

SECTION 22 33 00
ELECTRIC DOMESTIC WATER HEATERS

SPEC WRITER NOTES:

1. Use this section only for NCA projects.
2. Delete between //----// if not applicable to project. Also delete any other item or paragraph not applicable in the section and renumber the paragraphs.
3. 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.
4. Gas-fired water heaters are more efficient in source energy use than electrical resistance water heaters. Avoid use of electric water heaters unless they are shown through calculation to be life-cycle cost effective or gas service is not available.
5. Federal agencies are required by law to purchase products that are designated by the Federal Energy Management Program (FEMP) or qualified by ENERGY STAR. FEMP provides acquisition guidance for residential electric resistance water heaters. Ensure that the efficiencies are equal to or greater than the required values released by FEMP. These values can be found at:
<http://www1.eere.energy.gov/femp>.
6. If solar domestic water heating is deemed economically feasible, refer to Section 23 56 00, SOLAR ENERGY HEATING SYSTEM for specification requirements.
7. 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 installing a complete electric domestic water heater system ready for operation including the water heaters, thermometers, and all necessary accessories, connections, and equipment.

- B. 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 01, GENERAL REQUIREMENTS (Major NCA Projects).//
 B. //Section 01 00 02, GENERAL REQUIREMENTS (Minor NCA Projects).//
 C. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
 D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
 E. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
 F. //Section 03 30 00, CAST-IN-PLACE CONCRETE: Concrete and Grout.//
 G. // Section 09 91 00, PAINTING.//
 H. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.//
 I. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
 J. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING,
 K. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING
 L. Section 22 07 11, PLUMBING INSULATION.
 M. //Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//
 N. Section 22 11 00, FACILITY WATER DISTRIBUTION: Piping, Fittings, Valves and Gages.
 O. Section 22 11 23, DOMESTIC WATER PUMPS: Circulating Pumps.
 P. 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 National Standard Institute (ANSI):
 Z21.22B-2001(R2008).....Relief Valves for Hot Water Supply Systems

- C. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
- 90.1 (2013).....Energy Standard for Buildings Except Low-Rise Residential Buildings
- 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
- CSD-1-2012.....Controls and Safety Devices for Automatically Fired Boilers
- E. American Society of Sanitary Engineering (ASSE):
- 1005-1999.....Performance Requirements for Water Heater Drain Valves, 3/4 Inch Size
- F. International Code Council (ICC):
- IPC-2015.....International Plumbing Code
- G. National Fire Protection Association (NFPA)
- 70-2011.....National Electrical Code (NEC)
- H. NSF International (NSF):
- 5-2012.....Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
- 61-2012.....Drinking Water System Components - Health Effects
- 372-2011.....Drinking Water System Components - Lead Content
- I. Underwriters Laboratories, Inc. (UL):
- 174-04 (R2012).....Standard for Household Electric Storage Tank Water Heaters
- 499-05 (R2013).....Standard for Electric Heating Appliances
- 1453-04 (R2011).....Standard for Electric Booster and Commercial Storage Tank Water Heaters

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 33 00, ELECTRIC DOMESTIC WATER HEATERS", 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. Water Heaters.
 - 2. Pressure and Temperature Relief Valves.
 - 3. Thermometers.
 - 4. Pressure Gages.
 - 5. Vacuum Breakers.
 - 6. Expansion Tanks.
- D. For each electric domestic hot water heater type and size, the following characteristics shall be submitted:
 - 1. Rated Capacities.
 - 2. Operating characteristics.
 - 3. Electrical characteristics.
 - 4. Furnished specialties and accessories.
 - 5. 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 with //ASHRAE 90.1 for Service Water Heating// or //FEMP//.

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.

- 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

SPEC WRITER NOTE: For commercial applications, efficiencies shall meet the requirements of ASHRAE 90.1.

- A. Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for efficiency performance. ASHRAE 90.1, "Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings, for commercial water heaters
- B. Electrical components, devices and accessories shall be listed and labeled as defined in NFPA 70 by a qualified testing agency, and marked for intended location and application.
- C. ASME code construction shall be a vessel fabricated in compliance with the ASME BPVC Section VIII-1.
- D. Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- E. //The electric domestic water heater shall conform to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS, withstanding seismic movement without separation of any parts from the equipment when subjected to a seismic event.//
- F. The domestic water heater shall be certified and labeled by an independent testing agency.
- G. 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>.

H. Guaranty: Warranty of Construction, FAR clause 52.246-21.

1.6 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be // in electronic version on compact disc or DVD // 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.
- C. 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 in Auto-CADD version //____// provided on compact disc 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.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures

followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

SPEC WRITER NOTE:

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.

2.1 ELECTRIC DOMESTIC WATER HEATERS

- A. The tank construction shall be steel shell, with an inner tank liner complying with NSF 61 and NSF 372 for barrier materials for potable water. The inner liner shall be extended into the openings. The vessel shall be ASME BPVC Section VIII-1, fabricated with a pressure rating of 1035 kPa (150 psig). Provide with access for cleaning and disinfection.
- B. Tapping (openings and fittings) shall be factory fabricated of materials compatible with the tank and in accordance with appropriate ASME standard B1.20.1 for piping connections, pressure and temperature relief valve, pressure gauge, thermometer, drain valve, anode rods and controls as required. Tappings shall comply with the following 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.
- C. Tank insulation shall comply with // ASHRAE 90.1// //and// //ENERGY STAR// requirements.
- D. Heating Element: For domestic water heater sizes greater than 9 KW, the heating element shall be arranged in multiples of three elements. For heaters less than 9 KW, the heater elements shall be arranged in //single// //double// elements. Heater capacities are scheduled on the drawings.
- E. The domestic water heaters shall have screw in or bolt on immersion type, thermostatically adjustable elements. Set thermostat for minimum water storage temperature of 60 degrees C (140 degrees F). The

ELECTRIC DOMESTIC WATER HEATERS

electrical characteristics are scheduled on the drawings. Heaters shall be capable of raising the discharge temperature to 77 to 82 degrees C (170 to 180 degrees F) for thermal eradication.

- F. The Combination Pressure and Temperature Relief Valves shall be ANSI Z21.22 and ASME rated.
- G. The anode rod shall be replaceable magnesium.
- H. The drain valve shall be corrosion resistant metal complying with ASSE 1005.
- I. Comply with NSF 5 for water heaters.

SPEC WRITER NOTE: Tankless instantaneous heaters are intended for point-of-use applications only.

2.2 ELECTRIC, TANKLESS, DOMESTIC WATER HEATER

- A. Electric, Tankless, domestic water heaters shall be constructed with copper piping or tubing or thermoplastic complying with NSF 61 and NSF 372 for barrier materials for potable water heaters without storage capacity.
- B. The pressure rating shall be 1035 kPa (150 psig).
- C. The heating element shall be resistance heating system type.
- D. Temperature control shall be made with //flow control fittings//
//thermostat//.
- E. The safety control shall be a high temperature limit cutoff device or system.
- F. The heater shall have an enameled jacket with an aluminum or steel floor stand or wall bracket for off-floor mounting.
- G. Heater capacities and electrical characteristics are scheduled on the drawings.

2.3 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.

2.4 ELECTRIC WATER HEATER DRAIN PAN

A. A stainless steel drain pan shall be provided that is large enough to contain the volume of the heater. The drain pan shall include a drain outlet not less than 20 mm or DN 20 (NPS 3/4 inch) with ASME B1.20.7 garden hose threads.

2.5 HEAT TRAPS

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

2.6 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.

2.7 THERMOMETERS

A. Thermometers shall be rigid stem or remote sensing, scale or dial type with a stainless steel // aluminum, black metal, 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 212 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.

2.8 SUPPORTS

- A. Water heater stands shall be factory-fabricated steel for floor mounting capable of supporting water heater and water a minimum of 450 mm (18 inches) above the floor.
- B. Wall brackets for wall mounted heaters shall be factory-fabricated steel capable of supporting water heater and water.

2.9 MANIFOLD KITS

- A. For multiple water heater installation, provide factory-fabricated copper manifold kits to include ball-type shutoff valves to isolate each water heater and balancing valves to provide balanced flow through each water heater.

PART 3 - EXECUTION

PART 1 -

PART 2 -

PART 3 -

3.1 INSTALLATION

- A. Water heaters shall be installed on concrete bases unless elevated above the floor. 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. The 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 shall be installed on the 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. Dielectric unions shall be provided if there are dissimilar metals between the water heater connections and the attached piping.
- H. Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater is bottom fed. Refer to Specification Section 22 11 00, FACILITY WATER DISTRIBUTION.
- I. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
- J. All manufacturer's required clearances shall be maintained.

- K. //The electric domestic water heaters shall be installed with seismic restraint devices.//
- L. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank in accordance with manufacturer's recommendations. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge by positive air gap into a floor drain.
- M. Piping type heat traps shall be installed on the inlet and outlet piping of the electric domestic water heater storage tanks if not provided integrally with the tanks.
- N. 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 electric domestic water heaters without integral drains.
- O. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 LEAKAGE TEST

- A. Before piping connections are made, water heaters shall be tested with hydrostatic pressure of 1380 kPa (200 psig) and 1655 kPa (240 psig) for a unit with a MAWP of 1103 kPa (160 psig). Any domestic water heater leaking water shall be replaced with a new unit at no additional cost to the VA.

3.3 PERFORMANCE TEST

- A. All of the remote water outlets shall 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.

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 10 calendar 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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