

SECTION 22 67 19.16
REVERSE-OSMOSIS WATER EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION

Provide complete industrial-type packaged reverse osmosis (RO) water treatment system producing high purity water by removal of dissolved minerals, bacteria, particles and organic impurities. Designed for continuous automatic operation. The system shall include pre-filter, product storage tank and all devices necessary for fully operational system. RO system operation will be controlled by the water level in the product storage tank.

1.2 RELATED WORK

- A. Systems for service other than boiler plant make-up water, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. Section 23 07 11, HVAC, PLUMBING & BOILER PLANT INSULATION
- C. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATION
- D. SECTION 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.

1.3 QUALITY ASSURANCE

Manufacturer shall have been engaged in the manufacture of reverse osmosis systems as a primary product for at least ten years. The ten year requirement supersedes any conflicting requirement in other parts of the project specification.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Catalog cuts, complete description and specifications of all equipment and accessories
 - 2. Accessories including filters, product storage tank, pressure gages and test kit.

3. Performance data including normal and maximum flow and pressure drop.
Certification that required performance will be achieved.

4. Piping.

C. Complete detailed layout, setting, arrangement, and installation drawings including. 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.

1.5 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. American Society of Mechanical Engineers (ASME):

B40.100-2005.....Pressure Gages and Gage Attachments

C. ASTM International (ASTM):

A269-07.....Seamless and Welded Austenitic Stainless Steel
Tubing for General Service.

D1784.....Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic
Pipe, Schedules 40, 80, and 120.

D1785-06.....Poly (Vinyl Chloride) (PVC) Plastic Pipe,
Schedules 40, 80, and 120.

D. American Water Works Association (AWWA):

B300-04.....Hypochlorites

B301-04.....Liquid Chlorine

C651-05.....Disinfecting Water Mains

E. National Electrical Manufacturers Association (NEMA):

ICS-6-1993(R2001, R2006) Industrial Control and Systems: Enclosures

F. National Fire Protection Association (NFPA):

70- 08National Electrical Code.

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

CFR 21, Chapter 1, Part 175.300, 02 Resinous and Polymeric Coatings

PART 2 - PRODUCTS

2.1 REVERSE OSMOSIS SYSTEM

- A. 4800 Gallon per day packaged automatic reverse osmosis system mounted on steel frame, designed for project conditions. Equipment arranged on the frame to allow easy access for operating, maintenance and repair. Unit shall include reverse osmosis membrane, pressure vessels, pre-filtration system, high pressure pump and all required piping, wiring and controls for a fully operational system.
- B. Performance Requirements:
 - 1. Membrane reject ratio: 98% minimum. TDS of product is 2% maximum of input TDS.
 - 2. Capture rate: 70% minimum. Maximum amount of water to drain 30% of input.
- C. RO Membrane Elements: Thin-film composite with FRP over-wrap, anti-telescoping device, u-cup brine seal. The design salt rejection shall be 98% based on 2000 ppm water at 225 psig at 77 degrees F.
- D. RO Element Housings: Type 304 stainless steel with PVC end caps held in place with stainless steel bands. Each housing assembly complete with one set of O-rings and O-ring lubricant.
- E. High Pressure Pumps and Motors: Duplex high efficiency centrifugal type with Type 304 stainless steel casing, shaft, impellers. Tungsten carbide and ceramic shaft seals. Cast iron frame with flanged piping connections. Premium efficiency TEFC motor selected to be non-overloading on the entire performance curve.
- F. Manual Valves:
 - 1. Pump Throttle Valve: Type 316 stainless steel ball valve, socket welded.

2. Concentrate Throttle Valve, Recycle Throttle Valve: In-line needle style, stainless steel, rated for 300 psi minimum.
3. Inlet Isolation Valve, Product and Concentrate Check Valves: PVC with EPDM seats and seals.
4. Feedwater Sample Valve, Product Water Sample Valve: PVC plug valve with EPDM seats and seals.
5. High Pressure Sample Valve: Type 316 stainless steel plug valve.

G. Automatic Valves:

1. Automatic Inlet Shut Off Valve: Solenoid type, diaphragm actuated, normally closed, constructed of glass-filled Noryl thermoplastic.
2. Automatic Membrane Flush Valve: Provide for purging the membranes with fresh water upon machine shut down.

H. Piping:

1. Low Pressure Feed, Reject and Recycle Piping (75 psi and under): ASTM D1785, Schedule 80 CPVC, socket welded and flanged.
2. RO Product Tubing From Each Membrane Housing: ASTM D1785, Schedule 80 CPVC, socket welded and flanged.
3. Low Pressure Control and Pressure Gage Tubing: Polyethylene.
4. High Pressure Reject and Recycle Piping (above 75 psi): ASTM A269, Type 304 Schedule 10 stainless steel with butt welded joints.
5. High Pressure Control and Pressure Gage Tubing: 1000 psi burst nylon.

I. Controls:

1. Electronic PLC or microprocessor controller providing automatic control for all operating functions. Motor starter panel. All in FRP enclosures rated NEMA 4. All wiring factory-installed and tested. Comply with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW) and NFPA 70.
2. Autoflush indicator and control to flush RO concentrate at shut down or at predetermined intervals.

3. Warning Alarms: Low quality product, low feed pressure, high feed temperature.
4. Automatic Shutdowns and Alarms: Low feed pressure, low product quality, pretreatment out of service, storage tank full.
5. Status Indicators: Low feed pressure, low quality, flow alarm, high feed water temperature, product divert to drain valve open, pretreatment lockout, storage tank full.
6. Low and High pressure safety switches.
7. Tank water level control switches.
8. Pump Motor Starter: Comply with Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
9. Miscellaneous Controls: Elapsed run time indicator, alarm horn, chemical pump receptacles, convenience receptacles, auxiliary contacts.

J. Instrumentation and Displays:

1. All instrumentation readouts panel-mounted in FRP enclosures rated NEMA 4. All factory wiring. Comply with NFPA 70.
2. Digital flow indicators for, product, reject, recycle.
3. Pressure gages for inlet, cartridge filter outlet, RO feed, RO concentrate, and RO product.
4. Conductivity indicator measuring product quality with digital displays, alarm relays and automatic temperature compensation.
5. Conductivity probe mounted in the RO product.

K. Skid and Frame Assembly:

1. RO machine shall be built on a skid and frame constructed of welded structural carbon steel. The entire surface shall be sand-blasted and coated with high solids epoxy coating.

L. Reassembly:

1. Unit shall be shipped to the site completely assembled and tested.
If units or sections are to be disassembled at the site to allow for

installation in a limited space, the unit shall be reassembled and tested for intended operation.

2.2 PRE-FILTER

- A. Single multi-media filter sized for the RO machine inlet flow rate. Filter designed for suspended solids removal down to 5 10 microns and automatic backwash cycle.
- B. Media Tank: FRP designed for 150 psi. Pre-piped internal backwash distributor and filtered water collector.
- C. Filter Media: Top layer of anthracite, middle layer of silica sand, bottom layer of multi-grade garnet. Install filter media at job site.
- D. Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.
- E. Replacement Filter Media: Provide elements for one complete replacement.

2.3 ACTIVATED CARBON FILTER

- A. Single filter sized for the RO machine inlet flow rate. Designed to remove chlorine and prevent RO membrane damage.
- B. Media Tank: FRP designed for 150 psi. Pre-piped internal backwash distributor and filtered water collector.
- C. Filter Media: 12 x 40 mesh bituminous coal-based activated carbon. Install media at job site.
- D. Backwash Cycle: Top-mounted, piston-operated control valve with pre-sized drain line flow control orifice. The cycle shall be initiated by and adjustable seven day electronic time clock. Include RO lockout switch.

2.4 RO WATER STORAGE TANK

- A. Free-standing, closed-top, flat-bottom, 300 gallon total volume. Top access manway, PVC bulkhead fittings for high and low level alarm switches, RO permeate inlet, RO permeate discharge and drain. Install 0.2 micron tank vent filter at the top head. Vented to atmosphere.
- B. Materials of Construction: Linear polyethylene in one piece.

- C. Tank Water Level Control: Adjustable float switch that signal starting and stopping RO pump. High and low level alarm switches.

2.5 PRESSURE GAGES

- A. 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.

2.6 WATER TESTING EQUIPMENT:

- A. Furnish water testing equipment in a portable cabinet specially made for the installed equipment. Include sufficient materials for 6 months of normal testing procedures.
- B. Silt Density Index (SDI) apparatus to measure degree of suspended solids feeding the RO membranes. Include pressure regulator, pressure gage, filter holder, 600 mL beaker, sample valve, tubing and 0.45 micron filter papers.
- C. Test kit to measure total water hardness, total iron, free chlorine, pH.

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 recommendations, 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 RO system and tank 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 (COR).
- B. Procedure:

1. Operate RO system at constant maximum required capacity for one hour after demineralized RO product water is produced. When necessary, waste product water to sewer to maintain above flow rate. Product water production shall begin when a sample shows that demineralization complies with requirements.
 2. 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 COR 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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