

**SECTION 11 71 01**  
**MEDICAL WASHING AND STERILIZING EQUIPMENT**

SPEC WRITER NOTES:

1. Delete between // // if not applicable to project.
2. Delete other items or paragraphs in section that are not applicable and renumber the paragraphs.
3. Note that VA policy is to minimize and ultimately phase-out the use of EtO sterilizers.

**PART 1 - GENERAL**

**1.1 DESCRIPTIONS**

- A. This section specifies Medical Reprocessing and Sterilization Equipment including washer disinfectors, cart washers, ultrasonic cleaners, automated endoscope re-processors, steam sterilizers, ethylene oxide (EtO) sterilizer/aerator combination units, ethylene oxide (EtO) abators, plasma sterilizers, ethylene oxide (EtO) monitoring stations, liquid chemical sterilizers, drying cabinets, detergent dispensing units, water treatment systems, steam guns, and endoscope pre-processing sinks.

**1.2 DEFINITIONS**

- A. Ultrasonic Cleaner: A mechanical system that uses sound waves, water and detergent to loosen soil from instruments. Both countertop and floor units are available.
- B. Washer/Disinfector: An automated washing unit that uses high-temperature water and detergent to clean and high-level disinfect instruments and trays.
1. Cube Model - Single chamber washer/disinfector.
  2. Tunnel Model - Multiple chamber washer/disinfector.
- C. Cart Washer: An automated washing unit that uses high-temperature water and detergent to clean and high-level disinfect carts and equipment.
- D. Endoscope Drying Cabinet: Freestanding cabinet used to dry endoscopes with forced, filtered air within the cabinet, as well as through the channels of the scopes.
- E. Equipment Drying Cabinet: Freestanding cabinet used to dry equipment with forced, filtered air and variable temperature settings. There are single door and pass-thru units available.

- F. Automated Endoscopic Re-Processor (AER): Automated washing unit that uses water and EPA-approved high level disinfectants to clean and high level disinfect immersible, flexible endoscopes.
- G. Steam Sterilizer: A machine used to sterilize instruments and equipment by subjecting them to high-pressure steam up to 275 degrees F. Sterilizers are available in both cart-loading and floor-loading models. They can be either freestanding or recessed, with single or double doors (pass-thru). Steam sterilizers are also known as autoclaves.
- H. Ethylene-Oxide (EtO) Sterilizer/Aerator Combination: A machine that combines the sterilization and aeration process into one unit. Ethylene Oxide gas is used to sterilize heat-sensitive instruments and equipment by subjecting them to a temperature of up to 130 degrees F, and an aeration cycle immediately follows the sterilization cycle. ETO sterilizers can be freestanding or recessed, with single doors. A dedicated exhaust system is required for Ethylene Oxide.
- I. Ethylene Oxide (EtO) Disposal System (Abator): A machine used as a pollution-control device, that converts ethylene oxide gas exhausted from sterilizer/aerator units to CO<sub>2</sub> and water vapor through a heated catalytic process.
- J. Ethylene Oxide (EtO) Monitoring Station: A continuous monitoring device (Single point or multi-point system) used to detect Ethylene Oxide leakage into the room.
- K. Gas Plasma Sterilizer: A machine that uses hydrogen peroxide gas plasma to sterilize heat-sensitive instruments and equipment. These sterilizers are available as either floor, cart, or counter-mounted.
- L. Liquid Chemical Sterilizer: A machine that uses a low-temperature liquid chemical sterilant to process heat-sensitive rigid and flexible endoscopes.
- M. Water Treatment System: A mechanical system for use with steam sterilizers, washer/disinfectors and cart washers, that decreases the contaminants in the municipal water to reduce boiler scaling and instrument spotting.
- N. Detergent Dispensing System: A mechanical system that dispenses measured doses of detergent or other chemicals directly to washer disinfectors and cart washers.
- O. Steam Gun: Refer to Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING.

P. Endoscope Pre-Processing Sink: Refer to Section 22 40 00, PLUMBING FIXTURES.

### 1.3 RELATED WORK

- A. Section 22 11 00, FACILITY WATER DISTRIBUTION: Plumbing Connections.
- B. //Section 22 13 00, FACILITY SANITARY AND VENT PIPING: 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 22 66 00, CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES: Plumbing Connections. //
- F. Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- G. //Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Remote monitoring of the Steam Sterilizers and Monitoring system. //
- H. Section 23 22 13, STEAM AND CONDENSATE HEATING PIPING: Steam Connections//, Steam Gun//.
- I. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Electrical Connections.

### 1.4 PERFORMANCE REQUIREMENTS

SPEC WRITER NOTE: Check with user to verify service characteristics required for equipment.

- A. Equipment shall have built-in monitoring for timed cycles, and control devices for proper 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.

### 1.5 QUALITY CONTROL

- A. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC: "Quality Assurance, Products Criteria".
- B. Mechanical, electrical, and associated systems shall be safe, reliable, efficient, durable, easily and safely operable, maintainable, and accessible.
- 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 on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer workstations, shall be the current generation of technology and basic design that 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: Installer is authorized representative of sterilizer manufacturer and employs factory-trained personnel to install sterilizers. Installer is licensed as may be necessary by regulatory organizations.
- H. Steam Sterilizers: Comply with the most current version of ANSI/AAMI ST8.
- I. Ethylene-Oxide Sterilizers: Comply with the most current version of ANSI/AAMI ST24.

#### **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 medical reprocessing equipment.
  - 2. Optional auxiliary equipment and controls.
  - 3. Catalog or model numbers for each component.
  - 4. Utility requirements.
- 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.

**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):
  - ST8-2008.....Hospital Steam Sterilizer, 3<sup>rd</sup> edition
  - ST24-1999 (R2009).....Automatic, General-Purpose Ethylene Oxide Sterilizers and Ethylene Oxide Sterilant Sources Intended for Use in Health Care Facilities
- C. National Association of Architectural Metal Manufacturers (NAAMM):
  - AMP 500-06.....Metal Finishes Manual

**1.8 WARRANTY**

- A. Comply with FAR clause 52.246-21 in all areas except for warranty period, which shall be two 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**

SPEC WRITER NOTES:

- 1. Show utility service requirements for sterilizers on drawings.
- 2. Verify that dedicated exhaust service, venting directly to exterior, without recirculating, is supplied for sterilizers. Need for the dedicated exhaust system should be verified with the manufacturer and the VA Design Manual.

**2.1 ULTRASONIC CLEANER**

SPEC WRITER NOTE: Chamber sizes vary.  
Insert sizes based on project requirements.

- A. Floor Model:
  - 1. Chamber:
    - a. Interior: Insulated stainless steel.
    - b. Tank capacity: 11 gallons to 20 gallons.
  - 2. Doors:
    - a. Quantity: Single.
    - b. Operation: // Manual // Automatic //.
  - 3. Loading: Manual.
  - 4. Heat Source: // Electric //.
  - 5. Temperature:
    - a. Solution tank: 100 - 120 degrees F.
  - 6. Electrical Requirements: // 120V // 208V single-phase // 240V three-phase//.
- B. Countertop Model:
  - 1. Chamber:
    - a. Interior: Stainless steel.
    - b. Tank capacity: 3 gallons to 6 gallons.
  - 2. Doors:
    - a. Quantity: Single.
    - b. Operation: Manual.
  - 3. Loading: Manual.
  - 4. Heat Source: Electric.
  - 5. Temperature:
    - a. Solution tank: ambient to 176 degree F.
  - 6. Electrical Requirements: // 120V // 208V // single phase.
- C. Capable of cleaning robotic instruments.

**2.2 WASHER/DISINFECTOR**

SPEC WRITER NOTE: Chamber sizes vary.  
Insert sizes based on project requirements.

- A. Tunnel (Multi-Chamber) Model:
  - 1. Interior: Stainless steel.
  - 2. Doors:
    - a. Quantity: Double (Pass-thru).

- b. Operation: Automatic.
- 3. Loading: // Manual // Automatic //.
- 4. Controls: // Microprocessor // PC Based //.
- 5. Heat Source: // Clean Steam // Electric //.
- 6. Electrical Requirements: // 208V single-phase // 480V three-phase //.
- 7. Standard Cycles: // Wash // Rinse // Dry //.
- 8. Optional Cycles: // Prewash // Ultrasonic // Thermal Disinfection Rinse //.
- 9. Temperature:
  - a. Wash Cycle: // 140 - 180 degrees F //.
  - b. Rinse Cycle: // 180 - 194 degrees F //.
- B. Cube Model:
  - 1. Chamber Interior: Stainless steel.
  - 2. Doors:
    - a. Quantity: // Single // Double (Pass-thru) //.
    - b. Operation: // Manual // Automatic //.
  - 3. Loading: // Manual // Automatic //.
  - 4. Controls: // Microprocessor // PC Based //.
  - 5. Heat Source: // Clean Steam // Electric //.
  - 6. Electrical Requirements: // 208V single-phase // 240V three-phase //.
  - 7. Standard Cycles: // Wash // Rinse //.
  - 8. Optional Cycles: // Purified Water Rinse // Dry //.
  - 9. Temperature:
    - a. Wash Cycle: 140 - 180 degrees F.
    - b. Rinse Cycle: 158 - 194 degrees F.

### 2.3 CART WASHER

SPEC WRITER NOTE: Chamber sizes vary.  
Insert sizes based on project requirements.

- A. Interior: Stainless steel.
  - 1. Chamber Capacity: 134 - 241 cubic feet
- B. Doors:
  - 1. Quantity: // Single (Pass-thru) // Double (Pass-thru) //.
  - 2. Operation: Automatic.
- C. Controls: // Microprocessor // PC Based //.
- D. Heat Source: // Clean Steam // Electric //.

- E. Electrical Requirements: // 208V single-phase // 380V // 480V // 600V // three-phase//.
- F. Standard Cycles: // Wash // Rinse // Dry //.
- G. Optional Cycles: Thermal Disinfection Rinse.
- H. Installation Options: // Floor mount // Pit mount //.
- I. Temperature:
  - 1. Wash Cycle: 120 - 180 degrees F.
  - 2. Rinse Cycle: 180 - 194 degrees F.
- J. Loading: //Manual//Automatic//.

#### **2.4 ENDOSCOPE DRYING CABINET**

- A. Chamber:
  - 1. Interior: // Painted steel // Stainless Steel //.
  - 2. Capacity: Up to 10 Endoscopes.
- B. Doors:
  - 1. Quantity: // Single // Double //.
  - 2. Operation: Manual.
  - 3. Configuration: // Side hinged // Front opening // Back opening (Pass Through) //.
- C. Loading: Manual.
- D. Heat Source: Electric:
  - 1. Cabinet Temperature: 149 - 158 degrees F.
  - 2. Standard Drying Time: 0 - 120 minutes.
- E. Cabinet Filtration: HEPA filtered air through chamber and internal endoscope channels.
- F. Air Flow Monitoring: Constant.
- G. Electrical Requirements: 120V.

#### **2.5 EQUIPMENT DRYING CABINET**

- A. Chamber:
  - 1. Interior: Stainless steel.
  - 2. Capacity: Up to 9 Shelves or cassettes.
- B. Doors:
  - 1. Quantity: // Single // Double (Pass Through) //.
  - 2. Operation: Manual.
  - 3. Configuration: // Side hinged // Front opening // Back opening (Pass Through) //.
- C. Loading: Manual.
- D. Heat Source: Electric.
  - 1. Cabinet Temperature: 158 - 194 degrees F.

2. Standard Drying Time: 0 - 90 minutes.

E. Cabinet Filtration: HEPA filtered air.

F. Electrical Requirements: 120V.

## 2.6 AUTOMATIC ENDOSCOPE RE-PROCESSOR (AER)

SPEC WRITER NOTE: Chamber configurations vary. Insert sizes based on project requirements.

A. Configuration: Free Standing.

B. Chamber:

1. Chamber Quantity: // Single // Double // Triple //.

2. Chamber Processing Capacity: // 1 scope // 2 scopes //.

C. Standard Cycle:

1. Time: 22 - 42 minutes.

D. Printer: // Integrated // Remote Printer //.

E. Water Pressure: 30 - 70 PSI.

F. Electrical Requirements: // 110V // 120V // 208V // 220V // 230V  
//single-phase// 460V //three-phase //.

## 2.7 STEAM STERILIZER

SPEC WRITER NOTE: Chamber sizes vary. Insert sizes based on project requirements.

A. Chamber:

1. Interior: Stainless steel.

2. Chamber Sizes: // Small (4.6 to 9.7 cubic feet) // Medium (10.5 to 20.7 cubic feet) // Large (39.6 to 72 cubic feet) //.

3. Chamber Pressure: up to 45 PSIG.

4. Chamber Temperature: 230 - 275 degrees F.

B. Doors:

1. Quantity: // Single // Double (Pass-thru) //.

2. Operation: // Manual // Power //.

3. Configuration: // Vertical sliding // Hinged door // Front opening  
// Back opening (Pass through) //.

C. Standard Cycles: // Gravity // Vacuum //.

D. Heat Source: // Clean Steam // Electric //.

E. Loading: Manual.

F. Recorder: // Integrated Printer // Remote printer //.

G. Control Options: // Integrated controls // Remote 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.//

- H. Installation Options: // Floor mount // Pit mount //.
- I. Electrical Requirements: // 110V single-phase// 208V single-phase // 480V three-phase //.

## **2.8 ETHYLENE-OXIDE STERILIZER/AERATOR COMBINATION**

SPEC WRITER NOTE: Chamber sizes vary. Insert sizes based on project requirements.

- A. Chamber:
  - 1. Interior: Stainless steel.
  - 2. Size: 4.8 cubic feet to 7.9 cubic feet.
- B. Cycle Time:
  - 1. Exposure: 0 to 99 hours.
  - 2. Aeration: 0 to 99 hours.
  - 3. Chamber Pressure: Minimum 80 psi.
  - 4. Warm Sterilization Temperature: 55 degrees C (131 degrees F).
  - 5. Cold Sterilization Temperature: 37 degrees C (98.6 degrees F).
  - 6. Warm Aeration Temperature: 54 degrees C (130 degrees F).
  - 7. Cold Aeration Temperature: 38 degrees C (100 degrees F).
- C. Doors:
  - 1. Quantity: Single.
  - 2. Operation: // Manual // Automatic //.
- D. Recorder: // Integrated Printer // Remote Printer //.
- E. Installation Options: // Freestanding // Recessed //.
- F. Electrical Requirements: // 120V // 220V //.
- G. Vent Outlet: Ethylene oxide vent pipe connection for vent pipe connection to abator.
- H. Sterilant Delivery System: Single-Use Gas cartridge.

## **2.9 ETHYLENE-OXIDE ABATOR**

SPEC WRITER NOTE: Obtain an abator when an ethylene oxide sterilizer will be used. Per VA Policy, provide one Abator per Sterilizer. Coordinate electrical requirements with available facility power.

- A. System Components:
  - 1. Catalytic cell.
  - 2. Heater.
  - 3. Blower (Fan): // 115V // 230V //.

4. Prefilter.
5. Interconnection Kit: Links abator to ethylene-oxide sterilizer.
6. Construction: Stainless Steel.
7. Electrical Requirements: // 200V // 220V // 400V //.

B. Vent Accessories:

1. Inlet Vent: Ethylene oxide vent pipe connection for vent pipe connection to sterilizer.
2. Outlet Vent: Exhaust discharge connection. Provide 3 way blender exhaust discharge fitting with exhaust duct connection to mix high temperature abator discharge with room air for low temperature abator exhaust.
3. Auxiliary Vent: Ethylene oxide emergency vent pipe connection for vent pipe connection to outdoors.

**2.10 ETHYLENE-OXIDE (ETO) MONITOR:**

SPEC WRITER NOTE: Obtain an Ethylene-Oxide monitoring device when an ethylene-oxide sterilizer will be used.

A. System Components:

1. Electro Chemical Sensors Range 0-100 PPM (EtO/organic vapor).
2. Pre-filter to allow for greater specificity.
3. Supervisory panel where readings can be taken.
4. Alarm and strobe device (audible and visual alarm).
5. Second alarm for notification (Police, Fire Dept, etc.).
6. //Provide remote monitoring of the EtO monitoring system via the DDC control system. Coordinate interface with Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.//

**2.11 GAS PLASMA STERILIZER (HYDROGEN PEROXIDE):**

SPEC WRITER NOTE: Chamber sizes vary. Insert sizes based on project requirements.

A. Chamber:

1. Interior: Aluminum.
2. Capacity: 1.1 cubic foot to 9.5 cubic feet.
3. Standard Cycle:
  - a. Table top: 28 to 38 minutes.
  - b. Floor Unit: 47 to 75 minutes.
4. Cycle Temperature: Up to 131 degrees F.
5. Sterilant Delivery System: // Cartridge // Cassette //.

B. Doors:

1. Quantity: // Single // Double //.
  2. Operation: // Automatic // Manual //.
  3. Configuration: // Vertical sliding // Side hinged // .
- C. Loading: Manual.
- D. Heat Source: Electric.
- E. Electrical Requirements: // 120V // 208V //.

#### **2.12 LIQUID CHEMICAL STERILIZER:**

- A. Chamber Volume: 8.7 Gallons.
- B. Doors:
1. Quantity: Single.
  2. Operation: Manual.
  3. Configuration: Top Opening.
- C. Standard Cycle:
1. Cycle Time: Up to 25 minutes.
  2. Cycle Temperature: 115 - 131 degrees F.
  3. Devices Sterilized per Cycle: One.
- D. Loading: Manual.
- E. Heat Source: Electric.
- F. Sterilant Source: Liquid Sterilant S40 Peracetic Acid Sterilant Concentrate.
1. Rinse: Filtered tap water exposed to UV rays.
- G. Unit Placement: // Counter top // Cart //.
- H. Ultraviolet Water and Filter Treatment System:
1. Ultraviolet unit (UV): // Wall // Cart //.
  2. Pre-filter Assembly: // Wall // Cart //.
- I. Electrical Requirements: As indicated on drawings.
- J. Water Source: // Incoming Pressure 40 - 50 PSIG // Incoming Temperature 109 - 140 degrees F //.

#### **2.13 WATER TREATMENT SYSTEM:**

SPEC WRITER NOTE: Used to reduce boiler scaling and instrument spotting during washer/disinfector and cart washer cycles.

- A. Configuration: Free Standing.
- B. Water Treatment Process:
1. Pre-Filtration.
  2. Recirculation.
  3. Deionization.

4. Final Filtration.

5. Heating.

C. Average Output: 5,000 gallons per day.

D. Electrical Requirements: // 115V // 220V // 230V //.

**2.14 DETERGENT DISPENSING SYSTEM:**

SPEC WRITER NOTE: Unit selected may require a water source.

A. Configuration: Wall Mounted.

B. Controls: // PC Based // Microprocessor //.

C. Dispensing Options: // Enzymatic Solution // Detergent // Lubricant Solution //.

D. Electrical Requirements: // 110V // 120V //.

**2.15 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 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 square mm/mm (3 square inch/inch) of sterilizer width.

E. Canopies: Locate above ethylene-oxide 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 9.65 mm (0.38 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 square mm/mm (1 square 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.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install sterilizers according to manufacturer's written instructions.
- B. Coordinate installation with related mechanical and electrical work. Provide cutouts and openings for plumbing and electrical work as indicated or as required by trades involved.

#### **3.2 TESTS**

- 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.

**3.3 PROTECTING AND CLEANING**

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

**3.4 INSTRUCTIONS**

- 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 installer.

- - - E N D - - -