

SECTION 22 35 00
DOMESTIC WATER HEAT EXCHANGERS

SPEC WRITER NOTES:

1. Delete between //----// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
2. The "Safe Drinking Water Act" (SDWA) was originally passed into law in 1974. It was amended several times. The "Reduction of Lead in Drinking Water Act" was passed in January 2011 and amends the SDWA to the new lead free standard to include NSF 61 and NSF 372.
3. If solar domestic water heating is deemed economically feasible, refer to Section 23 56 00, SOLAR ENERGY HEATING SYSTEM for specification requirements.
4. Ensure stated temperature settings are in compliance with latest VA directive for hot water storage units.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes the requirements for domestic hot water heat exchangers including thermometers and all necessary accessories, connections and equipment.
- B. Application is for indirect water heating utilizing steam or hot water as a medium, and can be used for heat recovery or solar systems for pre-heating water prior to primary water heating equipment.
- C. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 81 11, SUSTAINABLE DESIGN REQUIREMENTS.
- //D. Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- //E. Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.//
- F. Section 09 91 00, PAINTING: Preparation and finish painting.
- //G. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENT FOR NON STRUCTURAL COMPONENTS: Seismic Restraint for Equipment.//
- H. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- I. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING.

- J. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING.
- K. Section 22 07 11, PLUMBING INSULATION.
- //L. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//
- M. Section 22 11 00, FACILITY WATER DISTRIBUTION: Piping, Fittings, Valves and Gages.
- N. Section 22 11 23, DOMESTIC WATER PUMPS: Circulating Pump.
- O. Section 23 56 00, SOLAR ENERGY HEATING SYSTEM.

1.3 APPLICABLE PUBLICATIONS

SPEC WRITER NOTE: Make material requirements agree with applicable requirements specified in the referenced Applicable Publications. Verify and update the publication list to that which applies to the project, unless the reference applies to all plumbing systems. Publications that apply to all plumbing systems may not be specifically referenced in the body of the specification, but, shall form a part of this specification.

- 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 Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - 90.1 (2013).....Energy Standard for Buildings Except Low-Rise Residential Buildings
- C. American National Standard Institute (ANSI):
 - Z21.22B-2001 (R2008)....Relief Valves for Hot Water Supply Systems
- D. American Society of Mechanical Engineers (ASME):
 - ASME Boiler and Pressure Vessel Code -
 - BPVC Section IV-2013....Rules for Construction of Heating Boilers
 - BPVC Section VIII-1-2013 Rules for Construction of Pressure Vessels, Division 1
 - Form U-1.....Manufacturer's Data Report for Pressure Vessels
 - B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
 - B16.5-2013.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard
 - B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

- PTC 25.3-02.....Pressure Relief Devices
- E. National Fire Protection Association (NFPA):
 - 70-2011.....National Electrical Code (NEC)
- F. NSF International (NSF):
 - 61-2012.....Drinking Water System Components - Health Effects
 - 372-2011.....Drinking Water System Components - Lead Content
- G. Underwriter Laboratories (UL):
 - 207-2013.....Standard for Refrigerant-Containing Components and Accessories, Nonelectrical
 - 778-2002.....Standard for Motor-Operated Water Pumps

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 22 35 00, DOMESTIC WATER HEAT EXCHANGERS", with applicable paragraph identification.
- C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
 - 1. Heat Exchangers.
 - 2. Heat Reclaimers.
 - 3. Pressure and Temperature Relief Valves.
 - 4. Steam Control Valves.
 - 5. Heating Hot Water Control Valves.
 - 6. Thermometers.
 - 7. Pressure Gages.
 - 8. Vacuum Breakers.
 - 9. Safety Valves.
 - 10. Expansion Tanks.
 - 11. Heat Traps.
- D. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel Code.
- E. Shop drawings shall include wiring diagrams for power, signal and control functions.

//F. Seismic qualification certificates shall be submitted that details equipment anchorage components identifies equipment center of gravity with mounting and anchorage provisions, and whether the seismic qualification certificate is based on an actual test or calculations.//

G. Submit documentation indicating compliance with applicable requirements of ASHRAE 90.1, Unfired Storage Tanks, for Service Water Heating.

SPEC WRITER NOTE: Coordinate O&M Manual and commissioning requirements with Section 01 00 00, GENERAL REQUIREMENTS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS. O&M Manuals shall be submitted for content review as part of closeout documents.

H. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:

1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

//I. Completed System Readiness Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

//J. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

1.5 QUALITY ASSURANCE

A. Equipment components in contact with potable water shall meet compliance requirements in documents NSF 61 and NSF 372.

B. Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 for efficiency performance.

//C. The domestic water heat exchanger shall conform to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENT FOR NON STRUCTURAL COMPONENTS on seismic restraint requirements, withstanding Seismic movement without separation of any parts from the equipment when subjected to a seismic event.//

D. The heat exchanger shall be certified and labeled by an independent testing agency.

E. Circulating pump shall be installed per NFPA 70.

- F. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual and commissioning requirements with Section 01 00 00, GENERAL REQUIREMENTS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.

- A. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
- B. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version //____// provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

PART 2 - PRODUCTS

SPEC WRITER NOTES:

1. Coordinate and assure that the electrical characteristics specified below are clearly shown on appropriate drawings. Coordinate with Electrical Engineer.

2. Heaters shall be capable of withstanding thermal and/or chemical eradication procedures to control bacteria.
3. Double-wall units are required for potable water systems.

2.1 SHELL AND TUBE, DOMESTIC WATER HEAT EXCHANGERS

SPEC WRITER NOTE: See standard details SD223500-01 and -02.DWG available at <http://www.cfm.va.gov/til/sDetail.asp>.

- A. The shell and tube heat exchangers shall be //single wall// //double wall// semi-instantaneous type, // //instantaneous // //vertical// //horizontal// with water in the // tubes// //shell// and //steam// //heating hot water// in the //tubes// //shell //. Heat exchanger shall be of counter-flow design. The shell and tube heat exchanger shall be a packaged assembly of tank, heat exchanger coils, control valves, controls, and specialties constructed of ASME code //copper lined, carbon steel// //stainless steel// //cupro-nickel// shell with 1035 kPa (150 psig) minimum working pressure. Heat exchanger shall comply with NSF 61 and NSF 372 for barrier materials for potable-water tank linings. Provide with access for cleaning and disinfection. Heat exchanger capacities are scheduled on the drawings.
- B. The stand or skid shall be factory fabricated for floor mounting.
- C. The tappings (openings) shall be factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards for piping connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls. The openings shall be in accordance with ASME standards listed below:
 1. 50 mm or DN50 (2 inch) and smaller: Threaded ends according to ASME B1.20.1.
 2. 65 mm or DN65 (2-1/2 inch) and larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B16.24.
- D. Shell insulation shall comply with ASHRAE 90.1 and suitable for operating temperature. The entire shell and nozzles shall be completely surrounded except connections, gages and controls.
- E. The heat exchanger coils shall be constructed from copper //copper alloy// and fabricated in a helix wound or straight tube configuration for //steam// //heating hot water// heating medium. The pressure rating

shall be equal to or greater than the //steam// //heating hot water// supply pressure plus 50 percent.

SPEC WRITER NOTE: Coordinate steam or hot water requirements to meet capacity with the Mechanical Engineer, and mechanical drawings and schedules.

F. The temperature controls shall be designed for an output temperature of 60 degrees C (140 degrees F) based upon an adjustable temperature transmitter that operates a control valve and is capable of maintaining outlet water temperature within 2 degrees C (4 degrees F) of setting. Heaters shall be capable of raising the discharge temperature to 77-82 degrees C (170-180 degrees F) for thermal eradication.

//1. Steam control valve if required shall regulate the control of steam flow to the heating coil // /water control valve// to control water temperature and shall be electronically //mechanically// operated. The outlet water temperature shall not vary more than ± 1 degrees C (± 2.5 degrees F).

2. A drip trap, steam condensate trap (if required), Y strainer, vacuum breaker, and pressure gage shall be factory sized and piped with steam control valve.//

//3. Heating hot water control valve if required shall regulate the flow of heating hot water to the heating coil // water control valve // to control water temperature and shall be electronically operated. The outlet water temperature shall not vary more than ± 1 degrees C (2.5 degrees F).//

4. A normally closed solenoid valve shall be rated at 5 amps, 120-volt. Solenoid valve shall close the //steam// //heating hot water// supply to the heating coil, should the water temperature in the tank reach the high set point.

G. Safety control shall be automatic, high temperature limit shutoff device.

H. The relief valves shall be ASME rated and stamped for combination temperature and pressure relief valves.

SPEC WRITER NOTE: Small amount of hot water storage is standard with semi-instantaneous heaters.

//I. The pressure storage vessel // shell of the exchanger// shall be all welded construction and ASME BPVC Section VIII-1 stamped for a working pressure of 1035 kPa (150 psig). The storage tank // shell of the

exchanger //shall be // carbon steel with a minimum of 16 mm (5/8 inch) thick cement lining // carbon steel with 4.9 kg/sq. meter (3 lb./sq. feet) copper lining // solid copper-silicon, grade SB-96 // solid stainless steel type // 304 // 316L // //epoxy lined// //cupro-nickel//. Lining shall meet NSF 61 and NSF 372 requirements. The storage vessel shall be provided with a fiberglass insulation system in compliance with ASHRAE 90.1, with jacket, and a magnesium anode. Provide with access for cleaning and disinfection.//

2.2 CIRCULATING DOMESTIC WATER HEAT EXCHANGERS

- A. A packaged //single wall// //double wall// unit with hot water storage tank shall be provided with circulator, heat exchanger coil, controls, sacrificial anode, and specialties. The domestic water heat exchanger with circulator shall be based upon a standard flow arrangement with water from bottom of storage tank circulated across the heat exchanger coil and returned to tank. The vessel shall be ASME BPVC Section VIII-1, fabricated with a pressure rating of 1035 kPa (150 psig). Tank shall comply with NSF 61 and NSF 372 for barrier materials for potable-water tank linings. Provide with access for cleaning and disinfection.
- B. A hot water outlet shall be included at the top of the tank.
- C. A temperature sensor shall be located inside the storage tank.
- D. A circulating pump complying with UL 778, all bronze construction, overhung impeller, and separately coupled inline pump shall be included. The pump shall have mechanical seals. The working pressure shall be rated at 861 kPa (125 psig).
- E. The stand shall be factory fabricated for floor mounting.
- F. The tappings (openings) shall be factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standards for piping connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls. The openings shall be in accordance with ASME standards listed below:
 - 1. 50 mm or DN50 (2 inch) and smaller: Threaded ends according to ASME B1.20.1.
 - 2. 65 mm or DN65 (2-1/2 inch) and larger: Flanged ends according to ASME B16.5 for steel and stainless steel flanges, and according to ASME B16.24.

- G. Shell fiberglass insulation shall comply with ASHRAE 90.1 and suitable for operating temperature, with jacket. The entire shell and nozzles shall be completely surrounded except connections and controls.
- H. The heat exchanger coils shall be constructed from copper //copper alloy// and fabricated in a //helix wound// // straight tube configuration // for //steam// //heating hot water// heating medium. The pressure rating shall be equal to or greater than the steam or water supply pressure plus 50 percent, but not less than 1035 kPa (150 psig).

SPEC WRITER NOTE: Coordinate steam or hot water requirements to meet capacity with the Mechanical Engineer, and mechanical drawings and schedules.

- I. The temperature controls shall be based upon an adjustable temperature transmitter that operates a control valve and is capable of maintaining outlet water temperature within 2 degrees C (4 degrees F) of setting of 60 degrees C (140 degrees F). Heaters shall be capable of raising the discharge temperature to 77-82 degrees C (170-180 degrees F) for thermal eradication.
- J. Safety control shall be automatic, high temperature limit shutoff device.
- K. The relief valves shall be ASME rated and stamped for combination temperature and pressure relief valves.

2.3 PLATE DOMESTIC WATER HEAT EXCHANGERS

- A. Brazed-Plate heat exchanger with assembly of stainless steel heat exchanger plates not less than 0.6 mm (0.024 inch) thick, permanently brazed together for //steam// //heating hot water// to heat domestic water. The working pressure shall be rated at 1035 kPa (150 psig).
- B. Connections shall be threaded for piping 50 mm (2 inch) and smaller or flanged for piping 65 mm (2-1/2 inch) and larger of stainless steel.

2.4 DOMESTIC WATER HEAT RECLAIMERS

- A. Waste heat recovery device complying with a listed according to UL 207 for heat reclaimers. Includes copper vertical drainage tube with helical, domestic-water preheat coil around drainage tube.
- B. The working pressure shall be rated at 1035 kPa (150 psig).

2.5 THERMOMETERS

- A. Thermometers shall be rigid stem or remote sensing, scale or dial type with an aluminum, black metal, stainless steel, or chromium plated brass case. The thermometer shall be back connected, red liquid

(alcohol or organic-based) fill, vapor, bi-metal or gas actuated, with 225 mm (9 inches) high scale dial or circular dial 50 to 125 mm (2 to 5 inches) in diameter graduated from 4 to 100 degrees C (40 to 210 degrees F), with two-degree graduations guaranteed accurate within one scale division. The socket shall be separable, double-seat, micrometer-fittings, with extension neck not less than 65 mm (2 1/2 inches) to clear tank or pipe covering. The thermometer shall be suitable for 20 mm (3/4 inch) pipe threads. Thermometers may be console-mounted with sensor installed in separate thermometer well.

2.6 SAFETY VALVES FOR SHELL AND COIL HEATERS

- A. Separate combination pressure/temperature relief valves shall be provided on each water heater.
- B. A double solenoid safety system shall be provided for each shell and coil heater to function as a safety over temperature prevention system. System shall consist of aquastat, pilot light, solenoid safety valve and solenoid water safety valve located in the control circuit. The aquastat shall be set at 60 degrees C (140 degrees F).

2.7 DOMESTIC HOT WATER EXPANSION TANKS

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air precharge shall be set to minimum system operating pressure at tank.
- B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- C. The interior finish shall comply with NSF 61 and NSF 372 for barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- D. The air charging valve shall be factory installed.

2.8 HEAT TRAPS

- A. Heat traps shall be installed in accordance with ASHRAE 90.1 unless provided integrally with the heaters.

2.9 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. The combination pressure and temperature relief Valve shall be ANSI Z21.22 and ASME rated and constructed of all brass or bronze with a self-closing reseating valve. The relief valves shall include a relieving capacity greater than the heat input and include a pressure setting less than the water heater's working pressure rating. Sensing element shall extend into storage tank.

PART 3 - EXECUTION**3.1 INSTALLATION**

- A. The water heaters shall be installed on concrete bases. Refer to Specification Section 03 30 00, CAST-IN-PLACE CONCRETE and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- B. The water heaters shall be installed level and plumb and securely anchored.
- C. Water heaters shall be installed and connected in accordance with manufacturer's written instructions with manufacturer's recommended clearances.
- D. All pressure and temperature relief valves discharge shall be piped to nearby floor drains with air gap or break.
- E. Thermometers and isolation valves shall be installed on water heater inlet and outlet piping and shall be positioned such that they can be read by an operator or staff standing on floor or walkway.
- F. The thermostatic control shall be set for a minimum setting of 60 degrees C (140 degrees F) for storage heaters and regulated to a maximum discharge temperature of 54 degrees C (130 degrees F) for distribution to personnel.
- G. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
- H. All manufacturer's required clearances shall be maintained.
- //I. The domestic water heaters shall be installed with seismic restraint devices.//
- J. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
- K. Piping type heat traps shall be installed on the inlet and outlet piping of the domestic water heater storage tanks, unless provided integrally with the tanks.
- L. Water heater drain piping shall be installed as indirect waste to spill by positive air gap into open drains or over floor drains. Hose end drain valves shall be installed at low points in water piping for gas fueled domestic hot water heaters without integral drains.
- M. Dielectric unions shall be provided if there are dissimilar metals between the water heater connections and the attached piping.

- N. Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater is bottom fed.
- O. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

3.2 LEAKAGE TEST

- A. Before piping connections are made, the water heaters shall be tested at a hydrostatic pressure of 1380 kPa (200 psig) for water heaters rated at less than 1103 kPa (160 psig) and 1654 kPa (240 psig) for units with an maximum working pressure of 1103 kPa (160 psig) or over. Any failed test shall be corrected and the water heater shall be replaced with a new unit at no additional cost to the VA.

3.3 PERFORMANCE TEST

- A. Ensure that all of the remote water outlets will have a minimum of 43 degrees C (110 degrees F) and a maximum of 49 degrees C (120 degrees F) water flow at all times. If necessary, make all correction to balance the return water system or reset the thermostat to make the system comply with design requirements.

3.4 STARTUP AND TESTING

- A. As recommended by product manufacturer and listed standards and under actual or simulated operating conditions, tests shall be conducted to prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with each integrated system.
- B. The tests shall include system capacity, control function, and alarm functions.
- C. When any defects are detected, correct defects and repeat test at no additional costs to the Government.

//D. The Commissioning Agent will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the Contracting Officer's Representative and Commissioning Agent. Provide a minimum of 7 days prior to notice.//

//3.5 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for
//four// // // hours to instruct VA Personnel in operation and
maintenance of the system.

//B. Submit training plans and instructor qualifications in accordance with
the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING
SYSTEMS.//

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