

SECTION 22 31 11
WATER SOFTENERS
01-01-14

PART 1 – GENERAL

1.1 DESCRIPTION:

Provide sodium cycle, cation exchange, pressure type, water softening equipment complete with piping services, electrical services, controls, accessories and auxiliary equipment.

1.2 RELATED WORK:

- A. Preparation and finish painting: Section 09 91 00, PAINTING.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

1.3 SUBMITTALS:

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Softener tank construction, coatings and linings.
 - 2. Tank distribution system design.
 - 3. Main operating valve.
 - 4. Control system and flow meter.
 - 5. Exchange resin.
 - 6. Brine system.
 - 7. Accessories including pressure gages and test kit.
 - 8. Performance data including normal and maximum flow and pressure drop.
Certification that required performance will be achieved.
 - 9. Piping.
- C. 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.
- D. Completed System Readiness Checklist provided by the Commissioning Agent 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.

1.4 PROJECT CONDITIONS:

- A. Contractor shall obtain the latest water analysis information prior to bidding and submit water analysis with the softener shop drawings/submittal:

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 Nephelometric Turbidity units _____

Zinc _____

Confirm the analysis with current samples and tests.

B. Design Parameters:

Backwash Volume: variable liters nominal (variable gallons nominal)

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

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

Daily Hours of Water Demand: 24hrs

Operating Temperature Range: 4 – 50 degrees C (40 – 120 degrees F)

Operating Pressure Range (System): 413 – 551 kPa (60 – 80 psig)

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

1.5 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. Federal Specifications (Fed. Spec.):

A-A-694D.....Sodium Chloride, Technical

C. American Society of Mechanical Engineers (ASME):

B16.1-1998Cast Iron Pipe Flanges and Flanged Fittings

B16.3-2006.....Malleable-Iron Threaded Fittings Classes 150 and 300

B40.100-2005Pressure Gages and Gage Attachments

Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, 2007

D. ASTM International (ASTM):

A53/A53M-07Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

D2665-04ae2.....Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Piping and Fittings.

E. American Water Works Association (AWWA):

B300-10Hypochlorites

B301-10Liquid Chlorine

C651-05.....Disinfecting Water Mains

F. National Electrical Manufacturers Association (NEMA):

ICS-6-1993(R2006.....Industrial Control and Systems: Enclosures

G. Department of Health and Human Services, Food and Drug Administration (FDA):

CFR 21, Chapter 1, Part 173.25, Ion-Exchange Resins

CFR 21, Chapter 1, Part 175.300, Resinous and Polymeric Coatings

H. International Code Council (ICC)

ICC IPC (2012).....International Plumbing Code

I. NSF INTERNATIONAL (NSF)

NSF/ANSI 61 (2012).....Drinking Water System Components – Health
Effects

NSF/ANSI 372 (2011).....Drinking Water System Components – Lead Content

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61 or NSF 372.

2.2 SOFTENING SYSTEM:

- A. Vertical, down flow, pressure type with automatic controls to operate on sodium cycle. Automatic-alternating triplex units. Designed for 690 kPa (100 psi) working pressure. All materials exposed to water shall be considered as generally safe by the Food and Drug Administration (FDA).
- B. Performance Requirements:
1. Continuous flow of zero hardness soft water (ASTM soap test method) with influent water conditions and flows listed in Part 1, with only one of the triplex 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.
- C. Softener Tanks-Steel: Butt-welded industrial grade steel. 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 to hold tanks in operating position above floor and designed to resist seismic loading requirements for Zone 4, UBC Importance Factor 1.0. 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, 0.20-0.25 mm (8-10 mils) thick. Interior coating shall be chemically inert, non-toxic, odorless and meet the requirements of CFR 21, Chapter 1, 175.300.

- 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.
- E. Exchange Material: Solid virgin high capacity styrene base resinous material. Material shall be stable over the entire pH range with good resistance to bead fracture from attrition or osmotic shock. Particle size 20-50 mesh and contain no agglomerates, shells, plates or other shapes that might interfere with the functioning of the softener. Exchange capacity as CaCO_3 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, 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 overfill.
- 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 will utilize alphanumeric, self-prompting programming for simple start-up. 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 (30 and 100 psi) 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% of maximum range, repeatability of +/-0.5% 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 fluoroelastomer polymer. Coating shall resist 1000 hour/5% salt spray test without sign of corrosion. 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 (30 to 100 psi). 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, galvanized, Schedule 40.
- B. Fittings: Malleable iron, ASME B16.3, or coated cast iron, ASME B16.1, class 125. Factory piping 2-1/2 inch and larger in diameter may be grooved fittings.
- 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.

2.4 BRINE PIPING:

Polyvinyl chloride (PVC), ASTM D2665, Schedule 80 with solvent welded joints.

2.5 VALVES

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

2.6 PRESSURE GAGES

ASME B40.100, Grade A, 1% accuracy, 110 mm (4-1/2 inches) diameter, all metal case, bottom connected. White dials, black hands, graduated from 0 to 700 kPa (0 to 100 psi) and identity labeled. Provide gages with gage cocks at softener hard water inlet and soft water outlet to show pressure drop thru softener.

2.7 BACKFLOW PREVENTER:

Provide on suction side of water softener serving boilers. Parts shall be made of corrosion-resistant materials and shall be of heavy duty construction, 850 kPa (125 psi) class minimum. Units shall operate automatically on line pressure without any manual control or assistance. Failure of any part vital to prevention of backflow shall be indicated by a continuous discharge for relief valve opening. Moving parts shall be easily removed and replaced without disconnecting backflow preventer, shall operate on "reduced pressure" principle and incorporate a zone where pressure is always less than supply pressure. Pressure differentials shall be maintained by two spring-load vertical check valves and one spring-load, diaphragm-actuated, differential pressure relief valve.

2.8 BRINE REUSE SYSTEM:

Automatic valving supplied to enable recovery of 25% of brine.

2.9 WATER TESTING EQUIPMENT:

- A. Furnish water testing equipment in a portable cabinet specially made for the installed equipment.
- B. Equipment shall permit the conducting of Boutron & Boudet standard soap test, or test as recommended by manufacturer of equipment.
- C. Include in the testing equipment kit the following:

1. One test bottle suitable for taking and shaking water samples, graduated to indicate proper quantity of sample.
2. One quart bottle with a screwed cap containing a solution of stock soap with the lather factor shown thereon.
3. One dropping bottle of 50 mL capacity with a screw cap and with dropping pipette as one integral part of the cap.
4. Two Baume hydrometers, calibrated for range necessary to test brine solution.
5. Two heat resisting glass cylinders suitable for holding brine solution for testing with hydrometer.

PART 3 – EXECUTION

3.1 REQUIRED TECHNICAL SERVICES:

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 run in presence of Contracting Officers Technical Representative (COTR) or Resident Engineer (RE). It will not be permitted, 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.
 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. Soft water production shall begin when a sample of 40 cc does not require more than five drops of Boutron & Boudet soap solution to produce a permanent lather.
 3. In order that color and turbidity of softened water may be under continuous observation during test, soft water sampling cock shall remain open and the stream of softened water run through a rubber hose discharging at the bottom of a wide mouth 4 L (1 gallon) clear glass container, set against a white background.

4. Demonstrate all features of the control system including diagnostics and flow and cycle indications.
- C. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Resident Engineer and Commissioning Agent. Provide a minimum of 7 days prior to notice.

3.4 COMMISSIONING

- A. Provide commissioning documentation accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS for all inspection, startup, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

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.

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