

Department of Veteran Affairs
Renovate Research Lab Phase 3
Nashville, TN
V.A. Project Number: 626-11-101

SECTION 22 31 11

WATER SOFTENERS

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 to serve existing Reverse Osmosis System.

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.
- E. Section 13 05 41 - Seismic Restraint Requirements for Non-Structural Components

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

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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. Influent Water Analysis:

Calcium, Ca:	95 mg/l
Magnesium, Mg:	28.1 mg/l
Total Hardness:	123 mg/l
Iron, Fe:	0.002 mg/l
Manganese, Mn:	<0.001 mg/l
Total Dissolved Solids:	167 ppm
Turbidity, NTU	0.14 NTU
Color:	Clear
PH:	7.33

Confirm the analysis with current samples and tests.

B. Design Parameters:

Normal System Flow and Pressure Drop: RO=5.2 gpm to Storage Tank, Loop
Circulation from Storage Tank back to Storage Tank would be 15-20 gpm
based on 800' 1.25" pipe.

Maximum System Flow and Pressure Drop: 20 gpm max flow in loop.

Backwash/Rinse Flow: 1) Carbon unit= 22 gpm during back wash to
drain (based on water temperature under 80F) 540 GALLONS TOTAL PER
REGENERATION. 2) Water Softener= 10 gpm during backwash to drain (based
on feed temperature below 80F) 230 GALLONS TOTAL PER REGENERATION.

Volume of soft water between regenerations: 14-15,000 gallons

Operating Temperature Range: 40 - 80 degrees F is recommended for
Min/Max

Operating Pressure Range (System): 35 psi feed to each pre-treatment
item and RO unit for operation.

Electrical Requirements: 208-230 or 460 VAC power for loop circulation
pump. Carbon and water softener require 120V-60Hz-1 phase

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

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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

PART 2 - PRODUCTS

2.1 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 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 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.

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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 foot¹) of existing material.
- C. Softener Tanks - Fiberglass Reinforced Plastic (FRP): Polyester reinforced by a continuous roving glass filament overwrap. Hydrostatically test at design pressure and provide certification. Support on a molded structural base. Tanks shall have flanged openings for mineral filling and removal. Provide vacuum breaker.
- E. 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.
- F. 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.
- G. 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.
- H. 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.
- I. System Controls:

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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 flouroplate 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.

J. Sampling Cocks: Provide for hard and soft water.

K. Sodium Chloride: Fed. Spec. A-A-694D. Provide sufficient quantity for ten regenerations.

2.2 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.

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.

2.3 BRINE PIPING:

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

2.4 VALVES

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

2.5 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.

2.6 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.

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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.

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- 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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