

SECTION 22 34 00
FUEL-FIRED, DOMESTIC-WATER HEATERS AND STORAGE TANKS

PART 1 - GENERAL

1.01 REFERENCE STANDARDS

- A. ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers; 2024.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. NSF 61 - Drinking Water System Components - Health Effects; 2024.

1.02 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.03 SUMMARY

- A. Section Includes:
 - 1. Commercial, gas-fired, domestic-water heaters.
 - 2. Domestic-water heater accessories, trim for generating domestic hot potable water.
 - 3. Domestic water storage tanks

1.04 PERFORMANCE REQUIREMENTS

1.05 ACTION SUBMITTALS

- A. Product Data: For each type and size of domestic-water heater and water storage tank indicated include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 - 1. Piping diagrams applicable to each site including layout in each room, drawing in Autocad, and provided in PDF and CD electronic format at 3/8" scale. Layout shall include actual equipment supplied, all required clearances, controls, panels, pumps, valves, gauges, housekeeping pads and vents, etc.
 - 2. Product dimensions and manufacturer required clearances.
 - 3. Operating weight and dimensions
 - 4. Storage capacity
 - 5. Manufacturer furnished accessories.
 - 6. Prior to flue vent installation, engineered calculations and drawings must be submitted to Engineer to thoroughly demonstrate that size and final configuration conform to recommended size, length and footprint for each submitted water heater.
 - 7. Hot water heater rigging plans.
- B. Shop Drawings:
 - 1. Wiring Diagrams: For power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of commercial, gas-fired domestic-water heater, from manufacturer.
- B. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.
- C. Source quality-control reports.
- D. Field quality-control reports.

- E. Warranty: Sample of special warranty.
- F. ASME Stamp Certification and report to include hydrostatic test report of all new piping.

1.07 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters and storage tanks to include in emergency, operation, and maintenance manuals.

1.08 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters and storage tanks to comply with ASHRAE/IESNA 90.1.
- C. ASME Compliance:
 - 1. ASME Compliance: Condensing water heaters must be constructed in accordance with ASME Water heater and Pressure Vessel Code, Section IV (HLW) Potable Water Heaters.
 - 2. Comply with ASME CSD-1
 - 3. Storage tanks shall be compliant with ASHRAE 90.1
- D. NOx Emission Standards. When installed and operated in accordance with manufacturer's instructions, condensing water heaters shall comply with the NOx emission standards outlined in South Coast Air Quality Management District (SCAQMD), Rule 1146, 1,2.
- E. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with NYCHA and the Commissioning Agent (CxA). Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 017700 Closeout Procedures, for closeout details. Refer to
 - 1. Section 019113 Project Commissioning Requirements, for detailed commissioning requirements.

1.09 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.10 WARRANTY

- A. Standard Warranty: Water heaters shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.
- B. Warranty Period for Fire-Tube Condensing Water heaters and trim: Five (5) years
- C. The pressure vessel shall carry a 10-year from shipment, non-prorated, limited warranty against any failure due to waterside corrosion, mechanical defects, or workmanship. The heat exchanger shall carry a 10-year from shipment, prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects, or workmanship.
- D. Compression Tanks: Five (5) years.
 - 1. Water Storage Tanks: Fifteen (15) years

PART 2 - PRODUCTS

2.01 COMMERCIAL, GAS-FIRED, STORAGE, DOMESTIC-WATER HEATERS AND STORAGE TANKS

- A. Commercial, Power Vent, Gas-Fired, Storage, Domestic-Water Heaters:
1. Available Manufacturers: Approved hot water heater manufacturers must be subject to and in compliance with this specification and all other applicable contract documents. Approved Manufacturers are:
 2. AERCO
 3. Lochinvar
 4. PVI
 5. Bradford White
 6. Rheem
 7. Patterson-Kelley
 8. Lochinvar
 9. Or Approved Equal
 10. General Description: Water heater shall be direct fired, fully condensing, fire-tube design. Power burner shall have full modulation. The minimum firing rate at 50,000 /HR input shall be possible. Water heaters that have an input greater than 50,000 BTU/Hr at minimum fire will not be considered equal. The water heater shall have the capability of discharging into a positive pressure vent. Water heater thermal efficiency shall increase with decreasing load (output),
 - a. while maintaining setpoint. Water heater shall have an operational setpoint capability of 50 °F to 190 °F and shall maintain the outlet temperature within an accuracy of +/- 4 degrees Fahrenheit during load changes of up to 50% rated capacity. Heater shall operate quietly, less than 55 dba. Water heater shall be factory-fabricated, factory-assembled and factory-tested, fire-tube condensing water heater with heat exchanger sealed pressure-tight, built on a steel base, including a sealed insulated sheet metal enclosure that acts as combustion-air intake plenum, flue- gas vent, water supply, return and condensate drain connections, and controls. Each water heater shall have an ASME approved temperature/pressure relief valve with a setting of 150 psig and 210 deg. F.
 11. Heat Exchanger: The heat exchanger shall be a stainless steel heat exchanger assembly featuring stainless steel helical fire tubes, combustion chamber and dished tubesheet, with a two-pass combustion gas flow design. The materials of construction shall consist of austenitic and noble metals, and autocatalytic chemical reduction processes to provide superior corrosion resistance and performance in domestic hot water applications. The fire tubes shall be 3/4" OD, with no less than 0.035" wall thickness. The upper and lower stainless steel tubesheet shall be no less than 0.625" thick. The heat exchanger shall be welded and brazed construction. The heat exchanger shall be ASME Sect IV (HLW) stamped for a working pressure not less than 160 psig.
 12. Shell Assembly Pressure Vessel: The shell assembly pressure vessel shall have a maximum water volume of 26 gallons. The water heater water pressure drop shall not exceed 2 psig at 30 gpm. The water heater water connections shall be 2 inch NPT male connections. The shell assembly pressure vessel shall be constructed of duplex stainless steel of 0.25 inch wall thickness. Duplex stainless steel, by nature of its grain structure, offers superior protection against salt/chloride attacks compared to 300 series stainless steels. Shell/pressure vessel materials of construction other than duplex stainless steel shall not be permitted. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The shell assembly pressure vessel shall be ASME Sect IV (HLW) stamped for a working pressure not less than 160 psig.
 13. Modulating Air/Fuel Valve and Burner: The water heater burner shall be capable of up to 12-to-1 turndown for less than 750MBH input and 21-to-1 turndown for units over 1000 MBH input turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall produce less than 20 ppm of NOx corrected to 3% excess oxygen. The unit shall be certified by the South Coast Air Quality Management District

(SCAQMD) as compliant with Rule 1146.2 for water heaters and water heaters less than or equal to 2 MBTUs, and the Texas Commission on Environmental Quality (TCEQ) as being compliant with Section 117.465 for water heaters and water heaters less than or equal to 2 MBTUs. The burner shall be metal-fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A modulating air/fuel valve shall meter the air and fuel input. The modulating motor must be linked to both the gas valve body and air valve body with a single linkage. The linkage shall not require any field adjustment. A variable frequency drive (VFD), controlled cast aluminum

- a. pre-mix blower shall be used to ensure the optimum mixing of air and fuel between the air/fuel valve and the burner.
14. The exhaust manifold shall be of corrosion resistant cast aluminum with a 6-inch diameter flue connection. The exhaust manifold shall have a collecting reservoir and a gravity drain for the elimination of condensation.
15. Blower. The water heater shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.
16. Motors: Blower motors shall comply with requirements specified in Division 22 Section "Common Motor Requirements for Plumbing Equipment."
17. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require a motor to operate in the service factor range above 1.0.
18. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.

B. Controls

1. The water heater shall have an integrated water heating control that is capable of operating the unit and associated accessories including but not limited to: its pumps, valves and dampers.
2. The control shall have a 4.5 inch color touch screen display as well as six function buttons that are separate from the display. User shall have the ability to navigate the menus via touchscreen or navigation buttons. Controls not equipped with navigation button options shall not be permitted.
3. The control shall be equipped with a multi-color linear LED light to indicate the level of firing and/or air/fuel valve position.
4. The control shall display two temperatures using two dedicated three-digit seven-segment displays.
5. The control shall offer an Enable/Disable toggle switch as well as two buttons for Testing and Resetting the Low Water Cutoff.
6. The water heater control system shall be segregated into three components: Control Panel, Power Box and Input/Output Connection Box. The entire system shall be Underwriters Laboratories recognized.
7. The control panel shall consist of seven individual circuit boards using state-of-the-art surface-mount technology in a single enclosure. These circuit boards shall include:
8. A microcontroller board with integrated 4.5 inch touchscreen color display providing the user interface.
9. A 7-segment display board. This board includes two 3-digit 7-segment displays. These displays shall be used to view a variety of temperature sensor values and operating and startup function status.
10. An Interface board connects the microcontroller board to internal components using ribbon cables.
11. An electric low-water cutoff board connects with microcontroller board for the test and manual reset functions.
12. A power supply board is designed to provide the various DC voltages required by control system boards. It also acts as voltage regulator and reduce power noise.

13. An ignition and combustion board. This board controls the air/fuel valve and Safety Shutoff Valve, flame status and ignition transformer
14. A connector board used to connect all external electrical connection.
15. Each board shall be individually field replaceable.
16. The combustion safeguard/flame monitoring system shall use spark ignition and a rectification-type flame sensor.
17. The control panel hardware shall have native support for both RJ-45 and RS-485 remote communications.
18. The controls shall annunciate water heater and sensor status and include comprehensive self-diagnostic capabilities that incorporate a minimum of eight separate status messages and 52 separate fault messages.
19. Copy and download control settings using USB: To significantly reduce installation time by reducing long repetitive work, during unit startup the control shall have the capability to save units settings to a USB flash drive. Installers shall have the ability to select preconfigured unit settings from USB flash drive and download to a new unit.
20. Software update: The control shall be capable of field software updates without a need for hardware component(s) replacement. This shall be performed either using software on a USB flash drive or via Internet connection. The software update shall not require a trained technician. The software update menus shall be secured using a password level. After the software update, the control shall retain all of its prior field settings.
21. Combustion calibration: The control shall offer at least 6 calibration points. The use of less than 5 calibration points is not permitted to improve overall system efficiency under all firing rates. Each combustion calibration point shall operate with 5% to 7% O₂ levels to improve operating efficiency. Deviating away from these values shall not be acceptable.
22. The control panel shall incorporate four self-governing features designed to enhance operation in modes where it receives an external control signal by eliminating nuisance faults due to over-temperature, improper external signal or loss of external signal. These features include:
23. Setpoint High Limit: Setpoint high limit allows for a selectable maximum water heater outlet temperature and acts as temperature limiting governor. Setpoint limit is based on a PID function that automatically limits firing rate to maintain outlet temperature within a 0 to 10 degrees selectable band from the desired maximum water heater outlet temperature.
24. Setpoint Low Limit: Setpoint low limit allows for a selectable minimum operating temperature.
25. Failsafe Mode: Failsafe mode allows the water heater to switch its mode to operate from an internal setpoint if its external control signal is lost, rather than shut off. This is a selectable mode, enabling the control can to shut off the unit upon loss of external signal, if so desired.
26. Freeze Protection: Protection mode that fires the unit and activates pump controls to prevent freezing of water volume within pressure vessel. Control system continually monitors water temperatures within vessel to prevent reaching freezing conditions when unit is enabled.
27. The water heater control system shall incorporate the following additional features for enhanced external system interface:
28. System start temperature feature
29. Pump delay timer
30. Auxiliary start delay timer
31. Auxiliary temperature sensor
32. Analog output feature to enable simple monitoring of temperature setpoint, outlet temperature or fire rate
33. Remote interlock circuit
34. Delayed interlock circuit
35. Fault relay for remote fault alarm

36. Water Heater Management: the water heater control system shall incorporate native sequencing logic that would allow lead-lag functionality & sequencing between multiple water heaters operating in parallel and must have the following capabilities:
 37. Efficiently sequence 2 up to 16 units on the same system to meet the load requirement.
 38. Individual unit feed-forward logic will still be enabled for accurate temperature control equal to individual unit's specification.
 39. Operate one motorized valve per unit as an element of the load sequencing, Valves shall close with decreased load as heaters turn off, minimum of one (quantity must be selectable) must always stay open for recirculation.
 40. Automatically rotate lead/lag amongst the units on the chain and monitor run hours per unit and balance load in an effort to equalize unit run hours.
 41. Automatic bump-less transfer of manager function to next unit on the chain in case of designated manager unit failure; manager/client status should be shown on the individual unit displays.
 42. Units will default to individual control upon failure of the communications chain.
 43. Night temperature setback.
 44. Designated manager control, used to display and adjust key system parameters.
 45. Unit and Plant Status: The control shall provide a quick view of the unit status and plant status.
 46. The unit status screen shall provide temperature setpoint, all water inlet and outlet and supply air and exhaust temperature sensors' values. It shall also provide unit current and target firing rates. Additional screens shall display unit run hours, cycle count and average cycles per hour.
 47. The plant status screens shall provide plant temperature setpoint, plant water supply and current temperatures. Additionally, a status screen shall show the water heater status of each plant unit, plant firing rate.
 48. Unit and Plant event history: The manager control shall display the last 500 historical events per plant or 200 historical events for single unit installations.
 49. Each water heater shall be supplied with a factory packaged and pre-wired motorized ball valve. This valve shall be controlled by the water heater control system as an element of the integrated water heater management.
 50. Each water heater shall include an electric, single-seated combination safety shutoff valve/regulator with proof of closure switch in its gas train. Each water heater shall incorporate dual over-temperature protection with manual reset, in accordance with ASME Section IV and CSD-1.
- C. Condensate
1. Low-profile condensate neutralizing tubes. Each tube shall be suitable for no less than 12 months continuous operation or 2,000 operating hours at full condensing rate. Tubes shall be refillable;
 2. Condensate traps, manufactured from only non-corrosive materials. In order to guarantee flue gasses cannot leak into the mechanical room, the traps shall be float-type traps NO EXCEPTIONS.
- D. Venting
1. The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with positive pressure, condensing flue gas service. UL listed vents of PVC, CPVC, PP, or AI 29-4C stainless steel must be used with water heaters.
 2. The minimum exhaust vent duct size for each water heater is six-inch diameter.
 3. Combustion-Air Intake: Water heaters shall be capable of drawing combustion air from the outdoors via a metal or PVC duct connected between the water heater and the outdoors.
 4. The minimum ducted combustion air duct size for each water heater is six-inch diameter.
 5. Common Vent and Common Combustion Air must be an available option for water heater installation. Consult manufacturer for common vent and combustion air sizing.
 6. Follow guidelines specified in manufacturer's venting guide.

E. Storage Tanks

1. Available Manufacturers: Manufacturer shall be a company specializing in manufacturing the products specified in this section. The storage tanks shall be manufactured by a company that has achieved certification to the ISO 9001 Quality Management
2. Manufacturers: Acceptable manufacturers shall be subject to compliance with the requirements.
3. Approved Manufacturers are:
4. AERCO
5. Lochinvar
6. PVI
7. Bradford White
8. AO Smith
9. On tanks 250 gallons and larger, tank design will include a manway access to the tank interior. Connection sizes shall be 2" NPT for units up to and including 400 gallons, and 3" NPT for units 500 gallons and larger. Tank shall include a 1" drain valve on tanks up to and including 400 gallons, and 1 ½" drain valve on 500 gallon and larger tanks. Tank shall include a 1" NPT relief valve opening.
10. Storage-Tank Construction: ASME-code duplex stainless steel with 150-psig working-pressure rating.
11. The storage tank shall be an unlined pressure vessel constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923 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 3651-2 and 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."
12. 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.
13. All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.
14. The storage tank shall be completely factory packaged on a single skid, requiring only job site hookup to plumbing.
15. Pressure relief valve rated to 150 PSI shall be factory installed
16. 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.
17. Water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
18. Lined or plated storage tanks will not be acceptable.
19. The storage tank will not require anodes of any type and none will be used.

PART 3 – EXECUTION

3.01 INSTALLATION REQUIREMENTS

- A. The natural gas boilers and storage tanks shall be installed in accord with the drawings, specifications, codes and manufacturer's published standards.

- B. Registration of Hot Water Heaters through NYC-DEP CATS system. Each hot water heater 350,000 btu/hr or greater in capacity must be registered through the NYC-DEP CATS system. Hot water heaters 2.8 MMBtu/hr in size or greater must be registered and installed by licensed professionals and require submittal of a boiler room plan, a Performance Test Worksheet and an Inspection Request Form, and inspection as specified under H.1.b. and H.1.d. and H.1.e. above. Hot water heaters 4.2 MMBtu/hr and above require a Work Permit and all submittals outlined in H.1.a-e. Registration requirements for the hot water heaters should be verified with NYS-DEC. Registrations fees should be verified and submitted based on the CATS Fee Schedule.

3.02 CONNECTIONS

- A. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping" and 221119 "Domestic Water piping Specialties".
- B. Comply with requirements for gas piping specified in Section 231623 "Facility Natural- Gas Piping."
 - 1. Drawings indicate general arrangement of piping, fittings, and specialties.
 - 2. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters as required by the manufacturer. Arrange piping for easy removal of domestic-water heaters.
 - 3. Provide thermostat ¾" well
 - 4. Installation kit consisting of isolation valves, unions and strainer shall be factory provided.

3.03 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- D. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 2. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Section 014000 "Quality Requirements" for retesting and re-inspecting requirements.
 - 3. Prepare test and inspection reports.

3.05 SYSTEM VERIFICATION TESTING

- A. System verification testing is part of the Commissioning Process. Verification testing shall be performed by the contractor and witnessed and documented by the Commissioning Agent. Refer to Section 019113, Project Commissioning Requirements, for detailed commissioning requirements.

3.06 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas domestic-water heaters.

END OF SECTION 22 34 00 22 34 00