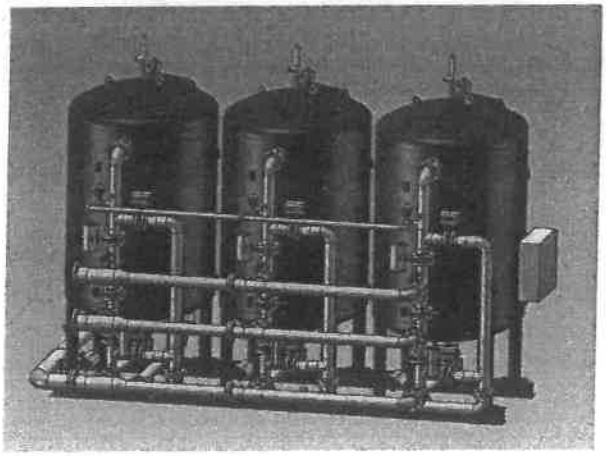
SIEMENS

Operation and Maintenance Manual

PTI Pretreatment Systems

Softener



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Model # **PTISPDA36X60**
Serial # **1200/000788-03**

CAUTIONS AND WARNINGS

Prior to operating or servicing this device, this manual must be read and understood. If something is not clear, call for assistance before proceeding. Keep this and other associated manuals for future reference and for new operators or qualified service personnel.

All electrical work should be performed by a qualified electrician in accordance with the latest edition of the National Electrical Code, as well as local codes and regulations.

To avoid electrical shock hazard, do not remove covers or panels when power is supplied to the device. Do not operate the device when covers or panels are removed.

WARNING **A faulty pump motor or wiring can be a serious shock hazard if it or surrounding water is accessible to human contact. To avoid this danger, DO NOT remove any grounding wire from the system.**

DISCLAIMER STATEMENT

This operation and maintenance manual is intended to be used with the component manufacturer literature provided in the Appendix. These manuals should provide complete and accurate information to meet your operating and/or service requirements based on the information available at the time of publication. However, Siemens Water Technologies assumes no responsibility for the technical content of the manufacturer literature.

This manual should be read fully and understood before installation, operation or maintenance of the system is attempted. The information in this manual may not cover all operating details or variations or provide for all conditions in connection with installation, operation and maintenance. Should questions arise which are not answered specifically in this manual, contact the Siemens Water Technologies Technical Support Department at the phone number provided on the cover of this manual.

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MANUAL USER'S GUIDE

This manual describes the procedures necessary to install, operate, and maintain your Siemens Water Technologies equipment. Please read this manual carefully before installing and operating it. The equipment warranty may be voided if installation or operation instructions are not followed correctly.

Warnings, Cautions, and Notes are used to attract attention to essential or critical information. Warnings and Cautions will appear before the text associated with them, and notes can appear either before or after associated text.

WARNING **Warnings indicate condition, practices, or procedures which must be observed to avoid personal injury or fatalities.**

CAUTION **Cautions indicate a situation that may cause damage or destruction of equipment or may pose a long term health hazard.**

NOTE: *Notes are used to add information, state exceptions, and point out areas that may be of greater interest or importance.*

EQUIPMENT SUPPORT

Siemens Water Technologies continually strives to provide safe, efficient, trouble-free equipment using the optimum technology for your application. If problems should develop, Siemens Water Technologies's worldwide network of technical support will be available to provide assistance. For service, sales, parts, or additional manual copies call your area representative or Siemens Water Technologies, Technical Support Department at the number provided on the cover of this manual.

1.0 SAFETY PRECAUTIONS

This section contains general safety guidelines that workers must follow when installing, operating, and maintaining the equipment. Make certain that it is read and understood prior to system start-up. The guidelines listed here must be followed at all times to prevent worker injury and equipment damage.

1.1 GENERAL SAFETY GUIDELINES

This subsection contains the safety precautions that are common to all the equipment.

1.1.1 Operator Training

Operators must be trained in equipment operation and proper handling of any hazardous materials or chemicals. Only experienced operators who have studied this entire manual should operate the equipment.

1.1.2 First-Aid Equipment

First-aid equipment must be available in all areas. This equipment must consist of items to treat most common injuries and the items required by the Material Safety Data Sheets (MSDS) for hazardous chemicals and materials used by the system.

1.1.3 Equipment Access

Workers must use caution when accessing the equipment. All measures must be taken to prevent falls and other accidents when equipment is being installed or serviced.

Use extreme caution when working around liquid-treatment equipment. Valve handles, sample pipes, and other protruding components can cause severe injury to body parts. Workers should wear hard hats and safety glasses and move cautiously when working under piping and around the equipment.

WARNING

Climbing on piping can cause worker injury or equipment damage due to falls and equipment tipping.

Never climb on piping to reach equipment or components.

If equipment to be installed or serviced is above an operator's normal reach, use safe, approved ladders or lifting devices to reach the required area.

Avoid using "extension" type or single-run ladders to access equipment, especially if there are no flat and stable surfaces for which a single-run ladder can rest. If possible, use a wide, stable folding (free-standing) ladder and tie it to the equipment or piping.

1.1.4 Protective Personal Equipment (PPE)

Maintain the necessary clothing and equipment to protect operating personnel. For protection when handling hazardous chemicals or materials, refer to the MSDS.

1.1.5 Pressures

WARNING

The sudden release of pressure from pressurized components can cause severe injury to workers.

Relieve all pressure from piping and components before performing service.

Extreme caution must be used when working with high air or liquid pressures. Pressure monitoring devices must always be installed and working properly. The liquid-treatment system must be operated within its rated pressure limits.

1.1.6 Servicing System Components and Equipment

Before performing maintenance on system components and equipment, and especially when disassembling individual components, workers must be certain that the components are isolated from pressure, fluids, and electricity. Spring-loaded devices, such as valves, must be in their "relaxed" state (no compression on the loading spring) to avoid the sudden and accidental movement of individual parts.

WARNING

An accidental and sudden release of pressure or fluid, accidental contact with energized electrical components, or the sudden movement of equipment parts during maintenance procedures can result in severe injury to workers.

Refer to the individual component literature included in the Appendix for specific maintenance guidelines.

1.1.7 Electricity

WARNING

Electricity can shock, injure, or cause death.

Always disconnect and lock out electrical power for panels or components before performing repairs or service.

Operators and workers must use caution when working with control panels and other electrical components. These components must be properly wired and grounded, and should not be allowed to come in contact with process fluids or other liquids.

Electrical control panels and instruments must be properly grounded.

1.1.8 Automatic System Testing

WARNING

Improper flows of liquids during a system test run can cause worker injury or equipment damage.

During a test run of a system, all hand valves must remain closed to prevent the accidental entry of process fluids.

Perform a test run on automatically controlled systems with water before initial equipment operation. Operators must verify that the entire system operates properly without leaks before using regenerants or process liquids.

1.1.9 Servicing Automatically-Controlled Components

WARNING

Accidental and unexpected operation of remote components can cause personal injury or death.

If controller programming or program modification is performed while system components are being serviced, disconnect the controller output devices or the individual component tubing or wiring to avoid accidental operation.

Workers must use extreme caution when servicing automatically controlled components. Sudden and unexpected operation of components being serviced can cause severe injury to the workers involved.

Before working on automatically controlled components, make sure that the automatic controller is disabled so it cannot be used to operate remote components. Close, lock, and tag valves, and lockout and tag electrical motor starters and other electrical devices.

Finally, inform other operators and control room workers of repairs or servicing in progress.

1.2 SPECIFIC SAFETY PRECAUTIONS

This subsection contains safety precautions specific to storage tanks.

WARNING

Empty tanks and vessels may tip forward suddenly and without warning, causing equipment damage or injury to workers.

Always brace tanks and vessels securely until they are loaded or are bolted to the plant floor.

Empty tanks and vessels may not balance when stood upright. Workers must use extreme caution when working with empty tanks and vessels and must brace them securely or mount them permanently to the plant floor.

WARNING

Heavy manway covers can cause equipment damage or severe personal injury or death if dropped from any height.

Do not stand under workers who are removing manway covers. Use extreme caution when removing or moving heavy manway covers.

Use extreme caution when removing heavy manway covers from vessels being loaded. If lifting davits (arms) are not provided for the covers, use a sling or chain and some type of lifting device to remove and hold the cover. Do not remove all of the cover bolts until it is certain that the cover is securely slung and supported and will not fall.

WARNING

Falls from the top of a vessel can cause severe injury or death to workers.

Always load vessels from a platform or lifting device. Platforms and lifting devices must be equipped with side rails and slip-resistant surfaces where workers will stand.

Do not stand of top of a vessel while loading it. The curved top surface does not provide adequate footing. The lack of handholds and the small surface area can lead to falls.

When a vessel is being loaded, workers must stand on a safe platform or lifting device and must take all necessary measures to avoid falls.

If a ladder must be used, make certain that it is a stable, free-standing ladder that allows easy access to the vessel opening. If possible, tie the ladder to the vessel with a rope.

WARNING

Confined spaces may contain insufficient oxygen or hazardous chemicals, materials, or vapors, which could result in serious injury or death.

If the vessel must be entered, adhere to the OSHA permit-required confined space procedures in standard #29 CFR Part 1910.

WARNING

Process fluids, especially chemicals, entering a vessel while workers are inside can cause severe injury or death.

Make sure all of the vessel's process entry and exit points have been blinded off.

Before entering a vessel, verify that all connections to the vessel have been isolated and tagged out. Also assign a person (called a "spotter") to stay outside the vessel near the manway. The spotter should be prepared to give assistance to those inside the vessel or call for help in the event of an emergency.

When handling vessel media, avoid stepping on any spilled media (slip hazard). Sweep up and dispose of the spilled media as soon as possible. Refer to the media Material Safety Data Sheets for cleanup details.

1.3 MATERIAL SAFETY DATA SHEETS (MSDS)

The appendix contains Material Safety Data Sheets (MSDS) for hazardous chemicals and materials supplied with this equipment. These sheets contain important information about specific hazards and first aid procedures. Have all operating personnel review this material.

1.3.1 Customer Purchased Chemicals

Chemicals purchased from outside sources are supplied with MSDS. A file of current MSDS should be kept in a location accessible to all personnel working within the chemical use area.

The manufacturer strongly recommends that another copy of these MSDS be included within the MSDS section of this manual.

2.0 INSTALLATION & START-UP

This section provides general information on receipt, installation and start-up of the Softener system. Installation instructions of specific components should be done per the manufacturer's guidelines.

NOTE: ***All equipment must be installed as shown on the piping, wiring and layout drawings for this job. Refer to the drawings supplied in the Appendix when reading and performing the procedures in this section.***

The manufacturer expects that all persons involved with equipment handling and installation are knowledgeable and experienced in these areas. Please refer to all appropriate Occupational Safety and Health Administration (OSHA) manuals listed below for any clarification if necessary.

2.1 EQUIPMENT HANDLING PROCEDURES

1. Only experienced construction workers using accepted rigging methods should perform all lifting and moving procedures.

2. Before beginning any equipment handling procedures, refer to the following sections in the Occupational Health and Safety Administration (OSHA) manual #2206: "General Industry Standards". Refer to any other applicable literature as well.

   Subpart N: "Materials Handling and Storage"
   Section 1910.176: "Handling Materials—General"
   Section 1910.178: "Powered Industrial Trucks"
   Section 1910.179: "Overhead and Gantry Cranes"
   Section 1919.180: "Locomotive and Truck Cranes"
   Section 1919.181: "Slings"

WARNING

Damaged lifting devices can fail in service and cause severe personal injury or equipment damage.

Never use slings or cables that are cut, frayed, or chinked. Refer to OSHA manual #2206 for information on inspecting lifting devices for damage.

3. Make sure that all equipment used for lifting and moving is properly maintained and is in good repair.

   Always inspect slings, cables, clevises, and other equipment prior to every lifting and moving event.

WARNING

Cables and slings can slip out of crane hooks not equipped with safety latches. Falling loads can cause severe personal injury or equipment damage.

Never use crane hooks that are not equipped with safety latches. All lifting hooks on cranes must be equipped with spring-loaded safety

latches to keep cables from slipping out of the hooks.

4. When using cables or woven straps as slings or chokers, place heavy carpeting, sections of tires, or other material between the sling and the object being lifted. This will help protect the sling device and the object being lifted.

5. Use lifting lugs or eyelets if they are installed on a component. Do not lift a vessel or equipment skid by attaching lifting devices to piping or other components.

6. Verify that all components being lifted are balanced, and will not tip or slip out of a sling.

   When lifting a large component, raise the object until it just clears the surface it was resting on and then stop. Observe the object to verify that it is balanced and is firmly held by the lifting devices. Do not use a method if there is any doubt about its safety. Instead, set the object down and reposition the lifting devices or use another method.

   Use extra caution when lifting equipment skids using lift points on the skid (base). Equipment skids are often top-heavy and may tip when lifted more than a few inches off the ground.

7. When moving a component with a crane or a lift truck, keep the load as low as possible at all times. Doing so will minimize component damage if the load tips over, slips, or falls.

WARNING

Also, keep hands and feet from under raised components. If operators must reach under a raised component, place some type of heavy blocking under the component to support it if the lifting device fails.

8. A foreman or lead person should verify that all workers are clear of the lifting devices, the object, and the immediate lift area before proceeding with the lift.

   When a large component is to be lifted and moved, all workers in the general area should be warned of the lifting event and should be instructed to stand clear of the component and the lift area.

   When a component is lifted with a crane or forklift, all workers must remain in the crane or forklift operator's view during the lifting operation.

9. If two or more lift points on a component are connected to a single crane or crane trolley, use cable spreader bars to prevent excessive side loads on lifting lugs, eyelets, and other lift points.

Vessel legs and other lift points must not be subjected to side loads.

10. If a large component must be lifted more than a few inches off the ground, attach tag lines to the component. Workers can use these tag lines to stabilize and control the component while it is suspended.

11. If the equipment being unloaded is to be stored temporarily, follow the storage

instructions as described in this manual.

Always set and store vessels and skids on wooden blocks in the same manner in which they were shipped.

2.2 INITIAL EQUIPMENT RECEIPT & INSPECTION

2.2.1 Equipment Inspection Upon Receipt

CAUTION **Use care when moving equipment and components. Refer to the safe handling guidelines in this manual.**

1. When the shipment is received, it must be inspected immediately for completeness and for shipping damage.

2. Compare the received items to those shown on the shipping list supplied with the equipment, and check off each item that has been located. If items appear to be missing, immediately contact the carrier and then Technical Support.

NOTE: *Small components that were removed from major components during preparation for shipping may not have item numbers. Refer to the supplied drawings and equipment list to identify the untagged components.*

3. Perform a close inspection of all major components, piping and sub-components. Damage can be easily missed during a quick inspection.

   Make sure that gauges, sample piping, and tubes have not been damaged or broken off. Also look for broken, pinched, or bent piping.

4. Perform a close inspection of all loose components. Verify that no damage has occurred to these pieces.

NOTE: *Shipping damage should be promptly reported to the carrier first and then Technical Support to ensure repair or replacement. Do not assemble any equipment until all damage claims and/or shortage problems have been resolved.*

5. Refer to the storage procedures in this manual if the equipment will be stored before being assembled.

2.2.2 Inspection of Vessel Interior

1. Remove the manway covers on lined vessels to allow the inspection of the linings and distribution piping.

2. Spark testing of vessel lining is recommended to detect pinhole leaks. If spark-testing equipment is not available, perform a close visual inspection for scratches, tears, seam separation, and bubbles.

3. If damage to the lining is found, notify Technical Support immediately so repairs can be made.

2.3 STORAGE OF UNASSEMBLED COMPONENTS

2.3.1 General Storage Guidelines

Use the following instructions if the equipment will be stored before it is assembled.

NOTE: *To store individual system components (such as instruments, valves, controls etc.) refer to the manufacturer's storage instructions.*

1. Complete all of the inspection procedures as just described.

2. Place a copy of the marked-up shipping list and the written list of received item numbers together and store them in a safe place. If necessary, make copies of these lists and distribute them to the individuals who will be involved in the assembly of the equipment.

CAUTION

Use extreme caution when moving the equipment—refer to the safe handling guidelines in this manual.

3. Select a storage location where all the equipment can be stored in one area. Avoid separating equipment, components, and crates.

   On large job sites, it is easy for small or separated components to become misplaced or lost. If the equipment must be separated, note the exact locations of all pieces on the shipping list or the written list of received pieces.

4. Set the skids and other components on wooden blocks to keep them out of any standing water and to protect their painted surfaces.

5. If possible, store the equipment indoors where it will be protected from sunlight and adverse weather conditions.

   If the equipment will be stored for an extended length of time (inside or outside), cover it with plastic or canvas tarps to protect it from water, dust, paint over-spray, etc.

6. If the equipment must be stored outside, special precautions must be taken. Items that can be damaged by water must be securely wrapped with plastic and covered with tarps.

CAUTION

Storing equipment in direct sunlight may result in the deterioration of equipment finishes, and glued or epoxied parts. Direct sunlight can weaken or distort plastic, and melt the glue that bonds these components together.

Store the equipment in a shaded area or cover it with light-colored tarps.

If outdoor temperatures are warm, remove all vessel manway covers to allow air circulation.

CAUTION

Always drain all liquids from components that must be stored in freezing temperatures. Expanding ice can damage components.

When the outdoor temperature is below 32°F (0°C), it is important to verify that the piping, pumps, valves, and any other components where liquid may have accumulated are completely drained.

Open all equipment hand valves so trapped water and moisture can escape.

7. To store electrical panels, make sure all of panel openings are sealed with tape, and all panel doors are securely closed.

8. Allow all equipment to adjust to the site's ambient temperature before beginning assembly, especially if the equipment is very cold.

9. When equipment is brought out of storage, retrieve the original shipping and received goods lists, and double-check the components. Any missing pieces must be located immediately to avoid delays in equipment assembly and start-up.

10. Before assembling any equipment, visually recheck for possible equipment damage.

2.4 EQUIPMENT INSTALLATION GUIDELINES

All equipment and mechanical components listed on the shipping list must be installed according to the piping, wiring, and layout drawings for this job. These lists and drawings were supplied with the equipment.

Only qualified maintenance or construction workers using applicable plumbing, wiring, and construction codes and procedures should perform the installation.

NOTE: *The information below is a suggested sequence for installing this system's components. This sequence may be altered, depending on the job site conditions. Some of the procedures may be performed simultaneously, depending on the availability of workers and operators.*

Before proceeding with these steps, read the installation procedures specific to each component manufacturer's literature.

1. Position and level all major components as shown on the layout and piping drawings, paying special attention to elevations and center-to-center dimensions.

CAUTION

If components do not attach easily or line up exactly, apply only a moderate amount of force to install them. Excessive force will put an unnecessarily high stress on the components, which could damage them or cause process stream leaks.

This equipment was originally assembled at the factory using the dimensions given on the design drawings. The components that were shipped loose or disassembled for shipping will fit back together more easily if the original design dimensions are adhered to during installation.

NOTE: *When installing an assembly or instrument, do not tighten the bolts and other fasteners until all of the adjacent assemblies and instruments have been attached to it. Then evenly tighten all of the assemblies and instruments at the same time.*

CAUTION

Vibration-induced movement of equipment can result in misalignment and damage to piping components.

2. Any equipment needing floor anchoring will be equipped with anchor bolt holes. Anchor each piece of equipment to the plant floor after positioning, aligning, and leveling it.

NOTE: *Vibrations may cause equipment to "move" if not properly anchored to the floor.*

3. Mount all loose instruments to their proper locations. Connect the valve/piping assemblies. Each valve/piping assembly and instrument is labeled with an item number, which corresponds to the same item number on the shipping list and on the piping drawings.

4. Be sure that all of the installed equipment is braced properly so that only a minimum

amount of stress is put on the components and fasteners.

5. Fabricate and/or install the interconnecting piping between the major components and their subassemblies, as required. Brace as needed. Always use piping materials that are compatible with the process stream(s) that the pipe will carry.

6. Connect the required process streams and utilities to the equipment as indicated on the piping drawings. Refer to the equipment specifications for process influent guidelines.

7. Install any remaining wiring and tubing.

2.4.1 Installation Instructions For Lined Vessels

Depending on the material composition, a lining's pliability can be severely compromised in extreme temperature situations.

1. Many linings can be damaged in high temperature situations, including prolonged exposure to direct sunlight or welding.

CAUTION

Do not weld on a lined vessel. If welding must be done on a vessel leg, do not weld within 12 inches of the lined vessel.

2. Do not expose a lined vessel to extreme cold climates because thermal stress and expansion may cause cracking.

CAUTION

If a vessel is lined with a hard epoxy material, use extreme caution when moving the vessel when it is cold.

Avoid bumping or any impact to the lined vessel when it is cold.

2.4.2 Installation Instructions For Vessels with Manways

1. Assemble clamp style manway so the yokes are parallel, and so each end makes maximum contact with the manway rim.

2. Tighten nuts so gasket seals and manway does not leak. Re-tighten nuts after vessel is pressurized. The nuts should be periodically checked while the unit is pressurized.

CAUTION

The pressurization of the vessel will cause compression of the manway gaskets. Not re-tightening after pressurization could lead to loosening of the manway. Locking nuts may be installed as well.

2.5 INSTALLATION OF UTILITIES & OTHER PERIPHERAL EQUIPMENT

This subsection covers utilities and equipment that are required to operate this system, but have not been provided with the supplied equipment.

The equipment and utilities listed here must be connected and operational before the equipment can be operated.

2.5.1 Process Feed

Feedwater quality must be maintained as described in the equipment specifications.

2.5.2 Separate Source Backwash - Optional (Plus, Deluxe, and Select)

1. Verify/Close HV-02.
2. Connect supply line to the flanged connection between HV-02 and FV-04. When duplex or triplex systems are ordered, an interconnecting manifold is available if ordered at the same time as the softener unit. See the specifications for more detail.
3. Connect wiring per electrical schematic or interconnect wiring diagram for a separate source backwash pump, if required.

2.5.3 Drain Piping (For Waste, Etc.)

CAUTION

Pipe elbows, tees, and other fittings combined with long pipe runs or elevation gains can increase backpressure to the point where proper backwash flows cannot be achieved.

Facility drain piping should be as straight and as short as possible. It should be one size larger than the manifold piping.

The site glass installed on the drain outlet piping is oriented in the vertical to ensure the horizontal line containing the flow meter is maintained full. When attaching the drain line piping, it is best practice to immediately route connection piping downward toward the facility drain. These installation practices should also be employed for 72" diameter and greater, Duplex and Triplex systems, as the interconnect piping, flow elements, and sight glass are field installed. See P&ID for more detail.

While drain piping can be piped into headers to drain, but it is best to pipe the individual component to a sump, drain trench, or other open drain. Open drains make it easier to take samples and allow for visual observation by the operating personnel.

If the drain flow will contain hazardous or corrosive chemicals, be sure to use piping materials that will resist these chemicals.

2.5.4 Interconnecting Piping

All customer-supplied piping must be installed at this time. This piping must be flushed and cleaned before it is connected to the equipment.

On high flow duplex and triplex units, a loose ship kit that includes a flow meter, sight glass, and a chlorine monitor (Select Units) is provided. These instruments must be installed. The flow meters will also need flow tees. Please reference the table below for additional information.

Instruments to be Field Installed on High Flow Units

	Plus		Deluxe		Select	
	Simplex	Duplex/Triplex	Simplex	Duplex/Triplex	Simplex	Duplex/Triplex
Product Flow Meter	Installed @ factory	Yes	Installed @ factory	Yes	Installed @ factory	Yes
Drain Line Flow Meter		Yes		Yes		Yes
Sight Glass		Yes		Yes		Yes
Chlorine Monitor	*	**	*	**	*	Yes

* - Installed @ factory if option is ordered at time of unit order.
** - Needs to be installed if optional kit was ordered.

Signet® flow tees are required and are not included. Sizes are as follows:

Plus Packages

4"	PVC	PV8S040	PVC Saddle
6"	PVC	PV8S060	PVC Saddle
8"	PVC	PV8S080	PVC Saddle
10"*	PVC	PV8S100	PVC Saddle
12"*	PVC	PV8S120	PVC Saddle

Deluxe/Select Packages

4"	SS	CR4W040	Weldolet w/ PVDF insert
6"	SS	CR4W060	Weldolet w/ PVDF insert
8"	SS	CR4W080	Weldolet w/ PVDF insert
10"*	SS	CR4W100	Weldolet w/ PVDF insert

* - A new style of paddle wheel will need to be purchased. Signet 3-2536-P2 (for 10"-36" diameter pipes).

2.5.5 Tubing and Wiring

All customer-performed tubing of control valves and wiring of instruments must be completed.

2.5.6 Electrical

Refer to the electrical schematic drawings for specific power requirements.

2.5.7 Air

Dry, oil-free plant air is required for valve operation on Plus, Deluxe, and Select trim packages. Air must be filtered to remove moisture, oil, and particulates. Pressure to the air regulator's inlet must be at least 80 psi.

On economy units, air may be used for valve operation instead of water. If so, then an air regulator is recommended. Ensure that the regulator set point is at a higher pressure than the maximum feedwater pressure, but not higher than 100 psig.

2.5.8 Customer-supplied equipment

All customer-supplied pumps must be installed and operational before softener start-up. Such pumps may include a booster pump for a separate source backwash, inlet pressure booster pump, etc.

2.6 EQUIPMENT PREPARATION CHECKLIST

This subsection contains a checklist that must be filled out before the softener can be started.

Customer Name _____

Location _____

Serial Number _____ Model Number _____

Comments: _____

_____

_____

_____

The "Responsible Party" column must be completed prior to the Field Service Engineer arriving onsite. The "Date Completed" column is to be completed by the responsible party as the item/task is completed.	Responsible Party				Date Completed:
	FACTORY	BRANCH	CUSTOMER	OTHER	
1) PIPING AND VESSELS A. All equipment installed, leveled, piped, anchored and grounded. B. All piping installation completed: inlet, interconnecting and outlet. C. Inlet water supply available at required flows and pressure. D. All interconnecting piping, air lines, and vessels pressure tested as required, and free of leaks. E. Adequate supports and braces provided for all piping.					
2) AIR SUPPLY (If Required) A. Air supply available at required flows are pressure. B. Air line, including tubing, complete to all enclosures, valves, etc. C. Air is of instrument quality: free of dirt, water, etc.					
3) ELECTRICAL AND INSTRUMENTATION A. Installation of all instruments and devices that were shipped loose. B. All electrical tie-ins completed, all circuits "rung out", including all 120VAC, neutrals, grounds, and from field installed devices. C. Instrument calibration checked by qualified technician and documented by log sheet or sticker on each device.					

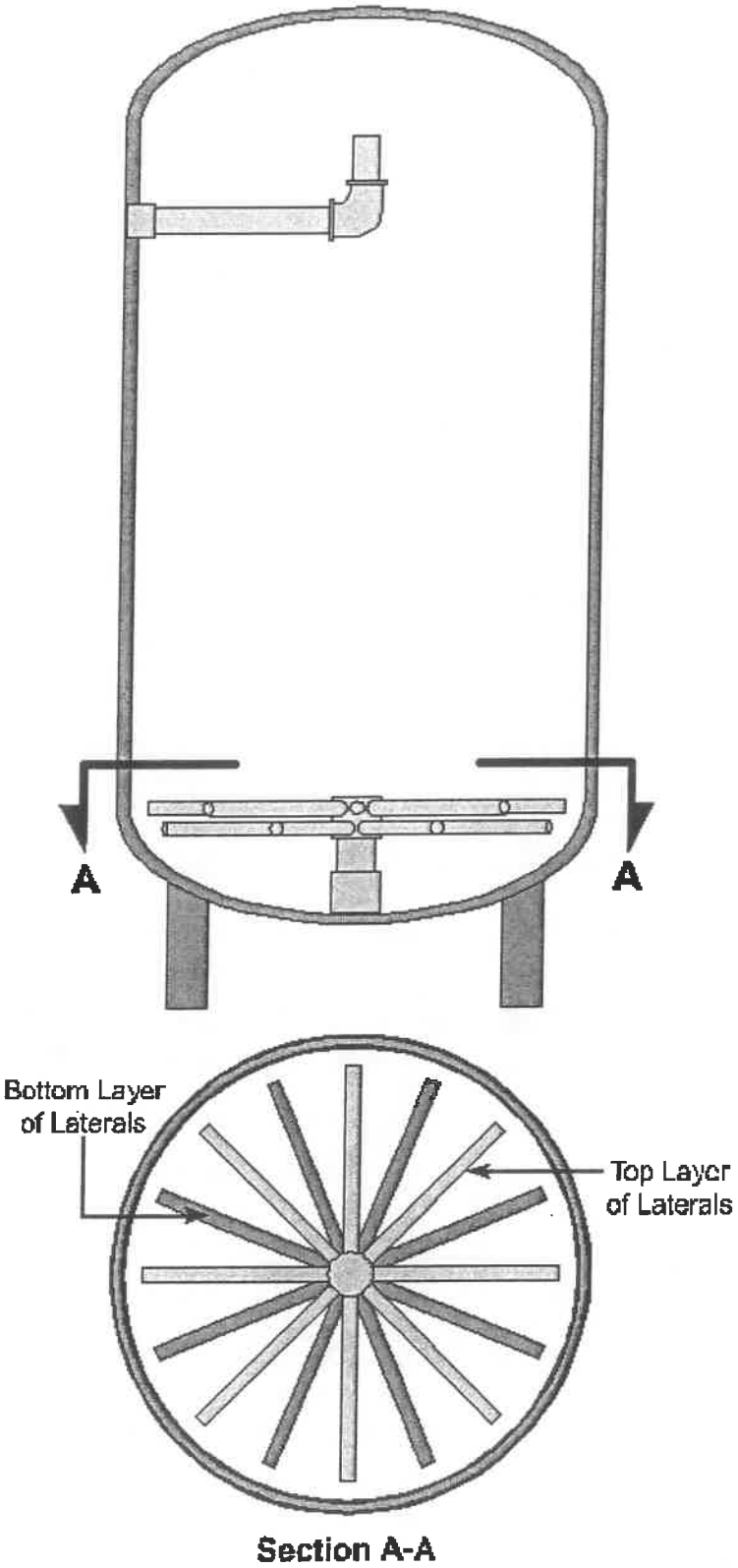
The "Responsible Party" column must be completed prior to the Field Service Engineer arriving onsite. The "Date Completed" column is to be completed by the responsible party as the item/task is completed.	Responsible Party				Date Completed:
	FACTORY	BRANCH	CUSTOMER	OTHER	
4) DRAIN CONNECTIONS A. All drain connections meet unit backpressure requirements. B. All drain piping installation complete (at least one pipe size larger than connection at units). C. Drain piping tested for leaks where applicable. **NOTE:** *Drain piping materials must be compatible with chemical waste streams.*					
5) MEDIA A. System media provided by: _____ B. Media storage to prevent damage by elements, such as direct sunlight, rain, freezing, etc. C. Loading of media. **NOTE:** *An inventory of media should be taken when this material arrives onsite to identify any shortages or damage. If not, liability may be in questions, and delays may result.* *Vessel loading must be carried out precisely as indicated by the instructions, or units may be inoperable.*					
6) LABOR A. Provide labor crews for media loading during start-up. B. Provide labor crews for completion of punch list items during start-up. C. Provide supervision of start-up activities. D. Provide training of operations personnel.					

2.7 INSPECTION OF FACTORY-INSTALLED DISTRIBUTION LATERALS

If distribution piping has already been installed in the vessel, inspect it using the procedures given below. If damage is found, call Technical Support immediately.

1. Internal vessel cleanliness is critical. Particulates and/or debris will plug distribution and adversely affect system operation. All precautions must be exercised, including:
   - all uniforms and shoes must be clean
   - all manways must be protected so debris does not enter a vessel, and
   - no flushing of pipes into the vessel.
2. Extreme care must be exercised so any tools or movement in a vessel does not damage the distribution or vessel lining. If accidental damage is sustained, then it is imperative that it is reported so repairs can be made.
3. Prior to entering an empty vessel, read and follow any vessel entry procedures.
4. Remove the vessel's manway cover.
5. To protect the distribution and/or vessel lining, rubber sheets or other suitable protective material must be placed wherever contact with the distribution or vessel lining is likely.
6. Inspect the internal distribution for the following. Refer to Figure 3-1 for proper lateral orientation.
   - All threaded and bolted distribution components are installed tightly.
   - All distribution openings are undamaged, clean, and free from bacterial growth and other foreign materials.
   - The vertical riser pipes contain slots right at the point where they exit the vessel. The slots prevent media loss.
   - Vessel is clean and lining is undamaged.
7. Use a long vacuum hose to clean any dirt or contaminants out of the vessel.
8. Replace the manway cover per section 2.4.2.

Figure 3-1: Lateral Location and Orientation



Section A-A

Note: The upper distributor may extend across the vessel and have up to 4 discharge points.

2.8 EQUIPMENT FLUSH PROCEDURES

The piping and other components must be flushed thoroughly prior to system start-up. The flushing procedures are critical to the proper start-up and operation of the equipment.

2.8.1 Customer-Supplied Inlet Piping Flushes

1. All system inlet piping must be flushed thoroughly before it is connected to the system.

   Newly installed piping usually contains welding slag, dirt, and other debris that will plug filters and can damage pumps.

2. If the inlet piping runs have already been connected to the skid, the piping must be disconnected at this time.

3. Each inlet piping run must be flushed with clean, clear water at the maximum possible velocity.

   The piping runs should be flushed one at a time while workers observe the effluent flow of water.

4. Flush each piping run until the effluent is clear and clean.

5. When a piping run has been flushed thoroughly, it can be connected to the system.

2.8.2 Chemical Feed/Storage Tank Flush

1. Inspect the interiors of all liquid storage tanks. If dirt or other material is present, use clean water to rinse out the tanks.

2. Dry tanks completely and replace the tank covers to keep out contaminants. Keep the tank covers in place except when manually adding to the tank or mixing the tank's contents.

2.8.3 Piping Flush

CAUTION

Do not flush into a vessel. Always flush out of a vessel to protect the vessel distribution piping (if applicable) and keep the vessel clean.

1. Open the various process valves needed to allow water to flow through and flush the system piping.

2. Start the flow of water to the system. If necessary, start a pump to move the flush water forward.

3. The flush water should now flow through the piping and to drain by the various effluent outlets.

   As the flush continues, close or throttle hand valves as required to direct the water through all areas of the piping.

   While the piping is flushing, briefly open each sample valve in the piping to flush all dead legs.

4. When the flush effluent is clear and clean, stop the water flow. If applicable, turn off the pump and reconnect the valve tubing.

2.8.4 Vessel Cleaning and Flushing

1. Inspect the interiors of all pressure vessels.

2. Remove any large debris or particulates by vacuuming or wiping. Follow the vessel entry procedures when entering a vessel to clean it.

3. Remove smaller particles and dirt by opening any low-point drain valve on the vessel face piping, or remove the caps or plugs at the bottom of the piping manifold. Use clean water to rinse out any remaining dirt.

2.9 PRESSURE TESTING

WARNING

Mechanical failure during pressure testing can result in serious injury to workers. Do not exceed the pressure rating of components when performing pressure tests.

Wear eye and face protection when performing pressure tests.

When all equipment and components have been installed, the system must be pressure tested with water using the following procedures.

2.9.1 General Pressure Test Guidelines

1. Vent any piping and vessels to be tested, and fill them with water through the normal inlet valves. Verify that all piping and vessels are filled with water.

WARNING

Do not pressure test the system with compressed air. If a mechanical failure occurs while the system is air pressurized, the released air can propel piping fragments or other components at high speeds, resulting in personnel injury or equipment damage.

Always fill and pressurize the system with water. Water is incompressible and will not "store" energy to the extent of compressed air.

2. Pressurize each portion of the system to its maximum operating pressure, but not any higher. To do this, deadhead the pump(s) that supplies process feed to that portion of the system.

3. During pressure testing, stand away from vessel windows, inline sight glasses, glass-tube flow meters, and plastic piping. These components are most likely to fail during pressure testing.

4. When the vessel and piping are completely filled with water, close any vent valves. Allow the maximum pressure rating of the inlet pump OR the vessel (100 psig) to be reached, whichever is lower.

   When the pressure stabilizes, close the inlet valves and turn off the pump to keep the system at the desired pressure.

5. If possible, perform an inspection after the system has been pressurized for several hours.

6. Tighten any fittings or other bolted components that are leaking. If components must be disassembled for repairs, relieve all pressure from the system first.

NOTE: *Fasteners may need to be retightened after the system has been operating at normal temperatures for some time. It is advisable to check and retighten manway nuts after several wash cycles (See section 2.4.2.)*

2.10 VESSEL LOADING

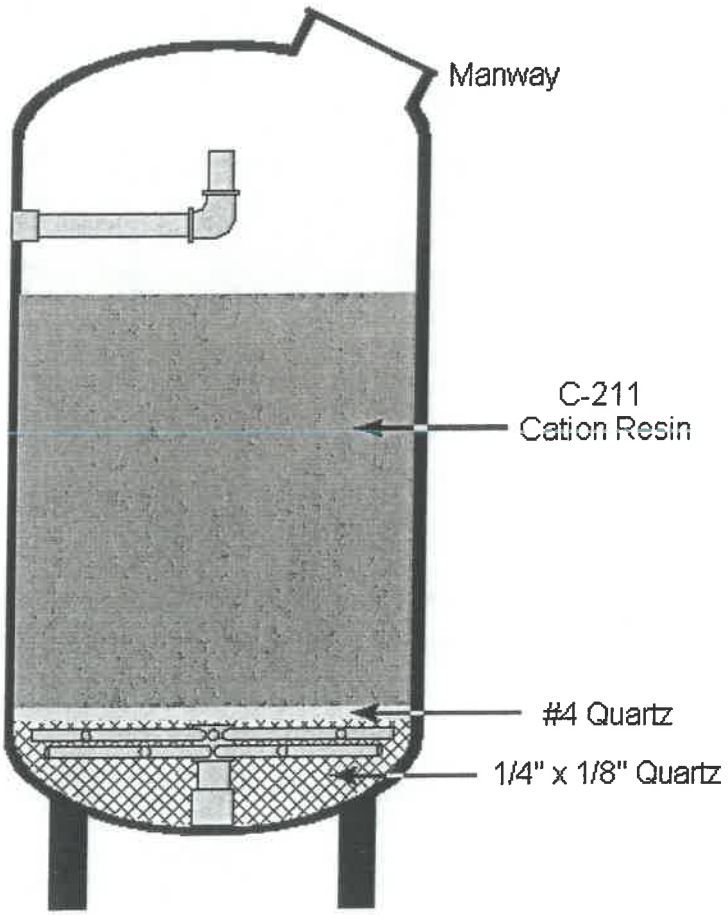
2.10.1 General Guidelines for Loading Softener Vessels

1. Remove the manway cover on the top or upper sidesheet of the vessel.

2. Prior to loading any quartz or resin into a vessel, all internal distribution laterals must be inspected, and the vessel must be cleaned to remove foreign material.

3. The vessel must be properly leveled and braced before loading begins.

2.10.2 Quartz Loading Procedures for Softener Vessels



1. There are two layer of support quartz for the softener. Refer to the equipment specifications for the sizes, types, and approximate quantities of quartz to be loaded into each vessel.

NOTE: *Extra quartz may be shipped with the system. Use only the amount required for your vessel size.*

While loading each softener, be sure to fill out the data form at the end of this Section.

2. Before loading any quartz, verify the manual drain valve (plus, deluxe and select trim packages) is closed. Then run water into the vessel until it is 24 to 34 inches over the top of the bottom distribution. This "water cushion" protects the distribution from damage.

3. Once the water cushion has been added, load the quartz (1/4" by 1/8" quartz) by slowly pouring it through the upper manway or the vessel's open top, leveling and filled to the depth listed in step 4.

NOTE: *If the water level in the vessel rises too high during the loading procedure, open the drain valve or low point drain and allow some of the water to drain out.*

4. Level the quartz layer as follows:
   a) drain the water to just above the top of the layer, and
   b) level the layer by using the water's surface as a guide.
   c) Make sure that all laterals have a layer of quartz 2 inches deep above them.

CAUTION To prevent media loss and excessive pressure drop, the ¼" x 1/8" quartz must cover the laterals by at least 2 inches.

5. After all of the first layer of quartz has been loaded, it must be rinsed to remove any dirt. There are two options:
   a. Backwash through the open manway, or
   b. Backwash at a flow rate higher than normal. This backwash flow must be unrestricted (such as from a flow-controller) and continued until the water is clear.

6. Drain down the water to the level of the quartz and re-level

7. Add the water cushion and repeat the process for the second layer of quartz. Add the required quantity (see specification) and repeat the rinse process.

2.10.3 Resin Loading Procedures for Softener Vessels

The following are general guidelines for loading media into the vessel.

1. Follow all of the equipment installation guidelines outlined in the previous sections.

2. Verify that the required quartz support bed has been properly installed as detailed in the previous subsection.

3. If media container labels are missing or there is doubt about any media's identity, contact your local representative or the media manufacturer.

   Prior to loading resin into process vessels, record the lot or batch number(s) of the resin. When loading the resin, record the installed location (vessel number or name) of each lot or batch of resin.

4. Larger resin quantities are most conveniently loaded using a large eductor. The eductor draw line is inserted directly into a shipping drum. The eductor outlet line is placed in the vessel manway. Once the eductor motive flow is started, a separate sluice line must be inserted into the drum to keep the resin fluidized.

   When transferring resin with an eductor, some of the vessel's water may have to be drained out as the transfer progresses.

5. If the cation resin is new, it must receive an initial backwash before being placed in Service. Perform all the following start-up procedures.

2.11 START-UP PROCEDURES

2.11.1 Brine System Setup – Up to 60" Diameter Softeners

1. Open the dilution water's isolation valve. Fill the brine tank with water until the air check valve on the draw piping is submerged. This marks the low brine level at which the "Brine In" step ends, and the "Slow Rinse" step begins
2. Carefully place about 6" of quartz across the bottom of the brine tank. This supports the salt to help prevent movement of the brine well and clogging of the brine well slots.
3. Carefully fill the brine tank with coarse rock salt to the low brine level. Distribute the salt evenly in the tank. This should be good for at least three regenerations.
4. Fill the brine tank with water to the brine draw height as shown on the brine tank drawing (same level as the float.) After approximately 8 hours on the initial fill, the concentration of the brine solution in the tank will be 26%. The brine should be allowed to set for a minimum of 4 hours on subsequent fills.
5. When introducing the brine into the softener for regeneration, the concentration of brine solution flowing to the softener vessel and measured at sample valve NV-1 or SP-01 should be 8% - 12%.

NOTE: *Salt for regeneration should be of a grade appropriate for the application. For general industrial applications, clean rock salt (containing no traces of oil or grease) at a minimum may be accepted. For high purity applications, higher purity grades of salt may be required to meet customer specifications. The higher the purity, the less frequent the quartz will have to be removed for tank cleaning.*

6. Adjust the float height on the brine refill assembly to close off the refill valve at the tank's current level. This will be the high brine level at which the brine tank refill ends.

2.11.2 Brine System Setup – 72" to 120" Diameter Softeners

1. Verify the Brine pumping skid has been installed, all process connections made, the brine maker contains a 26% brine solution, power has been connected and turned on, and interconnect with the softener control panel has been made per the electrical schematics or interconnect wiring diagram.
2. Verify PU-20 is in the Auto mode from the HMI.
3. Open the dilute manual isolation valve (HV-22) about 50%.
4. Open HV-21 about 25%.
5. When the softener setup and resin loading is complete, initiate a regeneration cycle.

6. Once the backwash has been completed, the softening unit will go into brine intro. As FV-05 opens, FV-20 should open and PU-20 turns on. The flows on the brine pump skid will need to be adjusted on FI-20 and FI-21 to the values listed in the specifications. Adjustments are made with HV-21 and HV-22, respectively.

7. When introducing the brine into the softener for regeneration, the concentration of brine solution flowing to the softener vessel and measured at sample valve SP-01 should be 8% - 12%.

NOTE: *Salt for regeneration should be of a grade appropriate for the application. For general industrial applications, clean rock salt (containing no traces of oil or grease) at a minimum may be accepted. For high purity applications, higher purity grades of salt may be required to meet customer specifications.*

8. Verify PU-20 turns off and FV-20 closes at the end of the brine-in process.

2.11.3 Softener Startup

1. Make sure the vent, sample, and drain valves (drain plug on an Economy) are closed.

2. Make sure that the plant waste system is ready to handle the wastes that will be generated by the softener system.

WARNING **Contact with electricity can cause burns, cardiovascular failure, or death. Take appropriate safety precautions.**

3. ECONOMY - Set up the stager controller following the manufacturer's guidelines. Input the initial control set points into the controller. See section 2.11.4.

4. PLUS, DELUXE, AND SELECT – Verify proper equipment setup from the Softener Setup 1 and Softener Setup 2 screens on the HMI. See section 2.11.5 for details.

5. Verify that the vessels have been properly loaded using the instructions in this section.

6. If required, verify that the air pressure regulator has been set to ensure that downstream pressure is equal to or greater than the feedwater pressure.

7. Perform a regeneration cycle on each unit using the regeneration procedures in this manual.

2.11.4 Controller Setup (Economy)

See programming pages of the Series 962 Electronic Stager Controls supplied with the manufacturer's literature.

2.11.5 HMI Setup (Plus, Deluxe, and Select)

The following parameters must be established prior to operation of the equipment:

Softener Setup 1 screen

Select Configuration
- Simplex
- Duplex Parallel
- Duplex Alternating
- Triplex Parallel
- Triplex 2 OL / 1 SB (2 Online / 1 Standby)
- Triplex Pro-Flo

Select Units For Flows
- GPM
- LPM
- M^3/Hr

Select Trim Package
- Plus
- Deluxe
- Select

Flow Setpoint For Standby Vessel Online (Pro-Flow Configuration)
- Enter setpoint for this parameter

Primary Vessel Assignment Rotation Time (Pro-Flo Configuration)
- Enter setpoint for this parameter

Set System Nominal Flow Rate
- Enter setpoint for this parameter

Brine Saturation Between Regens Time
- Enter setpoint for this parameter

This completes the start-up of the softener system.

3.0 OPERATION

This section gives the necessary procedures to operate the softener system, which consist of at least one softener vessel, a brine tank (60" diameter and smaller softeners) or a brine pumping skid (72" diameter and larger softeners), and either a controller (Economy) or a control panel (Plus, Deluxe, and Select) and solenoid panels (duplex and triplex 72" diameter softeners and larger).

3.1 FUNCTIONAL DESCRIPTION

3.1.1 Principle of Operation

Water softeners are typically used for treating boiler or RO feedwater to prevent scaling. Softeners use cation resin in the sodium form to reduce the water hardness to low levels. The amount of hardness leakage through the softener is dependent on the influent hardness concentration and salt dosage (pounds of sodium chloride [NaCl] per cubic feet of resin) used for softener regeneration. During the softening process, the hardness ions (mainly calcium and magnesium) are removed and replaced with sodium ions. To a lesser extent, the softener will also remove barium and strontium ions and trace metals such as aluminum and copper.

The cation resin has a fixed capacity for hardness removal. Once the resin capacity is exceeded, the resin is exhausted and will no longer be able to remove the hardness ions to the same degree and will allow significant levels of hardness to pass through the unit. Therefore, prior to exhaustion of the cation resin, the softener is removed from service and regenerated with a solution of sodium chloride (brine). The regeneration will displace the hardness ions to drain and restore the capacity of the cation resin. On 60" diameter and smaller softeners, a brine tank is provided with the softener to provide convenient storage of saturated brine solution (26% NaCl) for the regeneration. During the regeneration, water is mixed with the concentrated brine solution before contacting the resin to obtain the proper salt concentration. On 72" and larger units, a brine maker is required (by others) and connected with the supplied brine pumping/dilution skid. Salt dosages range between 6 to 15 pounds (lbs.) per cubic foot of resin, depending on the application and desired resin capacity. The higher salt dosage achieves higher resin capacities (up to 30 kilograins of hardness as $CaCO_3$ per cubic feet of resin) and lower hardness leakage.

3.1.2 Control Description

Economy

Control of the softener is accomplished with a solid-state, volume initiated controller with a membrane keypad and a rotary stager. These are used to set the cycle length for each step in the regeneration sequence. Additionally, the capacity of the ion exchange resin and the hardness of the feedwater can be entered to calculate the volume of water treated between regenerations. The solid-state controller has other features that are described in the manufacturer's literature included.

The rotary stager is a pilot device through which control fluid (water or air) is directed to either pressurize (close) or vent (open) the automatic valves on this system. A summary of the rotary stagers used on the Economy product line is shown below.

Simplex: The simplex softener uses a Model 948 stager with six ports.

Duplex: The duplex softeners use a Model 958 stager with 16 ports that controls both softeners. Duplex softeners operate in an alternating fashion as described below.

Plus, Deluxe, and Select

Low / Mid Flow

For Low / Mid Flow systems, the Softener controls are housed in a single NEMA 4 Control Panel mounted on the Simplex, Duplex, or Triplex Softener Skid. All skid wiring (for instrumentation, etc.) and pneumatic tubing (for automated valves) originate from this panel. This single Control Panel will provide control and monitoring for Simplex, Duplex, and Triplex Softener configurations.

High Flow

For High Flow systems, the Softener controls are housed in a single NEMA 4 Control Panel mounted on Unit A with individual Solenoid Panels providing valve control on each additional vessel (Unit B, or, Unit B and Unit C). All field wiring (for instrumentation, etc.) and pneumatic tubing (for automated valves) originate from the Control Panel for Unit A. For Unit B, or Unit B and Unit C; pneumatic tubing (for automated valves) originates from the Solenoid Panel(s). The Solenoid Panels contain the solenoid valves and terminal blocks for field wiring connections. High Flow vessels are free standing units (not skid mounted) and will require field wiring between the Control Panel and Solenoid Panel(s) by others.

3.1.3 Operating Modes

Economy

Simplex water softeners have two modes of operation: Service and Regeneration. When the day and time of the preset regeneration is reached, the water softener controller automatically begins the regeneration sequence. Afterwards, the softener returns to the Service mode. The regeneration mode has four steps: Backwash, Brine-In, Slow Rinse and Fast Rinse. Step times for the Backwash, combined Brine-In/Slow Rinse and the Fast Rinse are easily adjustable on the controller. The Brine-In step continues until the air check valve in the brine tank closes, at which time the softener enters the Slow Rinse step. The brine tank refills with a separate feedwater connection. An adjustable float operated refill valve will insure the precise liquid amount used during the next regeneration.

The water softener controller will automatically begin the regeneration sequence either immediately or at some preset delay. The volume initiated regeneration controller will display the volume remaining prior to the next scheduled regeneration.

Duplex systems have three operational modes: Service, Regeneration and Standby, and operate in alternating fashion. In alternating fashion, one water softener is in the Service mode while the other water softener is in the Regeneration or Standby mode. This provides a continuous, uninterrupted supply of softened water.

Plus, Deluxe, and Select

The Softener unit may be selected as "Offline" or "Online" by the operator from the HMI. Multiple units of different technologies (multi-media filter, carbon, softener, etc.) can be interlocked together so as to prevent more than one unit from entering a Wash Cycle or Regeneration Cycle at a time. Each Softener Unit operates continuously as long as it is selected as "Online" from the HMI and is not in a Regeneration Cycle. The Softener Unit has three (3) or four (4) main modes of operation (depending on configuration); Offline, Standby, Service, and Regeneration.

Further information regarding controls, equipment operation, valve sequences, and alarms of the Softener can be found on the following documents:

Low / Mid Flow

- S5132_001_CWU_x.doc — Detailed Description of Operation
- S5132_00y_OSM_x.xls — Operating Sequence Matrices
- S5132_001_IOL_x.xls — Listing of all I/O
- S5132_001_AL_x.xls — Alarm/Response Chart

High Flow

- S5132_021_CWU_x.doc — Detailed Description of Operation (this document)
- S5132_00y_OSM_x.xls — Operating Sequence Matrices
- S5132_021_IOL_x.xls — Listing of all I/O
- S5132_021_AL_x.xls — Alarm/Response Chart

Where "x" indicates revision number.
Where "y" refers to the configuration of the system (1=simplex, 2=duplex, and 3=triplex).

Service

During the service mode, water from the customer's source flows:

- into the softener vessel through the service inlet valve,
- into the top distribution piping,
- down through the softener bed,
- through the underdrain laterals and
- exits the softener through the service outlet valve.

Regeneration Cycle

During the regeneration mode, the ion exchange resin is backwashed to remove accumulated suspended solids, stripped of the hardness it had removed from the feedwater with sodium chloride (brine) and rinsed free of the brine. The concentrated brine diluted to a 7 to10% concentration prior to contacting the resin.

The regeneration mode has four steps:

1. Backwash
2. Brine-in
3. Slow rinse
4. Fast rinse

1. Backwash

During the backwash step, water from the customer's source flows through the softener vessel to remove accumulated suspended solids. The water flows:

- into the softener vessel through the backwash inlet valve,
- through the underdrain laterals,
- upwards through the resin bed,
- enters the upper distribution and
- exits the softener vessel through the waste outlet connection.

On the Economy trim package, a flow control orifice controls the backwash flow rate. On the Plus, Deluxe, and Select trim packages, travel stopped valves are adjusted to meet the flow requirements listed in the specifications. Sufficient flow is required to remove suspended solids, yet low enough to prevent resin loss during this step. The

backwash flow rate is approximately 5.5 gpm/ft.^{2} at 60°F. See the specifications for more details.

After a preset time, the backwash step terminates and the brine-in step is initiated. Backwash times are adjusted as follows

Economy - The backwash time can be set in increments of three minutes on the controller.

Plus, Deluxe, and Select – The backwash time can be set in increments of one minute on the HMI.

During the backwash step, the following valves are open:

- FV-03
- FV-04

2. Brine-In

All 60" Diameter And Smaller Units

During the brine-in step, water from the customer's source flows through the eductor, located on the brine tank, which will draw and dilute the concentrated brine. The diluted brine then flows into the softener vessel through the brine inlet valve, the top distribution, through the resin, out through the underdrain laterals and exits through the waste outlet connection.

The manual globe valve on the brine draw line, located at the brine tank, controls the flow rate of the concentrated brine.

The eductor is sized for a range of 40-60 psig with a suction lift of 3 ft to provide the correct dilution water flow rate.

When the float valve at the bottom of the brine tank closes, brine flow to the softener vessel is terminated and the softener will enter the slow rinse step. This step is approximately 30 minutes in duration.

During the brine-in step, the following valves are open:

- FV-05
- FV-06

All 72" Diameter And Larger Units

During the brine-in step, brine from the customers brine maker is supplied to the brine pumping skid. A Grundfos booster pump boosts the water pressure downstream, where it is mixed with dilution water to take the concentration from 26% to 8-10%. The diluted brine then flows into the softener vessel through the brine inlet valve, the brine distribution hub and radials, through the resin, out through the underdrain laterals and exits through the waste outlet connection.

The manual valves on the brine and dilution water lines, controls the flow rate of the brine.

When the PLC turns off PU-20 and FV-20 closes, brine flow to the softener vessel is terminated and the softener will enter the slow rinse step. This step is approximately 30-35 minutes for brine introduction. See the specifications for more detail.

During the brine-in step, the following valves are open:

- FV-05
- FV-06

3. **Slow Rinse**

All 60" Diameter and Smaller Units

During the slow rinse step, water from the customer's source flows through the eductor, located on the brine tank, but will not draw any concentrated brine because the check valve described above will prevent any further introduction of brine.

NOTE: *On the Economy trim package, there is no "Slow Rinse" step in the controller. It uses the combined time of the brine-in and slow rinse steps. The transition from brine-in to slow rinse is determined when the float valve located in the brine tank closes.*

The water then flows into the softener vessel through the brine inlet valve, the top distribution, through the resin, out through the underdrain laterals and exits through the waste outlet connection.

After a preset time, the slow rinse step terminates and the fast rinse step is initiated. On the Economy trim package, the combined brine-in and slow rinse time can be set in increments of three minutes. On Plus, Deluxe and Select, the rinse step can be set in increments of one minute.

During the slow rinse step, the following valves are open:

- FV-05
- FV-06

4. **Fast Rinse**

During the fast rinse step, water from the customer's source flows into the softener vessel through the service inlet valve, into the top distribution piping, down through the resin bed, through the underdrain laterals and exists the softener through the waste outlet valve.

The waste outlet valve (FV-06) controls the flow rate at approximately the service flow rate by setting the adjustable travel stop. After a preset time, the fast rinse step terminates and the softener enters the service mode or standby mode. On the Economy trim package, the fast rinse step time can be set in increments of three

minutes. On Plus, Deluxe, and Select, the fast rinse step time can be set in increments of one minute.

NOTE: *The fast rinse time duration should be based on the flow rate set with the adjustable travel stop on the waste outlet valve to achieve 48 gal/ft^3. The flow rate may be reduced to avoid overflowing the drain, however if reduced too far it will cause excessive backpressure during the Brine-in step preventing sufficient brine from being drawn into the eductor on 60" diameter units and smaller. If this happens, the travel stop will have to be adjusted open until the eductor draws brine correctly.*

On softeners with eduction brine draw, water from the customer's source is directed into the brine tank during this and subsequent steps to dissolve the dry salt for the next regeneration. The float operated brine valve will allow a precise amount of water to be added to the brine tank.

During the fast rinse step, the following valves are open:

- FV-01
- FV-06

Standby

After a vessel has completed the regeneration mode and if the unit is not called into service, the softener enters the standby mode. In this mode, all the valves are closed on the softener and no water is flowing to or through the softener. This softener will remain in the standby mode until called into service.

3.2 SPECIAL OPERATING PROCEDURES

On the Economy, Plus, and Deluxe trim packages, during the service mode, periodically sample the effluent at the vessel's lower sample valve and make sure that the product quality is acceptable. Refer to the Sampling & Testing section of this manual for typical sampling procedures. A chlorine monitor is available for procurement and use on the Plus and Deluxe trim packages. It comes as standard on the Select trim package.

4.0 SAMPLING & TESTING

This section gives the procedures needed to sample and test the softener system.

Selected sampling and testing procedures should be performed regularly during the operation of this system. A well-kept logbook of test dates, results, and operator observations is invaluable for troubleshooting performance problems. Any tests used with this system must be performed on a regular basis and must be accurately recorded in a logbook.

The frequency of sampling and testing is normally at the customer's discretion.

For further information on sampling and testing procedures, refer to the ASTM book of water standards.

4.1 TAKING SAMPLES FOR ANALYSIS

This section covers sampling and testing procedures specific to softener systems.

Prior to taking resin samples, be sure to have on hand an adequate supply of clean plastic bottles. Plastic sample bottles and bottle labels are available from your local service representative.

1. Resin samples should be taken after a complete backwash of the softener vessel.

CAUTION **When water is gravity-drained from a vessel, the vent plug must be removed or the vent valve opened near the top of the vessel. Failure to do so can cause the vessel to collapse due to the vacuum caused by the draining water.**

2. At the end of the backwash, remove the vent plug (or open the vent valve) at the top of the vessel and the plug (or open the drain valve) at the bottom of the piping manifold. Drain all water from the vessel.

3. Remove the upper manway or hand-hole at the top of the vessel.

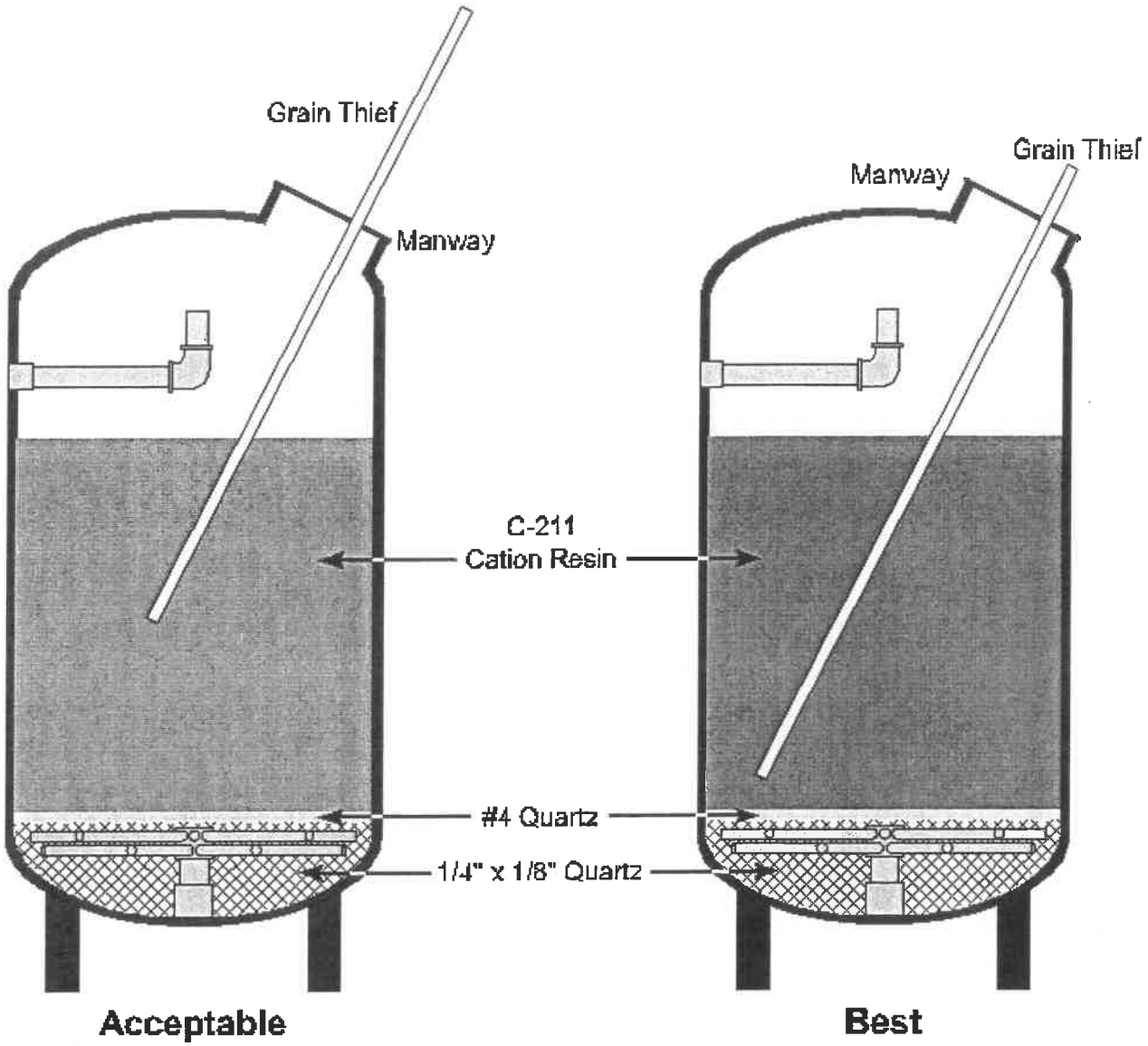
4. A sample must accurately indicate the condition of the entire resin bed. Use a "grain thief" or related device to take a core sample of the resin. Figure 4-1 demonstrates the use of a grain thief to take an accurate sample.

   Do not take a sample from only the top of the resin layer.

5. Take enough resin from the bed to fill a quart jar. Seal the jar tightly, and label it with the date, unit type (softener), and the sales order number on the inside of the controller door. Afterwards, send the sample to any lab with resin testing facilities.

   Contact Technical Support (see front cover) for current prices for resin testing services.

Figure 4-1: Media Sampling


Grain Thief
Manway
Grain Thief
Manway
C-211
Cation Resin
#4 Quartz
1/4" x 1/8" Quartz
Acceptable
Best

5.0 MAINTENANCE & TROUBLESHOOTING

This section provides periodic maintenance procedures to avoid problems with the softener system. While this liquid treatment system does not require substantial routine or periodic servicing (other than salt loading), certain maintenance procedures guarantee continued satisfactory operation. Listed in this section are components to use with this system, and their general inspection and maintenance procedures.

Because many of this system's instruments and mechanical components are complex, no specific instructions are given here for their maintenance or repair. Rather, this section is meant to alert operators and maintenance workers of general areas of required maintenance.

CAUTION

To avoid equipment damage, all plant-maintenance schedules and procedures must equal or exceed those recommended by the individual component manufacturers.

For specific and detailed maintenance procedures for individual components, refer to the manufacture's literature for that component.

NOTE: *If an approved plant-maintenance schedule exists and is followed regularly, such a schedule may be used as a substitute for many of the maintenance procedures given in the vendor literature.*

Unless an approved plant-maintenance schedule exists, be certain to follow the maintenance schedules recommended by the individual component manufacturers.

Most maintenance procedures for this equipment can be performed using common hand tools and plumbing equipment; any special tools required for individual components must be obtained from component manufacturers.

5.1 GENERAL MAINTENANCE GUIDELINES

NOTE: *Maintenance personnel should have a thorough understanding of the safety procedures outlined in this manual before attempting repairs or maintenance to this equipment.*

1. Before working on any of the components and equipment used with this system, workers must read and understand the safety-related material in this manual. Of special importance are the areas of equipment access, pressures, and servicing system components, and the precautions specific to the types of equipment in your system.

2. Only experienced technicians or maintenance workers familiar with the components and equipment used with this system should perform the maintenance procedures.

3. Workers who perform maintenance on the components and equipment used with this system should read and follow all component manufacturer's instructions and procedures.

4. Before attempting to perform maintenance on system components and equipment, and especially when attempting to disassemble individual components, workers must be certain that the components are isolated from pressure, fluids, and electricity.

   Spring-loaded devices, such as valves, should be in their "relaxed" state—that is, with no compression on the loading spring—to avoid the sudden and accidental motion of individual parts.

5. The Routine Maintenance Schedule Table contains typical maintenance schedules for the most commonly used system components. Use it as a guide only. For actual maintenance frequencies, refer to the component manufacturer's instructions.

Table 5-1: Routine Maintenance Schedule for a Softener System

PROCEDURE	RECOMMENDED INTERVAL
Influent and effluent water samples	Every six months or as required for diagnostic purposes.
Vessel and component painting	**As required**
Vessel and piping leak inspection	Weekly
Valve operation and leak checking	As required
Valve diaphragm replacement (Economy)	Annually
Instrumentation check by an independent lab	Every six months
Control panel and component maintenance	Weekly
Media sampling	Once a year or as required for diagnostic purposes
Media level check	When media is sampled
Inspect and clean brine tank	As required
Analyze bulk regenerant chemicals	Get assay for each truck load or chemical container/bag

5.2 COMPONENT MAINTENANCE

This subsection contains general maintenance procedures for the component types that are most often used on your system but not included in the supplied component literature.

The maintenance procedures for all other components on your system are covered by the component manufacturer's instructions.

5.2.1 Piping

The main piping on the system vessels is of Schedule 80 PVC or Schedule 10, 316L stainless steel. Any fasteners used on this piping may need periodic tightening to prevent leaks. If the system is operated within the temperature and pressure limitations given in this manual, little or no maintenance is required.

5.2.2 Feed Source and Product Storage

The feed supply and product storage area must be available for use and in good repair before attempting to operate the system.

5.2.3 Existing (Customer-Supplied) Equipment

Any existing (customer-supplied) equipment used with this equipment must be properly maintained and operated. Optimum performance of the equipment cannot be attained unless all other system components are operating properly.

5.2.4 Electrical Enclosures

Occasionally check any solenoid or other electrical enclosures to insure that the doors are closed tightly, and are latched or fastened properly. Water and other fluids must not enter the enclosures.

5.2.5 Control Panels/Controllers

Very little maintenance is required for control panels and their components. The following is a list of general guidelines for operators to use while operating and maintaining control panels.

1. Operators must be certain that the operating conditions for microprocessor controllers are within the ranges listed in the component manufacturer's instructions.

CAUTION **Do not place boxes or other items in front of air intakes.**

2. The controller must be properly grounded and protected from the possibility of static-electricity discharges.

3. Operators must monitor the condition of any controller backup battery and replace it as needed (Economy).

4. Control panel doors must be kept closed at all times to prevent excessive dirt or dust from collecting inside the panel.

5. If the control panel is located in a corrosive or damp atmosphere, the panel should be inspected and cleaned.

5.2.6 Contact Switches - Economy

Contact switches on the controller should be checked periodically for corrosion, debris, and loose or broken wires.

5.2.7 All Vessels

The vessels should provide many years of service with only minimal exterior maintenance (painting), provided the system is operated within the design pressure and temperature limitations.

If vessels are installed outside and are exposed to freezing temperatures, the vessels and their piping must be insulated and heated or else must be shut down and drained. When moving, they must be completely drained and must be handled carefully.

5.2.8 Lined Vessels

CAUTION

Welding on a lined vessel will damage the lining.

Never weld on a lined vessel or within 12 inches (30.5 cm) of the vessel.

The manufacturer guarantees all vessel linings against defective materials and workmanship for a limited period. Improper handling or storage procedures may void the lining guarantee. Follow all instructions given in this manual when handling or storing lined vessels.

5.2.9 Resins

CAUTION

Regeneration backwash flow rates must be monitored closely to prevent the loss of media through the backwash outlet.

The resin and support media are the most important part of the system, as it is responsible for the actual treatment process. The resin is also one of the most expensive components of the system. Its maintenance is a continual process through proper operation and backwashing. Strict attention to the operating conditions and the regeneration procedures is the best safeguard against premature resin loss and failure.

5.3 TROUBLESHOOTING

The section describes some of the common problems that can occur during the softener system's operation, and the steps to find their causes. Operators should read and be familiar with the rest of this manual before using this section.

5.3.1 General Troubleshooting Guidelines

1. The most helpful tool in troubleshooting problems is the operator's knowledge of the normal operating conditions. Then, if the system develops a problem, the operator may notice a change in operating conditions that could help him identify the cause of the problem.

   Selected sampling and testing procedures should be performed regularly during the operation of this system. While the actual frequency of sampling and testing is at the discretion of the customer, any tests used with this system must be performed on a regular basis and must be accurately recorded in a logbook.

   A well-kept logbook of test dates and results and of operator observations is an invaluable tool for troubleshooting future performance problems.

2. Verify that a problem really exists. An inaccurate instrument, or temporary change in feed quality, pressure or flow can indicate a problem where none exists.

3. Don't overlook these simple problems:

- A hand valve that is closed
- The power turned off to a control panel
- The power turned off to a pump
- Wires cut or disconnected
- Equipment damaged or missing
- Incorrect control setpoints
- Inaccurate instrumentation
- Plus, Deluxe and Select
  - An activated e-stop pushbutton
  - Improper parameters (Restore factory defaults if parameter(s) were changed incorrectly)

4. A large pressure drop can indicate a flow blockage. Check all system areas where water flow can be impeded until the blockage source is found.

5. To troubleshoot electrical problems:
   - Identify the control flow pattern, which is the pathway that the signal takes from an input device to the controller/control panel, through the controller/control panel, then to the output device.
   - Investigate all the components of this control flow pattern until the cause of the problem is discovered.
   - Start with the easiest and most probable components, such as the input and output modules (where applicable).

6. To troubleshoot an instrumentation problem, refer to the instrument manufacturer's service literature.

7. To troubleshoot problems with other equipment pieces, refer to the information available in the component manufacturer's service literature.

5.3.2 Troubleshooting Chart

This section provides operators with a quick-reference source while troubleshooting a problem with a softener system. The following chart highlights only the more common causes of the listed problems.

Table 5-3: Troubleshooting Procedures for a Softener System

PROBLEM	CAUSE	SOLUTION
Hardness in effluent water	Exhausted resin	Regenerate resin
	Channeling of resin bed	Backwash resin thoroughly.
	Iron interference on hardness check	Check test procedure.
	Unit overrun	Regenerate unit as soon as hardness appears and increases.
	Poor salt quality	Check salt quality
	Backwash inlet valve leaking feed into product	Check backwash inlet valve.
Water going to drain when unit has entered service	Low valve operating pressure	Check water supply pressure to stager (Economy) Verify proper air supply parameters (Plus, Deluxe, and Select)
	Debris caught in a valve	Move the valve through its full range.
	Service outlet, rinse outlet, and/or backwash outlet valves are leaking	Repair or replace faulty valve(s).
Shortened service run	Resin being lost from vessel	See "Losing resin from vessel" problem.
	Brine concentration is low	Adjust manual valve on brine line to ensure a 7 to 10% dilute brine solution is entering the softener. Ensure a minimum of 4 hours has elapsed since tank was refilled. Make sure brine tank has salt.
	Eductor not drawing brine	See "Eductor won't draw brine" problem.
	Brine concentration decreases before brine introduction time is complete.	Ensure brine concentration is correct. If not, adjust manual valve on brine line. Ensure brine tank salt level is NOT above the air check on the brine valve.
	Increase in feed hardness	Check water quality.
	Bacterial growth in resin bed	Regenerate or replace resin.

Losing resin from vessel	Backwash flow rate too high	Economy - Replace backwash flow controller or install a manual throttling valve in the backwash line. Plus, Deluxe, & Select - Adjust travel stop on backwash outlet valve.
	Broken bottom distributor	Replace distributor.
	Drop in water temperature	Lower backwash flow or raise water temperature.
Eductor won't draw brine	Eductor plugged	Clean eductor.
	Low / Excessive dilution flow	Check to see if dilution water pressure is between 40-60 psig. (High dilution flow may cause excessive backpressure).
	Excessive backpressure in vessel	Softener requires open drain.
	Brine draw maximum height exceeded	Verify eductor is within 3 feet above the brine draw inlet.
	Brine draw line plugged	Remove blockage.
	Brine well plugged	Remove blockage.
	Draw valve stuck	Remove and clean check valve.
Flow loss	Loss of feed flow	Check feed source.
	Stuck control valve	Repair affected valves
	Hand valve inadvertently closed	Open hand valve.
	Plugged/compacted resin bed	Perform wash cycle, increasing backwash flow if necessary. Mechanically loosen bed with rod.
	Valves not positioned properly	Verify valve position match OSM.
Pressure loss through resin bed	Resin bed plugged with particulates	Backwash better; check feed supply.
	Resin bed packed	Backwash better; loosen resin with prod or stick.
	Bottom distribution slots plugged with resin fines	Remove and clean distribution; backwash better.
	Bacterial growth in resin bed	Clean up or replace resin.

6.0 SHUTDOWN & STORAGE

6.1 TEMPORARY SHUTDOWN (NO MORE THAN FOUR DAYS)

Liquid treatment systems or units should not be shut down for any appreciable amounts of time without special storage procedures. Under certain circumstances, bacterial growth can occur quickly in water left stagnant within a vessel. Use the long term storage procedures in this section for shutdown periods longer than four days.

1. Turn off power to the controller or the control panel.

2. Close the manual isolation valves on the softener system's inlet and outlet lines, if supplied.

3. Vessels without pressure relief - Verify no pressure exists in the softener. Then slowly remove the vent plug (or open the vent valve) on top of each softener to prevent buildup of internal pressure.

4. Reverse the above procedures to return the softener to service.

5. Economy
   If power is temporarily interrupted, the controller will retain all of its programmed data and the number of days since the last clean-up. If the backup battery in installed, the time and water usage will also be maintained for up to 8 hours. The control will not initiate a clean-up while on battery backup. When power is restored, operation will continue as if no power outage had occurred.

   Plus, Deluxe and Select
   If power is temporarily interrupted, the PLC will retain all of its programmed data including setpoints entered on the HMI. When power is restored, the Softener will revert to Offline mode (fail-safe).

6.2 UNLOADING SOFTENER MEDIA

If the softener media must be removed for replacement, or if the vessel must be inspected, replaced or repaired, unload the media using the following procedures.

1. Turn off the power to the controller or control panel.

2. Close the manual isolation valves on the softener system inlet and outlet lines (supplied by others unless interconnecting option is purchased).

3. Slowly remove the vent plug (or open the vent valve) on top of each softener to relieve the vessel's internal pressure.

4. Remove the manway cover and insert a vacuum or siphon hose into the vessel through the manway. (High flow units (72" diameter and larger) have a 3" sluice port on the side

sheet. Drain the vessel, then attach the siphon hose.)

5. Open the manual isolation valve on the feedwater to a flow rate that will fluidize the media. If necessary, apply air or pneumatic pressure to the automatic drain valve to direct water flow upwards through the media bed.

6. Start the vacuum or the siphon to draw off the media. Throttle the feedwater isolation valve to maintain a steady level of water in the vessel.

7. When all media has been removed, close all valves.

8. When all of the resin has been unloaded, the quartz support bed can be removed (if required). The quartz may be removed by scooping, shoveling or siphoning.

CAUTION **Be careful not to damage the bottom distribution piping or vessel lining when removing a quartz support bed.**

9. Use the resin loading procedures in this manual when reloading the vessel.

NOTE: *If a quartz support bed is removed, do not reload the same bed in the vessel. Always obtain new quartz and reload as instructed in this manual.*

6.3 SOFTENER LONG TERM SHUTDOWN & STORAGE

1. Perform a normal backwash.

2. Shut down the softener(s) following the shut down procedures.

3. About once every five days, replace the vent plug (or close the vent valve) and open the manual isolation valve on the feedwater inlet. Allow water to flow to the drain for 5 to 10 minutes. If the system consists of two or three softeners, perform this procedure for each softener.

4. If the softener is exposed to temperatures of 32°F (0°C) or below, operators must drain the vessel, manifold piping, and valves, and remove the media to prevent damage from freezing water.

5. Components susceptible to moisture damage must be securely wrapped in plastic and covered with tarps.

6. PVC pipe must not be exposed to direct sunlight. High temperatures can distort and damage plastic piping.

7. Sunlight and high temperatures can damage vessel linings. Operators must verify that the sample valves are open and the vent plug is removed (or vent and drain valves opened) for circulation and pressure relief purposes.

8. Once each softener is ready to be returned to service, perform the start-up procedures as outlined in this manual, including a regeneration.

7.0 APPENDIX

7.1 RECOMMENDED SPARE PARTS LISTS

See the attached sheet(s) for Part Numbers, Descriptions, and Quantity used on the unit.

Contact Technical Support at the toll free number of this manual's front cover for current parts, prices and/or ordering information.

July 09, 2013

Equipment Spare Parts List for PTISPDA36X60

PART NO	DESCRIPTION	UM	QTY	TAG NO
03/31601-06	ALM, CONT TONE 24VDC MEDIUM	EA	1.0	AL1
03/34410-1100	CB, 1 POLE 10 AMP 480/277VAC UL489	EA	1.0	CB1
03/34410-1020	CB, 1 POLE 2 AMP 480/277VAC UL489	EA	2.0	CB4, CB5
03/34410-1050	CB, 1 POLE 5 AMP 480/277VAC UL489	EA	2.0	CB2, CB3
03/32665-04	CNCT, PROFIBUS 90 DEG CNCT	EA	1.0	
03/32665-02	CNCT, PROFIBUS 90 DEG CNCT W/ PG INTF	EA	1.0	
03/86850-01	CNVTR, SIGNAL OPTO NPN TO PNP TRML 300HZ	EA	2.0	OPTO-1, OPTO-2
03/34028-03	CORD, PATCH ETNT CAT 5E W/RJ45 3'	EA	2.0	
03/32661-01	CPU, SIEMENS CPU224XP AC/DC/REL 14/10	EA	1.0	
27/31904-28	CVR, 4 BRINE WELL	EA	1.0	
27/03806-04	CVR, TK 48" DIA HDPE	EA	1.0	
05/85869-43	EDU, PVC RED SOC 1 #542S-1	EA	1.0	
21/31623-01N	FLM, .5"-4" NIST SIGNET 2536	EA	2.0	FE-01, FE-02
49/32331-05	FLNG,COMP 4"FLNG X 3"FPT 1.25" THK NATPP	EA	4.0	
15/02332-03	GA, 0-100PSI 63MM .25NPT LIQ 316SS BM	EA	5.0	PI-01A, PI-02, PI-01B, PI-02
03/30542-03	LENS, PLT LT RED 22 MM SIEMENS	EA	1.0	LTR1
03/32661-20	MDL, S7-200 8PT 24VDC DO	EA	2.0	
03/32661-40	MDL, S7-200 COMM MODULE ENET	EA	1.0	
03/32661-02	MDL, SIEMENS EEPROM S7-200	EA	1.0	
18/33408-03	MON, SIEMENS TP177B 5.7" COLOR	EA	1.0	
05/14389-02	PLATE, END FOR 3 WAY STACKING VLV	EA	2.0	
03/30542-01	PLT LT, PWR MOD 24V 22 MM SIEMENS	EA	1.0	
03/32358-48	PWR SUPPLY, 24V 2A PHOENIX 2938730	EA	1.0	PS1
29/31859-01	QUARTZ, .250 X .125	CF	6.0	
29/31859-04	QUARTZ, .750 X .500	CF	6.0	
29/110001302	QUARTZ, NO. 4 KISCO	CF	2.0	
03/P91685	RES, .25W 10K 5% CRB FILM	EA	2.0	
29/109000060	RESIN, USF C-211B CATION, 1 CUFT BAG	CF	20.0	
05/85019-33	RGLTR, AIR BR NPT .12 0-160	EA	1.0	
03/31617-07	RLY, 24VDC INTERPOSING SPDT 6AMP	EA	3.0	CR1, CR2, CR3
03/30540-05	SW, 2 POLE MUSHROOM RED 22MM SIEMENS	EA	1.0	ES-1
03/30540-07	SW, CNTC BLC N/C 10AMP 22MM SIEMENS	EA	1.0	
03/30540-06	SW, CNTC BLC N/O 10AMP 22MM SIEMENS	EA	1.0	
03/32168-10	SW, ETNT 5 PORT 10/100TX 24VDC DIN	EA	1.0	SW1
03/30540-01	SW, MOM FLUSH PBTN 22MM SIEMENS	EA	1.0	PB1
03/30540-12	SW, YELLOW E-STOP PLATE	EA	1.0	
27/03774-13	TK, 360 GAL HDPE 48" X 48"	EA	1.0	
05/33813-16	VLV, BALL 1" FP FPT 3 PIECE	EA	2.0	HV-07A, HV-07B
05/31901-08	VLV, BRINE CNTL .5 PVC TYPE C	EA	1.0	
05/34665-16	VLV, BUT 1" WAF SS DSK EPDM FC EXT TS	EA	2.0	FV-05A, FV-05B
05/34666-20	VLV, BUT 2" LUG SS DSK EPDM FC EXT TS	EA	4.0	FV-03A, FV-06A, FV-03B, FV-06B
05/02952-24	VLV, BUT 3 W/ ACT NC BRAY 31	EA	4.0	FV-01A, FV-04A, FV-01B, FV-04B
05/02932-24	VLV, BUT 3" LUG SS DISK EPDM BRAY	EA	6.0	HV-01A, HV-02A, HV-03A, HV-01B, HV-02B, HV-03B
05/34666-24	VLV, BUT 3" LUG SS DSK EPDM FC EXT TS	EA	2.0	FV-02A, FV-02B
05/02461-04	VLV, LABCOCK .25 MPT X .25 FPT PVC	EA	4.0	SP-01A, SP-02A, SP-01B, SP-02B
05/85267-84	VLV, RLF 316/V .75MNPT X 1.25NPT	EA	2.0	PSV-01A, PSV-01B
05/02785-60	VLV, SOL 3WAY 181B 24VDC 60" LEAD	EA	14.0	FY-01A, FY-02A, FY-03A, FY-04A, FY-05A, FY-06A, FY-07A, FY-01B, FY-02B, FY-03B, FY-04B, FY-05B, FY-06B, FY-07B
05/85626-31	VLV, Y GLOBE .5 PVC PE IPS	EA	1.0	
49/S5100-A00E	VSL, 36X60 CS EP 100 PSIG ASME	EA	2.0	
27/31903-48	WELL, BRINE 4 X 48 SLOTTED	EA	1.0	

7.2 DRAWINGS & DOCUMENTS

Economy

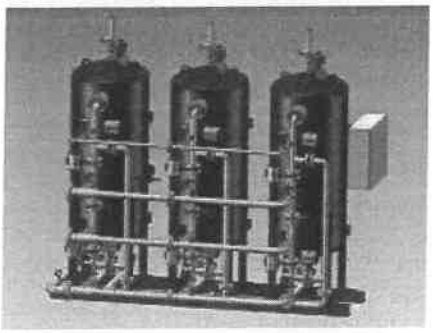
The drawings and documents specific to your softener system are included following this appendix. Documents included are the Equipment Specifications, P&ID, and General Arrangement Drawing.

Plus, Deluxe, and Select

The drawings and documents specific to your softener system are included following this appendix. Documents included are listed in the table below. In addition, an Acrobat file of HMI code and an Acrobat file of the PLC code are also provided.

Applies To	Configuration	Document #	Document Description
≤ 60" Diameter	All	S5130-020	Specifications
	All	Specific to Unit	P&ID
	All	Specific to Unit	GA
	All	XXXXXX-XX	Brine Tank GA
	All	Specific to Unit	Electrical Schematic
	All	S5132_001_CWU	Controls Write-Up
	All	S5132_001_IOL	I/O List
	All	S5132_001_AL	Alarm List
	Simplex	S5132_001_OSM	Operating Sequence Matrix
	Duplex	S5132_002_OSM	Operating Sequence Matrix
	Triplex	S5132_003_OSM	Operating Sequence Matrix
≥ 72" Diameter	All	S5131-020	Specifications
	All	Specific to Unit	P&ID
	All	Specific to Unit	GA
	72" - 84" Dia	S5130-230	GA - Brine Skid
	96" -120" Dia	S5130-240	GA - Brine Skid
	All	Specific to Unit	Electrical Schematic
	All	S5132_021_CWU	Controls Write-Up
	All	S5132_021_IOL	I/O List
	All	S5132_021_AL	Alarm List
	Simplex	S5132_001_OSM	Operating Sequence Matrix
	Duplex	S5132_002_OSM	Operating Sequence Matrix
	Triplex	S5132_003_OSM	Operating Sequence Matrix

Equipment Specifications
PTI Series Softener
(24"-60" Diameter)



GENERAL SYSTEM DESCRIPTION

General Description

The softening units are designed and manufactured for industrial applications in sizes from 24" to 60" diameter tanks. The units are available in three configurations (Simplex, Duplex, and Triplex) and with four packaged options (Economy, Plus, Deluxe, and Select). Triplex configurations are available on the Plus, Deluxe, and Select packages. Duplex and triplex configurations have multiple modes of operation to maximize operational flexibility.

They are rugged, pre-engineered, pre-assembled units that minimize expensive installation and start-up costs. They require simple utility connections, media loading, and minor configuration for immediate online service. The softener's simple design maximizes the efficiency and repeatability of the unit during the service and regeneration modes in order to provide a truly reliable water treatment unit.

Mechanical Description

The softener consists of steel pressure vessel(s) that contain C-211 cation resin along with 2 support bed layers. The pressure vessels are sandblasted, lined with an NSF approved material, and painted with a durable epoxy coating. The piping and tank internals are constructed of Schedule 80 PVC or Schedule 10, 316L stainless steel. Four structural steel legs, designed to meet International Building Code (IBC) to meet the requirements in 98% of North American installations, support each vessel. Duplex and triplex units are supplied with a structural steel beam frame under the vessel legs and interconnect piping. A relief valve sized for thermal expansion pressure relief is supplied on each tank as a part of the Plus, Deluxe, and Select packages.

Separate source backwash manifold option kits are available for Plus, Deluxe, and Select trim packages. See the Options section for ordering information.

One high-density polyethylene brine tank with cover is included with an eductor, a level controlled brine draw, and refill valve. The brine tank is designed as a "wet" system. This means the salt level in the tank is always below the air check on the brine draw valve. The brine tank is sized to hold enough salt for at least three consecutive vessel regenerations before additional salt must be loaded. The brine tank is shipped loose and will require a separate customer-supplied water connection to the brine tank for brine dilution/re-fill. Additionally, the customer must connect the brine tank to the softener with Schedule 80 PVC or similar corrosion resistant material.

An overview of the trim packages and the options associated with each follows on the next page.

Overview					
		Trim Packages			
Item	Detail	Economy	Plus	Deluxe	Select
Configurations	Simplex	X	X	X	X
	Duplex	X	X	X	X
	Triplex	-	X	X	X
Control		Stager	PLC/HMI	PLC/HMI	PLC/HMI
Vessel	Non - Code	X	X	X	X
	ASME	-	X	X	X
Face Piping	Material	PVC	PVC	316L SS	316L SS
Internals	Upper/Lower	PVC	PVC	PVC	316L SS
Separate Source Backwash		-	Option Kit	Option Kit	Option Kit
Other	Hardness Monitor	-	Option Kit	Option Kit	X
	DL Sight Glass	-	PVC	PVC	Borosilicate
	PSV (Thermal)	-	X	X	X
	Air Vent	-	Manual	Automatic	Automatic

Electrical Description

Economy

The softener is controlled by an Aquamatic® 962 series electronic controller. It is combined with an Aquamatic (948 or 958) stager in a NEMA-rated enclosure. The Aquamatic stager is a rotary style valve with multiple ports for directing fluid or air to operate the various valves installed in the softener system. This trim package is available in simplex or duplex alternating operation only.

Plus, Deluxe, and Select

The softener controls are housed in a single NEMA 4 Control Panel mounted on the Simplex, Duplex, or Triplex Skid. All skid wiring (for instrumentation, etc.) and pneumatic tubing (for automated valves) originate from this panel. This single Control Panel will provide control and monitoring for Simplex, Duplex, and Triplex configurations. The Control Panel is provided complete with a programmable logic controller and operator interface. An S7-200 Siemens Programmable Logic Controller (PLC) Processor is utilized to provide reliable control of the system's operating and safety functions. A Siemens 6" Color Touch Screen, Human Machine Interface (HMI), acts as the interface between the operator and the process. An Ethernet module is provided for communication with a SCADA or other control system.

Operational Description

The Softener has the following Modes of Operation and Regeneration Cycle steps based on the flow configuration and vessel arrangement (Simplex, Duplex, or Triplex configuration):

Simplex (all trim packages)

- Modes of Operation: 3 (Offline, Service, and Regeneration)
- Regeneration Cycle Steps: 4 (Backwash, Brine Intro, Slow Rinse, and Fast Rinse)

Simplex operation consists of one vessel that will run in Service mode. Upon request of a Regeneration Cycle, the unit will regenerate accordingly. After completion of the Regeneration Cycle, the unit will return to Service mode.

Duplex Parallel (Plus, Deluxe, and Select trim packages)

- Modes of Operation: 3 (Offline, Service, and Regeneration)
- Regeneration Cycle Steps: 4 (Backwash, Brine Intro, Slow Rinse, and Fast Rinse)

Duplex Parallel operation consists of two vessels that will both run in Service mode. Upon request of a Regeneration Cycle, both units will regenerate consecutively (Unit A, then, Unit B), leaving one unit online at all times.

Duplex Alternating (all trim packages)

- Modes of Operation: 4 (Offline, Standby, Service, and Regeneration)
- Regeneration Cycle Steps: 4 (Backwash, Brine Intro, Slow Rinse, and Fast Rinse)

Duplex Alternating operation consists of two vessels that will run with one in Service mode, and one in Standby mode. Upon request of a Regeneration Cycle, the vessel in Service mode will regenerate, while the vessel in Standby mode will enter Service mode.

Triplex Parallel (Plus, Deluxe, and Select trim packages)

- Modes of Operation: 3 (Offline, Service, and Regeneration)
- Regeneration Cycle Steps: 4 (Backwash, Brine Intro, Slow Rinse, and Fast Rinse)

Triplex Parallel operation consists of three vessels that will all run in Service mode. Upon request of a Regeneration Cycle, all units will regenerate consecutively (Unit A, then, Unit B, then, Unit C), leaving two unit online at all times.

Triplex 2 Online / 1 Standby (Plus, Deluxe, and Select trim packages)

- Modes of Operation: 4 (Offline, Standby, Service, and Regeneration)
- Regeneration Cycle Steps: 4 (Backwash, Brine Intro, Slow Rinse, and Fast Rinse)

Triplex 2 Online / 1 Standby operation consists of three vessels that will run with two in Service mode, and one in Standby mode. Upon request of a Regeneration Cycle, the vessels in Service mode will regenerate consecutively. The vessel in Standby will enter Service mode. After completion of the Regeneration Cycles, the last vessel to be regenerated will enter Standby mode.

Triplex Pro-Flo (Plus, Deluxe, and Select trim packages)

- Modes of Operation: 4 (Offline, Standby, Service, and Regeneration)
- Regeneration Cycle Steps: 4 (Backwash, Brine Intro, Slow Rinse, and Fast Rinse)

Triplex Pro-Flo operation consists of three vessels that will run with two in Service mode (Primary vessel and Secondary vessel), and one in Standby mode (Tertiary vessel). When product flow rises above a pre-defined setpoint, the vessel in Standby mode will enter Service mode. This vessel will return to Standby mode when product flow falls below the pre-defined setpoint. Upon request of a Regeneration Cycle, all units will regenerate consecutively (Primary vessel, Secondary vessel, then, Tertiary vessel). When a vessel is being regened, the remaining two vessels will be in Service mode. After completion of the Regeneration Cycles, the vessel assignment will return to the state they were in prior to the initiation of the Regeneration Cycle.

SYSTEM DESIGN SPECIFICATIONS

The design specifications for the PTI series softeners are listed in this section.

PRODUCT OFFERING OVERVIEW:

	Economy Product Flow Rates							
	Min. Flow (2 gpm/sqft)		3 gpm/cuft		5 gpm/cuft		7 gpm/cuft	
Model Number	Simplex	Duplex*	Simplex	Duplex*	Simplex	Duplex*	Simplex	Duplex*
PTIS 24X48	6.3	13	20	40	33	67	47	93
PTIS 30X60	9.8	20	45	90	75	150	105	210
PTIS 36X60	14	28	60	120	100	200	140	280
PTIS 42X60	19	38	105	210	175	350	245	490
PTIS 48X72	25	50	120	240	200	400	280	560
PTIS 54X72	32	64	150	300	250	500	350	700
PTIS 60X72	39	79	180	360	300	600	420**	840**

* While operating in a duplex alternating mode, the product flow rates are the same as a simplex unit.
** Not recommended due to high piping velocities.

	Plus, Deluxe, and Select Product Flow Rates (gpm)											
	Min. Flow (2 gpm/sqft)			Best Flow (3 gpm/cuft)			Better Flow (5 gpm/cuft)			Good Flow (7 gpm/cuft)		
Model Number	Simplex	Duplex*	Triplex**	Simplex	Duplex*	Triplex**	Simplex	Duplex*	Triplex**	Simplex	Duplex*	Triplex**
PTIS 24X48	6.3	13	19	21	42	63	35	70	105	49	98	147
PTIS 30X60	9.8	20	29	42	84	126	70	140	210	98	196	294
PTIS 36X60	14	28	42	60	120	180	100	200	300	140	280	420
PTIS 42X60	19	38	58	81	162	243	135	270	405	189	378	567
PTIS 48X72	25	50	75	105	210	315	175	350	525	245	490	735
PTIS 54X72	32	64	95	135	270	405	225	450	675	315	630	945
PTIS 60X72	39	79	118	168	336	504	280	560	840	392	784	1176

* While operating in a duplex alternating mode, the product flow rates are the same as a simplex unit.
** While operating in a 2 to 1 mode, the flow rates match a duplex unit. While operating in a progressive flow mode, the minimum flow rate matches the duplex

DESIGN PARAMETERS:

Configuration	Simplex (Economy, Plus, Deluxe, and Select) Duplex (Economy, Plus, Deluxe, and Select) Triplex (Plus, Deluxe, and Select)
Feed Temperature	60°F
Feed Pressure	45 psig
Maximum Inlet Turbidity*	5 NTU (Nephelometric Turbidity Units)
Maximum Inlet TDS*	750 ppm as $CaCO_3$ (29.2 grains/gallon)
Sizing: Service Flow Rate Backwash Flow Rate Rinse Flow Rate	 3 gpm/ft^3 5 gpm/ft^3 7 gpm/ft^3 5.5 gpm/ft^2 at 60°F (Economy) Adjustable on Plus, Deluxe, and Select Economy - Service flow Rate Plus, Deluxe, Select – 1.5 gpm/ft^3
Bed Depth	Economy – 26.5" to 37" Plus, Deluxe, & Select – 26.5" to 34.5" minimum
Freeboard	Economy - 36% tank free board (minimum) Plus, Deluxe, & Select - 50% tank free board (minimum)
Resin	Siemens C-211B cation resin, 8% cross-linked
Capacities	30,000 grains/ft^3
Regeneration	15 lbs (dry) NaCl per ft^3 (6.05 gallons of saturated NaCl/ ft^3)
Support Bed	3" depth of #4 quartz (1.54mm average size) 2" over laterals - ¼" x ⅛" quartz

* *If process is not within the given limit, then contact applications engineering for assistance.*

OPERATING LIMITS:

Feedwater Temperature: Minimum Maximum	 45°F 95°F for PVC piping systems 120°F for stainless steel piping systems
Feedwater Pressure: Minimum Recommended Maximum Maximum	 45 psig 90 psig max recommended to prevent premature discharge of pressure relief valve on Plus, Deluxe, and Select 100 psig max (Economy)

GENERAL SPECIFICATIONS:

Pressure Vessels

Tank Property	Unit Description	Description
Materials	All	Carbon steel
Rating	All Trim Packages	100 psig non-code
	Plus, Deluxe, Select	100 psig ASME code with stamp
Support:	Simplex - All	Four structural steel legs, Seismic IBC*
	Duplex - All	Four structural steel legs and two structure steel beams (skid), all Seismic IBC*
	Triplex / Plus, Deluxe, Select	Four structural steel legs and two structure steel beams (skid), all Seismic IBC*
Access Openings:	24"-30" dia.	Two 4" by 6" hand holes (top and bottom)
	36" dia.	One 4" by 6" hand hole and one 12" by 16" crab style
	42" – 60" dia.	One 12" by 16" crab style
Process Connections	All except vent	Carbon Steel pad flanges
	Vent	316L stainless steel FPT
Paint	All	4 to 6 mils DFT epoxy
Lining	All	8 - 16 mil DFT epoxy nominal (NSF-61 Approved)

* See Regulations and Standards for detailed seismic information.

Distribution Systems

Distributor	Unit Description	Description
Upper	Economy, Plus, Deluxe	Schedule 80 PVC Single point distributor
	Select	Schedule 10 316L stainless steel Single point distributor
Lower (under drain)	Economy, Plus, & Deluxe	Schedule 80 PVC hub and radial
	Select	316L stainless steel hub and radial

Piping Systems

Piping	Unit Description	Description
Face Piping	Economy, Plus	Schedule 80 PVC socket welded, flanged, threaded, and grooved connections (NSF Approved Fittings and Pipe)
	Deluxe, Select	316L stainless steel flanged, threaded, and grooved connections
Separate Source Backwash Option Header Kit	Duplex, Triplex	Plus - Schedule 80 PVC socket welded, flanged (NSF Approved Fittings and Pipe) Deluxe – 316L Stainless Steel, butt-welded, flanged

GENERAL SPECIFICATIONS (continued):

Process Valves

Package	Size	Description
Economy	3" and smaller	AquaMatic V52 series, Noryl™, angle pattern globe
	Actuator	Line pressure to open, hydraulic pressure to close
	4" and larger	Bray, cast iron butterfly with EPDM seats and stainless steel disk
	Actuator	Air to Close / Spring Open
Plus, Deluxe, Select	1" and larger	Air Vent – Plus: GF Series 546 PVC manual ball valve Deluxe and Select: Flow-Tek 316SS ball valve with RPTFE seat and PTFE seals (Manual on Plus, Automated on Deluxe and Select) Process - Bray, cast iron butterfly with EPDM seats and stainless steel disk (wafer design 1" through 1.5", lug design for 2" and larger). The brine valve as well as service, backwash, and drain outlet valves have adjustable travel stops to set flows.
	Actuation	Air to Open / Spring to Close

Sample Valves

Valve	Unit Description	Description
Inlet Sample	Economy, Plus	One ¼" PVC ball valve
	Deluxe, Select	One ¼" 316 SS plug valve
Product & Drain Sample	Economy, Plus	One ¼" PVC ball valve
	Deluxe, Select	One ¼" 316 SS plug valve

INSTRUMENTATION SPECIFICATIONS:

Instrument	Unit Description	Description
Pressure Gauges	All	316 SS, 63mm dial, FDA approved glycerin filled, ¼" NPT
Flow Sensors	Economy	Product - Signet 2536 paddlewheel
	Plus, Del, & Sel	Product & Drain - Signet 2536 paddlewheel
Hardness Monitor	Plus, Deluxe	Optional (See Options Section) Hach SP-510
	Select	Included – Hach SP-510
Pressure Differential Switch	Option Kit	316ss process connection and diaphragm, ¼" NPT

CONTROLS SPECIFICATIONS FOR TIMECLOCK CONTROLLER PACKAGE (ECONOMY MODEL):

Timeclock Controller	AquaMatic 948 (simplex) or 958 (duplex) stager with 962 controller
Timeclock Enclosure	NEMA 4X fiberglass

CONTROLS SPECIFICATIONS FOR PLC PACKAGES (PLUS, DELUXE AND SELECT MODELS):

Main control panel	Carbon Steel enclosure, frame mounted, NEMA 4, ANSI 61 gray
Programmable Logic Controller (PLC)	Siemens S7/200 CPU224XP w/ Ethernet
PLC input/output	Discrete 24 point (14 input and 10 output) (Expandable) Analog 2 input and 1 output (Expandable) Discrete 8 point output module(s) for larger configurations
HMI – Color Touch Screen	Siemens TP177B DP/PN with Ethernet
Shutdown alarms	Emergency Stop Pushbutton Activated
HMI status indicator/value	All alarms (popup alarm banner) Product flow, drain flow Process inlet, process outlet, backwash outlet, backwash inlet, brine inlet, rinse outlet valve status Softener status
HMI Switches / Pushbuttons	FV-07A Open (All configurations) FV-07B Open (Duplex & Triplex configurations) FV-07C Open (Triplex configurations) offline / online select Regeneration cycle method select Manual regeneration cycle initiate Regeneration cycle step advance Regeneration cycle step hold Totalized flow reached – regeneration cycle start delay Totalized product flow reset Alarm silence Alarm reset
Miscellaneous controls	Alarm horn and alarm pilot light Auxiliary contacts for fault

INTERFACE COMMUNICATION SPECIFICATIONS:

In regeneration cycle	Activation of this signal confirms that the Softener is in a regeneration cycle. (Dry contacts)
Fault	Activation of this signal confirms that the Softener is in a fault condition. (Dry contacts)
Backwash Pump (not included)	Activation of this signal confirms that the Softener is in backwash step of a regeneration cycle. (Dry contacts)

REGULATIONS & STANDARDS:

Pressure Vessel Codes	None *Optional:* ASME Section VIII
Surface Preparation	SSPC SP-10 for vessel interior SSPC SP-6 for external steel surfaces
Electrical	NEMA 4
Seismic Rating	IBC (2006) S_1 = 1.1 S_S = 2.5 Seismic Use = Group I Seismic Design Category = E Site Class = B Response Modification Factor = 3 Concrete = 3000 psi minimum ultimate 28 day strength.
Piping	Hydrotested to 100 psig

DOCUMENTATION PACKAGE:

Documents	Storage, installation and operating instructions
Drawings	Process & Instrumentation Diagram (P&ID), General Arrangement (GA) and Electrical Schematic (Plus, Deluxe, and Select)
Quality Documents	None *Optional:* U-1A form with ASME Code vessels

PRESSURE DROP SPECIFICATIONS:

All pressure drops are based on a simplex unit with a clean bed. Pressure drop includes all loses from the inlet flange to the outlet flange on the face piping. Interconnect piping on duplex and triplex systems are not included in these calculations. All values are approximate, based on sch80 PVC, and 77°F water.

ECONOMY

		Flow (gpm) / Pressure Drop (psi)						
	Config *	**24 x 48**	**30 x 60**	**36 x 60**	**42 x 60**	**48 x 72**	**54 x 72**	**60 x 72**
7 gpm/ft^3	S	50 / 19	105 / 12	140 / 20	245 / 23	280 / 10	350 / 14	420** / 19
5 gpm/ ft^3	S	35 / 12	75 / 8	100 / 12	175 / 14	200 / 6	250 / 9	300 / 11
3 gpm/ ft^3	S	20 / 6	45 / 4	60 / 6	105 / 7	120 / 4	150 / 5	180 / 6

* S is simplex. For Duplex systems, the flow rate doubles, but the pressure drop remains the same.
** Not recommended due to excessively high piping velocities.

PLUS, DELUXE, & SELECT

		Flow (gpm) / Pressure Drop (psi)						
	Config *	**24 x 48**	**30 x 60**	**36 x 60**	**42 x 60**	**48 x 72**	**54 x 72**	**60 x 72**
7 gpm/ft^3	S	49 / 14.4	98 / 18.8	140 / 13	189 / 15.1	245 / 13	315 / 14.6	392 / 17.2
5 gpm/ ft^3	S	35 / 10.5	70 / 12.9	100 / 10.5	135 / 10.9	175 / 9.8	225 / 10.8	280 / 11.9
3 gpm/ ft^3	S	21 / 7.6	42 / 8.7	60 / 7.5	81 / 7.9	105 / 7.5	135 / 7.9	168 / 8.3

* S is simplex. For Duplex systems, the flow rate doubles and for Triplex, the flow rate triples, but the pressure drop remains the same.

MEDIA SPECIFICATIONS:

ECONOMY

	Config*	Media Quantities ($ft.^3$ / lbs.)						
		24 x 48	30 x 60	36 x 60	42 x 60	48 x 72	54 x 72	60 x 72
Capacity (KGrains)	S	210	450	600	900	1,200	1,500	1,800
C-211 Resin	S	7 / 350	15 / 750	20 / 1,000	30 / 1,500	40 / 2,000	50 / 2,500	60 / 3,000
#4 Quartz	S	0.8 / 80	1.2 / 120	1.8 / 180	2.4 / 240	3.1 / 310	4 / 400	4.9 / 490
¼" by ⅛" Quartz	S	1.5 / 150	2.8 / 280	4.2 / 420	6.2 / 620	9.2 / 920	13 / 1,300	17 / 1,700

* S is simplex. For Duplex systems, double the media quantities / capacity.

PLUS, DELUXE, & SELECT

	Config*	Media Quantities ($ft.^3$ / lbs.)						
		24 x 48	30 x 60	36 x 60	42 x 60	48 x 72	54 x 72	60 x 72
Capacity (KGrains)	S	210	420	600	810	1,050	1,350	1,680
C-211 Resin	S	7 / 350	14 / 700	20 / 1000	27 / 1350	35 / 1,750	45 / 2,250	56 / 2,800
#4 Quartz	S	1 / 100	1 / 100	2 / 200	3 / 300	3 / 300	4 / 400	5 / 500
¼" by ⅛" Quartz	S	2.3 / 230	4 / 400	6 / 600	8.6 / 860	12.3 / 1230	17 / 1700	22 / 2200

* S is simplex. For Duplex systems, double the media /capacity quantities and for Triplex, triple the media / capacity quantities.

REGENERATION SEQUENCE, TIMES, AND FLOW RATE:

ECONOMY

Regeneration Step	Time (minutes)
Backwash	12
Brine Intro	30
Slow Rinse	21
Fast Rinse	15
Total Time	78

STEP	Flow Rate (gpm)						
	24 x 48	30 x 60	36 x 60	42 x 60	48 x 72	54 x 72	60 x 72
Backwash @ 60°F	17	27	39	53	69	87	108
Saturated Brine	1	3	4	6	8	10	12
Dilute (10%) Brine	4	8	11	17	22	28	34
Dilution Water	3	6	7	11	15	18	22

Slow Rinse	3	6	7	11	15	18	22
Fast Rinse*	SERVICE FLOW RATE						

* Rinse outlet valve is supplied with an adjustable travel stop for field set.

REGENERATION SEQUENCE, TIMES, AND FLOW RATE (continued):

PLUS, DELUXE, & SELECT

			Flow Rate (gpm)					
Step	Series (Dia-Side Sht)	Std. Duration (min)	<40°F	40°F to 50°F	50°F to 60°F	60°F to 70°F	70°F to 80°F	80°F to 90°F
Backwash*	24X48	15	13	16	17	19	22	24
	30X60		21	25	27	29	34	37
	36X60		30	35	39	42	49	53
	42X60		40	48	53	58	67	72
	48X72		53	63	69	75	88	94
	54X72		67	80	87	95	111	119
	60X72		82	98	108	118	137	147
Saturated Brine	24X48	30	1.4					
	30X60		2.8					
	36X60		4.0					
	42X60		5.4					
	48X72		7.0					
	54X72		9.0					
	60X72		11.2					
Dilute Brine 10%	24X48		3.9					
	30X60		7.8					
	36X60		11.1					
	42X60		15.0					
	48X72		19.4					
	54X72		25.0					
	60X72		31.1					
Slow Rinse	24X48	15	2.5					
	30X60		5.0					
	36X60		7.1					
	42X60		9.6					
	48X72		12.4					
	54X72		16.0					
	60X72		19.9					
Fast Rinse*	24X48	10	Service Flow Rate					
	30X60							
	36X60							
	42X60							
	48X72							
	54X72							
	60X72							

* Outlet Valve is provided with an adjustable travel stopped valve to be field set based on water temperature.

BRINE TANK SPECIFICATIONS:

Vessel Size (inches)	24 x 48	30 x 60	36 x 60	42 x 60
Brine Tank Diameter (inches)	24	30	48	52
Brine Tank Height (inches)	48	60	48	60
Operating Weight (lbs. worst case)*	980	1,897	3,918	5,702
Storage (lbs.)**	315	685	1,845	3,050
Storage (regeneration quantity)	3	3	4	4
Brine Draw (inches)	21	28	15	19

Vessel Size (inches)	48 x 72	54 x 72	60 x 72
Brine Tank Diameter (inches)	52	55	55
Brine Tank Height (inches)	60	70	70
Operating Weight (lbs. worst case)*	5,702	7,407	7,407
Storage (lbs.)**	2,555	3,360	2,860
Storage (regeneration quantity)	3	4	3
Brine Draw (inches)	25	29	34

* Based on Tank with 6" gravel and completely filled with 26% brine solution.
** Based on 83#/cuft salt density.

NOTE: *The brine tank requires a minimum salt volume for the brine refill to result in a saturated brine solution.*

CUSTOMER CONNECTION SPECIFICATIONS:

All connections are class 150 flanges or equivalent unless otherwise noted.

ECONOMY

	Config	24 x 48	30 x 60	36 x 60	42 x 60	48 x 72	54 x 72	60 x 72
Service Inlet / Outlet	S	1-1/2"	2-1/2"	2-1/2"	3"	4"	4"	4"
	D	2" / 1.5"	2-1/2"	3" / 2.5"	4" / 3"	4"	4"	6" / 4"
Drain	S	1-1/2"	2"	2-1/2"	3"	3"	4"	4"
	D	1-1/2"	2"	2"	3"	3"	4"	4"
Brine	All	¾"	1"	1"	1-1/2"	1-1/2"	1-1/2"	1-1/2"

PLUS

	Config	24 x 48	30 x 60	36 x 60	42 x 60	48 x 72	54 x 72	60 x 72
Service Inlet & Outlet	S	1-1/2"	2"	3"	3"	4"	4"	4"
	D	2"	3"	3"	4"	4"	6"	6"
	T	3"	3"	4"	4"	6"	6"	8"
Drain	All	1-1/2"	2"	3"	3"	4"	4"	4"
Brine*	All	1"	1"	1"	1-1/2"	1-1/2"	1-1/2"	1-1/2"
PSV Outlet	All	1-1/4" FPT						
Vent Outlet	All	1"						

* One brine connection per vessel.

DELUXE AND SELECT

	Config	24 x 48	30 x 60	36 x 60	42 x 60	48 x 72	54 x 72	60 x 72
Service Inlet / Outlet	S	1-1/2"	2"	2"	3"	3"	3"	4"
	D	1-1/2"	2"	3"	3"	3"	4"	4"
	T	2"	3"	4"	4"	4"	6"	6"
Drain	All	1-1/2"	2"	2"	3"	3"	3"	4"
Brine*	S/D	1"	1"	1"	1-1/2"	1-1/2"	1-1/2"	1-1/2"
PSV Outlet	All	1-1/4" FPT						
Vent Outlet	All	1"						

* One brine connection per vessel.

UTILITY REQUIREMENTS:

Vessel Size (inches)	24 x 48	30 x 60	36 x 60	42 x 60	48 x 72	54 x 72	60 x 72
Ambient air limitation	100°F maximum for all trim packages						
Electrical service	120 VAC/1 Phase/60 Hz/10 Full Load Amps						
Feedwater pressure range	All - 45 psig minimum Economy - 100 psig maximum Plus, Deluxe, and Select - 90 psig maximum recommended to prevent premature discharge of pressure relief valve						
Air (Plus, Del., Sel. and 60" Economy)	2 scfm @ 80 – 100 psig clean, oil-free, dry air						
Drain requirements	Floor & waste drains for general maintenance purposes						
Maximum Drainage (gpm)*	49	98	140	189	245	315	392

* Based on worst case service flow for a single unit (fast rinse).

PHYSICAL DIMENSION SPECIFICATIONS:

NOTE: *Dimensions do not include operating space requirements. All weights are approximate and are based on the heaviest options.*

SOFTENER ECONOMY MODELS

	Config	LENGTH (in / mm)	WIDTH (in / mm)	HEIGHT (in / mm)	SHIPPING WEIGHT* (lbs / kg)	OPERATING WEIGHT (lbs / kg)
24x48	S	41 / 1041	41 / 1041	76 / 1930	597 / 271	1494 / 679
	D	97 / 2464	41 / 1041	80 / 2032	1010 / 459	2809 / 1277
30x60	S	47 / 1194	51 / 1295	90 / 2286	560 / 255	2511 / 1142
	D	97 / 2464	51 / 1295	94 / 2388	1510 / 686	5018 / 2281
36x60	S	51 / 1295	57 / 1448	96 / 2438	1080 / 491	3603 / 1637
	D	101 / 2565	57 / 1448	100 / 2540	1989 / 904	7039 / 3199
42x60	S	55 / 1397	63 / 1600	100 / 2540	1284 / 584	4739 / 2155
	D	133 / 3378	63 / 1600	104 / 2642	2560 / 1164	9358 / 4254
48x72	S	62 / 1575	76 / 1930	118 / 2997	1706 / 775	7123 / 3237
	D	133 / 3378	76 / 1930	122 / 3099	3265 / 1484	14098 / 6408
54x72	S	65 / 1651	82 / 2083	121 / 3073	1918 / 872	8778 / 3991
	D	158 / 4013	82 / 2083	123 / 3124	4040 / 1836	17515 / 7962
60x72	S	70 / 1778	88 / 2235	127 / 3226	2369 / 1077	10840 / 4928
	D	158 / 4013	97 / 2464	127 / 3226	4699 / 2136	21641 / 9837

* Dry unit without media

PHYSICAL DIMENSION SPECIFICATIONS (continued):

SOFTENER PLUS MODELS

	Config	LENGTH (in / mm)	WIDTH (in / mm)	HEIGHT (in / mm)	SHIP HT. (in / mm)	SHIPPING WEIGHT** (lbs / kg)	OPERATING WEIGHT (lbs / kg)
24x48	S	40 / 1016	53 / 1346	91 / 2311	76 / 1930	615 / 280	1525 / 694
	D	69 / 1753	53 / 1346	95 / 2413	80 / 2032	1041 / 473	2861 / 1300
	T	97 / 2464	57 / 1448	95 / 2413	80 / 2032	1468 / 667	4197 / 1908
30x60	S	44 / 1118	57 / 1448	108 / 2743	93 / 2362	780 / 355	2550 / 1160
	D	88 / 2235	64 / 1626	112 / 2845	97 / 2464	1557 / 708	5096 / 2317
	T	128 / 3251	68 / 1727	112 / 2845	97 / 2464	2224 / 1011	7532 / 3424
36x60	S	51 / 1295	69 / 1753	110 / 2794	95 / 2413	1113 / 506	3659 / 1663
	D	91 / 2311	74 / 1880	115 / 2921	100 / 2540	2050 / 932	7141 / 3246
	T	131 / 3327	77 / 1956	115 / 2921	100 / 2540	2977 / 1353	10614 / 4824
42x60	S	59 / 1499	76 / 1930	117 / 2972	102 / 2591	1352 / 615	4807 / 2186
	D	110 / 2794	82 / 2083	121 / 3073	106 / 2692	2577 / 1171	9487 / 4312
	T	162 / 4115	82 / 2083	121 / 3073	106 / 2692	3668 / 1667	14033 / 6379
48x72	S	63 / 1600	87 / 2210	133 / 3378	118 / 2997	1796 / 816	6123 / 2784
	D	115 / 2921	88 / 2235	137 / 3480	122 / 3099	3437 / 1562	12096 / 5499
	T	169 / 4293	92 / 2337	137 / 3480	122 / 3099	5121 / 2328	18117 / 8235
54x72	S	68 / 1727	90 / 2286	137 / 3480	122 / 3099	2019 / 918	8879 / 4037
	D	134 / 3404	98 / 2489	143 / 3632	128 / 3251	3995 / 1816	17715 / 8053
	T	198 / 5029	98 / 2489	143 / 3632	128 / 3251	5887 / 2676	26467 / 12031
60x72	S	74 / 1880	96 / 2438	140 / 3556	125 / 3175	2494 / 1134	10965 / 4985
	D	140 / 3556	104 / 2642	146 / 3708	131 / 3327	4946 / 2248	21888 / 9949
	T	204 / 5182	104 / 2642	146 / 3708	131 / 3327	7310 / 3323	32722 / 14874

** Dry unit without media

SOFTENER DELUXE & SELECT MODELS

	Config	LENGTH (in / mm)	WIDTH (in / mm)	HEIGHT (in / mm)	SHIP HT. (in / mm)	SHIPPING WEIGHT** (lbs / kg)	OPERATING WEIGHT (lbs / kg)
24x48	S	41 / 1041	49 / 1245	91 / 2311	76 / 1930	748 / 340	1658 / 754
	D	70 / 1778	49 / 1245	95 / 2413	80 / 2032	1184 / 538	4723 / 2147
	T	98 / 2489	49 / 1245	95 / 2413	80 / 2032	1468 / 667	5611 / 2551
30x60	S	46 / 1168	59 / 1499	108 / 2743	93 / 2362	1071 / 487	2841 / 1292
	D	89 / 2261	59 / 1499	112 / 2845	97 / 2464	1964 / 893	5503 / 2502
	T	129 / 3277	61 / 1549	112 / 2845	97 / 2464	2620 / 1191	7928 / 3604
36x60	S	50 / 1270	69 / 1753	110 / 2794	95 / 2413	1247 / 567	3793 / 1724
	D	92 / 2337	74 / 1880	115 / 2921	100 / 2540	2358 / 1072	7449 / 3386
	T	132 / 3353	77 / 1956	115 / 2921	100 / 2540	3525 / 1602	11162 / 5073
42x60	S	56 / 1442	76 / 1930	117 / 2972	102 / 2591	1634 / 743	5089 / 2314
	D	110 / 2794	82 / 2083	121 / 3073	106 / 2692	3165 / 1439	10075 / 4580
	T	162 / 4115	82 / 2083	121 / 3073	106 / 2692	4755 / 2161	15120 / 6873
48x72	S	65 / 1651	82 / 2083	133 / 3378	118 / 2997	2024 / 920	7441 / 3382
	D	117 / 2972	82 / 2083	137 / 3480	122 / 3099	3867 / 1758	14700 / 6682
	T	169 / 4293	83 / 2108	137 / 3480	122 / 3099	5766 / 2621	22015 / 10007
54x72	S	70 / 1778	88 / 2235	137 / 3480	122 / 3099	2254 / 1025	9114 / 4144
	D	137 / 3480	90 / 2286	143 / 3632	128 / 3251	4431 / 2014	18151 / 8251
	T	202 / 5131	92 / 2337	143 / 3632	128 / 3251	6639 / 3018	27219 / 12373
60x72	S	69 / 1753	99 / 2515	140 / 3556	125 / 3175	2875 / 1307	11346 / 5158
	D	140 / 3556	99 / 2515	146 / 3708	131 / 3327	5691 / 2587	22633 / 10288
	T	207 / 5258	100 / 2540	146 / 3708	131 / 3327	8574 / 3897	33986 / 15448

** Weights are approximated for the heaviest unit with all options without media.

ORDERING INFORMATION MATRIX

Vantage® PreTreatment - Industrial (PTI) Softener

Sample Part Number:	PTIS	D	S	N	60X72

PTIS	Vantage® PTI Softener
TRIM PACKAGE	
E	ECONOMY - (PVC piping, Stager)
P	PLUS - (PVC piping, PLC/HMI)
D	DELUXE - (316L SS piping, PVC Internals, PLC/HMI)
S	SELECT - (316L SS piping & internal dist, PLC HMI)
SYSTEM CONFIGURATION	
S	SIMPLEX
D	DUPLEX
T	TRIPLEX (Plus, Deluxe, and Select Only)
VESSEL CODE	
N	NON-CODE
A	ASME Section VIII Div 1 (Plus, Deluxe, and Select Only)
VESSEL (Diameter x Shell Height)	
24X48	24" Dia X 48" Side Sheet
30X60	30" Dia X 60" Side Sheet
36X60	36" Dia X 60" Side Sheet
42X60	42" Dia X 60" Side Sheet
48X72	48" Dia X 72" Side Sheet
54X72	54" Dia X 72" Side Sheet
60X72	60" Dia X 72" Side Sheet

OPTION KITS (Separate PO line Items)

INSTRUMENTATION

Option	Option Kit #	Description
Hardness Monitor	W3T81708	Hach SP-510 Option kit for Plus and Deluxe Trim Packages
Pressure Differential Switch	W3T81815	Ashcroft, Differential Pressure Switch with PVC isolation valves, 316ss process connections and diaphragm, ¼" NPT

SEPARATE SOURCE BACKWASH MANIFOLD KIT

Part Number	Description	Material	Configuration	Tank Size
W3T82494	KIT, PTI SSBW 24" DPLX 316SS	316 SS	Duplex	24"
W3T82495	KIT, PTI SSBW 30" DPLX 316SS	316 SS	Duplex	30"
W3T82496	KIT, PTI SSBW 36" DPLX 316SS	316 SS	Duplex	36"
W3T82497	KIT, PTI SSBW 42" DPLX 316SS	316 SS	Duplex	42"
W3T82498	KIT, PTI SSBW 48" DPLX 316SS	316 SS	Duplex	48"
W3T82499	KIT, PTI SSBW 54" DPLX 316SS	316 SS	Duplex	54"
W3T82500	KIT, PTI SSBW 60" DPLX 316SS	316 SS	Duplex	60"
W3T82501	KIT, PTI SSBW 24" TPLX 316SS	316 SS	Triplex	24"
W3T82502	KIT, PTI SSBW 30" TPLX 316SS	316 SS	Triplex	30"
W3T82503	KIT, PTI SSBW 36" TPLX 316SS	316 SS	Triplex	36"
W3T82504	KIT, PTI SSBW 42" TPLX 316SS	316 SS	Triplex	42"
W3T82505	KIT, PTI SSBW 48" TPLX 316SS	316 SS	Triplex	48"
W3T82506	KIT, PTI SSBW 54" TPLX 316SS	316 SS	Triplex	54"
W3T82507	KIT, PTI SSBW 60" TPLX 316SS	316 SS	Triplex	60"
W3T82451	KIT, PTI SSBW 24" DPLX PVC	Sch 80 PVC *	Duplex	24"
W3T82452	KIT, PTI SSBW 30" DPLX PVC	Sch 80 PVC *	Duplex	30"
W3T82453	KIT, PTI SSBW 36" DPLX PVC	Sch 80 PVC *	Duplex	36"
W3T82454	KIT, PTI SSBW 42" DPLX PVC	Sch 80 PVC *	Duplex	42"
W3T82455	KIT, PTI SSBW 48" DPLX PVC	Sch 80 PVC *	Duplex	48"
W3T82456	KIT, PTI SSBW 54" DPLX PVC	Sch 80 PVC *	Duplex	54"
W3T82457	KIT, PTI SSBW 60" DPLX PVC	Sch 80 PVC *	Duplex	60"
W3T82458	KIT, PTI SSBW 24" TPLX PVC	Sch 80 PVC *	Triplex	24"
W3T82459	KIT, PTI SSBW 30" TPLX PVC	Sch 80 PVC *	Triplex	30"
W3T82460	KIT, PTI SSBW 36" TPLX PVC	Sch 80 PVC *	Triplex	36"
W3T82461	KIT, PTI SSBW 42" TPLX PVC	Sch 80 PVC *	Triplex	42"
W3T82462	KIT, PTI SSBW 48" TPLX PVC	Sch 80 PVC *	Triplex	48"
W3T82463	KIT, PTI SSBW 54" TPLX PVC	Sch 80 PVC *	Triplex	54"
W3T82464	KIT, PTI SSBW 60" TPLX PVC	Sch 80 PVC *	Triplex	60"

* Available at time of order only.