

## **SECTION 22 14 00**

### **DOMESTIC WATER HEATERS**

#### **PART 1 - GENERAL**

##### 1.1 RELATED DOCUMENTS:

- A. The Conditions of the Contract and applicable requirements of Division 1, "General Requirements", and Section 23 00 10, "Mechanical General Provisions", govern this Section.

##### 1.2 DESCRIPTION OF WORK:

- A. Work Included: Provide domestic water heaters as specified, scheduled, and indicated.
- B. Types: The types of domestic water heaters required for the project include, but are not limited to, the following:

##### [EDIT TO SUIT PROJECT]

1. Gas-fired water heaters.
2. Electric water heaters.
3. Steam-fired water heaters.

##### 1.3 QUALITY ASSURANCE:

- A. Manufacturers: Provide products complying with these specifications and produced by one of the following:
  1. Pressure Vessels, Inc. (PVI).
  2. [Rheem Mfg. Co., Water Heating Division.]
  3. [AIRCO]
  4. [A. O. Smith, Corp.]
  5. [Armstrong]
  6. [State Water Heaters.]
  7. Adamson Company Inc.
  8. Bradford White, Corp.
- B. Electrical Standards: Provide electrical products which have been tested, listed, and labeled by Underwriters' Laboratories, Inc. (UL) and which comply with National Electrical Manufacturers' Association (NEMA) standards.

##### 1.4 SUBMITTALS:

- A. Shop drawing submittals shall include, but not be limited to, the following:
  1. Cut sheets on water heaters with capacities, electrical characteristics, features and options clearly indicated.
  2. Control and power wiring diagrams, sequence of operation, safety controls and FM and UL labels and listings.
  3. Manufacturers recommended installation instructions for water heater.
  4. A floor plan layout showing water heaters installed in the space available on the Drawings.

5. Additional information as required in Section 23 00 10.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver domestic water heaters in factory-fabricated water-resistant wrapping.
- B. Handle domestic water heaters carefully to avoid damage to material component, enclosure and finish.
- C. Store domestic water heaters in a clean, dry space and protect from the weather.

**PART 2 - PRODUCTS**

[SELECT TYPES TO SUIT PROJECT REQUIREMENTS]

2.1 GAS-FIRED WATER HEATERS:

- A. General: Provide gas-fired water heaters of the size and type with storage and recovery capacity as scheduled and shown on the Drawings. Each unit shall be a complete factory-fabricated and assembled package, including operating and safety controls. Each unit shall include an ASME pressure and temperature relief valve, temperature limiting device, and a drain valve. Each unit shall be Underwriters' Laboratories, Inc. approved and labeled.

[EDIT TANK LINING TO SUIT PROJECT]

- B. Tank: The tank shall be constructed in accordance with ASME Code, Section IV, and stamped with appropriate symbol for **160 psi** [\_\_\_\_\_ psi] working pressure. The tubes shall be covered with pure dead soft copper, expanded, beaded, and welded into the tube sheet. The interior tank surfaces shall be coated with Glashield, a thermosetting, polymerized fluorocarbon lining with high temperature resistance for long life qualities and rust free water. A 4" diameter handhole shall permit maintenance and inspection. Insulate heaters with heavy density fiberglass insulation and trimmed with a baked enamel steel jacket.
- C. Burner: Power burner shall be designed to operate with electrical power as scheduled or shown on Drawings. Motor shall be designed for continuous service with overload protection. Burner shall be designed so all components are outside the fire box for long life and ease of maintenance. It shall fire with a compact, swirling gas to burn more efficiently and release maximum Btu per volume of gas. A multivane blower shall supply precise amount of air for complete combustion. The burner shall be listed by Underwriters' Laboratories, Inc.
- D. Efficiency: The water heater shall have a minimum combustion efficiency of 80% and a standby heat loss not to exceed  $2.3 + (67/V)$  as a percent of total Btus stored.
- E. Controls: Controls shall include a field-adjustable control to permit selection of hot water supply temperatures from 105°F to 160°F.
  - 1. Solid state electronic programmer provides spark ignition to interrupted pilots with flame rod monitoring the main flame. Flame response time is 2 to 4 seconds. Precise sequencing provides prepurging of chamber, 10 seconds for proof of pilot, 15 seconds for proof of main burner, and 15 seconds post-purging of chamber. Automatic fluid power gas valve, manual main gas valve, pilot valve, and gas pressure regulator. A low water cut-off shall prevent unit operation upon sensing a low water status.
- F. Draft Regulator: Draft control shall be provided by heater manufacturer for installation in flue.
- G. Accessories: Factory-installed accessories shall include a redundant, high pressure protective device, a dial thermometer, and a dial pressure gauge.
- H. Warranty: Each water heater shall be provided with a full one year warranty, and a second through tenth year prorata tank warranty.

2.2 GAS-FIRED WATER HEATERS:

AE Project Number:

Domestic Water Heaters

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Revision Date: 1/29/2014

- A. **General:** Provide **[vertical] [horizontal]** gas turbine water heaters of the size and type with storage and recovery capacity as scheduled and shown on the Drawings. The heating section of each water heater shall be a single or dual module gas turbine burner and heat exchanger, capable of recovering the scheduled requirements at the scheduled difference in temperature using natural gas. The burner and heat exchanger assembly shall have a minimum start-up efficiency of 83%.

[EDIT TANK LINING TO SUIT PROJECT]

- B. **Tank:** The tank shall be constructed in accordance the ASME Code, Section IV and stamped with the appropriate symbol for **[125 psi] [\_\_\_\_\_ psi]** working pressure and registered with the National Board. The tank shall be of the capacity scheduled on the drawings and shall contain a strata-baffle to divert the incoming cold water allowing draw efficiencies of up to 80% of the tank capacity. The tank shall be completely lined with chemically-deposited shield of electroless nickel to form a nonferrous, corrosion resistant barrier and then all interior surfaces of the shall be coated with three individual baked applications of Glashield, a high heat thermosetting polymerized fluorocarbon with highly water resistant qualities as protection against rust and corrosion. The tank shall be insulated with heavy density fiberglass insulation and trimmed with a baked enamel finish steel jacket with field replaceable panels.
- C. **Heating Section:** The entire heating section for each burner module shall have all heating surfaces completely surrounded by water with all nonferrous materials on the water side. Each burner module shall be a fully integrated heating section with cast aluminum sealed gas burner, combustion chamber, blower, fire tubes, flue gas outlet, gas train, **[FM] [IRI (FIA)]** approved burner controls and an efficiency indicator. The gas train shall include regulators suitable for connection at the gas supply pressure available at the water heater.
1. Burner controls shall be include solid state electronic flame safeguard with programmed prepurge and postpurge of the fire chamber for all modules. All water heaters shall be provided with an electronic low water cutoff.
  2. An efficiency indicator shall sense flue temperature and shall have a green section (0°F to 400°F) to indicate normal operation, an amber section (401°F to 450°F) to indicate heat exchanger is ready for cleaning and a red section (451°F up) indicating excessive flue temperature. A switch interlock shall be provided to shutdown the burner module if the flue temperature exceed 500°F.
- D. **Accessories:** Water heater accessories shall include, but not be limited to, a solid brass drain valve, an ASME temperature and pressure relief valve, a 3-1/2" dial - 20°F to 200°F thermometer and a 3-1/2" dial - 0 to 200 psi pressure gauge.
- E. **Warranty:** Each water heater shall be provided with a full one year warranty and a second through tenth year prorata tank warranty.

2.3 ELECTRIC WATER HEATERS:

[INSERT TEXT FOR COMMERCIAL GRADE ELECTRIC WATER HEATERS]

[SEE SECTION 22 12 00 FOR SMALL POINT OF USE STORAGE WATER HEATERS]

2.4 STEAM-FIRED WATER HEATERS:

- A. **General:** Provide **[horizontal] [vertical]** steam-fired hot water heaters with dimensions and recovery and storage capacity as scheduled and shown on the Drawings. Specifications are provided for both copper and nickel lined tanks. Either construction will be acceptable for installation in this project, providing the generator conforms to the provisions of this specification. The manufacturers mentioned in this Specification or on the Drawings are listed for the purposes of indicating acceptable manufacturers, and establishing a standard of quality for the equipment to be provided for this project.

The equipment as supplied by any of these acceptable manufacturers, or an approved equal, shall comply with all of the provisions of this specification.

- B. Vessel: The shell and heads of the vessel shall be constructed of ASME Code quality steel with all seams welded. The vessel shall be designed and fabricated for a minimum of **[125 pounds]** **[\_\_\_\_\_ pounds]** per square inch **[150 psi]** **[\_\_\_\_\_ psi]** working pressure, and hydrostatically tested to 150% of the working pressure in accordance with ASME Code and so inspected and stamped.
- C. Controls: There shall be a minimum of two operating thermostats. These operating controls should be set at **[120°F]** **[\_\_\_\_\_ °F]** for the lower thermostat and **[130°F]** **[\_\_\_\_\_ °F]** for the upper thermostat with a maximum circulating water temperature in the plumbing system not to exceed **[130°F]** **[\_\_\_\_\_ °F]**. There shall be one temperature limiting device designed to prevent temperatures from exceeding a maximum of 200°F. There shall also be an ASME temperature and pressure relief valve set at not more than **[125 psi]** **[\_\_\_\_\_ psi]** and 205°F. A thermal expansion control valve shall be installed in the cold section of the tank, set to relieve pressures of no greater than **[100 psi]** **[\_\_\_\_\_ psi]**.
- D. Insulation: The tank shall be painted using the manufacturers standard paint system and insulated with high density fiberglass insulation and shall be jacketed with a minimum of 22 gauge aluminum sheet metal. Non-aluminum sheet jacketing shall be protected with a factory-baked enamel finish. The heat loss of the insulated tank shall not exceed 14 Btu/hr. per square foot of tank surface area at an ambient temperature of 65°F. The entire water heater shall rest on galvanized or baked enamel protected channel iron skids.
- E. Option A - Nickel Lined Tank: The nickel lined (plated) tank shall be constructed in accordance with ASME Code Section IV, stamped with the appropriate symbol, and hydrostatically tested at a minimum of 190 psi. The tank shall have a removable manway entry into the vessel with a minimum diameter of 23". The tank may be of modular design where more than one tank module will be required to meet the total gallon capacity, however the total space required shall not exceed the footprint shown in the Drawings, and the total tank capacity shall be as scheduled on the Drawings. The tank shall contain a baffle to divert the incoming cold water to allow 80% of the total tank storage to be effective at a usable temperature of within 5°F from the set point of the operating thermostats. All fittings shall be of Type K heavy copper, and shall be welded to the tank prior to the application of the nickel plating, and subsequent application of the nickel plating, and subsequent application of the polymer coating.
1. Lining: The tank shall be completely lined, inside and out, with 97% pure nickel. The method of applying the nickel shall be by non-electric, chemical deposition method, creating a holiday-free, nonferrous layer of nickel over the interior of the vessel. The nickel lined tank shall have an additional interior overcoat of an elastomeric, polymeric, hydrophobic cross-linked plastic to prevent any electrolysis that may develop within the plumbing system. Sacrificial anodes will not be required.
  2. Steam Heat Exchanger: The heat exchanger element shall have the capacity as scheduled or shown on the Drawings. The steam heat exchanger shall produce a minimum capacity as scheduled with the scheduled difference in temperature with 15 psi steam. This installation will be supplied with the quantity of steam scheduled or shown on the Drawings. The steam heat exchanger shall produce a minimum of 1300 Btu/°F/square foot of heating surface. All internal wetted parts shall be made of 9010 copper-nickel. The heat exchanger shall be complete with all required steam valves, traps, and controls so that only field steam and condensate connections are required.
  3. Manufacturer: Nickel lined generators shall be manufactured by PVI Industries, Fort Worth, Texas.
- F. Option B - Copper Lined Tank: Extra heavy copper silicon threaded or flanged openings shall be provided for inlet, outlet, drain, recirculation, relief valve, vacuum breaker, thermometer, pressure gauge and thermostat. One nominal 11" x 15" manhole shall be provided, having copper lined ring and cover. Nozzles and couplings may be ASTM SB466 alloy COA710 annealed (80-20 copper

nickel). The vessel shall be lined with 3 pounds per square foot deoxidized electrolytic sheet copper, attached to the steel shell and to all fittings by inert gas shielded arc welding. Lining shall be installed so that stored water contacts only nonferrous metals, and is to be tested and proven free of leaks prior to shipment. The annulus between the tank shell and lining shall be pressurized to 1-1/2 psi and soap applied to all welded seams to test for leakage. The quantity of 1-1/2 vacuum breakers shall be as recommended and furnished by the tank manufacturer. All connections to the tank, whether just a fitting or pipe connection, shall be made with properly installed dielectric fittings.

1. Steam Heat Exchanger: The heat exchanger element shall have the capacity as scheduled or shown on the Drawings. The heating element shall consist of (1-1/2" OD x 16 gauge, horizontal tanks), seamless copper U-tubes expanded into a solid bronze tube sheet. Element head shall be cast iron. If heating element exceeds 2'in length, a solid bronze spacer plate shall be provided. If heating element length is 4' or longer, a solid bronze element support shall be provided. The heating element length shall be at least two-thirds of the length (horizontal) of the tank. The nozzle into which the element is inserted shall be constructed with neck portion of solid copper silicon to which the steel slip-on flange is welded. The heat exchanger shall be complete with all required steam valves, traps and controls so that only field steam and condensate connections are required.
  2. Manufacturer: Copper lined generators shall be manufactured by Adamson Company, Inc., East Palestine, Ohio.
- G. Accessories: Provide a lower operating thermostat, upper operating thermostat, ASME temperature and pressure relief valve, temperature limiting device, thermometer, drain valve and other factory-installed accessories as required.
- H. Tank Warranty: Generator tanks shall have a minimum of an 8 year warranty to protect the Owner against defects in material and workmanship, discolored water, or tank perforation due to erosion and corrosion. Should the tank or liner fail for any reason within the first eight full years after start-up, the manufacturer shall, at the Owner's option, pay for all repairs or replacement, including material, labor, incidental costs and freight. The tank warranty must be submitted with the total package submittals. The submission of any submittal with a warranty less than that described, or the absence of a warranty with the submittal, will be sufficient cause for complete submittal rejection.
- I. Heat Exchanger Warranty: The heat exchanger shall have a minimum of a 3 year warranty against material and workmanship, corrosion and erosion, thermal shock, and fouling. All material, labor, freight, and incidental expenses shall be the responsibility of the manufacturer, should the warranty be exercised. The heat exchanger warranty must be submitted with total package submittals. The submission of any warranty less than that described, or the absence of a warranty with the submittal, will be sufficient cause for complete submittal rejection.

### **PART 3 - EXECUTION**

#### **3.1 INSPECTION:**

- A. General: Installer shall examine the conditions under which the water heaters are to be installed and notify Contractor in writing of conditions detrimental to proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

#### **3.2 INSTALLATION:**

- A. General: Pipe and install water heaters as shown on the Drawings and in accordance with the manufacturer's written installation instructions.
- B. Housekeeping Pads: Water heaters shall be installed on a reinforced concrete housekeeping pad as specified in Section 23 03 00.
- C. Relief Piping: Extend full size relief discharge piping from each water heater relief valve to the nearest floor drain or other approved point of safe discharge.

- D. Space Requirements: Furnished equipment shall fit in the space provided as shown on the Drawings. A floor plan layout of the equipment installation shall be included in the shop drawing submittal.
- E. Flue Piping: Provide draft regulator and recommended flue size to flue installer.
- F. Thermostat Adjustment: Adjust water heater thermostats to provide system water temperature as shown on the drawings.

3.3 START-UP, ADJUSTMENTS AND TRAINING:

- A. Startup: Water heater checkout, start-up and adjustment shall be performed by a representative of the equipment manufacturer. Refer to Section 23 05 93 for additional requirements.
- B. Training: Owner's operator training in water heater operation and maintenance procedures shall be performed by a representative of the equipment manufacturer. System Operating and Maintenance Manuals shall be available to the Owner's operator at the time of operator training. Refer to Section 23 00 10 for additional requirements.
- C. Operating Instructions: A complete set of operation instructions covering the installation, maintenance and operation of each water heater shall be furnished bound in booklet form in the Operating and Maintenance Manuals. Refer to Section 23 01 00 for additional requirements.

3.4 IDENTIFICATION:

- A. Refer to Section 23 03 00 for applicable painting, nameplates, and labeling requirements.

**END OF SECTION 22 14 00**