AWS SERIES

Reverse-osmosis water treatment system

Installation, Operation, and Maintenance Manual

Read and save these instructions

Warnings and cautions

⚠ WARNING

Attention installer
Read this manual before installing, and leave this manual with product owner. This product must be installed by qualified plumbing, HVAC and/or electrical contractors. Installation must be code approved.

Disconnect electrical power
Disconnect electrical power before installing supply wiring or performing service or maintenance procedures on any part of the system. Failure to disconnect electrical power could result in fire, electrical shock, and other hazardous conditions. These hazardous conditions could cause property damage, personal injury, or death.

Contact with energized circuits can cause property damage, severe personal injury, or death as a result of electrical shock or fire. Do not remove pump cover, or subpanel access panels until electrical power is disconnected.

Follow the shutdown procedure in this manual before performing service or maintenance procedures on any part of the system.

Electric shock hazard
If the reverse-osmosis system starts up during maintenance, severe bodily injury or death from electric shock could occur. To prevent such start-up, follow the procedure below before performing service or maintenance procedures on this reverse-osmosis system:

1. Use Vapor-logic® keypad/display to change control mode to Standby.
2. Shut off all electrical power to the reverse-osmosis system using field-installed fused disconnect, and lock all power disconnect switches in OFF position.
3. Close field-installed manual water supply shut-off valve.

Tipping hazard
Before installing the AWS series reverse-osmosis system, use supplied leg brackets or lag points to permanently fix the system to the floor and/or adjacent building structure. Failure to install according to instructions can result in serious injury or death. See page 17 for instructions.

NOTICE

Health risks
The user is responsible for operating and maintaining the provided system in accordance with city, state, and federal regulations. Please follow local health and state codes for regulations around application of water treatment systems. There is an associated risk with all water sources and the potential for bio growth, including bacterium that causes Legionnaires disease.

Anden water treatment systems, products, and components are designed, with consideration, to reduce the risk of Legionnaires disease and other similar situations. The water treatment design takes into account lower operating temperatures, minimization of stagnant water through mechanical design and flush cycles, and provides an option for UV disinfection of the RO storage water.

Inadequate installation, operation or maintenance of the water system can support the growth of bacterium.

A competent environmental, health, and safety representative should identify the risks of any interacting systems. As deemed appropriate, plans and controls should be implemented at the facility to help mitigate risk.

Warnings and cautions

CAUTION	
Operate system at above-freezing temperatures. Operating the system at temperatures below freezing can damage the system or cause other property damage.	
Maintain pumping and water treatment equipment. Inadequately maintained pumping and water treatment equipment can cause the system to fail. Refer to the maintenance section of this IOM for recommended maintenance.	
Do not install the system using steel or galvanized-steel piping and joints. Steel and steel-galvanized piping and joints can corrode and cause system damage. Use PVC or stainless steel piping and joints when assembling system.	
Follow all instructions in this manual to maintain product warranty.	
Damage to pump Do not close the valve on the outlet of the pump. Do not operate the pump below minimum combined flow rate (permeate + concentrate + recirculating). Model AWS-03: 4 gpm (15.2 L/min) Model AWS-06 - AWS-19: 6 gpm (22.7 L/min)	
	**Team lift required** Team lift is required when replacing the membranes. Membrane banks are heavy. Do not try to lift without assistance. Wear steel-toed shoes and have adequate room for maneuvering when servicing. Never lean membrane banks vertically when removed from system. Failure to do so may damage the system or result in injury. See maintenance information on page 56.

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ATTENTION INSTALLER

Read this manual before installing.
Leave manual with product owner.

Anden® Technical Support
800-972-3710

WHERE TO FIND MORE INFORMATION

Our website:

The following document is available on our web site: www.Anden.com

- Water treatment system catalog
- Product manuals

Call us at 800-972-3710

Keypad/display and troubleshooting

The *Vapor-logic Installation and Operation Manual*, which was shipped with the system, is a comprehensive operation manual. Refer to it for information about using the keypad/display and Web interface, and for troubleshooting information.

System dimensions

FIGURE 6-1: ANDEN AWS SERIES REVERSE-OSMOSIS SYSTEM OVERVIEW (SEE TABLES BELOW)

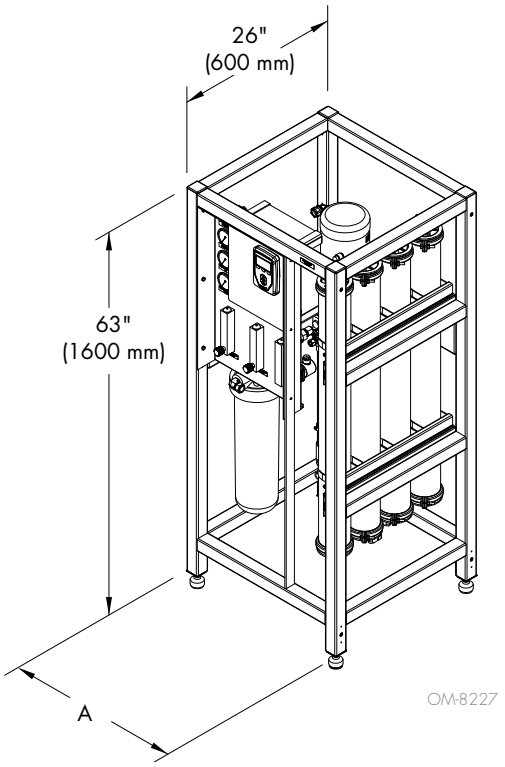


Table 6-1:
Anden AWS series RO system dimensions

Model	A	
	inches	mm
AWS03	28	711
AWS06-V1 AWS06-V4	28	711
AWS10-V1 AWS10-V4	37	940
AWS13-V1 AWS13-V4	37	940
AWS19-V1 AWS19-V4	46	1181

System clearances

FIGURE 7-1: AWS SERIES REVERSE-OSMOSIS SYSTEM CLEARANCES

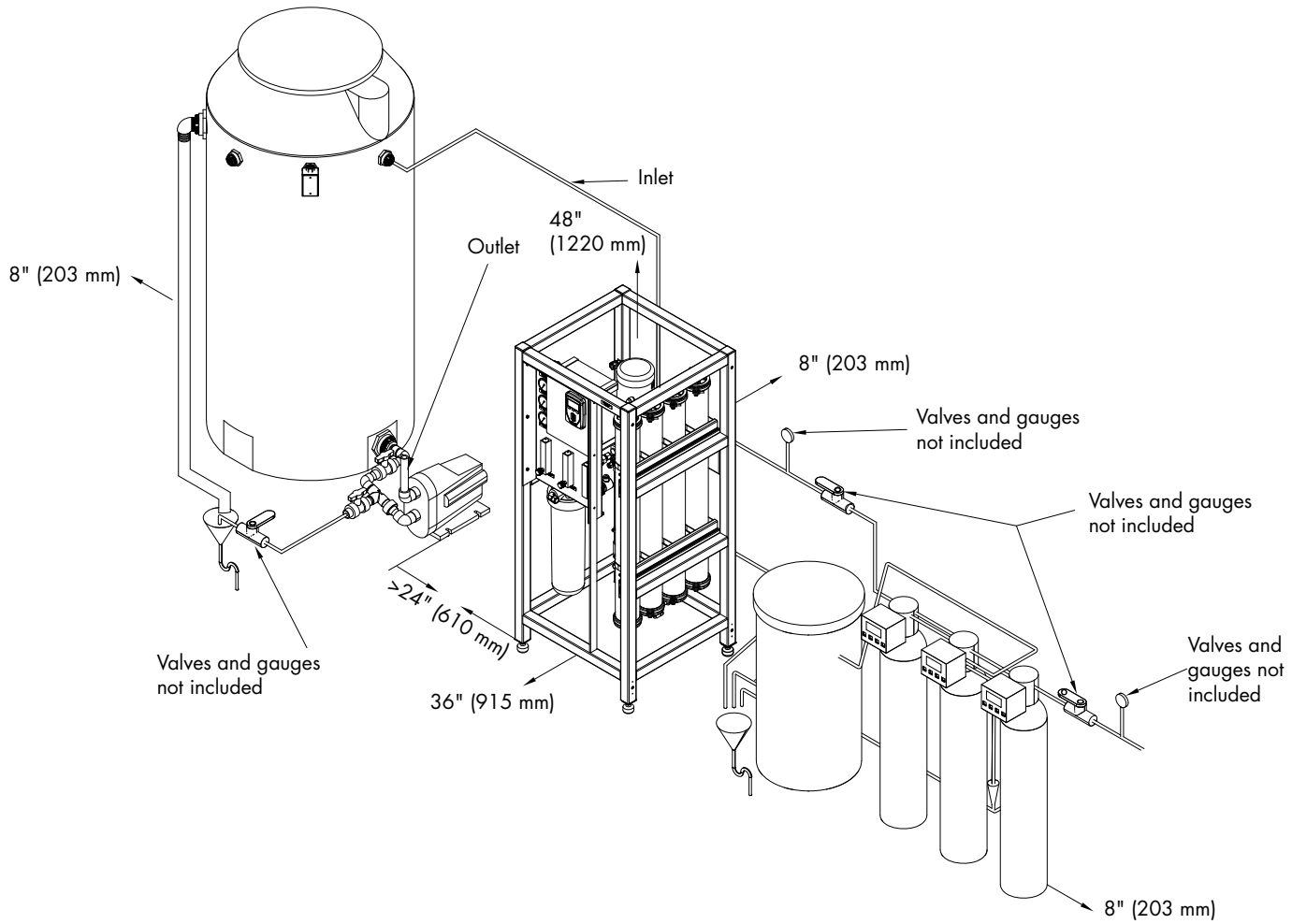


Table 7-1: RO membrane specification	
Element Configuration	Spiral wound, FRP wrapping
Typical Ionic Rejection (Nominal)	99.40%
Membrane Type	Thin film composite
Membrane material	Polyamide (PA)
Effective Membrane Area	85 ft^2
Permeate flow rate	2,400 GPD
Membrane length	40"
Membrane Diameter	3.9"
Maximum operating pressure	600 psig
Maximum feed flow rate	18 gpm[1]
Test conditions: 2,000 ppm NaCl at 225 psig applied pressure, 15% recovery, 77°F, pH 6.5-7.0, permeate flow rate for each element may vary +25%/-15%	
[1] Per membrane manufacturer specification, not total system specification.	

FIGURE 8-1: AWS SERIES REVERSE-OSMOSIS SYSTEM CLEARANCES

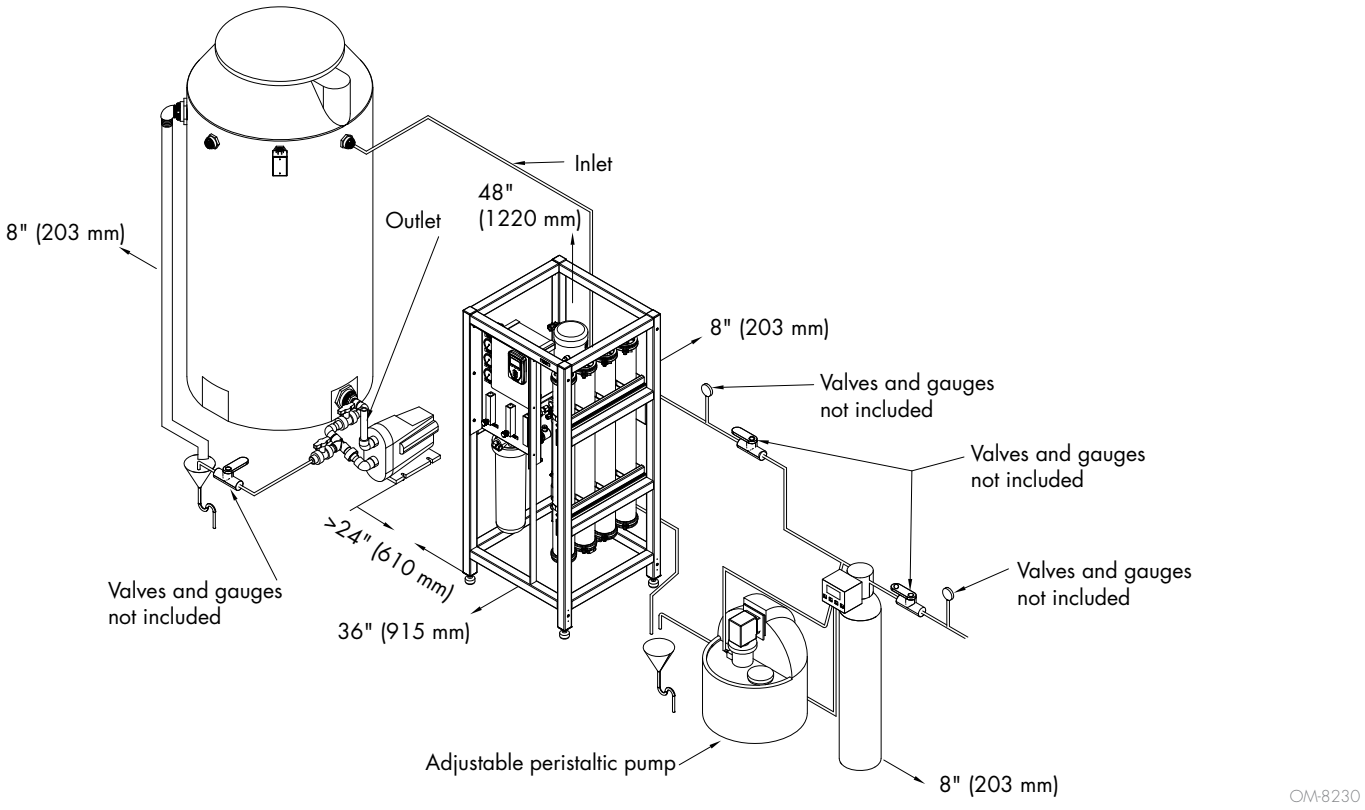
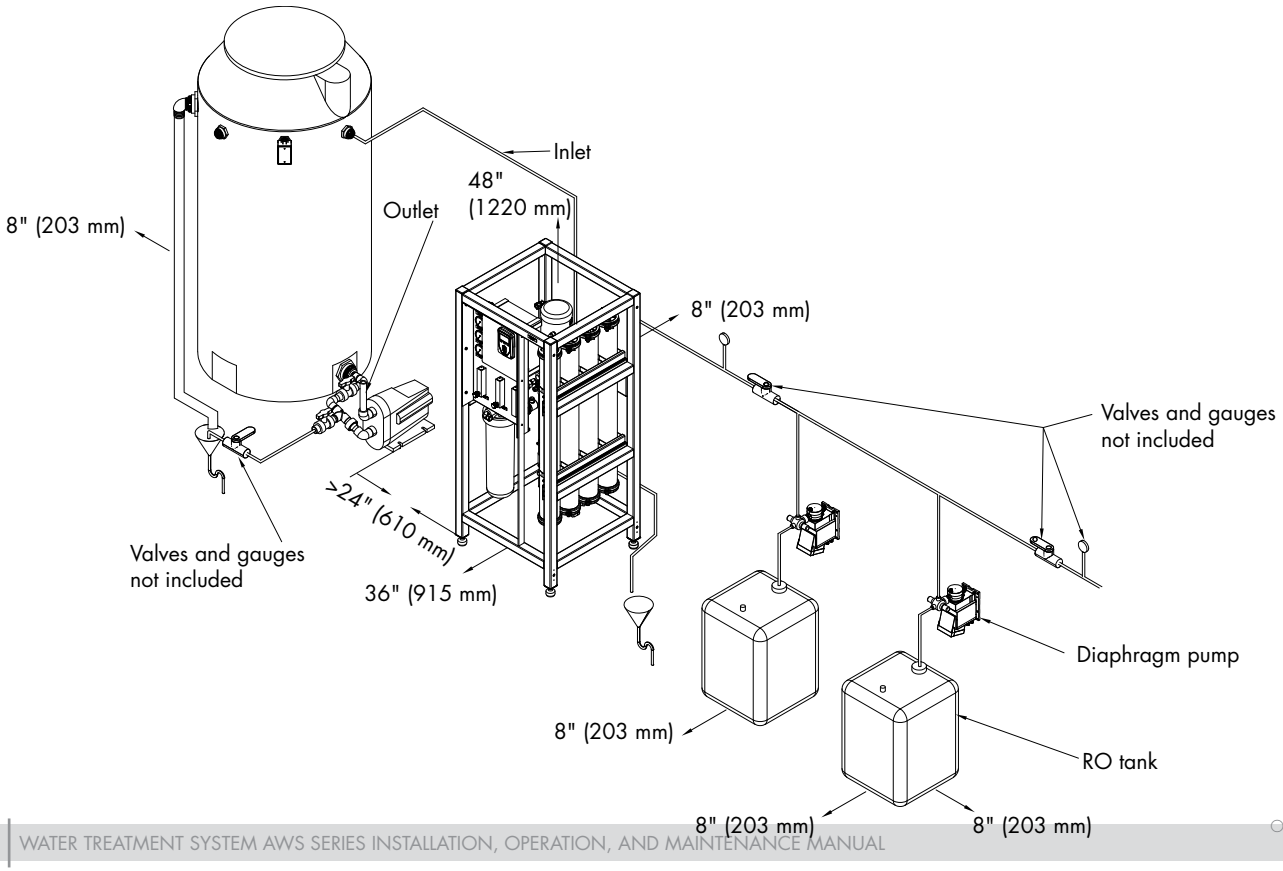
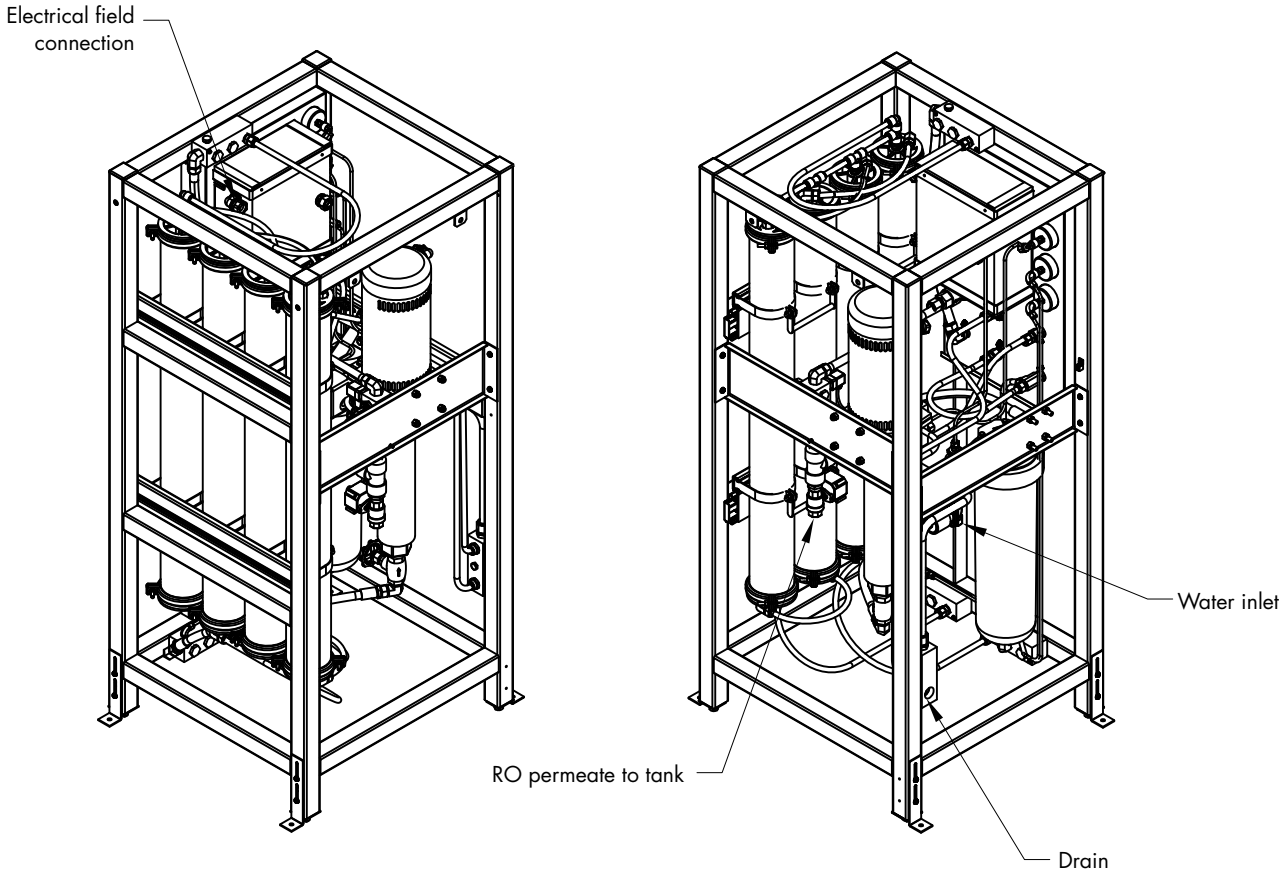


FIGURE 8-1: AWS SERIES REVERSE-OSMOSIS SYSTEM CLEARANCES



System overview

FIGURE 9-1: AWS SERIES REVERSE-OSMOSIS SYSTEM CONNECTION POINTS



Water quality and component overview

WATER QUALITY

Supply water must be softened and dechlorinated before being supplied to the reverse-osmosis system. If water is not properly dechlorinated or softened, it can damage reverse osmosis membranes. If you are not installing Anden water pretreatment components, verify that your water has had chlorine removed and is softened.

DECHLORINATOR REMOVES CHLORINE

The dechlorinator removes chlorine from supply water before it enters the reverse osmosis membranes.

Supply water enters the dechlorinator and passes through a charcoal sieve, which neutralizes chlorine before entering the water softener. The dechlorinator is automatically backflushed whenever a programmed calendar date or water meter usage is met. During automatic backflushing, clean water flows through the dechlorinator to rinse the charcoal, and then flows to drain (tank dechlorinators only). See the Pre-treatment Installation, Operation, and Maintenance Manual for more information.

WATER SOFTENER REMOVES CALCIUM, MAGNESIUM, AND IRON

The water softener removes dissolved hard water minerals from supply water before it enters the reverse osmosis membranes.

Water passes from the dechlorinator into the softener where dissolved minerals are removed by an ion-exchange process. Softened water exits through a water meter to enter the reverse osmosis membranes. When the water meter flow setpoint is satisfied, the softener will take brine from the brine tank to regenerate the resin. Water will be rejected to drain during this period of rinsing. See the Pre-treatment Installation, Operation, and Maintenance Manual for more information.

MULTI-MEDIA FILTERS

Multi-media filters remove sediment or suspended solids from the water. This technology is usually the first stage of water treatment to protect downstream equipment from fouling with suspended solids.

Anden's multi-media filters are layered with gravel, garnet, filter sand, and anthracite. The multi layered approach helps increase capacity of the filter, while maintaining effluent quality. The filter is best utilized when removing particulate greater than 10 micron. The filter will remove particles as small as 1 micron but with limited success. Other post treatment filtration should be used, if particulate is small.

Systems will do a backwash automatically based on a time set point.

GREENSAND FILTRATION

Greensand filtration is the preferred technology to remove iron, manganese, and hydrogen sulfide. It is very similar to multi-media filtration except the active media is an oxidized sand. The media is able to remove suspended or dissolved iron/manganese.

With Anden's systems we have chosen to regenerate continuously with chlorine chemical feed. The system still backwashes to remove solid load.

Water quality and component overview

CHEMICAL DOSING SYSTEMS

Chemical feed systems are used for the modification of water in many processes. The reasons to use chemical include corrosion protection, disinfection removal, dissolved solid management, disinfection, and process related characteristics need. Chemical feed systems are the means in which we add chemical to the water system. The systems include a chemical metering pump and accessories, such as, back-pressure valve, pressure regulation/relief, control cables, injection quill, foot valve, and check valves.

Specifically, anti-scalant is used to modify the scale potential by increasing the total dissolved solids (TDS) solubility. The anti-scalant polymer is fed via a metering pump upstream of an RO system in lieu of using a traditional softener. Instead of exchanging the cationic components, in the water, we are allowing those chemistries the ability to concentrate further. The polymer is easily rejected into the concentrate stream of the RO due to the large molecular weight.

Sodium metabisulfite is the chemistry used in lieu of a dechlorinator (also known as activated carbon filter). This chemistry is used for a few things but as it relates to our offering, we are using this chemistry for a reduction reaction with disinfection products, added at municipalities. The "why" to removing disinfection products are due to membrane compatibility and life. The membranes in the RO systems are susceptible to degradation from low levels of oxidants.

REVERSE OSMOSIS MEMBRANES ELIMINATE REMAINING MINERALS AND ORGANICS

Dissolved minerals and organics must be eliminated from the water in order to keep system components operating properly. Potable water passes through a dechlorinator and duplex water softener to take out chlorine and hard water deposits. The softened water enters the RO station, then flows through a 5 micron filter cartridge. Thereafter, a multi-stage pump pressurizes the water to approximately 125 psig (860 kPa), depending on the quality of water and the desired flow. Then, water is forced to cross a reverse-osmosis membrane, which removes most dissolved minerals. The water is now purified and contains very few minerals (typically less than 10 ppm) and is then stored in the storage tank. A portion of the rejection water may be recirculated; the rest, which is saturated with minerals, is sent to the drain.

CAUTION

Water supplied to the reverse-osmosis system that does not meet the required water quality standards will cause premature component failure and void the Anden warranty.

Important:

- System pressure is a variable. It is important to adjust the pressure to get the correct permeate and concentrate flows. The exact value of the pressure is not important.
- Permeate flow will increase at higher temperature.

CAUTION

Damage to pump
Do not close the valve. Do not operate the pump below minimum combined flow rate (permeate + concentrate + recirculating).

Model AWS-03: 4 gpm (15.2 L/min)
Models AWS-06 - AWS-19: 6 gpm (22.7 L/min)

COMPONENT OVERVIEW

Your system may include all or some of the following components.

- Water pretreatment components
  - Dechlorinator (tank style floor mount recommended on all sizes, cartridge style wall mount available)
  - Single or duplex water softener and brine tank
- RO storage options include:
  - Atmospheric RO holding tank with booster pump

Water quality and component overview

SCALE

Scale occurs when the solubility of the dissolved solids increases above the solubility limit. In reverse osmosis, this occurs by concentrating up the solids. For example, 50% recovery of the water doubles the concentration of solids in the concentrate stream. The most common scaling components are: hardness, carbonates, sulfates and silica.

Scale control comes into play when we want to increase the life of the membrane but limit the wastewater we are sending out. This will help operators manage their operating expense as it relates to membranes and water. Scale control can be influenced by temperature, recovery rate (decreasing), ion exchange for removal of hardness, pH (acid addition), and/or anti-scalant (polymer based). If pretreatment is not desired, cleaning chemicals can be used as a means to remove existing scale from membrane surfaces.

Solubility is the ability of a substance (dissolved solids) to form a solution with a solvent (water). Insolubility occurs when the maximum threshold of the solvent has been overcome with existing solids for a given condition.

NON-SCALE

Non-scale foulants can also be a concern for the longevity of RO membranes. These will lower the permeate production and decrease the salt rejection. These foulants are usually made up of bacteria, turbidity (clay), silica or total suspended solids. The RO system has requirements around incoming turbidity, bacteria, and Slit Density Index (SDI). The system will need further pretreatment, if these exist. The typical technologies are cartridge filtration, media/oxidative filtration, ultrafiltration,or anti-foulant chemicals. For upstream biofouling, disinfection technologies can be applied. Chlorination is the most common but needs to be removed prior to the RO system to prevent damage. UV radiation can also be used to kill bacterial cells. No matter what foulant is present, it should be verified that the pretreatment methodology is effectively removing the foulant.

MEMBRANE DEGRADATION

Membrane degradation can occur from oxidants such as free chlorine or chloramines. These chemicals are typically in source water to protect water supplies from harmful bacteria. However, these active oxidants will attack the membrane, polyamide, surface and begin to decrease the membranes ability to reject salts. There is some tolerance to chlorine attack and depends on specific membrane being used. The typical tolerance is 200-1000 ppm-h of chlorine. Once membranes have gone beyond threshold they will not meet desired permeate conditions and will need to be replaced.

Water quality and component overview

STORAGE TANKS

RO systems and the subsequent systems that are fed by RO permeate require a storage tank to be included in the design. The main reasons for this are to allow for a buffer for when the RO system first starts up and not sending water to the tank, to allow for maintenance intervals on the RO while maintaining downstream equipment feed, to prevent backflow to the RO system and potentially damage the membranes/system, and to handle large peak loads that have smaller average flow rates.

PUMP OPERATION FOR THE STORAGE TANK

Forwarding pumps are required to get the atmospheric permeate to the end user. Most systems require a minimum pressure of water supply to operate and the most common method for commercial applications is to use a pump.

TUBING

Tubing on the unit will be color coded for ease of troubleshooting and system tracing.

- **Black** tubing indicates feed water.
- **Green** tubing indicates concentrate water.
- **Blue** tubing indicates permeate water.

Water quality and component overview

DESIGN BASIS

- Systems rated at: 50°F (10°C) using 1000 PPM sodium chloride solution operating at 200 psi pressure.
- Minimum feed pressure to RO System: 40 PSI. System capacity changes significantly with water temperature. For higher TDS a water analysis must be supplied and could result in modifications to the system.
- Chlorine/chloramines must be removed if present in feed water prior to RO with a dechlorinator.
- Pre-treatment for scaling potential is highly recommended to increase time between cleaning/replacement. Typical technologies include softeners or anti-scalant chemical feed.
- Feed water turbidity: Less than 1 NTU; Feed water silt density index (SDI): 3 maximum. If exceeded, pretreatment with media filter recommended. All pretreatment equipment are available from Anden.
- Capacity Basis: 24 hrs/day.
  Note: The RO needs occasional maintenance and should be accounted for in design.

DESIGN NOTES

1. Pump flow/Feed flow: The pump has been designed to include recycle flow (if any) coming back to the pump inlet from the concentrate stream based on desired recovery. The sum of permeate flow, concentrate flow and recycle flow (if any) will equal the pump design flow.
2. Permeate flow: Indicates design flow rate from RO membranes as product water for use.
3. Concentrate flow: Water flowing to the drain. Concentrate flow is critical for proper system operation.
4. Recycle flow: Flow stream that returns from the concentrate line back to the pump intake, rather than to the drain.

PERFORMANCE BASIS

The RO system will nominally reduce incoming TDS and conductivity by 98%. The following parameters affect the permeate quality/quantity:

1. Feed Temperature: colder water derates capacity
2. Feed TDS: Higher TDS derates capacity
3. System Pressure: Higher system pressure increases production.
4. Pre-treatment: Maintenance required to maintain RO capacity and minimize fouling.
5. Fouling: Particulate, scale, biofilm reduce quality and capacity.
6. Membrane Age: Capacity reduces over time.

Table 14-1:
RO supply water guidelines

RO Operating Parameter	Limit
Minimum inlet pressure	40 psi (dynamic)
Maximum inlet pressure	70 psi (static)
Minimum water temperature in	40°F (4°C)
Design water temperature	50°F (10°C)
Maximum water temperature in	100°F (38°C)
Minimum ambient temperature	40°F (4°C)
Maximum ambient temperature	104°F (40°C)
Feed TDS	<1,500 ppm
Operating pH range	4.0-9.0
Feed Water Turbidity	<1 NTU
Feed Water Silt Denity Index (SDI)	<3
Maximum feed iron concentration	<0.05 ppm
Maximum free chlorine concentration	<0.01 ppm*
Maximum feed silica concentration	<10 ppm
Maximum chloride ion concentration	<350 ppm

* Any oxidant or free chlorine will begin to degrade the membrane properties.

Supply water outside of the guidelines may void your Anden warranty. Please contact your Anden Representative or Anden Technical Support if you need advice.

System operation temperature

Anden rates reverse-osmosis systems at both 50°F (10°C) and the industry standard of 77°F (25°C).

To find the membrane permeate rate at a different temperature, follow these steps:

1. Find the temperature correction factor (TCF) from the below table.
2. Divide the rated permeate flow from Table 15-1 on page 15 by the temperature correction factor.

The result is the permeate flow at the desired temperature.

Table 15-1:
Corrective permeate rate

Feed water temperature		Temperature correction factor (TCF)									
°C	°F	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
5	41.0	2.093	2.085	2.077	2.069	2.060	2.052	2.044	2.036	2.028	2.020
6	42.8	2.012	2.004	1.997	1.989	1.981	1.973	1.966	1.958	1.950	1.943
7	44.6	1.935	1.927	1.920	1.913	1.905	1.898	1.890	1.883	1.876	1.868
8	46.4	1.861	1.854	1.847	1.840	1.833	1.826	1.819	1.812	7.805	1.798
9	48.2	1.791	1.784	1.777	1.770	1.763	1.757	1.750	1.743	1.737	1.730
10	50.0	1.723	1.717	1.710	1.704	1.697	1.691	1.684	1.678	1.672	1.665
11	51.8	1.659	1.653	1.646	1.640	1.634	1.628	1.622	1.616	1.610	1.603
12	53.6	1.597	1.591	1.585	1.579	1.574	1.568	1.562	1.556	1.550	1.544
13	55.4	1.539	1.533	1.527	1.521	1.516	1.510	1.504	1.499	1.493	1.488
14	57.2	1.482	1.477	1.471	1.466	1.460	1.455	1.450	1.444	1.439	1.434
15	59.0	1.428	1.423	1.418	1.413	1.407	1.402	1.397	1.392	1.387	1.382
16	60.8	1.377	1.372	1.367	1.362	1.357	1.352	1.347	1.342	1.337	1.332
17	62.6	1.327	1.323	1.318	1.313	1.308	1.304	1.299	1.294	1.289	1.285
18	64.4	1.280	1.276	1.271	1.266	1.262	1.257	1.253	1.248	1.244	1.239
19	66.2	1.235	1.230	1.226	1.222	1.217	1.213	1.209	1.204	1.200	1.196
20	68.0	1.192	1.187	1.183	1.179	1.175	1.171	1.166	1.162	1.158	1.154
21	69.8	1.150	1.146	1.142	1.138	1.134	1.130	1.126	1.122	1.118	1.114
22	71.6	1.110	1.106	1.102	1.098	1.095	1.091	1.087	1.083	1.079	1.076
23	73.4	1.072	1.068	1.064	1.061	1.057	1.053	1.050	1.046	1.042	1.039
24	75.2	1.035	1.032	1.028	1.024	1.021	1.017	1.014	1.010	1.007	1.003
25	77.0	1.000	0.997	0.993	0.990	0.986	0.983	0.980	0.976	0.973	0.970
26	78.8	0.971	0.968	0.965	0.962	0.959	0.956	0.953	0.951	0.948	0.945
27	80.6	0.942	0.939	0.937	0.934	0.931	0.928	0.926	0.923	0.920	0.918
28	82.4	0.915	0.912	0.910	0.907	0.904	0.902	0.899	0.896	0.894	0.891
29	84.2	0.888	0.886	0.883	0.881	0.878	0.876	0.873	0.871	0.868	0.866
30	86.0	0.863	0.861	0.858	0.856	0.853	0.851	0.848	0.846	0.843	0.841
31	87.8	0.838	0.836	0.834	0.831	0.829	0.827	0.824	0.822	0.819	0.817
32	89.6	0.815	0.812	0.810	0.808	0.806	0.803	0.801	0.799	0.796	0.794
33	91.4	0.792	0.790	0.787	0.785	0.783	0.781	0.779	0.776	0.774	0.772
34	93.2	0.770	0.768	0.765	0.763	0.761	0.759	0.757	0.755	0.753	0.751
35	95.0	0.748	0.746	0.744	0.742	0.740	0.738	0.736	0.734	0.732	0.730
36	96.8	0.728	0.726	0.724	0.722	0.720	0.718	0.716	0.714	0.712	0.710
37	98.4	0.708	0.706	0.704	0.702	0.700	0.698	0.696	0.694	0.692	0.690
38	100.4	0.689	0.687	0.685	0.683	0.681	0.679	0.677	0.675	0.674	0.672
39	102.2	0.67	0.668	0.666	0.664	0.663	0.661	0.659	0.657	0.656	0.654
40	104.0	0.652	0.650	0.648	0.647	0.645	0.643	0.641	0.640	0.638	0.636

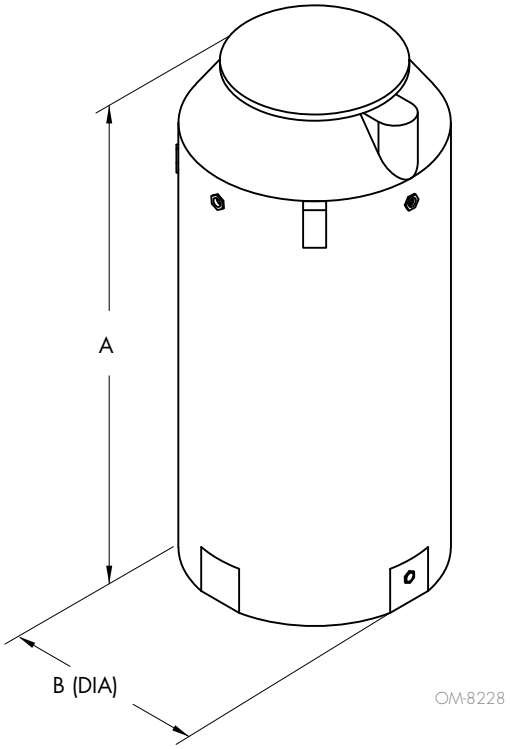
NOTE: Temperature correction factor only includes membrane performance and doesn't include mechanical design considerations.

Components overview

ATMOSPHERIC RO HOLDING TANK

The atmospheric RO hold tank holds a large amount of RO water for large jobs or when additional runtime needs to be guaranteed. System includes a recirculation/booster pump system (shipped loose) to ensure water purity and supply 30-60 psi (207-345 kPa) water to downstream equipment.

FIGURE 16-1: ATMOSPHERIC HOLDING TANK



Note: System components and configuration may vary to meet application requirements.

FIGURE 16-2: FORWARDING PUMP

Atmospheric RO holding tank specifications

Tank		Dimensions				Weight		Opening Size		Connection			
		A		B						In (PVC)		Out (NPT)	
Model	gallons	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm	inches	mm
AWP201	300	77	1956	35.5	902	80	2032	16	406	1	25	2	25
AWP202	500	71	12700	48	1219	110	2794	16	406	1	25	2	25
AWP203	1000	78	1981	64	1626	175	4445	16	406	1	25	2	25
AWP204	5000	152	3861	102	2591	950	24130	16	406	1	25	2	25

Pumps and disinfection

	Make	Model	Voltage	Phase	Frequency	Running Amps	Noise level dB(A)
Forwarding pump	Grundfos	Scala2	120V	single	60 Hz	2.8A	<47

Placing components

When placing components, consider the following:

- Easy access for maintenance
- Select a location near a water supply, power supply, and drain.
- Minimize distance between the RO station and the equipment using the RO water.
- Maximum ambient temperature is 104°F (40°C).
  Minimum ambient temperature is 40°F (4.4°C)
- Clearance recommendations (see Figure 16-1).
- Electrical connections: Power, control, and safety circuits
- Plumbing connections: Supply water and drain piping (see the "System piping" section of this manual, beginning on Page25.
- Avoid locations above critical equipment or processes.
- Avoid locations close to sources of electromagnetic emissions, such as power distribution transformers and high horsepower motors controlled by variable frequency drives.

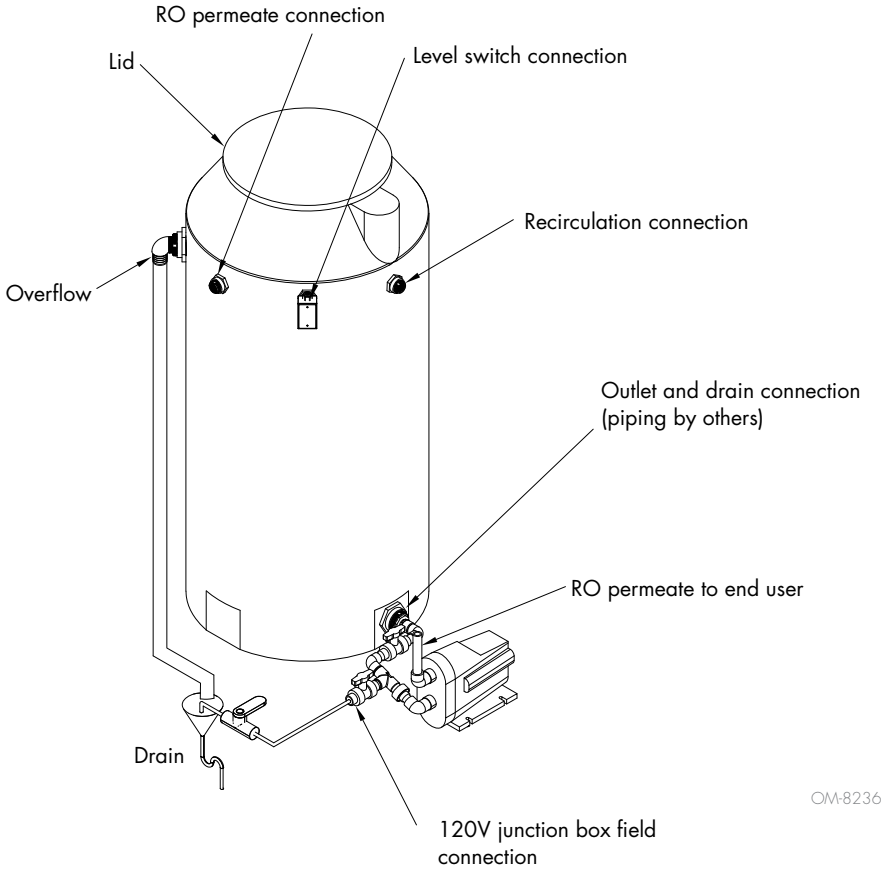
Important:

Installation must comply with governing codes.

⚠ WARNING

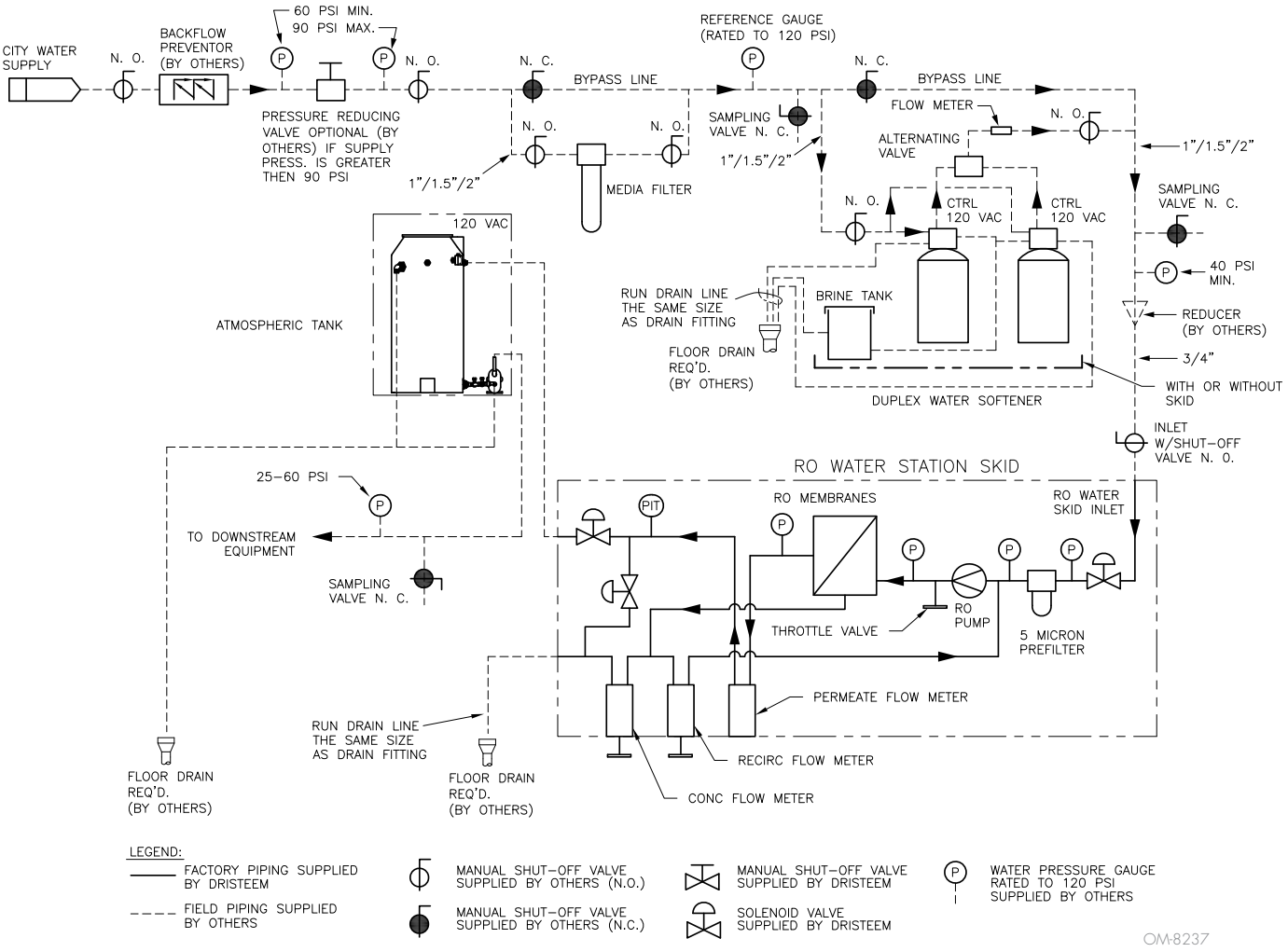
All Anden AWS series reverse-osmosis systems must be bolted to the floor or permanently attached to the building structure. Use the shipping brackets that come with the system to anchor the system to the floor or use the attachment points on the underside of the top frame rail on the back of the system to secure the system to the building structure. Ensure adequate anchors and/retaining means are used. Failure to install according to instructions can result in serious injury or death.

FIGURE 17-1: ATMOSPHERIC HOLDING TANK CONNECTIONS



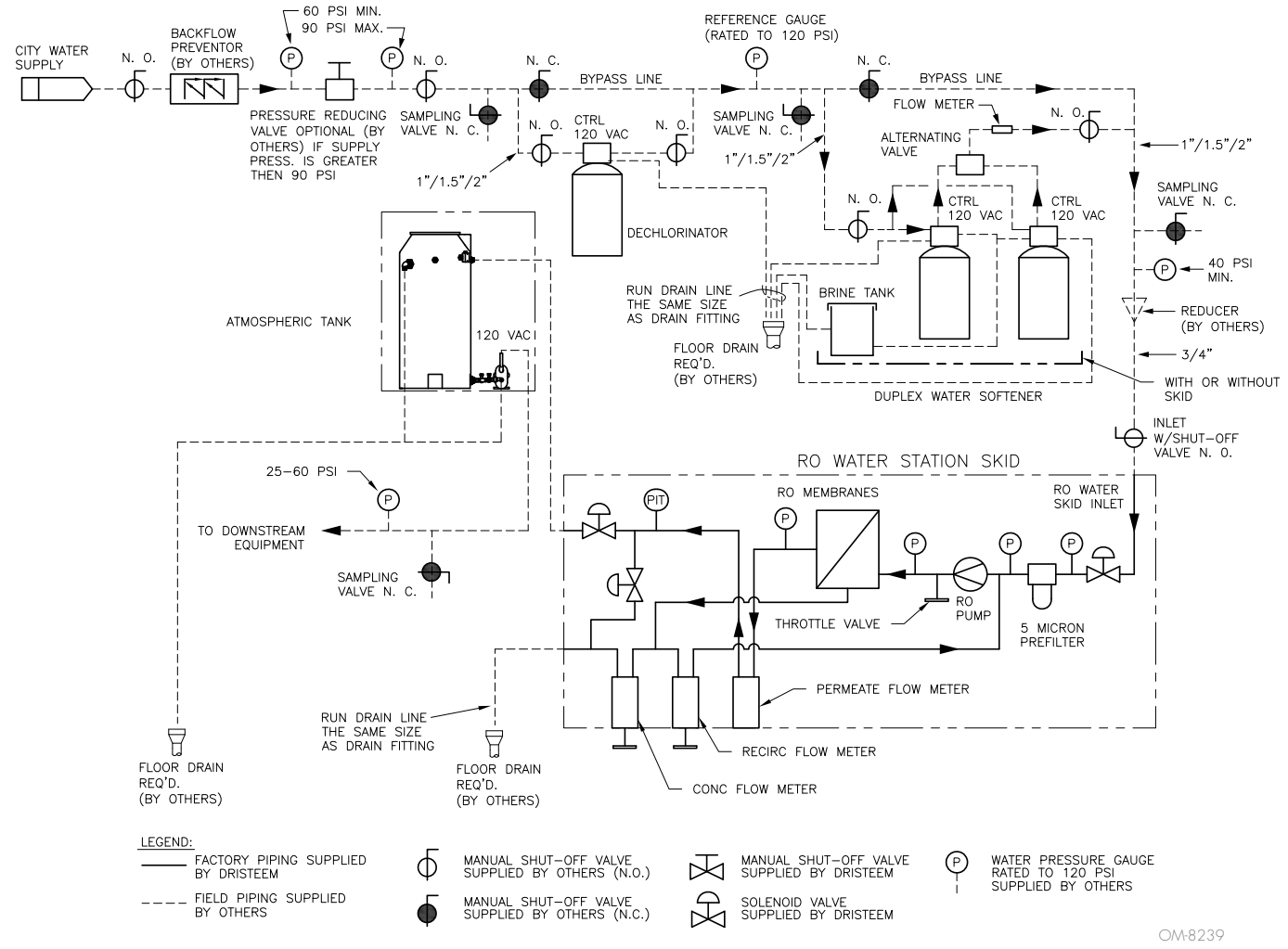
Piping and instrumentation arrangement: Well water (tank style)

FIGURE 18-1: FLOW SCHEMATIC DECHLORINATOR AND ATMOSPHERIC STORAGE TANK (WELL WATER - TANK STYLE)



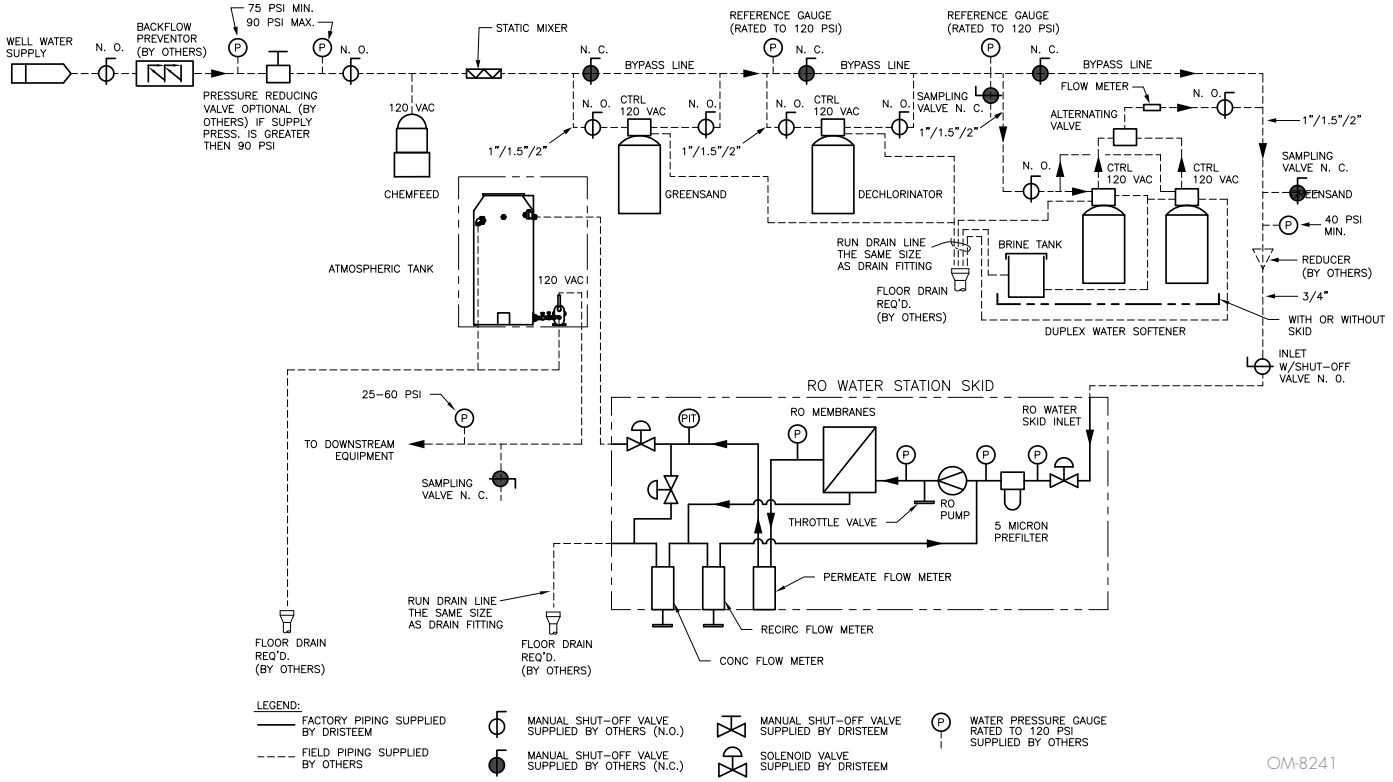
Piping and instrumentation arrangement: City water (tank style)

FIGURE 19-1: FLOW SCHEMATIC DECHLORINATOR AND ATMOSPHERIC STORAGE TANK (CITY WATER - TANK STYLE)



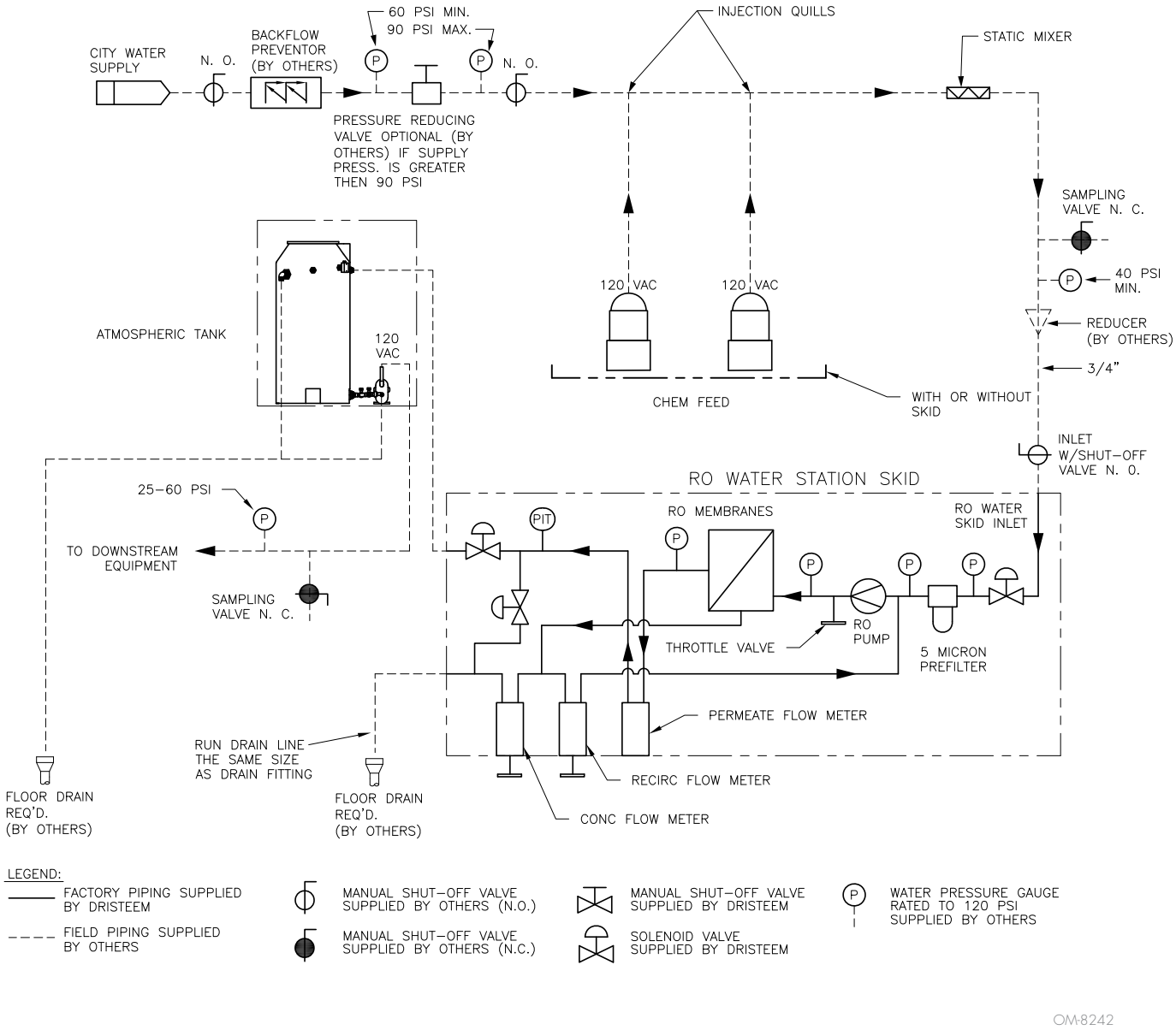
Piping and instrumentation arrangement: Well water (greensand)

FIGURE 20-1: FLOW SCHEMATIC DECHLORINATOR AND ATMOSPHERIC STORAGE TANK (WELL WATER - GREENSAND)



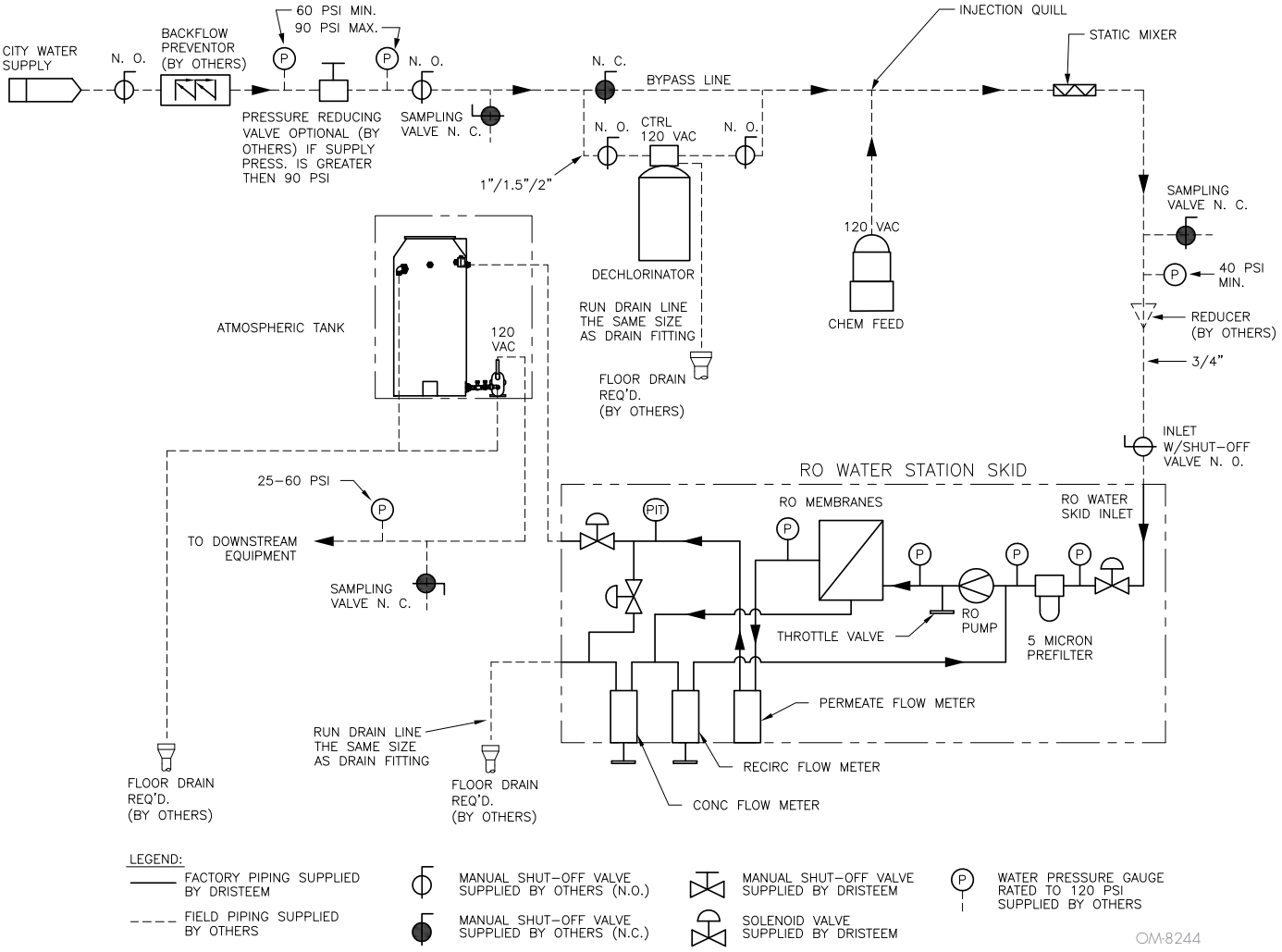
Piping and instrumentation arrangement: City water (chemical feed)

FIGURE 21-1: FLOW SCHEMATIC DECHLORINATOR AND ATMOSPHERIC STORAGE TANK - CITY WATER (CHEMICAL FEED)



Piping and instrumentation arrangement: City water (mixed)

FIGURE 22-1: FLOW SCHEMATIC DECHLORINATOR AND ATMOSPHERIC STORAGE TANK (WELL WATER - TANK STYLE)



Interconnecting tubing requirements

Table 23-1:
Maximum length of interconnecting tubing between pump station and RO holding tank

RO station model	Volume		Tubing nominal diameter	Minimum tube I.D.		Maximum developed length*	
	gpm	L/m		in.	mm	ft	m
AWS-03	1.65	6.4	1/2"	0.375	10	64	>20
			3/4"	0.625	16	>100	>30
			1"	0.875	23	>100	>30
AWS-06	3.6	13.6	1/2"	0.375	10	—	—
			3/4"	0.625	16	>100	>30
			1"	0.875	23	>100	>30
AWS-10	5.50	20.8	1/2"	0.375	10	—	—
			3/4"	0.625	16	95	29
			1"	0.875	23	>100	>30
AWS-13	7.20	27.3	1/2"	0.375	10	—	—
			3/4"	0.625	16	51	16
			1"	0.875	23	>100	>30
AWS-19	11	41.6	1/2"	0.375	10	—	—
			3/4"	0.625	16	22	7
			1"	0.875	23	89	27

* Calculations are based on pipe finish factor of 130 and low-pressure piping length of 1' (0.3 m).
** Installation must meet the minimum and maximum inlet pressures for all components, as stated in the specification tables in the "Installation" section of this manual.

Components and tools needed

System configuration may not include all components.

TYPICAL TOOLS/SUPPLIES NEEDED

- PTFE-tape
- Adjustable wrench for water fittings
- Screwdrivers for power connections and cabinet access
- Precision screwdrivers for signal connections

TYPICAL FIELD-SUPPLIED COMPONENTS

- Gauges, fittings, and interconnecting piping as shown in Figure 18-1.
- Pipe supports/hangers (if needed)
- Reducing fittings for water connections (if needed)
- Drain line and clamp for flush valve
- Interconnecting piping and fittings
- Water softener salt (pulverized type recommended)
- Plastic tee for duplex-water-softener-to-brine-tank connection
- Funnel for pouring resin beads into duplex water softener tanks for 21" (533 mm) and larger
- Code approved electrical disconnect.
- Sample valves
- Backflow prevention
- Pressure regulatory valve (if required)
- Booster pump upstream of system (if required)

System piping

FOR SYSTEMS TO BE PIPED IN THE FIELD

WATER PRE-TREATMENT

Typical inlet pressure range to dechlorinator is 60 to 90 psi (415 to 620 kPa). Minimum inlet dynamic (while running) pressure to dechlorinator is 60 psi (415 kPa). Typical feed pressure to greensand plus filter is 75 psi (517 kPa) to account for downstream process losses.

DECHLORINATOR

For detailed instructions see the dechlorinator manual that shipped with your system.

Refer to for arrangement of piping and instrumentation.

1. Connect the water supply and bypass piping to the inlet of the dechlorinator.
2. Plumb drain outlet from the dechlorinator to nearby drain.
3. Connect outlet of dechlorinator to water softener inlet.
4. Plug in the power cord to a 120V, single-phase receptacle.
5. **For systems that have a tank style carbon filter with control valve (Figures 18-1 and 19-1):** Be sure that the elastomeric Drain Line Flow Control restrictor washer is installed correctly in the drain outlet plumbing assembly prior to use. This item is required to prevent overflow and potential carry over of carbon to the drain system.

DUPLEX WATER SOFTENER

For detailed instructions see the water softener manual that shipped with your system.

Refer to Figure 18-1 and 19-1 for arrangement of piping and instrumentation.

1. Connect water supply and bypass piping to inlet to duplex water softener.
2. Connect brine tank to water softener control system using plastic hose supplied.
3. Add salt to brine tank. Anden recommends using highest purity salt available.
4. Plumb drain outlet from water softener to nearby drain.
5. Connect water softener outlet to RO station inlet.
6. Plug in power cord to a 120V, single-phase receptacle.

System piping

7. Program softener for site conditions and requirements.

MULTI-MEDIA FILTERS

For detailed instructions see the manual that shipped with your system.

Refer to for arrangement of piping and instrumentation.

1. Connect the water supply and bypass piping to the inlet of the multi-media filter.
2. Plumb drain outlet from the multi-media filter downstream equipment (softener or RO).
3. Connect outlet of multi-media filter to water softener inlet.
4. Plug in the power cord to a 120V, single-phase receptacle.
5. **For systems that have a tank style carbon filter with control valve (Figures 18-1 and 19-1):** Be sure that the elastomeric Drain Line Flow Control restrictor washer is installed correctly in the drain outlet plumbing assembly prior to use. This item is required to prevent overflow and potential carry over of carbon to the drain system.

GREENSAND FILTRATION

For detailed instructions see the manual that shipped with your system.

Refer to for arrangement of piping and instrumentation.

1. Connect the water supply and bypass piping to the inlet of the greensand filter.
2. Plumb drain outlet from the greensand filter to nearby drain.
3. Connect outlet of greensand filter to downstream equipment (dechlorinator).
4. Plug in the power cord to a 120V, single-phase receptacle.
5. **For systems that have a tank style carbon filter with control valve (Figures 18-1 and 19-1):** Be sure that the elastomeric Drain Line Flow Control restrictor washer is installed correctly in the drain outlet plumbing assembly prior to use. This item is required to prevent overflow and potential carry over of carbon to the drain system.

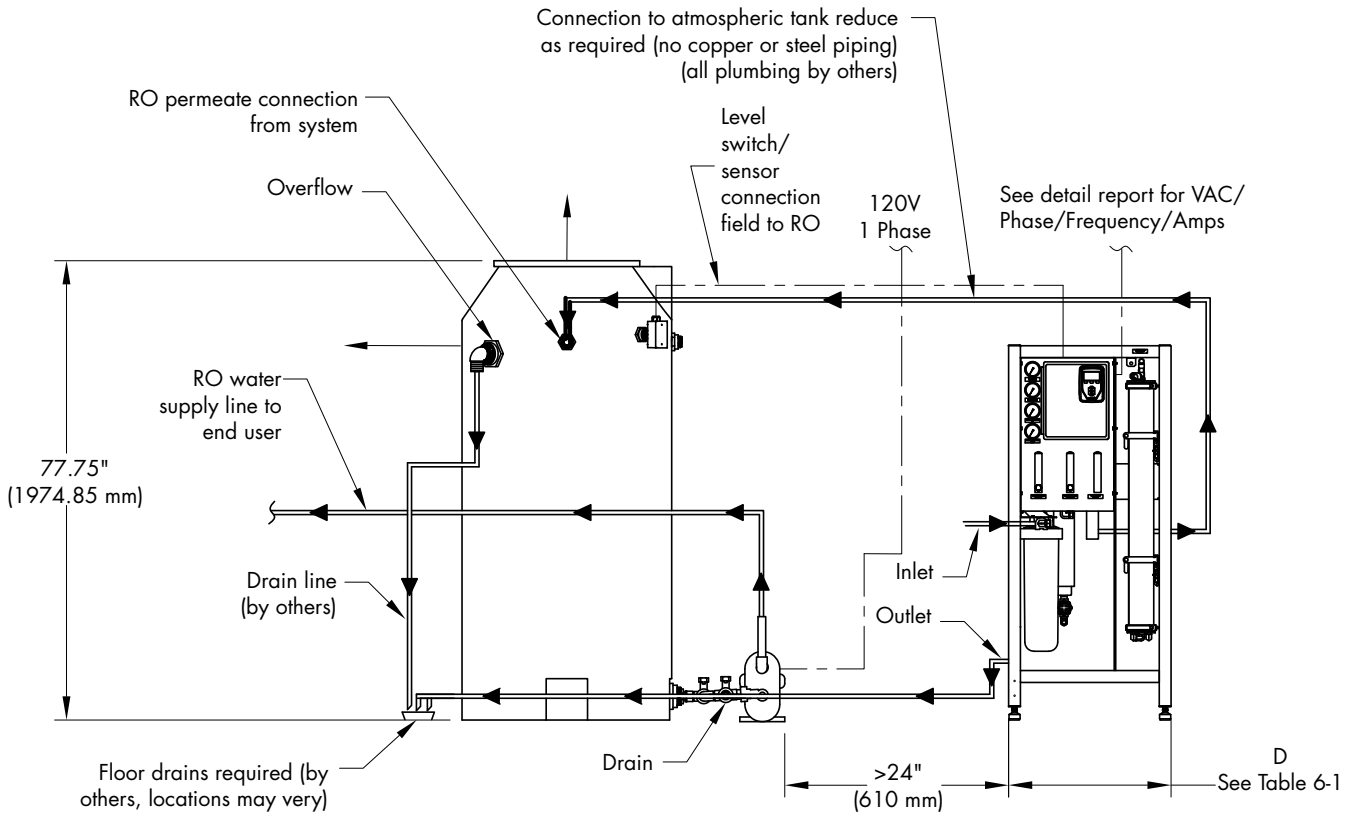
System piping

RO STATION AND ATMOSPHERIC HOLDING TANK

Refer to Figure 27-1 for arrangement of piping and instrumentation.
Minimum inlet dynamic (while running) pressure is 40 psi (275 kPa).

1. Connect source water (pretreated) to RO station inlet.
2. Plumb RO drain connection to drain.
3. Plumb RO permeate to atmospheric tank (3/4" upper tank connection). Plumb storage tank overflow and drain connection to drain.
4. Set recirc flow meter to desired level, but not above the maximum allowed setting corresponding to specific model as shown in Table 36-1.
5. Set forwarding pump to desired pressure and flow output.

FIGURE 27-1: SYSTEM PLUMBING WITH A ATMOSPHERIC TANK



System piping

PLUMBING

Plumbing materials can significantly contribute to the contamination of the water. Care must be exercised over the choice of thread sealants. PTFE tape is suitable for all threaded connections in this system. Pipe dope can leach objectionable impurities into the water and must be avoided.

FEED WATER CONNECTION

Connect the raw water supply to the inlet of the solenoid valve, observing the following:

- The line size shall be ¾ inches (19 mm) or larger to minimize pressure loss.
- A manual valve should be installed on this line to shut off the water supply if it will ever be needed. Be sure that this valve in no way restricts the water flow when it is fully open.
- Water supply minimum pressure 40 psi (276 kPa). A pressure regulator may be required if pressure is above 70 psi (483 kPa).

CONCENTRATE/REJECT CONNECTION

Connect a line to the single point drain outlet on the skid. The drain must have a minimum capacity which meets or exceeds the combined output of all system drains.

- AWS-03 - AWS-06: 10 gpm
- AWS-10 - AWS-19: 20 gpm

PERMEATE/PRODUCT WATER CONNECTION

Connect the product water line to the product connection point on the system. Run this line to your storage tank or other downstream equipment, observing the following:

- Run this line in such a manner as to minimize static head pressure in the product line.
- The product line should have no restrictions to the product flow.
- Inspect to insure that no flexible pumping lines have been kinked or damaged during installation.

See Figure 9-1 for all connection point locations.

CAUTION

This unit produces high quality water which could cause corrosion or leaching of the plumbing following the system. Use only plumbing components of inert material that are compatible with the application. Copper plumbing cannot be used.

Important:

All plumbing is to be done in accordance with state and local codes.

CAUTION

RO membranes will fail immediately if the product water is allowed to flow backward into the elements.

CAUTION

The highest point of the tubing should not be higher than four feet above the top of the RO membrane housing, or the elements may be damaged.

CAUTION

Do not fully close the manual valve located directly after the RO pump. This could cause cavitation and premature pump failure.

CAUTION

Damage to pump

Do not close the valve. Do not operate the pump below minimum combined flow rate (permeate + concentrate + recirculating).

AWS-03: 4 gpm (15.2 L/min)
AWS-06 - AWS-19:
6 gpm (22.7 L/min)

Connecting components

WIRING

- Ladder style wiring diagrams (included with unit, separate from this manual) show power, control, and equipment-to-control-cabinet interconnection requirements.

  Note: If using a field supplied floor water leak switch (terminals P15-3 and P15-4) remove factory jumper from the control board.
- External connections diagrams (included with unit, separate from this manual) show connection points to the microprocessor-based controller and wire terminals for external safety and control devices.

  Note: A motor starter switch is provided to interlock any equipment downstream, if desired. The switch is directly located on the motor starter.

All wiring must be in accordance with all governing codes and with wiring diagrams.

ELECTRICAL INSTALLATION

Wiring and branch circuit protection is provided by the installer per NEC (or IEC 60364 in Europe) requirements.

For power supply and machine ground connections, size the wire using the 75 °C wiring table, per NEC (or IEC 60364 in Europe) requirements. Then use copper conductors rated for a 105 °C environment. The wiring from the control cabinet to the equipment must be rated for 105 °C.

Verify electrical current characteristics (voltage, phase and amp draw) and capacity requirements against those listed on the name plate.

SERVICE DISCONNECT

A service disconnect must be installed per NEC requirements and governing codes.

PREVENTING ELECTRICAL NOISE

Electrical noise can produce undesirable effects on electronic control circuits, thereby affecting controllability. Electrical noise is generated by electrical equipment such as inductive loads, electric motors, solenoid coils, welding machinery, or fluorescent light circuits. The electrical noise or interference generated from these sources (and the effect on controllers) is difficult to define, but the most common symptoms are erratic control or intermittent operational problems.

Most electrical noise problems can be prevented by using proper wiring practices and techniques to prevent coupling or inducing of electrical interference into control circuits. The following wiring practices should minimize interaction of noise and controls:

- Connect unit and control cabinet to a code approved earth ground.
- Separate the line voltage wiring from low voltage control circuit wiring when routing electrical wiring inside the control cabinet.

⚠ WARNING

Electric shock hazard
Only qualified electrical personnel should perform field wiring installation procedures. Improper wiring or contact with energized circuits can cause property damage, severe personal injury, or death as a result of electric shock and/or fire.

Do not open control cabinet, pump motor, or subpanel access panels until electrical power is disconnected.

CAUTION

Damage from debris
When drilling penetrations in the control cabinet, protect all internal components from debris, and vacuum out the control cabinet when finished. Failure to comply with this directive can damage sensitive electronic components, cause erratic operation or failure, and void your Anden warranty.

Important:

Failure to follow these wiring procedures can result in erratic operation or failure.

This product has been tested at the factory for proper operation. Product failures resulting from faulty handling, incorrect wiring, or shorting of wires together on external components are not covered under your Anden warranty. Review information and diagrams before proceeding.

Connecting components

GROUNDING REQUIREMENTS

The approved earth ground must be made with solid metal-to-metal connections and must be a good conductor of radio frequency interference (RFI) to earth (multistranded conductors).

Ground wire should be the same AWG (mm^2) size as the power wiring or sized per NEC requirements (in Europe, IEC 60364 requirements).

CAUTION

On three-phase units ensure proper supply line voltage wiring. Incorrect wiring will cause the RO pump to run backwards and void your Anden warranty.

WARNING

Tipping hazard
Before installing the AWS series reverse-osmosis system, use supplied leg brackets or lag points to permanently fix the system to the floor and/or adjacent building structure. Failure to install according to instructions can result in serious injury or death. See page 17 for instructions.

Start-up checklist

If an item in the Start-up checklist below does not apply to your system, skip to the next item and continue the process.

- ☐ Setup pre-treatment according to the Pre-Treatment Installation, Operation and Maintenance Manual.
- ☐ Verify pre-treatment systems have been backwashed/flushed of contaminants.
- ☐ Read this manual and all other information that was provided with your system.
- ☐ Verify that all field wiring is done according to the instructions in this manual and in the unit wiring diagram and per local codes.
- ☐ Confirm that proper grounding and an approved earth ground are provided.
- ☐ Confirm that the keypad/display is mounted with its modular cable routed away from high-voltage circuits and connected to the Display connector on the Vapor-logic board.
- ☐ Install cartridge filter and check for leaks. (See "System Piping" on Pages 18 through 22.)
- ☐ Turn on the water supply, and confirm there are no leaks.
- ☐ Turn on power to the unit, and confirm the Main menu is displayed on the keypad/display. The display may take several seconds to appear as the controller powers up.
- ☐ Flush system of shipping/storage preservative.
- ☐ Confirm in the Main Menu that the mode is "Auto".
- ☐ Confirm that the inlet pressure is at least 40 psi (276 kPa) on the "Filter In" pressure gauge.
- ☐ With sufficient water available, the system in Auto mode, and the storage tank pressure less than 30 psi (210 kPa), verify that the pump is activated.
- ☐ Set permeate and concentrate flow meter to desired setting. See Table 36-1.
- ☐ If you experience difficulties, have the keypad/display information available along with the serial number and unit Model, and call Anden Technical Support at 800-972-3710.

  Note: Instructions on how to properly care for the freeze protect chemical that is shipped with the system is available on the MSDS sheet at www.Anden.com.

- ☐ Inspect to insure that no flexible plumbing lines have been kinked or damaged during installation.
- ☐ Test inlet water to make sure SDI, turbidity, temperature, pH, conductivity, bacteria, chlorine, and iron are all within requirements.
- ☐ All piping is completed and compatible with temperatures, pressures, and corrosion properties.
- ☐ Verify planned instrumentation and sample ports are installed.
- ☐ Confirm fittings are tight.
- ☐ Confirm permeate line is unblocked.
- ☐ Check motor rotation for correct direction.

Start-up

START-UP PROCEDURE

Check component installation per the layout shown in Figure 18-1 through Figure 22-1 (depending on your model). After all components are installed and connected properly:

1. Perform all applicable "Start-up checklist" items on Page 31.
2. Read and follow instructions in the "Operation" section of *Vapor-logic Installation and Operation Manual*.

   Note: During start-up, do not leave the system unattended.
3. Close the manual valves to both the RO holding tank and all downstream equipment. Open the manual valve leading to the drain.
4. Open the feed water supply valve.
5. Open the system pressure (pump throttle) control valve fully counterclockwise (if applicable). Open the concentrate control valve fully counterclockwise. Close the recycle valve.
6. Put the system into 'Auto' mode. Note inlet water pressure must be at least 40 psi (276 kPa).
7. If incoming pressure is too high, an inlet pressure regulator (not included) may be installed. This should be set at 40 psi (276 kPa).
8. Some fittings may have loosened during shipment. Check for leaks at all tube fittings and threaded joints.
9. Allow the unit to run to drain for at least 30 minutes to flush the preservative solution from the system.
10. Once the preservative solution has been flushed from the system, shut down the system by putting the system into 'Standby' mode on the Vapor-logic keypad and close the manual valve going to the drain. Open the manual valves to both the RO storage tank and downstream equipment.

Important

If the system is not in operation within six months of shipment, it is strongly recommended to use an organic cleaning cartridge prior to performing the start-up checklist to ensure proper operation. See page 54 for information and part number.

If the system is not operational by six months, use another preservative cartridge to preserve for an additional six months.

Start-up

11. Put the system back into 'Auto' mode.
12. Adjust the throttle valve to get the specified permeate flow within the range listed in their individual flow columns to equal the combined flow listed. See Table 36-1.
13. Adjust the concentrate and recycle valves until the specified concentrate flow and recycle flow are obtained. It may be necessary to make iterative adjustments to all three valves. See Table 36-1.
    Note: The permeate flow may exceed the minimum value listed depending on water temperature.
14. Test the operation of the pressure switch by slowly closing the inlet water supply valve. The unit should shut off after a short 5 second time delay.
15. Once all the desired flows are set, allow the system to run for approximately 30 minutes. Then record the performance information using the system operation data log on page 63. The values recorded at startup will be important for determining system performance at a later date.
16. Check pre-treatment effluent to confirm it is in expected/designed range.
17. Confirm concentrate LSI (Langelier Saturation Index) is within solubility considerations.
    NOTE: LSI should be negative with chemical antiscalant or ion exchange. Adjust recovery or plan for cleaning.
    NOTE: Recheck operating parameters after 48 hours.
18. Leave system in Auto mode. It will automatically refill the RO holding tank.

OPERATING DO'S AND DONT'S

DO

1. Change the cartridge filters regularly
2. Monitor the system and keep a log daily
3. Run the system, as much as possible, on a continuous basis.
4. Adjust the system recovery to the recommended value

DON'T

1. Permit chlorine in the feed water.
2. Shut down the system for extended periods. If system will be down for more than one week, treat the system with a membrane preservative. See page 55 for instructions.
3. Close the throttle valve completely.
4. Operate the system with insufficient feed flow.

CAUTION

Do not operate the system with the throttle valve closed.

Important:

By setting the feed pressure as low as possible to meet the application requirement, the service life of the pump and RO elements will be optimized. The system should be run continuously when possible, rather than go through frequent start/stop cycles.

CAUTION

Damage to pump
Do not close the throttle valve. Do not operate the pump below minimum combined flow rate (permeate + concentrate + recirculating).

AWS-03 4 gpm (15.2 L/min)
AWS-06 - AWS-19:
6 gpm (22.7 L/min)

CAUTION

Damage to membranes or housings if the feed flow rate is ramped up too quickly.

CAUTION

Damage to membranes if feed flush did not remove all entrapped air.

Sequence of operation

NORMAL OPERATION

1. Demand signal generated by float switch in the RO storage tank or level sensor (4-20mA).
2. RO system opens inlet water solenoid valve.
   - Allows 10 seconds for inlet pressure switch to close or inlet pressure to be greater than 10 psi.
3. RO flushes for 30 seconds, sends water to drain.
4. RO turns on pump.
5. RO begins to fill permeate storage tank.
   - If permeate divert is enabled, the system will drain water for up to 10 minutes or until the divert setpoint is reached.
6. RO recognizes tank is full through, or level switch, or level sensor, and turns off pump, goes to idle mode.
7. RO flushes for default two seconds, sends water to drain (user can change)
   - Older systems had a smaller valve and the default flush time was 300 seconds.

Sequence of operation

ADDITIONAL PROCESS RELATED FUNCTIONS

1. RO monitors inlet pressure to protect pump, permeate TDS to alarm (signifies need to clean/replace membranes), water temperature.
    - Inlet pressure has to be above 10 psig to operate.
        - Allows 10 seconds for inlet pressure switch to close or inlet pressure to be 10 psig.
    - Permeate TDS has two alarm points that are 50 ppm default (user adjustable) and a 75 ppm hardcoded alarm.
        - There is a message and an alarm. Both are "Excessive TDS". There is a secondary setting that tells the unit to stop (alarm) if the 75 ppm value is exceeded or disables the alarm (message only).
2. RO has inactivity flush sequence that is user defined but defaulted for every 72 hours of inactivity (helps prevent biological growth by keeping water moving).
    - Drains the RO system and goes through a normal run cycle.
    - Drains for a default of 60 seconds (user defined).
3. If permeate divert is activated:
    - Setpoint is determined by the end user (50 ppm default).
    - System is running with pump.
    - The RO will send water to drain until setpoint is met.
        - Motorized ball valve opens to drain and water flow is directed through the drain manifold
        - Motorized ball valve to tank/end user closes so water cannot flow downstream. Closes during the initial 30 second flush and during permeate divert if enabled.
    - Once setpoint has been reached the permeate drain valve will shut and the end user valve will open

NOTE: Additional interlocks for floor switch, Pretreat, master enable, and motor starter. They all prevent the unit from filling if alarmed.

System operation

Table 36-1:
Recommended concentrate and permeate flow

RO station model	Permeate flow (minimum)		Combined concentrate and recirc	Concentrate flow		Recirc (recycle)*	
	gpm	L/m	gal/liter	gpm	L/m	gpm	L/m
AWS-03	1.7	6.4	3.4/12.9	1.6 - 2.6	6.1 - 9.8	0.8 - 1.8	3.0 - 6.8
AWS-06	3.6	13.6	4.0/15.1	1.5 - 3.0	5.7 - 11.4	1.0 - 2.5	3.8 - 9.5
AWS-10	5.5	20.8	5.5/20.8	2.0 - 4.0	7.6 - 15.1	1.5 - 3.5	5.7 - 13.2
AWS-13	7.2	27.3	6.5/24.6	2.5 - 4.5	13.2 - 17.2	2.0 - 3.0	7.6 - 11.4
AWS-19	11.0	41.6	6.5/24.6	3.5 - 4.5	13.2 - 17.2	2.0 - 3.0	7.6 - 11.4

*Higher recirculation increases water efficiency.
NOTE: Values for permeate al 50°F inlet condition. Warmer water will have more permeate flow.

SHUTDOWN

1. Put the system in 'Standby' mode or remove power. Close the isolation valve if it is installed on the feed line.
2. Confirm system is non operational via verification step.
3. If the unit is to be shut down for more than one week, a membrane preservative should be used. To accomplish this, perform 30 second flush using cartridge filter insert (see page 32 and 54 for more information). After 30 seconds, press the power button OFF, and close the concentrate valve. This will hold the preservative in the pressure vessel.
4. When the system is restarted after an extended shutdown, follow initial system start-up procedures.
5. Membranes need to be kept wet after initial wetting. Appropriate solution should be used to preserve integrity of elements (1-1.5% SMBS).
6. Protect system from extreme temperatures.
7. Check pH once a week and if goes below three then change preservation solution.

FIGURE 36-1: CONTROL VALVES

CAUTION

To prevent concentrate from precipitating and causing irreversible fouling of the RO membrane, do not operate the system with the concentrate to drain valve completely closed.

Permeate tank pressure loss: 0.5" Polyethylene

Table 37-1:
Permeate tank pressure loss (psig) (0.5" Polyethylene)

Developed length of tubing (ft)	Maximum water use (gpm)					
	0.10	0.20	0.30	0.40	0.50	0.60
20	0	0	0	1	1	2
40	0	0	1	2	2	3
60	0	1	1	2	4	5
80	0	1	2	3	5	7
100	0	1	2	4	6	8
125	0	1	3	5	7	10
150	0	2	3	6	9	13
200	1	2	5	8	12	17

NOTE:
- Shaded cells indicates pressure loss is too great (<25 psig at end user, based on pressurized or AT RO tank options).
- Outlet condition of pressurized storage tank or permeate forwarding pump assumed to be 30 psig.
- Developed length doesn't include vertical (static pressure drop).
- Vertical contribution to pressure loss is 1 psi per 2.31' of vertical pipe.

Permeate tank pressure loss: 0.5" Stainless Steel Tube

Table 38-1:
Permeate tank pressure loss (psig) (0.5" Stainless Steel Tube)

Developed length of tubing (ft)	Maximum water use (gpm)			
	0.5	**1**	**2**	**3**
20	0	1	3	6
40	0	1	5	11
60	1	2	8	17
80	1	3	11	23
100	1	4	13	28
125	1	5	17	35
150	2	6	20	43
200	2	7	27	57
250	3	9	33	71

NOTE:
- Shaded cells indicates pressure loss is too great (<25 psig at end user, based on pressurized or AT RO tank options).
- Outlet condition of pressurized storage tank or permeate forwarding pump assumed to be 30 psig.
- Developed length doesn't include vertical (static pressure drop).
- Vertical contribution to pressure loss is 1 psi per 2.31' of vertical pipe.

Permeate tank pressure loss: 0.5" Polyvinyl Chloride (PVC) Pipe

Table 39-1:
Permeate tank pressure loss (psig) (0.5" Polyvinyl chloride pipe)

Developed length of tubing (ft)	Maximum water use (gpm)			
	0.5	**1**	**2**	**3**
20	0	0	1	2
40	0	0	2	4
60	0	1	3	6
80	0	1	4	8
100	0	1	4	9
125	0	2	6	12
150	1	2	7	14
200	1	2	9	19
250	1	3	11	24

NOTE:
- Shaded cells indicates pressure loss is too great (<25 psig at end user, based on pressurized or AT RO tank options).
- Outlet condition of pressurized storage tank or permeate forwarding pump assumed to be 30 psig.
- Developed length doesn't include vertical (static pressure drop).
- Vertical contribution to pressure loss is 1 psi per 2.31' of vertical pipe.

Permeate tank pressure loss: 0.75 Stainless Steel Tube

Table 40-1:
Permeate tank pressure loss (psig) (0.75" Stainless Steel Tube)

Developed length of tubing (ft)	Maximum water use (gpm)											
	0.5	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
20	0	0	0	1	1	2	3	4	5	6	7	9
40	0	0	1	2	3	4	6	7	9	12	14	17
60	0	0	1	2	4	6	8	11	14	18	21	26
80	0	0	1	3	5	8	11	15	19	24	29	34
100	0	1	2	4	7	10	14	18	24	29	36	43
125	0	1	2	5	8	12	17	23	30	37	45	53
150	0	1	3	6	10	15	21	28	35	44	54	64
200	0	1	4	8	13	20	28	37	47	59	71	85
250	0	1	5	10	16	25	35	46	59	73	89	107

NOTE:
- Shaded cells indicates pressure loss is too great (<25 psig at end user, based on pressurized or AT RO tank options).
- Outlet condition of pressurized storage tank or permeate forwarding pump assumed to be 30 psig.
- Developed length doesn't include vertical (static pressure drop).
- Vertical contribution to pressure loss is 1 psi per 2.31' of vertical pipe.

Permeate tank pressure loss: 0.75" Polyvinyl Chloride (PVC) Pipe

Table 41-1:
Permeate tank pressure loss (psig) (0.75" Polyvinyl chloride pipe)

Developed length of tubing (ft)	Maximum water use (gpm)											
	0.5	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
20	0	0	0	0	0	1	1	1	2	2	2	3*
40	0	0	0	1	1	1	2	3	3	4	5	6
60	0	0	0	1	1	2	3	4	5	6	7	9
80	0	0	0	1	2	3	4	5	6	8	10	12
100	0	0	1	1	2	3	5	6	8	10	12	14
125	0	0	1	2	3	4	6	8	10	12	15	18
150	0	0	1	2	3	5	7	9	12	15	18	22
200	0	0	1	3	4	7	9	13	16	20	24	29
250	0	0	2	3	6	8	12	16	20	25	30	36

NOTES:
- Shaded cells indicates pressure loss is too great (<25 psig at end user, based on pressurized or AT RO tank options).
- Outlet condition of pressurized storage tank or permeate forwarding pump assumed to be 30 psig.
- Developed length doesn't include vertical (static pressure drop).
- Vertical contribution to pressure loss is 1 psi per 2.31' of vertical pipe.

* Cells signify pipe velocities over 7 ft/sec and are not recommended.

Permeate tank pressure loss: 1.0" Stainless Steel Tube

Table 42-1:
Permeate tank pressure loss (psig) (1.0 Stainless Steel Tube)

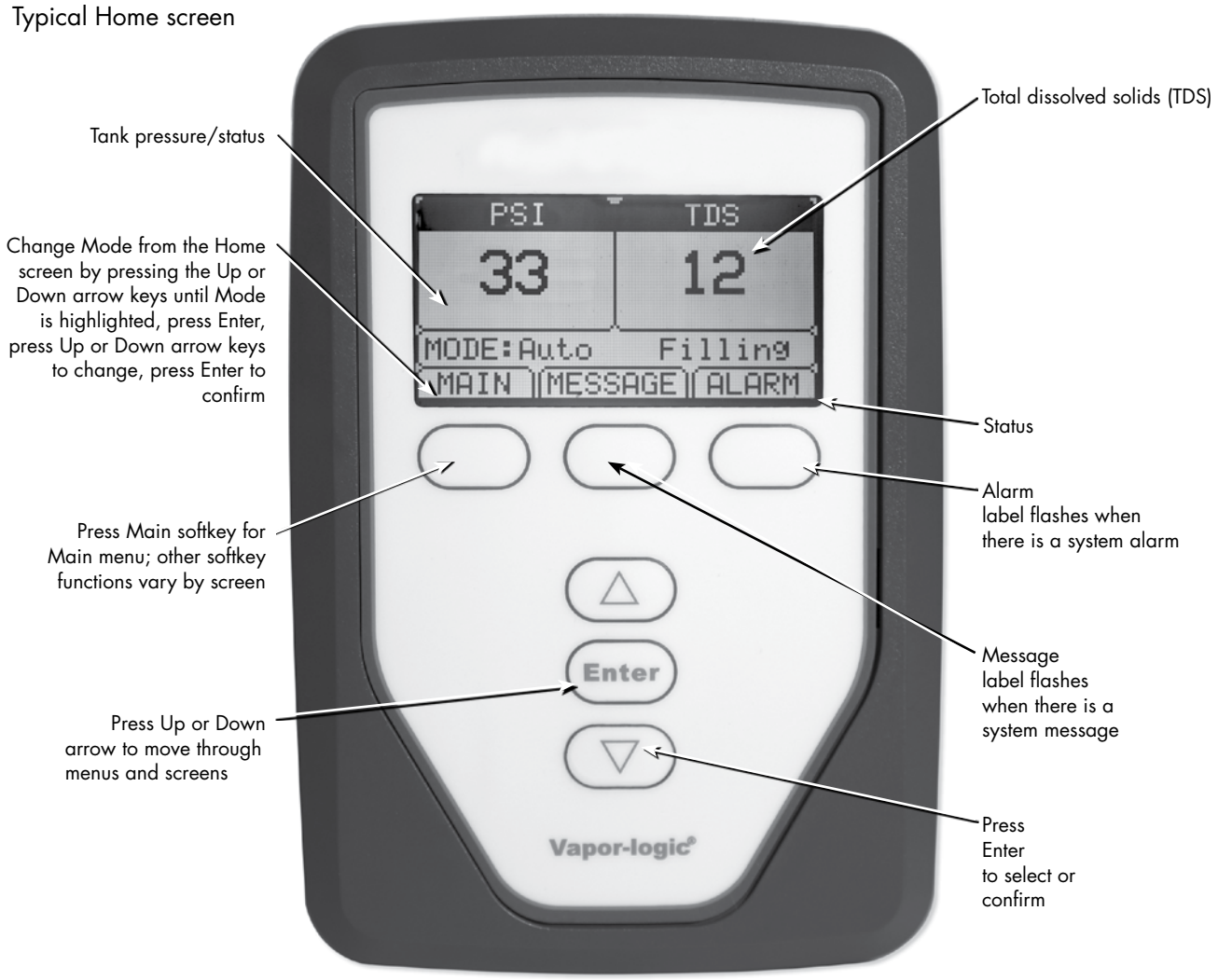
Developed length of tubing (ft)	Maximum water use (gpm)										
	5	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**14**	**16**	**18**
20	0	1	1	1	1	2	2	2	3	4*	5*
40	1	1	2	2	3	4	4	5	7	8	10
60	1	2	3	3	4	5	6	7	10	13	16
80	2	3	4	5	6	7	8	10	13	17	21
100	2	3	5	6	7	9	10	12	16	21	26
125	3	4	6	7	9	11	13	15	20	26	33
150	4	5	7	9	11	13	16	18	25	31	39
200	5	7	9	12	14	18	21	25	33	42	52
250	6	9	11	15	18	22	26	31	41	52	65
300	7	10	14	17	22	26	31	37	49	63	78
400	10	14	18	23	29	35	42	49	66	84	104

NOTES:
- Shaded cells indicates pressure loss is too great (<25 psig at end user, based on pressurized or AT RO tank options).
- Outlet condition of pressurized storage tank or permeate forwarding pump assumed to be 30 psig.
- Developed length doesn't include vertical (static pressure drop).
- Vertical contribution to pressure loss is 1 psi per 2.31' of vertical pipe.

* Cells signify pipe velocities over 7 ft/sec and are not recommended.

Vapor-logic keypad/display

FIGURE 43-1: USING THE VAPOR-LOGIC KEYPAD/DISPLAY



Keypad/display Home screens,Test outputs, Test run

Vapor-logic returns to the Home screen on the keypad/display after a user-defined period of idleness. The Home screen displays the items most frequently viewed.

FIGURE 44-1: RO STATION KEYPAD/ DISPLAY HOME SCREEN

CHANGING MODE

Mode can be changed from the Home screen. Press the Up or Down arrow key until the Mode is highlighted, press Enter, press Up or Down arrow key to change value, press Enter to confirm. All other parameters shown on the Home screen are for viewing only and cannot be changed. Go to the Setup menu to change these items.

CONTROLLER DISPLAY ACTIVITY DEFINITIONS (FIGURE 44-1)

RO flush: System is performing an RO flush.

Idle: No demand, or an active alarm is preventing operation.

Filling: System is supplying high-pressure water to meet demand.

Full: Storage tank is full, system not running.

Divert: System is sending permeate water to drain until water quality is acceptable (user defined).

TEST OUTPUTS

When completing an installation or repair, cycle all outputs, to verify operation. Go to the test outputs section of the Diagnostics menu and scroll through each connected output to verify operation. During testing, the unit mode changes to Standby and the tank status changes to Test.

Status screen

Table 45-1: Status screen

Note: Your system might not have all of the items listed in this table.

Menu item	Default value	Minimum value	Maximum value	Units	Notes
Run mode	Standby	–	–	–	Operating mode of unit. Choose from Auto, Standby, or Drain. • In **Auto mode**, the unit operates normally. All unit components are monitored and controlled. If there is a call for RO permeate, the system reacts. • In **Standby mode**, the unit is offline. All control inputs appear but are not acted upon; however, if the water temperature falls below the freeze protect set point, the drain valve opens. • In **Drain mode**, the RO permeate drain valve opens, the RO tank drains, and the RO system begins making RO water. All unit operation is suspended, and the RO Flush valve remains open until the model specific RO flush time is met the unit is taken out of RO flush mode, or the RO tank is drained. • See page 44 for information about **Test output** mode.
TDS	–	0	9999	ppm	
TDS set point	50	0	100	ppm	
Water temperature	–	-50	250	°F	Sensor range
	–	-46	121	°C	Sensor range
Safety interlock	Closed	Open	Closed	–	
Inlet pressure switch	–	No water	Water		
Storage pressure	–	0	100	psi	Storage tank pressure.
Pump hours	–	0	100,000	Hours	

Table 45-2: Setup screen

Note: Your system might not have all of the items listed in this table.

Menu item	Default value	Minimum value	Maximum value	Units	Notes
Membrane flush	0	0	300	seconds	Sub menu = Flush duration
System flush duration	60	15	600	seconds	Sub menu = Flush duration
System flush frequency	72	1	336	hours	Sub menu = Idle time for flush
Permeate divert	-	Enabled	Disabled	-	Sub menu = Permeate divert
Permeate TDS set point	50	10	50	ppm	Sub menu = TDS set point

Table 45-3: TDS setting

Note: Your system might not have all of the items listed in this table.

Menu item	Default value	Minimum value	Maximum value	Units	Notes
High TDS causes	Alarm	Message	Alarm	–	
TDS mess. setpoint	50	25	125	–	

Diagnostics and Alarms

Table 46-1: Diagnostics menu

Note: Your system might not have all of the items listed in this table.

Message	Description	Auto-clear?
Pretreat lockout	Softener or other pretreatment is preventing the RO station from operation.	Yes
No master enable	Master enable for the system is open.	Yes
Excessive TDS	TDS measurement during RO production exceeds the TDS set point. The system will continue to operate but the membranes may need to be replaced.	Yes
Service unit	Regularly scheduled unit servicing is due.	No
I-lock open	Interlock safety switch is open.	Yes

Notes:
- The Messages Log displays message name, date and time of occurrence, plus “Active,” “Cleared” or “Auto-cleared.”
- Active messages display first in the Messages Log, followed by cleared messages (auto-cleared and/or manually-cleared) listed in order of occurrence.
- The Messages Log displays a maximum of 10 messages. Cleared messages leave the log first.
- If a message event occurs and is not manually or auto cleared during unit operation, the message will stay there until there is demand and the unit is running.

Table 46-2: Alarm menu

Alarm level	Description	Auto-clear?
Temp sensor fault	Water temperature/TDS sensor reading is out of range.	Yes
Low inlet pressure*	Water pressure at RO inlet is less than 10 psi.	Yes
High storage pressure	Tank storage pressure has exceeded 60 psi.	Yes
Floor sensor active	Optional flooded floor pan circuit is active.	No
Storage pressure sensor	Pressure sensor reading is out of range.	Yes
Excessive TDS	TDS measurement during RO production exceeds the TDS set point. The system will continue to operate but the membranes may need to be replaced.	No

Notes:
- The Alarms Log displays alarm name, date, and time of occurrence, plus "Active," "Cleared," or "Auto-cleared."
- Active alarms display first in the Alarms Log, followed by cleared alarms (auto-cleared and/or manually-cleared) listed in order of occurrence.
- The Alarms Log displays maximum 30 alarms. Cleared alarms leave the log first.
- If an alarm event occurs and is not manually cleared or auto-cleared during unit operation, the alarm will remain until there is demand and the unit is running.

* Pressure alarm will occur if inlet pressure falls below 5 psi. Alarm will self-clear when RO system supply pressure is above 10 psi for at least 10 consecutive seconds. A pressure fault can be manually cleared at any time. System will try to operate every 10 consecutive seconds per hour up to 72 hours while in low pressure alarm condition.

BACnet interoperability

Table 47-1:
Interoperability vaiable and object names

Variable name and BACnet object name	Read Only (RO) or Read Write (RW)	BACnet Object Type and Instance	Description	Units		Range	
				I-P units	SI units	I-P units	SI units
Read-only analog variables							
Storage_pressure	RO	AI-1	Storage pressure	psi	bar	0	100
Pump_1_hour	RO	AI-2	Hours of operation	hours	hours	0	100000
Water_temp	RO	AI-3	Temperature of RO water	F	C	-50 to 250	-46 to 121
TDS	RO	AI-4	TDS	—	—	0	9999
Set Variables							
Run_mode	Write	MSV-01	Mode of the unit or system. The defined options are: 1=Auto; 2=Local standby; 3=System standby; 4=Manual drain; 5=Test outputs; 6=Test run	—	—	1 to 4	1 to 4
	Read	MSV-01	Mode of the unit or system. The defined options are: 1=Auto; 2=Local standby; 3=System standby; 4=Manual drain; 5=Test outputs; 6=Test run			1 to 6	1 to 6
TDS_setpoint	RW	AV-1	TDS set point	—	—	0	75
Read-only digital I/O							
Safety_interlock	RO	BI-01	0=Open; 1=Closed	—	—	—	—
Pretreat_lockout_sw	RO	BI-02	0=Open; 1=Closed	—	—	—	—
Floor_water_sw	RO	BI-03	0=Water; 1=No Water	—	—	—	—
Inlet_pressure_sw	RO	BI-04	0=No Water; 1=Water	—	—	—	—
Master_enable_sw	RO	BI-05	0=Open; 1=Closed	—	—	—	—
Supply_valve	RO	BO-01	0=Open; 1=Closed	—	—	—	—
Drain_valve	RO	BO-02	0=Open; 1=Closed	—	—	—	—
RO_pump	RO	BO-03	0=Off; 1=On	—	—	—	—

BACnet interoperability

Table 48-1:
Interoperability vaiable and object names

Variable name and BACnet object name	Read Only (RO) or Read Write (RW)	BACnet Object Type and Instance	Description	Units		Range	
				I-P units	SI units	I-P units	SI units
Faults and Alarms							
ProgOutput1_status	RW	BV-01	NO or NC output	—	—	—	—
ProgOutput2_status	RW	BV-02	No or NC output	—	—	—	—
Active_manually_cleared_alarm_exists	RW	BV-03	Flags all manually cleared alarms	—	—	—	—
Clear_all_faults	RW	BV-04	When set will clear all active faults	—	—	—	—
Alarm_temp_sensor_failed	RW	BV-05	See Table 46-1: Alarm menu	—	—	—	—
Alarm_low_inlet_pressure	RW	BV-06	See Table 46-1: Alarm menu	—	—	—	—
Alarm_excessive_storage_pressure	RW	BV-07	See Table 46-1: Alarm menu	—	—	—	—
Alarm_floor_water_sensor_activated	RW	BV-08	See Table 46-1: Alarm menu	—	—	—	—
Alarm_pressure_sensor_out_of_range	RW	BV-09	See Table 46-1: Alarm menu	—	—	—	—
Alarm_excessive_TDS_during_fill	RW	BV-10	See Table 46-1: Alarm menu	—	—	—	—
Message_pretreat_lockout_active	RW	BV-11	See Table 46-2: Diagnostics menu	—	—	—	—
Message_excessive_TDS_during_fill	RW	BV-12	See Table 46-2: Diagnostics menu—	—	—	—	—
Message_service_unit	RW	BV-13	See Table 46-2: Diagnostics menu—	—	—	—	—
Message_interlock_open	RW	BV-14	See Table 46-2: Diagnostics menu—	—	—	—	—
Message_master_enable_open	RW	BV-15	— See Table 46-2: Diagnostics menu	—	—	—	—

Maintenance information

MAINTENANCE TIPS

Maintain proper operating conditions:

- Do not exceed 60-90 psi (414-620 kPa)on the system inlet pressure gauge.
- Do not over use recycle flow. This can cause premature scaling of the membrane. A proper concentrate flow is required for a long membrane life. See page 36 for maximum recycle flow.
- Review solubility calculations for optimal settings.
- To ensure no chlorine reaches the RO membranes, test the water from your RO inlet piping periodically for chlorine break through.

WHEN TO CHANGE SEDIMENT FILTERS

Sediment filters should be changed regularly to maintain proper pressure and flow.

Change the filters when the difference between filter pressure gauge increases by 10 psi over the initial pressure difference. For example, if initial readings are 60 psi in and 58 psi out, the difference is 2 psi. Therefore, when that difference reaches 12 psi, it is time to replace the sediment and carbon cartridges.

WHEN TO CLEAN MEMBRANES

In normal operation, the membrane in reverse osmosis elements can become fouled by mineral scale, biological matter, and grime. These deposits build up during operation until it causes loss in water output or loss of salt rejection, or both. Elements should be cleaned or replaced whenever the water output rate drops by 10 percent from its initial flow rate (the flow rate established during the first 24 to 48 hours of operation) or when TDS in the product water (permeate) rises above 50. Use the factory mounted TDS sensor located on the right side of the system.

It should be noted that the water output rate will drop if feed water temperature decreases (about 1.5% per °F). This is normal and does not indicate membrane fouling. A malfunction in the pretreatment, pressure control or pump can cause a drop in feed water delivery pressure, feed water flow, product water output, or an increase in salt passage. If such adjustments are needed, the element may not require cleaning.

MEMBRANE CLEANING AND PRESERVATIVE CARTRIDGES

- Clean and preserve membranes without removing them from your system
- Reduce downtime
- Maintain your system performance at a higher level
- Prolong membrane life by regular use of cleaning cartridge

FIGURE 49-1: SEDIMENT FILTER

Anden replacement
part number: 71000215

Maintenance information

WHEN TO CLEAN SYSTEM

Normalized permeate flow is a calculation based on initial performance compared to current performance. The guideline is to clean if the normalized permeate flow drops by 10% or if the normalized salt passage increases by 5-10% or the normalized pressure drop increases 5-10%. These indicators show that the system has fouled but can still restore performance. If these items are significantly higher than values listed above the system might not be able to be restore and new membranes will be needed. Normalized data is used because there are many variables that can give misleading results. Temperature is the most likely one to fluctuate.

The following raw data is needed for the calculations:

- Feed Temp (°F)
- Permeate flow (gpm)
- Concentrate flow to drain (gpm)
- Feed pressure (psi)
- Concentrate pressure (psi)
- Permeate pressure (psi)
- Inlet conductivity (µS)
- Permeate conductivity (µS

FIGURE 50-1: NORMALIZED PERMEATE FLOW CALCULATION

$$\textbf{NPF} = \text{Permeate Flow} \times \left(\frac{\text{Baseline aNDP}}{\text{aNPD}}\right) \times \left(\frac{\text{Baseline TCF}}{\text{TCF}}\right)$$

where

$$\textbf{Feed TDS} = \frac{\text{Feed Conductivity}}{2}$$

$$\textbf{Concentrate Factor} = \frac{\text{Permeate Flow} + \text{Concentrate Flow}}{\text{Concentrate Flow}}$$

Concentrate TDS = Feed TDS x Concentrate Factor

$$\textbf{aNDP (average net driving pressure)} = \left(\left(\frac{\text{Feed Pressure} + \text{Concentrate Pressure}}{2}\right) - \left(\frac{\text{Feed TDS} + \text{Concentrate TDS}}{200}\right)\right) - \text{Permeate Pressure}$$

$$\textbf{Feed Temp C} = \left(\frac{5}{9}\right) \times (\text{Feed Temp} - 32)$$

$$\textbf{TCF} \text{ (Temperature Correction Factor)} = \text{EXP}\left(2640 \times \left(\left(\frac{1}{298}\right) - \left(\frac{1}{273 + \text{Field Temp C}}\right)\right)\right)$$

Maintenance information

FIGURE 51-1: NORMALIZED SALT REJECTION CALCULATION

$$\textbf{NSR} = 100 - \left(\left(\text{Salt Passage} \times \left(\frac{\text{Permeate Flow}}{\text{Baseline Permeate Flow}} \right) \times \text{TCF} \right) \times 100 \right)$$

where

Permeate TDS = Permeate Conductivity x 0.67

$$\textbf{Feed TDS} = \frac{\text{Feed Conductivity}}{2}$$

$$\textbf{Salt Rejection} = 1 - \left(\frac{\text{Permeate TDS}}{\text{Feed TDS}} \right)$$

Salt Passage = 1 - Salt Rejection

$$\textbf{Feed Temp C} = \left(\frac{5}{9} \right) \times (\text{Feed Temp} - 32)$$

$$\textbf{TCF} \text{ (Temperature Correction Factor)} = \text{EXP} \left(2640 \times \left(\left(\frac{1}{298} \right) - \left(\frac{1}{273 + \text{Field Temp C}} \right) \right) \right)$$

FIGURE 51-2: NORMALIZED PRESSURE DIFFERENTIAL CALCULATION

$$\textbf{NPD} = \text{Pressure Drop} \times \frac{\text{Baseline Average Flow}}{\text{Average Flow}}$$

where

Pressure Drop = Feed Pressure - Concentrate Pressure

$$\textbf{Average Flow} = \frac{\text{Permeate Flow} + \text{Concentrate Flow}}{2}$$

Maintenance continued

SEDIMENT PRE-FILTER CARTRIDGE

WHEN TO CHANGE SEDIMENT PREFILTER CARTRIDGE

Sediment filters should be changed regularly to maintain proper pump pressure and flow. If the pressure drop across the cartridge filter (as indicated by the differential between the filter inlet and filter outlet pressure gauges) increases by 10 psi, the sediment filters should be changed.

CHANGING CARTRIDGE FILTERS

1. Put the system into 'Standby' mode and shut down the RO system.
2. Close inlet supply valve.
3. Un-assemble the filter housing (twist the sump counter-clockwise).
4. Remove and inspect the cartridge. Replace as needed.
5. Before replacing housing, insure that O ring seal is lubed and placed in groove of housing. Inspect seal and replace as needed.
6. Assemble housing (turn the sump clockwise into the cap until tight).

FIGURE 52-1: DAMAGED FILTER

Maintenance continued

MEMBRANE CLEANING IN THE RO SYSTEM

Membrane cleaning cartridges:

- Clean membranes without having to remove them from the RO system
- Reduce downtime
- Maintain the system performance at a higher level
- Prolong membrane life by regular use of cleaning cartridges

HOW DOES IT WORK?

NOTE: Clean monthly to obtain optimum results.

1. Exchange the system's sediment filter with a cleaning cartridge.
2. Follow the instructions.
3. Restart the system.
4. Repeat the process if required.

SCALE CLEANING CARTRIDGE

The scale cleaning cartridge is for removal of mineral scale and build-up.

CLEANING PROCEDURE

1. Put the system into 'Standby' mode and shutdown the RO system.
2. Disconnect permeate line and divert to drain before any cleaning cartridge is installed.
3. Remove the sediment filter from the pre-filter housing.
4. Replace the sediment filter with the cleaning cartridge and assemble into the filter housing.
5. Turn the system ON and put into 'Auto' mode. After 30-40 seconds, shut down the system.

   OPTIONAL: Instead of time, use one of the following criteria:
   - Run the system until the pH of the concentrate is almost the same as the cleaning solution (pH=3)
   - Permeate rate for the system drops to a very low value.
6. Let the membrane(s) soak in the cleaning solution overnight.
7. Remove the empty cleaning cartridge and replace it with the original filter.
8. Restart the system. Direct the permeate to drain for five minutes.
9. Go back to normal operations.

Note: Depending on the amount of foulant, multiple cartridges will be needed to handle foulant load.

FIGURE 53-1: 20 INCH BIG BLUE SCALE CLEANING CARTRIDGE

Anden replacement part number 71000202

CAUTION

Handle all chemicals with care. Wear protective clothing and eye protection.

CAUTION

The system must be flushed thoroughly between acid and alkaline cleaning.

Maintenance continued

ORGANIC CLEANING CARTRIDGE

The organic cleaning cartridge is for removal of organics/fouling.

CLEANING PROCEDURE

1. Put the system into 'Standby' mode and shutdown the RO system.
2. Disconnect permeate line and divert permeate to drain during cleaning.
3. Remove the sediment filter from the filter housing.
4. Replace the sediment filter with the cleaning cartridge and assemble into the filter housing.
5. Turn the system ON. After 30-40 seconds, shut down the RO system.
   OPTIONAL: Instead of time, use one of the following criteria:
   - Run the system until the pH of the concentrate is almost the same as the cleaning solution (pH=10-12)
   - Permeate rate for the system drops to a very low value.
6. Let the membrane(s) soak in the cleaning solution overnight.
7. Remove the empty cleaning cartridge and replace it with the original filter.
8. Restart the system. Direct the permeate to drain for five minutes.
9. Go back to normal operations.

UV LAMP REPLACEMENT

Check annually and replace the UV lamp if intensity decreases.

REPLACEMENT PROCEDURE

1. Turn off power and isolate.
2. Remove the quartz sleeve and UV lamp.
3. Replace the quartz sleeve and new UV lamp into the unit.
4. Return power to the system.

Note: Depending on the amount of foulant, multiple cartridges will be needed to handle foulant load.

FIGURE 54-1: 20 INCH BIG BLUE ORGANIC CLEANING CARTRIDGE

Anden replacement part number: 71000201

CAUTION

Handle all chemicals with care. Wear protective clothing and eye protection.

CAUTION

The system must be flushed thoroughly between acid and alkaline cleanings.

Storage

To prevent bacterial growth and help maintain flux, it is recommended that elements be immersed in a preservative solution if the system will be OFF for more than one week.

MEMBRANE PRESERVATIVE CARTRIDGE

PRESERVING PROCEDURE

1. Put the system into 'Standby' mode and shutdown the RO system.
2. Disconnect the permeate line and direct permeate to drain during cleaning/preserving.
3. Remove the sediment filter from the pre-filter housing.
4. Replace the sediment filter with the preservative cartridge and assemble into the filter housing.
5. Turn the system ON. After 30-40 seconds, shut down the system.
6. Drain the system of the permeate solution as much as possible by opening a valve/fitting at a low point in the system.
7. Put the system into 'Standby' mode and shutdown the RO system.
8. Close OFF the inlet and outlet to the system.

FLUSHING OUT PRESERVATIVE/RESTART PROCEDURE

9. Open valves and put the system back in the position it was before preserving.
10. Remove the empty preservative cartridge and replace it with a new sediment filter.
11. Restart the system. Direct permeate to drain for 15-30 minutes.
12. Go back to normal operation.

FIGURE 55-1: 20 INCH BIG BLUE PRESERVATIVE CARTRIDGE

Anden replacement part number: 71000206

CAUTION

Handle all chemicals with care. Wear protective clothing and eye protection.

CAUTION

The system must be flushed thoroughly between acid and alkaline cleanings.

Membrane removal

TOOLS

- Rubber mallet
- Flathead screwdriver
- Open end wrench, ⅞ inch
- Food grade silicone (Dow Corning® III or Molykote® III recommended)
- Safety glasses
- Anti-sieze
- Rubber gloves
- Clean rags
- Safety shoes

MEMBRANE REMOVAL

1. Turn off unit, follow shutdown procedure. Isolate the system from hazards (water pressure, electricity, etc.)
2. Remove all dust, debris, foreign matter from membrane vessel before opening.
3. Slide out rack and either leave on unit or remove rack to bench top.
4. Remove clamps from vessel using 9/16" socket or wrench. Use two screw drivers on each side to push end caps out of vessel slowly.
5. Remove end cap hardware.
6. Push the membrane out through the vessel from the feed end towards the concentrate end.
   NOTE: Take note of the brine seal location. The membrane only has one flow direction as it relates to brine seal.
7. brine seal. The new membrane should be in the same orientation to give desired results.
8. Lubricate the o-rings on the end caps and the brine seal.
9. If needed, replace damaged brine seals or o-rings.
10. If there is not enough room to remove the membrane from the vessel through the concentrate end it can be removed from the feed end.

FIGURE 56-1: ANDEN REVERSE OSMOSIS MEMBRANES

Anden replacement part number:
Membrane: 71000207
End caps: 71000230
4" O-ring: 71000214
1" O-ring: 41000213

⚠ CAUTION

Team lift required
Membrane banks are heavy. Do not try to lift without assistance. Wear steel-toed shoes and have adequate room for maneuvering when servicing. Never lean membrane banks vertically when removed from system. Failure to do so may damage the system or result in injury.

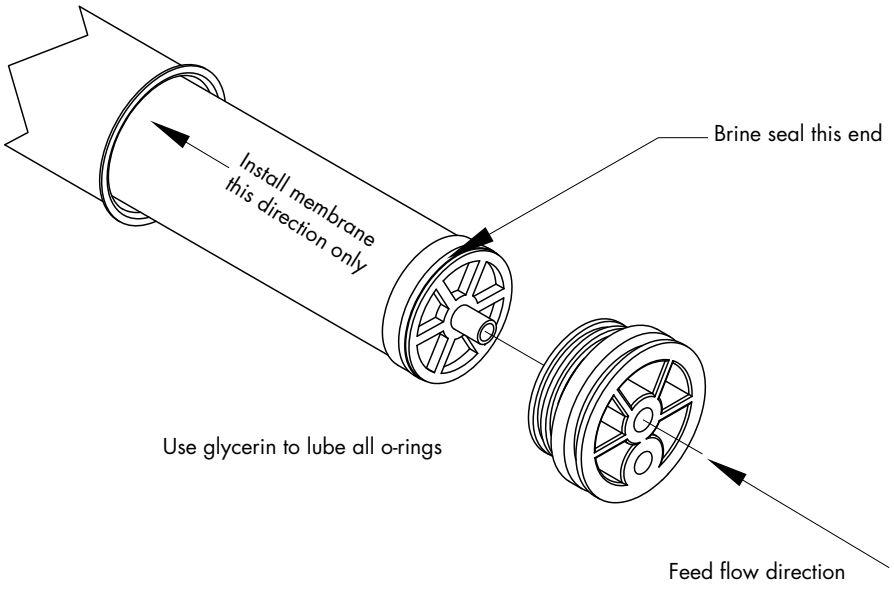
Membrane replacement

MEMBRANE REPLACEMENT

1. Install the new membrane from the feed end. Ensure that the brine seal is oriented towards the feed end. Check that the end adapters and all O-rings are in good condition and in position.
2. Replace end caps(s) using glycerin lubricant as required on O-rings.
3. It is highly recommended to have a spare set of O-rings and brine seal while replacing the membranes.
4. As the membranes may have preservative or be contaminated, wash your hands thoroughly after replacing membranes.

   Note: Keep all plumbing routed the same as shipped from Anden. Any different orientation will destroy the RO membranes.
5. Replace clamps for each vessel using the 9/16" socket and hardware. Apply anti-sieze to help prevent gulling for stainless steel hardware.
6. Flush system for <30 minutes after replacement. See page 32 for start-up procedure.

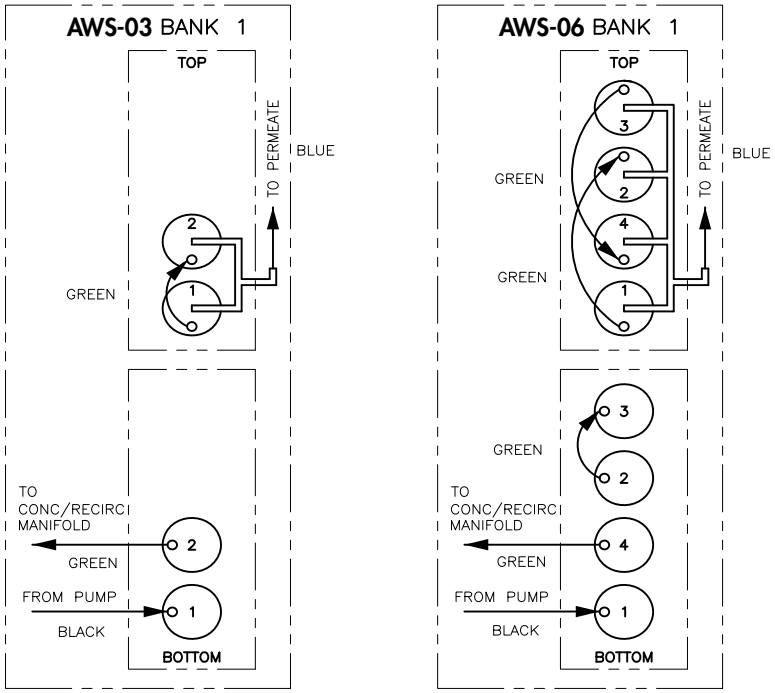
FIGURE 57-1: MEMBRANE DIRECTION



OM-8221

Membrane replacement

FIGURE 58-1: AWS-03 - AWS-06 MEMBRANE BANK PIPING ARRANGEMENT



LEGEND:

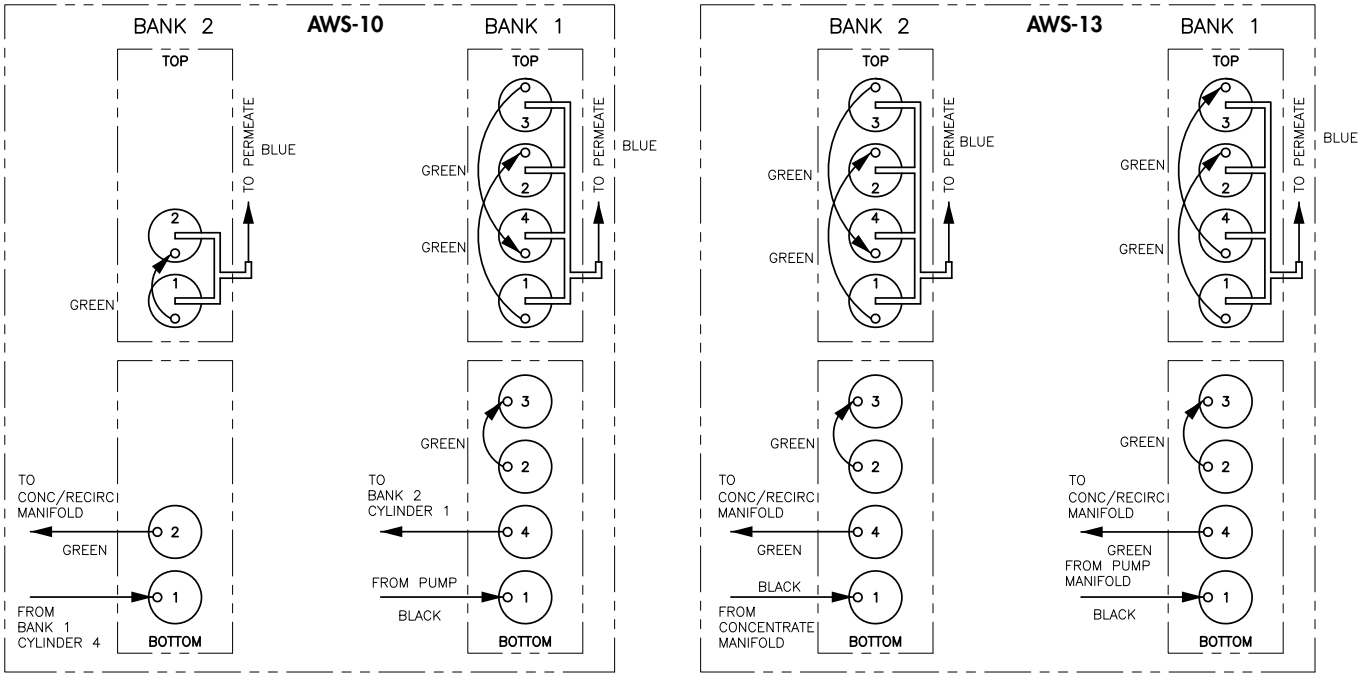
FACTORY SUPPLY/CONCENTRATE PIPING

FACTORY PERMEATE PIPING

OM-8222-1-ANDEN

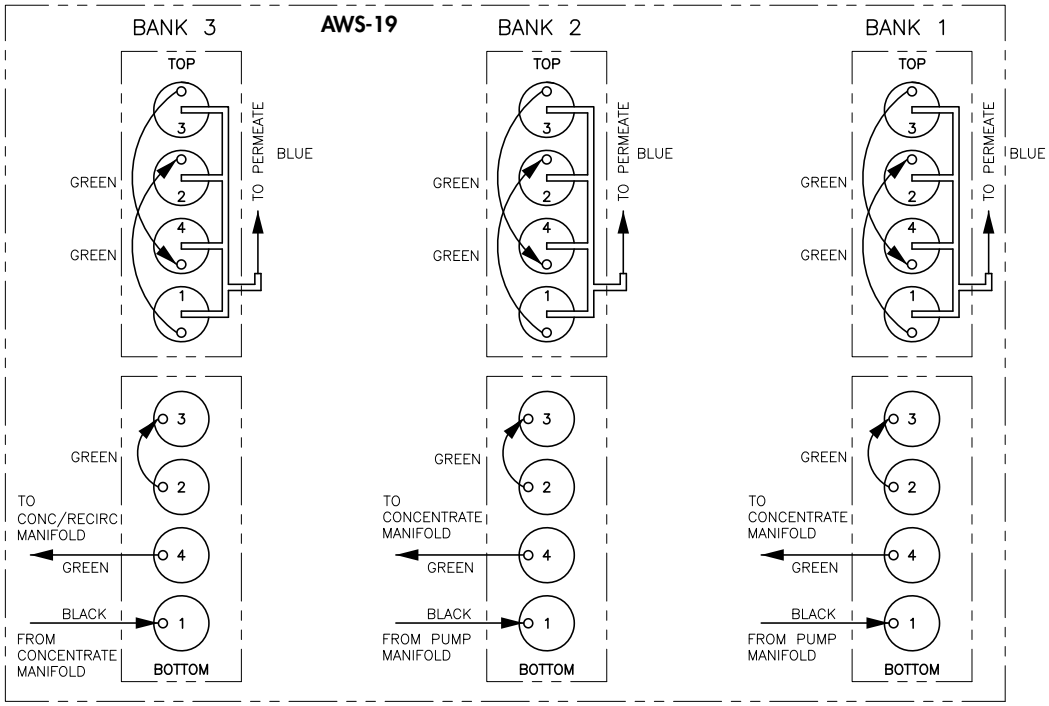
Membrane replacement

FIGURE 59-1: AWS-10 - AWS-13 MEMBRANE BANK PIPING ARRANGEMENT



Membrane replacement

FIGURE 60-1: AWS-19 MEMBRANE BANK PIPING ARRANGEMENT



LEGEND:

FACTORY SUPPLY/CONCENTRATE PIPING

FACTORY PERMEATE PIPING

OM-8222-3

Components

GAUGES AND VALVES

Verify proper operation by visual inspection during operation.

PRE-TREATMENT

See the Pre-treatment Installation, Operation, and Maintenance Manual.

ATMOSPHERIC RO HOLDING TANK

1. Place level sensor in tank and land wires on Vapor-logic board per wiring diagram.
2. Set the level sensor height input on the Vapor-logic controller to desired height. Factory default might not be end user desired height.
3. Land level sensor wires at the Vapor-logic controller.
4. Fill tank and verify water height.
5. Check for leaks.
6. Turn on permeate forwarding pump and set the system output.

System Design Input Form

Table 62-1:
System design input form

Parameter	Value
Water type	
Conductivity	
pH	
Temperature	
NH_4^+	
K^+	
Na^+	
Mg^{2+}	
Ca^{2+}	
Ba^{2+}	
Sr^{2+}	
Fe^{2+}	
Mn^{2+}	
Boron	
CO_2	
CO_3^{2-}	
HCO_3^-	
NO_3^-	
Cl^-	
F^-	
SO_4^{2-}	
PO_4^{2-}	
SiO_2	
Turbidity	
SDI	
Alklainity	
Hardness	
Bacteria	
Chlorine	

System operating log

SYSTEM MONITORING AND RECORD KEEPING

The system should be monitored and all pertinent data recorded on a daily basis. This includes cartridge filter pressure in/out, system pressure in/out, flow and water quality (TDS) in/out. Data is needed to determine operating efficiency and for performing system maintenance. The latter includes cleaning of the membranes, adjusting the operating conditions as well as replacement of cartridge filters and RO membranes.

Table 63-1:
System operating log

Date							
Time							
Chlorine (ppm)							
Filter in (psi)							
Filter out (psi)							
Water temperature (°F)							
TDS in (ppm)							
TDS out (ppm)							
Hardness incoming (ppm)							
Hardness outgoing (ppm)							
Concentrate in (psi)							
Concentrate out (psi)							
pH in							
pH out							
Alk in (ppm)							
Permeate flow (gpm)							
Inlet flow (gpm)							
Recovery rate (%)							
Cartridge filter change (yes/no)							
Membrane change (yes/no)							
Recorded by							

Notes

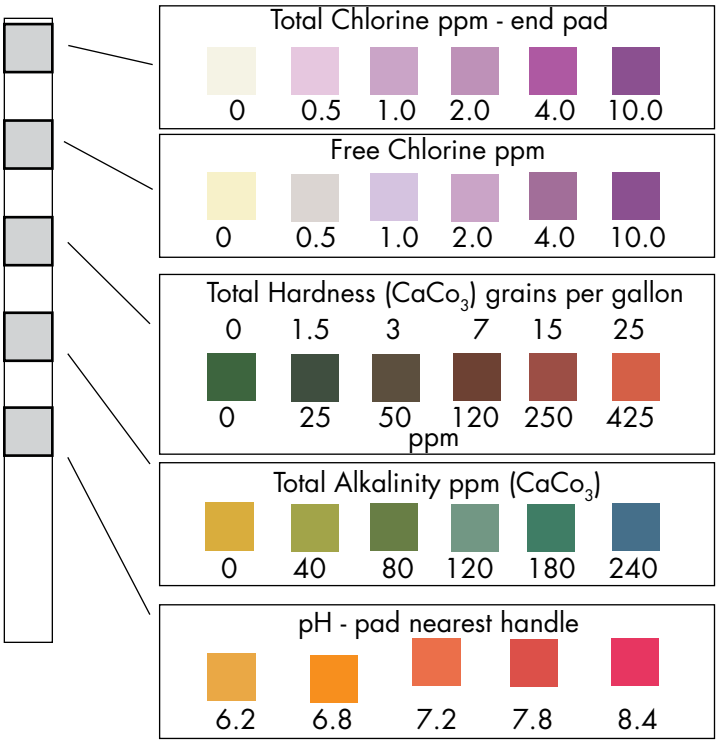
Water quality test strips

The carbon filters removes chlorine. Change the carbon filter or media when chlorine from supply water starts to pass through. Check regularly for chlorine pass through.

To check for chlorine, obtain a water sample from the supply line to the RO system and test the water. If chlorine is present, change the carbon filter/media and record the interval to estimate the next carbon change.

For best results, test water chlorine every two weeks.

To order more Water Quality Test Strips, contact your local Anden rep, or call 1-800-972-3710.



DIRECTIONS:

1. Dip entire strip into water for 1 second (or pass under water stream), remove. Do not shake excess water from the test strip. Hold the strip for 30 seconds.
2. Compare TOTAL HARDNESS, TOTAL ALKALINITY and pH pads to color chart to the left.
3. Dip strip into the water again and move back and forth for 30 seconds (or hold two chlorine pads under water stream for 10 seconds).
4. Compare CHLORINE pads to color chart to the left.
5. Track results in the chart below.
6. Change the carbon cartridge filter once chlorine is detected in the concentrate water of the low-maintenance humidification system (see page 32).

Troubleshooting

The following troubleshooting instructions are specific to the Anden Reverse-Osmosis System.

Table 65-1: Troubleshooting

Problem	Possible cause	Action
The system does not start manually or automatically.	• Incorrect installation • Not wired • Safety interlock switch engaged • No demand	Check supply voltage. Check circuit breakers. Check interlock switch.
		Verify that the field supplied manual inlet valve is open. Verify that the water pressure is at least 40 psi (276 kPa). 10 psi (69 kPa) is shut off. Verify that the sediment filter is clean.
		Check for alarms.
		Check the control and power fuses located inside the control and power panel. Check the transformer voltage.
		Verify the RO pressure holding tank is empty and is not pressurized with trapped air.
		Verify there is a demand on the atmospheric tank.
The system is operating but provides only low pressure or no pressure.	• Malfunctioning system • Outside of design conditions	Check if there are any leaks in the water lines. Repair if needed.
		Verify that the field supplied manual inlet valve is open. Verify that the water pressure is at least 40 psi (276 kPa). 10 psi (69 kPa) is shut off. Verify that the sediment filter is clean.
		Verify the RO flush valve is not open.
		Verify that the field supplied manual permeate supply valve(s) are open.
		Verify that the internal plumbing does not have a kink.
		Check pump rotation for three phase motors.
		Verify the temperature is in range.
The system turns on but it turns off after a certain period of time.	• Incorrect installation • Safety interlock switch engaged	Verify that the field supplied manual inlet valve is open. Verify that the water pressure is at least 40 psi (276 kPa). 10 psi (69 kPa) is shut off. Verify that the sediment filter is clean. Check for alarms.
		Verify that there are no leaks in the water piping. Repair if needed.
		Verify that the RO flush or divert valve is not enabled.
Inlet pressure low*	• Incorrect installation • Outside of design conditions	Correct incoming supply pressure.
		Verify the sediment filter is not plugged. Change filters if needed.
		Verify solenoid valve is working properly. Replace if needed.

* Pressure alarm will occur if inlet pressure falls below 5 psi. Alarm will self-clear when RO system supply pressure is above 10 psi (69 kPa) for at least 10 consecutive seconds. A pressure fault can be manually cleared at any time. System will try to operate every 10 consecutive seconds per hour up to 72 hours while in low pressure alarm condition.

Troubleshooting

Table 66-1: Troubleshooting

Problem	Possible cause	Action
Permeate flow low	• Low temperature • High TDS	Capacity of RO is influenced by low temperature.
		Adjust concentrate control valve to prevent low system pressure.
		Clean membranes.
		Adjust pump throttling valve.
Pump noisy	Low inlet pressure	Correct low inlet pressure.
Permeate quality poor	• High TDS • Fouling outside of design	Adjust concentrate control valve to prevent low inlet flow.
		Correct low inlet pressure.
		Reduce too high of a recovery.
		Clean membranes.
		Replace damaged membranes.
		Ensure adequate concentrate to drain flow.
Atmospheric tank is empty but indicates 'full' on the RO system.	Incorrect wiring	Check wiring, both field and factory.
		Lift float to see if the Vapor-logic controller changes status.
Atmospheric tank forwarding pump is turning off.	• Fault interlock • No demand	Is there flow allowed to the tank or system?
		Check the water temperature.
		Is the inlet valve shut?
		Check the power supply.
High permeate TDS, high permeate flow	Oxidation damage	Replace membrane
	Membrane leak	
	O-ring leak	Replace o-rings
	Damaged element	Correct plumbing
	Concentrate connected to permeate	
Unknown fouling or degradation	Unknown	Send membranes out to get a membrane autopsy
Increased permeate flow, increased salt passage	Oxidative damage from disinfectant	Replace membranes
	Cause poor control on pretreatment for disinfectant removal	Check dechlorinator effluent for free chlorine
		Replace carbon media/filter if no longer effective
		Check chemical dosing and adjust to appropriate levels
		Check chemical supply and maintain chemical storage levels

Troubleshooting

Table 67-1:
Troubleshooting

Problem	Possible cause	Action
Lower permeate flow, higher salt passage, increased differential pressure	Poor control on pretreatment for scale control	Confirm softener is functioning correctly
		Salt in brine tank
		Elution study for softener effectiveness
		Check softener configuration settings
		Check incoming hardness to softener compared to settings
		Verify chemical feed is correct
		Verify dosing is correct
		Check chemical levels
	Too high of water recovery	Decrease recovery if the solubility cant support the incoming water recovery
		Clean the membranes with the Scale Cleaning membrane solution (acid).
		Replace membranes if the normalized permeate flow is unrecoverable.
Decreased permeate flow, increased salt passage, increased pressure drop, fully saturated prefilter or leaking prefilter (bypass	Iron fouling	Replace membranes Improve pretreatment
	Colloidal fouling	Improve pretreatment
High pressure incoming	Low Water Temperature High incoming TDS Scaling Foulants	Increase water temperature to design
		More pretreatment or lower recovery
		Clean membranes or replace membranes
Loud banging, low permeate flow, low salt passage	Air entrapment Compaction	Flush system of air
		Replace membranes
High SDI or TSS reaching membrane	Poorly sealed or crushed pre filter	Replace prefilter
		Replace damaged prefilter housing
Pump is loud, flow is not being produced	Shut off throttling valve	Open valve
		Replace pump
	Abrasive material in inlet water	Better pretreatment to remove abrasive material

Troubleshooting

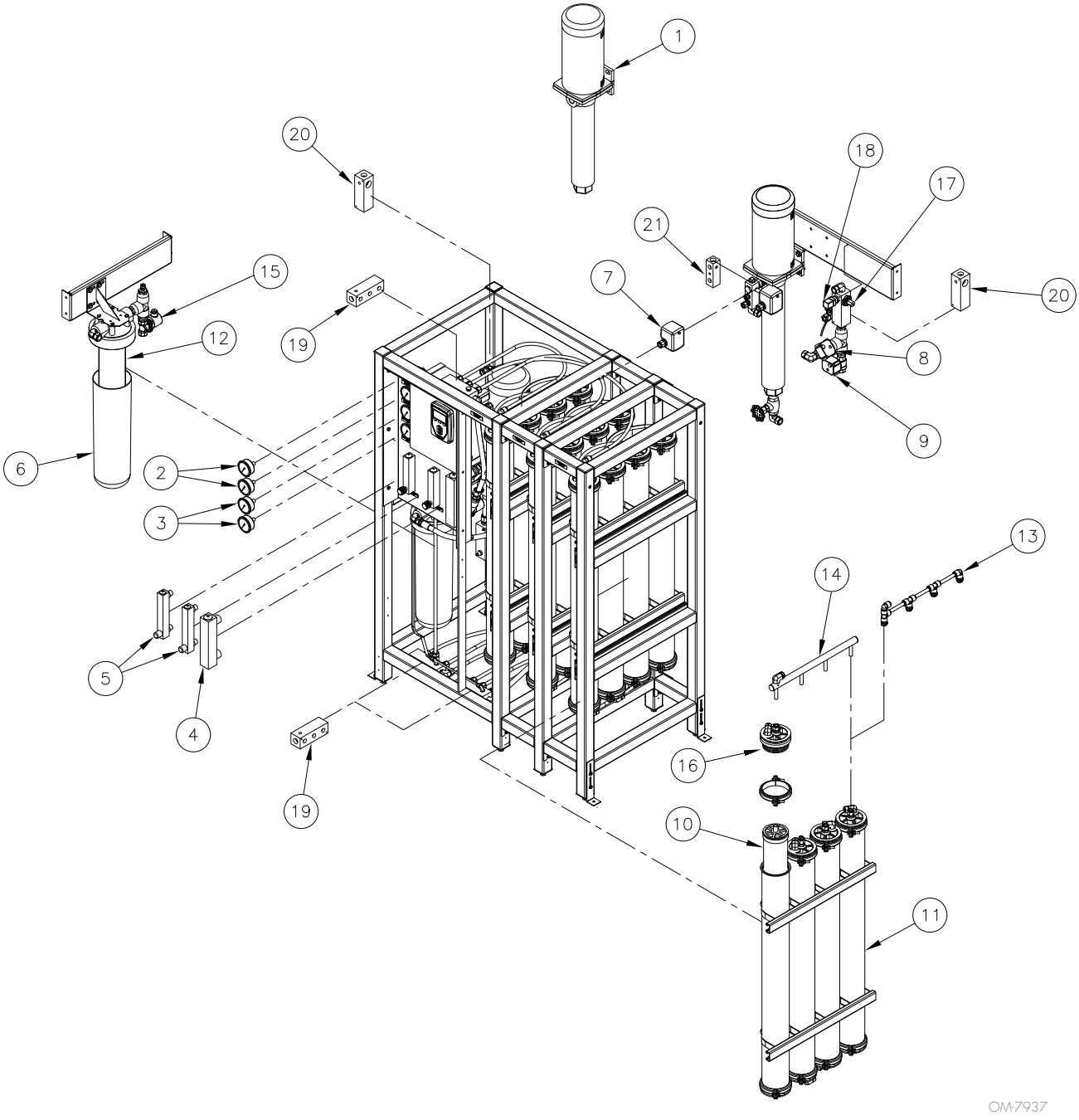
Table 68-1:
Vapor-logic troubleshooting guide

	Issue	Possible causes	Actions
Vapor-logic Controller power issues	Green power indicator light is off.	• No control voltage	• Check for proper supply voltage.
		• Heater fuses open	• Check heaters and replace fuses.
		• Transformer secondary circuit breaker tripped	• Check for wiring shorts; reset breaker.
	No remote indication of alarm light No remote activation of fan	• Dry contact or triac connection not programmed from Setup menu	• Go to the programmable outputs section of Setup menu to program dry contacts.
		• Field wiring not installed	• Provide field wiring.
		• Field-supplied remote fault indicator lamp is burned out	• Check if at remote indicator light is burned out; replace if needed.
		• Remote fault Vapor-logic dry contact is not switching	• Check dry contact continuity (Vapor-logic terminal P12) for contact closure.
	No readable information on keypad/display	• No power or incorrect voltage to Vapor-logic board	• Check main power supply. • Reset control transformer circuit breaker if tripped. • Reset thermal cutout if tripped. • Low limit thermostat is not satisfied (outdoor enclosure only).
		• Modular communication cable is disconnected	• Connect modular cable.
	Keypad/display does not energize	• Nonexistent supply voltage to unit	• Check main fuse. • Check main line safety switches. • Check heater fuses.
		• Nonexistent 24 VAC supply	• Check for proper supply. • Verify proper transformer voltage characteristics. • Verify proper wiring of transformer. • Check for control circuit voltage, 24 VAC. If voltage is not present, check transformer circuit breaker. Reset if needed.
		• Humidifier over-temperature thermostat open	• Reset manual switch located above heater below terminal cover.
	Display is completely black	• Keypad/display is overheated	• Cool the keypad.
		• Communication cable not connected	• Connect cable.
		• Defective cable	• Replace cable.
		• Defective keypad	• Replace.
		• Defective control board	• Contact DriSteem.

Continued

RO system

FIGURE 69-1: AWS SYSTEM REPLACEMENT PARTS



RO system

Table 70-1:
RO system replacements parts

No.	Description	Qty.	Part No.
1	PUMP RO 10 GPM 1 HP 208-230/460V 3PH	1	71000219
	PUMP RO 20 GPM 3 HP 208-230/460V 3PH	1	71000220
	PUMP RO 10 GPM 1 HP 115/230V 1PH	1	71000218
	PUMP RO 20 GPM 3 HP 208/230V 1PH	1	71000221
2	GAUGE LIQUID FILLED 100 PSI PNL MNT KIT	1-2	71000203
3	GAUGE LIQUID FILLED 400 PSI PNL MNT KIT	1-2	71000204
4	METER 5 GPM WATER FLOW	1	71000210
	METER 10 GPM WATER FLOW	1	71000208
	METER 20 GPM WATER FLOW	1	71000209
5	METER 5 GPM WATER FLOW W/ NEEDLE VALVE	1-2	71000211
6	HOUSING FILTER 4.5" DIA X 20"	1	71000205
7	PRESSURE SWITCH DPST, 10/5 PSI	1	71000216
8	VALVE 3/4" NPT SST (NC) 30VAC 2NM	1	71000223
9	VALVE 3/4" NPT SST (NO) 30VAC 2NM	1	71000224
10	MEMBRANE RO 4.0" X 40" EXTRA LOW ENERGY	2-12	71000207
11	RO MEMBRANE HOUSING 4" DIA X 40" 304 SST	2-12	71000222
12	PLUMB FILTER SEDIMENT 5 MICRON 4" X 20"	1	71000215
13	KIT MANIFOLD PP 1 MEMBRANE	1	71000225
	KIT MANIFOLD PP 2 MEMBRANE	1	71000226
	KIT MANIFOLD PP 3 MEMBRANE	1	71000227
	KIT MANIFOLD PP 4 MEMBRANE	1-3	71000228
14	KIT MANIFOLD SST 1 MEMBRANE	1	CONSULT FACTORY
	KIT MANIFOLD SST 2 MEMBRANE	1	CONSULT FACTORY
	KIT MANIFOLD SST 3 MEMBRANE	1	CONSULT FACTORY
	KIT MANIFOLD SST 4 MEMBRANE	1	CONSULT FACTORY
	KIT MANIFOLD SST 1 - 4 MEMBRANE	1	CONSULT FACTORY
15	VALVE SOLENOID 3/4" NPT BRASS	1	71000229
16	END CAP 1/2" NPT CON WO/O-RING	2-24	71000230
17	PROBE TDS CONDUCTIVITY W/TEMP COMP	1	71000217
19	RO MANIFOLD BLOCK WATER DISTRIBUTION (WITHOUT FITTINGS)	2	71000231
20	RO MANIFOLD BLOCK INLET SUPPLY (WITHOUT FITTINGS)	3	71000232
21	O-RING 4"DIA FILTER HOUSING EPDM (NOT SHOWN)	1	71000212
22	O-RING RO MEMBRANE 1.012" OD EPDM (NOT SHOWN)	8-48	71000213
	O-RING RO MEMBRANE 4.020" OD EPDM (NOT SHOWN)	8-48	71000214
23	WRENCH 4" FILTER HOUSING (NOT SHOWN)	1	71000233

* Specify RO system model and serial numbers when ordering.

Subpanel

FIGURE 71-1: CONTROL CABINET ASSEMBLY

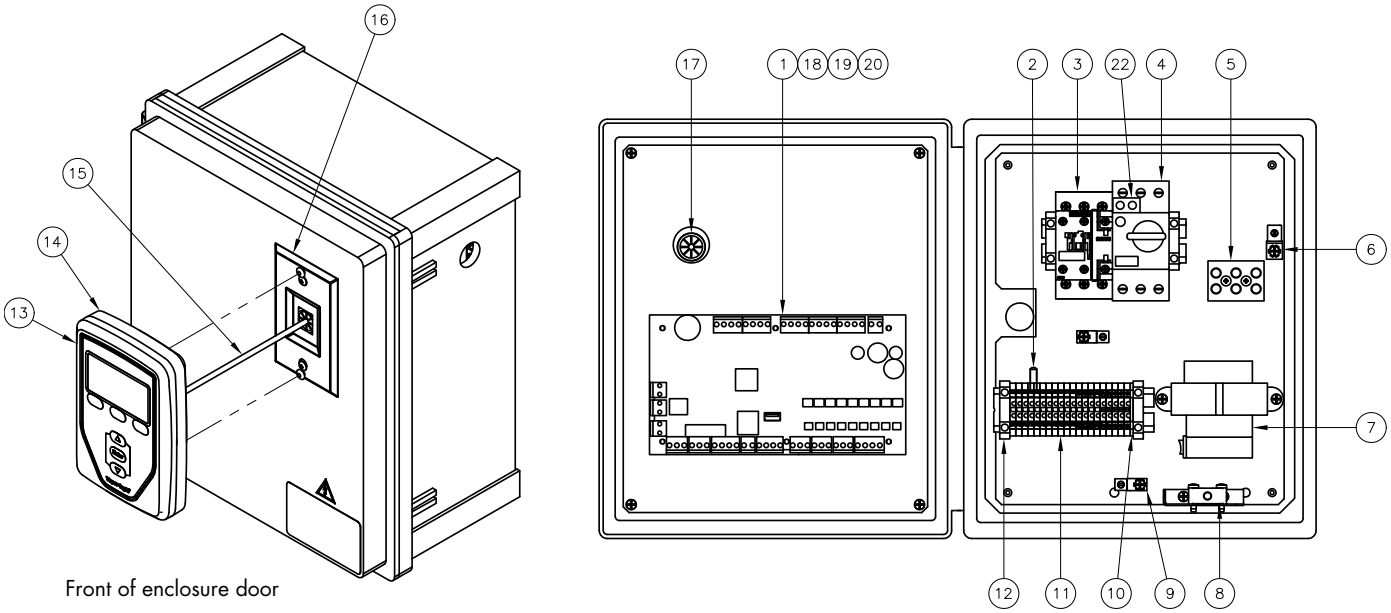


Table 71-1:
Control cabinet assembly

No.	Description	Qty.	Part No.	No.	Description	Qty.	Part No.
1	MAIN CONTROLLER VL6	1	71000256	7	TRANSFORMER 120/208/240/480V TO24VAC 75V	1	71000255
2	Resistor 1.2K OHM through hole	1	71000239	8	SWITCH DOOR INTERLOCK SNAP ACTION	1	71000253
3	CONTACTOR	1	71000234	13	Display VL w/o back Vapor-logic	1	71000235
4	STARTER MOTOR 1.1 - 1.6 AMP SIEMENS	1	71000240	18	PLUG 2 CIRCUIT VERTICAL EURO MOLEX	1	71000236
	STARTER MOTOR 1.4 - 2.0 AMP SIEMENS	1	71000241	19	PLUG 3 CIRCUIT VERTICAL EURO MOLEX	1	71000237
	STARTER MOTOR 1.8 - 2.5 AMP SIEMENS	1	71000242	20	PLUG 4 CIRCUIT VERTICAL EURO MOLEX	1	71000238
	STARTER MOTOR 17 - 22 AMP SIEMENS	1	71000245				
	STARTER MOTOR 2.2 - 3.2 AMP SIEMENS	1	71000246				
	STARTER MOTOR 3.5 - 5.0 AMP SIEMENS	1	71000248				
	STARTER MOTOR 9 - 12.5 AMP SIEMENS	1	71000252				
	STARTER MOTOR 4.5 - 6.3 AMP SIEMENS	1	71000249				
	STARTER MOTOR 5.5 - 8.0 AMP SIEMENS	1	71000250				
5	Terminal block 3 pole pressure contact	1	71000254				

Atmospheric tank

FIGURE 72-1: ATMOSPHERIC STORAGE TANK

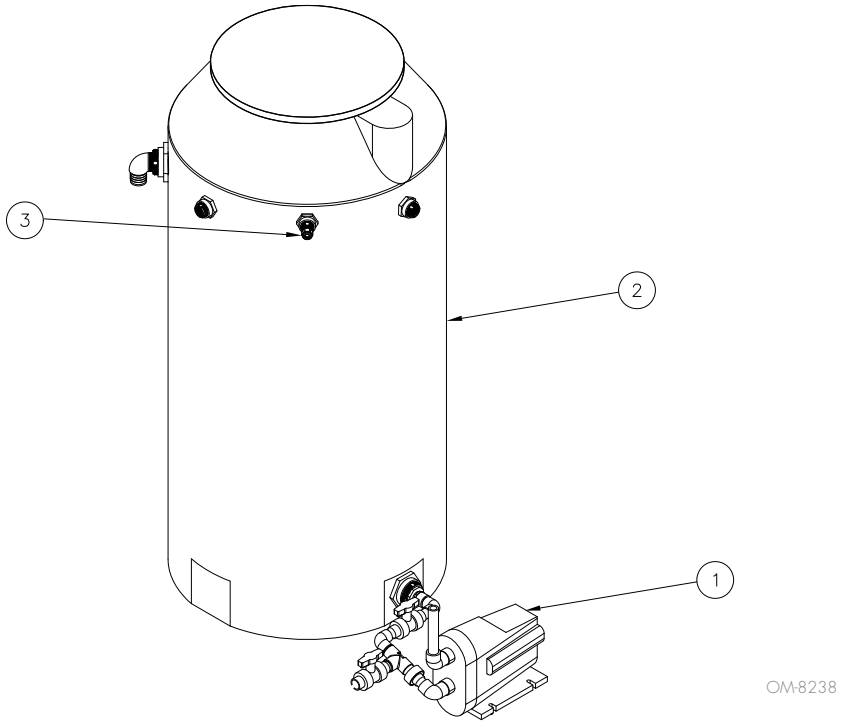


Table 72-1:
Atmospheric Tank

No.	Description	Qty.	Part No.
1	PUMP, ATMOSPHERIC STORAGE, SCALA 2	1	71000286
2	TANK, ATMOSPHERIC STORAGE, 300 GAL, BLACK	1	71000279
	TANK, ATMOSPHERIC STORAGE, 500 GAL, BLACK	1	71000280
	TANK, ATMOSPHERIC STORAGE, 1000 GAL, BLACK	1	71000281
	TANK, ATMOSPHERIC STORAGE, 5000 GAL, BLACK	1	71000282
3	TRANSDUCER SUB LEVEL SENSOR 4-20 MA	1	71000284

Glossary

Table 73-1: Terms and definitions	
Antiscalant:	A chemical added to the inlet side of the RO system to inhibit scaling of inorganic salts on the membrane surface.
Autopsy	The dissection of the RO membrane to investigate the poor/unknown performance issues.
Biocide	A chemical that kills bacteria.
Brine seal	A rubber seal on the outside of the membrane to prevent by-pass between the membrane and the membrane housing.
Chloramine	A chemical combination of chlorine and ammonia that is used in disinfection.
Chlorine, free available	A chemical used for disinfection and oxidizing agent. It can be in several forms such as chlorine, hypochlorite ions, hypochlorous acid or a combination.
Colony forming unit (CFU)	A unit of measure for bacteria counts.
Concentrate	One of the exiting streams from crossflow filtration and holds a majority of the dissolved solids. This stream doesn't pass through the membrane surface.
Concentrate recycle	The stream that is sent back to the inlet to create a blend of water. This recycle increases the recovery rate of the RO system.
Conductivity	The property of a solution that shows its ability to transmit electricity. Pure water is a resistor but impure water with dissolved solids carries a conductance.
Crossflow filtration	A separation filtration that takes one stream and produces two streams of water. The flow is tangential to the membrane surface and this is the main process of reverse osmosis.
Dead end filtration	A filtration process in which water is forced through a media to capture solids/particles. This filtration process has one stream in and one stream out.
Dissolved solids	This is the solute that is within water and is made up of ions and ionic solutions. These are the impurities that are left behind once solids and gases are removed from the water
Feed water	The inlet water to the RO system or other water treatment technologies
Flux	The membrane throughput as represented by volumetric flow over a given time. Usually represented in GFD.
Hardness	The chemical makeup of calcium and magnesium in the water supply. Usually expressed in ppm or grains per gallon.
Langelier Saturation Index (LSI)	An index of water as it relates to ability of the water to dissolve or form calcium carbonate.
Manifold	Piping arrangement to connect multiple items to one source or product line
Membrane element	The functional component of RO technology in which the membrane sheet is formed into a complete element bound together.
Normalized data	The normalized data is taking raw data and accounting for the variables such as temperature. This is a means to standardize data from two different collection periods.
Oxidation Reduction Potential (ORP)	The electromotive force caused by an oxidant dissolved in water. Chlorine is a large contributor to a high ORP in feed water.
Osmosis	The flow of water from a less concentrated solution to a more concentrate solution as it passes through a semipermeable membrane.
Osmotic pressure	The potential pressure required to overcome the properties of the water differential on both sides of the membrane. This pressure must be overcome (usually by a mechanical pump) to produce permeate.
Pass	One step treatment of the feed water through a membrane.

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