

**SECTION 22 31 11
WATER SOFTENERS**

SPEC WRITER NOTES:

- 1. Delete between //--// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraph.
- 2. The "Safe Drinking Water Act" (SDWA) was originally passed into law in 1974. It was amended several times. The "Reduction of Lead in Drinking Water Act" was passed in January 2011 and amends the SDWA to the new lead free standard to include NSF 61 and NSF 372.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide sodium cycle, cation exchange, pressure type, water softening equipment complete with piping services, electrical services, controls, accessories and auxiliary equipment.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- //D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- //E. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
- F. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- //G. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.//

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings:
Classes 25, 125, 250
 - B16.3-2011.....Malleable Iron Threaded Fittings: Classes 150
and 300

- I. National Electrical Manufacturers Association (NEMA):
 - ICS 6-1993 (R2001, R2006) Industrial Control and Systems:
 - Enclosures
- J. NSF International (NSF):
 - 61-2014a.....Drinking Water System Components - Health
 - Effects
 - 372-2011.....Drinking Water System Components - Lead Content
- K. Underwriters' Laboratories, Inc. (UL):
 - 979-2005 (R2014).....Standard for Water Treatment Appliances

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 31 11, WATER SOFTENERS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Softener tank construction, coatings and linings. Bio-based materials shall be utilized when possible.
 - 2. Tank distribution system design.
 - 3. Main operating valve.
 - 4. Control system and flow meter.
 - 5. Wiring diagram for controls.
 - 6. Exchange resin.
 - 7. Brine system.
 - 8. Accessories including pressure gages and test kit.
 - 9. Performance data including normal and maximum flow and pressure drop. Certification that required performance shall be achieved.
 - 10. Piping.
- D. Complete detailed layout, setting, arrangement, and installation drawings including electrical/pneumatic controls. Drawings shall also show all parts of the apparatus including relative positions, dimensions, and sizes and general arrangement of connecting piping.
- //E. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the

date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

//F. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

1.5 QUALITY ASSURANCE

A. Bio-Based Materials: For products designated by the USDA’s Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

1.6 PROJECT CONDITIONS

A. Water sample shall be tested by USEPA certified testing laboratory. Sample shall be taken by // water softener equipment contractor // VA // and submitted for testing.

B. Influent Water Analysis:

Component	Concentration (mg/L)
Alkalinity	_____
Aluminum	_____
Arsenic	_____
Barium	_____
Cadmium	_____
Carbonate Hardness as Calcium Carbonate	_____
Free Carbon Dioxide Calcium Carbonate	_____
Methyl Orange as Calcium Carbonate	_____
Noncarbonate Hardness as Calcium Carbonate	_____
Phenolphthalein as Calcium Carbonate	_____
Total Hardness as Calcium Carbonate	_____
Chlorides	_____
Residual Chlorine	_____
Chromium	_____
Copper	_____
Fluoride	_____
Dissolved Iron	_____
Total Iron	_____
Lead	_____
Magnesium	_____

Manganese _____
 Mercury _____
 Nickel _____
 Nitrates _____
 Odor _____
 Dissolved Oxygen _____
 Conductivity pH _____
 Color by Platinum Standard Comparison _____
 Silica _____
 Silver _____
 Sodium _____
 Sodium Potassium _____
 Total Dissolved Solids _____
 Sulphate _____
 Turbidity in Nethlometric Turbidity units _____
 Zinc _____

Confirm the analysis with current samples and tests.

C. Design Parameters:

Normal System Flow and Pressure Drop: _____ L/s @ 100 kPa (_____ gpm @ 15 psig)

Maximum System Flow and Pressure Drop: _____ L/s @ 100 kPa (_____ gpm @ 25 psig)

Backwash/Rinse Flow: _____ L/s (_____ gpm)

Backwash Volume: _____ liters nominal (_____ gallons nominal)

Daily Water Usage: _____ liters per day (_____ gallons per day)

Volume of soft water between regenerations: _____ liters (_____ gallons) min.

Daily Hours of Water Demand: _____

Operating Temperature Range: 4 to 49 degrees C (40 to 120 degrees F)

Operating Pressure Range (System): _____ - _____ kPa (_____ - _____ psig)

Electrical Requirements: Dedicated 120 v, 60 Hz, 1 phase receptacle.

1.7 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.

- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be // in electronic version on compact disc or DVD // inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CADD version //____// provided on compact disc or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

SPEC WRITER NOTE: Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Update and specify only that which applies to the project.

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead is prohibited in any potable water system intended

for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.

2.2 SOFTENING SYSTEM

- A. Vertical, down flow, pressure type with automatic controls to operate on sodium cycle. Automatic-alternating duplex units. Designed for 690 kPa (100 psig) working pressure. All materials exposed to water shall be considered as generally safe by the Food and Drug Administration (FDA). System shall comply with UL 979.
- B. Performance Requirements:
1. Continuous flow of zero hardness soft water (use hardness test strips) with influent water conditions and flows listed in Part 1, with only one of the duplex units in service.
 2. Exchanger material shall not wash out of apparatus during any softening run regardless of rate of flow.
 3. Turbidity and color of treated water shall not increase above that of raw water.
 4. Dirty or turbid water shall not occur during any softening run, regardless of changes in demand rate.
 5. Strainer system, gravel bed, and exchange material shall not become fouled, either by turbidity in the raw water, or by dirt, rust or scale from pipe to the extent to render backwash ineffective.
 6. Regeneration shall be accomplished within a period of 75 minutes and occur not more than once per day. Regeneration period shall be that part of cycle of operation from the time unit has delivered its softening capacity until it is ready to be delivering soft water again, including all backwashing, brining and brine washout, complete. Amount of salt necessary to completely recondition unit after a capacity run shall not exceed 240 kg per cubic meter (15 pounds per cubic foot) of existing material.

SPEC WRITER NOTE: Choose steel or FRP tank construction. Steel with ASME construction is recommended for durability and quality of construction and resistance to shock loads such as water hammer or impacts. ASME construction may be required in certain jurisdictions. FRP is subject to impact failure, cannot withstand a vacuum and is not suitable for seismic areas.

- C. Softener Tanks-Steel:

1. Butt-welded steel conforming to ASTM A6/A6M. Test hydrostatically at 1.5 times the design pressure and provide certification. // Conform to ASME Boiler and Pressure Vessel Code, Section VIII. Provide stamp on tank and written certification. // Sidewall height shall be adequate to allow 50 percent of the mineral bed depth for expansion. Tanks shall have openings for mineral filling and removal. Provide steel supports welded to tank before testing and labeling to hold tanks in operating position above floor // and designed to resist seismic loading as required by IBC. Provide seismic calculations//. Exterior shall be degreased, cleaned, and coated with manufacturer's standard prime and finish coatings. Interior shall have near-white sandblast and lined with phenolic epoxy, 0.20 to 0.25 mm (8 to 10 mils) thick. Interior coating shall be chemically inert, non-toxic, odorless and meet the requirements of CFR 21, Chapter 1, Part 175.300. Bio-based materials shall be utilized when possible.
 2. Fiberglass Reinforced Plastic (FRP): Polyester reinforced by a continuous roving glass filament overwrap. Hydrostatically test at design pressure and provide certification to comply with ASME Boiler and Pressure Vessel Code, Section X. Support on a molded structural base. Tanks shall have flanged openings for mineral filling and removal. Provide vacuum breaker.
- D. Distribution System: Soft water collector and backwash water distributor shall be non-clogging, single point and hub radial laterals, designed to not cause channeling in the bed, PVC, Schedule 80. The distributor system shall be fully covered by one layer of quartz under-bedding with no debris or fines mesh size from 16 to 40 and above.
- E. Exchange Material: Solid virgin high capacity styrene base resinous material. Material shall be stable over the entire pH range with resistance to bead fracture from attrition or osmotic shock. Particle size 20 to 50 mesh and contain no agglomerates, shells, plates or other shapes that might interfere with the functioning of the softener. Exchange capacity as CaCO₃ shall be considered to be 840 grains per cubic meter (23.8 grains per cubic foot) at 240 kg per cubic meter (15 pounds per cubic foot) salt dosage. Resin shall not require dosing or addition of any chemical, mixture, or solution to the water requiring treatment, or the water used for backwashing, other than NaCl for

regeneration. Resin shall be FDA compliant under CFR 21, Chapter 1, Part 173.25.

- F. Brine Measuring Tank with Cover: Rotationally molded high density polyethylene. Tank sized to provide a minimum of four regenerations per load of salt at a full salting. Tank shall include elevated salt plate and a chamber to house the brine valve assembly.
- G. Brine System Controls: Automatic valve shall open to admit brine to softener and close to prevent air admission to the softener. During refill, the valve shall regulate flow of soft water to the brine tank. Provide float-operated safety valve to prevent brine tank overflow.
- H. System Controls:
 - 1. The controller shall be completely automatic and shall sequence all steps of regeneration and return the softener to a service or stand-by mode and alternate the duplex units. Selectable time or flow meter initiated regeneration. The initiating time or volume set points shall automatically reset upon initiation of the regeneration sequence. Controller shall permit manual initiation of regeneration.
 - 2. Computer-based field-programmable controller with selectable flow meter based and time clock based operating cycles. The controller shall utilize alphanumeric, self-prompting programming for simple startup. EEPROM memory shall store program data eliminating need for battery back up on configuration input after power loss. Self-diagnostic and capable of emitting an audible error signal and displaying error-specific messages. Lockout function to prevent unauthorized access to the program data. Sealed keypad with capability of all programming functions. Fluorescent alphanumeric display on face of controller. Enclose controls in NEMA ICS 6; Type 4X enclosure mounted approximately 1.5 meters (5 feet) above the floor.
 - 3. Operating conditions shall be continuously monitored and display shall show time of day, volume remaining before next regeneration, number of regenerations in last 14 days, number of days since last regeneration, instantaneous flow rate, resettable totalized flow since the last regeneration, time of next regeneration, and identify the cycle that is in progress.
 - 4. Flow shall be regulated to prevent resin loss, operate between 200 and 690 kPa (29 and 100 psig) supply pressure, and prevent noise and

- hydraulic shock. Control shall permit only one unit to regenerate at a time.
5. Flow meter shall have turndown range of 60/1, minimum accuracy of +/-1 percent of maximum range, repeatability of +/-0.5 percent of full range. Install with manufacturer's recommended straight pipe before and after the meter.
 6. Main operating valve shall be a fully automatic multiport diaphragm type or valve nest constructed of cast iron or corrosion resistant alloy material with hard-coat anodization and final coat of flouroplate polymer. Coating shall resist 1000 hour/5 percent salt spray test without sign of corrosion. Bio-based materials shall be utilized when possible. Valves shall be slow opening and closing, free of water hammer; diaphragm assembly shall be fully guided. All valve parts accessible for service. The main operating valve shall include a valve mounted automatic self-adjusting brine injector to draw brine and control rinse at a constant rate regardless of water pressure in the range of 200 to 690 kPa (29 to 100 psig). Valve shall have soft water sampling cock and indicator to show system status.
- I. Sampling Cocks: Provide for hard and soft water.
 - J. Sodium Chloride: Fed. Spec. A-A-694D. Provide sufficient quantity for ten regenerations.

2.3 EXTERNAL SOFTENER PIPING

- A. Pipe: ASTM A53/A53M, // galvanized, Schedule 40 // stainless steel // PVC, ASTM D1785, Schedule 80 //.
- B. Fittings: // Malleable iron, ASME B16.3, or coated cast iron, ASME B16.1, Class 125 // PVC, Schedule 80 // stainless steel //.
- C. Flanges: ASME B16.1, Class 125.
- D. Threaded Joints: Shall be made with ends reamed out. Apply bituminous base lubricant or fluorocarbon resin tape to male threads only. Bio-based materials shall be utilized when possible.

2.4 BRINE PIPING

- A. Polyvinyl chloride (PVC), ASTM D1785, Schedule 80 with solvent welded joints.

2.5 VALVES

- A. Ball: Carbon steel body, stainless steel trim, reinforced Teflon seat and seal, full port, threaded ends.

2.6 PRESSURE GAGES

- A. ASME B40.100, Grade A, 1 percent accuracy, 115 mm (4-1/2 inches) diameter, all metal case, bottom connected. White dials, black hands, graduated from 0 to 690 kPa (0 to 100 psig) and identity labeled. Provide gages with gage cocks at softener hard water inlet and soft water outlet to show pressure drop thru softener.

SPEC WRITER NOTE: Use backflow preventer, only for softener serving boilers.

2.7 REDUCED PRESSURE BACKFLOW PREVENTER

- A. Provide on suction side of water softener serving boilers. Parts shall be made of corrosion-resistant materials and shall be of heavy duty construction, 861 kPa (125 psig) class minimum. Backflow preventer shall meet the requirements of ICC IPC, ASSE 1013, and AWWA C511.

2.8 WATER TESTING EQUIPMENT

- A. Furnish water testing hardness test strips which measure 0-25 grains of hardness with minimum bottle of 50 strips with color code chart for reading test strips.

PART 3 - EXECUTION

3.1 REQUIRED TECHNICAL SERVICES

- A. Provide services of a qualified manufacturer's representative to check complete installation for conformance to manufacturer's recommendation, put system into service, make all adjustments required for full conformance to design and specified requirements, and perform all demonstrations and tests.

3.2 FLUSHING AND DISINFECTING

- A. Flush and disinfect new water lines and softener interiors in accordance with AWWA C651.
- B. Material:
 - 1. Liquid chlorine: AWWA B301.
 - 2. Hypochlorite: AWWA B300.

3.3 STARTUP AND TESTING

- A. Operating: Tests shall be conducted in presence of COR. It is prohibited, for testing purposes, to add to or subtract from exchange material used in apparatus, neither will any regenerating agent, other than the solution specified, be permitted.
- B. Procedure:
 - 1. Regenerate system to demonstrate operation of multiport valve.

SPEC WRITER NOTE: See Article, PROJECT CONDITIONS for required flow rates.

2. Operate each softener at constant maximum required capacity for ten minutes after soft water is produced. When necessary, waste softened water to sewer to maintain above flow rate. Contractor shall submit samples to a USEPA certified testing laboratory. A certified test report shall be prepared indicating hardness levels are within the specified range. Hardness shall be less than 50 mg/L or as specified.
 3. Demonstrate all features of the control system including diagnostics and flow and cycle indications.
- C. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

//3.4 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.5 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hours to instruct VA Personnel in operation and maintenance of units.
- //B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

//3.6 MAINTENANCE SERVICE

- A. Provide full maintenance contract for // // months by service technician of water softener manufacturers, including preventative maintenance as required for proper operation of water softener equipment. Servicing company shall be within 2 hours drive and be capable of responding within 6 to 8 hours.//

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