

**SECTION 11 71 02**  
**LABORATORY WASHING AND STERILIZING EQUIPMENT**  
**10-11**

**PART 1 - GENERAL**

**1.1 DESCRIPTIONS**

This section specifies Laboratory Washing and Sterilization Equipment including laboratory glassware and utensil washers, steam sterilizers, drying ovens, cage and cart washers, animal water bottle washers/fillers, animal, ice machines, exhaust hoods, and water purification systems.

**1.2 DEFINITIONS**

- A. Glassware and Utensil Washer: An automated washing unit that uses high-temperature water and detergent to clean and disinfect instruments and lab glassware.
  - 1. Under-counter Model - Single chamber washer/disinfector.
  - 2. Counter-top Model - Single chamber washer/disinfector.
  - 3. Free standing Model - Multiple chamber washer/disinfector.
- B. Steam Sterilizer: A machine used to sterilize instruments and equipment by subjecting them to high-pressure steam up to 135°C (275°F). Sterilizers are available in both cart-loading and counter-top models. They can be either freestanding or recessed, with single or double doors(pass-thru). Steam sterilizers are also known as autoclaves. More efficient models employ a vacuum pump to remove air from the chamber prior to a sterilization cycle, thus providing more efficient steam sterilization. In animal facilities or other high throughput environments, autoclaves with very large floor-level chambers capable of accepting "roll-in" racks of cages or other items may be needed.
- C. Sterilizer Enclosure Panels: Removable Stainless Steel metal panels used to fill the gaps between the tops and sides of freestanding sterilizers to the surrounding walls and ceilings while allowing service access.
- D. Ice Machine: Machine capable of making, holding, and dispensing ice. Volume production, total storage capacity and type of ice to be specified to meet the specific project demands.
- E. Water Treatment System: A mechanical system for use with steam sterilizers, washer/disinfectors and cart washers, that decreases

contaminates in the domestic water to reduce boiler scaling and instrument spotting.

- F. Central Compressed Air System: A system to provide 'oil free' and contaminate free compressed to equipment where compressed air is an optional feature.

### **1.3 RELATED WORK**

- A. Section 01 91 00, General Commissioning Requirements
- B. Section 22 11 00, FACILITY WATER DISTRIBUTION and Section 22 13 00, FACILITY SANITARY SEWERAGE Section 22 66 00, CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES: Plumbing Connections.
- C. Section 22 15 00, GENERAL SERVICE COMPRESSED-AIR SYSTEMS: Connections to Compressed Air System.
- D. Section 22 40 00, PLUMBING FIXTURES.
- E. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- F. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Electrical Connections.
- G. Section 22 67 19.16, REVERSE OSMOSIS EQUIPMENT
- H. Section 22 67 21, WATER DEALKALIZING SYSTEM
- I. Section 23 08 00, Commissioning of HVAC System

### **1.4 PERFORMANCE REQUIREMENTS**

- A. Equipment shall have built-in monitoring for timed cycles, and control devices for temperature and pressure. Equipment shall have a printer, either integrated or remote, for recording cycle time, temperature, and pressure.
- B. Manufacturer safeguards must be provided with the equipment to protect the operator from harm during normal operation of the equipment.
- C. As needed in the application, provide a means of preventing accidental tampering with cycle times and parameters, via electric or physical safeguards.
- D. Provide water use reduction cycles and features where available. For instance, equipment utilizing steam should scavenge steam instead of wasting cold water to condition hot water/steam prior to entering drains.
- E. Provide energy use reduction cycles and features where available.

### **1.5 QUALITY CONTROL**

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC: Quality Assurance 1.3.D - Products Criteria.

- B. Mechanical, electrical, and associated systems shall be safe, reliable, efficient, durable, easily and safely operable, maintainable, and accessible. Such equipment shall be appropriately protected from failures due to moist environments, as appropriate to use.
- C. Standard Products: Material and equipment shall be the standard products of the selected manufacturer, and they should be regularly engaged in the manufacture of such products for at least 3 years. The design, model and size of each item shall have been in satisfactory and efficient operation in a similar installation environment (eg laboratory setting, or an animal facility) on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work stations, shall be the current generation of technology and basic design at the time of purchase, which has a proven satisfactory service record of at least three years.
- D. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
- E. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
- F. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
- G. Installer Qualifications: For sterilizers, installer is authorized representative of sterilizer manufacturer and employs factory-trained personnel to install sterilizers. For other equipment, installer shall be licensed as may be necessary by regulatory organizations. For all equipment, installer shall meet the qualifications of ANSI/ASSE Standard 6010.
- H. Steam Sterilizers: Comply with the most current version of ANSI/AAMI ST8 or ST55.

#### **1.6 SUBMITTALS**

- A. Submit in accordance with specification Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data: Include the following:

1. Illustrations and descriptions of laboratory washing, cleaning, filling, drying, sterilizing, and sanitizing equipment.
  2. Optional auxiliary equipment and controls.
  3. Catalog or model numbers for each component.
  4. Accessories and optional features which enhance equipment performance or operation.
  5. Utility requirements.
  6. Control wiring diagrams.
  7. Installation Manuals
- C. Shop Drawings: Show details of fabrication, installation, adjoining construction, coordination with mechanical and electrical work, anchorage, and other work required for complete installation.
- D. Field Test Reports: Provide certification reports from accredited service technicians or installers.
- E. Operating Instructions: Comply with requirements in specification Section 01 00 00, GENERAL REQUIREMENTS.
- F. As is appropriate (eg animal rack and cage washers), a statement regarding proper placement, configuration, and installation of exhaust ductwork to prevent condensation from cooling moist air from entering back into equipment.
- G. Air compressor systems (Provide certified compressor test data at start-up.):
1. Compressors: Manufacturer and model.
  2. Characteristic performance curves.
  3. Compressor operating speed (RPM).
  4. Capacity: Free air delivered at indicated pressure (L/s) (SCFM).
  5. Type of bearing in compressor.
  6. Type of lubrication.
  7. Type and adjustment of drive.
  8. Electric motors: Manufacturer, frame and type.
  9. Speed of motors (RPM).
  10. Current characteristics and horsepower of motors.
  11. Receiver capacity and rating.
  12. Air silencer: Manufacturer, type and model.
  13. Air filters: Manufacturer, type, model and capacity.
  14. Pressure regulators: Manufacturer and capacity.
  15. Dew point monitor: Manufacturer, type and model.
  16. Air dryers: Manufacturer, type, model and capacity (L/s) (SCFM).

17. Carbon monoxide monitor manufacturer, type and model.

18. Aftercoolers.

#### **1.7 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 National Standards Institute/Association for the Advancement of Medical Instrumentation (ANSI/AAMI):

ST79-2006.....Comprehensive guide to steam sterilization

ST8-2008.....Hospital Steam Sterilizer, 3<sup>rd</sup> edition

ST55-2008.....Table-top Sterilizers

C. National Association of Architectural Metal Manufacturers (NAAMM):

AMP 500-06.....Metal Finishes Manual

D. Underwriters Laboratories):

UL Standard 61010-1

#### **1.8 WARRANTY**

Comply with FAR clause 52.246-21 in all areas except for warranty period, which shall be no less than three years for all equipment.

#### **1.9 GUARANTEE PERIOD SERVICES**

A. Engage factory-trained authorized manufacturers' representatives to perform maintenance service on equipment during guarantee period.

1. Maintenance Service:

a. Inspection of equipment at regularly scheduled intervals as defined by the manufacturer.

b. Testing, cleaning, adjusting, repairing, and furnishing and installing replacement components as required to maintain equipment in reliable working condition.

2. Maintenance service does not include cleaning, adjusting, repairing, furnishing and installing replacement components required because of improper use.

### **PART 2 - PRODUCTS**

#### **2.1 LABORATORY GLASSWARE AND UTENSIL WASHER**

A. Undercounter Model: Fully programmable high performance laboratory glassware washer/dryer. Capable of direct injection washing of narrow-necked glassware (with proper inserts) and providing a heated DI water final rinse cycle, detergent / neutralizer / rinse aid dosing systems, and accepts a wide variety of baskets and inserts for various laboratory glassware types. Approximately 1956 mm high by 889 mm wide

by 737 mm deep (77 inches high by 35 inches wide by 29 inches deep).

Basis of Design - Labconco 4400321 Undercounter SteamScrubber Glassware Washer.

1. Exterior/Interior: Construction:
  - a. Interior: Chamber walls, ceiling, and floor are constructed of type 304 stainless steel for corrosion resistance.
  - b. Exterior cabinet. Constructed of type 304 brushed stainless steel for corrosion-resistance
2. Doors:
  - a. Quantity: Single door
  - b. Operation: Automatic.
3. Chamber size: Interior useable space approximately: 673 mm high by 533 mm wide by 610 mm deep (26 inches high by 21 inches wide by 24 inches deep).
4. Loading: Manual.
5. Controls: Digital control system. Includes standard and service-diagnostic programs. Space is available for custom programs. Multi-language display. RS-232, infrared serial ports or more modern technology such as USB ports are provided for connection to a PC.
6. Heat Source: Electric Steam Pressure: 36-145 PSI.
7. Electrical Requirements: Electrical Connection (Electric Only): 3 Phase, 208/220V, 60Hz, 30A.
8. Standard Cycles: Wash Rinse Dry.
9. Optional Cycles: NONE.
10. Temperature:
  - a. Wash Cycle: 50 - 70°C (122 - 158°F).
  - b. Rinse Cycle: 50 - 70°C (122 - 158°F).
11. Plumbing Connections:
  - a. Hot Tap Water connection: One inlet valve 50 to 70 degree C (122 degree F to 158 degree F). Supply pressure: 207 kPa to 1014 kPa (30 psi to 147 psi), 15 l/minute (4 gal/minute). Provided inlet hose: Approx. 1524 mm (5 feet) long, 13 mm (1/2 inch) ID with 19 mm (3/4 inch) male hose thread ends.
  - b. Cold Tap Water connection: One inlet valve. Supply pressure: 207 kPa to 1014 kPa (30 psi to 147 psi), 15 l/min (4 gal/min). Provided inlet hose: Approx. 1524 mm (5 feet) long, 13 mm (1/2 inch) ID with 19 mm (3/4 inch) male hose thread ends.

- c. DI Rinse Water Connection: One inlet valve. Supply pressure: 207 kPa to 1014 kPa (30 psi to 147 psi), 15 l/min (4 gal/min) to RODI wall mounted system. Provided inlet hose: Approx. 1524 mm (5 feet) long, 13 mm (1/2 inch) ID with 19 mm (3/4 inch) male hose thread ends; coordinate with manufacturer of RODI system and washer manufacturer. Provide DI pump kit for input pressure below 690 kPa (10 psi).
  - d. Drain Connection: Two 25 mm (1 inch) O.D. flexible drain hoses for connection to 51 mm (2 inches) I.D. floor drain or standpipe.
12. Design:
- a. Pump system: Washer circulates water through the built-in upper and lower spray arms. Second pump is rated at 401 liters/minute (106 gallons per minute) and provides circulation through direct injection baskets or baskets with spray arms.
  - b. Dispensing Systems: Detergent dispensing container(s) of approximately 19 liters (5 gal) allow for dispensing of detergents at specified wash temperatures. Each dispensing unit includes a flow meter that precisely monitors detergent amount dispensed.
  - c. Basket System: Modular basket system allows for single or double level washing. Capable of injection washing and standard washing in a single load.
  - d. Pure Water Rinsing: Pure water is pre-heated in a tank built-in the washer, and re-circulated through spray arms and injectors at temperatures up to 95 degree C (203 degree F).
  - e. Spray arms: Include upper and lower spray arms.
  - f. Water fill: Adjustable from 11 to 30 liters (3 to 8 gallons). Fill level is monitored by flow meters and is accurate to 4 ml (0.15 oz). Standard fill level is 19 liters (5 gallons).
  - g. Pull Down Door: Features dual axis motion to minimize unnecessary wear on the gasket. Designed to support the weight of loaded baskets without additional supports.
  - h. Water temperature of any cycle is adjustable up to 95 degrees C (203 degrees F). Temperature is monitored by dual sensors with control accuracy of +/-0.5 degree.
  - i. Steam condenser: For installations where machine is indicated or required to be vented into the room or connected to an air-conditioned ventilation system.

**2.2 LABORATORY STEAM STERILIZER:** Basis of Design - AMSCO Century Medium Steam Sterilizer 26"x 26" (Scientific)-(Intergra Steam Electric Generator)

- A. Chamber:
  - 1. Interior: Type 316 Stainless steel.
  - 2. Chamber Sizes: Medium 0.30 to 0.59 cu. m (10.5 to 20.7 cu. ft.) 3.  
Chamber Pressure: up to 45 PSIG.
  - 3. Chamber Temperature: 110 - 135 degrees C (230 - 275 degrees F).
- B. Doors:
  - 1. Quantity: Double (Pass-thru).
  - 2. Operation: Power.
  - 3. Configuration: Vertical sliding Front opening Back opening (Pass through).
- C. Standard Cycles: Gravity.
- D. Heat Source: Electric.
- E. Electrical Requirements: 120V controls, 1 phase, 60Hz, 2 amps; vacuum pump 480v, 3 phase, 60Hz, 3 amps per phase.
- F. Loading: Manual.
- G. Recorder: Integrated Printer.. Verify that integrated printer hardware is protected from moisture, and readily accessible for repairs and paper changes.
- H. Control Options: Integrated controls
- I. Accessories: Loading rack and two shelves

**2.3 STERILIZER-ENCLOSURE PANELS (MODULAR WALLS):**

- A. Design and custom fabricate to conceal from view body, wiring, piping, and other appurtenances, and to confine water vapor, gases, and heat in the enclosed area:
  - 1. Size panels and support members to extend from floor to finished ceiling.
- B. Panels: Fabricate panels of not less than 1.27 mm (0.050-inch) thick type 304 stainless steel, with corners welded. Insulate with 13 mm (1/2-inch) moisture-resistant, sound-deadening, material bonded to surface of back side.
- C. Support Columns: Fabricate of not less than 1.52 mm (0.060 inch) thick, stainless-steel tubing, not less than 38 mm (1-1/2 inches) square, with mounting plates welded to top and bottom.
  - 1. Location: At each side of doors and at each vertical panel extending from floor to finished ceiling.



- D. Louvers: Stainless steel, located in panels above sterilizer doors, and with minimum clear opening area equal to 76 sq. mm/mm (3 sq. in./in.) of sterilizer width.
- E. Canopies: Locate above sterilizer doors.
  - 1. Securely attach canopies to modular wall panels to produce a tight fit.
  - 2. Join canopies, front and side panels by welding. Fabricate of same material and finish as modular wall panels.
  - 3. Apply moisture- and corrosion-resistant coating on interior surfaces.
  - 4. Type: Sloping.
  - 5. Overhang: Overhang sterilizer doors a minimum of 305 mm (12 inches).
  - 6. Coordination with Air-Intake: Include air-intake opening in modular wall panel within canopy, sized to meet airflow requirements indicated on drawings.
- F. Louvered Doors: Fabricated from not less than 13 mm (0.5 inch) thick stainless steel; double pan construction; with internal stiffeners and sound-deadening insulation.
  - 1. Equip door with heavy-duty hinges and locks.
  - 2. Center louvers and locate them within 152 mm (6 inches) of bottom of doors.
  - 3. Size louvers to produce clear opening of not less than 25 sq. mm/mm (1 sq. inch/inch) of sterilizer or aerator width.
  - 4. Equip with spring-hinged, non-louvered, access doors at wall openings above rack return conveyor.
- G. Scribe Strips: Stainless-steel closures to fit assembly to wall or ceiling.
  - 1. Maximum Width: 102 mm (4 inches). Use panels to close spaces greater than 102 mm (4 inches).
- H. Finish: No. 4 finish (bright, directional polish) complying with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" Finish after welding.
- I. Bio-membrane for sealing autoclave wall penetrations. If installation of a two-door (pass-through) autoclave will be in an area where biological agents must be contained (eg Biosafety Level 3 facilities), a sealing membrane system must be specified to prevent cross-contamination of air from one space to another around or through the equipment (when both doors are closed).

## 2.4 ICE MACHINE

- A. Freestanding ice and water dispenser with removable air cooled icemaker, approximately 533 mm (21 inches) wide x 609 mm (24 inches) deep x 1575 mm (62 inches) high for 11 kg (25 lbs) capacity. (Basis of design - Scotsman CU0415 Essential Ice)
- B. Exterior: Stainless steel frame with stainless steel panels.
- C. Storage Capacity: 11 kg (25 lbs).
- D. Production: Approximately 181 kg (400 lbs) of compressed nugget ice in a 24-hour period.
- E. Dispenser Controls: Infrared sensor activated.
- F. Electrical Requirements: 115V, 60 Hz, 1 phase, 14 amp
- G. Coordinate with electrical to provide GFCI protection.
- H. Provide 2 m (7 foot) cord and NEMA 5-20 90-degree hospital-grade plug.
- I. Dispenser to have automatic storage bin level control to start and stop icemaker and to allow dispensing to continue with icemaker removed.
- J. Icemaker to use environmentally friendly R404A refrigerant, and be easily removed for service and maintenance.
- K. Controls: Microprocessor controls with diagnostics program for servicing.
- L. Storage bin to be insulated with high-density, foamed-in-place polyurethane.
- M. Storage bin to be easily accessed for manual loading of back-up ice.
- N. Energy consumption: maximum of 5.7 KWH per 45 kg (100 lbs) ice produced.
- O. Water Consumption: 49 L (13 gal) of potable water usage per 45 kg (100 lbs) of ice produced.
- P. Installation:
  - 1. Coordinate with Mechanical for water supply and drains.
  - 2. Coordinate with electrical for GFCI protection and receptacle compatibility.
- C. Construction: Canopy hoods shall be fabricated in single section units, for ease and convenience in handling and installation. A 152 mm (6 inch), wide fascia shall be on front and both ends with roof sloping three ways to a 25 mm (1 inch) high, circular exhaust outlet. A water tight condensation gutter shall surround interior perimeter of canopy. Fabricate of not less than 1.27 mm (0.050-inch) thick type 304 stainless steel, with corners welded and ground smooth.
- F. Electrical Requirements: 115V, 60 Hz, 1 phase, 6 amp.

## **2.5 WATER TREATMENT SYSTEM:**

- A. Unit is wall hung water filtration and purification unit. Basis of design - Type 1 Ultra Pure 18.2 megohm cm RODI Systems. Standard, Model #RODI - C-12A and Model #RODI 2000-01A (with 200 liter storage tank for laboratory glassware washer).
- B. Water Treatment Process:
  - 1. Pre-Filtration.
  - 2. Recirculation.
  - 3. Deionization.
  - 4. Final Filtration.
  - 5. Heating.
  - 6. Chlorine injection
- C. Average Output: 2 liters per minute RO; 10 LPH DI.
- D. Electrical Requirements: 115V.
- E. Low Voltage Controls:
  - 1. Fully Automated, Programmable, with automatic membrane flushing, alarm set points for post RO pH, and detailed monitor screens for tank level, Pre-treatment, RO machine, RO distribution permeate flow and water temperature.
  - 2. Automated daily log records percent rejection, permeate conductivity, normalized differential pressure, post chlorine, and pH.
  - 3. Remote PC access for monitoring and diagnostics.
- F. Construction:
  - 1. Frame - 16 GA powder coat steel
  - 2. Piping - 3/4 OD 316 stainless steel
  - 3. Quick Disconnects - universal style
  - 4. 316 stainless steel (wetted parts):
    - a. Ball Check in QD plug
    - b. Ball and Check Valves
    - c. Solenoid Valve
  - 5. Membrane:
    - a. Cellulose Acetate (CA or CTA) Membrane (Chlorine tolerant)
    - b. Polyimide (PA) Membrane
- G. Utilities
  - 1. Water Pressure - potable or chlorinated: 6 Lpm at 3-4 bars (1.5 gpm at 40-60 psi)
  - 2. Water Temperature: 4-49 degrees C (40-120 degrees F)

3. Electrical: 115 VAC, 50/60 Hz, 1 amp, requires GFI circuit

4. Water Reclamation: minimum 45% of feed water

## **2.6 CENTRAL COMPRESSED AIR SYSTEM:**

- A. System Design: The laboratory air system shall be of a modular base mounted design consisting of multiplexed compressor, dryer/control, and an air receiver. Each unit must be fully compliant with the latest edition of NFPA 99.
- B. Compressors: Continuous duty rated "oil-less" type with permanently lubricated, sealed bearings. Single stage design, air cooled, reciprocating type with corrosion resistant reed type valves with stainless steel reeds. Both the compression rings and rider rings shall be made from a long life, fluororesin material designed for continuous duty operation. The crankshaft shall be constructed of a durable nodular graphite cast iron and designed to be fully supported on both ends by heavy duty ball bearings permanently lubricated and sealed. The crankcase shall be constructed of gray cast iron. Maximum heat dissipation shall be achieved through cast aluminum alloy cylinders treated for optimum corrosion and wear resistance. Cylinder sleeves shall not be required. Additionally, heat transmission from the piston wall to the piston pin needle bearing shall be minimized by an insulated "heat cut" piston pin. The connecting rod shall be of a one piece design for maximum reliability.
- C. Compressor Drive and Motor: V-belt driven through a combination flywheel/sheave and steel motor sheave with tapered bushing and protected by an OSHA approved, totally enclosed belt guard. Belt tensioning shall be achieved by a pivoting motor mounting base that is fully adjustable through twin adjusting screws. The motor shall be a NEMA rated, open drip proof, 1800 RPM, with 1.15 service factor suitable for 208/230/460V electrical service, as specified in Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT and Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- D. Intake Piping: Provide a pre-piped intake manifold with one "hospital type" inlet air filter with threaded opening for remote intake connection. Isolate filter housing from the intake manifold with a braided 304 stainless steel flex connector.
- E. Discharge Piping: Provide an integral air cooled aftercooler designed for a maximum approach temperature of -11 degrees C (12 degrees F) complete with moisture separator and timed automatic solenoid drain

valve with a manual drain valve by-pass. Provide each cylinder head with a pre-wired high discharge air temperature shutdown switch. Include a flex connector, safety relief valve, and check valve. The compressor discharge line the piping shall be of ASTM B-819 copper tubing, brass, and/or stainless steel. The discharge flex connector shall be braided 304 stainless steel, brass or bronze.

- F. Isolation System: Isolate the compressor and monitor from the main compressor module base by means of a four point, heavy duty, spring isolation system for a minimum of 95% isolation efficiency.
- G. Dryer/Control: The dryer/control shall include a NEMA 12, U.L. labeled control system, duplexed desiccant drying system, duplexed final line filters, duplexed final line regulators, and combination dew point/CO monitor. All of the above shall be pre-wired and pre-piped in accordance with NFPA 99 and include valving to allow complete air receiver by-pass, as well as air sampling port.
- H. Dryer: Size each desiccant dryer for the peak calculated demand and capable of producing -12 degrees C (10 degrees F) pressure dew point. Dryer purge flow shall be minimized through an on-demand purge saving control system. Include a mounted prefilter rated for 0.01 micron with automatic drain and element change indicator on the inlet of each dryer.
- I. Control System: Mounted and pre-wired control system shall be NEMA 12 and U.L. labeled. This control system shall provide automatic lead/lag sequencing with circuit breaker disconnects for each compressor with external operators, one non-fused main disconnect with external operators, full voltage motor magnetic starters with overload protection, redundant 120V control circuit transformers, visual and audible reserve unit alarm with isolated contacts for remote alarm, hand-off-auto (HOA) lighted selector switches, automatic alternation of both compressors with provisions for simultaneous operation if required, automatic activation of reserve unit if required, visual alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm, and duplexed run time hour meters.
- J. Final Line Filters and Regulators: Fully duplexed final line filters rated for 0.01 micron with element change indicators shall be factory mounted and pre-piped, along with duplexed factory mounted and pre-piped final line regulators and duplex safety relief valves.

- K. Dew Point Hygrometer/CO Monitor: Mounted, pre-piped and wired, combination dew point hygrometer/CO monitor shall be of the ceramic type with integral chemical type CO sensor. System accuracy shall be  $\pm 2$  °F for dew point and 2PPM (at 10 PPM) for carbon monoxide. Dew point alarm shall be factory set at 4 degrees C (39 degrees F) per NFPA 99, and the CO alarm shall be factory set at 10 PPM. Both set points shall be field adjustable.
- L. Air Receiver: Vertical air receiver, galvanized, ASME Coded, National Board Certified, rated for minimum 150 PSIG design pressure and includes a sight gauge glass as well as a timed automatic solenoid drain valve. Provide three valve bypass on supply.
- M. Example of an acceptable product and manufacturer: Beacon Medical Products "Lifeline Medical Air Systems".

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install units in accordance with manufacturer's documented instructions.
- B. Coordinate installation with related mechanical, plumbing and electrical work. Provide cutouts and openings for mechanical, plumbing and electrical work as indicated or as required by trades involved.

#### **3.2 TESTING AND CERTIFICATIONS**

- A. Field test installed equipment after water and steam systems are pressurized for proper operation.
  - 1. Operate each unit for six hours through repeated full cycles. During and after testing, there shall be no evidence of leaks, overheating, electrical failure, or other symptoms of failure.
  - 2. For units that fail testing, make adjustments and corrections to installation, or replace equipment, and repeat tests until equipment complies with requirements.
- B. Where applicable, installer shall provide certificate of compliance and/or documented cycle records validating the activation and ready-for-use status of the equipment.

#### **3.3 PROTECTING AND CLEANING**

- A. Protect equipment from dirt, water, and chemical or mechanical injury during storage, installation, and throughout the duration of the construction period.
- B. At the completion of work, clean equipment as required to produce ready-for-use condition.

### **3.4 SEISMIC PROVISIONS**

Where required by Seismic Zone Classification and/or local regulations, provide seismically approved anchors, mountings and tie-downs per Manufacturer and/or Certified Structural Engineer

### **3.5 DEMONSTRATION AND TRAINING:**

- A. Instruct personnel and transmit operating instructions in accordance with requirements in specification Section 01 00 00, GENERAL REQUIREMENTS.
- B. Training must be provided by the manufacturer, or manufacturer certified instructors.
- C. Orientation and Training on all equipment to be provided to a minimum of two owner designated personnel per equipment item/system and shall certify their operational competency.

### **3.6 COMMISSIONING**

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00 - COMMISSIONING OF HVAC SYSTEMS for all inspection, start up, 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 23 08 00 - COMMISSIONING OF HVAC SYSTEMS and related sections for contractor responsibilities for system commissioning.

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