SECTION 223400
FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 GENERAL

1.01 SUMMARY

A. This Section includes the following fuel fired domestic water heaters and associated equipment:
   1. Commercial, high-efficiency, tank type gas water heaters.
   2. Domestic Water Compression Tanks

1.02 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
   1. Diagram power, signal, and control wiring.
   2. Diagram Venting configurations for both sealed combustion air intake and

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.

F. Warranty: Special warranty specified in this Section.

1.03 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Standards Compliance:
   1. Listing: The water heater will be listed ETL listed to UL 795 or ANSI Z21.10.3 -2004/CSA 4.3-2004 “Gas Water Heaters”
   2. ASME tank Construction: Fabricate and label commercial water heater tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
   3. ASHRAE 90.1 Compliant
   4. SCAQMD Rule 1146.2 for low-NOx emissions.
   5. UL Certification: Design-certified by Underwriters Laboratories Internationl, according to ANSZ21.10.3-CSA4.3 standards governing storage type water heaters.
   6. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.
      a. Comply with NSF 372, Lead Content
   7. CSD-1: “Controls and Safety Devices for Automatically Fired Boilers”
   8. ASTM G123 – 00, “Standard Test Method for Evaluation Stress Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.

D. Thermal Efficiency: Tested to the ANSI Z21.10.3 thermal efficiency test protocol (DOE 10 CFR 431)
   1. Water heaters with full rated input between 199,000 and 300,000 BTU will operate at a minimum 95.3%, at full firing rate.
   2. Water heaters with full rated input between 399,000 and 600,000 BTU will operate at a minimum 96%, at full firing rate.

1.04 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail, in materials or workmanship, within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period(s): To begin from the date as defined in Division 0:
   a. Commercial High Efficiency Gas Water Heaters:
      1) Entire Unit (Parts and Labor): Two (2) years
      2) Tank: Fifteen (15) years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
   1. WH-2 & WH-4:
      a. Basis of Design: PVI CONQUEST 50L-130A-GCML.

2.02 COMMERCIAL, HIGH-EFFICIENCY, TANK TYPE, GAS WATER HEATERS:

A. Description: Integral storage tank type, high efficiency, category IV, natural gas burning, condensing water heater, single pass down fire, vertical fire tube, design that is constructed and stamped in accordance with Section IV, Part HLW of the ASME code. Water heater will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure.

B. Storage-Tank Construction: Unlined, Duplex Stainless-Steel Alloy
   1. Tank, Combustion chamber, and fire tubes will be constructed from phase-balanced austenitic and ferritic duplex stainless steel with a chemical structure containing a minimum of 21% Chromium to prevent corrosion and mill certified per ASTM A923 Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2and ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution
   2. Tappings: Factory fabricated non-ferrous or stainless steel. Attach tappings to tank before testing.
      a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
   3. Waterside surfaces shall be welded internally utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
   4. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% post-consumer recycled materials and be 100% recyclable.

C. Factory-Installed, Storage-Tank Appurtenances:
   1. Drain Valve: Ball-type, Corrosion-resistant metal complying with ASSE 1005.
   2. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.
   3. Jacket: Steel with enameled finish.
   4. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

D. Burner: Stainless steel, Down-fired with precise air fuel ratio control for optimum efficiency requiring no special calibration, tuning, or setup and adaptive to variation in gas and vent

pressures.
1. Units of rated inputs 500mbh and higher shall employ pulse width burner modulation.

E. Heat Exchanger: Stainless steel construction matching storage tank to fully protect against corrosion due flue gas condensate. Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.

F. Temperature & Ignition Control: Integrated solid-state with graphical user interface, fault history display and digital temperature readout & adjustment. Include the following control Trim features:
1. Electronic Flame Monitoring
2. Electronic Low-Water Cutoff
3. Immersion sensor for operating control
4. Immersion UL temperature limiting device

G. Safety Controls: Automatic, immersion high-temperature-limit and low-water cutoff devices or systems. Anode draw readout for anode rod remaining life.
1. CSD-1 compliant: Including but not limited to high and low pressure switches on gas train.
2. Terminals for Remote (EPO) safety shutdown switch.

H. Fuel Gas Train: ANSI Z.21.10.3 or UL 795 compliant.
1. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.
2. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.
3. CSD-1 Compliant

I. Building Automation System Interface: BACnet IP

J. Performance:
1. Peak Thermal Efficiency: 97%
2. Burner NOx emissions will be less than 20 ppm when corrected to 3% oxygen.

K. Capacity and Characteristics:
1. Minimum Tank Capacity: 130 gals.
2. Temperature Setting: 130 deg F.
3. Fuel Gas Input: 500,000 Btu/h.
4. Gas Pressure Required at Burner: 3.5” WC minimum, 14” WC maximum.
5. Electrical Characteristics: 120V/1ph/60Hz, 11A
6. Minimum Vent Diameter: As shown on the drawings. Verify with manufacturer’s representative/vendor during submittals phase.

2.03 WATER HEATER ACCESSORIES/OPTIONS

A. Condensate trap and acid neutralization system: One per unit

B. Factory Combustion Air filtration (washable)

C. 120V plug-in pigtail power cord.

D. CSD-1 Compliant Controls

2.04 COMPRESSION TANKS

A. 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.
1. Manufacturers:
a. AMTROL Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett
d. Smith, A. O.; Aqua-Air Div.
e. State Industries, Inc.
f. Taco, Inc.
g. Watts Regulator Co.

h. Wessels Co.

2. Construction:
   a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.
3. Capacity and Characteristics:
   a. Working-Pressure Rating: 150 psig
   b. Acceptance Capacity: 11 Gal
   c. Tank Capacity: 25 Gal

2.05 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, & HANDLING

A. Heaters shall be shipped assembled and crated for shipping protection from the factory on a single skid/pallet and shall only require job site hookup to utilities. Venting, water piping, gas piping, condensate drain piping shall be field installed.

3.02 WATER HEATER INSTALLATION

A. Install water heaters on 3.5” min concrete bases.

B. Install 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 and disassembly does not require full disconnection and moving.

C. Install gas water heaters according to NFPA 54.

D. Implement and Install sealed combustion vent and air intake piping in accordance with manufacturer’s recommendations. Provide factory 6” diameter concentric vent kit for flat roof use and extend exhaust vent inner pipe to provide a minimum of 36” vertical distance between vent and intake. Intake shall be min 24” above roof. Install combustion condensate drain piping to local floor drain for indirect drain with proper air gap.

E. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

F. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

G. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

H. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, 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.

I. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater 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.

J. Install water heater 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 water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Domestic Water Piping Specialties"

for hose-end drain valves.

K. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

L. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.

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. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

N. Fill water heaters with water, bleed distribution system of air, and Charge expansion tanks with air.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: This contractor shall coordinate the engagement of a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing, documenting all factory checklist items.

B. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.05 DEMONSTRATION

A. This contractor shall coordinate the engagement of a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

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