

SECTION 11 71 02
LABORATORY WASHING AND STERILIZING EQUIPMENT

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 cage and rack washers, animal bedding dispensers, animal bedding disposal equipment, glassware dryers, ice machines, exhaust hoods, flushing rack systems, steam guns, instrument washer, detergent dispensing units, 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.
- D. Utensil & Cart Washer: An automated washing unit that uses high-temperature water and detergent to clean and high-level disinfect cages, utensils and carts. Units are generally large enough to readily roll entire racks or carts directly into the washing chamber.
- F. Counter-top Sterilizer: A counter top mounted or free-standing machine used to sterilize instruments.
- J. Exhaust Hood: Exhaust canopy hood for venting heat, steam, moist air, and odors. Frequently placed over autoclave doors and entry/exit

locations on other equipment when moisture or steam is expected to enter the environment from the equipment.

- L. Steam Gun: Hand held hose and high pressure steam spray wand used in manually washing cages, carts, and other large containers.
- O. Detergent Dispensing System: A mechanical system that dispenses measured doses of detergent or other chemicals directly to washer disinfectors and cart washers.
- P. Water Treatment System: A mechanical system for use with steam sterilizers, washer/disinfectors and cart washers, that decreases contaminants in the domestic water to reduce boiler scaling and instrument spotting.
- S. Chlorine Injector Station: For automatically injecting chlorine into water used for Recoil Hose Flush Stations, Reverse Osmosis Systems, and other applications.
- U. 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 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 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Steam Connections.
- G. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Remote monitoring of the Steam Sterilizers.
- H. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Electrical Connections.
- I. Section 22 31 00, WATER SOFTENERS
- J. Section 22 67 19.16, REVERSE OSMOSIS EQUIPMENT
- K. Section 22 67 21, WATER DEALKALIZING SYSTEM
- L. 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, 3rd 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 UTENSIL WASHER

- A. Cabinet 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).
- 1. Exterior/Interior: Construction:
 - a. Interior: Chamber walls, ceiling, and floor are constructed of type 316 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: Steam Steam Pressure: 36-145 PSI.
- 7. Electrical Requirements: Electrical Connection (Electric Only): 3 Phase, 208/220V, 60Hz, 30A.
- 8. Standard Cycles: Wash Rinse Dry .

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). 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. 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. Construction:

- a. Interior: Chamber walls, ceiling, and floor are constructed of type 316 stainless steel for corrosion resistance.
- b. Exterior cabinet. Constructed of type 304 brushed stainless steel for corrosion-resistance

13. 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. Optional Drying System: Built-in, does not require additional floor space, features temperatures up to 115 degree C (239 degree F), HEPA-filtered forced hot air through injectors and wash

chamber, allows for two time and temperature settings and a cool-down cycle, and shall perform at less than 70 dBA.

- e. 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).
 - f. Spray arms: Include upper and lower spray arms.
 - g. 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).
 - h. 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.
 - i. 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.
 - j. Steam condenser: For installations where machine is indicated or required to be vented into the room or connected to an air-conditioned ventilation system.
14. Accessories:
- a. Additional chemical pump(s) to allow for injections of different chemicals during desired treatments.
 - b. Air compressor, 'oil free', complete with automatic tank drain and pressure switch.
 - c. Barrier wall flange kit, includes six stainless steel flanges to seal the opening between the pass through washer and the wall.
 - d. Booster Heater for high temp rinse cycle.

2.2 LABORATORY STEAM STERILIZER

A. Chamber:

- 1. Interior: Type 316 Stainless steel.
- 2. Chamber Sizes: Small 0.13 to 0.27 cu. m (4.6 to 9.7 cu. ft.) Medium 0.30 to 0.59 cu. m (10.5 to 20.7 cu. ft.) .
- 3. Chamber Pressure: up to 45 PSIG.
- 4. Chamber Temperature: 110 - 135 degrees C (230 - 275 degrees F).

B. Doors:

- 1. Quantity: Single; Double (Pass-thru) .
- 2. Operation: Manual.
- 3. Configuration: Hinged door Front opening; Back opening (Pass through) .

- C. Standard Cycles: Gravity.
- D. Heat Source: Steam.
- E. Electrical Requirements: 120V208V.
- 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 . Provide remote monitoring of the steam sterilizer via the DDC control system. Coordinate interface with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.//
- I. Installation Options: Floor mount.
- J. Accessories: Loading car and transfer carriage //
- K. If a loading cart assembly will be used, verify appropriate model for sterilizer.

2. UTENSIL & CART WASHER

- A. Interior: Stainless steel.
 - 1. Chamber Capacity: 196 CUFT..
- B. Doors:
 - 1. Quantity Single (Pass-thru).
 - 2. Operation: Manual.
- C. Controls: Integrated, Programmable, Microprocessor with paper printer.
- D. Heat Source: Steam.
- E. Electrical Requirements: 208V.
- F. Standard Cycles: Wash Rinse Dry.
- G. Optional Cycles: Thermal Disinfection Rinse.
- H. Installation Options: Pit mount.
- I. Temperature:
 - 1. Wash Cycle: 49 - 82 degrees C (120 - 180 degrees F).
 - 2. Rinse Cycle: 82 - 90 degrees C (180 - 194 degrees F).
- J. Loading: Manual
- K. Jet spray system: Two main types are in use, spinning spray arms fixed in the enclosure walls, ceiling, and cabinet, cabinet and jet spray assemblies mounted on an oscillating manifold on each side the washer. Due to the higher water pressure generally achieved with fixed arms and the increased rate of repairs for manifold spray systems outside of warranty periods (due to more moving parts), fixed spray arm configurations are generally preferred.

- L. Automatic self-flushing debris strainer
- M. Accessories: Universal wash cart Booster heater for high temp rinse cycle.
- N. Complete list of purchased parts, including original equipment manufacturer part numbers, shall be provided. All purchased machine components such as jets, valves, PLC modules, pneumatic system parts, etc., shall be entirely non-proprietary and available for purchase freely and widely through normal industrial supply outlets.
- O. Option: Air compressor, 'oil free', complete with automatic tank drain and pressure switch.
- P. Specific instructions on placement and configuration of exhaust ductwork to prevent run-back of condensation into enclosure.
- Q. Details of any pit or floor modification needed prior to installation.

2.6 COUNTER-TOP STERILIZER

- A. For sterilizing small utensils and hand held instruments, approximately 584 mm W x 457 mm D x 457 mm H (23 inches W x 18 inches D x 18 inches High).
- B. Chamber:
 - 1. Interior: Stainless steel.
 - 2. Chamber Size: 279 mm Diameter x 457 mm D (11 inches Diameter x 18 inches D).
 - 3. Chamber Pressure: up to 45 PSIG.
 - 4. Chamber Temperature: 110 - 135 degrees C (230 - 275 degrees F).
- C. Single door
- D. Standard Cycles: Gravity
- E. Electrical Requirements: 115V, 15A, 1-Phase
- F. Loading: Manual.
- G. Recorder: Integrated Printer.
- H. Water reservoir: 4 liters (1 gal).
- I. Trays: two large, two small

2.8 EQUIPMENT DRYING CABINET

- A. For Drying large quantities of glassware, plastic ware and metal goods. Unit is approximately 914 mm W x 813 mm D x 2032 mm H (36 inches W x 32 inches D x 80 inches H).
- B. Cabinet Exterior: Type 304 Stainless Steel
- C. Interior Chamber:
 - 1. Interior: Type 304 Stainless steel.

2. Capacity: Up to 5 shelves.

D. Doors:

1. Quantity: Single.
2. Operation: Manual.
3. Configuration: Side hinged Front opening.

E. Loading: Manual.

F. Controls: Digital with adjustable cycle time and temperature controls.

G. Heat Source: Electric.

1. Cabinet Temperature: Adjustable up to 115 degrees C (240 degrees F).
2. Drying Time: 0 - 99:59 hours.

H. Electrical Requirements: 208V, 3-Phase, 4-wire

I. Cabinet Filtration: HEPA filtered air.

J. Recirculation Blower: minimum 1/3 HP motor

2.10 EXHAUST HOOD

A. Refer to HVAC spec section 23 31 00 - HVAC DUCTS AND CASINGS for further information.

2.15 COUNTER-TOP INSTRUMENT WASHER:

C. Cabinet 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 instrument types. Approximately 851 mm high x 902 mm wide x 699 mm deep (33.5 inches high by 35.5 inches wide by 27.5 inches deep).

1. Exterior/Interior: Construction:

- a. Interior: Chamber walls, ceiling, and floor are constructed of type 316 stainless steel for corrosion resistance.

2. Doors:

- a. Quantity: Single door
- b. Operation: Automatic.

3. Chamber size: Interior useable space approximately: 483 mm high by 559 mm wide by 533 mm deep (19 inches high by 22 inches wide by 21 inches deep).

4. Loading: Manual

5. Controls: Digital control system includes standard and service-diagnostic programs, with space available for custom programs, and

- shall provide for Multi-language display. RS-232 and Infrared serial ports are to be included for connection to a PC.
6. Heat Source: Electric.
 7. Electrical Requirements: Electrical Connection (Electric Only): single-phase, 208/220V, 60Hz, 15A.
 8. Standard Cycles: Wash Rinse Dry .
 10. Temperature:
 - a. Wash Cycle: 50 - 70 degrees C (122 - 158 degrees F).
 - b. Rinse Cycle: 50 - 70 degrees C (122 - 158 degrees F).
 11. Plumbing Connections:
 - b. Cold Tap Water connection: One inlet valve. Supply pressure: 207 kPa to 1014 kPa (30 psi to 147 psi), 15 liters/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.
 - 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.
 - e. Construction:
 - 1) Interior: Chamber walls, ceiling, and floor are constructed of type 316 stainless steel for corrosion resistance.
 - f. Design:
 - 1) Pump system: Washer pump(s) provides circulation through direct injection baskets or baskets with spray arms.
 - 2) Dispensing Systems: Detergent dispensing container(s) of approximately 19 liter (5 gal) allow for dispensing of detergents at specified wash temperatures. Each dispensing unit includes a flow meter that precisely monitors detergent amount dispensed.
 - 5) Pure Water Rinsing: Pure water is pre-heated and re-circulated through spray arms and injectors at temperatures up to 70 degrees C (158 degree F).
 - 6) Spray arms: Include upper and lower spray arms.
 - 7) 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).
 - 8) 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.

- 9) Water temperature of any cycle is adjustable up to 70 degrees C (158 degree F), Temperature is monitored by dual sensors with control accuracy of +/-0.5 degree.

2.16 DETERGENT DISPENSING SYSTEM:

- A. Configuration: Floor Mounted.
- B. Controls: Integrated, Programmable, Microprocessor controls with remote PC interface control capability.
- C. Dispensing Options: Enzymatic Solution, Detergent, Lubricant Solution.
- D. Solution Tank Options: 95 (25) liters (gallons) capacity.
- F. All tubing and connections required for connection to adjacent equipment

2.17 WATER TREATMENT SYSTEM:

- A. Refer to plumbing spec section 22 67 19.16 - REVERSE-OSMOSIS WATER EQUIPMENT for further information.

2.20 CHLORINE INJECTOR STATION:

- A. Unit is used to automatically inject chlorine into water used for Reverse Osmosis Systems, and other applications.
- B. Capacity: The system is adaptable to a wide range of flow rates. Solution content mixture in water is adjustable via pump settings.
- C. Operation: Manual Switch for treated or untreated water.
- D. Dimensions: Approximately 991 mm H x 940 mm w x 229 mm d (39 inches H x 37 inches W x 9 inches D)
- E. Construction:
 - 1. Back Panel - 16 GA stainless steel
 - 2. Piping - 1/2 OD 316 stainless steel
 - 3. Flow Switch: plastic 1 lpm (.25 gpm) rated
 - 4. Injection Pump:
 - a. Positive displacement type
 - b. 31 ml/min capacity
 - 5. Solution tank: 15 L (4 gal) polyethylene
 - 6. 316 stainless steel Ball and Check Valves
 - 7. Plumbing Connections:
 - a. Inlet - flange/swivel nut for 1/2 MPT adapter
 - 8. Mixing Chamber - polypropylene

F. Utilities:

1. Water - potable or purified
2. Electrical: 115 VAC, 50/60 Hz, 1 amp, requires GFI circuit

2.22 CENTRAL COMPRESSED AIR SYSTEM:

- A. Refer to Plumbing spec section 22 63 00 - GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES for further information.

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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