

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Division 00 and 01, apply to this Section.
- B. Related Sections: The following sections contain requirements that relate to this section.
 - 1. Division 23.
 - 2. Division 22.
 - 3. Division 26.

1.2 SUMMARY

- A. This Section includes the following for domestic water systems:
 - 1. Commercial, gas water heaters.
 - 2. Tankless, electrical water heaters.
 - 3. Commercial, electric water heaters.
 - 4. Semi-Instantaneous, steam water heaters.
 - 5. Expansion tanks.
 - 6. Accessories.

1.3 DEFINITIONS

- A. Domestic Water Piping: Piping inside building that conveys potable cold and hot water to fixtures and equipment throughout the building.

1.4 CODES AND STANDARDS

- A. Codes and Standards shall be the current version adopted by the Authority Having Jurisdiction.

1.5 SUBMITTALS

- A. General: See Division 23 for general requirements of Product Data, Shop Drawings, Reports and Certificates, and Operation and Maintenance data submittals.
- B. Product Data: Provide submittals of the following:
 - 1. Commercial, gas water heaters.
 - 2. Tankless, electrical water heaters.
 - 3. Commercial, electric water heaters.
 - 4. Semi-Instantaneous, steam water heaters.
 - 5. Expansion tanks.
 - 6. Accessories.
- C. Maintenance Data: For water heaters and heat exchangers to include in maintenance manuals specified in Division 01.
- D. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters and heat exchangers through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. ANSI Compliance: Provide gas water heaters that comply with ANSI standards for gas water heaters and related products and that bear AGA certification label.
- D. ASME Compliance: Fabricate and label heat exchangers, water heaters, and hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1 and Section IV, "Rules for Construction of Heating Boilers," Part HLW Requirements for Potable-Water Heaters.
- E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
 - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.
 - 2. ASHRAE 90.2, "Energy Efficient Design of New Low-Rise Residential Buildings," for residential water heaters.
- F. Comply with the Reduction of Lead in Drinking Water Act of 2011. This act redefines "lead free" as "not containing more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent lead when used with respect to wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures". Products required to be "lead free" shall have NSF 61-G or NSF 372 certification.
- G. Soldered Lead Free End Connections: Copper alloys with silicone content greater than 0.005% are not allowed.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
 - 1. Warranty Period: From date of Substantial Completion:
 - a. Storage Tanks: Ten years.
 - b. Circulators: Eight years.
 - c. Burner Assemblies: Five years.
 - d. Heating Elements: Five years.
 - e. Storage Tanks: Ten years.
 - f. Steam Water Heater Pressure Vessels and Anticipators: Ten years.

PART 2 – PRODUCTS

2.1 BASIC, COMMON FEATURES

- A. Lead free products and materials shall be used.
- B. Soldered Lead Free End Connections: Copper alloys with silicone content greater than 0.005% are not allowed.

2.2 COMMERCIAL, STORAGE, GAS WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commercial, Storage, Atmospheric-Vent, or Automatic-Vent, Gas Water Heaters:
 - a. Bock Water Heaters, Inc.
 - b. Bradford White Corp.
 - c. Lochinvar Corp.
 - d. PVI Industries, Inc.
 - e. Rheem Manufacturing Co.; Rheem/Ruud Water Heater Div.
 - f. Smith: A. O. Smith Water Products Co.
 - g. State Industries.
 - h. Or Approved Equal.
- B. Description: Comply with ANSI Z21.10.3.
- C. Storage Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.
 - 1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
 - b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 - 3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 - 4. Jacket: Steel, with enameled finish.
 - 5. Handhole Cleanout: Provide for tanks 70 gallons and larger.
- D. Burner: For use with automatic-vent water heaters for natural-gas [or propane] fuel.
 - 1. Temperature Control: Adjustable thermostat.
 - 2. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 - 3. Automatic Ignition: ANSI Z21.20, automatic gas-ignition system and components.
 - 4. Automatic Damper: ANSI Z21.66, gas-fired-appliance, automatic-vent-damper device.
- E. Anode Rods: Factory installed, magnesium.
- F. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.

- G. T&P Relief Valve: Factory installed, AGA/ASME rated.
- H. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- I. Draft Control: [Draft diverter; comply with ANSI Z21.12][Powered-vent system].

2.3 COMMERCIAL, COPPER TUBE-TYPE, GAS WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commercial, Copper Tube-Type, Gas Water Heaters:
 - a. Lochinvar Corp.
 - b. Raypak, Inc.
 - c. Rheem Manufacturing Co.; Rheem/Ruud Water Heater Div.
 - d. Smith: A. O. Smith Water Products Co.
 - e. Teledyne Laars.
 - f. Weben-Jarco, Inc.
 - g. Or Approved Equal.
- B. Description: Atmospheric-fired type water heater. Comply with UL 795 and ANSI Z21.13; include storage tank, circulator, piping, and controls.
- C. ASME: Comply with ASME CSD-1; control safety devices.
- D. Water Heater: Enclosed, insulated unit with controls.
 - 1. Construction: According to ASME Boiler and Pressure Vessel Code: Section IV with 160-psig working-pressure rating.
 - 2. Heat Exchanger: Copper, [horizontal-grid,][coiled,] finned tube with bronze or glass-lined cast-iron headers.
 - 3. Burner: Manufacturer's standard, for use with tube-type water heaters and natural-gas [or propane] fuel.
 - a. Temperature Control: Adjustable, storage tank temperature-control fitting and flow switch, interlocked with circulator and burner.
 - b. Safety Control: Automatic, high-temperature-limit cutoff device or system.
 - c. Automatic Ignition: Intermittent electronic ignition complying with ANSI Z21.20.
 - d. Automatic Damper: ANSI Z21.66, gas-fired-appliance, automatic-vent-damper device.
 - 4. T&P Relief Valve: Factory installed, AGA/ASME rated.
 - 5. Draft Hood: Draft diverter; complying with ANSI Z21.12.
- E. Hot-Water Storage Tank: Connected with piping to circulator and water heater.
 - 1. Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with 125-psig working-pressure rating.
 - a. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.

- 1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
- 2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- b. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
- c. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
- d. Jacket: Steel, with enameled finish.
2. Anode Rods: Factory installed, magnesium.
3. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- F. Mounting: Water heater, tank, and accessories factory mounted on skids.
- G. Circulator: UL 778, all bronze, in-line, centrifugal, single-stage, radially split case design, with mechanical seals; with 125-psig- minimum working-pressure rating and 225 deg F continuous water temperature.
- H. Piping: Manufacturer's standard copper tubing.

2.4 COMMERCIAL, STORAGE, FORCED-DRAFT, GAS WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Commercial, Storage, Forced-Draft, Gas Water Heaters:
 - a. Bock Water Heaters, Inc.
 - b. PVI Industries, Inc.
 - c. Sellers Engineering Co.
 - d. Smith: A. O. Smith Water Products Co.
 - e. Or Approved Equal.
- B. Description: Gas-fired water heater with powered gas burner with electronic flame safeguard, intermittent ignition, main and pilot automatic gas valves, redundant solenoid gas valve, gas pressure regulator, diaphragm air switch and flame inspection port. Provide National Board Stamp. Comply with UL 795.
- C. Shell Construction: ASME-code steel with 160-psig working-pressure rating.
 1. Fire Tubes: Single-pass, copper-clad, seamless steel.
 2. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
 - b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.

3. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 4. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 5. Handhole Cleanout: Provide two 3" or larger cleanouts.
 6. Combination temperature and pressure gauge.
 7. Jacket: Steel, with enameled finish.
- D. Components, Gas Train, and Controls: Manufacturer's standard, unless otherwise indicated.
- E. Burner: Forced-draft assembly for natural-gas [or propane] fuel made with nozzles for fire tubes, and complying with appropriate requirements of UL 795.
1. Temperature Control: Adjustable upper and lower thermostats.
 2. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
 3. Automatic Ignition: ANSI Z21.20, automatic gas-ignition system and components.
 4. Automatic Damper: ANSI Z21.66, gas-fired-appliance, automatic-vent-damper device.
- F. Anode Rods: Factory installed, magnesium.
- G. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- H. T&P Relief Valve: Factory installed, AGA/ASME rated.
- I. Mounting: Factory-fabricated, structural-steel skids.
- 2.5 COMMERCIAL, DIRECT VENT, GAS WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Commercial, Direct Vent, Gas Water Heaters:
 - a. Aerco International, Inc.
 - b. American Water Heater Co.
 - c. Bock Water Heaters, Inc.
 - d. PVI Industries, Inc.
 - e. Lochinvar Corp.
 - f. Smith: A. O. Smith Water Products Co.
 - g. Patterson – Kelly.
 - h. Or Approved Equal.
- B. Description: Sealed-combustion-chamber configuration and components complying with appropriate requirements of ANSI Z21.13 and UL 795, with nominal efficiency rating not less than 80 percent.
- C. Unit Construction: ASME code with 160-psig working-pressure rating.
1. Tappings: Factory fabricated of materials compatible with tank for piping and other connections as required. Attach tappings to unit before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.

- b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2. Interior Finish: Corrosion-resistant metal or materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 - 3. Insulation: Comply with ASHRAE 90.1.
 - 4. Handhole Cleanout: Provide two cleanouts.
 - 5. Jacket: Steel, with enameled finish.
 - D. Burner: For use with sealed combustion chamber and natural-gas [or propane] fuel, and complying with appropriate requirements of UL 795.
 - 1. Temperature Control: Adjustable thermostat.
 - 2. Automatic Ignition: ANSI Z21.20, automatic gas-ignition system and components.
 - 3. Automatic Damper: ANSI Z21.66, gas-fired-appliance, automatic-vent-damper device.
 - E. Anode Rods: Factory installed, magnesium.
 - F. T&P Relief Valve: Factory installed, AGA/ASME rated.
 - G. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.
 - H. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- 2.6 COMMERCIAL, HIGH-EFFICIENCY, CONDENSING, DIRECT VENT, GAS WATER HEATERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Commercial, High-Efficiency, Condensing, Direct Vent, Gas Water Heaters:
 - a. Aerco International, Inc.
 - b. American Water Heater Co.
 - c. Bock Water Heaters, Inc.
 - d. PVI Industries, Inc.
 - e. Lochinvar Corp.
 - f. Smith: A. O. Smith Water Products Co.
 - g. Patterson – Kelly.
 - h. Or Approved Equal.
 - B. Description: Condensing, sealed combustion chamber configuration and components complying with appropriate requirements of ANSI Z21.10.3 and UL 795, with nominal efficiency rating not less than 93 percent.
 - C. Shell Construction: ASME code with 160-psig working-pressure rating.
 - 1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.

- b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 - 3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 - 4. Handhole Cleanout: Provide one or more cleanouts.
 - 5. Jacket: Steel, with enameled finish. Required clearance to combustibles shall be zero inches.
- D. Burner: Condensing type for natural-gas [or propane] fuel, complying with appropriate requirements of UL 795.
- E. Controls: Microprocessor controls with control panel, integral diagnostics, digital display, electronic ignition controls, and thermostat.
- F. Anode Rods: Factory installed, magnesium.
- G. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.
- H. T&P Relief Valve: Factory installed, ASME rated.
- I. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.

2.7 POINT-OF-USE, TANKLESS, ELECTRIC WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Point-of-Use, Tankless, Electric Water Heaters:
 - a. Insta-Hot.
 - b. Chronomite Laboratories, Inc.
 - c. Eemax, Inc.
 - d. Electric Heater Co.
 - e. Hot Aqua, Inc.
 - f. Waste King.
 - g. Or Approved Equal.
- B. Description: Comply with UL 499.
- C. Construction: Without hot-water storage.
- 1. Working-Pressure Rating: 150 psig.
 - 2. Tappings: ASME B1.20.1, pipe thread.
 - 3. Interior Finish: Materials complying with NSF 61, barrier materials for potable-water tank linings.
 - 4. Heating Coils: Stainless steel.
 - 5. Jacket: Aluminum or steel, with enameled finish, or plastic.
 - 6. Flow control fitting in outlet piping.

D. Heating System: Electric-resistance type.

1. [Temperature Control:] [Adjustable thermostat][Adjustable, microprocessor temperature control thermostat for remote, wall-mounting installation. Include control wiring].
2. [Temperature Control: Factory-set, temperature-control thermostat for fixed, outlet-water temperature.]
3. Safety Control: Automatic, high-temperature-limit cutoff device or system.

E. Mounting: Bracket or device for wall mounting.

2.8 COMMERCIAL, POINT-OF-USE, STORAGE, 1 TO 5 GALLONS, ELECTRIC WATER HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Commercial, Point-of-Use, Storage, 1 to 5 Gallons, Electric Water Heaters:
 - a. GSW Water Heating Co.
 - b. Lochinvar Corp.
 - c. Rheem Manufacturing Co.; Rheem/Ruud Water Heater Div.
 - d. Smith: A. O. Smith Water Products Co.
 - e. State Industries.
 - f. Or Approved Equal.

B. Description: Comply with UL 174, and listed by manufacturer for commercial applications.

C. Storage Tank Construction: Bronze or copper metal with 150-psig working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
4. Jacket: Steel, with enameled finish.

D. Heating Element: Electric, replaceable, immersion type.

1. Temperature Control: Adjustable thermostat and high temperature cutoff.
2. Provide on/off switch and grounded electrical cord.

E. Anode Rod: Factory installed, magnesium.

F. T&P Relief Valve: Provide for field installation, ASME rated.

G. Wall Bracket: Provide wall bracket for each water heater.

H. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed. Omit if water heater is without drain outlet and include general-duty drain valve in piping.

2.9 COMMERCIAL, POINT-OF-USE, STORAGE, 6 TO 40 GALLONS, ELECTRIC WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Commercial, Point-of-Use, Storage, 6 to 40 Gallons, Electric Water Heaters:
 - a. Bradford White Corp.
 - b. Lochinvar Corp.
 - c. Rheem Manufacturing Co.; Rheem/Ruud Water Heater Div.
 - d. Smith: A. O. Smith Water Products Co.
 - e. State Industries.
 - f. Or Approved Equal.
- B. Description: Comply with UL 174 or UL 1453, and listed by manufacturer for commercial applications.
- C. Storage Tank Construction: [ASME-code][Non-ASME-code] steel with 150-psig working-pressure rating.
1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
 2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 4. Jacket: Steel, with enameled finish.
- D. Heating Elements: Two, unless otherwise indicated; electric, screw-in, immersion type.
1. Temperature Control: Adjustable thermostat.
- E. Anode Rod: Factory installed, magnesium.
- F. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- G. T&P Relief Valve: Factory installed, ASME rated.

2.10 COMMERCIAL, STORAGE, OVER 40 GALLONS, ELECTRIC WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Commercial, Storage, over 40 Gallons, Electric Water Heaters:
 - a. Bradford White Corp.
 - b. Cemline Corp.
 - c. Lochinvar Corp.
 - d. Patterson-Kelley Co.
 - e. PVI Industries, Inc.
 - f. Rheem Manufacturing Co.; Rheem/Ruud Water Heater Div.
 - g. Smith: A. O. Smith Water Products Co.
 - h. State Industries.
 - i. Or Approved Equal.

- B. Description: Comply with UL 1453.
- C. Storage Tank Construction: [ASME-code][Non-ASME-code] steel with 150-psig working-pressure rating.
 - 1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, pressure gage, thermometer, drain, anode rods, and controls as required. Attach tappings to tank shell before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
 - b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
 - 2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
 - 3. Insulation: Comply with ASHRAE 90.1. Surround entire storage tank except connections and controls.
 - 4. Handhole Cleanout: Provide one or more cleanouts.
 - 5. Jacket: Steel, with enameled finish.
- D. Heating Elements: Electric, screw-in or bolt-on, immersion type arranged in multiples of three.
 - 1. Exception: Water heaters up to 9-kW input may have 2 or 3 elements.
 - 2. Staging: Input not exceeding 18 kW per step.
 - 3. Temperature Control: Adjustable [, immersion][, surface-mounted] thermostat.
 - 4. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
- E. Drain Valve: ASSE 1005, corrosion-resistant metal, factory installed.
- F. Anode Rods: Factory installed, magnesium.
- G. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.
- H. T&P Relief Valve: Factory installed, ASME rated.

2.11 SEMI-INSTANTANEOUS STEAM WATER HEATERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Semi-Instantaneous Steam Water Heaters:
 - a. Aerco International, Inc.
 - b. Cemline Corp.
 - c. Leslie Controls, Inc.
 - d. Patterson-Kelley Co.
 - e. PVI Industries, Inc.
 - f. RECO Industries, Inc.
 - g. Sellers Engineering Co.
 - h. Or Approved Equal.

- B. Description: Packaged, commercial, ASME labeled, indirect-fired, vertical U-tube, double-wall water heater with negligible storage capacity; and heat exchanger for heating water with steam. Semi-instantaneous design with service water in the shell and steam in the tubes. The ratio of hot water volume to steam volume shall be a minimum of 5:1.
- C. Pressure Vessel: ASME code, with 185-psig- minimum working-pressure rating at 400-degrees F. Include nozzle or other arrangement for heat exchanger. The water vessel shall be designed for an average water velocity of 5 feet per second, maximum. Maximum allowable water pressure drop shall not exceed 10 psi at design flow.
- D. U-Tube Coils: Double-wall copper tube bundle for steam, with atmospherically-vented, clearly labeled, visible leak detection port.
 - 1. Pressure Rating: ASME, 250-psig- minimum working-pressure rating at 400-degrees F.
 - 2. Tappings: Factory fabricated of materials compatible with water heater shell for piping connections, relief valve, pressure gage, thermometer, blowdown, vent, and controls as required. Attach tappings to shell before testing and labeling.
 - a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1, pipe threads.
 - b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges and according to ASME B16.24 for copper and copper-alloy flanges.
- E. Materials of Construction: All surfaces in contact with water shall be non-ferrous alloy.
 - 1. Shell: Type 304 stainless steel.
 - 2. Tubes: Outer wall 0.049" minimum copper and Inner wall 0.025" minimum copper.
 - 3. Upper Tubesheet: Passivated type 304 stainless steel.
 - 4. Lower Tubesheet: Carbon steel.
 - 5. Top Head: Bronze.
- F. Temperature Control: Adjustable anticipator thermostat that operates steam-control valve and that is capable of maintaining outlet-water temperature within 4 deg F of setting at all load conditions.
- G. Safety Control: Automatic, dual solenoid valve high-temperature-limit cutoff device system. Provide control panel with on/tripped status lights, thermometer for domestic water temperature indication, and compound steam pressure gauge. Provide dry contacts for high limit status indication for DDC system.
- H. Miscellaneous Components: Provide the following:
 - 1. Self-contained steam control valve for 125-psig maximum steam pressure.
 - 2. Bronze T&P relief valve, 125-psig, conforming to ANSI Z21.22.
 - 3. Minimum 1-1/2" thick resilient insulation kit in accordance with ASHRAE 90.1 and local energy code requirements.
- I. Stand: Factory fabricated for floor mounting.

2.12 EXPANSION TANKS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Expansion Tanks:
 - a. Amtrol, Inc.
 - b. Armstrong Pumps, Inc.
 - c. Taco, Inc.
 - d. Zurn Industries, Inc.; Wilkins Div.
 - e. Bell & Gossett.
 - f. Or Approved Equal.
- B. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm and poly-propylene liner. Include air precharge to minimum system-operating pressure at tank.
- C. Construction: 150-psig working-pressure rating.
- D. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1, pipe thread, brass or stainless steel.
- E. Tank Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
- F. Tank Exterior Finish: Manufacturer's standard, unless finish is indicated.
- G. Air-Charging Valve: Factory installed, brass with plastic cap.
- H. Floor Mounting Stand: Provide integral floor mounting stand and bottom elbow system connection where vertical, floor-mounted tanks are indicated.

2.13 WATER HEATER ACCESSORIES

- A. Combination Temperature and Pressure Relief Valves: According to the following:
 - 1. Gas Water Heaters: ANSI Z21.22, combination temperature and pressure relief valve.
 - 2. Electric and Steam Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.
 - 3. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
 - 4. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping.
- B. Pressure Relief Valves: According to the following:
 - 1. Gas Water Heaters: ANSI Z21.22 pressure relief valve for storage tanks of 200,000 Btuh.
 - 2. Electric and Steam Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than heat-exchanger working-pressure rating.

- C. Vacuum Relief Valves: According to the following:
 - 1. Gas Water Heaters: ANSI Z21.22.
 - 2. Electric and Steam Water Heaters: Comply with ASME PTC 25.3. Furnish for installation in piping.
 - 3. Exception: Omit if water heater has integral vacuum-relieving device.
- D. Gas Shutoff Valves: ANSI Z21.15, manually operated. Furnish for installation in piping.
- E. Gas Pressure Regulators: ANSI Z21.18, appliance type, factory or field installed. Include pressure rating, capacity, and pressure differential required for water heater and gas supply.
- F. Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
- G. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch- high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1 drain outlet with ASME B1.20.1, pipe thread.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Water Heater Stand and Drain Pan Units:
 - 1) Safety: W. H. Safety Products, Inc.
 - 2) Or Approved Equal.
- H. Water Heater Stands: Water heater manufacturer's factory-fabricated, steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.
- I. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated, steel bracket for wall mounting and capable of supporting water heater and water.
- J. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.
- K. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.
- L. Hose and Drain Valve: Provide with water heater.
- M. Install R-10 insulation on concrete pad for electric water heaters.
- N. Install restraints as required for seismic zone.
- O. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1 or ASHRAE 90.2.

PART 3 – EXECUTION

3.1 WATER HEATER AND HEAT EXCHANGER INSTALLATION

- A. Install water heaters and heat exchangers on concrete housekeeping pads, unless indicated to be suspended.
- B. Install water heaters and heat exchangers, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- C. Anchor water heaters and heat exchangers to substrate.
- D. Install seismic restraints for water heaters and heat exchangers. Anchor to substrate.
- E. Install and connect gas water heaters according to NFPA 54.
 - 1. Install appliance, gas pressure regulators on gas-burner inlets of water heaters without pressure regulators.
 - 2. Install vent piping from gas-train pressure regulators and valves to outside of building where required. Terminate vent piping with brass-screened vent cap fitting. Do not combine vents except with approval of authorities having jurisdiction.
- F. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- G. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- H. Install vacuum relief valves in cold-water-inlet piping.
- I. Install vacuum relief valves in water heater and heat exchanger storage tanks that have copper lining.
- J. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains.
- K. Install thermometers on water heater and heat exchanger inlet and outlet piping.
 - 1. Exception: Omit thermometers for the following:
 - a. Residential, water heater inlet and outlet piping.
 - b. Commercial, point-of-use, water heater inlet piping.
- L. Install pressure gages on water heater and heat exchanger piping.
- M. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve, and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet.
- N. Arrange for insulation on equipment and piping not furnished with factory-applied insulation.
- O. Fill water heaters and heat exchangers with water prior to activation.

- P. Charge expansion tanks with air.
- Q. In addition to the operating control used for normal water heater operation, install separate high temperature limit that will automatically cut off the fuel supply. The temperature range of the high temperature control shall not allow a setting over 210 deg F.
 - 1. Gas-Fired Water Heaters: High temperature limit control when actuated shall shutoff the fuel supply with a shutoff means other than the operating control valve.
 - 2. Electric Water Heaters: High temperature limit control when actuated shall cut off all current flow to the burner mechanism.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 21, 22, and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- D. Connect gas piping to gas burner with drip leg, tee, shutoff valve, and union; minimum size same as inlet connection.
- E. Make connections with dielectric fittings where piping is made of dissimilar metal.
- F. Gas, Water Heater Vent Connections: Venting connection per manufacturer's instructions.
- G. Electrical Connections: Power wiring and disconnect switches are specified in Division 26 Sections. Arrange wiring to allow unit service. Ground equipment.

3.3 FIELD QUALITY CONTROL

- A. [Engage a factory-authorized service representative to perform startup service.]
- B. In addition to manufacturer's written installation and startup checks, perform the following:
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment and retest until satisfactory results are achieved.
 - 2. Verify that piping system tests are complete.
 - 3. Check for piping connection leaks.
 - 4. Check for clear relief valve inlets, outlets, and drain piping.
 - 5. Check operation of circulators.
 - 6. Test operation of safety controls, relief valves, and devices.
 - 7. Energize electric circuits.
 - 8. Adjust operating controls.
 - 9. Adjust hot-water-outlet temperature settings. Do not set above 140 deg F unless piping system application requires higher temperature.
 - 10. Balance water flow through manifolds of multiple-unit installations.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters and heat exchangers.
 - 1. Train Owner's maintenance personnel on procedures for starting and stopping troubleshooting, servicing, and maintaining equipment.
 - 2. Review data in maintenance manuals. Refer to Division 01 Sections.
 - 3. Schedule [x] hours of training with Owner, through Architect, with at least seven days' advance notice.

END OF SECTION