SECTION 223500 - DOMESTIC-WATER HEAT EXCHANGERS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

MasterSpec includes provisions for LEED 2009, LEED v4, ASHRAE 189.1, IgCC, and Green Globes. Some sustainable design requirements are either mandatory or optional and may be inserted into the Section Text using the hypertext links. See the Evaluations for other requirements that are associated with sustainable design and may be considered "best practice" or retained, even if a sustainable design standard is not a project requirement.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Shell-and-tube, domestic-water heat exchangers.

Instantaneous, domestic-water heaters.

Semi-instantaneous, domestic-water heaters.

Indirect-fired, storage, domestic-water heaters.

Plate, domestic-water heat exchangers.

Drainline heat exchangers.

Accessories.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.[ Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.]

Retain "Shop Drawings" paragraph below if equipment includes wiring.

* + - * 1. Shop Drawings:

Include diagrams for power, signal, and control wiring.

Retain "Coordination Drawings" paragraph below for situations where limited space necessitates maximum use for efficient installation of different components or if coordination is required for installation of products and materials by separate installers. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades. Also indicate the following:

Tube removal space, both vertical and/or horizontal as applicable.

Structural members to which heat exchangers will be attached.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordinate with Sections specifying mechanical vibration, supports, and seismic controls. See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates, for domestic-water heat exchangers, water heaters, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Product Certificates" paragraph below to require submittal of product certificates from manufacturers. Certificates may indicate that products have passed certain performance tests, complied with standards such as ENERGY STAR and GreenGuard, or conformed with other product certification programs.

* + - * 1. Product Certificates: For each type of [shell-and-tube heat exchanger] [instantaneous water heater] [semi-instantaneous water heater] [and] [plate heat exchanger] from manufacturer.

Retain "Domestic-Water, Heat-Exchanger Labeling" and/or "Domestic-Water Heater Labeling" subparagraph below if plumbing codes for Project area require domestic-water heat exchangers and water heaters to be independent testing agency certified. Verify availability for units retained.

Domestic-Water, Heat-Exchanger Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

* + - * 1. Source quality-control reports.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
				2. Sample Warranty: For special warranty.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For domestic-water heat exchangers and heaters to include in emergency, operation, and maintenance manuals.
			2. COORDINATION
				1. Coordinate sizes and locations of concrete bases with actual equipment provided.
			3. WARRANTY

When warranties are required, verify with Director’s Representative’s that warranties stated in this article are not less than remedies available to Director’s Representative under prevailing local laws.

* + - * 1. Special Warranty: Manufacturer agrees to repair or replace components of domestic-water heat exchangers and heaters that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, the following:

Structural failures, including domestic-water heat exchanger, water heater, storage tank, and supports.

Faulty operation of controls.

Deterioration of metals, metal finishes, and other materials beyond normal use.

Verify available warranties and warranty periods for units and components.

Warranty Periods: From date of Substantial Completion.

Shell-and-Tube, Domestic-Water Heat Exchangers:

Tube Coil: [**One**] <**Insert number**> year(s).

Controls and Other Components: [**One**] <**Insert number**> year(s).

Instantaneous, Domestic-Water Heaters:

Tank: [**Five**] [**10**] <**Insert number**> years.

Tube Coil: [**Five**] [**10**] <**Insert number**> years.

Controls and Other Components: [**Three**] <**Insert number**> years.

Semi-Instantaneous, Domestic-Water Heaters:

Tank: [**Five**] <**Insert number**> years.

Tube Coil: [**Five**] <**Insert number**> years.

Controls and Other Components: [**Three**] <**Insert number**> years.

Indirect-Fired, Storage, Domestic-Water Heaters:

Storage Tank: [**Five**] <**Insert number**> years.

Tube Coil: [**Five**] <**Insert number**> years.

Controls and Other Components: [**Three**] <**Insert number**> years.

Plate, Domestic-Water Heat Exchangers:

Brazed-Plate Type: [**One**] <**Insert number**> year(s).

Plate-and-Frame Type: [**One**] <**Insert number**> year(s).

Drainline Heat Exchanger: [**One**] <**Insert number**> year(s).

Compression Tanks: [**One**] <**Insert number**> year(s).

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications

See discussions on various types of domestic-water heat exchangers and water heaters in the Evaluations for minimum and maximum limits on capacity and recovery of domestic-water heat exchangers and water heaters in this Section.

* + - 1. PERFORMANCE REQUIREMENTS

Compliance with ASHRAE/IES 90.1 is required by LEED 2009, LEED v4, IgCC, ASHRAE 189.1, and Green Globes and may be required, even when they do not apply.

* + - * 1. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1.
				2. ASME Compliance: Where ASME-code construction is indicated, fabricate and label heat-exchanger storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
				3. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61and NSF 372.
				4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

Retain "Seismic Performance" paragraph below with "Seismic Qualification Data" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with structural engineer.

* + - * 1. Seismic Performance: Domestic-water heat exchangers and heaters shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table, for requirements to be inserted in subparagraph below.

<Insert requirements for Component Amplification Factor and Component Response Modification Factor>.

* + - 1. SHELL-AND-TUBE, DOMESTIC-WATER HEAT EXCHANGERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13472) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Armstrong Fluid Technology](http://www.specagent.com/Lookup?uid=123457132836).

[Bell & Gossett; a Xylem brand](http://www.specagent.com/Lookup?uid=123457132837).

[Taco Comfort Solutions](http://www.specagent.com/Lookup?uid=123457132835).

Approved equivalent.

* + - * 1. Description: Factory-packaged assembly of shell, U-tube heat-exchanger coils, and specialties for heating domestic water with [**heating hot water**] [**steam**] in shells.
				2. Construction:

Fabricate and label heat exchanger to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

* + - * 1. Configuration: U-tube with removable [**two-pass**] [**four-pass**] bundle.
				2. Shell Materials: Carbon-steel shell with [**150-psig**] <**Insert value**> minimum working-pressure rating.

Tappings: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

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.

* + - * 1. Head: Cast iron, flanged and bolted to shell.

Retain first option in "Heat-Exchanger Coil" paragraph below for applications where heated domestic water is intended for potable purposes.

* + - * 1. Heat-Exchanger Coil: Double-wall, [**copper**] [**copper-nickel**] coils for domestic water. Include pressure rating equal to or greater than heating-fluid-supply pressure.
				2. Relief Valves: ASME rated and stamped for combination temperature- and pressure-relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting of less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.

Retain "Miscellaneous Components for Heating Hot-Water Unit" or "Miscellaneous Components for Steam Unit" paragraph below. Retain first paragraph for heating hot-water units; retain second paragraph for steam units.

* + - * 1. Miscellaneous Components for Heating Hot-Water Unit: Control valve, valves, and piping. [ Include components fitted for [electronic] [pneumatic] control].
				2. Miscellaneous Components for Steam Unit: Strainers, steam-control valve, steam trap, valves, pressure gauge, thermometer, and piping. **[ Include components fitted for [electronic] [pneumatic] control].**
				3. Exception: Steam trap is not required if manufacturer's written instructions direct that it not be used.
				4. Stand: Factory fabricated on skid for floor mounting.
				5. Insulation: Complying with ASHRAE/IES 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire shell and nozzle, except connections and controls.
				6. Required Connections: Domestic cold water in; domestic hot water out; [**heating hot-water-**] [**steam**] supply in; [**heating hot water out**] [**condensate return out**].
				7. Capacity and Characteristics:

Domestic Water:

Recovery: <Insert **gpm**> at [**100 deg F**] <Insert temperature> temperature rise.

Hot-Water Temperature Setting: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Retain "Heating Hot-Water Supply" subparagraph or "Steam Supply" subparagraph below.

Heating Hot-Water Supply:

Inlet Temperature: <**Insert deg F**>.

Outlet Temperature: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Steam Supply:

Inlet Pressure: <**Insert psig**>.

Demand Rate: <Insert **lb/h**>.

Input Rating: <**Insert Btu/h**>.

Steam Pipe Size: <**Insert NPS**>.

Retain "Condensate Pipe Size" subparagraph below if retaining "Steam Supply" subparagraph above.

Condensate Pipe Size: <**Insert NPS**>.

* + - 1. INSTANTANEOUS, DOMESTIC-WATER HEATERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13467) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Cemline Corporation](http://www.specagent.com/Lookup?uid=123457132844).

[Circor Energy/Leslie Controls](http://www.specagent.com/Lookup?uid=123457132842).

[Spirax Sarco Limited](http://www.specagent.com/Lookup?uid=123457132843).

Approved equivalent.

* + - * 1. Description: Factory-packaged assembly of heat exchanger, blending valve, controls, and specialties for heating domestic water in coils with steam in shell utilizing feed forward principle design.
				2. Construction: ASME code, with [**cast-iron**] [**or**] [**steel**] shell for steam.

Cast-Iron Shell Pressure Rating: [**50 psig**] [**75 psig**].

Steel Shell Pressure Rating: 150 psig.

Standard: Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

In "Heat-Exchanger Coils" paragraph below, retain first option if used with potable water.

* + - * 1. Heat-Exchanger Coils: Spiral-wound, double-wall [**copper or copper-alloy**] [**stainless steel**] coils for domestic water.
				2. Temperature Control: Adjustable thermostat that operates blending valve and is capable of maintaining outlet water temperature within 4 deg F of setting.
				3. Safety Control: Automatic feed forward blending valve actuated by differential pressure.
				4. Miscellaneous Components: Strainers (main and drip), main trap, drip trap, outlet water temperature gauge, steam pressure gauge, and piping.
				5. Stand: Factory-fabricated steel skid for floor mounting.
				6. Insulation: Factory-fabricated and -installed cover placed over top of the exchanger.
				7. Required Connections: Domestic cold water in; domestic hot water out; steam supply in; condensate return out.

Units are usually available with capacity in increments of 15/30 gpm (15, 30, 45, 60, 90, 120, etc.). Provide multiple units piped in parallel if demand exceeds 120 gpm or a certain level of redundancy is required/desired.

* + - * 1. Capacity and Characteristics:

Domestic Water:

Recovery: <Insert **gpm**> at [**100 deg F**] <Insert temperature> temperature rise.

Hot-Water Temperature Setting: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Steam Supply:

Inlet Pressure: <**Insert psig**>.

Demand Rate: <Insert **lb/h**>.

Input Rating: <**Insert Btu/h**>.

Steam Pipe Size: <**Insert NPS**>.

Condensate Pipe Size: <**Insert NPS**>.

Retain "Recirculation Kit" paragraph below if the domestic hot-water system is being recirculated. Refer to manufacturer's information regarding additional components needed when recirculation is used.

* + - 1. SEMI-INSTANTANEOUS, DOMESTIC-WATER HEATERS
				1. Semi-Instantaneous, Heating-Fluid-in-Coil, Packaged, Compact, Less than 100-Gal., Domestic-Water Heater:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=13470) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Harsco Industrial, Patterson-Kelley](http://www.specagent.com/Lookup?uid=123457207479).

[Hubbell Electric Heater Co](http://www.specagent.com/Lookup?uid=123457132829).

Approved equivalent.

Description: Factory-packaged assembly of shell, heat-exchanger coils, and specialties for heating domestic water with steam in coils.

Construction:

Fabricate and label heat exchanger to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

Configuration: Vertical.

Shell Materials: Carbon steel, copper-lined shell with [**250- psig**] <**Insert value**> minimum working-pressure rating.

Tappings: Factory fabricated of materials compatible with heat-exchanger shell. Attach tappings to shell before testing and labeling.

2 inch and Smaller: Threaded ends according to ASME B1.20.1.

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 for copper and copper-alloy flanges.

Head: Cast iron, flanged and bolted to shell.

Retain first option in "Heat-Exchanger Coil" subparagraph below for applications where heated domestic water is intended for potable purposes.

Heat-Exchanger Coil: Double-wall, [**copper**] [**copper-nickel**] coils for domestic water. Include pressure rating equal to or greater than heating-fluid supply pressure. Heat-Exchanger tube bundle shall have ability to be removed without disconnection of piping.

Relief Valves: ASME rated and stamped for combination temperature- and pressure-relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input and include pressure setting of less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.

Miscellaneous Components: Strainers, steam-control valve, steam trap, valves, pressure gauge, thermometer, and piping. **[ Include components fitted for [electronic] [pneumatic] control].**

Exception: Steam trap is not required if manufacturer's written instructions direct that it not be used.

Stand: Factory fabricated on skid for floor mounting.

Insulation: Complying with ASHRAE/IES 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire shell and nozzle, except connections and controls.

Required Connections: Domestic cold water in; domestic hot water out; steam supply in; condensate return out.

Capacity and Characteristics:

Domestic Water:

Recovery: <Insert **gpm**> at [**100 deg F**] <Insert temperature> temperature rise.

Hot-Water Temperature Setting: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Steam Supply:

Inlet Pressure: <**Insert psig**>.

Demand Rate: <Insert **lb/h**>.

Input Rating: <**Insert Btu/h**>.

Steam Pipe Size: <**Insert NPS**>.

Condensate Pipe Size: <**Insert NPS**>.

* + - * 1. Semi-Instantaneous, Heating-Fluid-in-Shell, Packaged, Compact, Less than 100-Gal., Domestic-Water Heat Exchangers:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=13471) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Harsco Industrial, Patterson-Kelley](http://www.specagent.com/Lookup?uid=123457207479).

[Hubbell Electric Heater Co](http://www.specagent.com/Lookup?uid=123457132829).

Approved equivalent.

Description: Factory packaged, less than 100-gal. storage-capacity hot-water storage tank with heat-exchanger coil, circulator, controls, and specialties for heating domestic water with [**heating hot water**] [**steam**] in coil.

Flow Pattern: Standard-flow arrangement, with water from bottom of storage tank circulated across heat-exchanger coil and returned to tank. Include hot-water outlet located at top of tank and temperature sensor in tank.

Construction:

Fabricate and label semi-instantaneous domestic-water heater to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.

Configuration: Vertical or horizontal.

Shell Materials: ASME-code, copper-silicon or corrosion-resistant metal with 150-psig working-pressure rating. Include nozzle and head for heat-exchanger tube coil.

Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.

2 inch and Smaller: Threaded ends according to ASME B1.20.1.

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 for copper and copper-alloy flanges.

Retain first option in "Heat-Exchanger Coil" subparagraph below for applications where heated domestic water is intended for potable purposes.

Heat-Exchanger Coil: Double copper or copper-alloy U tubes with tube sheet and supporting baffles. Include heat-exchanger pressure rating equal to or greater than heating-fluid supply pressure. Heat-Exchanger tube bundle shall have ability to be removed without disconnection of piping.

Temperature Control: Adjustable thermostat.

Safety Control: Automatic, high-temperature-limit cutoff device or system. Include automatic low-water cutoff device or system.

Relief Valves: ASME rated and stamped for combination temperature- and pressure-relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input and include pressure setting of less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.

Gauges: Factory-mounted thermometer and pressure gauge.

Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, [**125- psig**] <**Insert value**> minimum working-pressure rating, and 225 deg F continuous-water-temperature rating.

Pump Control: Sensor for operating pump and control valve.

Retain "Miscellaneous Components for Heating Hot-Water Units" or "Miscellaneous Components for Steam Units" subparagraph below. Retain first subparagraph for heating hot-water units; retain second subparagraph for steam units.

Miscellaneous Components for Heating Hot-Water Units: Control valve, valves, and piping.

Miscellaneous Components for Steam Units: Strainers, steam-control valve, steam trap, valves, pressure gauge, thermometer, and piping.

Support: Factory mounted on skid for floor mounting.

Energy Management System Interface: Normally closed dry contacts for enabling and disabling heat exchanger.

Insulation: Complying with ASHRAE/IES 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire storage tank and nozzle, except connections and controls.

Required Connections: Domestic cold water in; domestic hot water out; [**heating hot-water**] [**steam**] supply in; [**heating hot water**] [**condensate return**] out.

Capacity and Characteristics:

Domestic Water:

Recovery: <Insert **gpm**> at [**100 deg F**] <Insert temperature> temperature rise.

Hot-Water Temperature Setting: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Retain "Heating Hot-Water Supply" subparagraph or "Steam Supply" subparagraph below.

Heating Hot-Water Supply:

Inlet Temperature: <**Insert deg F**>.

Outlet Temperature: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Steam Supply:

Inlet Pressure: <**Insert psig**>.

Demand Rate: <Insert **lb/h**>.

Input Rating: <**Insert Btu/h**>.

Steam Pipe Size: <**Insert NPS**>.

Retain "Condensate Pipe Size" subparagraph below if retaining "Steam Supply" subparagraph above.

Condensate Pipe Size: <**Insert NPS**>.

* + - 1. INDIRECT-FIRED, STORAGE, DOMESTIC-WATER HEATERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13468) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Hubbell Electric Heater Co](http://www.specagent.com/Lookup?uid=123457132854).

[Harsco Industrial, Patterson-Kelley](http://www.specagent.com/Lookup?uid=123457207479).

[PVI; A WATTS Brand](http://www.specagent.com/Lookup?uid=123457132847).

Approved equivalent.

In "Description" paragraph below, the majority of manufacturers offer the "circulator" option, but some do not. Consult manufacturers.

* + - * 1. Description: Factory-packaged, hot-water storage tank with heat-exchanger coil, [**circulator**], controls, and specialties for heating domestic water with [**heating hot water**] [**steam**] in coil.
				2. Flow Pattern: Standard-flow arrangement, with water from bottom of storage tank circulated across heat-exchanger coil and returned to tank. Include hot-water outlet located at top of tank and temperature sensor in tank.
				3. Storage-Tank Construction: [**Non-**]ASME-code [**steel**] <**Insert material**> with [**125-psig**] [**150- psig**] <**Insert value**> working-pressure rating. Include nozzle and head for heat-exchanger tube coil.

Configuration: [**Horizontal**] [**Vertical**].

In the "Manhole" subparagraph below, the majority of manufacturers offer manholes integral with the unit, but some do not. Consult manufacturers.

Manhole: 11 by 15 inches in [**end head of horizontal**] [**sidewall of vertical**] storage-tank shell.

Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing and labeling.

2 inch and Smaller: Threaded ends according to ASME B1.20.1.

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 for copper and copper-alloy flanges.

In the "Lining" subparagraph below, not all manufacturers offer all options. Consult manufacturers.

Lining: [**Cement**] [**Glass**] [**Nickel**] [**Epoxy/Phenolic coating**] [**Stainless steel**] <**Insert material**> complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

Insulation: Complying with ASHRAE/IES 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire storage tank and nozzle, except connections and controls.

Anode Rods: Factory installed, magnesium.

In the "Heat-Exchanger Coil" paragraph below, all manufacturers do not offer all options. Consult manufacturers.

* + - * 1. Heat-Exchanger Coil: [**3/4 inch**] [**1-1/4 inch**] <**Insert pipe size**> diameter, double-wall copper or copper-alloy U tubes with tube sheet and supporting baffles. Include heat-exchanger pressure rating equal to or greater than heating-fluid supply pressure.
				2. Temperature Control: Adjustable-temperature aquastat, mounted in storage-tank shell head unless otherwise indicated.
				3. Safety Control: Automatic, high-temperature-limit cutoff device or system. Include automatic low-water cutoff device or system.
				4. Relief Valves: ASME rated and stamped for combination temperature- and pressure-relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting of less than working-pressure rating of heat exchanger. Select one relief valve with sensing element that extends into storage tank.
				5. Gauges: Factory-mounted thermometer and pressure gauge.

In the "Circulating Pump" paragraph below, the majority of manufacturers offer circulating pumps that are integral with the unit, but some do not. Consult manufacturers.

* + - * 1. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately coupled in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, [**125-psig**] <**Insert value**> minimum working-pressure rating, and 225 deg F continuous-water-temperature rating.

Pump Control: Sensor for operating pump and control valve.

* + - * 1. Support: Factory mounted on skids.
				2. Energy Management System Interface: Normally closed dry contacts for enabling and disabling heat exchanger.
				3. Required Connections: Domestic cold water in; domestic hot water out; [**heating hot-water**] [**steam**] supply in; [**heating hot water**] [**condensate return**] out.

If more than one indirect-fired, storage, domestic-water heater is required on Project, delete "Capacity and Characteristics" paragraph below and schedule on Drawings.

* + - * 1. Capacity and Characteristics:

Domestic Water:

Storage Capacity: <**Insert gal.**>.

Recovery: <Insert **gph**> at [**100 deg F**] <Insert temperature> temperature rise.

Pipe Size: <Insert **NPS**>.

Hot Water Temperature Setting: <**Insert deg F**>.

Retain "Heating Hot-Water Supply" subparagraph or "Steam Supply" subparagraph below.

Heating Hot-Water Supply:

Inlet Temperature: <**Insert deg F**>.

Outlet Temperature: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Steam Supply:

Inlet Pressure: <**Insert psig**>.

Demand Rate: <Insert **lb/h**>.

Input Rating: <**Insert Btu/h**>.

Steam Pipe Size: <**Insert NPS**>.

Retain "Condensate Pipe Size" subparagraph below if retaining "Steam Supply" subparagraph above.

Condensate Pipe Size: <**Insert NPS**>.

Electrical Characteristics:

Volts: <Insert number>.

Phases: <Insert number>.

Hertz: <Insert number>.

Full-Load Amperes: <**Insert number**>.

Minimum Circuit Ampacity: <**Insert number**>.

Maximum Overcurrent Protection: <**Insert amperage**>.

* + - 1. PLATE, DOMESTIC-WATER HEAT EXCHANGERS

Domestic-water heat exchangers in this article do not have controls. Control valves and devices are specified in heating-fluid piping Sections.

* + - * 1. Brazed-Plate, Domestic-Water Heat Exchangers:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2429) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Bell & Gossett; a Xylem brand](http://www.specagent.com/Lookup?uid=123457132868).

[Kelvion, Inc](http://www.specagent.com/Lookup?uid=123457132867).

[Harsco Industrial, Patterson-Kelley](http://www.specagent.com/Lookup?uid=123457207479).

[Polaris Heat Exchangers](http://www.specagent.com/Lookup?uid=123457132859).

Approved equivalent.

Description: Factory-packaged assembly of heat-exchanger plates, permanently brazed together, for using [**heating hot water**] [**steam**] to heat domestic water.

Working-Pressure Rating: [**150 psig**] [**200 psig**] <Insert value> minimum.

Verify availability of selected models if vented, double-wall units in "Plate Construction" subparagraph below are required. Retain first option for applications where heated domestic water is intended for potable purposes.

Plate Construction: [**Vented]** double-wall.

Plate Material: Stainless steel.

Plate Thickness: Not less than [**0.0197 inch**] [**0.024 inch**].

Connections: Stainless steel, threaded.

Brazing Filler Metal: [**Copper**] [**or**] [**nickel**].

* + - * 1. Frame-and-Plate, Domestic-Water Heat Exchangers:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2430) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Bell & Gossett; a Xylem brand](http://www.specagent.com/Lookup?uid=123457132881).

[Kelvion, Inc](http://www.specagent.com/Lookup?uid=123457132875).

[Polaris Heat Exchangers](http://www.specagent.com/Lookup?uid=123457132878).

Approved equivalent.

Description: Factory-packaged assembly of nonfixed-position, heat-exchanger plates, with frame, for using [**heating hot water**] [**steam**] to heat domestic water.

Working-Pressure Rating: [**150 psig**] [**200 psig**] [**250 psig**] [**400 psig**] <Insert value> minimum.

Frame:

Carrying and Guide Bars: [Carbon steel] [Stainless steel] <Insert material>.

Fixed, Frame Plate; Pressure Plate; Support Column; and Nuts and Bolts: Carbon steel.

Channel Plates:

Verify availability of selected models if vented, double-wall units in "Type" subparagraph below are required. Retain first option for applications where heated domestic water is intended for potable purposes.

Type: [**Vented]** double-wall.

Material: Stainless steel.

Plate Thickness: Not less than [**0.0197 inch**] [**0.024 inch**] [**0.031 inch**].

Gasket Material: Butyl or acrylonitrile-butadiene rubber, suitable for potable water.

Connections: [**Stainless steel**] <**Insert material**>, suitable for potable water.

NPS 2 and Smaller: Threaded.

NPS 2-1/2 and Larger: Flanged.

Protective Shroud: Steel, covering channel plates.

Insulation: Complying with ASHRAE/IES 90.1, unless otherwise indicated, and suitable for operating temperature. Surround entire heat exchanger, except connections.

* + - * 1. Required Connections: Domestic cold water in; domestic hot water out; [**heating hot water**] [**steam**] supply in; [**heating hot water**] [**condensate return**] out.

If using more than one plate, and domestic-water heat exchanger is required on Project, delete "Capacity and Characteristics" paragraph below and schedule plate, domestic-water heat exchangers on Drawings.

* + - * 1. Capacity and Characteristics:

Heat-Exchanger Surface Area: <**Insert sq. ft.**>.

Number of Plates: <**Insert number**>.

Domestic Water:

Recovery: <Insert **gph**> at [**100 deg F**] <Insert temperature> temperature rise.

Pipe Size: <Insert **NPS**>.

Hot-Water Temperature Setting: <**Insert deg F**>.

Retain "Heating Hot-Water Supply" subparagraph or "Steam Supply" subparagraph below.

Heating Hot-Water Supply:

Inlet Temperature: <**Insert deg F**>.

Outlet Temperature: <**Insert deg F**>.

Pipe Size: <Insert **NPS**>.

Steam Supply:

Inlet Pressure: <**Insert psig**>.

Demand Rate: <Insert **lb/h**>.

Input Rating: <**Insert Btu/h**>.

Steam Inlet Pipe Size: <**Insert NPS**>.

Retain "Condensate Outlet Pipe Size" subparagraph below if retaining "Steam Supply" subparagraph above.

Condensate Outlet Pipe Size: <**Insert NPS**>.

* + - 1. DRAINLINE HEAT EXCHANGER

Drainline heat exchangers in this article do not have controls. These products are intended for residential applications, to reclaim some of the waste heat from shower drains to preheat the cold-water supply to the shower.

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13469) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[Ecodrain](http://www.specagent.com/Lookup?uid=123457132821).

[EcoInnovation Technologies](http://www.specagent.com/Lookup?uid=123457132822).

[RenewABILITY Energy, Inc](http://www.specagent.com/Lookup?uid=123457132823).

Approved equivalent.

Drainage tube is available in DWV 2, 3, and 4 inch (DN 50, DN 80, and DN 100). Domestic-water preheat coil is available in 1/2, 3/4, and 1-inch (DN 15, DN 18, and DN 25) Type L tubes. Drainage-tube unit lengths available are 24 to 96 inches in 6-inch (DN 600) increments, depending on manufacturer.

* + - * 1. Description: Drainline heat exchanger, full-size vertical or horizontal drainage tube with domestic-water preheat coil around drainage tube.

Drainage Tube: ASTM B306, Type DWV copper drainage tube of size indicated.

Domestic-Water Preheat Coil: ASTM B88, Type L copper water tube of connection size indicated attached to drainage tube.

Working-Pressure Rating: 150 psig on domestic-water supply tubing.

Standards:

All surfaces coming into contact with potable water must be NSF approved for potable water applications.

Thermal effectiveness of heat exchanger shall be certified to CSA B55.1.

Construction of heat exchanger shall be certified to CSA B55.2.

In "Capacities and Characteristics" paragraph below, drainline heat-exchanger capacity and domestic-water connection size vary with manufacturer. Coordinate with retained manufacturers.

* + - * 1. Capacities and Characteristics:

[**2 inch**] [**3 inch**] [**4 inch**] DWV Drainage Tube:

Unit Length: <Insert **inches**>.

Domestic-Water Preheat Coil Connection: [**1/2 inch**] [**3/4 inch**] [**1 inch**].

* + - 1. ACCESSORIES

Retain "Domestic-Water Compression Tanks" paragraph below only if small, non-ASME-code diaphragm tanks with a capacity of 25 gal. (95 L) or less are required. Small tanks are usually available with 150-psig (1035-kPa) working-pressure rating. Large tanks are usually available with 100-psig (690-kPa) working-pressure rating. A multiple small-tank arrangement may be used to match system pressure and volume requirements. Other compression tanks are specified in Section 221223.11 "Facility Indoor Potable-Water Storage Tanks."

* + - * 1. Domestic-Water Compression Tanks:

[Manufacturers:](http://www.specagent.com/Lookup?ulid=2432) Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

[AO Smith](http://www.specagent.com/Lookup?uid=123457132892).

[Flexcon Industries](http://www.specagent.com/Lookup?uid=123457132886).

[Honeywell International Inc](http://www.specagent.com/Lookup?uid=123457132887).

Approved equivalent.

Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air precharge to minimum system operating pressure at tank.

Construction:

Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

Interior Finish: Comply with NSF 61 barrier materials for potable water tank linings, including extending finish into and through tank fittings and outlets.

Air-Charging Valve: Factory installed.

If more than one domestic-water compression tank is required on Project, delete "Capacity and Characteristics" subparagraph below and schedule domestic-water compression tanks on Drawings.

Capacity and Characteristics:

Working Pressure Rating: [**100 psig**] [**150 psig**] <Insert value>.

Capacity Acceptable: [**2 gal.**] [**4 gal.**] [**7 gal.**] [**10 gal.**] <Insert value> minimum.

Air Precharge Pressure: <**Insert system pressure**>.

Option in "Piping-Type Heat Traps" paragraph below is not applicable if applying for LEED certification.

* + - * 1. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IES 90.1[**or ASHRAE 90.2**].
				2. Heat-Trap Fittings: ASHRAE 90.2.
				3. Combination Temperature- and Pressure-Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than heat-exchanger working-pressure rating. Select relief valves with sensing element that extends into storage tank.
				4. Pressure-Relief Valves: ASME rated and stamped. Include pressure setting less than heat-exchanger working pressure rating.
				5. Vacuum-Relief Valves: ANSI Z21.22/CSA 4.4.
			1. SOURCE QUALITY CONTROL

Retain "Factory Tests" paragraph below for factory-assembled, domestic-water heat exchangers and domestic-water heaters. Factory tests are an added cost option and may not be available from some manufacturers. Verify requirement with Director’s Representative.

* + - * 1. Factory Tests: Test and inspect domestic-water heat exchangers and domestic-water heaters specified to ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
				2. Hydrostatically test domestic-water heat exchangers and domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
				3. Domestic-water heat exchangers and domestic-water heaters will be considered defective if they do not pass tests and inspections.
				4. Prepare test and inspection reports.
1. EXECUTION
	* + 1. INSTALLATION OF DOMESTIC-WATER HEAT EXCHANGERS AND DOMESTIC-WATER HEATERS
				1. Domestic-Water Heat Exchangers and Domestic-Water Heaters Mounting: Install domestic-water heat exchangers and domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."

Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

Install anchor bolts to elevations required for proper attachment to supported equipment.

Anchor heat exchangers and heaters to substrate.

* + - * 1. Install domestic-water heat exchangers and domestic-water heaters 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.

Install shutoff valves on domestic cold-water supply piping to domestic-water heat exchangers and domestic-water heaters and on domestic-hot-water outlet piping.

Install shutoff valves on heating hot-water piping to domestic-water heat exchangers and domestic-water heaters.

Install shutoff valves on steam and condensate piping to domestic-water heat exchangers and domestic-water heaters.

Retain first paragraph below if domestic-water heat exchangers and domestic-water heaters are required to withstand seismic design loads. Insert special requirements for seismic restraints here or detail on Drawings.

* + - * 1. Install domestic-water heat exchangers and domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
				2. Install temperature- and pressure-relief valves in top portion of domestic-water storage tank shells. Use relief valves with sensing elements that extend into shells. Extend relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
				3. Install [**combination temperature- and**]pressure-relief valves in water piping for domestic-water heat exchangers and domestic-water heaters without storage. Extend relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
				4. Install domestic-water heat exchangers and domestic-water heaters drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in domestic-water piping for heat exchangers and heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
				5. Install thermometer on each domestic-water heat exchanger and domestic-water heater [**inlet and**] outlet piping, and install thermometer on each heat exchanger and heater heating-fluid[**inlet and**] outlet piping. Comply with requirements for thermometers specified in Section 220519 "Meters and Gauges for Plumbing Piping."
				6. Install pressure gauges on domestic-water heat exchanger and domestic-water heater heating-fluid piping. Comply with requirements for pressure gauges specified in Section 220519 "Meters and Gauges for Plumbing Piping."
				7. Fill domestic-water heat exchangers and domestic-water heaters with water.
				8. Charge domestic-water compression tanks with air.
			1. PIPING CONNECTIONS

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Drawings indicate general arrangement of piping, fittings, and specialties.
				2. Where installing piping adjacent to domestic-water heat exchangers and heaters, allow space for service and maintenance. Arrange piping for easy removal of heat exchangers and heaters.
			1. IDENTIFICATION
				1. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
			2. FIELD QUALITY CONTROL

Retain one of first four paragraphs below. Retain first "Testing Agency" paragraph below if Director’s Representative will hire an independent testing agency.

* + - * 1. Testing Agency: Director’s Representative will engage a qualified testing agency to perform tests and inspections.

Retain "Testing Agency" paragraph below to require Contractor to hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a Company Service Advisor to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Field Advisor to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform tests and inspections" paragraph below to require Contractor to perform tests and inspection, and retain option to require Contractor to arrange for the assistance of a Company Service Advisor.

* + - * 1. Perform tests and inspections with the assistance of a Company Field Advisor.

Retain test requirements below with any combination of paragraphs above.

* + - * 1. Tests and Inspections:

Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

* + - * 1. Domestic-water heat exchangers and domestic-water heaters will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. DEMONSTRATION
				1. Engage a Company Field Advisor to train Director’s Representative's Facility’s maintenance personnel to adjust, operate, and maintain domestic-water **[heat exchangers] [and] [instantaneous] [semi-instantaneous] [indirect-fired]** domestic-water heaters.
				2. Instruction of State Personnel: The Company Field Advisor shall instruct Director’s Representative's Facility’s maintenance personnel in the operation and maintenance of the domestic-water heater system and all accessories. **[Provide a minimum of 8 hours for on-site instruction purposes, exclusive of all pre-start-up, start-up and service call time].** **[Provide a minimum of 16 hours for on-site instruction purposes, in two 8-hour intervals, exclusive of all pre-start-up, start-up and service call time at facilities that operate multiple shifts of maintenance staff per day].**

END OF SECTION 223500