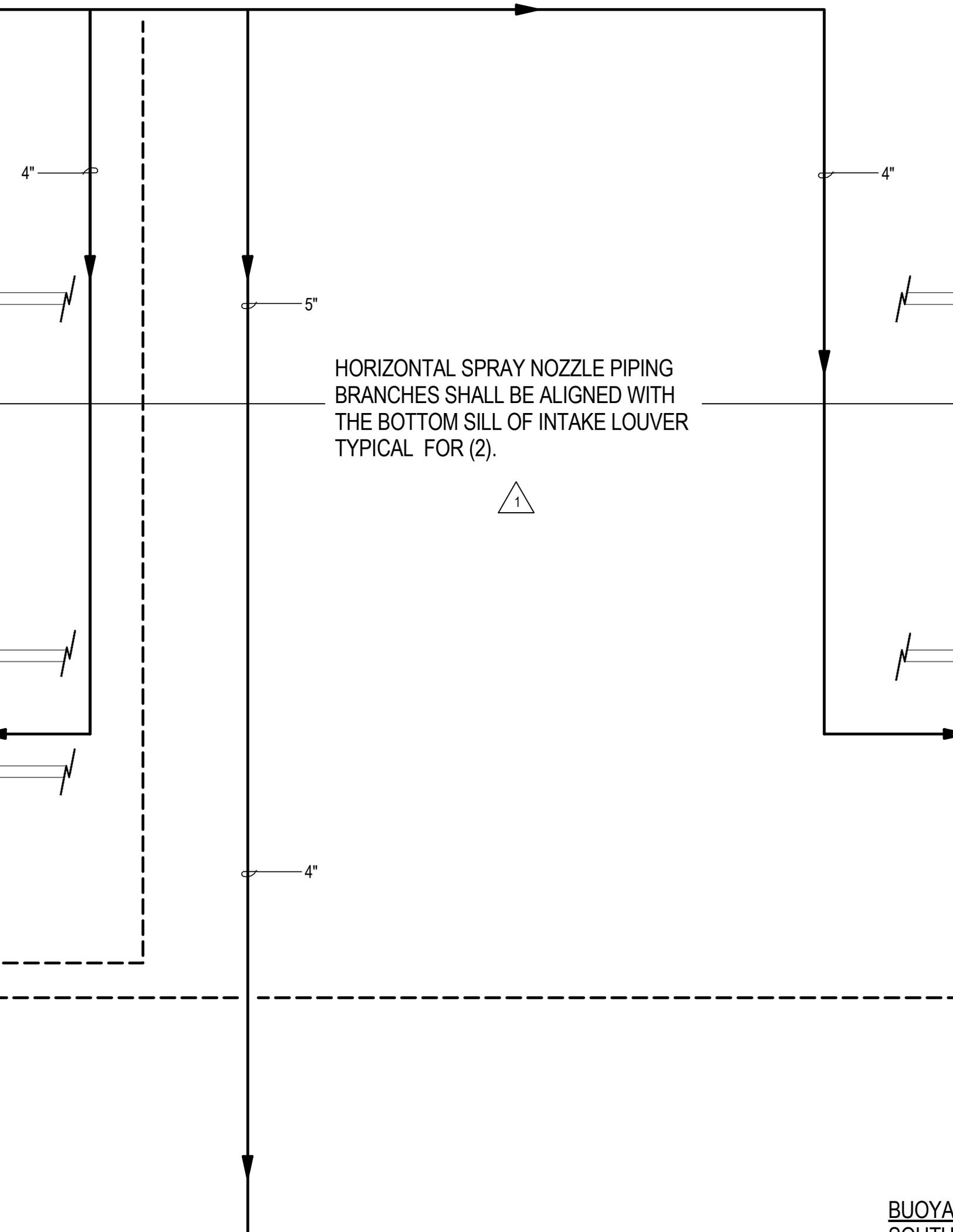


HORIZONTAL  
BRANCHES  
THE BOTTO  
TYPICAL F



BUOYANCY SPRAY SYSTEM  
NORTH AIR INTAKE SHAFTS  
16 NOZZLES (107 GPM) TOTAL





4"

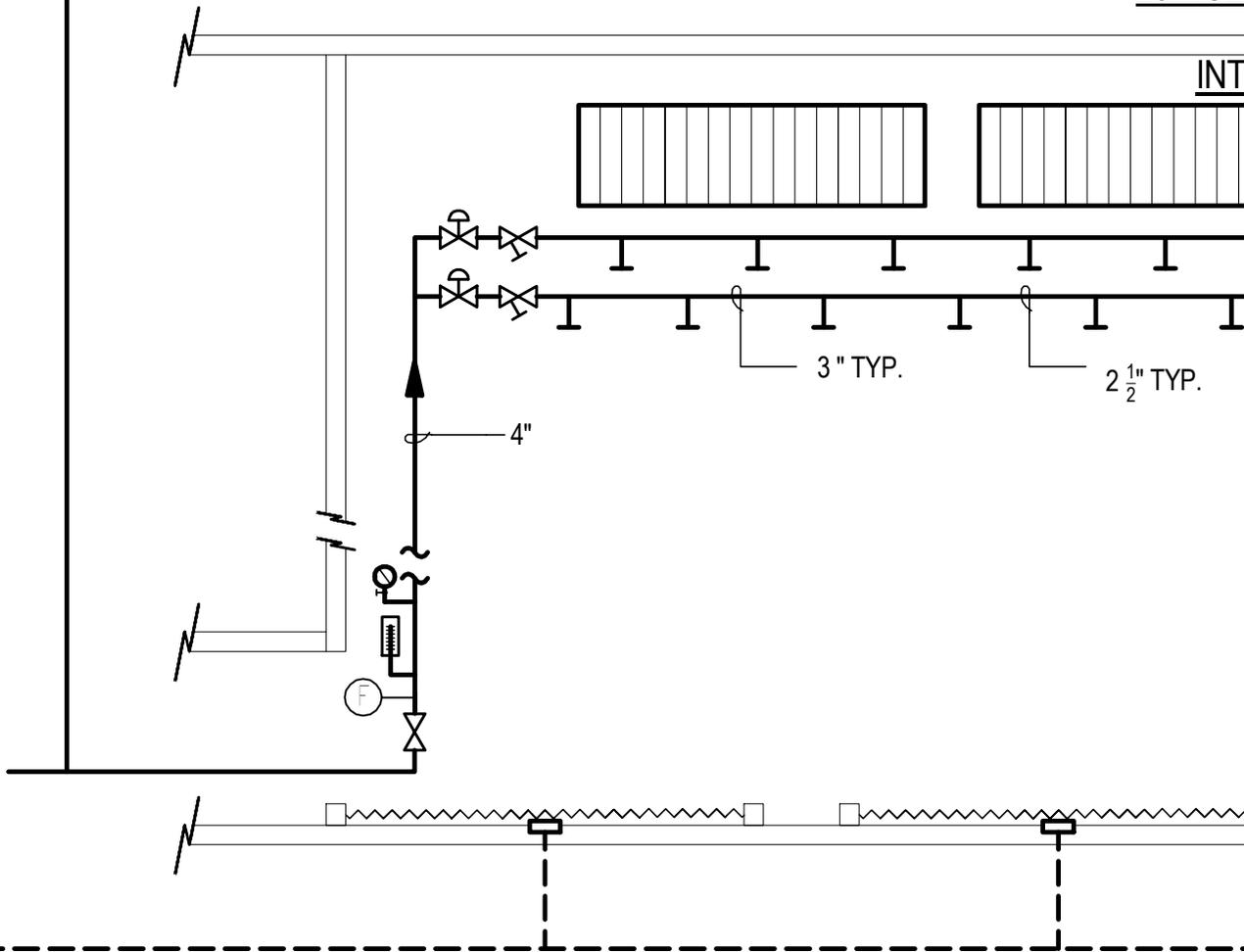
4"

5"

HORIZONTAL SPRAY NOZZLE PIPING  
BRANCHES SHALL BE ALIGNED WITH  
THE BOTTOM SILL OF INTAKE LOUVER  
TYPICAL FOR (2).

1

4"



SUMP  
ER TO  
TAILS

INTAKE SHAFT SPRAY NOZZLE PIPING

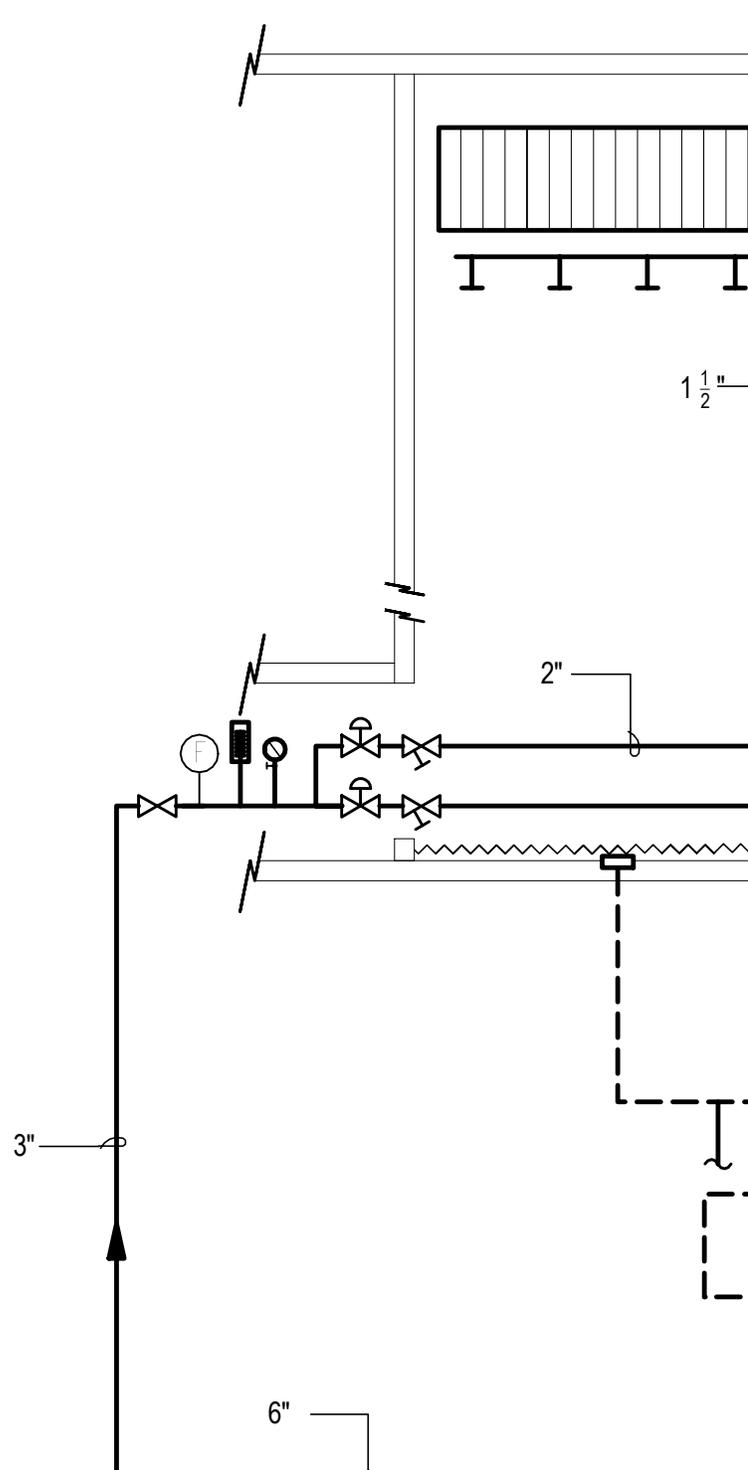
6"

3"

6"

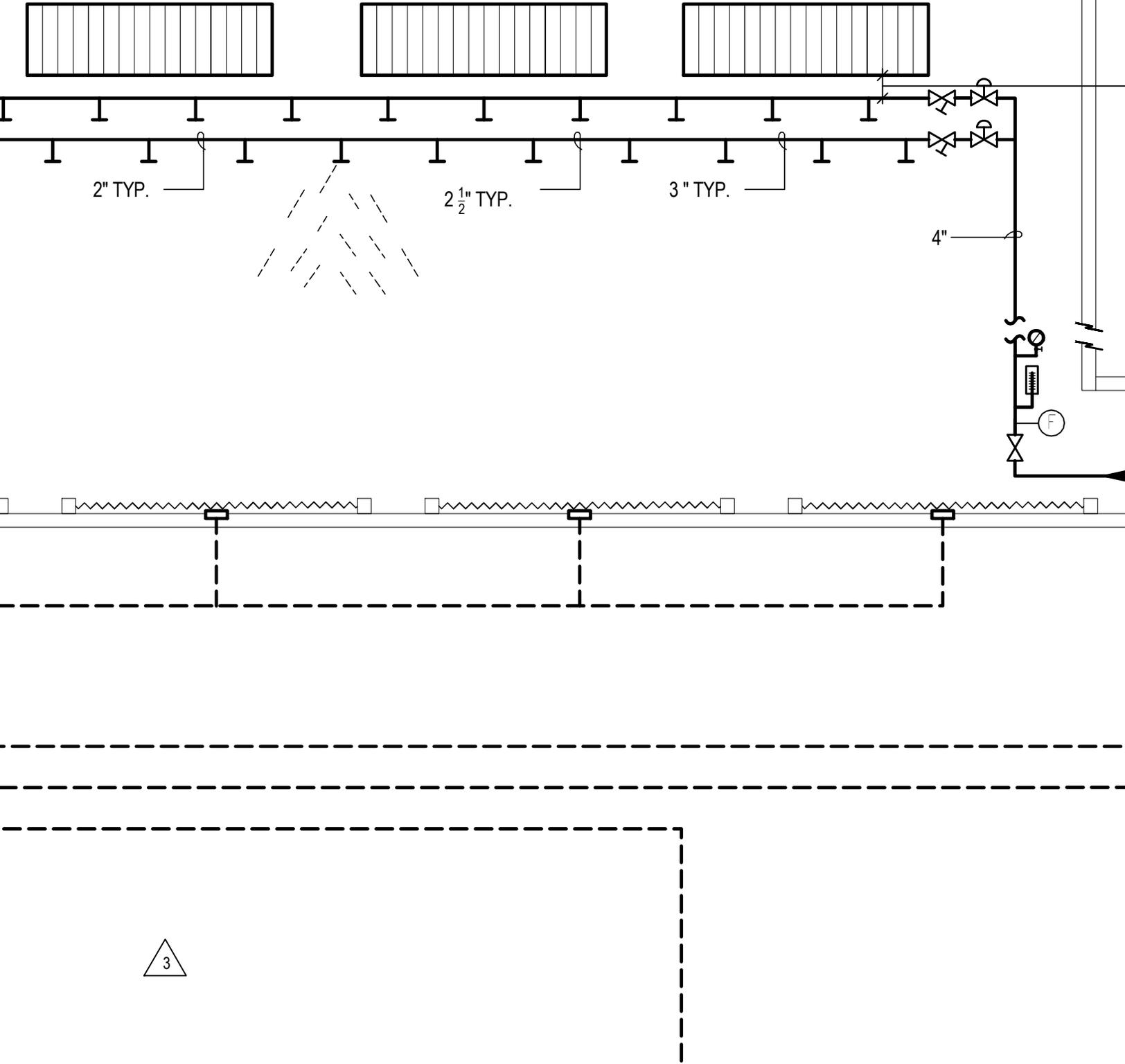
2"

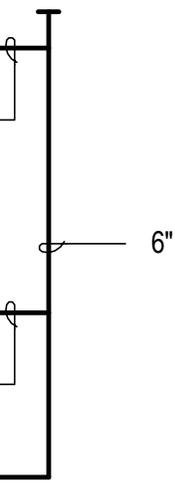
1 1/2"



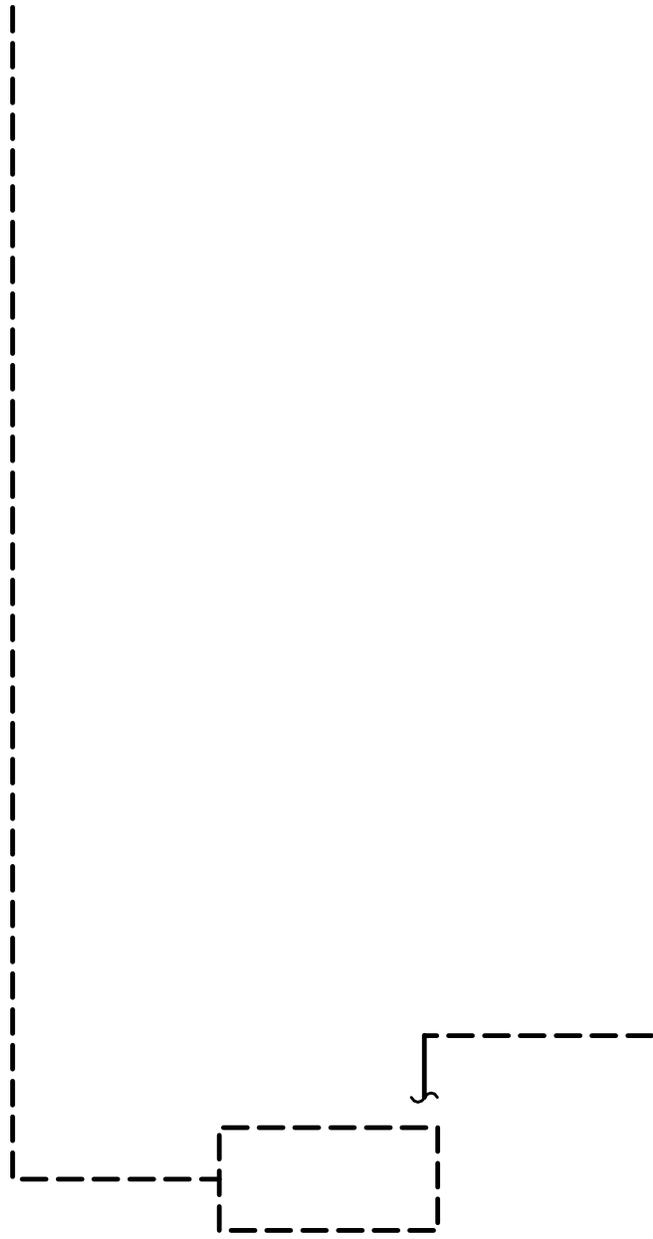
BUOYANCY SPRAY SYSTEM  
WEST AIR INTAKE SHAFT  
27 NOZZLES (182 GPM) TOTAL

INTAKE LOUVERS

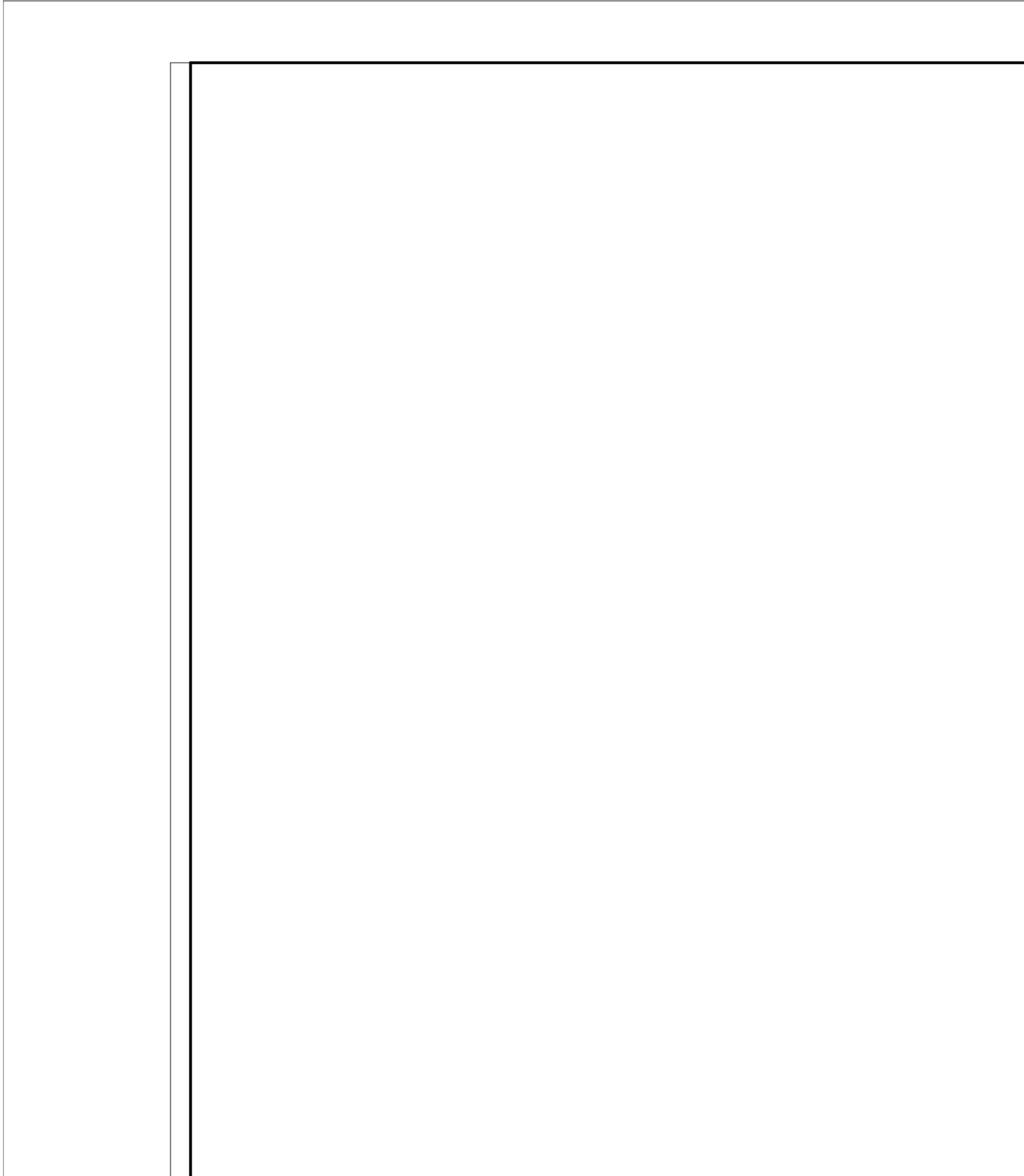




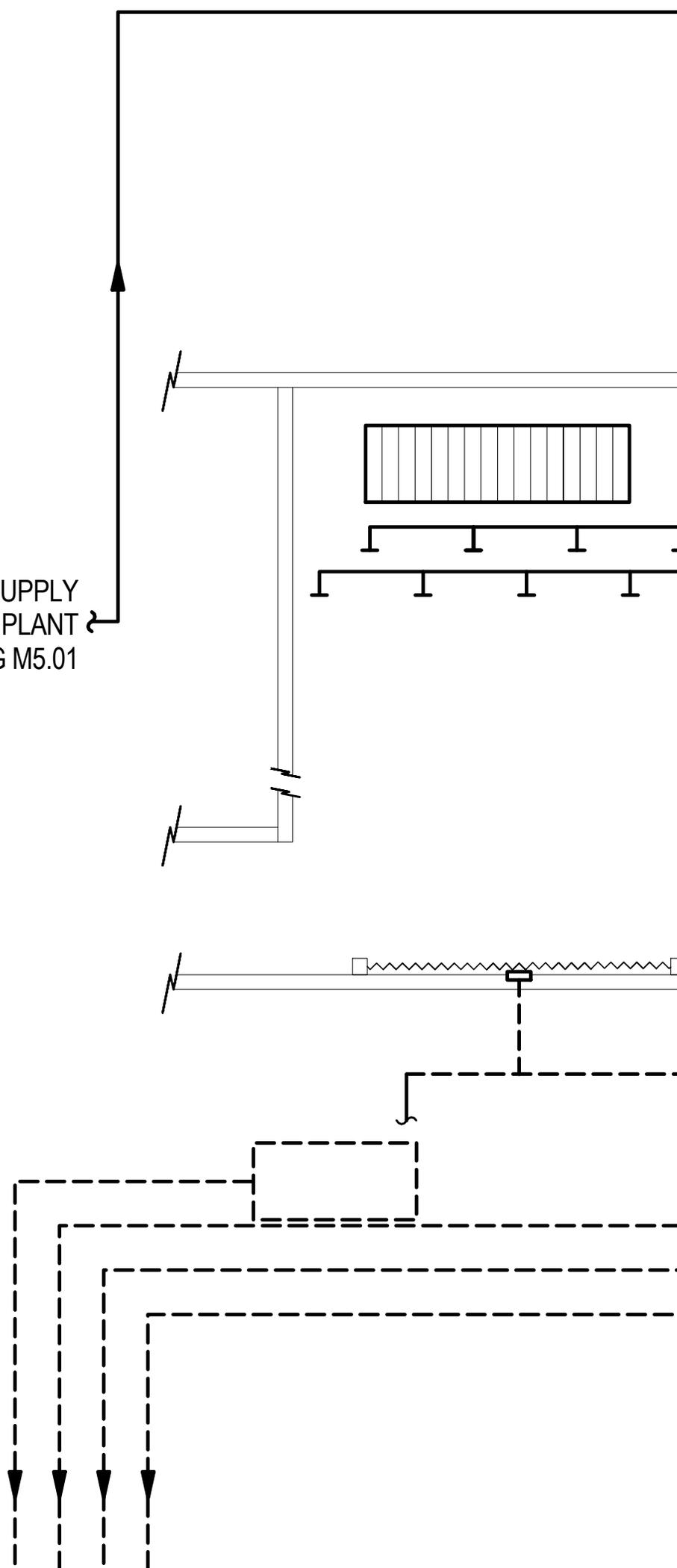
MENT PARKING LEVEL



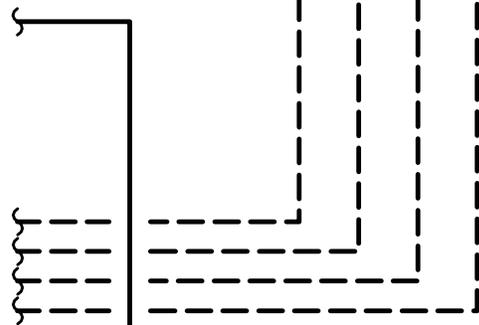
SPRAY WATER RETURN DRAIN LINE,  
TANK AND TRANSFER PUMP REFERENCE  
PLBG DRAWINGS FOR DE



CHILLED WATER SUPPLY  
FROM CENTRAL PLANT  
CONT. ON DWG M5.01

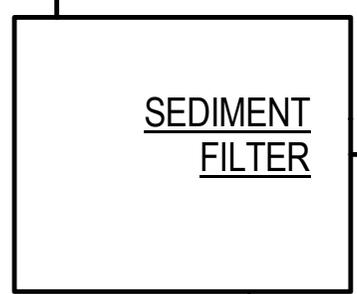


RECIRC LOOP  
WATER CONT.  
ON DWG M5.01

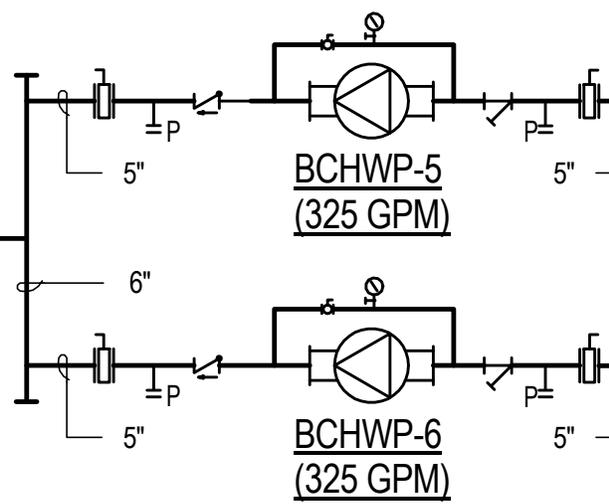


6"

SPRAY RETURN  
TREATMENT PUMPS



SEDIMENT  
FILTER



BCHWP-5  
(325 GPM)

BCHWP-6  
(325 GPM)

RECIRC LOOP  
WATER CONT.  
ON DWG M5.01

2"

CENTRAL PLANT BASE

PLOT DATE: 3/24/2017 2:58:08 PM  
TEMPLATE VERSION:

# HKS

## ARCHITECT

HKS, INC.  
RICHMOND, VA 23223

## ASSOCIATE ARCHITECT

COMMONWEALTH ARCHITECTS  
RICHMOND, VA 23219

## STRUCTURAL

THORNTON-TOMASETTI  
WASHINGTON, DC 20036

## LANDSCAPE ARCHITECT

OCULUS  
CHARLOTTESVILLE, VA 22902

## CIVIL

DRAPER ADEN ASSOCIATES  
BLACKSBURG, VA 24060

## MEP

WSP-FLACK & KURTZ  
ARLINGTON, VA 22209

## TRACK AND FIELD DESIGNER

OLYMPVS INTERNATIONAL  
MIAMI, FL 33133

## GEOTECHNICAL

FROEHLING & ROBERTSON, INC  
ROANOKE, VA 24012

## FIRE PROTECTION

HOWE ENGINEERS  
NORWELL, MA 02061

## AV, IT, SECURITY, AND ACOUSTICS

ANTHONY JAMES PARTNERS  
RICHMOND, VA 23233

## LIGHTING

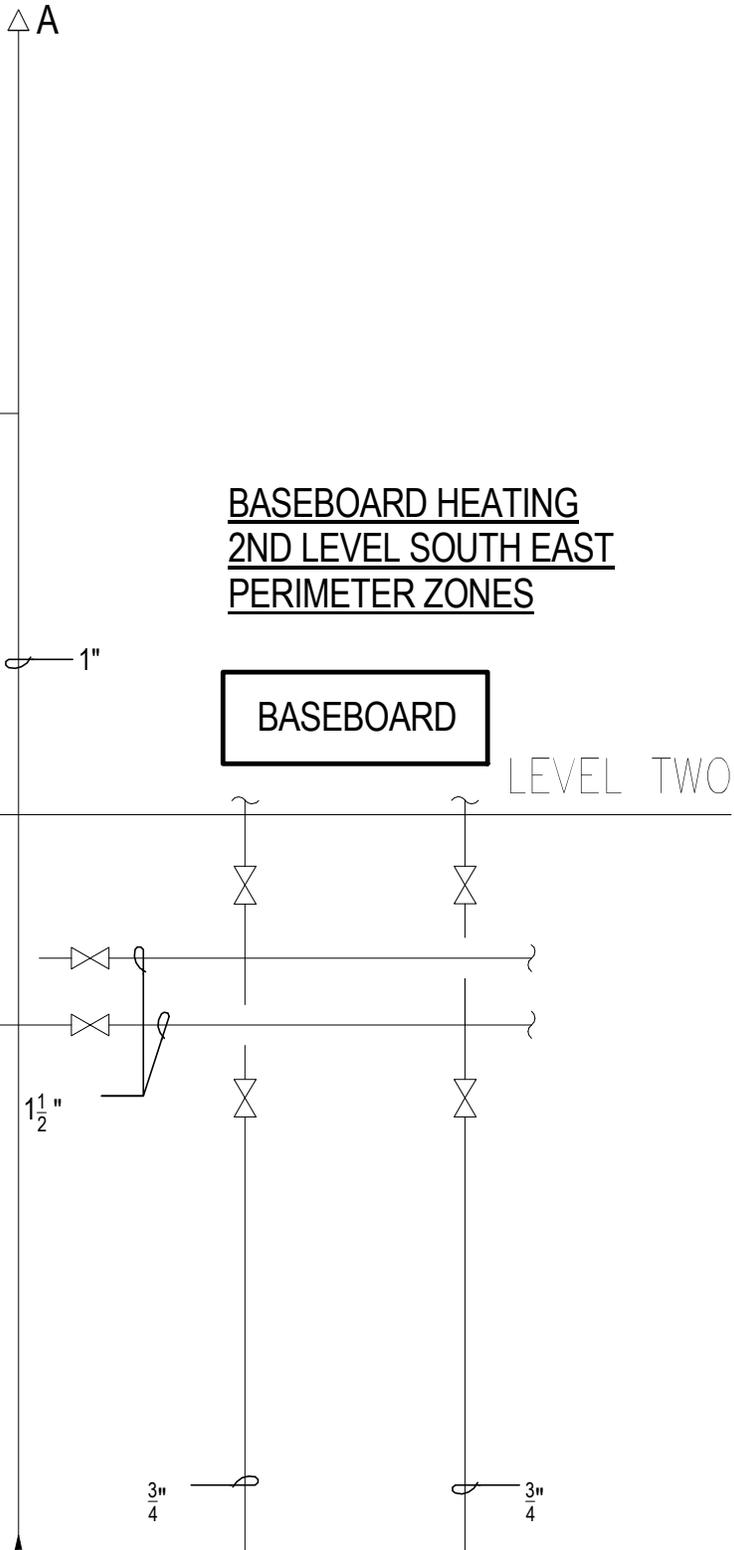
COVENTRY LIGHTING  
CHEVY CHASE, MD 20815

## OBSTACLE COURSE DESIGNER

CHALLENGE DESIGN INNOVATIONS, INC.  
PINEOLA, NC 28662

## SIGNAGE AND EXHIBIT DESIGNER

THE 1717 DESIGN GROUP  
RICHMOND, VA 23223



OWNER

VIRGINIA MILITARY INSTITUTE  
LEXINGTON, VA 24450



VIRGINIA MILITARY INSTITUTE

LEXINGTON, VA 24450

# CORPS PHYSICAL TRAINING FACILITY PHASE 1

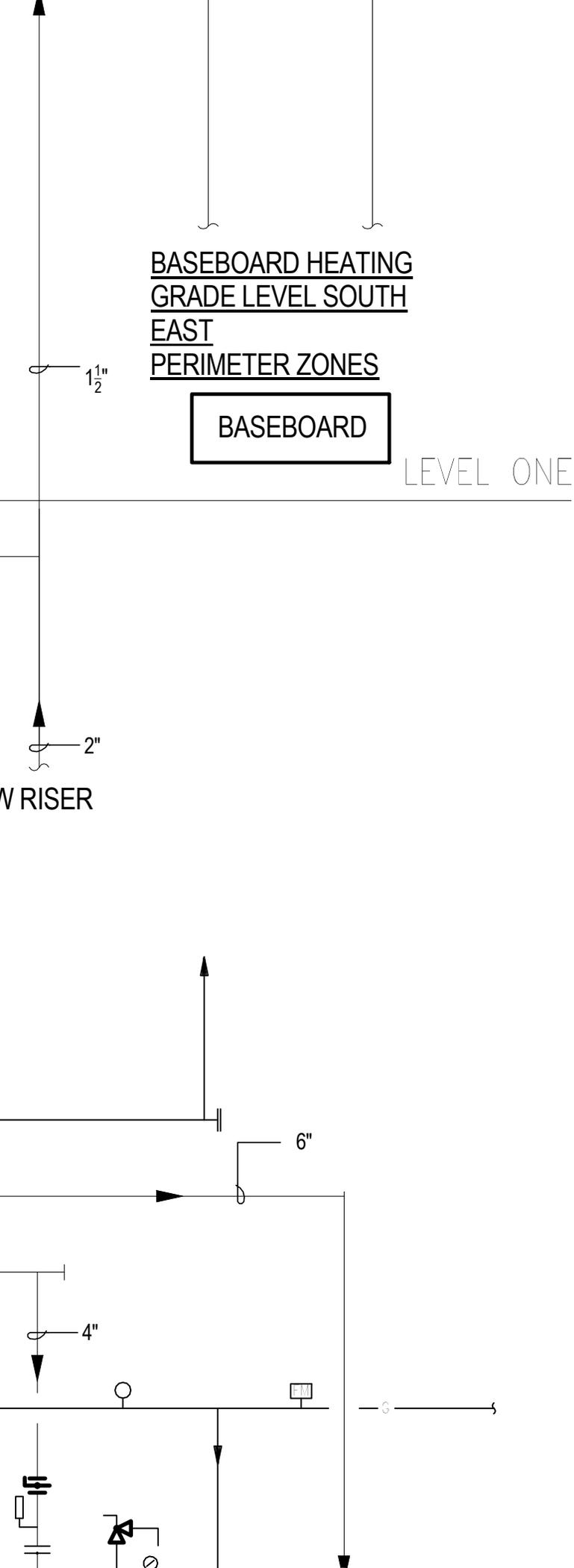
## RECORD SET

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KEY PLAN



BASEBOARD HEATING  
GRADE LEVEL SOUTH  
EAST  
PERIMETER ZONES

BASEBOARD

LEVEL ONE

1 1/2"

2"

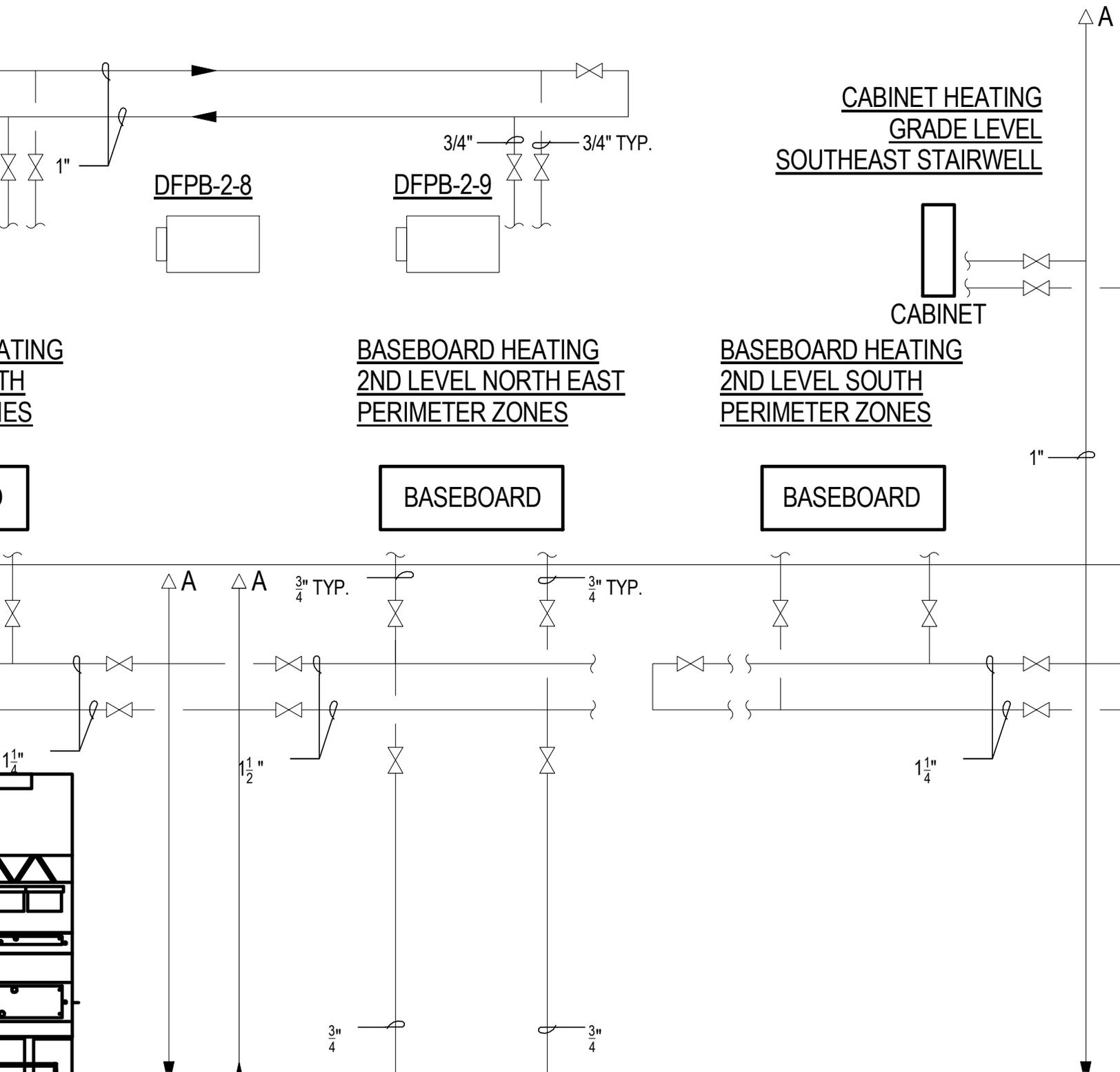
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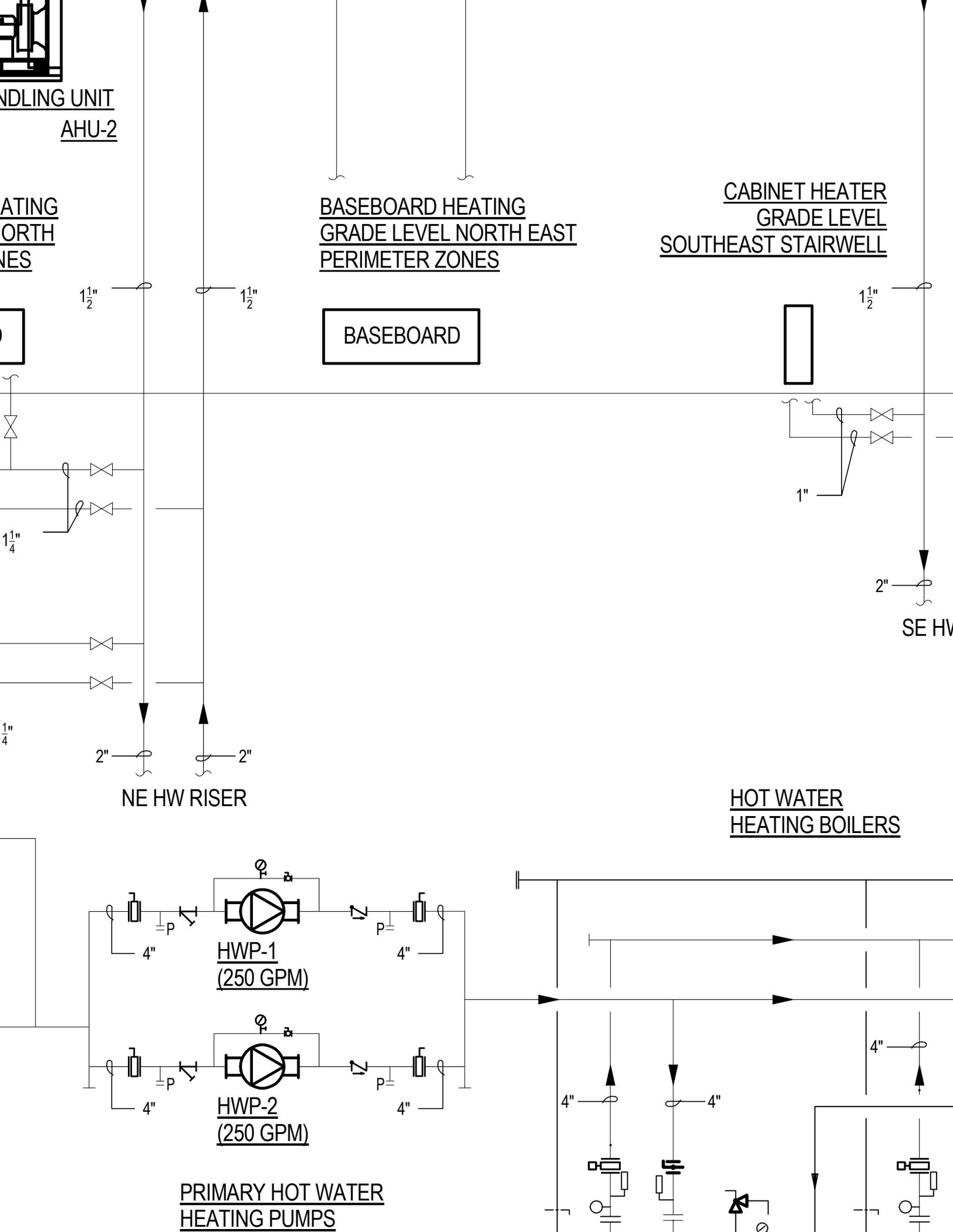
6"

4"

6"







HANDLING UNIT  
AHU-2

HEATING  
NORTH  
ZONES

BASEBOARD HEATING  
GRADE LEVEL NORTH EAST  
PERIMETER ZONES

CABINET HEATER  
GRADE LEVEL  
SOUTHEAST STAIRWELL

BASEBOARD

CABINET HEATER

1 1/2"

1 1/2"

1 1/2"

1 1/4"

1"

2"

SE HW

1 1/4"

2"

2"

NE HW RISER

HOT WATER  
HEATING BOILERS

HWP-1  
(250 GPM)

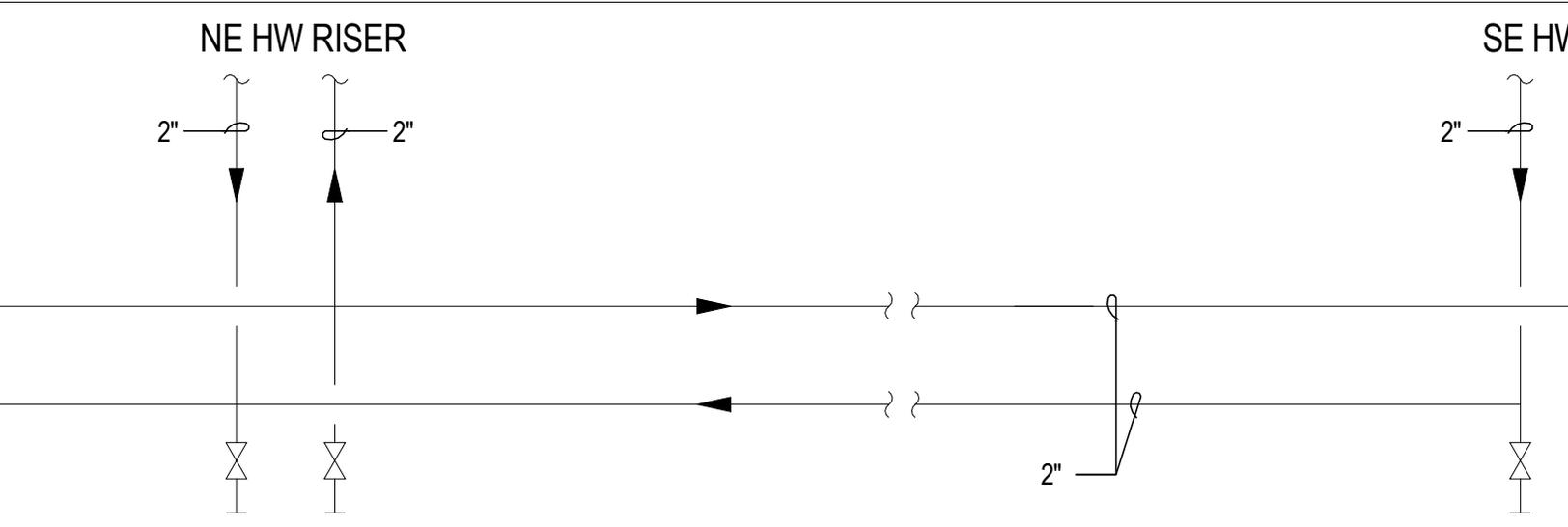
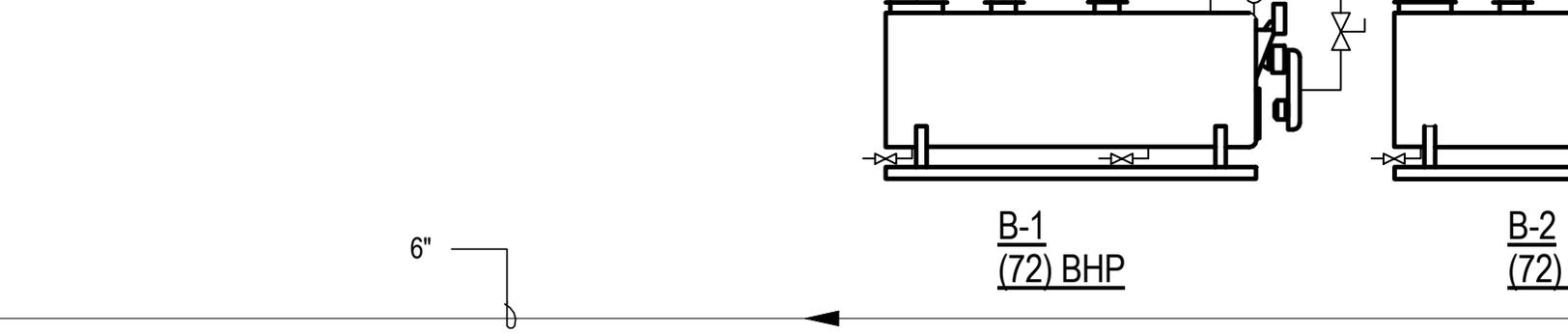
HWP-2  
(250 GPM)

PRIMARY HOT WATER  
HEATING PUMPS

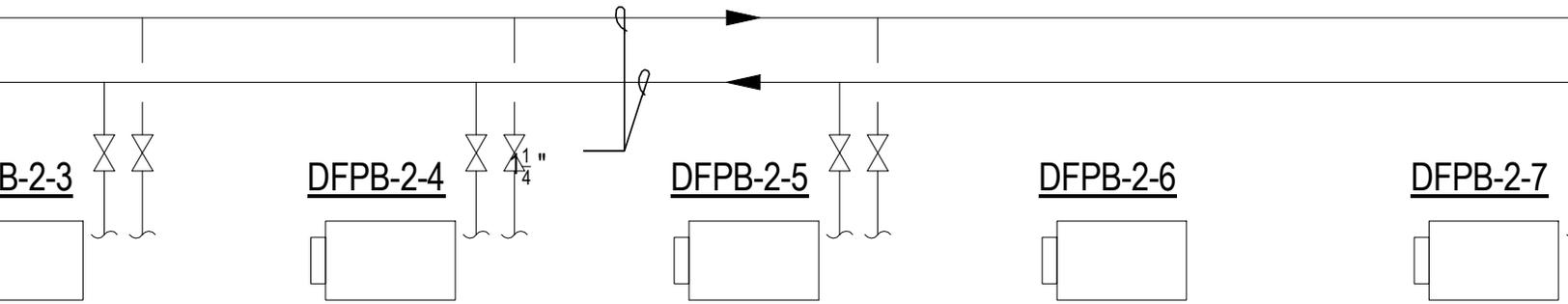
4"

4"

4"



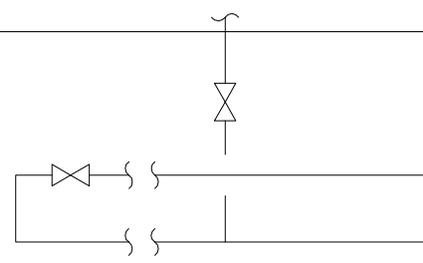
LEVEL TWO SUPPORT  
SPACES DOAS TERMINALS



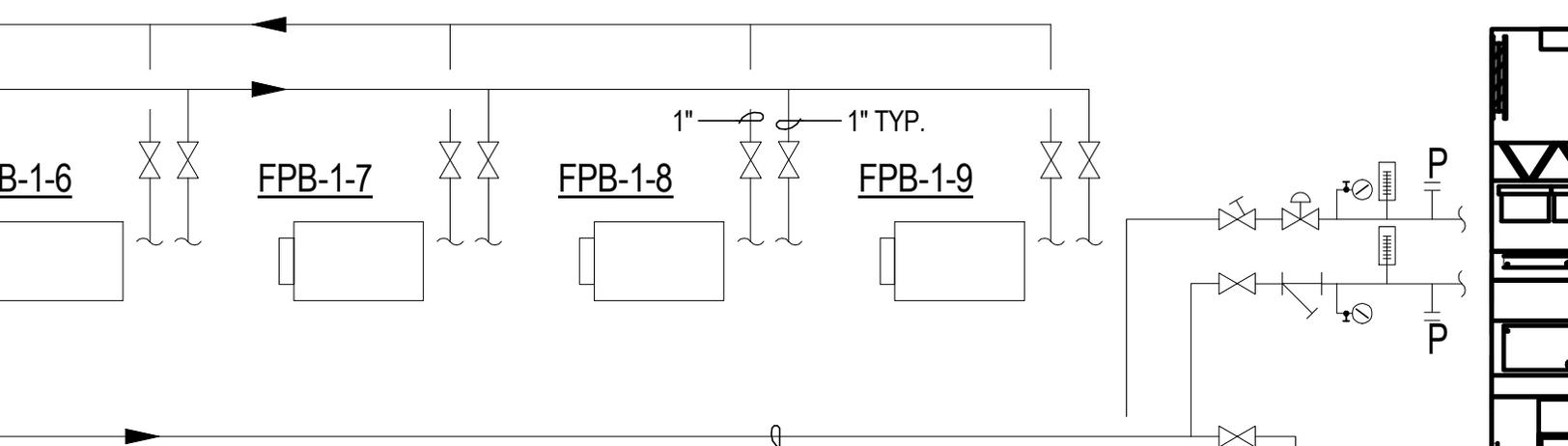
REFER TO DRAWING M5.01 FOR  
CHILLED WATER PIPING  
CONNECTIONS TO AHUS, FCUS, DOAS  
TERMINALS AND LOBBY RADIANT  
MANIFOLDS

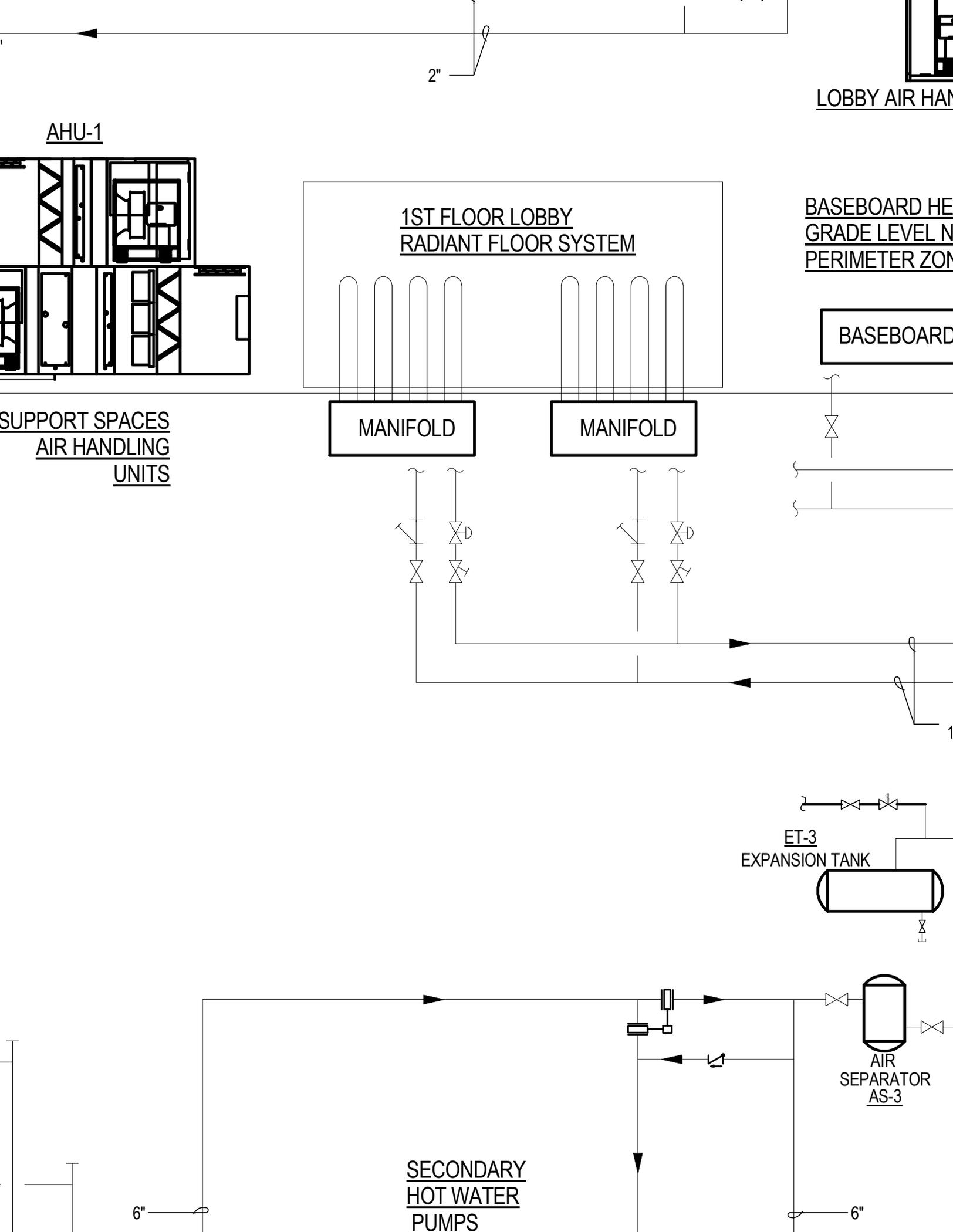
BASEBOARD HEATERS  
2ND LEVEL NORTH  
PERIMETER ZONE

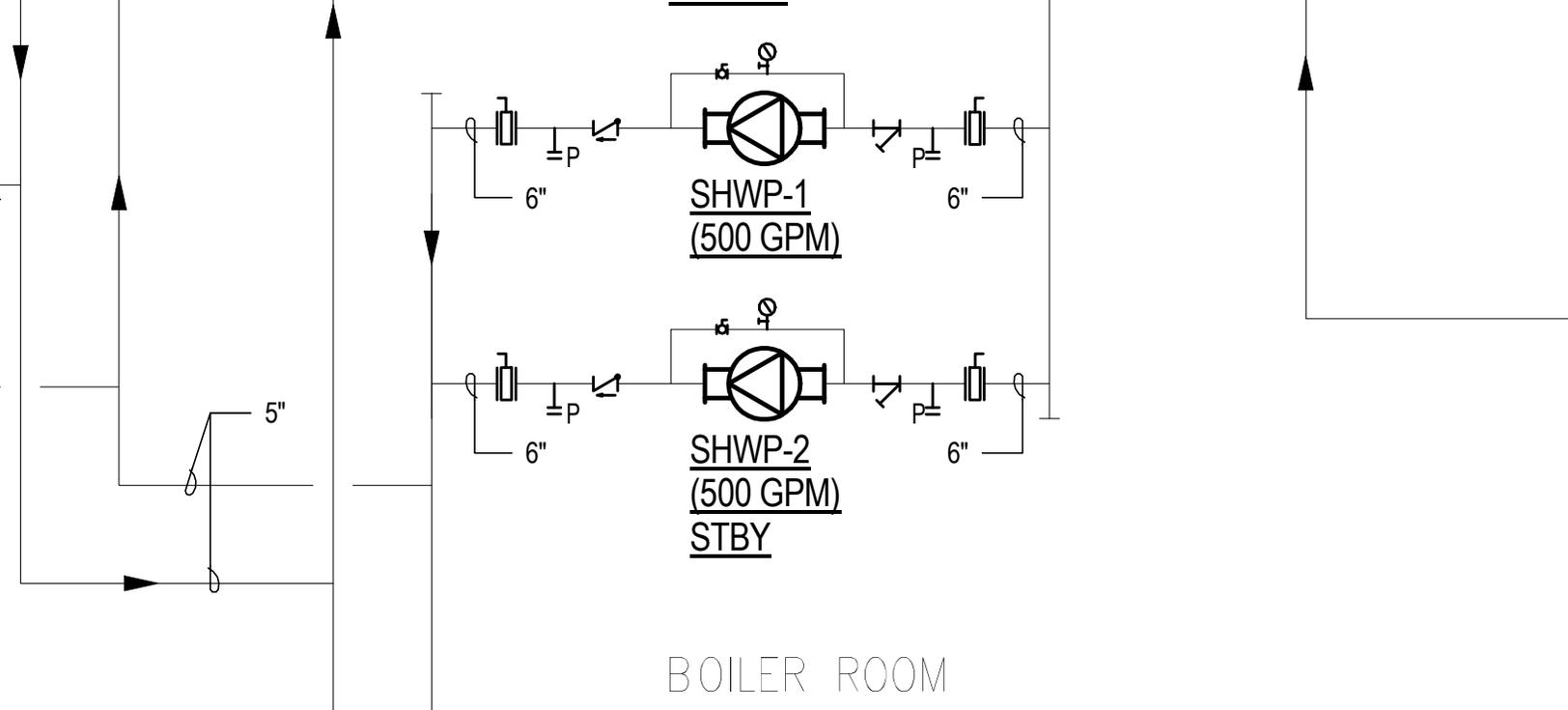
BASEBOARD



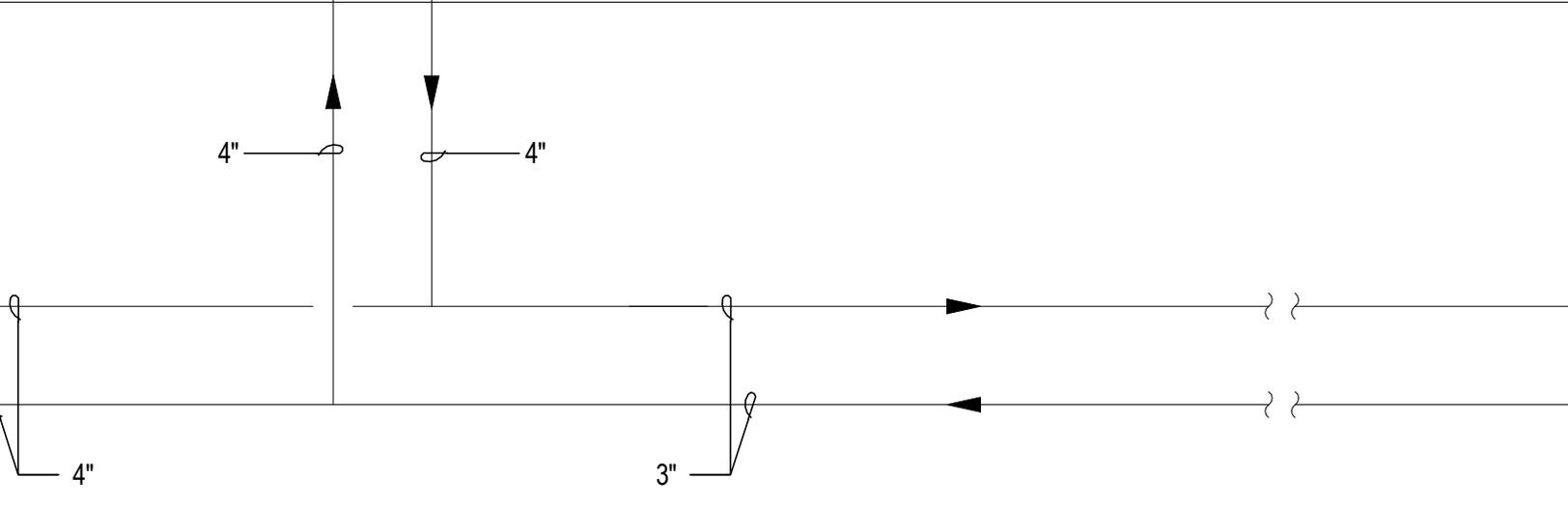
LEVEL ONE SUPPORT  
SPACES DOAS TERMINALS



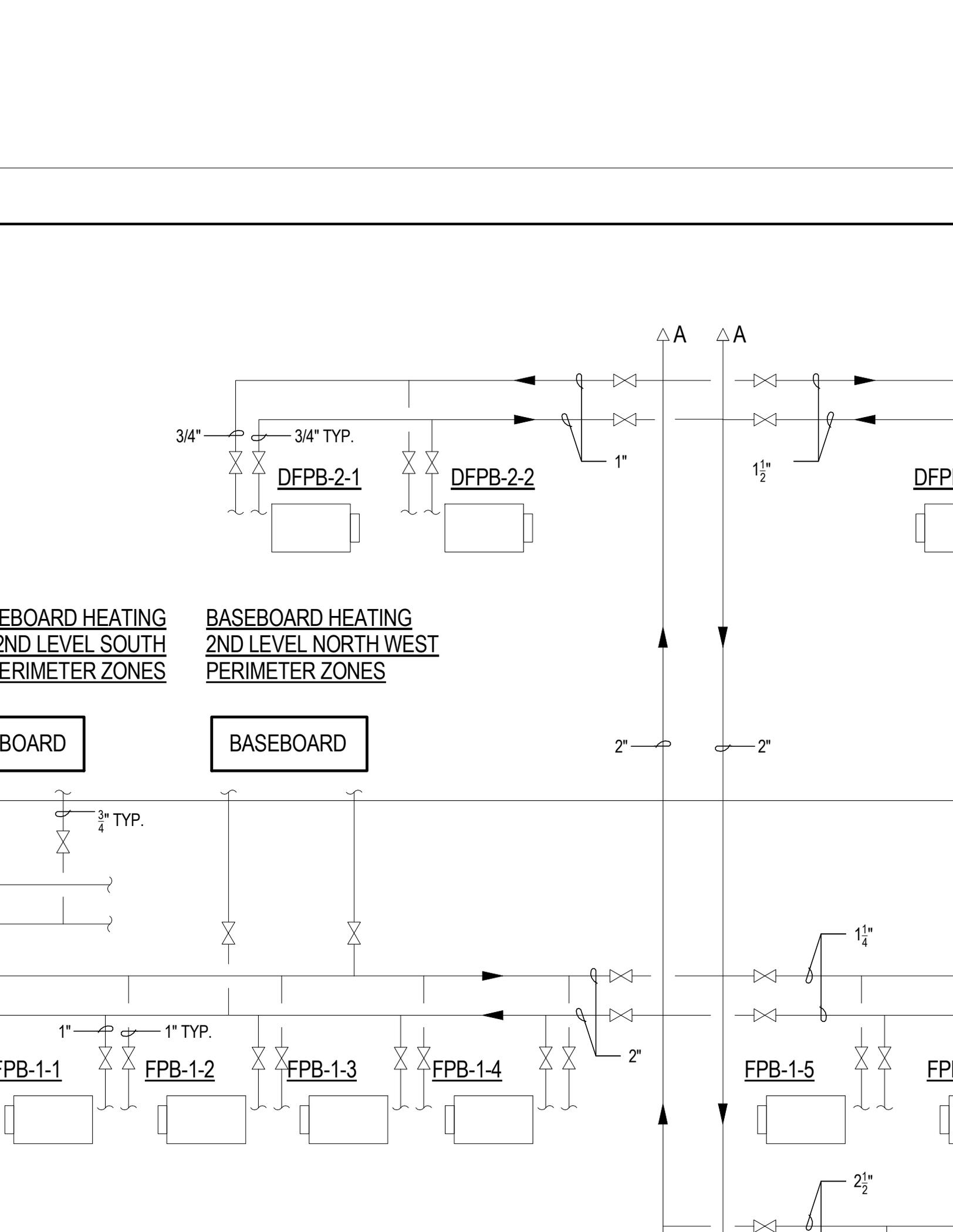




BOILER ROOM



HOT AND GLYCOL WATER SYSTEM PIPING



3/4" — 3/4" TYP.  
DFPB-2-1

1" —  
DFPB-2-2

1 1/2"

DFPB-2-1

BASEBOARD HEATING  
2ND LEVEL SOUTH  
PERIMETER ZONES

BASEBOARD HEATING  
2ND LEVEL NORTH WEST  
PERIMETER ZONES

BOARD

BOARD

2" — 2"

3/4" TYP.

1" — 1" TYP.

FPB-1-1

FPB-1-2

FPB-1-3

FPB-1-4

FPB-1-5

FPB-1-6

2"

1 1/4"

2 1/2"

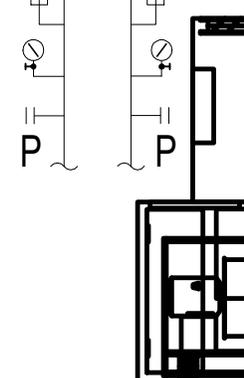
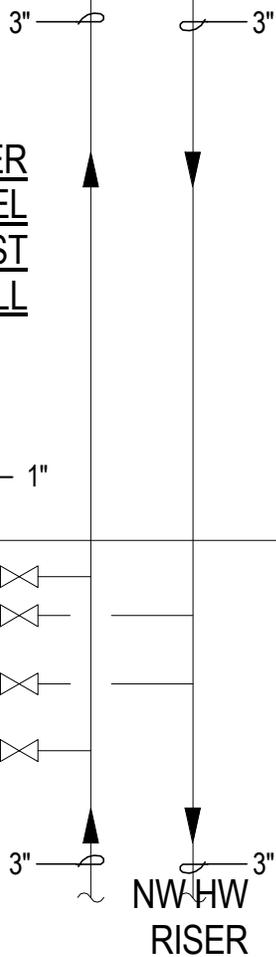
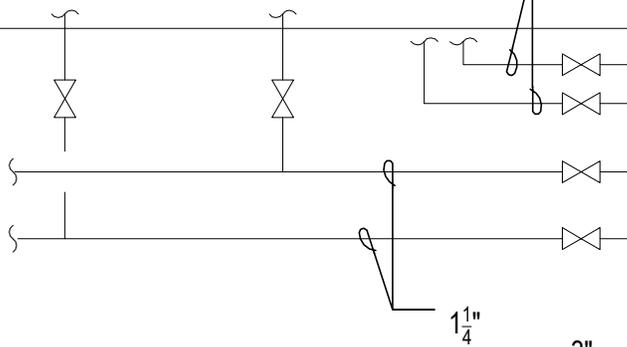
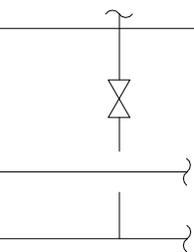
HEATING  
EL SOUTH  
ER ZONES

BASEBOARD HEATING  
GRADE LEVEL NORTH WEST  
PERIMETER ZONES

CABINET HEATER  
GRADE LEVEL  
NORTHWEST  
STAIRWELL

BOARD

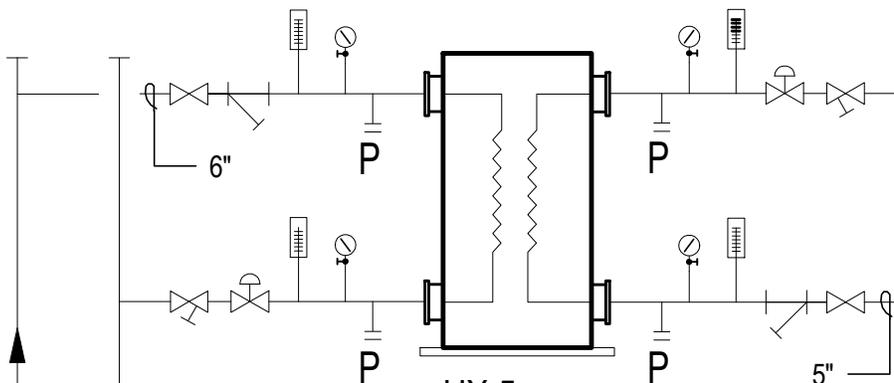
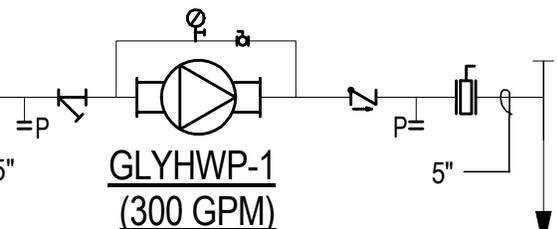
BOARD



1

GLYCOL / WATER  
HEATING  
HEAT EXCHANGERS

GLYCOL / WATER  
HEATING PUMPS

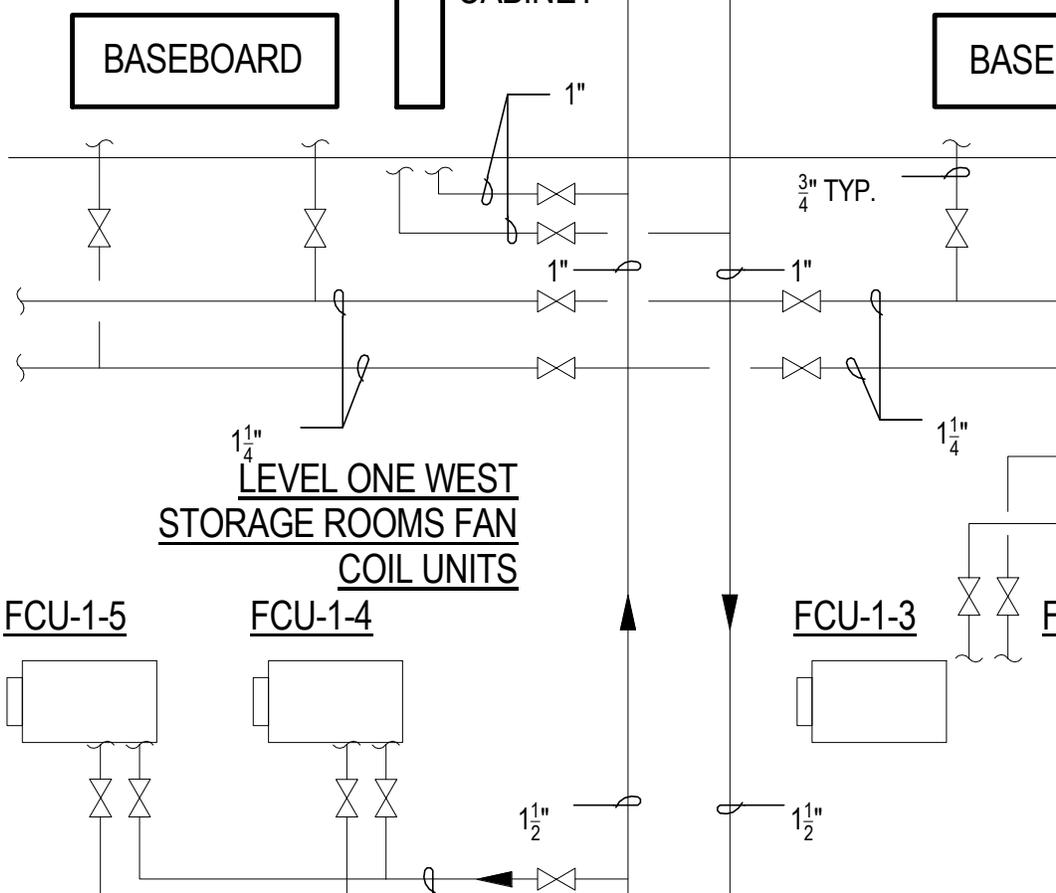




BASEBOARD HEATING  
2ND LEVEL SOUTHWEST  
PERIMETER ZONES

CABINET HEATER  
2ND FLOOR LEVEL  
SOUTHWEST  
STAIRWELL

BAS  
2  
P

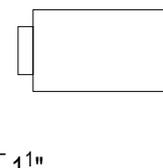
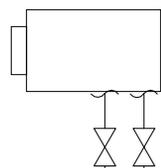
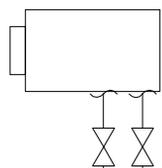


LEVEL ONE WEST  
STORAGE ROOMS FAN  
COIL UNITS

FCU-1-5

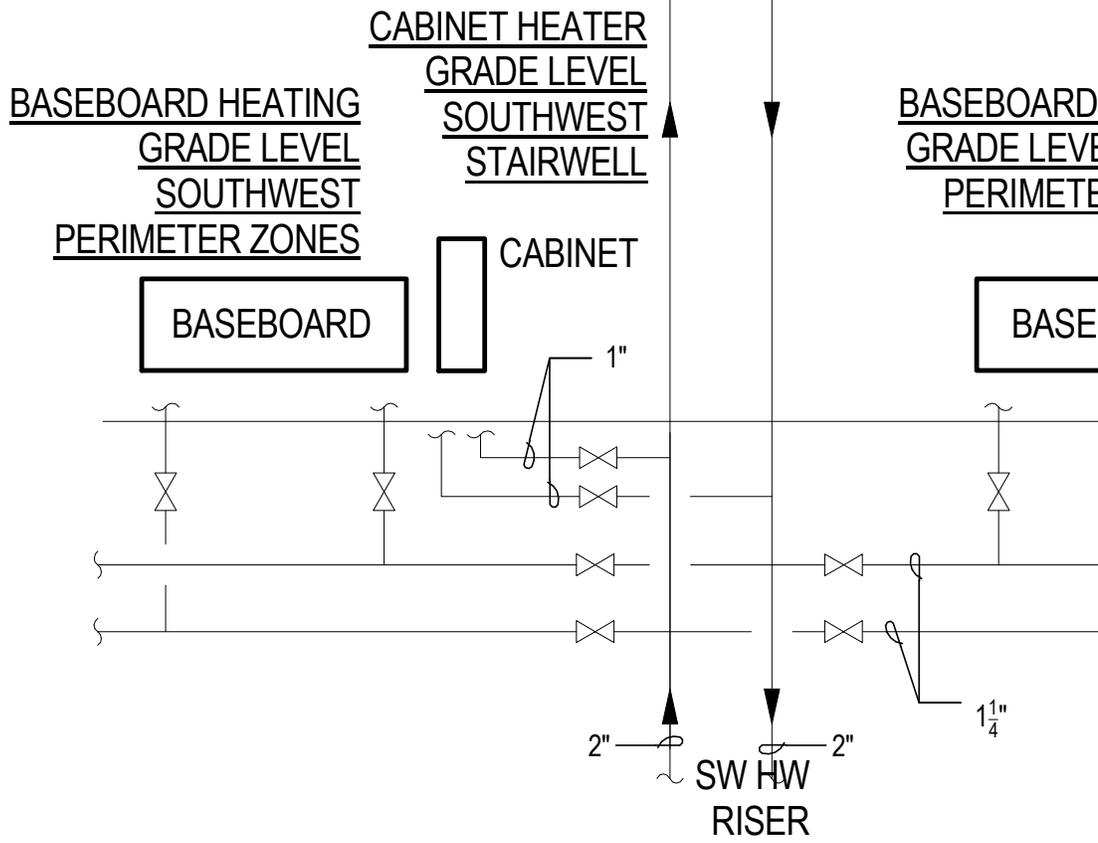
FCU-1-4

FCU-1-3

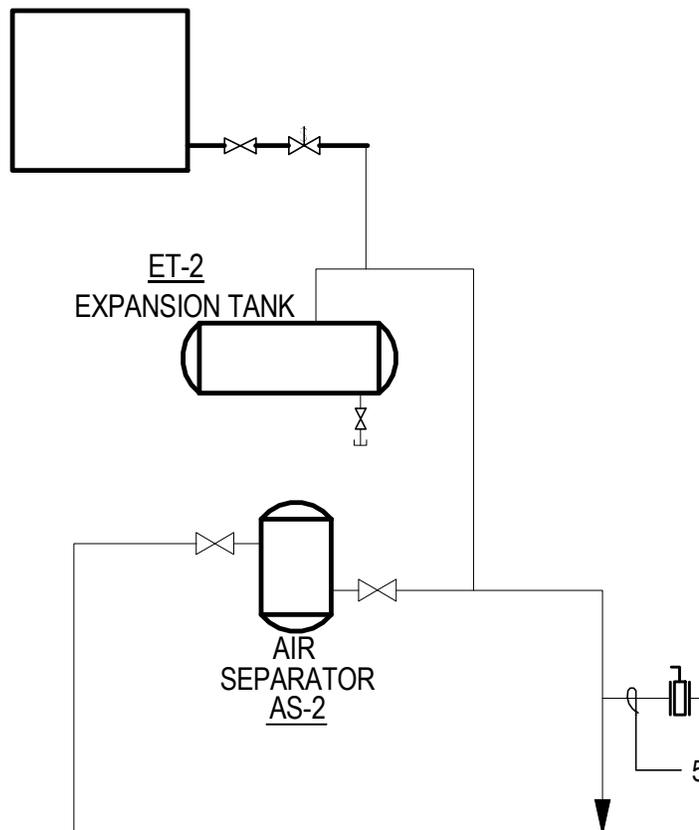


1 1/2"

1 1/2"



GLYCOL MAKEUP WATER SYSTEM

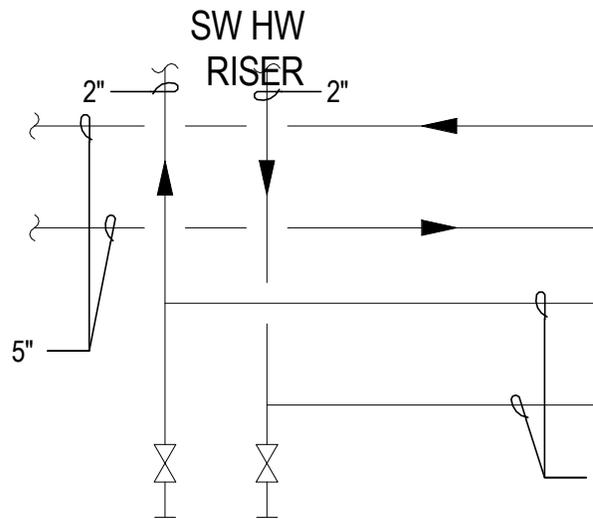


MAIN LINE,  
 PUMP REFER  
 DETAILS

PLOT DATE:  
3/24/2017 2:58:13 PM

TEMPLATE VERSION:

GLYCOL / WATER HEAT  
RECOVERY LOOP CONNECTION  
TO CONDENSER WATER  
SYSTEM  
IN CENTRAL PLANT CONTINUED  
ON DRAWING M5.01





**WATER TREATMENT SYSTEM**  
**INSTALLATION, OPERATION, AND MAINTENANCE MANUAL**

**JOB NAME:**

**MODEL:**

**P.O. NUMBER:**

**JOB NUMBER:**

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<b>Section 2</b> .....	ACA-12G-1 Carbon Filter
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<b>Section 10</b> .....	Control Panel Operation General Arrangement Drawings Electrical Wiring Drawings

# Section 1



---

**INSTALLATION, OPERATION,  
AND MAINTENANCE MANUAL**

---

**MID 1&G-1  
1" 2750 TIMECLOCK SERIES  
COMMERCIAL A98-5 : =@H9F**

COMPLETE FOR FUTURE REFERENCE:

MODEL NO:

SERIAL NO:

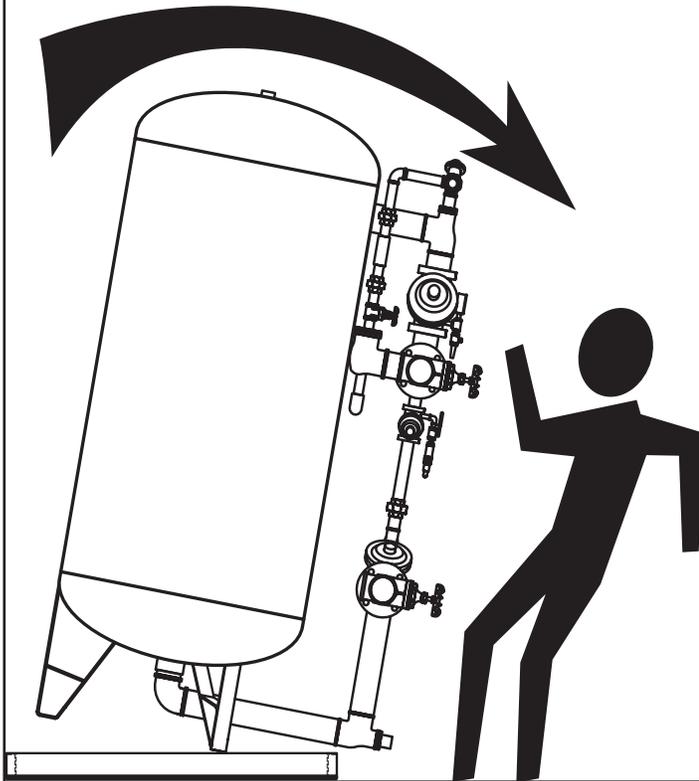
DATE INSTALLED:

DEALER:

**Marlo Incorporated**  
2227 South Street  
P.O. Box 044170  
Racine, WI 53404-7003  
Ph. (262) 681-1300  
Fax (262) 681-1318  
Info@Marlo-Inc.com  
www.Marlo-Inc.com

# CAUTION

Unit is front-heavy and may tip.  
Use caution when uncrating.



Form 5-244 07/04  
Part# A2006051

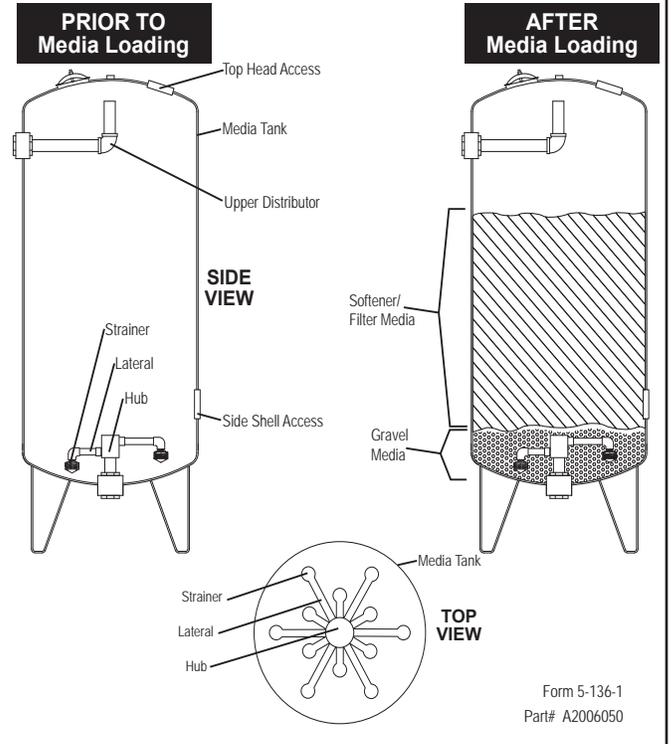
# INSTALLATION WARNING

## Inspection Requirement Prior to Loading Media

1. Inspect condition of upper distributor piping. Verify fittings are tight and positioned as shown.
2. Inspect condition of strainers, laterals and hub through top or side access ports. Verify laterals are secured to hub and strainers are secured to laterals.

## INSTALLER WARNING

3. **DO NOT** load media if damaged components are observed. Contact factory.
4. Installer is responsible for media loss into treated water resulting from failure to report and repair damaged components inside media tank prior to media loading.
5. Refer to installation instructions for media loading procedure. Improper loading of media will damage components inside media tank.



Form 5-136-1  
Part# A2006050

Please Circle and/or Fill in the Appropriate Data for Future Reference:

Filter Model: ACA/AGA/MID/MGA  
System Size: Single/Twin/Triple/Quad  
Configuration: Timeclock/Pressure Differential/Metered  
BW/Regen Time: \_\_\_\_\_ AM/PM or OFF

Additional Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**IMPORTANT PLEASE READ:**

- Warranty of this product extends to manufacturing defects.
- The information, specifications and illustrations in this manual are based on the latest information available at the time of printing. The manufacturer reserves the right to make changes at any time without notice.
- This product should be installed by a plumbing professional on potable water systems only.
- This product must be installed in compliance with all local and state and municipal plumbing and electrical codes. Permits may be required at the time of installation.
- If operating pressure exceeds 100 psi a pressure reducing valve must be installed. If operating pressure drops below 30 psi a booster pump must be installed.
- Do not install the unit where temperatures may drop below 32°F or rise above 100°F.
- A prefilter should be used on installations in which free solids are present.
- A constant voltage of 120V/60Hz (unless otherwise specified) must be supplied to the controller to maintain proper function.
- Union or flange fittings are recommended at the control valve's inlet, outlet, and drain connections
- If distance of drain line is over a 10 ft. vertical or 25 ft. horizontal run, increase drain line one pipe size over that provided on the control valve.
- Do not make a direct connection to the drain. Provide an air gap of at least four times the diameter of the pipe to conform to sanitation codes and to permit observation of the flow.

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**COMMERCIAL AND INDUSTRIAL PRODUCT WARRANTY**

Marlo, Inc. warrants all commercial and industrial water treatment products manufactured and/or distributed by it to be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If within that period any products shall be proven to Marlo, Inc.'s satisfaction to be defective, those products will be replaced or the price refunded at Marlo Inc.'s option.

Marlo Inc.'s obligations or nonperformance, defective, or any damage caused by its products or their use, and buyer's exclusive remedy therefore, shall be limited to product replacement or refund and shall be conditioned upon Marlo Inc.'s receiving written notice together with a demand for such replacement or refund:

The foregoing warranty is exclusive and in lieu of all other expressed implied warranty (except of title) including but not limited to implied warranty of merchantability and fitness for particular purpose.

**Marlo Inc. will not be subject to and disclaims the following:**

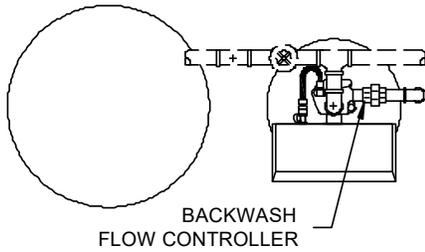
1. Any other obligations or liabilities arising out of breach of contract or out of warranty.
2. Any obligations whatsoever arising from tort claims (including negligence and strict liability) or arising under other theories of law with respect to products sold or services rendered by Marlo Inc. or any undertakings, acts, or omissions relating thereto.
3. All consequential, incidental, and contingent damages. Labor charges, change backs or handling charges are excluded from Marlo Inc.'s warranty provisions.

**COMMERCIAL AND INDUSTRIAL WATER CONDITIONER GUARANTEE**

Under normal operating conditions:

1. The loss of filter media through attrition during the first three (3) years shall not exceed 3% per year.
2. The filter media shall not be washed out of the system during backwash.
3. The color and turbidity of the softener effluent shall not be greater than the incoming water.

Any mechanical equipment proving defective in workmanship or material within one year after installation or eighteen (18) months after shipment, whichever comes first, shall be replaced FOB factory.

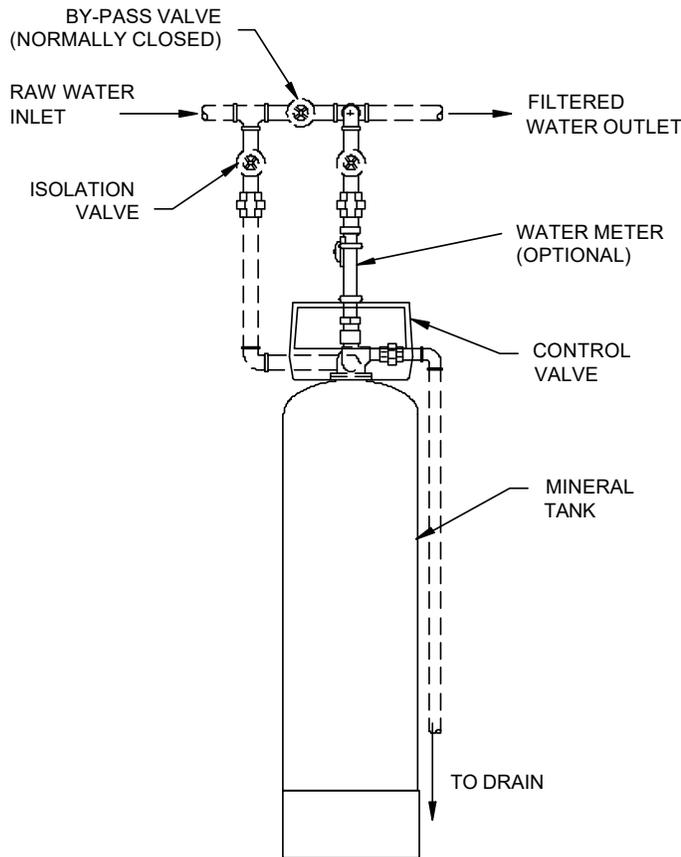


**NOTES:**

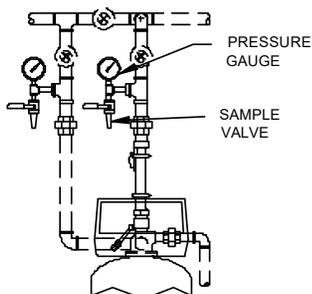
ALL PIPING, FITTINGS, ECT. SHOWN IN DOTTED LINES ARE SUPPLIED BY OTHERS.

GENERAL PLUMBING CONNECTIONS ARE SHOWN FOR CLARITY ONLY.

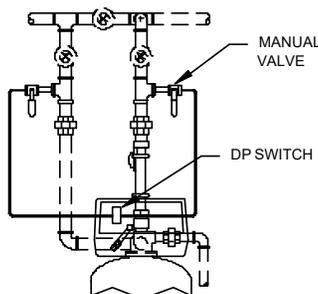
CONSULT I/O MANUAL FOR EXACT PLUMBING CONNECTIONS OF THE CONTROL VALVE.



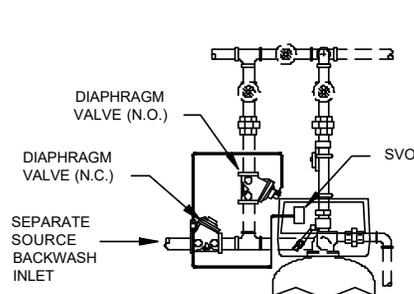
**PRESSURE GAUGE & SAMPLE VALVE OPTION**



**DIFFERENTIAL PRESSURE SWITCH INITIATION OPTION**



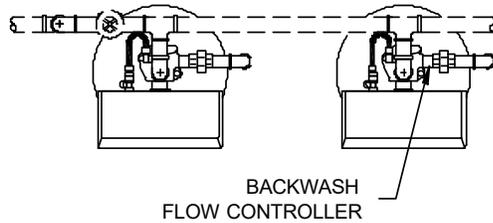
**SEPARATE SOURCE BACKWASH OPTION**



<b>MFG 1" (2750) SINGLE FILTER GENERAL ARRANGEMENT DRAWING</b>		FILE ID. MFG 2750 SINGLE	SHEET 1 OF 1	REV. 0
FRAC. #	DEC. #	SCALE	NTS	DRAWING NO.
DRN.	BCD			
APPD.				
DATE	7-13-94			

**CONTROL VALVE FILTER  
STANDARD**

REVISIONS		REMARKS
NO.	DATE	BY

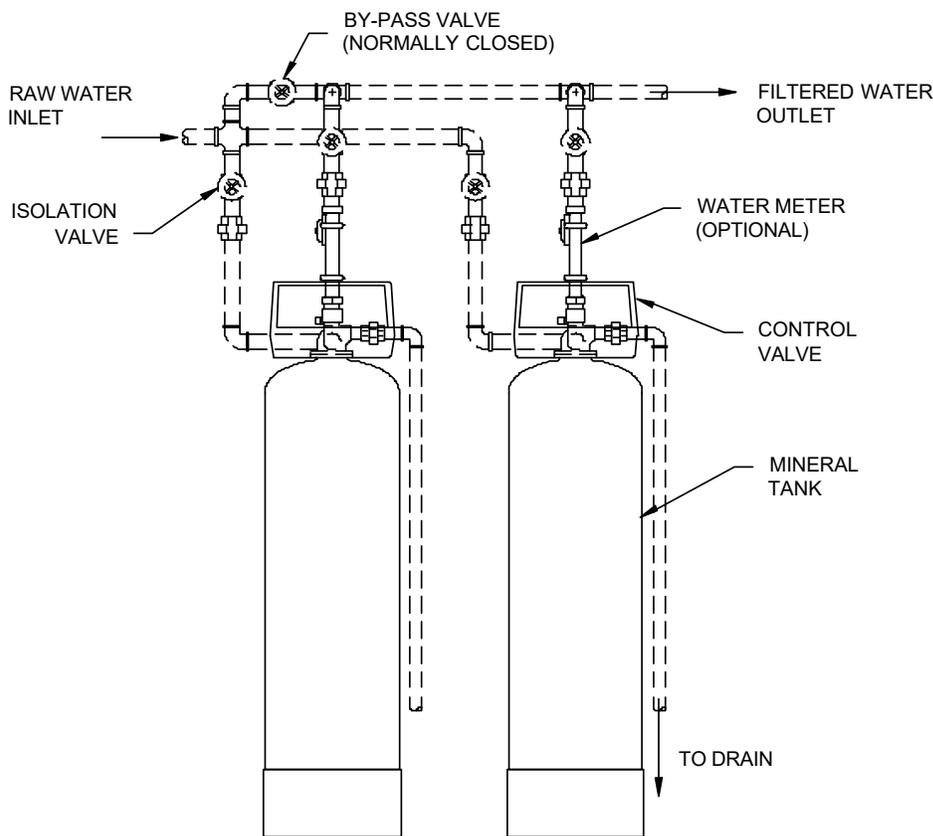


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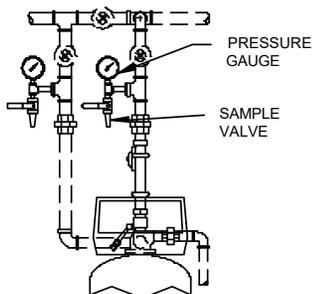
ALL PIPING, FITTINGS,  
ECT. SHOWN IN DOTTED  
LINES ARE SUPPLIED  
BY OTHERS.

GENERAL PLUMBING  
CONNECTIONS ARE  
SHOWN FOR CLARITY  
ONLY.

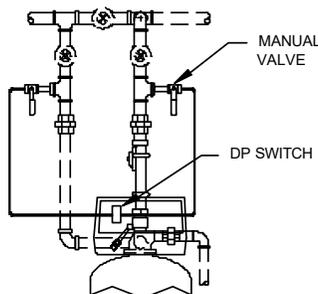
CONSULT I/O MANUAL  
FOR EXACT PLUMBING  
CONNECTIONS OF THE  
CONTROL VALVE.



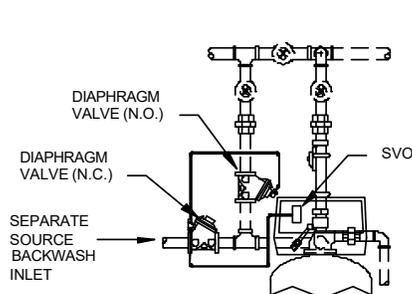
**PRESSURE GAUGE &  
SAMPLE VALVE OPTION**



**DIFFERENTIAL PRESSURE  
SWITCH INITIATION OPTION**



**SEPARATE SOURCE  
BACKWASH OPTION**



**MFG 1" (2750) TWIN FILTER  
GENERAL ARRANGEMENT DRAWING**

FRAC. #	DEC. #	SCALE	SHEET	OF	REV.
		NTS	1	1	0
DRN.	BCD	FILE ID.	DRAWING NO.		
		MFG 2750 TWIN			
APPD.	DATE				
	5-9-03				

**CONTROL VALVE FILTER  
STANDARD**

**REVISIONS**

NO.	DATE	BY	REMARKS

**SPECIFICATION CHART**

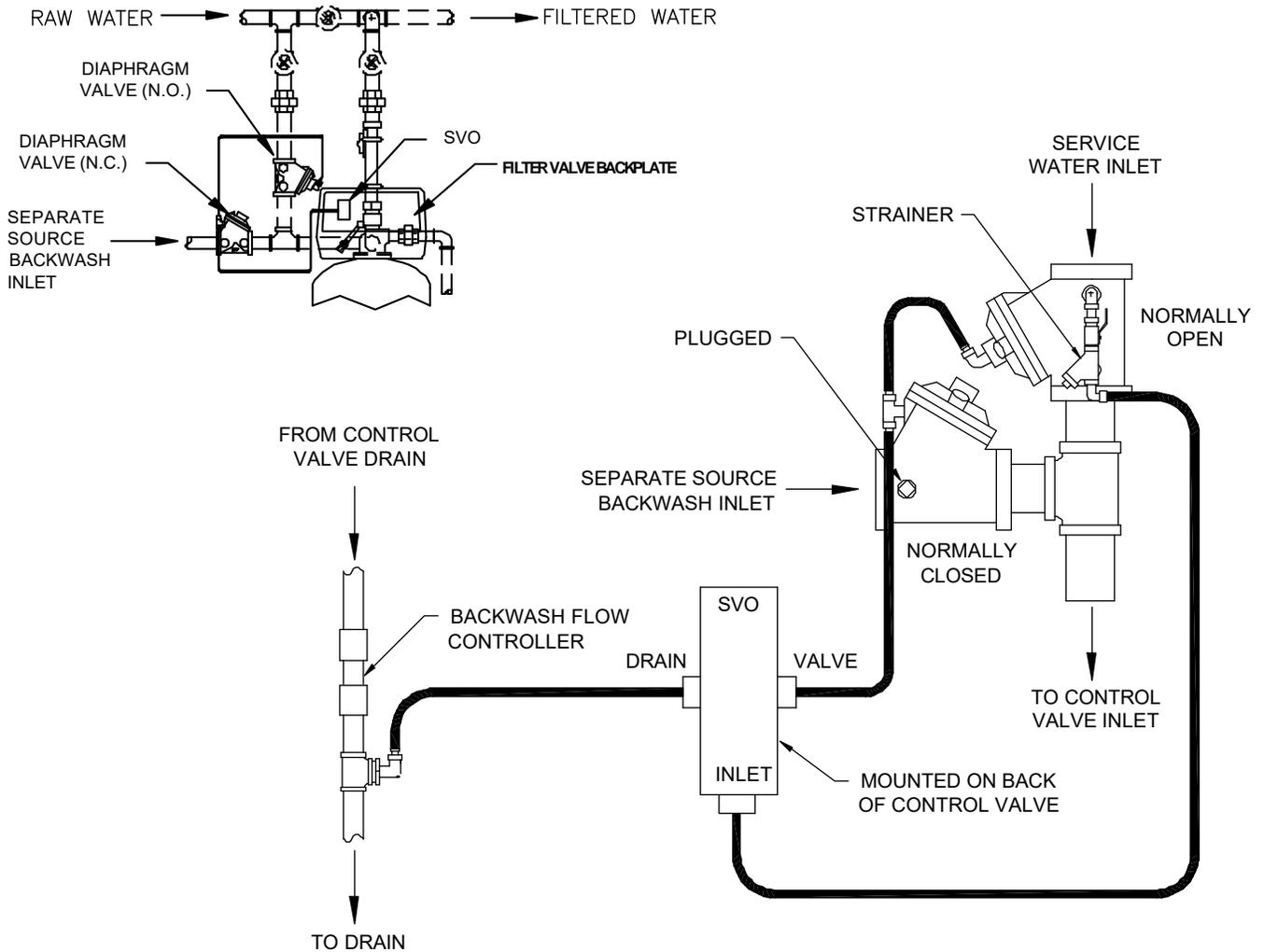
MODEL MID -		10G	12G	14G	16G	18G	
SYSTEM SIZE	Service Connection (in)	1	1	1	1	1	
	Drain Connection (in)	3/4	3/4	3/4	3/4	3/4	
FLOWRATE (GPM)	Service - Normal (gpm)	5	8	10	14	17	
	Service - DP (gpm)	2	5	4	6	8	
	Service - Peak (gpm)	10	16	20	28	34	
	Service - DP (gpm)	6	10	13	21	29	
	Backwash & Fast Flush (gpm)	8	12	15	20	25	
	Settle (gpm)	0	0	0	0	0	
TIMER SETTINGS	Backwash	Pins	8	8	8	8	8
		Minutes	16	16	16	16	16
	Settle	Pins	3	3	3	3	3
		Minutes	6	6	6	6	6
	Fast Flush	Pins	3	3	3	3	3
		Minutes	6	6	6	6	6
	Settle	Pins	2	2	2	2	2
		Minutes	4	4	4	4	4
	Return to Service	Pins	2	2	2	2	2
		Minutes	4	4	4	4	4
	TANK	Size - Dia. x Ht. (in)	10x54	12x52	14x65	16x65	18x65
		Gravel Subfill (lbs)	20	40	60	80	80
Media		1	2	3	4	5	
MEDIA LOADING AMOUNTS (LBS)	Anthracite - Top Layer	28	56	73	95	123	
	Red Sand	30	60	80	100	135	
	Garnet 30-40	30	55	75	95	120	
	Garnet 8-12	20	40	55	70	90	
	Gravel - Bottom Layer	20	40	60	80	80	

VOLUME (Cu. Ft.) VERSUS WEIGHT (LBS) OF MEDIA		
ANTHRACITE "C"	56# per Cu. Ft.	1 Cu. Ft. per bag
RED SAND	100# per Cu. Ft.	100# per bag
GARNET 30-40	130# per Cu. Ft.	50# per bag
GARNET 8-12	140# per Cu. Ft.	50# per bag
GRAVEL	100# per Cu. Ft.	100# per bag
NOTE: Bag size may vary. Please confirm weight and volume before loading. Consult Media sheets on media pallet.		

**SEPARATE SOURCE BACKWASH (OPTIONAL)**

This option allows the filter to use a separate water source for backwashing the system. The separate source uses diaphragm valves to control the flow of the backwash water. The diaphragm valves are controlled by a SVO (Service Valve Operator) that is mounted to the filter valve backplate.

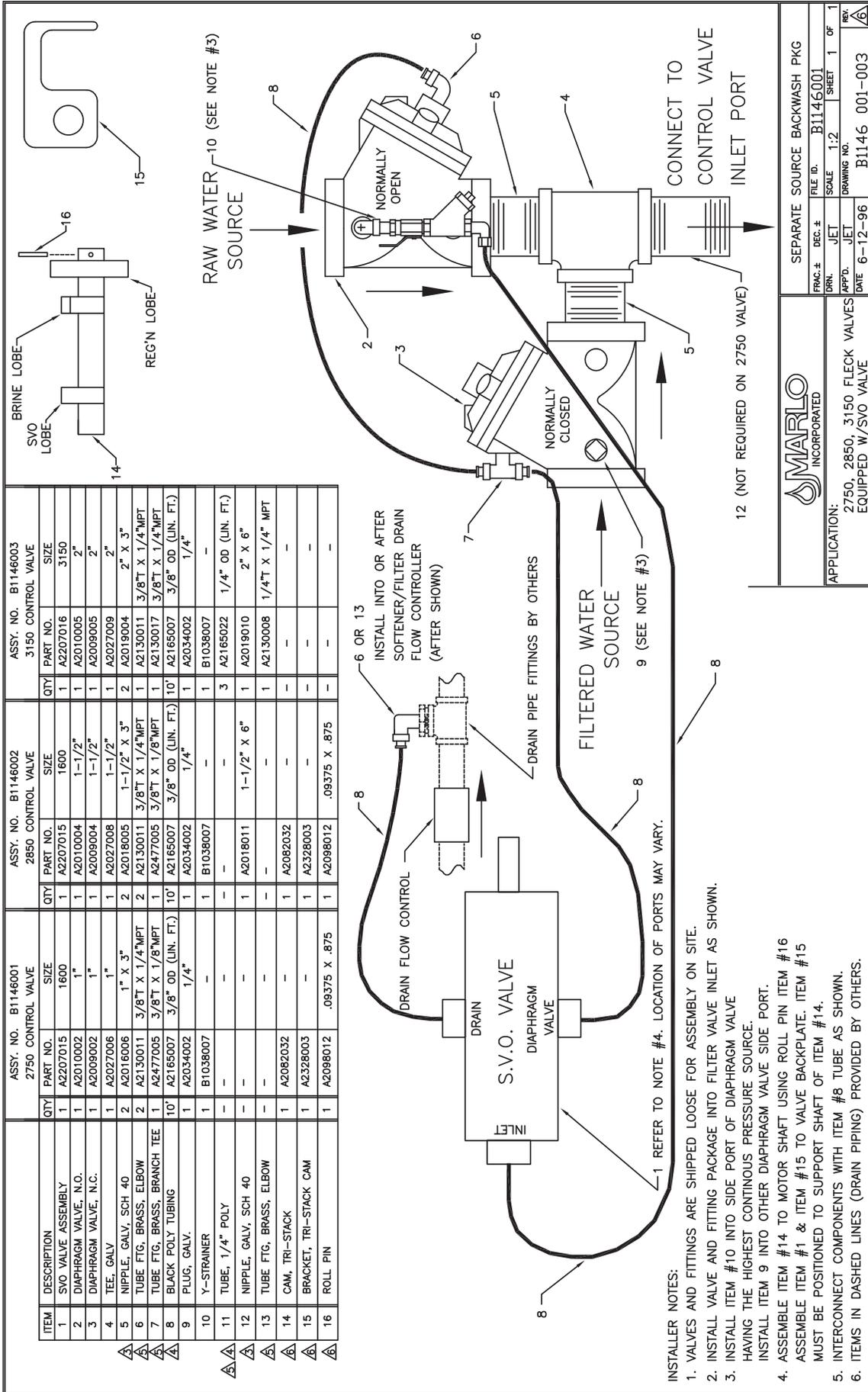
The piston in the SVO Valve is actuated by a cam on the filter valve motor shaft. Extending the piston will allow Raw Water flow. Depressing the piston will allow Separate Source water flow.



ACTUAL SVO PORT LOCATIONS MAY VARY.

DRAWING IS SHOWN FOR CLARITY ONLY.

INSTALL THE STRAINER ASSEMBLY INTO THE INLET BOSS OF THE VALVE WITH THE HIGHEST PRESSURE. PLUG THE OTHER VALVE'S INLET BOSS.



ASSY. NO. B1146001 2750 CONTROL VALVE				ASSY. NO. B1146002 2850 CONTROL VALVE				ASSY. NO. B1146003 3150 CONTROL VALVE			
ITEM	DESCRIPTION	QTY	PART NO.	SIZE	QTY	PART NO.	SIZE	QTY	PART NO.	SIZE	
1	S.V.O. VALVE ASSEMBLY	1	A2207015	1600	1	A2207015	1600	1	A2207015	3150	
2	DIAPHRAGM VALVE, N.O.	1	A2010002	1"	1	A2010004	1-1/2"	1	A2010005	2"	
3	DIAPHRAGM VALVE, N.C.	1	A2009002	1"	1	A2009004	1-1/2"	1	A2009005	2"	
4	TEE, GALV.	1	A2027006	1"	1	A2027008	1-1/2"	1	A2027009	2"	
5	NIPPLE, GALV, SCH 40	2	A2016006	1" X 3"	2	A2018005	1-1/2" X 3"	2	A2019004	2" X 3"	
6	TUBE FTG. BRASS, ELBOW	2	A2130011	3/8" T X 1/4" MPT	2	A2130011	3/8" T X 1/4" MPT	2	A2130011	3/8" T X 1/4" MPT	
7	TUBE FTG. BRASS, BRANCH TEE	1	A2477005	3/8" T X 1/8" MPT	1	A2477005	3/8" T X 1/8" MPT	1	A2130017	3/8" T X 1/4" MPT	
8	BLACK POLY TUBING	10'	A2165007	3/8" OD (LIN. FT.)	10'	A2165007	3/8" OD (LIN. FT.)	10'	A2165007	3/8" OD (LIN. FT.)	
9	PLUG, GALV.	1	A2034002	1/4"	1	A2034002	1/4"	1	A2034002	1/4"	
10	Y-STRAINER	1	B1038007	-	1	B1038007	-	1	B1038007	-	
11	TUBE, 1/4" POLY	-	-	-	-	-	-	3	A2165022	1/4" OD (LIN. FT.)	
12	NIPPLE, GALV, SCH 40	-	-	-	1	A2018011	1-1/2" X 6"	1	A2019010	2" X 6"	
13	TUBE FTG. BRASS, ELBOW	-	-	-	-	-	-	1	A2130008	1/4" T X 1/4" MPT	
14	CAM, TRI-STACK	1	A2082032	-	-	-	-	-	-	-	
15	BRACKET, TRI-STACK CAM	1	A2328003	-	1	A2328003	-	-	-	-	
16	ROLL PIN	1	A2098012	.09375 X .875	1	A2098012	.09375 X .875	-	-	-	

- INSTALLER NOTES:**
1. VALVES AND FITTINGS ARE SHIPPED LOOSE FOR ASSEMBLY ON SITE.
  2. INSTALL VALVE AND FITTING PACKAGE INTO FILTER VALVE INLET AS SHOWN.
  3. INSTALL ITEM #10 INTO SIDE PORT OF DIAPHRAGM VALVE HAVING THE HIGHEST CONTINUOUS PRESSURE SOURCE. INSTALL ITEM 9 INTO OTHER DIAPHRAGM VALVE SIDE PORT.
  4. ASSEMBLE ITEM #14 TO MOTOR SHAFT USING ROLL PIN ITEM #16 ASSEMBLE ITEM #1 & ITEM #15 TO VALVE BACKPLATE. ITEM #15 MUST BE POSITIONED TO SUPPORT SHAFT OF ITEM #14.
  5. INTERCONNECT COMPONENTS WITH ITEM #8 TUBE AS SHOWN.
  6. ITEMS IN DASHED LINES (DRAIN PIPING) PROVIDED BY OTHERS.

**MARLO**  
INCORPORATED

APPLICATION:  
2750, 2850, 3150 FLECK VALVES  
EQUIPPED W/SVO VALVE

SEPARATE SOURCE BACKWASH PKG

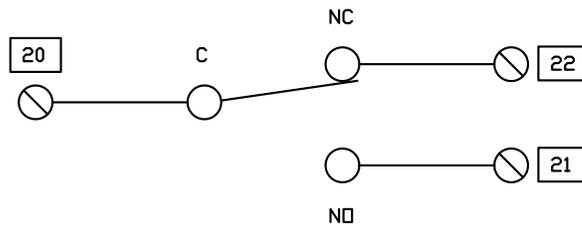
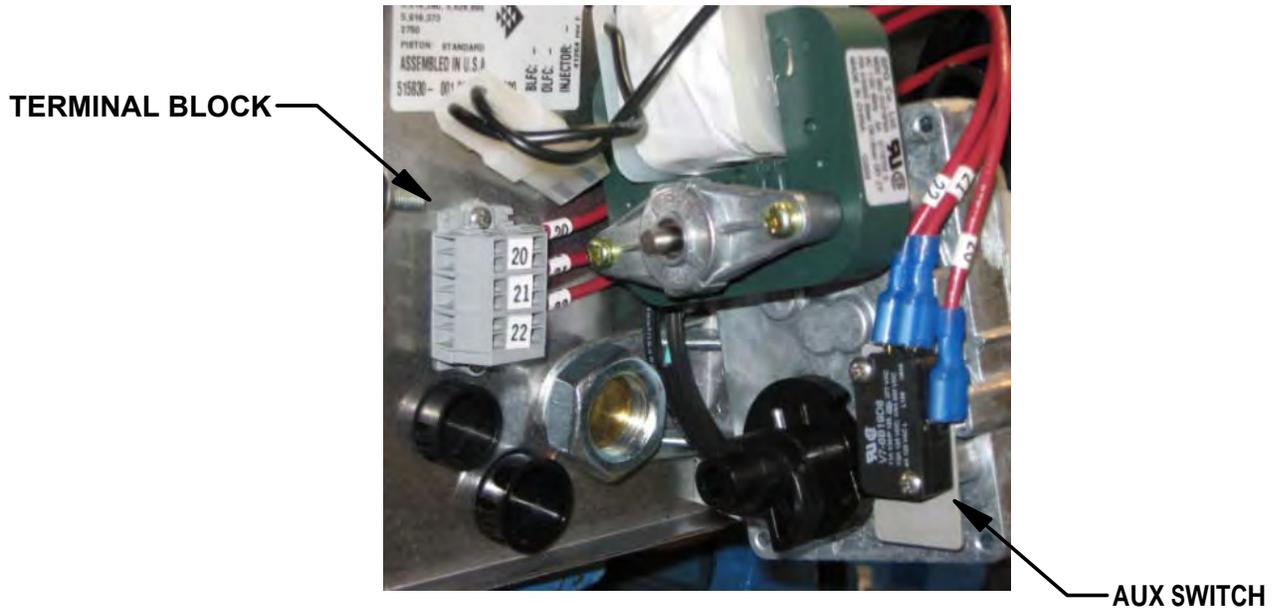
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DRN.	JET	SCALE	1:2
APP'D.	JET	DRAWING NO.	B1146 001-003
DATE	6-12-96		

12 (NOT REQUIRED ON 2750 VALVE)

**AUX SWITCH (OPTIONAL)**

The Aux Switch Option provides an extra switch on the brine valve cam assembly that ties to the terminal strip located on the back-plate of the valve. The switch provides a dry contact circuit that changes status dependent on filter valve's step. It is most commonly used to lockout an RO activate a pump, or activate separate source inlet valves.

The switch is normally closed during service and normally open during regeneration.



STEP	DRY CONTACT STATUS	
	OPEN	CLOSED
SERVICE	20-21	20-22
BACKWASH// REGENERATION	20-22	20-21

Contact Rating: 220 VAC Max. / 2.0 AMP Max.

AUX SWITCH (OPTIONAL)

PN	QTY	DESCRIPTION
MICROSWITCH ASSEMBLY		
A2154001	1	MICROSWITCH VALVE / STAGER RD LOCKOUT
A2083027	2	SCREW 4-40 X 1/2 SELF TAP PHIL MACH
A2490014	1	CAM SHUTOFF VALVE (12777)
A2098012	1	ROLL PIN .09375 X .875 (10338)
A2158001	1	INSULATOR LIMIT SWITCH (10302)
TERMINAL STRIP ASSEMBLY		
A2445043	1	END STOP W / FIXING FLANGE
A2307015	3	TERMINAL BLOCK GRAY 15A 300V
A2457003	2	SCREW 6-32 X 3/8 MACH RD HD SS
A2095048	2	6-32 NUTS SS
A2486021	2	WASHER LOCK #6 SPLIT SS
A2173009	3 FT	WIRE 16 RED

CONSTRUCTION NOTES:

1. INSTALL MICROSWITCH ASSEMBLY NEXT TO BRINE VALVE CAM ASSEMBLY ON VALVE.
2. INSTALL THE 3 TERMINALS AND LABEL THE TERMINALS NUMBERS 20, 21, 22.
3. WIRE THE MICROSWITCH USING 16 AWG RED WIRE.
4. WIRE AS FOLLOWS:

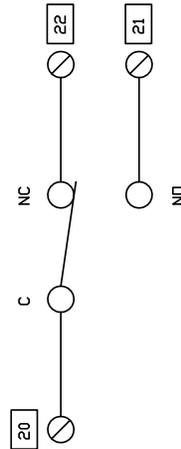
COMMON TO 20  
NORMALLY OPEN TO 21  
NORMALLY CLOSED TO 22

LOCKOUT SWITCH NOTES:

2900 AND 3900 VALVE ALREADY USES THIS SWITCH FOR ITS OPERATION.  
3150 VALVE SYSTEM 4. THIS SWITCH IS ALREADY INSTALLED ON THE VALVE  
AND IS AVAILABLE FOR RD LOCKOUT USE.

WIRING DIAGRAM OF AUXILIARY SWITCH (5 AMP MAXIMUM)

SWITCH ON NORMALLY CLOSED SIDE DURING SERVICE. NORMALLY OPEN DURING REGENERATION.



NO.	DATE	BY	REVISIONS	REMARKS

		BRINE VALVE CAM SWITCH ADDITION TO TOP MOUNT MULTIPOINT VALVE	
FRAC.#	REC.#	FILE ID.	B1055006
DRN.	JEC	SCALE	N.T.S.
APP'D.		SHEET	1 OF 1
		DRAWING NO.	B1055006
		DATE	2-3-04

## INSTALLATION INSTRUCTIONS

### GENERAL INFORMATION

1. Minimum operating pressure is 25 psi. If pressures less than 25 psi are encountered, a pump must be installed.
2. Maximum operating pressure is 120 psi. If pressures greater than 120 psi are encountered, a pressure regulator must be installed.
3. Power requirements are shown on inside cover of the control valve.
4. Standard units are designed to condition unheated water not to exceed 100° F. Special valve assemblies are available to handle heated water supplies exceeding 100°F. Consult factory if applicable.
5. Each mineral tank is shipped with distributor manifold and control valve preassembled. Take care when uncrating and erecting so that no items are damaged.
6. The distributor assembly has been shipped inside the fiberglass mineral tank. Check to make sure that there is no damage to the riser pipe, basket, laterals, or hub.

### LOCATE MINERAL TANKS

1. Select a location that is accessible and near a floor drain that has adequate carrying capacity to handle the water conditioner backwash flow. See specification table for the backwash flow rate.
2. Erect the mineral tanks on a concrete or other firm foundation and level.
3. A grounded electric receptacle is required for the control valves.

### LOAD FILTER TANKS

1. On tank sizes 10” and 12” the media has been pre-loaded at the factory. Skip this section and go to “Mount Control Valve Assembly”.
2. Fill tank(s) approximately 1/3 full of water using a hose, bucket, etc. Plug the PVC distributor manifold pipe using a plastic cap, cork, rag, etc. No gravel or resin should go into this distributor manifold pipe.
3. Verify the distributor manifold is center in the tank with the distributor resting on the bottom of the tank. Verify the riser pipe is still plugged.  
**Note:** Reference the specification table in the front of this manual for the correct quantities of gravel and media. Note that these quantities are for each tank. Make sure you have the required amounts on site before you begin.
4. With care not to damage any lateral, pour in the gravel provided for each tank through the top opening in the tank and level out evenly. This will cover the distributor assembly.  
**Note:** Wetting the gravel in the bags before loading will eliminate the normal amount of dust.
5. When gravel is loaded and leveling is completed, proceed as follows:
6. Refer to the specification table for the correct amounts and the order of media. Load the bottom layer first and work your way up to the top layer. With the distributor riser pipe still plugged, add the proper amount of media supplied for each tank through the top opening in the tank and then level the media layer.
7. Repeat step 6 for each type of media.
8. When loading is complete, remove plastic cap, cork, or rag that was used to plug the distributor riser pipe. Be careful not to let any foreign debris fall into the pipe. The result could be damage to system.
9. Repeat instruction steps 1-8 for each media tank.



**MOUNT CONTROL VALVE ASSEMBLY**

1. Verify that the distributor riser pipe is not plugged.
2. Lubricate the distributor O-ring on the bottom of the control valve with silicone.
3. Insert disperser in threaded base of control valve. The threaded base has a groove machined into the inside of the threaded part of the base to allow for the installation of this disperser.
4. Screw control valve into top opening of tank making sure the distributor riser pipe slides easily through the distributor O-ring. Care must be taken not to “nick” this O-ring as hard water leakage could result.
5. Tighten down the control valve to ensure positive O-ring seal at top of tank.
6. Repeat instruction steps 1-5 for each filter tank.

**INSTALLATION OF CONNECTION PIPING****Note:**

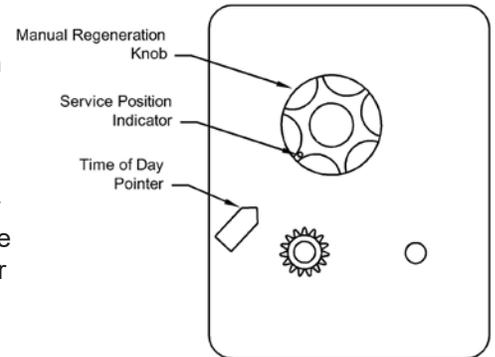
- Use thread sealing tape on all threaded piping connections.
- Install the piping conforming to federal, provincial, and local codes.
- Union or flanges are recommended at the control valve’s inlet, outlet, and drain connections
- To enhance the monitoring of the system’s performance sample valves and pressure gauges can be installed at the inlet and outlet piping to each control valve.
- If distance of drain line is over a 10 ft. vertical or 25 ft. horizontal run, increase drain line one pipe size over that provided on the control valve.
- Do not make a direct connection to the drain. Provide an air gap of at least four times the diameter of the pipe to conform to sanitation codes and to permit observation of the flow.

**Caution:** All piping must be properly supported. The tank and valve assemblies are not meant to support the connecting piping.

1. Install piping as shown on installation diagram. It is recommended that unions be installed on inlet and outlet connections to facilitate service of unit. Be sure piping is free of thread chips and other foreign matter. The connecting piping should be the same size or larger than the service inlet and outlet of the control valve. On multiple units that are both in service at the same time the common service inlet and outlet headers should be up-sized to accommodate the total flow.
2. Verify that the flow arrow stamped on the brass flow controller is pointing away from the control valve. See installation diagram or valve manual for the location. Install a drain line from backwash control assembly to an appropriate drain using a minimum of elbows. Install a union near the backwash control to facilitate cleaning. Do not install a valve on the drain line.

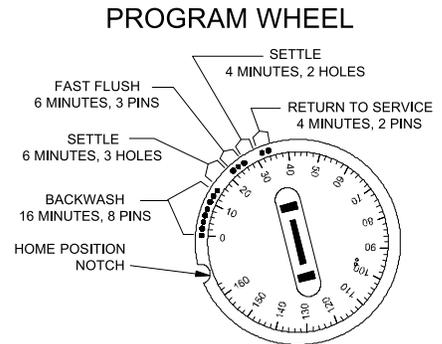
## START-UP

1. Make sure all plumbing is complete and tight including drain line(s). Make all electrical connections per wiring diagrams provided.
2. Make sure inlet and outlet isolation valves are closed, and then turn on power to the system.
3. Remove the black plastic cover from the control valve. The regeneration cycle timer is secured to the backplate of the control valve. The timer is hinged on the right side. Grab the upper left corner of the timer and pull towards you. The timer will swing out to the right. The backside of the timer has a program wheel with holes and pins in it. Each hole or pin represents two (2) minutes.



The holes and pins control the regeneration cycle times as follows:

- |                                     |                       |
|-------------------------------------|-----------------------|
| <b>Step 1 - (Backwash)</b>          | First group of pins   |
| <b>Step 2 - (Settle)</b>            | First group of holes  |
| <b>Step 3 - (Fast Rinse)</b>        | Second group of pins  |
| <b>Step 4 - (Settle)</b>            | Second group of holes |
| <b>Step 5 - (Return to Service)</b> | Third group of pins   |



4. Locate the manual regeneration knob on the front side of the timer. Slightly turn the knob clockwise. The control valve will advance to backwash position. Be patient this will take several minutes.
5. Remove electrical power from unit, and then slowly open inlet water valve approximately half open. Water will begin to fill through bottom distributor into tank. When tank is full, water will begin to flow out of drain line. Slowly pen the inlet valve until full open. Allow water to flow from drain line for approximately 15 minutes.
 

**Note:** Carbon filters will normally have considerable black fines on the initial backwash and may take 10-15 minutes to run clear. Monitor this drain water flow carefully. There is a problem if you see media in the drain water. Turn off inlet water immediately and then consult factory.
6. Restore electrical power to unit. Advance the control valve to settle position, using the same method as step 5. There should also be to flow at the drain line.
7. Advance the control valve to the fast rinse position. Remove electrical power to the unit. Let water run to drain position for approximately 5 minutes or until water runs clear.
8. Advance control valve to service position.
9. Proceed to start up the next tank (if applicable), by repeating steps 1-8.

### SETTING THE TIME / DAY CLOCK

#### How to set the time of day:

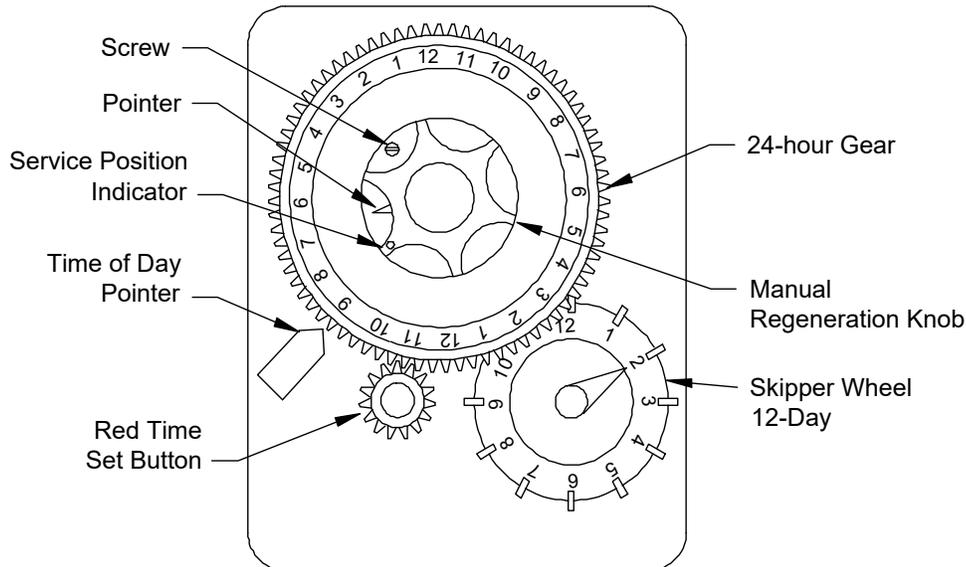
1. Press and hold the red button in to disengage the drive gear.
2. Turn the large gear until the actual time is at the time of day pointer.
3. Release the red button to again engage the drive gear.

#### How to set days on which the filter is to regenerate:

1. Rotate the skipper wheel until the number "1" is at the red pointer.
2. Set the day that regeneration is to occur by sliding tabs on the skipper wheel outward to expose trip fingers. Each tab is one day. Finger at red pointer is tonight.
3. Moving clockwise from the red pointer, extend or retract fingers to obtain the desired regeneration schedule.

#### How to manually regenerate your Water Conditioner at any time:

Turn the manual regeneration knob clockwise. This slight movement of the manual regeneration knob engages the program wheel and starts the regeneration program. The manual regeneration knob will make one revolution in approximately three hours and stop in the position shown in the drawing. Even though it takes three hours for this center knob to complete one revolution, the regeneration cycle of your unit might be set only half of this time. In any event, conditioned water may be drawn after rinse water stops flowing from the water conditioner drain line.



#### How to adjust the time of day regeneration occurs:

1. Disconnect the power source.
2. Locate the three screws behind the manual regeneration knob by pushing the red button in and rotating the 24-hour dial until each screw appears in the cut out portion of the manual regeneration knob.
3. Loosen each screw slightly to release the pressure on the time plate from the 24-hour gear.
4. Locate the regeneration time pointer on the inside of the 24-hour dial in the cutout. The pointer is hard to see.
5. Turn the time plate so the pointer on the desired regeneration time aligns next to the raised arrow.
6. Push the red button in and rotate the 24-hour dial. Tighten each to the three screws.
7. Push the red button and locate the pointer one more time to ensure the desired regeneration time is correct.
8. Reset the time of day and restore power to the unit.

**Note:** On twin or triple unit filters with time clock controls, each unit should be set to regenerate on different days or different times to avoid simultaneous regenerations.

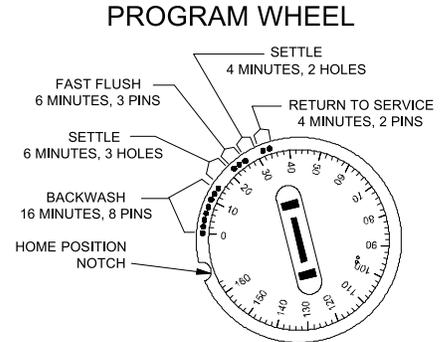
**Note:** The screw and pointer are shown for reference only. There is only one cutout in the knob

**SETTING THE REGENERATION CYCLE PROGRAM TIMER**

The regeneration cycle program on your water softener has been factory set. However, portions of the cycle program may be lengthened or shortened in time to suit local conditions. The regeneration cycle timer is secured to the back-plate of the control valve. The timer is hinged on the right side. Grab the upper left corner of the timer and pull towards you. The timer will swing out to the right. The backside of the timer has a program wheel with holes and pins in it.

The holes and pins control the regeneration cycle times as follows:

- |                                     |                       |
|-------------------------------------|-----------------------|
| <b>Step 1 - (Backwash)</b>          | First group of pins   |
| <b>Step 2 - (Settle)</b>            | First group of holes  |
| <b>Step 3 - (Fast Rinse)</b>        | Second group of pins  |
| <b>Step 4 - (Settle)</b>            | Second group of holes |
| <b>Step 5 - (Return to Service)</b> | Third group of pins   |



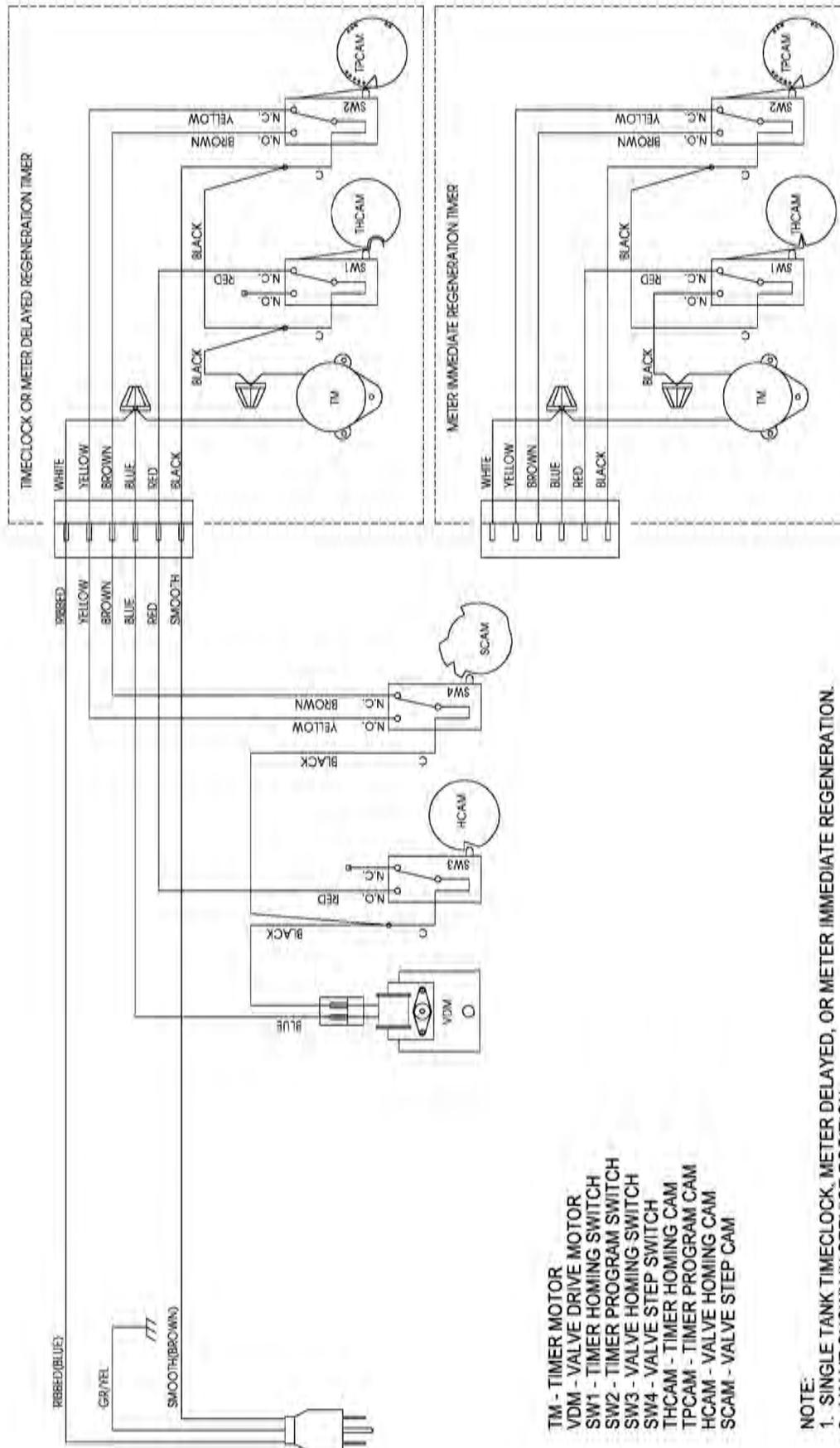
- **Backwash:** The cycle duration is factory set at 16 minutes for clean feed water applications. Increase time if turbidity is present in the feed water.
- **Settle:** The cycle duration is factory set at 6 minutes for clean feed water applications.
- **Fast Flush:** The cycle duration is factory set at 6 minutes.
- **Settle:** The cycle duration is factory set at 4 minutes.
- **Cycle End:** The cycle duration is factory set at 4 minutes. Its purpose is to identify the end of regeneration and advance the filter back to the service cycle.

To adjust the regeneration cycle program it is easier to remove the program wheel by pushing the two black tabs located in the center of the program wheel while pushing up on the program wheel.

As you look at the number side of the program wheel, starting at zero the number of the group of pins determines the length of time that your unit will be in Backwash. If there are six pins in this section, the time of backwash will be 16 minutes (2 minutes per pin). You must add or remove pins to change the length of this time. All the following groups of holes or pins must be adjusted to maintain their original time.

**Important:** Changing the time duration in any cycle will require a readjustment of all pins and holes for all the following steps.

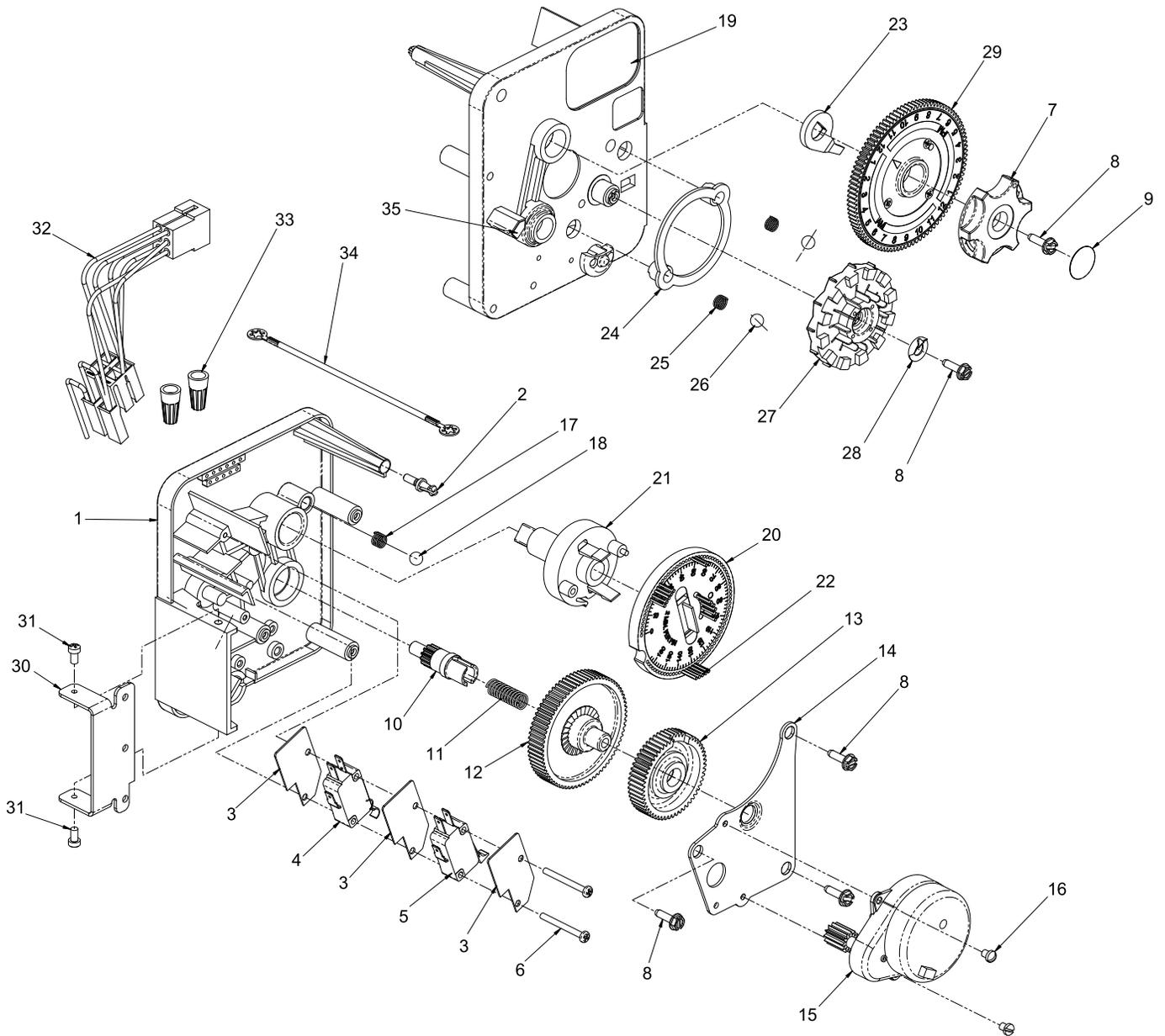
**2750 WIRING DIAGRAM**



- TM - TIMER MOTOR
- VDM - VALVE DRIVE MOTOR
- SW1 - TIMER HOMING SWITCH
- SW2 - TIMER PROGRAM SWITCH
- SW3 - VALVE HOMING SWITCH
- SW4 - VALVE STEP SWITCH
- THCAM - TIMER HOMING CAM
- TPCAM - TIMER PROGRAM CAM
- HCAM - VALVE HOMING CAM
- SCAM - VALVE STEP CAM

**NOTE:**  
 1. SINGLE TANK TIMECLOCK, METER DELAYED, OR METER IMMEDIATE REGENERATION.  
 2. VALVE SHOWN IN SERVICE POSITION.

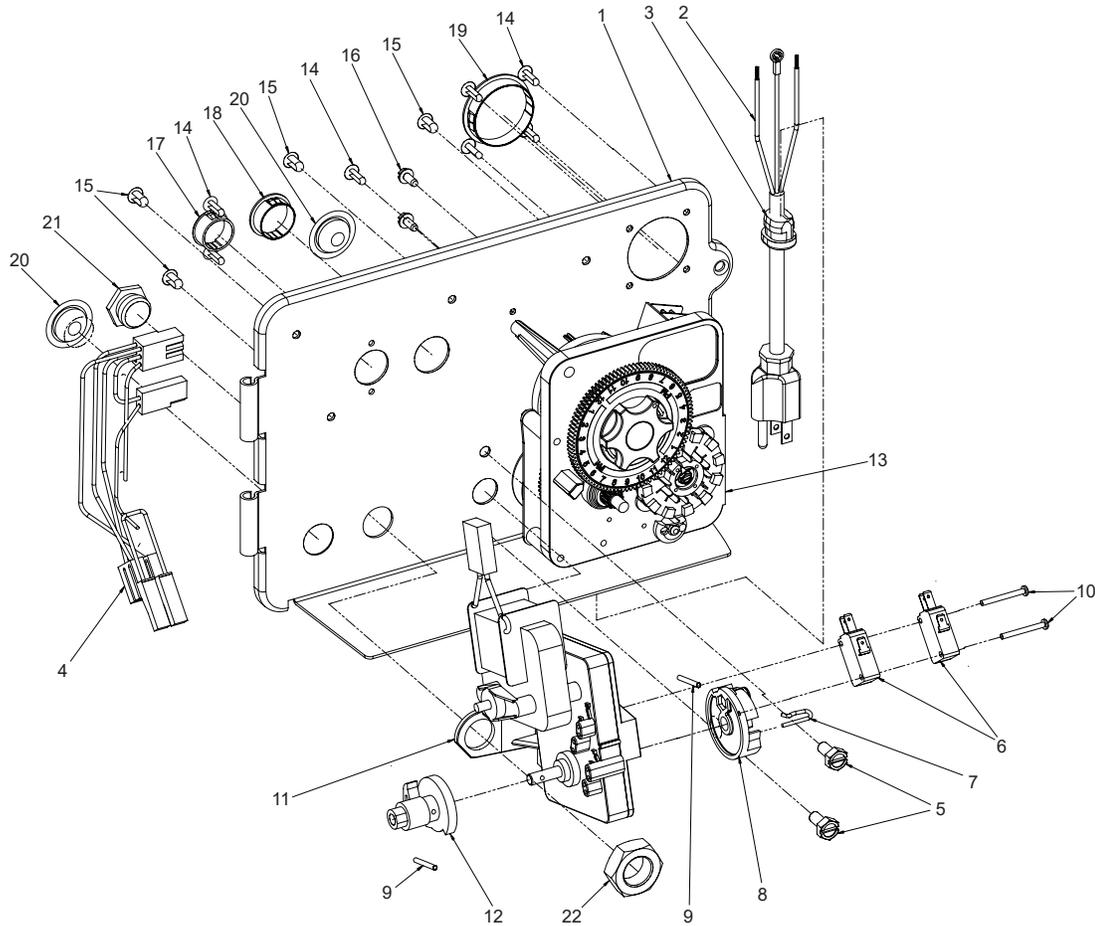
**3200 TIMER ASSEMBLY**



**3200 TIMER ASSEMBLY PARTS LIST**

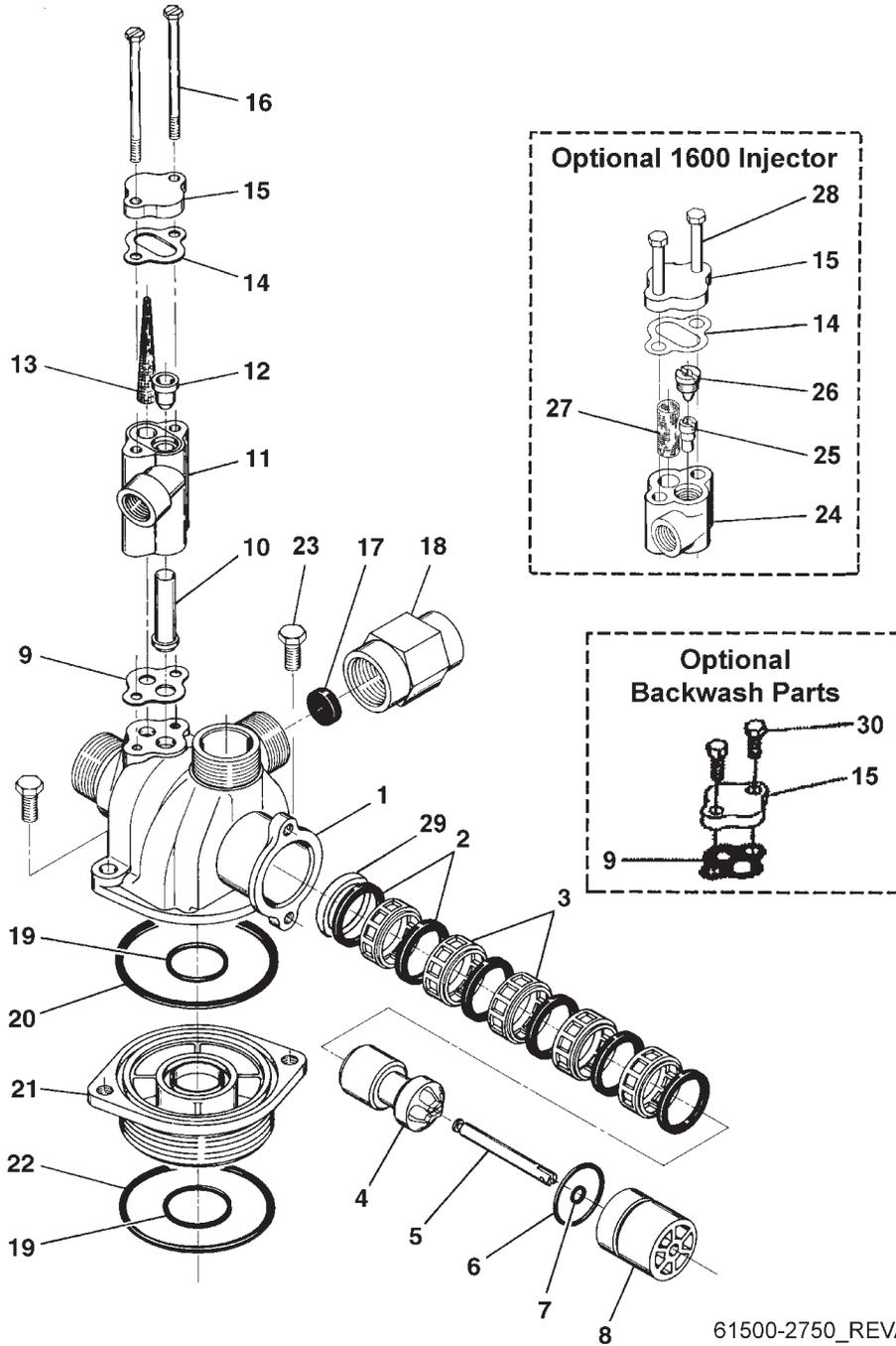
Item No.	Quantity	Part No.	Description
1	1	13870	Housing, Timer, 3200
2	1	14265	Clip, Spring
3	3	14087	Insulator
4	1	10896	Switch, Micro
5	1	15320	Switch, Micro, Timer
6	2	11413	Screw, Pan Hd Mach, 4-40 x 1-1/8
7	1	13886	Knob, 3200
8	5	13296	Screw, Hex Wsh, 6-20 x 1/2
9	1	11999	Label, Button
10	1	13018	Pinion, Idler
11	1	13312	Spring, Idler Shaft
12	1	13017	Gear, Idler
13	1	13164	Gear, Drive
14	1	13887	Plate, Motor Mounting
15	1	18743-1	Motor, 120V, 60Hz, 1/30 RPM, 5600
		19659-1	Motor, 24V, 60Hz, 1/30 RPM
16	2	13278	Screw, Slt'd Fillister Hd 6-32 x .156
17	1	15424	Spring, Detent, Timer
18	1	15066	Ball, 1/4", Delrin
19	1	15465	Label, Caution
20	1	19210	Program Wheel Assy
21	1	13911	Gear, Main Drive, Timer
22	17	41754	Pin, Spring, 1/16 x 5/8 SS, Timer
23	1	13011	Arm, Cycle Actuator
24	1	13864	Ring, Skipper Wheel
25	2	13311	Spring, Detent, Timer
26	2	13300	Ball, 1/4", SS
27	1	14381	Skipper Wheel Assy, 12 Day
		14860	Skipper Wheel Assy, 7 Day
28	1	13014	Pointer, Regeneration
29	1	40096-24	Dial, 12 AM Regen Assy, Black
		40096-02	Dial, 2 AM Regen Assy, Black
30	1	13881	Bracket, Hinger Timer
31	2	11384	Screw, Phil, 6-32 x 1/4 Zinc
32	1	13902	Harness, 3200
33	2	40422	Nut, Wire, Tan
34	1	15354-01	Wire, Ground, 4"
35	1	14007	Label, Time of Day

2750 POWERHEAD - ENVIRONMENTAL



Item No.	Quantity	Part No.	Description
1	1	18697-13	Backplate, Hinged
2	1	11838	Power Cord, 6' Fleck
3	1	13547	Strain Relief, Cord
4	1	40400	Harness, Drive, Designer/Enviromental
5	2	10231	Scrw, Slot Hex, 1/4-20 x 1/2
6	2	10218	Switch, Micro
7	1	10909	Pin, Connecting Rod Spring
8	1	60160-15	Drive Cam Assy, STF, Blue, 2900
9	2	10338	Pin, Roll, 3/32 x 7/8
10	2	14923	Screw, Pan HD Mach, 4-40 x 1
11	1	41543	Motor, Drive, 115V/60HZ
12	1	12777	Cam, Shut-off Valve
13	1	61502-3200	Timer Assy, 3200 Clock
14	7	19800	Plug (Hole Size: Dia .140)
15	4	19801	Plug, Dia .190
16	2	10300	Screw, Hx Wash Head, 8 x 3/8
17	1	15806	Hole Plug, Heyco
18	1	16493	Plug, Hole, Heyco, .88 Dia
19	1	40306	Plug, 1.50 Hole, Dome, Heyco
20	2	19691	Plug, .750 Dia. Hole, Flush
21	1	10712	Fitting, Brine Valve
22	1	10269	Nut, Jam, 3/4-16

**2750 CONTROL VALVE**



61500-2750\_REVA

**2750 CONTROL VALVE**

Item No.	Quantity	Part No.	Description
1.....	1 .....	14749.....	Valve Body, 2750
2.....	6 .....	10545.....	Seal, Piston
3.....	5 .....	11451.....	Spacer, 12 Hole
		16589.....	Spacer, HW
4.....	1 .....	14451.....	Piston, 2750
5.....	1 .....	14452.....	Rod, Piston
6.....	1 .....	10234-01 .....	O-Ring, -024, 560CD
7.....	1 .....	10209.....	Quad Ring, -010
8.....	1 .....	10598.....	End Plug Assembly
		10598-01 .....	End Plug Assembly, Hot Water
9.....	1 .....	14805.....	Gasket, Injector Body, 1600/1700
10.....	1 .....	14802-xxc.....	Throat, Injector, -xxc is for Injector Size
11.....	1 .....	17777.....	Body, Injector, 1700
12.....	1 .....	14801-xxc.....	Nozzle, Injector, -xxc is for Injector Size
13.....	1 .....	14803.....	Screen, Injector
14.....	1 .....	10229.....	Gasket, Injector Cap, 1600
15.....	1 .....	11893.....	Cap, Injector, Stainless Steel
		10228.....	Cap, Injector, Brass
16.....	2 .....	14804.....	Screw, Hex Hd Mach, 10-24 x 2-3/4
17.....	1 .....		Washer - Flow Control (specify size)
18.....	1 .....	60365-00 .....	Housing, DLFC, 1/2"F x 3/4"F
19.....	2 .....	11710.....	O-ring, -215
20.....	1 .....	11208.....	O-ring, -232
21.....	1 .....	12461-01 .....	Adapter Base, 1" 2-1/2" - 8 Quick Connect
22.....	1 .....	10381.....	O-ring, -231
23.....	2 .....	11224.....	Screw, Hex Hd, 5/16 - 18 x 5/8
24.....	1 .....	17776.....	Body, Injector
25.....	1 .....	10914-xx.....	Throat, Injector, -xx is for Injector Size
26.....	1 .....	10913-xx.....	Nozzle, Injector, -xx is for Injector Size
27.....	1 .....	10227.....	Screen, Injector
28.....	2 .....	10692.....	Screw, Slot Hex Hd, 10-24 x 18-8 Stainless Steel
29.....	1 .....	10757.....	Spacer, End
		10757B .....	Spacer, End, Brass
30.....	1 .....	15137.....	Screw, Hex Wsh Mach, 10-24 x 3/8
Not Shown ....	1 .....	16221.....	Disperser, Air, 1600
	1 .....	17996.....	Disperser, Air, 1700

**SERVICE ASSEMBLIES****ADAPTERS - SIDE MOUNT**

A2285017 Sidemount Adapter Assembly

**AUXILIARY MICRO SWITCH**

A2203010 3200 Series Timer

**COVERS**

A2103095 Environmental

A2103043 Designer 1 piece ( only available in black )

**DRAIN LINE FLOW CONTROLS**

60366-\_\_ 1" FNPT x 3/4" FNPT ( specify flow control .6 - 7.0)

60701-\_\_ 1" FNPT x 1" FNPT ( specify flow control 8.0 - 25.0 )

60702-\_\_ 1" FNPT x 1" MNPT ( specify flow control 8.0 - 25.0 )

60708-\_\_ 1" FNPT x 3/4" FNPT ( specify flow control 8.0 - 25.0 )

60721-\_\_ 1" FNPT x 1" FNPT ( specify flow control .6 - 7.0)

**CAM ASSEMBLY**

A2300002 Separate time fill drive cam ( Black )

**PISTON ASSEMBLIES**

A2309002 2750/2900 Piston Assy Hard Water By-Pass

A2309003 2750/2900 Piston Assy Hot Water

A2309025 2750 Piston Assy No-Hard Water By-Pass

**SEAL & SPACER KITS**

A2435025 Seals &amp; Spacers Kit

A2435038 Seals &amp; Spacers Kit - Hot Water

**SERVICE EQUIPMENT**

A2475001 Seal &amp; Spacer stuffer tool

A2474001 Spacer puller tool

A2423002 Silicone, 2 oz. Tube

**SERVICE VALVE OPERATOR ASSEMBLY ( SVO )**

A2207015 Service Valve Operator Assembly - SVO



**TROUBLESHOOTING 2750 VALVE**

<b>Problem</b>	<b>Cause</b>	<b>Correction</b>
1. Water conditioner fails to regenerate.	A. Electrical service to unit has been interrupted	A. Assure permanent electrical service (check fuse, plug, pull chain, or switch)
	B. Timer is defective.	B. Replace timer.
	C. Power failure.	C. Reset time of day.
2. Untreated water.	A. By-pass valve is open.	A. Close by-pass valve
	B. Leak at distributor tube.	B. Make sure distributor tube is not cracked. Check O-ring and tube pilot.
	C. Internal valve leak.	C. Replace seals and spacers and/or piston.
3. Loss of water pressure.	A. Iron buildup in line to water conditioner.	A. Clean line to water conditioner.
	B. Iron buildup in water conditioner.	B. Clean control and add mineral cleaner to mineral bed. Increase frequency of regeneration.
	C. Inlet of control plugged due to foreign material broken loose from pipes by recent work done on plumbing system.	C. Remove piston and clean control.
4. Loss of mineral through drain line.	A. Air in water system.	A. Assure that well system has proper air eliminator control. Check for dry well condition.
	B. Improperly sized drain line flow control.	B. Check for proper drain rate.
5. Iron in conditioned water.	A. Fouled mineral bed.	A. Check backwash, brine draw, and brine tank fill. Increase frequency of re-generation. Increase backwash time.
6. Control cycles continuously.	A. Misadjusted, broken, or shorted switch.	A. Determine if switch or timer is faulty and replace it, or replace complete power head.
7. Drain flows continuously.	A. Valve is not programming correctly.	A. Check timer program and positioning of control. Replace power head assembly if not positioning properly
	B. Foreign material in control.	B. Remove power head assembly and inspect bore. Remove foreign material and check control in various regeneration positions.
	C. Internal control leak.	C. Replace seals and piston assembly.

NOTES

NOTES



2227 South Street • P.O. Box 044170 • Racine, WI 53404-7003  
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# Section 2



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**INSTALLATION, OPERATION,  
AND MAINTENANCE MANUAL**

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**ACA 1&G-1  
1" 2750 TIMECLOCK**

**COMMERCIAL 75 F6 CB: =@H9F**

COMPLETE FOR FUTURE REFERENCE:

MODEL NO:

SERIAL NO:

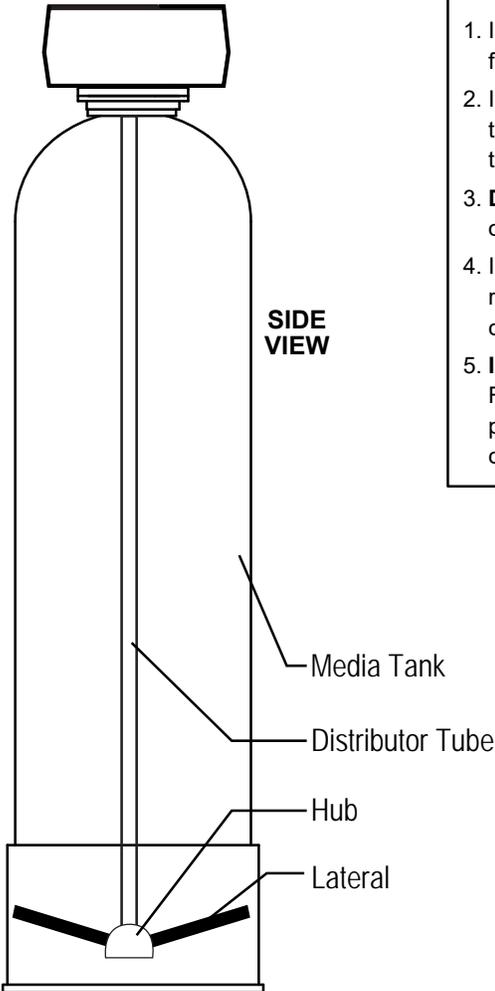
DATE INSTALLED:

DEALER:

**Marlo Incorporated**  
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P.O. Box 044170  
Racine, WI 53404-7003  
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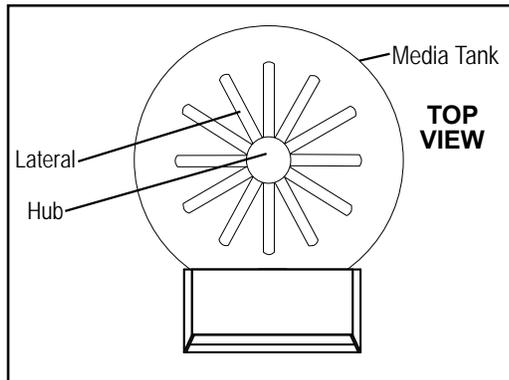
# INSTALLATION WARNING

**PRIOR TO Media Loading**

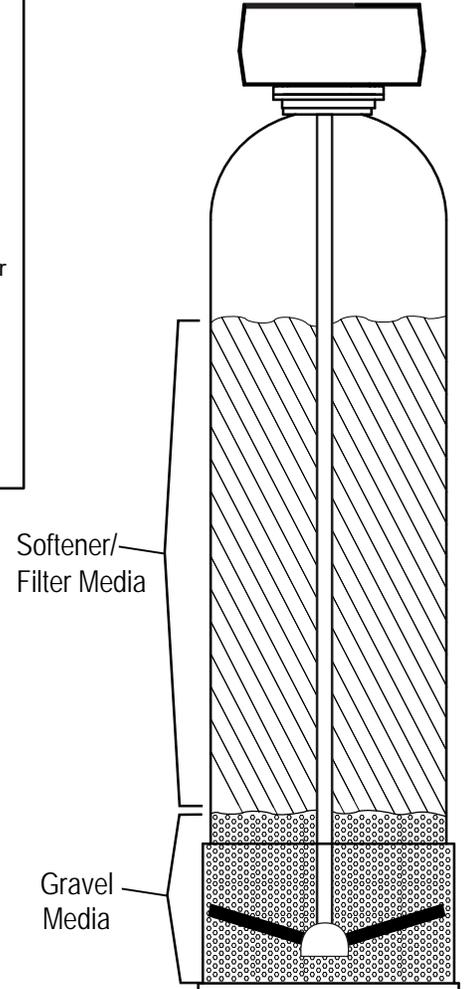


**Inspection Requirement  
Prior to Loading Media**

1. Inspect condition of upper distributor piping. Verify fittings are tight and positioned as shown.
2. Inspect condition of strainers, laterals and hub through top or side access ports. Verify fittings are secured to hub.
3. **DO NOT** load media if damaged components are observed. Contact factory.
4. Installer is responsible for media loss into treated water resulting from failure to report and repair damaged components inside media tank prior to media loading.
5. **INSTALLER WARNING:**  
Refer to installation instructions for media loading procedure. Improper loading of media will damage components inside media tank.



**AFTER Media Loading**



Please Circle and/or Fill in the Appropriate Data for Future Reference:

Filter Model: ACA/AGA/MID/MGA  
System Size: Single/Twin/Triple/Quad  
Configuration: Timeclock/Pressure Differential/Metered  
BW/Regen Time: \_\_\_\_\_ AM/PM or OFF

Additional Notes: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**IMPORTANT PLEASE READ:**

- Warranty of this product extends to manufacturing defects.
- The information, specifications and illustrations in this manual are based on the latest information available at the time of printing. The manufacturer reserves the right to make changes at any time without notice.
- This product should be installed by a plumbing professional on potable water systems only.
- This product must be installed in compliance with all local and state and municipal plumbing and electrical codes. Permits may be required at the time of installation.
- If operating pressure exceeds 100 psi a pressure reducing valve must be installed. If operating pressure drops below 30 psi a booster pump must be installed.
- Do not install the unit where temperatures may drop below 32°F or rise above 100°F.
- A prefilter should be used on installations in which free solids are present.
- A constant voltage of 120V/60Hz (unless otherwise specified) must be supplied to the controller to maintain proper function.
- Union or flange fittings are recommended at the control valve's inlet, outlet, and drain connections
- If distance of drain line is over a 10 ft. vertical or 25 ft. horizontal run, increase drain line one pipe size over that provided on the control valve.
- Do not make a direct connection to the drain. Provide an air gap of at least four times the diameter of the pipe to conform to sanitation codes and to permit observation of the flow.

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**MAINTENANCE**

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**COMMERCIAL AND INDUSTRIAL PRODUCT WARRANTY**

Marlo, Inc. warrants all commercial and industrial water treatment products manufactured and/or distributed by it to be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. If within that period any products shall be proven to Marlo, Inc.'s satisfaction to be defective, those products will be replaced or the price refunded at Marlo Inc.'s option.

Marlo Inc.'s obligations or nonperformance, defective, or any damage caused by its products or their use, and buyer's exclusive remedy therefore, shall be limited to product replacement or refund and shall be conditioned upon Marlo Inc.'s receiving written notice together with a demand for such replacement or refund:

The foregoing warranty is exclusive and in lieu of all other expressed implied warranty (except of title) including but not limited to implied warranty of merchantability and fitness for particular purpose.

**Marlo Inc. will not be subject to and disclaims the following:**

1. Any other obligations or liabilities arising out of breach of contract or out of warranty.
2. Any obligations whatsoever arising from tort claims (including negligence and strict liability) or arising under other theories of law with respect to products sold or services rendered by Marlo Inc. or any undertakings, acts, or omissions relating thereto.
3. All consequential, incidental, and contingent damages. Labor charges, change backs or handling charges are excluded from Marlo Inc.'s warranty provisions.

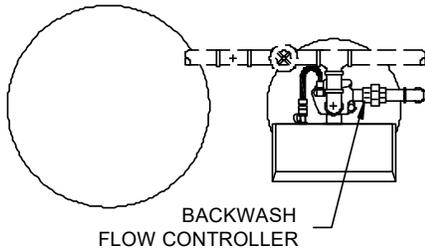
**COMMERCIAL AND INDUSTRIAL WATER CONDITIONER GUARANTEE**

Under normal operating conditions:

1. The loss of filter media through attrition during the first three (3) years shall not exceed 3% per year.
2. The filter media shall not be washed out of the system during backwash.
3. The color and turbidity of the softener effluent shall not be greater than the incoming water.

Any mechanical equipment proving defective in workmanship or material within one year after installation or eighteen (18) months after shipment, whichever comes first, shall be replaced FOB factory.



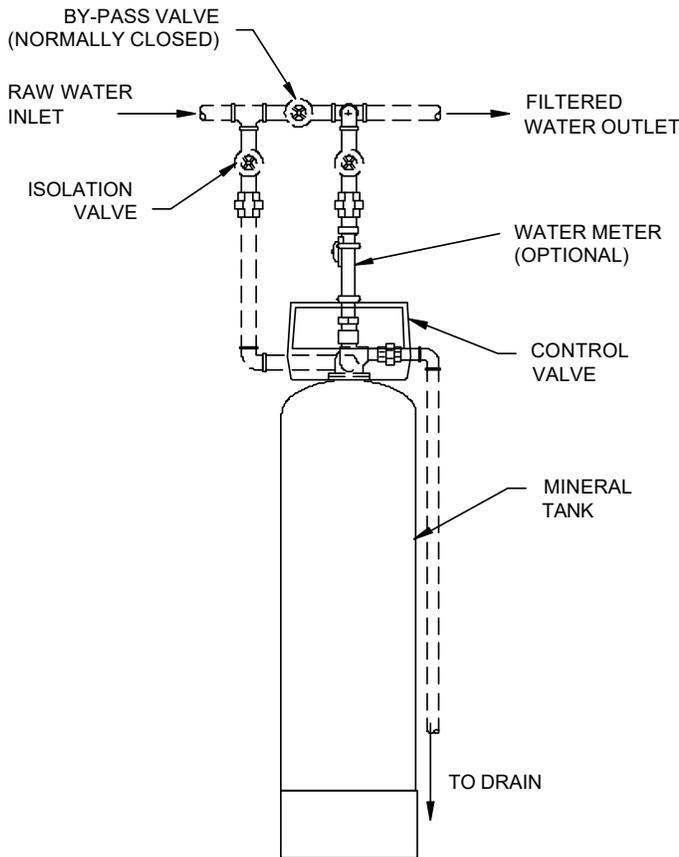


**NOTES:**

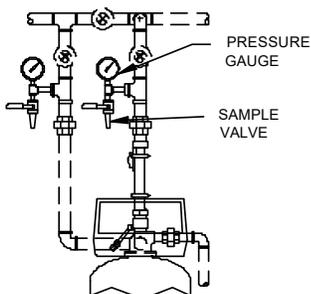
ALL PIPING, FITTINGS,  
ECT. SHOWN IN DOTTED  
LINES ARE SUPPLIED  
BY OTHERS.

GENERAL PLUMBING  
CONNECTIONS ARE  
SHOWN FOR CLARITY  
ONLY.

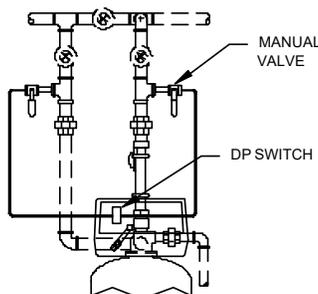
CONSULT I/O MANUAL  
FOR EXACT PLUMBING  
CONNECTIONS OF THE  
CONTROL VALVE.



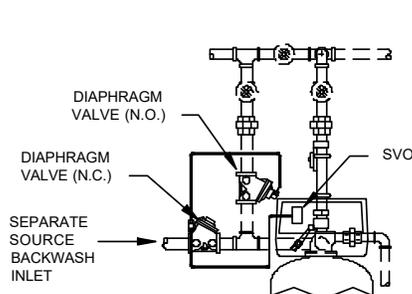
**PRESSURE GAUGE &  
SAMPLE VALVE OPTION**



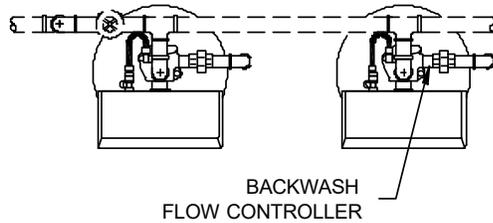
**DIFFERENTIAL PRESSURE  
SWITCH INITIATION OPTION**



**SEPARATE SOURCE  
BACKWASH OPTION**



<p><b>MFG 1" (2750) SINGLE FILTER GENERAL ARRANGEMENT DRAWING</b></p>		FILE ID.	MFG 2750 SINGLE	SHEET	1 OF 1	REV.	0
		FRAC. #	DEC. #	SCALE	NTS	DRAWING NO.	
<p><b>CONTROL VALVE FILTER STANDARD</b></p>		DRN.	BCD				
		APPD.					
<p>DATE</p>		<p>7-13-94</p>					
<p><b>REVISIONS</b></p>							
NO.	DATE	BY	REMARKS				

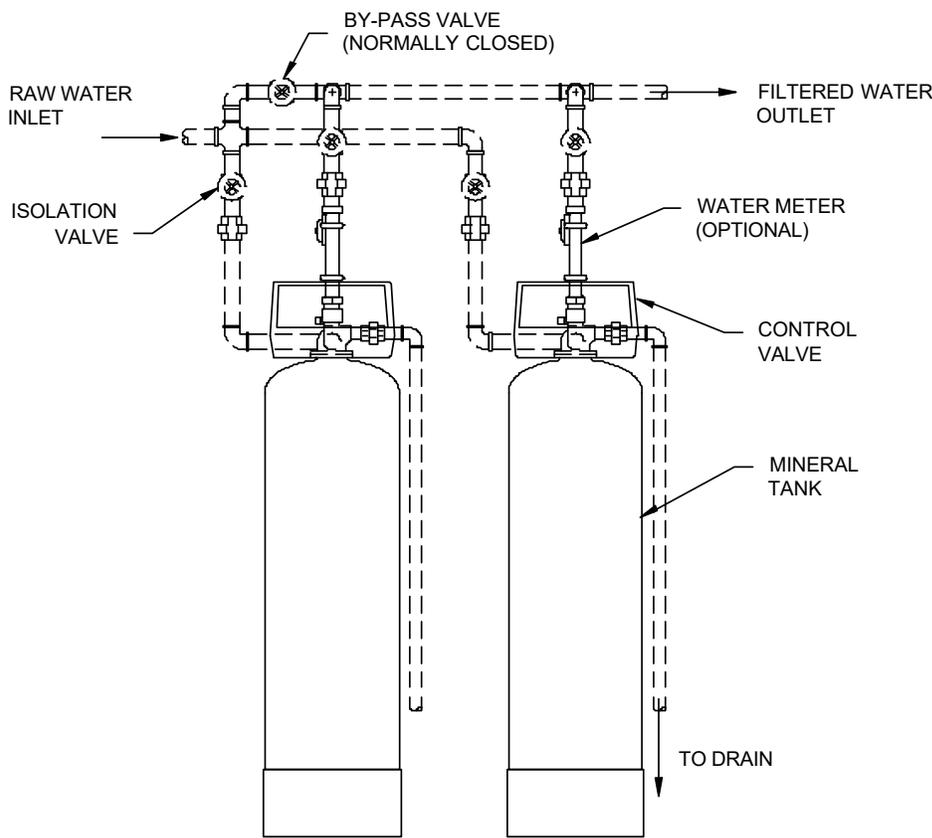


**NOTES:**

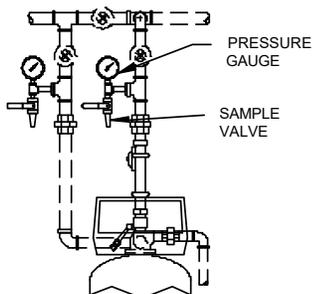
ALL PIPING, FITTINGS,  
ECT. SHOWN IN DOTTED  
LINES ARE SUPPLIED  
BY OTHERS.

GENERAL PLUMBING  
CONNECTIONS ARE  
SHOWN FOR CLARITY  
ONLY.

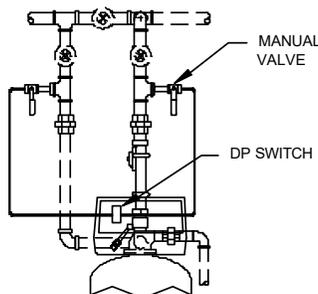
CONSULT I/O MANUAL  
FOR EXACT PLUMBING  
CONNECTIONS OF THE  
CONTROL VALVE.



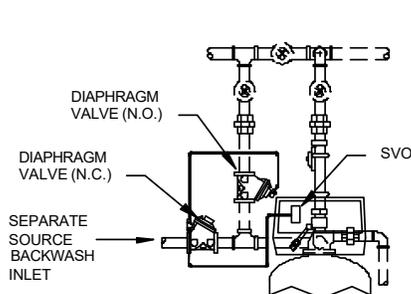
**PRESSURE GAUGE &  
SAMPLE VALVE OPTION**



**DIFFERENTIAL PRESSURE  
SWITCH INITIATION OPTION**



**SEPARATE SOURCE  
BACKWASH OPTION**



<b>MFG 1" (2750) TWIN FILTER GENERAL ARRANGEMENT DRAWING</b>		FILE ID: MFG 2750 TWIN	SHEET 1 OF 1	REV. 0
FRAC. #	DEC. #	SCALE	NTS	DRAWING NO.
DRN. BCD	APPD.	DATE	5-9-03	

<b>CONTROL VALVE FILTER STANDARD</b>	
--	--

REVISIONS		REMARKS
NO.	DATE	BY

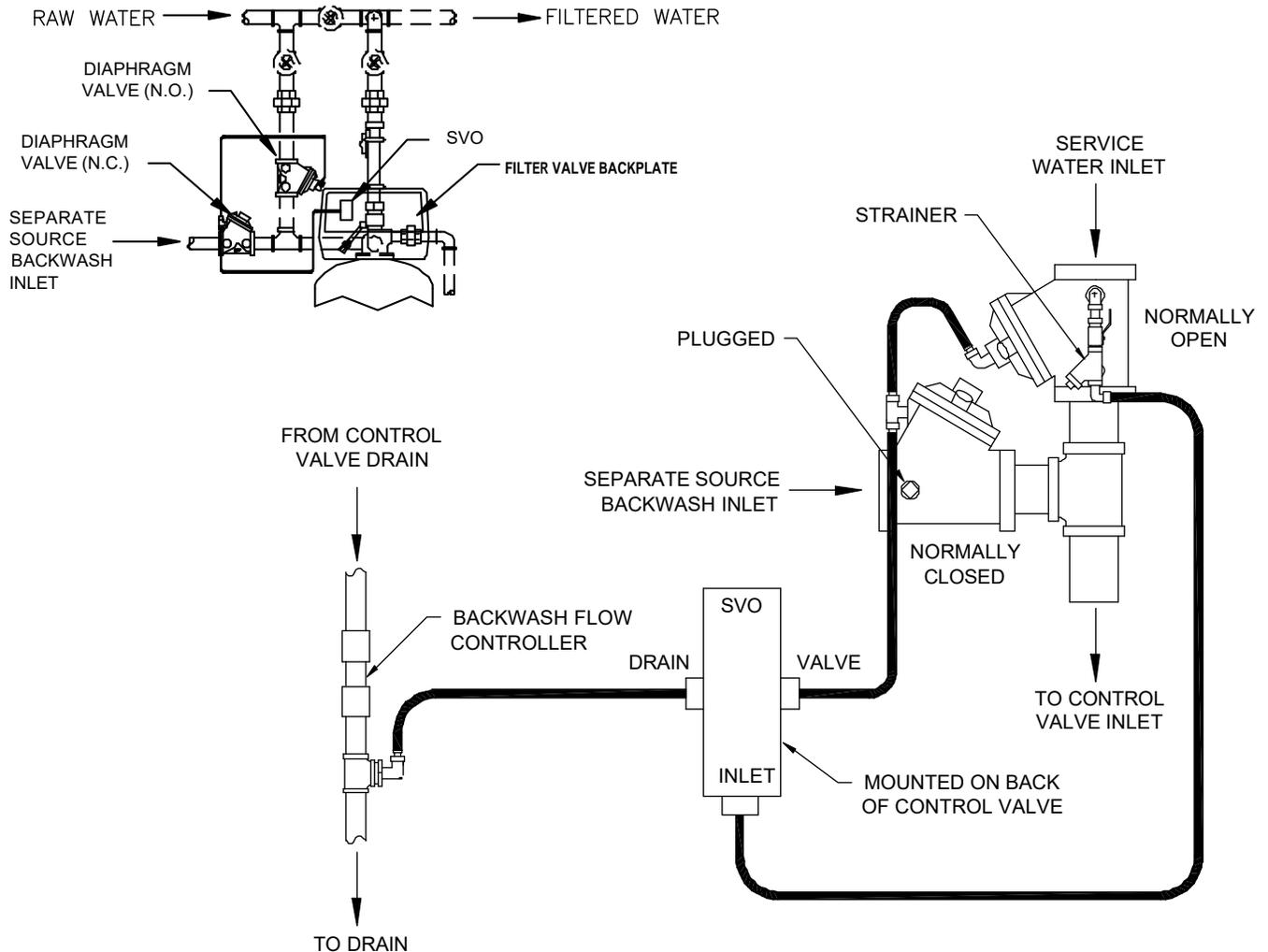
**SPECIFICATION CHART**

MODEL MID -		10G	12G	14G	16G	18G	
SYSTEM SIZE	Service Connection (in)	1	1	1	1	1	
	Drain Connection (in)	3/4	3/4	3/4	3/4	3/4	
FLOWRATE (GPM)	Service - Normal (gpm)	2	4	5	7	9	
	Service - DP (gpm)	2	3	3	4	4	
	Service - Peak (gpm)	5	8	10	14	18	
	Service - DP (gpm)	4	6	6	9	11	
	Backwash & Fast Flush (gpm)	5	8	10	15	17	
	Settle (gpm)	5	8	10	15	17	
	TIMER SETTINGS	Backwash	Pins	8	8	8	8
Minutes			16	16	16	16	16
Settle		Pins	3	3	3	3	3
		Minutes	6	6	6	6	6
Fast Flush		Pins	3	3	3	3	3
		Minutes	6	6	6	6	6
Settle		Pins	2	2	2	2	2
		Minutes	4	4	4	4	4
Return to Service		Pins	2	2	2	2	2
		Minutes	4	4	4	4	4
TANK		Size - Dia. x Ht. (in)	10x54	12x52	14x65	16x65	18x65
		Gravel Subfill (lbs)	30	40	60	80	80
	Media	1	2	3	4	5	

**SEPARATE SOURCE BACKWASH (OPTIONAL)**

This option allows the filter to use a separate water source for backwashing the system. The separate source uses diaphragm valves to control the flow of the backwash water. The diaphragm valves are controlled by a SVO (Service Valve Operator) that is mounted to the filter valve backplate.

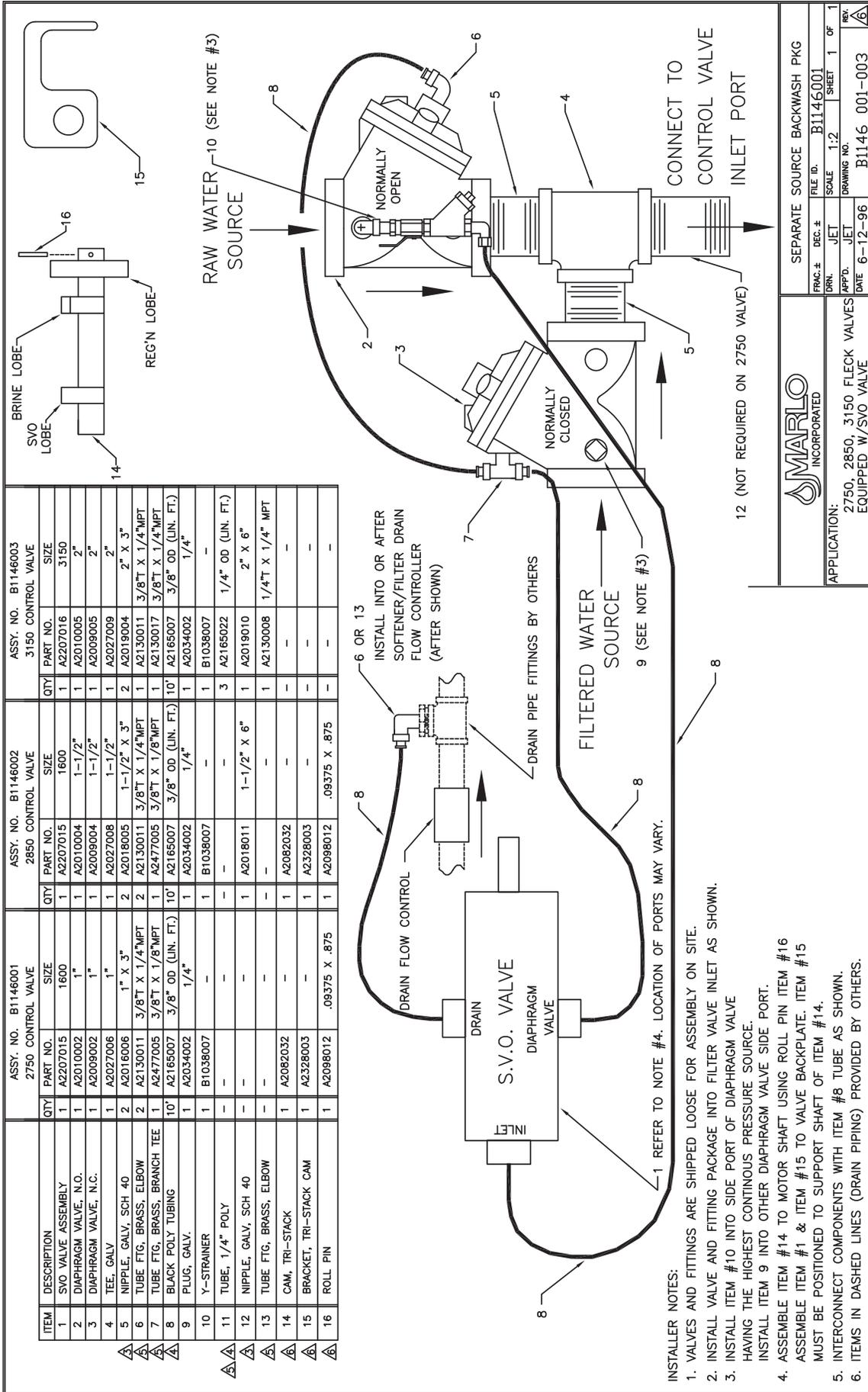
The piston in the SVO Valve is actuated by a cam on the filter valve motor shaft. Extending the piston will allow Raw Water flow. Depressing the piston will allow Separate Source water flow.



ACTUAL SVO PORT LOCATIONS MAY VARY.

DRAWING IS SHOWN FOR CLARITY ONLY.

INSTALL THE STRAINER ASSEMBLY INTO THE INLET BOSS OF THE VALVE WITH THE HIGHEST PRESSURE. PLUG THE OTHER VALVE'S INLET BOSS.



- INSTALLER NOTES:**
1. VALVES AND FITTINGS ARE SHIPPED LOOSE FOR ASSEMBLY ON SITE.
  2. INSTALL VALVE AND FITTING PACKAGE INTO FILTER VALVE INLET AS SHOWN.
  3. INSTALL ITEM #10 INTO SIDE PORT OF DIAPHRAGM VALVE HAVING THE HIGHEST CONTINUOUS PRESSURE SOURCE. INSTALL ITEM 9 INTO OTHER DIAPHRAGM VALVE SIDE PORT.
  4. ASSEMBLE ITEM #14 TO MOTOR SHAFT USING ROLL PIN ITEM #16 ASSEMBLE ITEM #1 & ITEM #15 TO VALVE BACKPLATE. ITEM #15 MUST BE POSITIONED TO SUPPORT SHAFT OF ITEM #14.
  5. INTERCONNECT COMPONENTS WITH ITEM #8 TUBE AS SHOWN.
  6. ITEMS IN DASHED LINES (DRAIN PIPING) PROVIDED BY OTHERS.

**MARLO**  
INCORPORATED

APPLICATION:  
2750, 2850, 3150 FLECK VALVES  
EQUIPPED W/SVO VALVE

SEPARATE SOURCE BACKWASH PKG

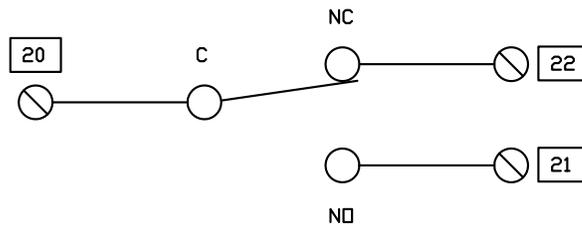
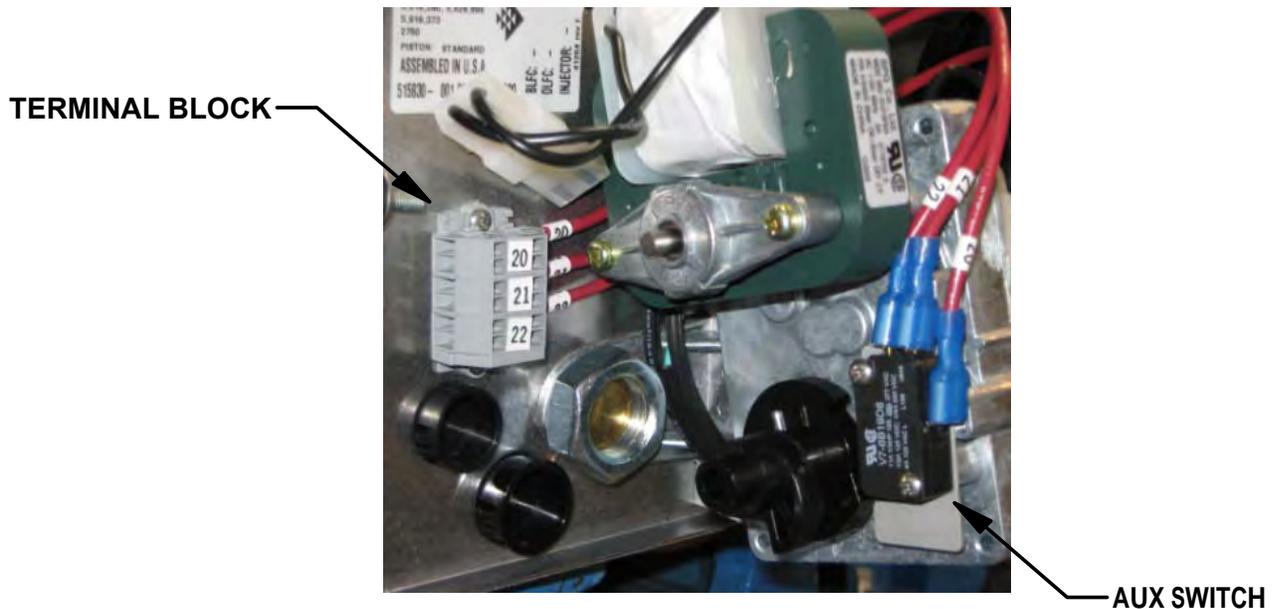
FRAC. #	DEC. #	FILE ID.	B1146001
DRN.	JET	SCALE	1:2
APP'D.	JET	DRAWING NO.	B1146 001-003
DATE	6-12-96		

12 (NOT REQUIRED ON 2750 VALVE)

**AUX SWITCH (OPTIONAL)**

The Aux Switch Option provides an extra switch on the brine valve cam assembly that ties to the terminal strip located on the back-plate of the valve. The switch provides a dry contact circuit that changes status dependent on filter valve's step. It is most commonly used to lockout an RO activate a pump, or activate separate source inlet valves.

The switch is normally closed during service and normally open during regeneration.



STEP	DRY CONTACT STATUS	
	OPEN	CLOSED
SERVICE	20-21	20-22
BACKWASH// REGENERATION	20-22	20-21

Contact Rating: 220 VAC Max. / 2.0 AMP Max.

AUX SWITCH (OPTIONAL)

PN	QTY	DESCRIPTION
MICROSWITCH ASSEMBLY		
A2154001	1	MICROSWITCH VALVE / STAGER RD LOCKOUT
A2083027	2	SCREW 4-40 X 1/2 SELF TAP PHIL MACH
A2490014	1	CAM SHUTOFF VALVE (12777)
A2098012	1	ROLL PIN .09375 X .875 (10338)
A2158001	1	INSULATOR LIMIT SWITCH (10302)
TERMINAL STRIP ASSEMBLY		
A2445043	1	END STOP W / FIXING FLANGE
A2307015	3	TERMINAL BLOCK GRAY 15A 300V
A2457003	2	SCREW 6-32 X 3/8 MACH RD HD SS
A2095048	2	6-32 NUTS SS
A2486021	2	WASHER LOCK #6 SPLIT SS
A2173009	3 FT	WIRE 16 RED

CONSTRUCTION NOTES:

1. INSTALL MICROSWITCH ASSEMBLY NEXT TO BRINE VALVE CAM ASSEMBLY ON VALVE.
2. INSTALL THE 3 TERMINALS AND LABEL THE TERMINALS NUMBERS 20, 21, 22.
3. WIRE THE MICROSWITCH USING 16 AWG RED WIRE.
4. WIRE AS FOLLOWS:

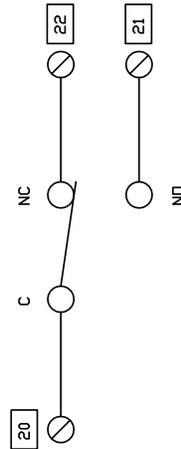
COMMON TO 20  
NORMALLY OPEN TO 21  
NORMALLY CLOSED TO 22

LOCKOUT SWITCH NOTES:

2900 AND 3900 VALVE ALREADY USES THIS SWITCH FOR ITS OPERATION.  
3150 VALVE SYSTEM 4 THIS SWITCH IS ALREADY INSTALLED ON THE VALVE  
AND IS AVAILABLE FOR RD LOCKOUT USE.

WIRING DIAGRAM OF AUXILIARY SWITCH (5 AMP MAXIMUM)

SWITCH ON NORMALLY CLOSED SIDE DURING SERVICE. NORMALLY OPEN DURING REGENERATION.



NO.	DATE	BY	REVISIONS	REMARKS

BRINE VALVE CAM SWITCH ADDITION TO TOP MOUNT MULTIPOINT VALVE	
FRAC.#	REC.#
FILE NO.	B1055006
APP'D.	JEC
SCALE	NTS
SHEET	1 OF 1
DRAWING NO.	B1055006
DATE	2-3-04

## **INSTALLATION INSTRUCTIONS**

### **GENERAL INFORMATION**

1. Minimum operating pressure is 25 psi. If pressures less than 25 psi are encountered, a pump must be installed.
2. Maximum operating pressure is 120 psi. If pressures greater than 120 psi are encountered, a pressure regulator must be installed.
3. Power requirements are shown on inside cover of the control valve.
4. Standard units are designed to condition unheated water not to exceed 100° F. Special valve assemblies are available to handle heated water supplies exceeding 100°F. Consult factory if applicable.
5. Each mineral tank is shipped with distributor manifold and control valve preassembled. Take care when uncrating and erecting so that no items are damaged.
6. The distributor assembly has been shipped inside the fiberglass mineral tank. Check to make sure that there is no damage to the riser pipe, basket, laterals, or hub.

### **LOCATE MINERAL TANKS**

1. Select a location that is accessible and near a floor drain that has adequate carrying capacity to handle the water conditioner backwash flow. See specification table for the backwash flow rate.
2. Erect the mineral tanks on a concrete or other firm foundation and level.
3. A grounded electric receptacle is required for the control valves.

### **LOAD FILTER TANKS**

1. On sizes 10 and 12 the media has been pre-loaded at the factory. Skip this section and go to "Mount Control Valve Assembly".
2. Fill tank(s) approximately 1/3 full of water using a hose, bucket, etc. Plug the PVC distributor manifold pipe using a plastic cap, cork, rag, etc. No gravel or resin should go into this distributor manifold pipe.
3. Verify the distributor manifold is center in the tank with the distributor resting on the bottom of the tank. Verify the riser pipe is still plugged.  
**Note:** Reference the specification table in the front of this manual for the correct quantities of gravel and media. Note that these quantities are for each tank. Make sure you have the required amounts on site before you begin.
4. With care not to damage any lateral, pour in the gravel provided for each tank through the top opening in the tank and level out evenly. This will cover the distributor assembly.  
**Note:** Wetting the gravel in the bags before loading will eliminate the normal amount of dust.
5. When gravel is loaded and leveling is completed, proceed as follows:
6. Refer to the specification table for the correct amounts and the order of media. Load the bottom layer first and work your way up to the top layer. With the distributor riser pipe still plugged, add the proper amount of media supplied for each tank through the top opening in the tank and then level the media layer.
7. Repeat step 6 for each type of media.
8. When loading is complete, remove plastic cap, cork, or rag that was used to plug the distributor riser pipe. Be careful not to let any foreign debris fall into the pipe. The result could be damage to system.
9. Repeat instruction steps 1-8 for each media tank.



**MOUNT CONTROL VALVE ASSEMBLY**

1. Verify that the distributor riser pipe is not plugged.
2. Lubricate the distributor O-ring on the bottom of the control valve with silicone.
3. Insert disperser in threaded base of control valve. The threaded base has a groove machined into the inside of the threaded part of the base to allow for the installation of this disperser.
4. Screw control valve into top opening of tank making sure the distributor riser pipe slides easily through the distributor O-ring. Care must be taken not to "nick" this O-ring as hard water leakage could result.
5. Tighten down the control valve to ensure positive O-ring seal at top of tank.
6. Repeat instruction steps 1-5 for each filter tank.

**INSTALLATION OF CONNECTION PIPING****Note:**

- Use thread sealing tape on all threaded piping connections.
- Install the piping conforming to federal, provincial, and local codes.
- Union or flanges are recommended at the control valve's inlet, outlet, and drain connections
- To enhance the monitoring of the system's performance sample valves and pressure gauges can be installed at the inlet and outlet piping to each control valve.
- If distance of drain line is over a 10 ft. vertical or 25 ft. horizontal run, increase drain line one pipe size over that provided on the control valve.
- Do not make a direct connection to the drain. Provide an air gap of at least four times the diameter of the pipe to conform to sanitation codes and to permit observation of the flow.

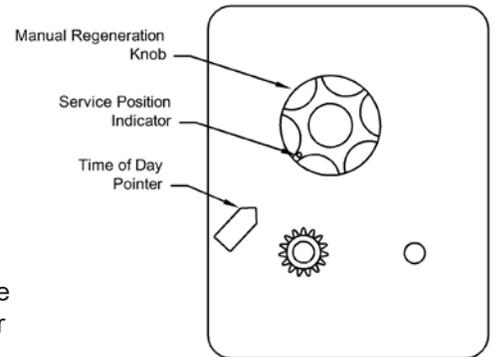
**Caution:** All piping must be properly supported. The tank and valve assemblies are not meant to support the connecting piping.

1. Install piping as shown on installation diagram. It is recommended that unions be installed on inlet and outlet connections to facilitate service of unit. Be sure piping is free of thread chips and other foreign matter. The connecting piping should be the same size or larger than the service inlet and outlet of the control valve. On multiple units that are both in service at the same time the common service inlet and outlet headers should be up-sized to accommodate the total flow.
2. Verify that the flow arrow stamped on the brass flow controller is pointing away from the control valve. See installation diagram or valve manual for the location. Install a drain line from backwash control assembly to an appropriate drain using a minimum of elbows. Install a union near the backwash control to facilitate cleaning. Do not install a valve on the drain line.

## START-UP

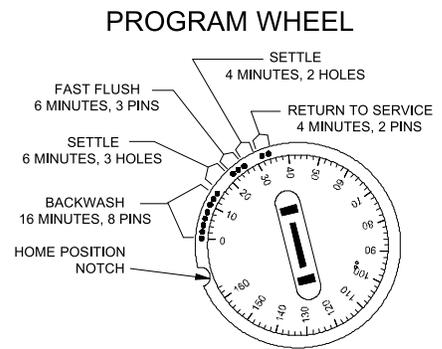
**Note:** The Activated Carbon needs be allowed to soak for 1 to 2 hours before it can be backwashed. Dry Activated Carbon tends to float in water and will washout to drain.

1. Make sure all plumbing is complete and tight including drain line(s). Make all electrical connections per wiring diagrams provided.
2. Make sure inlet and outlet isolation valves are closed, and then turn on power to the system.
3. Remove the black plastic cover from the control valve. The regeneration cycle timer is secured to the backplate of the control valve. The timer is hinged on the right side. Grab the upper left corner of the timer and pull towards you. The timer will swing out to the right. The backside of the timer has a program wheel with holes and pins in it. Each hole or pin represents two (2) minutes.



The holes and pins control the regeneration cycle times as follows:

- |                                     |                       |
|-------------------------------------|-----------------------|
| <b>Step 1 - (Backwash)</b>          | First group of pins   |
| <b>Step 2 - (Settle)</b>            | First group of holes  |
| <b>Step 3 - (Fast Rinse)</b>        | Second group of pins  |
| <b>Step 4 - (Settle)</b>            | Second group of holes |
| <b>Step 5 - (Return to Service)</b> | Third group of pins   |



4. Locate the manual regeneration knob on the front side of the timer. Slightly turn the knob clockwise. The control valve will advance to backwash position. Be patient this will take several minutes.
5. Remove electrical power from unit, and then slowly open inlet water valve approximately half open. Water will begin to fill through bottom distributor into tank. When tank is full, water will begin to flow out of drain line. Slowly pen the inlet valve until full open. Allow water to flow from drain line for approximately 15 minutes.

**Note:** Carbon filters will normally have considerable black fines on the initial backwash and may take 10-15 minutes to run clear. Monitor this drain water flow carefully. There is a problem if you see media in the drain water. Turn off inlet water immediately and then consult factory.

6. Restore electrical power to unit. Advance the control valve to settle position, using the same method as step 5. There should also be to flow at the drain line.
7. Advance the control valve to the fast rinse position. Remove electrical power to the unit. Let water run to drain position for approximately 5 minutes or until water runs clear.
8. Advance control valve to service position.
9. Proceed to start up the next tank (if applicable), by repeating steps 1-8.

### SETTING THE TIME / DAY CLOCK

#### How to set the time of day:

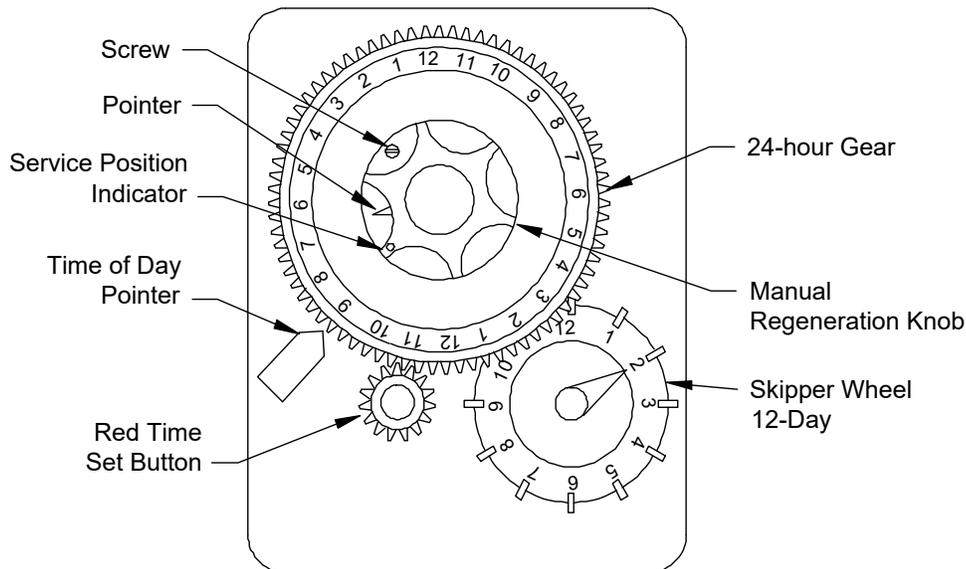
1. Press and hold the red button in to disengage the drive gear.
2. Turn the large gear until the actual time is at the time of day pointer.
3. Release the red button to again engage the drive gear.

#### How to set days on which the filter is to regenerate:

1. Rotate the skipper wheel until the number "1" is at the red pointer.
2. Set the day that regeneration is to occur by sliding tabs on the skipper wheel outward to expose trip fingers. Each tab is one day. Finger at red pointer is tonight.
3. Moving clockwise from the red pointer, extend or retract fingers to obtain the desired regeneration schedule.

#### How to manually regenerate your Water Conditioner at any time:

Turn the manual regeneration knob clockwise. This slight movement of the manual regeneration knob engages the program wheel and starts the regeneration program. The manual regeneration knob will make one revolution in approximately three hours and stop in the position shown in the drawing. Even though it takes three hours for this center knob to complete one revolution, the regeneration cycle of your unit might be set only half of this time. In any event, conditioned water may be drawn after rinse water stops flowing from the water conditioner drain line.



#### How to adjust the time of day regeneration occurs:

1. Disconnect the power source.
2. Locate the three screws behind the manual regeneration knob by pushing the red button in and rotating the 24-hour dial until each screw appears in the cut out portion of the manual regeneration knob.
3. Loosen each screw slightly to release the pressure on the time plate from the 24-hour gear.
4. Locate the regeneration time pointer on the inside of the 24-hour dial in the cutout. The pointer is hard to see.
5. Turn the time plate so the pointer on the desired regeneration time aligns next to the raised arrow.
6. Push the red button in and rotate the 24-hour dial. Tighten each to the three screws.
7. Push the red button and locate the pointer one more time to ensure the desired regeneration time is correct.
8. Reset the time of day and restore power to the unit.

**Note:** On twin or triple unit filters with time clock controls, each unit should be set to regenerate on different days or different times to avoid simultaneous regenerations.

**Note:** The screw and pointer are shown for reference only. There is only one cutout in the knob

## SETTING THE TIME CLOCK AND GALLONAGE (For filters with the water meter option)

Set the gallons required by lifting the gallon dial and rotating it so that the number of gallons required is aligned with the white dot on the program wheel gear. Release the gallon dial and check for firm engagement with the gear.

**Note:** To set meter capacity at the initial start-up, either:

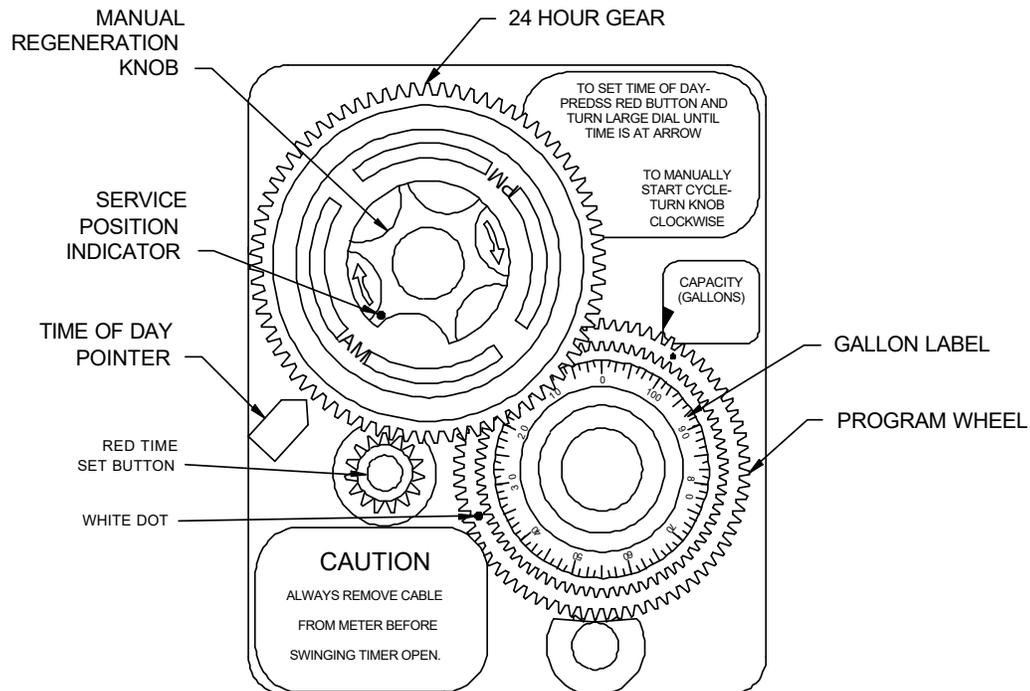
- Rotate the manual regeneration knob one full revolution.
- Rotate the program wheel manually clockwise and align the white dot with the capacity arrow.

### How to set the time of day:

1. Press and hold the red button in to disengage the drive gear.
2. Turn the large gear until the actual time is at the time of day pointer.
3. Release the red button to again engage the drive gear.

### How to manually regenerate your filter at any time:

Turn the manual regeneration knob clockwise. This slight movement of the manual regeneration knob engages the program wheel and starts the regeneration program. The manual regeneration knob will make one revolution in approximately three hours and stop in the position shown in the drawing. Even though it takes three hours for this center knob to complete one revolution, the regeneration cycle of your unit might be set only half of this time. In any event, conditioned water may be drawn after rinse water stops flowing from the water conditioner drain line.

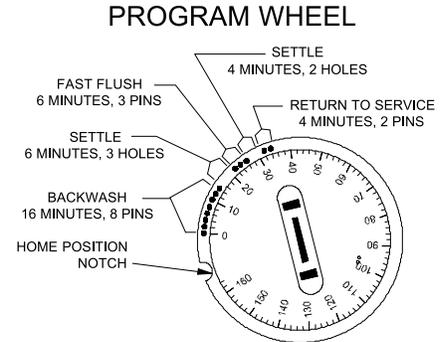


**SETTING THE REGENERATION CYCLE PROGRAM TIMER**

The regeneration cycle program on your water softener has been factory set. However, portions of the cycle program may be lengthened or shortened in time to suit local conditions. The regeneration cycle timer is secured to the back-plate of the control valve. The timer is hinged on the right side. Grab the upper left corner of the timer and pull towards you. The timer will swing out to the right. The backside of the timer has a program wheel with holes and pins in it.

The holes and pins control the regeneration cycle times as follows:

- Step 1 - (Backwash)**                      First group of pins
- Step 2 - (Settle)**                        First group of holes
- Step 3 - (Fast Rinse)**                  Second group of pins
- Step 4 - (Settle)**                        Second group of holes
- Step 5 - (Return to Service)**        Third group of pins



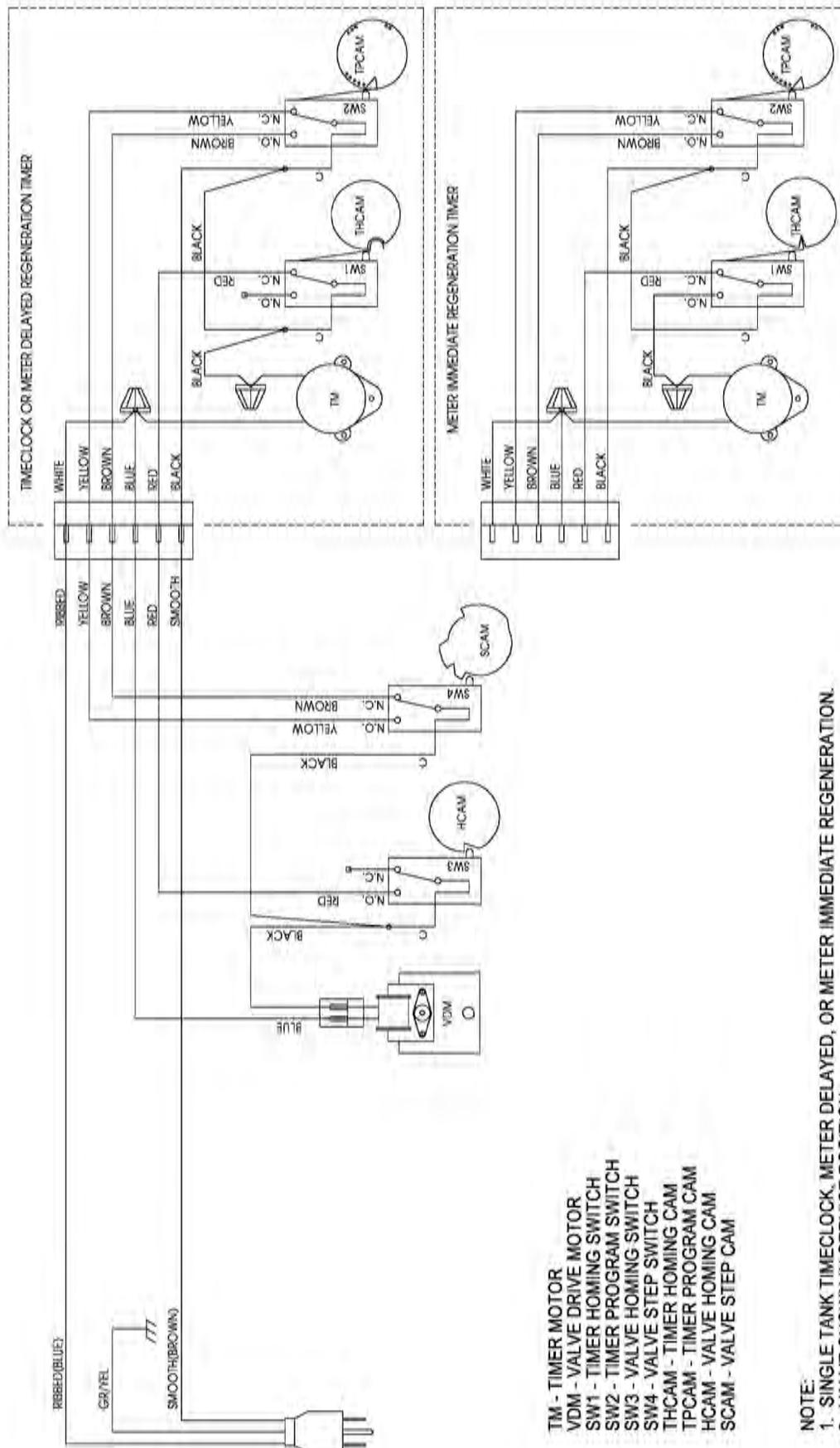
- **Backwash:** The cycle duration is factory set at 16 minutes for clean feed water applications. Increase time if turbidity is present in the feed water.
- **Settle:** The cycle duration is factory set at 6 minutes for clean feed water applications.
- **Fast Flush:** The cycle duration is factory set at 6 minutes.
- **Settle:** The cycle duration is factory set at 4 minutes.
- **Cycle End:** The cycle duration is factory set at 4 minutes. Its purpose is to identify the end of regeneration and advance the filter back to the service cycle.

To adjust the regeneration cycle program it is easier to remove the program wheel by pushing the two black tabs located in the center of the program wheel while pushing up on the program wheel.

As you look at the number side of the program wheel, starting at zero the number of the group of pins determines the length of time that your unit will be in Backwash. If there are six pins in this section, the time of backwash will be 16 minutes (2 minutes per pin). You must add or remove pins to change the length of this time. All the following groups of holes or pins must be adjusted to maintain their original time.

**Important:** Changing the time duration in any cycle will require a readjustment of all pins and holes for all the following steps.

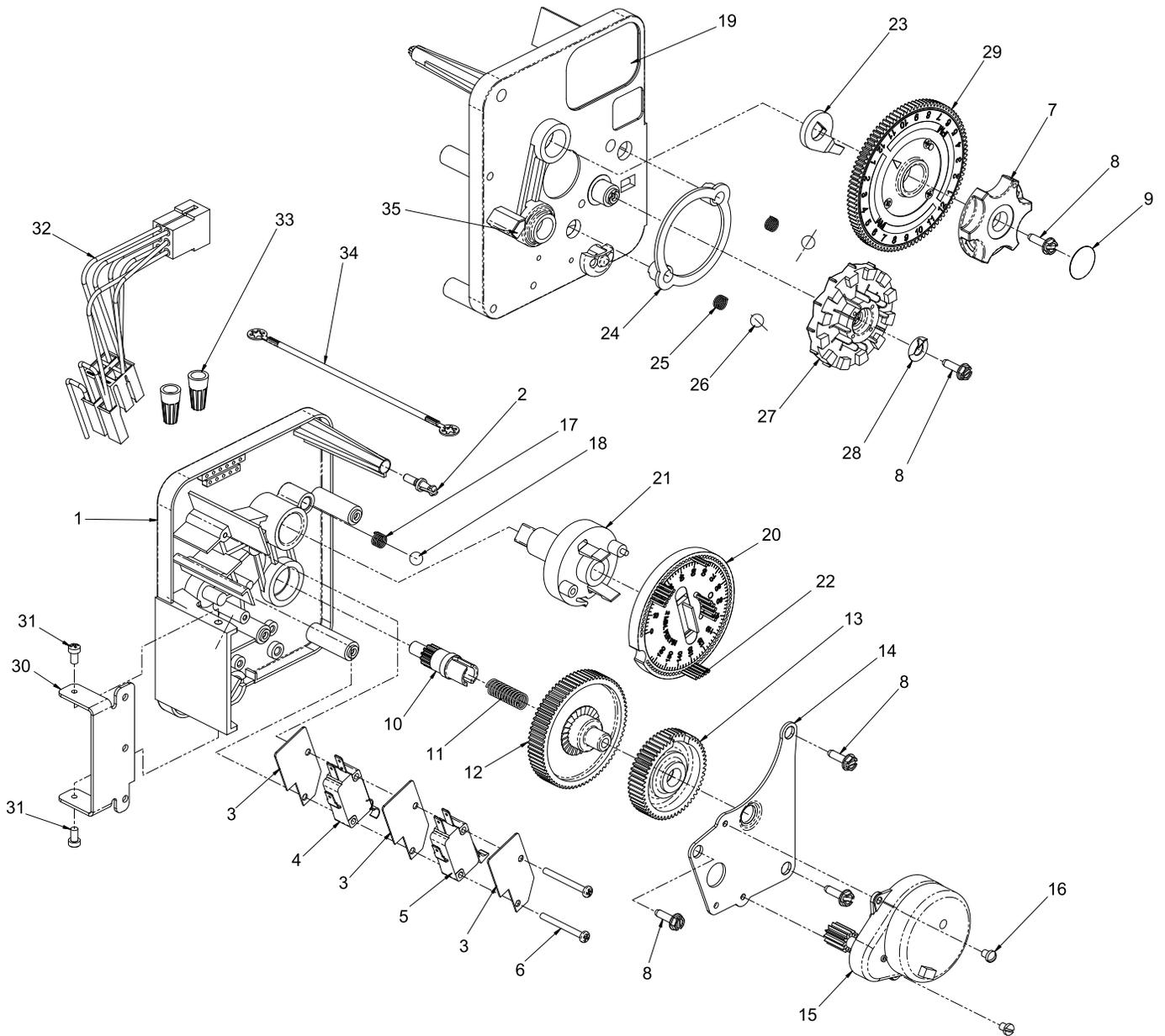
**2750 WIRING DIAGRAM**



- TM - TIMER MOTOR
- VDM - VALVE DRIVE MOTOR
- SW1 - TIMER HOMING SWITCH
- SW2 - TIMER PROGRAM SWITCH
- SW3 - VALVE HOMING SWITCH
- SW4 - VALVE STEP SWITCH
- THCAM - TIMER HOMING CAM
- TPCAM - TIMER PROGRAM CAM
- HCAM - VALVE HOMING CAM
- SCAM - VALVE STEP CAM

**NOTE:**  
 1. SINGLE TANK TIMECLOCK, METER DELAYED, OR METER IMMEDIATE REGENERATION.  
 2. VALVE SHOWN IN SERVICE POSITION.

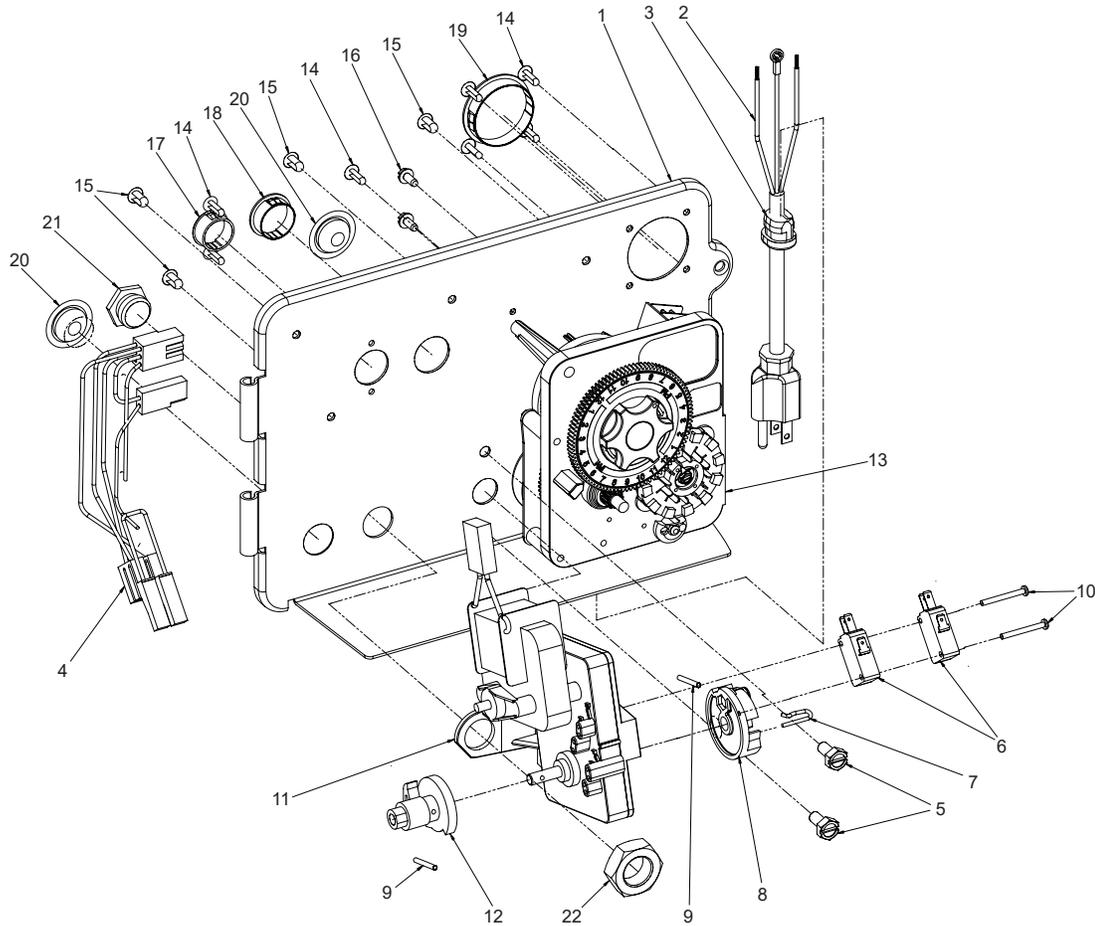
**3200 TIMER ASSEMBLY**



**3200 TIMER ASSEMBLY PARTS LIST**

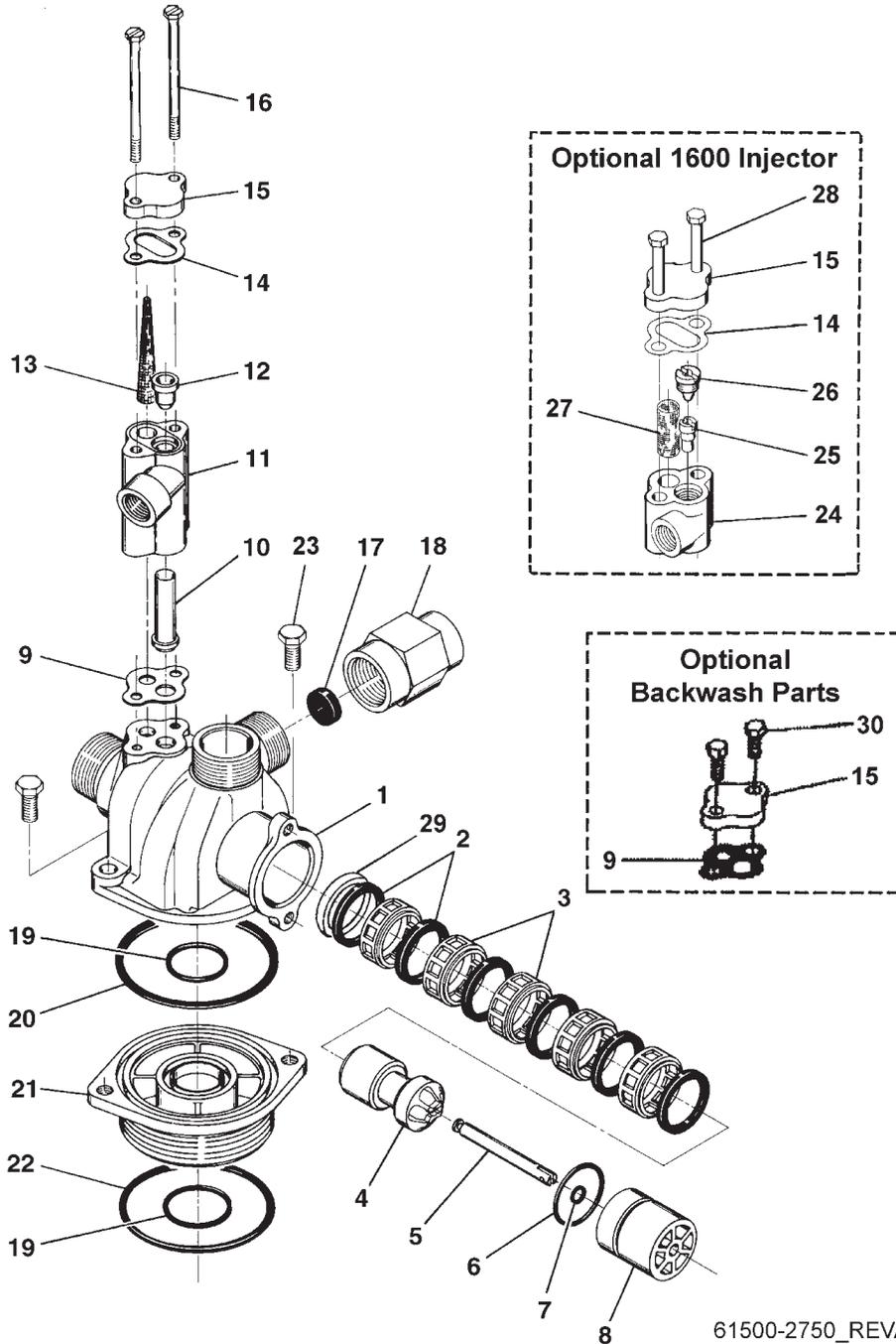
Item No.	Quantity	Part No.	Description
1	1	13870	Housing, Timer, 3200
2	1	14265	Clip, Spring
3	3	14087	Insulator
4	1	10896	Switch, Micro
5	1	15320	Switch, Micro, Timer
6	2	11413	Screw, Pan Hd Mach, 4-40 x 1-1/8
7	1	13886	Knob, 3200
8	5	13296	Screw, Hex Wsh, 6-20 x 1/2
9	1	11999	Label, Button
10	1	13018	Pinion, Idler
11	1	13312	Spring, Idler Shaft
12	1	13017	Gear, Idler
13	1	13164	Gear, Drive
14	1	13887	Plate, Motor Mounting
15	1	18743-1	Motor, 120V, 60Hz, 1/30 RPM, 5600
		19659-1	Motor, 24V, 60Hz, 1/30 RPM
16	2	13278	Screw, Slt'd Fillister Hd 6-32 x .156
17	1	15424	Spring, Detent, Timer
18	1	15066	Ball, 1/4", Delrin
19	1	15465	Label, Caution
20	1	19210	Program Wheel Assy
21	1	13911	Gear, Main Drive, Timer
22	17	41754	Pin, Spring, 1/16 x 5/8 SS, Timer
23	1	13011	Arm, Cycle Actuator
24	1	13864	Ring, Skipper Wheel
25	2	13311	Spring, Detent, Timer
26	2	13300	Ball, 1/4", SS
27	1	14381	Skipper Wheel Assy, 12 Day
		14860	Skipper Wheel Assy, 7 Day
28	1	13014	Pointer, Regeneration
29	1	40096-24	Dial, 12 AM Regen Assy, Black
		40096-02	Dial, 2 AM Regen Assy, Black
30	1	13881	Bracket, Hinger Timer
31	2	11384	Screw, Phil, 6-32 x 1/4 Zinc
32	1	13902	Harness, 3200
33	2	40422	Nut, Wire, Tan
34	1	15354-01	Wire, Ground, 4"
35	1	14007	Label, Time of Day

**2750 POWERHEAD - ENVIRONMENTAL**



Item No.	Quantity	Part No.	Description
1	1	18697-13	Backplate, Hinged
2	1	11838	Power Cord, 6' Fleck
3	1	13547	Strain Relief, Cord
4	1	40400	Harness, Drive, Designer/Enviromental
5	2	10231	Scrw, Slot Hex, 1/4-20 x 1/2
6	2	10218	Switch, Micro
7	1	10909	Pin, Connecting Rod Spring
8	1	60160-15	Drive Cam Assy, STF, Blue, 2900
9	2	10338	Pin, Roll, 3/32 x 7/8
10	2	14923	Screw, Pan HD Mach, 4-40 x 1
11	1	41543	Motor, Drive, 115V/60HZ
12	1	12777	Cam, Shut-off Valve
13	1	61502-3200	Timer Assy, 3200 Clock
14	7	19800	Plug (Hole Size: Dia .140)
15	4	19801	Plug, Dia .190
16	2	10300	Screw, Hx Wash Head, 8 x 3/8
17	1	15806	Hole Plug, Heyco
18	1	16493	Plug, Hole, Heyco, .88 Dia
19	1	40306	Plug, 1.50 Hole, Dome, Heyco
20	2	19691	Plug, .750 Dia. Hole, Flush
21	1	10712	Fitting, Brine Valve
22	1	10269	Nut, Jam, 3/4-16

**2750 CONTROL VALVE**



61500-2750\_REVA

**2750 CONTROL VALVE**

Item No.	Quantity	Part No.	Description
1.....	1 .....	14749.....	Valve Body, 2750
2.....	6 .....	10545.....	Seal, Piston
3.....	5 .....	11451.....	Spacer, 12 Hole
		16589.....	Spacer, HW
4.....	1 .....	14451.....	Piston, 2750
5.....	1 .....	14452.....	Rod, Piston
6.....	1 .....	10234-01 .....	O-Ring, -024, 560CD
7.....	1 .....	10209.....	Quad Ring, -010
8.....	1 .....	10598.....	End Plug Assembly
		10598-01 .....	End Plug Assembly, Hot Water
9.....	1 .....	14805.....	Gasket, Injector Body, 1600/1700
10.....	1 .....	14802-xxc.....	Throat, Injector, -xxc is for Injector Size
11.....	1 .....	17777.....	Body, Injector, 1700
12.....	1 .....	14801-xxc.....	Nozzle, Injector, -xxc is for Injector Size
13.....	1 .....	14803.....	Screen, Injector
14.....	1 .....	10229.....	Gasket, Injector Cap, 1600
15.....	1 .....	11893.....	Cap, Injector, Stainless Steel
		10228.....	Cap, Injector, Brass
16.....	2 .....	14804.....	Screw, Hex Hd Mach, 10-24 x 2-3/4
17.....	1 .....		Washer - Flow Control (specify size)
18.....	1 .....	60365-00 .....	Housing, DLFC, 1/2"F x 3/4"F
19.....	2 .....	11710.....	O-ring, -215
20.....	1 .....	11208.....	O-ring, -232
21.....	1 .....	12461-01 .....	Adapter Base, 1" 2-1/2" - 8 Quick Connect
22.....	1 .....	10381.....	O-ring, -231
23.....	2 .....	11224.....	Screw, Hex Hd, 5/16 - 18 x 5/8
24.....	1 .....	17776.....	Body, Injector
25.....	1 .....	10914-xx.....	Throat, Injector, -xx is for Injector Size
26.....	1 .....	10913-xx.....	Nozzle, Injector, -xx is for Injector Size
27.....	1 .....	10227.....	Screen, Injector
28.....	2 .....	10692.....	Screw, Slot Hex Hd, 10-24 x 18-8 Stainless Steel
29.....	1 .....	10757.....	Spacer, End
		10757B .....	Spacer, End, Brass
30.....	1 .....	15137.....	Screw, Hex Wsh Mach, 10-24 x 3/8
Not Shown ....	1 .....	16221.....	Disperser, Air, 1600
	1 .....	17996.....	Disperser, Air, 1700

**SERVICE ASSEMBLIES****ADAPTERS - SIDE MOUNT**

A2285017 Side mount Adapter Assembly

**AUXILIARY MICRO SWITCH**

A2203010 3200 Series Timer

A2203108 Lower Drive (2nd Switch)

**COVERS**

A2103096 Environmental lower cover

A2103095 Environmental

A2103043 Designer 1 piece ( only available in black )

A2103047 Designer Lower cover

**DRAIN LINE FLOW CONTROLS**

60366-\_\_ 1" FNPT x ¾" FNPT ( specify flow control .6 - 7.0)

60701-\_\_ 1" FNPT x 1" FNPT ( specify flow control 8.0 - 25.0 )

60702-\_\_ 1" FNPT x 1" MNPT ( specify flow control 8.0 - 25.0 )

60708-\_\_ 1" FNPT x ¾" FNPT ( specify flow control 8.0 - 25.0 )

60721-\_\_ 1" FNPT x 1" FNPT ( specify flow control .6 - 7.0)

**CAM ASSEMBLY**

A2300002 Separate time fill drive cam ( Black )

60160-20 Lower drive (Designer)

A2300013 Lower drive (Environmental)

**PISTON ASSEMBLIES**

A2309054 Upper Piston

A2309056 Lower piston, Hard Water By-Pass

A2309055 Lower Piston, No By-Pass

**SEAL & SPACER KITS**

A2435011 Upper kit

A2435026 Lower kit

**SERVICE EQUIPMENT**

A2475001 Seal &amp; Spacer stuffer tool upper

A2474003 Spacer puller tool lower

A2475003 Seal &amp; Spacer stuffer tool lower

A2474001 Spacer puller tool upper

A2423002 Silicone, 2 oz. Tube

A2164006 Meter Checker Std. Range

A2164005 Meter Checker Ext. Range

**SERVICE VALVE OPERATOR ASSEMBLY ( SVO )**

A2207015 SVO (Old Style)

60150-01 SVO (New Style)



**TROUBLESHOOTING 2750 VALVE**

<b>Problem</b>	<b>Cause</b>	<b>Correction</b>
1. Water conditioner fails to regenerate.	A. Electrical service to unit has been interrupted	A. Assure permanent electrical service (check fuse, plug, pull chain, or switch)
	B. Timer is defective.	B. Replace timer.
	C. Power failure.	C. Reset time of day.
2. Untreated water.	A. By-pass valve is open.	A. Close by-pass valve
	B. Leak at distributor tube.	B. Make sure distributor tube is not cracked. Check O-ring and tube pilot.
	C. Internal valve leak.	C. Replace seals and spacers and/or piston.
3. Loss of water pressure.	A. Iron buildup in line to water conditioner.	A. Clean line to water conditioner.
	B. Iron buildup in water conditioner.	B. Clean control and add mineral cleaner to mineral bed. Increase frequency of regeneration.
	C. Inlet of control plugged due to foreign material broken loose from pipes by recent work done on plumbing system.	C. Remove piston and clean control.
4. Loss of mineral through drain line.	A. Air in water system.	A. Assure that well system has proper air eliminator control. Check for dry well condition.
	B. Improperly sized drain line flow control.	B. Check for proper drain rate.
5. Iron in conditioned water.	A. Fouled mineral bed.	A. Check backwash, brine draw, and brine tank fill. Increase frequency of re-generation. Increase backwash time.
6. Control cycles continuously.	A. Misadjusted, broken, or shorted switch.	A. Determine if switch or timer is faulty and replace it, or replace complete power head.
7. Drain flows continuously.	A. Valve is not programming correctly.	A. Check timer program and positioning of control. Replace power head assembly if not positioning properly
	B. Foreign material in control.	B. Remove power head assembly and inspect bore. Remove foreign material and check control in various regeneration positions.
	C. Internal control leak.	C. Replace seals and piston assembly.





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# Section 3



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**INSTALLATION, OPERATION,  
AND MAINTENANCE MANUAL**

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**""MAT ' \$M-' #**  
**TWIN ALTERNATING**  
**METERED 3/4" – 1" SXT SERIES**  
**""COMMERCIAL WATER GC: H9BER**

COMPLETE FOR FUTURE REFERENCE:

MODEL NO:

SERIAL NO:

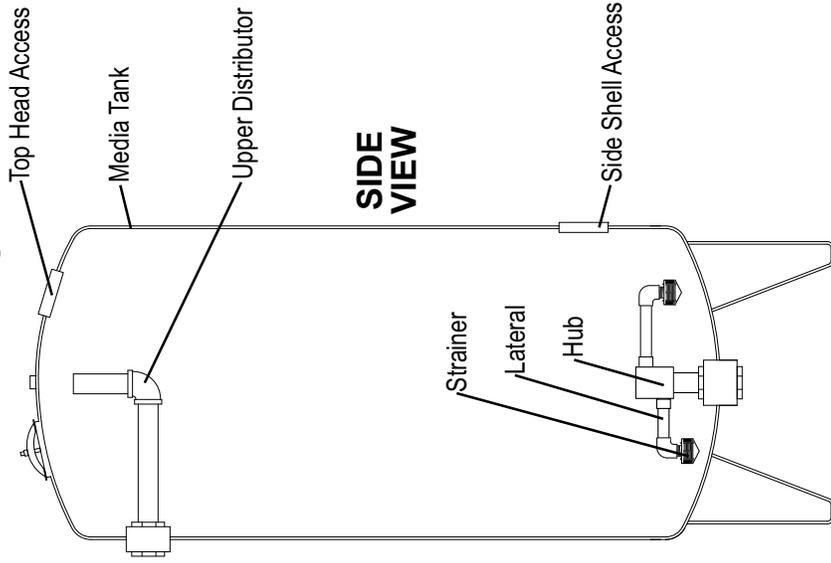
DATE INSTALLED:

DEALER:

**Marlo Incorporated**  
2227 South Street  
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Racine, WI 53404-7003  
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# INSTALLATION WARNING

## PRIOR TO Media Loading

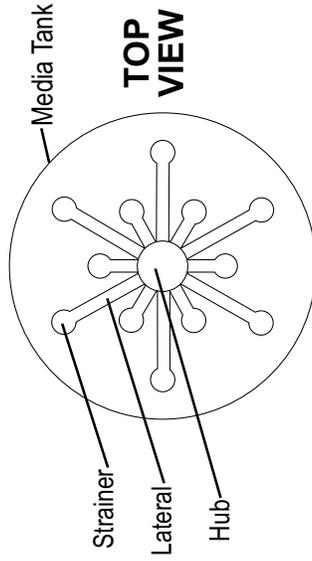
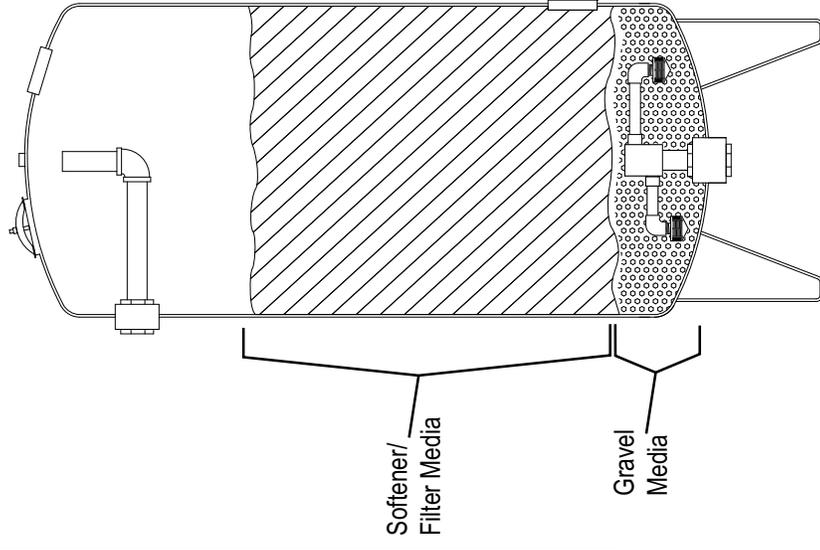


### SIDE VIEW

## Inspection Requirement Prior to Loading Media

1. Inspect condition of upper distributor piping. Verify fittings are tight and positioned as shown.
2. Inspect condition of strainers, laterals and hub through top or side access ports. Verify fittings are secured to hub and strainers are secured to laterals.
3. **DO NOT** load media if damaged components are observed. Contact factory.
4. Installer is responsible for media loss into treated water resulting from failure to report and repair damaged components inside media tank prior to media loading.
5. **INSTALLER WARNING:**  
Refer to installation instructions for media loading procedure. Improper loading of media will damage components inside media tank.

## AFTER Media Loading



### TOP VIEW



# MAT 15M-120M SXT 3/4"-1" TWIN ALTERNATING METERED

Please Circle and/or Fill in the Appropriate Data for Future Reference:

Softener Model:                    **MAT**

System Size:                    **Twin Alternating - Twin Tank**

Configuration:                   **Timeclock/Electromechanical Metered/SXT Metered/XT Metered**

BW/Regen Time:                \_\_\_\_\_ **AM/PM or OFF**

Additional Notes: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**IMPORTANT PLEASE READ:**

- Warranty of this product extends to manufacturing defects.
- The information, specifications and illustrations in this manual are based on the latest information available at the time of printing. The manufacturer reserves the right to make changes at any time without notice.
- This product should be installed by a plumbing professional on potable water systems only.
- This product must be installed in compliance with all local and state and municipal plumbing and electrical codes. Permits may be required at the time of installation.
- If operating pressure exceeds 100 psi a pressure reducing valve must be installed. If operating pressure drops below 30 psi a booster pump must be installed.
- Do not install the unit where temperatures may drop below 32°F or rise above 100°F.
- A prefilter should be used on installations in which free solids are present.
- A constant voltage of 120V/60Hz (unless otherwise specified) must be supplied to the controller to maintain proper function.
- Union or flange fittings are recommended at the control valve's inlet, outlet, and drain connections
- If distance of drain line is over a 10 ft. vertical or 25 ft. horizontal run, increase drain line one pipe size over that provided on the control valve.
- Do not make a direct connection to the drain. Provide an air gap of at least four times the diameter of the pipe to conform to sanitation codes and to permit observation of the flow.

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**COMMERCIAL AND INDUSTRIAL PRODUCT WARRANTY**

Marlo, Inc. warrants all commercial and industrial water treatment products manufactured and/or distributed by it to be free from defects in materials and workmanship for a period of one (1) year from the date of shipment. The fiberglass mineral tank(s) alone have a warranty for a period of five (5) year from the date of shipment. If within that period any products shall be proven to Marlo, Inc.'s satisfaction to be defective, those products will be replaced or the price refunded at Marlo Inc.'s option.

Marlo Inc.'s obligations or nonperformance, defective, or any damage caused by its products or their use, and buyer's exclusive remedy therefore, shall be limited to product replacement or refund and shall be conditioned upon Marlo Inc.'s receiving written notice together with a demand for such replacement or refund:

The foregoing warranty is exclusive and in lieu of all other expressed implied warranty (except of title) including but not limited to implied warranty of merchantability and fitness for particular purpose.

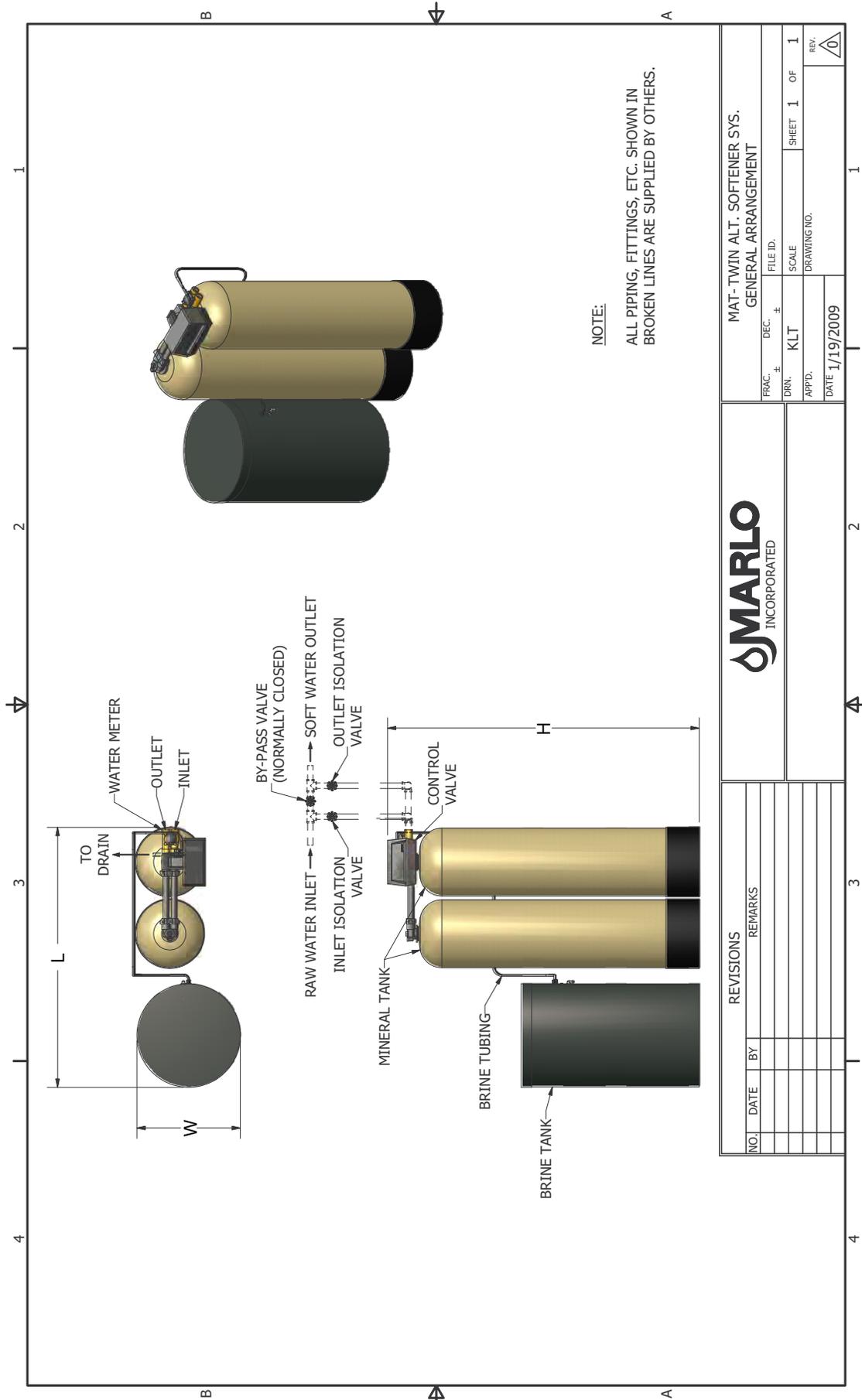
Marlo Inc. will not be subject to and disclaims the following:

1. Any other obligations or liabilities arising out of breach of contract or out of warranty.
2. Any obligations whatsoever arising from tort claims (including negligence and strict liability or arising under other theories of law with respect to products sold or services rendered by Marlo Inc. or any undertakings, acts, or omissions relating thereto.
3. All consequential, incidental, and contingent damages.  
Labor charges, charge backs or handling charges are excluded from Marlo Inc.'s warranty provisions.

**COMMERCIAL AND INDUSTRIAL WATER SOFTENER GUARANTEE**

Under normal operating conditions:

1. The softener effluent shall be zero soft as determined by a soap test.
2. The loss of softening resin through attrition during the first three (3) years shall not exceed 3% per year.
3. The softening resin shall not be washed out of the system during backwash.
4. The color and turbidity of the softener effluent shall not be greater than the incoming water.  
Any mechanical equipment proving defective in workmanship or material within one year after installation or eighteen (18) months after shipment, whichever comes first, shall be replaced FOB factory.



MAT - TWIN ALT. SOFTENER SYS. GENERAL ARRANGEMENT			
FRAC. #	DEC. #	FILE ID.	
DRN. #	KLT	SCALE	SHEET 1 OF 1
APPD.		DRAWING NO.	REV. 
DATE 1/19/2009			



NO.	DATE	BY	REVISIONS

**DIMENSION CHART**

MODEL	INLET SIZE (Inches)	TANK SIZE		LENGTH (Inches)	WIDTH (Inches)	HEIGHT* (Inches)
		SOFTENER (Inches)	BRINE (Inches)			
15	3/4	7x44	18x33	38	18	52
22	3/4	8x44	18x33	40	18	52
30	3/4 or 1	9x48	18x33	42	18	48
45	3/4 or 1	10x54	18x40	45	18	62
60	3/4 or 1	12x52	18x40	36	18	65
90	1	14x65	18x40	38	18	78
120	1	16x65	24x40	46	25	78

\*Leave a minimum 24 inch clearance to the height of the unit for loading media.  
Dimensions are for general arrangement use only.

**SPECIFICATION CHART**

SYSTEM SIZE	MODEL	15	22	30	45	60	90	120	
	VALVE SIZE (IN)	3/4	3/4	3/4	3/4	1	1	1	
	MAX CAPACITY (KILOGRAINS)	15	22	30	45	60	90	120	
	MIN CAPACITY (KILOGRAINS)	10	15	20	30	40	60	80	
FLOWRATE (GPM)	SERVICE - CONTINUOUS (GPM)	12	13	14	13	28	31	34	
	SERVICE - PEAK (GPM)	16	17	19	18	39	42	46	
	BACKWASH & FAST FLUSH (GPM)	1.2	1.6	2	2.4	3.5	5	6	
	BRINE DRAW & RINSE (GPM)	.31	.45	.45	1	1	1	1.2	
	BRINE TANK REFILL (GPM)	.25	.25	.5	1	1	1	1	
TIMER SETTINGS	BACKWASH & FAST FLUSH (MIN)	10	10	10	10	10	10	10	
	BRINE DRAW & RINSE (MIN)	60	60	60	60	60	60	60	
	FAST FLUSH (MIN)	10	10	10	10	10	10	10	
	BRINE TANK REFILL (MIN)	10	16	10	8	10	16	20	
SOFTENER TANK	SIZE (IN)	7x44	8x44	9x48	10x54	12x52	14x65	16x65	
	GRAVEL (LBS)	0	0	0	0	0	30	35	
	RESIN (FT <sup>3</sup> )	0.5	0.75	1	1.5	2	3	4	
	FREEBOARD (IN)	17	15	8	17	16	21	21	
BRINE SYSTEMS	EQUIPMENT	TANK SIZE	18x33	18x33	18x33	18x40	18x40	18x40	24x40
		MAX SALT STORAGE (LBS)	290	290	290	320	320	270	550
		INJECTOR CODE	0	1	3	3	3	3	4
		INJECTOR COLOR	RED	WHT	YEL	YEL	YEL	YEL	GRN
	SALT	SALT DOSAGE- MAX (LBS)	7.5	11.25	15	22.5	30	45	60
		SALT DOSAGE- MIN (LBS)	3	4.5	6	9	10	16	20
	REFILL	REFILL TIME - MAX (MIN)	10	16	10	8	10	16	19
		REFILL TIME - MIN (MIN)	4	4	4	4	4	6	8
	REGEN	REGEN PER SALT REFILL-MAX	39	26	19	14	10	6	9
		REGEN PER SALT REFILL-MIN	97	64	48	36	26	15	23
	REGENERATION WASTE VOLUME (GAL)	40	52	64	116	126	156	188	

**SPECIFICATION NOTES**

Maximum salting is 15 pounds of salt per cubic foot of resin.  
 Minimum salting is 6 pounds of salt per cubic foot of resin.

The regeneration timer is setup for maximum salting at the factory.  
 The Timer Settings are factory set and user adjustable.

On continuous flow rates pressure loss does not exceed 15 psig.  
 On peak flow rates pressure loss does not exceed 30 psig.

Minimum operating pressure is 30 psi.  
 Maximum operating pressure is 120 psi.

Standard units are designed to soften unheated water within the range of 35-100°F.  
 Power requirements are 120 Volt, 60 Hertz, Single Phase, 2 amps non-interrupted.

Freeboard is the distance between the surface of the resin and the top of the tank.  
 Salt specifications are pelletized or solar salt, 99% pure, containing less than 1% insolubles.

## **INSTALLATION INSTRUCTIONS**

### **GENERAL INFORMATION**

1. Minimum operating pressure is 30 psi. If pressure less than 30 psi is encountered, a regulator must be installed

**NOTE:** The control valve will not operate correctly if feeding into an atmospheric tank. A pressure control device must be added to the outlet to maintain the minimum pressure.

2. Maximum operating pressure is 120 psi. If pressure greater than 120 psi is encountered, a pressure regulator must be installed.

3. Power requirements are shown on a voltage sticker on the motor inside cover of the control valve. You can also tell by wire color on the motor: Black wires are 115 volt. Yellow wires are 220 volt. Blue wires are 24 volt.

4. Standard units are designed to soften unheated water not to exceed 100° F. Special valve assemblies are available to handle heated water supplies exceeding 100°F. Consult factory if applicable.

5. Each softener tank is shipped with distributor manifold and control valve preassembled. Take care when uncrating and erecting so that no items are damaged.

6. The distributor assembly has been shipped inside the fiberglass mineral tank. Check to make sure that there is no damage to the riser pipe, baskets, laterals, or hub prior to loading media.

### **LAYOUT REQUIREMENTS**

1. Select a location that is accessible and near a floor drain that has adequate carrying capacity to handle the softener regeneration flow. See specification table for the flow rate. Allow a minimum of 24" above the tank for loading media.

2. Erect each the softener tanks on a concrete or other firm foundation and level.

**NOTE:** If the system is skid mounted, it will be prepiped and preloaded at the factory. Skip the following instructions and go to the section "Installation of Connection Piping".

3. Position the brine tank according to the illustration and supplementary brine tank information. Keep the brine tank as close as possible to the softener tanks.

**NOTE:** The distance between the softener and brine tanks will affect the brine injector performance, as the distance increases the injector performance decreases. This may cause an inadequate regeneration. Maximum recommended distance is 5 ft.

4. A grounded electric receptacle is required for the control valve transformer.

## **INSTALLATION INSTRUCTIONS**

### **LOADING TANK**

**NOTE:** If the system is skid mounted, it will be prepiped and preloaded at the factory. Skip the following instructions and go to the section of "Installation of connection piping".

1. On Models MAT-15, 30, 45, and 60 the softening media has been pre-loaded at the factory. Skip this section and go to "Mounting Control Valve Assembly".
2. Fill a tank approximately 1/3 full of water using a hose, bucket, etc. Plug the PVC distributor manifold pipe using a plastic cap, cork, rag, etc. No gravel or resin should go into this distributor manifold pipe.
3. Verify the distributor manifold is center in the tank with the distributor resting on the bottom of the tank. Verify the riser pipe is still plugged.

**NOTE:** Reference the specification table in the front of this manual for the correct quantities of gravel and resin. These quantities are for each tank. Make sure you have the required amounts on site before you begin.

4. With care not to damage any lateral, pour in the gravel provided for each tank through the top opening in the tank and level out evenly. This will cover the distributor assembly.

**NOTE:** Wetting the gravel in the bags before loading will eliminate the normal amount of dust.

5. When gravel is loaded and leveling is completed, proceed as follows:
6. With the distributor riser pipe still plugged, add the proper amount of resin supplied for each tank through the top opening in the tank.

**CAUTION: The softener resin is very slippery. Take care when stepping on any spilled resin. Remove spilled resin from standing surface immediately.**

7. When loading is complete, remove plastic cap, cork, or rag that was used to plug the distributor riser pipe. Be careful not to let any foreign debris fall into the pipe. The result could be damage to system.
8. Repeat instruction steps 1-7 for the second softener tank.

### **MOUNTING WATER METER ASSEMBLY (MAY BE FACTORY CONNECTED)**

1. Locate the meter. The water meter has a flow arrow stamped on it. The flow arrow on the meter should be pointing away from the control valve.
2. Attach the meter to the control valve's outlet water connection.
3. Interconnect meter cable between the control valve timer and water meter dome.

### **MOUNT CONTROL VALVE ASSEMBLY**

1. Verify that the distributor riser pipe is not plugged.
2. Lubricate the distributor o-ring on the bottom of the control valve with silicone.
3. Insert disperser in threaded base of control valve. The threaded base has a groove machined into the inside of the threaded part of the base to allow for the installation of this disperser.
4. Screw control valve into top opening of tank making sure the distributor riser pipe slides easily through the distributor o-ring. Care must be taken not to "nick" this o-ring as hard water leakage could result.
5. Tighten down the control valve to ensure positive o-ring seal at top of tank.
6. Repeat instruction steps 1-5 for each softener tank (if applicable).



## **INSTALLATION OF CONNECTION PIPING**

### **NOTES:**

- Use thread sealing tape on all threaded piping connections.
- Install the piping conforming to federal, provincial, and local codes.
- Unions or flanges are recommended at the control valve's inlet and outlet connections• To enhance the monitoring of the system's performance sample valves and pressure gauges can be installed at the inlet and outlet piping of the softening unit (not provided).
- If distance of drain line is over 10 ft. vertical or 25 ft. horizontal run, increase drain line one pipe size over that provided on the control valve.
- Do not make a direct connection to the drain. Provide an air gap of at least four times the diameter of the pipe to conform to sanitation codes and to permit observation of the flow.
- It is not recommended that an overhead or a long horizontal drain run be used. The increase of backpressure will cause problems when drawing brine.

**Caution: All piping must be properly supported. The tank and valve assemblies are not meant to support the connecting piping.**

1. Install piping as shown on installation diagram. It is recommended that unions be installed before the inlet and outlet valves to facilitate service of unit. Be sure piping is free of thread chips and other foreign matter. The connecting piping should be the same size or larger than the service inlet and outlet of the control valve.
2. Verify that the flow arrow stamped on the drain flow controller is pointing away from the control valve. See installation diagram or valve manual for the location. Install a drain line from backwash control assembly to an appropriate drain using a minimum of elbows. Install a union near the backwash control to facilitate cleaning. Do not install a valve on the drain line.
3. Interconnect the brine line tubing between the control valve and the brine tank. Verify that the brine line tubing is not kinked or restricted
4. Run flexible tubing (not provided) from the brine tank's over flow fitting to an appropriate, nonelevated, open drain.

### **START-UP**

1. Again, make sure all plumbing is complete and tight including drain line and brine line. Make sure all electrical connections are complete per wiring diagrams provided.
2. Using a bucket or hose, fill brine tank with water to 2" above salt platform. Do not add salt at this time.
3. Make sure inlet and outlet isolation valves are closed. Turn on power to the system.

**NOTE:** Start up only one (1) tank at a time.

The softening cycle steps are as follows:

- Service
- Step 1 (Backwash)
- Step 2 ( Brine Draw/ Slow Rinse)
- Step 3 (Fast Rinse)
- Step 4 (Brine Tank Refill)
- Return to Service

**START-UP (continued)****REGENERATION STEPS**

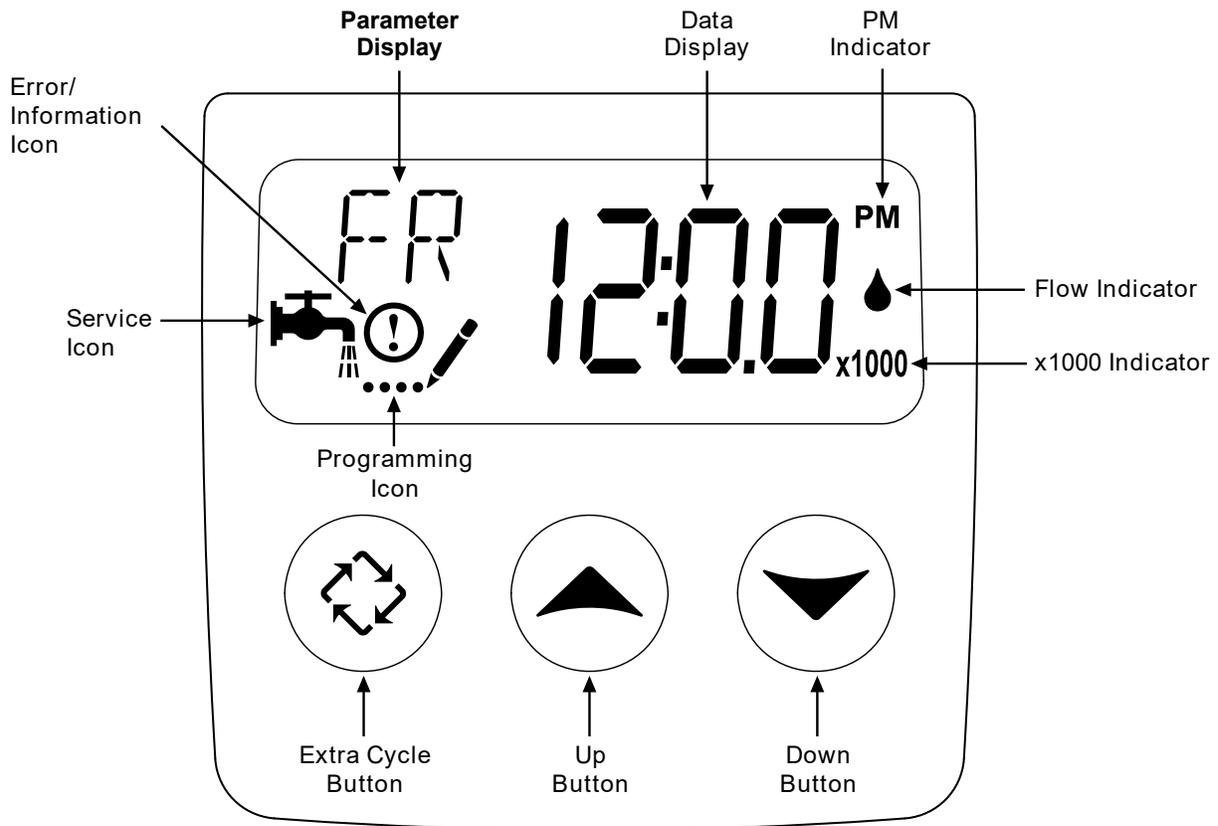
- **Backwash:** The cycle duration is factory set at 10 minutes for clean feed water applications. Increase time duration to 15 minutes when turbidity is present in the feed water.
- **Brine Draw/Rinse:** The cycle duration is factory is set at 60 minutes to assure the required amount of brine is introduced and rinsed from the resin. Increase time duration when the injector feed pressure is below 40 psi.
- **Fast Flush:** The cycle duration is factory set at 10 minutes to rinse chlorides from the resin prior to the softener is placed online. Increase time duration to 15 minutes if traces of chlorides are present in the service outlet water.
- **Brine Tank Refill:** The cycle duration is factory set at the maximum salt to achieve maximum softener capacity. The published minimum salt can be programmed to reduce salt consumption by 50% and reduced softening capacity by 30%.
- **Cycle End:** The cycle duration is factory set at 4 minutes. Its purpose is to identify the end of regeneration and advance the softener control valve to the Standby position.

**Note:** Brine Draw / Slow Rinse step is actually two events. The brine is suctioned from the brine tank until the level falls to the bottom of the brine valve. An air check in the valve will close once the brine is to low. This is the end for the Brine Draw step and should last about twenty (20) minutes. The rest of the time in Step 2 is Slow Rinse.

4. Locate the extra regeneration button  on the front side of the timer. Press the button for 5 seconds. The softener control valve will advance to Backwash position. Be patient this will take several minutes.
5. Remove electrical power from unit, and then slowly open inlet water valve approximately half open. Water will begin to fill through bottom distributor into tank. When tank is full, water will begin to flow out of drain line. Slowly open inlet valve until full open. Allow water to flow from drain line for approximately 15 minutes. Warning: Monitor this drain water flow carefully. There is a problem if you see softener resin in the drain water. Turn off inlet water immediately and then consult factory.
6. Restore electrical power to unit. Advance the control valve to Brine Draw / Slow Rinse position, using the same method as step 5. Make sure unit draws water from brine tank. There should also be reduced flow at the drain line.
7. Advance the control valve to the Fast Rinse position. Remove electrical power to the unit. Let water run to drain position for approximately 5 minutes or until water runs clear.
8. Restore electrical power to unit. Advance the control valve to Brine Refill position. Water should begin to refill brine tank. Allow the brine tank to refill until water in salt tank is again 2" above the salt platform. There should be no flow to drain in this valve position.
9. Advance control valve to Service position. Brine tank refill should stop. Open outlet valve and run water at the nearest cold water faucet to the water softener system for
10. Repeat instruction steps 1-10 for each softener tank.
11. Add salt to the brine tank. **Use pelletized or solid salt**, 99.0 – 99.8% pure salt containing less than 0.5% insoluble.
12. Use the test kit provided to check water for softness. Check the water hardness daily the first week in order to establish how often the softener should be regenerated. approximately 5 minutes.



**TIMER FEATURES**



**FEATURES OF THE SXT:**

- Power backup that continues to keep time and the passage of days for a minimum of 48 hours in the event of power failure. During a power outage, the control goes into a power-saving mode. It does not monitor water usage during a power failure, but it does store the volume remaining at the time of power failure.
- Settings for both valve (basic system) and control type (method used to trigger a regeneration).
- Day-of-the-Week controls.
- While in service, the display alternates between time of day, volume remaining or days to regeneration, and tank in service (twin tank systems only).
- The Flow Indicator flashes when outlet flow is detected.
- The Service Icon flashes if a regeneration cycle has been queued.
- A Regeneration can be triggered immediately by pressing the Extra Cycle button for five seconds.
- The Parameter Display displays the current Cycle Step (BW, BF, RR, etc) during regeneration, and the data display counts down the time remaining for that cycle step. While the valve is transferring to a new cycle step, the display will flash. The parameter display will identify the destination cycle step (BW, BF, RR, etc) and the data display will read "----". Once the valve reaches the cycle step, the display will stop flashing and the data display will change to the time remaining. During regeneration, the user can force the control to advance to the next cycle step immediately by pressing the extra cycle button.

## **TIMER FEATURES**

### **SETTING THE TIME OF DAY**

1. Press and hold either the Up or Down buttons until the programming icon replaces the service icon and the parameter display reads TD.
2. Adjust the displayed time with the Up and Down buttons. When the desired time is set, press the Extra Cycle button to resume normal operation. The unit will also return to normal operation after 5 seconds if no buttons are pressed.



### **ENTERING MASTER PROGRAMMING MODE**

Set the Time Of Day display to 12:01 P.M. Press the Extra Cycle button (to exit Setting Time of Day mode). Then press and hold the Up and Down buttons together until the programming icon replaces the service icon and the Display Format screen appears.

### **EXITING MASTER PROGRAMMING MODE**

Press the Extra Cycle button to accept the displayed settings and cycle to the next parameter. Press the Extra Cycle button at the last parameter to save all settings and return to normal operation. The control will automatically disregard any programming changes and return to normal operation if it is left in Master Programming mode for 5 minutes without any keypad input.

### **RESETS**

**Soft Reset:** Press and hold the Extra Cycle and Down buttons for 25 seconds while in normal Service mode. This resets all parameters to the system default values, except the volume remaining in meter immediate or meter delayed systems and days since regeneration in the time clock system.

**Master Reset:** Hold the Extra Cycle button while powering up the unit. This resets all of the parameters in the unit. Check and verify the choices selected in Master Programming Mode.

## **CONTROLLER OPERATION**

### **METER IMMEDIATE CONTROL**

A meter immediate control measures water usage and regenerates the system as soon as the calculated system capacity is depleted. The control calculates the system capacity by dividing the unit capacity (typically expressed in grains/unit volume) by the feedwater hardness and subtracting the reserve. Meter Immediate systems generally do not use a reserve volume. However, in twin tank systems with soft-water regeneration, the reserve capacity should be set to the volume of water used during regeneration to prevent hard water break-through. A Meter Immediate control will also start a regeneration cycle at the programmed regeneration time if a number of days equal to the regeneration day override pass before water usage depletes the calculated system capacity.

### **METER DELAYED CONTROL**

A Meter Delayed Control measures water usage and regenerates the system at the programmed regeneration time after the calculated system capacity is depleted. As with Meter Immediate systems, the control calculates the system capacity by dividing the unit capacity by the feedwater hardness and subtracting the reserve. The reserve should be set to insure that the system delivers treated water between the time the system capacity is depleted and the actual regeneration time. A Meter Delayed control will also start a regeneration cycle at the programmed regeneration time if a number of days equal to the regeneration day override pass before water usage depletes the calculated system capacity.

### **METER DELAYED CONTROL**

A Time Clock Delayed Control regenerates the system on a timed interval. The control will initiate a regeneration cycle at the programmed regeneration time when the number of days since the last regeneration equals the regeneration day override value.

## **CONTROLLER OPERATION (continued)**

### **DAY OF THE WEEK CONTROL**

This control regenerates the system on a weekly schedule. The schedule is defined in Master Programming by setting each day to either “off” or “on.” The control will initiate a regeneration cycle on days that have been set to “on” at the specified regeneration time.

### **CONTROL OPERATION DURING REGENERATION**

During regeneration, the control displays a special regeneration display. In this display, the control shows the current regeneration step number the valve is advancing to, or has reached, and the time remaining in that step. The step number that displays flashes until the valve completes driving to this regeneration step position. Once all regeneration steps are complete the valve returns to service and resumes normal operation.

Pressing the Extra Cycle button during a regeneration cycle immediately advances the valve to the next cycle step position and resumes normal step timing.

### **CONTROL OPERATION DURING PROGRAMMING**

The control only enters the Program Mode with the valve in service. While in the Program Mode, the control continues to operate normally monitoring water usage and keeping all displays up to date. Control programming is stored in memory permanently, eliminating the need for battery backup power.

### **MANUALLY INITIATING A REGENERATION**

1. When timer is in service, press the Extra Cycle button for 5 seconds on the main screen.
2. The timer advances to Regeneration Cycle Step #1 (backwash), and begins programmed time count down.
3. Press the Extra Cycle button once to advance valve to Regeneration Cycle Step #2 (brine draw & slow rinse).
4. Press the Extra Cycle button once to advance valve to Regeneration Cycle Step #3 (rapid rinse).
5. Press the Extra Cycle button once to advance valve to Regeneration Cycle Step #4 (brine refill).
6. Press the Extra Cycle button once more to advance the valve back to in service.

**NOTE:** If the unit is a filter or upflow, the cycle step order may change.

**NOTE:** A queued regeneration can be initiated by pressing the Extra Cycle button. To clear a queued regeneration, press the Extra Cycle button again to cancel. If regeneration occurs for any reason prior to the delayed regeneration time, the manual regeneration request shall be cleared.

## **TIMER FEATURES**

### **CONTROL OPERATION DURING A POWER FAILURE**

The SXT includes integral power backup. In the event of power failure, the control shifts into a power-saving mode. The control stops monitoring water usage, and the display and motor shut down, but it continues to keep track of the time and day for a minimum of 48 hours.

The system configuration settings are stored in a non-volatile memory and are stored indefinitely with or without line power. The Time of Day flashes when there has been a power failure. Press any button to stop the Time of Day from flashing.

If power fails while the unit is in regeneration, the control will save the current valve position before it shuts down. When power is restored, the control will resume the regeneration cycle from the point where power failed. Note that if power fails during a regeneration cycle, the valve will remain in its current position until power is restored. The valve system should include all required safety components to prevent overflows resulting from a power failure during regeneration.

The control will not start a new regeneration cycle without line power. If the valve misses a scheduled regeneration due to a power failure, it will queue a regeneration. Once power is restored, the control will initiate a regeneration cycle the next time that the Time of Day equals the programmed regeneration time. Typically, this means that the valve will regenerate one day after it was originally scheduled. If the treated water output is important and power interruptions are expected, the system should be setup with a sufficient reserve capacity to compensate for regeneration delays.

**MASTER PROGRAMMING MODE CHART**

<b>Master Programming Options</b>			
<b>Abbreviation</b>	<b>Parameter</b>	<b>Option Abbreviation</b>	<b>Options</b>
DF	Display Format	GAL	Gallons
		Ltr	Liters
		Cu	Cubic Meters
VT	Valve Type	St1b	Standard Downflow/Upflow Single Backwash
		St2b	Standard Downflow/Upflow Double Backwash
		Fltr	Filter
		UFbF	Upflow Brine First
		Othr	Other
CT	Control Type	Fd	Meter (Flow) Delayed
		FI	Meter (Flow) Immediate
		tc	Time Clock
		dAY	Day of Week
NT	Number of Tanks	1	Single Tank System
		2	Two Tank System
TS	Tank in Service	U1	Tank 1 in Service
		U2	Tank 2 in Service
C	Unit Capacity		Unit Capacity (Grains)
H	Feedwater Hardness		Hardness of Inlet Water
RS	Reserve Selection	SF	Percentage Safety Factor
		rc	Fixed Reserve Capacity
SF	Safety Factor		Percentage of the system capacity to be used as a reserve
RC	Fixed Reserve Capacity		Fixed volume to be used as a reserve
DO	Day Override		The system's day override setting
RT	Regen Time		The time of day the system will regenerate
BW, BD, RR, BF	Regen Cycle Step Times		The time duration for each regeneration step. Adjustable from OFF and 0-199 minutes. <b>NOTE: If "Othr" is chosen under "Valve Type", then R1, R2, R3, etc, will be displayed instead</b>
D1, D2, D3, D4, D5, D6, & D7	Day of Week Settings		Regeneration setting (On or OFF) for each day of the week on day-of-week systems
CD	Current Day		The Current day of the week
FM	Flow Meter Type	t0.7	3/4" Turbine Meter
		P0.7	3/4" Paddle Wheel Meter
		t1.0	1" Turbine Meter
		P1.0	1" Paddle Wheel Meter
		t1.5	1.5" Turbine Meter
		P1.5	1.5" Paddle Wheel Meter
		Gen	Generic or Other Meter
K	Meter Pulse Setting		Meter pulses per gallon for generic/other flow meter

**NOTE:**

Some items may not be shown depending on timer configuration.

The timer will discard any changes and exit Master Programming Mode if any button is not pressed for sixty seconds.

**CAUTION: Before entering Master Programming, please contact your local professional water dealer.**

**MASTER PROGRAMMING MODE**

**ENTERING MASTER PROGRAMMING MODE**

Set the Time Of Day display to 12:01 P.M. Press the Extra Cycle button (to exit Setting Time of Day mode). Then press and hold the Up and Down buttons together until the programming icon replaces the service icon and the Display Format screen appears.

When the Master Programming Mode is entered, all available option setting displays may be viewed and set as needed. Depending on current option settings, some parameters cannot be viewed or set.

**1. Display Format (Display Code DF)**

This is the first screen that appears when entering Master Programming Mode. The Display Format setting specifies the unit of measure that will be used for volume and how the control will display the Time of Day. This option setting is identified by "DF" in the upper left hand corner of the screen. There are three possible settings:

DISPLAY FORMAT SETTING	UNIT OF VOLUME	TIME OF DISPLAY
GAL	U.S. Gallons	12-hour AM/PM
Ltr	Liters	24-Hour
Cu	Cubic Meters	24-Hour



**2. Valve Type (Display Code VT)**

Press the Extra Cycle button. Use this display to set the Valve Type. The Valve Type setting specifies the type of cycle that the valve follows during regeneration. Note that some valve types require that the valve be built with specific subcomponents. Ensure the valve is configured properly before changing the Valve Type setting. This option setting is identified by "VT" in the upper left hand corner of the screen. There are 5 possible settings:

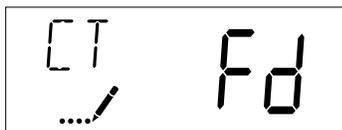
ABBREVIATION	PARAMETER
St1b	Standard Downflow/Upflow, Single Backwash
St2b	Standard Downflow/Upflow, Double Backwash
Filtr	Filter
UFbF	Upflow Brine First
Othr	Other



**3. Control Type (Display Code CT)**

Press the Extra Cycle button. Use this display to set the Control Type. This specifies how the control determines when to trigger a regeneration. For details on how the various options function, refer to the "Timer Operation" section of this service manual. This option setting is identified by "CT" in the upper left hand corner of the screen. There are four possible settings:

- Meter Delayed: Fd
- Meter Immediate: FI
- Time Clock: tc
- Day of Week: dAY

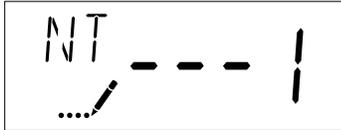


**MASTER PROGRAMMING MODE (continued)**

**4. Number of Tanks (Display Code NT)**

Press the Extra Cycle button. Use this display to set the Number of Tanks in your system. This option setting is identified by "NT" in the upper left hand corner of the screen. There are two possible settings:

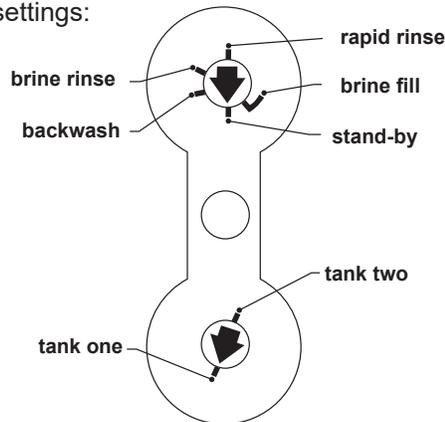
- Single Tank System: 1
- Two-Tank System: 2



**5. Tank in Service (Display Code TS)**

Press the Extra Cycle button. Use this display to set whether tank one or tank two is in service. This option setting is identified by "TS" in the upper left hand corner of the screen. This parameter is only available if the number of tanks has been set to 2. There are two possible settings:

- Tank One in Service: U1
- Tank Two in Service: U2



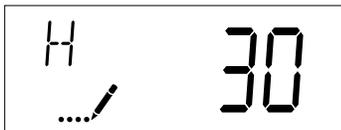
**6. Unit Capacity (Display Code C)**

Press the Extra Cycle button. Use this display to set the Unit Capacity. This setting specifies the treatment capacity of the system media. Enter the capacity of the media bed in grains of hardness when configuring a softener system, and in the desired volume capacity when configuring a filter system. This option setting is identified by "C" in the upper left hand corner of the screen. The Unit Capacity parameter is only available if the control type has been set to one of the metered options. Use the Up and Down buttons to adjust the value as needed.



**7. Feedwater Hardness (Display Code H)**

Press the Extra Cycle button. Use this display to set the Feedwater Hardness. Enter the feedwater hardness in grains per unit volume for softener systems, or 1 for filter systems. This option setting is identified by "H" in the upper left hand corner of the screen. The feedwater hardness parameter is only available if the control type has been set to one of the metered options. Use the Up and Down buttons to adjust the value as needed.

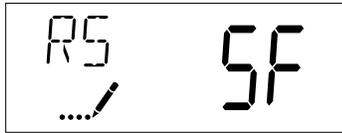


**CAUTION: Before entering Master Programming, please contact your local professional water dealer.**

**MASTER PROGRAMMING MODE (continued)**

**8. Reserve Selection (Display Code RS)**

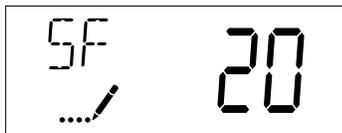
Press the Extra Cycle button. Use this display to set the Safety Factor. Use this display to select the type of reserve to be used in your system. This setting is identified by "RS" in the upper left-hand corner of the screen. The reserve selection parameter is only available if the control type has been set to one of the metered options. There are two possible settings.



RS	SF - Safety Factor
rc	Fixed Reserve Capacity

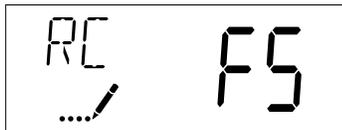
**9. Safety Factor (Display Code SF)**

Press the Extra Cycle button. Use this display to set the Safety Factor. This setting specifies what percentage of the system capacity will be held as a reserve. Since this value is expressed as a percentage, any change to the unit capacity or feedwater hardness that changes the calculated system capacity will result in a corresponding change to the reserve volume. This option setting is identified by "SF" in the upper left hand corner of the screen. Use the Up and Down buttons to adjust the value from 0 to 50% as needed.



**10. Fixed Reserve Capacity (Display Code RC)**

Press the Extra Cycle button. Use this display to set the Reserve Capacity. This setting specifies a fixed volume that will be held as a reserve. The reserve capacity cannot be set to a value greater than one-half of the calculated system capacity. The reserve capacity is a fixed volume and does not change if the unit capacity or feedwater hardness are changed. This option setting is identified by "RC" in the upper left-hand corner of the screen. Use the Up and Down buttons to adjust the value as needed.



**11. Day Override (Display Code DO)**

Press the Extra Cycle button. Use this display to set the Day Override. This setting specifies the maximum number of days between regeneration cycles. If the system is set to a timer-type control, the day override setting determines how often the system will regenerate. A metered system will regenerate regardless of usage if the days since last regeneration cycle equal the day override setting. Setting the day override value to "OFF" disables this function. This option setting is identified by "DO" in the upper left hand corner of the screen. Use the Up and Down buttons to adjust the value as needed.



**CAUTION: Before entering Master Programming, please contact your local professional water dealer.**

**MASTER PROGRAMMING MODE (continued)**

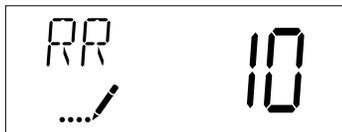
**12. Regeneration Time (RT)**

Press the Extra Cycle button. Use this display to set the Regeneration Time. This setting specifies the time of day the control will initiate a delayed, manually queued, or day override triggered regeneration. This option setting is identified by "RT" in the upper left hand corner of the screen. Use the Up and Down buttons to adjust the value as needed.



**13. Regeneration Cycle Step Times**

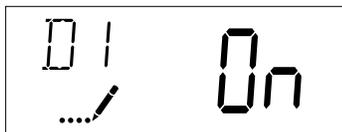
Press the Extra Cycle button. Use this display to set the Regeneration Cycle Step Times. The different regeneration cycles are listed in sequence based on the valve type selected for the system, and are identified by an abbreviation in the upper left-hand corner of the screen. The abbreviations used are listed below. If the system has been configured with the "OTHER" valve type, the regeneration cycles will be identified as R1, R2, R3, R4, R5, and R6. Each cycle step time can be set from 0 to 199 minutes, or "OFF." Setting a cycle step to "OFF" will disable all of the following steps. Setting a cycle step time to 0 will cause the control to skip that step during regeneration, but keeps the following steps available. Use the Up and Down buttons to adjust the value as needed. Press the Extra Cycle button to accept the current setting and move to the next parameter.



CYCLE STEP	ABBREVIATION
BD	Brine Draw
BF	Brine Fill
BW	Backwash
RR	Rapid Rinse
SV	Service

**14. Day of Week Settings**

Press the Extra Cycle button. Use this display to set the regeneration schedule for a system configured as a Day of Week control. The different days of the week are identified as D1, D2, D3, D4, D5, D6, and D7 in the upper left-hand corner of the display. Set the value to "ON" to schedule a regeneration or "OFF" to skip regeneration for each day. Use the Up and Down buttons to adjust the setting as needed. Press the Extra Cycle button to accept the setting and move to the next day. Note that the control requires at least one day to be set to "ON." If all 7 days are set to "OFF", the unit will return to Day One until one or more days are set to "ON."



**15. Current Day (Display Code CD)**

Press the Extra Cycle button. Use this display to set the current day on systems that have been configured as Day of Week controls. This setting is identified by "CD" in the upper left-hand corner of the screen. Use the Up and Down buttons to select from Day 1 through Day 7.



**CAUTION: Before entering Master Programming, please contact your local professional water dealer.**

**MASTER PROGRAMMING MODE (continued)**

**16. Flow Meter Type (Display Code FM)**

Press the Extra Cycle button. Use this display to set the type of flow meter connected to the control. This option setting is identified by "FM" in the upper left-hand corner of the screen. Use the Up and Down buttons to select one of the 7 available settings.



t0.7	Fleck 3/4" Turbine Meter
P0.7	Fleck 3/4" Paddle Wheel Meter
t1.0	Fleck 1" Turbine Meter
P1.0	Fleck 1" Paddle Wheel Meter
t1.5	Fleck 1 1/2" Turbine Meter
P1.5	Fleck 1 1/2" Paddle Wheel Meter
GEn	Generic/Other Meter

**17. Meter Pulse Setting (Display Code K)**

Press the Extra Cycle button. Use this display to specify the meter pulse setting for a non-standard flow meter. This option setting is identified by "K" in the upper left-hand corner of the screen. Use the Up and Down buttons to enter the meter constant in pulses per unit volume.



**K-FACTOR TABLE - SIGNET 2536**  
(Pulses per Gallon)

PIPE SIZE (inches)	GENERIC FLOW METER SETTINGS		
	TEE GALVANIZED	TEE PVC	SADDLE IRON
1	213	352	
1-1/4	128	177	
1-1/2	94	118	
2	59	67	54
2-1/2		43	38
3		27	23

**AUTO TURBINE METER**

METER SIZE	K-FACTOR
1	65
2	15

**CLACK METER**

METER SIZE	K-FACTOR
1-1/2	37
2	20
3	8

**Note:** Make sure to select the proper K-factor for the fitting and pipe size of your system.

**18.** Press the Extra Cycle button to save all settings and exit Master Programming Mode.

**CAUTION:** Before entering Master Programming, please contact your local professional water dealer.

**USER PROGRAMMING MODE**

USER PROGRAMMING MODE OPTIONS		
ABBREVIATIONS	PARAMETER	DESCRIPTION
DO	Day Override	The timer's override setting
RT	Regeneration Time	The time of day that the system will regenerate (meter delayed, timeclock, and day-of-week systems)
H	Feed Water Hardness	The hardness of the inlet water - used to calculate system capacity for metered systems
RC	Reserve Capacity	The fixed reserve capacity
CD	Current Day	The current day of week

**NOTES: Some items may not be shown depending on timer configuration. The timer will discard any changes and exit User Mode if any button is not pressed for sixty seconds.**

**START-UP**

1. Press the Up and Down buttons for five seconds while in service, and the time of day is NOT set to 12:01 PM.
2. Use this display to adjust the Day Override. This option setting is identified by "DO" in the upper left hand corner of the screen.



3. Press the Extra Cycle button. Use this display to adjust the Regeneration Time. This option setting is identified by "RT" in the upper left hand corner of the screen.



4. Press the Extra Cycle button. Use this display to adjust the Feed Water Hardness. This option setting is identified by "FH" in the upper left hand corner of the screen.



5. Press the Extra Cycle button. Use this display to adjust the Fixed Reserve Capacity. This option setting is 18 identified by "RC" in the upper left-hand corner of the screen.



6. Press the Extra Cycle button. Use this display to set the Current Day of the Week. This option setting is identified by "CD" in the upper left hand corner of the screen.



7. Press the Extra Cycle button to end User Programming Mode.

**DIAGNOSTIC PROGRAMMING MODE**

USER PROGRAMMING MODE OPTIONS		
ABBREVIATIONS	PARAMETER	DESCRIPTION
DO	Day Override	The timer's override setting
RT	Regeneration Time	The time of day that the system will regenerate (meter delayed, timeclock, and day-of-week systems)
H	Feed Water Hardness	The hardness of the inlet water - used to calculate system capacity for metered systems
RC	Reserve Capacity	The fixed reserve capacity
CD	Current Day	The current day of week

**NOTES: Some items may not be shown depending on timer configuration. The timer will discard any changes and exit User Mode if any button is not pressed for sixty seconds.**

**START-UP**

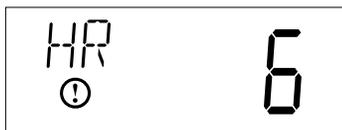
1. Press the Up and Down buttons for five seconds while in service, and the time of day is NOT set to 12:01 PM.
2. Use this display to adjust the Day Override. This option setting is identified by "DO" in the upper left hand corner of the screen.



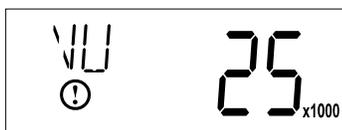
3. Press the Extra Cycle button. Use this display to view the Peak Flow Rate since the last regeneration cycle. This option setting is identified by "PF" in the upper left hand corner of the screen.



4. Press the Extra Cycle button. Use this display to view the Hours in Service since the last regeneration cycle. This option setting is identified by "HR" in the upper left hand corner of the screen.



5. Press the Extra Cycle button. Use this display to view the Volume Used since the last regeneration cycle. This option setting is identified by "VU" in the upper left hand corner of the screen.



**CAUTION: Before entering Master Programming, please contact your local professional water dealer.**

**DIAGNOSTIC PROGRAMMING MODE**

6. Press the Up button. Use this display to view the Reserve Capacity. This option setting is identified by "RC" in the upper left hand corner of the screen.



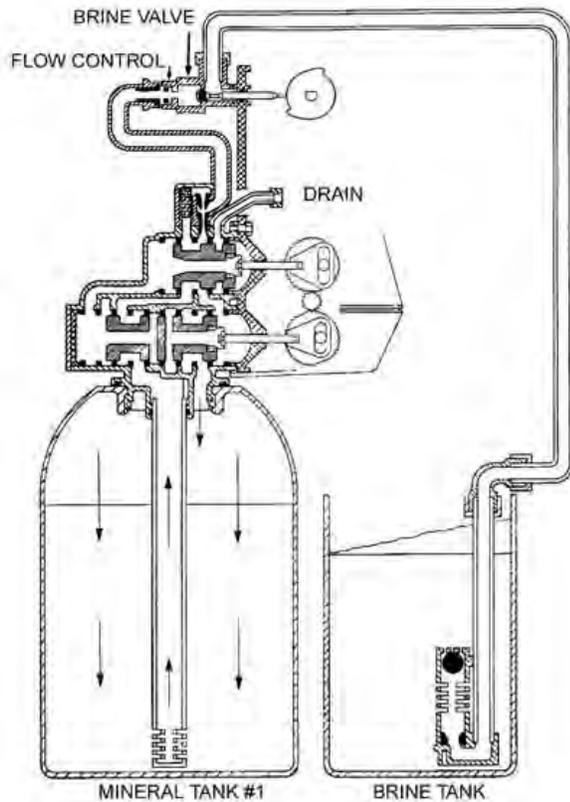
7. Press the Up button. Use this display to view the Software Version. This option setting is identified by "SV" in the upper left hand corner of the screen.



8. Press the Extra Cycle button to end Diagnostic Programming Mode.

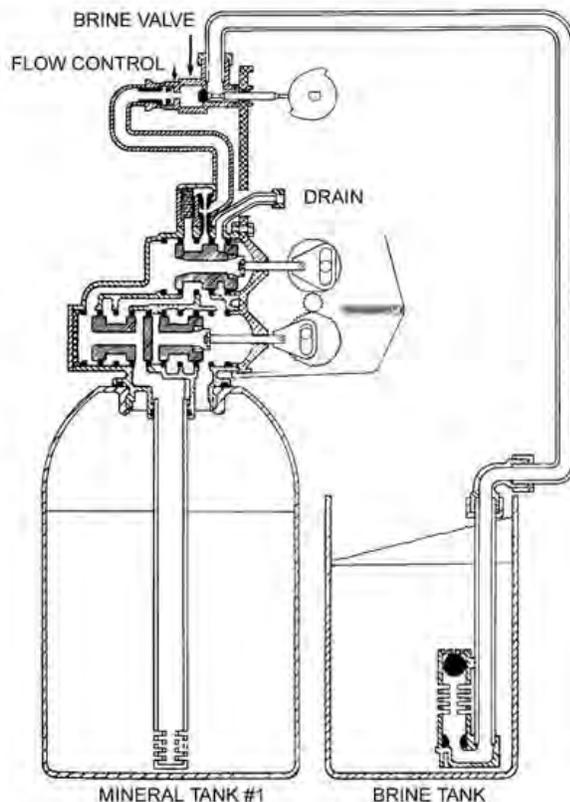
**CAUTION: Before entering Master Programming, please contact your local professional water dealer.**

**FLOW DIAGRAMS**



**1 - SERVICE POSITION**

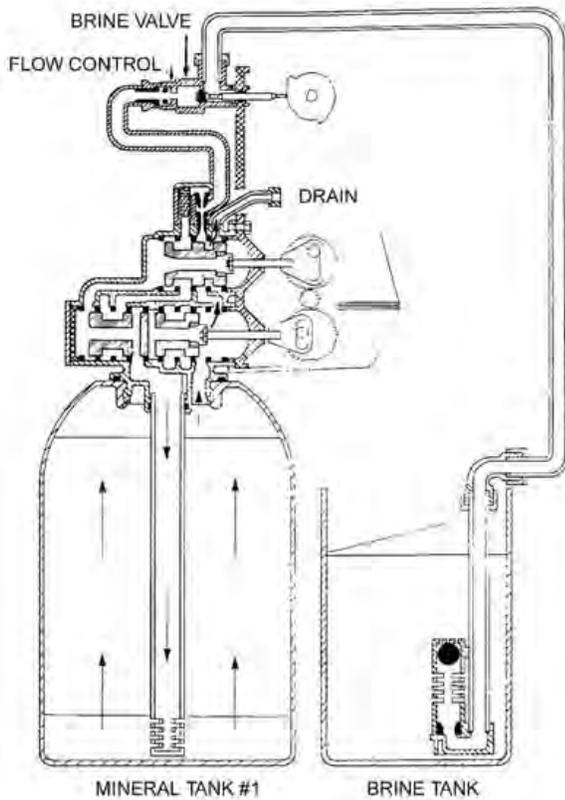
Hard water enters the unit at the valve inlet, flows around the lower piston, and down through the mineral in the first tank. Conditioned water enters the center tube through the bottom distributor, flows up through the center tube, around the lower piston, through the meter, and out the valve outlet. The second mineral tank is regenerated and on standby.



**2 - TANKS SWITCHING  
(the meter has initiated a regeneration)**

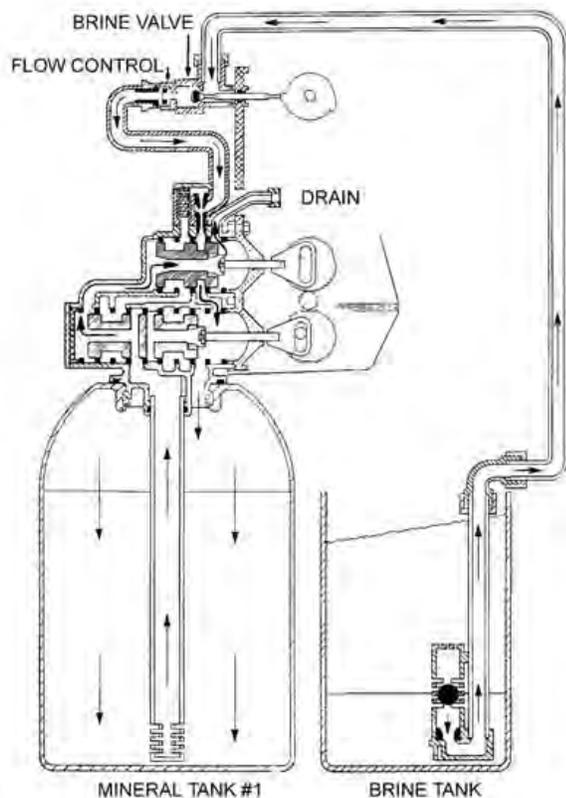
Hard water enters the unit at the valve inlet, flows around the lower piston, through the pipe leading to the second mineral tank, and down through the mineral in the second tank. Conditioned water enters the center tube of this second tank through the bottom distributor, flows up through the center tube, through the pipe leading back to the main valve, around the lower piston, through the meter, and out the valve outlet. The depleted first mineral tank is out of the flow path, and ready for regeneration.

**FLOW DIAGRAMS**



**3 - BACKWASH**

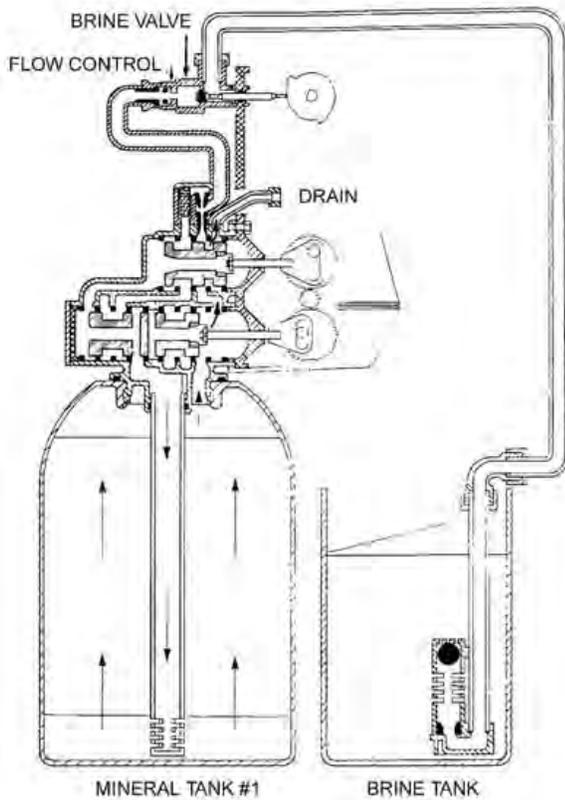
Conditioned water from the second mineral tank flows around the lower piston, around the upper piston, through the center of the lower piston, down the center tube, up through the mineral, around the upper piston, and out the drain line.



**4 - BRINE DRAW**

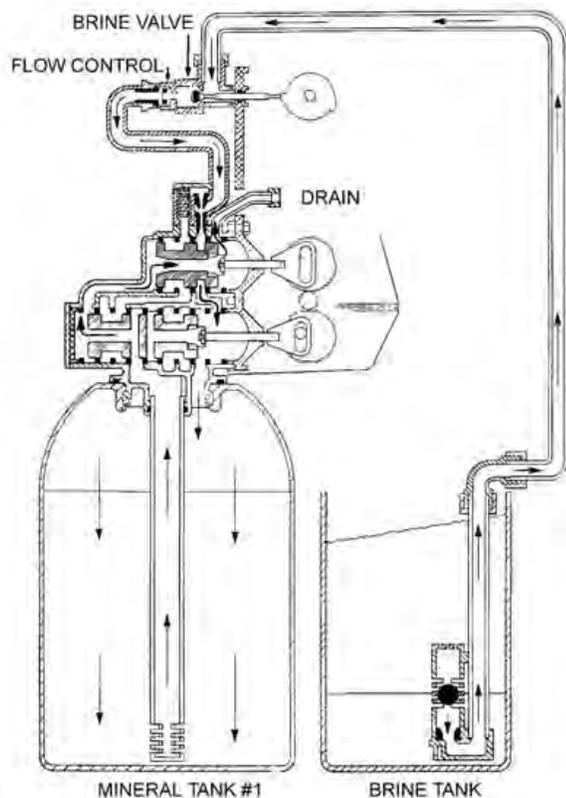
Conditioned water from the second mineral tank flows around the lower piston, around the upper piston, into the injector housing, and down through the nozzle and throat to draw brine from the brine tank. Brine flows around the upper piston, down through the mineral, into the center tube through the bottom distributor, up the center tube through the center of the lower piston, through the center of the upper piston, and out through the drain line.

**FLOW DIAGRAMS**



**5 - SLOW RINSE**

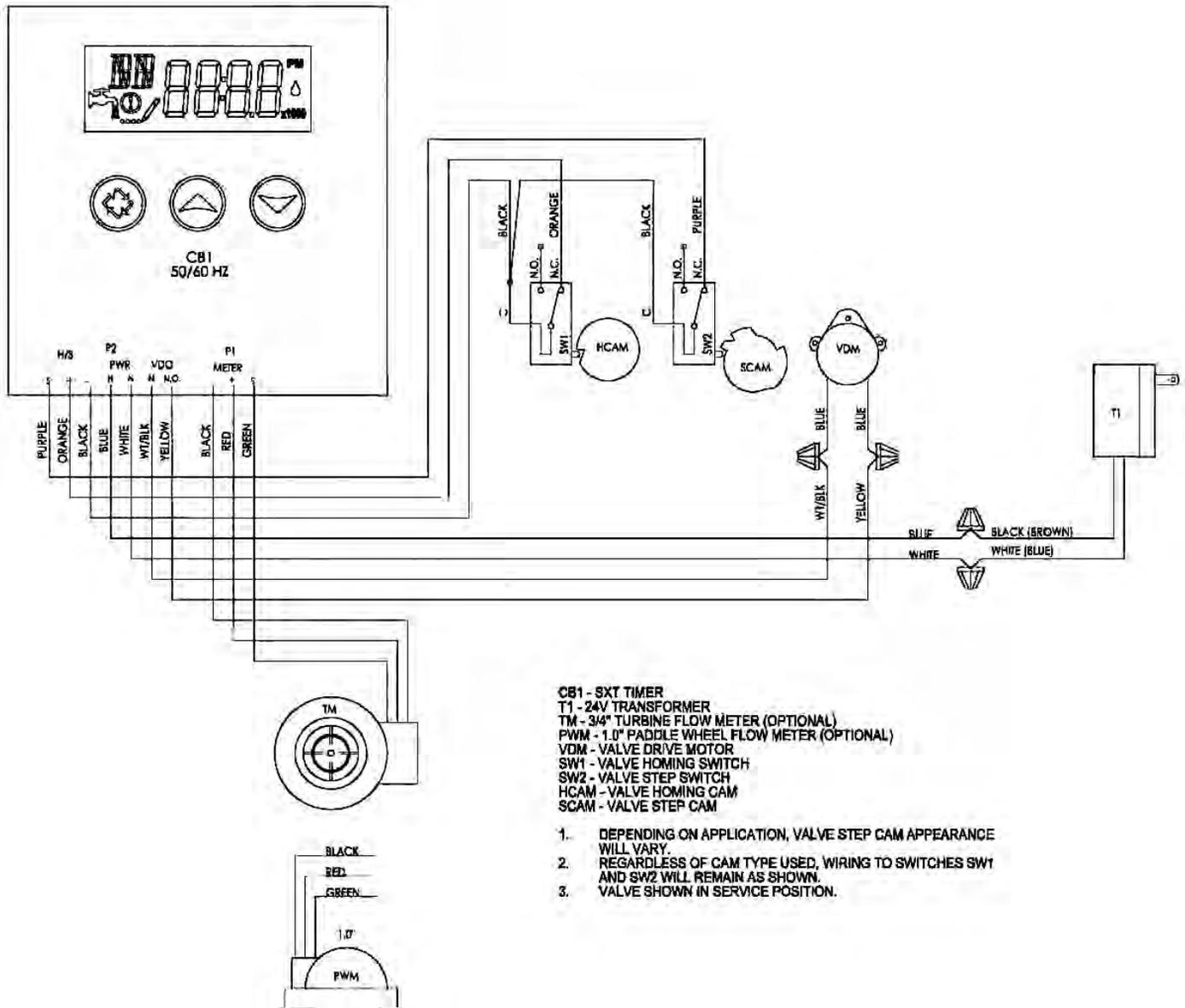
Conditioned water from the second mineral tank flows around the lower piston, around the upper piston, into the injector housing, down through the nozzle and throat, around the upper piston, down through the mineral, into the center tube through the bottom distributor, up the center tube, through the center of the lower piston, through the center of the upper piston, and out through the drain line.



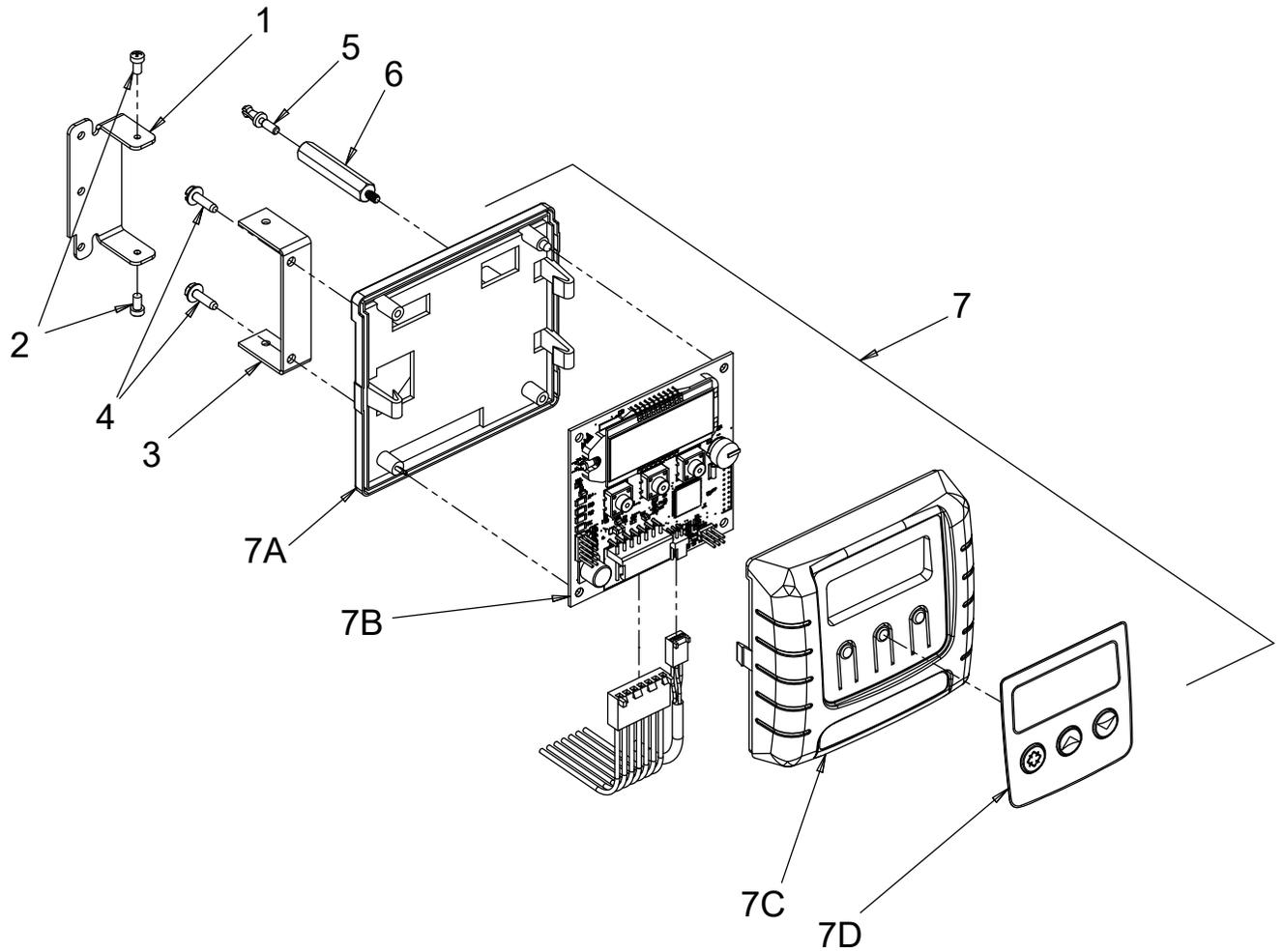
**6 - RAPID RINSE**

Conditioned water from the second mineral tank flows around the lower piston, around the upper piston, and down through the mineral in the first tank. Rinse water from the mineral bed enters the center tube through the bottom distributor, flows up the center tube, through the center of the lower piston, through the center of the upper piston, and out through the drain line.

**SXT WIRING DIAGRAM**

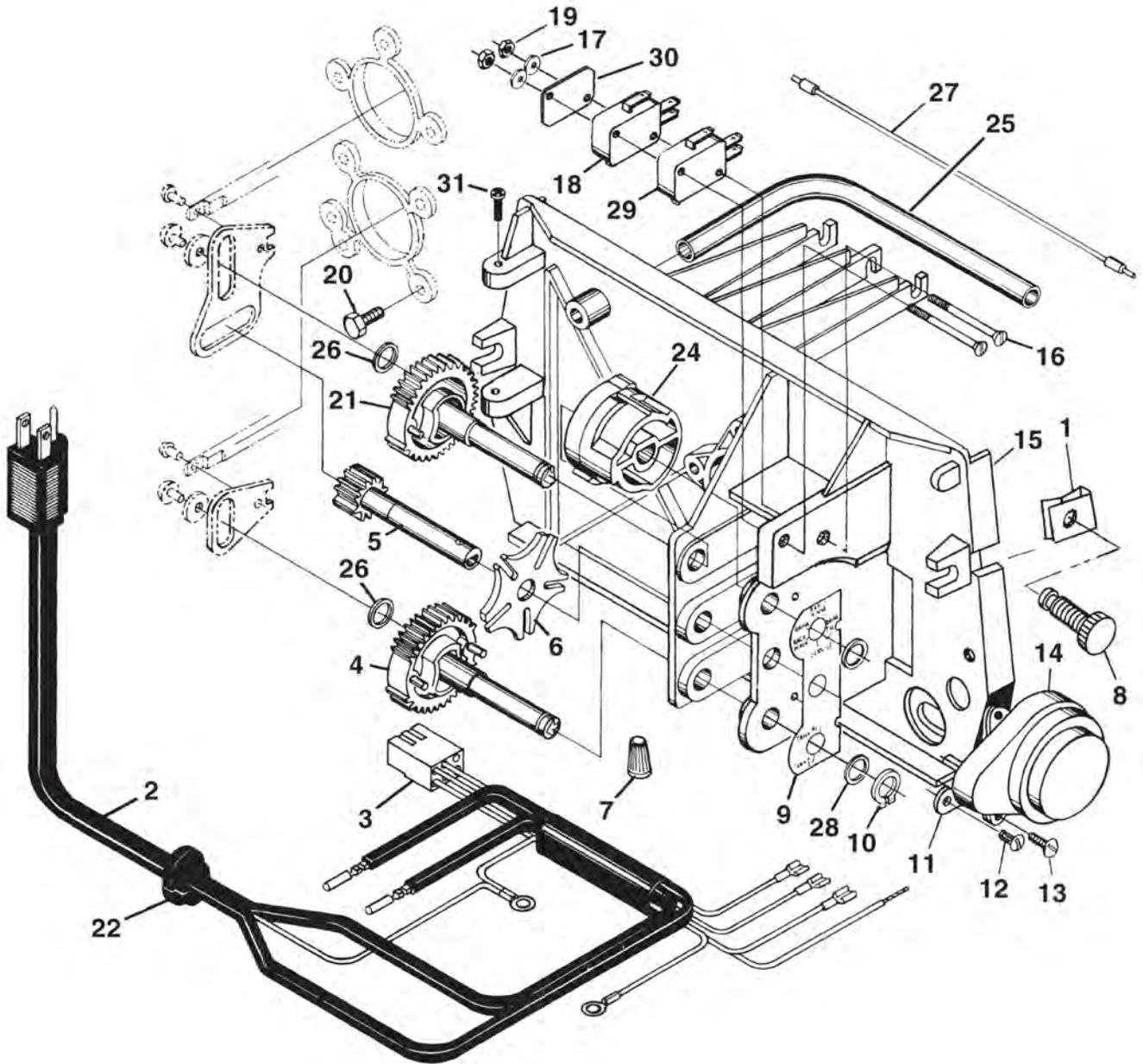


**SXT TIMER ASSEMBLY**



Item No.	Quantity	Part No.	Description
1.....	1.....	13881.....	BRACKET, HINGE TIMER
2.....	2.....	11384.....	SCREW, PHIL, 6-32 X 1/4
3.....	1.....	42732.....	BRACKET, TIMER, 9000SXT
4.....	2.....	13296.....	SCREW, HEX WSH, 6-20 X 1/2
5.....	1.....	14265.....	CLIP, SPRING
6.....	1.....	42733.....	STAND-OFF, TIMER, 9000SXT
7.....	1.....	61464.....	TIMER, SXT, 2510/2750/9000, D/F
7A.....	1.....	19889.....	HOUSING, CIRCUIT BOARD
7B.....	1.....	42196.....	CIRCUIT BOARD, SE
7C.....	1.....	42635.....	COVER, FRONT, SXT, SQUARE
7D.....	1.....	42637.....	LABEL, DISPLAY, SE

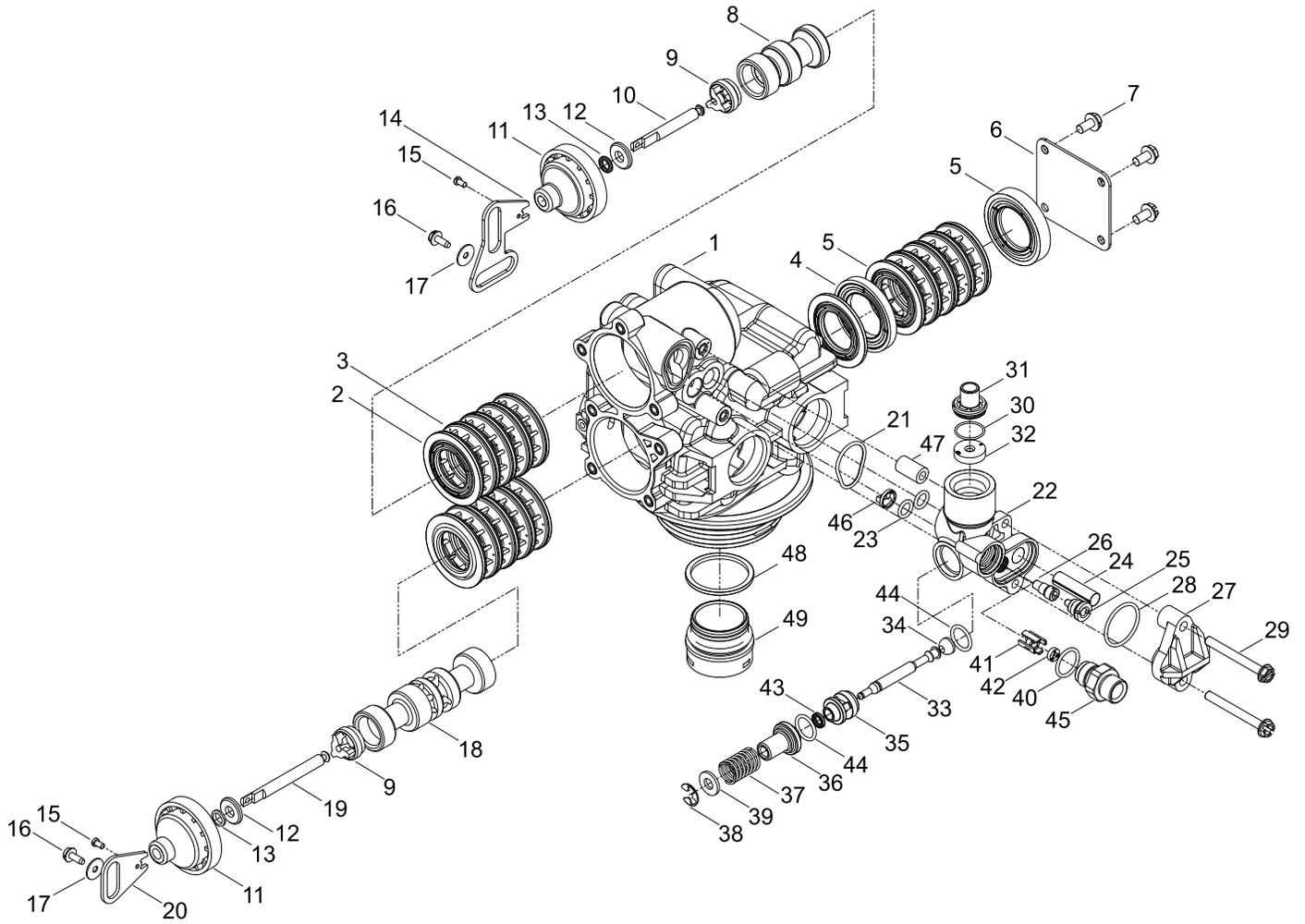
**POWERHEAD ASSEMBLY**



**POWERHEAD PARTS LIST**

Item No.	Quantity	Part No.	Description
1	2	18728	Nut, Tinnerman, U Type, 8-32
2	1	11838	Power Cord, 6' Fleck
		11839	Power Cord, 12' Fleck
		40084-12	Power Cord, 12' U.S., Round, 120V Sys 5, 6, 7 & 2900/3150/3900 #4
		11545-01	Power Cord Assy, 4' Black, Euro w/Terminals
		14678	Power Cord, U.S., 220/60
		19303-01	Power Cord Assy, Australian w/Terminals
		40085-12	Power Cord, 12' US, Round, 240V
		19674	Transformer, 24V, 9.6VA Residential Valves
		41475	Transformer, 24V, 9.6VA, European
3	1	15202	Harness, 9000/9500, Drive
		14822	Harness, 2900
		40041-06	Harness, Low V, 9000/9500
4	1	15134	Gear Assy, Drive, 1/2" Stroke 9000/9500
5	1	15135	Gear, Drive, 9000
6	1	14896	Wheel, Geneva
7	2	40422	Nut, Wire, Tan
8	2	19367	Screw, Designer Cover, Thumb 8-32 Blank UV Stable Material
9	1	15175	Label, Shaft Position
10	2	14917	Ring, Retaining
11	1	15199	Plate, Ground, 9000/9500
12	1	14430	Screw, Hex Wsh St, 6 x 1/4 Type "B"
13	2	19160	Screw, Phil Pan, Thread 6-32 x 3/8 Type 23 Zinc
14	1	18737	Motor, 24V, 50/60 Hz, 1 RPM
		18738	Motor, 120V, 50/60 Hz 1 RPM
		18739	Motor, 220V, 50/60 Hz 1 RPM
15	1	15131	Backplate, 9000
		17784-05	Panel, Control, 9000/9500 ET
16	2	15172	Screw, Flt Hd Mach, 4-40 x 1 3/8 Steel Zinc Plate
17	2	10340	Washer, Lock #4, Zinc
18		10218	Switch, Micro
19	1	10339	Nut, Hex, 4-40 Zinc Plated
20	1	15331	Screw, Hex Wsh Mach, 10-24 x 3/4 410 S.S.
21	2	15133	Gear Assy, Drive, 3/4" Stroke
22	1	13547	Strain Relief, Flat Cord Heyco #30-1
23	1	15810	Ring, Retaining
24	1	15132	Cam, Triple
		17331	Cam, 9500
		17765	Cam Assy, Aux Switch, 9500
25	1	15368	Tube, Cable Guide, 2-Tank
		17337	Tube, Cable Guide, 9500
26	2	15372	Washer, Thrust, 3/8
27	1	15216	Meter Cable Assy, 15.25"
		15425	Meter Cable, 13.25"
		17744	Meter Cable Assy, 20.75" 1 1/2" Std
		19121-01	Meter Cable Assy, SE, Paddle 6600/6700
		19121-05	Meter Cable Assy, ET, 28" 2750/3150 Systemax 4-6
		19791-01	Meter Cable Assy, Turbine/SE
28	2	15692	Washer, Plain, 3/8"
29	1	16433	Switch, Miniature
30	1	10302	Insulator, Limit Switch
31	2	15173	Screw, Slot Rd Hd Mach, 5-20 x 3/8
		Not Shown	
	1	60232-110	Cover, Designer, 1 Pc Black
	1	60232-112	Cover, Designer, 1 Pc Black w/Left Window
	1	60320-09	Switch Assy, 9000, Drive Cam
	1	60320-10	Switch Assy, 9500, Drive Cam

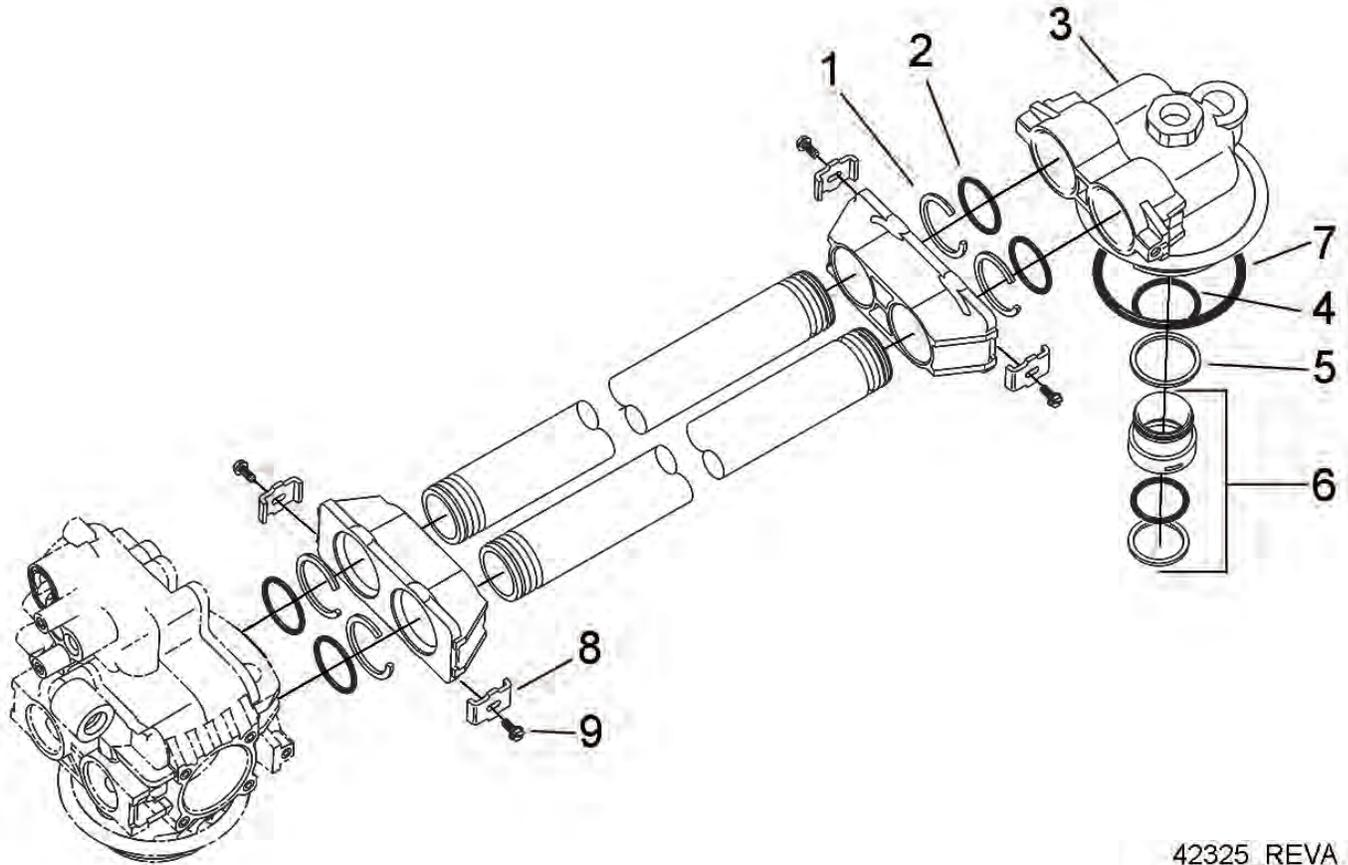
**9100 CONTROL VALVE ASSEMBLY**



**9100 CONTROL VALVE PARTS LIST**

Item No.	Quantity	Part No.	Description
1.....	1.....	40688.....	Valve Body Assy, 9100
2.....	16.....	13242.....	Seal, 5600
3.....	12.....	14241.....	Spacer, 5600
4.....	1.....	16595.....	Spacer, 9000
5.....	1.....	14928.....	Plug, End Stub, 9000
6.....	1.....	14906.....	Plate, End, 9000
7.....	4.....	15137.....	Screw, Hex Wsh Mach, 10-24 x 3/8
8.....	1.....	14914.....	Piston, 9000, Upper
9.....	2.....	14309.....	Retainer, Piston Rod
10.....	1.....	14919.....	Rod, Piston, Upper
11.....	2.....	13243.....	Plug, End, 5600
12.....	2.....	13008.....	Retainer, End Plug Seal
13.....	2.....	10209.....	Quad Ring, -010
14.....	1.....	14921.....	Link, Piston Rod
15.....	2.....	11335.....	Screw, Slot Phil Hd, 4-40 x 3/16
16.....	2.....	17020.....	Screw, Slot Ind Hex, 6-20 x 3/8
17.....	2.....	13363.....	Washer, Plain, .145 ID SS
18.....	1.....	14905.....	Piston, 9000
19.....	1.....	14920.....	Rod, Piston, Lower, 9000
20.....	1.....	15019.....	Link, Piston Rod, 9000/9500
21.....	1.....	41500.....	O-ring, Drain, 9100
22.....	1.....	15215.....	Body, Injector, 9000
23.....	2.....	13301.....	O-ring, -011, Injector
24.....	1.....	10227.....	Screen, Injector
25.....	1.....	10913-1.....	Nozzle, Injector, #1, White
26.....	1.....	10914-1.....	Throat, Injector, #1, White
27.....	1.....	13166.....	Cap, Injector, 5600
28.....	1.....	13303.....	O-ring, -021
29.....	2.....	13387.....	Screw, Hex Hd Wash, 10-24 x 1 3/4
30.....	1.....	15348.....	O-ring, -563
31.....	1.....	13173.....	Retainer, DLFC Button
32.....	1.....	12085.....	Washer, Flow, 1.2 GPM
33.....	1.....	14925.....	Brine Valve Stem, 9000
34.....	1.....	12626.....	Seat, Brine Valve
35.....	1.....	13167.....	Spacer, Brine Valve
36.....	1.....	13165.....	Cap, Brine Valve
37.....	1.....	11973.....	Spring, Brine Valve
38.....	1.....	11981-01.....	Ring, Retaining
39.....	1.....	16098.....	Washer, Nylon Brine
40.....	1.....	12977.....	O-ring, -015
41.....	1.....	13245.....	Retainer, BLFC
42.....	1.....	129095.....	Washer, Flow, .50 GPM
43.....	1.....	12550.....	Quad Ring, -009
44.....	2.....	13302.....	O-ring, -014
45.....	1.....	13244.....	Adapter, BLFC
46.....	1.....	13497.....	Dispenser, Air, 5600
47.....	1.....	13361.....	Spacer, 4650/9000/WCC
48.....	1.....	40538.....	Retainer, 32mm, O-ring Dist, 7000
49.....	1.....	61419.....	Kit, 1.05" Distributor, Adapter
Not Shown.....	1.....	13333.....	Label, Injector, Blank
Not Shown.....	1.....	10759.....	Label, .5 GPM, 1.5 LBS Salt/Min

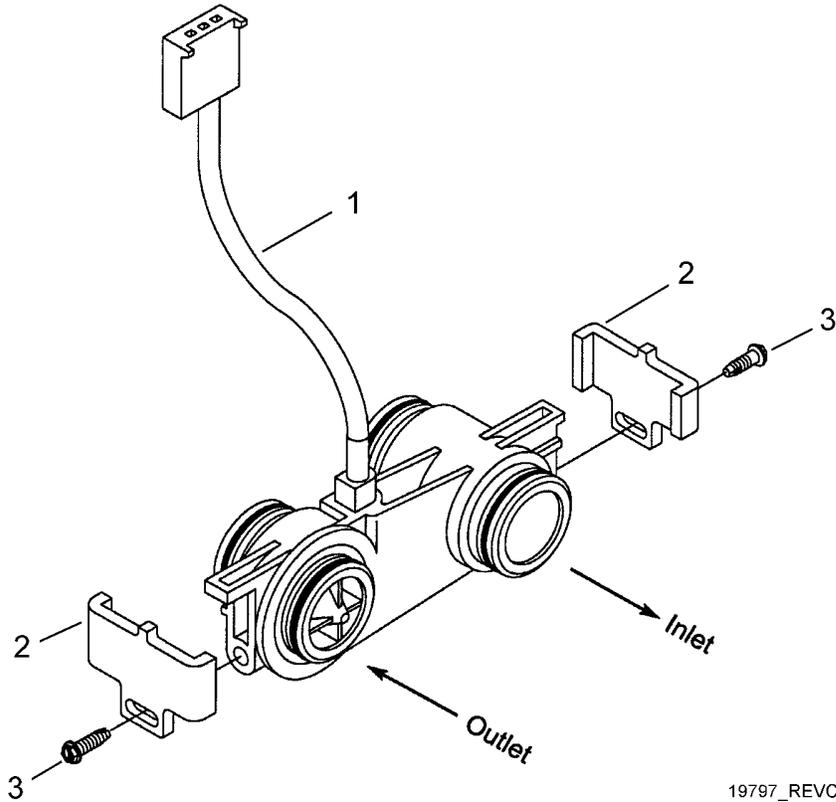
**9100 SECOND TANK ASSEMBLY**



42325\_REVA

Item No.	Quantity	Part No.	Description
1	4	40678	Ring, 9100, Yoke Retainer
2	4	13287	O-ring, -123
3	1	14865	Adapter Assy, 2nd Tank, 9100
4	1	19054	O-ring, -124
5	1	40538	Retainer, 32mm, O-ring Dist, 7000
6	1	61419	Kit, 1.05" Distributor, Adapter
7	1	18303	O-ring, -336
8	4	13255	Clip, Mounting
9	4	14202-01	Screw, Hex Wsh Mach, 8-32 x 5/16

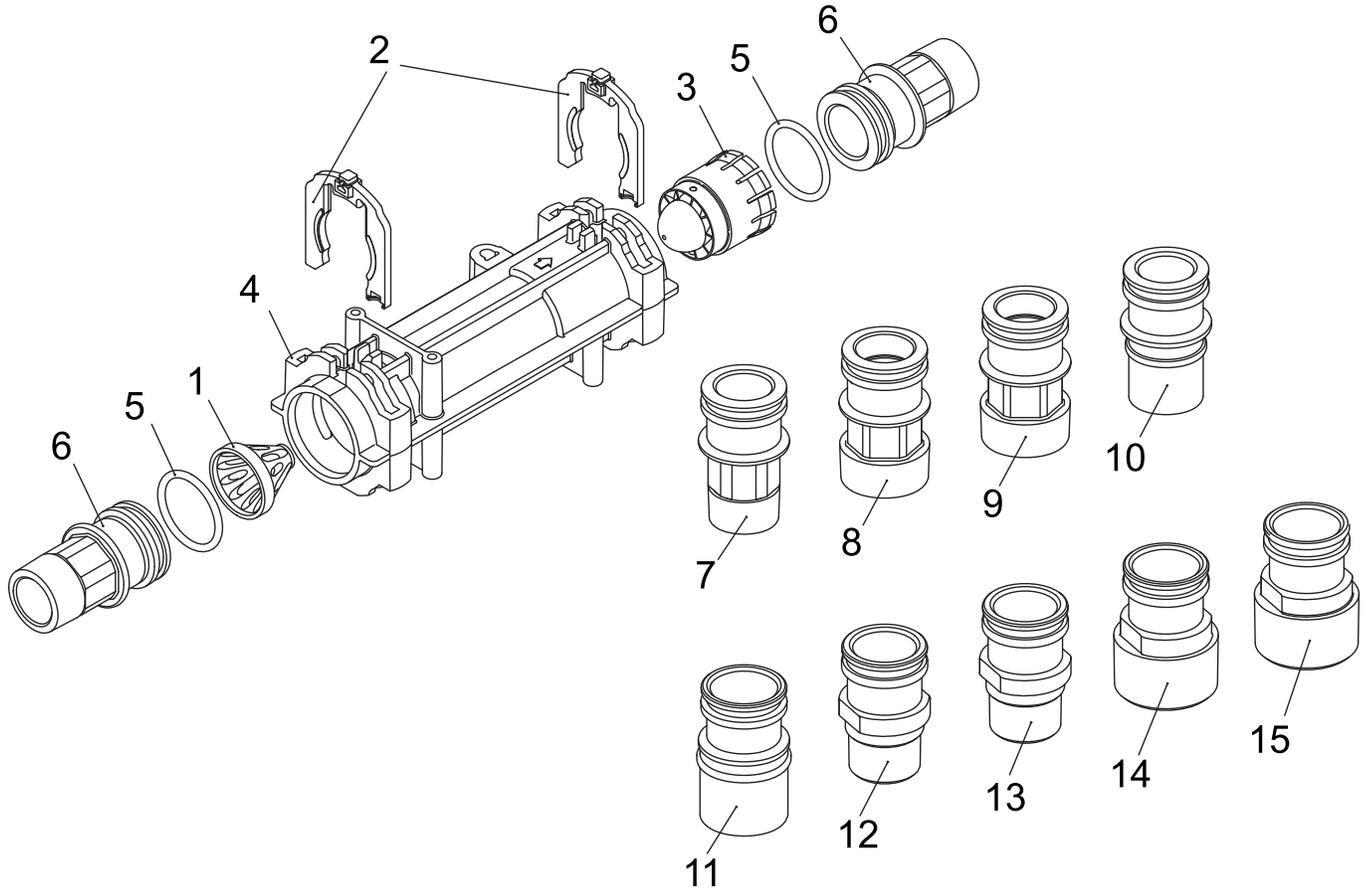
**3/4" TURBINE METER**



19797\_REVC

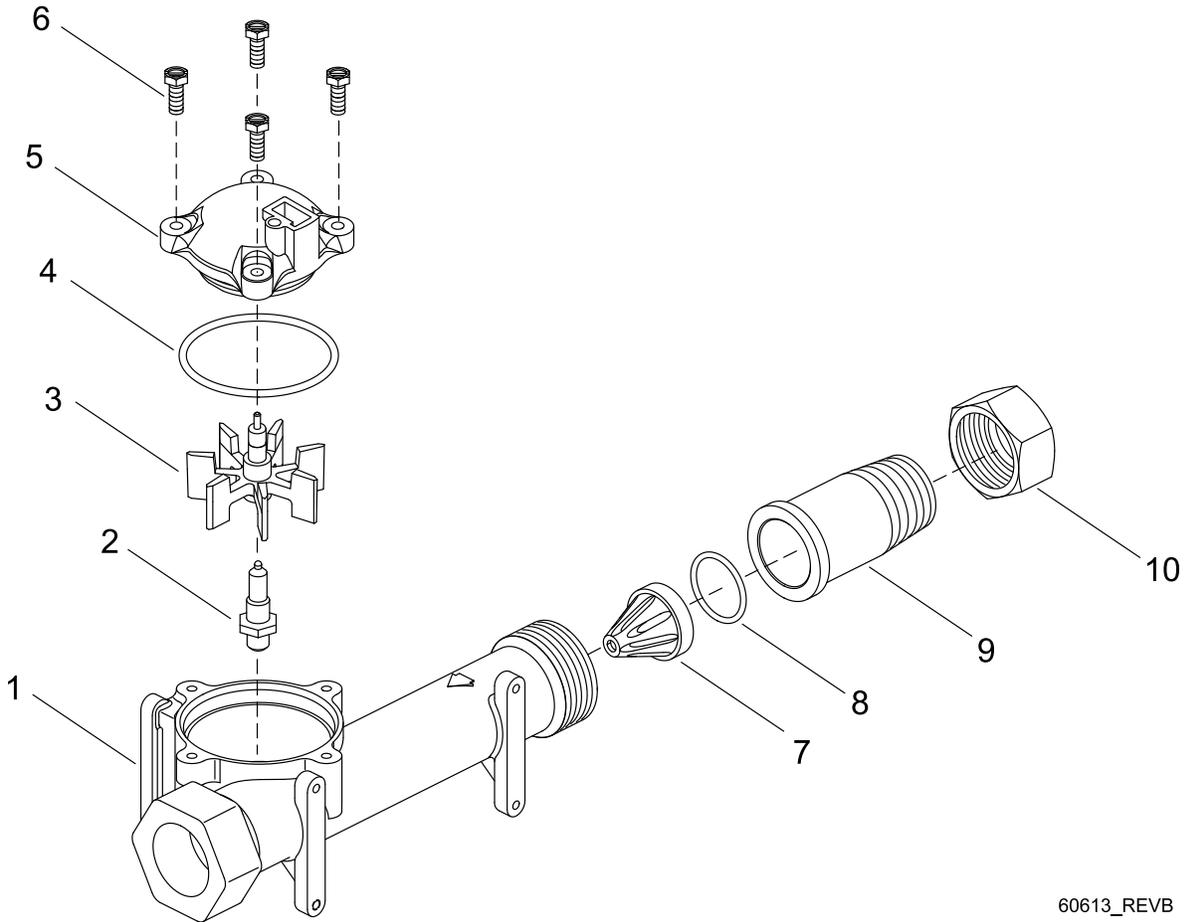
Item No.	Quantity	Part No.	Description
1.....	1 .....	19791-01 .....	Meter Cable Assy, Turbine/SXT
2.....	2 .....	19569 .....	Clip, Flow Meter
3.....	2 .....	13314 .....	Screw, Slot Ind Hex, 8-18 x .60

**1" & 1-1/2" INLINE METER**



Item No.	Quantity	Part No.	Description
1.....	1.....	17542.....	Flow Straightener
2.....	2.....	40576.....	Clip, H, Plastic, 7000
3.....	1.....	40577.....	Turbine Meter Assy, 7000
4.....	1.....	41555.....	Body, Remote Meter
5.....	2.....	40951.....	O-ring, -220
6.....	2.....	40563.....	Connector, 1" NPT, 7000
7.....	2.....	40563-10.....	Connector, 1" BSP, 7000
8.....	2.....	40565.....	Connector, 1 1/4" NPT, 7000
9.....	2.....	40565-10.....	Connector, 1 1/4" BSP, 7000
10.....	2.....	41242.....	Connector, 1" & 1 1/4" Sweat
11.....	2.....	41243.....	Connector, 1 1/4 & 1 1/2" Sweat
12.....	2.....	41596.....	Connector, Brass, 1" NPT
13.....	2.....	41596-10.....	Connector, Brass, 1" BSP
14.....	2.....	41597.....	Connector, Brass, 1 1/2" NPT
15.....	2.....	41597-10.....	Connector, Brass, 1 1/2" BSP

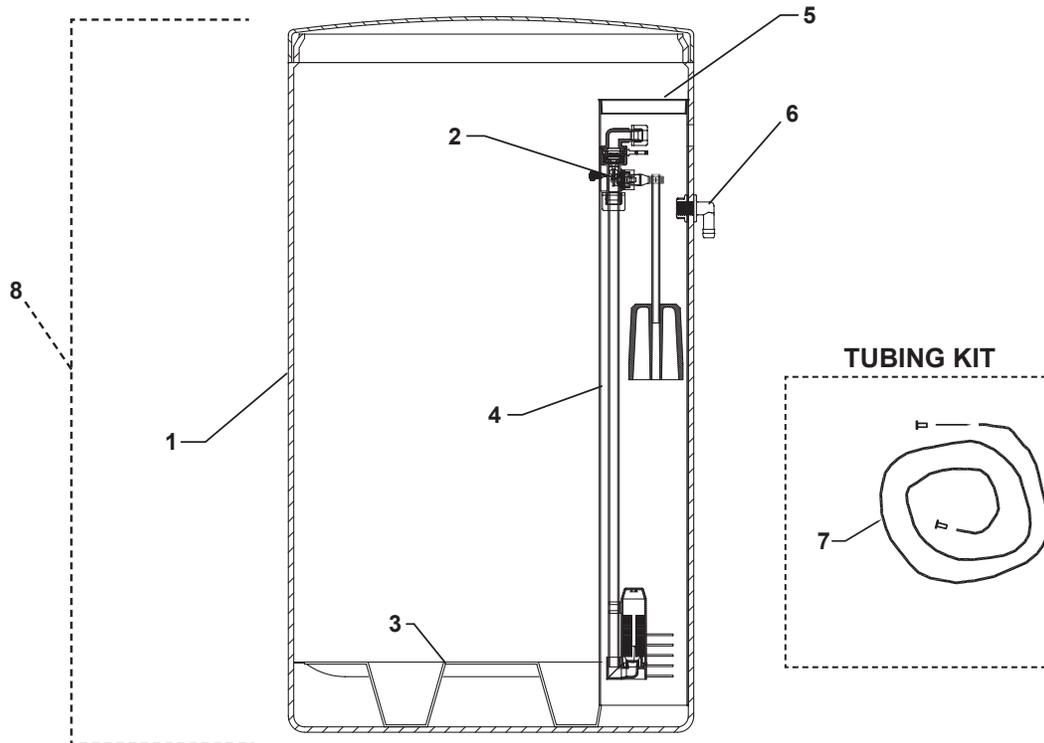
**1" BRASS METER**



60613\_REVB

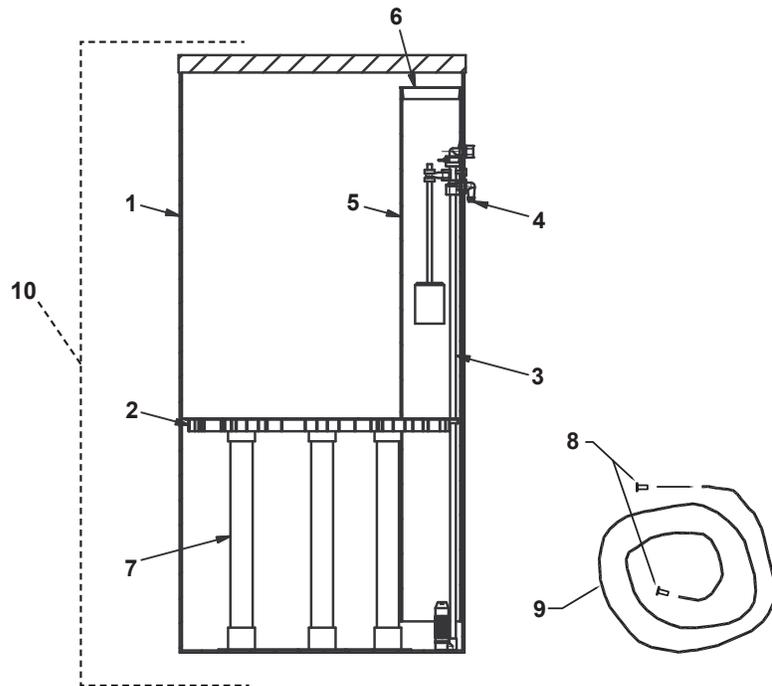
Item No.	Quantity	Part No.	Description
1.....	1 .....	14959 .....	Body, Meter, 2750
2.....	1 .....	13882 .....	Post, Meter Impeller
3.....	1 .....	13509 .....	Impeller, Meter
4.....	1 .....	13847 .....	O-ring, -137, Std/560CD, Meter
5.....	1 .....	14716 .....	Meter Cap Assy, ET/NT
6.....	4 .....	12112 .....	Screw, Hex Hd Mach, 10-24 x 1/2
7.....	1 .....	14960 .....	Flow Straightener, 1"
8.....	1 .....	13287 .....	O-ring, -123
9.....	1 .....	14961 .....	Fitting, 1" Quick Connector
10.....	1 .....	14962 .....	Nut, 1" Meter, Q/C

**BRINE SYSTEM FOR MAT 15M-90M**



Item Number	Description	Part Number
1	Brine Tank 18" x 33" / Black Molded Cover - MAT 15M-30M	A2042020
	Brine Tank 18"x40"/Black Molded Cover - MAT 45M-90M	A2042028
2	Brine Safety Valve Assembly 3/8"	A2005058
3	3" Grid Plate - Plastic - MAT 15M-30M	A2284017
	5" Grid Plate - Plastic - MAT 45M-90M	A2284002
	6" Grid Extension - Plastic MAT 60M - 90M	A2215007
4	Slotted Brine Well - 4" x 28" - MAT 15M-30M	A2071005
	Slotted Brine Well - 4" x 36" - MAT 45M-90M	A2071003
5	4" Brine Well Cap	A2118010
6	1/2" Overflow Elbow w/ Nut	A2165007
7	3/8" x 1/4" Tubing Kit	A2207018
8	Complete Brine Tank Assembly for MAT / MGT 15M-30M	A2042062
	Complete Brine Tank Assembly for MAT/MGT 45M	B1300023
	Complete Brine Tank Assembly for MAT/MGT 60M-90M	A2042064

**BRINE SYSTEM FOR MAT 120M-300M**



Item Number	Description	Part Number
1	Brine Tank 24" x 41" w/ Holes - MAT 120M	B1002039
	Brine Tank 24"x50" w/ Holes - MAT 150M-300M	B1002016
2	24" Diameter 5BW Plastic Grid Plate	A2284007
3	Brine Valve (474) for MAT/MGT 120	B1180014
4	1/2" Overflow Elbow w/ Nut	A2250003
5	5" x 46" Drilled Brine Well	B1015008
6	5" Red Cap plug	A2072001
7	1-1/2" SDR or SCH40 DWV Pipe	A2275007
8	1/2" Poly Insert	A2476001
9	1/2" x 3/8" Black Poly Tubing	A2165002
10	Complete Brine Tank Assembly for MAT / MGT 120M (10" Shelf Height)	B1295015

**SERVICE ASSEMBLIES****COVERS**

A2103128 Designer with Left Window

**BRINE LINE FLOW CONTROLS**

A2389001 BLFC, .25 GPM, 1600

A2389002 BLFC, .50 GPM, 1600

A2389004 BLFC, 1.0 GPM, 1600

**BRINE VALVE ASSEMBLY**

A2005019 Brine Valve Assy 9000/9100, Cold & HW 180°

**BYPASS ASSEMBLY**

A2354005 Bypass Valve, 5600, 3/4" NPT

A2354006 Bypass Valve, 5600, 1" NPT

A2354001 Bypass Plastic Assy

**PISTON ASSEMBLIES**

A2309018 Piston Assy, 9000/9100, Upper

A2309017 Piston Assy, 9000/9100, Lower.

**SEAL & SPACER KITS**

A2435078 Seal & Spacer Kit, 9000/9100 Upper,

A2435024 Seal & Spacer Kit, 9000/9100, Bottom

**SECOND TANK ASSEMBLIES (9000)**

A2460014 Screw, Hex Wsh Mach, 8-32 x 5/16

A2411005 Clip, Mounting

A2412010 Adapter Assy, 1" Coupling

A2097007 Adapter, 9000 2nd Tank, Machd w/O-rings

A2487001 Yoke Assy, 6" - 12" Tank, 8 1/2 Tube

A2487010 Yoke Assy, 14" Tank, 10 1/2" Tube

A2487011 Yoke Assy, 16" Tank, 12 1/2" Tube

**SECOND TANK ASSEMBLIES (9100)**

A2097041 Adapter Assy, 2nd Tank, 9100

A2534014 Tube Assy, 9100, 6-12" Tanks

A2534013 Tube Assy, 9100, 13-16" Tanks

**SERVICE EQUIPMENT**

A2475003 Seal & Spacer Stuffer Tool

A2474001 Spacer Puller Tool

A2423002 Silicone, 2 oz. Tube

A2164006 Meter Checker Std. Range

A2164005 Meter Checker Ext. Range



**TROUBLESHOOTING**

**ERROR CODES**

**NOTE:** Error codes appear on the In Service display.

ERROR CODE	PROBABLE CAUSE	RECOVER & RESETTING
[Err0]	Drive motor is stalled	Unplug the unit from the power source[
[Err1]	Drive motor is running continuously	When power is restored to the unit, the Err _ display code clears. If the condition causing the error has not been resolved the Err _ code reappears in the four digit display. Do not at-tempt to troubleshoot this problem any further.
[Err2]	There have been more than 99 days since the last Regeneration. If the Day of the Week mode of regeneration is selected and days since last regeneration exceeds 7 days.  [ 7 - - 5 ]: There have been more than 7 days since the last regen-eration. All individual settings (d1, d2, d3, d4, d5, d6, d7) are set to 0.	Regeneration must occur for the unit to recover, the display to clear and the valve to function normally.  [ 7 - - 5 ]: To recover from [Err2], the user must initiate a regeneration or set at least one individual day to 1.
[Err3]	Control board memory failure.	Perform a Master Reset. If the error returns, do not attempt to troubleshoot this problem any further.

**ERROR DISPLAY EXAMPLE**



**NOTE:** Unit will flash when error exists.

**TROUBLESHOOTING 2900 VALVE**

PROBLEM	CAUSE	CORRECTION
1. Softener Fails To Regenerate.	A. Electrical Service To Unit Has Been Interrupted. B. Timer Is Defective. C. Power Failure.	A. Assure Permanent Electrical Service (Check Fuse, Plug, Pull Chain or Switch). B. Replace Timer. C. Reset Time of Day.
2. Hard Water.	A. By-Pass Valve is Open. B. No Salt in Brine Tank C. Injector Screen Plugged. D. Insufficient Water Flowing Into Brine Tank E. Hot Water Tank Hardness. F. Leak At Distributor Tube. G. Internal Valve Leak H. Service Adapter Did Not Return To Service.	A. Close By-Pass Valve. B. Add Salt To Brine Tank and Maintain Salt Level Above Water Level. C. Clean Injector Screen. D. Check Brine Tank Fill Time And Clean Brine Line Flow Control If Plugged. E. Repeated Flushings Of The Hot Water Tank is Required. F. Make Sure Distributor Tube Is Not Cracked. Check O-Ring And Tube Pilot. G. Replace Seals and Spacers And/ Or Piston. H. Check Drive Motor And Switch.
3. Unit Used Too Much Salt	A. Improper Salt Setting. B. Excessive Water in Brine Tank	A. Check Salt Usage and Salt Setting. B. See Problem No. 7.
4. Loss Of Water Pressure.	A. Iron Buildup In Line To Water Conditioner. B. Iron Buildup in Water Conditioner. C. Inlet of Control Plugged Due to Foreign Material Broken Loose From Pipes By Recent Work Done On Plumbing System.	A. Clean Line To Water Conditioner. B. Clean Control and Add Mineral Cleaner to Mineral Bed. Increased Frequency of Regeneration. C. Remove Piston and Clean Control.
5. Loss of Mineral Through Drain Line.	A. Air In Water System. B. Improperly Sized Drain Line Flow Control.	A. Assure That Well System Has Proper Air Eliminator Control. Check For Dry Well Condition. B. Check For Proper Drain Rate.
6. Iron In Conditioned Water.	A. Fouled Mineral Bed.	A. Check Backwash, Brine Draw And Brine Tank Fill. Increase Frequency of Regeneration. Increase Backwash Time.

**TROUBLESHOOTING 2900 VALVE (CONTINUED)**

<b>PROBLEM</b>	<b>CAUSE</b>	<b>CORRECTION</b>
7. Excessive Water In Brine Tank.	<ul style="list-style-type: none"> <li>A. Plugged Drain Line Flow Control.</li> <li>B. Plugged Injector System.</li> <li>C. Timer Not Cycling.</li> <li>D. Foreign Material In Brine Valve.</li> <li>E. Foreign Material In Brine Line Flow Control.</li> </ul>	<ul style="list-style-type: none"> <li>A. Clean Flow Control.</li> <li>B. Clean Injector and Screen.</li> <li>C. Replace Timer.</li> <li>D. Replace Brine Valve Seat And Clean Valve.</li> <li>E. Clean Brine Line Flow Control.</li> </ul>
8. Softener Fails To Draw Brine.	<ul style="list-style-type: none"> <li>A. Drain Line Flow Control Is Plugged.</li> <li>B. Injector Is Plugged.</li> <li>C. Injector Screen Plugged.</li> <li>D. Line Pressure Is Too Low.</li> <li>E. Internal Control Leak</li> <li>F. Service Adapter Did Not Cycle.</li> </ul>	<ul style="list-style-type: none"> <li>A. Clean Drain Line Flow Control.</li> <li>B. Clean Injector.</li> <li>C. Clean Screen.</li> <li>D. Increase Line Pressure To 20 P.S.I.</li> <li>E. Change Seals, Spacers and Piston Assembly.</li> <li>F. Check Drive Motor And Switches.</li> </ul>
9. Control Cycles Continuously.	<ul style="list-style-type: none"> <li>A. Misadjusted, Broken or Shorted Switch.</li> </ul>	<ul style="list-style-type: none"> <li>A. Determine If Switch or Timer Is Faulty and Replace It or Replace Complete Power Head.</li> </ul>
10. Drain Flows Continuously.	<ul style="list-style-type: none"> <li>A. Valve Is Not Programming Correctly.</li> <li>B. Foreign Material In Control.</li> <li>C. Internal Control Leak</li> </ul>	<ul style="list-style-type: none"> <li>A. Check Timer Program and Positioning of Control. Replace Power Head Assembly If Not Positioning Properly.</li> <li>B. Remove Power Head Assembly And Inspect Bore. Remove Foreign Material and Check Control In Various Regeneration Positions.</li> <li>C. Replace Seals and Piston Assembly.</li> </ul>

**General Service Hints For Meter Control**

Problem: Softener Delivers Hard Water.

Cause could be that . . . Reserve Capacity Has Been Exceeded.

Correction: Check salt dosage requirements and reset program wheel to provide additional reserve.

Cause could be that . . . Program Wheel Is Not Rotating With Meter Output

Correction: Pull cable out of meter cover and rotate manually. Program wheel must move without binding and clutch must give positive "clicks" when program wheel strikes regeneration stop. If it does not, replace timer.

Cause could be that . . . Meter Is Not Measuring Flow.

Correction: Check meter with meter checker.



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# Section 4



# REVERSE OSMOSIS

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MRO 2500

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INSTALLATION, OPERATION, AND  
MAINTENANCE MANUAL

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## Introduction

Your MRO™ commercial reverse osmosis system is a durable piece of equipment which, with proper care, will last for many years. This User's Manual outlines installation, operating, maintenance, and troubleshooting details vital to the sustained performance of your system.

The test results which are included with this User's Manual indicate your system's permeate (product) and rejection test results. Your system is designed to operate at a pressure of 150 psi, unless otherwise stated. The recovery set for your system is between 33%-50%.

If your system is altered at the site of operation or if the feed water conditions change, please contact your local dealer or distributor to determine the proper recovery for your application. **NOTE:** In order to maintain warranty, an operating log must be maintained. Copies must be sent to your local dealer or distributor for review.

**NOTE:** Prior to operating or servicing the MRO™ commercial reverse osmosis system, this User's Manual must be read and fully understood. Keep it and other associated information for future reference and for new operators or qualified personnel near the system.

## Safety

The Safety section of this User's Manual outlines the various safety headings used throughout this manual's text and are enhanced and defined below:

**NOTE:** Indicates statements that provide further information and clarification.

**CAUTION:** Indicates statements that are used to identify conditions or practices that could result in equipment or other property damage.

**WARNING:** Indicates statements that are used to identify conditions or practices that could result in injury or loss of life. **FAILURE TO FOLLOW WARNINGS COULD RESULT IN SERIOUS INJURY OR EVEN DEATH.**

## Labeling

Do not under any circumstance, remove any Caution, Warning, or other descriptive label from the system.

## System Specifications

Model	MRO™ 500	MRO™ 1000	MRO™ 1500	MRO™ 2500
Design	Vertical	Vertical	Vertical	Vertical
Gallons Per Day	500	1000	1500	2500
Dimensions (approx.)	13.5" x 20" x 26.5"	13.5" x 20" x 26.5"	19" x 23" x 45.5"	19" x 23" x 45.5"
Weight (approx.)	65 lbs.	70 lbs.	105 lbs.	115 lbs.
Recycle Line	Optional	Optional	Optional	Optional
Auto Flush	NA	NA	NA	NA
Element Size (in.)	2521 TFC HF-3	2521 TFC HF-3	2540 TFC HF-3	2540 TFC HF-3
Elements (qty.)	2	3	2	3
Motor HP	1/3	1/2	3/4	3/4
Voltage	110/220	110/220	110/220	110/220
Hertz	50/60	50/60	50/60	50/60

Feed Connection	3/4"	3/4"	3/4"	3/4"	3/4"
Product Connection	3/8"	3/8"	3/8"	3/8"	3/8"
Waste Connection	3/8"	3/8"	3/8"	3/8"	3/8"

## Feed Water & Operation Specifications

Nothing has a greater effect on a reverse osmosis system than the feed water quality. For lasting performance it is important to supply the system with the feed water quality shown below. It is also important to feed the system the required amount of feed water. **NOTE:** It is very important to meet the feed water requirements. Failure to do so will cause the membranes to foul and void the warranty.

Feed Water Specifications			
Hardness	<1 grain	Hydrogen Sulfide	0 ppm
Free Chlorine	0 ppm	Manganese	<0.05 ppm
Total Dissolved Solids	<2000 ppm	Organics	<1 ppm
Turbidity (SDI)	<5	Temperature	40°F - 80°F
pH	3-11		8°C - 27°C
Iron	<0.01 ppm	Pressure	20 – 60 psi
Silica	<1 ppm	Flow Rate	3 gpm

The manufacturer has provided you with operation specifications. These specifications should be met in order to have the reverse osmosis system perform optimally. All operation specifications are based on the test conditions listed below.

Operation Specifications			
Min. Feed Pressure	35 psi	Max. Pressure	150 psi
Min. NaCl % Rejection	96%	Max. NaCl % Rejection	98%
Min. Feed (GPM)	1.5	Max. Feed (GPM)	3
Max. Hardness	15 Grains / Gallon	pH Range	3 – 11
Max. TDS	2000 ppm	Max. Temperature	105°F
<b>Test Conditions:</b> Permeate flow and salt rejection based on 2000 ppm NaCl, 150 psi, 77°F (25°C), pH 7, and recovery as indicated. <b>NOTE:</b> Higher TDS and/or lower temperatures will reduce the system's production.			

## Rejection, Recovery, & Flow Rates

MRO™ reverse osmosis systems are designed to produce purified water at the capacities indicated by the suffix in the system's name under the conditions listed above. For example, the MRO™ 2500 produces 2500 gallons per day of purified water.

The amount of total dissolved solids (TDS) rejected by the membrane is expressed as a percentage. For example, a 99% rejection rate means that 99% of total dissolved solids do not pass through the membrane. To calculate the % rejection, use the following formula:

$$\% \text{ Rejection} = (\text{Feed TDS} - \text{Product TDS} / \text{Feed TDS}) \times 100$$

**NOTE:** All TDS figures must be expressed in the same units, usually parts per million (ppm) or milligrams per liter (mg/l).

MRO™ commercial reverse osmosis systems are designed to reject up to 98% NaCl, unless computer projections have been run and provide a different rejection percentage. The amount of purified water recovered for use is expressed as a percentage recovery. To calculate % recovery, use the following formula:

$$\% \text{ Recovery} = (\text{Product Water Flow Rate} / \text{Feed Water Flow Rate}) \times 100$$

**NOTE:** All Flow Rates must be expressed in the same units, usually gallons per minute (gpm).

MRO™ commercial reverse osmosis systems are designed to have a recovery of 33% - 50%, unless computer projections have been run and provide a different recovery percentage.

## System Requirements & Operation Guidelines

### Plumbing

The membranes and high pressure pumps used on MRO™ systems require a continuous and non-turbulent flow of water to the system with a minimum feed pressure of 35 psi, which does not exceed a temperature of 105°F.

The tubing or piping used for the inlet of the concentrate is ¾" NPT. The tubing or piping used for the discharge of the concentrate is ⅜" NPT and should be run to an open drain in a free and unrestricted manner.

The tubing or piping used for the permeate is ¾" NPT and can be transported to the holding tank or directly to the point-of-use through a high quality nylon, tubing or PVC pipe, or other FDA accepted materials.

Material must not precipitate in the system. Be certain that all of the components of the feed water are soluble at the concentrations attained in the system. A system operating at 33% recovery, concentrates nearly all impurities 1.5 times. A system operating at a 50% recovery concentrates nearly all impurities 2 times. If the feed water contains a slightly soluble material such as calcium sulfate, silica, or colloidal clay, an anti-scalant should be used.

**CAUTION:** Any restrictions or blockage in the drain can cause backpressure, which will increase the system's operating pressure. This can result in damage to the system's components.

### Electrical

The motors used on the MRO™ 500, 1000, 1500, 1800, & 2500 systems are carbonator motors. They are available in single phase 110 volt or 220 volt at 50 or 60 hertz.

Please ensure that the electrical circuit supplying the system is compatible with the requirements of the specific MRO™ model.

**NOTE:** We recommend that a licensed electrician install your system in accordance with local and national electrical codes.

**WARNING:** To reduce the risk of electrical shock, the incoming power supply must include a protective earth ground.

Each MRO™ system is equipped with an 7 foot electrical cord. All 110 volt system's are provided with a 3 prong plug for use in a standard North American household outlet receptacle. All 220 volt 50 hertz models may require the replacement of the standard plug to fit certain receptacles.

## Pre-Filtration

MRO™ systems are supplied with a polypropylene pre-filter that filters out most particles over 5 microns, and a carbon block that removes chlorine; before the water is pumped through the reverse osmosis membrane. Change the cartridges at least every month or whenever there is a pressure difference of 15% or more between the pressure readings before and after the filter.

**NOTE:** The system must be operated on filtered water only. Do not attempt to clean used filter cartridges.

**CAUTION:** If the pre-filter becomes clogged and the water flow to the pump is reduced or interrupted, cavitation will occur. This will damage the pump.

## Pump

The pumps used on the MRO™ 500, 1000, 1500, 1800, & 2500 systems are brass rotary vane pumps. These pumps are also available in stainless steel. Follow these guidelines to ensure proper operation of the pump:

- The pump must NEVER be run dry. Operating the pump without sufficient feed water will damage the pump.
- ALWAYS feed the pump with filtered water. The pump is susceptible to damage from sediment and debris.

## Mounting

The free standing system should be bolted down in compliance to local regulation standards. It has a lightweight and portable design for a variety of applications.

## Membrane Elements

MRO™ reverse osmosis systems come preloaded with Thin Film Composite High Flow membranes. General membrane element performance characteristics are listed below:

Membrane Element Characteristics			
Min. Working Pressure	100 psi	Max. Pressure	400 psi
Min. NaCl % Rejection	96%	Max. NaCl % Rejection	98%
Min. Feed (GPM)	1.5	Max. Feed (GPM)	3
Max. Hardness	15 Grains / Gallon	pH Range	3 – 11
Max. TDS	2000 ppm	Max. Temperature	105°F
Thin Film Composite (TFC) Membranes			
<b>Test Conditions:</b> Permeate flow and salt rejection based on 2000 ppm NaCl, 150 psi, 77°F (25°C), pH 7, and recovery as indicated. <b>NOTE:</b> Higher TDS and/or lower temperatures will reduce the system's production.			

## Start-Up

Unless otherwise indicated, these instructions cover the MRO™ 500, 1000, 1500, 1800, & 2500 reverse osmosis systems. Please refer to the flow diagrams and exploded view diagrams found in this User's Manual for additional information.

## Installation

The MRO™ reverse osmosis systems are free standing and require no special installation; however, if placed on an uneven floor, the system may vibrate. If this occurs, place the system on a rubber mat to reduce the vibrations.

Carefully inspect your system before start-up. Check all plumbing and electrical connections. Connections may have come loose during shipment.

A User's Manual, Test Results, and Filter Housing Wrench will accompany your MRO™ reverse osmosis system.

## Start-Up

1. Locate the feed water inlet on the pre-filter housing.
2. Attach the inlet tubing to the feed water source, or permanently plumb the feed water piping or tubing to the inlet. Always maintain a smooth and sufficient flow of feed water during operation.
3. Locate the permeate tubing.
4. Attach the permeate tubing to the permeate outlet. Make sure that the permeate water can flow freely and that there is no backpressure. Backpressure can cause damage to the membrane.

**CAUTION:** The plumbing in the permeate line can contaminate the high quality water produced by the system; ensure that the components are compatible with the application. The pH of the reverse osmosis permeate will normally be 1-2 points lower than the feed water pH. A pH of 6.5 or lower can be very aggressive to some plumbing materials, such as copper piping.

5. Locate the concentrate (waste) tubing. Locate the concentrate outlet on the drain side of the concentrate control valve.
6. Attach, the drain line to the concentrate tubing.
7. Run the concentrate line to the drain. Water must be allowed to run freely, without any restrictions or blockage in the drain line. Make sure that no backpressure exists on the concentrate line.
8. Ensure that the electrical power requirements of the MRO™ system match your electrical power supply.
9. MRO™ systems are typically controlled with a liquid level switch in a storage tank. The liquid level switch turns the system on when the water level in the tank drops, and off when the tank is full. If your reverse osmosis system is equipped with an electrical control box, the level control is connected to the level control connections in the control box. Do not exceed the level control's power rating. Liquid level switches can be obtained by your local dealer or distributor. If a liquid level switch is to be used, install it at this time and turn the power to the MRO™ system on. Otherwise, turn the system on by plugging in the power cord. Allow the system to run for about three to five minutes with the concentrate control valve fully open to purge air from the system.
10. The MRO™ system's permeate or product water should be discarded for the first hour of operation. This will flush out any impurities which are in the system. Turn the concentrate control valve until the concentrate pressure gauge indicates a pressure of 50 psi. Flush the system at 50 psi for 1 hour to remove the impurities from the system. Check for leaks. All MRO™ reverse osmosis systems are fully tested prior to shipment, but leaks may occur due to shipping.

11. Connect the permeate line to the storage tank or point-of-use application. Make sure that no backpressure exists on the permeate line.
12. Locate the concentrate control valve and the concentrate pressure gauge.
13. Turn the concentrate control valve until the designated permeate flow is acquired. For example a MRO™ 2500 should be adjusted until it produces about 2500 GPD or 1.74 GPM of permeate or product water. The concentrate pressure will increase as the concentrate control valve is closed. The exact operating pressure may vary depending on the temperature and TDS of your feed water. It may be necessary to re-adjust the system if there is a major change in feed water temperature and/or TDS.

$$\text{GPM} = \text{GPD}/1440$$

**WARNING:** Never exceed the maximum pressure rating of your membrane or pressure vessel.

**NOTE:** The MRO™ 500, 1000, 1500, 1800, & 2500 reverse osmosis systems are equipped with a concentrate control valve. This valve is used to adjust the system to the desired recovery. Feed water enters the system through an automatic shut-off valve. Ensure that the valve opens when the system turns on, allowing water to flow through the system, and close when the system turns off, stopping the water from flowing through the system. This will save water and prevent premature fouling of the reverse osmosis membrane.

## Operation & Maintenance

The reverse osmosis process causes the concentration of impurities in the concentrate stream to increase. The impurities may precipitate (come out of the solution) when their concentration reaches saturation levels. **NOTE:** Precipitation can scale or foul membranes and must be prevented.

Check your feed water chemistry. Pre-treat the water and/or reduce the system recovery as required. If necessary, consult with your local dealer or distributor.

### Pre-Filter Pressure Gauges

These gauges measure the feed water pressure when it enters and exits the pre-filter housing. A pressure differential of 15% or more on the two pressure readings indicates that the pre-filter needs to be replaced. For example, if the inlet pressure is 40 psi, the filter should be changed when the outlet pressure is 34 psi or below.

### Product (Permeate) Flow Meter & Waste (Concentrate) Flow Meter

These flow meters indicate the flow rates of permeate and concentrate water. The measurements, when added together, also indicate the feed water flow rate, if the system is not equipped with a waste recycle. Permeate and Concentrate flow meters are optional MRO™ 500, 1000, 1500, & 2500 and come standard on the MRO™ 1800 systems.

### Waste Recycle Valve

This valve allows you to recycle some of the concentrate water back to the feed of the pump. This will increase the recovery of the MRO™ system. The amount of waste water recycled is limited by the TDS of the feed water. The drawback of using concentrate recirculate is an increase of total dissolved solids in the permeate water.

A waste recycle valve is optional for MRO™ 500, 1000, 1500, & 2500 systems and come standard on the MRO™ 1800 systems.

**CAUTION:** Excessive recycling may cause premature fouling or scaling of the membrane elements.

## Low Pressure Switch

The low pressure switch shuts off the system when the feed water pressure drops too low for the system to function properly. This prevents damage to the pump. The system restarts automatically when the pressure is restored. If you notice the pressure fluctuating, and the system cycling off and on repeatedly, turn the system off and ensure that proper feed flow and pressure are available to the system.

## Low Pressure Shut-Off Control Box

This feature consists of an electrical control box with a low pressure protection circuit, level control connections, pre-treat lockout connections, and an on/off switch. The low pressure shut-off switch can be ordered with manual or automatic reset.

## Pump Bypass Valve

This valve is installed as a standard feature on the MRO™ 500, 1000, 1500, & 2500 reverse osmosis systems. It provides an adjustment for pump pressure, which will vary as the required system pressure changes.

<b>401 Rotary Vane Pump</b>		
<b>Pressure</b>	100 psi	200 psi
<b>Flow</b>	140 gph	134 gph
<b>601 Rotary Vane Pump</b>		
<b>Pressure</b>	100 psi	200 psi
<b>Flow</b>	196 gph	190 gph
<b>1001 Rotary Vane Pump</b>		
<b>Pressure</b>	100 psi	200 psi
<b>Flow</b>	322 gph	-NA- gph

As the feed water temperature decreases, and/or the feed water TDS increases, the system will require a higher operating pressure to produce the specified permeate flow. A MRO™ system installed in Florida may provide the specified permeate flow of 1.74 gpm at 150 psi; however the same system installed in Maine – much colder feed water – may require 190 psi to produce the same amount of permeate. The system in Florida would have a higher concentrate flow to the drain because of the lower operating pressure, which would result in poor system recovery.

$$\% \text{ Rejection} = (\text{Feed TDS} - \text{Product TDS}) / (\text{Feed TDS}) \times 100$$

## Membrane Removal & Replacement

Changing membranes in pressure vessels is an easy process if you have the proper information and tools at hand. Please refer to the following instructions when removing and replacing membrane elements:

1. Remove the end caps from the top of the membrane housings. This is done by removing the white Nylon snap ring of the Champ housing or unscrewing the bolts of the PuroTech housing, which holds on the clamp.

2. Remove the membrane bag containing the membrane element from the shipping box.
3. Cut the bag open as close as possible to the seal at the end of the bag, so the bag may be re-used if necessary.
4. Remove the membrane element from the bag and remove the black core tube protectors from each end of the membrane.
5. Remove parts from the parts container (if included) and inspect. Make sure that all parts are clean and free from dirt. Examine the brine seal, and permeate tube for nicks or cuts. Replace the O-rings or brine seal if damaged.
6. Flow directions should be observed for installation of each element in each housing.

As time progresses, the efficiency of the membrane will be reduced. In general, the salt rejection does not change significantly until two or three years after installation when operated on properly pretreated feed water. The permeate flow rate will begin to decline slightly after one year of operation, but can be extended with diligent flushing and cleaning of the system. A high pH and/or precipitation of hardness can cause premature loss in rejection of membrane elements in the system.

To replace the membrane elements:

1. Remove all of the membrane element(s) from the membrane element housings from the top of the housing. Heavy-duty pliers and channel lock pliers may be necessary to pull the old membrane element out of the membrane element housing.
2. Install the brine seal side of the membrane elements first. When the housings have a direction of flow from bottom to top, the brine seal should be located on the end of the membrane element at the bottom of the housing.
3. Lubricate the brine seal with a food grade lubricant.
4. At a slight angle insert membrane while slightly rotating element being careful not to tear or flip the brine seal. Re-lube the brine seal if necessary.
5. With a smooth and constant motion, push the membrane element into the housing so that the brine seal enters the housing without coming out of the brine seal groove. A slow twisting motion should be used to insert the membrane element, to ensure that the brine seal stays in place.
6. Re-install the end caps by gently twisting the end cap while pushing it onto the housing. Ensure that you do not pinch or fatigue any O-rings while pushing the end plug on. Push the end plug on until the outer diameter of the plug is flush with the outer diameter of the membrane housing.
7. Insert nylon snap ring until fully seated. Snap ring must be able to be spun in place if fully seated. If you are using a stainless steel housing, install the clamps halves, and tighten bolts until the clamp halves meet.
8. Reconnect any fittings that may have been disconnected when the membrane element housings were disassembled.
9. To Start-Up the system, refer to Start-Up

**CAUTION:** New or factory cleaned membranes are shipped in a preservative solution. New or cleaned membranes must be flushed for at least 1 hour to remove the preservative from the membrane. Discard all of the permeate and concentrate, which is produced during the flush.

## Flushing the System

The system should be flushed weekly to remove sediment from the surface of the membranes. To manually flush the system following the preceding steps:

1. The system must be running during the flushing procedure.
2. Open the concentrate valve until the pressure gauge reads approximately 50 psi (3.5 bar).  
**NOTE:** If pressure will not drop to approximately 50 psi (3.5 bar) pressure during flushing, the concentrate valve must be cleaned.
3. Allow the system to run for 10 to 20 minutes.
4. After 10 to 20 minutes, close the concentrate valve to its previous position, raising the operating pressure to 150 psi. Ensure the proper concentrate flow rate is going to the drain.
5. The system is now ready to operate.

## Draining the System for Shipment

Prior to shipping or storing your system, the system should be cleaned with an appropriate cleaner, flushed with water, and protected from biological attack with an appropriate solution for membrane elements. The membrane housing(s) and plumbing lines of the system must be completely drained. Any water remaining in the plumbing of a system may freeze, causing serious damage. The party shipping or storing the system is responsible for any damage resulting from freezing.

To drain the system:

1. Disconnect the inlet, concentrate, pre-filter, and permeate plumbing.
2. Drain all water from the pre-filter cartridge housings by unscrewing the housings, removing the pre-filter cartridges, and drain the water from the housings.
3. Disconnect the tubing from the connector on the permeate and concentrate inlets and outlets.
4. Fully open the concentrate valve.
5. Drain the flow meters by disconnecting the tubing from the bottom fitting of each meter.
6. Allow the system to drain for a minimum of eight hours or until the opened ports quit dripping.
7. After draining is complete, reconnect all of the plumbing.

## Troubleshooting

If the system production declines or the system stops working, check the mechanical components for any visual problems. Listed below are the items to check for any visual problems. Listed below are the items to check for two of the most commonly encountered problem conditions: Low system pressure and abnormal permeate flow. Also refer to the reverse osmosis troubleshooting matrix on the next page.

### Low System Pressure

Low system pressure occurs when sufficient feed water pressure and flow are not obtained. This causes the high-pressure reverse osmosis pump to cavitate. Failure to provide the proper feed will result in lower system pressure that may result in low production and poor rejection. Check the following components:

1. Pump:

Isolate the pump and determine how much pressure can be achieved. This can be determined by checking the pump discharge pressure gauge at this point. If the system is not equipped with this gauge, disconnect the hose that runs from the pump to the pressure vessel. Install a pressure gauge. The pressure of the pump must reach at least 190 psi when the flow is restricted.

2. Pre-Filter:

Check the differential in the pre-filter gauges to determine if the filter needs to be replaced. If the system is not equipped with these gauges, examine the pre-filter cartridge to make sure that it is not clogged and does not restrict feed flow to the pump. Replace, if necessary.

3. Low Feed Water Flow Rate:

Determine that the system is getting a sufficient volume of feed water. Disconnect the feed water hose from the system and place it in a one gallon bucket. Measure the time it takes to fill the bucket to determine the feed flow. (Feed flow is measured in gallons per minute, so divide 1 gallon by the time in minutes to obtain the flow rate). Refer to the System Specifications for the required feed flow.

4. Inlet Solenoid Valve:

Feed water enters the system through an automatic solenoid shut-off valve, which is normally closed. Ensure that the solenoid opens when the reverse osmosis pump starts. The system can be operated without the solenoid for troubleshooting. Remove the solenoid to see if it is contributing to the problem. Normally, cleaning the solenoid diaphragm will correct any malfunction of the solenoid.

5. Electric:

Check to ensure that there are no electrical fuses blown and that all electrical connections are secure. Use a voltmeter to verify that the motor is getting sufficient power.

6. Pressure Gauge:

Check for foreign matter on the gauge fitting. Remove any visible matter and replace the fitting. Verify that the tube is not pushed too far inside the fitting. This could restrict flow and cause an inaccurate display. If the fitting and tube are fine and the pressure gauge is still malfunctioning, the gauge should be replaced.

7. Concentrate Control Valve:

The concentrate control valve may have a tear in the diaphragm. Remove the valve, inspect the diaphragm, and replace if necessary.

8. Motor:

The motor may not be drawing the correct current. Use a clamp-on amp meter to check the current draw.

9. Leaks:

Check the system for leaks, as this can result in low pressure.

### Abnormal Permeate Flow

Permeate flow should be within 15% of the rated production, after correcting the feed water temperatures above or below 77°F. Check your permeate flow meter to determine the permeate flow rate. If the system does not have a permeate flow meter, measure the time it takes to fill a 1 gallon container then calculate the permeate flow rate at gallons per minute or gallons per day.

**NOTE:** To determine the temperature correction factor, locate the Temperature Correction Table in this User's Manual and follow the directions.

1. Causes of Low Permeate Flow:
  - Cold Feed Water
  - Low Operating Pressure
  - Defective Membrane Brine Seal
  - Fouled or Scaled Membrane
  
2. Causes of High Permeate Flow:
  - Defective Product Tube O-Rings
  - Defective or Oxidized Membrane
  
3. Causes of Poor Permeate Quality:
  - Low Operating Pressure
  - Defective Product Tube O-Rings
  - Defective or Oxidized Membrane
  - Fouled or Scaled Membrane

Reverse Osmosis System Troubleshooting						
Symptoms			Location	Possible Causes	Verification	Corrective Action
Salt Passage	Permeate Flow	Pressure Drop				
Normal to Increased	Decreased	Normal to Increased	Predominately First Stage	Metal Oxide Fouling	Analysis of Metal Ions in Cleaning Solution.	Improve pretreatment to remove metals. Clean with Acid Cleaners.
Normal to Increased	Decreased	Increased	Predominately First Stage	Colloidal Fouling	SDI Measurement of Feed Water.	Optimize pretreatment for colloid removal. Clean with high pH anionic cleaners.
Increased	Decreased	Increased	Predominately First Stage	Scaling (CaSO <sub>4</sub> , CaSO <sub>3</sub> , BaSO <sub>4</sub> , SiO <sub>2</sub> )	Analysis of metal ions in cleaning solution by checking LSI of reject. Calculate max. solubility of CaSO <sub>4</sub> , BaSO <sub>4</sub> , SiO <sub>2</sub> in reject.	Increase acid addition and antiscalant dosage for CaVO <sub>3</sub> and CaCO <sub>4</sub> . Reduce recovery. Clean with Acid Cleaners.
Normal to Moderate Increase	Decreased	Normal to Moderate Increase	Any Stage	Biological Fouling	Bacteria count in permeate and reject. Slime in pipes and pressure vessels.	Shock dosage of Sodium Bi-Sulfate. Continuous feed of Sodium Bi-Sulfate at reduced pH. Formaldehyde disinfection. Chlorination and de-chlorination. Replace cartridge filters.
Decreased or Slightly Increased	Decreased	Normal	Any Stage	Organic Fouling	Destructive Element Testing.	Activated Carbon or other pretreatment. Clean with high pH cleaner.
Increased	Increased	Decreased	Most Severe in First Stage	Chlorine Oxidation	Chlorine Analysis of feed water. Destructive element test.	Check Chlorine feed equipment and de-chlorination system.
Increased	Increased	Decreased	Most Severe in First Stage	Abrasion of membrane by Crystalline Material	Microscopic solids analysis of feed. Destructive element test.	Improve pretreatment. Check all filters for media leakage.
Increased	Normal to Increased	Decreased	At Random	O-Ring Leaks, End or Side Seal Leaks	Probe test. Vacuum test. Colloidal material test.	Replace O-Rings. Repair or replace elements.
Increased	Normal to Low	Decreased	At Random	Recovery Too High	Check Flows and Pressure Against Design Guidelines.	Reduce the recovery rate. Calibrate and/or add sensors.

Operation Log		
Company: _____	Date of Start-Up: _____	
Location: _____	Date of Last Cleaning: _____	
Week Of: _____	Cleaning Formulation: _____	
System Serial #: _____		
<b>Date</b>		
Time		
<b>Hours of Operation</b>		
Cartridge Filter Inlet Pressure (psi)		
<b>Differential Pressure (psi)</b>		
Permeate Pressure (psi)		
<b>Feed Pressure (psi)</b>		
Concentrate Pressure (psi)		
<b>Differential Pressure (psi)</b>		
Pump Discharge Pressure (psi)		
<b>Permeate Flow (GPM)</b>		
Concentrate Flow (GPM)		
<b>Feed Flow (GPM)</b>		
Recovery %		
<b>Feed Temperature</b>		
Feed Conductivity (mg/L)		
<b>Permeate Conductivity (mg/L)</b>		
Rejection %		
<b>Feed pH</b>		
Permeate pH		
<b>Scale Inhibitor Feed (ppm)</b>		
Acid Feed (ppm)		
<b>Sodium Bisulfite Feed (ppm)</b>		
Feed Water:		
<b>Iron (mg/L)</b>		
Free Chlorine (mg/L)		
<b>Hardness (ppm CaCO<sub>3</sub>)</b>		
Turbidity (NTU)		

### Temperature Guide

<b>TEMPERATURE GUIDE</b>			
<b>Temperature Correction Factors For Membrane Flux</b>			
<b>TEMPERATURE</b>		<b>C.A.B.</b>	<b>TFC<sup>®</sup></b>
<b>°C</b>	<b>°F</b>	<b>(Cellulose Acetate/Triacetate Blend)</b>	<b>(Thin Film Composite)</b>
1°	33°	1.861	2.487
2°	35°	1.813	2.387
3°	37°	1.765	2.291
4°	39°	1.720	2.200
5°	41°	1.675	2.114
6°	43°	1.632	2.031
7°	45°	1.590	1.952
8°	46°	1.548	1.876
9°	48°	1.507	1.804
10°	50°	1.468	1.736
11°	52°	1.429	1.670
12°	54°	1.391	1.607
13°	55°	1.355	1.547
14°	57°	1.320	1.490
15°	59°	1.286	1.435
16°	61°	1.253	1.383
17°	63°	1.221	1.332
18°	64°	1.190	1.284
19°	66°	1.160	1.238
20°	68°	1.132	1.194
21°	70°	1.104	1.152
22°	72°	1.076	1.112
23°	73°	1.050	1.073
24°	75°	1.025	1.036
25°	77°	1.000	1.000
26°	79°	0.988	0.966
27°	81°	0.976	0.933
28°	82°	0.964	0.902
29°	84°	0.953	0.871
30°	85°	0.942	0.842
31°	88°	0.930	0.814
32°	90°	0.919	0.788
33°	91°	0.908	0.762
34°	93°	0.898	0.737
35°	95°	0.887	0.713
36°	97°	0.876	0.691
37°	99°	0.865	0.669
38°	100°	0.854	0.647
39°	102°	0.843	0.627
40°	104°	0.831	0.607
41°	106°	0.819	0.589
42°	108°	0.806	0.570
43°	109°	0.793	0.553
44°	111°	0.779	0.536
45°	113°	0.765	0.520

*To use: Simply multiply the actual flux to obtain temperature corrected flux.*

## Service Assistance

If service assistance is required, take the following steps:

1. Call your distributor.
  - a. Prior to making the call, have the following information available:
    - i. Machine installation date
    - ii. Serial number (found on left-hand side of front panel)
    - iii. Daily Log Sheets
    - iv. Current operating parameters (i.e., flow, operating pressures, pH, etc.)
    - v. Detailed description of problem

## Warranty & Guarantee

The manufacturer of your MRO™ reverse osmosis system guarantees that the proposed product is to be free from defects in material or workmanship when operated in accordance with written instructions for a period of one year from start-up or fifteen months from receipt, whichever is shorter. Parts that are not manufactured directly by the manufacturer of your reverse osmosis system will be covered by their manufacturer's warranties which are normally for one year.

The manufacturer's membrane elements are guaranteed to operate within specifications when used for general water treatment for a period of 12 months from receipt providing the membrane elements have not been abused by operating at high temperatures, high or low pH's, on un-disinfected water, or on solutions which tend to precipitate.

For applications or water conditions other than those specified in the original purchase order for the reverse osmosis system, the User should consult with their local dealer or distributor to access the suitability of the solution to be run in the membrane elements.

Limitations on pH and temperature can vary with membrane element type and the application of the equipment. For special applications or for pH or temperature ranges outside the stated limits, the manufacturer may reduce the warranty period at their discretion.

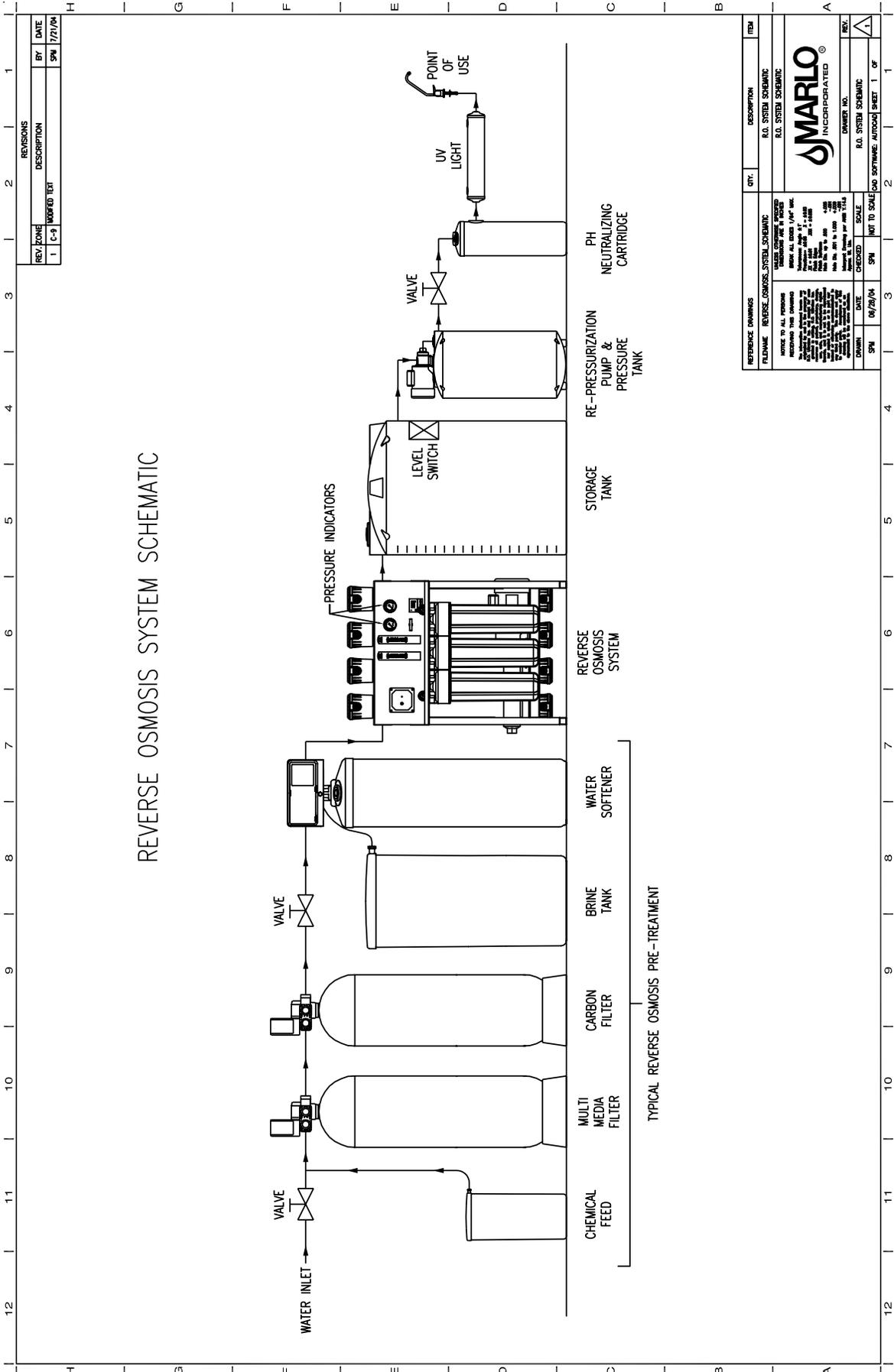
A membrane element which fails to perform satisfactorily within the first 90 days after receipt, has not been mishandled, and is returned to the factory, will be replaced free of charge except for freight and local labor. If a membrane element fails to perform satisfactorily during the balance of the warranty period and with the return of the membrane element to the factory, the manufacturer will replace the membrane element with a new membrane element and will charge the User for the portion of the 12 months that the membrane element was used plus incoming freight and local labor. Such pro-rated charges will be based on the list price prevailing at the time of warranty consideration. A new membrane element supplied under warranty terms will carry the standard 12 month new membrane element warranty.

If a membrane element is to be returned for warranty inspection, the User must obtain a Return Good Authorization (RGA) number from their dealer or distributor before returning the membrane elements. Completely fill out a Return Merchandise Form, which will accompany the returned good. Membrane elements are to be returned freight prepaid to the manufacturer.

The manufacturer will return any warranty replacement membrane elements to the customer prepaid. Membrane elements must be kept damp at all times and must be clean and bagged in a watertight bag before returning. Only the manufacturer approved cleaners, biocides, dispersants or other chemicals may be used with the membrane elements. Use of other chemicals may void the warranty. The User is responsible for knowing the membrane element material and for ensuring that chemicals harmful to the membrane element are never in contact with the membrane elements.

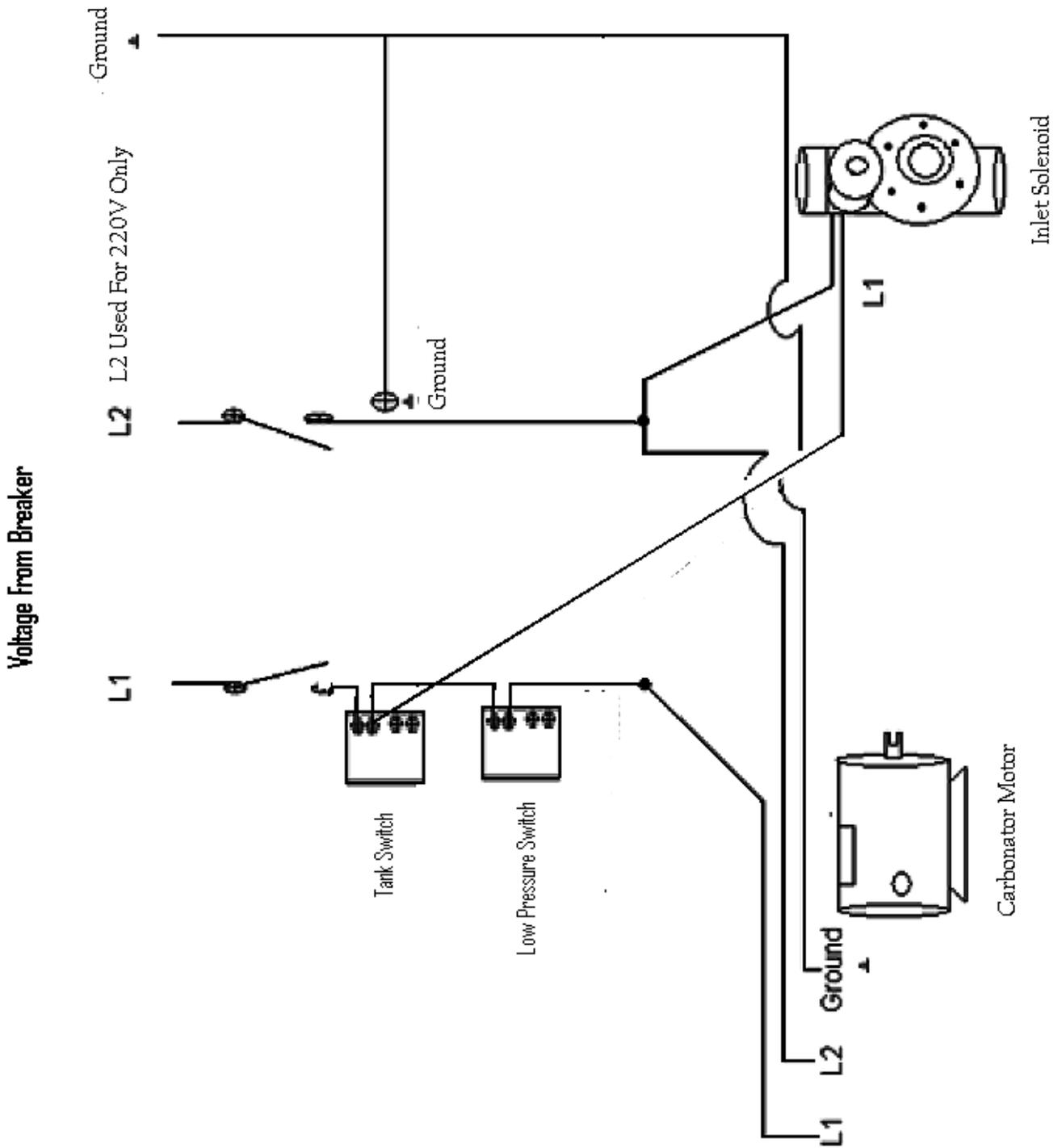
It is the obligation of the User to maintain frequent operating data records. The manufacturer may request these records in the warranty evaluation. The User must notify their dealer or distributor at the very first sign of changes in operation of the system or membrane elements. Such notification should be in writing and should include all data requested on the operating log sheets.

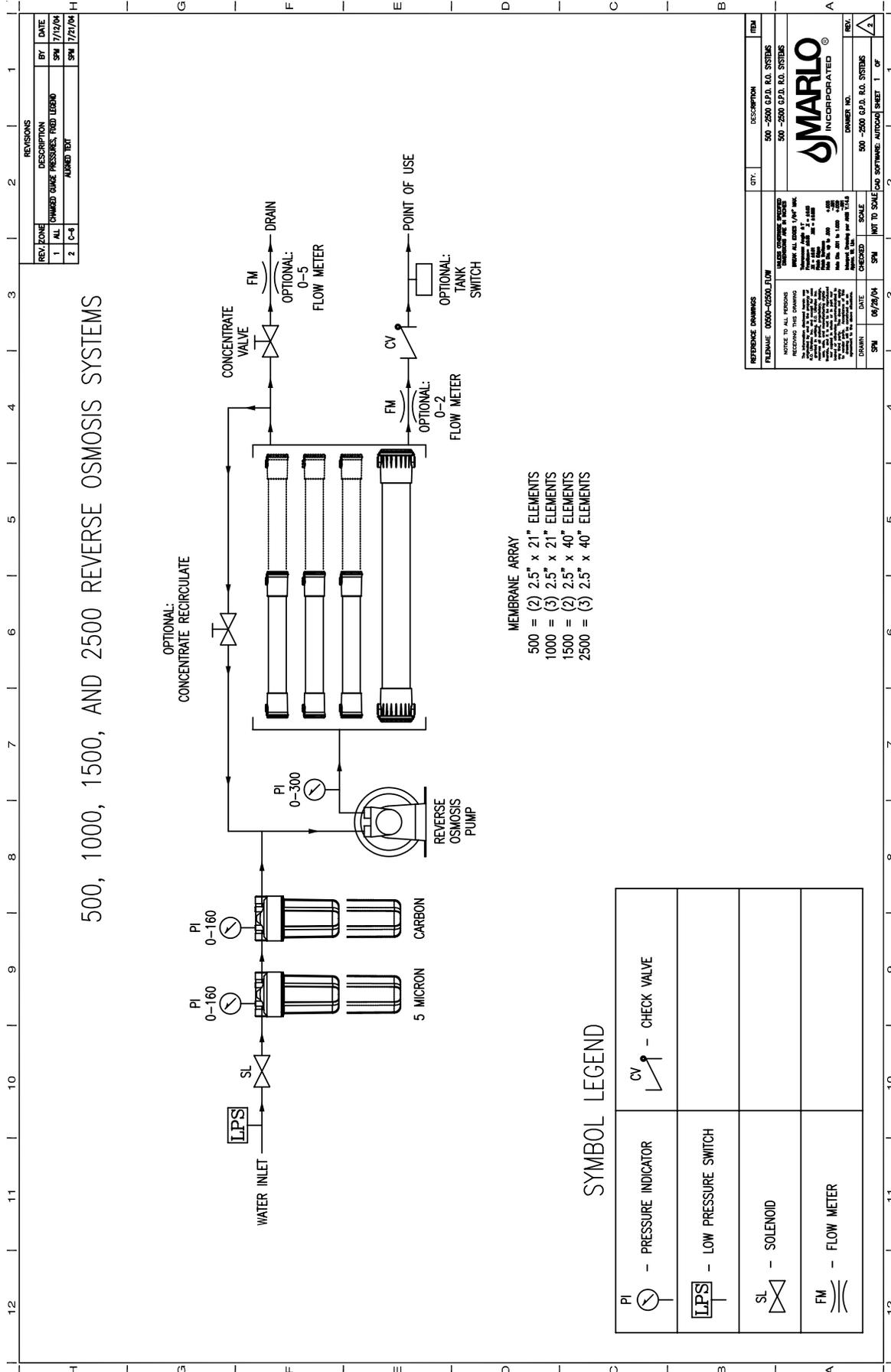
To obtain a copy of the manufacturer's warranty for their systems and terms and conditions, please contact your local dealer and distributor.



REVISIONS		REV. NO.	DESCRIPTION	BY	DATE
1	C-9	MARKED TEXT		SPM	1/22/04

REFERENCE DRAWINGS	QTY.	DESCRIPTION	ITEM
FILENAME: REVERSE_OSMOSIS_SYSTEM_SCHEMATIC		R.O. SYSTEM SCHEMATIC	
<p><b>MARLO</b> INCORPORATED®</p>			
DATE: 06/29/04	SCALE:	NOT TO SCALE (SEE SOFTWARE AUTOCAD SHEET)	REV. 1 OF 1
DRAWN: SPM	CHECKED:		





MRO 500 SYSTEM

MRO 1000 SYSTEM

	2	2521 CHAMP 3/8" NPT PART# 1620002	(A1)
	2	THIN FILM COMPOSITE MEMBRANE 2521 TFC HF3 PART# 1520014	(A2)
	4	CHAMP 2.5" END PLUG PART# 1630002	(A3)
	4	CHAMP 2.5" SNAP RING PART# 1630003	(A4)
	4	CHAMP 2.5" O-RING SET PART# 1630004	(A5)
	1	2.5" 0-300 PSI PANEL MOUNT STAINLESS STEEL GLYCERINE FILLED GAUGE PART# 1102003	(B)
	1	SINGLE POLE ON/OFF SWITCH 110 VOLT PART# 11320028	(C)
	1	1/4" BRASS NEEDLE VALVE (MANUAL FLUSH) PART#11320016	(D)
	2	0-160 PSI TOP MOUNT STAINLESS STEEL GAUGE PART# 11020001	(E)
	2	PUROTECH 10" BIG GREY DOUBLE O-RING FILTER HOUSING PART# 1820001	(F)
	1	4.5" X 10" BIG GREY 5 MICRON POLY-PRO PART# 1710009 (12 PIECES PER CASE)	(F1)
	1	4.5" X 10" BIG GREY 10 MICRON CARBON BLOCK PART# 1720004 (12 PIECES PER CASE)	(F2)
	1	GE 1/3 HP MOTOR 110/220 V PART# 11120001	(G)
	1	FLUID O TECH 601 ROTARY VANE PUMP 3 GPM PART# 11110006	(H)
	1	SOLENOID VALVE 110 VOLT 3/4" NPT PART# 11320012	(I)
	1	SQUARE D LOW PRESSURE SWITCH 22/12 PART# 11320002	(J)
	1	POWDER COATED EPOXY FRAME PART# N/A	(K)
OPTIONAL	1	PUROTECH 0-5 FLOW METERS PART# 11010008	(L)
OPTIONAL	1	PUROTECH 0-2 FLOW METERS PART# 11010007	(L1)
OPTIONAL	2	SQUARE D HIGH PRESSURE SWITCH 40/60 PART# 11320001	(M)
OPTIONAL	2	CONCENTRATE RECIRCULATE SYSTEM OPTION PART# 11320032	(N)
OPTIONAL	2	DAYTON NORMALLY CLOSED FLOAT SWITCH 110 VOLT PART# 11320006	(O)

	3	2521 CHAMP 3/8" NPT PART# 1620002	(A)
	3	THIN FILM COMPOSITE MEMBRANE 2521 TFC HF3 PART# 1520014	(A2)
	6	CHAMP 2.5" END PLUG PART# 1630002	(A3)
	6	CHAMP 2.5" SNAP RING PART# 1630003	(A4)
	6	CHAMP 2.5" O-RING SET PART# 1630004	(A5)
	1	2.5" 0-300 PSI PANEL MOUNT STAINLESS STEEL GLYCERINE FILLED GAUGE PART# 1102003	(B)
	1	SINGLE POLE ON/OFF SWITCH 110 VOLT PART# 11320028	(C)
	1	1/4" BRASS NEEDLE VALVE (MANUAL FLUSH) PART#11320016	(D)
	2	0-160 PSI TOP MOUNT STAINLESS STEEL GAUGE PART# 11020001	(E)
	2	PUROTECH 10" BIG GREY DOUBLE O-RING FILTER HOUSING PART# 1820001	(F)
	1	4.5" X 10" BIG GREY 5 MICRON POLY-PRO PART# 1710009 (12 PIECES PER CASE)	(F1)
	1	4.5" X 10" BIG GREY 10 MICRON CARBON BLOCK PART# 1720004 (12 PIECES PER CASE)	(F2)
	1	GE 1/3 HP MOTOR 110/220 V PART# 11120001	(G)
	1	FLUID O TECH 601 ROTARY VANE PUMP 3 GPM PART# 11110006	(H)
	1	SOLENOID VALVE 110 VOLT 3/4" NPT PART# 11320012	(I)
	1	SQUARE D LOW PRESSURE SWITCH 22/12 PART# 11320002	(J)
	1	POWDER COATED EPOXY FRAME PART# N/A	(K)
OPTIONAL	1	PUROTECH 0-5 FLOW METERS PART# 11010008	(L)
OPTIONAL	1	PUROTECH 0-2 FLOW METERS PART# 11010007	(L1)
OPTIONAL	2	SQUARE D HIGH PRESSURE SWITCH 40/60 PART# 11320001	(M)
OPTIONAL	2	CONCENTRATE RECIRCULATE SYSTEM OPTION PART# 11320032	(N)
OPTIONAL	2	DAYTON NORMALLY CLOSED FLOAT SWITCH 110 VOLT PART# 11320006	(O)

MRO 1500 SYSTEM

	2	2540 CHAMP 3/8" NPT PART# 1620003	(A1)
	2	THIN FILM COMPOSITE MEMBRANE 2540 TFC HF3 PART# 1520023	(A2)
	4	CHAMP 2.5" END PLUG PART# 1630002	(A3)
	4	CHAMP 2.5" SNAP RING PART# 1630003	(A4)
	4	CHAMP 2.5" O-RING SET PART# 1630004	(A5)
	1	2.5" 0-300 PSI PANEL MOUNT STAINLESS STEEL GLYCERINE FILLED GAUGE PART# 11020003	(B)
	1	SINGLE POLE ON/OFF SWITCH 110 VOLT PART# 11320028	(C)
	1	1/4" BRASS NEEDLE VALVE (MANUAL FLUSH) PART#11320016	(D)
	2	0-160 PSI TOP MOUNT STAINLESS STEEL GAUGE PART# 11020001	(E)
	2	PUROTECH 10" BIG GREY DOUBLE O-RING FILTER HOUSING PART# 1820001	(F)
	1	4.5" X 10" BIG GREY 5 MICRON POLY-PRO PART# 1710009 (12 PIECES PER CASE)	(F1)
	1	4.5" X 10" BIG GREY 10 MICRON CARBON BLOCK PART# 1720004 (12 PIECES PER CASE)	(F2)
	1	GE 1/3 HP MOTOR 110/220 V PART# 11120001	(G)
	1	FLUID O TECH 601 ROTARY VANE PUMP 3 GPM PART# 11110006	(H)
	1	SOLENOID VALVE 110 VOLT 3/4" NPT PART# 11320012	(I)
	1	SQUARE D LOW PRESSURE SWITCH 22/12 PART# 11320002	(J)
	1	POWDER COATED EPOXY FRAME PART# N/A	(K)
OPTIONAL	1	PUROTECH 0-5 FLOW METERS PART# 11010008	(L)
OPTIONAL	1	PUROTECH 0-2 FLOW METERS PART# 11010007	(L1)
OPTIONAL	2	SQUARE D HIGH PRESSURE SWITCH 40/60 PART# 11320001	(M)
OPTIONAL	2	CONCENTRATE RECIRCULATE SYSTEM OPTION PART# 11320032	(N)
OPTIONAL	2	DAYTON NORMALLY CLOSED FLOAT SWITCH 110 VOLT PART# 11320006	(O)

TITAN 2500 SYSTEM

	3	2540 CHAMP 3/8" NPT PART# 162003	(A1)
	3	THIN FILM COMPOSITE MEMBRANE 2540 TFC HF3 PART# 1520023	(A2)
	6	CHAMP 2.5" END PLUG PART# 1630002	(A3)
	6	CHAMP 2.5" SNAP RING PART# 1630003	(A4)
	6	CHAMP 2.5" O-RING SET PART# 1630004	(A5)
	1	2.5" 0-300 PSI PANEL MOUNT STAINLESS STEEL GLYCERINE FILLED GAUGE PART# 11020003	(B)
	1	SINGLE POLE ON/OFF SWITCH 110 VOLT PART# 11320028	(C)
	1	1/4" BRASS NEEDLE VALVE (MANUAL FLUSH) PART#11320016	(D)
	2	0-160 PSI TOP MOUNT STAINLESS STEEL GAUGE PART# 11020001	(E)
	2	PUROTECH 10" BIG GREY DOUBLE O-RING FILTER HOUSING PART# 1820001	(F)
	1	4.5" X 10" BIG GREY 5 MICRON POLY-PRO PART# 1710009 (12 PIECES PER CASE)	(F1)
	1	4.5" X 10" BIG GREY 10 MICRON CARBON BLOCK PART# 1720004 (12 PIECES PER CASE)	(F2)
	1	GE 1/3 HP MOTOR 110/220 V PART# 11120001	(G)
	1	FLUID O TECH 601 ROTARY VANE PUMP 3 GPM PART# 11110006	(H)
	1	SOLENOID VALVE 110 VOLT 3/4" NPT PART# 11320012	(I)
	1	SQUARE D LOW PRESSURE SWITCH 22/12 PART# 11320002	(J)
	1	POWDER COATED EPOXY FRAME PART# N/A	(K)
OPTIONAL	1	PUROTECH 0-5 FLOW METERS PART# 11010008	(L)
OPTIONAL	1	PUROTECH 0-2 FLOW METERS PART# 11010007	(L1)
OPTIONAL	2	SQUARE D HIGH PRESSURE SWITCH 40/60 PART# 11320001	(M)
OPTIONAL	2	CONCENTRATE RECIRCULATE SYSTEM OPTION PART# 11320032	(N)
OPTIONAL	2	DAYTON NORMALLY CLOSED FLOAT SWITCH 110 VOLT PART# 11320006	(O)

## INSTALLATION / OPERATION ADDENDUM RO WITH BLADDER TANK

### INSTALLATION

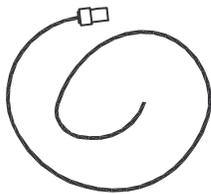
1. LOCATE BLADDER TANK ON SUITABLE FLAT SURFACE. ATTACH MANIFOLD ASSEMBLY AS SHOWN BELOW.
2. CONNECT PRESSURIZED PERMEATE OUTLET TO PROCESS PIPING (PIPE MATERIAL TO BE SUITABLE FOR USE WITH RO WATER). BE SURE TO SUPPORT MANIFOLD PIPING WITH HANGERS TO ELIMINATE ANY PIPING STRESSES.
3. CONNECT SUPPLIED 3/8" TUBING FROM THE RO UNIT PERMEATE OUTLET TO THE CHECK VALVE ON THE MANIFOLD AS SHOWN BELOW. (USE THE 1/4" TUBING AND THE 3/8 X 1/4 TUBE REDUCER ON THE T-200 MODEL RO.

### OPERATION

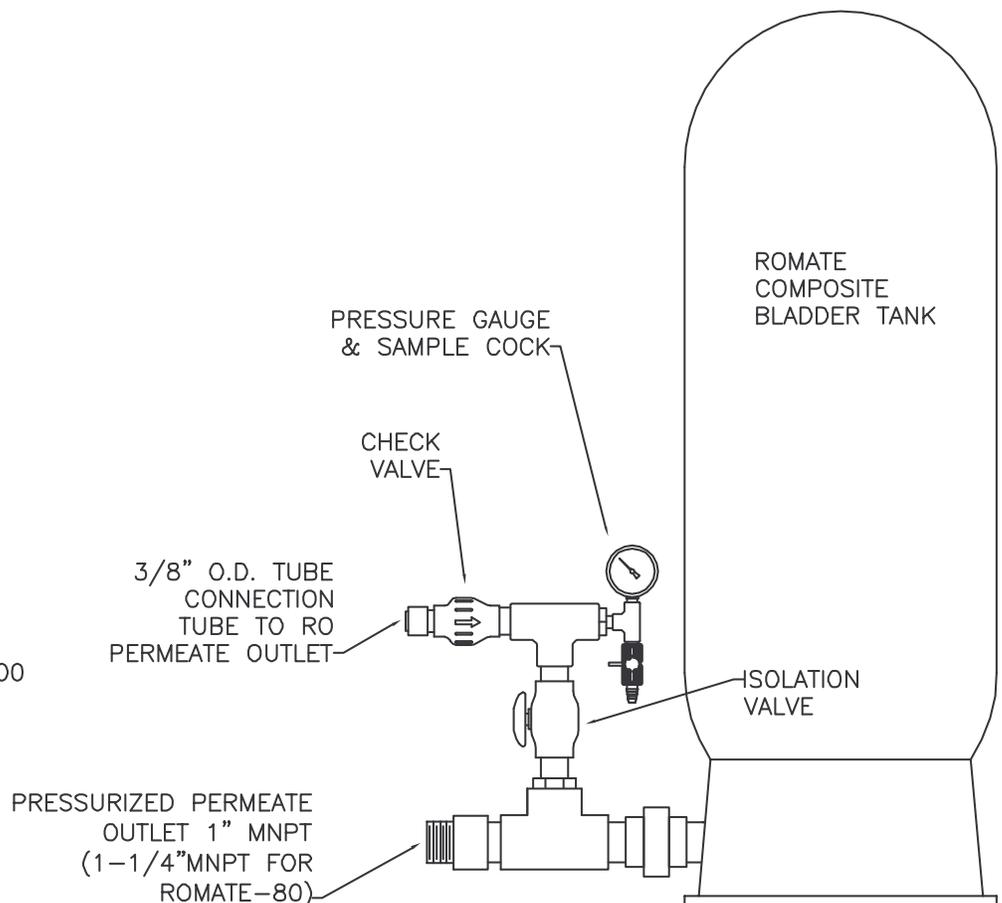
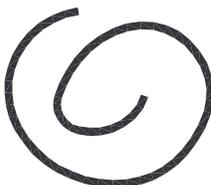
1. THE RO UNIT WITH PERMEATE PRESSURE SWITCH OPTION INCORPORATES A PRESSURE SWITCH FACTORY PIPED AND WIRED TO THE RO. THE PRESSURE SWITCH IS SET AT 40PSI CUT IN AND 60PSI CUT OUT. THE RO UNIT WILL AUTOMATICALLY RUN WHEN THE PRESSURE IN THE BLADDER TANK FALLS BELOW 40PSI AND IT WILL CUT-OFF WHEN THE PRESSURE RISES TO 60PSI.
2. THE OPERATOR CAN TEST THE PRESSURE SWITCH OPERATION BY CLOSING THE ISOLATION VALVE ON THE MANIFOLD. THE PRESSURE IN THE LINE SHOULD RISE TO 60PSI AND THE RO SHOULD SHUT-OFF. OPENING THE ISOLATION VALVE WILL RELIEVE PRESSURE AND THE RO SHOULD START RUNNING.

### PERMEATE TUBING

USE 1/4" TUBING  
10FT COIL FOR  
MRO200 RO UNITS  
(SUPPLIED WITH  
3/8T X 1/4T TUBE  
REDUCER)



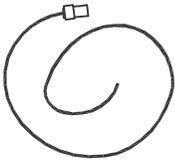
USE 3/8" TUBING  
10FT COIL FOR  
MRO300 TO MRO2500  
RO UNITS



## INSTALLATION / OPERATION ADDENDUM TITAN RO WITH BULK STORAGE TANK & REPRESSURE PUMP

### PERMEATE TUBING

USE 1/4" TUBING  
10FT COIL FOR  
T-200 RO UNITS  
(SUPPLIED WITH  
3/8T X 1/4T TUBE  
REDUCER)



USE 3/8" TUBING  
10FT COIL FOR  
T-300 TO T-2500  
RO UNITS

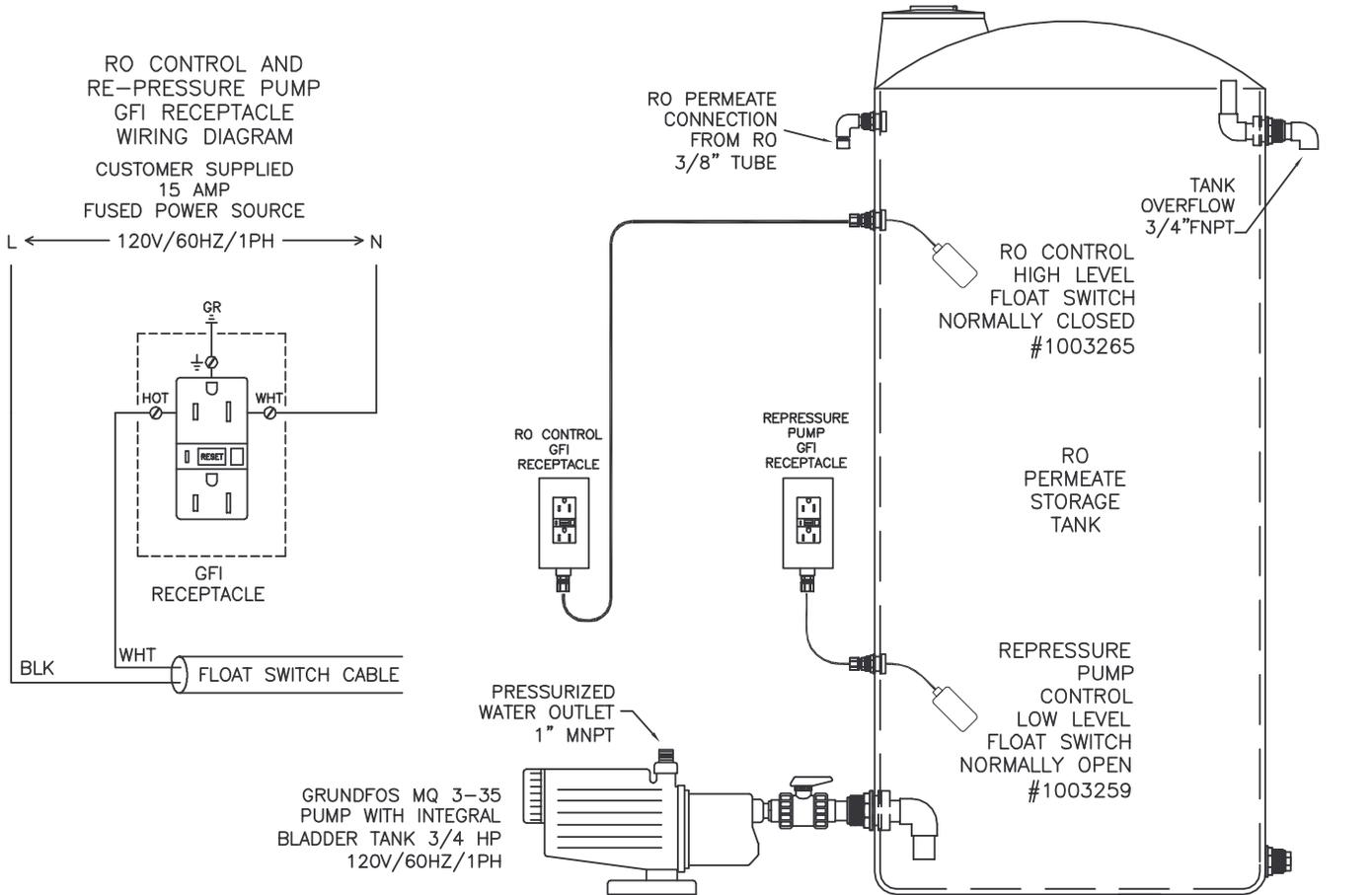


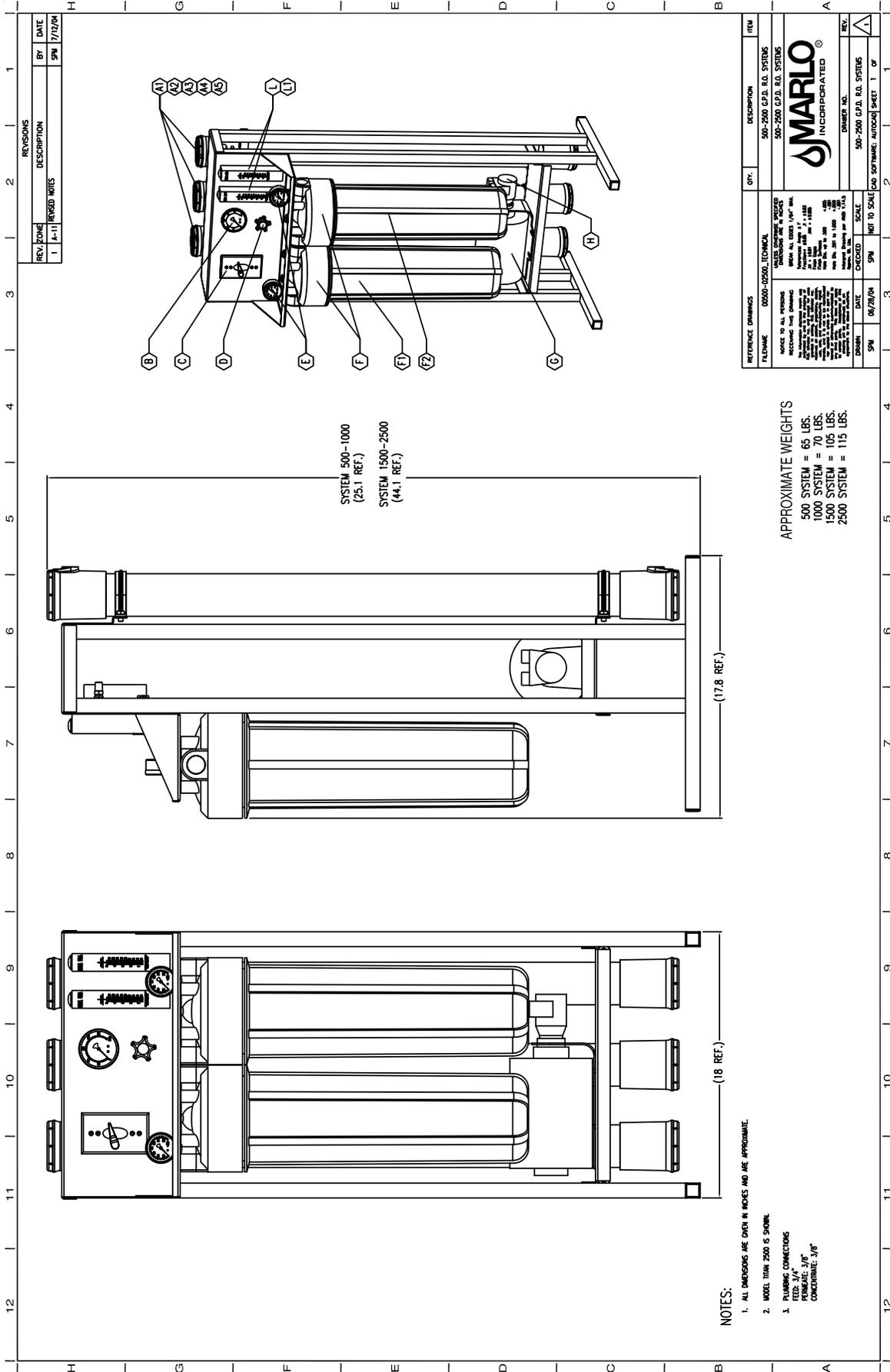
### INSTALLATION

1. LOCATE BULK STORAGE TANK ON SUITABLE FLAT SURFACE. CONNECT REPRESSURE PUMP TO STORAGE TANK WITH SUPPLIED FITTINGS AS SHOWN BELOW. PIPE TANK OVERFLOW TO DRAIN.
2. CONNECT PUMP PRESSURIZED OUTLET TO PROCESS PIPING (PIPE MATERIAL TO BE SUITABLE FOR USE WITH RO WATER).
3. CONNECT 3/8" TUBING FROM THE RO UNIT PERMEATE OUTLET TO THE BULK STORAGE TANK AS SHOWN BELOW. (USE THE 1/4" TUBING AND THE 3/8 X 1/4 TUBE REDUCER ON THE T-200 MODEL RO.)
4. WALL MOUNT THE FLOAT SWITCH GFI RECEPTACLES AND HAVE A QUALIFIED ELECTRICIAN RUN POWER TO THE RECEPTACLES FOLLOWING LOCAL ELECTRICAL CODES AND THE WIRING DIAGRAM SHOWN BELOW.
5. PLUG THE RO UNIT INTO THE TOP FLOAT SWITCH GFI RECEPTACLE. PLUG THE REPRESSURE PUMP INTO THE BOTTOM FLOAT SWITCH GFI RECEPTACLE. DO NOT PLUG ANY OTHER DEVICES INTO THESE DEDICATED RECEPTACLES.

### OPERATION

1. THE RO UNIT WILL AUTOMATICALLY RUN BASED ON THE POSITION OF THE TOP FLOAT SWITCH. THE LENGTH OF THE FLOAT SWITCH CABLE INSIDE THE TANK DETERMINES THE ON/OFF WATER LEVEL. AS THE CABLE LENGTH INCREASES, THE ON/OFF DIFFERENTIAL INCREASES. TYPICAL LENGTH IS 12"
2. THE LOW LEVEL FLOAT SWITCH OPERATES IN THE SAME MANNER. THE REPRESSURE PUMP WILL NOT RUN UNLESS THE WATER LEVEL IN THE TANK ACTIVATES THE LOW LEVEL FLOAT SWITCH. TYPICAL LENGTH OF THIS FLOAT SWITCH IS ALSO 12". THE PUMP WILL AUTOMATICALLY ACTIVATE TO MAINTAIN 30PSI ON THE DISCHARGE OF THE PUMP. MAXIMUM FLOW IS 20GPM.





REV. ZONE	REVISED	DATE
1	1	7/17/04

REVISIONS	BY	DATE
DESCRIPTION	SPM	7/17/04

REFERENCE DRAWINGS	ITEM
00500-02500 TECHNICAL	500-2500 C.P.A. R.O. SYSTEMS
00500-02500 C.P.A. R.O. SYSTEMS	500-2500 C.P.A. R.O. SYSTEMS

DATE	SCALE	NOT TO SCALE
06/28/04	SPM	SPM

DATE	SCALE	NOT TO SCALE
06/28/04	SPM	SPM

DATE	SCALE	NOT TO SCALE
06/28/04	SPM	SPM

DATE	SCALE	NOT TO SCALE
06/28/04	SPM	SPM

DATE	SCALE	NOT TO SCALE
06/28/04	SPM	SPM

DATE	SCALE	NOT TO SCALE
06/28/04	SPM	SPM

SYSTEM 500-1000  
(25.1 REF.)  
SYSTEM 1500-2500  
(44.1 REF.)

APPROXIMATE WEIGHTS  
500 SYSTEM = 65 LBS.  
1000 SYSTEM = 70 LBS.  
1500 SYSTEM = 105 LBS.  
2500 SYSTEM = 115 LBS.

- NOTES:
1. ALL DIMENSIONS ARE GIVEN IN INCHES AND ARE APPROXIMATE.
  2. MODEL THIN 2500 IS SHOWN.
  3. PLUMBING CONNECTIONS  
FEED: 3/4"  
PERMEATE: 3/8"  
CONCENTRATE: 3/8"



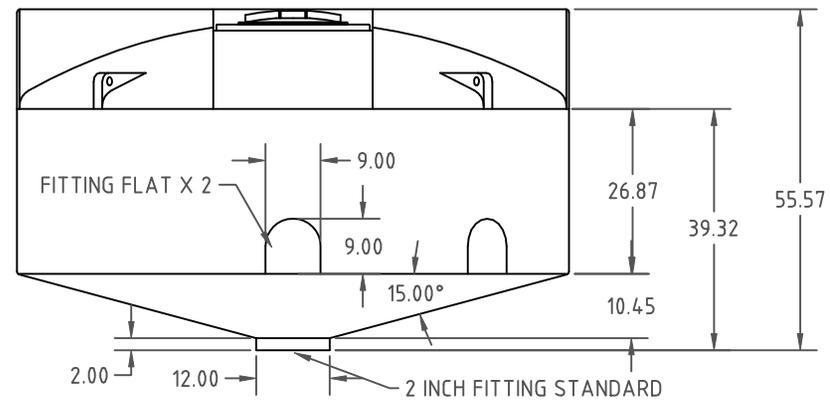
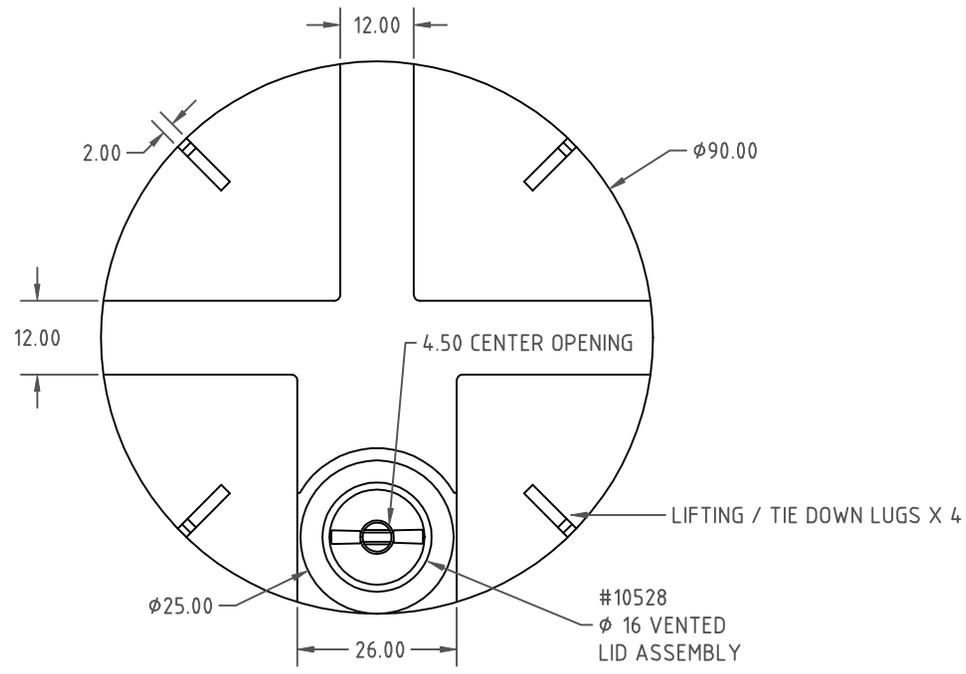




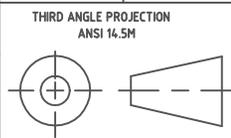
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P.O. Box 044170  
Racine, WI 53404-7003  
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# Section 5

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				DRAWN / DATE DHJ 1/7/11	MATERIAL 10420
				APPRD. / DATE REH 2/2/11	
REV	DESCRIPTION	BY / DATE	CCN	SHOT WEIGHT: 210 LBS.	NOTES: 1. THICKNESS @ BOTTOM SIDE WALL .280
	ALL DIMENSIONS ARE IN DECIMAL INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED			SHIPPING WEIGHT: 212 LBS.	
	POLYETHYLENE ±1% @ 68° F			FINISH:	
	METAL DECIMAL ± .125" FRACTION ± 1/4" ANGLE ± 1°				



**Den Hartog**  
INDUSTRIES, INC.

Ace Roto-Mold Injection Molding Blow Molding Sowjoy  
4010 HOSPERS DRIVE S. BOX 425, HOSPERS, IOWA 51238-0425

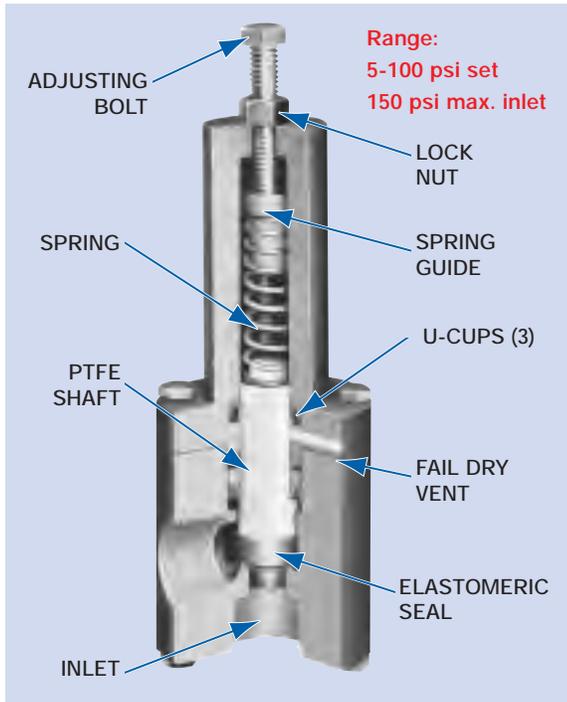
DESCRIPTION	850 GALLON 90" DIA. X 15° CONE BOTTOM TANK W/ INDUSTRIAL TOP		
SCALE	N.S.	PART NO.	CB0850-90



# SERIES RVT • Solid PTFE Shaft Design



angle pattern valve with high pressure and flow rates



## Features:

- PTFE shaft prevents chatter and sticking.
- Triple U-cup seal isolates spring, provides added safety.
- Patented Fail-Dry® advance warning vent allows maintenance to be scheduled conveniently, without costly shut-down.
- Angle pattern offers compact size and convenient piping.
- 1/2" through 2" pipe sizes.
- No wetted metal parts.

## Design:

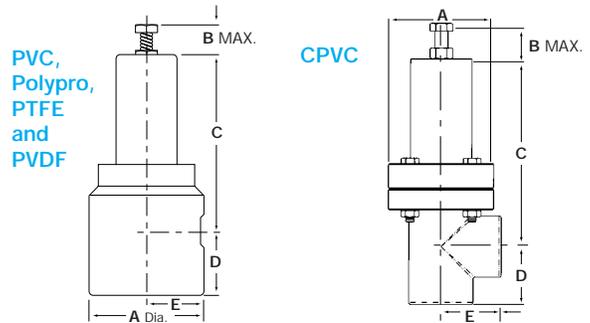
Series RVT angle pattern pressure relief valve features a solid, non-sticking PTFE shaft passing through three U-cup seals. It is a proven, high performance relief valve providing rugged dependability for acids and other highly corrosive liquids. Relief setting is infinitely adjustable from 5 psi to 100 psi. Maximum inlet pressure is 150 psi. Not recommended for salt solutions and other liquids that can crystallize.

## Materials of Construction:

Available in PVC, CPVC, Natural Polypropylene, PVDF and PTFE. Seals are available in EPDM or FKM (Viton®). For alternate body or seal materials, consult factory. The adjusting bolt, lock nut and fasteners are stainless steel. The control spring is plated steel. No metal parts are in contact with liquid.

## Series RVT Dimensions

NPT or BSP	A		B		C		D		E	
	in.	mm.	in.	mm.	in.	mm.	in.	mm.	in.	mm.
For PVC (PV), Polypro (PP), PTFE (TF), PVDF (PF) Bodies										
1/2	2.5	63.0	1	55.0	5	127.0	1.25	31.0	1.25	31.0
3/4	3	76.0	2.25	57.0	5.375	137.0	1.25	31.0	1.5	38.0
1	3	76.0	2.25	57.0	5.562	141.0	2	51.0	1.5	38.0
1 1/4	4	101.6	2.5	63.5	7.625	193.6	2	50.8	2	50.8
1 1/2	4.5	114.0	3.875	98.0	7.125	181.0	2.25	57.0	2.25	57.0
2	5.5	140.0	3.875	98.0	8.5	216.0	2.625	67.0	2.75	70.0
CPVC (Corzan™) Body										
1/2	2.5	63.5	1	25.4	5	127.0	1.25	31.7	1.25	31.7
3/4	2.5	63.5	1.5	38.1	5.25	133.3	1.5	38.1	1.5	38.1
1	3.0	76.2	1.75	44.4	5.5	139.7	1.75	44.4	1.75	44.4
1 1/4	3.5	88.9	2.5	63.5	7.625	193.6	2	50.8	2	50.8
1 1/2	3.75	95.2	2	50.8	7	177.8	2.187	53.9	2.125	53.9
2	4.25	109.7	3.25	82.5	8.5	215.9	2.5	61.2	2.25	57.1

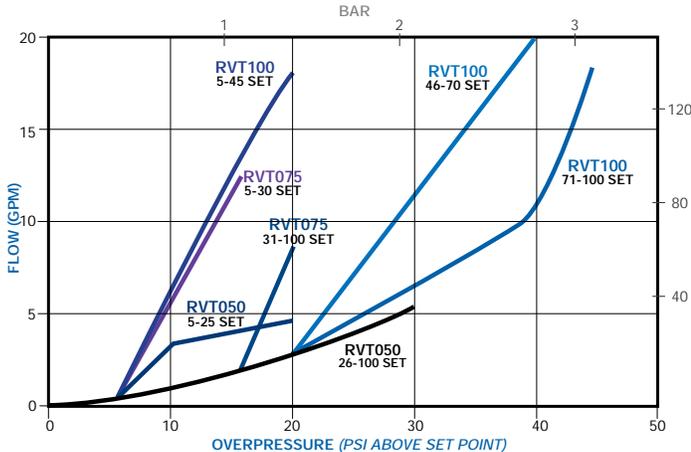


## Series RVT Model Numbers

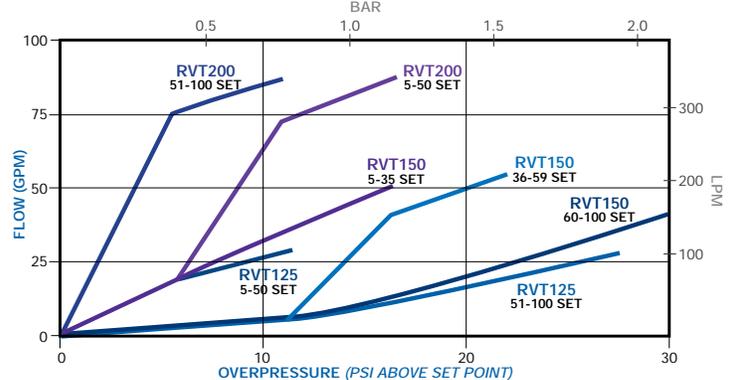
PIPE SIZE	PVC* Model No.	POLYPRO Model No.	PVDF Model No.	PTFE Model No.
1/4	RVT025V-PV	RVT025V-PP	RVT025V-PF	RVT025V-TF
1/2	RVT050V-PV	RVT050V-PP	RVT050V-PF	RVT050V-TF
3/4	RVT075V-PV	RVT075V-PP	RVT075V-PF	RVT075V-TF
1	RVT100V-PV	RVT100V-PP	RVT100V-PF	RVT100V-TF
1 1/4	RVT125V-PV	N/A	N/A	N/A
1 1/2	RVT150V-PV	RVT150V-PP	RVT150V-PF	RVT150V-TF
2	RVT200V-PV	RVT200V-PP	RVT200V-PF	RVT200V-TF

\* For CPVC change -PV to -CP.

## Series RVT 1/2", 3/4" and 1" Flow Characteristics



## Series RVT 1 1/4", 1 1/2" and 2" Flow Characteristics



# INSTALLATION & MAINTENANCE INSTRUCTIONS FOR TRUE BLUE™ SERIES RVT RELIEF VALVES

## I. IMPORTANT - BEFORE INSTALLING

Series RVT relief valves will open when inlet pressure exceeds the set pressure, when properly installed and used within the recommended ranges of pressure, temperature, and chemical compatibility. The ultimate determination of material compatibility is previous successful use in the same application. Call our Technical Support for information about your application.

**CAUTION:** Series RVT is not a pop safety relief valve. It is not intended for air or gas service. It does not regulate pressure downstream of the valve. Connecting the outlet to a suction line may cause air to be drawn into the line. Connecting the outlet to a pressurized line or vessel may cause valve malfunction. Plastic materials will degrade in ultraviolet (UV) light or sunlight. Polypropylene and PVDF often look similar. Do not install in your system if you are not sure.

## MAXIMUM INLET PRESSURES for WATER\*

BODY MAT'L	COLOR	at 77°F (25°C)	at 104°F (40°C)	at MAX. TEMP.
PVC	DARK GRAY	150 PSI 10 Bar	106 PSI 7 Bar	34 PSI @ 140°F 2 Bar @ 60°C
CPVC	LIGHT GRAY	150 PSI 10 Bar	120 PSI 8 Bar	37 PSI @ 180°F 2 Bar @ 80°C
Polypro	TRANSLUC. WHITE	150 PSI 10 Bar	125 PSI 8 Bar	40 PSI @ 180°F 2 Bar @ 80°C
KymerPVDF	TRANSLUC. WHITE	150 PSI 10 Bar	120 PSI 8 Bar	22 PSI @ 280°F 1 Bar @ 140°C
PTFE	OPAQUE WHITE	150 PSI 10 Bar	140 PSI 9 Bar	10 PSI @ 280°F 69 KPa @ 140°C

\*or compatible chemical - ratings reduced for some applications. Not rated for suction or vacuum. Minimum temperature 40°F (5°C). EPDM seals limited to 250°F (120°C), Buna-N to 200°F (95°C). See the Product Data Sheet or consult our Technical Support staff for more information.

## II. INSTALLATION INSTRUCTIONS

Install the valve in the proper flow direction as indicated by the flow label. The valve may be set vertically or horizontally.

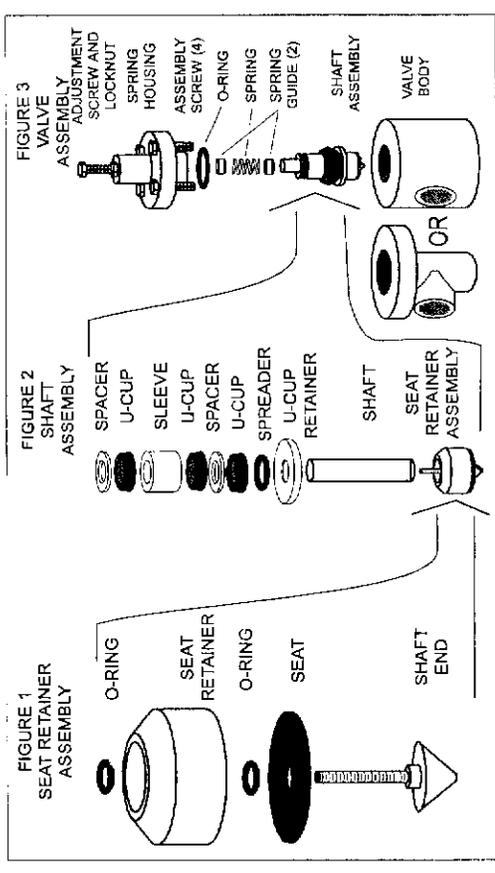
**A. THREADED CONNECTION** - Apply a suitable thread sealant (for example, PTFE tape) to male tapered threads to assure a "leak-tight" seal. Assemble "hand-tight" followed by a quarter (1/4) turn with a strap wrench. Do not over tighten or use pipe wrenches on plastic pipe and components. **Caution:** PTFE tape will "string" as pipe threads are joined. Loose "strings" could lie across the seating surface and prevent the valve from completely closing. To avoid this problem, clean out old tape, and do not apply tape to the first thread.

continued...

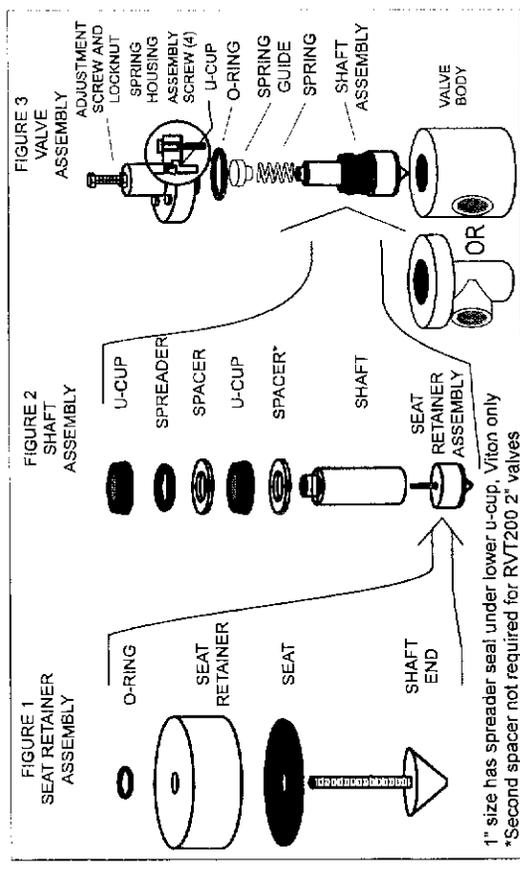


**VI. MAINTENANCE**  
Plast-O-Matic recommends keeping a spare seal kit available for repairs. Seal life will vary in applications due to cycles, temperatures, pressures, chemicals, and concentration. Based on the application, a periodic inspection and maintenance plan should be established. The seal kit part number is "SK" plus the part number less the material suffix. For example, the seal kit for RVT050V-PV is SKRVT050V.

## PARTS AND ILLUSTRATION - RVT050



## RVT075, RVT100, RVT125, RVT150, RVT200



1" size has spreader seal under lower u-cup, Viton only  
\*Second spacer not required for RVT200 2" valves



## PLAST-O-MATIC VALVES, INC.

1384 Pompton Ave • Cedar Grove, NJ 07009  
973-256-3000 • FAX: 973-256-4745

www.plastomatic.com

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**Caution:** Connect to plastic pipe and fittings only; when using metal pipe, install an intervening plastic fitting. Metal pipe and straight threaded pipe tends to cut, stretch, and distort the plastic bodies, resulting in cracking or leaking over time.

**NON-THREADED CONNECTIONS** - For solvent cementing or heat fusion, follow the instructions supplied with the cement or fusion equipment, or contact your distributor.

**MOUNTING** - These valves are designed to be supported by the piping. The piping must be properly supported, taking into account the weight of the valve, piping, and process liquid.

### III. SPRING REPLACEMENT

Pressure setting range can be changed by replacing one or more springs in the valve

RVT Spring Selection Chart

MODEL	PIPE SIZE	ADJUST RANGE	SPRINGS
RVT050	1/2"	5 - 25	LC042G-7
		26 - 70	LC045G-7
		71 - 100	LC055G-7
RVT075	3/4"	5 - 30	LC049H-10
		31 - 70	LC063H-10
		71 - 100	LC072H-9
RVT100	1"	5 - 25	LC072H-9
		26 - 55	LC080H-9
		56 - 100	LC080H-9 & LC091K-1
RVT125	1 1/4"	5 - 15	LC063H-10
		16 - 50	LC105L-8
		51 - 70	LC120L-7
		71 - 100	LHC156M-6
RVT150	1 1/2"	5 - 25	LC105L-8
		26 - 59	LC120L-7
		60 - 100	LC148J-7
RVT200	2"	5 - 40	LHC162N-8
		41 - 100	LHC218T-4
RVTX300	3"	5 - 100	LHL2000A-8

### IV. OPERATION

#### Relief Operation

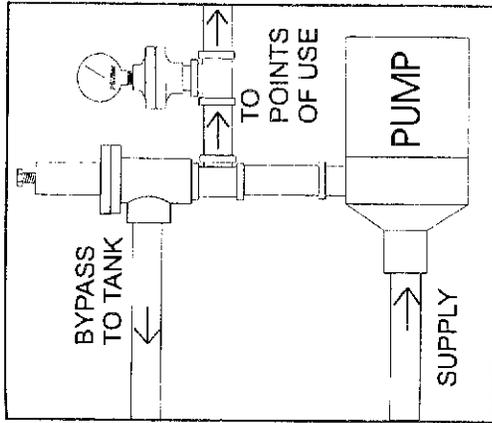
The function of a relief valve is to protect a pressurized pipeline, vessel, or other similar system from excessive pressure. When the inlet pressure exceeds the set point, the valve opens to bleed off the excess pressure.

#### Back Pressure Operation

A back pressure valve controls pressure in a line or system by closing when the pressure drops below the set point. Pressure at the outlet can drop, but upstream pressure is maintained.

#### By-pass Operation

A by-pass valve is set on the outlet of a pump (see figure) to prevent dead-heading and control the pump's outlet pressure. When pressure exceeds the set point, the valve opens to allow the liquid to recycle (by-pass) to the pump inlet.



Typical By-pass Operation

### V. PRESSURE SETTING INSTRUCTIONS

Series RVT pressure relief valves sense inlet pressure; therefore it may be helpful to install a pressure gauge at the inlet of the valve for setting.

#### Setting for relief or backpressure operation:

1. Install the relief valve in the piping system.
2. Loosen the locking nut on the adjusting screw assembly and turn the adjusting screw all the way in.
3. Increase the inlet pressure to the desired set point
4. Turn the adjusting screw slowly out until flow is observed.
5. Tighten the locking nut to lock in the setting.

Relief valves may be set off-line using pressurized air. Connect the inlet to a pressurized air supply that is regulated to the desired set pressure. Fill the outlet port with water, or run a line into a container of water, to observe bubbles.

## PLAST-O-MATIC GAUGE GUARDS PROTECT YOUR PROCESS



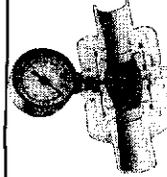
#### Series GGME

- Economical
- Superb accuracy
- Gauge ranges from vacuum to 200 psi



#### Series GGM

- For corrosive & ultra-pure applications
- Superior accuracy
- Gauge ranges from vacuum to 200 psi
- Available with shields, removable housings, and many other optional features

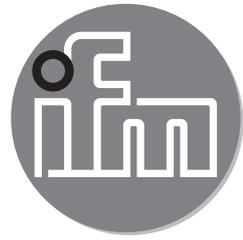


#### Series GGMU

- The Ultimate Ultra-Pure Gauge Guard
- Superior accuracy
- Gauge ranges from 0 to 200 psi



ifm electronic



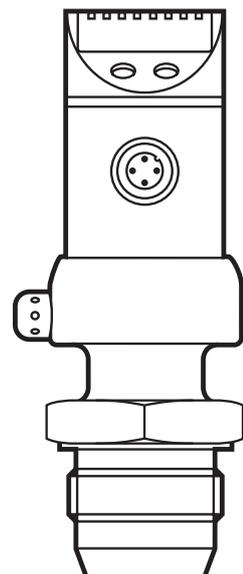
Operating instructions  
Electronic pressure sensor

**efector500<sup>®</sup>**

**PI16xx**

**UK**

704639 / 00 06 / 2009



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# 1 Preliminary note

## 1.1 Symbols used

- ▶ Instruction
- > Reaction, result
- [...] Designation of buttons, switches or indications
- Cross-reference



Important note

Non-compliance can result in malfunctions or interference.

## 2 Safety instructions

- Read this document before installing the unit. Ensure that the product is suitable for your application without any restrictions.
- Non-adherence to the operating instructions or technical data can lead to personal injury and/or damage to property.
- In all applications check compliance of the product materials (→ chapter 12 Technical data) with the media to be measured.
- For units with cULus approval and the scope of validity cULus → chapter 6 Electrical connection.

## 3 Functions and features

The pressure sensor detects the system pressure of machines and installations.

### 3.1 Applications

Type of pressure: relative pressure

Order no.	Measuring range		Permissible overload pressure		Bursting pressure	
	bar	PSI	bar	PSI	bar	PSI
PI1693	-1...25	-14.4...362.7	100	1 450	350	5 070
PI1694	-1...10	-14.5...145	50	725	150	2 175
PI1695	-1...4	-14.5...58	30	435	100	1 450
PI1696	-0.124...2.5	-1.8...36.24	20	290	50	725
	mbar	PSI	bar	PSI	bar	PSI
PI1689	5...100	-0.073...1.45	4	58	30	435
PI1697	-50...1 000	-0.73...14.5	10	145	30	435
PI1698	-12.4...250	-0.18...3.62	10	145	30	435
PI1699	-1 000...1 000	-14.5...14.5	10	145	30	435

$$\text{MPa} = \text{bar} \div 10 / \text{kPa} = \text{bar} \times 100$$



Static and dynamic overpressures exceeding the indicated overload pressure are to be avoided by taking appropriate measures.

The indicated bursting pressure must not be exceeded. Even if the bursting pressure is exceeded only for a short time, the unit can be destroyed.

NOTE: Risk of injury!

## 4 Function

### 4.1 Processing of the measured signals

- The unit displays the current system pressure.
- It generates 1 output signal according to the parameter setting.

<b>OUT</b>	analogue signal 4...20 mA (20...4 mA)
------------	---------------------------------------

### 4.2 Pressure monitoring/ analogue function

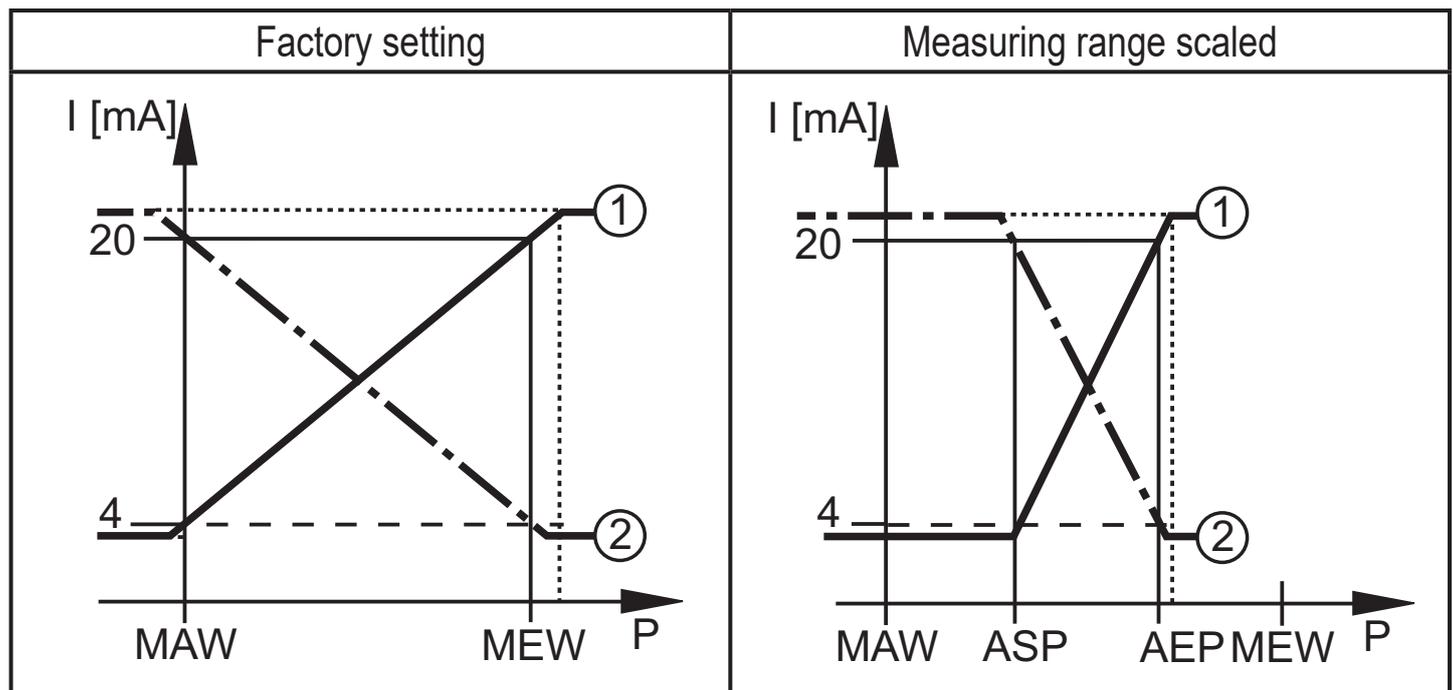
The analogue signal can be set.

- [OU2] defines whether the set measuring range is provided as a 4...20 mA signal ([OU2] = [I]) or a 20...4 mA signal ([OU2] = [InEG]).

Scaling can also be set by means of the teaching process or by entering a value for the ASP and AEP parameters.

- By teaching the analogue start point (tASP) or setting the parameter ASP you define the measured value at which the output signal is 4 mA (20 mA at [InEG]).
- By teaching the analogue end point (tAEP) or setting the parameter AEP you define the measured value at which the output signal is 20 mA (4 mA at [InEG]).

Minimum distance between [ASP] and [AEP] = 25 % of the final value of the measuring range (turn down 1:4).



UK

P = system pressure, MAW = initial value of the measuring range, MEW = final value of the measuring range

①: [OU2] = [I]; ②: [OU2] = [InEG]

The output signal is between 4 and 20 mA ([OU2] = [I]) or between 20 and 4 mA ([OU2] = [InEG]). It is also indicated:

- System pressure above the measuring range:
  - output signal > 20 mA if [OU2] = [I].
  - output signal between 4 and 3.8 mA if [OU2] = [InEG].
- System pressure below the measuring range:
  - output signal between 4 and 3.8 mA if [OU2] = [I].
  - output signal > 20 mA if [OU2] = [InEG].

## 5 Installation

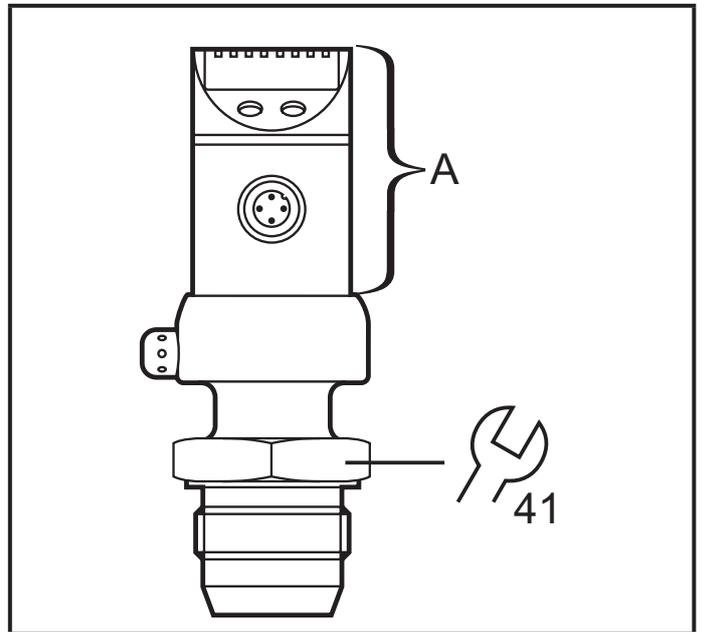
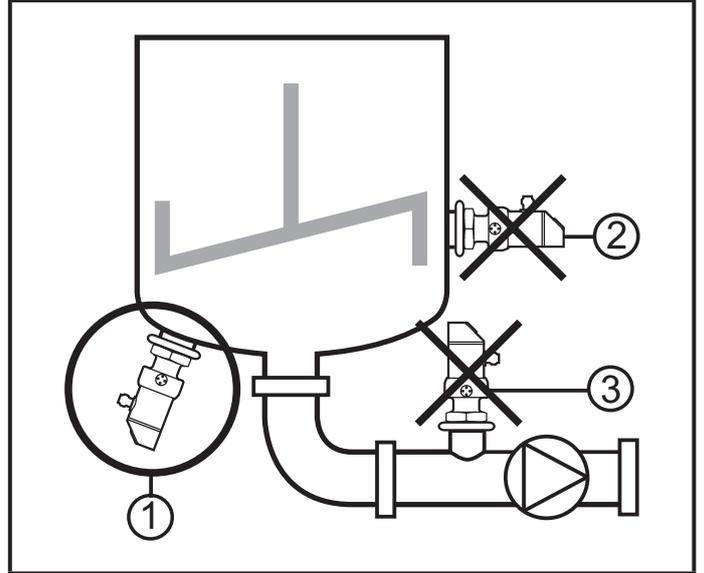


Ensure that no pressure is applied to the installation while mounting or removing the sensor. Please note: Display „0%“ does not mean that the system is free of pressure!

Horizontal mounting recommended for high medium temperatures.

To monitor a tank:

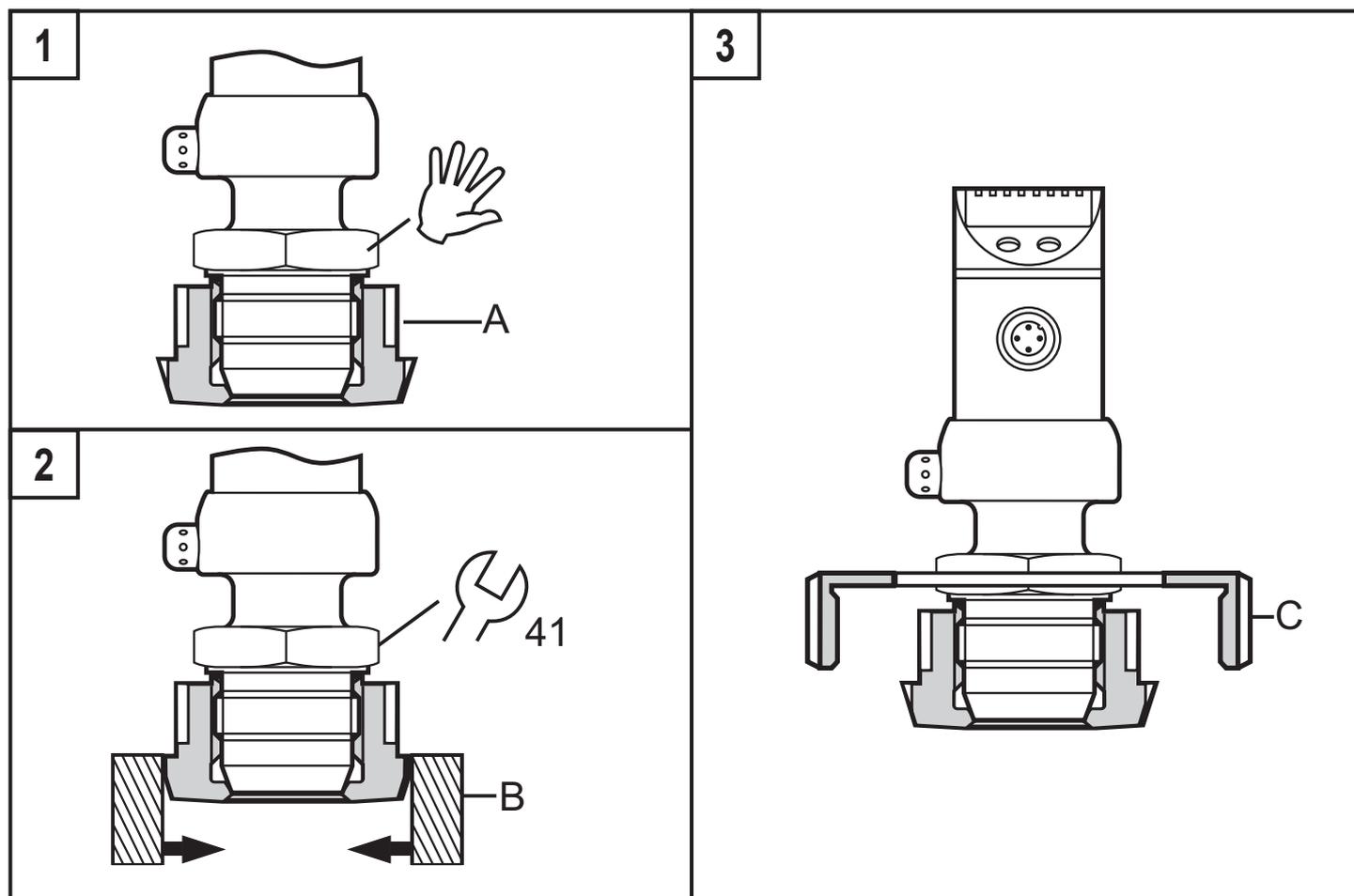
- ▶ If possible, mount the sensor at the bottom of the tank (1). Do not mount near an agitator (2), a pump (3) or in the spout of the tank (3).
- ▶ Screw the sensor into a G 1 process fitting.
- ▶ Tighten the sensor with a spanner. Tightening torque: 20 Nm..



A = freely rotatable housing

The unit is adaptable for various G 1 process fittings. G 1 process adapters to be ordered separately as accessories.

## Mounting



- ▶ Screw the unit into the adapter (A) until it is hand-tight (fig. 1). Do not damage the sealing chamfers.
- ▶ Clamp sensor and adapter into a clamping device (B); (fig. 2). Tighten the clamping device only slightly so that the adapter does not warp.
- ▶ Tighten the sensor using a spanner .  
Tightening torque: 20 Nm.
- ▶ Fix the unit + adapter to the process connection by means of a coupling nut, a clamp flange or the like (C); (fig 3).

NOTE: A guarantee for a long-term stable sealing of the metal seal is only valid for once-only mounting.

## Welding adapter

- ▶ First weld the adapter, then mount the sensor. Follow the instructions included with the adapter.

UK

## 6 Electrical connection



The unit must be connected by a qualified electrician.

The national and international regulations for the installation of electrical equipment must be adhered to.

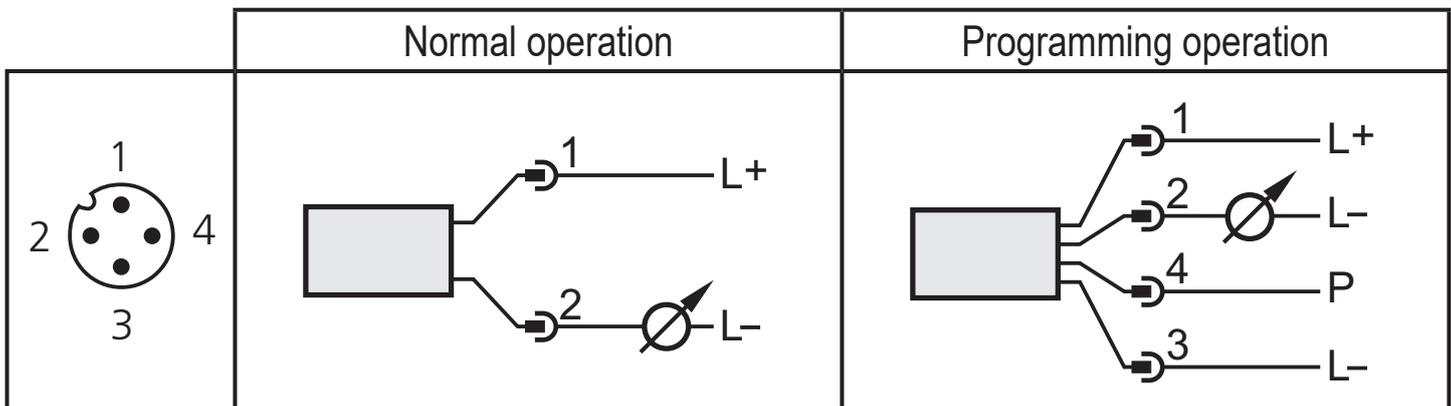
Voltage supply to EN50178, SELV, PELV.

For units with cULus approval and the scope of validity cULus: The device shall be supplied from an isolating transformer having a secondary Listed fuse rated as noted in the following table.

Overcurrent protection		
Control-circuit wire size		Maximum protective device rating [A]
AWG	[mm <sup>2</sup> ]	
22	0.32	3
20	0.52	5
18	0.82	7
16	1.3	10
14	2.1	20
12	3.3	25

► Disconnect power.

► Connect the unit as follows:

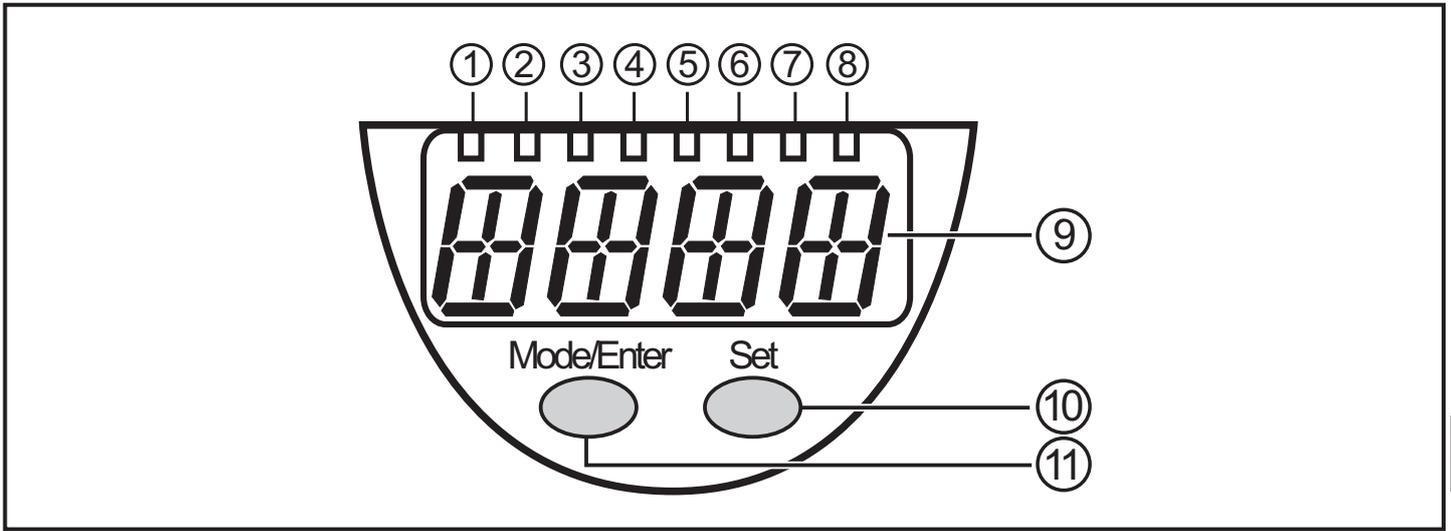


<b>Pin 1</b>	Ub+
<b>Pin 3</b>	Ub-
<b>Pin 4 (P)</b>	P = communication via EPS / FDT interface
<b>Pin 2 (OUT2)</b>	analogue output for system pressure

Core colours of ifm sockets:

1 = BN (brown), 2 = WH (white), 3 = BU (blue), 4 = BK (black)

# 7 Operating and display elements



UK

## 1 to 8: Indicator LEDs

- LED 1 to LED 6 = system pressure in unit of measurement as indicated on the label. LEDs 5 to 6 not used for units with 3 adjustable units of measurement.
- LED 7 not used.
- LED 8 not used.

## 9: Alphanumeric display, 4 digits

- Indication of the current system pressure.
- Indication of the parameters and parameter values.

## 10: Set pushbutton

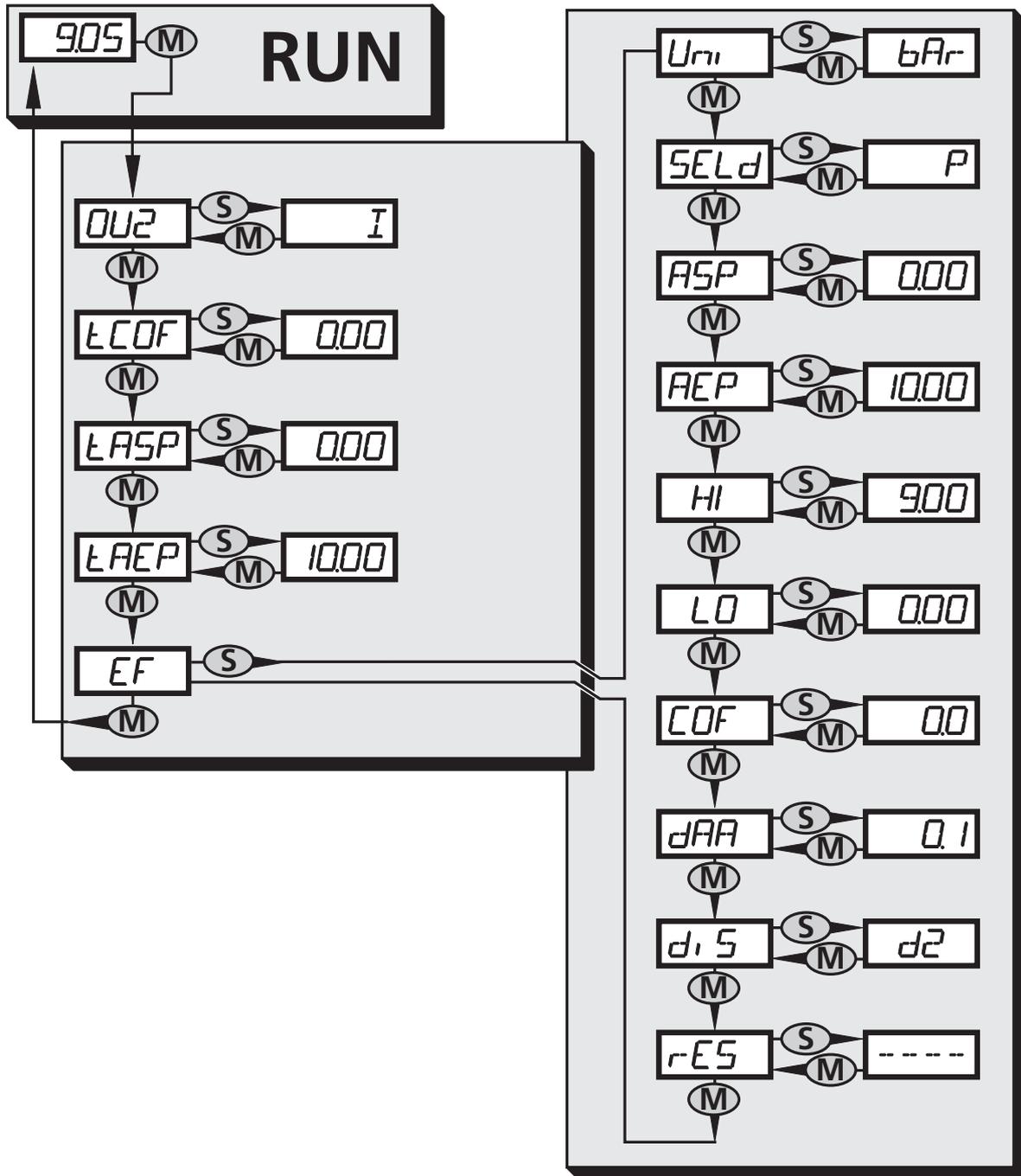
- Setting of the parameter values (scrolling by holding pressed, incremental by pressing briefly).

## 11: Mode/Enter pushbutton

- Selection of the parameters and acknowledgement of the parameter values.

# 8 Menu

## 8.1 Menu structure



## 8.2 Menu explanation

OU2	Output function for OUT2: • Analogue signal for the current system pressure: 4...20 mA [I] or 20...4 mA [InEG].
tCOF	Teaching zero-point calibration.
tASP	Teaching analogue start point for the system pressure: set value at which 4 mA are output (20 mA on [OU2] = [InEG]).
tAEP	Teaching analogue end point for the system pressure: set value at which 20 mA are output (4 mA on [OU2] = [InEG]).
EF	Extended functions / Opening menu level 2.
Uni	Standard unit of measurement for the system pressure.
SELd	Display mode: • Pressure in the unit set in [Uni]. • Pressure in % of the set scaling of the analogue output.
ASP	Analogue start point for the system pressure: measured value at which 4 mA are output (20 mA on [OU2] = [InEG]).
AEP	Analogue end point for the system pressure: measured value at which 20 mA are output (4 mA on [OU2] = [InEG]).
HI	Maximum value memory for the system pressure.
LO	Minimum value memory for the system pressure.
COF	Zero point calibration.
dAA	Damping for the analogue output.
diS	Update rate and orientation of the display.
rES	Restore the factory setting.

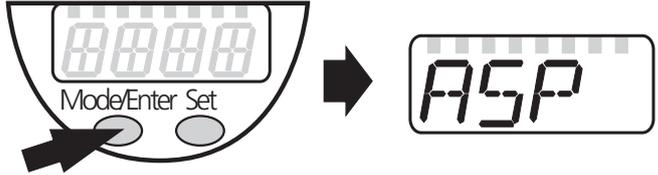
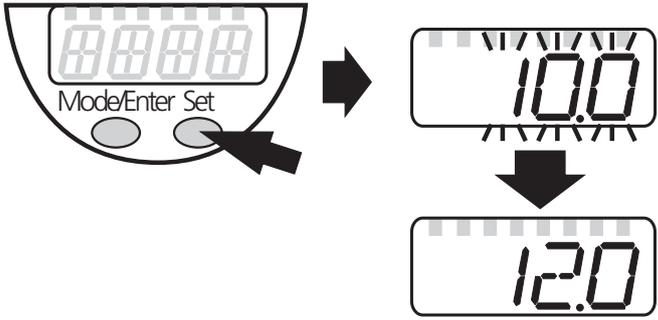
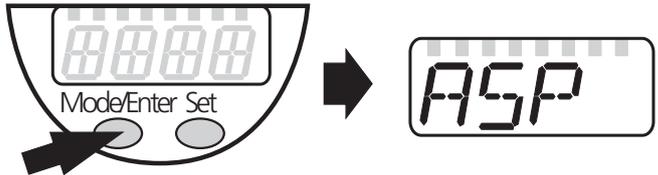
UK

# 9 Parameter setting

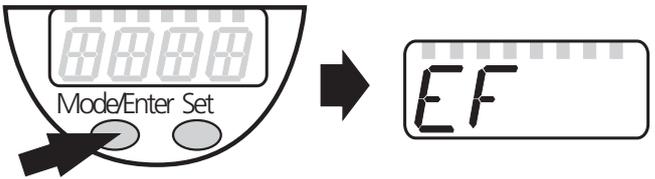
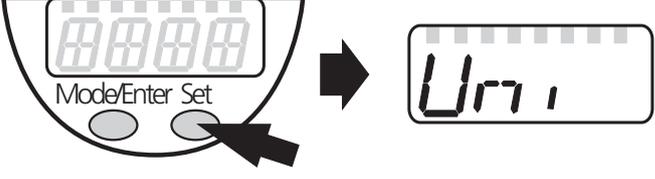
During the parameter setting process the unit remains in the operating mode. It continues its monitoring function with the existing parameters until parameter setting has been terminated.

## 9.1 Parameter setting general

Each parameter setting requires 3 steps:

<p><b>1</b></p>	<p><b>Selecting parameter</b></p> <ul style="list-style-type: none"> <li>▶ Press [Mode/Enter] until the requested parameter is displayed.</li> </ul>	
<p><b>2</b></p>	<p><b>Setting the parameter value</b></p> <ul style="list-style-type: none"> <li>▶ Press [Set] and keep the button pressed.</li> <li>&gt; Current setting value of the parameter bit flashes for 5 s.</li> <li>&gt; After 5 s: Setting value is changed: incremental by pressing briefly or scrolling by holding pressed.</li> </ul>	
<p>The numerical values are incremented continuously. If the value is to be reduced: Let the display move to the maximum setting value. Then the cycle starts again at the minimum setting value.</p>		
<p><b>3</b></p>	<p><b>Acknowledge parameter value</b></p> <ul style="list-style-type: none"> <li>▶ Press [Mode/Enter] briefly.</li> <li>&gt; The parameter is displayed again. The new setting value is stored.</li> </ul>	
<p><b>Set more parameters</b></p> <ul style="list-style-type: none"> <li>▶ Start again with step 1.</li> </ul>		
<p><b>Finishing parameter setting</b></p> <ul style="list-style-type: none"> <li>▶ Press [Mode/Enter] several times until the current measured value is displayed or wait for 15 s.</li> <li>&gt; The unit returns to the operating mode.</li> </ul>		

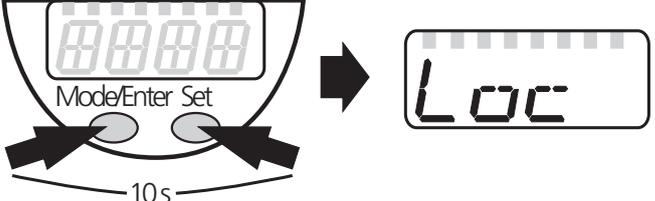
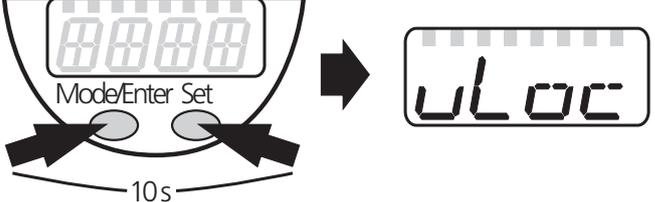
- Changing from menu level 1 to menu level 2:

<ul style="list-style-type: none"> <li>▶ Press [Mode/Enter] until [EF] is displayed.</li> </ul>	
<ul style="list-style-type: none"> <li>▶ Press [Set] briefly.</li> <li>&gt; The first parameter of the submenu is displayed (here: [Uni]).</li> </ul> <p>If menu level 2 is protected by an access code, „Cod1“ flashes in the display.</p> <ul style="list-style-type: none"> <li>▶ Press [Set] and keep it pressed until the valid code no. is displayed.</li> <li>▶ Press [Mode/Enter] briefly.</li> </ul> <p>Delivery by ifm electronic: no access restriction.</p>	

UK

- Locking / unlocking

The unit can be locked electronically to prevent unintentional wrong settings.

<ul style="list-style-type: none"> <li>▶ Ensure that the unit is in the normal operating mode.</li> <li>▶ Press [Mode/Enter] + [Set] for 10 s.</li> <li>&gt; [Loc] is displayed.</li> </ul>	
<p>During operation: [Loc] is displayed briefly when you try to change parameter values.</p>	
<p>For unlocking:</p> <ul style="list-style-type: none"> <li>▶ Press [Mode/Enter] + [Set] for 10 s.</li> <li>&gt; [uLoc] is displayed.</li> </ul>	

On delivery: Unlocked.

- Timeout:

If no button is pressed for 15 s while the parameters are being set, the unit returns to the operating mode with unchanged values.

## 9.2 Configuring the display (optional)

<p>▶ Select [Uni] and set the unit of measurement:</p> <ul style="list-style-type: none"> <li>- [bAr], [mbAr],</li> <li>- [MPa], [kPa],</li> <li>- [PSI],</li> <li>- [InHO] (only PI1689, PI1696, PI1697, PI1698, PI1699),</li> <li>- [mWS] (only PI1696, PI1697, PI1699),</li> <li>- [mmWS] (only PI1689 and PI1698).</li> </ul>	
<p>▶ Select [SELD] and set the display mode:</p> <ul style="list-style-type: none"> <li>- [P]: Pressure in the unit set in Uni.</li> <li>- [P%]: percentage value (pressure in % of the set scaling of the analogue output. The following applies: 0% = ASP value; 100% = AEP value).</li> </ul> <p>NOTE: Display „0%“ does not mean that the system is free of pressure.</p>	
<p>▶ Select [diS] and set update rate and orientation of the display:</p> <ul style="list-style-type: none"> <li>- [d1]: Update of the measured value every 50 ms.</li> <li>- [d2]: Update of the measured value every 200 ms.</li> <li>- [d3]: Update of the measured value every 600 ms.</li> <li>- [rd1], [rd2], [rd3]: Display like d1, d2, d3; rotated by 180°.</li> <li>- [OFF]: The display is deactivated in the operating mode. If one of the buttons is pressed, the current measured value is displayed for 15 s. Another press of the Mode/Enter button opens the Display mode. The LEDs remain active even if the display is deactivated.</li> </ul>	

## 9.3 Setting the output signal

### 9.3.1 Setting the output function

<p>▶ Select [OU2] and set the analogue function:</p> <ul style="list-style-type: none"> <li>- [I] = current signal proportional to the pressure 4...20 mA,</li> <li>- [InEG] = current signal proportional to the pressure 4...20 mA.</li> </ul>	
--	---

## 9.3.2 Scaling the analogue value

<ul style="list-style-type: none"> <li>▶ Set the requested minimum pressure in the system.</li> <li>▶ Press [Mode/Enter] until [tASP] is displayed.</li> <li>▶ Press [Set] and keep the buton pressed.</li> <li>&gt; The currently set value flashes.</li> <li>▶ Release [Set] when the display stops flashing.</li> <li>&gt; The new set value is displayed.</li> <li>▶ Press [Mode/Enter] briefly.</li> <li>&gt; The current system pressure is defined to be the start value for the analogue signal.</li> </ul>	
<ul style="list-style-type: none"> <li>▶ Set the requested maximum pressure in the system.</li> <li>▶ Press [Mode/Enter] until [tAEP] is displayed.</li> <li>▶ Press [Set] and keep the buton pressed.</li> <li>&gt; The currently set value flashes.</li> <li>▶ Release [Set] when the display stops flashing.</li> <li>&gt; The new set value is displayed.</li> <li>▶ Press [Mode/Enter] briefly.</li> <li>&gt; The current system pressure is defined to be the end value for the analogue signal.</li> </ul>	
<p>ASP / AEP can only be taught within defined limits (→ 12.1 setting ranges). If the teaching process is carried out at an invalid pressure, [UL] or [OL] is displayed. After acknowledgement by [Mode/Enter], [Err] flashes, the ASP value / AEP value is not changed.</p>	
<p>As an alternative:</p> <ul style="list-style-type: none"> <li>▶ Select [ASP] and set measured value at which 4 mA are output (20 mA at [OU2] = [InEG]).</li> <li>▶ Select [AEP] and set measured value at which 20 mA are output (4 mA at [OU2] = [InEG]).</li> </ul> <p>Minimum distance between ASP and AEP = 25 % of the final value of the measuring range (scaling factor 1:4).</p>	

UK

## 9.4 User settings (optional)

### 9.4.1 Zero-point calibration

<ul style="list-style-type: none"><li>▶ Select [COF] and set a value between -5% and 5% of the final value of the measuring range. The internal measured value "0" is shifted by this amount.</li></ul>	COF
<p>As an alternative: Automatic adaptation offset (setting range 0 bar <math>\pm 5\%</math>); e.g. in the event of a deviation of the mounting location of the sensor and the zero point level for level measurement.</p> <ul style="list-style-type: none"><li>▶ Make sure that no pressure is applied to the system.</li><li>▶ Press [Mode/Enter] until [tCOF] is displayed.</li><li>▶ Press [Set] and keep the button pressed.</li><li>&gt; The current offset value (in %) briefly flashes, then the current system pressure (in the selected display unit) is displayed.</li><li>▶ Release [Set].</li><li>▶ Press [Mode/Enter] briefly to confirm the new offset value.</li></ul>	tCOF

### 9.4.2 Setting the damping for the analogue signal

<ul style="list-style-type: none"><li>▶ Select [dAA] and set value between 0.1 and 100.0 s (at 0.0 = [dAA] is not active).</li></ul> <p>dAA value = response time between pressure change and change of the analogue signal in seconds.</p>	dAA
---	-----

## 9.5 Service functions

### 9.5.1 Reading the min./max. values for the system pressure

<ul style="list-style-type: none"><li>▶ Select [HI] or [LO], press [Set] briefly. [HI] = maximum value, [LO] = minimum value.</li></ul> <p>Delete memory:</p> <ul style="list-style-type: none"><li>▶ Select [HI] or [LO].</li><li>▶ Press [SET] until [----] is displayed.</li><li>▶ Press [MODE/ENTER] briefly.</li></ul>	HI LO
---	----------

### 9.5.2 Reset all parameters to the factory setting

<ul style="list-style-type: none"><li>▶ Select [rES]</li><li>▶ Press [SET] until [----] is displayed.</li><li>▶ Press [MODE/ENTER] briefly.</li></ul> <p>It makes sense to note down your own settings before executing the function (<math>\rightarrow</math> 13 Factory preset).</p>	rES
--	-----

## 10 Operation

After power on of the supply voltage the unit is in the Run mode (= normal operation). It carries out its measurement and evaluation functions and generates output signals according to the set parameters.

Operation indicatin → chapter 7 Operating and display elements.

### 10.1 Read the set parameter values

- ▶ Press [Mode/Enter] until the requested parameter is displayed.
- ▶ Press [Set] briefly.
- > The unit displays the corresponding parameter value for about 15 s. After another 15 s the unit returns to the Run mode.

UK

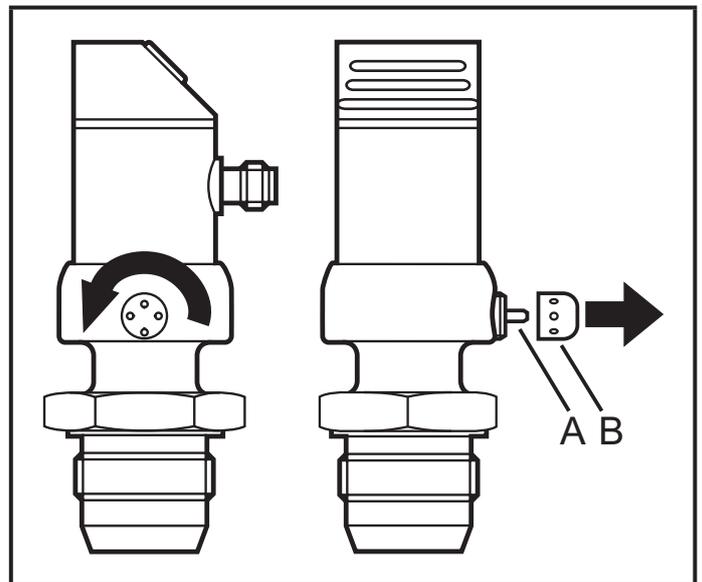
### 10.2 Fault indication

[OL]	Overload pressure (measuring range exceeded).
[UL]	Underpressure range (measuring range below the minimum value).
[Err]	Internal fault, invalid input (indicated even if the display is deactivated).

### 10.3 Cleaning of the filter cover

If viscous and residues producing media clog the filter cover of the sensor (and thus reduce the measuring accuracy slightly), you can clean it.

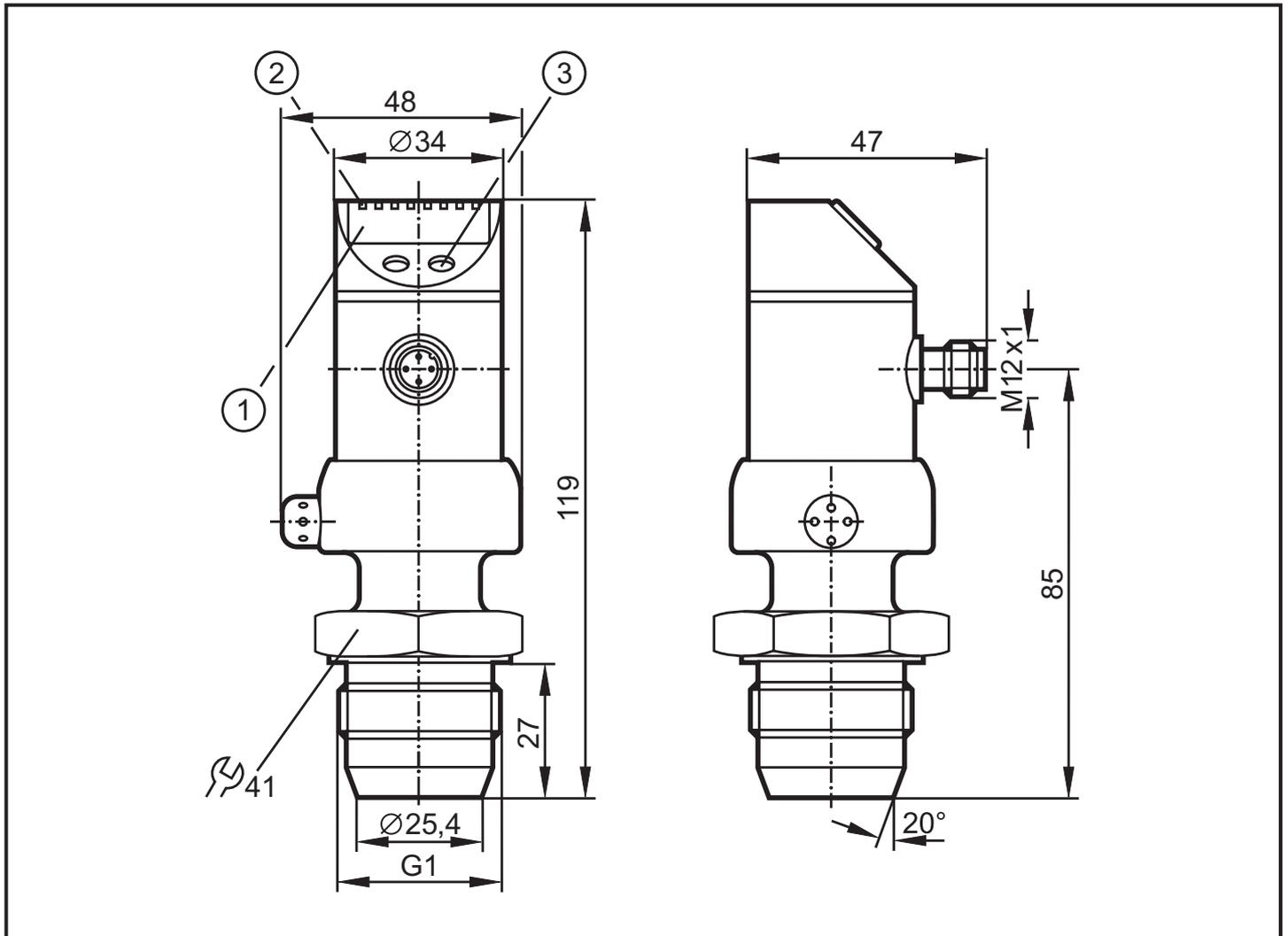
- ▶ Unscrew the filter cover (B) (use a pair of pliers with plastic-covered jaws for this).
- ▶ Clean the cover thoroughly.



The vent (A) should only be cleaned by skilled personnel and with utmost care. Possible medium residues must not be compressed and pressed into the vent. This could clog the filter system and reduce the measuring accuracy of the sensor.

- ▶ Screw the filter cover again tightly.

## 11 Scale drawing



Dimensions are in millimeters

1: display

2: LED's

3: programming button

## 12 Technical data

Operating voltage [V].....	20...32 DC
Reverse polarity / overload protection, integrated watchdog	
Power-on delay time [s].....	0.5
Analogue output .....	4...20 mA / 20...4 mA
Max. load current output [ $\Omega$ ] .....	300
Switch-on peak current.....	60 mA (30 ms)
Step response time analogue output [ms] .....	40

Accuracy / deviation (in % of the span)<sup>1)</sup>

	PI169x	PI1689
Characteristics deviation (linearity, incl. hysteresis and repeatability) <sup>2)</sup>	< ± 0.2	< ± 0.5
Linearity	< ± 0.15	< ± 0.15
Hysteresis	< ± 0.15	< ± 0.15
Repeatability (with temperature fluctuations < 10 K)	< ± 0.1	< ± 0.1
Long-term stability (in % of the span per year)	< ± 0.1	< ± 0.1

- Temperature coefficient (TC) in the compensated temperature range 0 ... 70°C (in % of the span per 10 K)

	PI169x	PI1689
Greatest TC of the zero point	< ± 0.05	< ± 0.1
Greatest TC of the span	< ± 0.15	< ± 0.2

Material (wetted parts)

..... stainless steel 316L / 1.4435, surface characteristics: Ra 0.4 / Rz 4  
ceramics (99.9 % Al<sub>2</sub> O<sub>3</sub>); PTFE;

Housing materials

..... stainless steel 316L / 1.4404; PC (Makrolon); PBT (Pocan); PEI; FPM (Viton); PTFE

Protection ..... IP 67 / IP 69K

Protection class ..... III

Insulation resistance [MΩ] ..... > 100 (500 V DC)

Shock resistance [g] ..... 50 (DIN / IEC 68-2-27, 11ms)

Vibration resistance [g] ..... 20 (DIN / IEC 68-2-6, 10 - 2000 Hz)

Switching cycles min. .... 100 million

Operating temperature [°C] ..... -25 ... +80

Medium temperature [°C] ..... -25... 125 (145 max. 1h)

Storage temperature [°C]..... -40...+100

EMC EN 61000-4-2 ESD: ..... 4 / 8 KV

EN 61000-4-3 HF radiated: ..... 10 V/m

EN 61000-4-4 Burst: ..... 2 KV

EN 61000-4-5 Surge: ..... 0.5 / 1 KV

EN 61000-4-6 HF conducted: ..... 10 V

<sup>1)</sup> all indications are referred to a turn down of 1:1

<sup>2)</sup> limit value setting to DIN 16086

UK

## 12.1 Setting ranges

		ASP		AEP		$\Delta P$
		min	max	min	max	
<b>PI1689</b>	mbar	5.0	75.0	20.0	100.0	0.1
	kPa	-0.50	7.50	2.00	10.00	0.01
	inH <sub>2</sub> O	-2.00	30.12	8.04	40.16	0.04
	mmWS	-51	765	204	1020	1
<b>PI1693</b>	bar	-1.00	18.74	5.24	25.00	0.02
	PSI	-14.4	271.8	76.2	362.7	0.3
	MPa	-0.100	1.874	0.524	2.500	0.002
<b>PI1694</b>	bar	-1.00	7.50	1.50	10.00	0.01
	PSI	-14.5	108.7	21.8	145.0	0.1
	MPa	-0.100	0.750	0.150	1.000	0.001
<b>PI1695</b>	bar	-1.000	3.000	0.000	4.000	0.005
	PSI	-14.50	43.50	0.00	58.00	0.05
	kPa	-100.0	300.0	0.0	400.0	0.5
<b>PI1696</b>	bar	-0.124	1.880	0.500	2.500	0.002
	PSI	-1.80	27.27	7.26	36.27	0.03
	kPa	-12.4	188.0	50.0	250.0	0.2
	inH <sub>2</sub> O	-50	755	201	1004	1
	mWS	-1.26	19.17	5.10	25.49	0.01
<b>PI1697</b>	mbar	-50	750	200	1000	1
	PSI	-0.73	10.88	2.90	14.50	0.01
	kPa	-5.0	75.0	20.0	100.0	0.1
	inH <sub>2</sub> O	-20.0	301.2	80.4	401.6	0.4
	mWS	-0.51	7.65	2.04	10.20	0.01
<b>PI1698</b>	mbar	-12.4	187.4	50.0	250.0	0.2
	kPa	-1.24	18.74	5.00	25.0	0.02
	inH <sub>2</sub> O	-5.0	75.3	20.1	100.4	0.1
	mmWS	-126	1912	510	2250	2

$\Delta P$  = increments

		ASP		AEP		$\Delta P$
		min	max	min	max	
<b>PI1699</b>	mbar	-1000	500	-500	1000	1
	PSI	-14.50	7.25	-7.25	14.50	0.05
	kPa	-100.0	50.0	-50.0	100.0	0.1
	inH <sub>2</sub> O	-401	201	-201	401	1
	mWS	-10.20	5.10	-5.10	10.20	0.01

$\Delta P$  = increments

## 13 Factory setting

UK

	Factory setting	User setting
<b>OU2</b>	<b>I</b>	
<b>ASP / tASP</b>	<b>0% VMR*</b>	
<b>AEP / tAEP</b>	<b>100% VMR*</b>	
<b>COF / tCOF</b>	<b>0.0</b>	
<b>dAA</b>	<b>0.1</b>	
<b>Uni</b>	<b>bAr / mbAr</b>	
<b>SELd</b>	<b>P</b>	
<b>dis</b>	<b>d2</b>	

\* = the indicated percentage of the final value of the measuring range (VMR) of the corresponding sensor in bar / mbar is set.

Technical data and further information at  
[www.ifm.com](http://www.ifm.com) → Select your country → Data sheet direct:

# Section 6



Position	Count	Description
	1	<p><b>CRN 5-8 A-FGJ-G-E-HQQE</b></p> <div style="display: flex; justify-content: space-around; align-items: center;">  </div> <p style="text-align: right; margin-right: 20px;">Product photo could vary from the actual product</p> <p>Product No.: <a href="#">96085023</a></p> <p>Vertical, non-self-priming, multistage, in-line, centrifugal pump for installation in pipe systems and mounting on a foundation.</p> <p>The pump has the following characteristics:</p> <ul style="list-style-type: none"> <li>- Impellers, intermediate chambers and outer sleeve are made of Stainless steel, DIN W.-Nr. 1.4401.</li> <li>- Pump head cover and base are made of Stainless steel, DIN W.-Nr. 1.4408.</li> <li>- The shaft seal has assembly length according to EN 12756.</li> <li>- Power transmission is via cast iron split coupling.</li> <li>- Pipework connection is via ANSI flanges/couplings.</li> </ul> <p>The motor is a 3-phase AC motor.</p> <p><b>Liquid:</b></p> <p>Pumped liquid: Water          Liquid temperature range: -4 .. 248 °F</p> <p><b>Technical:</b></p> <p>Speed for pump data: 3461 rpm          Rated flow: 30.4 US gpm          Rated head: 196 ft          Shaft seal: HQQE          Approvals on nameplate: ANSI/NSF61</p> <p><b>Materials:</b></p> <p>Pump housing: Stainless steel          Pump housing: DIN W.-Nr. 1.4408          Pump housing: ASTM A 351 CF 8M          Impeller: Stainless steel          Impeller: DIN W.-Nr. 1.4401</p>



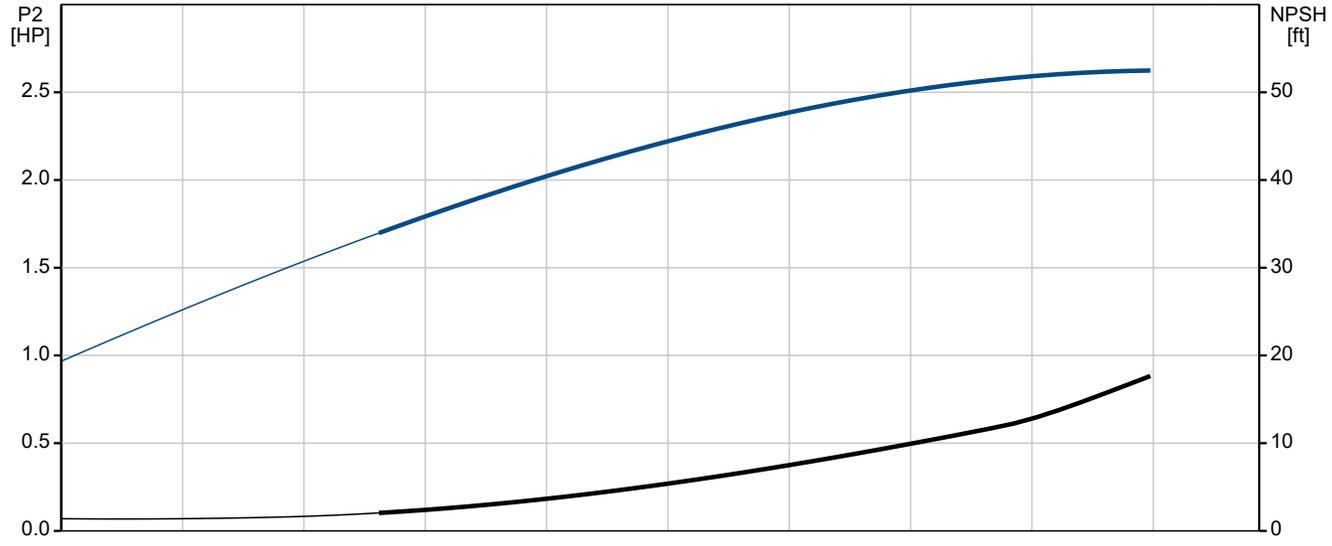
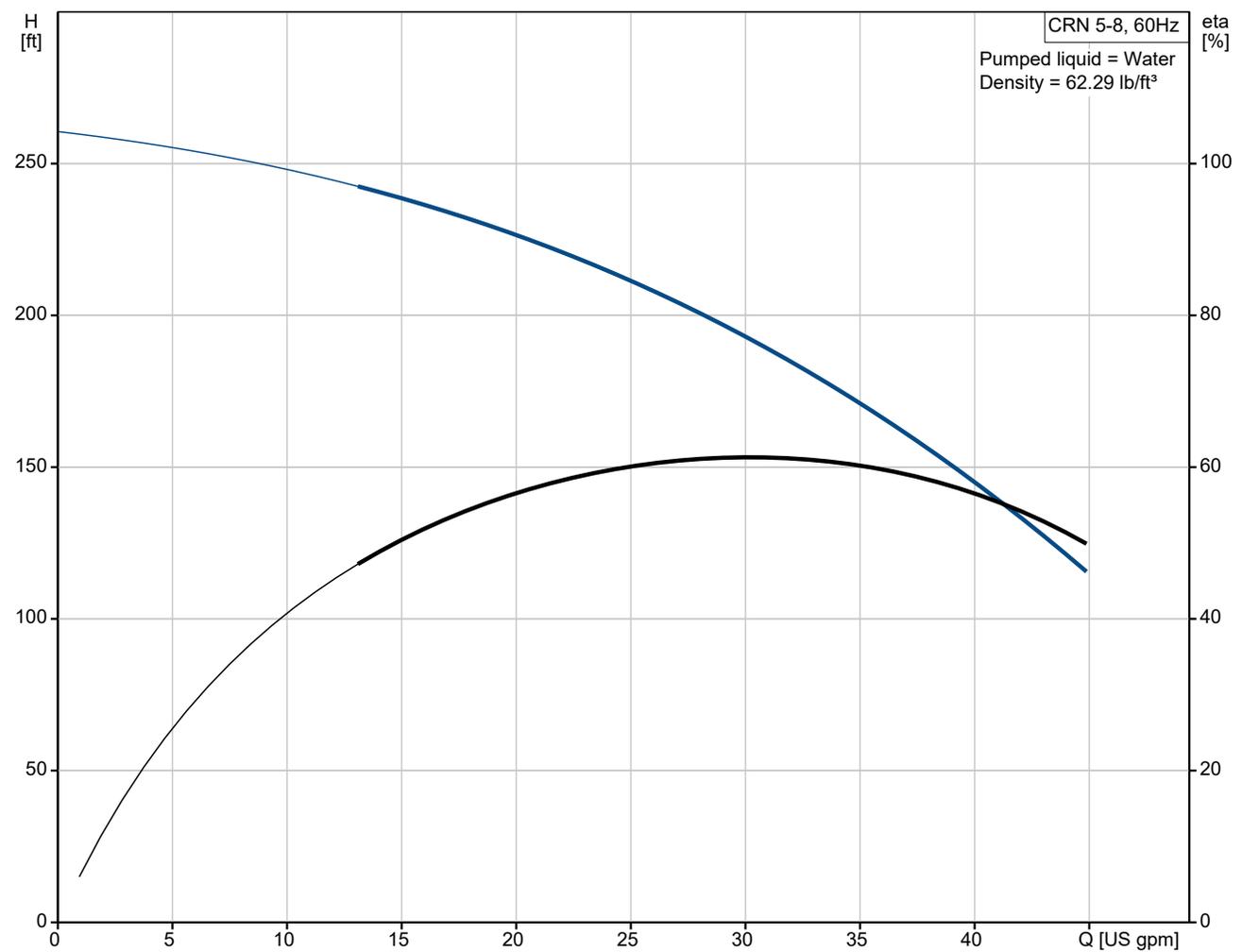
Company name: -  
 Created by: -  
 Phone: -  
 Fax: -  
 Date: -

Position	Count	Description
		Impeller: AISI 316  <b>Installation:</b> Maximum ambient temperature: 104 °F Max pressure at stated temperature: 363 psi / 250 °F Max pressure at stated temperature: 363 psi / -4 °F Flange standard: ANSI Pipe connection: 1 1/4" Pressure stage: CLASS 300 Flange size for motor: 182TC  <b>Electrical data:</b> Motor type: 90FA Number of poles: 2 Rated power - P2: 3 HP Power (P2) required by pump: 3 HP Power (P2) required by pump: 3 HP Main frequency: 60 Hz Rated voltage: 3 x 208-230/460 V Service factor: 1,15 Rated current: 8.40-7.70/3.90 A Starting current: 940-1040 % Cos phi - power factor: 0.89-0.86 Rated speed: 3510-3530 rpm Motor efficiency at full load: 86.5 % Motor efficiency at 3/4 load: 86.5-87.5 % Motor efficiency at 1/2 load: 85.0-86.0 % Enclosure class (IEC 34-5): 55 (Protect. water jets/dust) Insulation class (IEC 85): F  <b>Others:</b> Net weight: 93.8 lb Gross weight: 108 lb Shipping volume: 2.83 ft³



Company name: -  
Created by: -  
Phone: -  
Fax: -  
Date: -

### 96085023 CRN 5-8 60 Hz



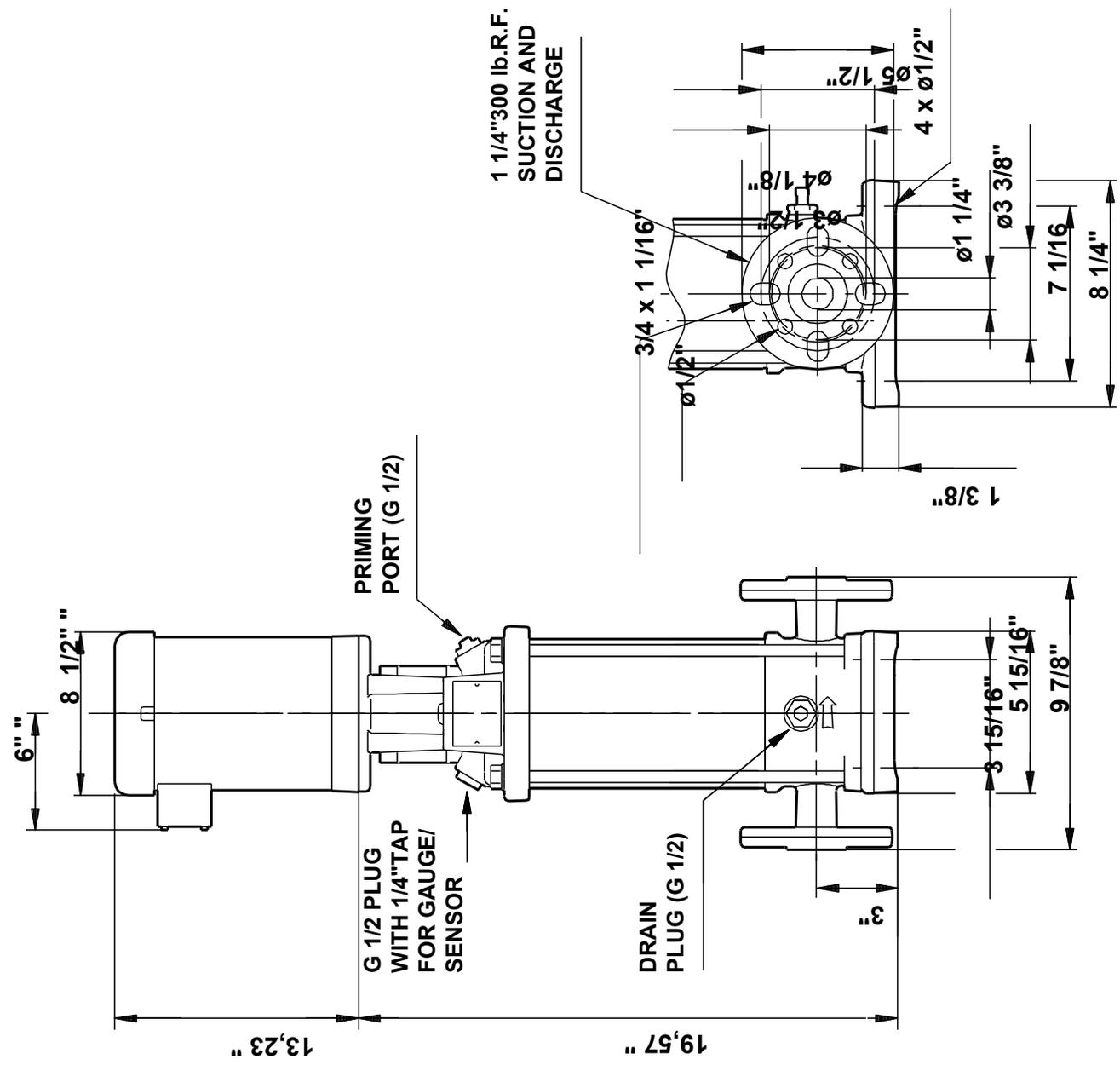




Company name: -  
Created by: -  
Phone: -  
Fax: -  
Date: -

Description	Value
Insulation class (IEC 85):	F
Motor protection:	None
Motor Number:	85900706
<b>Others:</b>	
Net weight:	93.8 lb
Gross weight:	108 lb
Shipping volume:	2.83 ft <sup>3</sup>

96085023 CRN 5-8 60 Hz



Note! All units are in [mm] unless others are stated.  
 Disclaimer: This simplified dimensional drawing does not show all details.

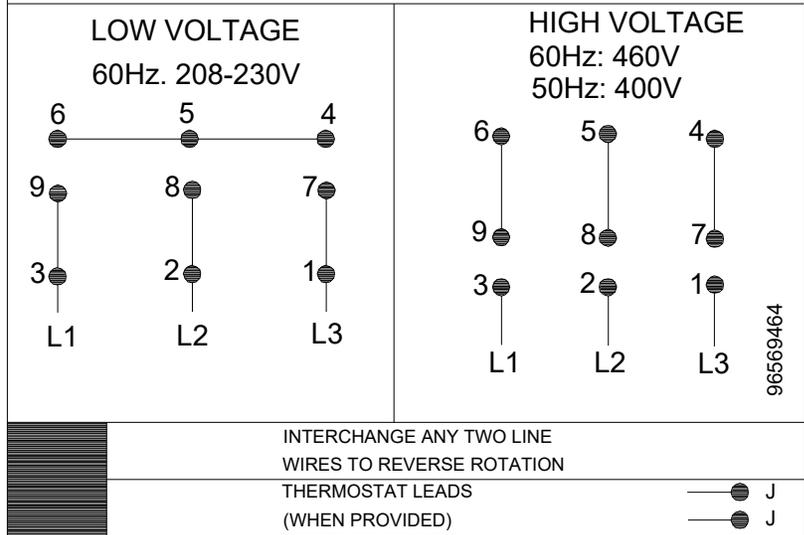
96085023 CRN 5-8 60 Hz



**WARNING**

MOTOR MUST BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL CODES BY TRAINED PERSONNEL TO PREVENT SERIOUS ELECTRICAL SHOCKS.

TO SERVICE MOTOR, DISCONNECT POWER SOURCE FROM MOTOR AND ANY ACCESSORY DEVICES AND ALLOW MOTOR TO COME TO A COMPLETE STAND STILL.



96669464

All units are [mm] unless otherwise presented.

# CR, CRI, CRN, CRT

## Installation and Operating Instructions

Please leave these instructions with the pump for future reference



# SAFETY WARNING

## Electrical Work

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

## Shock Hazard

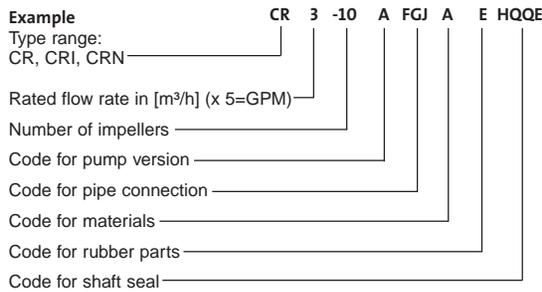
A faulty motor or wiring can cause electrical shock that could be fatal, whether touched directly or conducted through standing water. For this reason, proper grounding of the pump to the power supply's grounding terminal is required for safe installation and operation.

In all installations, the above-ground metal plumbing should be connected to the power supply ground as described in Article 250-80 of the National Electrical Code.

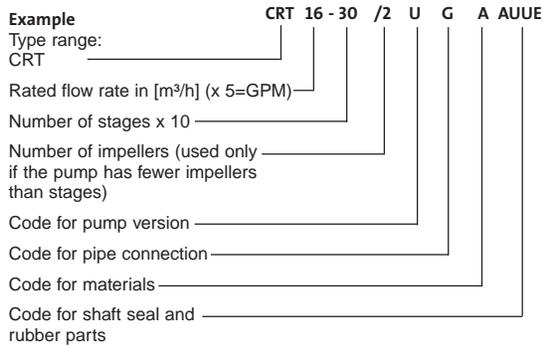
# Nameplate Data

## Type key

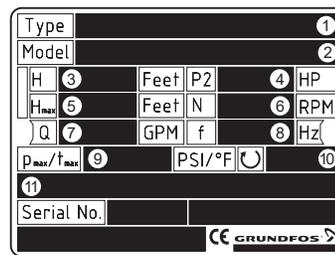
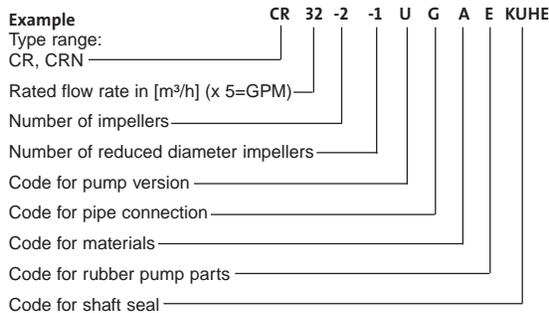
CR, CRI, CRN 1s, 1, 3, 5, 10, 15, and 20



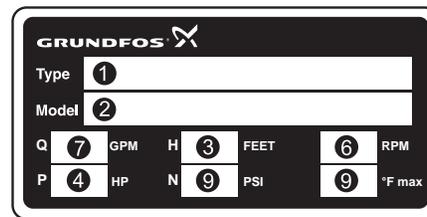
CRT 2, 4, 8 and 16



CR, CRN 32, 45, 64, AND 90



- ① Type designation
- ② Model, material number, production number
- ③ Head in feet at nominal flow
- ④ Nominal motor HP
- ⑤ Head at zero flow
- ⑥ Rated RPM
- ⑦ Nominal flow
- ⑧ Rated frequency
- ⑨ Maximum pressure and maximum fluid temperature
- ⑩ Direction of rotation
- ⑪ Production country



## Model Key





# Pre-installation Checklist

## 1. Confirm you have the right pump

Read the pump nameplate to make sure it is the one you ordered.

- CR — Centrifugal pump with standard cast iron and 304 stainless steel construction
- CRI — Centrifugal pump; all parts in contact with water are 304 stainless steel construction
- CRN — Centrifugal pump; all parts in contact with water are 316 stainless steel construction
- CRT — Centrifugal pump; all parts in contact with water are titanium construction
- CRE — Centrifugal pump with a Grundfos MLE VFD motor attached

## 2. Check the condition of the pump

The shipping carton your pump came in is specially designed around your pump during production to prevent damage. As a precaution, the pump should remain in the carton until you are ready to install it. Examine the pump for any damage that may have occurred during shipping. Examine any other parts of the shipment as well for any visible damage.

**If the pump is shipped as a complete unit (motor attached to pump end), the position of the coupling (that connects the pump shaft to the motor shaft) is set at factory specifications. No adjustment is required. If the unit is delivered as a pump end only, follow the adjustment procedures on pages 11 - 12.**

**Pump without Motor (CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 Only):** If you purchased a pump without a motor, the shaft seal has been set by the factory. Do not loosen the three set screws on the shaft seal when attaching the motor.

**Pump without Motor (CR(N) 32, 45, 64 & 90 Only):** If you purchased a pump without a motor, you must install the seal. The seal is protected in its own sub boxing within the pump packaging crate. To protect the shaft and bearings during shipment, a shaft holder protective device is used. This device must be removed prior to installation of the seal. Read the seal installation instructions which are included in the pump package.

## 3. Verify electrical requirements

Verification of the electrical supply should be made to be certain the voltage, phase and frequency match that of the pump motor. The proper operating voltage and other electrical information can be found on the motor nameplate. These motors are designed to run on  $\pm 10\%$  of the nameplate-rated voltage. For dual-voltage motors, the motor should be internally connected to operate on the voltage closest to the 10% rating, i.e., a 208 voltage motor wired per the 208 volt connection diagram. The wiring connection diagram can be found on either a plate attached to the motor or on a diagram inside the terminal box cover. If voltage variations are larger than  $\pm 10\%$ , do not operate the pump.

## 4. Is the application correct for this pump?

Compare the pump's nameplate data or its performance curve with the application in which you plan to install it. Will it perform the way you want it to perform? Also, make sure the application falls within the following limits:

Type	Designed to pump...
CR	Hot and chilled water, boiler feed, condensate return, glycols and solar thermal fluids.
CRI/CRN	Deionized, demineralized and distilled water. Brackish water and other liquids unsuitable for contact with iron or copper alloys. (Consult manufacturer for specific liquid compatibilities.)
CRN-SF	High pressure washdown, reverse osmosis, or other high pressure applications.
CRT	Salt water, chloride based fluids and fluids approved for titanium.

## Operating Conditions

Pump	Fluid Temperatures
CR(I)(N) 1s, 3, 5, 10, 15, and 20	-4 to +248°F (-20 to +120°C)
*CR(N) 32, 45, 64, and 90	-22 TO +248°F (-30 TO +120°C)
CRT 2, 4, 8, 16	-4 to +248°F (-20 to +120°C)
CRN-SF	-4 to +221°F (-15 to +105°C)
with Cool-Top™	up to +356°F (+180°C)

All motors are designed for continuous duty in +104°F (+40°C) ambient air conditions. For higher ambient temperature conditions consult Grundfos.

\* xUBE Shaft Seals are recommended for temperatures above +200°F. Pumps with hybrid shaft seals can only operate up to +200°F (+90°C). Pumps with xUUE shaft seals can be operated down to -40°F (-40°C) (where "x" is the seal type).

# Pre-installation Checklist (continued)

## Minimum Inlet Pressures

All CR, CRI, CRN  
CRN-SF

NPSHR + 2 feet  
29 psi (2 bar)

## Maximum Inlet Pressures

Pump Type/Connection	50 Hz Stages	60 Hz Stages	Max. psi / bar
CR, CRI, CRN 1s	2 to 36	2 to 36 27	145 / 10 217 / 15
CR, CRI, CRN 1	2 to 36	2 to 36 27	145 / 10 217 / 15
CR, CRI, CRN 3	2 to 29 31 to 36	2 to 15 17 to 25	145 / 10 217 / 15
CR, CRI, CRN 5	3 to 16 18 to 36	2 to 9 10 to 24	145 / 10 217 / 15
CR, CRI, CRN 10	1 to 6 7 to 22	1 to 5 6 to 18	116 / 8 145 / 10
CR, CRI, CRN 15	1 to 3 4 to 17	1 to 2 3 to 12	116 / 8 145 / 10
CR, CRI, CRN 20	1 to 3 4 to 17	1 2 to 10	116 / 8 145 / 10
CR, CRN 32	1-1 to 4 5-2 to 10 11 to 14	1-1 to 2 3-2 to 6 7-2 to 11-2	58 / 4 145 / 10 217 / 15
CR, CRN 45	1-1 to 2 3-2 to 5 6-2 to 13-2	1-1 to 1 2-2 to 3 4-2 to 8-1	58 / 4 145 / 10 217 / 15
CR, CRN 64	1-1 to 2-2 2-1 to 4-2 4-1 to 8-1	1-1 1 to 2-1 2 to 5-2	58 / 4 145 / 10 217 / 15
CR, CRN 90	1-1 to 1 2-2 to 3-2 3 to 6	1-1 to 1 2-2 to 4-1	58 / 4 145 / 10 217 / 15
CRT 2	2 to 11 13 to 26	2 to 6 7 to 18	145 / 10 217 / 15
CRT 4	1 to 12 14 to 22	1 to 7 8 to 16	145 / 10 217 / 15
CRT 8	1 to 20	1 to 16	145 / 10
CRT 16	2 to 16	2 to 10	145 / 10
CRN-SF	all	all	72 / 5* 362 / 25**

\* while pump is off or during start-up

\*\* during operation

## Maximum Operating Pressures

at 250°F (194°F for CRN-SF)

Pump Type/Connection	50 Hz Stages	60 Hz Stages	Max. psi / bar
CR, CRI, CRN 1s			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 1			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 3			
Oval flange	1 to 23	1 to 17	232 / 16
FGJ, PJE	1 to 36	1 to 27	362 / 25
CR, CRI, CRN 5			
Oval flange	1 to 22	1 to 16	232 / 16
FGJ, PJE	1 to 36	1 to 24	362 / 25
CR, CRI, CRN 10			
Oval flange		1 to 10	145 / 10
Oval flange	1 to 16		232 / 16
FGJ, GJ, PJE	1 to 16	1 to 10	232 / 16
FGJ, GJ, PJE	17 to 22	12 to 17	362 / 25
CR, CRI, CRN 15			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 8	232 / 16
FGJ, GJ, PJE	12 to 17	9 to 12	362 / 25
CR, CRI, CRN 20			
Oval flange	1 to 7	1 to 5	145 / 10
FGJ, GJ, PJE	1 to 10	1 to 7	232 / 16
FGJ, GJ, PJE	12 to 17	8 to 10	362 / 25
CR, CRN 32			
	1-1 to 7 8-2 to 12 13-2 to 14	1-1 to 5 6-2 to 8 9-2 to 11-2	232 / 16 362 / 25 580 / 40
CR, CRN 45			
	1-1 to 5 6-2 to 9 10-2 to 13-2	1-1 to 4-2 4-1 to 6 7-2 to 8-1	232 / 16 362 / 25 580 / 40
CR, CRN 64			
	1-1 to 5 6-2 to 8-1	1-1 to 3 4-2 to 5-2	232 / 16 362 / 25
CR, CRN 90			
	1-1 to 4 5-2 to 6	1-1 to 3 4-2 to 4-1	232 / 16 362 / 25
CRT 2	2 to 26	2 to 18	305 / 21
CRT 4	1 to 22	1 to 16	305 / 21
CRT 8	1 to 12 14 to 20	1 to 8 10 to 16	232 / 16 362 / 25
CRT 16	1 to 8 10 to 16	1 to 8 10 to 12	232 / 16 362 / 25

Consult Grundfos for other working conditions.

## Select pump location

The pump should be located in a dry, well-ventilated area which is not subject to freezing or extreme variation in temperature. Care must be taken to ensure the pump is mounted at least 6 inches (150 mm) clear of any obstruction or hot surfaces. The motor requires an adequate air supply to prevent overheating and adequate vertical space to remove the motor for repair. For open systems requiring suction lift the pump should be located as close to the water source as possible to reduce piping losses.

## Foundation

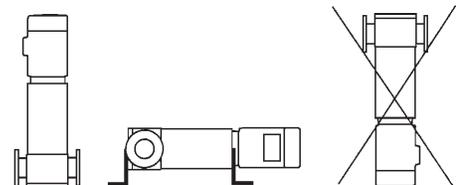
Concrete or similar foundation material should be used to provide a secure, stable mounting base for the pump. Bolt hole center line dimensions for the various pump types are given in Figure 1, page 6. Secure the pump to the foundation using all four bolts and shim pump base to assure the pump is vertical and all four pads on the base are properly supported. Uneven surfaces can result in pump base breakage when mounting bolts are tightened.

The pump can be installed vertically or horizontally (see drawing at right). Ensure that an adequate supply of cool air reaches the motor cooling fan. The motor must never fall below the horizontal plane.

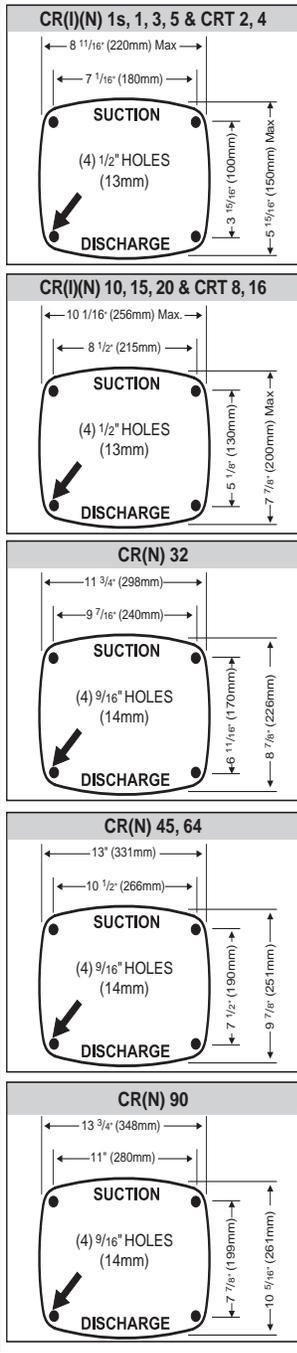
Arrows on the pump base show the direction of flow of liquid through the pump.

To minimize possible noise from the pump, it is advisable to fit expansion joints on either side of the pump and anti-vibration mountings between the foundation and the pump.

Isolating valves should be fitted either side of the pump to avoid draining the system if the pump needs to be cleaned, repaired or replaced.



**Figure 1: Bolt Hole Centers**



## Pipework

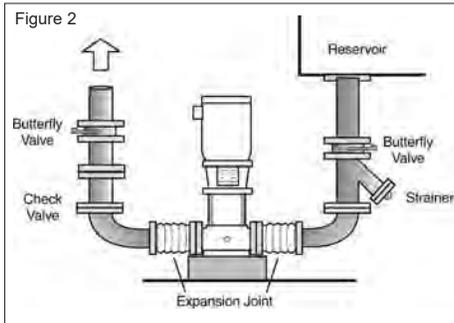


**NOTE:** The CR, CRI, CRN pumps are shipped with covered suction and discharge. The covers must be removed before the final pipe flange to pump connections are made.

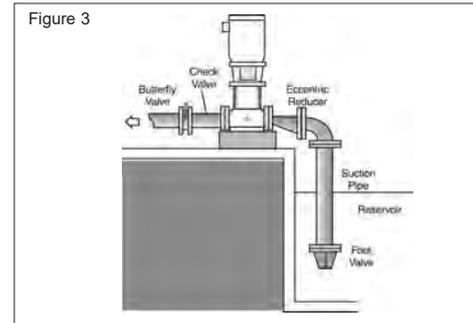
## Recommended installation torques

Model	Recommended foundation torque (ft.- lbs)	Recommended flange torque (ft.- lbs)
CR, CRI, CRN 1s/1/3/5, CRT 2/4	30	37 - 44
CR, CRI, CRN 10/15/20, CRT 8/16	37	44 - 52
CR, CRN 32/45/64/90	32	52 - 59

### Flooded Suction



### Suction Lift\*



\* CRN-SF pumps cannot be used for suction lift. The suction pipe should have a fitting on it for priming.

## Suction pipe

The suction pipe should be adequately sized and run as straight and short as possible to keep friction losses to a minimum (minimum of four pipe diameters straight run prior to the suction flange). Avoid using unnecessary fittings, valves or accessory items. Butterfly or gate valves should only be used in the suction line when it is necessary to isolate a pump because of a flooded suction condition. This would occur if the water source is above the pump. See Figures 2 and 3. Flush piping prior to pump installation to remove loose debris.

## Minimum suction pipe sizes

The following recommended suction pipe sizes are the smallest sizes which should be used with any specific CR pump type. The suction pipe size should be verified with each installation to ensure good pipe practices are being observed and excess friction losses are not encountered. High temperatures may require larger diameter pipes to reduce friction and improve NPHSA.

CR(I)(N) 1s, 1, 3, CRT 2	1"	Nominal diameter sch 40 pipe
CR(I)(N) 5, CRT 4	1 1/4"	Nominal diameter sch 40 pipe
CR(I)(N) 10, 15, 20, CRT 8, 16	2"	Nominal diameter sch 40 pipe
CR(N) 32	2 1/2"	Nominal diameter sch 40 pipe
CR(N) 45	3"	Nominal diameter sch 40 pipe
CR(N) 64	4"	Nominal diameter sch 40 pipe
CR(N) 90	4"	Nominal diameter sch 40 pipe

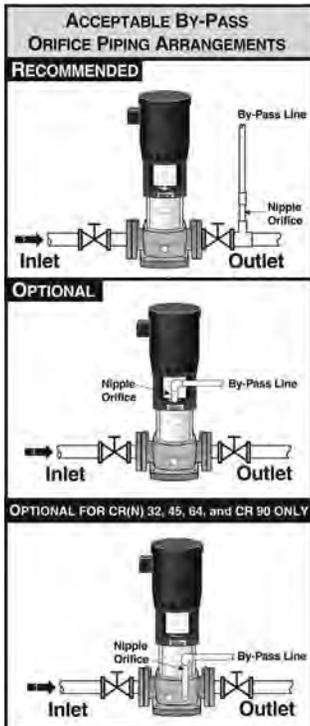
## Discharge piping

It is suggested that a check valve and isolation valve be installed in the discharge pipe. Pipe, valves and fittings should be at least the same diameter as the discharge pipe or sized in accordance with good piping practices to reduce excessive fluid velocities and pipe friction losses. **Pipe, valves and fittings must have a pressure rating equal to or greater than the maximum system pressure.** Before the pump is installed it is recommended that the discharge piping be pressure checked to at least the maximum pressure the pump is capable of generating or as required by codes or local regulations.

Whenever possible, avoid high pressure loss fittings, such as elbows or branch tees directly on either side of the pump. The piping should be adequately supported to reduce thermal and mechanical stresses on the pump. Good installation practice recommends the system be thoroughly cleaned and flushed of all foreign materials and sediment prior to pump installation. Furthermore, the pump should never be installed at the lowest point of the system due to the natural accumulation of dirt and sediment. If there is excessive sediment or suspended particles present, it is advised a strainer or filter be used. Grundfos recommends that pressure gauges be installed on inlet and discharge flanges or in pipes to check pump and system performance.



**NOTE:** To avoid problems with waterhammer, fast closing valves must not be used in CRN-SF applications.



**Table A**

**Minimum Continuous Duty Flow Rates for CR(I)(N)(T)**

Pump Type	min°F to 176°F	at 210°F	at 248°F	at 356°F
	min°C to 80°C	at 99°C	at 120°C	at 180°C
CR, CRI, CRN 1s	0.5	0.7	1.2	1.2*
CR, CRI, CRN 1	0.9	1.3	2.3	2.3*
CR, CRI, CRN 3	1.6	2.4	4.0	4.0*
CR, CRI, CRN 5	3.0	4.5	7.5	7.5*
CR, CRI, CRN 10	5.5	8.3	14	14*
CR, CRI, CRN 15	9.5	14	24	24*
CR, CRI, CRN 20	11	17	28	28*
CR, CRN 32	14	21	35	35*
CR, CRN 45	22	33	55	55*
CR, CRN 64	34	51	85	85*
CR, CRN 90	44	66	110	110*
CRT 2	1.3	2.0	3.3	N/A
CRT 4	3.0	4.5	7.5	N/A
CRT 8	4.0	6.0	10	N/A
CRT 16	8.0	12	20	N/A

\*Grundfos Cool-Top is only available in the following pump types.

Pump Type	CR 1s	CR 1	CR 3	CR 5	CR 10	CR 15	CR 20	CR 32	CR 45	CR 64	CR 90
Standard (CR)								•	•	•	•
I Version (CRI)	•	•	•	•	•	•	•				
N Version (CRN)	•	•	•	•	•	•	•	•	•	•	•

## Check valves

A check valve may be required on the discharge side of the pump to prevent the pump's inlet pressure from being exceeded. For example, if a pump with no check valve is stopped because there is no demand on the system (all valves are closed), the high system pressure on the discharge side of the pump will "find" its way back to the inlet of the pump. If the system pressure is greater than the pump's maximum inlet pressure rating, the limits of the pump will be exceeded and a check valve needs to be fitted on the discharge side of the pump to prevent this condition. **This is especially critical for CRN-SF applications because of the very high discharge pressures involved. As a result, most CRN-SF installations require a check valve on the discharge piping.**

## Bypass

A bypass should be installed in the discharge pipe if there is any possibility the pump may operate against a closed valve in the discharge line. Flow through the pump is required to ensure adequate cooling and lubrication of the pump is maintained. See Table A for minimum flow rates. Elbows should be a minimum of 12" from the orifice discharge to prevent erosion.

## Temperature rise

It may sometimes be necessary to stop the flow through a pump during operation. At shut-off, the power to the pump is transferred to the pumped liquid as head, causing a temperature rise in the liquid. The result is risk of excess heating of and consequent damage to the pump. The risk depends on the temperature of the pumped liquid and for how long the pump is operating without flow. (See temperature rise chart.)

Pump Type	Time for Temperature Rise of 18° F (10°C)	
	Seconds	Minutes
CR 1s, 1, 3	210	3.5
CR 5	240	4.0
CR 10	210	3.5
CR 15	150	2.5
CR 20	120	2.0
CR 32, 45, 64, 90	60	1.0

## Conditions/Reservations

The listed times are subject to the following conditions/reservations:

- No exchange of heat with the surroundings.
- The pumped liquid is water with a specific heat of  $1.0 \frac{\text{Btu}}{\text{lb.}^\circ\text{F}}$  ( $4.18 \frac{\text{kJ}}{\text{kg}^\circ\text{C}}$ ).
- Pump parts (chambers, impellers and shaft) have the same thermal capacity as water.
- The water in the base and the pump head is not included.

These reservations should give sufficient safety margin against excessive temperature rise. The maximum temperature must not exceed the pump maximum rating.

# Electrical

## WARNING



THE SAFE OPERATION OF THIS PUMP REQUIRES THAT IT BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL GOVERNING CODES OR REGULATIONS. CONNECT THE GROUND WIRE TO THE GROUNDING SCREW IN THE TERMINAL BOX AND THEN TO THE ACCEPTABLE GROUNDING POINT.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, local codes and regulations.

## Motor

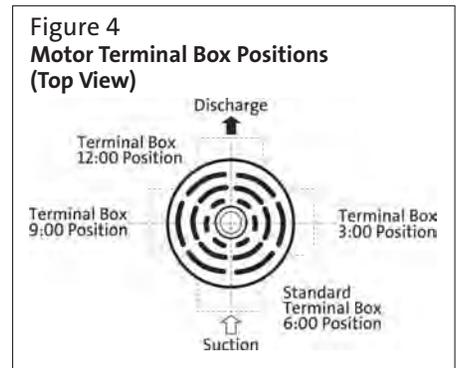
Grundfos CR pumps are supplied with heavy-duty 2-pole (3600 RPM nominal), ODP or TEFC, NEMA C frame motors selected to our rigid specifications. Motors with other enclosure types and for other voltages and frequencies are available on a special-order basis. CRN-SF pumps are supplied with an IEC (metric) type motor with a reverse thrust bearing. If you are replacing the pumping unit, but are using a motor previously used on another CR pump, be sure to read the “Motor Replacement” section on page 11 for proper adjustment of the coupling height.

## Position of Terminal Box

The motor terminal box can be turned to any of four positions in 90° steps. To rotate the terminal box, remove the four bolts securing the motor to the pump but do not remove the shaft coupling; turn the motor to the desired location; replace and securely tighten the four bolts. See Figure 4.

## Field Wiring

Wire sizes should be based on the current carrying properties of a conductor as required by the latest edition of the National Electrical Code or local regulations. Direct on line (D.O.L.) starting is approved due to the extremely fast run-up time of the motor and the low moment of inertia of pump and motor. If D.O.L. starting is not acceptable and reduced starting current is required, an auto transformer, resistant starter or soft start should be used. It is suggested that a fused disconnect be used for each pump where service and standby pumps are installed.



## Motor Protection

### 1. Single-Phase Motors:

With the exception of 10 HP motors which require external protection, single-phase CR pumps are equipped with multi-voltage, squirrel-cage induction motors with built-in thermal protection.

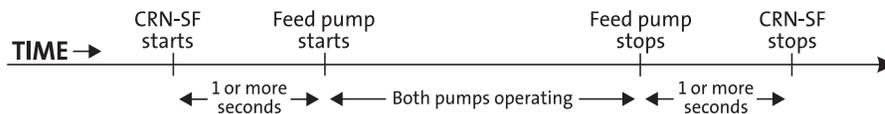
### 2. Three-Phase Motors

CR pumps with three-phase motors must be used with the proper size and type of motor-starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overloads. A properly sized starter with manual reset and ambient-compensated extra quick trip in all three legs should be used. The overload should be sized and adjusted to the full-load current rating of the motor. Under no circumstances should the overloads be set to a higher value than the full load current shown on the motor nameplate. This will void the warranty. Overloads for auto transformers and resistant starters should be sized in accordance with the recommendations of the manufacturer. Three phase MLE motors (CRE-Pumps) require only fuses as a circuit breaker. They do not require a motor starter. Check for phase imbalance (worksheet is provided on page 17).

**NOTE: Standard allowable phase imbalance difference is 5%.**

### 3. CRN-SF

The CRN-SF is typically operated in series with a feed pump. Because the maximum allowable inlet pressure of the CRN-SF increases from 73 psi (when pump is off and during start-up) to 365 psi (during operation), a control device must be used to start the CRN-SF pump one second before the feed pump starts. Similarly, the CRN-SF must stop one second after the feed pump stops.



# Starting the Pump the First Time

## Priming

To prime the pump in a closed system or an open system where the water source is above the pump, close the pump isolation valve(s) and open the priming plug on the pump head. See Figures 5a, 5b, and 5d. Gradually open the isolation valve in the suction line until a steady stream of airless water runs out the priming port. Close the plug and securely tighten. Completely open the isolation valves. **For pumps with Cool-Top, see page 14.**

In open systems where the water level is below the pump inlet, the suction pipe and pump must be filled and vented of air before starting the pump. Close the discharge isolation valve and remove the priming plug. Pour water through the priming hole until the suction pipe and pump are completely filled with water. If the suction pipe does not slope downward from the pump toward the water level, the air must be purged while being filled. Replace the priming plug and securely tighten.

1. Switch power off.
2. Check to make sure the pump has been filled and vented.
3. Remove the coupling guard and rotate the pump shaft by hand to be certain it turns freely.
4. Verify that the electrical connections are in accordance with the wiring diagram on the motor.
5. Switch the power on and observe the direction of rotation. When viewed from the top, the pump should rotate counter-clockwise (clockwise for CRN-SF).
6. To reverse the direction of rotation, first switch OFF the supply power.
7. On three-phase motors, interchange any two power leads at the load side of the starter. On single-phase motors, see connection diagram on nameplate. Change wiring as required.
8. Switch on the power and again check for proper motor rotation. Once rotation has been verified, switch off power again. Do not attempt to reinstall the coupling guards with the motor energized. Replace the coupling guard if the rotation is correct. After guards are in place the power can be reapplied.

**Note - CR, CRI, CRN 1s to 5:** For these pumps, it is advisable to open the bypass valve (Figure 5c) during start-up. The bypass valve connects the suction and discharge sides of the pump, thus making the filling procedure easier. When the operation is stable, the bypass valve must be closed.



**NOTE: Motors should not be run unloaded or uncoupled from the pump at any time; damage to the motor bearings will occur.**

**REMINDER: Do not start the pump before priming or venting the pump (Figure 5d). Never operate the pump dry.**

## Operating Parameters

CR multi-stage centrifugal pumps installed in accordance with these instructions and sized for correct performance will operate efficiently and provide years of service. The pumps are water-lubricated and do not require any external lubrication or inspection. The motors may require periodic lubrication as noted in the following Maintenance Section.

Under no circumstances should the pump be operated for any prolonged periods of time without flow through the pump. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed to allow sufficient water to circulate through the pump to provide adequate cooling and lubrication of the pump bearings and seals.

## Pump Cycling

Pump cycling should be checked to ensure the pump is not starting more than:

- 20 times per hour on 1/3 to 5 HP models
- 15 times per hour on 7 1/2 to 15 HP models
- 10 times per hour on 20 to 60 HP models

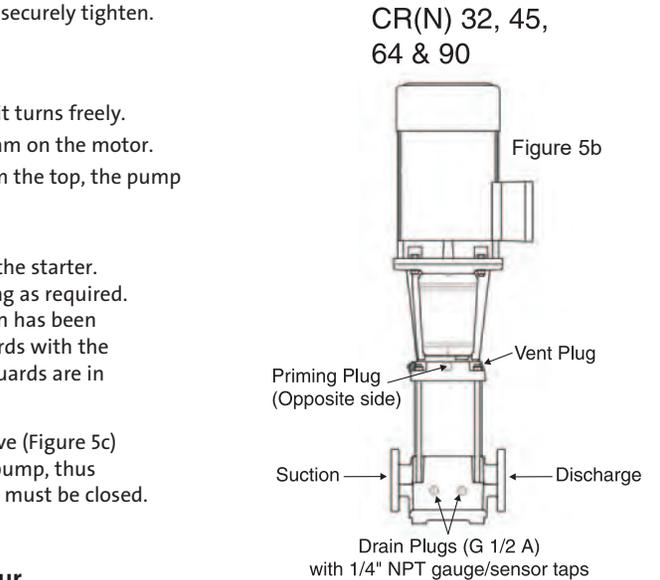
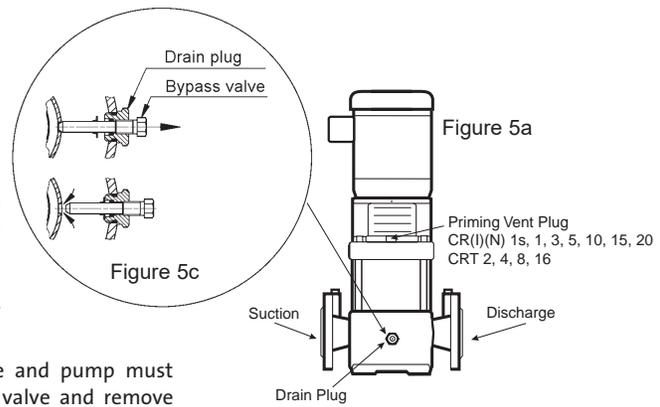
Rapid cycling is a major cause of premature motor failure due to increased heat build-up in the motor. If necessary, adjust controls to reduce the frequency of starts and stops.

## Boiler-feed installations

If the pump is being used as a boiler-feed pump, make sure the pump is capable of supplying sufficient water throughout its entire evaporation and pressure ranges. Where modulating control valves are used, a bypass around the pump must be installed to ensure pump lubrication (see "Minimum Continuous Duty Flow Rates").

## Freeze Protection

If the pump is installed in an area where freezing could occur, the pump and system should be drained during freezing temperatures to avoid damage. To drain the pump, close the isolation valves, remove the priming plug and drain plug at the base of the pump. Do not replace the plugs until the pump is to be used again. Always replace the drain plug with the original or exact replacement. **Do not** replace with a standard plug. Internal recirculation will occur, reducing the output pressure and flow.



## Motor Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every three months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

### WARNING:



**DO NOT TOUCH ELECTRICAL CONNECTIONS BEFORE YOU FIRST ENSURE THAT POWER HAS BEEN DISCONNECTED. ELECTRICAL SHOCK CAN CAUSE SERIOUS OR FATAL INJURY. ONLY QUALIFIED PERSONNEL SHOULD ATTEMPT INSTALLATION, OPERATION, AND MAINTENANCE OF THIS EQUIPMENT.**

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper, pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use an Ohmmeter ("Megger") periodically to ensure that the integrity of the winding insulation has been maintained. Record the Ohmmeter readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

## Motor Lubrication

Electric motors are pre-lubricated at the factory and do not require additional lubrication at start-up. Motors without external grease fittings have sealed bearings that cannot be re-lubricated. Motors with grease fittings should **only** be lubricated with approved types of grease. Do not **over-grease** the bearings. Over greasing will cause increased bearing heat and can result in bearing/motor failure. Do not mix petroleum grease and silicon grease in motor bearings.

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a grease (over time) depends primarily on the type of grease, the size of the bearings, the speed at which the bearings operate and the severity of the operating conditions. Good results can be obtained if the following recommendations are used in your maintenance program. It should also be noted that pumps with more stages, pumps running to the left of the performance curve, certain pump ranges may have higher thrust loads. Pumps with high thrust loads should be greased according to the next service interval level.

**If pump is fitted with a bearing flange that requires grease, see the stickers on either the bearing flange or coupling guards for proper grease type and greasing schedule.**

Severity of Service	Ambient Temperature (Maximum)	Environment	Approved Types of Grease
Standard	+104°F (+40°C)	Clean, little corrosion	Grundfos ML motors are greased for life or will have the grease type on the nameplate. Baldor motors are greased with Polyrex EM (Exxon Mobile).
Severe	+122°F (+50°C)	Moderate dirt, corrosion	
Extreme	>+122°F (+50°C) or Class H insulation	Severe dirt, abrasive dust, corrosion	

## Motor Lubrication Schedule (for Motors with Grease Nipples)

New motors that have been stored for a year or more should be regreased.

NEMA/(IEC) Frame Size	Standard Service Interval	Severe Service Interval	Extreme Service Interval	Weight of Grease to Add Oz./(Grams)	Volume of Grease to Add In <sup>3</sup> /(Teaspoons)
Up through 210 (132)	5500 hrs.	2750 hrs.	550 hrs.	0.30 (8.4)	0.6 (2)
Over 210 through 280 (180)	3600 hrs.	1800 hrs.	360 hrs.	0.61 (17.4)*	1.2 (3.9)*
Over 280 up through 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	0.81 (23.1)*	1.5 (5.2)*
Over 360 (225)	2200 hrs.	1100 hrs.	220 hrs.	2.12 (60.0)*	4.1 (13.4)*

\*The grease outlet plug MUST be removed before adding new grease.

## Procedure

### CAUTION:



**TO AVOID DAMAGE TO MOTOR BEARINGS, GREASE MUST BE KEPT FREE OF DIRT. FOR AN EXTREMELY DIRTY ENVIRONMENT, CONTACT GRUNDFOS, THE MOTOR MANUFACTURER OR AN AUTHORIZED SERVICE CENTER FOR ADDITIONAL INFORMATION. MIXING DISSIMILAR GREASE IS NOT RECOMMENDED.**

1. Clean all grease fittings. If the motor does not have grease fittings, the bearing is sealed and cannot be greased externally.
2. If the motor is equipped with a grease outlet plug, remove it. This will allow the old grease to be displaced by the new grease.
3. If the motor is stopped, add the recommended amount of grease. If the motor is to be greased while running, a slightly greater quantity of grease will have to be added.

**NOTE: If new grease does not appear at the shaft hole or grease outlet plug, the outlet passage may be blocked. At the next service interval the bearings must be repacked.**

Add grease **SLOWLY** taking approximately one minute until new grease appears at the shaft hole in the endplate or grease outlet plug. Never add more than 1-1/2 times the amount of grease shown in the lubrication schedule.

4. For motors equipped with a grease outlet plug, let the motor run for 20 minutes before replacing the plug.

# Preventative Maintenance

At regular intervals depending on the conditions and time of operation, the following checks should be made:

1. Pump meets required performance and is operating smoothly and quietly.
2. There are no leaks, particularly at the shaft seal.
3. The motor is not overheating.
4. Remove and clean all strainers or filters in the system.
5. Verify the tripping of the motor overload protection.
6. Check the operation of all controls. Check unit control cycling twice and adjust, if necessary.
7. If the pump is not operated for unusually long periods, the unit should be maintained in accordance with these instructions. In addition, if the pump is not drained, the pump shaft should be manually rotated or run for short periods of time at monthly intervals.
8. To extend the pump life in severe duty applications, consider performing one of the following actions:
  - Drain the pump after each use.
  - Flush the pump, through system, with water or other fluid that is compatible with the pump materials and process liquid.
  - Disassemble the pump liquid components and thoroughly rinse or wash them with water or other fluid that is compatible with the pump materials and process liquid.

If the pump fails to operate or there is a loss of performance, refer to the Troubleshooting Section on pages 15 - 16.

## Motor Replacement

If the motor is damaged due to bearing failure, burning or electrical failure, the following instructions detail how to remove the motor for replacement. It must be emphasized that motors used on CR pumps are specifically selected to our rigid specifications. Replacement motors must be of the same frame size, should be equipped with the same or better bearings and have the same service factor. Failure to follow these recommendations may result in premature motor failure.

### Disassembly

1. Turn off and lock out power supply. The power supply wiring can not be safely disconnected from the motor wires.
2. Remove the coupling guards.  
**CR 1s, 1, 3, 5, 10, 15, and 20: do not loosen the three shaft seal securing allen screws.**
3. Using the proper metric Allen wrench, loosen the four cap screws in the coupling. Completely remove coupling halves. On CR1s-CR20, the shaft pin can be left in the pump shaft. CR(N)32, 45, 64 and 90 do not have a shaft pin.
4. With the correct size wrench, loosen and remove the four bolts which hold the motor to the pump end.
5. Lift the motor straight up until the shaft has cleared the motor stool.

### Assembly

1. Remove key from motor shaft, if present, and discard.
2. Thoroughly clean the surfaces of the motor and pump end mounting flange. The motor and shaft must be clean of all oil/grease and other contaminants where the coupling attaches. Set the motor on the pump end.
3. Place the terminal box in the desired position by rotating the motor.
4. Insert the mounting bolts, then diagonally and evenly tighten. For 3/8" bolts (1/2 to 2 HP), torque to 17 ft.-lbs., for 1/2" bolts (3 to 40 HP) torque to 30 ft.-lbs., and for 5/8" bolts (50 - 60 HP) torque to 59 ft.-lbs.
5. **CR 1s, 1, 3, and 5:**  
Insert shaft pin into shaft hole. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even, and that the motor shaft keyway is centered in the coupling half, as shown in Figure 6a, page 12. Tighten the screws to the correct torque.

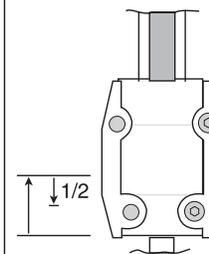
#### **CR 10, 15 and 20:**

Insert shaft pin into shaft hole. Insert plastic shaft seal spacer beneath shaft seal collar. Reinstall the coupling halves onto shaft and shaft pin. Reinstall the coupling screws and leave loose. Check that the gaps on either side of the coupling are even and that the motor shaft key way is centered in the coupling half, as shown in Figure 6a, page 12. Tighten the screws to the correct torque. Remove plastic shaft seal spacer and hang it on inside of coupling guard.

#### **CRT 2, 4, 8 and 16:**

Reinstall coupling halves. Make sure the shaft pin is located in the pump shaft. Put the cap screws loosely back into the coupling halves. Using a large screwdriver, raise the pump shaft by placing the tip of the screwdriver under the coupling and carefully elevating the coupling to its highest point (see Figure 6). Note: the shaft can only be raised approximately 0.20 inches (5mm). Now lower the shaft half way back down the distance you just raised it and tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides. When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a criss-cross pattern.

Figure 6  
CRT 2, 4, 8, and 16



- Note the clearance below the coupling
- Raise the coupling higher, as far as it will go.
- Lower it halfway back down (1/2 the distance you just raised it).
- Tighten screws (see torque specifications below)

**CR(N) 32, 45, 64 & CR90:**

Place the plastic adjustment fork under the cartridge seal collar (see Figure 7).

Fit the coupling on the shaft so that the top of the pump shaft is flush with the bottom of the clearance chamber in the coupling (see Figure 8).

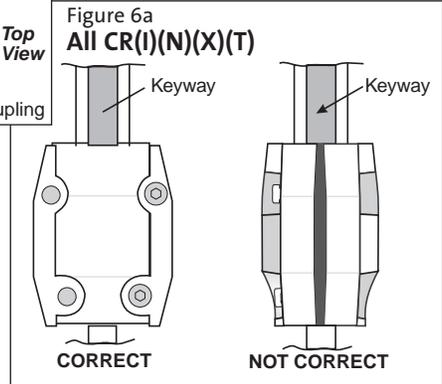
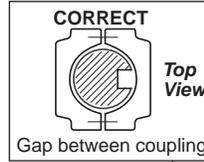
Lubricate the coupling screws with an anti-seize and lubricating compound. Tighten the coupling screws (finger tight) while keeping the coupling separation equal on both sides and the motor shaft keyway centered in the coupling half as shown in Figure 6a.

When the screws are tight enough to keep the couplings in place, then torque the screws evenly in a crisscross pattern.

Torque coupling screws to 62 ft.-lbs. Remove the adjustment fork from under the cartridge seal collar and replace it to the storage location (see Figure 9).

6. Check to see that the gaps between the coupling halves are equal. Loosen and readjust, if necessary.
7. Be certain the pump shaft can be rotated by hand. If the shaft cannot be rotated or it binds, disassemble and check for misalignment.
8. Prime the pump.
9. Follow the wiring diagram on the motor label for the correct motor wiring combination which matches your supply voltage. Once this has been confirmed, reconnect the power supply wiring to the motor.
10. Check the direction of rotation, by bump-starting the motor. Rotation must be left to right (counter-clockwise) when looking directly at the coupling.
11. Shut off the power, then re-install the coupling guards. After the coupling guards have been installed the power can be turned back on.

Torque Specifications CR(I)(N) 1s, 1, 3, 5, 10, 15, and 20 CRT 2, 4, 8, and 16	
Coupling Bolt Size	Min. Torque Specifications
M6	10 ft.-lbs.
M8	23 ft.-lbs.
M10	46 ft.-lbs.

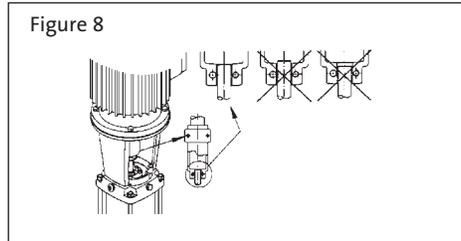
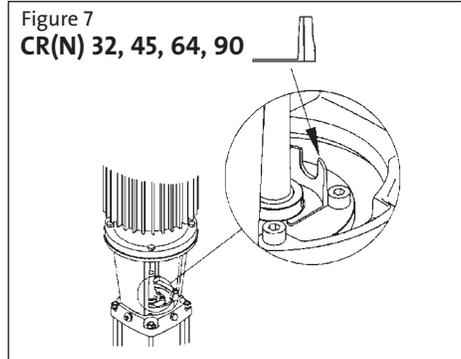


**Parts List**

For each CR pump model Grundfos offers an extensive **Parts List** and diagram of part used in that pump and is recommended to have on hand for future maintenance. In addition, the listings also provide information about prepackaged **Service Kits** for those pump components most likely to exhibit wear over time, as well as the complete Impeller Stack needed to replace the “guts” of each model. These Parts Lists are available separately from the Grundfos literature warehouse or as a set with extensive service instructions in the Grundfos **CR Service Manuals** (for a small charge).



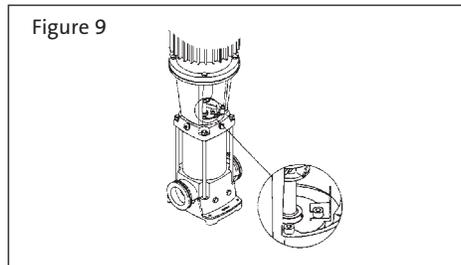
Left, prepackaged impeller stacks ready for immediate installation; right, prepackaged flange kits.



**NOTE:** To avoid damaging the coupling halves, ensure that no portion of the keyway on the motor shaft lies within the gap between the two coupling halves.

**Spare Parts**

Grundfos offers an extensive list of spare parts. For a current list of these parts, refer to: “All Product Spare Parts/Service Kits” Price List, Form # L-SK-SL-002.

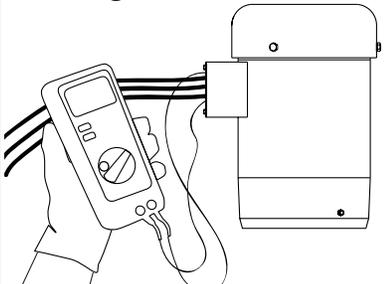


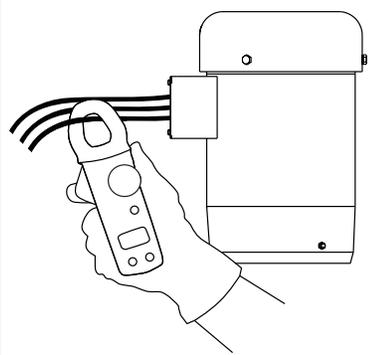
**WARNING:**

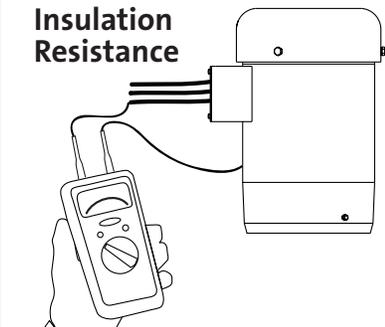


WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRICAL SHOCK. IT IS RECOMMENDED THAT RUBBER GLOVES AND BOOTS BE WORN, AND METAL TERMINAL BOXES AND MOTORS ARE GROUNDED BEFORE ANY WORK IS DONE. FOR YOUR PROTECTION, ALWAYS DISCONNECT THE PUMP FROM ITS POWER BEFORE HANDLING.

**Preliminary tests**

<p><b>Supply voltage</b></p> 	<p><b>How to measure</b></p> <p>Use a voltmeter, (set to the proper scale) measure the voltage at the pump terminal box or starter.</p> <p>On single-phase units, measure between power leads L1 and L2 (or L1 and N for 115 volt units). On three-phase units, measure between:</p> <ul style="list-style-type: none"><li>• Power leads L1 and L2</li><li>• Power leads L2 and L3</li><li>• Power leads L3 and L1</li></ul>	<p><b>What it means</b></p> <p>When the motor is under load, the voltage should be within <math>\pm 10\%</math> of the nameplate voltage. Larger voltage variation may cause winding damage.</p> <p>Large variations in the voltage indicate a poor electrical supply and the pump should not be operated until these variations have been corrected.</p> <p>If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.</p>
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<p><b>Current measurement</b></p> 	<p><b>How to Measure</b></p> <p>Use an ammeter, (set on the proper scale) to measure the current on each power lead at the terminal box or starter. See the motor nameplate for amp draw information.</p> <p>Current should be measured when the pump is operating at constant discharge pressure.</p>	<p><b>What it Means</b></p> <p>If the amp draw exceeds the listed service factor amps (SFA) or if the current imbalance is greater than 5% between each leg on three-phase units, check the following:</p> <ol style="list-style-type: none"><li>1. Burned contacts on motor starter.</li><li>2. Loose terminals in starter or terminal box or possible wire defect.</li><li>3. Too high or too low supply voltage.</li><li>4. Motor windings are shorted or grounded. Check winding and insulation resistances.</li><li>5. Pump is damaged causing a motor overload.</li></ol>
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<p><b>Insulation Resistance</b></p> 	<p><b>How to Measure</b></p> <p>Turn off power and disconnect the supply power leads in the pump terminal box. Using an ohm or mega ohm meter, set the scale selector to Rx 100K and zero adjust the meter.</p> <p>Measure and record the resistance between each of the terminals and ground.</p>	<p><b>What it Means</b></p> <p>Motors of all HP, voltage, phase and cycle duties have the same value of insulation resistance. Resistance values for new motors must exceed 1,000,000 ohms. If they do not, motor should be repaired or replaced.</p>
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## Startup for Cool-Top (from page 9)

**Note:** Do not start the pump until it has been filled with liquid and vented.



Pay attention to the direction of the vent hole and take care to ensure that the escaping liquid does not cause injury to persons or damage to the motor or other components.  
In hot-liquid installations, special attention should be paid to the risk of injury caused by scalding hot liquid.  
It is recommended to connect a drain pipe to the 1/2" air vent in order to lead the hot water/steam to a safe place.

Step	Action
1	<p><b>Note:</b> The air-cooled top should only be started up with cold liquid. Close the isolation valve on the discharge side and open the isolation valve on the suction side of the pump.</p>
	TM02 4151 5001
2	<p>Remove the priming plug from the <b>pump head (1)</b> and slowly fill the pump with liquid. When the pump is completely filled with liquid, replace the priming plug and tighten securely.</p>
	TM02 4152 1503
3	<p>Remove the priming plug from the <b>air-cooled chamber (2)</b> and slowly fill the chamber with liquid. When the chamber is completely filled with liquid, replace the priming plug and tighten securely.</p>
	TM02 4153 1503
4	<p>Open the isolation valve on the discharge side of the pump. Valve may have to be partially closed when pump is started if no back pressure is present (i.e. boiler not up to pressure).</p>
	TM02 5907 4002
5	<p>Start the pump and check the direction of rotation. See the correct direction of rotation of the pump on the motor fan cover. If the direction of rotation is wrong, interchange any two of the incoming supply wires. After 3 to 5 minutes, the air vent has been filled with liquid. <b>Note:</b> During start-up of a cold pump with hot liquid, it is normal that a few drops of liquid are leaking from the sleeve.</p>
	TM01 1406 3702 / TM01 1405 4497

## Diagnosing specific problems

Problem	Possible cause	Remedy
<b>The pump does not run</b>	<ol style="list-style-type: none"> <li>1. No power at motor.</li> <li>2. Fuses are blown or circuit breakers are tripped.</li> <li>3. Motor starter overloads are burned or have tripped out.</li> <li>4. Starter does not energize.</li> <li>5. Defective controls.</li> <li>6. Motor is defective.</li> <li>7. Defective capacitor. (Single-phase motors)</li> <li>8. Pump is bound.</li> </ol>	<p>Check for voltage at motor terminal box. If no voltage at motor, check feeder panel for tripped circuits and reset circuit.</p> <p>Turn off power and remove fuses. Check for continuity with ohmmeter. Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation, motor and wires must be checked.</p> <p>Check for voltage on line and load side of starter. Replace burned heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.</p> <p>Energize control circuit and check for voltage at the holding coil. If no voltage, check control circuit fuses. If voltage, check holding coil for shorts. Replace bad coil.</p> <p>Check all safety and pressure switches for operation. Inspect contacts in control devices. Replace worn or defective parts or controls.</p> <p>Turn off power and disconnect wiring. Measure the lead to lead resistances with ohmmeter (RX-1). Measure lead to ground values with ohmmeter (RX-100K). Record measured values. If an open or grounded winding is found, remove motor and repair or replace.</p> <p>Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (<math>\infty</math>). Replace if defective.</p> <p>Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair.</p>
<b>The pump runs but at reduced capacity or does not deliver water</b>	<ol style="list-style-type: none"> <li>1. Wrong rotation</li> <li>2. Pump is not primed or is airbound.</li> <li>3. Strainers, check or foot valves are clogged.</li> <li>4. Suction lift too large.</li> <li>5. Suction and/or discharge piping leaks.</li> <li>6. Pump worn.</li> <li>7. Pump impeller or guide vane is clogged.</li> </ol>	<p>Check wiring for proper connections. Correct wiring.</p> <p>Turn pump off, close isolation valve(s), remove priming plug. Check fluid level. Refill the pump, replace plug and start the pump. Long suction lines must be filled before starting the pump.</p> <p>Remove strainer, screen or valve and inspect. Clean and replace. Reprime pump.</p> <p>Install compound pressure gauge at the suction side of the pump. Start pump and compare reading to performance data. Reduce suction lift by lowering pump, increase suction line size or removing high friction loss devices.</p> <p>Pump runs backwards when turned off. Air in suction pipe. Suction pipe, valves and fittings must be airtight. Repair any leaks and retighten all loose fittings.</p> <p>Install pressure gauge, start pump, gradually close the discharge valve and read pressure at shutoff. Convert measured pressure (in PSI) to head (in feet): (Measured PSI x 2.31 ft./PSI = _____ ft.). Refer to the specific pump curve for shutoff head for that pump model. If head is close to curve, pump is probably OK. If not, remove pump and inspect.</p> <p>Disassemble and inspect pump passageways. Remove any foreign materials found.</p>

## Diagnosing specific problems

Problem	Possible cause	Remedy
<b>The pump runs but at reduced capacity or does not deliver water</b> (continued)	8. Incorrect drain plug installed. 9. Improper coupling setting.	If the proper drain plug is replaced with a standard plug, water will recirculate internally. Replace with proper plug. Check/reset the coupling, see page 11 - 12.
<b>Pump cycles too much</b>	1. Pressure switch is not properly adjusted or is defective. 2. Level control is not properly set or is defective. 3. Insufficient air charging or leaking tank or piping. 4. Tank is too small. 5. Pump is oversized.	Check pressure setting on switch and operation. Check voltage across closed contacts. Readjust switch or replace if defective. Check setting and operation. Readjust setting (refer to level control manufacturer's data). Replace if defective. Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume. Repair as necessary. Check tank size and air volume in tank. Tank volume should be approximately 10 gallons for each gpm of pump capacity. The normal air volume is 2/3 of the total tank volume at the pump cut-in pressure. Replace tank with one of correct size. Install pressure gauges on or near pump suction and discharge ports. Start and run pump under normal conditions, record gauge readings. Convert PSI to feet (Measured PSI x 2.31 ft./PSI = _____ ft.) Refer to the specific pump curve for that model, ensure that total head is sufficient to limit pump delivery within its design flow range. Throttle pump discharge flow if necessary.
<b>Fuses blow or circuit breakers or overload relays trip</b>	1. Low voltage. 2. Motor overloads are set too low. 3. Three-phase current is imbalanced. 4. Motor is shorted or grounded. 5. Wiring or connections are faulty. 6. Pump is bound. 7. Defective capacitor (single-phase motors). 8. Motor overloads at higher ambient temperature than motor.	Check voltage at starter panel and motor. If voltage varies more than ±10%, contact power company. Check wire sizing. Cycle pump and measure amperage. Increase heater size or adjust trip setting to a maximum of motor nameplate (full load) current. Check current draw on each lead to the motor. Must be within ±5%. If not, check motor and wiring. Rotating all leads may eliminate this problem. Turn off power and disconnect wiring. Measure the lead-to-lead resistance with an ohmmeter (RX-1). Measure lead-to-ground values with an ohmmeter (RX-100K) or a megaohm meter. Record values. If an open or grounded winding is found, remove the motor, repair and/or replace. Check proper wiring and loose terminals. Tighten loose terminals. Replace damaged wire. Turn off power and manually rotate pump shaft. If shaft does not rotate easily, check coupling setting and adjust as necessary. If shaft rotation is still tight, remove pump and inspect. Disassemble and repair. Turn off power and discharge capacitor. Check with ohmmeter (RX-100K). When the meter is connected to the capacitor, the needle should jump towards 0 ohms and slowly drift back to infinity (∞). Replace if defective. Use a thermometer to check the ambient temperature near the overloads and motor. Record these values. If ambient temperature at motor is lower than at overloads, especially where temperature at overloads is above +104°F (+40°C), ambient-compensated heaters should replace standard heaters.

## Three Phase Motors

Below is a worksheet for calculating current unbalance on a three-phase hookup. Use the calculations below as a guide.

EXPLANATION & EXAMPLES	
<p>Here is an example of current readings at maximum pump loads on each leg of a three-wire hookup. You must make calculations for all three hookups. To begin, add up all three readings for hookup number 1, 2, and 3.</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p>T1 = 51 Amps T2 = 46 Amps T3 = 53 Amps</p> <hr style="width: 100%;"/> <p>TOTAL = 150 Amps</p> </div>
<p>Divide the total by three to obtain the average.</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p style="text-align: center;">50 Amps</p> <p>3   150 Amps</p> </div>
<p>Calculate the greatest current difference from the average.</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p style="text-align: center;">50 Amps - 46 Amps</p> <hr style="width: 100%;"/> <p style="text-align: center;">4 Amps</p> </div>
<p>Divide this difference by the average to obtain the percentage of unbalance.</p>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p style="text-align: center;">.08 or 8%</p> <p>50   4.00 Amps</p> </div>
<p>In this case, the current unbalance for hookup number 1 is 8%.</p>	

**NOTE:**

Current unbalance should not exceed 5% at service factor load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the power source. However, if the reading farthest from the averages moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

FIGURE HERE		
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p>L<sub>1</sub> to T<sub>1</sub> = ___ Amps L<sub>2</sub> to T<sub>2</sub> = ___ Amps L<sub>3</sub> to T<sub>3</sub> = ___ Amps</p> <hr style="width: 100%;"/> <p>TOTAL = ___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 2</b></p> <p>L<sub>1</sub> to T<sub>3</sub> = ___ Amps L<sub>2</sub> to T<sub>1</sub> = ___ Amps L<sub>3</sub> to T<sub>2</sub> = ___ Amps</p> <hr style="width: 100%;"/> <p>TOTAL = ___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 3</b></p> <p>L<sub>1</sub> to T<sub>2</sub> = ___ Amps L<sub>2</sub> to T<sub>3</sub> = ___ Amps L<sub>3</sub> to T<sub>1</sub> = ___ Amps</p> <hr style="width: 100%;"/> <p>TOTAL = ___ Amps</p> </div>
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p style="text-align: center;">___ Amps</p> <p>3   ___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 2</b></p> <p style="text-align: center;">___ Amps</p> <p>3   ___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 3</b></p> <p style="text-align: center;">___ Amps</p> <p>3   ___ Amps</p> </div>
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p style="text-align: center;">___ Amps - ___ Amps</p> <hr style="width: 100%;"/> <p style="text-align: center;">___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 2</b></p> <p style="text-align: center;">___ Amps - ___ Amps</p> <hr style="width: 100%;"/> <p style="text-align: center;">___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 3</b></p> <p style="text-align: center;">___ Amps - ___ Amps</p> <hr style="width: 100%;"/> <p style="text-align: center;">___ Amps</p> </div>
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 1</b></p> <p style="text-align: center;">___ or ___ %</p> <p>___   ___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 2</b></p> <p style="text-align: center;">___ or ___ %</p> <p>___   ___ Amps</p> </div>	<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <p><b>Hookup 3</b></p> <p style="text-align: center;">___ or ___ %</p> <p>___   ___ Amps</p> </div>

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## LIMITED WARRANTY

Products manufactured by (GRUNDFOS) GRUNDFOS PUMPS CORPORATION are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. GRUNDFOS' liability under this warranty shall be limited to repairing or replacing at GRUNDFOS' option, without charge, F.O.B. GRUNDFOS' factory or authorized service station, any product of GRUNDFOS' manufacture. GRUNDFOS will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by GRUNDFOS are subject to the warranty provided by the manufacturer of said products and not by GRUNDFOS' warranty. GRUNDFOS will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with GRUNDFOS' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of GRUNDFOS' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact GRUNDFOS or an authorized service station for instructions. Any defective product to be returned to GRUNDFOS or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limitations on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

L-CP-TL-003 12/05 (US)  
Subject to alterations

# Section 7



## 7FOS

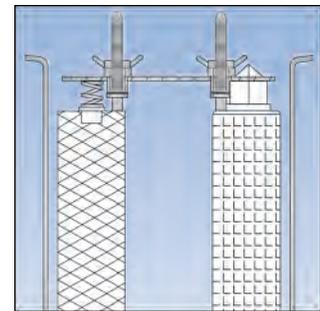
### Universal Multi-Cartridge Housings

Our seven round models are designed for flow rates to 200 GPM. "Universal" housings accept DOE, 222 fin or flat cartridges. Options include 304L or 316L stainless steel; band clamp or swing bolt closure. Design pressure 150psi (10bar) @ 300°F (149°C). Standard inlet and outlet connections are 2" MNPT with many other options available by special order. Standard finish is poly-coat over stainless. All seven round models are standard with mounting legs. Standard gasket is FDA grade Buna-N.



## Features

- Designed for industrial and commercial filtration needs
- Heavy duty stainless steel construction for durability
- 304L standard and 316L stainless steel available.
- Band clamp and swing-bolt closures for quick cartridge change outs
- Pipe fittings readily accessible for easy installation
- Mounting legs standard
- Knife edge seal at both cartridge ends to eliminate by-pass
- Standard housings accept double-open-end cartridges and 222/Flat or Fin
- Available with 226 cartridge adapters
- Complete selection of pipe fittings: flanged, sanitary, BSP, grooved and others
- See ordering guide for a complete selection of options to fit your application



Adjustable top plate takes DOE or 222/Fin or Flat Cartridges

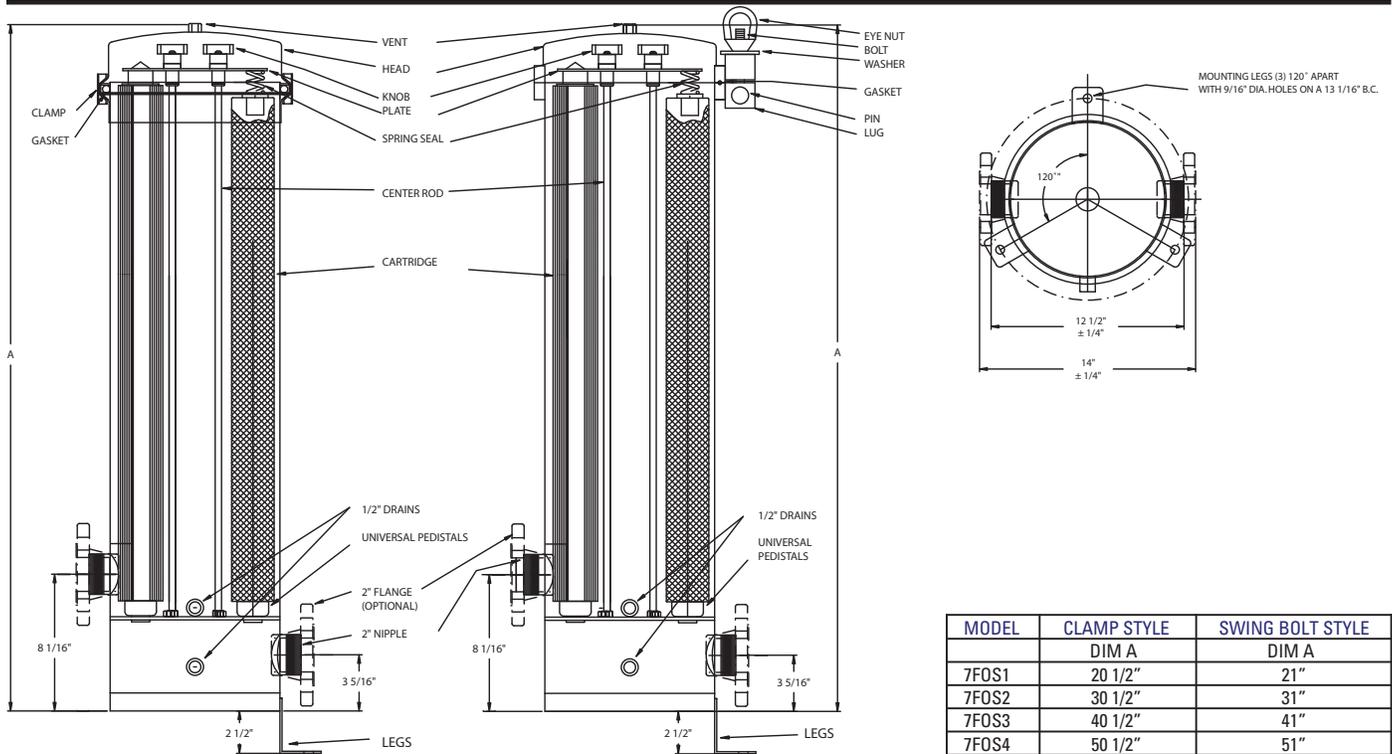
## Standard Design Specifications

Model	Qty. (Length) of Cartridges†	Flow Rate GPM*	Pipe Size	Drains	Vent	Max Ctg Diameter	Shipping Wgt. Clamp	Box Size Clamp	Shipping Wgt. Swing Bolt	Box Size Swing Bolt
7FOS1	7 (10")	49	2" MNPT	1/2"NPT	1/4"NPT	2 3/4" OD	40 lbs	18x18x25	71 lbs	18x18x29
7FOS2	7 (20")	98	2" MNPT	1/2"NPT	1/4"NPT	2 3/4" OD	51 lbs	18x18x35	82 lbs	18x18x39
7FOS3	7 (30")	147	2" MNPT	1/2"NPT	1/4"NPT	2 3/4" OD	60 lbs	18x18x45	91 lbs	18x18x49
7FOS4	7 (40")	196	2" MNPT	1/2"NPT	1/4"NPT	2 3/4" OD	70 lbs	18x18x55	101 lbs	18x18x59

†Housings will accept: 10" = (9 3/4" or 10") 20" = (19 1/2" or 20") 30" = (29 1/4" or 30") 40" = (39" or 40") lengths

\*Based on 7gpm per 10" length with a 25 micron wound cartridge at 2PSID clean and a viscosity of 1 cps. Flow rates are for guide lines only. Actual flow rates are based on fluid, viscosity, cartridge type, micron ratings and other factors. It is recommended if your flow rate is greater than 150gpm that you increase your pipe size to 3" to reduce the pressure drop across the housing.

# Dimensions



MODEL	CLAMP STYLE	SWING BOLT STYLE
	DIM A	DIM A
7FOS1	20 1/2"	21"
7FOS2	30 1/2"	31"
7FOS3	40 1/2"	41"
7FOS4	50 1/2"	51"

## ORDERING GUIDE

7 FOS 3 - SB - 316 - 226 - 2F - EP - OL - E									
No. of Columns	Product Code	No. of Stacks	Closure Style	Material	Cartridge Configuration	Connection Type	Finish	Options	Gasket
7	FOS	1 = 1 High 2 = 2 High 3 = 3 High 4 = 4 High	Blank = V-Band Clamp SB = Swing Bolt	Blank = 304L 316 = 316L	Blank = Universal Pedistal 226 = 226 Style Cartridge Fin or Flat	Blank = 2" MNPT 1.5MNPT = 1 1/2" MNPT BSP = 2" BSP-NIPPLE 1F = 1" Flange 1.5F = 1 1/2" Flange 2F = 2" Flange 3F = 3" Flange 1TC = 1" Ferrules 1.5TC = 1 1/2" Ferrules 2TC = 2" Ferrules 2.5TC = 2 1/2" Ferrules 3TC = 3" Ferrules GF1.5 = 1 1/2" Grooved Fittings GF2 = 2" Grooved Fittings GF3 = 3" Grooved Fittings 2FMPT = 2" Coupling	Blank = Standard Poly Coat EP = Electro-Polished GB = Glass Bead P = Passivate	Blank = ML Legs OL = Heavy Duty Legs GP = Gauge Ports GPA = Gauge Ports with gauges	Blank = Buna E = EPR S = Silicone V = Viton TS = Teflon Encapsulated Silicone



Flanged Fittings



Sanitary Fittings



Gauge Port Assembly



Electro-polish



tel: 860.854.6121  
800.543.5843  
fax: 860.854.6120  
e-mail: info@shelco.com  
www.shelco.com

# SHELCO FILTERS

100 Bradley Street . Middletown, CT 06457 . USA

# **SHELCO FILTERS**

## **SERVICE INSTRUCTIONS MULTI TUBE BAND CLAMP DESIGN**

### **SERVICE INSTRUCTIONS FOR FILTER SERIES 4FO, 5FO, 7FO, 12FO, 15FO, 17FO, 19FO, 22FO**

This filter has been inspected and found to be free from manufacturing defects. Before installing this housing be sure the proper cartridge and gasket seals have been selected for the application. Be sure to always follow the arrow in the directing of flow. Do not install the filter backwards.

#### **CARTRIDGE CHANGE**

1. Close inlet side valve. Open bottom drain plug to begin draining filter.
2. Remove top vent plug and allow filter to drain completely.
3. When filter is drained loosen cover clamp nut and remove T-Bolt from retainer. Remove cover clamp and head.
4. Loosen hold down knob and remove top plate. If filter is equipped with spring seals be careful not to drop the spring seal assembly down into filter chamber.
5. Remove spring and seal assemblies.
6. Remove and discard the used cartridges and install new ones.
7. Examine the shell gasket for deterioration and positioning.
8. If gasket is worn replace it.
9. Replace spring seal assemblies (if provided) to the top of cartridges, replace top seal plate making sure the individual seal plates are positioned in the top end of each cartridge and tighten down knob.
10. Replace the head. Be sure the edge of the head is aligned with the bottom flange. Position the cover clamp. Replace the T- Bolt and tighten the clamp nut. A gap of about 1/2" should remain between clamp ends.
11. Replace drain plugs.
12. Open inlet valve slowly. Allow to vent to remain open until a steady stream of liquid comes out the vent hole. Replace vent plug. Check for leaks. If a leak appears close the inlet valve relieve the pressure by opening the drain and repeat steps 1,3,10,11 and 12.

Your filter is now operational.

**PLEASE NOTE SAFETY LABEL ON EACH HOUSING**

# Section 8

# Owner's Manual

# TROJANUVMAX™

Pro Series (Pro10, Pro20, Pro30, Pro50)  
Plus Series (G Plus, H Plus, J Plus, K Plus)  
Basic Series (G, H, J, K)

## Ultraviolet Water Purification System

Congratulations. By purchasing this system, you have taken the first step in ensuring safe drinking water. Designed using the most advanced UV technology available today, your UV system is designed to provide you with years of trouble free operation with minimal maintenance required.

**Date of installation:** \_\_\_\_\_  
**Installed by:** \_\_\_\_\_  
**Installer phone#:** \_\_\_\_\_  
**Serial #:** \_\_\_\_\_  
(Found on label on side of Power Supply)

### KEY INFORMATION YOU SHOULD KNOW:

- A 5-micron (nominal) sediment filter must be installed upstream of (before) any UV system.
- This product is for **indoor use only**. Keep all components clean and dry.
- Clean the sleeve regularly for optimum performance.



NSF information pertains to  
TrojanUVMax™ Pro10, Pro20, Pro30 models.  
System tested and certified by NSF  
International against NSF/ANSI Standard 55  
for disinfection performance, Class A.



TrojanUVMax™ Pro50 model is USEPA  
UVDGM 2006 validated.

**VIQUA** - a Trojan Technologies Company

425 Clair Road West, Guelph ON, Canada N1L 1R1  
1 800 265 7246 (North America), 519 763 1032 www.viqua.com info@viqua.com

Dec 2009 602936 revJ

# SAFETY INSTRUCTIONS

## GROUNDING

This product must be grounded. If it should malfunction or breakdown, grounding provides a path of least resistance for electric current to reduce the risk of electrical shock. This system is equipped with a cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into an appropriate outlet that is properly installed and grounded in accordance with all local codes and ordinances.

**DANGER** – Improper connection of the equipment-grounding conductor can result in a risk of electrocution. Check with a qualified electrician or service personnel if you are in doubt as to whether the outlet is properly grounded. Do not modify the plug provided with this system – if it will not fit the outlet, have a proper outlet installed by a qualified electrician. Do not use any type of adapter with this system.

## GROUND FAULT CIRCUIT INTERRUPTER PROTECTION

To comply with the National Electrical Code (NFPA 70) and to provide additional protection from the risk of electric shock, this system should only be connected to a properly grounded, grounding-type power supply receptacle that is protected by a Ground Fault Circuit Interrupter (GFCI). Inspect operation of GFCI as per manufacturers suggested maintenance schedule.

## EXTENSION CORDS

If an extension cord is necessary, use only 3-wire extension cords that have 3-prong grounding-type plugs and 3-pole cord connectors that accept the plug from this system. Use only extension cords that are intended for outdoor use. Use only extension cords having an electrical rating not less than the rating of the system. A cord rated for less amperes or watts than this system rating may overheat. Exercise caution when arranging the cord so that it will not be tripped over or pulled. Do not use damaged extension cords. Examine extension cord before using and replace if damaged. Do not abuse extension cord. Keep extension cord away from heat and sharp edges. Always disconnect the extension cord from the receptacle before disconnecting this system from the extension cord. Never yank cord to pull plug from outlet. Always grasp the plug and pull to disconnect.

**WARNING** – *To guard against injury, basic safety precautions should be observed, including the following:*

1. **READ AND FOLLOW ALL SAFETY INSTRUCTIONS.**
2. **DANGER** – To avoid possible electric shock, special care should be taken since water is employed in the use of this system. Unless a situation is encountered that is explicitly addressed by the provided maintenance and troubleshooting sections, do not attempt repairs yourself; refer to an authorized service facility.
3. **CAUTION** - Do not operate with broken or faulty parts as this may result in exposure to ultraviolet radiation. Contact supplier for replacement parts.
4. Do not operate the system if it has a damaged cord or plug, or if it is malfunctioning or if it has been dropped or damaged in any manner.
5. Always unplug the system, shut off water flow and release water pressure before servicing or cleaning. Never yank cord to remove from outlet; grasp the wall plug and pull to disconnect.
6. Do not use the system for other than intended use. The use of attachments not recommended or sold by the manufacturer may cause an unsafe condition.
7. To prevent risk of electrical shock, connect this system only to a properly grounded, grounding-type power supply receptacle that is protected by a Ground Fault Circuit Interrupter (GFCI). Inspect performance of GFCI as per manufacturer's suggested maintenance schedule. If an extension cord is used, ensure it is of a sufficient rating and accepts the plug from this system; never use an adapter.
8. Visually inspect this system prior to installation. If the quartz sleeve or lamp is broken, cracked or damaged in any way, do not use. Contact the supplier for replacement parts
9. Keep all connections dry and off the ground. Do not touch plug with wet hands.
10. The light emitted by the lamp will cause serious eye damage and burn unprotected skin. Do not plug system into an electrical outlet without first properly securing the lamp into the chamber. Unplug the system prior to removing the lamp from the chamber.
11. If the UV system malfunctions or fails, water must be boiled prior to consumption until the UV system is operational and the water lines have been shocked. System failure is indicated by the system's audible and visual alarms or the absence of any indicator light.
12. Intended for indoor use only. System must not be exposed to weather elements. In seasonal applications, chamber must be drained to prevent freezing.
13. Installation of this system must be in accordance with local plumbing and electrical codes as well as any and all applicable regulations and laws.
14. **SAVE THESE INSTRUCTIONS.**



**WARNING** – Do not look directly at UV lamp when it is operating. The light emitted by the lamp will cause serious eye damage and burn unprotected skin.



**WARNING** – Read manual before installing or servicing this system. Only authorized personnel possessing a strong understanding of this system should attempt to replace lamp or service this system.

**NOTE** – Maximum pressure rating is 100 PSI (6.89 bar)

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# COMPONENTS

For replacement components please contact your installer (listed on the front of this manual) or contact VIQUA directly for a referral: 1 800 265 7246 (North America), 519 763 1032, or info@viqua.com.

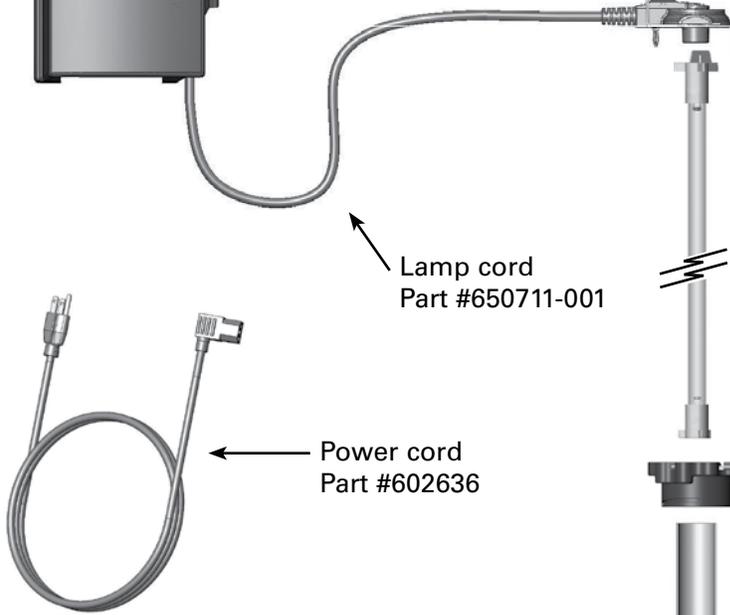


Power supply  
 Pro10: part #650709-003  
 Pro20: part #650709-006  
 Pro30: part #650709-009  
 Pro50: part #660020-R

G Plus: part #650709-002  
 H Plus: part #650709-005  
 J Plus: part #650709-008  
 K Plus: part #660019-R

G: part #650709-001  
 H: part #650709-004  
 J: part #650709-007  
 K: part #660018-R

(power supply includes lamp cord)



Lamp cord  
 Part #650711-001

Power cord  
 Part #602636

Accessory	Part Number
1" Solenoid Valve (option)	650627
2" Solenoid Valve (option)	410888-R
COMMcentre (option) Remote Controller (Pro10, 20, 30, 50 series only)	650623-001

Lamp  
 Pro10, G Plus, G: part #602854  
 Pro20, H Plus, H: part #602855  
 Pro30/50, J/K Plus, J/K:  
 part #602856

Top bolt & wireform  
 Part #602916 & 602896

Sleeve  
 Pro10, G Plus, G: part #602974  
 Pro20, H Plus, H: part #602975  
 Pro30/50, J/K Plus, J/K:  
 part #602976

O-ring

CoolTouch™ fan  
 Part #650630

Plug Kit  
 (Comes installed with Basic  
 Series chamber)

Sensor  
 (Pro and Plus Series only)  
 Part #650580

Chamber

Sleeve removal  
 tool  
 Part #602988

O-ring

Bottom bolt (includes screw)  
 Part #603053

Note: keep this tool with system at all times.

# SPECIFICATIONS

## General (All Models)

Operating Parameters	
Maximum operating pressure	100 PSI (689 kPa)
Minimum operating pressure	4 PSI (27 kPa)
Maximum ambient air temperature	104°F (40°C)
Minimum ambient air temperature	32°F (0°C)
Maximum humidity	100%
Maximum hardness	120 ppm (7 grains per gallon)
Maximum iron	0.3 ppm
Minimum UVT	75% *
Installation	Vertical ONLY
Other	
Chamber material	316L SST
Rated service life of lamp	2 years

\* Pro50 has a minimum UVT rating of 85%

	Pro10	Pro20	Pro30	Pro50*	G, G Plus*	H, H Plus*	J, J Plus*	K, K Plus**
Rated flow dose of 30 mJ/cm <sup>2</sup>	--	--	--	--	up to 19 gpm (72 lpm)	20-39 gpm (76-148 lpm)	40-45 gpm (151-170 lpm)	80 gpm (303 lpm)
Rated flow dose of 40 mJ/cm <sup>2</sup>	10 gpm (38 lpm)	20 gpm (76 lpm)	30 gpm (114 lpm)	50 gpm (189 lpm)	up to 15 gpm (57 lpm)	16-29 gpm (61-110 lpm)	30-44 gpm (114-167 lpm)	--
Electrical								
Voltage	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz
Max. current	1.2 Amp	1.6 Amp	2.4 Amp	2.4 Amp	1.2 Amp	1.6 Amp	2.4 Amp	2.4 Amp
Max. power consumption	120 Watts	160 Watts	230 Watts	230 Watts	120 Watts	160 Watts	230 Watts	230 Watts
Lamp power consumption	100 Watts	140 Watts	200 Watts	200 Watts	100 Watts	140 Watts	200 Watts	200 Watts
Port Size								
Inlet and outlet	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	2" MNPT	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	2" MNPT

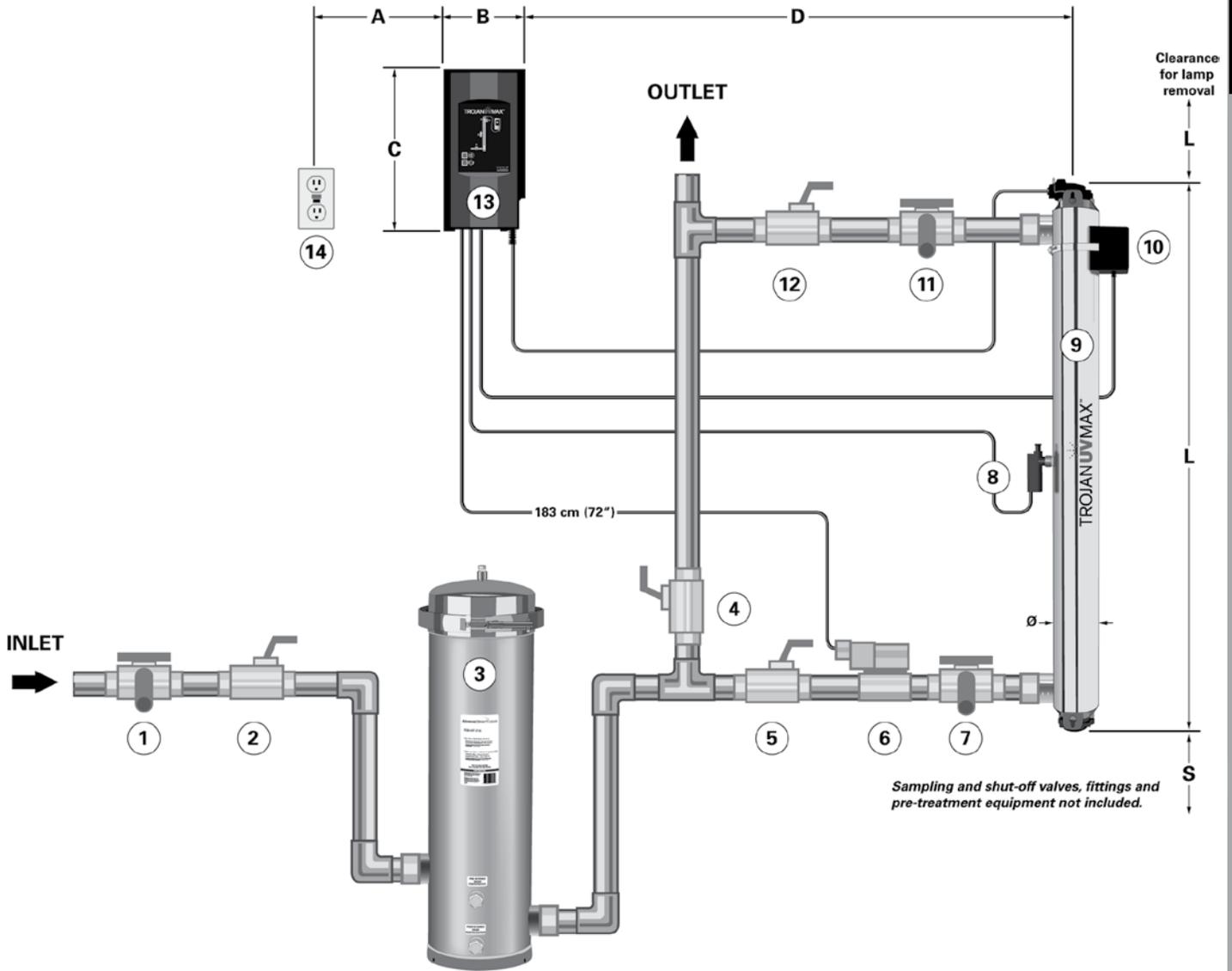
\*Flow rates shown are at 85% UVT.

\*\* Flow rates show are at 95% UVT.

## SPECIFICATIONS

	Pro Series	Plus Series	Basic Series
Color-coded plug and play connections	Yes	Yes	Yes
Sensor with diagnostic test	Yes	Yes	--
CoolTouch fan	Yes	Yes	Yes
Dynamic flow restrictor	Yes (not Pro50)	--	--
Communications ports (two, RJ45)	Yes	Yes	Yes
COMMcenter control package	Optional	--	--
Solenoid valve	Optional	Optional	Optional
<b>Controls</b>			
Audible alarm mute button	Yes	Yes	Yes
New lamp button	Yes	Yes	Yes
Lamp age indicator	Yes	Yes	Yes
Lamp operation indicator	Yes	Yes	Yes
Power supply operation indicator	Yes	Yes	Yes
Solenoid operation indicator	Yes	Yes	Yes
Fan operation indicator	Yes	Yes	Yes
Sensor reading indicator	Yes	Yes	--
<b>NSF/ANSI certification</b> (Pro10, 20, 30 models only)	 Standard 55 Class A	--	--
<b>USEPA UVDGM 2006</b> (Pro50 model only)	Yes	--	--
<b>Other certifications</b>	 	 	 

# DIMENSIONS & LAYOUT



Model	L	S (min.)	Ø	A (max.)	B	C	D (max.)
Pro50	41" (103cm)	12" (30cm)	4" (10cm)	72" (182cm)	6.5" (16.5cm)	13" (33cm)	48" (122cm)
K	41" (103cm)	12" (30cm)	4" (10cm)	72" (182cm)	6.5" (16.5cm)	13" (33cm)	48" (122cm)
K Plus	41" (103cm)	12" (30cm)	4" (10cm)	72" (182cm)	6.5" (16.5cm)	13" (33cm)	48" (122cm)

- ① Sample valve: Allows for sampling of raw water.
- ② Shut-off valve: Required to allow maintenance of pre-treatment equipment.
- ③ Pre-treatment: For the UV system to operate effectively, the water should meet certain water quality parameters, as outlined below. To meet these, pre-treatment of the water may be required. Pre-treatment equipment must be installed BEFORE the UV chamber. Pre-treatment systems can be comprised of one or more of the following elements: sediment filters; carbon filters; iron removal systems; water softeners; cyst reduction filters, etc.

**Water Quality Requirements:**

Iron:	< .3 PPM (.3 mg/L)
Hardness:	< 120 PPM (7 Grains Per Gallon)
% UVT:	> 75%

**IMPORTANT:**  
**A 5 micron (nominal) sediment filter must be installed before the UV system and after any water softening equipment.**

- ④ Bypass shut-off valve: Bypass line and valve are optional. Intended to provide emergency water supply in the event that the UV system is unavailable.
- ⑤ Shut-off valve: Required to allow maintenance of UV system.
- ⑥ Solenoid valve: Optional piece of equipment supplied by manufacturer. Allows water supply to be shut-off when proper disinfection cannot be assured (1" & 2" SOLENOID available).

Note: If the ground from your electrical panel is tied to your copper water lines, and you are using a solenoid valve, installation of an approved ground strap is required. This ground strap will maintain continuity between the lines that have been cut to install the solenoid. Check your local electrical code for the correct clamp and cable size.



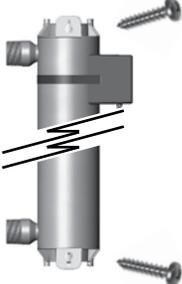
- ⑦ Sample valve: Allows for sampling of water entering UV chamber; necessary in order to confirm water being treated is of adequate quality.
- ⑧ Plug kit: A stopper provided and installed on Basic models.
- ⑨ Sensor: Monitors UV output to ensure proper dose (UV exposure) is being provided. Unique test function allows verification of sensor performance.
- ⑩ UV chamber: Provides disinfection of the water. MUST BE INSTALLED VERTICALLY.
- ⑪ CoolTouch™ fan: Removes excess heat from water in chamber during periods without water flow.
- ⑫ Sample valve: Allows for sampling of water immediately following UV treatment; necessary in order to confirm proper operation of UV system.
- ⑬ Shut-off valve: Required to allow maintenance of UV system.
- ⑭ Power supply: Powers and controls the UV lamp and other devices. Provides human interface, displaying information and allowing control inputs (such as muting the audible alarm).
- ⑮ Power source: Provides power to the power supply. For safety reasons the outlet must be protected by a Ground Fault Circuit Interrupter (GFCI). NOTE: to protect the power supply, a UL1449 certified (or equivalent) transient voltage surge suppressor is required.

# INSTALLING THE UV SYSTEM

1 Determine appropriate indoor location of the power supply and chamber, referring to Dimensions and Layout drawing. Power supply should be installed higher than chamber away from all water sources. Ensure adequate clearance above chamber to allow for removal of the lamp and sleeve.

2 Attach chamber to wall vertically. Install screws apart:

G, Pro10: 18.5"  
 H Pro20: 27.5"  
 J, K, Pro30/50: 37.5"

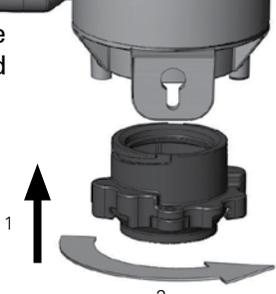


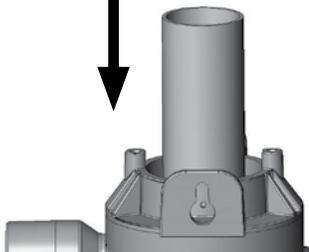
3 Make all necessary plumbing connections.

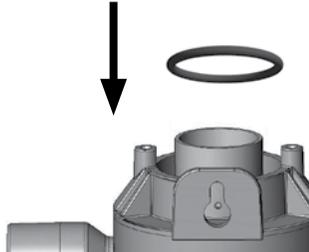
4  Only for Pro and Plus Series.



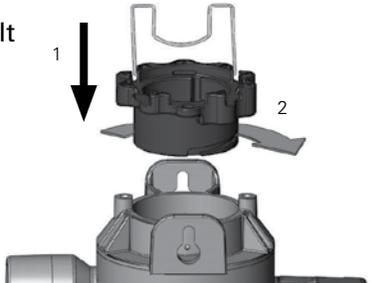
5 Ensure sleeve bolt is rotated full 1/4 turn until positive stop.

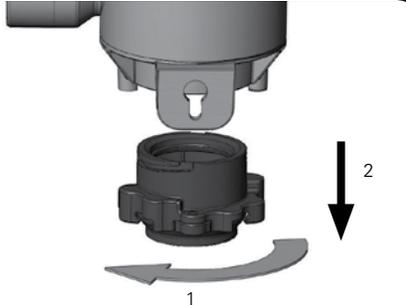


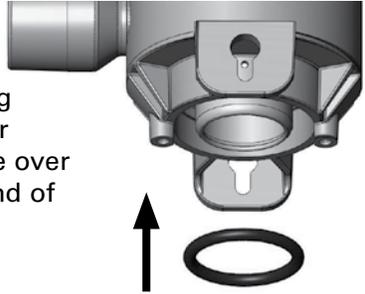
6  Do not touch glass with bare hands. Insert curved end of sleeve first. Do not rotate sleeve.

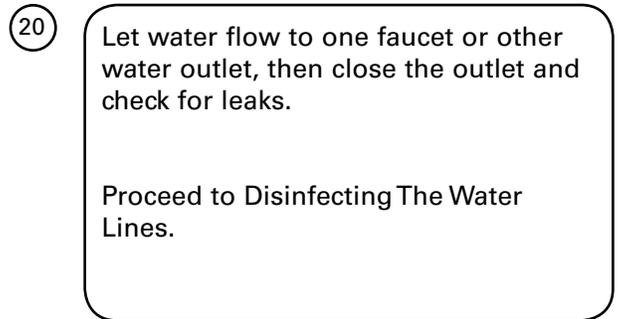
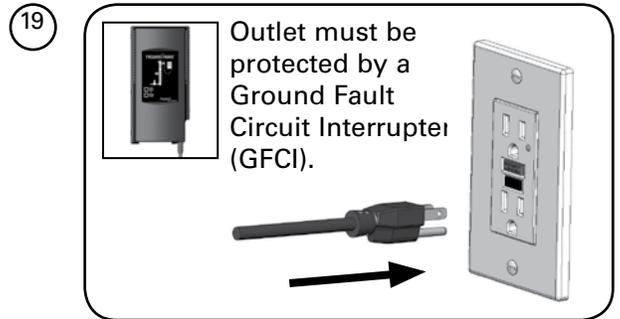
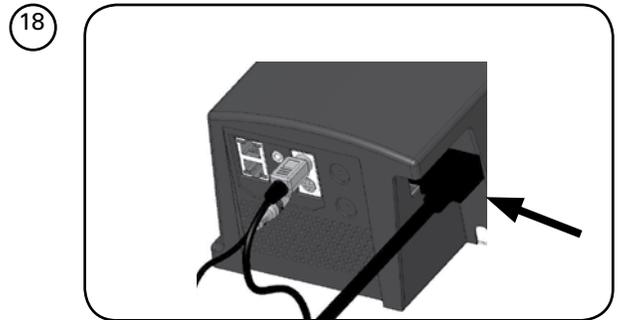
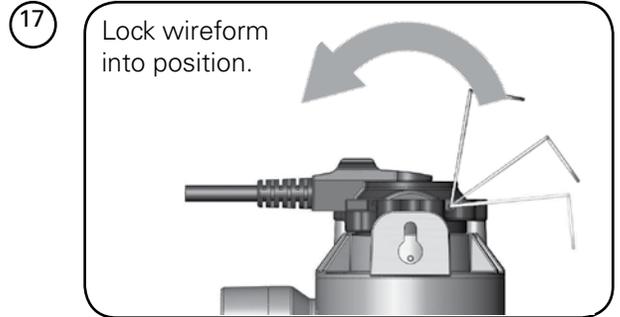
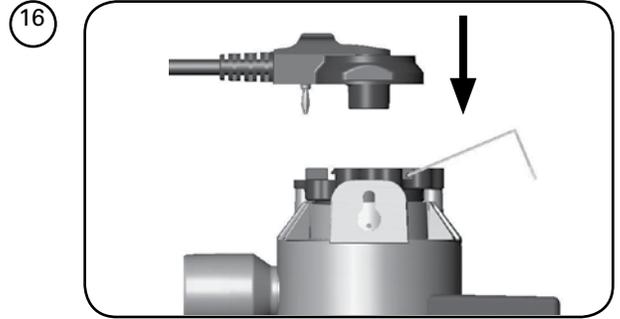
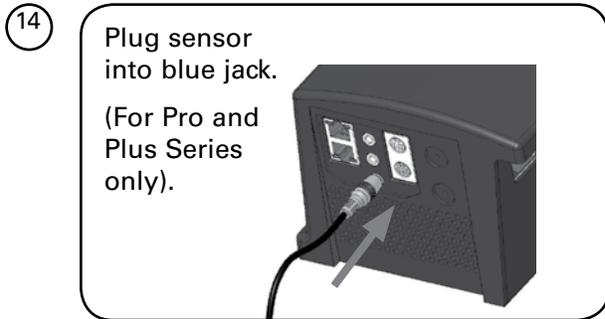
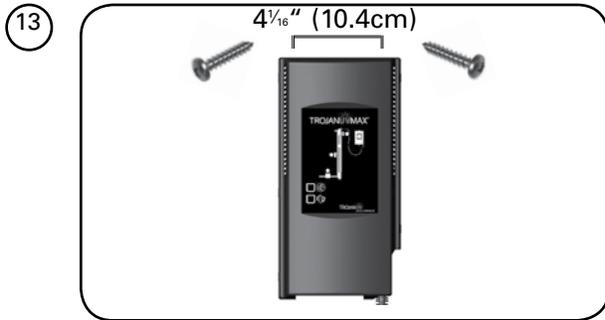
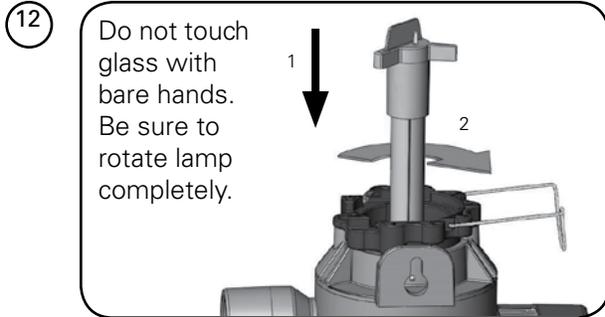
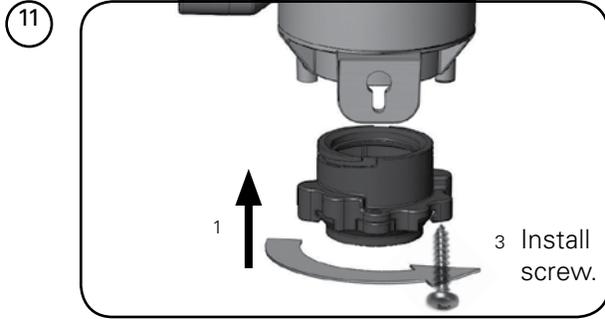
7  Wet O-ring with water then place over top end of sleeve.

8 Ensure sleeve bolt is rotated full 1/4 turn until positive stop.



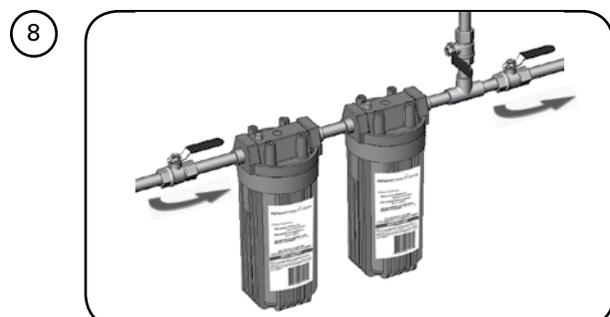
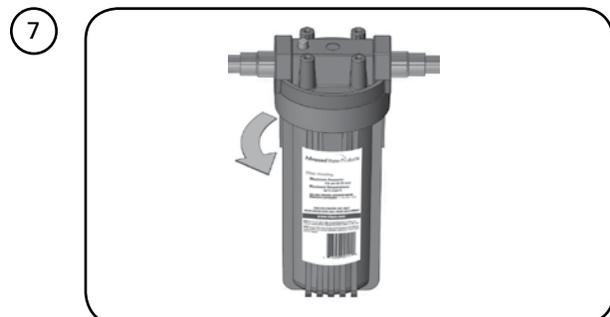
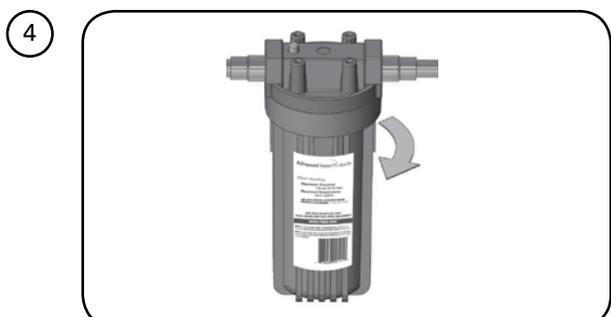
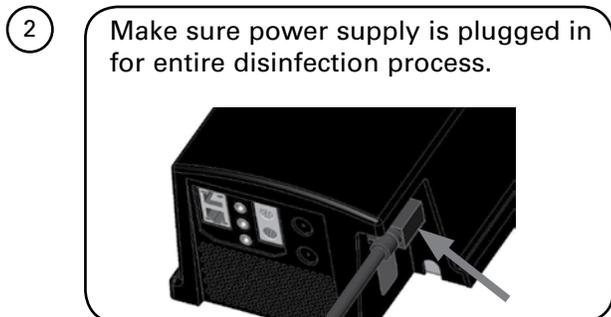
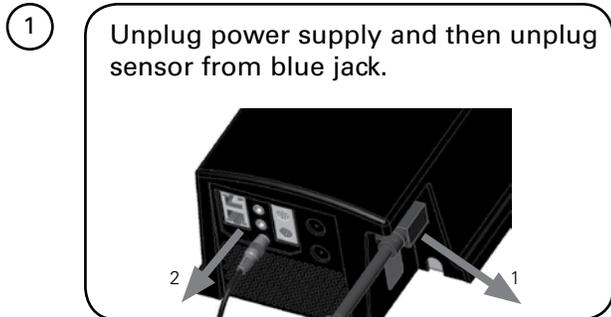
9 

10  Wet O-ring with water then place over bottom end of sleeve.

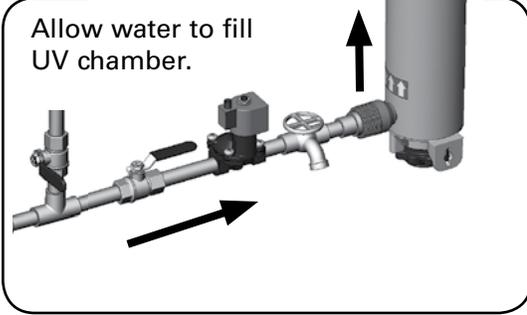


## DISINFECTING THE WATER LINES

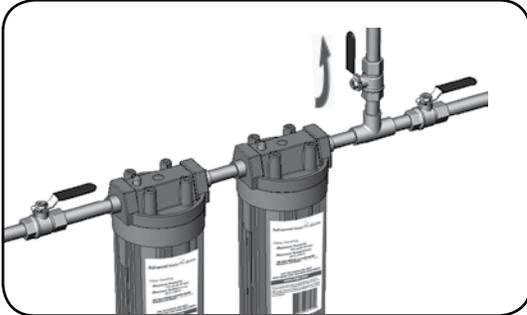
UV systems disinfect the water using ultraviolet light, treating the water as it passes through the system. When there is a risk that water downstream of the UV system has been contaminated it is critical that these water lines be chemically disinfected. Disinfection of the water lines is therefore required after initial system installation and following any period of time during which the system is inoperative, whether due to an alarm condition, a power failure, or for any other reason.



9



10



11

Go to a water outlet and allow the cold water to flow until you can smell bleach, then stop the flow. Allow hot water (if present) to flow until you can smell bleach, then stop the flow. Repeat procedure at all water outlets. Remember to include all faucets, washing machines, toilets, outside taps, and other water outlets. **Note:** You will likely run out of bleach; if you cannot smell bleach at a given outlet, turn off the main water supply, depressurize and add more bleach to the filter housing.

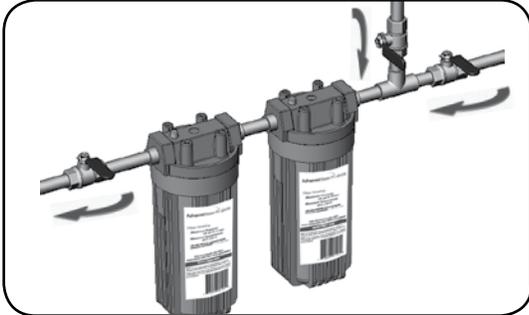


12

Let the bleach sit in the water lines for at least four hours.



13



14



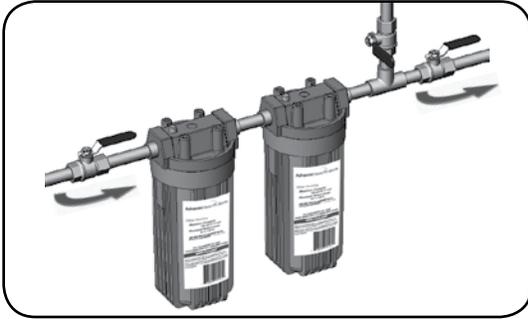
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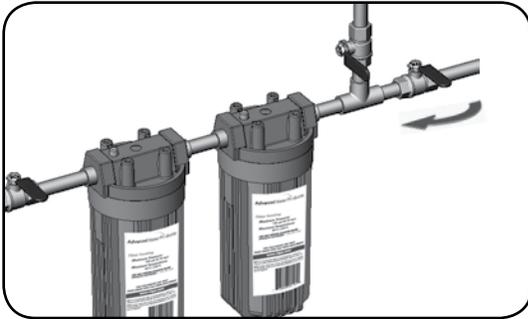


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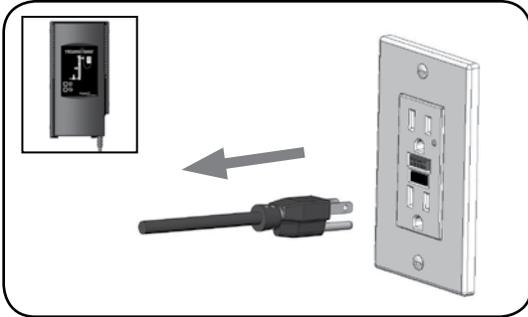
Flush all water outlets until bleach can no longer be smelled (at least 5 minutes).



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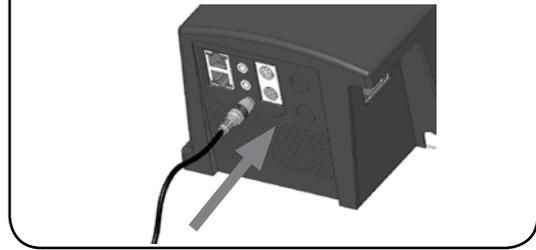


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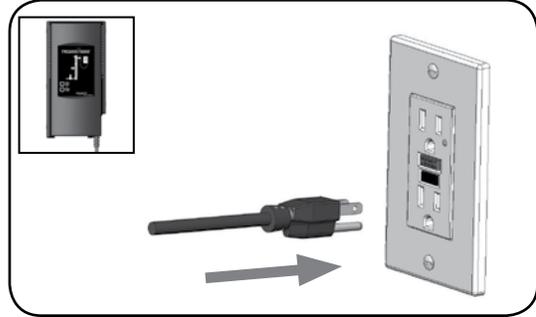


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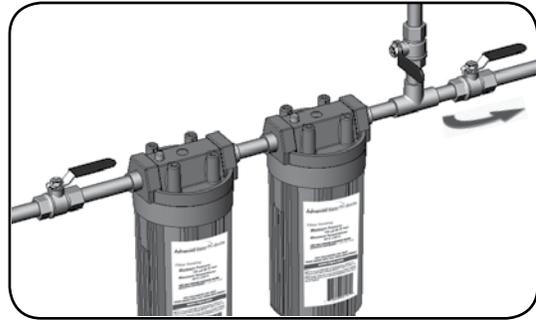
Plug sensor into blue jack.



22



23



## CONTROL PANEL

### Buttons

Button	Meaning
<b>A</b> Mute	Press this button in order to turn off the audible alarm. When the alarm is due to the lamp's age, the mute button will deactivate the audible alarm for 7 days; this may be repeated up to a maximum of 4 times.
<b>B</b> New Lamp	After installing a new lamp, press and hold this button until you hear a beep (about five seconds). This will reset the internal clock.



### Indicator lights

Indicator lights only indicate a problem with the component when flashing red.

The table below is a list of *possible* causes and solutions. Before replacing parts, please contact Technical Assistance for any new troubleshooting techniques. 1 800 265 7246.

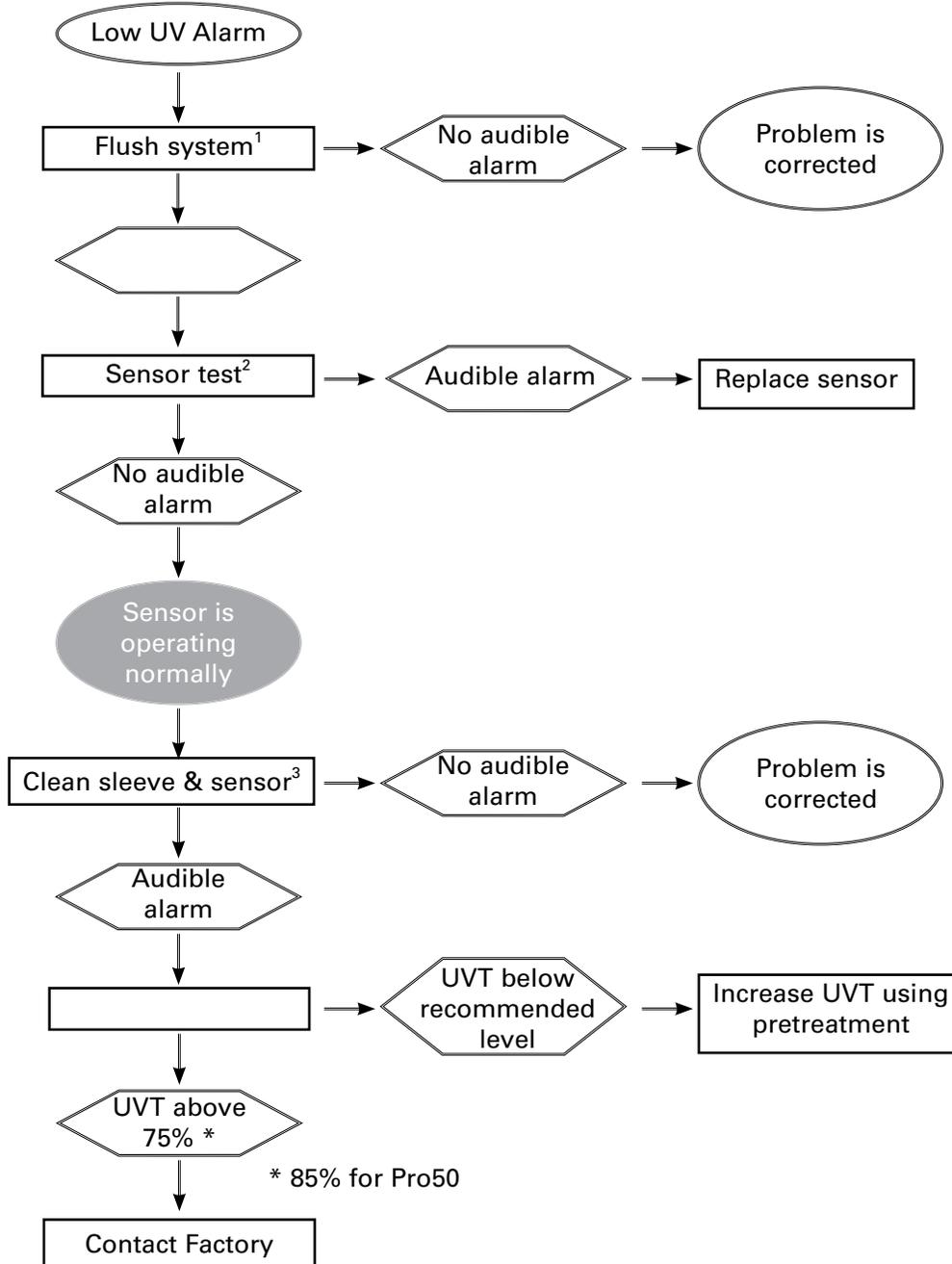
	Green	Yellow	Flashing Red	Solid Red
①	Operating normally	Not applicable	Power supply failure; replace power supply	Power supply inactive due to lamp failure
②	Operating normally	Not applicable	Fan disconnected; reconnect  Fan turning slower than required; unplug system, clean blades using a Q-tip  Fan damaged; replace fan	Not applicable
③	Operating normally <b>NOTE:</b> During the lamp warm up, the indicator will flash	Warning; lamp will require replacement shortly	Lamp disconnected; unplug system, reconnect lamp and plug-in system again  Lamp failure; replace lamp	Lamp inactive due to power supply failure
④	UV dose is adequate and sensor is operating normally  <i>(Pro &amp; Plus models only)</i>	UV dose is near the minimum required	Sensor disconnected; unplug system, reconnect sensor and plug-in system again  UV dose is below minimum required, see Low UV Alarm section	Sensor inactive due to lamp or power supply failure
⑤	Solenoid valve open  <i>(If equipped with solenoid)</i>	Not applicable	Solenoid valve disconnected; reconnect  Solenoid coil damaged; replace coil <i>(not entire solenoid)</i>	Solenoid valve inactive (closed) due to failure of another component, in order to ensure safety of the water supply

# TROUBLESHOOTING

The table below is a list of *possible* causes and solutions. Before replacing parts, please contact Technical Assistance for any new troubleshooting techniques. 1 800 265 7246.

Symptom	Possible Cause	Possible Solution
No power	GFCI and/or breaker tripped	Reset GFCI and/or breaker
	Power supply fuse has blown	Replace power supply fuse - see Fuse Replacement section
	Transient voltage surge suppressor (TVSS) damaged	Replace TVSS
	Power supply damaged	Replace power supply and use a TVSS
GFCI or breaker repeatedly trips	Connection between lamp and lamp plug is wet	Clean and dry the lamp plug and lamp end lamp, check unit for leaks or condensation
	Short-circuit in the electrical assembly	Replace power supply
Leak at inlet or outlet	Threaded pipe fittings are leaking	Clean threads, reseal with Teflon tape and retighten
Leak detected from area of chamber	Condensation of moist air on cold chamber (slow accumulation)	Control humidity or relocate unit
	O-ring damaged, deteriorated or incorrectly installed	Inspect and replace if deteriorated
	Sleeve bolt not tight enough	Ensure nut is turned completely (to stops)
Alarm	See Control Panel section	See Control Panel section
System is operating but water tests reveal bacterial contamination	Equipment downstream of UV system is acting as a breeding ground for pathogens	Ensure UV is the last piece of treatment equipment
	Pathogens are residing in the distribution lines post-UV	Ensure all distribution lines have been disinfected with chlorine - see Disinfecting the Water Lines section
	Recontamination from pipe dead-ends	Remove any pipe dead-ends and flush with chlorine - see Disinfecting the Water Lines section

# LOW UV ALARMS (Pro & Plus Series Only)



- 1 In some cases, short-term flows of low ultraviolet transmittance (UVT) water can be created following and during the regeneration cycle of a water softener, resulting in a sensor alarm. Flushing the UV system alleviates this condition until the softener goes through another regeneration cycle. In the longer term, the softener's settings must be modified. To flush the UV system, unplug the sensor, then open a tap downstream and let water run for two (2) minutes. Disinfect the water lines following the procedures outlined under "Disinfecting The Water Lines" in the Installation section.
- 2 Pro and Plus Series are equipped with a unique, patented, self-test sensor. Simply press the test button located at the top of the sensor and hold until the audible alarm stops (usually about 5 seconds). If the audible alarm is still present after 30 seconds, release the button and replace the sensor.
- 3 Refer to Sleeve Cleaning And Lamp Replacement section of the Owner's Manual.
- 4 Contact your water treatment dealer to inquire about testing the UVT of your water.

## SLEEVE CLEANING & LAMP REPLACEMENT

### Sleeve cleaning

Minerals in the water slowly form a coating on the sleeve. This coating must be removed because it reduces the amount of UV light reaching the water, thereby reducing disinfection performance. The need to clean the sleeve will be indicated by a low UV alarm (flashing red indicator light beside the sensor on control panel - see Control Panel section for details).

Note: Low UV alarms are for Pro & Plus Series only. If you own a Basic model, please clean the sleeve regularly (3-4 times per year, or more often depending on water quality).

When only cleaning is required, follow the instructions below and re-install the current lamp.

### Lamp replacement

The amount of UV light created by the lamp decreases over time, requiring that the lamp be replaced. The system will automatically notify you when it is time to replace the lamp (the lamp should last approximately 24 months). If the lamp requires replacement, follow the instructions below and install a new lamp. NOTE: The UV system is designed to operate continuously and should not be shut off for short periods of time, such as over a period of less than three weeks.

### Equipment required:



#2 Phillips  
screw driver



Clean cotton,  
latex or plastic  
gloves are  
preferred.



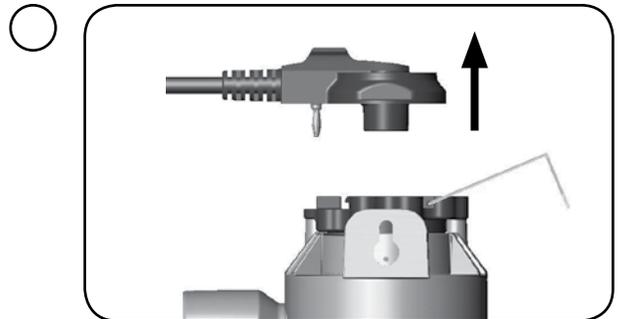
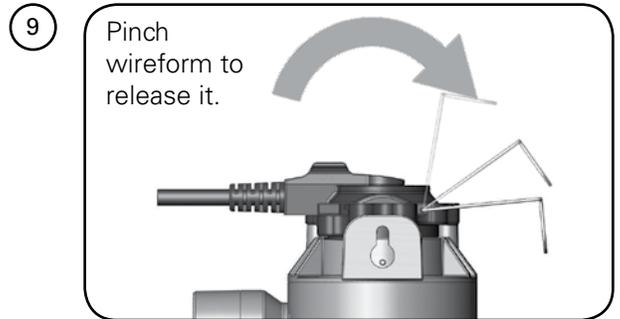
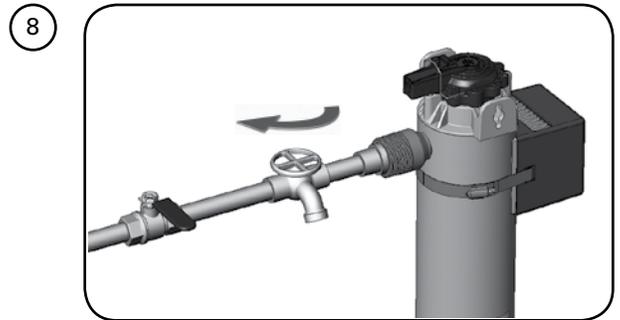
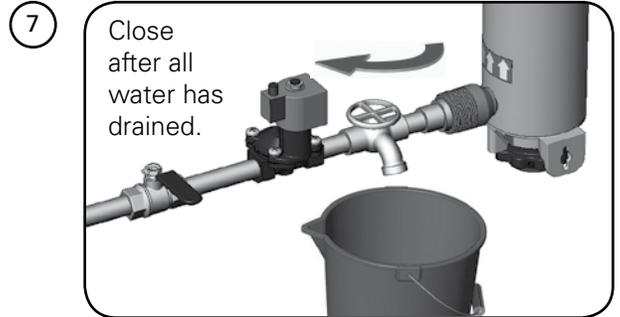
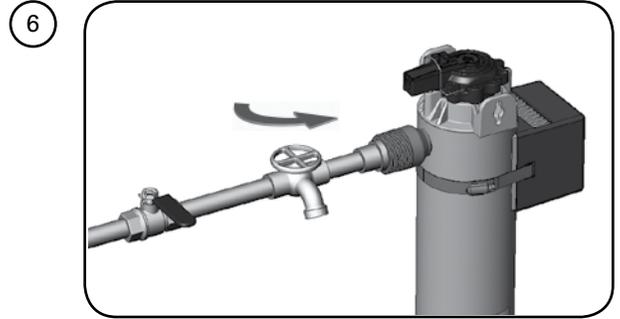
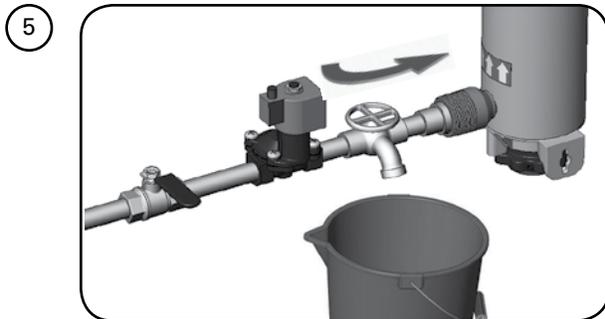
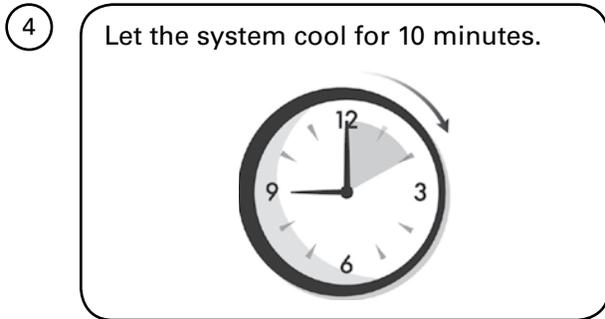
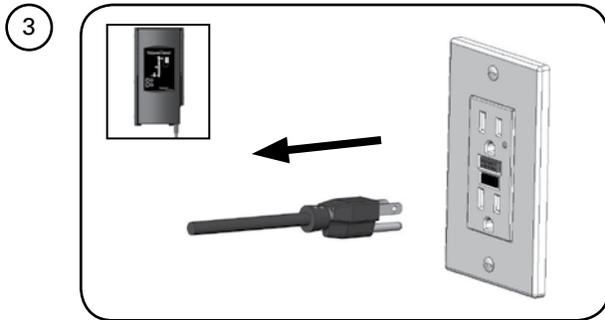
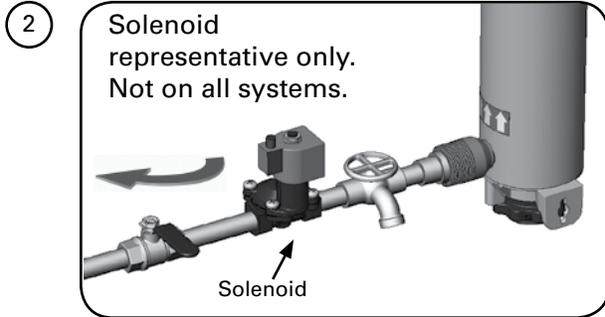
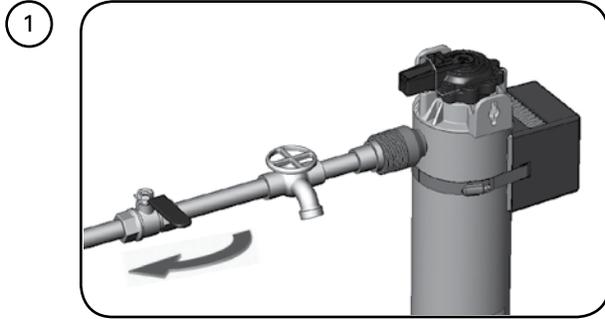
Scale remover  
such as CLR™ or  
Lime-Away™.

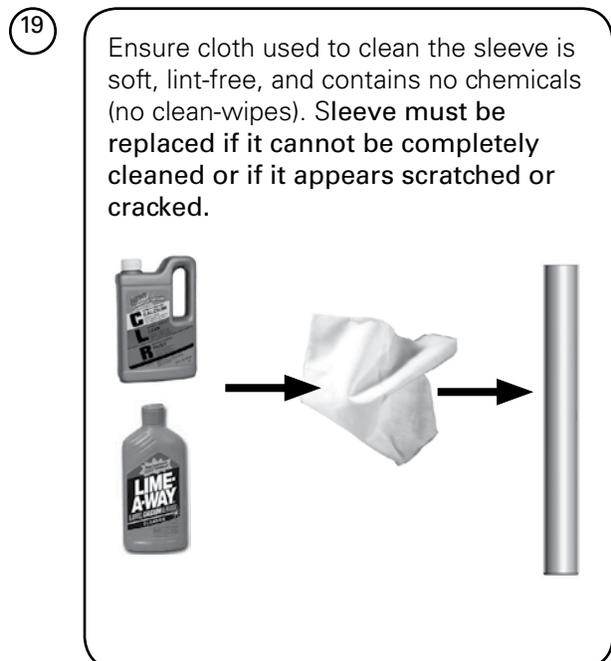
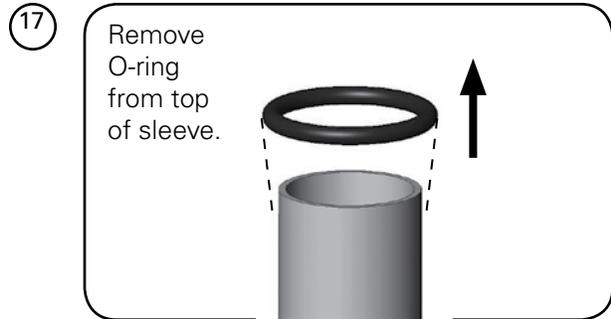
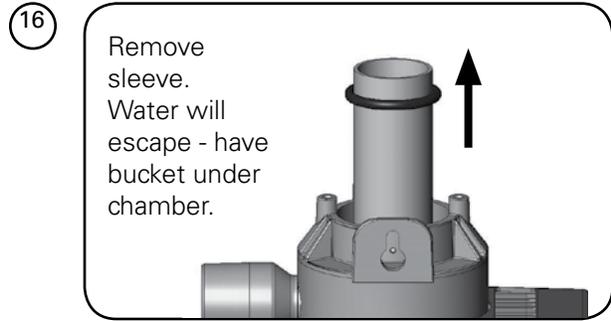
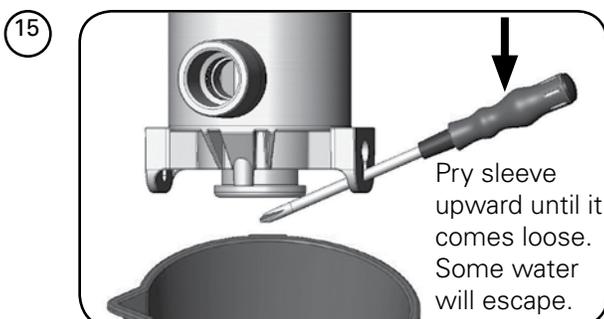
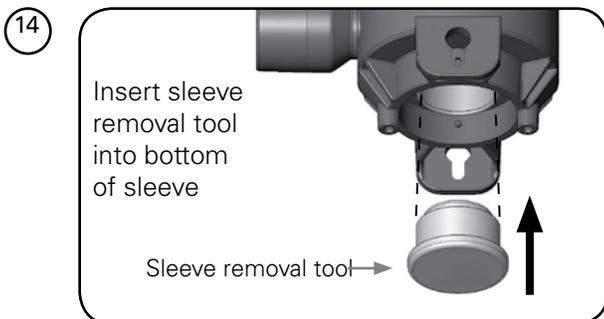
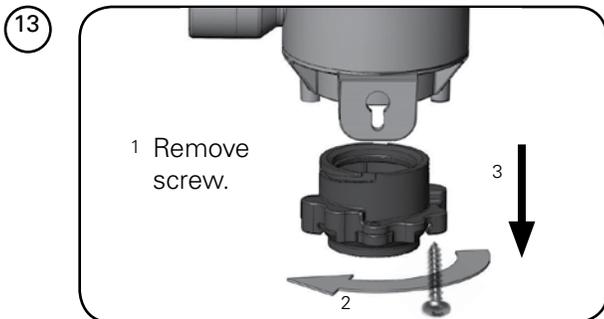
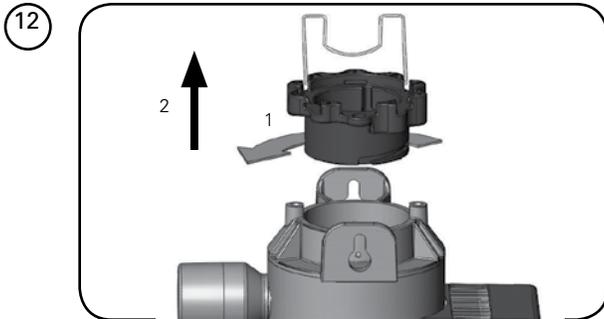
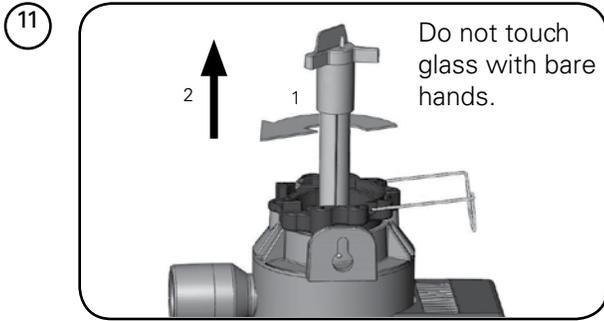


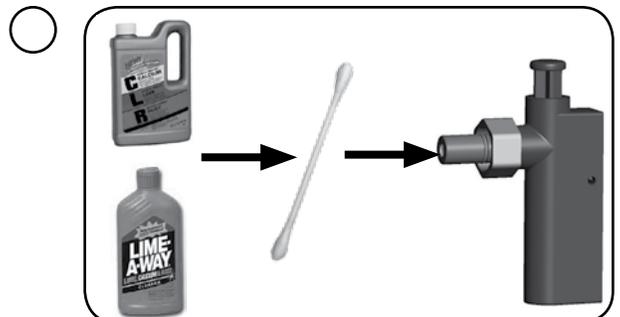
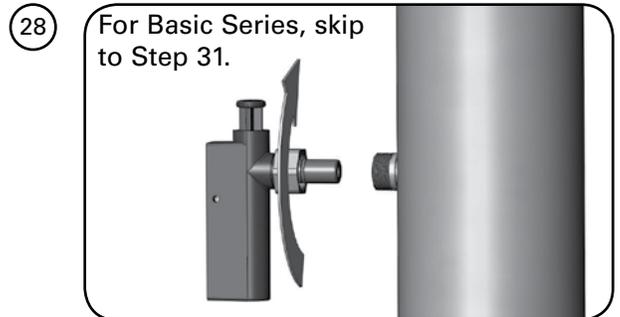
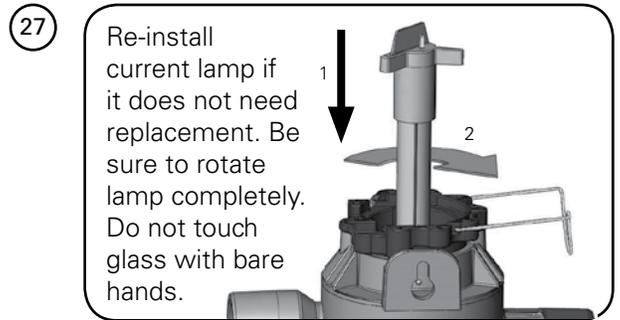
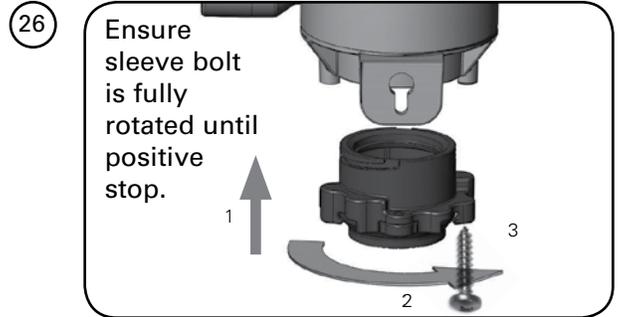
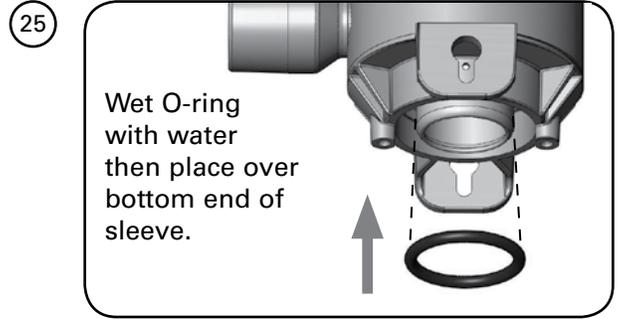
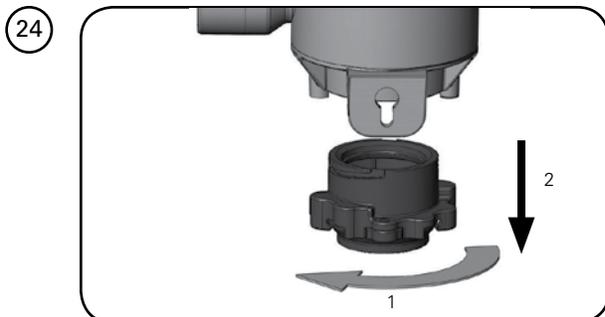
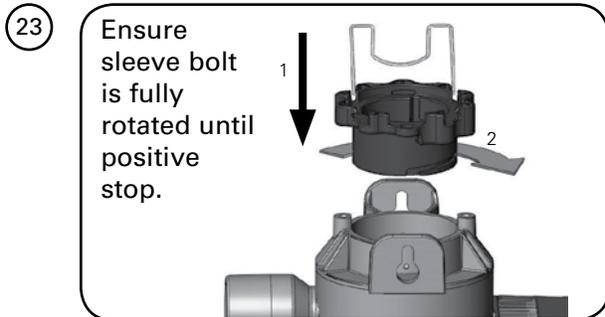
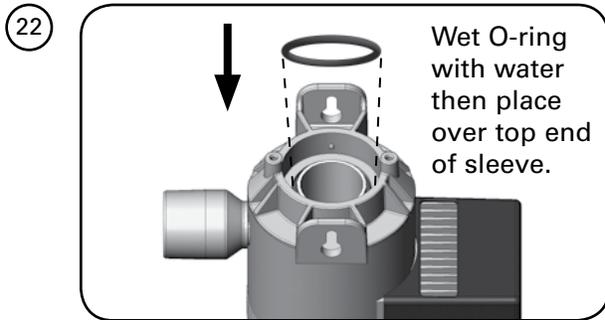
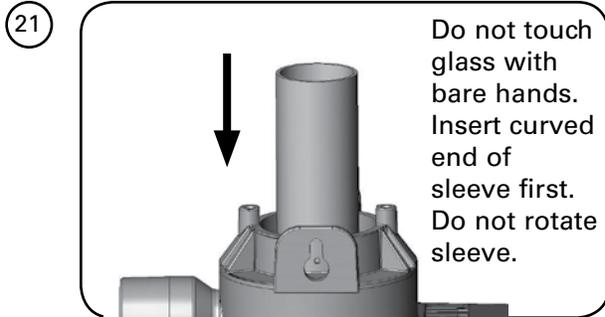
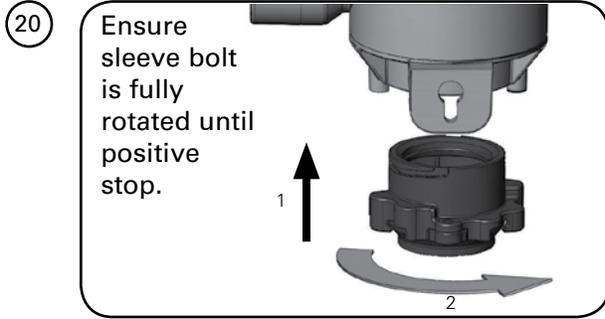
Cloth must be  
soft, lint-free, and  
chemical-free. No  
clean-wipes.

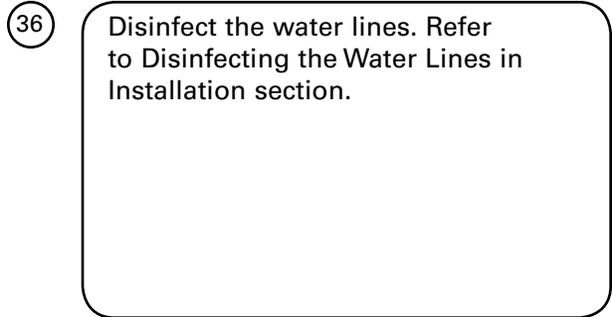
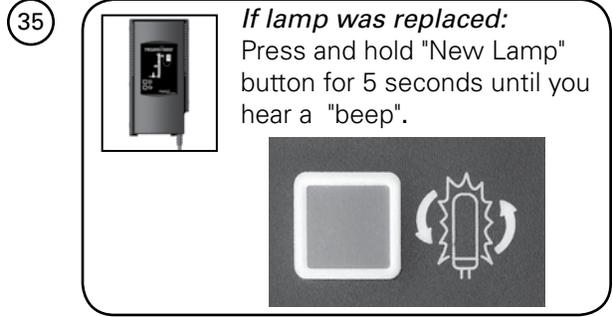
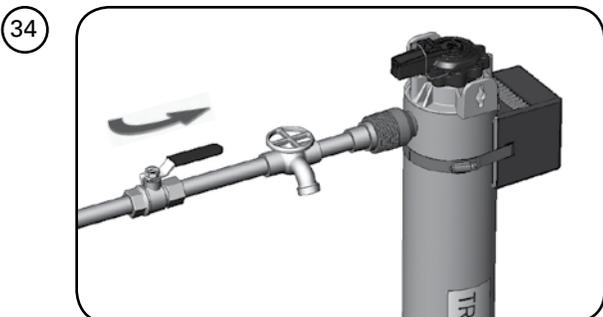
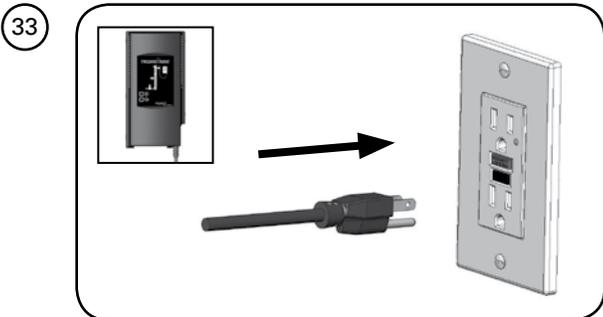
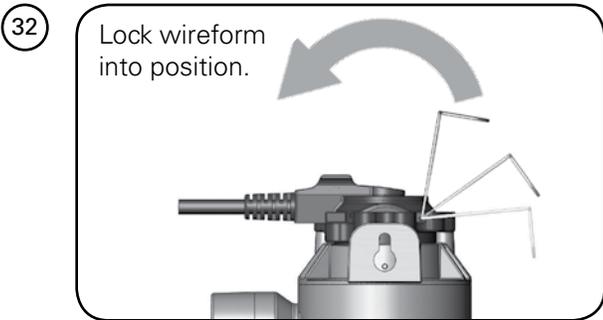
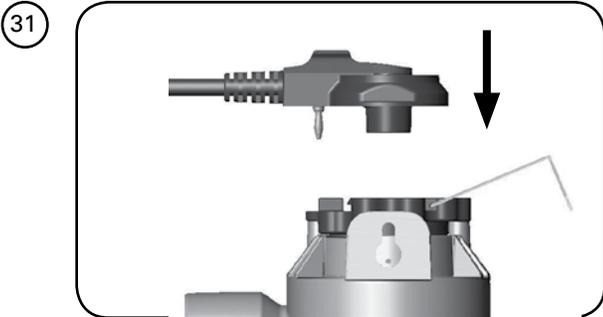
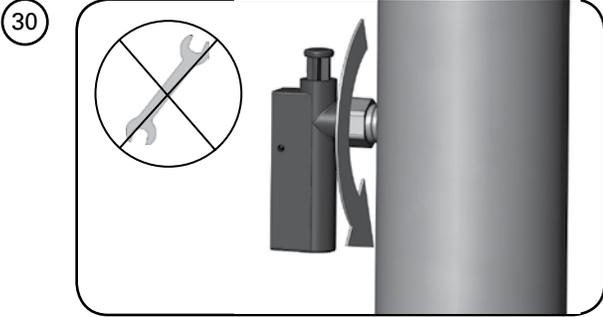


Cotton swab.



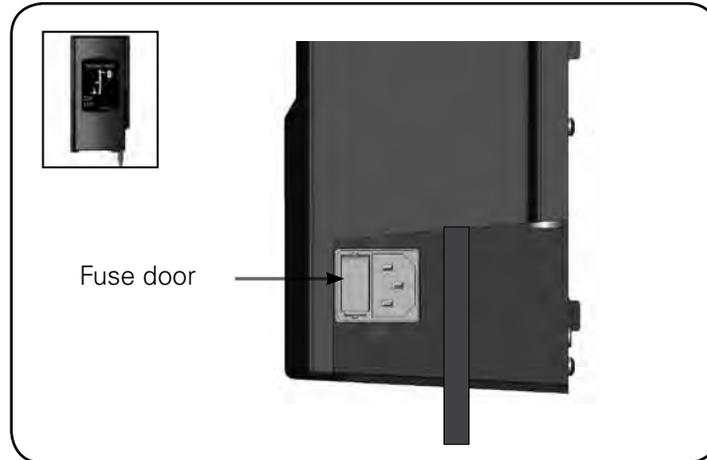
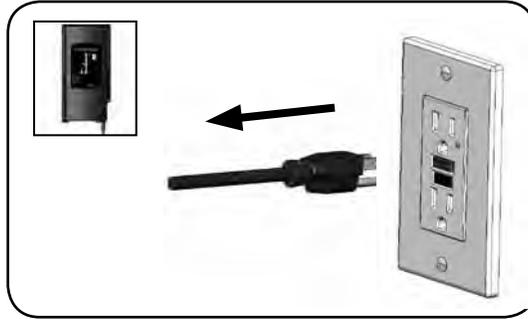






## FUSE REPLACEMENT

The system comes equipped with one functioning and one spare 250V 2.5A fuse. To access the fuses, first unplug system and disconnect the power cord from the power supply. Remove the fuse door by pushing in the tab on one side using a knife or other tool and gently prying outwards. Repeat on the other side.



# WARRANTY

## Our Commitment

To maximize the superior quality of disinfection, each TrojanUVMax™ product must be properly sized, installed, and maintained. If you experience difficulty with your product, our Technical Support Centre is available to help you.

During the applicable warranty period noted below, we will provide the warranty coverage, described below, for your product.

## How to Get Help

To obtain help under this warranty, contact the TrojanUVMax Technical Support Center at 1 800 265 7256 or by email at info@viqua.com. Please have available the model number, the date of purchase, the name of the dealer from whom you purchased your TrojanUVMax product ("the source dealer"), as well as a description of the problem you are experiencing. A VIQUA technician will help you troubleshoot the problem and isolate the defective part.

In order to establish proof of purchase when making a warranty claim, you will either need your original invoice, previously completed and returned your warranty card through the mail or online.

## Specific Warranty Coverage

Warranty coverage is specific to the following TrojanUVMax products:

### Ten-Year Limited Warranty for TrojanUVMax™ UV Chamber

VIQUA warrants the UV chamber on the TrojanUVMax™ product to be free from defects in material and workmanship for a period of ten (10) years from the date of purchase. During this time, we will repair or replace, at its option, any defective TrojanUVMax™ UV chamber.

Please return the defective part to a TrojanUVMax dealer, who will return it to VIQUA - a Trojan Technologies Company. We will either make the necessary repairs or, if it is determined that a replacement is required, we will provide a replacement part. We will then return the part to the dealer. This warranty does not include shipping and handling charges which will be collected from you by the dealer.

Parts repaired or replaced under this ten (10) year warranty will be covered under warranty to the end of the original ten (10) year warranty period. This warranty is also subject to the conditions and limitations outlined under the heading "General Conditions and Limitations" below.

### Five-Year Limited Warranty for Structural, Hardware and Electrical Components

VIQUA warrants the structural, hardware, and electrical components to be free from defects in material and workmanship for a period of five (5) years from the date of purchase. During this time, we will repair or replace, at its option, any defective parts covered by the warranty.

Please return the defective part to a TrojanUVMax dealer, who will return it to VIQUA - a Trojan Technologies Company. We will either make the necessary repairs or, if it is determined that a replacement is required, we will provide a replacement part. We will then return the part to the dealer. This warranty does not include shipping and handling charges which will be collected from you by the dealer.

Parts repaired or replaced under this five (5) year warranty will be covered under warranty to the end of the original five (5) year warranty period. This warranty is also subject to the conditions and limitations outlined under the heading "General Conditions and Limitations" below.

### One-Year Limited Warranty for Lamps, Sleeves and UV Sensors

VIQUA warrants original lamps, sleeves and UV sensors to be free from defects in material and workmanship for a period of one (1) year from the date of purchase. During this time, we will repair or replace, at its option, any defective parts covered by the warranty.

The warranty period for lamps and sleeves may be verified using date codes in addition to purchase receipts and VIQUA's database of registered owners. We will advise you whether the defective item needs to be returned to a TrojanUVMax dealer for failure analysis. Replacement lamps and sleeves provided under warranty will be sent to your TrojanUVMax dealer.

If the UV sensor experiences a problem which VIQUA confirms is covered by warranty, please return the sensor to a TrojanUVMax dealer who will return it to us. We will either repair or replace the sensor and return the sensor to your dealer. This warranty on lamps, sleeves and sensors does not include shipping and handling charges which will be collected from you by the dealer.

Parts replaced under this one (1) year warranty will be covered under warranty to the end of the original one (1) year warranty period. This warranty is also subject to the conditions and limitations outlined under the heading "General Conditions and Limitations" below.

### Warranty for Replacement Lamps and Parts

VIQUA warrants replacement lamps, purchased for bi-annual routine maintenance, and other parts purchased to repair product components that are no longer covered by the original warranty, to be free from defects in material and workmanship for a period of three (3) months from the date of purchase. During this time, we will repair or replace, at its option, a defective replacement lamp or part free of charge except for shipping and handling charges.

The warranty period on replacement lamps and parts will be verified using date codes and/or purchase receipts. VIQUA will advise you whether the defective item needs to be returned to a TrojanUVMax dealer for failure analysis. Replacement lamps and parts provided under warranty will be sent to your TrojanUVMax dealer.

### General Conditions and Limitations

None of the above warranties cover damage caused by improper use or maintenance, accidents, acts of God or minor scratches or imperfections that do not materially impair the operation of the product. The warranties also do not cover products that are not installed as outlined in the applicable Owner's Manual.

The limited warranties described above are the only warranties applicable to the TrojanUVMax products listed in the "Specific Warranty Coverage" section. These limited warranties outline the exclusive remedy for all claims based on a failure of or defect in any of these products, whether the claim is based on contract, tort (including negligence), strict liability or otherwise. These warranties are in lieu of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or of fitness for a particular purpose shall apply to any of these products.

VIQUA - a Trojan Technologies Company does not assume any liability for personal injury or property damage caused by the use or misuse of any of the above products. VIQUA shall not in any event be liable for special, incidental, indirect or consequential damages. VIQUA's liability shall, in all instances, be limited to repair or replacement of the defective product or part and this liability will terminate upon expiration of the applicable warranty period.



System tested and certified by NSF International against NSF/ANSI Standard 55 for disinfection performance, Class A.

NSF information pertains to TrojanUVMax™ Pro Series models – Pro10, Pro20, Pro30.

This Class A system conforms to NSF Standard 55 for the disinfection of microbiologically contaminated water that meets all other public health standards. The system is not intended for treatment of water that has an obvious contamination source, such as raw sewage; nor is the system intended to convert wastewater to microbiologically safe drinking water. The system is intended to be installed on visually clear water (not colored, cloudy, or turbid water). If this system is used for the treatment of surface waters a prefilter found to be in compliance for cyst reduction under NSF/ANSI Standard 53: Drinking Water Treatment Units - Health Effects shall be installed upstream of the system.

NSF Standard 55 defines waste water to include human and/or animal body waste, toilet paper, and any other material intended to be deposited in a receptacle designed to receive urine and/or feces (black waste); and other waste materials deposited in plumbing fixtures (gray waste).

TrojanUVMax™ Pro50 model is USEPA UVDGM 2006 validated.

# VIQUA™

A TROJAN TECHNOLOGIES COMPANY

# Section 9



3-2850.090-1

Rev. B 05/06

English

## WARNING!



### SAFETY INSTRUCTIONS

1. Depressurize and vent system prior to installation or removal.
2. Confirm chemical compatibility before use.
3. Do not exceed maximum temperature/pressure specifications.
4. Wear safety goggles or faceshield during installation/service.
5. Do not alter product construction.
6. When using chemicals or solvents, care should be taken and appropriate eye, face, hand, body, and/or respiratory protection should be used.



## Contents

- |  |   |
|--|---|
| <ol style="list-style-type: none"> <li>1. Description</li> <li>2. Specifications</li> <li>3. In-Line Installation</li> <li>4. Submersible Installation</li> <li>5. Wiring 4-20 mA Output version</li> <li>6. Wiring Digital Output (S<sup>3</sup>L) version</li> </ol> | <ol style="list-style-type: none"> <li>7. Wiring Dual Digital Output (S<sup>3</sup>L) version</li> <li>8. Cell Constant Selection</li> <li>9. Range Selection for 4 to 20mA Output</li> <li>10. Calibration</li> <li>11. Maintenance</li> <li>12. Ordering Information</li> </ol> |
|--|---|

## 1. Description

Signet 2850 Conductivity/Resistivity Sensor Electronics provides a two-wire 4 to 20 mA output, or a digital interface in S<sup>3</sup>L™ format. The 4 to 20 mA output models provide eight ranges for each electrode cell constant, plus the ability to invert each range. The Easy-Cal feature allows the devices to automatically recognize standard conductivity test solution values for simple field calibration.

## 2. Specifications

### General

Compatible Electrodes: All Signet models with PT-1000 RTD

#### Materials and Shipping Weight:

- Integral mount: PBT: 0.75 kg (1.75 lb.)
  - Remote mount: PBT, CPVC: 0.75 kg (1.75 lb.)
- Temperature Compensation: PT-1000 RTD

#### Easy-Cal:

Automatic recognition of the following conductivity values:

- 146.93 μS, 1408.8 μS, 12856 μS (@25°C)  
(Test solutions Per ASTM D1125-95)
- 10 μS, 100 μS, 200 μS, 500 μS, 1000 μS, 5000 μS, 10,000 μS, 50,000 μS, 100,000 μS (@25°C)

### Electrical

Power: 12 to 24 VDC for 4 to 20 mA output  
5 VDC +/-5% regulated, 3.0 mA max. for Digital (S<sup>3</sup>L) output (Reverse polarity and short circuit protected)

#### Digital (S<sup>3</sup>L) Output:

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• Accuracy:</li> <li>• Resolution:</li> <li>• Update Rate:</li> </ul> | <p>Serial ASCII, TTL level 9600 bps</p> <p>Conductivity: ±2% of reading</p> <p>Temperature: ±0.5°C</p> <p>Conductivity: 0.1% of reading</p> <p>Temperature: &lt;0.2°C</p> <p>Single channel models: &lt;600 ms</p> <p>Dual channel models: &lt;1.2 s</p> |
|--|--|

#### Available data via Digital (S<sup>3</sup>L) Output:

- Raw conductivity
- Calibrated conductivity
- Calibrated temperature-compensated conductivity
- Temperature

Error Indication: Open input and out of range diagnostics for temperature or internal electronic error.

#### Current Output:

- Field-selectable ranges
- Factory set Span:
 

0.01 cell (2819, 2839):	4 to 20 mA = 0 to 100 μS
0.10 cell (2820, 2840):	4 to 20 mA = 0 to 1000 μS
1.0 cell (2821, 2841):	4 to 20 mA = 0 to 10,000 μS
10.0 cell (2822, 2842):	4 to 20 mA = 0 to 200,000 μS
20.0 cell (2823):	4 to 20 mA = 0 to 400,000 μS

- Max. Loop Resistance:
 

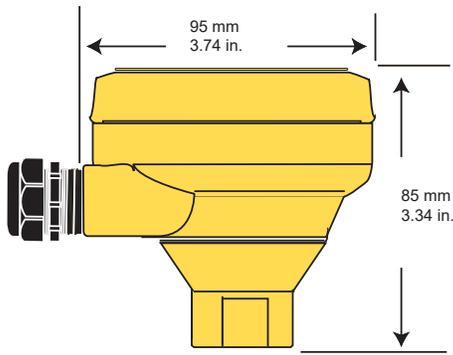
50 Ω @ 12 VDC
325 Ω @ 18 VDC
600 Ω @ 24 VDC
- Accuracy: ±2% of output span
- Resolution: 7 μA
- Update Rate: <600 ms
- Error Indication: 22 mA

#### Standards and Approvals

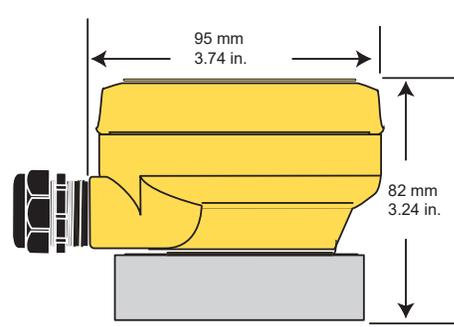
- NEMA 4X/IP65
- CE
- Immunity: EN61326-1
- Emissions: EN55011 Class B
- Manufactured under ISO 9001 and ISO 14001

## Dimensions

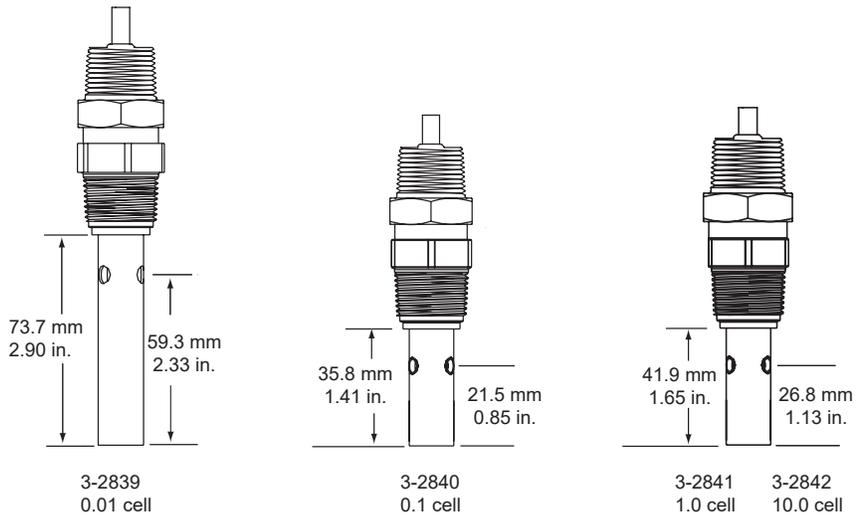
### 2850-51, -52 Integral mount



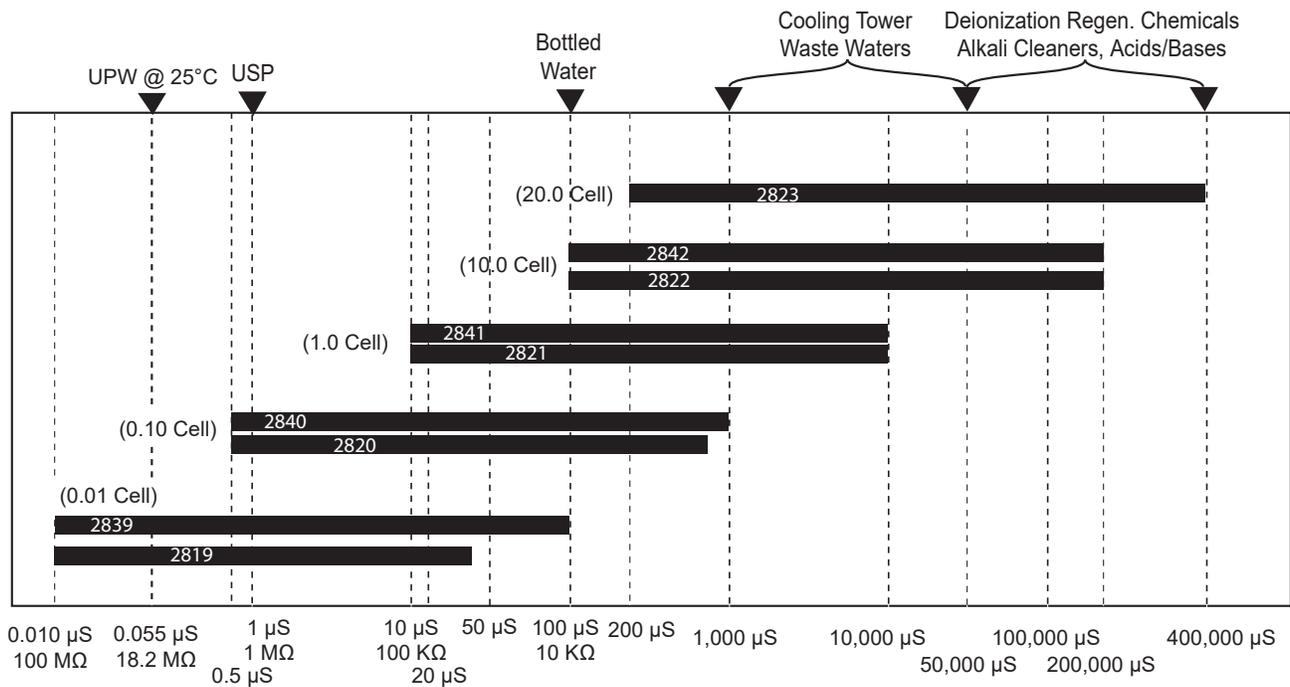
### 2850-61, -62, -63 Universal mount



## Conductivity Sensor Dimensions



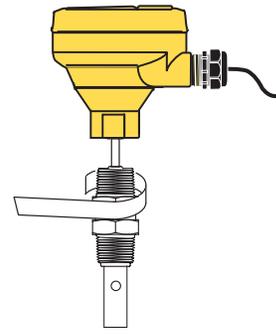
## Operating Range Chart



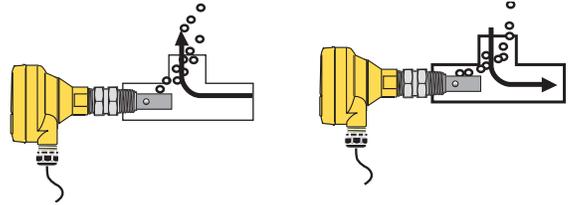
### 3. In-Line Installations

Most of the Conductivity/Resistivity electrodes used with the 2850 can be installed into standard 3/4 in. (NPT or ISO 7-R3/4) fittings.

The 2850-5X models are designed for integral systems, where the electronics are attached directly to the sensor. For these models, select any electrode with a short (6 inch) cable.

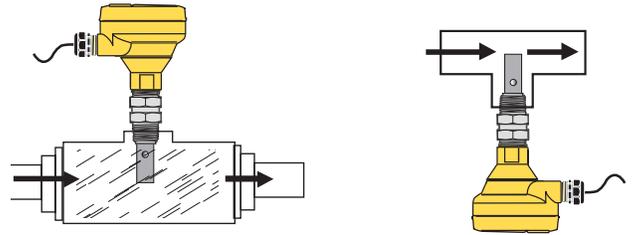


The preferred installation for in-line applications directs flow straight into the electrode. This configuration reduces the probability of entrapped air bubbles, and provides the best continuous sampling of the fluid content.

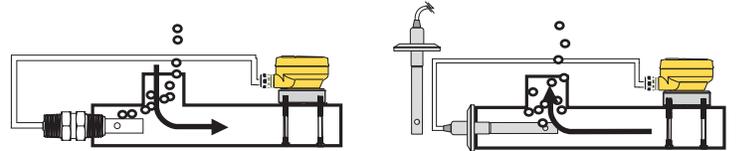


If the electrode is mounted vertically in a tee, do not recess the electrode orifices inside the tee. Mounting upside down may help prevent air entrapment.

An oversized tee or flow cell may be helpful for inline installations. At least 4 threads (ANSI B1.20.1) must be engaged to meet the pressure rating as published in the specifications.



Use the 2850-6X models for in-line installations where the electronics must be separated from the electrode. Conductivity electrodes with sanitary flange fittings must be installed using this option.



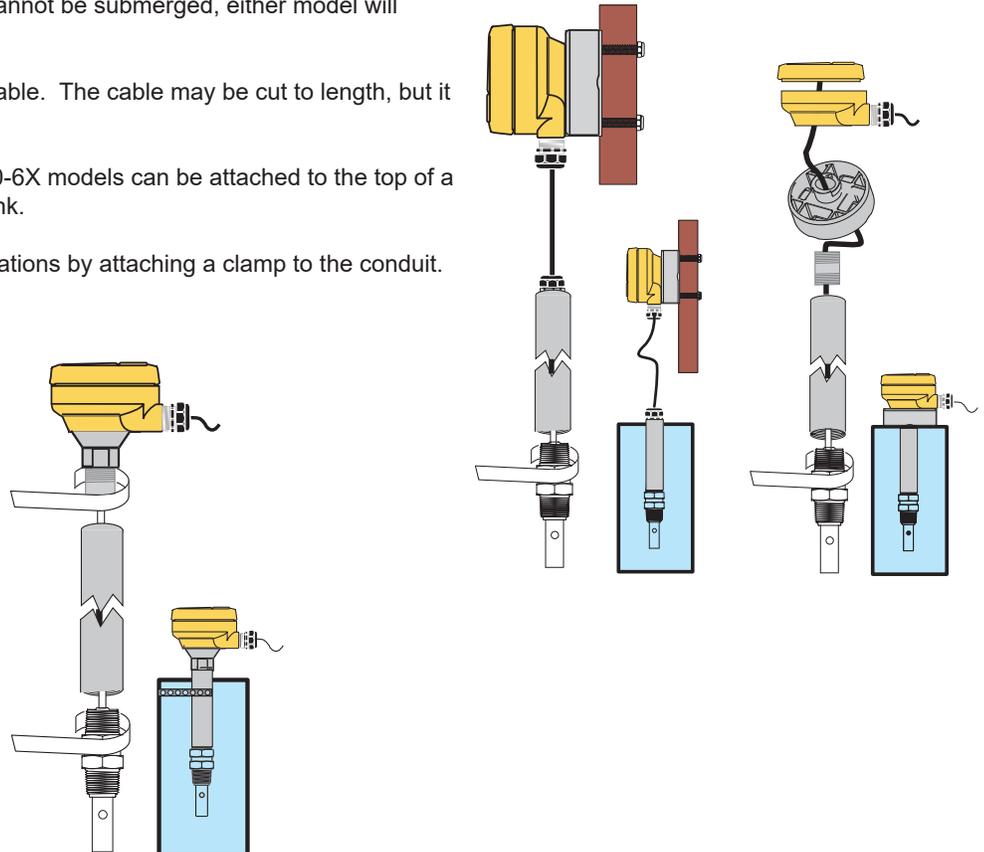
### 4. Tank Installations

While the 2850-5X and -6X electronics cannot be submerged, either model will accommodate tank installation.

Select any electrode with a 5 m (15 ft.) cable. The cable may be cut to length, but it CANNOT BE EXTENDED.

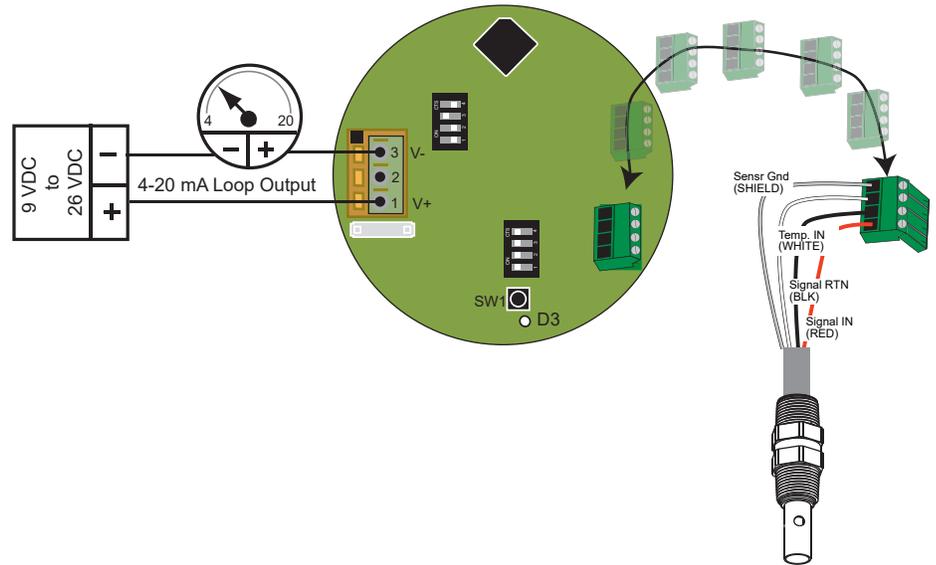
The universal adapter included with 2850-6X models can be attached to the top of a tank or mounted to a surface near the tank.

Adapt the 2850-5X models to tank installations by attaching a clamp to the conduit.



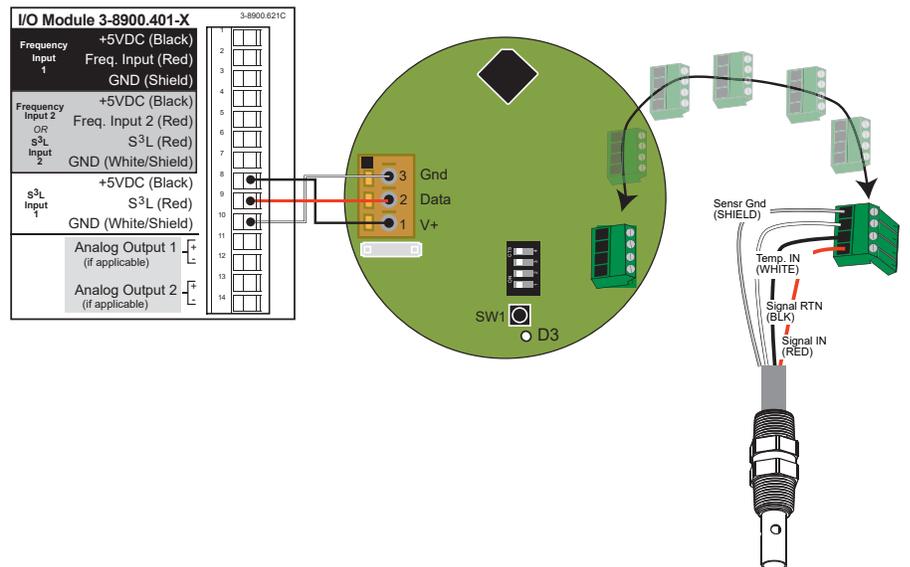
## 5. Wiring 4-20 mA Output version

- Maximum length of 4-20 mA loop is 300 meters (1000 ft.)



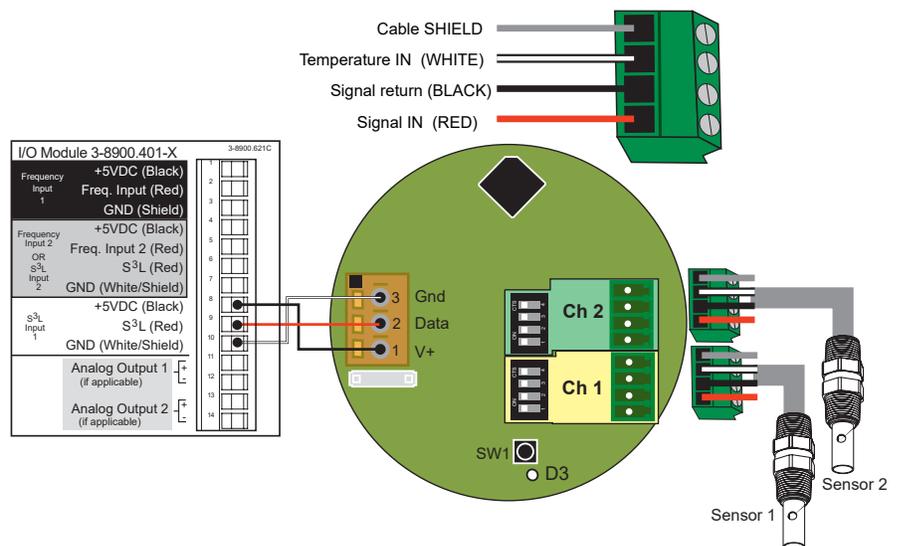
## 6. Wiring Digital Output (S<sup>3</sup>L) version

- The digital output is compatible with the Signet 8900 Multi-Parameter Controller.
- Refer to the wiring section of the 8900 manual to determine cable length limitations.



## 7. Wiring Dual Digital Output (S<sup>3</sup>L) version

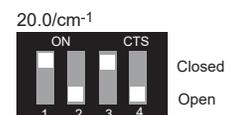
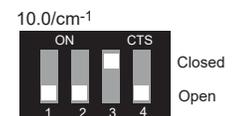
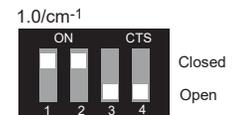
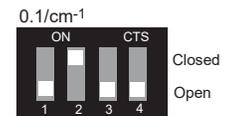
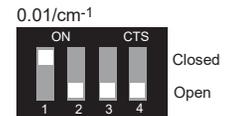
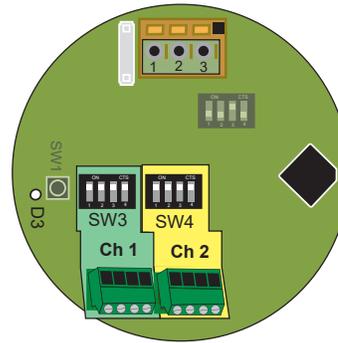
- Dual channel input is available on digital models only.
- Sensors may be the same or different cell constants.
- If a dual channel model is used with a single sensor, connect it to channel 1, and set all of the channel 2 switches to OFF.



## 8. Cell Constant Selection

### Cell Constant Selection

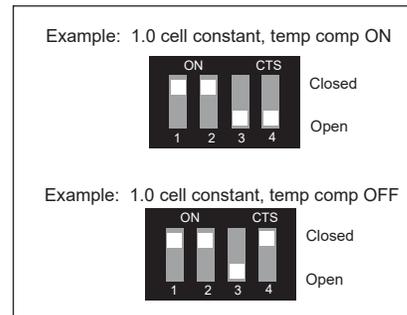
- Switch banks SW3 and SW4 are used to select the CELL CONSTANT of the electrode. The Dual Input model is illustrated. Single input models use only SW3.
- Make all switch settings before connecting power. Switch changes made with the power ON will take 15-20 seconds before becoming effective.
- Use SW3 #1-3 to select the cell constant for the first sensor.
- Use SW3 #4 to disable the PT1000 Temp Compensation function in the 2850 (as required for USP applications.) This disables the function for BOTH CHANNELS.
- Use SW4 #1-3 to select the cell constant for the second sensor.
- Set SW4 #4 to OPEN to disable the second channel.



SW3 Cell Constant and Temp Compensation				
#1	#2	#3	#4	For Cell Constant
C	O	O	O	0.01/cm <sup>-1</sup>
O	C	O	O	0.1/cm <sup>-1</sup>
C	C	O	O	1.0/cm <sup>-1</sup>
O	O	C	O	10.0/cm <sup>-1</sup>
C	O	C	O	20.0/cm <sup>-1</sup>
#4: Open = Temp Comp ON Closed = Temp Comp OFF				

SW4:	
#1, #2 and #3	operate the same as SW3.
#4	turns channel 2 OFF when set to OPEN. (Open = Off, Closed = On)

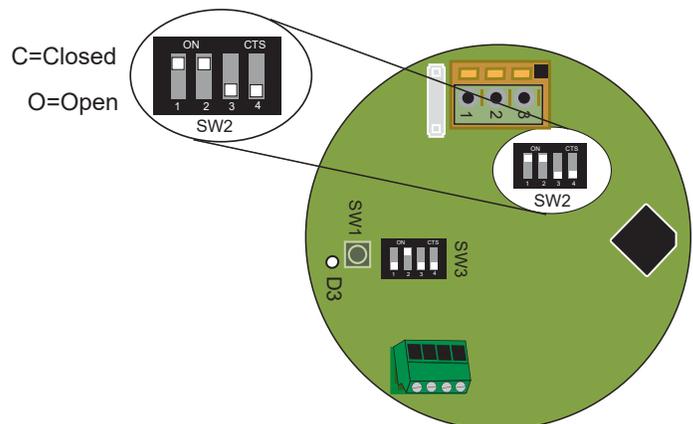


## 9. Range Selection for 4 to 20mA Output

- The Range selection switch bank (SW2) provides eight range selections for each cell constant. Each range can be inverted, making a total of 16 range options.
- Select a range from the table below and set SW2 as indicated.

### Example (refer to shaded selections of chart):

- The electrode installed is the 3-2840-1, with a 0.10 cell constant.
- The required output is 4-20 mA = 0-100  $\mu$ S.
- Set SW2 switch bank to C-C-O-O.
- To invert range (4-20 mA = 100-0  $\mu$ S), Close switch #4.

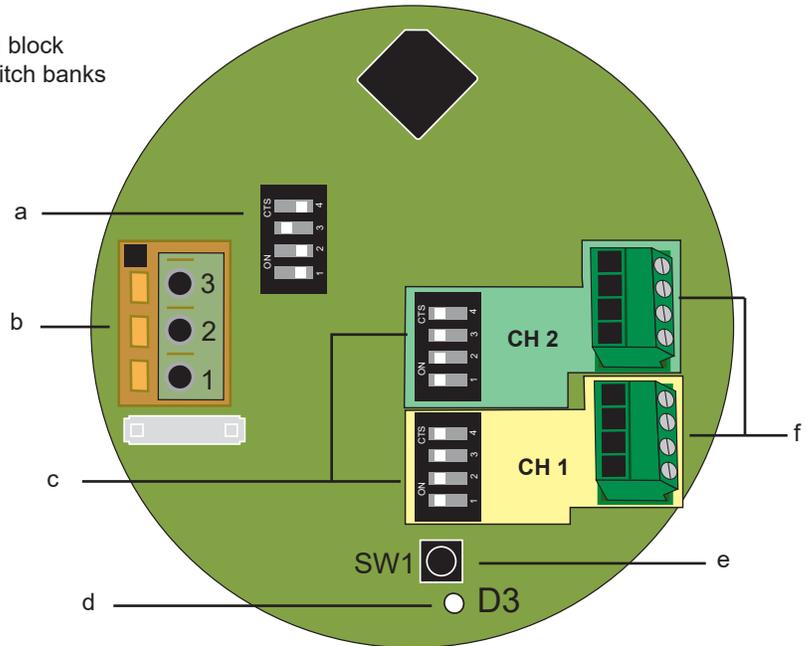


SW2 Switch setting				0.01 Cell	0.10 Cell	1.0 Cell	10.0 Cell	20.0 Cell
#1	#2	#3	#4	Resistivity Ranges in BOLD				
C	C	C	O	10 to 20 M $\Omega$	0 to 2 $\mu$ S	0 to 20 $\mu$ S	0 to 200 $\mu$ S	0 to 400 $\mu$ S
C	C	C	C	20 to 10 M $\Omega$	2 to 0 $\mu$ S	20 to $\mu$ S	200 to 0 $\mu$ S	400 to 0 $\mu$ S
O	C	C	O	2 to 10 M $\Omega$	0 to 5 $\mu$ S	0 to 50 $\mu$ S	0 to 500 $\mu$ S	0 to 1000 $\mu$ S
O	C	C	C	10 to 2 M $\Omega$	5 to 0 $\mu$ S	50 to 0 $\mu$ S	500 to 0 $\mu$ S	1000 to 0 $\mu$ S
C	O	C	O	0 to 2 M $\Omega$	0 to 10 $\mu$ S	0 to 100 $\mu$ S	0 to 1 000 $\mu$ S	0 to 2000 $\mu$ S
C	O	C	C	2 to 0 M $\Omega$	10 to 0 $\mu$ S	100 to 0 $\mu$ S	1 000 to 0 $\mu$ S	2000 to 0 $\mu$ S
O	O	C	O	0 to 1 $\mu$ S	0 to 50 $\mu$ S	0 to 500 $\mu$ S	0 to 5 000 $\mu$ S	0 to 10000 $\mu$ S
O	O	C	C	1 to 0 $\mu$ S	50 to 0 $\mu$ S	500 to 0 $\mu$ S	5 000 to 0 $\mu$ S	10000 to 0 $\mu$ S
<b>C</b>	<b>C</b>	<b>O</b>	<b>O</b>	0 to 5 $\mu$ S	<b>0 to 100 <math>\mu</math>S</b>	0 to 1 000 $\mu$ S	0 to 10 000 $\mu$ S	0 to 20 000 $\mu$ S
C	C	O	C	5 to 0 $\mu$ S	100 to 0 $\mu$ S	1 000 to 0 $\mu$ S	10 000 to 0 $\mu$ S	20 000 to 0 $\mu$ S
O	C	O	O	0 to 10 $\mu$ S	0 to 200 $\mu$ S	0 to 2 000 $\mu$ S	0 to 50 000 $\mu$ S	0 to 100 000 $\mu$ S
O	C	O	C	10 to 0 $\mu$ S	200 to 0 $\mu$ S	2 000 to 0 $\mu$ S	50 000 to 0 $\mu$ S	100 000 to 0 $\mu$ S
C	O	O	O	0 to 50 $\mu$ S	0 to 500 $\mu$ S	0 to 5 000 $\mu$ S	0 to 100 000 $\mu$ S	0 to 200 000 $\mu$ S
C	O	O	C	50 to 0 $\mu$ S	500 to 0 $\mu$ S	5 000 to 0 $\mu$ S	100 000 to 0 $\mu$ S	200 000 to 0 $\mu$ S
O	O	O	O	0 to 100 $\mu$ S	0 to 1 000 $\mu$ S	0 to 10 000 $\mu$ S	0 to 200 000 $\mu$ S	0 to 400 000 $\mu$ S
O	O	O	C	100 to 0 $\mu$ S	1 000 to 0 $\mu$ S	10 000 to 0 $\mu$ S	200 000 to 0 $\mu$ S	400 000 to 0 $\mu$ S
C = CLOSED O = OPEN				Switch #4 inverts the output: OPEN = 4-20 mA, CLOSED = 20-4 mA				

## 10. Calibration

- All 2850 Conductivity/Resistivity Sensor Electronics are factory-calibrated for maximum out-of-the-box accuracy.
- The Easy-Cal feature allows calibration to be performed at the sensor.

- a. SW2: 4-20 mA output range selection switch bank
- b. Power and 4 to 20 mA or Digital (S<sup>3</sup>L) output terminal block
- c. SW3 and SW4: Electrode Cell Constant selection switch banks
- d. D3: LED indicator
- e. SW1: Easy-Cal Push-button
- f. Conductivity Electrode connections



### 10.1 Easy-Cal

Easy-Cal is a single-point calibration system. During this procedure, if the measured value is within  $\pm 10\%$  of any of the test values listed below, the 2850 will automatically recognize the test value and calibrates the output to that value.

#### Note:

The first step (Reset) is recommended each time an electrode is replaced, but is NOT necessary upon initial installation or periodic calibration.

1. **Reset** the 2850 Sensor to factory calibration: Set all switches on SW3 (and SW4 for dual input) to OPEN. Apply power, wait at least 3 seconds, then press and hold SW1 until the LED (D3) comes on steady then goes off again (approx. 10 seconds). When the LED goes off, release SW1; reset is complete. Reset SW3 and SW4 to the proper settings.
2. **Place** the electrode/sensor assembly into the conductivity test solution appropriate to your operating range. Shake the electrode to dislodge any air bubbles visible on the surface of the electrode.
  - 146.93  $\mu\text{S}$ , 1408.8  $\mu\text{S}$ , 12856  $\mu\text{S}$  (per ASTM D1125-95)
  - 10  $\mu\text{S}$ , 100  $\mu\text{S}$ , 200  $\mu\text{S}$ , 500  $\mu\text{S}$ , 1000  $\mu\text{S}$ , 5000  $\mu\text{S}$ , 10,000  $\mu\text{S}$ , 50,000  $\mu\text{S}$ , 100,000  $\mu\text{S}$
- Allow at least 2 minutes for the electrode response to stabilize.
3. **Press** and hold SW1 for approximately 8 to 10 seconds. During this time, the LED will come on steady then go back off. (If the LED blinks several times rapidly, the calibration was not successful. See the troubleshooting section.)

Calibration is complete. Return the system to service.

#### Calibrating the Dual-channel model 3-2850-63

- The 2850-63 can only be calibrated if both channels are used, or if channel 2 is disabled.
  - To disable channel 2: Set SW4, #4 to OPEN.
- Place each sensor into a test solution that represents the operating range of that sensor. When SW1 is pressed, the 2850 will calibrate both channels simultaneously.
- Dual channel applications usually include one sensor with a smaller cell constant and one sensor with a larger cell constant. Place the larger cell constant on channel 1. This allows periodic recalibration of the larger cell by simply turning channel 2 OFF.

## 11. Maintenance

- The 2850 requires no periodic maintenance.
- Coatings on the electrode may cause slow response or drift.  
Clean metallic surfaces with a mild detergent and a non-abrasive brush or cotton swab.

### 11.1 Troubleshooting

LED and Output Condition	Possible Causes	Suggested Solutions
<b>Current Out:</b> <b>LED off, current output is 22 mA</b>  <b>S<sup>3</sup>L out: "Check Sensor"</b>	<ul style="list-style-type: none"> <li>• SW3 and SW4 set to all OPEN (factory setting)</li> <li>• No electrode installed</li> <li>• SW3 (and SW4) not set correctly</li> <li>• System not ready</li> </ul>	<ul style="list-style-type: none"> <li>• Normal for new system</li> <li>• Install electrode</li> <li>• Set SW3 and SW4 correctly</li> <li>• Retry (recycle power)</li> </ul>
<b>During EasyCal, the LED blinks rapidly for 4 seconds.</b>	<ul style="list-style-type: none"> <li>• Measured value of the test solution is outside the <math>\pm 10\%</math> tolerance.</li> <li>• The electronics or the electrode is defective.</li> </ul>	<ul style="list-style-type: none"> <li>• Use fresh test solutions and restart the calibration.</li> <li>• Replace the electronics or the electrode.</li> </ul>
<b>After completing calibration procedure, the output values are inaccurate.</b>	<ul style="list-style-type: none"> <li>• Insufficient time allowed for electrode stabilization during Cal procedure.</li> <li>• Test solutions are contaminated.</li> <li>• EZ-Cal performed with temp comp OFF, then temp comp turned ON for measurement. (or vice versa)</li> </ul>	<ul style="list-style-type: none"> <li>• Recalibrate and wait at least 2 minutes after placing electrode in solution before pressing SW1.</li> <li>• Use fresh test solutions and restart the calibration.</li> </ul>
<b>The output of the 2850 indicates a value that is off by a factor of 10 (ie: 10x, 100x the correct value)</b>	<ul style="list-style-type: none"> <li>• The cell constant selection on the 2850 (SW3 or SW4) does not match the actual input.</li> </ul>	<ul style="list-style-type: none"> <li>• Match the 2850 switch settings to agree with the sensor being used.</li> </ul>

### Electronic Certification/Calibration

Signet offers conductivity simulators in five different values. These tools enable the user to validate the performance of the electronics independently of the electrode. This requirement is defined by ASTM D 1125-95 (Standard Test Methods for Electrical Conductivity and Resistivity of Water) which is commonly used for USP 24 applications.



3-2850.101-1 (159 001 392)	1.0 $\mu\text{S} \pm 0.1\%$	3-2850.101-2 (159 001 393)	2.5 $\mu\text{S} \pm 0.1\%$
3-2850.101-3 (159 001 394)	10.0 $\mu\text{S} \pm 0.1\%$	3-2850.101-4 (159 001 395)	18.2 M $\Omega \pm 0.1\%$
3-2850.101-5 (159 001 396)	10.0 M $\Omega \pm 0.1\%$		

#### Before using the Simulator:

Before using the simulators, disconnect all electrodes and reset the 2850 Electronics to factory calibration:

1. Set all switches on SW3 (and SW4 for dual input) to OPEN. Turn the power on, wait at least 3 seconds
2. Press and hold SW1 until the LED (D3) comes on steady then goes off again (approx. 10 seconds).
3. When the LED goes off, release SW1. Reset is complete.

#### To validate channel 1:

1. Turn the power off.
2. Set SW3 to accept a 0.01 cell constant. Leave SW4 in the all-OPEN position.
3. Install the simulator into the 2850 at the channel 1 conductivity electrode terminals.
4. Connect the 2850 output terminals to the appropriate display instrument. Turn the power on.
  - The display should indicate a conductivity value within  $\pm 2\%$  of the simulator value.
  - If the output is x10 or x100 of the correct value, recheck step 2. The 2850 is not set to accept a 0.01 cell constant.
  - If the correct value is displayed, the electronics are calibrated to ASTM D 1125 specifications. Remove the simulator and reset SW3 to the correct cell constant before reinstalling the electrode.
  - If the correct value is not displayed, contact the factory.

#### To validate channel 2:

1. Turn the power off.
2. Set SW4 to accept a 0.01 cell constant.
3. Install the simulator into the 2850 at the channel 2 conductivity electrode terminals.
4. Set SW3 switches to the all-OPEN position.
5. Turn the power on and repeat step 4.

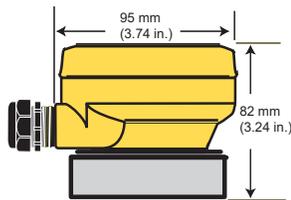
**Remember** to reset all switches to their correct position before resuming normal operation.

## 12. Ordering Information

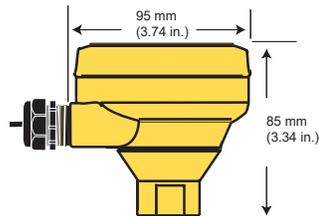
Mfr. Part No.	Code	Description
3-2850-51	159 001 398	2850 Sensor Electronics w/ Digital Output and 3/4 inch adapter
3-2850-52	159 001 399	2850 Sensor Electronics w/ 4-20 mA Output and 3/4 inch adapter
3-2850-61	159 001 400	2850 Sensor Electronics w/ Digital Output and Universal adapter
3-2850-62	159 001 401	2850 Sensor Electronics w/ 4-20 mA Output and Universal adapter
3-2850-63	159 001 402	2850 Sensor Electronics w/ Dual Inputs, Digital Outputs and Universal adapter
3-2850-51-39	159 001 339	Integral 2850 system, Digital (S <sup>3</sup> L) output, 0.01 cell, NPT threads
3-2850-51-40	159 001 340	Integral 2850 system, Digital (S <sup>3</sup> L) output, 0.1 cell, NPT threads
3-2850-51-41	159 001 341	Integral 2850 system, Digital (S <sup>3</sup> L) output, 1.0 cell, NPT threads
3-2850-51-42	159 001 342	Integral 2850 system, Digital (S <sup>3</sup> L) output, 10.0 cell, NPT threads
3-2850-51-39D	159 001 343	Integral 2850 system, Digital (S <sup>3</sup> L) output, 0.01 cell, ISO threads
3-2850-51-40D	159 001 344	Integral 2850 system, Digital (S <sup>3</sup> L) output, 0.1 cell, ISO threads
3-2850-51-41D	159 001 345	Integral 2850 system, Digital (S <sup>3</sup> L) output, 1.0 cell, ISO threads
3-2850-51-42D	159 001 346	Integral 2850 system, Digital (S <sup>3</sup> L) output, 10.0 cell, ISO threads
3-2850-52-39	159 001 347	Integral 2850 system, 4-20 mA output, 0.01 cell, NPT threads
3-2850-52-40	159 001 348	Integral 2850 system, 4-20 mA output, 0.1 cell, NPT threads
3-2850-52-41	159 001 349	Integral 2850 system, 4-20 mA output, 1.0 cell, NPT threads
3-2850-52-42	159 001 350	Integral 2850 system, 4-20 mA output, 10.0 cell, NPT threads
3-2850-52-39D	159 001 351	Integral 2850 system, 4-20 mA output, 0.01 cell, ISO threads
3-2850-52-40D	159 001 352	Integral 2850 system, 4-20 mA output, 0.1 cell, ISO threads
3-2850-52-41D	159 001 353	Integral 2850 system, 4-20 mA output, 1.0 cell, ISO threads
3-2850-52-42D	159 001 354	Integral 2850 system, 4-20 mA output, 10.0 cell, ISO threads

### Parts and Accessories

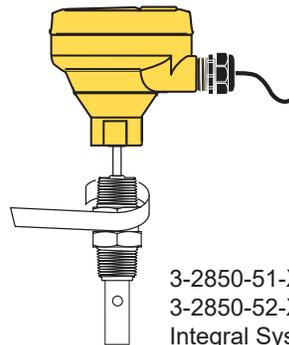
Mfr. Part No.	Code	Description
3-9000.392-1	159 000 839	Liquid-tight connector kit, 1 set, 1/2 in. NPT
3-9000.392-2	159 000 841	Liquid-tight connector kit, 1 set, PG 13.5
3-9000.392-3	159 001 430	Liquid-tight connector kit, dual-cable gland
3-2850.101-1	159 001 392	Plug-in NIST traceable recertification tool, 1.0 µS
3-2850.101-2	159 001 393	Plug-in NIST traceable recertification tool, 2.5 µS
3-2850.101-3	159 001 394	Plug-in NIST traceable recertification tool, 10.0 µS
3-2850.101-4	159 001 395	Plug-in NIST traceable recertification tool, 18.2 MΩ
3-2850.101-5	159 001 396	Plug-in NIST traceable recertification tool, 10.0 MΩ



3-2850-61  
3-2850-62  
3-2850-63  
Electronics w/Universal adapter



3-2850-51  
3-2850-52  
Electronics w/3/4 in. adapter



3-2850-51-XX  
3-2850-52-XX  
Integral System



3-2850.101-1 NIST traceable recertification tool, 1.0 µS



George Fischer Signet, Inc., 3401 Aerojet Avenue, El Monte, CA 91731-2882 U.S.A. • Tel. (626) 571-2770 • Fax (626) 573-2057  
For Worldwide Sales and Service, visit our website: [www.gfsignet.com](http://www.gfsignet.com) • Or call (in the U.S.): (800) 854-4090





# +GF+ SIGNET 2350 Temperature Sensor

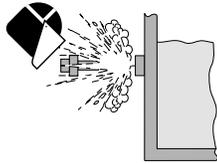


3-2350.090-1

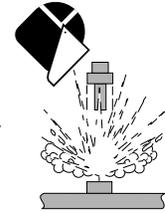


D (11/02) English

## Safety Instructions



- Prior to installation or removal:
  - Depressurize and vent system
  - Drain below sensor level
- Confirm chemical compatibility before use.
- Do not exceed maximum temperature/pressure specifications.
- Wear safety goggles or faceshield during installation/service.
- Do not alter product construction.
- Dispose of properly; DO NOT INCINERATE!



## Table of Contents

- Description
- Specifications
- Installation
- S<sup>3</sup>L™ wiring
- 4 to 20 mA wiring
- 4 to 20 mA span adjustment
- Ordering information

## 1. Description

The 2350 Temperature Sensor has a one-piece injection molded PVDF body that is ideal for use in high purity applications. It also outlasts metal sensors in aggressive liquids and eliminates the need for costly custom thermowells. These sensors are available with S<sup>3</sup>L™ digital output or field-scaleable 4 to 20mA output. Dual threaded ends (3/4 in. NPT) allow submersion in process vessels, or in-line installation with conduit connection. Integral adapters (sold separately) may be used to create a compact assembly with field mount versions of the 8350 Temperature Transmitter.

## 2. Specifications

### Compatibility

	5001	8350	8900
2350-1, -2	●	●	●
2350-3	●		

### 2.1 General

Wetted material: PVDF  
 Temperature range: -10°C to 100°C (14°F to 212°F)  
 Response time, τ: 10 s  
 Process connection: 3/4 in. NPT male thread  
 Rear connection: 3/4 in. NPT male thread  
 Cable type: 3 cond + shield, 22 AWG  
 Black/Red/White/Shield

### Standard cable length:

- 2350-1, -3: 4.6 m (15 ft.)
  - 2350-2: 16 cm (6 in.)
- Shipping weight: .22 kg (0.5 lb)

### Power requirements:

- S<sup>3</sup>L™ models: 5 VDC ±10%, <1.5 mA
- 4-20 mA models: 12-24 VDC ±10%

Short circuit & reverse polarity protected

### S<sup>3</sup>L™ output:

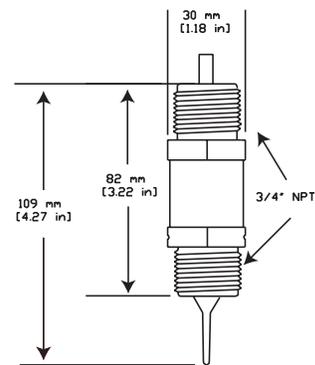
Serial ASCII, TTL level 9600 bps

- Accuracy: ±0.5°C (±0.9°F)
- Repeatability: ±0.1°C (±0.2°F)
- Resolution: 0.1°C (0.2°F)
- Update rate: <100 ms

### 4-20 mA output:

- Accuracy: ±0.5% of full scale
- Repeatability: ±0.1°C (±0.2°F)
- Resolution: <5 μA
- Span: Factory set 4 to 20 mA = 0°C to 100°C, Field-scaleable.
- Max loop impedance: 50Ω @ 12 V  
325Ω @ 18 V  
600Ω @ 24 V
- Update rate: <100 ms

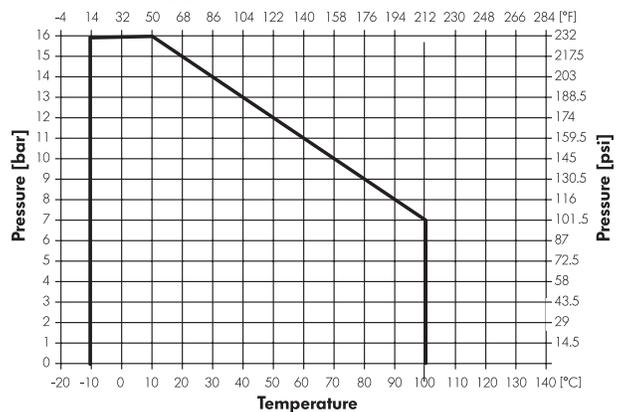
## Dimensions



## Environmental

- Relative humidity: 0 to 95% (Non-condensing)
- Storage temperature: -55°C to 100°C (-67°F to 212°F)
- Operating temperature: -10°C to 100°C (14°F to 212°F)

## Application Limits



## Approvals & Standards

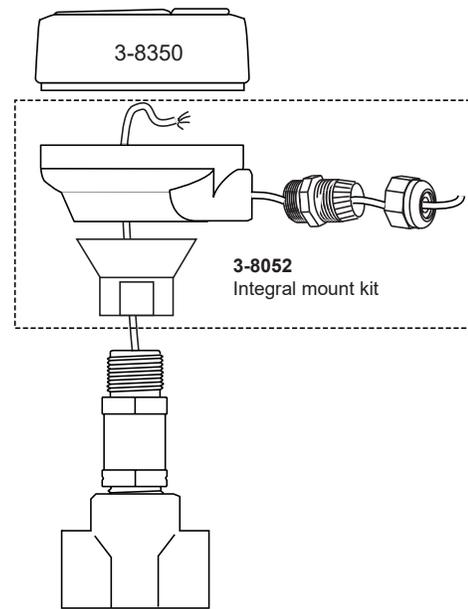
- CE
- EN 61326-2 Heavy Industry Immunity
- EN 55011 Class A Heavy Industry Emissions
- Manufactured under ISO 9001 and ISO 14001

### 3. Installation

#### 3.1 2350-2 Integral Assembly

The 3-8052 Integral Kit connects the 8350 Temperature Transmitter directly onto the 2350 sensor.

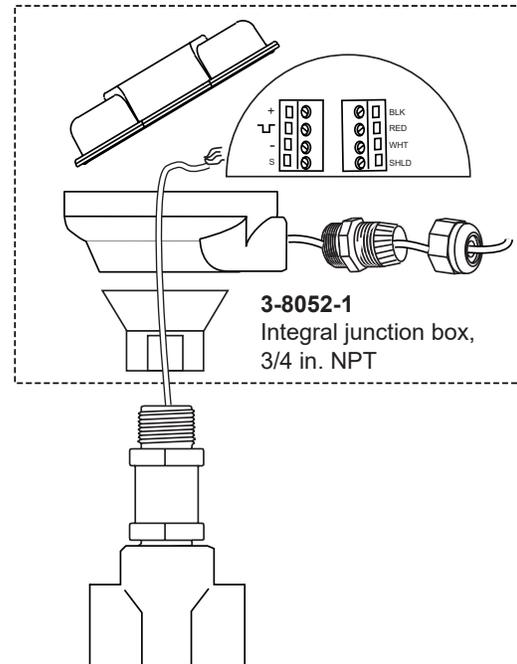
- Use the 2350-2 sensor with 6 in. cable and S<sup>3</sup>L™ output.
- The 3-8052 Integral kit includes:
  - 3/4 in. NPT process connection
  - 3-9000.392-1 liquid tight connector, 1/2 in. NPT
  - Conduit base to attach 8350.
- Apply sealant or PTFE tape to the process connection threads, after inspecting threads to ensure integrity. Do not install a sensor with damaged threads.
- Tighten the sensor 1 1/2 turns past finger tight into the process connection.



#### 3.2 2350-2 or 2350-3 In-line Remote Assembly

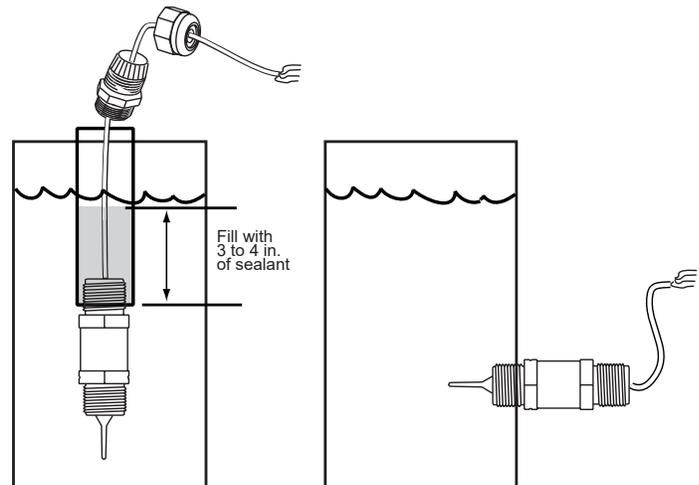
The optional 3-8052-1 Integral Junction box with 3/4 in. process connection offers a convenient terminal point to extend the 2350 cable over a distance.

- The kit includes:
  - 3/4 in. NPT process connection
  - Conduit base and cap with junction terminals
  - 3-9000.392-1 liquid tight connector, 1/2 in. NPT
- Apply sealant or PTFE tape to the process connection threads, after inspecting threads to ensure integrity. Do not install a sensor with damaged threads.
- Tighten the sensor 1 1/2 turns past finger tight into the process connection.



#### 3.3 2350-1 or 2350-3 Submersible Installation

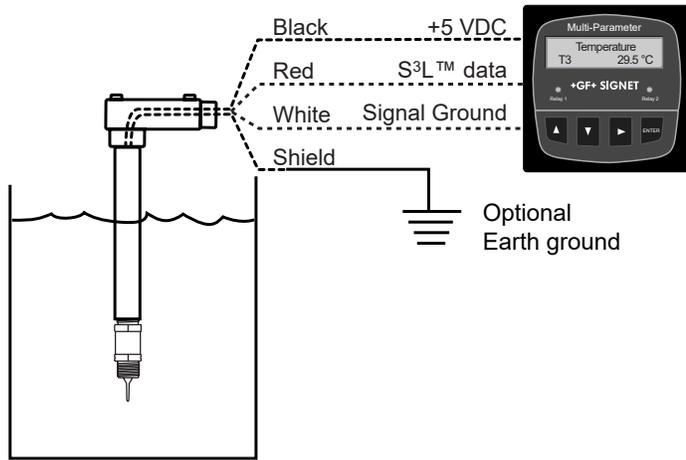
- Use the 2350-1 or 2350-3 sensor with 15 ft. cable.
- Mount the sensor to an extension pipe or watertight conduit using thread sealant.
- Use a cable gland at the top of the extension to prevent moisture intrusion/accumulation inside the pipe.
- For additional defense against possible accumulation of condensation at the back seal area of the sensor, fill the lower 3-4 inches (75-100 mm) of conduit or extension pipe with a flexible sealant such as silicone.
- The 8050-1 and the 8052-1 junction boxes can be useful accessories for this installation option.



## 4. S<sup>3</sup>L™ Wiring

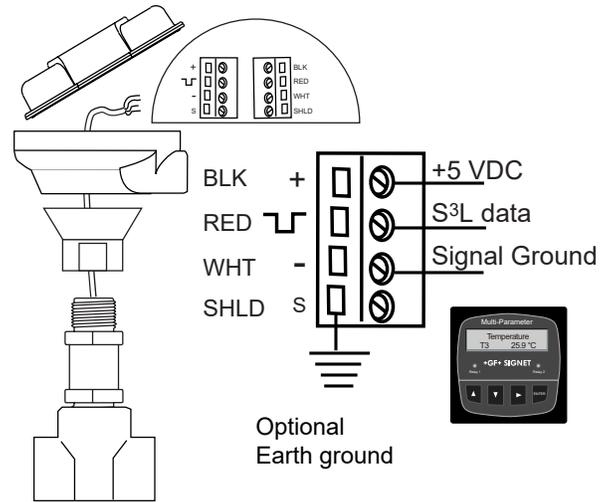
- All models of the 2350 provide S<sup>3</sup>L™ output when powered with 5 VDC.
- Connecting the SHIELD to a direct Earth ground may reduce electrical noise interference.
- The maximum S<sup>3</sup>L™ cable length is dependent upon the instrument to which the sensor is connected. Consult the instrument manual for details.

### 4.1 S<sup>3</sup>L™ With No Junction Box



- Connect the 2350 cable directly to S<sup>3</sup>L I/O terminals.

### 4.2 S<sup>3</sup>L™ with Junction Box

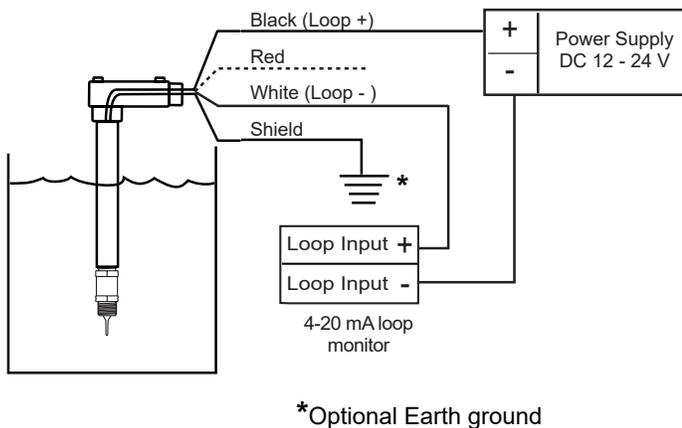


- When the 2350 includes a junction box, connect the 2350 terminals to any S<sup>3</sup>L™ I/O port as shown.

## 5. 4-20 mA Loop Wiring

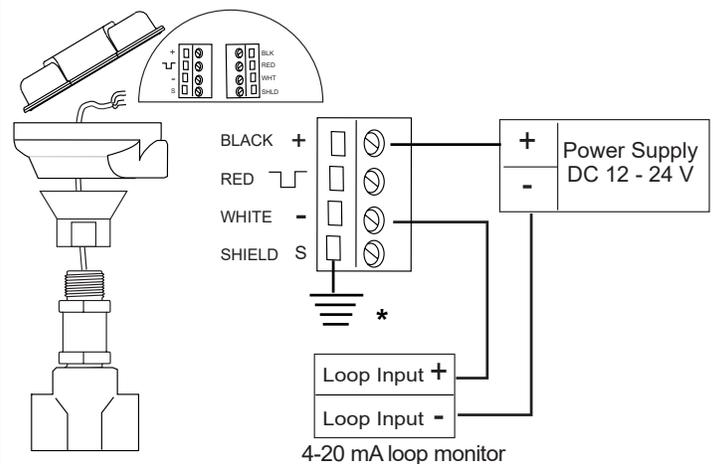
- The 2350-3 provides a 4-20 mA loop output when powered with 24 VDC.
- Connecting the SHIELD to a direct Earth ground may reduce electrical noise interference.

### 5.1 Current Loop With No Junction Box



- Connect the 2350 cable directly to a loop device as shown.

### 5.2 Current Loop With Junction Box



- \*Optional Earth ground

- When the 2350 includes a junction box, connect the 2350 terminals to a loop device as shown.

## 6. 4 to 20mA Span Adjustment

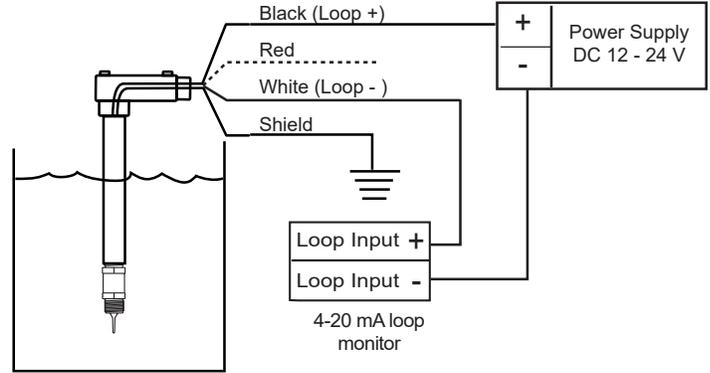
The 4 to 20 mA endpoint values are independent of one another and may be adjusted in the field. For example, to reduce the 20 mA endpoint value from the factory limit of 100°C, but to allow the 4 mA endpoint to remain at 0°C, perform only the steps listed in 6.2 below.

**NOTE:** The RED wire, which is not connected during normal 4 to 20 mA operation, assumes an important role in the following procedures.

### 6.1 To adjust the 4mA endpoint in the field:

- Expose the sensor to the temperature desired to correspond with 4 mA (-10 to 100°C).  
(Be sure to allow sufficient time for the sensor to equilibrate to this temperature.)
- With power applied as described in Section 5, connect the RED wire to the WHITE wire for 15 seconds.  
(After about 10 seconds the output will drop to 3.6 mA and remain there until the RED wire is disconnected.)
- Disconnect the RED wire from the WHITE wire; the 4 mA endpoint has been adjusted.

**NOTE:** The output will act as a switch if the 4 and 20 mA endpoints are set very near to the same value.



### 6.2 To adjust the 20 mA endpoint in the field:

- Expose the sensor to the temperature desired to correspond with 20 mA (-10 to 100°C).  
(Be sure to allow sufficient time for the sensor to equilibrate to this temperature.)
- With power applied as described in Section 5, connect the RED wire to the BLACK wire for 15 seconds.  
(After about 10 seconds the output will rise to 22 mA and remain there until the RED wire is disconnected.)
- Disconnect the RED wire from the BLACK wire; the 20 mA endpoint has been adjusted.

**NOTE:** The output will act as a switch if the 4 and 20 mA endpoints are set very near to the same value. Minimum span is  $\pm 2\%$  of maximum range.

### 6.3 To restore the factory setting:

- Disconnect power to the sensor. Wait 10 s for circuit to discharge.
- Connect the RED wire to the WHITE wire.
- Apply power as described in Section 5, but with the RED wire connected to the WHITE wire for 15 seconds.  
(After about 10 seconds the output will drop to 3.6 mA and remain there until the RED wire is disconnected.)
- Disconnect the RED wire from the WHITE wire; factory settings have been restored.

Mfr. Part No.	Factory Span
3-2350-3	4 to 20 mA = 0°C to 100°C

## 7. Ordering Information

Mfr. Part No.	Code	Description
3-2350-1	159 000 021	Temperature sensor, S <sup>3</sup> L™ output, 3/4 in. NPT, 4.6 m (15 ft.) cable
3-2350-2	159 000 022	Temperature sensor, S <sup>3</sup> L™ output, 3/4 in. NPT, 16 cm (6 in.) cable
3-2350-3	159 000 911	Temperature sensor, 4 to 20 mA output, 3/4 in. NPT, 4.6 m (15 ft.) cable

### Accessories

Mfr. Part No.	Code	Description
3-8050-1	159 000 753	Universal mount junction box
3-8052	159 000 188	3/4 in. Integral mounting kit
3-8052-1	159 000 755	3/4 in. NPT mount junction box
3-9000.392-1	159 000 839	Liquid tight connector kit, NPT (1 piece)
3-9000.392-2	159 000 841	Liquid tight connector kit, PG13.5 (1 piece)
5523-0322	159 000 761	Cable, 3 conductor + shield, 22 AWG, black/red/white/shield

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## SAFETY INSTRUCTIONS

1. Depressurize and vent system prior to installation or removal.
2. Confirm chemical compatibility before use.
3. Do not exceed maximum temperature/pressure specifications.
4. Wear safety goggles or faceshield during installation/service.
5. Do not alter product construction
6. If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
7. **This device is not approved for use or installation in hazardous locations.**



## Description

The 2537 Paddlewheel Flowmeter Series offer low flow, low power and high resolution with various output options such as a flow switch, pulse divider, Digital (S<sup>3</sup>L), or 4-20 mA. This unit can be configured on-site directly through the built-in user interface.

- The Digital model provides a digital (S<sup>3</sup>L) output for use with the Signet 8900 Multi-Parameter Controller.
- The 4-20 mA model provides a blind current loop output.
- The Flow Switch Model uses a single relay (mechanical or solid state) for Hi or Lo alarm operation.
- The Pulse model uses a single relay (mechanical or solid state) and has two selectable operating modes:
  - The Divider mode scales the paddlewheel frequency down to accommodate low frequency input devices.
  - In Total mode, the Pulse Model becomes a traditional pump pulser, able to output one pulse per a set volume of fluid.

A small LCD enables the 2537 to be programmed without any external equipment. During normal operation the display is not visible.

## Specifications

### General

#### Wetted Materials

Model Suffix	Sensor Body	Rotor	Pin	O-ring
-P0, -P1	glass-filled PP	PVDF, Black	Titanium	FPM
-T0	PVDF, Natural	PVDF, Natural	PVDF, Natural	FPM

Case: PBT, yellow  
 Inside cover: Valox, black  
 Wiring ports: ½ in. NPT threads; liquid-tight connector accepts cables 7-10 mm od (0.275-0.394 in.)

#### Power requirements

Pulse, Flow Switch  
 With dry-contact relay: 24 VDC nominal (21.6 VDC min. to 26.4 VDC max.)  
 30 mA max current  
 With solid-state relay: 5 to 24 VDC nominal (5.0 VDC min to 26.4 VDC max.)  
 30 mA max current  
 Digital (S<sup>3</sup>L): 5 VDC nominal (5.0 VDC min to 6.5 VDC max.)  
 30 mA max current (1.5 mA nominal)  
 4-20 mA: 12 VDC to 32 VDC nominal (10.8 VDC min to 35.2 VDC max.)  
 400 mV max ripple voltage  
 30 mA max current  
 Reverse Polarity and short circuit protected: Up to 40V, 1 hour  
 Over-voltage protection: +60 VDC, -50 VDC

#### Paddlewheel sensor performance specifications

Pipe Size Range: DN15 to DN 200 (½ in. to 8 in.)  
 Min. Reynolds Number: 4500  
 Paddlewheel Frequency: 49 Hz per m/s nominal (15 Hz per ft/s nominal)  
 Operating Range: 0.1 m/s to 6 m/s (0.3 ft/s to 20 ft/s)  
 Linearity: ±1% of max. range @ 25°C (77°F)  
 Repeatability: ±0.5% of max. range @ 25°C (77°F)

#### Electronics performance specifications

Input Frequency Range: 1 Hz to 1000 Hz  
 System Response: 100 ms update rate nominal

#### Environmental Requirements

Enclosure rating: NEMA 4X/IP65  
 Storage Temperature: -10°C to 75°C  
 Ambient Temperature: 0°C to 65°C  
 Relative Humidity: 0 to 90% RH, non-condensing  
 Altitude: 2000 m (6562 ft.)  
 Pollution Degree: 2

#### Output specifications

Signal Averaging: Programmable 0 to 100 seconds  
 Sensitivity Response: Programmable 0 to 9 scale  
**Pulse divider/Total pulse output**  
 Pulse Divider Setting: 1.0000 to 99999  
 Maximum pulse rate: 300 Hz  
 Maximum pulse width: 50 ms

#### Flow switch output

Relay Modes: Low, High  
 Time Delay: 0.0 to 6400.0 seconds  
 Hysteresis: Adjustable in Engineering Units

#### Relay Specifications

Mechanical SPDT: 5A @ 30 VDC, 5A @ 250VAC  
 Solid-State Relay: 100mA @ 40VDC, 70 mA @ 33 VAC

#### Digital (S<sup>3</sup>L) output

Type: Serial ASCII, TTL level 9600 bps  
 Maximum cable length: See S<sup>3</sup>L specifications

#### Current output (Passive 4 to 20 mA)

Loop Accuracy: ±32 µA (@ 25°C @ 24 VDC)  
 Loop resolution: 5 µA  
 Temp. drift: ±1 µA per °C max.  
 Power supply rejection: ±1 uA per V  
 Maximum cable: 300 m (1000 ft.)  
 Max Loop Resistance: 600Ω @ 24 VDC, 1KΩ @ 32 VDC

#### Standards & Approvals

- UL
  - CE
  - EN61326: Immunity and Emissions for Control Equipment
  - EN61010: Safety requirements for electrical equipment
- George Fischer Signet, Inc. maintains an ISO 9001 Quality System and an ISO 14001 Environmental System

## Fluid Conditions

Pressure/Temperature Ratings:

Polypropylene Body:

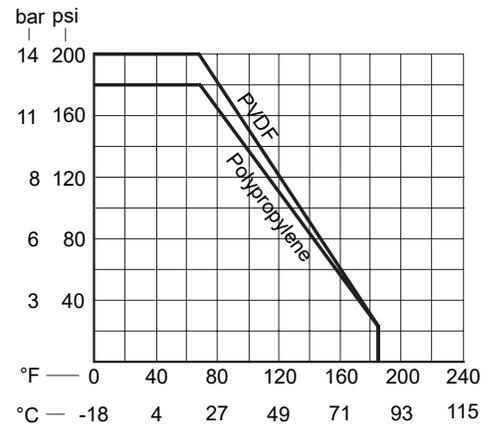
- 12.5 bar (180 psi) max. @ 20 °C (68 °F)
- 1.7 bar (25 psi) max. @ 85 °C (185 °F)

PVDF Body:

- 14 bar (200 psi) max @ 20 °C (68 °F)
- 1.7 bar (25 psi) max @ 85 °C (185 °F)

**Intended Use:** This product is intended for use in industrial water treatment and waste water treatment applications where the chemical content and the fluid temperatures are consistent with the specifications listed herein.

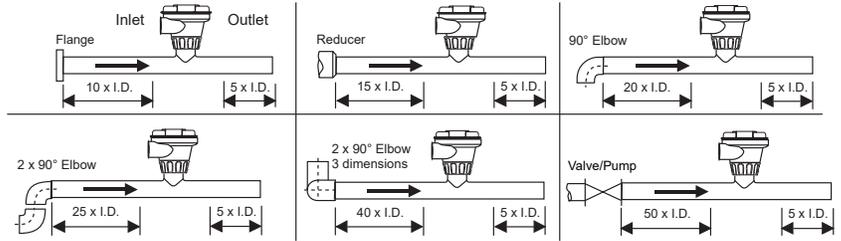
**This device is not approved for use or installation in flammable liquids.**



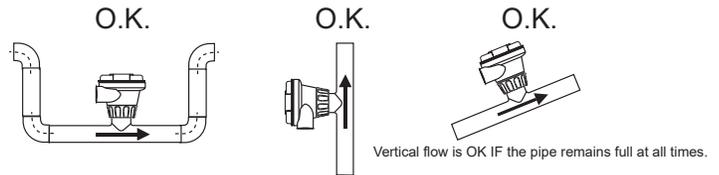
## Location of Fitting

Recommended sensor upstream/downstream mounting requirements

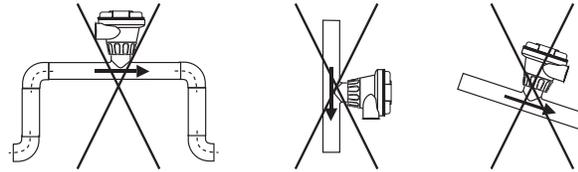
Select a location with sufficient length of straight pipe immediately upstream of the sensor.



Locating the sensor in a trap or where the flow is upward helps to protect the sensor from exposure to air bubbles when the system is in operation.

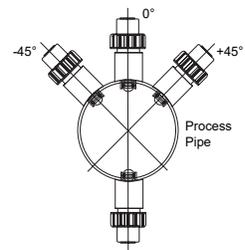


These configurations are not recommended because it is difficult to keep the pipe full.



## Sensor Mounting Position

- Horizontal pipe runs: Mount sensor in the upright (0°) position for best performance. Mount at a maximum of 45° when air bubbles are present (pipe must be full). Do not mount on the bottom of the pipe when sediments are present.
- Vertical pipe runs: Mount sensor in any orientation, however, downward flow is not recommended. Upward flow is preferred to ensure full pipe.



## Installation: Pipe fittings

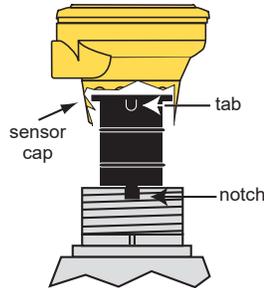
George Fischer Signet offers a wide selection of installation fittings that control the position of the paddlewheel in relation to the dimensions of the pipe.

Type	Description	Type	Description
<p>Plastic tees</p>	<ul style="list-style-type: none"> <li>• 0.5 to 4 inch versions</li> <li>• PVC or CPVC</li> </ul>	<p>Iron, Carbon Steel, 316 SS Threaded tees</p>	<ul style="list-style-type: none"> <li>• 0.5 to 2 inch versions</li> <li>• Mounts on threaded pipe ends</li> </ul>
<p>Metric Union Fitting</p>	<ul style="list-style-type: none"> <li>• For pipes from DN 15 to 50 mm</li> <li>• PP or PVDF</li> </ul>	<p>Carbon steel &amp; stainless steel Weld-on Weldolets</p>	<ul style="list-style-type: none"> <li>• 2 to 4 inch, cut 1-7/16 inch hole in pipe</li> <li>• Over 4 inch, cut 2-1/8 inch hole in pipe</li> </ul>
<p>PVC Saddles</p>	<ul style="list-style-type: none"> <li>• 2 to 4 inch, cut 1-7/16 inch hole in pipe</li> <li>• 6 to 8 inch, cut 2-1/8 inch hole in pipe</li> </ul>	<p>Fiberglass tees &amp; saddles: FPT FPS</p>	<ul style="list-style-type: none"> <li>• 1.5 inch to 8 in. PVDF insert</li> <li>• &gt; 8 inch PVC insert</li> </ul>
<p>Iron Strap-on saddles</p>	<ul style="list-style-type: none"> <li>• 2 to 4 inch, cut 1-7/16 inch hole in pipe</li> <li>• Over 4 inch, cut 2-1/8 inch hole in pipe</li> </ul>	<p>Metric Wafer Fitting</p>	<ul style="list-style-type: none"> <li>• For pipes DN 65 to 200 mm</li> <li>• PP or PVDF</li> </ul>

### 3. Installation

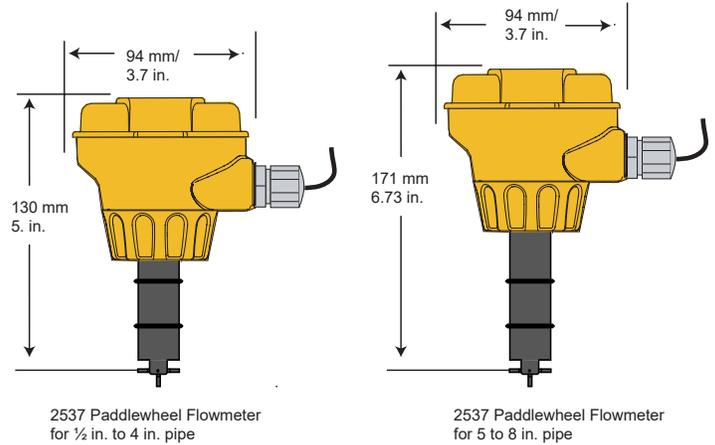
#### 3.3 Plastic sensor installation tips

- Inspect the sensor O-rings for nicks and other damage that may compromise the seal.
- Lubricate the sensor O-rings with a suitable lubricant before each installation. Do not use any petroleum based lubricant, which can attack the O-rings.
- Using an alternating/twisting motion, lower the sensor into the fitting, making sure the conduit ports on the yellow housing are pointing in the direction of flow.
- Engage one thread of the sensor cap then turn the sensor until the alignment tab is seated in the fitting notch.
- Hand tighten the sensor cap.



**DO NOT USE ANY TOOLS ON THE SENSOR CAP.**

#### Dimensions

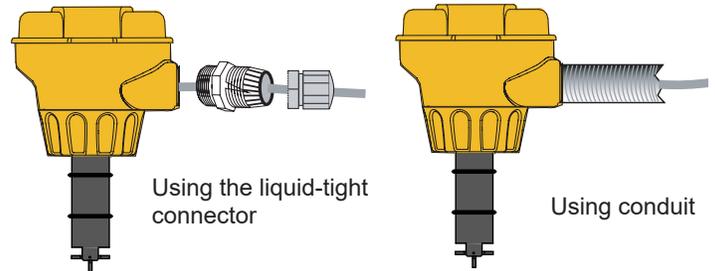
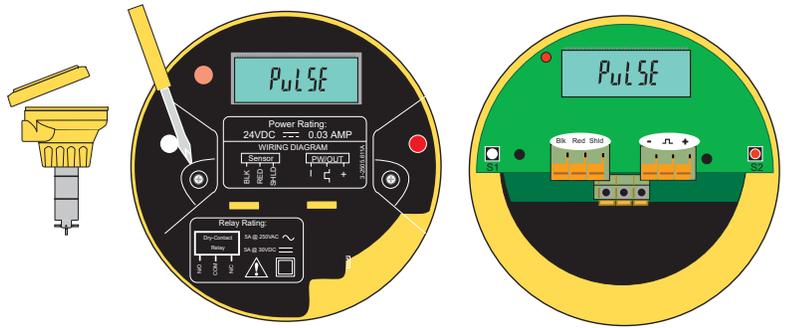


### Wiring

Electrical connections to this product should be made only by qualified personnel.

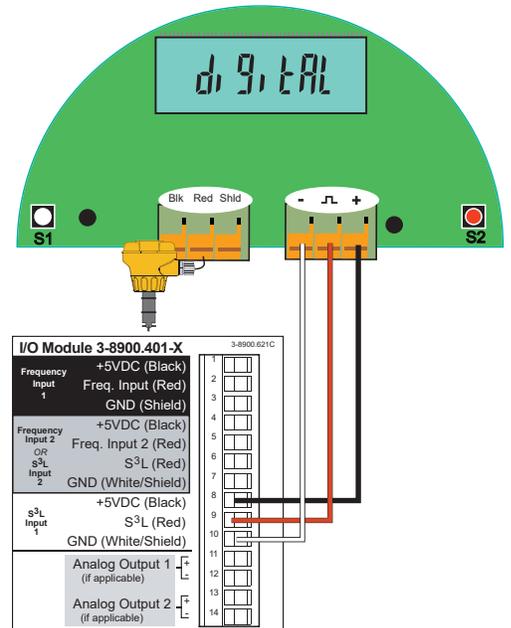
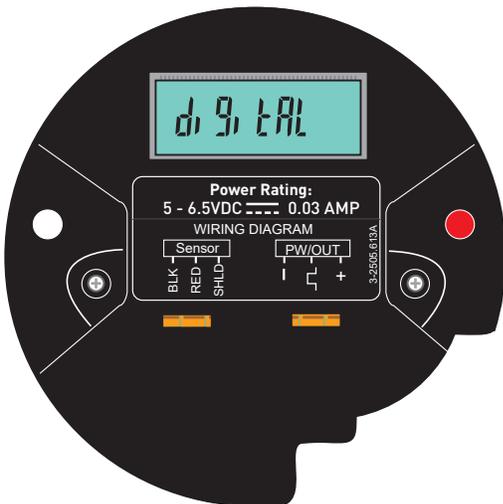
To access the wiring terminals:

- Turn yellow cap 1/4 turn counterclockwise to remove.
- Remove the two retaining screws and remove the black cover.
- Route all cables through the conduit ports before connecting them to the terminals.
- Wiring terminals are rated for 16-22 AWG conductors.
- The cable must be 7 to 10 mm in diameter (0.275 to 0.394 in.) to seal properly in the liquid tight connector.
- The conduit ports have 1/2 inch NPT threads. After routing the cables, seal the port with a liquid tight conduit connector (3-9000.392-1) or with conduit.
- For conduit installations:
  - Thread conduit with 1/2 in. NPT threads directly into the conduit port.
  - For conduit with ISO threads, use the black thread adapter included with the connector kit.
  - To comply with NEC requirements, do not use any metal conduit in the installation.



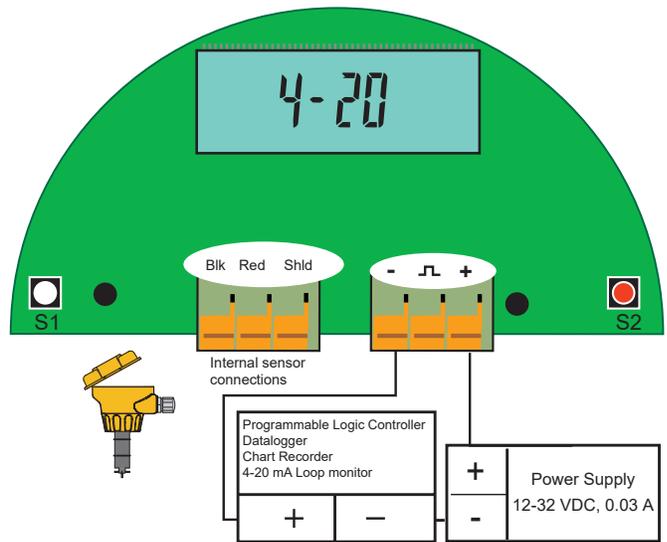
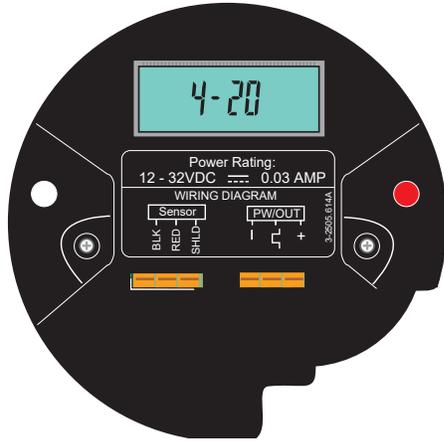
### Wiring: Digital (S<sup>3</sup>L) Output

The Digital (S<sup>3</sup>L) output is compatible with the 3-8900 Multi-Parameter Controller.



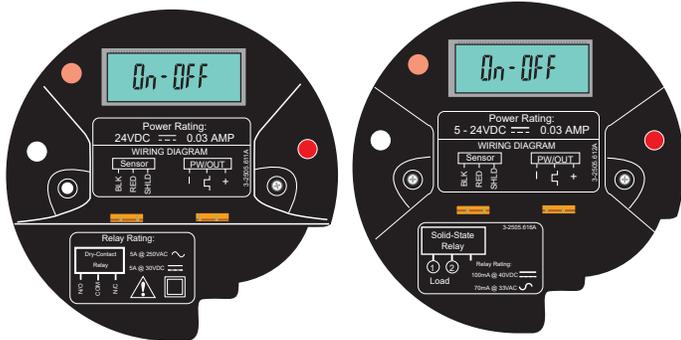
## Wiring: 4-20 mA Output

The 4-20 mA output can be connected to Chart Recorders, PLCs or any device that requires a 4-20 mA signal.  
The 4-20 mA model requires an external power source of 12-32 VDC.



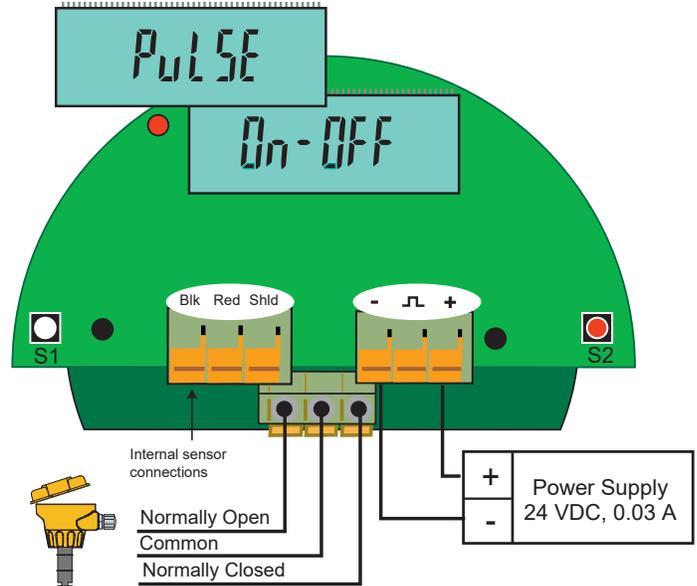
## Wiring: Flow Switch Output (On-Off)

- The Flow Switch models provide a single relay that is programmable as a HIGH setpoint or LOW setpoint.
- The relay may be a dry-contact type or a solid state type.
- The dry contact relay requires an external power source of 24 VDC  $\pm$  10%.
- The solid state relay requires an external power source of 5 to 24 VDC.



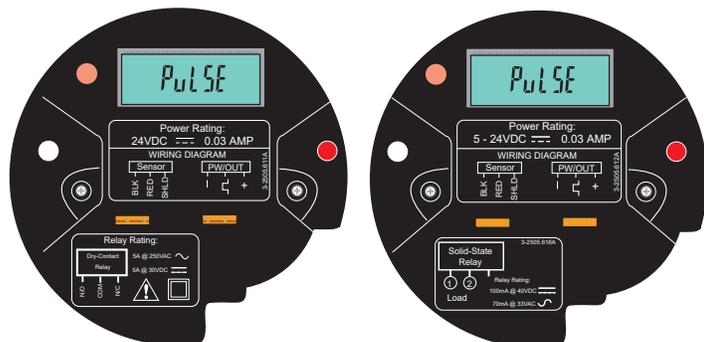
## Dry Contact Relay Wiring

- The wiring is identical for On-Off and Pulse models.



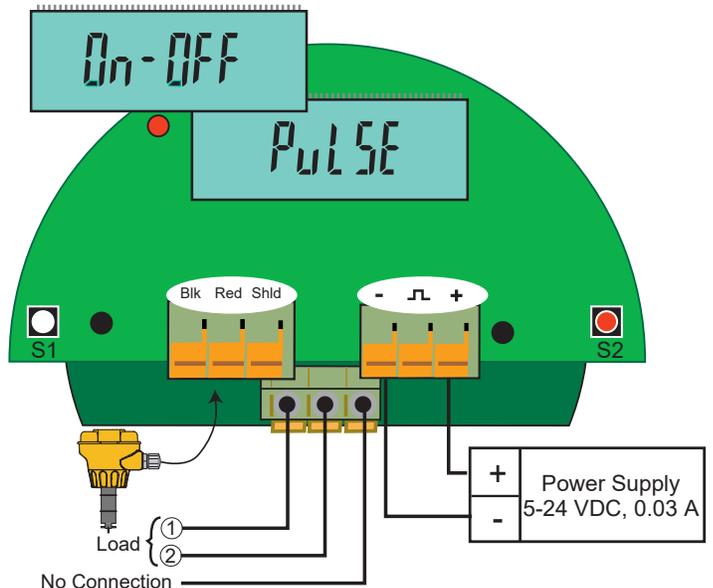
## Wiring: Pulse Output

- The Pulse model provides a single relay that is programmable as a Volumetric pulse output or as a simple pulse divider output.
- The relay may be a dry-contact type or a solid state type.
- The dry contact relay requires an external power source of 24 VDC  $\pm$  10%.
- The solid state relay requires an external power source of 5 to 24 VDC.



## Solid State Relay Wiring

- The wiring is identical for On-Off and Pulse models.



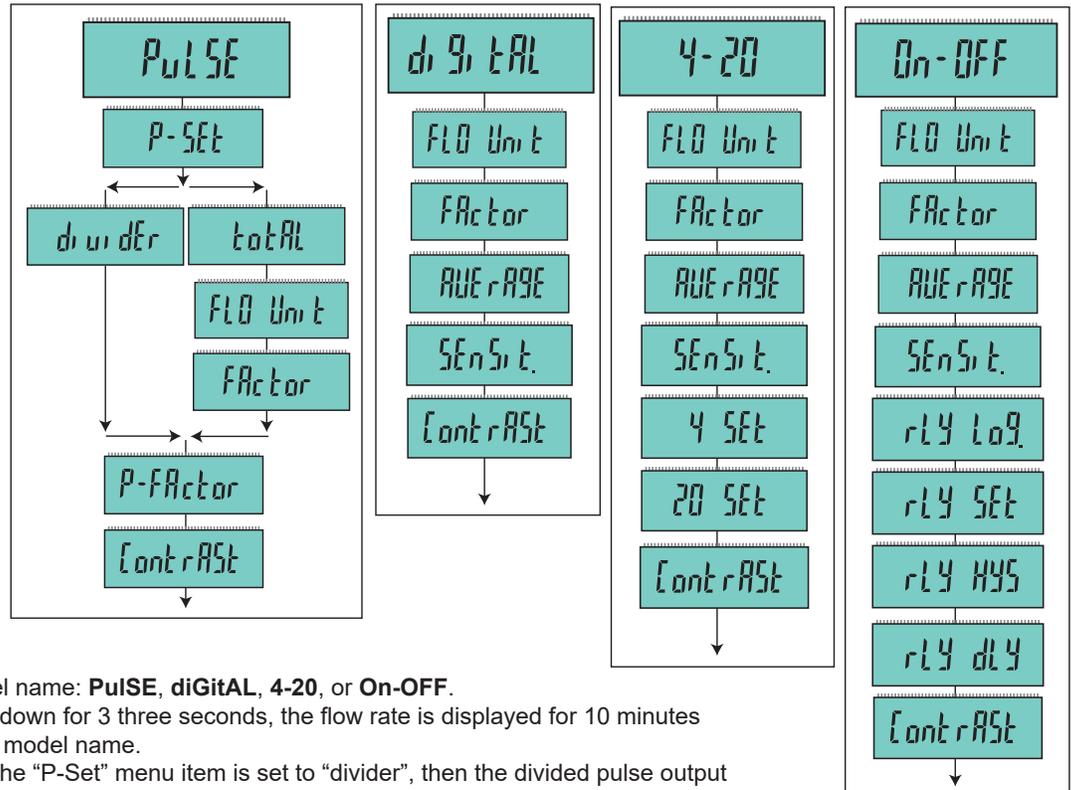
## Operation

The 2537 Flowmeter is available in 4 different models. The programming menus vary significantly from one model to another.

This chart is provided inside the yellow cover to assist in navigating the menus in the 2537.

MODE				
VIEW	→ Display Flow Rate	→ Go to MENU	→ Go to MENU	→ Go to VIEW
MENU	1X → Next Menu	1X → Display Current Val	1X → Display Current Val	Previous MODE
		→ Go to EDIT	→ Go to EDIT	Previous MODE
EDIT	1X → Increment Value	1X → Shift digit to right	1X → Shift digit to right	Previous MODE
		→ Go to SAVE	→ Go to SAVE	Previous MODE
SAVE	1X → Toggle	1X → Store Change	1X → Store Change	N/A

This table shows the menu sequence for each model.



### View Mode Function

- All models display the model name: **PULSE**, **diGiTAL**, **4-20**, or **On-OFF**.
- If the white key (S1) is held down for 3 three seconds, the flow rate is displayed for 10 minutes before reverting back to the model name.
  - In the **PULSE** Model, if the “P-Set” menu item is set to “divider”, then the divided pulse output will be displayed in pulses/seconds, (p/s).

This table shows the definition of each menu function, the setting parameters and the page where detailed instructions can be located.

Menu Function	Definition	Setting Parameters	More Information On
Flow Unit	Liters or Gallons per sec, min, hour or day	See list on page 6	page 6
(K)Factor	Set PULSES per VOLUME UNIT	0.0001 to 999999	page 6
Average	Smooths out erratic flow conditions	0 to 100 seconds	page 7
Sensitivity	Overrides Average for large rate changes	0 to 9	page 7
P-Set	Select the mode for the PULSE OUT	Total or Divider	page 8
P-Factor	As PULSE <b>DIVIDER</b> , divides input freq.	1.0000 to 99999	page 8
P-Factor	As PULSE <b>TOTAL</b> , multiplies K-Factor	1.0000 to 99999	page 8
Relay Logic	Select Hi alarm or Lo alarm mode	Hi or Lo	page 9
Relay Set	Set Relay Setpoint	0.0000 to 99999	page 9
Relay Hysteresis	Rate inside Setpoint to DEENERGIZE relay	0.0000 to 99999	page 9
Relay Delay	Time delay before relay is ENERGIZED	0000.0 to 6400.0	page 9
4 Set	Set flow RATE to be represented by 4 mA	0.0000 to 99999	page 6
20 Set	Set flow RATE to be represented by 20 mA	0.0000 to 99999	page 6
Contrast	Adjust visibility of liquid crystal display	1 to 3	page 6

## Flow Units

This function is available on these versions of the 2537.



Select the volumetric units for the flow measurement.

$\frac{L}{s}$  Liters/second       $\frac{g}{s}$  Gallons/second

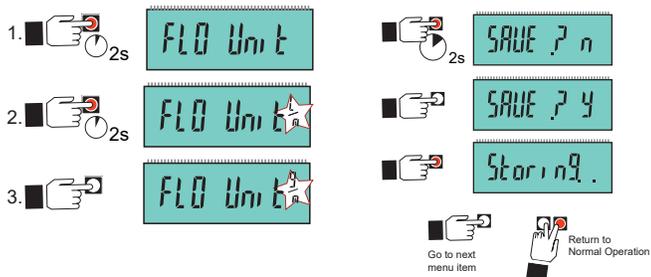
$\frac{L}{m}$  Liters/minute (Factory setting)       $\frac{g}{m}$  Gallons/minute

$\frac{L}{h}$  Liters/hour       $\frac{g}{h}$  Gallons/hour

$\frac{L}{d}$  Liters/day       $\frac{g}{d}$  Gallons/day

### Example: Set the Flow Units to Gallons per minute:

Save the new setting:



## K-Factor

This function is available on these versions of the 2537.



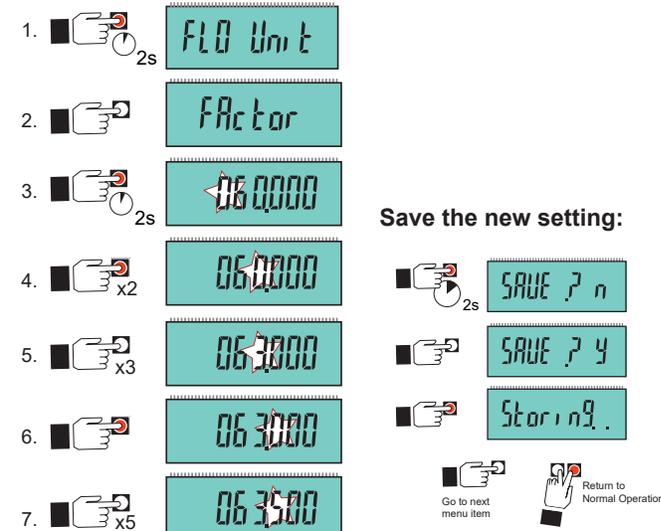
The factory setting is 60.0000.  
Locate the K-factor in the tables on page 10.

Factor

Minimum value 0.0001

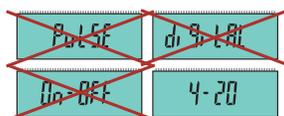
Maximum value 999999

### Example: Set the K-Factor to 63.5 Pulses per Gallon:



## Set 4 and Set 20

This function is available on these versions of the 2537.

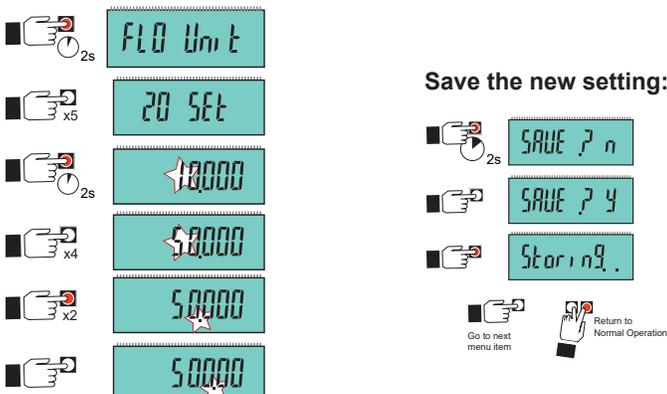


These two functions are used to span the 4-20 mA output signal to the required range.

The factory setting is 4-20 mA = 0 to 10.000

Only the 20 mA span is illustrated here.

### Example: Set 20 mA = 500 GPM.



## Set Contrast

This function is available on these versions of the 2537.



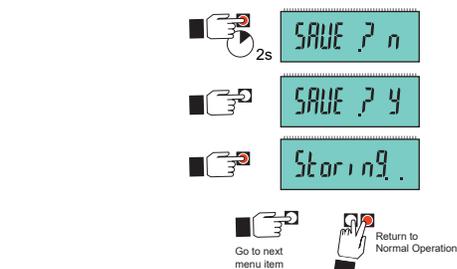
All models of the 2537 have the CONTRAST adjustment. It is always located at the end of the menu.

- 2s To access the adjustment, enter the menu and scroll until the Contrast display appears.
- x1 Repeat until :

Contrast There are three levels of adjustment. The factory setting of 3 is the highest contrast setting.

Choose: 1 OR 2 OR 3

Save the new setting:



## Averaging and Sensitivity Settings

- Because ideal flow conditions are often impossible to achieve, the flow rate is often erratic, which causes any control features (ie; relays, 4-20 mA loops, etc.) that are associated with the flow rate to be erratic.
- The best solution to these problems is to correct any piping deficiency that causes the instability. This may involve longer straight runs upstream, reducing the pipe size to maintain a full pipe at all times, and other installation changes. But in many situations these measures are simply not possible.
- The 2537 meter provides two tools that are designed to "work around" these deficiencies. The Averaging and the Sensitivity features should be studied before making adjustments.

### Averaging Time in Seconds (Factory set: 0 seconds)

- Set the time the meter will use as the averaging period. The range is from 0 (no average applied to input) to 100 (seconds of averaging applied to input).

Use higher averaging times to smooth the display and current output where the flow in the pipe is erratic.

### Quick Response Sensitivity (Factory set: 0)

- Set the relative degree of change in the flow rate required to allow the 2537 to disable the AVERAGING and jump to a new flow rate immediately. The scale is from 0 (Least sensitive, averaging is never disabled.) to 9 (a very small change in flow rate will disable the averaging).

#### ■ ■ ■ ■ ■ No AVERAGING, no SENSITIVITY

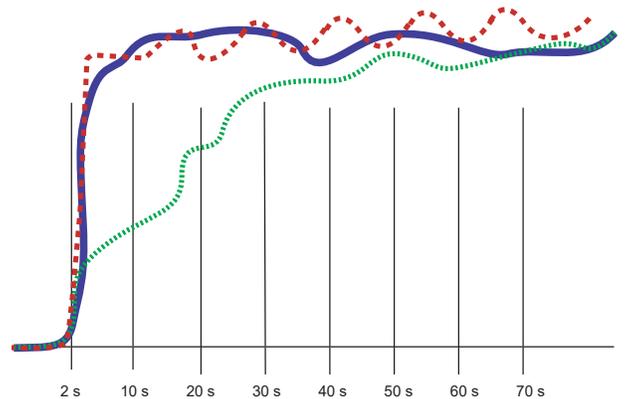
With AVERAGING set to 0 (zero) and with SENSITIVITY set to zero, the 2537 responds to every unstable shift in the flow. The dashed red line represents the actual output of the flow sensor in unstable flow conditions.

#### ..... AVERAGING only

With AVERAGING set to 50 seconds and SENSITIVITY still set to zero the flow rate is stabilized, but a sharp change in flow rate is not represented for 50 seconds or longer. (dotted green line).

#### ———— AVERAGING and SENSITIVITY

With AVERAGING at 50 seconds and SENSITIVITY set to 4 OR 5, the flow rate is stabilized, while the sudden shift in flow is reflected very quickly. (Solid blue line)



NOTE: The SENSITIVITY function is ineffective if the AVERAGING function is set to zero (seconds).

### Set Averaging

This function is available on these versions of the 2537:

<del>Part 5E</del>	d, 9, tRL
0n-0FF	4-70

The factory setting is 0 (zero).

Minimum value	000 <sub>s</sub>
Maximum value	100 <sub>s</sub>

**Example: Set the Averaging for 50 seconds.**

1. FLO Unit
2. AVE r AGE
3. 000<sub>s</sub>
4. 000<sub>s</sub>
5. 050<sub>s</sub>

**Save the new setting:**

SAVE ? n
SAVE ? y
Storing .

Go to next menu item     Return to Normal Operation

### Set Sensitivity

This function is available on these versions of the 2537:

<del>Part 5E</del>	d, 9, tRL
0n-0FF	4-70

The factory setting is 0 (zero).

Minimum value	0
Maximum value	9

**Example: Set the Sensitivity to 5.**

1. FLO Unit
2. SEnSIt.
3. 0
4. 5

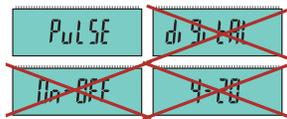
**Save the new setting:**

SAVE ? n
SAVE ? y
Storing .

Go to next menu item     Return to Normal Operation

## P-Set

This function is available on these versions of the 2537:



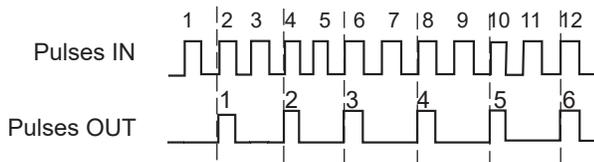
Select DIVIDER or TOTAL operation.  
The factory setting is TOTAL.

**PULSE DIVIDER Output = Input pulses ÷ P-Factor**

DIVIDER allows you to set a scaling value (P-Factor) from 1.0000 to 99999.

Example: If the P-Factor is set for 2, then the 2537 will output one pulse for every 2 pulses received from the sensor. This selection enables the output frequency to be scaled down to match associated equipment capabilities.

When using the PULSE DIVIDER output, associated equipment must divide the K-factors in this manual by the P-Factor for correct calibration.



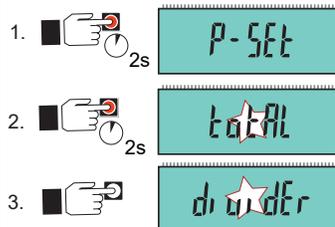
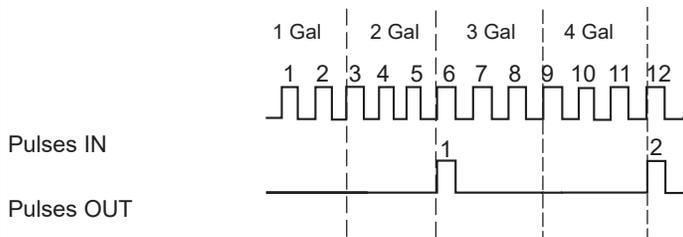
**PULSE TOTAL Output = Input pulses ÷ (K-Factor • P-Factor)**

TOTAL is a traditional pump pulser function. This selection will allow the entry of a K-Factor to define a volumetric unit, then set a P-Factor to define the number of volumetric units required to generate one pulse out.

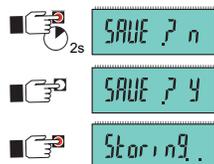
Example:

Set the Total Pulse output so there is one pulse out for each 2 gallons that passes the sensor if the K-factor is 3.0.

1. (K) Factor = 3.0 (pulses in per gallon)
2. P- Factor = 2 (gallons out per pulse)

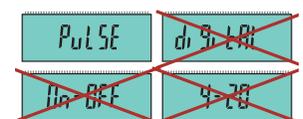


Save the new setting:



## P-Factor

This function is available on these versions of the 2537:



The factory setting is 1.0000

P-Factor

Minimum value

1.0000

Maximum value

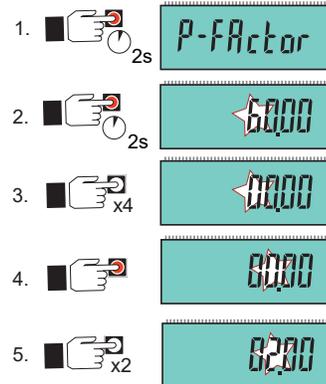
99999

**In PULSE DIVIDER mode the P-Factor divides:**

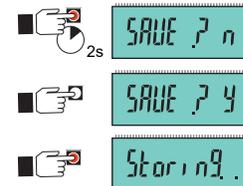
The pulse stream from the paddlewheel sensor will be divided by the P-Factor. The resulting frequency is output through a relay.

**In PULSE TOTAL mode the P-Factor multiplies:**

The pulse stream from the paddlewheel sensor is divided by the K-Factor MULTIPLIED by the P-factor. The resulting frequency is output through a relay.

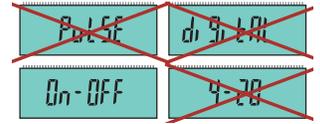


Save the new setting:



# Set Relay operation

The Flow Switch has one relay (SPDT or solid-state) that can be programmed as a HIGH (Hi) alarm or a LOW (Lo) alarm.



### 1. Select HI or LO Relay Alarm logic

**Example: Change the Relay Logic to Low:**

A HI alarm will be activated when the flow rate rises ABOVE the setpoint.

A LO alarm will be activated when the flow rate falls BELOW the setpoint.

The factory setting is Hi(gh).

- 2s FLO Unit
- x4 rly Lo9.
- 2s Hi
- Lo

**Save the new setting:**

SAVE ? n  
SAVE ? y  
Storing .

Go to next menu item | Return to Normal Operation

### 2. Program the SETPOINT.

**Example: Change the Setpoint to 8.0000:**

The SETPOINT is the flow rate where the relay will be energized. The factory setting is 5.0000.

**Minimum value** 0.0000 L<sub>m</sub>

**Maximum value** 99999 L<sub>m</sub>

- 2s FLO Unit
- x5 rly SET
- 2s 5.0000 L<sub>m</sub>
- x3 8.0000 L<sub>m</sub>
- 8.0000 L<sub>m</sub>

**Save the new setting:**

SAVE ? n  
SAVE ? y  
Storing .

Go to next menu item | Return to Normal Operation

### 3. Program the HYSTERESIS.

**Example: Change the Hysteresis to 5.0000:**

Hysteresis holds a relay energized until the flow rate moves this amount past the setpoint. The factory setting is 0.5000

**Minimum value** 0.0000 L<sub>m</sub>

**Maximum value** 99999 L<sub>m</sub>

- 2s FLO Unit
- x6 rly HYS
- 2s 0.5000 L<sub>m</sub>
- x5 5.0000 L<sub>m</sub>

**Save the new setting:**

SAVE ? n  
SAVE ? y  
Storing .

Go to next menu item | Return to Normal Operation

### 4. Program the DELAY.

**Example: Change the Delay to 10.0:**

When the flow rate reaches the setpoint, the 2537 will wait this long (in seconds) before triggering the alarm. The factory setting is 0000.0 seconds.

**Minimum value** 00000

**Maximum value** 64000

- 2s FLO Unit
- x7 rly dLY
- 2s 0000 s
- 10.00 s
- 10.00 s

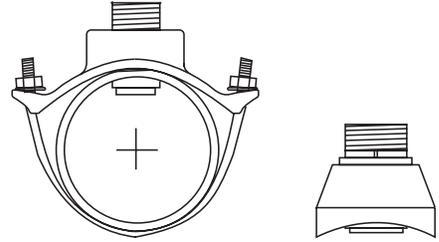
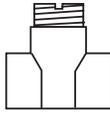
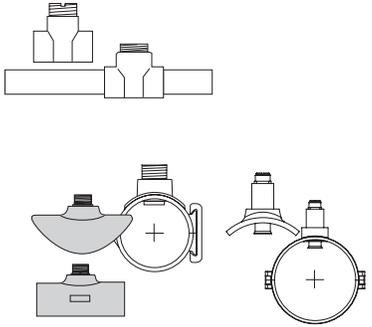
**Save the new setting:**

SAVE ? n  
SAVE ? y  
Storing .

Go to next menu item | Return to Normal Operation

## K-Factors

When using the PULSE DIVIDER output, associated equipment must divide the K-factors by the P-Factor.



PIPE SIZE (IN.)	FITTING	2536/8512-XX	
		U.S. GAL	LITERS
<b>SCH 80 PVC TEES FOR SCH 80 PVC PIPE</b>			
1/2	PV8T005	991.71	262.01
3/4	PV8T007	545.14	144.03
1	PV8T010	352.44	93.114
1-1/4	PV8T012	177.18	46.812
1-1/2	PV8T015	117.85	31.137
2	PV8T020	66.739	17.633
2-1/2	PV8T025	42.994	11.359
3	PV8T030	26.652	7.0414
4	PV8T040	15.006	3.9645
<b>SCH 80 CPVC TEES FOR SCH 80 CPVC PIPE</b>			
1/2	CPV8T005	991.71	262.01
3/4	CPV8T007	545.14	144.03
1	CPV8T010	352.44	93.114
1-1/4	CPV8T012	177.18	46.812
1-1/2	CPV8T015	117.85	31.137
<b>SCH 80 PVC SADDLES FOR SCH 80 PVC PIPE</b>			
2	PV8S020	66.739	17.633
2-1/2	PV8S025	42.994	11.359
3	PV8S030	26.652	7.0414
4	PV8S040	15.006	3.9645
6	PV8S060	8.3246	2.1994
8	PV8S080	5.0164	1.3253
<b>SCH 80 PVC SADDLE ON SCH 40 PVC PIPE</b>			
2	PV8S020	54.700	14.452
2-1/2	PV8S025	37.159	9.8175
3	PV8S030	23.697	6.2608
4	PV8S040	13.456	3.5552
6	PV8S060	7.4594	1.9708
8	PV8S080	4.5292	1.1966

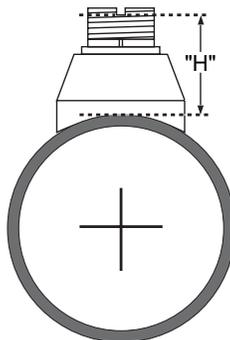
PIPE SIZE (IN.)	FITTING	2536/8512-XX	
		U.S. GAL	LITERS
<b>CARBON STEEL TEES ON SCH 40 PIPE</b>			
1/2	CS4T005	756.00	199.74
3/4	CS4T007	438.69	115.90
1	CS4T010	286.78	75.768
1-1/4	CS4T012	121.22	32.026
1-1/2	CS4T015	91.139	24.079
2	CS4T020	54.468	14.391
<b>STAINLESS STEEL TEES ON SCH 40 PIPE</b>			
1/2	CR4T005	734.20	193.98
3/4	CR4T007	412.10	108.88
1	CR4T010	252.70	66.764
1-1/4	CR4T012	128.12	33.849
1-1/2	CR4T015	77.320	20.428
2	CR4T020	45.780	12.095
<b>GALVANIZED IRON TEES ON SCH 40 PIPE</b>			
1	IR4T010	213.01	56.277
1-1/4	IR4T012	127.75	33.751
1 1/2	IR4T015	94.401	24.941
2	IR4T020	59.420	15.699
<b>BRONZE TEES ON SCH 40 PIPE</b>			
1	BR4T010	213.01	56.277
1-1/4	BR4T012	127.75	33.751
1-1/2	BR4T015	94.401	24.941
2	BR4T020	59.420	15.699
<b>COPPER TEE FITTINGS ON COPPER PIPE SCH K</b>			
1/2	CUKT005	917.84	242.50
3/4	CUKT007	428.27	113.15
1	CUKT010	256.43	67.749
1-1/4	CUKT012	176.44	46.615
1-1/2	CUKT015	115.69	30.565
2	CUKT020	63.385	16.746
<b>COPPER TEE FITTINGS ON COPPER PIPE SCH L</b>			
1/2	CUKT005	858.22	226.74
3/4	CUKT007	385.74	101.91
1	CUKT010	241.64	63.841
1-1/4	CUKT012	170.90	45.152
1-1/2	CUKT015	112.03	29.598
2	CUKT020	61.74	16.310

PIPE SIZE (IN.)	FITTING	2536/8512-XX	
		U.S. GAL	LITERS
<b>STAINLESS STEEL WELDOLETS ON SCH 40 PIPE</b>			
2-1/2	CR4W025	37.600	9.9339
3	CR4W030	24.340	6.4306
4	CR4W040	13.920	3.6777
5	CR4W050	10.860	2.8692
6	CR4W060	7.5200	1.9868
8	CR4W080	4.3400	1.1466
<b>CARBON STEEL WELDOLETS ON SCH 40 PIPE</b>			
2-1/2	CS4W025	37.600	9.9339
3	CS4W030	24.340	6.4306
4	CS4W040	13.920	3.6777
5	CS4W050	10.860	2.8692
6	CS4W060	7.5200	1.9868
8	CS4W080	4.3400	1.1466
<b>COPPER/BRONZE BRAZOLETS ON SCH 40 PIPE</b>			
2-1/2	BR4B025	37.600	9.934
3	BR4B030	24.340	6.431
4	BR4B040	13.920	3.678
5	BR4B050	10.860	2.869
6	BR4B060	7.5200	1.987
8	BR4B080	4.3400	1.147
<b>SCH 80 IRON SADDLES ON SCH 80 PIPE</b>			
2	IR8S020	64.720	17.099
2-1/2	IR8S025	42.480	11.223
3	IR8S030	26.420	6.980
4	IR8S040	14.700	3.884
5	IR8S050	12.180	3.218
6	IR8S060	8.4400	2.230
8	IR8S080	4.9000	1.295
<b>SCH 80 IRON SADDLE ON SCH 40 PIPE</b>			
2	IR8S020	53.640	14.172
2-1/2	IR8S025	37.600	9.934
3	IR8S030	23.220	6.135
4	IR8S040	13.260	3.503
5	IR8S050	11.040	2.917
6	IR8S060	7.2400	1.913
8	IR8S080	4.4000	1.162

## H-Dimensions

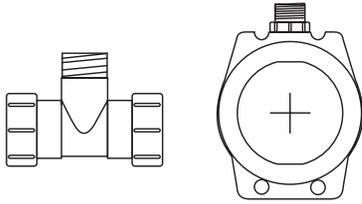
The plastic insert in Weldolet fittings MUST be removed during the welding process. When reinstalled, it is important that the insert be threaded to the proper height ("H" dimension).

Weldolet part number	"H" dimension	
	inches	mm
CS4W020	2.38	60.45
CS4W025	2.33	59.18
CS4W030	2.32	58.92
CS4W040	2.30	58.42
CS4W050	3.09	78.48
CS4W060	2.96	75.18
CS4W080	2.73	69.34



Weldolet part number	"H" dimension	
	inches	mm
CR4W020	2.38	60.45
CR4W025	2.33	59.18
CR4W030	2.32	58.92
CR4W040	2.30	58.42
CR4W050	3.09	78.48
CR4W060	2.96	75.18
CR4W080	2.73	69.34

## K-Factors



PIPE SIZE	FITTING	2536/8512-XX	
		U.S. GAL	LITERS
<b>POLYPROPYLENE FITTINGS (DIN/ISO AND BS AND ANSI)</b>			
DN 15	PPMT005	952.87	251.75
DN 20	PPMT007	563.10	148.77
DN 25	PPMT010	291.60	77.042
DN 32	PPMT012	169.22	44.709
DN 40	PPMT015	103.90	27.450
DN 50	PPMT020	60.789	16.060
DN 65	PPMT025	41.498	10.964
DN 80	PPMT030	26.786	7.0769
DN 100	PPMT040	17.415	4.6011
DN 125	PPMT050	10.168	2.6864
DN 150	PPMT060	7.3119	1.9318
DN 200	PPMT080	3.9946	1.0554

PIPE SIZE	FITTING	2536/8512-XX	
		U.S. GAL	LITERS
<b>PVDF FITTINGS (DIN/ISO AND BS AND ANSI)</b>			
DN 15	SFMT005	827.26	218.56
DN 20	SFMT007	489.87	129.42
DN 25	SFMT010	283.55	74.915
DN 32	SFMT012	158.59	41.899
DN 40	SFMT015	86.980	22.980
DN 50	SFMT020	50.385	13.312
DN 65	SFMT025	36.133	9.5465
DN 80	SFMT030	24.715	6.5297
DN 100	SFMT040	16.120	4.2589
DN 125	SFMT050	8.8624	2.3415
DN 150	SFMT060	6.4543	1.7052
DN 200	SFMT080	4.0720	1.0758
<b>PVC FITTINGS (DIN/ISO) - EUROPE ONLY</b>			
DN 15	PVMT005	972.37	256.90
DN 20	PVMT007	485.69	128.32
DN 25	PVMT010	297.27	78.540
DN 32	PVMT012	170.25	44.980
DN 40	PVMT015	103.71	27.400
DN 50	PVMT020	59.500	15.720
DN 65	PVMT025	34.973	9.2400
DN 80	PVMT030	24.981	6.6000
DN 100	PVMT040	16.275	4.3000
DN 150	PVMT060	8.1756	2.1600
DN 200	PVMT080	4.0878	1.0800

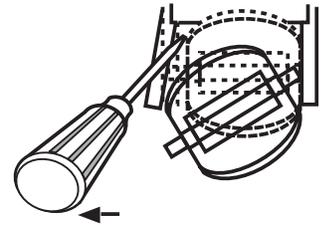
## Maintenance and Cleaning

The 2537 requires very little maintenance.

- If the paddlewheel becomes fouled, it can be cleaned with mild detergents and a small brush.
- The electronics portion of the 2537 does not require maintenance or cleaning.

## Rotor Replacement Procedure

1. To remove the rotor, insert a small screwdriver between the rotor and the ear of the sensor.
2. Twist the screwdriver blade to flex the ear outward enough to remove one end of the rotor and pin. DO NOT flex the ear any more than necessary! If it breaks, the sensor cannot be repaired.
3. Install the new rotor by inserting one tip of the pin into the hole, then flex the opposite ear back enough to slip rotor into place.



## Ordering Information

Mfr. Part No.	Code	Description
<b>2537 system for 0.5 in. to 4 in. pipes, with polypropylene body, Black PVDF rotor, Titanium pin, FPM O-rings</b>		
3-2537-1C-P0	159 001 291	Pulse Divider via Dry-Contact Relay, Integral Mount
3-2537-2C-P0	159 001 292	Pulse Divider via Solid-State Relay, Integral Mount
3-2537-3C-P0	159 001 293	Flow Switch via Dry-Contact Relay, Integral Mount
3-2537-4C-P0	159 001 294	Flow Switch via Solid-State Relay, Integral Mount
3-2537-5C-P0	159 001 295	Digital (S <sup>3</sup> L), Integral Mount
3-2537-6C-P0	159 001 296	4-20 mA, Integral Mount

<b>2537 system for 5 in. to 8 in. pipes, with polypropylene body, Black PVDF rotor, Titanium pin, FPM O-rings</b>		
3-2537-1C-P1	159 001 303	Pulse Divider via Dry-Contact Relay, Integral Mount
3-2537-2C-P1	159 001 304	Pulse Divider via Solid-State Relay, Integral Mount
3-2537-3C-P1	159 001 305	Flow Switch via Dry-Contact Relay, Integral Mount
3-2537-4C-P1	159 001 306	Flow Switch via Solid-State Relay, Integral Mount
3-2537-5C-P1	159 001 307	Digital (S <sup>3</sup> L), Integral Mount
3-2537-6C-P1	159 001 308	4-20 mA, Integral Mount

<b>2537 system for 0.5 in. to 4 in. pipes, with natural PVDF body, rotor and pin, FPM O-rings</b>		
3-2537-1C-T0	159 001 315	Pulse Divider via Dry-Contact Relay, Integral Mount
3-2537-2C-T0	159 001 316	Pulse Divider via Solid-State Relay, Integral Mount
3-2537-3C-T0	159 001 317	Flow Switch via Dry-Contact Relay, Integral Mount
3-2537-4C-T0	159 001 318	Flow Switch via Solid-State Relay, Integral Mount
3-2537-5C-T0	159 001 319	Digital (S <sup>3</sup> L), Integral Mount
3-2537-6C-T0	159 001 320	4-20 mA, Integral Mount

## Accessories

Mfr. Part No.	Code	Description
3-2536.320-1	198 820 052	Rotor, PVDF Black
3-2536.320-2	159 000 272	Rotor, PVDF Natural
3-2536.320-3	159 000 273	Rotor, Tefzel®
3-2536.321	198 820 054	Rotor and Pin, PVDF Natural
3-2536.322-1	198 820 056	Sleeved Rotor, PVDF Black
3-2536.322-2	198 820 057	Sleeved Rotor, PVDF Natural
3-2536.322-3	198 820 058	Sleeved Rotor, Tefzel®
M1546-1	198 801 182	Rotor Pin, Titanium
M1546-2	198 801 183	Rotor Pin, Hastelloy-C
M1546-3	198 820 014	Rotor Pin, Tantalum
M1546-4	198 820 015	Rotor Pin, Stainless Steel
P51545	198 820 016	Rotor Pin, Ceramic
1220-0021	198 801 186	O-Ring, FPM
1224-0021	198 820 006	O-Ring, EPDM
1228-0021	198 820 007	O-Ring, FFPM
P31536	198 840 201	Sensor Plug, Polypro
P31536-2	159 000 649	Sensor Plug, PVDF
3-8050.396	159 000 617	RC Filter kit (for relay use)
3-9000.392-1	159 000 839	Liquid tight connector kit, NPT (1 piece)
3-9000.392-2	159 000 841	Liquid tight connector kit, PG13.5 (1 piece)
3-9000.392-3	159 001 430	Liquid-tight connector kit, dual-cable gland
7300-7524	159 000 687	24 VDC Power Supply 7.5 W, 300mA
7300-1524	159 000 688	24 VDC Power Supply 15 W, 600mA
7300-3024	159 000 689	24 VDC Power Supply 30 W, 1.3 A
7300-5024	159 000 690	24 VDC Power Supply 50 W, 2.1 A
7300-1024	159 000 691	24 VDC Power Supply 100 W, 4.2 A



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# Quarter-Bloc™ Ball Valve

## Installation & Operation Instructions

### Operating Instructions

The valve should be operated within the range of the published working pressure vs. temperature ratings. Refer to the "QUARTER-BLOC CHEMICAL RESISTANCE GUIDE".

The valve should not be used where the media contains suspended particles.

The valve is not rated for vacuum service.

The valve should not be used in certain chemical applications such as  $H_2O_2$ ,  $NaClO$ , etc.

Some chemicals, as listed above, can create an off-gassing effect, which can lead to excessive pressure increase and create valve failure.

Preventative measures need to be taken to insure the valve is not frozen in cold environments.

Insulation or Heat Tracing should be considered. (This could cause valve failure)

The valve should be properly disposed of. (The valve generates a toxic gas if incinerated)

Contact the proper waste disposal company in your area.

### Installation Instructions

Ensure that the valve is free from pipe misalignment, stress or external impact. Check the centering and parallelism upon installation.

Do not install the valve when the atmospheric temperature is lower than 40° F

Proper ventilation should be used to prevent the adhesive fumes from building up.

Do not apply excessive adhesives. (Excessive solvents can cause stress cracking, which can lead to valve failure)

Check the union nuts for proper tightening after installation.

Avoid excessive tightening of pipe supports if used. Excessive tightening of supports can cause leakage by creating misalignment or stress on the the valve end connector.

The valve has two flow directional arrows on the body. When installing the valve, insure the arrows are in the direction of the flow. (This insures the threaded carrier is to the upstream side, for ultimate safety when used as a blocking valve)

Periodic inspection and re-tightening should be considered.

### Troubleshooting

#### *What if handle does not rotate smoothly?*

Foreign material has formed on the ball or seat. Clean both.

Internal parts chemically attacked or swollen. Refer to QUARTER-BLOC CHEMICAL RESISTANCE GUIDE for compatibility.

Carrier over tightened. Retighten properly.

#### *What if handle rotates too freely?*

Stem is damaged.

Handle is not engaged with stem. Inspect.

Engaging part of stem and/or ball is damaged.

#### *What if stem leaks?*

Stem or O-Ring is damaged.

#### *What if the fluid still flows when valve is closed?*

Carrier is not properly tightened. Tighten it firmly.

PTFE seat is damaged or worn.

Foreign material is caught between ball and PTFE seat. Remove material as needed.

#### *What if fluid leaks between body and union nuts?*

Carrier or face O-ring is damaged, worn, or missing.

- ***This valve is designed for water and light chemical application only.***
- ***Use ASAHI Type 21 Ball Valves in severe applications or when accessories are required.***
- ***There are NO replacement parts for the Quarter-Bloc Ball Valve.***
- ***Please contact your local distributor for new valve.***

# Quarter Master Series 94 Actuator



## Installation, Operation and Maintenance Manual



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## Series 94 Electric Actuator Introduction

### Description

The Series 94 electric actuators feature a reversing, capacitor run motor, with a permanently lubricated gear train. These actuators are equipped with integral thermal overload protection (AC models) with automatic reset, independently adjustable limit switches, declutchable manual override, position indicator, Zytel FR50 housing with stainless steel trim, ISO bolt circle, and 2 (two) ½” NPT conduit entries.

Standard models are offered in 115 VAC, feature an enclosure of Nema-4X, and provide up to 300 in/lbs of output torque.

Various options are available such as operating voltages, additional limit switches, heater and thermostat, feedback potentiometers, etc. Please see page 8 regarding these options.

### Electrical Requirement

**CAUTION:** Proper voltage must be supplied to actuator or damage will result.



**CAUTION:** If 115vac & 220vac models are PLC driven, output contacts of PLC should be rated at a minimum of 1.5 times required input voltage of actuator

**NOTE:** To conform to various electrical codes, a green grounding screw has been installed (on the baseplate) inside of actuator.

Terminal strip is suitable for up to #14 AWG wire, and should be wired as per the attached diagrams or the wiring diagram affixed inside of actuator cover.

Model	Torque (in/lbs)	115 Vac		230 Vac		12 Vdc		24 Vdc		12 Vac		24 Vac		Cycle Time per 90 Degrees (Seconds)	Weight (lbs)
		Amp Draw	Duty Cycle												
A94	150	0.5	100%	0.4	100%	2.0	75%	4.0	75%	2.0	75%	4.0	75%	5	3.5
B94	300	0.8	75%	0.6	75%	2.0	75%	4.0	75%	2.0	75%	4.0	75%	5	3.5

**Note:** Amp rating is considered locked rotor

Duty cycles are for ambient temperature (73° F)

## **Installation**

### **Electrical** **Reference Drawing #279QM**

1. To gain access to terminal strip (Part #8 & 9) it is necessary to remove manual override handle (Part #34) by loosening slotted setscrew (Part #35). Remove 8 cover screws and cover.
2. Make electrical connections to terminal strip as shown on wiring schematic located inside the cover (per various electrical codes there is a green screw on the actuator base plate for grounding purposes). Terminals are suitable for up to #14 AWG wire. All units are completely calibrated prior to shipment, and no internal adjustments should be required.

3. Install 1/2" NPT conduit fitting(s) to actuator base.

**Note:** Proper conduit fitting must be used to maintain NEMA 4X enclosure rating

**NOTE:** We recommend sealing conduit openings on units installed outdoors or exposed to large temperature swings (15°F or more).

We also recommend the heater and thermostat option in these applications.

4. Replace actuator (gasket if removed) cover, and install 8 cap screws supplied and tighten securely. For outdoor or wet locations it is recommended prior to replacing the cover that the top shaft seal be cleaned and coated with silicone grease. Also clean shaft and lightly coat seal area of shaft with silicone grease. Unit is now ready for operation.

### **Type 21 Ball Valve**

Position the valve and the actuator to corresponding positions (either OPEN or CLOSED). The flats on the actuator shaft extension indicate valve position

#### **Type 21 Ball Valves (See Drawing #0106BV sizes 1/2" – 2")**

Install mounting bracket #3 to actuator #2 using bolts #8 and washers #9. Insert coupling #4 on stem of valve #1 and then bolt valve #1 to mounting bracket #3 using bolts #5, nuts #7, and washers #6.

**Note:** All bolts should be snug and not excessively over tightened.

#### **Type 21 Ball Valves (See Drawing #0112BV sizes 2-1/2" - 3")**

Install mounting bracket #3 to actuator #2 using bolts #8 and washers #9. Insert coupling #4 on stem of valve #1 and then bolt valve #1 to mounting bracket #3 using bolts #5, nuts #7, and washers #6.

**Note:** All bolts should be snug and not excessively over tightened.

### **Type 23 Ball Valve (3-way)**

Position the valve and the actuator to corresponding positions (either OPEN or CLOSED). The flats on the actuator shaft extension indicate valve position

#### **Type 23 Ball Valves (3-way): (See Drawing #0129BV, sizes ½” - 3”)**

Install mounting bracket #3 to actuator #2 using bolts #8 and washers #9. Insert coupling #4 on stem of valve #1 and then bolt valve #1 to mounting bracket #3 using bolts #5, nuts #7, and washers #6.

### **Type 57 / 57L Butterfly Valves**

**CAUTION:** If valve is in line, system must be shut down and have no line pressure before removing throttle plate and retaining washer.

Position the valve and the actuator to corresponding positions (either OPEN or CLOSED). The flats on the actuator shaft extension indicate valve position

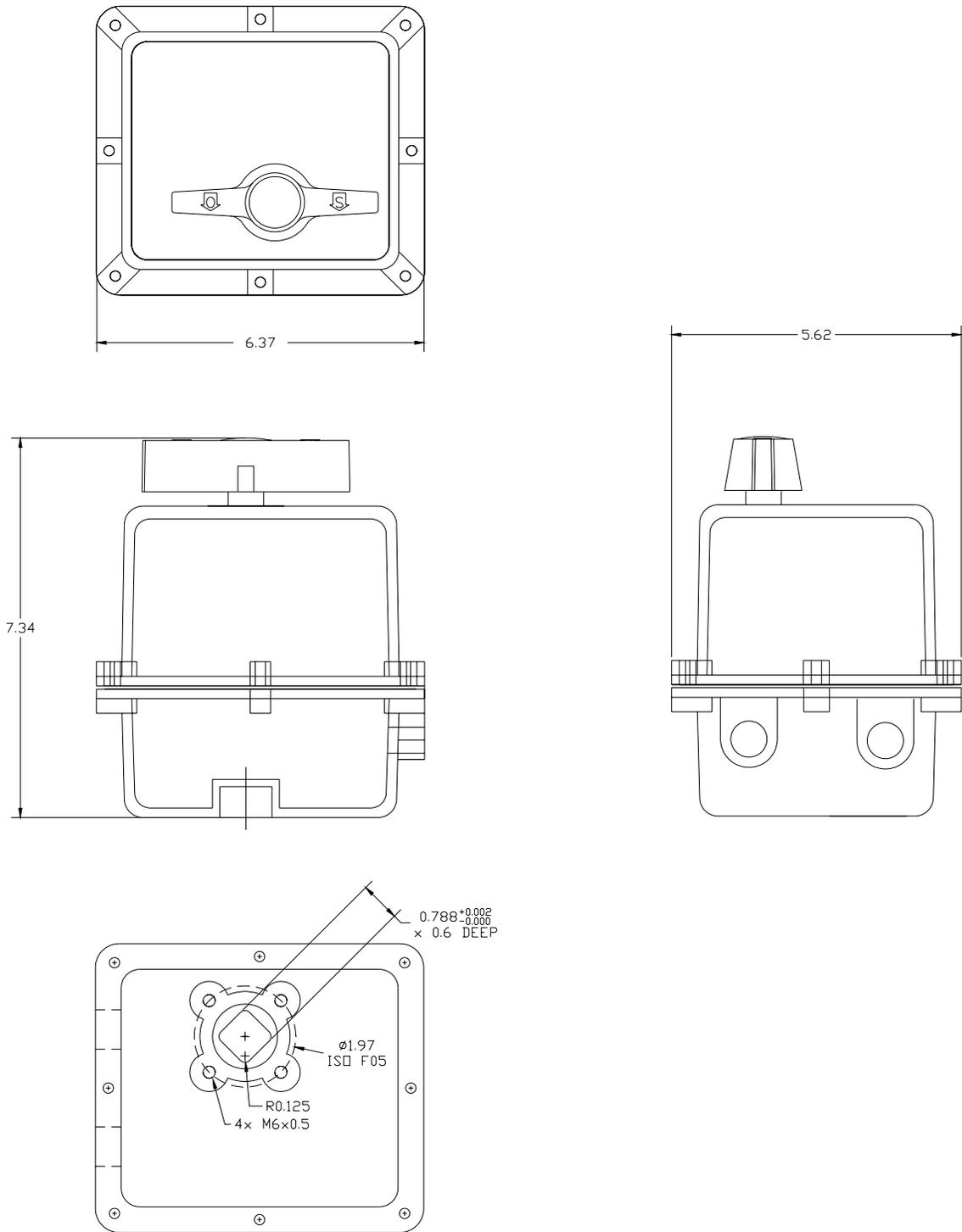
#### **Butterfly Valves (See Drawing # 0203BF57 sizes 1-1/2” - 4”)**

No specially machined stem or valve body drilling required. Remove handle (remove handle cap and hex head bolt) to expose throttle plate screws. Remove throttle plate and retaining washer to expose existing bolt pattern. Mount bracket #3 to actuator #2 with bolts #8 and washers #9 and tighten evenly. Insert coupling #4 into actuator #2. Install valve #1 onto mounting bracket #3 and align stem of valve to engage with coupling. (Line scribed on top of stem indicates disc orientation). Install bolts #5, washers #6 and nuts #7 and tighten evenly.



**CAUTION:** If mounted unit is installed other than straight up, the actuator should be supported independently to prevent side loading and loosening up of fasteners.

### Actuator Mounting Dimensions



## Operation

### Manual Override Operation Reference Drawing #279QM

Push down on handle (Part #34) and rotate within labeled limits.  
To re-engage simply rotate actuator handle in opposite direction until it moves up and re-engages.

**CAUTION:** The manual override should only be used when there is no power applied to actuator. When power is restored the actuator will automatically resume normal operation.

### Setting Limit Switches Reference Drawing #279QM



#### **Disconnect power!**

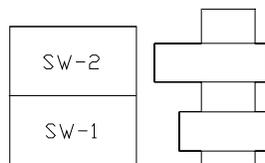
#### **Open Travel Limit Switch (SW-2 Part #14):**

Using declutchable manual override, move the valve into a full open position. Then loosen set screws on top cam (Part #21) and rotate cam (CCW) into limit switch arm until a click is heard, this designates the switch circuit has opened and defines a full open position. Tighten 2 set screws (Part #22) on cam.

#### **Close Travel Limit Switch (SW-1 Part #14):**

Using declutchable manual override, move the valve to a full closed position, loosen set screws on bottom cam (Part #21) and rotate cam (CW) into limit switch arm until a click is heard, this designates the switch circuit has opened and defines a full closed position. Tighten 2 set screws (Part #22) on cam.

Manually position valve to midstroke. Reapply power to actuator and drive to open or closed position. Actuator motor will run. The shaft will not turn until drive pins (Part #7) reseat in drive gear. This could take up to 25 seconds.



SW-2 OPEN TRAVEL SWITCH

SW-1 CLOSE TRAVEL SWITCH

**Options**

**Models A94 & B94**

**Single Limit Switch**

Install additional limit switch directly on top of standard limit switches using screws provided.

Wiring for SW-3 is as follows:

- Pink = Common to Terminal #6
- Purple = NC to Terminal #7
- Blue = NO to Terminal #8

***Cam must be set so that this switch is tripped just ahead of Closed limit switch.***

Wire tie loose wiring and check operation before installing cover.

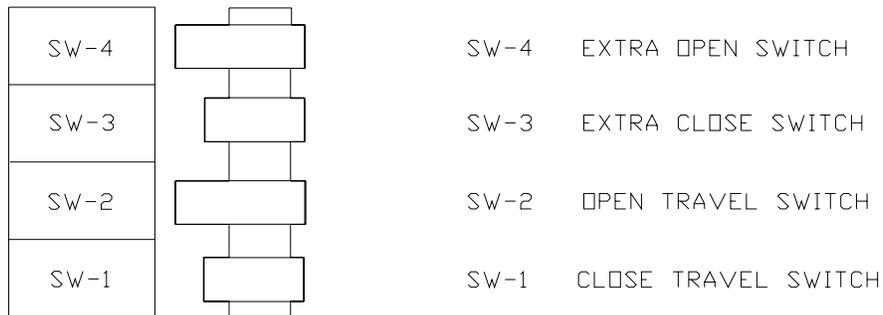
**Double Limit Switch**

Installation and wiring is the same as for the single limit switch, with the addition of wiring for SW-4 as follows:

- Brown = Common to Terminal #9
- Green = NC to Terminal #10
- Orange = NO to Terminal #11

***Cam must be set so that this switch is tripped just ahead of Open limit switch.***

Wire tie loose wiring and check operation before installing cover.



### **Heater and Thermostat**

Install Heater into threaded hole located on actuator base plate.

Wiring is as follows:

Heater lead = Terminal #12

Thermostat lead = Terminal #13

Wire tie loose wiring and check operation before installing cover.

### **Mechanical Brake**

Loosen two (2) motor screws diagonally from each other and install bracket with tabs facing upward. Tighten screws

Install hexagonal adapter over armature shaft and tighten set screws.

**NOTE:** The adapter should be resting on the step of the armature shaft.

Install brake assembly onto hexagonal adapter making sure that the brake assembly is sitting flush on the bracket. Tighten with supplied screws.

Remove motor leads "A" & "B" from capacitor and install "piggy back connectors to capacitor, the re-install motor leads to their original locations.

Connect brake leads to piggy back connectors on capacitor (orientation does not matter)

Wire tie loose wiring and check operation before installing cover.

### **Feedback Potentiometer**

Install drive gear face up over output shaft.

Install potentiometer and bracket on to base plate with potentiometer gear facing output shaft.

Wiring for potentiometer as follows:

#1 on potentiometer (white w/black stripe) #16 on terminal strip.

#2 on potentiometer (grey) #15 on terminal strip.

#3 on potentiometer (brown w/white stripe) #14 on terminal strip.

Using multimeter set at 2k ohms, calibrate potentiometer with leads from meter connected to terminals #15 and #16. With actuator in closed position multimeter should read between 95 and 100 ohms.

Rotate actuator 90 degrees (open position).

Connect leads from multimeter to terminal #14 and #15; multimeter should read 95 to 100 ohms. If necessary adjust open limit switch cam so that multimeter will read 95-100 ohms.

**Series 94 Options Codes for Serial # Tags**

M1	1 extra limit switch
M2	2 extra limit switches
HT	Heater & thermostat
P	Feedback potentiometer
DP	Dual feedback potentiometers
C1	4-20 mA Positioner
M	Mechanical brake
CO	Center off
CLC	Cycle length control
2WC	2-wire control
FS	Failsafe Battery Pak
C3	4-20mA Output Transducer
A4	4-12mA Input Signal Positioner
B12	Split Range Positioner

Example 1: A94**HTPWJ**

Heater & thermostat and feedback potentiometer installed.

Example 2: **AM94M1WJ**

Mechanical brake and 1 extra limit switch installed.

**Troubleshooting**

**Q:** *What if there is no output, but the motor runs?*

**A:** Manual override possibly engaged.

When the manual override is engaged, the motor will run, but no output will be observed until the manual override re-engages with the output shaft.

**A:** Valve stem broken. When the valve stem is broken, there will not be a change in fluid movement, making it seem as if the actuator has no output.

**Q:** *What if valve does not cycle?*

**A:** No power source to actuator. Check for power.

**A:** Power source disconnected. Check for broken wire, loose connection or no connection as per appropriate wiring diagram.

**A:** Low or wrong power source. Check for proper voltage.

**A:** Mechanical Brake jammed or misaligned. Check alignment of brake assembly.

This could occur during installation when someone would rest their hand on the Mechanical Brake to steady themselves.

**Q:** *What if there is water and/or moisture inside of the unit?*

**A:** Conduit fitting installed improperly. Re-install correctly.

**A:** Cover and/or base seal damaged. Replace damaged seal(s).

**A:** Base gasket damaged or installed improperly. Check gasket and replace if necessary.

**A:** Temperature swings of more than 15 degrees F. Install heater and thermostat to eliminate condensation.

When these temperature swings occur, the unit will “sweat” on the inside causing internal corrosion unless the actuator is equipped with a heater and thermostat to keep a constant temperature inside of the housing.

**A:** Unit has been submerged. Raise unit above liquid level.

An actuator that is to be submerged **MUST** meet NEMA 6 for the proper protection of the actuator and the elimination of a potential hazard. We do not recommend submerging the Series 94 Actuator as the electrical rating does not meet NEMA 6.

**Q:** *What if unit is oscillating?*

**A:** Valve torque exceeds output torque of actuator. Check for chemical compatibility of valve, and flange torque.

**Q:** *What if thermal overload frequently cuts out motor?*

**A:** Frequency of operation exceeds duty cycle rating. Check cycling period.

**A:** Unit is oscillating. Refer to above.

**Q:** *What if motor hums and no output is observed?*

**A:** Foreign material caught in valve. Remove material and inspect valve for damaged and/or worn parts. Replace parts as necessary.

**A:** Unit wired incorrectly (simultaneously powering open and closed). Check wiring as per appropriate wiring diagram.

**A:** Capacitor worn. Replace.

**Q:** *What if actuator “over-shoots” limit switches without stopping?*

**A:** Actuator wired in parallel to each other. Please note that each actuator requires it’s own set of switch contacts.

## Maintenance

### **Disconnect power!**



### ***NEVER REMOVE ACTUATOR COVER WHILE CIRCUITS ARE LIVE!***

**CAUTION:** It is imperative for reducing the chance of electrical shock, and to prevent ignition of hazardous atmospheres that you

**Disconnect power**  
**before** any maintenance or repairs are performed.

Series 94 actuators are virtually maintenance free. We do however, recommend that periodic checks are made to ensure that all fasteners are tight and properly torqued to extend the life of the actuator and valve.

Series 94 Actuators are manufactured with factory lubricated grease in the gear case and gearbox. This lubricant should never have to be replenished.

For outdoor or wet locations keep top and bottom seals coated with a silicone based grease.

### **Spare Parts** **Reference Drawing #279QM**

We recommend that the following be kept on hand as spare parts.

- 1 --- Limit Switch (Part #14)
- 1 --- Capacitor (Part #13)

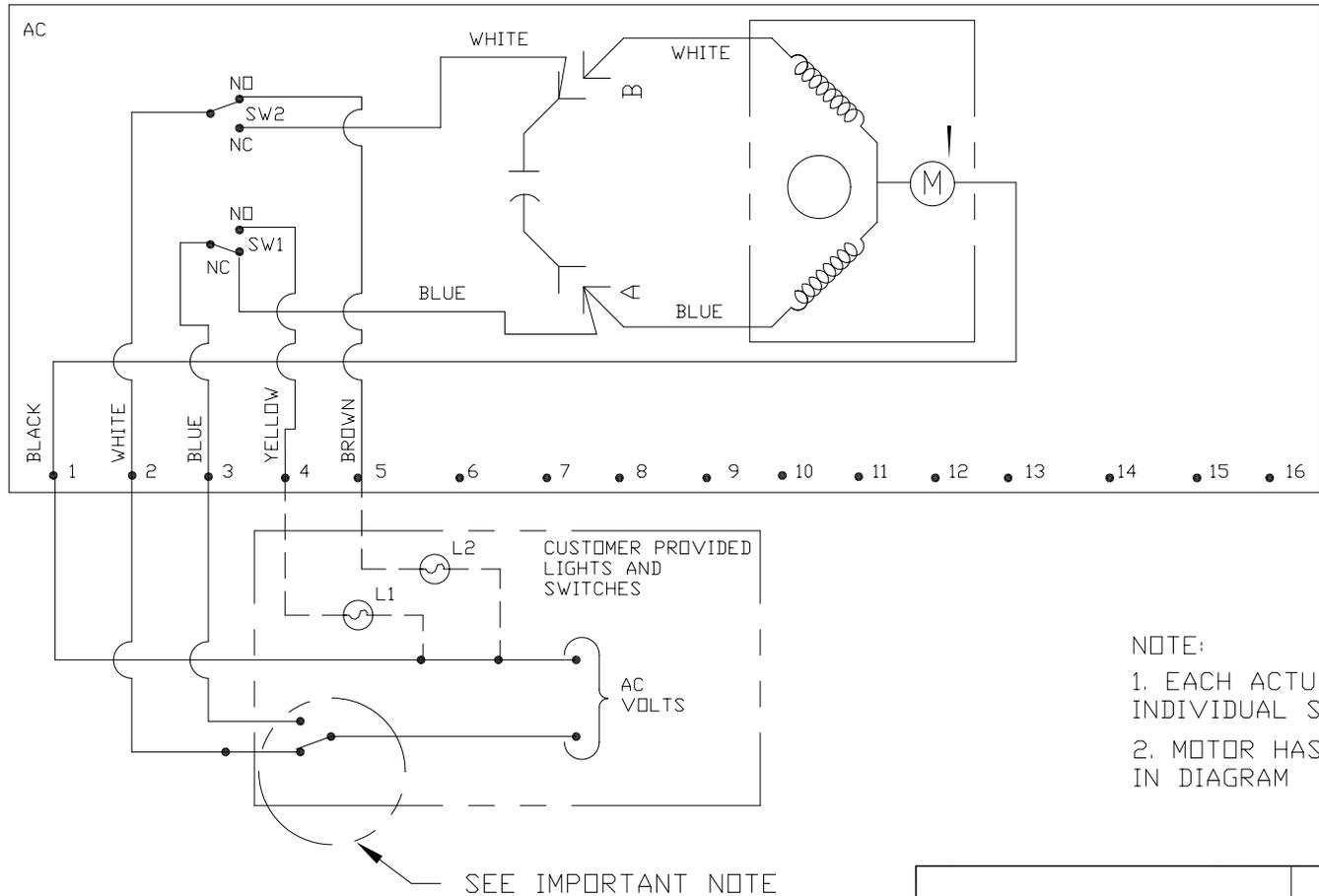
**NOTE:** When ordering replacement motor parts and/or options specify model # and voltage.

#### **Attachments:**

8 drawings: 296S92, 295S92, 297S92, 0106BV, 0112BV,  
0129BV, 0203BF57, 279QM

WIRING DIAGRAM FOR 115 VAC AND 220 VAC ONLY

ACTUATOR SHOWN IN COUNTER-CLOCKWISE EXTREME OF TRAVEL, OR "OPEN" POSITION



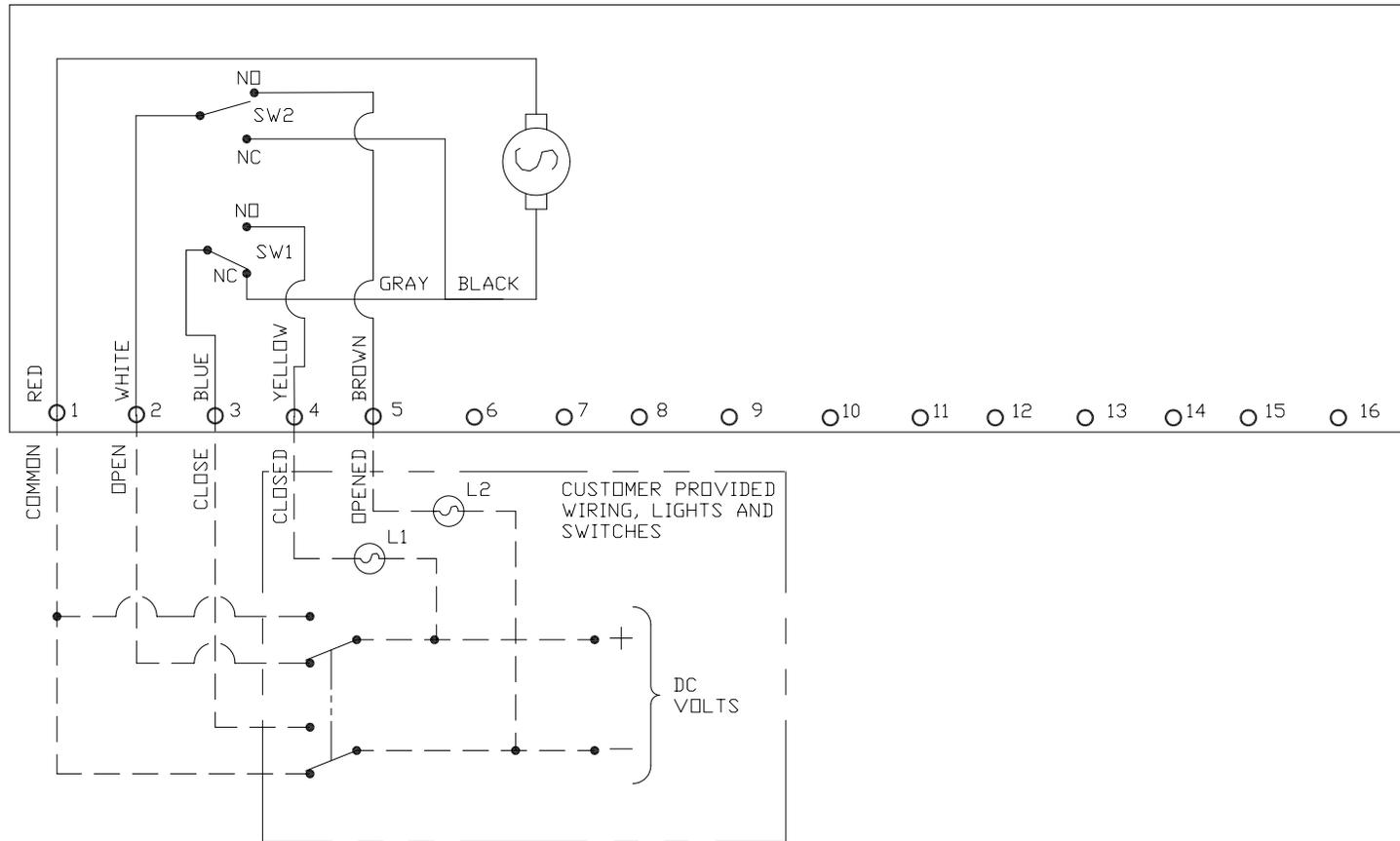
NOTE:  
 1. EACH ACTUATOR MUST BE POWERED THRU ITS OWN INDIVIDUAL SWITCH CONTACTS TO AVOID CROSS FEED  
 2. MOTOR HAS A THERMAL PROTECTOR AS SHOWN BY (M) IN DIAGRAM

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SERIES 94 WIRING DIAGRAM 120/220 VAC					
DR	D CAMERON	DATE	9/11/01	SIZE	A
APPD	DAVE HURLEY	DATE	9/11/01	DWG. NO.	296S92
PROD	LED LESTER	DATE	9/11/01	REV	B
WO#/SO#		SCALE		NTS	
FILE		ACAD11\S92		SHEET 1 OF 1	

ACTUATOR SHOWN IN COUNTER CLOCKWISE EXTREME OF TRAVEL OR "OPEN" POSITION

DC WIRING DIAGRAM



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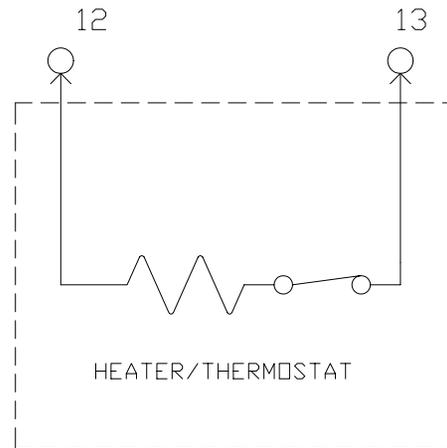
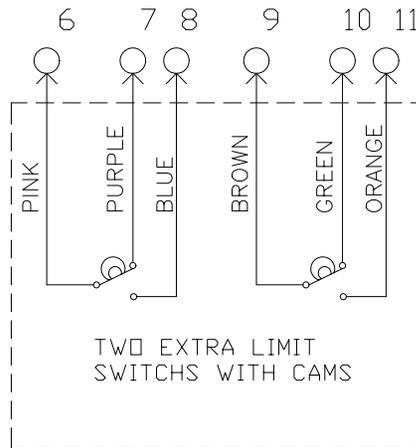
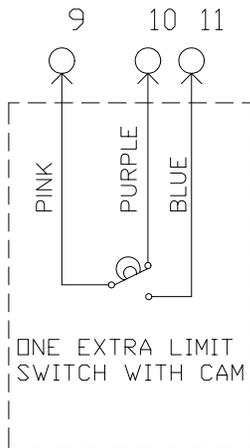
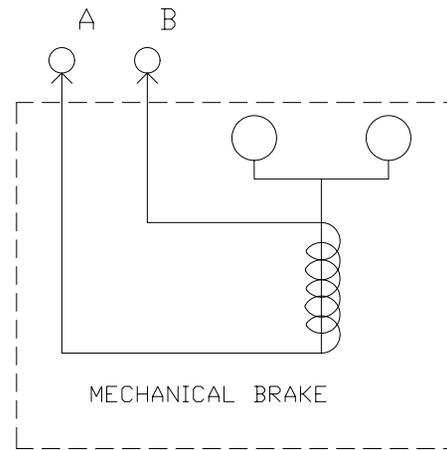
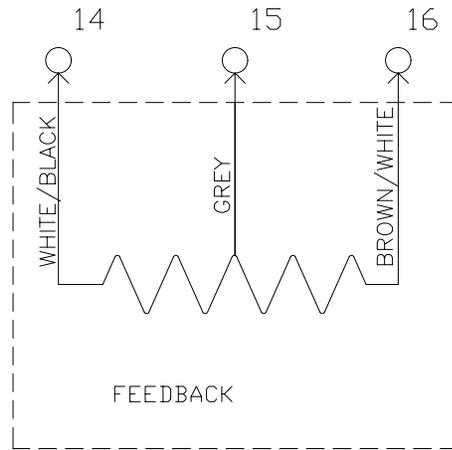
	NAME	DATE
DR	D CAMERON	9/13/01
APPD	DAVE HURLEY	9/13/01
PROD	LED LESTER	9/13/01
WO#/SO#		
FILE	ACAD11\S92	

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**ISO 9001 CERTIFIED**  
 35 GREEN STREET, P.O. BOX 653, MALDEN, MA.



QUATER MASTER - 94  
 DC WIRING DIAGRAM

SIZE	A	DWG. NO.	295S92	REV	B
SCALE	NTS		SHEET 1 OF 1		



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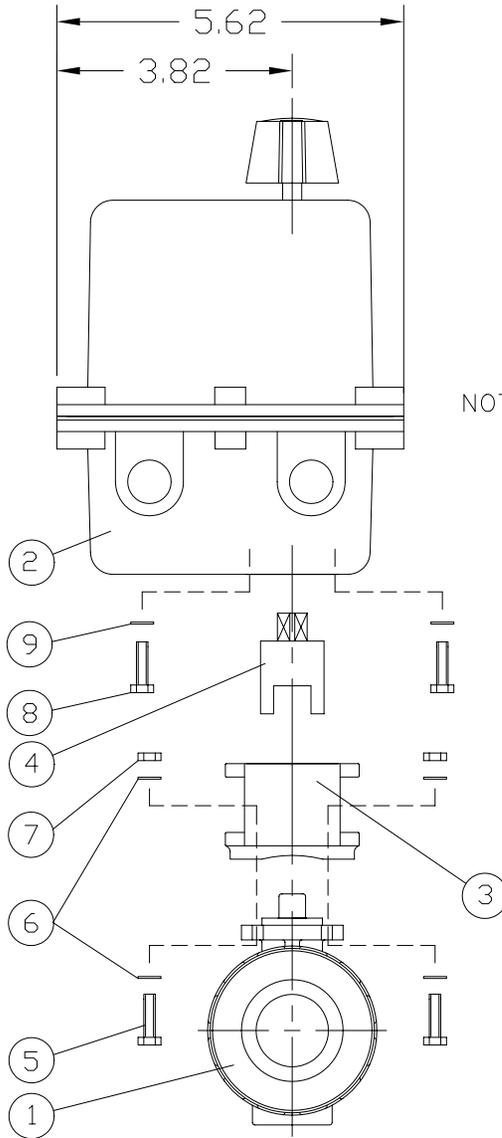
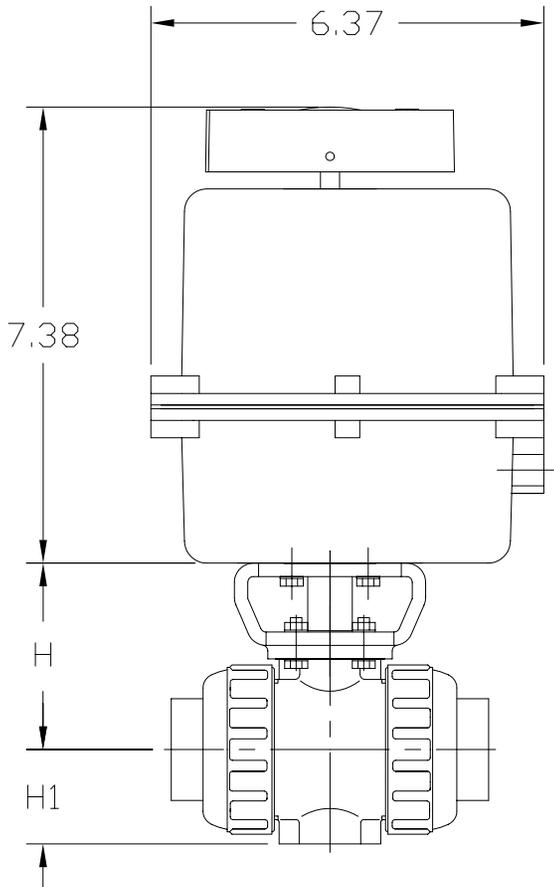
35 GREEN STREET, P.O. BOX 653, MALDEN, MA.



QUATER MASTER - 94  
OPTIONS WIRING DIAGRAM

	NAME	DATE
DR	D CAMERON	9/13/01
APPD	DAVE HURLEY	9/13/01
PROD	LED LESTER	9/13/01
WO#/SO#		
FILE	ACAD11/S92	

SIZE	A	DWG. NO.	297S92	REV	B
SCALE	NTS		SHEET 1 OF 1		



UNIT: INCH

VALVE SIZE	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
H	2.76	3.01	3.29	3.64	3.98	4.43
H1	1.14	1.38	1.54	1.85	2.17	2.60

NOTE. The shape and appearance of assembly differ a little with nominal size compared to this drawing.

9	FLAT WASHER (M6.0)	STAINLESS STEEL	4
8	BOLT (M6.0x1-16LG)	STAINLESS STEEL	4
7	NUT (FOR 1/2" THRU 1-1/4" : M5.0x8) (FOR 1-1/2" THRU 2" : M6.0x1)	STAINLESS STEEL	4
6	FLAT WASHER (FOR 1/2" THRU 1-1/4" : M5.0) (FOR 1-1/2" THRU 2" : M6.0)	STAINLESS STEEL	8
5	BOLT (FOR 1/2" THRU 1-1/4" : M5.0x8-16LG) (FOR 1-1/2" THRU 2" : M6.0x1-20LG)	STAINLESS STEEL	4
4	COUPLING	STAINLESS STEEL 303	1
3	MOUNTING BRACKET	PPG	1
2	ACTUATOR SERIES 94	ZYTEL	1
1	BALL VALVE TYPE 21	PVC,CPVC,PP,PVDF	1
ITEM	DESCRIPTION	MATERIAL	QTY

**FOR REFERENCE ONLY  
ASAHI/AMERICA**

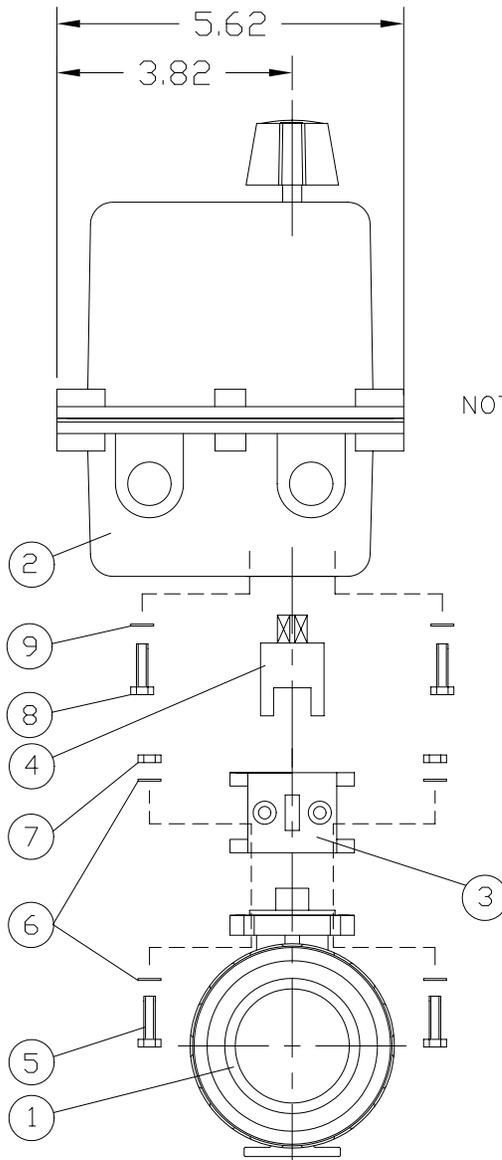
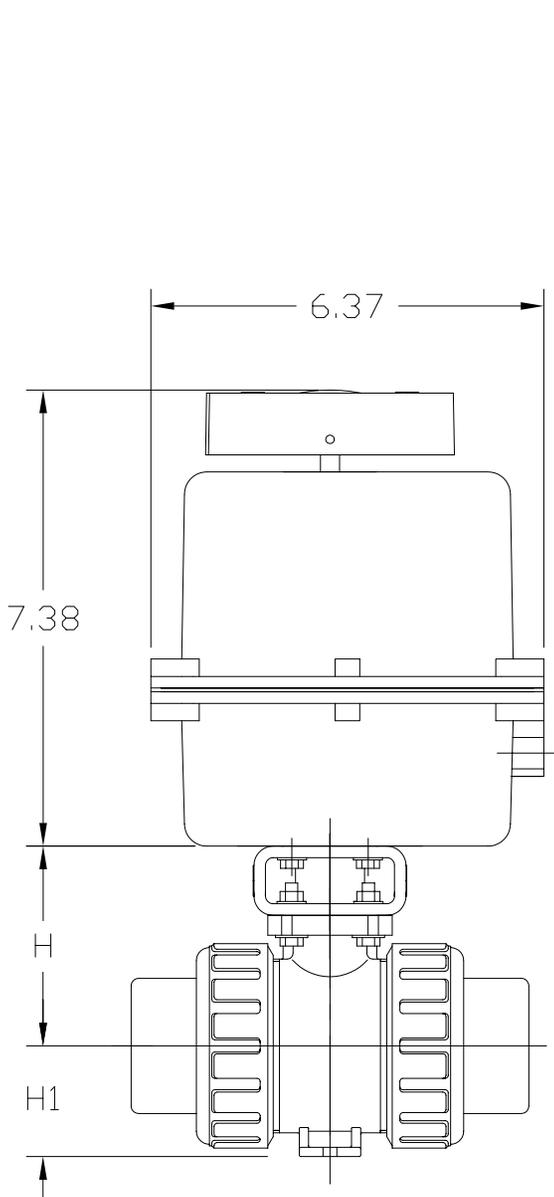
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	NAME	DATE
DR	KENICHI MIYAZAKI	8/2/01
APPD	DAVE HURLEY	8/2/01
PROD	LED LESTER	8/2/01
WO#/CO#		
FILE		

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35 GREEN STREET, P.O. BOX 653, MALDEN, MA.

BALL VALVE TYPE21  
SERIES94 ELECTRIC ACTUATOR  
1/2" THRU 2"

SIZE	A	DWG. NO.	0106BV	REV	A
SCALE	NTS		SHEET 1 OF 1		



UNIT: INCH		
VALVE SIZE	2-1/2"	3"
H	5.12	5.47
H1	2.83	3.35

NOTE. The shape and appearance of assembly differ a little with nominal size compared to this drawing.

9	FLAT WASHER (M6.0)	STAINLESS STEEL	4
8	BOLT (M6.0x1-16LG)	STAINLESS STEEL	4
7	NUT (M8.0x1.25)	STAINLESS STEEL	4
6	FLAT WASHER (M8.0)	STAINLESS STEEL	8
5	BOLT (M8.0x1.25-35LG)	STAINLESS STEEL	4
4	COUPLING	STAINLESS STEEL 303	1
3	MOUNTING BRACKET	PPG	1
2	ACTUATOR SERIES 94	ZYTEL	1
1	BALL VALVE TYPE 21	PVC,CPVC,PP,PVDF	1
ITEM	DESCRIPTION	MATERIAL	QTY

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	NAME	DATE
DR	KENICHI MIYAZAKI	8/14/01
APPD	DAVE HURLEY	8/14/01
PROD	LED LESTER	8/14/01
WO#/CO#		
FILE		

**ASAHI/AMERICA**

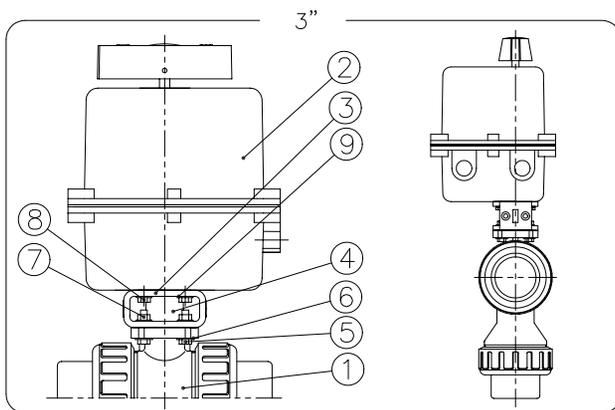
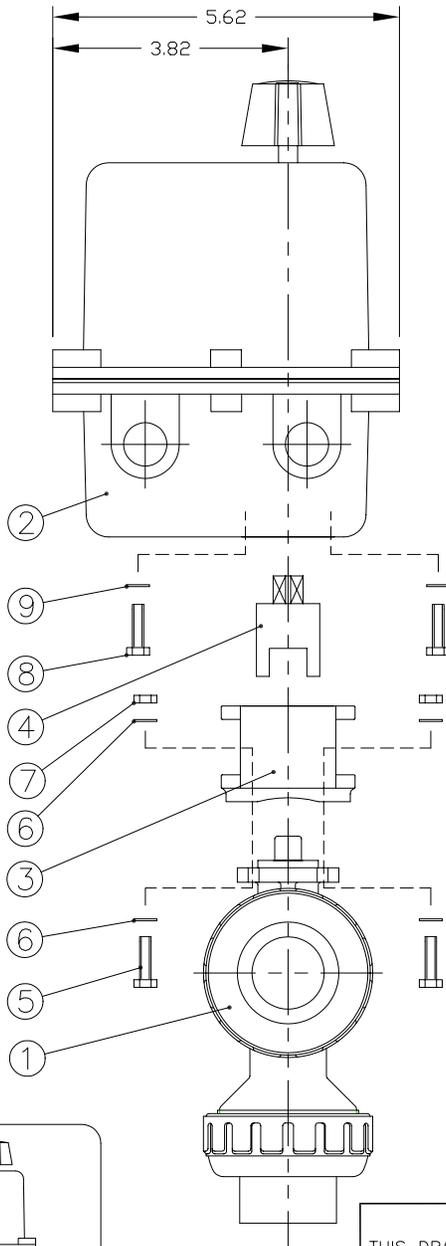
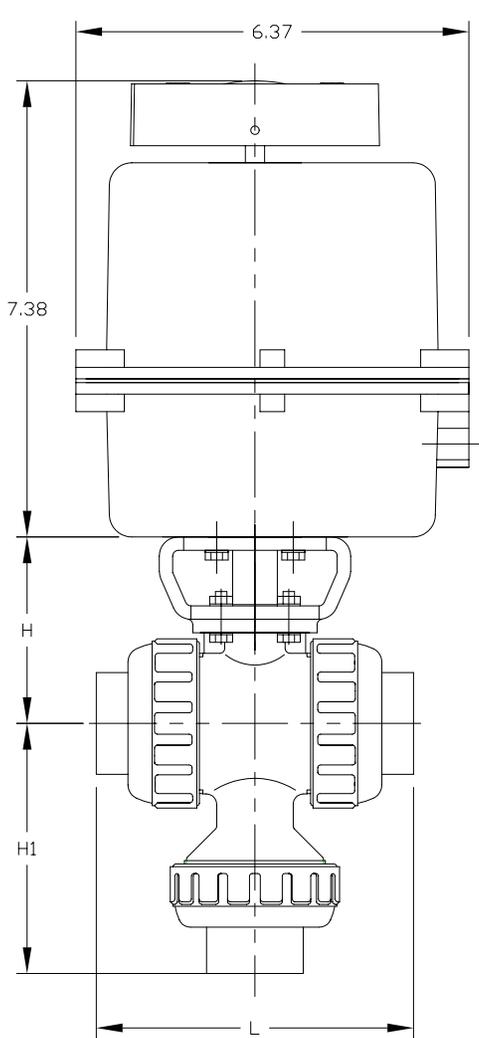
ISO 9001 CERTIFIED

35 GREEN STREET, P.O. BOX 653, MALDEN, MA.



BALL VALVE TYPE21  
SERIES94 ELECTRIC ACTUATOR  
2-1/2" THRU 3"

SIZE	A	DWG. NO.	0112BV	REV	A
SCALE	NTS		SHEET 1 OF 1		



DIMENSIONS TABLE

UNIT: inch

NOMINAL SIZE	H	FLANGED		THREADED		SOCKET						SPIGOT (BUTT END)		
		H1	L	H1	L	PVC, CPVC		PP, PVDF (DIN)		PP, PVDF (IPS)		H1	L	
						H1	L	H1	L	H1	L			
1/2" 15mm	2.76	3.70	5.63	2.89	4.02	3.08	4.45	2.80	3.90	3.09	4.45	3.27	4.88	
3/4	20	3.01	4.50	6.77	3.48	4.72	3.56	5.08	3.27	4.49	3.61	5.08	3.90	5.67
1	25	3.29	5.24	7.36	4.13	5.16	4.32	5.75	3.94	4.84	4.37	5.75	4.53	6.06
1 1/2	40	3.98	6.50	8.35	5.53	6.42	5.71	7.24	5.16	5.83	5.85	7.24	6.02	6.85
2	50	4.43	7.34	9.21	6.61	7.76	6.66	8.23	6.06	6.93	6.76	8.23	7.01	8.82
3	80	5.47	10.06	11.97	9.25	10.39	9.59	11.10	8.82	9.88	11.10	11.10	9.69	11.61

- NOTE; 1) THE SHAPE AND APPEARANCE OF ASSEMBLY DIFFER A LITTLE WITH NOMINAL SIZE COMPARED TO THIS DRAWING.  
 2) FOR DETAILED VALVE DIMENSIONS, REFER TO DWG. NO. 0126BV, 0127BV, 0128BV.  
 L-PORT : DWG. NO. 0126BV  
 DOUBLE L-PORT : DWG. NO. 0127BV  
 CROSS PORT : DWG. NO. 0128BV

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9	FLAT WASHER (M6.0)	STAINLESS STEEL	4
8	BOLT (M6.0x1-16LG)	STAINLESS STEEL	4
7	NUT (FOR 1/2" THRU 1" : M5.0x8) (FOR 1-1/2" THRU 2" : M6.0x1) (FOR 3" : M8.0x1.25)	STAINLESS STEEL	4
6	FLAT WASHER (FOR 1/2" THRU 1" : M5.0) (FOR 1-1/2" THRU 2" : M6.0) (FOR 3" : M8.0)	STAINLESS STEEL	8
5	BOLT (FOR 1/2" THRU 1" : M5.0x8-16LG) (FOR 1-1/2" THRU 2" : M6.0x1-20LG) (FOR 3" : M8.0x1.25-35LG)	STAINLESS STEEL	4
4	COUPLING	STAINLESS STEEL 303	1
3	MOUNTING BRACKET	PPG	1
2	ACTUATOR SERIES 94	ZYTEL	1
1	MULTI PORT BALL VALVE TYPE23	PVC, CPVC, PP, PVDF	1
ITEM	DESCRIPTION	MATERIAL	QTY

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	NAME	DATE
DR	KENICHI MIYAZAKI	1/28/03
APPD	DAVE HURLEY	1/28/03
PROD	LEO LESTER	1/28/03
WO#/CO#		
FILE		

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 35 GREEN STREET, P.O. BOX 653, MALDEN, MA.



MULTI PORT BALL VALVE  
 TYPE23 WITH SERIES94 ACT.  
 1/2" THRU 3"

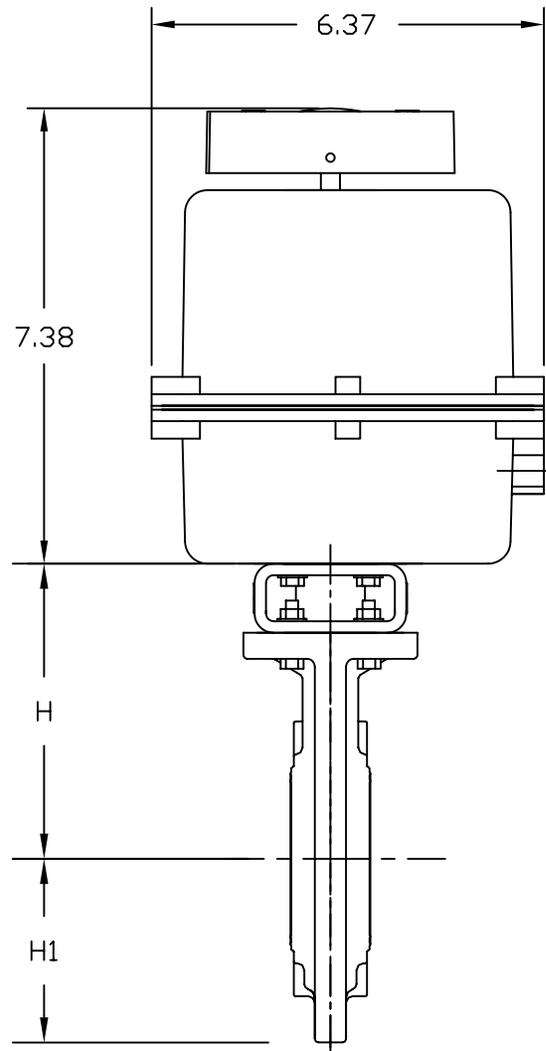
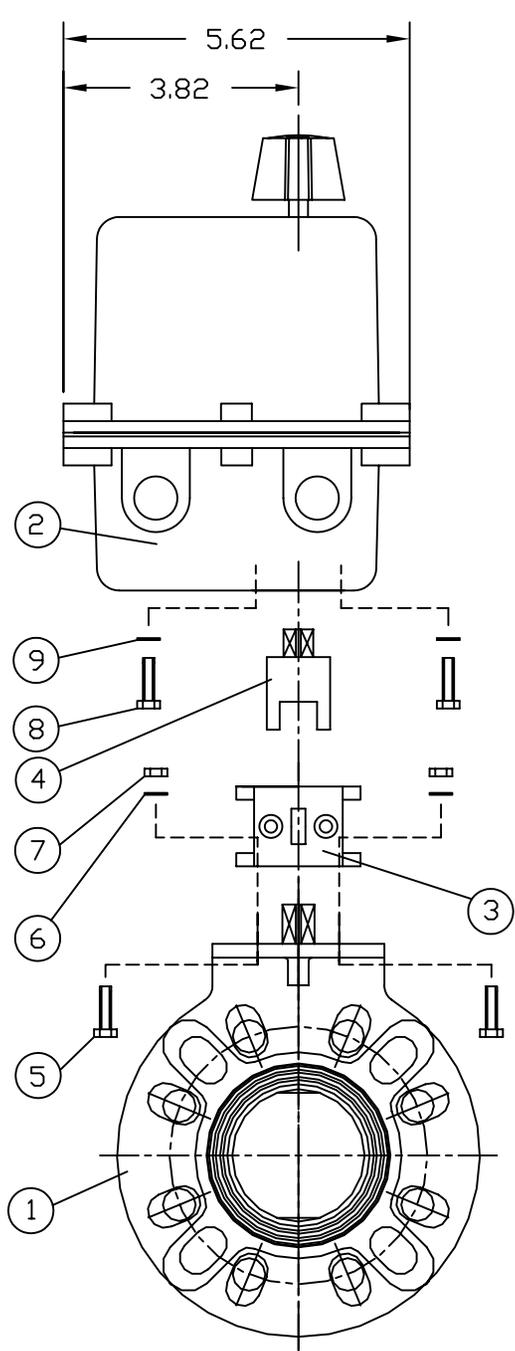
SIZE	A	DWG. NO.	0129BV	REV	A
SCALE	NTS		SHEET 1 OF 1		

UNIT: INCH

VALVE SIZE	1-1/2"	2"	2-1/2"	3"	4"
H	5.51	5.75	6.18	6.46	7.16
H1	2.95	3.27	3.66	3.94	4.53

NOTE: 1.The shape and appearance of assembly differ a little with nominal size compared to this drawing.  
2. For Mounting Bracket : F07xF05, F07

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9	FLAT WASHER (M6.0)	STAINLESS STEEL	4
8	BOLT (M6.0x1-16LG)	STAINLESS STEEL	4
7	NUT (FOR 1-1/2" THRU. 4" : M8.0x1.25)	STAINLESS STEEL	4
6	FLAT WASHER (FOR 1-1/2" THRU. 4" : M8.0)	STAINLESS STEEL	8
5	BOLT (FOR 1-1/2" THRU. 4" : M8.0x1.25-35LG)	STAINLESS STEEL	4
4	COUPLING	STAINLESS STEEL 303	1
3	MOUNTING BRACKET	PPG	1
2	ACTUATOR SERIES 94	ZYTEL	1
1	BUTTERFLY VALVE TYPE 57	U-PVC,PP,PVDF	1
ITEM	DESCRIPTION	MATERIAL	QTY

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	NAME	DATE
DR	JOHN GLASSFORD	6/10/05
APPD	DAVE HURLEY	6/10/05
PROD	LEO LESTER	6/10/05
WO#/CO#		
FILE		

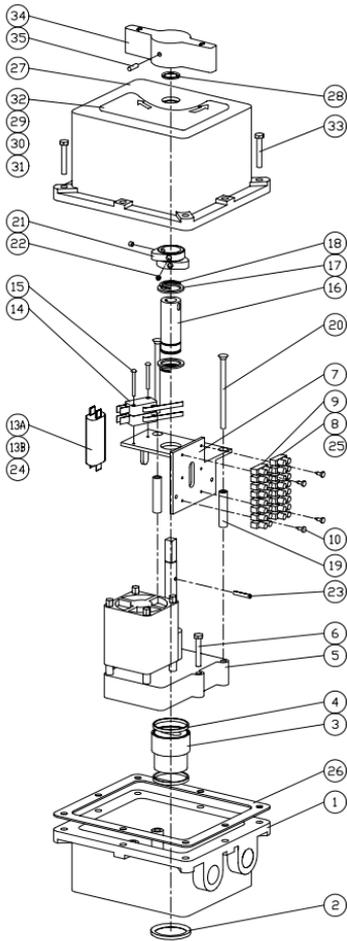
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35 GREEN STREET, P.O. BOX 653, MALDEN, MA.



BUTTERFLY VALVE TYPE57  
SERIES94 ELECTRIC ACTUATOR  
1-1/2" THRU 4"

SIZE	A	DWG. NO.	0203BF57	REV	A
SCALE	NTS		SHEET 1 OF 1		



ITEM	PART NO	QTY	DESCRIPTION
1	7403002	1	BASE
2	7403000	1	BASE SEAL
3	7403017	1	OUTPUT COUPLING
4	7403005	2	COUPLING GASKET
5	7403004	1	MDTOR
6	7403022	2	MDTOR SCREW
7	7403011	1	BASE PLATE
8	7401420	1	TERMINAL BLOCK 1-8
9	7401425	1	TERMINAL BLOCK 9-16
10	7401600	4	TERMINAL BLOCK SCREW
11A	7401948	1	4.2 MFD CAPACITOR - A94
11B	7402004	1	6.7 MFD CAPACITOR - B94
14	7401460	2	LIMIT SWITCH
15	7401620	2	LIMIT SWITCH SCREW
16	7403016	1	OUTER SHAFT
17	7403006	2	OUTER SHAFT GASKET
18	7403009	2	RETAINING RING
19	7403018	2	STANDOFF
20	7403014	2	BASE PLATE SCREW
21	7401480	2	CAM
22	7401740	4	CAM SCREW
23	7403010	1	PIN
24	7403023	1	2 PC HARNESS
25	7403015	1	4 PC HARNESS
26	7403007	1	BASE GASKET
27	7403001	1	COVER
28	7403020	1	COVER SEAL
29	7403019	1	WIRE DIAGRAM LABEL
30	7403025	1	OPTION LABEL
31	7403030	1	GM II LABEL
32	7403040	1	OVERRIDE LABEL
33	7403032	8	COVER SCREW
34	7403003	1	HANDLE
35	7401700	1	HANDLE SCREW
36	7403021	1	GM II BDX

NOTE:

1. LOCATE ITEM 29 & 30 ON INSIDE SURFACES OF COVER (ITEM 27).
2. LOCATE ITEM 31 ON OUTSIDE BACK SURFACE OF COVER (ITEM 27).

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	NAME	DATE
DR	D CAMERON	9/13/01
APPD	DAVE HURLEY	9/13/01
PROD	LEO LESTER	9/13/01
WO# / SO#		
FILE	ACAD11/GM	

**ASAHI/AMERICA**

ISO 9001 CERTIFIED

35 GREEN STREET, P.O. BOX 653, MALDEN, MA.



SERIES 94  
EXPLODED VIEW

SIZE	A	DWG. NO.	279QM	REV	B
SCALE	NTS		SHEET 1		OF 1

# Section 10

# High Purity Skid Installation / Operation

## Overview

Refer to the P&ID drawing, skid general arrangement dwg and all wiring diagrams.

## Equipment Location

Place the skid and storage tank on a flat concrete surface designed to carry the weight of the equipment. There are anchoring holes arranged around the perimeter of the RO frame. The frame and tank must be securely anchored to the floor for safety.

## Plumbing Installation

Connect piping as shown on the drawings. DI and RO water is very aggressive. Use plastic or stainless piping in your recirculation loop piping.

## Wiring Installation

Refer to the electrical wiring diagrams for specific power requirements. A qualified electrician should do electrical connection. The electrical interconnections, field wiring, and power requirements are shown on the electrical schematics contained in this manual. Confirm that the power supply is compatible and that sufficient amperage is available. The power supply should be properly fused with a disconnect switch at the distribution panel.

## RO Membranes and Cartridge Filters

The membranes are factory installed. If required, the membranes should be loaded in the direction of flow. Cartridge filters are shipped loose and need to be installed at the jobsite. Refer to P&ID drawing and skid general arrangement drawing for micron ratings of cartridges.

## UV Sterilizer

The UV lamp is usually shipped loose and will need to be installed before start-up. Follow the UV sterilizer instruction manual for lamp installation.

## Operation

Allow the RO unit to fill the permeate storage tank at least half way with water before proceeding. With the MCP selector switches in AUTO position, the pump and UV will activate unless the water level in the storage tank is low. Adjust the permeate loop pressure relief valve on the storage tank so that water is constantly recirculating and the desired loop pressure is achieved.

# HIGH PURITY SYSTEM: CONTROLLER and STARTERS DESCRIPTION AND OPERATION

**NOTE:** Reference main control panel (MCP) wiring diagrams and MCC wiring diagrams in section four of this manual.

**READ AND UNDERSTAND THE ENTIRE MANUAL BEFORE ATTEMPTING TO START THIS SYSTEM. VERIFY PUMP ROTATION BEFORE RUNNING PUMPS**

Abbreviations:

MCP=Main Control Panel

MCC= Motor Control Center

HP=High Purity

## **SECTION A: INTRODUCTION:**

The HP skid contains the main PLC with operator interface (OIT) and MCC-1. The PLC controls the operation of the RO on the pretreatment skid and transfer pumps on the HP skid. The OIT allows local monitoring and operator intervention with the PLC. The RO will normally run when the permeate tank is low and will shut off when the permeate tank is high. The transfer pumps will run until the permeate tank level falls below the low level alarm setting entered on the level settings screen. The UV light will operate in parallel with either pump. The high temp dump valve will be normally closed until the temperature in the HP loop exceeds the preset temperature at which time the valve will open. The valve will remain open until the temperature falls below the preset value.

## **SECTION B: RO INTERCONNECT WIRING SUMMARY**

Reference the wiring diagrams for details.

Wire one 3 phase 480VAC/60Hz and one single phase 120VAC/60Hz power to MCC-1. Wire one single phase 120VAC/60Hz power to MCC-2.

Reference wiring diagram [EP12-147-09-01](#) for interconnecting the panels.

## SECTION C: MCP PUSHBUTTON (PB) AND LIGHTS (LT)

### PUSHBUTTON (PB)

**PB-1** Alarm Acknowledge/Silence – PB is a momentary pushbutton. This pushbutton is used to acknowledge or silence the alarm horn.

### LIGHTS (LT)

**LT-3 HP General Alarm Light-** This light is red and will flash when any of the following alarms occur.

#### Standard Alarms-

- Permeate Tank High Level
- Permeate Tank Low Level
- Low Primary Resistivity
- Low Polished Resistivity
- Low Loop Flow
- High Loop Temp

## SECTION D: MCP INSTRUMENTS

**OPERATOR INTERFACE-** An operator interface is provided to show data on the HP system. It also allows changes to various presets in the program. Details on this are listed later in this document.

## SECTION E: HP MCC-1 SELECTOR SWITCHES AND LIGHTS:

### REPRESSURIZATION PUMP SELECTOR SWITCH SS3

P-1/P-2	This is a 2 position maintained switch, it controls which repressurization pump is in operation.
P-1	When in this position P-1 is in operation.
P-2	When in this position P-2 is in operation.

### REPRESSURIZATION PUMP P-1 SELECTOR SWITCH SS2/LT2

Hand, Off, Auto	This is a 3 position maintained switch, it controls the operation of the transfer pump.
Auto -	When in this position the transfer pump will be controlled automatically by the PLC.
Off	When in this position the transfer pump will be forced off.
Hand	When in this position the transfer pump is not controlled by the PLC and will run continuously uncontrolled until an operator puts the pump back in AUTO

**NOTE:** *The normal position for this selector switch is AUTO.*

### REPRESSURIZATION PUMP P-2 SELECTOR SWITCH SS1/LT1

Hand, Off, Auto	This is a 3 position maintained switch, it controls the operation of the transfer pump.
Auto -	When in this position the transfer pump will be controlled automatically by the PLC.
Off	When in this position the transfer pump will be forced off.
Hand	When in this position the transfer pump is not controlled by the PLC and will run continuously uncontrolled until an operator puts the pump back in AUTO

**NOTE:** *The normal position for this selector switch is AUTO.*

**P-1 & P-2 OVERLOAD SETTING-** Located on the bottom of the pumps contactor is the adjustable overload relay. There is a small dial on this overload. The dial needs to be set to the full load amp (FLA) draw of the pump. This value is on the pump motors nameplate. It was set at the factory but should be rechecked before starting.

**WARNING: IT IS NOT RECOMMENDED TO RUN ANY OF THE PUMPS IN HAND WITHOUT HAVING AN OPERATOR THERE TO MONITOR THE HP SYSTEM.**

**NOTE: CONNECTION TIGHTENING- VERIFY ALL WIRE CONNECTIONS IN THE MCC ARE TIGHT. SHIPPING MAY HAVE CAUSED TERMINALS TO LOOSEN. A LOOSE CONNECTION CAN CAUSE FUSES TO BLOW OR PROBLEMS WITH THE MOTOR.**

## SECTION E: HP MCC-1 SELECTOR SWITCHES AND LIGHTS: cont'd...

### UV SELECTOR SWITCH SS4/LT4

<b>Hand, Off, Auto</b>	This is a 3 position maintained switch, it controls the operation of the UV light.
Auto -	When in this position the UV light will turn on automatically when either repressurization pump runs.
Off	When in this position the UV light will be forced off.
Hand	When in this position the UV light is not controlled. The UV light will remain on until an operator puts the UV back in AUTO

**NOTE:** *The normal position for this selector switch is AUTO.*

### LIGHT (LT)

**LT-3 Low Tank Level-** This light is red and will be lit steady when the permeate tank level is below the low level setting entered in the OIT.

## SECTION E: RO MCC-2 SELECTOR SWITCHES AND LIGHTS:

### TITAN RO PUMP SELECTOR SWITCH SS1/LT1

<b>Hand, Off, Auto</b>	This is a 3 position maintained switch, it controls the operation of the Titan RO pressure pump.
Auto -	When in this position the RO will be controlled automatically by the PLC.
Off	When in this position the RO will be forced off.
Hand	When in this position the RO is not controlled by the PLC and will run continuously uncontrolled until an operator puts the RO back in AUTO.

**NOTE:** *The normal position for this selector switch is AUTO.*

### LIGHTS (LT)

- LT-2 High Tank Level-** This light is amber and will be lit steady when the permeate tank level is above the RO stop setting entered in the OIT.
- LT-3 RO Lockout-** This light is amber and will be lit steady when the either of the filters on the pretreatment skid are in regeneration.

## **SECTION F: ALARMS:**

**ALARM BANNER- ANY ALARM WILL GENERATE AN ALARM BANNER. AN ALARM BANNER IS A MESSAGE OF THE ALARM THAT WILL POP UP ON THE OPERATOR INTERFACE (OIT). ALL ALARMS ARE RECORDED ON THE ALARM HISTORY SCREEN.**

### **ALARMS:**

- 1. PERMEATE TANK HIGH LEVEL-** When the level in the permeate tank has reached the high level alarm setpoint an alarm will occur.
- 2. PERMEATE TANK LOW LEVEL-** When the level in the permeate tank has reached the low level alarm setpoint an alarm will occur. The repressurization pumps will be disabled until the level in the permeate tank rises above the loop pumps level enable setting.
- 3. LOW PRIMARY RESISTIVITY:** If the primary resistivity falls below the setpoint for x amount of seconds then the alarm is triggered.
- 4. LOW POLISHED RESISTIVITY:** If the polished resistivity falls below the setpoint for x amount of seconds then the alarm is triggered.
- 5. LOW LOOP FLOW:** If the loop flow falls below the setpoint for x amount of seconds then the alarm is triggered.
- 6. HIGH LOOP TEMPERATURE:** The high temp dump valve will be normally closed until the temperature in the HP loop exceeds the preset temperature at which time the valve will open and the alarm is triggered.

# **SECTION G: MCP RO SEQUENCE OF OPERATION AND MCC MISCELLANEOUS**

**RO SEQUENCE OF OPERATION-** Normally the RO starts and stops based on level in the permeate storage tank. When the level is low the RO will run. When the level is high the RO will stop. When the RO stops based on high level the RO will not restart until the level goes low again.

**REPRESSURIZATION PUMPS AND UV SEQUENCE OF OPERATION-** Normally the transfer pumps will operate uninhibited until the level in the permeate storage tank falls below the low level setting entered in the OIT.

## **MISCELLANEOUS**

Delays - There are many delays programmed into the system. It is normal for the system to delay before things happen.

## **BUMPING PUMPS TO VERIFY CORRECT ROTATION**

**Motor Rotation and Overloads-** Before running the pumps verify proper rotation by bumping the pumps.

**Normal Switch Positions-** Under normal operation the following switch positions should be maintained.

1. RO Control Selector on MCC-2 should be in "AUTO"
2. Repressurization Pump P-1 Selector Switch on MCC-1 should be in the "AUTO" position.
3. Repressurization Pump P-2 Selector Switch on MCC-1 should be in the "AUTO" position.
4. UV Selector Switch on MCC-1 should be in the "AUTO" position.

## SECTION H. OPERATOR INTERFACE (OIT)

### General Information:

The OIT is located on the MCP on the HP skid. It allows the user to monitor, choose and change detailed data in regards to the system. The OIT communicates with the Programmable logic controller via a cable. This is a touch screen monitor.

Below is sequence that applies to all screens where data can be changed:

**Numeric Entry Button-** All numeric entry button have a red border with a checkered yellow background. The number displayed is the current value for that preset. If a change in data is necessary, touch the desired button on the screen. A small keypad will pop up. Enter in the desired value using this keypad. Press the enter key. (long arrow key) There is a minimum and maximum value that can be entered. If the value entered is out of range a small banner will pop up indicating this.

**SCREEN CHANGE BUTTON-** This is located on every screen except the screen list screen. it can be used to go to the screen list selector to change to a different screen.

## SYSTEM MAIN SCREEN

This is the main system screen and displays the status of the RO. This screen is also used to view the instrument readings.

1ST Line- Displays the status of the RO system. This can be any of the following:

1. **RO Enabled**- The RO system is in auto and the RO pressure pump is allowed to run.
2. **High Level Shutdown**- The RO is shut down due to high level in the permeate tank.
3. **RO Lockout**- The filter has gone into regeneration and has locked out the operation of the RO until the filter has finished regeneration.

Standard Data Displays-

**Loop Flow**- the loop flow is shown here in gpm.

**Loop Temp**- the loop temperature is shown here in degrees Fahrenheit.

**Primary Resistivity**- the primary resistivity is shown here in megohms.

**Polished Resistivity**- the polished resistivity is shown here in megohms.

**Tank Level**- the permeate storage tank level is displayed here as a percentage. Where 0% is empty and 100% is full.

**High Temp Dump Valve Status**- if the loop temp is below the alarm setpoint this indicator will be green. If the loop temp rises above the alarm setpoint then it will change to red and flash.

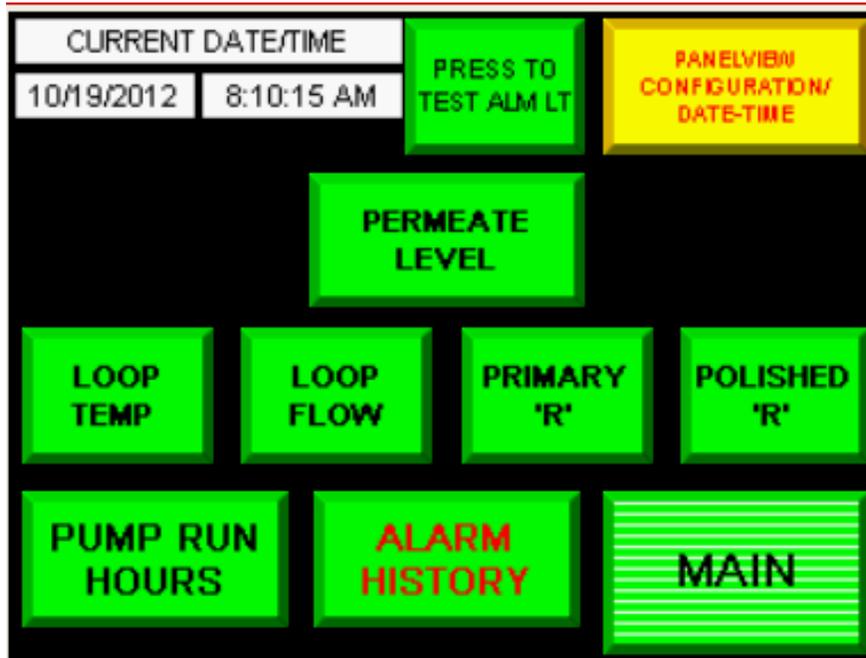
**P-1/P-2 Run Status**- if the pump is running then the display will be green. If the pump is stopped the display will be red.



**SCREEN: SELECTOR SCREEN**

This screen allows the user to go to a different screen. Press the button of the screen you want to go to.

Time and date- the current time and date are shown. This is only used for the time/date stamp on any alarm. If time or date is not correct go to the configuration and change. See configuration screen on next page.



## SCREEN: CONFIGURATION CHOICE SCREEN

Use the button in the upper right hand corner to go to the configuration screen.

This button allows access to various setup parameters of the panelview. The only item that may need to be adjusted is the time and date. The time and date is only used for the alarm history records.

The image shows a configuration choice screen with a yellow background. At the top, there is a white box with a black border containing a warning: "WARNING- DO NOT GO TO CONFIG SETTINGS UNLESS YOU KNOW WHAT YOU ARE DOING.CHANGES TO THESE SETTINGS COULD CAUSE OPERATIONAL PROBLEMS." Below this is another white box with a black border containing instructions: "ON INITIAL START UP THE DATE/TIME WILL HAVE TO BE SET.PRESS 'GO TO CONFIG' AND THEN CHOOSE DATE/TIME. ENTER IN THE CORRECT DATA.PRESS 'FILE MANAGER'.PRESS 'RUN'. DATE AND TIME WILL HAVE TO BE RE-ENTERED IF POWER IS LOST." At the bottom, there are three main elements: a red button with a diagonal hatched pattern and the text "Goto Config"; a white box labeled "CURRENT DATE/TIME" containing two sub-boxes with the date "9/28/2011" and the time "10:22:25 AM"; and a blue button with the text "RETURN".

**WARNING- DO NOT GO TO CONFIG SETTINGS UNLESS YOU KNOW WHAT YOU ARE DOING.CHANGES TO THESE SETTINGS COULD CAUSE OPERATIONAL PROBLEMS.**

**ON INITIAL START UP THE DATE/TIME WILL HAVE TO BE SET.PRESS "GO TO CONFIG" AND THEN CHOOSE DATE/TIME. ENTER IN THE CORRECT DATA.PRESS "FILE MANAGER".PRESS "RUN". DATE AND TIME WILL HAVE TO BE RE-ENTERED IF POWER IS LOST.**

**Goto Config**

CURRENT DATE/TIME

9/28/2011

10:22:25 AM

**RETURN**

## SCREEN: ALARM HISTORY AND ALARM BANNER SCREEN

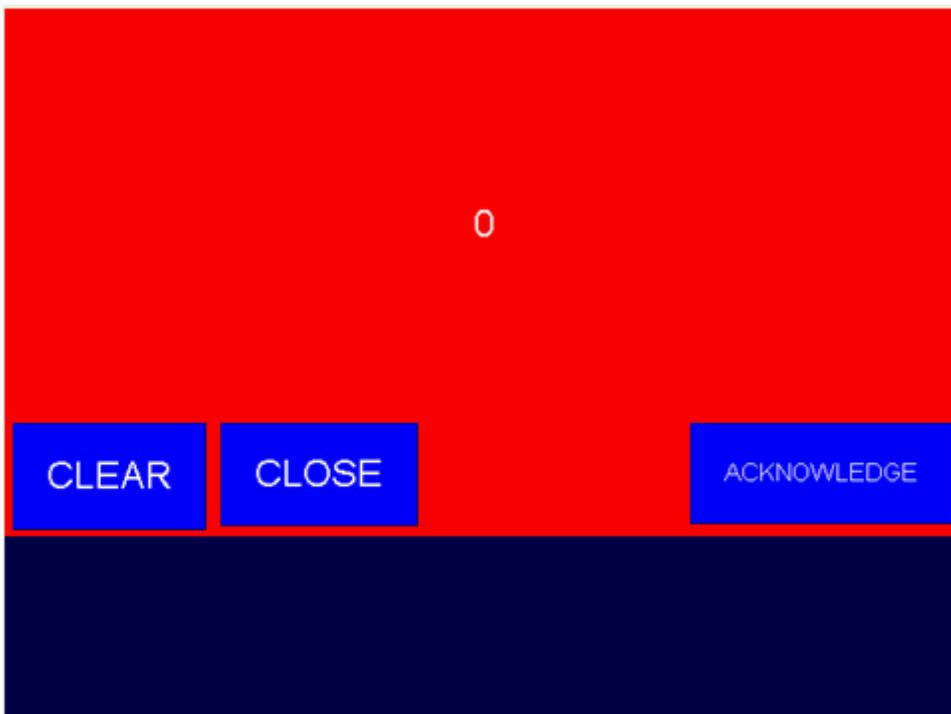
The alarm history screen displays the date and time of any alarm. Next to the date will be the actual alarm message.



Alarm Message	ALM TIME	ALM DATE	ACK TIME	ACK DATE
Alarm Message	Occurrence Time	Occurrence Date	Ack Time	Ack Date

Navigation buttons: Up arrow, Down arrow, Upward-pointing triangle, Clear All Alarms, SCREEN CHANGE

**ALARM BANNER-** When an alarm occurs the alarm message will pop up over the current screen. Use the acknowledge button to clear the banner.

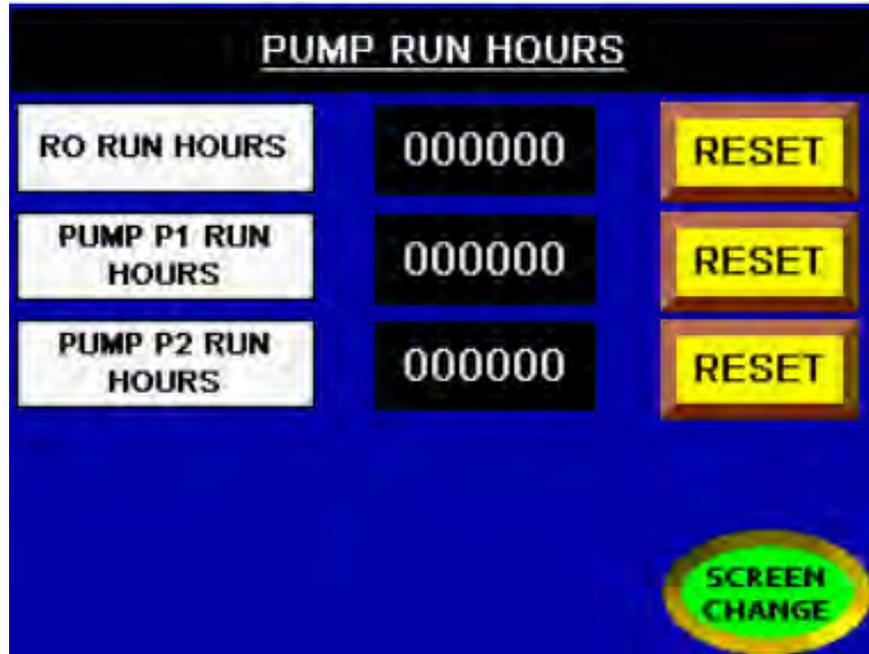


**SCREEN: PUMP RUN HOURS SCREEN**

RO RUN HOURS-This display records the number of hours the RO has been in service based on the pump running. Use the reset button to reset the hours.

P-1 RUN HOURS-This display records the number of hours transfer pump P-1 has been in service based on the pump running. Use the reset button to reset the hours.

P-2 RUN HOURS-This display records the number of hours transfer pump P-2 has been in service based on the pump running. Use the reset button to reset the hours.



## SCREEN: PERMEATE TANK LEVEL SETPOINTS SCREEN

Use this screen to change and view the following presets:

RO Stop Setpoint- this is the level at which the RO will stop. It will not turn back on again until it reaches the RO start setpoint.

RO Start Setpoint- this is the level at which the RO will turn on. It will normally run until the level reaches the RO stop setpoint.

Level Max Analog- this value should equal the scaled 20 ma value of the transmitter. **This value must match the transmitter or the level display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- max = 100.**

Level Min Analog this value should equal the scaled 4 ma value of the transmitter. **This value must match the transmitter or the level display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- min = 0.**

Level Adjustment- use this as a multiplier in order to fine tune the level display. Normally this should be 1.

High Level Alarm- this is the level at which a high level alarm will occur.

Low Level Alarm- this is the level at which a low level alarm will occur.

Loop Pumps Level Enable- this is the level at which the loop pumps will be allowed to operate.

PERMEATE TANK ANALOG LEVEL SETTINGS			
RO STOP SETPOINT	RO START SETPOINT	LEVEL MAX ANALOG	LEVEL MIN ANALOG
[Yellow Box]	[Yellow Box]	[Yellow Box]	[Yellow Box]
LEVEL ADJUST	HIGH LEVEL ALARM	LOW LEVEL ALARM	LOOP PUMPS LEVEL ENABLE
[Yellow Box]	[Yellow Box]	[Yellow Box]	[Yellow Box]
LEVEL	0000.0	SCREEN CHANGE	

## SCREEN: PRIMARY RESISTIVITY SETTINGS SCREEN

Use this screen to change the parameters for the primary resistivity.

Max Analog- this value should equal the scaled 20 ma value of the transmitter. **This value must match the transmitter or the display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- max = 10.**

Min Analog- this value should equal the scaled 4 ma value of the transmitter. **This value must match the transmitter or the display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- min = 2.**

Alarm Delay- this is the delay in seconds before the low alarm is triggered.

Low Resistivity Alarm Setpoint- Enter a value in megohms where the primary resistivity will alarm.

**PRIMARY RESISTIVITY ('R') PRESETS**

LOW 'R' ALARM SETPOINT (MΩ)	LOW 'R' ALARM DELAY (SEC)	MAX ANALOG
<input type="text"/>	<input type="text"/>	<input type="text"/>
		MIN ANALOG
		<input type="text"/>
PRIMARY 'R' (MΩ)	000.0	SCREEN CHANGE

## SCREEN: POLISHED RESISTIVITY SETTINGS SCREEN

Use this screen to change the parameters for the polished resistivity.

Max Analog- this value should equal the scaled 20 ma value of the transmitter. **This value must match the transmitter or the display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- max = 20.**

Min Analog- this value should equal the scaled 4 ma value of the transmitter. **This value must match the transmitter or the display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- min = 10.**

Alarm Delay- this is the delay in seconds before the low alarm is triggered.

Low Resistivity Alarm Setpoint- Enter a value in megohms where the polished resistivity will alarm.

**POLISHED RESISTIVITY (R) PRESETS**

LOW 'R' ALARM SETPOINT (MΩ)	LOW 'R' ALARM DELAY (SEC)	MAX ANALOG
<input type="text"/>	<input type="text"/>	<input type="text"/>
		MIN ANALOG
		<input type="text"/>
POLISHED 'R' (MΩ)	000.0	SCREEN CHANGE

## SCREEN: LOOP TEMPERATURE SETTINGS SCREEN

Use this screen to change the parameters for the loop temperature.

Max Analog- this value should equal the scaled 20 ma value of the transmitter. **This value must match the transmitter or the display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- max = 100.**

Min Analog- this value should equal the scaled 20 ma value of the transmitter. **This value must match the transmitter or the display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- min = 0.**

**High Temp Alarm Setpoint-** when the temperature exceeds this setpoint the high temp dump valve will open.

**High Temp Alarm Delay-** this is the delay that must pass before the high temp dump valve opens.

**Close Dump Valve Temp Setpoint-** the high temp dump valve will close when the loop temp falls below this setpoint.

**Delay to Close Dump Valve-** this is the delay that must pass before the high temp dump valve closes.

The screenshot shows a control interface titled "LOOP TEMP PRESETS" on a blue background. It features several adjustable parameters, each with a yellow display box and a red border:

- HIGH TEMP ALARM SETPOINT**: A yellow display box.
- CLOSE DUMP VLV TEMP SETPOINT**: A yellow display box.
- MAX ANALOG**: A yellow display box.
- HIGH TEMP ALARM DELAY (SEC)**: A yellow display box.
- DELAY TO CLOSE DUMP VLV (SEC)**: A yellow display box.
- MIN ANALOG**: A yellow display box.

At the bottom left, there is a label "LOOP TEMP (°F)" and a black display box showing the value "000". At the bottom right, there is a green oval button labeled "SCREEN CHANGE".

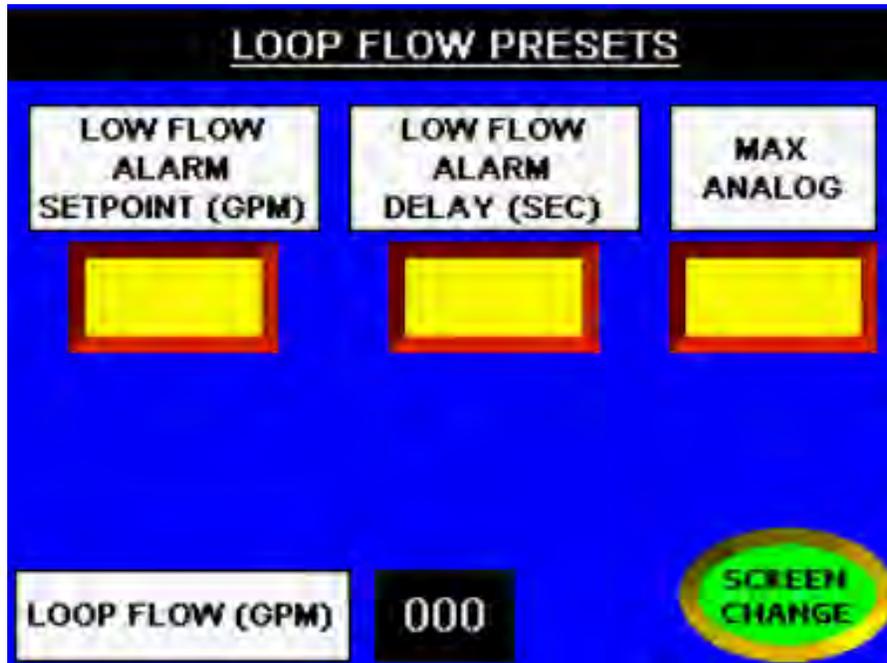
## SCREEN: LOOP FLOW SETTINGS SCREEN

Use this screen to change the parameters for the loop flow.

Max Analog- this value should equal the scaled 20 ma value of the transmitter. **This value must match the transmitter or the display will not be accurate. This value was preset at the factory and shouldn't need to be adjusted- max = 100.**

Alarm Delay- this is the delay in seconds before the low alarm is triggered.

Low Flow Alarm Setpoint- Enter a value in gpm where the loop flow will alarm.

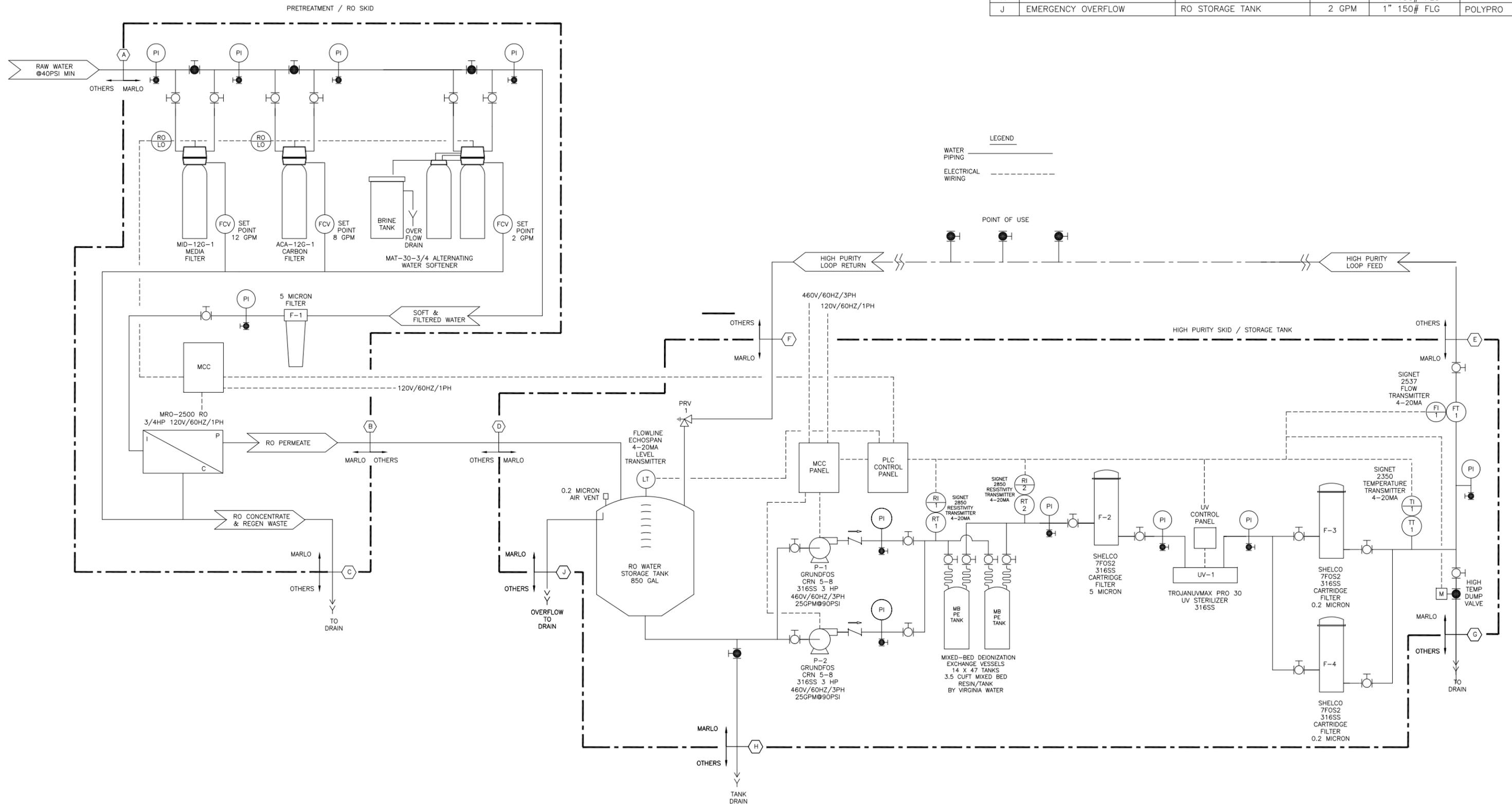


**MISCELLANEOUS:**

**SCREEN SAVER-** AFTER A PERIOD OF 10-15 MINUTES WITHOUT ANY ACTIVITY ON THE SCREEN THE OIT WILL DISPLAY A SCREENSAVER. Touch the screen to go back to a normal display.

**DRY ALARM CONTACT-** there is an auxiliary alarm dry contact between terminals 9 and 10 in the MCP. This contact will close upon an alarm.

CONNECTION SCHEDULE					
ITEM	DESCRIPTION	LOCATION	MAX. FLOW	SIZE	MATERIAL
A	RAW WATER INLET @50PSI MIN	PRETREATMENT / RO SKID	12 GPM	1" 150# FLG	SCH80 PVC
B	RO PERMEATE TO STORAGE TANK	PRETREATMENT / RO SKID	2 GPM	1/2" 150# FLG	SCH80 PVC
C	WASTE TO DRAIN	PRETREATMENT / RO SKID	12 GPM	1" 150# FLG	SCH80 PVC
D	RO PERMEATE INLET	RO STORAGE TANK	2 GPM	1/2" 150# FLG	POLYPRO
E	HIGH PURITY LOOP FEED	HIGH PURITY SKID	25 GPM	1-1/4" 150# FLG	POLYPRO
F	HIGH PURITY LOOP RETURN	HIGH PURITY SKID	25 GPM	1-1/4" 150# FLG	POLYPRO
G	HIGH TEMP DUMP TO DRAIN	HIGH PURITY SKID	25 GPM	1" 150# FLG	POLYPRO
H	TANK DRAIN	RO STORAGE TANK	10 GPM	1" 150# FLG	POLYPRO
J	EMERGENCY OVERTFLOW	RO STORAGE TANK	2 GPM	1" 150# FLG	POLYPRO



REVISIONS				
NO.	DATE	BY	REVISIONS	REMARKS

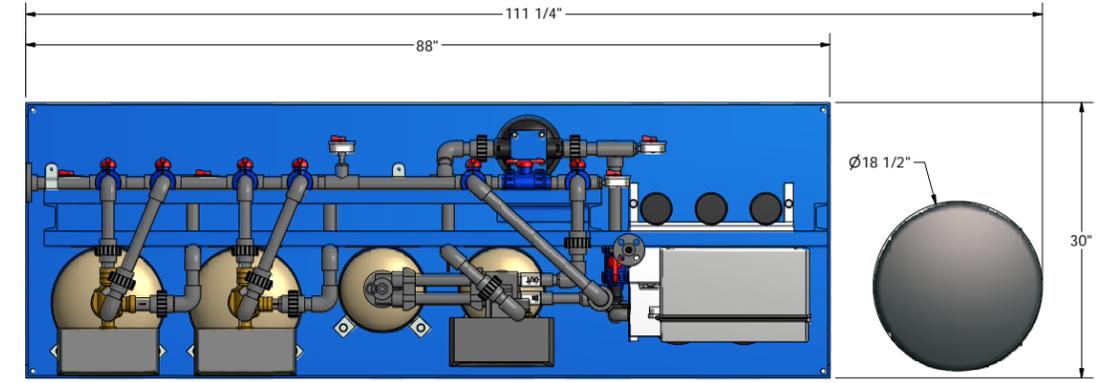
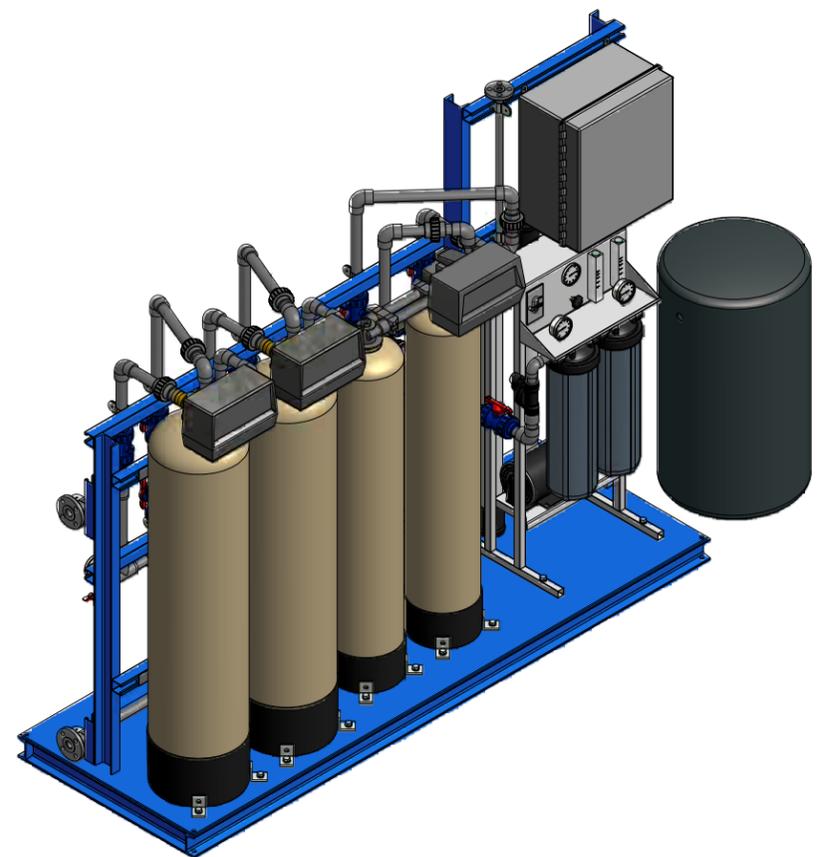
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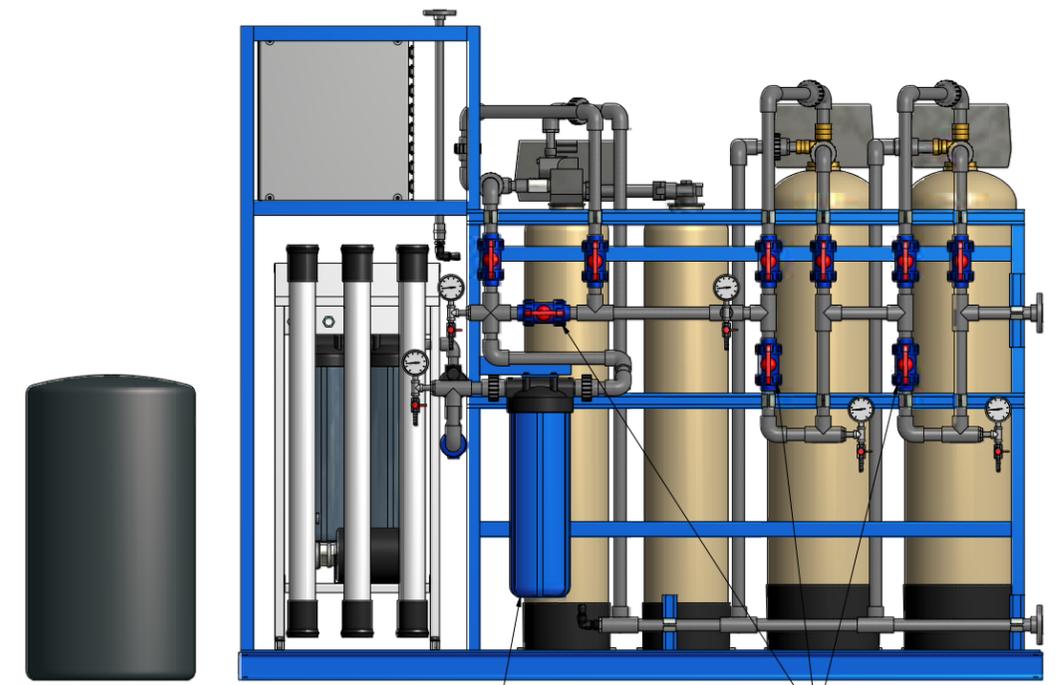
HIGH PURITY WATER TREATMENT SYSTEM P & I DIAGRAM			
FRAC. ±	DEC. ±	FILE ID.	EP-120147
DRN.	BCD	SCALE	NTS SHEET 1 OF 1
APP'D.		DRAWING NO.	
DATE	3/29/12		

CONNECTION SCHEDULE						
ITEM	DESCRIPTION	LOCATION	MAX. FLOW	SIZE	CONNECTION	MATERIAL
A	RAW WATER INLET @ 50 PSIG MIN.	PRE-TREATMENT/R.O. SKID	12 GPM	1"	150# FLANGE	SCH. 80 PVC
B	R.O. PERMEATE TO STORAGE TANK	PRE-TREATMENT/R.O. SKID	2 GPM	1/2"	150# FLANGE	SCH. 80 PVC
C	WASTE TO DRAIN	PRE-TREATMENT/R.O. SKID	12 GPM	1"	150# FLANGE	SCH. 80 PVC

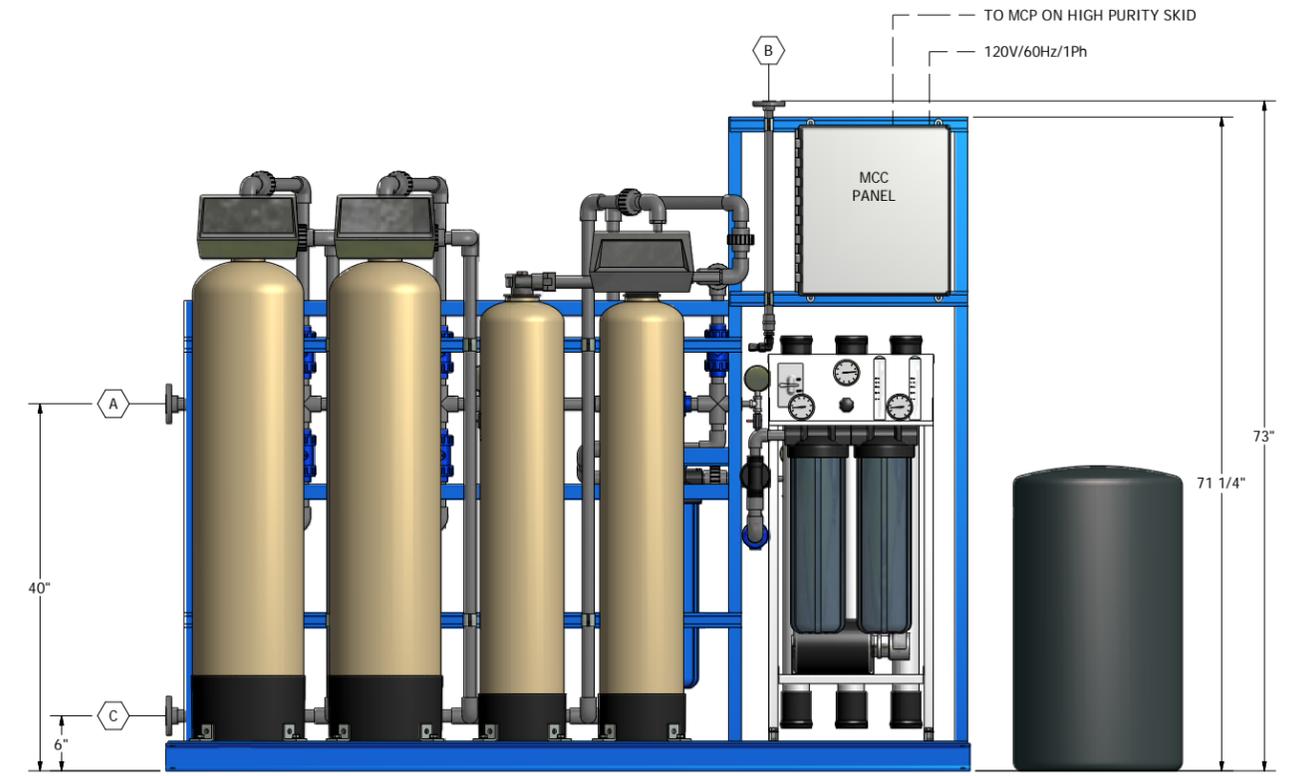
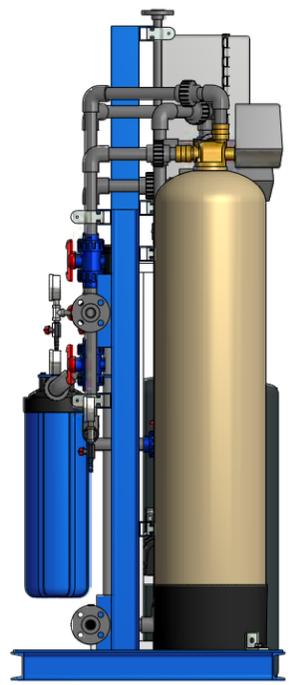
- CONSTRUCTION NOTES:**
- SKID IS WELDED STRUCTURAL STEEL WITH PRECAUTION BLUE EPOXY COATING.
  - ALL PIPING AND VALVES ARE SCH. 80 PVC.
  - ALL PRESSURE GAUGES ARE STAINLESS STEEL LIQUID FILLED.
  - CONTROL PANELS ARE RATED NEMA 4X.
  - ENTIRE SYSTEM PREPIPED, PREWIRED AND FACTORY TESTED.
  - ESTIMATED SHIPPING WEIGHT: 2,150 LBS.



MID-12G-1 MEDIA FILTER    ACA-12G-1 CARBON FILTER    MAT-30-3/4 ALTERNATING WATER SOFTENER    MRO-2500 R.O. 3/4HP, 120V/60Hz/1Ph    BRINE TANK



RESIN TRAP 5 MICRON FILTER    BY-PASS VALVE (NORMALLY CLOSED)



REVISIONS			
NO.	DATE	BY	REMARKS

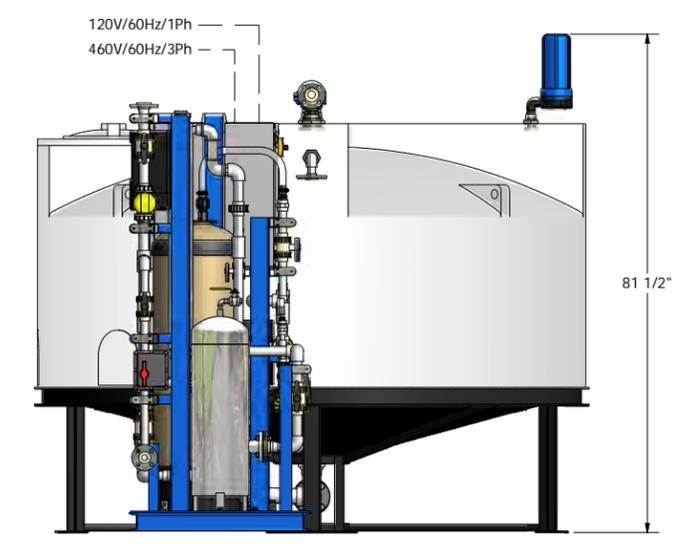
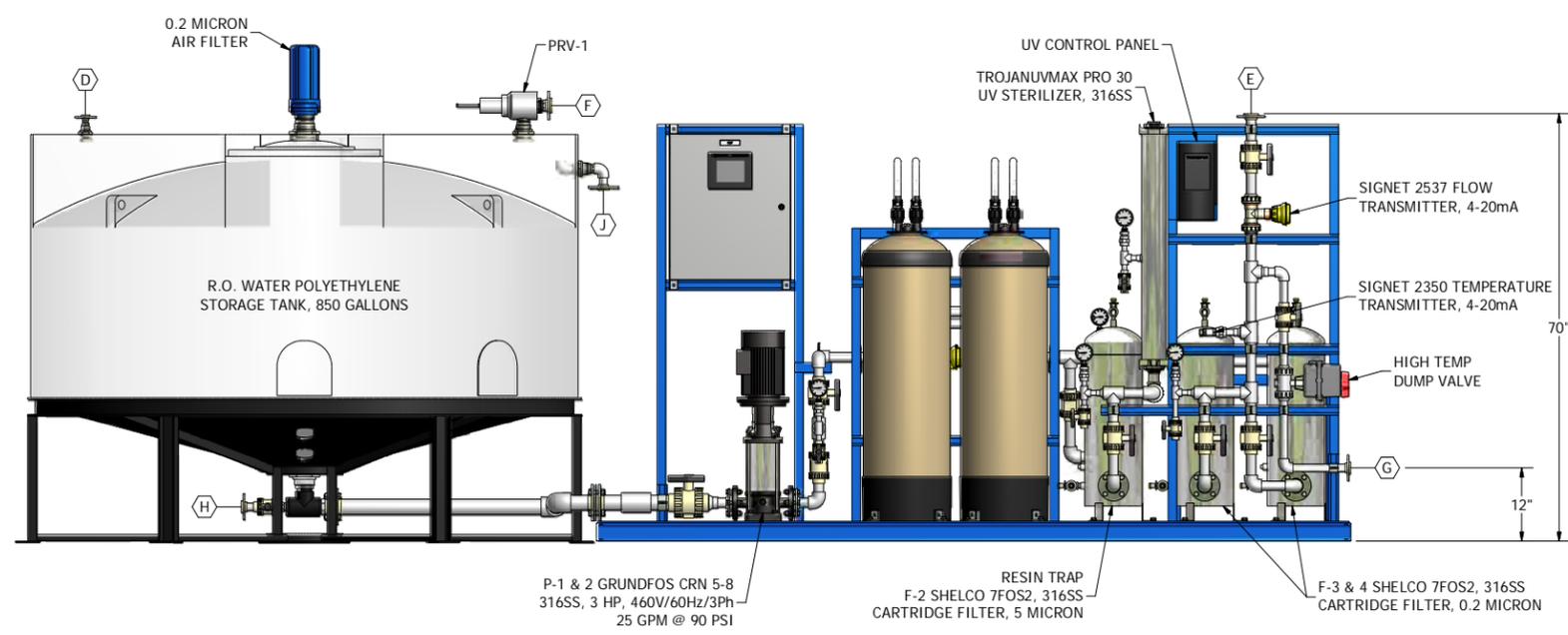
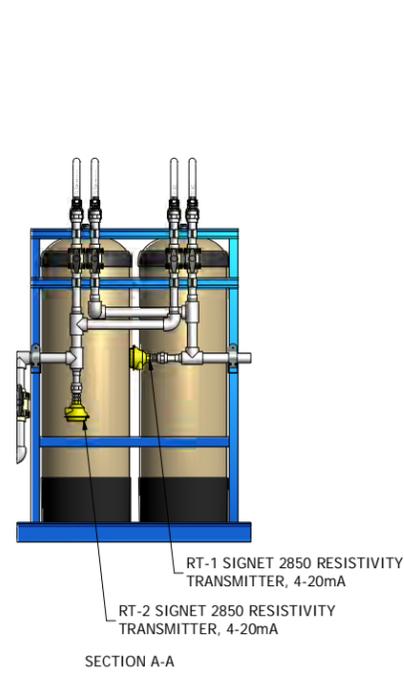
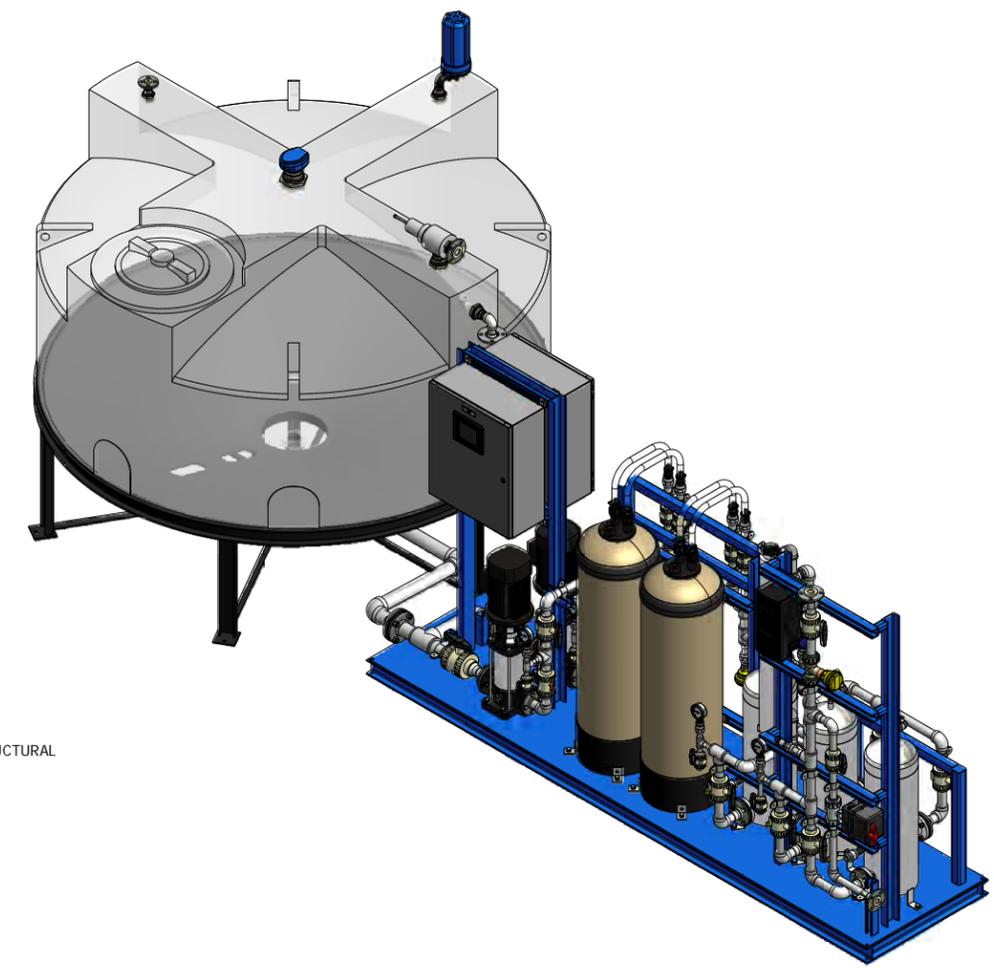
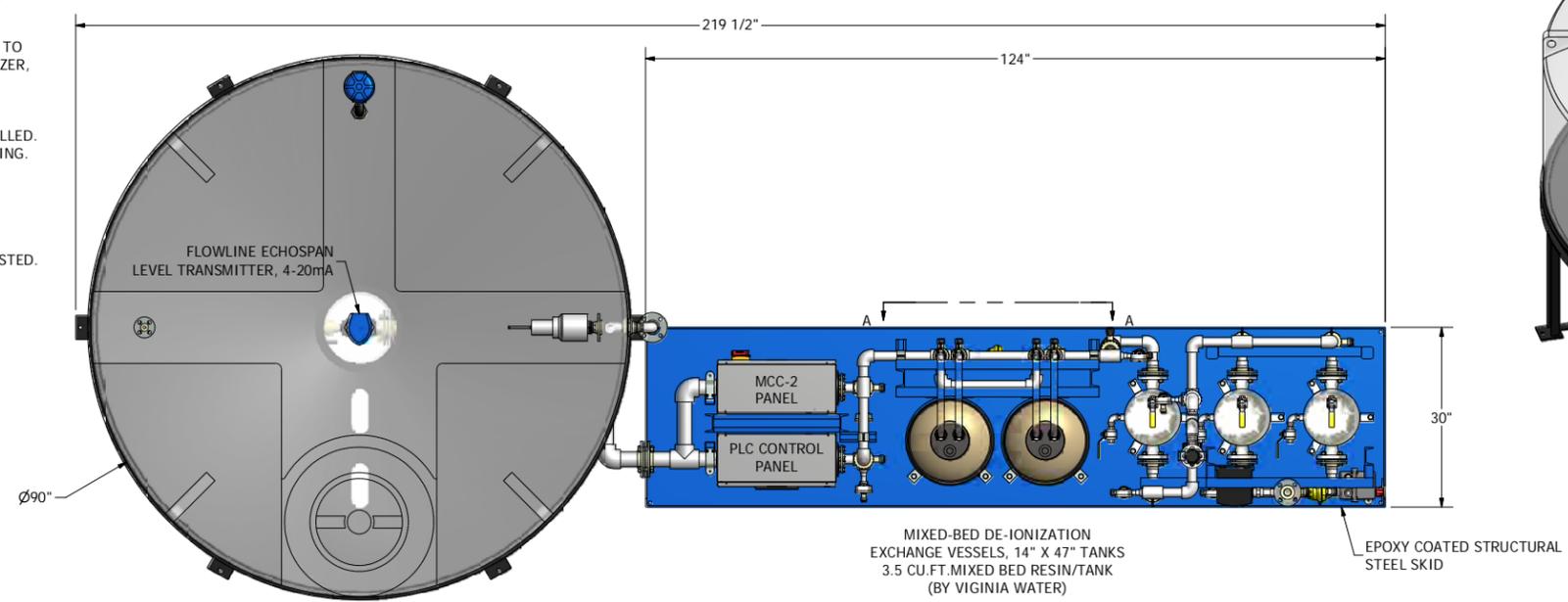


VIRGINIA WATER SYSTEMS  
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PRE-TREATMENT/R.O. SKID GENERAL ARRANGEMENT			
FRAC.	DEC.	FILE ID.	
DRN	KLT	SCALE	SHEET 1 OF 2
APPD.		DRAWING NO.	
DATE	7/13/2012	EP12-147-03-01	

CONNECTION SCHEDULE						
ITEM	DESCRIPTION	LOCATION	MAX. FLOW	SIZE	CONNECTION	MATERIAL
D	R.O. PERMEATE INLET	R.O. STORAGE TANK	2 GPM	1/2"	150# FLANGE	PN10 POLYPRO
E	HIGH PURITY LOOP FEED	HIGH PURITY SKID	25 GPM	1-1/4"	150# FLANGE	PN10 POLYPRO
F	HIGH PURITY LOOP RETURN	R.O. STORAGE TANK	25 GPM	1-1/4"	150# FLANGE	PN10 POLYPRO
G	HIGH TEMP DUMP TO DRAIN	HIGH PURITY SKID	25 GPM	1"	150# FLANGE	PN10 POLYPRO
H	TANK DRAIN	R.O. STORAGE TANK	10 GPM	1"	150# FLANGE	PN10 POLYPRO
J	EMERGENCY OVERFLOW	R.O. STORAGE TANK	2 GPM	1"	150# FLANGE	PN10 POLYPRO

- CONSTRUCTION NOTES:**
- SKID IS WELDED STRUCTURAL STEEL WITH PRECAUTION BLUE EPOXY COATING.
  - ALL PIPING AND VALVES FROM THE R.O. STORAGE TANK TO REPRESSURE PUMPS, D.I. EXCHANGE TANKS, UV STERILIZER, AND FINAL FILTER IS VIRGIN SOCKET FUSION WELDED POLYPROPYLENE.
  - ALL PRESSURE GAUGES ARE STAINLESS STEEL LIQUID FILLED. GAUGE GAURDS ARE INCLUDED ON POLYPROPYLENE PIPING.
  - R.O. STORAGE TANK IS VIRGIN POLYETHYLENE.
  - CONTROL PANELS ARE RATED NEMA 4.
  - ENTIRE SYSTEM PREPIPED, PREWIRED AND FACTORY TESTED.
  - ESTIMATED SHIPPING WEIGHT: 2,500 LBS.



REVISIONS			
NO.	DATE	BY	REMARKS

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INCORPORATED

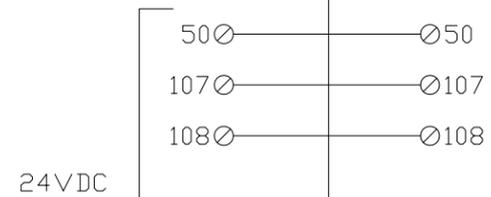
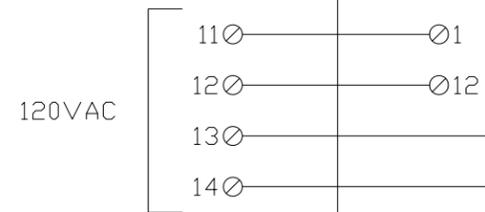
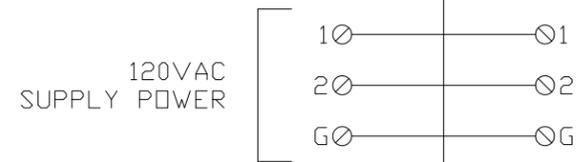
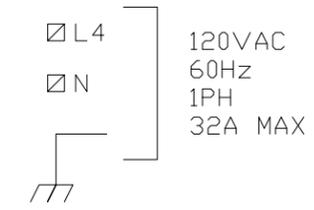
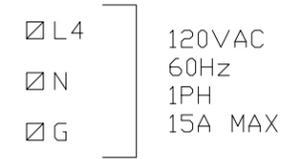
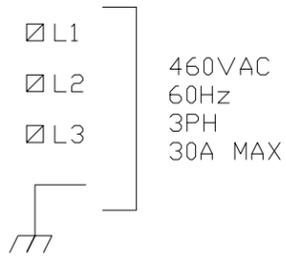
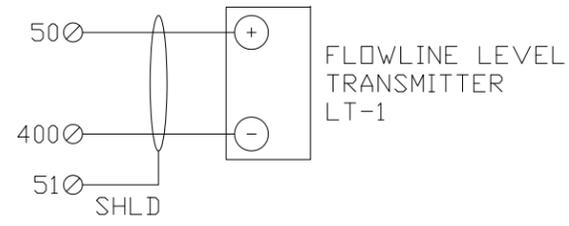
VIRGINIA WATER SYSTEMS  
VMI

HIGH PURITY SKID GENERAL ARRANGEMENT			
FRAC.	DEC.	FILE ID.	
DRN.	KLT	SCALE	SHEET 1 OF 2
APPD.		DRAWING NO.	
DATE	7/13/2012	EP12-147-03-02	

MCP

MCC-1

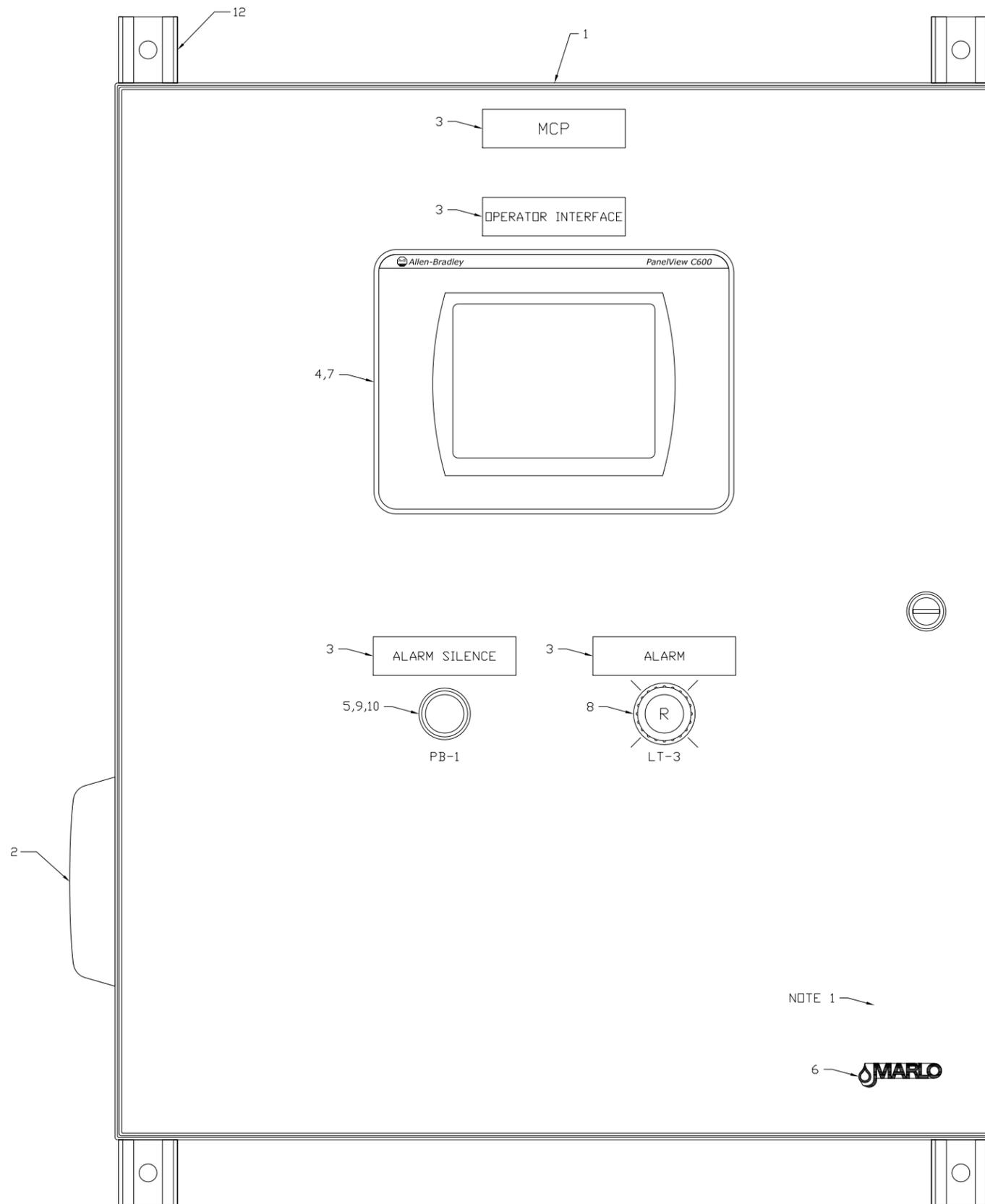
MCC-2



REVISIONS				
NO.	DATE	BY	REMARKS	

  
 VIRGINIA WATER SYSTEMS  
 VMI

HIGH PURITY SYSTEM FIELD INTERCONNECT WIRING DIAGRAM				
FRAC. ±	DEC. ±	FILE ID.	EP12-147-09-01	
DRN.	MRP	SCALE	NTS	SHEET 1 OF 1
APP'D.	DRAWING NO.		EP12-147-09-01	REV. 0
DATE	8/17/12			



NOTE 1



Seqn	Item Number	Vendor No	Qty	Description
1	A2147103	CSD24208	1	ENCLOSURE 24X20X8 NEMA 4(C-SD242008
2	A2310006	870P-N5	1	HORN ALARM 115 EDWARDS(870P-N5)
3	A2150200	200221 BEV/ADH	4	NAMEPLATE 7/8X3.25 BLANK W/TAPE WHT
4	A2586029	2711C-T6T	1	PANELVIEW 6 COLOR TOUCH 2711C-T6T
5	A2415002	800F-ALP	1	LATCH MOUNTING (AB800F-ALP)
6	A2150017	A2150017	1	NAMEPLATE MARLO SILVER (SMALL)
7	A2325005	1761-CBL-PM02	1	CABLE ASSY 1761-CBL-PM02
8	A2151032	800L-22L10R	1	LIGHT LED RED 120 VAC (800L-22L10R)
9	A2414016	800FP-E4	1	PUSHBUTTON MOM CONTACT EXT RED
10	A2323008	800F-X10	1	BLOCK CONTACT N.O. (AB800F-X10)
11	A2000014	41216	2	LABEL MARLO SERIAL NUMBER
100	A2148035	CP2420	1	SUBPANEL 24 X 20 (CP2420)
101	A2331001	1762-L24BWA	1	CONTROL MICRO 1200 PLC 120V BWA
102	A2162049	2834504 (85D849	4	RELAY 115V 8A 2PDT LED (2834504)
103	A2307007	1492-N23	4	ANCHOR END TERMINAL BLOCK
104	A2547010	G1X2WH6	5	DUCT WIRE 1X2 WHITE(WAS E1X2WH6)
105	A2103098	C1WH6F	5	COVER WIRE DUCT 1 WHITE
106	A2307004	1492-F2	84	BLOCK TERMINAL
107	A2318002	1492-N18	2	BARRIER TERMINAL END (1492N18)
108	A2331075	2868648	1	POWER SUPPLY 1.75A STEP 24VDC UL
109	A2427119	1762-IF4	2	MODULE INPUT 4 CH ANALOG 1762-IF4
110	A2307046	BNL-5	4	ANCHOR DIN RAIL (BNL-5)
111	A2595003	LAMA2-14-QY	1	LUG GROUND ALUM 2-14AWG 1/4 STUD

**MARLO ELECTRICAL SPECIFICATIONS**

Max Line Voltage:  Phase:  Hz:   
 Largest Motor FLA:  Total FLA:   
 SCCR:  Ref Dwg:

11 NOTE 1

NOTE: THIS PANEL DOES NOT HAVE A MAIN DISCONNECT. THE MAIN DISCONNECT IS LOCATED IN MCC-1 PANEL.

11 NOTE 1

WARNING - CONDUIT HUBS AND/OR ANY DEVICE THAT PENETRATES THIS ENCLOSURE MUST MAINTAIN THE UL RATING OF THIS ENCLOSURE.

UL ENVIRONMENTAL RATING: 1

11 NOTE 1

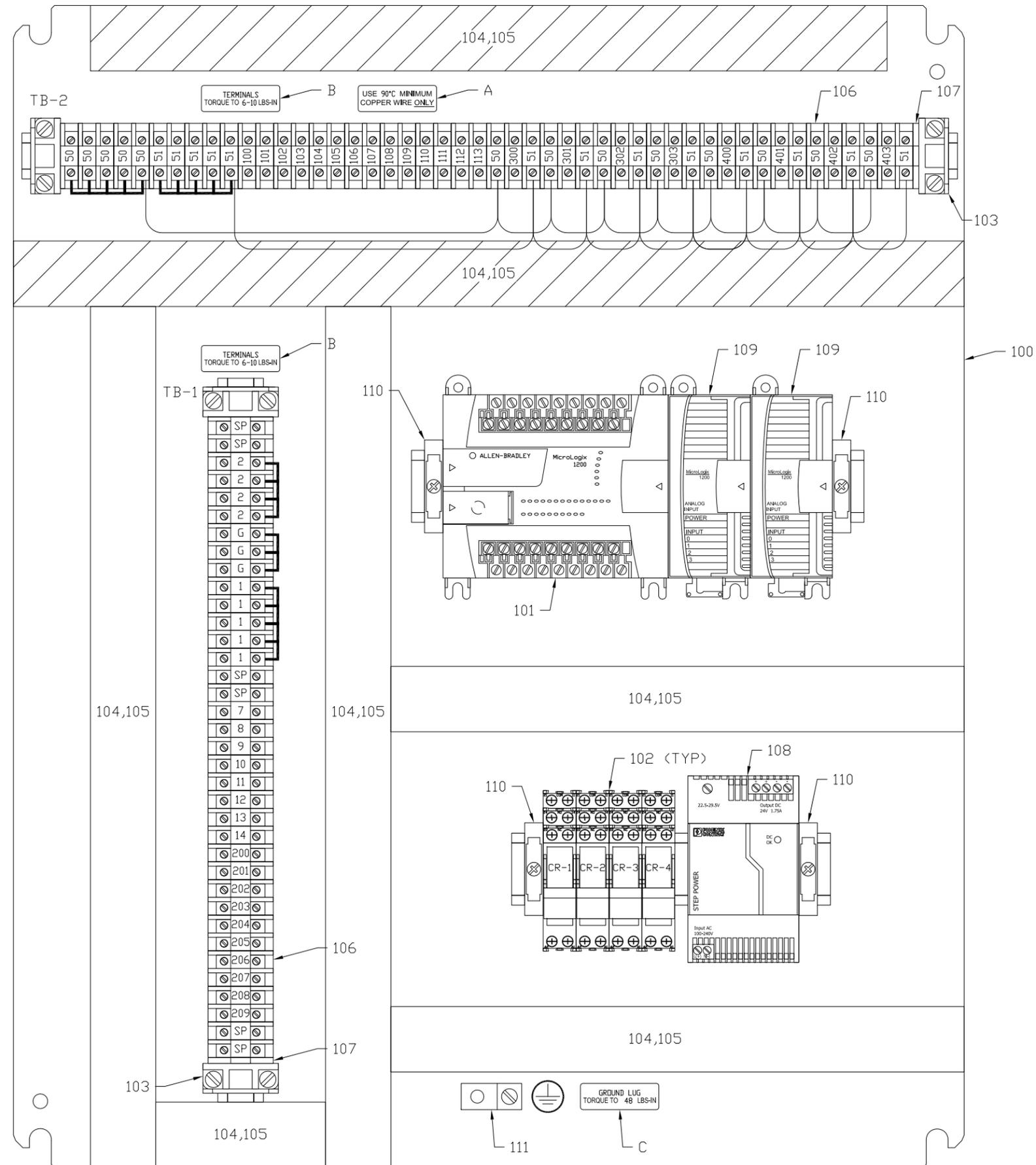
NOTES:

- LOCATE LABEL ON INSIDE OF ENCLOSURE DOOR.

REVISIONS				MARLO INCORPORATED		MCP PLC CONTROLLER ENCLOSURE ASSEMBLY				
NO.	DATE	BY	REMARKS	FRAC. ±	DEC. ±	FILE ID.	SCALE	NTS	SHEET	OF
						EP12-147A-10-01			1	2
				DRN.	MRP					
				APP'D.						
				DATE						
				8/17/12		EP12-147A-10-01				

VIRGINIA WATER SYSTEMS  
VMI





Seqn	Item Number	Vendor No	Qty	Description
1	A2147103	CSD24208	1	ENCLOSURE 24X20X8 NEMA 4(C-SD242008)
2	A2310006	870P-N5	1	HORN ALARM 115 EDWARDS(870P-N5)
3	A2150200	200221 BEV/ADH	4	NAMEPLATE 7/8X3.25 BLANK W/TAPE WHT
4	A2586029	2711C-T6T	1	PANELVIEW 6 COLOR TOUCH 2711C-T6T
5	A2415002	800F-ALP	1	LATCH MOUNTING (AB800F-ALP)
6	A2150017	A2150017	1	NAMEPLATE MARLO SILVER (SMALL)
7	A2325005	1761-CBL-PM02	1	CABLE ASSY 1761-CBL-PM02
8	A2151032	800L-22L10R	1	LIGHT LED RED 120 VAC (800L-22L10R)
9	A2414016	800FP-E4	1	PUSHBUTTON MOM CONTACT EXT RED
10	A2323008	800F-X10	1	BLOCK CONTACT N.O. (AB800F-X10)
11	A2000014	41216	2	LABEL MARLO SERIAL NUMBER
100	A2148035	CP2420	1	SUBPANEL 24 X 20 (CP2420)
101	A2331001	1762-L24BWA	1	CONTROL MICRO 1200 PLC 120V BWA
102	A2162049	2834504 (85D849)	4	RELAY 115V 8A 2PDT LED (2834504)
103	A2307007	1492-N23	4	ANCHOR END TERMINAL BLOCK
104	A2547010	G1X2WH6	5	DUCT WIRE 1X2 WHITE(WAS E1X2WH6)
105	A2103098	C1WH6F	5	COVER WIRE DUCT 1 WHITE
106	A2307004	1492-F2	84	BLOCK TERMINAL
107	A2318002	1492-N18	2	BARRIER TERMINAL END (1492N18)
108	A2331075	2868648	1	POWER SUPPLY 1.75A STEP 24VDC UL
109	A2427119	1762-IF4	2	MODULE INPUT 4 CH ANALOG 1762-IF4
110	A2307046	BNL-5	4	ANCHOR DIN RAIL (BNL-5)
111	A2595003	LAMA2-14-QY	1	LUG GROUND ALUM 2-14AWG 1/4 STUD

USE 90°C MINIMUM COPPER WIRE ONLY → A

TERMINALS TORQUE TO 6-10 LBS-IN → B

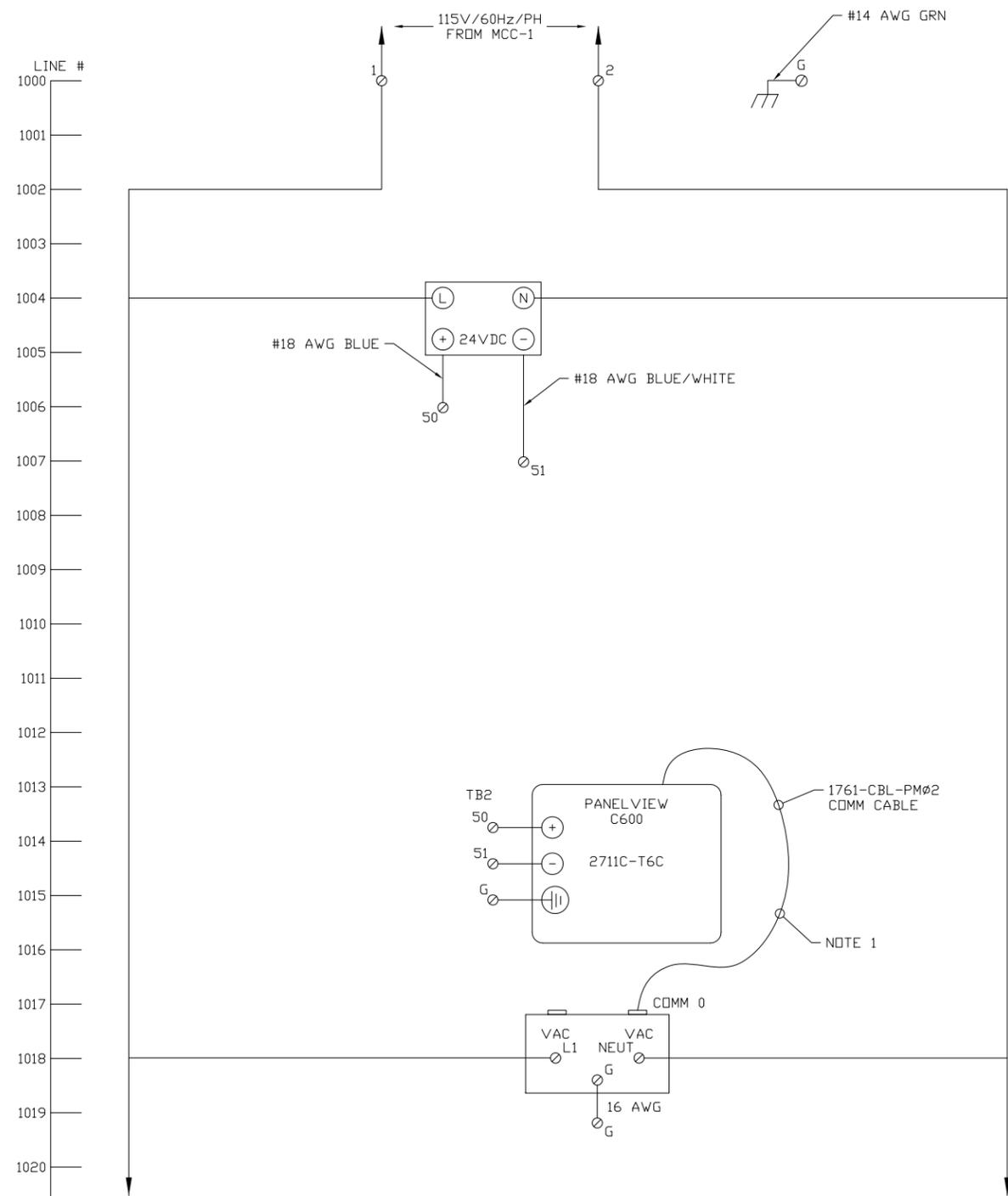
GROUND LUG TORQUE TO 48 LBS-IN → C

= LOW VOLTAGE DUCT

NOTES:  
1. INSULATE ALL EXPOSED RESISTOR LEADS.

REVISIONS				MARLO INCORPORATED		MCP PLC CONTROLLER SUB-PANEL				
NO.	DATE	BY	REMARKS	FRAC. ±	DEC. ±	FILE ID.	SCALE	NTS	SHEET	OF
						EP12-147A-10-01			2	2
				DRN.	MRP					
				APP'D.						
				DATE	8/17/12	EP12-147A-10-01				

VIRGINIA WATER SYSTEMS  
VMI



24V DC POWER SUPPLY  
1.75A

PANELVIEW HMI

MICROLOGIX 1200  
POWER SUPPLY

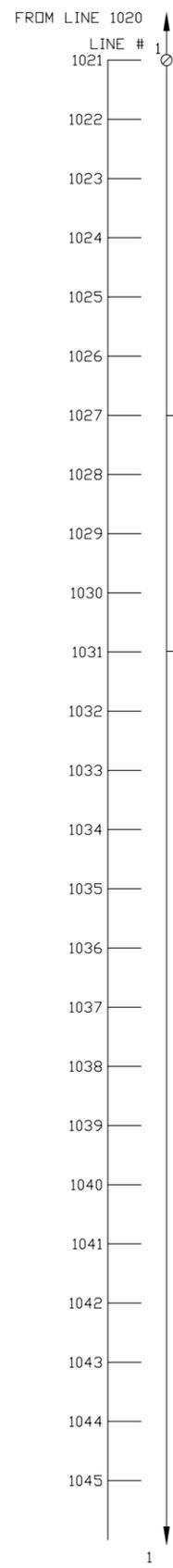
TO LINE 1021

KEY

WIRE DESIGNATION	
-----	= FACTORY INTERCONNECT
-----	= INTERNAL WIRING
- - - - -	= EXTERNAL WIRING
-----	= CENTER JUMPER
○	= TERMINAL DESIGNATION NUMBER OR WIRE ON DEVICE
( )	= WIRE NUMBERS
[ ]	= COIL/CONTACT LINE & REF.
⊗	= TERMINAL IN MCP
⊙	= TERMINAL IN LCP
≡	= HARNESS OR SPLICE
≡	= CABINET GROUND
///	= SUB PANEL GROUND

NOTES:

- FACTORY SUPPLIED CABLE. (DO NOT RUN WITH AC POWER CABLES)
- ALL EQUIPMENT IS SHOWN DE-ENERGIZED.
- WIRE COLOR CODE AS FOLLOWS:
  - A. BLACK 115V HOT
  - B. RED 115V FUSED
  - C. WHITE COMMON
  - D. GREEN GROUND
  - E. YELLOW EXTERNAL POWER
  - F. BLUE +DC WIRING
  - G. BLUE/WHT STRIPE -DC WIRING
- ALL WIRE #18 AWG UNLESS OTHERWISE NOTED.
- WIRE NUMBERS TO BE THE SAME AS TERMINAL NUMBERS UNLESS OTHERWISE NOTED. GROUND AND NEUTRAL WIRES NOT TAGGED, COLOR CODED ONLY.
- RUN LOW AND HIGH VOLTAGE LINES SEPARATE.
- LOW VOLTAGE TAGS ARE TAGGED TB2. ALL OTHERS ARE TB1.



HIGH TEMP  
DUMP VALVE

ALARM HORN

DRY ALARM CONTACTS  
CUSTOMER USE OPTIONAL  
(CLOSE ON ALARM)

LOW LEVEL CUTOUT  
DRY CONTACT

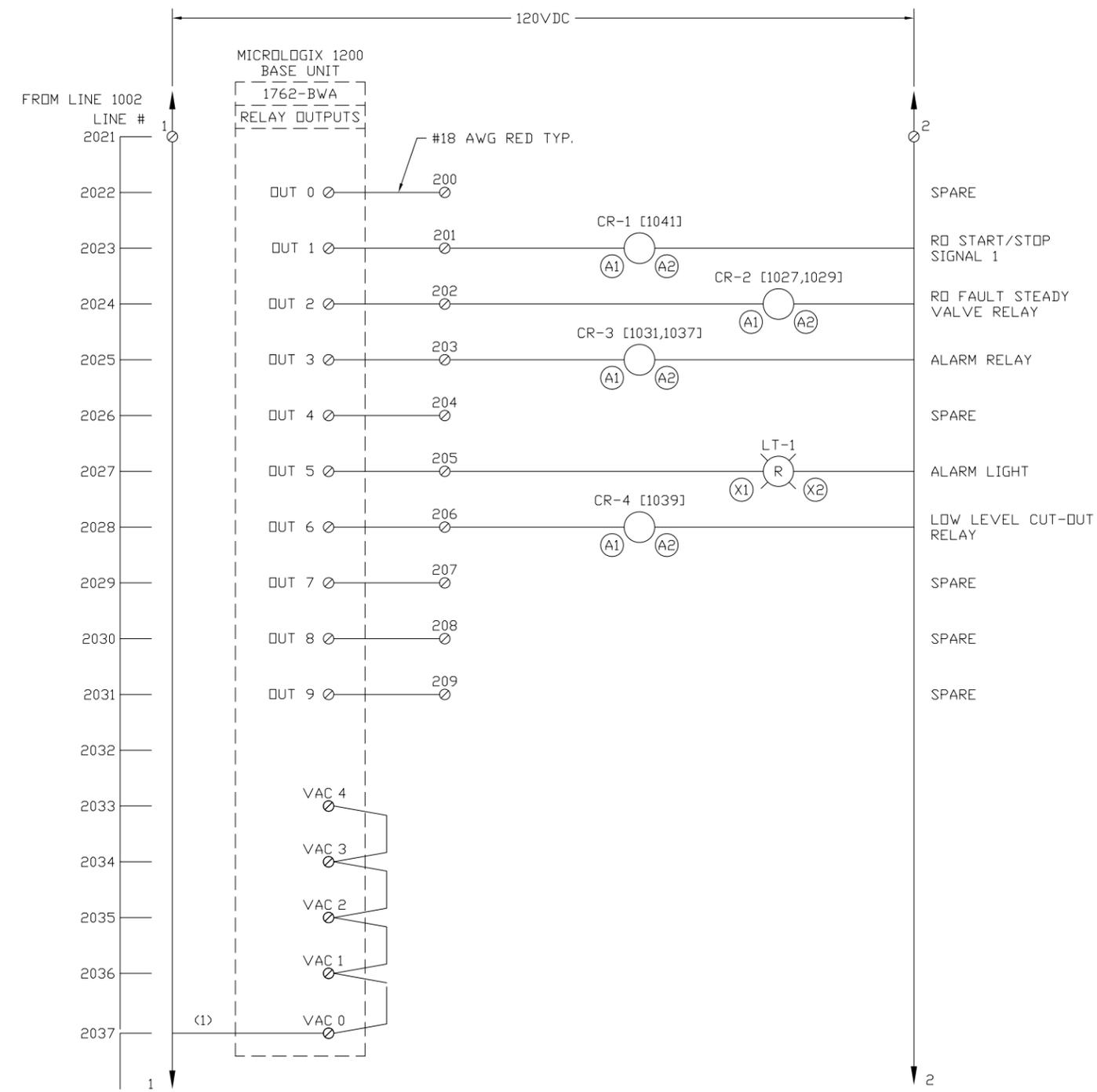
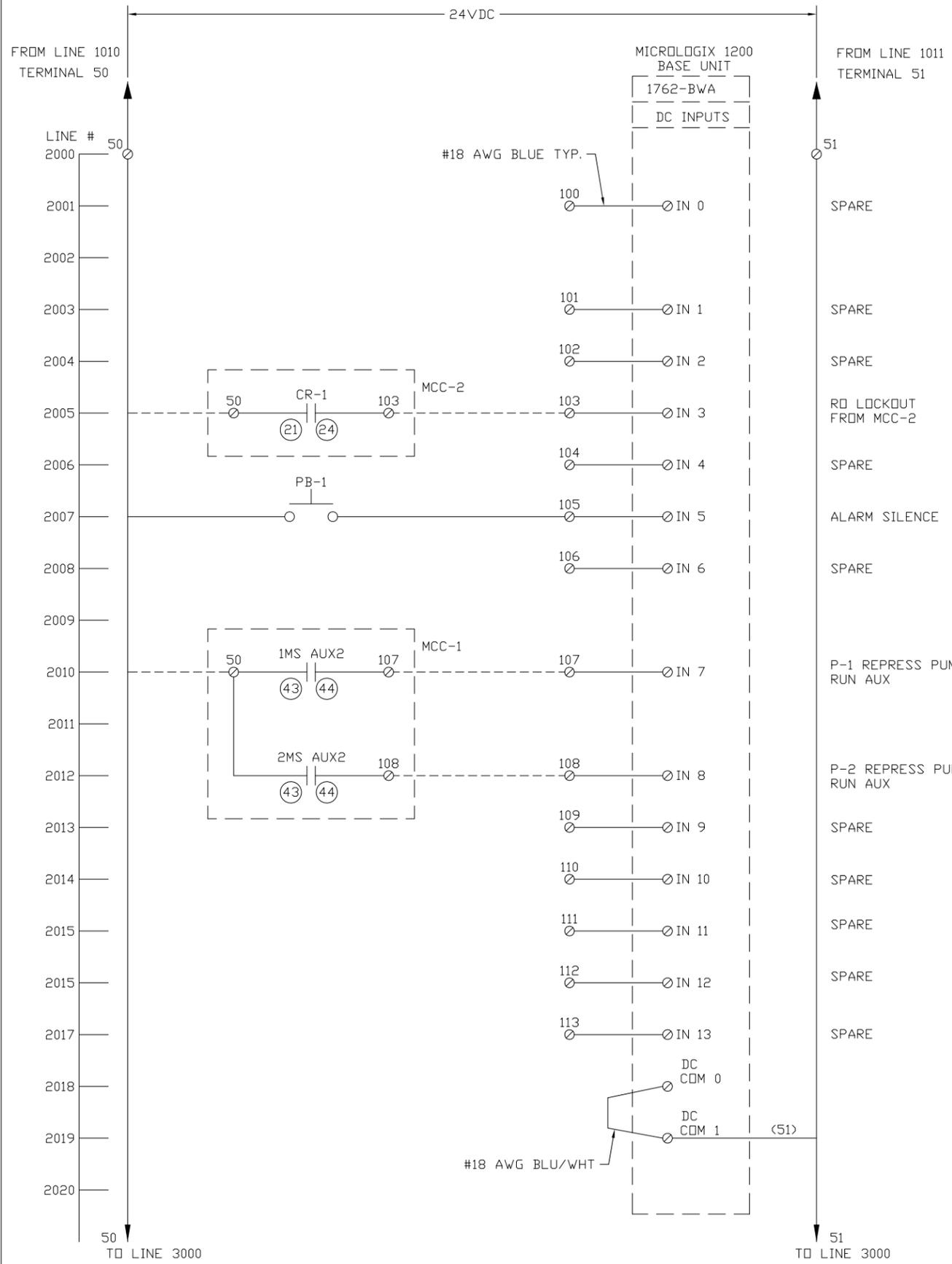
R.O. PUMP CONTROL

REVISIONS			
NO.	DATE	BY	REMARKS

**MARLO**  
INCORPORATED

VIRGINIA WATER SYSTEMS  
VMI

MCP PLC CONTROLLER WIRING DIAGRAM			
FRAC. ±	DEC. ±	FILE ID.	EP12-147A-08-01
DRN.	MRP	SCALE	NTS
APP'D.		DRAWING NO.	SHEET 1 OF 4
DATE	8/17/12	EP12-147A-08-01	REV.



KEY

WIRE DESIGNATION

- = FACTORY INTERCONNECT
- \_\_\_\_\_ = INTERNAL WIRING
- - - - - = EXTERNAL WIRING
- — — — = CENTER JUMPER
- = TERMINAL DESIGNATION NUMBER OR WIRE ON DEVICE
- <> = WIRE NUMBERS
- [ ] = COIL/CONTACT LINE & REF.
- ⊙ = TERMINAL IN MCP
- <<>> = HARNESS OR SPLICE
- ≡ = CABINET GROUND
- // = SUB PANEL GROUND

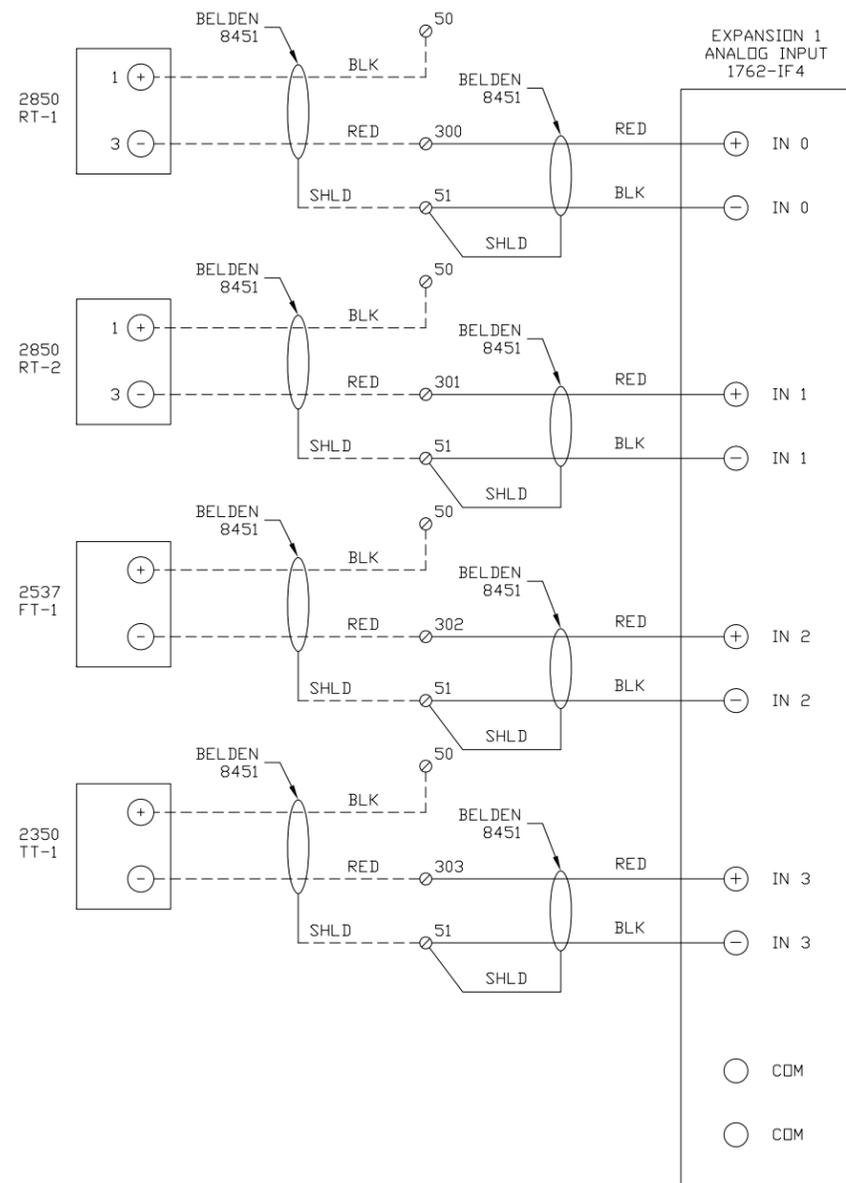
REVISIONS			
NO.	DATE	BY	REMARKS

**MARLO**  
INCORPORATED

VIRGINIA WATER SYSTEMS  
VMI

MCP PLC CONTROLLER LINE WIRING DIAGRAM			
FRAC. #	DEC. #	FILE ID.	
		EP12-147A-08-01	
DRN.	MRP	SCALE	NTS SHEET 2 OF 4
APP'D.		DRAWING NO.	
DATE	8/17/12	EP12-147A-08-01	REV.

LINE #  
 3000  
 3001  
 3002  
 3003  
 3004  
 3005  
 3006  
 3007  
 3008  
 3009  
 3010  
 3011  
 3012  
 3013  
 3014  
 3015  
 3016  
 3017  
 3018  
 3019  
 3020  
 3021



PRIMARY RESISTIVITY  
 0-10 MΩ = 4-20mA

POLISHED RESISTIVITY  
 2-20 MΩ = 4-20mA

LOOP FLOW  
 0-100 GPM = 4-20mA

LOOP TEMPERATURE  
 0-200°F = 4-20mA

KEY

WIRE DESIGNATION	
-----	= FACTORY INTERCONNECT
-----	= INTERNAL WIRING
-----	= EXTERNAL WIRING
-----	= CENTER JUMPER
○	= TERMINAL DESIGNATION NUMBER OR WIRE ON DEVICE
( )	= WIRE NUMBERS
[ ]	= COIL/CONTACT LINE & REF.
⊙	= TERMINAL IN MCP
«»	= HARNESS OR SPLICE
≡	= CABINET GROUND
//	= SUB PANEL GROUND

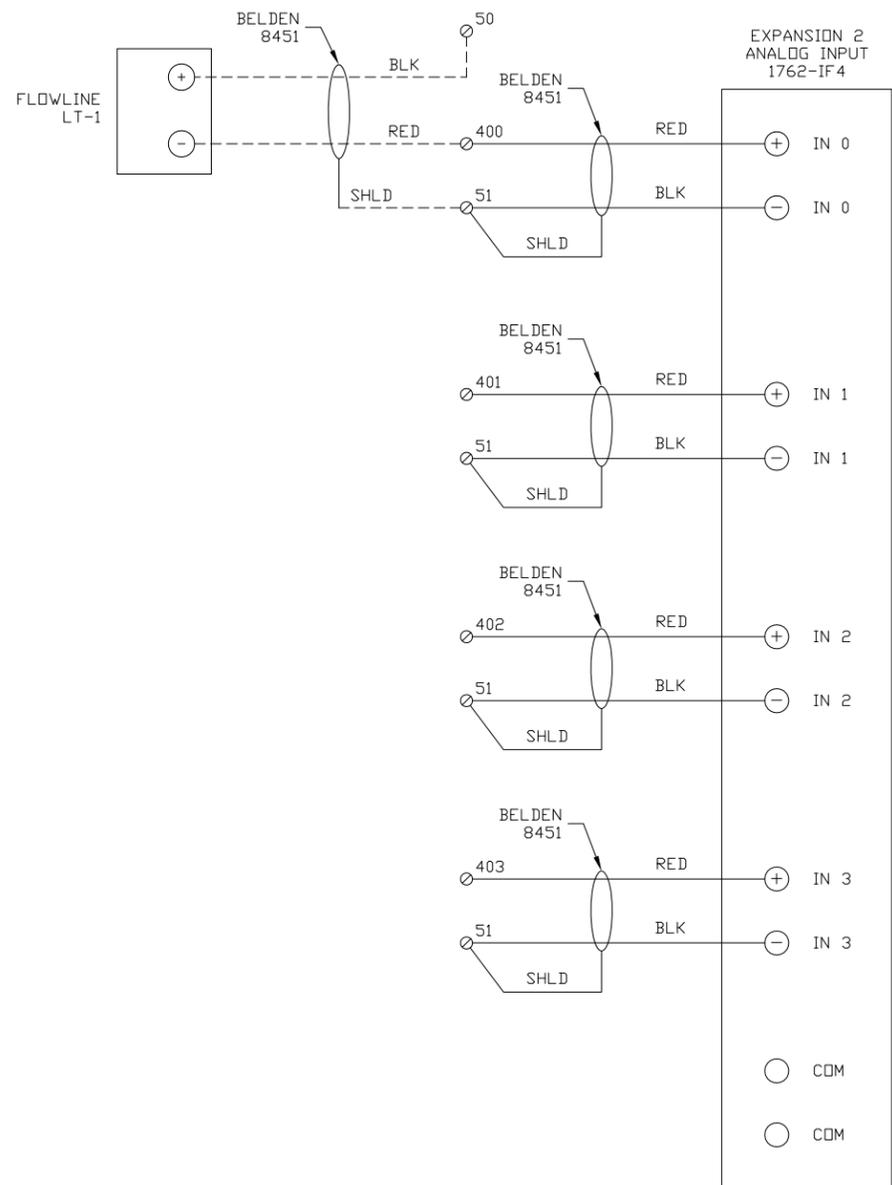
REVISIONS			
NO.	DATE	BY	REMARKS

**MARLO**  
INCORPORATED

VIRGINIA WATER SYSTEMS  
VMI

MCP PLC CONTROLLER WIRING DIAGRAM			
FRAC. ±	DEC. ±	FILE ID.	EP12-147A-08-01
DRN.	MRP	SCALE	NTS SHEET 3 OF 4
APP'D.		DRAWING NO.	
DATE	8/17/12		

LINE #  
 4000  
 4001  
 4002  
 4003  
 4004  
 4005  
 4006  
 4007  
 4008  
 4009  
 4010  
 4011  
 4012  
 4013  
 4014  
 4015  
 4016  
 4017  
 4018  
 4019  
 4020  
 4021



RD WATER STORAGE TANK  
 LEVEL TRANSMITTER  
 0-100% = 0-XXXX INCHES = 4-20mA

SPARE

SPARE

SPARE

KEY

WIRE DESIGNATION	
-----	= FACTORY INTERCONNECT
-----	= INTERNAL WIRING
-----	= EXTERNAL WIRING
-----	= CENTER JUMPER
○	= TERMINAL DESIGNATION NUMBER OR WIRE ON DEVICE
( )	= WIRE NUMBERS
[ ]	= COIL/CONTACT LINE & REF.
⊙	= TERMINAL IN MCP
«»	= HARNESS OR SPLICE
≡	= CABINET GROUND
//	= SUB PANEL GROUND

REVISIONS			
NO.	DATE	BY	REMARKS

**MARLO**  
INCORPORATED

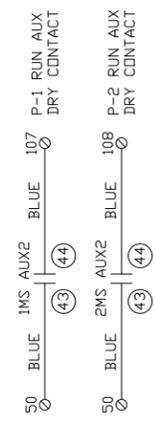
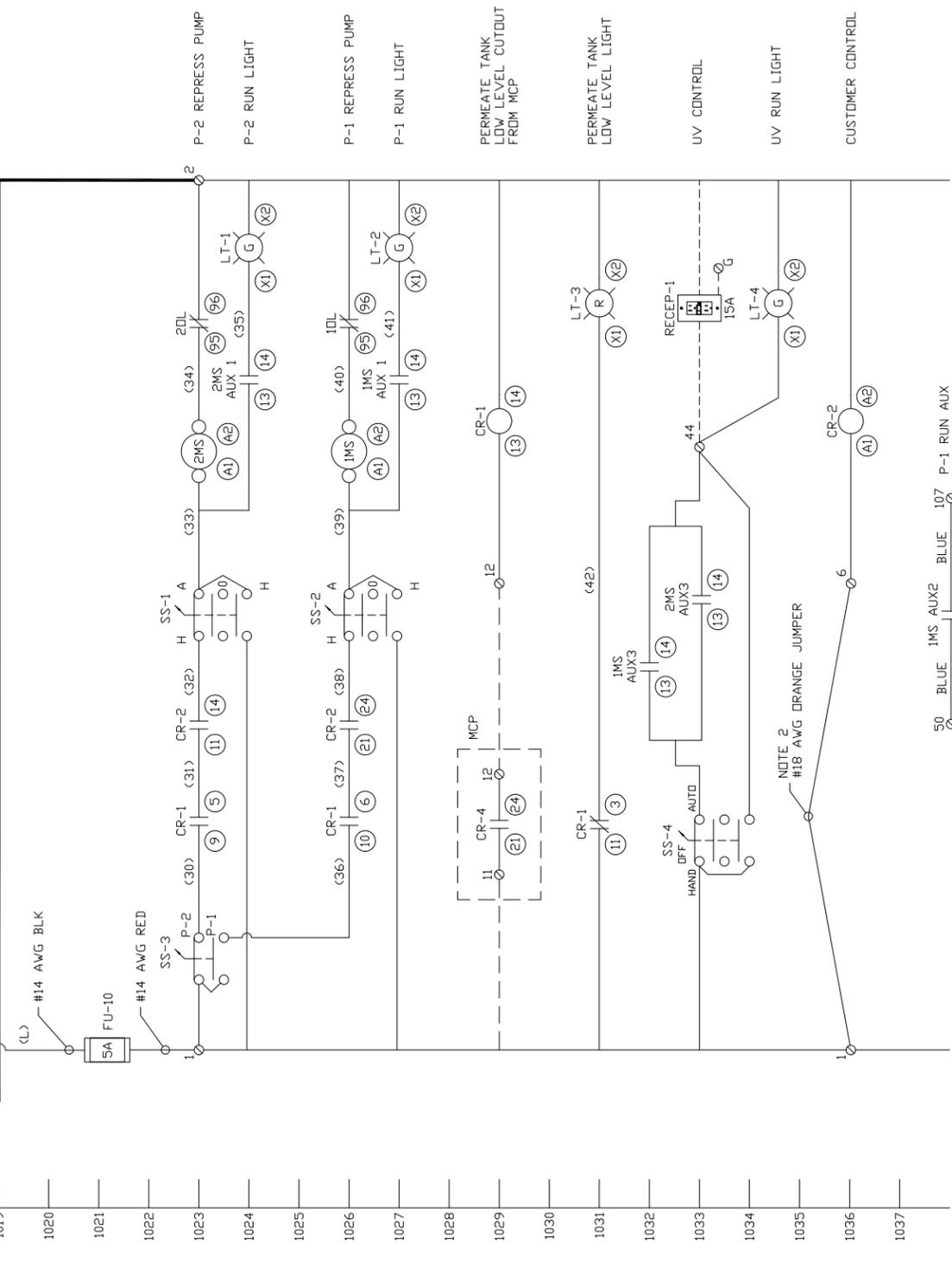
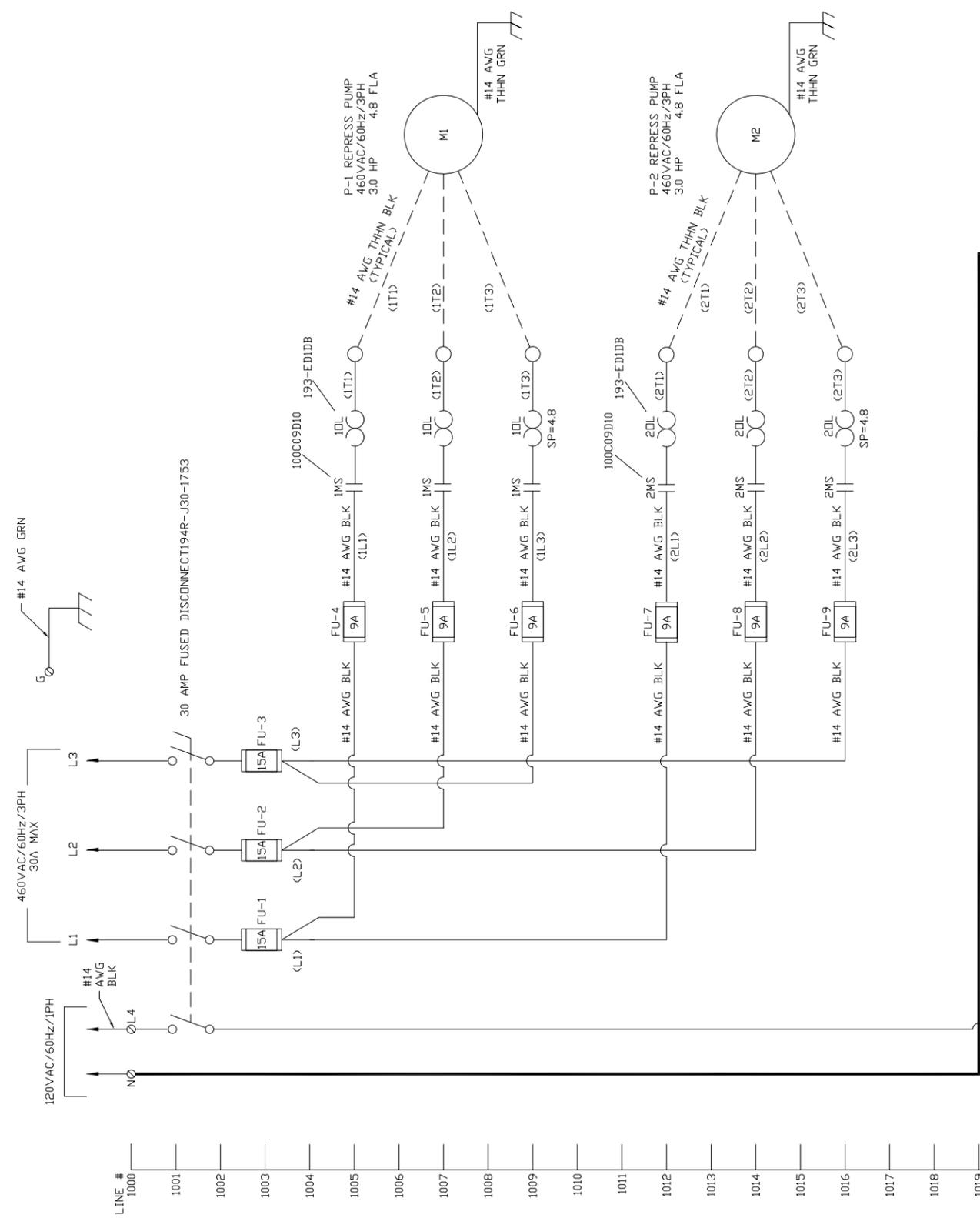
VIRGINIA WATER SYSTEMS  
VMI

MCP PLC CONTROLLER WIRING DIAGRAM			
FRAC. ±	DEC. ±	FILE ID.	S031512001-08-01
DRN.	MRP	SCALE	NTS SHEET 4 OF 4
APP'D.		DRAWING NO.	
DATE	4/23/12		









KEY

WIRE DESIGNATION	
---	FACTORY INTERCONNECT
---	INTERNAL WIRING
---	EXTERNAL WIRING
---	CENTER JUMPER
---	TERMINAL DESIGNATION
○	NUMBER OR WIRE
○	ON DEVICE
( )	WIRE NUMBERS
⊔	COIL/CONTACT LINE & REF.
⊔	TERMINAL IN MCP
⊔	TERMINAL IN LCP
⊔	HARNES SPLICE
⊔	CABINET GROUND
⊔	SUB PANEL GROUND

NOTE: 1. ALL WIRE #18 AWG UNLESS NOTED OTHERWISE.  
 2. FOR OPTIONAL AUTOMATIC CONTROL BY OTHERS, REMOVE POWER, REMOVE JUMPER AND INSTALL NEW CONTROL DEVICE. THE CONTACTS FOR THE NEW CONTROL DEVICE MUST CLOSE TO ENABLE THE PUMPS TO RUN.

REVISIONS			
NO.	DATE	BY	REMARKS
1	9/6/12	MRP	AS BUILT

**MARLO**  
INCORPORATED

VIRGINIA WATER SYSTEMS  
VMI

REPRESS PUMP MOTOR STARTER MCC-1 LINE WIRING			
FRAC. #	DEC. #	FILE ID.	REV.
		EPI2-147B-08-01	
DRN.	MRP	SCALE	SHEET 1 OF 1
APP'D.		DRAWING NO.	
DATE	8/17/12	EPI2-147B-08-01	

Seqn	Item Number	Vendor No	Qty	Description
1	A2147101	A181610CHSCFG	1	ENCLOSURE 18X16X10 NEMA 4 FRP SCRWB
2	A2148022	A18P16	1	SUBPANEL 18 X 16
3	A2203048	800FP-LSM33	1	SWITCH SELECTOR ILLUM 3-POSITION
4	A2427121	800F-N5G	1	MODULE LED POWER 120V GREEN
5	A2415002	800F-ALP	1	LATCH MOUNTING (AB800F-ALP)
6	A2323008	800F-X10	2	BLOCK CONTACT N.O. (AB800F-X10)
7	A2150017	A2150017	1	NAMEPLATE MARLO SILVER (SMALL)
8	A2203110	194E-A32-1753	1	SWITCH DISCONNECT 3P 32A WSHAFT
9	A2392043	LPJ-25SP	1	FUSE 25AMP BUSSMANN (LPJ-25SP)
10	A2399019	3048386(3004906	1	FUSEHOLDER W/DISC LEVER 10.3 38MM
11	A2392008	FNM-5(FLM-5)	1	FUSE 250V 5AMP
12	A2307004	1492-F2	17	BLOCK TERMINAL
13	A2318002	1492-N18	1	BARRIER TERMINAL END (1492N18)
14	A2307007	1492-N23	2	ANCHOR END TERMINAL BLOCK
15	A2087017	194L-HE6N-175	1	KNOB SELECTOR SWITCH(194L-HE6N-175)
16	A2137036	194L-G3394	1	SHAFT DISC METAL 230-350MM
17	A2547010	G1X2WH6	2	DUCT WIRE 1X2 WHITE(WAS E1X2WH6)
18	A2103098	C1WH6F	2	COVER WIRE DUCT 1 WHITE
19	A2399006	J60030-1CR	1	FUSEBLOCK 600V 30AMP (J60030-1CR)
20	A2162049	2834504 (85D849	2	RELAY 115V 8A 2PDT LED (2834504)
21	A2151034	800L-22L10A	2	LIGHT LED AMBER 120 VAC(800L-22L10A)
22	A2595003	LAMA2-14-QY	2	LUG GROUND ALUM 2-14AWG 1/4 STUD
23	A2307046	BNL-5	2	ANCHOR DIN RAIL (BNL-5)
24	A2000014	41216	3	LABEL MARLO SERIAL NUMBER
25	A2000161	C8002-29DHYD	1	LABEL DANGER HAZARDOUS VOLTAGE 2X4(C8002-29DHYD)
26	A2332003	100C16D10	1	CONTACTOR 16A/3P/115V
27	A2150201	200221	4	NAMEPLATE 7/8X3.25 BLANK NOTAPE WHT
28	A2307003	1492-CD2	5	BLOCK TERMINAL 600V 100A 14-4 AWG
29	A2318001	1492-N16	1	BARRIER TERMINAL END (1492N16)

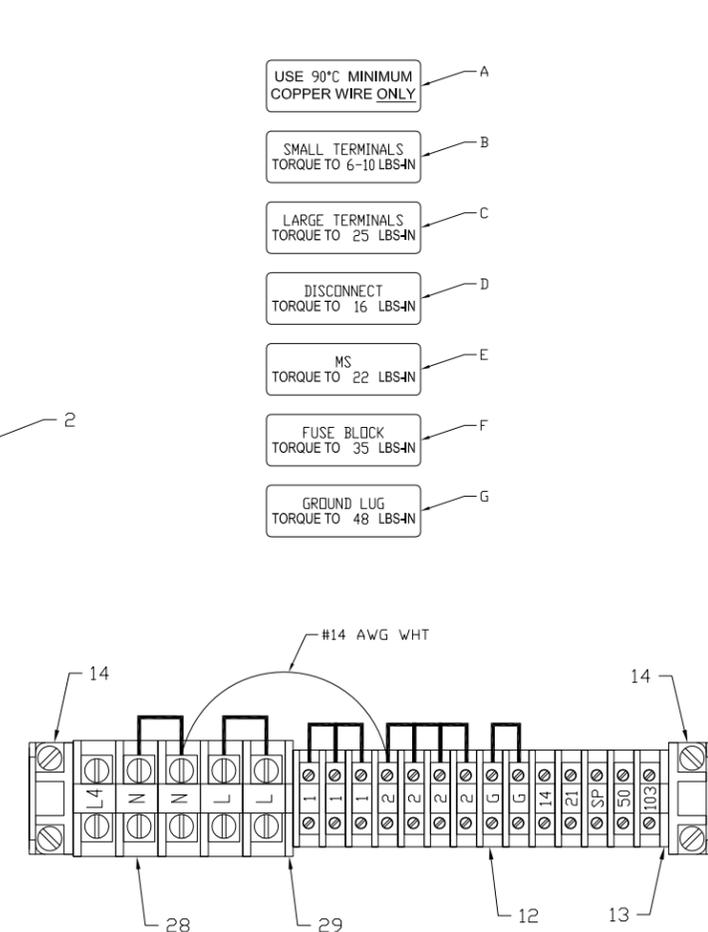
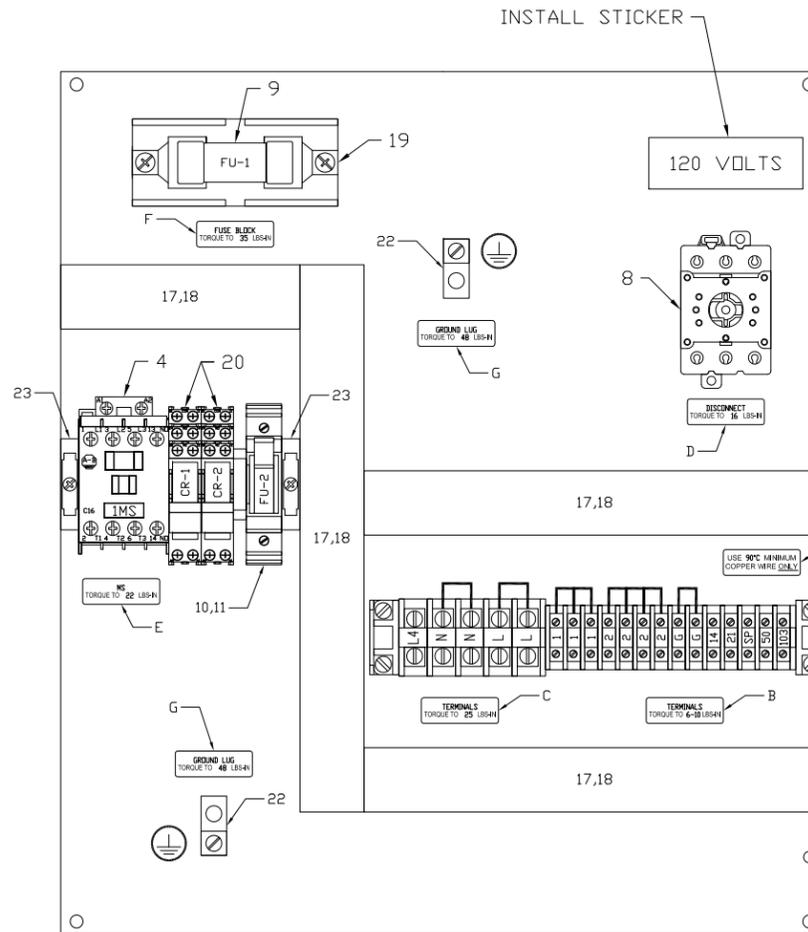
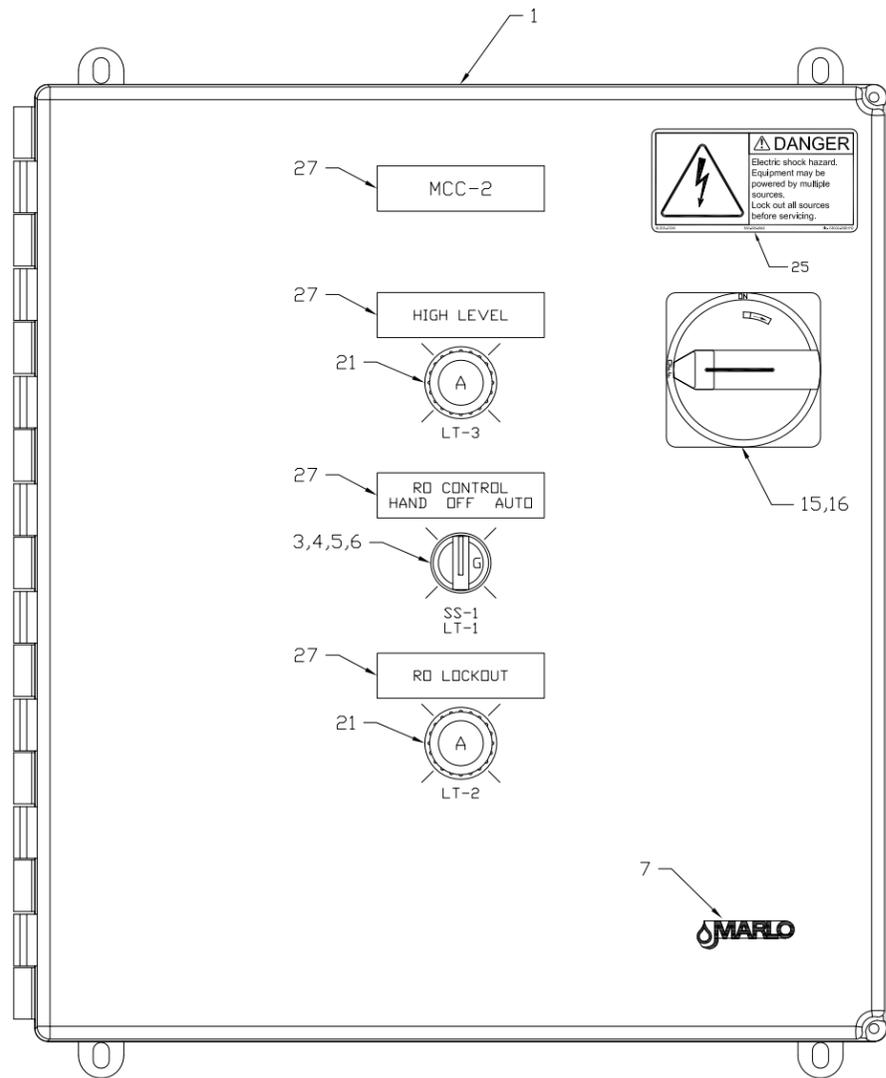
**MARLO ELECTRICAL SPECIFICATIONS**  
 Max Line Voltage: 120VAC Phase: 1 Hz: 60  
 Largest Motor FLA: NA Total FLA: NA  
 SCCR: NA Ref Dwg: EP12-147-09-01

**CAUTION: TO REDUCE THE RISK OF FIRE, REPLACE FUSE ONLY WITH SAME TYPE AMPS OR EQUIVALENT, UL LISTED ONLY.**  
**FUSE REPLACEMENT CHART**  
 FU-1 LPJ-25SP 25A  
 FU-2 FNM-5 5A

**WARNING - CONDUIT HUBS AND/OR ANY DEVICE THAT PENETRATES THIS ENCLOSURE MUST MAINTAIN THE UL RATING OF THIS ENCLOSURE.**  
 UL ENVIRONMENTAL RATING: 1

**NOTES:**

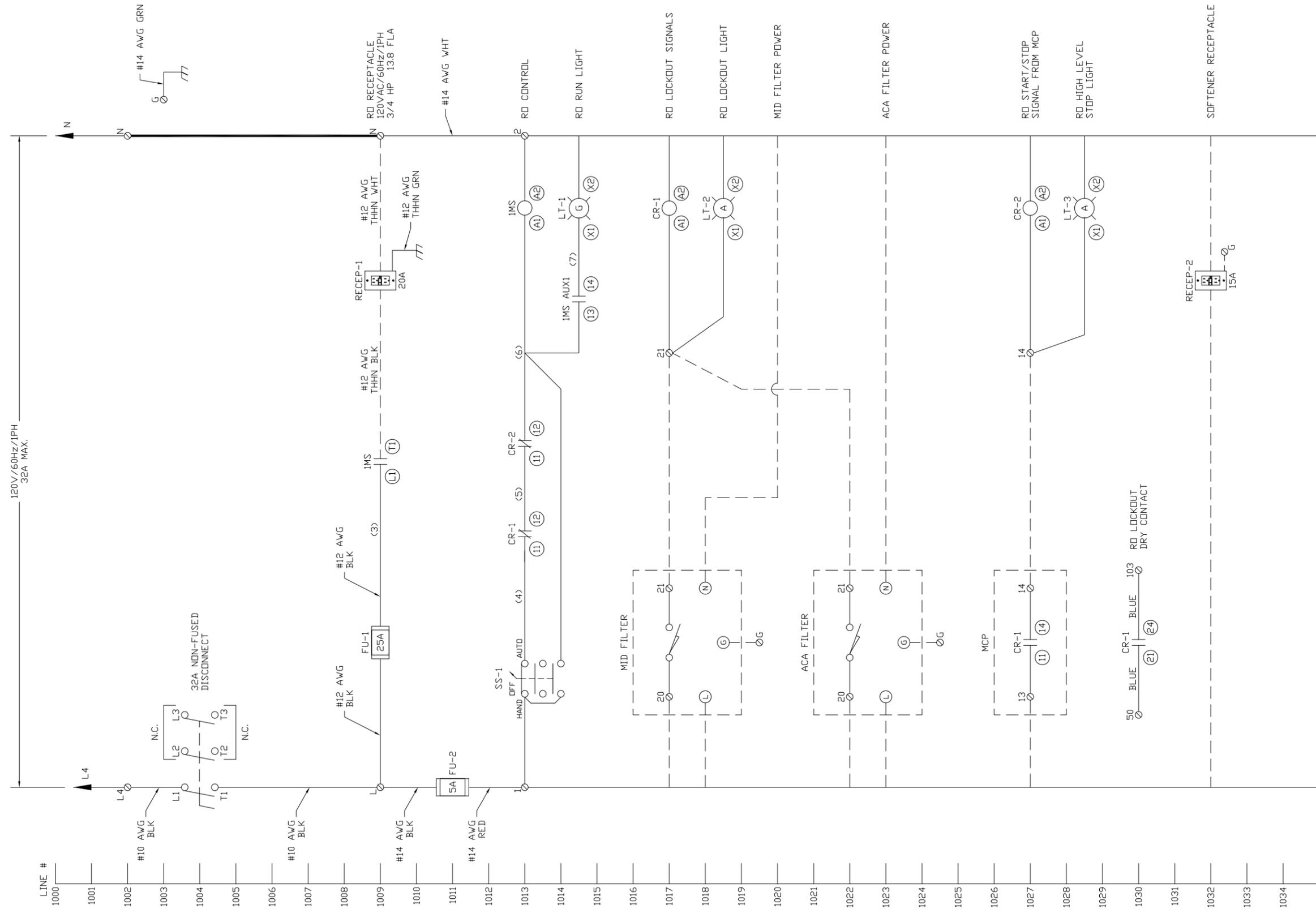
- 1) LEVEL SWITCH TO BE DIFFERENTIAL STYLE CLOSE ON LOW AND RISING LEVEL, OPEN ON HIGH AND DECREASING LEVEL. ANY OTHER LOGIC ON SWITCH REQUIRES REPROGRAMMING THE 150 SWITCH SETTING VALVE.



REVISIONS			
NO.	DATE	BY	REMARKS

**MARLO** INCORPORATED  
 VIRGINIA WATER SYSTEMS  
 VMI

RD MCC-2 CONTROLLER  
 ENCLOSURE & SUB-PANEL  
 FRAC. ± DEC. ± FILE ID. EP12-147C-10-01  
 DRN. MRP SCALE NTS SHEET 1 OF 1  
 APP'D. DRAWING NO. EP12-147C-10-01  
 DATE 8/17/12 REV. 1



LINE #  
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REVISIONS			
NO.	DATE	BY	REMARKS

**MARLO**  
INCORPORATED

VIRGINIA WATER SYSTEM  
VMI

RD MCC-2 CONTROLLER LINE WIRING DIAGRAM			
FRAC. #	DEC. #	FILE ID.	
		EPI2-147C-08-01	
DRN.	MRP	SCALE	SHEET 1 OF 1
APP'D.		NTS	
DATE	8/17/12	DRAWING NO.	REV.
		EPI2-147C-08-01	

**KEY**

---	= FACTORY INTERCONNECT
---	= INTERNAL WIRING
---	= EXTERNAL WIRING
---	= CENTER JUMPER
---	= TERMINAL DESIGNATION
---	= NUMBER DR WIRE
○	= ON DEVICE
○	= WIRE NUMBERS
○	= TERMINAL WIRE & REF.
○	= TERMINAL MCP
○	= HARNESS DR SPLICE
○	= CABINET GROUND
○	= SUB PANEL GROUND

- NOTES:**
- FACTORY SUPPLIED CABLE.
  - DID NOT RUN WITH AC POWER CABLES.
  - WIRE COLOR CODE AS FOLLOWS:
    - A. BLACK
    - B. RED
    - C. WHITE
    - D. GREEN
    - E. YELLOW
    - F. BLUE
    - G. BLUE/WHITE STRIPE
  - ALL WIRE #18 AWG UNLESS OTHERWISE NOTED.
  - WIRE NUMBERS TO BE THE SAME AS TERMINAL NUMBERS UNLESS OTHERWISE NOTED. GROUND AND NEUTRAL CANNOT BE THE SAME.
  - NO TAGS ON WIRE ENDS.
  - RUN LOW VOLTAGE WIRE SEPARATE.
  - LOW VOLTAGE TAGS ARE TAGGED TBE. ALL OTHERS ARE TBI.



## ADDENDUM 1 V211-23-001

314 Smith Hall                      Lexington, VA 24450  
Phone: 540-464-7357              Fax: 540-464-7682

**Project:**        *Water Treatment Services*

**Date/Time:**   *13 May 2022*

**To:** *Prospective Offerors*

This Addendum forms a part of the Contract Documents and modifies, corrects or supplements the original Bidding Documents dated. Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.

### **SITE VISIT:**

Virginia Military Institute has scheduled a site visit for Water Treatment Services, RFP #V211-23-001. Interested parties should RSVP their plans to attend to [carmacklw@vmi.edu](mailto:carmacklw@vmi.edu). Details as shown below:

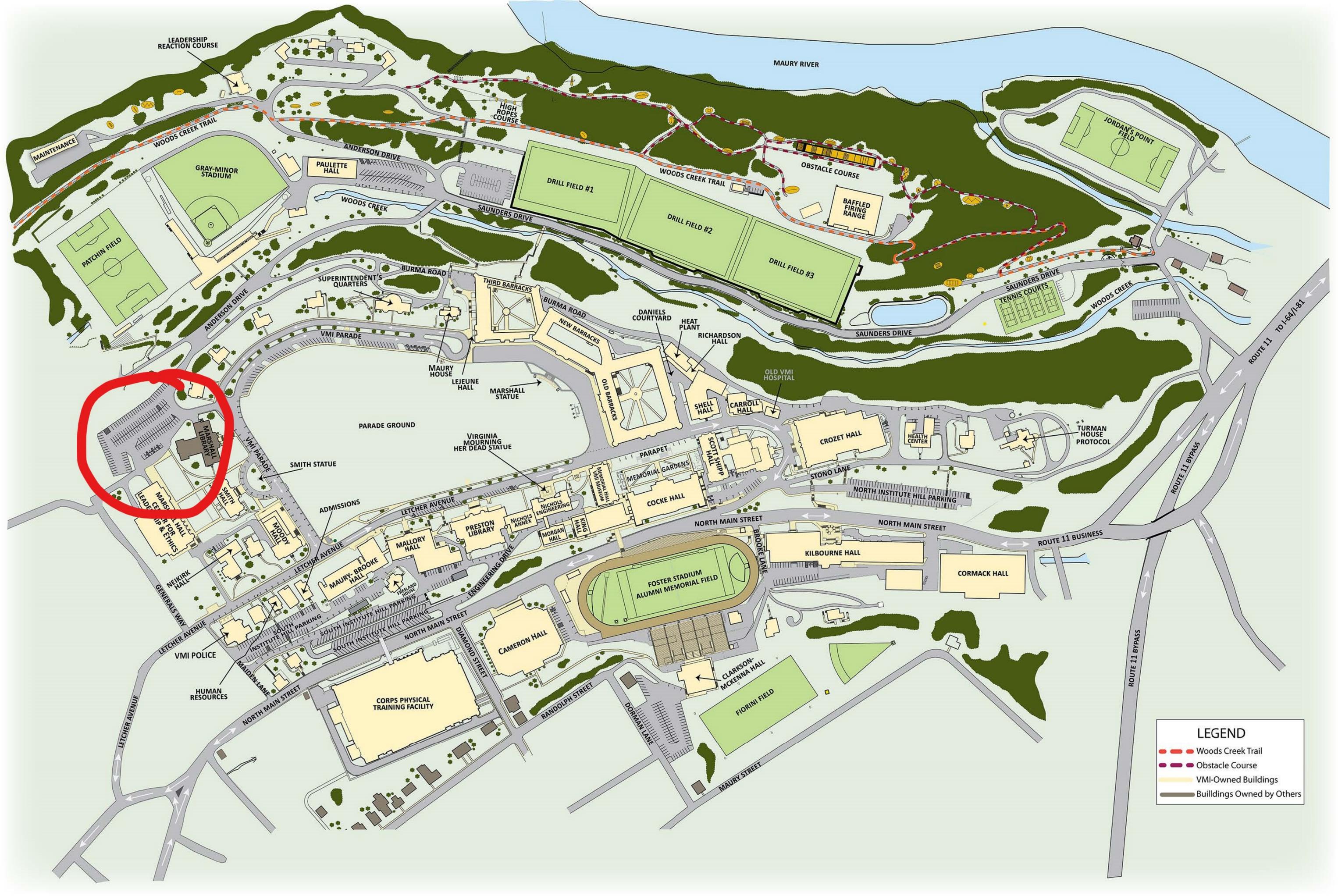
Date: Thursday, 19 May 2022

Time: 9:00 AM

Location: Meet in the parking lot of VMI Marshall Hall, Center for Leadership & Ethics, as shown on attached map.

Submitted by:

MAJ Lynn W. Carmack  
Assistant Director of Procurement Services  
540-464-7223  
[carmacklw@vmi.edu](mailto:carmacklw@vmi.edu)



LEADERSHIP REACTION COURSE

MAURY RIVER

HIGH ROPES COURSE

WOODS CREEK TRAIL

MAINTENANCE

GRAY-MINOR STADIUM

PAULETTE HALL

DRILL FIELD #1

WOODS CREEK TRAIL

OBSTACLE COURSE

JORDAN'S POINT FIELD

WOODS CREEK

SAUNDERS DRIVE

DRILL FIELD #2

BAFFLED FIRING RANGE

PATCHIN FIELD

DRILL FIELD #3

TENNIS COURTS

ANDERSON DRIVE

SUPERINTENDENT'S QUARTERS

BURMA ROAD

THIRD BARRACKS

BURMA ROAD

DANIELS COURTYARD

HEAT PLANT

RICHARDSON HALL

SAUNDERS DRIVE

WOODS CREEK

MAURY HOUSE

LEJEUNE HALL

MARSHALL STATUE

NEW BARRACKS

OLD VMI HOSPITAL



PARADE GROUND

VIRGINIA MOURNING HER DEAD STATUE

OLD BARRACKS

SHELL HALL

CARROLL HALL

CROZET HALL

HEALTH CENTER

TURMAN HOUSE PROTOCOL

SMITH STATUE

ADMISSIONS

LECHER AVENUE

PRESTON LIBRARY

NICHOLS ENGINEERING

PARAPET

MEMORIAL GARDENS

SCOTT SHIP HALL

COCKE HALL

STONO LANE

NORTH INSTITUTE HILL PARKING

MARS HALL

LEADERSHIP & ETHICS

WOODY HALL

MALLORY HALL

NICHOLS ANNEX

MORGAN HALL

KING HALL

KILBOURNE HALL

CORMACK HALL

NEIKIRK HALL

MAURY-BROOKE HALL

FREE AND HOUSE

ENGINEERING DRIVE

FOSTER STADIUM ALUMNI MEMORIAL FIELD

NORTH MAIN STREET

BROOKE LANE

NORTH MAIN STREET

ROUTE 11 BUSINESS

GENERALS WAY

LECHER AVENUE

SOUTH PARKING

SOUTH INSTITUTE HILL PARKING

NORTH MAIN STREET

DIAMOND STREET

CLARKSON-MCKENNA HALL

FIORINI FIELD

MAURY STREET

VMI POLICE

MAIDEN LANE

NORTH MAIN STREET

CAMERON HALL

RANDOLPH STREET

DORMAL LANE

MAURY STREET

HUMAN RESOURCES

NORTH MAIN STREET

CORPS PHYSICAL TRAINING FACILITY

DIAMOND STREET

RANDOLPH STREET

DORMAL LANE

MAURY STREET

**LEGEND**

- Woods Creek Trail
- Obstacle Course
- VMI-Owned Buildings
- Buildings Owned by Others



## ADDENDUM 2 V211-23-001

314 Smith Hall                      Lexington, VA 24450  
Phone: 540-464-7357              Fax: 540-464-7682

**Project:**      *Water Treatment Services*

**Date/Time:**   *20 May 2022*

**To:**   *Prospective Offerors*

This Addendum forms a part of the Contract Documents and modifies, corrects or supplements the original Proposal Documents.

***Updates to Solicitation:***

- The RFP will remain a set-aside for SWaM certified vendors. We are unable to change the status in the middle of the process.
- The last day for questions is Thursday, May 26 at 2:00 PM
- Proposals are due on Tuesday, June 7 at 2:00 PM

***Attachment: Pre-Proposal Sign-In Sheet***

Submitted by:

MAJ Lynn W. Carmack  
Assistant Director of Procurement Services  
540-464-7223  
[carmacklw@vmi.edu](mailto:carmacklw@vmi.edu)



RFP #V211-23-001

Water Treatment Services

19 May 2022 - Pre-Proposal Meeting, Sign In Sheet

NAME	COMPANY	PHONE	EMAIL	SIGNATURE
MAJ Lynn Carmack	VMI	540-464-7223	<a href="mailto:carmacklw@vmi.edu">carmacklw@vmi.edu</a>	
MAJ Todd Willey	VMI		<a href="mailto:willeytj@vmi.edu">willeytj@vmi.edu</a>	
Jeffrey Enniss	Nalco Water	276 340 2947	<a href="mailto:jeffrey.enniss@ecolab.com">jeffrey.enniss@ecolab.com</a>	
Andy Lowe	Nalco	276 451 0888	<a href="mailto:andrew.lowe@ecolab.com">andrew.lowe@ecolab.com</a>	
Luke Russaw	WCI	804 221 6261	<a href="mailto:luke.russaw@waterchemistry.com">luke.russaw@waterchemistry.com</a>	
Scott Russaw	Water Chemistry, Inc	203-328-1671	<a href="mailto:scott.russaw@waterchemistry.com">scott.russaw@waterchemistry.com</a>	
Todd Willey	VMI	540-319-8959	<a href="mailto:willeytj@vmi.edu">willeytj@vmi.edu</a>	
Paul Hanner	Southwest Air	540 421 9244	<a href="mailto:Paul.Hanner@SouthwestAir.com">Paul.Hanner@SouthwestAir.com</a>	
Mike Brown	Coastline	434-444-4283	<a href="mailto:MBrown@coastlineLTD.com">MBrown@coastlineLTD.com</a>	



## ADDENDUM 3 V211-23-001

314 Smith Hall                      Lexington, VA 24450  
Phone: 540-464-7357              Fax: 540-464-7682

**Project:      *Water Treatment Services – Set-Aside for SWaM Certified Company***

**Date/Time:   *June 1 2022***

**To: *Prospective Offerors***

This Addendum forms a part of the Contract Documents and modifies, corrects or supplements the original Proposal Documents.

***Change to Schedule: Proposals are due at 2:00 PM Tuesday 14 June 2022***

### ***Answers to Submitted Questions:***

1. CPTF1 Legionella Testing: Please Confirm:
  - a. There are 3 locations at CPTF1 that have to be tested for Legionella  
**Correct. The testing locations are the sump tank, filter pump, and main buoyance tank.**
  - b. Testing is done twice per month during the summer months and once per month for the other 9 months for a total of 45 tests per year.  
**Correct. Testing is 2x/month during the summer and 1x/month during the rest of the year. 45 tests total. Additional owner requested testing should be considered supplemental work, and a quote generated to cover the cost.**
  - c. Testing has to be done at an independent, CDC-ELITE laboratory.  
**Yes, the lab performing the testing needs to carry this certification.**
  - d. Complete lab reports have to be provided for the samples sent in.  
**Yes, complete lab reports need to be sent to the owner.**
  
2. Boiler Testing Reagents – Please confirm that the water treatment contractor has to provide.  
**Yes, the contractor is responsible for supply all testing reagents.**
  
3. Maury Brooke RO/DI System: Please provide the model number of the UV System so we can determine the correct replacement part number.  
**From the manufacturers tag:  
UVMMax made by VIQUA**

Model: Pro30

Serial: 120721047

Part #650659

Replacement Lamp: 602856

4. It seems a location has an additional legionella testing service not listed in the solicitation. Please identify how many of these tests and the frequency they are to be performed. Also, will this line item be added to the pricing page? **Please see responses to the questions in Item 1.**
5. Are there any other additional services or materials not currently listed in the solicitation that should be added to the solicitation? **We are unaware of any additional services that should be added at this time.**
6. From the tour, it was noted that the dosing system for the closed circuit coolers may not be operating correctly and is currently only set up for one treatment product. Will this be repaired prior to new contract award or will this be an issue carried over to the next award for repairs? **When the contract is awarded, the systems will be in the same condition as they were during the pre-bid walkthrough.**
7. A tower dosing station was noted to only have an inhibitor and single biocide feed station since it is missing a dosing pump. Standard recommended operation is a dual biocide feed in alternation. Will this issue be addressed before or after the next contract award? **When the contract is awarded, the systems will be in the same condition as they were during the pre-bid walkthrough.**
8. While at the steam plant, it was noted from the test logs that the boilers are not always operating in the recommended treatment ranges. Plant staff indicated that they typically do not adjust the dosing controls since they were installed recently and they were still learning their operation. If the boiler system falls out of ranges due to lack of standard plant operator routine dosing or blowdown adjustments, will the contractor be held liable for any negative boiler system results? **Any recommendations for improvements to dosing or blowdowns should be reviewed with the plant staff and contract administrator, and documented in the site visit reports. If the owner decides not to act on the recommendations, this should be documented in the reports as well.**
9. There are several water softener systems in the campus facility. Please verify the tour comment that VMI, not the contractor, provides and adds the salt to the brine tank for their operation. **VMI staff will provide and add salt to the brine tanks to maintain the proper level.**
10. In addition to SWaM certification, how are you evaluating the advantages of a vendor with additional contract capabilities under VASCUPP? **VMI can access the services of any vendor with an existing cooperative VASCUPP contract under the terms of that contract. Those contract capabilities are not part of the evaluation process for this solicitation.**
11. How would you describe the points evaluation system? What categories are assigned points? What fraction or percentage of points are assigned to each category? **The members of the evaluation panel will review each proposal and assign scores based on assigned criteria. These scores will be combined and averaged to determine the final ranking. Each category was**

assigned equal points. The evaluation criteria and points is part of the RFP and is also provided here.

	<u>Points</u>
1. Plan for providing Water Treatment Services to VMI	20
2. Qualifications and experience of Offeror	20
3. Price	20
4. Implementation, Planning and Services	20
5. References where similar goods and/or services have been provided	20
<hr/>	
TOTAL:	100
12. If terms or conditions need adjustment, what/when does the terms and conditions review process occur/look like? <i>If needed, this would occur during the negotiations process before the contract is awarded. The General Terms and Conditions for the Commonwealth of Virginia, and the Special Terms and Conditions are provided in the RFP document.</i>	
13. What is the value of the current contract? <i>The purchase order for fiscal year 2022, ending 6/30/22, was \$18,624.00.</i>	
14. Concerning Closed Loops: <i>Will VMI accept a fixed estimated cost per month for maintenance and an estimated cost per gallon water treated for any out of scope losses? VMI would like a single fixed cost per loop with the understanding that occasional losses will occur due to mechanical failures, and it will be the vendor's responsibility to re-treat.</i>	
15. <i>What specific sizes part numbers/detailed specifications are required for the Marlow softening, resin exchange, and RO?</i> <i>For the Marlow Pre-Treatment/RO Skid, the tag information says:</i> <b><i>Model# PRE-TREATMENT/RO SKID</i></b> <b><i>Serial# EP-120147-1-1</i></b> <b><i>UIN# EP-120147-01</i></b> <b><i>Refer to above information when ordering replacement parts</i></b>	
16. What is the current annual billing amount for the Service of the Maury Brooke Hall Laboratory RO/ DI System? <i>\$6,624.00/yr</i>	
17. When was the last time the Service Carbon tanks were replaced on the Maury Brooke Hall Laboratory RO/DI System? <i>An exact date is unavailable, but the carbon tanks are due for replacement.</i>	
18. When was the last time the Service Deionization tanks were replaced on the Maury Brooke Hall Laboratory RO/DI System? <i>Deionization tanks are currently replace 2x/yr.</i>	
19. What is the estimated annual gallons of water that is produced by the Maury Brooke Hall	

Laboratory RO/DI System? From informally surveying lab technicians and professors, a high estimate would be approximately 50 liters per week during spring and fall semesters. Summer semester courses use little if any DI water.

20. What is the procedure to get independent laboratory subcontractors approved/authorized? Specifically for Legionella testing. Submit a request to use an outside laboratory, along with the laboratory's relevant information (Name, Address, Certifications, etc.) to the contract administrator for review and approval. This information may be included with your proposals if the information is available.
21. Can full drawings be provided? Each drawing included in the specifications are cut in multiple section to be assembled to get a full view of the drawing. This is confusing and may lead to errors on treatment evaluation process for bidding purposes. The drawings provided are the only ones available

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