

SECTION 22 33 00
DOMESTIC WATER HEATING SYSTEMS

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. Domestic water heaters
- B. Miscellaneous water heating system accessories
- C. Water testing kits

1.02 RELATED DOCUMENTS

- A. Section 01 91 00 - Commissioning
- B. Section 22 05 01 – Plumbing General Provisions
- C. Section 22 0519 – Meters, Gauges and Thermometers for Plumbing
- D. Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing
- E. Section 22 07 19 – Insulation for Plumbing
- F. Section 22 11 00 – Domestic Water Systems
- G. Section 22 11 10 – Plumbing Piping and Accessories
- H. Section 22 11 23 – Plumbing Pumps

1.03 REFERENCE STANDARDS

- A. Regulatory compliance: All work performed under this Division shall comply with the latest currently adopted editions of all codes and regulations and all requirements of all Authorities Having Jurisdiction. The following references and standards are hereby made a part of this Section and work shall conform to applicable requirements herein except as otherwise specified herein or shown on the Drawings.
- B. Codes and Standards: Conform to all applicable codes and standards as stated herein and as described in Division 1 of the Specifications, including the following:
 - 1. AGA – American Gas Association
 - 2. ANSI – American National Standards Institute
 - 3. ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers
 - 4. ASME – American Society of Mechanical Engineers
 - 5. ASTM – American Society for Testing and Materials
 - 6. AWWA – American Water Works Association
 - 7. ISO – International Organization for Standardization
 - 8. MSS – Manufacturers Standardization Society of the Valve and Fittings Industry
 - 9. NFPA 70, Edition 08 – The NEC: National Electrical Code

- 10. NSF – National Sanitation Foundation
- 11. UL – Underwriters Laboratories Inc.
- 12. International Plumbing Code

1.04 QUALITY ASSURANCE

- A. Comply with the applicable provisions and recommendations of the standards and codes listed in Paragraph 1.03 and the requirements of the listed Related Documents.
- B. Water Heaters Storage Tank Insulation: Comply with applicable requirements of ASHRAE Standard 90.1.
- C. Gas-Fired Equipment: Certified by the American Gas Association.
- D. Electric Water Heaters: Listed by UL in conformance with UL 1453 Electric Booster and Commercial Storage Tank Water Heaters.
- E. Storage Tanks / Pressure Vessels: Shall have the seal of American Society of Mechanical Engineers for compliance with ASME Code - Section VIII.
- F. Storage Type Water Heaters: Shall have an independent laboratory listing for standards UL 795 and/or ANSI Z21.10.3b.
- G. Storage Type Water Heaters: Manufacturer shall be ISO 9001 registered.
- H. Valve construction shall be suitable for the pressure, temperature, and fluid quality of the service in which they are to be used.
- I. All valves shall be manufactured in accordance with ANSI, AWWA, ASTM, and MSS-SP-70 & 80 (Manufacturers Standardization Society of the Valve and Fittings Industry) standards and specifications.
- J. ASME B31.1 for power piping valves and ASME B31.9 for building services piping valves.
- K. ASME B16.10 and ASME B16.34 for valve dimension and design criteria.
- L. NSF Compliance: NSF 61 for valve materials for potable-water service.
- M. Minimum test pressure for all valves shall be 1.5 times maximum system working pressure unless noted otherwise.

1.05 SUBMITTALS

- A. Comply with requirements of Section 01 33 00 – Submittal Procedures, and as modified in Section 22 05 01 – Plumbing General Provisions.
- B. Product Data: Submit manufacturer's latest product literature, including material specifications, construction details, rated capacity data, operating characteristics, installation data and other information required to demonstrate compliance with specified requirements for following items:
 - 1. Water heaters

2. Hot water storage tank
 3. Point-of-use water heaters
 4. Heat exchangers
 5. Internal heat exchanger
 6. Pressure and temperature relief valves
 7. Drain valves
 8. Aquastats
 9. Expansion tanks
- C. Submit, for all equipment provided under this Section, dimensions, accessories, required clearances, electrical requirements and wiring diagrams specific to this project that clearly differentiate between manufacturer-installed and field-installed wiring, and location and size of all required field connections.
- D. Submit manufacturer's installation instructions, operation data, start-up instructions, maintenance data, parts list and controls specific to this project, accessories and maintenance data.
- E. Submit warranties, complete warranty and service policies, including all exclusions and conditions.
- F. Submit Operational and Maintenance (O&M) manuals.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Following is a list of manufacturers whose products may be submitted for review. All items submitted as being equal, shall have same quality, finish, free area, material construction, etc., as those specified under base specification.
- B. Approved Manufacturers:
1. Electric Water Heaters: A.O. Smith, Bradford White, Lochinvar, PVI Industries, Rheem, Rudd.
 2. Direct-Fired Storage Type Water Heaters: A.O. Smith, Patterson-Kelly, PVI Industries, RECO.
 3. Direct-Fired Storage Type Water Heaters – Residential: A.O. Smith, American Water Heater, Lochinvar, PVI.
 4. Semi-instantaneous Water Heaters: Patterson-Kelly (no known equal).
 5. Indirect-Fired Storage Type Water Heaters: Lochinvar, Bradford White, A.O. Smith, Laars, Raypak.
 6. Storage Tanks: A.O. Smith, Patterson-Kelly, RECO, Adamson.
 7. Water Heater Storage Tank with Heat Exchanger: A.O. Smith, Patterson-Kelly, RECO, Adamson.
 8. Electric Water Heaters – Point of Use: Eemax, Chronomite.

2.02 ELECTRIC WATER HEATERS

- A. Comply with Energy Conservation Standards, Title 24 approved, UL Listed, ASME tank construction. Refer to schedule on the Drawings for capacities, recovery rates and electrical characteristics.

- B. Water Heater: Internal fusing glass-lined storage tank, 125 pounds per square inch working pressure for 65- through 120-gallon capacity and 150 pounds per square inch working pressure for 5- through 50-gallon capacity, equipped with multi-anode system consisting of magnesium or aluminum anode and European style power anode, jacketed and insulated to meet ASHRAE 90.1 standards, 3-years' warranty; similar to "Model DSE" by A.O. Smith, or approved specified equivalent by Bradford White, Lochinvar, or Rheem-Rudd.
- C. Immersion Heaters: Medium watt density elements in each immersion heater with Incoloy sheathing and ceramic terminal block. KW capacities and voltages shall be as scheduled on the Drawings.
- D. Tank Features:
 - 1. Construction: Manufactured and stamped in accordance with ASME Code Section IV, hydrostatically tested at 225 psi minimum, and National Board Registered for 150 psi working pressure.
 - 2. Tank shall be cathodically protected with powered anodes.
 - 3. Liner: Glass, with an alkaline borosilicate composition fused to steel at 1600 degrees F.
 - 4. Hand-hole clean-out.
 - 5. Controls compartmented with hinged door enclosing:
 - a. 120-volt control circuit transformer
 - b. Terminal block for power
 - c. Magnetic contactors rated for 100,000 cycles
 - d. Immersion type operating thermostat for each immersion heater
 - e. Immersion reset high-limit cut-off at 190 degrees F with manual reset
 - f. Power circuit fusing where applicable to meet NEC
 - g. Solid state modulating step controller for multiple immersion heaters
 - h. Safety door interlock, which prevents opening of control panel when heater power is energized
 - i. Override switches
 - j. Indicating/Pilot lights
 - k. Pressure limit switches
 - l. Programmable economy-mode operation
- E. Insulation: Factory-installed foam insulation with heat loss not to exceed ASHRAE Standard 90.1 and steel enclosure cover with factory-baked enamel finish over bonderized undercoat.
- F. Accessories:
 - 1. Anodic protection.
 - 2. Factory-installed AGA/ASME rated temperature and pressure relief valve set at relief pressure of 125 psi.
 - 3. Low water cut-off probe to prevent energizing elements in the event of low water condition.
- G. Domestic water heater shall be seismically braced as per Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing.

2.03 INDIRECT-FIRED STORAGE TYPE WATER HEATERS

- A. Water Heater: Gas-fired atmospheric burner copper-finned heat exchanger and copper coil combustion chamber, design certified by the American Gas Association and ANSI approved independent rating laboratory, and bearing ASME "H" stamp. Refer to schedule on the Drawings for capacities, recovery rates, gas demand and electrical requirements.
- B. Water Heaters Storage Tank Insulation: Comply with applicable requirements of ASHRAE Standard 90.1.
- C. Thermal Efficiencies: No less than 82 percent minimum as tested in compliance with ANSI Z21.10.3b.
- D. Combustion Chamber: Formed from a two-passage copper coil of continuous copper tube with 160 psi working pressure rating and test pressure of 240 psi.
- E. Rating: See schedule sheet on drawings.
- F. Heat Exchanger: Extended surface copper tube having integral copper fins on outside and extended directly from tube.
- G. Controls:
 - 1. Electric gas valve of step-opening type.
 - 2. Adjustable high limit control, which will break the electric circuit on temperature rise.
 - 3. Intermittent ignition device, with a one (1) second shut-down in event of pilot flame failure.
 - 4. Electronic flame supervision for a four (4) second shut-down in event of flame failure.
 - 5. Coil limit switch for shut-off in event of excessive water temperature.
 - 6. Certified draft diverter.
 - 7. Gas pressure regulator properly set for the gas to be supplied.
 - 8. "Thermal Balancer" System: Pump delay system allowing boiler and pump to run simultaneously but delays pump shut-off at end of heating cycle to remove usable heat from heater and reduce the scale-forming tendencies of motionless hot water.
 - 9. Freeze-Stat Controls: Provide remote bulb thermostat. Remote bulb aquastat; similar to "No. A19ABC-24C" and insertion well "No. WEL-14A-602R" by Penn-Johnson in ¾-inch tee on inlet side of water heater circulation loop. Provide 110-volt power wiring and conduit to connect directly to circulation pump to start circulating pump. Set controls to start pump at 60 degrees F and turn off at 70 to 80 degrees F.
- H. Accessories:
 - 1. Flow Switch: As recommended by water heater manufacturer for low flow rates induced circulators; similar to Penn-Johnson No. F61KB.
 - 2. Pressure Relief Valve: Tested under ANSI Z21.22b with ratings as certified and listed by AGA and rated relief capacities greater than water heater BTU-per-hour input rating; products by Watts.
 - 3. Fan Prover Switch with Related Accessories: Tjernlund No. PS 1503.

- 4. Draft Inducer:
- 5. Utility Requirements:
 - a. 120 volt, 60 hertz.
 - b. 14-inch W.C. maximum gas pressure.

I. Warranties: Include materials, labor and freight required to repair or replace defective or failed equipment, in accordance with terms stated in following limited warranties:

- 1. Five-year limited warranty for coil, heat exchanger, and burner.

2.04 STORAGE TANKS

A. Vertical storage tank. Refer to equipment schedule on the Drawings for capacities.

B. Tank Features:

- 1. Construction:
 - a. Manufactured and stamped in accordance with ASME Code Section IV, hydrostatically tested at 225 psi minimum, and National Board Registered for 150 psi working pressure.
 - b. 11-inch by 15-inch manhole for tanks 30-inch and larger diameter.
 - c. Dielectric NPT tapings for 4-inch connections.
 - d. Steel supports.
 - e. Liner: Hydraulic calcium aluminate cement with 13,335 psi 28-day compressive strength in accordance with ASTM C109/C 109M, water absorption of 8.2 percent, density of approximately 140 pounds per cubic foot; similar to "Formula G-8 PreKrete" by Pocono Fabricators.

C. Accessories:

- 1. Magnesium anode rods.
- 2. Temperature and pressure relief valve with ASME label and AGA rating exceeding heat exchanger temperature steam rating; by Watts Regulator Co.
- 3. Factory steel jacket with powder-coat paint finish and insulation complying with ASHRAE 90.1.
- 4. Provide factory tank saddle supports.

D. Seismic Bracing: Storage Tanks shall be seismically braced as per Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing.

E. Warranty: Twenty-year materials and labor warranty against defects in material and workmanship, discolored water or tank perforation due to corrosion or erosion.

2.05 WATER HEATERS STORAGE TANK WITH HEAT EXCHANGER

A. Energy Conservation Standards, Title 24 approved, UL Listed, ASME tank construction. Refer to schedule on the Drawings for storage capacities, boiler water characteristics, and recovery rates.

B. The heat exchanger shall be a double-wall (atmospherically vented), cupro-nickel U-tube bundle with appropriate non-ferrous waterside tube sheet, baffles, and tie rods.

Standard heat exchanger will be constructed to ASME code and rated for 150 psi operating pressure and 225 psi test pressure and 300 degrees F service.

- C. Boiler Water Controls: Inlet heat will be moved through the heat exchanger by an on/off fan. Fan will be activated and de-activate by immersion thermostat(s) located near the hot outlet of the shell.
- D. Equip Storage Tank with upper and lower immersion operating thermostats, immersion temperature limiting device and an ASME-rated temperature and pressure relief valve, intra-tank circulating loop, tank pressure gauge, manual reset, boiler water temperature gauge, electronic low water cut-off.
- E. Construction: Construct Storage Tank in accordance with Section IV of the ASME code, and pressure-test to 225 pounds per square inch, and National Board Registered and - stamped for 150 pounds per square inch operating pressure. Tank shall be of lined steel construction, with non-ferrous connections, be wrapped in heavy density fiberglass insulation and jacketed with enameled steel panels to meet ASHRAE 90.1 standards for heat loss.
 - 1. Equipped with internal baffle to divert incoming cold water to allow 80 percent of total storage volume to be at usable temperature.
 - 2. Tank Liner: Hydraulic calcium aluminate cement with 13,335 psi 28-day compressive strength in accordance with ASTM C109/C 109M, water absorption of 8.2 percent, density of approximately 149 pounds per cubic foot; similar to "Formula G-8 PreKrete" by Pocono Fabricators.
 - 3. Fittings: Non-ferrous; stainless steel materials.
 - 4. Support: Factory tank saddles.
 - 5. Insulation: Factory steel jacket with powder-coat paint finish and insulation complying with ASHRAE 90.1.
- F. Seismic Bracing: Storage tanks shall be seismically braced as per Section 22 05 48 – Vibration Isolation and Seismic Restraints for Plumbing.
- G. Warranties: Include materials, labor and freight required to repair or replace defective or failed equipment, in accordance with terms stated in the following warranties:
 - 1. Twenty-Year Tank and Heat Exchanger Warranty against defects in material or workmanship, discolored water or tank perforation due to corrosion or erosion.

2.06 ELECTRIC WATER HEATERS – POINT OF USE

- A. Commercial grade, factory-assembled and -wired, electric type with the capacities as listed on the equipment schedule on the Drawings and located where indicated on the Drawings. The complete heater shall be listed by ETL or UL, and shall bear the UL or ETL label. Unit shall be approved, listed and constructed in accordance with NSF Standard No.5 and shall meet the energy efficiency requirements of ASHRAE Standard 90.1 Provide a two (2) year manufacturer's commercial installation warranty for the entire unit.
- B. Refer to schedule of the Drawings for capacities, recovery rates, and electrical requirements.

2.07 MISCELLANEOUS HEATING SYSTEM ACCESSORIES

- A. Aquastat: Remote bulb direct immersion type, UL Listed, device for high and low limiting temperature of liquids in storage tanks with temperature control range of 100 to 240 degrees F, adjustable midscale differential of 5 to 30 degrees F, 120 volt rated micro-switch snap acting switch, bulb, capillary; "Tradeline Model L4008A1015" by Honeywell with accessories.
 - 1. Accessories:
 - a. $\frac{3}{4}$ -inch NPT copper immersion well with clamp; select for applicable insulation thickness.
 - b. Single-pole double-throw switch.
 - c. Field-addable setpoint lock.
- B. Relief Valves:
 - 1. Pressure and Temperature Relief Valve: Bronze body and spring and diaphragm combination pressure and temperature type relief valves with test lever and automatically reseating type thermostatic element. Tested under ANSI Z21.22b with ratings as certified and listed by AGA and rated relief capacities greater than water heater's BTU-per-hour input rating; by Watts.
 - 2. Vacuum Relief Valve: Conformance with ANSI Z21.22b, CSA certified. Brass body and include a protective cap; "Model N36-M1" by Watts or "VR-10" by Wilkins. Number "40L" by Watts or "TP220" by Wilkins for higher BTU-per-hour input ratings.
- C. Thermal Expansion Tank:
 - 1. Vertical steel expansion tank constructed and designed per ASME Code Section VIII, 125 psi working pressure, steel outer shell, rigid polypropylene liner, heavy-duty butyl rubber diaphragm and non-ferrous system connection tapping, suitable for potable hot water. Refer to schedule on the Drawings for size; by Amtrol, Bell and Gossett, or Wilkins.

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Pipe relief drain full size to spill over floor receptor or to other safe location.
- B. Install water heater and accessories in full compliance with manufacturer's instructions and recommendations.
- C. Install draft regulators in full compliance with manufacturer's instructions and recommendations.
- D. Install seismic restraints on all water heaters per all applicable local and state codes. The use of solid non-flexible supply materials in lieu of seismic restraints is not acceptable.
- E. Pressure and Temperature Relief Valves:

1. Provide adjustable bronze spring and diaphragm combination pressure and temperature type relief valves with test lever and automatically reseating type thermostatic element.
2. Pipe drain to spill over floor drain or to other safe location.
3. Locate on storage tank water heaters.

3.02 TESTING AND ADJUSTMENTS

- A. Provide factory-authorized technician for system inspection and start-up, and verify proper installation of all water heaters.

END OF SECTION 22 33 00