

SECTION 224850 – LABORATORY PURE WATER EQUIPMENT

First Edition 5-16-2017

(Engineer shall edit specifications and blue text in header to meet project requirements. This includes but is not limited to updating Equipment and/or Material Model Numbers indicated in the specifications and adding any additional specifications that may be required by the project. Also turn off all “Underlines”.)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section and all other sections of Division 22.

1.2 SUMMARY

- A. This section includes the requirements for the pure water (RO/DI) equipment and all necessary components for a complete equipment skid and including the following: **<Edit**

For particular Project>

1. Depth filters.
2. Carbon filters.
3. Water softener.
4. Recirculating pumps
5. Reverse osmosis unit.
6. Mix bed deionizers.
7. UV sterilization unit.
8. Deionized water tanks.
9. Distribution pumps.
10. Polishers.
11. Sub-micron filters.
12. Resistivity sensor.
13. Flow meters.
14. Water meter.
15. Pressure gauges.

1.3 DEFINITION

- A. Pure Water Equipment: All equipment and components needed to produce Reverse Osmosis and Deionized Water (RO/DI) water for laboratory use.

1.4 PERFORMANCE

- A. System Performance: Deliver RO/DI water at [100] psig. **<Edit For particular Project>**

1.5 ACTION SUBMITTALS

- A. Product Data: For each specified product, include manufacturers cut sheets, dimensional data, performance data, installation instructions, wirings diagrams, power requirements, specified options, and warranty information.
 - 1. Shop Drawings: For air all equipment in this specification.
 - a. Include plans, elevations, sections, and mounting details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
 - d. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For pure water equipment, accessories, and components from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Field quality control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Include a copy of each approved submittal along with any applicable maintenance data in the project operation and maintenance manual.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Laboratory Air Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the pure water equipment testing indicated, that is an NRTL and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

1.9 WARRANTY AND GUARENTEE

- A. See Division 22, Specification Section “Basic Mechanical Requirements – Plumbing” for warranty and guarantee requirements.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Equipment Design and Selection: Pure water, equipment and specialties shall be designed and selected, for the intended use, in accordance with the scheduled capacities on the drawings and the requirements of this specification.

- B. Basis of Design: The basis of design for pure water, equipment shall be as follows: **<Edit required for project>**

1. Pure Water System – NEU-ION Inc.
2. System Components:
 - a. Depth Filters: Culligan, Bethel, CT.
 - b. Carbon Filters: Culligan, Bethel, CT.
 - c. Water Softener: Culligan, Bethel, CT.
 - d. Recirculating Pump: Eastern
 - e. Reverse Osmosis (RO): Culligan, Bethel, CT.
 - f. Mix Bed Deionizer: Culligan, Bethel, CT.
 - g. Deionized (DI) Water Tank: Nalgene Inc.
 - h. Distribution Pumps: Worthington
 - i. Polisher: Culligan, Bethel, CT.
 - j. Ultra Violet Sterilization: Aquafine
 - k. Sub Micron Filter: Pall Corporation
 - l. Resistivity Sensor: Signet Scientific
 - m. Flow Meter: Signet Scientific
 - n. Water Meter: Hershey

- C. Other Acceptable Manufacturers: Subject to compliance with requirements, provide pure water equipment by one (1) of the following: **<Edit required for project>**

1. Pure Water System – Burt Process Equipment, Evoqua Water Technologies (formally US Filter), ELGA Lab Water, GE Mobile Water Inc. (formerly Ionics)
2. System Components:

- a. Depth Filters: US Filter, Inc., Penfield Inc., Vaponics, Plymouth, Mass., and Substitutions are not permitted.
- b. Carbon Filters: US Filter, Inc., Penfield Inc., Vaponics, Plymouth, Mass., and Substitutions are not permitted.
- c. Water Softener: US Filter, Inc., Penfield Inc., Millipore, and Substitutions are not permitted.
- d. Recirculating Pump: Aurora, Gould, and Substitutions are not permitted.
- e. RO: US Filter, Inc., Ionpure, Millipore, and Substitutions are not permitted.
- f. Mix Bed Deionizer: US Filter, Inc., Ionpure, Vaponics, Plymouth, Mass., and Substitutions are not permitted.
- g. DI Water Tank: Chemtainer, Raven and Substitutions are not permitted.
- h. Distribution Pumps: Aurora, Gould, and Substitutions are not permitted.
- i. Polisher: US Filter, Inc., Penfield Inc., Vaponics, Plymouth, Mass., and Substitutions are not permitted.
- j. UV Sterilization: Ultradynamics and Substitutions are not permitted.
- k. Sub Micron Filter: Gelman, Nuclepore Corp., and Substitutions are not permitted.
- l. Resistivity Sensor: Foxboro, Myron-L and Substitutions are not permitted.
- m. Flow Meter: US Filter, Inc., Penfield Inc., Vaponics, Plymouth, Mass., and Substitutions are not permitted.
- n. Water Meter: Rockwell, Badger and Substitutions are not permitted.

2.2 GENERAL EQUIPMENT REQUIREMENTS

- A. Assembly: Pure water equipment and components shall be factory assembled, wired, piped, and tested assembly to perform as specified.
- B. Mounting Skid: The mounting skid shall be fabricated of welded two (2) inch tubular steel frame with grating to support the equipment and accessories and include reinforcement strong enough to resist movement during normal operation when the base mounting frame is anchored to the building structure. Grind welds smooth and sandblast entire unit to white metal finish. Wash in phosphoric acid. Finish shall be two (2) coats of polyurethane enamel.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Motors: Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 22 Specification Section "Motor Requirements for Plumbing Equipment."
- E. Main Control Panel: Include the following:
 1. Two (2) meter/controllers.

2. Hand off automatic selector switches.
3. One (1) electric alternator adjustable from 0-12 hours to alternate sequence of pump operation as well as to provide two (2) pump simultaneous operation if demand rate requires.
4. Tank gauge and level controls.
5. Alarm bell.
6. Heavy duty oil tight selector switches.
7. Indicating pilot lamps.
8. Interconnecting control and power wiring between skid mounted equipment and control panels.
9. Starters with disconnects, transformers for 11 SV power and control requirements, and required overcurrent protection.
10. Auxiliary Alarm Contacts: Provide auxiliary alarm contacts for the following alarms to the BAS through BAC Net IP protocol:
 - a. General equipment alarm.
 - b. System low pressure alarm

2.3 DEPTH FILTERS

- A. Description: Low velocity multimedia filter (designed to remove turbidity, suspended solids and sediments).
- B. Tank Welded cold rolled carbon steel with dished head.
- C. Vessel and Pressure Parts:
 1. Construct and stamp in accordance with ASME Code, Section VIII and U-1 (Unfired Pressure Vessels). Design vessel for a maximum operating pressure of not less than 100 psig and test pressure of not less than 300 psi.
 2. Line 'interior of vessel with 4 to 6 mil sprayed and baked phenolic epoxy extending over full face of flanges. Finish exterior with a rust inhibiting primer paint.
 3. Filter Bed Media: Minimum of four (4) layers of minerals especially selected for removing particles down to ten (10) micron (nominal) in size. Ship filter bed media separately.
 4. Furnish vessel with an inlet, outlet, backwash outlet, backwash sight glass, drain valves, inlet and outlet pressure gauges with isolating valves, automatic controls, time clock and flow controls necessary for automatic regeneration.

2.4 CARBON FILTERS

- A. Description: Activated carbon media filter (designed for removal of organic compounds responsible for taste, odors and chlorine and for removal of low molecular weight materials) factory assembled with interconnecting piping.

B. Tanks: Welded cold rolled carbon steel with dished heads.

C. Vessels and Pressure Parts:

1. Construct and stamp in accordance with ASME Code, Section VIII and U-1 (unfired pressure vessels). Design vessel for a maximum operating pressure of not less than 100 psi and a test pressure of not less than 300 psi.
2. Line interior of vessels with 4 to 6 mil sprayed and baked phenolic epoxy extending over full face of flanges. Finish exterior with a rust inhibiting primer paint.
3. Filter bed media shall consist of four (4) layers of graduated supporting gravel, one layer of sand and 1.5 cubic feet of activated carbon. Ship filter bed media separately.
4. Furnish vessels with an inlet, outlet, backwash outlet, backwash sight glass, drain valves, inlet and outlet pressure gauges with isolating valves, automatic controls, time clock and flow controls required for automatic regeneration.

2.5 WATER SOFTENER

A. Description: Water conditioner with brine tank (designed to remove hardness (expressed as CaCO₃) to not more than 0.3 grain per gallon); factory assembled with interconnecting piping.

B. Softener Tank: Welded cold rolled carbon steel.

1. Design tank for a maximum operating pressure of not less than 120 psi and a hydrostatic test of 200 psi.
2. Line interior of tank with a 20 mil thick (minimum) vinyl bag. Finish exterior with high glass, rust inhibiting epoxy paint.
3. Design side shell height to allow for a minimum free board of 50% of mineral bed for expansion during back washing.
4. Mineral Bed: Non-phenolic polystyrene resin, minimum exchange capacity of 20,000 grains per cubic foot when regenerated with seven (7) pounds of salt per cubic foot. Mineral shall be solid and of proper particle size (not more than 4% through a No. 40 mesh screen) and shall contain no agglomerates, shells, plates or other shapes which might interfere with normal function of softener.
5. Furnish tank with an inlet, outlet, backwash outlet, backwash sight glass, drain valves, inlet and outlet pressure gauges with isolating valves, automatic controls, seven (7) day calendar clock, and flow controls necessary for automatic regeneration.

C. Brine Tank: Molded, corrosion proof rigid polyethylene tank with cover, sized to hold a minimum of ten (10) regenerations per refill.

1. Furnish tank with a metering system with automatic valve control.

2.6 RECIRCULATING PUMP

- A. Description: In line 316 passivated stainless steel pump with tungsten carbide mechanical seals, teflon gaskets, stainless steel impeller, 460V 3 phase, 60 Hertz electrical service.
- B. Size and Capacity: As shown.

2.7 REVERSE OSMOSIS

- A. Description: Pressurized membrane process capable of producing water 95% to 97% free of organics over 200 moleculars in weight, particulates, bacteria and pyrogens.
 - 1. Furnish unit with prefiltration, pressurizing pump, membrane cartridges, interconnecting pipe, valves and control wiring.
 - 2. Assemble on skid with epoxy coated steel frame, and factory pipe, wire and test.
- B. Pre-filter: Stainless steel housing with pressure gauges with EPDM O-Rings. Tubing and connections shall be stainless steel.
 - 1. Cartridges: Polypropylene with the capability of removing all particulate greater than five (5) microns.
- C. Vessels and Pressure Parts:
 - 1. Components upstream of pressurizing pump shall be rated for a maximum operating pressure of 125 psi and a hydrostatic test of 185 psi.
 - 2. Components downstream of pressurizing pump shall be rated for a maximum operating pressure of 225 psi and hydrostatic test of 300 psi.
- D. Pressurizing Pump:
 - 1. High-speed, multi stage, centrifugal type, non-overloading, close coupled end-auction, frame mounted.
 - 2. Type 316 stainless steel with John Crane Type 1 tungsten carbide mechanical seals (Type 9-21), teflon gaskets, stainless steel impeller.
 - 3. Pump shall operate on 460 volts, service. 3 phase, 60 hertz electrical service.
- E. Membrane Modules: Provide two (2) membrane modules each consisting of membrane of thin film composite.
- F. Controls: Panel mount controls and instrumentation on a common frame. Construct panel of stainless steel or epoxy coated aluminum. Include the following:
 - 1. Product and concentrate flow meters.
 - 2. Inlet, membrane operating and concentrate pressure gauges.

3. Concentrate control valve.
4. Pump starter with running indicator.
5. Feed water low pressure shutdown.
6. Feed water flow switch for automatic shutdown on low flow.
7. Time controller for automatic fast flush.
8. Conductivity monitor/controller with selector switch for feed and permeate.
9. Alarms.
10. NEMA 12 electrical equipment enclosures.
11. Transformer and overcurrent protection for 115V power and control requirements.

2.8 MIXED-BED DEIONIZERS

- A. Description: Reinforced fiberglass tank with vinylester lining for removing dissolved ionized solids and capable of producing water having a minimum resistivity of ten (10) megohm-CM at 25°C.
- B. Design tank for a maximum operating pressure of not less than 125 psig and test pressure not less than 185 psig.
- C. Furnish tank with sanitary type fittings.
- D. Size and Capacity: As shown.
- E. Provide one additional standby de ionizer.

2.9 ULTRA VIOLET STERILIZATION UNIT

- A. Description: In line sterilizer designed to provide bacterial reduction at designed maximum flow rating.
- B. Unit shall house one (1) ultra violet lamp, designed for operation on 120 volt, I phase, 60Hz.
- C. Construct cabinet housing of Type 316 stainless steel No. 4 finish. Construct parts in contact with deionized water of Type 316 stainless steel, electro-polished and passivated to Mil Spec. S-5002.
- D. Furnish unit with sensor element to indicate level of UV radiation being produced.

2.10 DEIONIZED WATER STORAGE TANK

- A. Description: Seamless, one (1) piece vertical/cylindrical/conical or dished bottom configuration storage tank constructed of heavy duty FDA approved food grade fiberglass. Equip tank with the following:
 1. Tank support with access to bottom outlet.

2. One (1) top eighteen (18) inch manway (bolted) with viton gasket.
3. One (1) bottom outlet and four top inlets with clamp fittings and viton gasket.
4. Rupture disc.

B. Vent Filter: Provide one nonwetting, hydrophobic filter membrane sterile vent filter with type 316 stainless steel housing with pet cock.

C. Tank controls shall include a differential pressure regulator, two (2) inch scale flow meter, magnehelic measuring gauge, pressure switches, PVC tubing and interconnecting control wiring.

D. Size and capacity as shown.

2.11 DISTRIBUTION PUMPS

A. Description: Centrifugal type, non overloading, close coupled end suction, TEFC, frame mounted, piped in parallel distribution pumps.

B. Pumps: 316 stainless steel with John Crane Type 1 tungsten carbide mechanical seals, teflon gaskets, stainless steel impeller and drain connection; operate on 460 volts, 3 phase, 60 hertz electrical service.

C. Size and capacity as shown.

D. Starters and Accessories: Comply with the requirements in Division 26.

2.12 POLISHERS

A. Description: System shall be equipped with five (5) portable mixed-bed deionizers with regenerated resin beds and filled, designed to maintain stored deionized water in range of 5 to 10 megohm-cm at 25°C, plus removal of silica and carbon dioxide.

B. Polisher Rating: 100 psi with 2.1 feet of resin and exchange capacity of approximately 20,000 grains as CaCO₃.

C. Provide a piping manifold including service valves constructed of polypropylene for parallel connection of polishers.

D. Provide one (1) additional mixed-bed deionized on standby.

2.13 ULTRA VIOLET STERILIZATION UNIT

A. Description: In line sterilizer designed to provide bacterial reduction at designed maximum flow rating.

B. Unit shall house twelve (12) ultra violet lamps, designed for operation on 120 volt, 1 phase, 60 Hz.

- C. Construct cabinet housing of Type 316 stainless steel No. 4 finish. Construct parts in contact with deionized water of Type 316 stainless steel, electro-polished and passivated to Mil Spec. S-5002.
- D. Furnish unit with sensor element to indicate level of U-V radiation being produced.

2.14 SUB-MICRON FILTERS

- A. Description: One pharmaceutical medium flow sanitary type multi cartridge housing, at 0.45 microns for removal of particulates.
- B. Housing: Design working pressure; 150 psi. All parts, 316 stainless steel (pickled and passivated), ASME ANSIBPVC Section 8, Division I U stamp with the following components:
 - 1. Viton housing seals.
 - 2. Viton Cartridge O ring seals.
 - 3. Bottom inlet/outlet.
 - 4. Drain and vent connections.
 - 5. Sanitary clamp fittings.
 - 6. Stainless steel legs for floor mounting.
 - 7. 180 grit interior polish.
- C. Filter Cartridges: Absolute removal rated, non asbestos, non fiber releasing, pleated, nylon with viton O-rings.
 - 1. Construct Cartridges so that two layers of filter medium are corrugated with a layer of polyester non woven upstream, and another layer downstream.
 - 2. Cartridges shall be capable to withstand sufficient reverse pressure to retain integrity to a maximum of 50 psig at room temperature.
 - 3. 0.40 micron cartridges; six (6) round, four (4) high and 60.0 sq. ft. of filter area.
 - 4. Cartridges shall be suitable for steam sterilizing.
 - 5. Cartridges shall be pharmaceutical grade rated.

2.15 RESISTIVITY SENSOR

- A. Description: One resistivity meter/controller with capability of measuring resistivity from 0-18 megohm cm.
- B. Meter/controller shall have a three (3) scale selector switch; ranges (0-0.12 megohm-cm, 0-1.8 megohm-cm, 0-18 megohm cm) with an accuracy of plus or minus 2%, and an eight (8) way switch for selecting any of the four (4) resistivity cells, temperature compensation and on off switch.

1. Resistivity cells; Polypropylene housing, stainless steel head, titanium electrodes, range from 0 to 25.0 megohm CM, temperature sensor with range from 1-100 °C, vitron O-ring seals.
2. Cells; threaded design for permanent mounting.
3. Provide detachable patch cord for each cell.

C. Design meter/controller for operation on 115 volt, 1 phase, 60Hz. electrical service.

2.16 FLOW METER

- A. Description: Paddle wheel type flow sensor, linear flow output, 220°F maximum temperature, rated at 200 psi, constructed of polypropylene with titanium shaft.
- B. Provide a seven (7) digit non reset counter with totalizer.
- C. Provide twenty five (25) feet of interconnecting cable.

2.17 WATER METER

- A. Description: Magnetic drive, positive displacement disc type, flanged ends, bronze construction with reinforced hard rubber disc piston, 150 psi working pressure.

2.18 PRESSURE GAUGES

- A. Pressure Gauges: Comply with the requirements in Division 22 Specification Section “Meters and Gauges for Plumbing Systems”.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- A. Install the work in accordance with manufacturer's instructions, reviewed submittals, referenced codes, and referenced Sections of the Specifications.
- B. Mount all equipment and skids on individual concrete pads.
- C. Connect, calibrate and adjust devices and instrumentation to perform functions shown or specified.

3.2 EQUIPMENT INSTALLATION

- A. General Requirements for Pure Water Equipment Installation:
 1. Install pure water equipment to allow maximum headroom unless specific mounting heights are indicated.
 2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.

3. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
4. Install equipment to allow right of way for piping installed at required slope.

B. Nonmedical Laboratory Pure Water Equipment Installation:

1. Install pure water equipment, on cast in place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Architectural Specification Section "Miscellaneous Cast in Place Concrete."
2. Comply with requirements for vibration isolation and seismic control devices specified in Division 22 Specification Section "Vibration and Seismic Controls for Plumbing Piping and Equipment".
3. Comply with requirements for vibration isolation devices specified in Division 22 Specification Section "Vibration Controls for Plumbing Piping and Equipment".

3.3 BALANCING

- A. Provide field supervision for operating testing balancing of RO/DI water distribution piping system.

3.4 SANITIZING

- A. Provide field supervision for sanitizing deionized water distribution piping system and equipment.
- B. Supervise isolation and bypassing of equipment.
- C. Supervise to ensure that required equipment for sanitizing and flushing of system is provided.
- D. Supervise sanitizing the flushing procedures.
- E. Supervise procedure for containment and off-site disposal of chemicals.

3.5 CONNECTIONS

- A. Comply with requirements for water supply piping specified in Division 22 Specification Section "Domestic & Laboratory Water Piping Systems and Specialties". Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements for drain piping specified in Division 22 Specification Section "Sanitary Waste and Vent Piping". Drawings indicate general arrangement of piping, fittings, and specialties.

- C. Comply with requirements for pure water piping specified in Division 22 Specification Section "Laboratory Piping Systems and Specialties". Drawings indicate general arrangement of piping, fittings, and specialties.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.

3.6 IDENTIFICATION

- A. Identification: Comply with requirements for identification specified in Division 22 Specification Section "Identification for Plumbing Piping and Equipment".

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory authorized service representative.
 - 1. Replace damaged and malfunctioning controls and equipment.
 - 2. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - a. Inspections performed.
 - b. Procedures, materials, and gases used.
 - c. Test methods used.
 - d. Results of tests.
- D. Components will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Engage a factory authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Check for equipment vibration control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
 - 3. Check safety valves for correct settings. Ensure that settings are higher than air compressor discharge pressure, but not higher than rating of system components.
 - 4. Check for proper seismic restraints.

5. Drain receiver tank(s).
6. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
7. Test and adjust controls and safeties.

B. Prepare written report documenting testing procedures and results.

3.9 DEMONSTRATION

- A. Engage a factory authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, vacuum pumps and deionizing equipment.

END OF SECTION 224850