

HAWAII ADMINISTRATIVE RULES

TITLE 12

DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

SUBTITLE 8

HAWAII OCCUPATIONAL SAFETY AND HEALTH DIVISION

PART 10

PRESSURE RETAINING ITEMS

CHAPTER 223.1

HEATING BOILERS - STEAM HEATING BOILERS, HOT-WATER
HEATING BOILERS, HOT-WATER SUPPLY BOILERS, AND POTABLE
WATER HEATERS

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Historical Note: This chapter is based substantially upon chapter 223. [Eff 12/6/82; am 12/9/83; am and comp 12/6/90; am 7/6/98; am 11/18/12; R 12/21/19]

§12-223.1-1 Scope. Service limitations. The requirements of this section shall apply to heating boilers including steam heating boilers not exceeding fifteen (15) psig, hot-water heating boilers, hot-water supply boilers, and potable water heaters, but not limited to the following:

- (1) Steam heating boiler: steam or vapor boiler operating at pressures not exceeding fifteen (15) psig;
- (2) Hot-water heating boiler: hot-water boiler installed to operate at pressures not exceeding 160 psig or temperatures more than 250 degrees Fahrenheit;
- (3) Hot-water supply boiler: a boiler that furnishes hot water to be used externally to itself at a pressure less than or equal to 160 psig or a temperature less than or equal to 250 degrees Fahrenheit at or near the boiler outlet;
- (4) Modular boiler: a steam or hot-water heating assembly consisting of a group of individual heating boilers called modules, without intervening stop valves in between the modules, intended to be installed as a system unit, with a single inlet and single

- outlet. Modules may be under one jacket or may be individually jacketed;
- (5) Pool heater: a boiler in which no steam is generated, from which hot water is circulated to a swimming pool, hot tub, or spa and returned to the boiler, and which operates at a pressure not exceeding 160 psig or a temperature not exceeding 250 degrees Fahrenheit;
 - (6) Potable water heaters: a corrosion resistant appliance that includes the controls and safety devices to supply potable hot water at pressure not exceeding 160 psig and temperature not more than 210 degrees Fahrenheit and includes the following types:
 - (A) Fired storage water heater: a potable water heater in which water is heated by electricity, the combustion of solid, liquid, or gaseous fuels, and stores water within the same appliance;
 - (B) Indirect fired water heater: a potable water heater in which water is heated by an internal coil or heat exchanger that receives its heat from an external source. Indirect fired water heaters provide water directly to the system or store water within the same appliance; and
 - (C) Circulating water heater: a potable water heater which furnishes water directly to the system or to a separate storage tank. Circulating water heaters may be either natural or forced flow; and
 - (7) Modular water heaters: a hot-water heating assembly consisting of a group of individual water heaters called modules having an aggregate input value greater than 200,000 Btu per hour (58.6 KW), with or without intervening stop valves in between the modules, intended to be installed as a system unit, with a single inlet and single outlet. Modules may be under one jacket or

may be individually jacketed. [Eff and comp
12/21/19; comp SEP - 8 2024] (Auth: HRS
§397-4) (Imp: HRS §397-4)

12-223.1-2 General requirements for heating

boilers. (a) The following shall apply to all heating
boilers:

- (1) All heating boilers in operation in this jurisdiction shall have a current and valid operating permit issued to a specific location by the department;
- (2) Changes in location or ownership shall require department notification and may require reinspection;
- (3) Heating boilers shall bear the ASME Code Symbol Stamp "H", "HLW" or ASME certification mark with "H", "HLW" designator and the NB registration number;
- (4) ASME and NB stamping shall be legible and not be concealed by insulation or paint; and
- (5) Upon completion of the installation of a new heating boiler, it shall be marked by the inspector employed by the department with a state serial number, consisting of letters and figures to be not less than 5/16 inch in height and arranged as HHB####-Year.

(b) Steam heating boilers not in use for a period of one year or more, for any reason, shall be inspected internally and externally before being placed into operation.

(c) Replacement of an existing heating boiler shall be in accordance with the requirements for new heating boiler installations.

(d) Replacement of a heating boiler at an existing location with a used or secondhand boiler shall comply with the requirements of new heating boiler installations. The following shall apply to used or secondhand heating boilers:

- (1) Used or secondhand heating boilers when installed in this jurisdiction, shall be

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equipped with fittings and appurtenances that comply with new installations; and

- (2) Weld repairs, alterations, and inspection records shall be submitted with the installation application for used or second-hand heating boilers.

(e) Replacement or repairs to boiler fittings, appurtenances or appliances, controls and safety devices, shall comply with the requirements for new installations and applicable ASME BPVC and NBIC sections.

(f) Galvanized pipe shall not be used for steam supply and blowdown piping.

(g) State specials: applicable provisions include sections 12-220-2(b) and 12-220-16(e)(6). [Eff and comp 12/21/19; am and comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

12-223.1-3 Responsibility of owners and users.

The following are requirements of owners and users:

- (1) The owner or user of the pressure retaining item is responsible for ensuring that all equipment meets all the requirements of the department at the point of installation including licensing, registration, and certification of those performing installations. The department may require additional safety standards and when a conflict arises, the rules of the department shall prevail;
- (2) Owners or users shall ensure heating boilers are operated only with a valid operating permit. The operation of a heating boiler with an expired operating permit is not allowed and may be subject to penalties as described in this part. Changes in location or ownership shall require notification of the department and may require reinspection;
- (3) Owners or users shall ensure operating permit renewal inspections are completed prior to the permit expiration date. It is the

responsibility of the owner or user to schedule boiler permit renewal inspections. Permit renewal inspections shall include boiler shutdown, dismantling, internal inspection where applicable, and testing of controls and safety devices;

- (4) Additional inspection requirements may be conducted at the inspector's discretion, e.g., internal inspections, pressure tests, and non-destructive exams (NDEs);
- (5) Request for the extension of the operating permit expiration date may be considered for valid reasons by submitting a written request to the chief boiler inspector;
- (6) The unavailability of the special inspector to conduct inspections is not a valid reason for requesting permit extensions; deputy inspectors may perform the inspection in the absence of the special inspectors;
- (7) When a boiler task is required, it is the owner or the owner's designee that is expected to perform such task, however, the owner retains responsibility for compliance; and
- (8) Owners or users are responsible to ensure compliance with the preventive maintenance requirements as specified in 12-223.1-14. [Eff and comp 12/21/19; comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

§12-223.1-4 Inspections. (a) Initial heating boiler acceptance inspections shall be conducted and witnessed by the chief boiler inspector or a deputy inspector designee. The initial inspection shall include internal inspection where construction permits, post-installation pressure test, and operational testing of controls and safety devices in accordance with ASME CSD-1, NBIC, and this chapter by the installer, contractor, or owner.

(b) Permit renewal inspections. The following shall apply to permit renewal inspections:

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- (1) Steam or vapor heating boilers shall have an external inspection every two years, or where construction permits, an internal inspection at the discretion of the inspector;
- (2) Steam or vapor heating boilers with a heating surface greater than twenty (20) square feet and less than or equal to one hundred (100) square feet shall be internally inspected at least every four years;
- (3) Steam or vapor heating boilers with any one of the following criteria: a manway, a Btu per hour input greater than 400,000, or a heating surface greater than one hundred (100) square feet, shall be internally inspected annually. They shall be externally inspected and operationally tested approximately six months after the internal inspection;
- (4) Hot-water heating, hot-water supply heating boilers, potable water heaters (including modular installations) shall have an external inspection every two years, or where construction permits, an internal inspection at the discretion of the inspector;
- (5) Pool heaters shall have an external inspection every two years;
- (6) State special: see sections 12-220-2(b) and 12-220-16(e) (6); and
- (7) Based upon actual service conditions by the owner or user of the operating equipment, the department may, at its discretion, permit variations in the inspection frequency requirements. [Eff and comp 12/21/19; am and comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

12-223.1-5 Technical installation requirements.

- (a) General requirements. The following shall apply to all heating boilers:
 - (1) Heating boilers shall be installed pursuant to sections 12-220-2, 12-220-2.1, 12-220-5, 12-220-6, 12-220-15, and this chapter;

- (2) Owners and users shall adhere to the heating boiler installation requirements as specified in the NBIC Part 1;
 - (3) An application for installation permit shall be submitted to the department prior to commencement of work;
 - (4) Heating boilers installed without an installation permit may be subject to penalties of up to \$10,000 per day pursuant to section 12-220-22;
 - (5) Only contractors holding a valid Hawaii C-4 contractor license shall install steam heating, hot-water heating, hot-water supply heating boilers, and water heaters with more than 200,000 Btu per hour (58.6 KW);
 - (6) Contractors holding a valid Hawaii C-37 contractor license may install water heaters up to 200,000 Btu per hour; and
 - (7) All heating boilers shall be equipped with controls and safety devices based upon the Btu per hour burner input, as specified in the original code of construction.
- (b) First acceptance inspection and certification requirements shall include the following:
- (1) The owner and contractor shall comply with section 12-220-2.1 and upon completion of the installation, shall arrange for an acceptance inspection by the department;
 - (2) For heating boilers subject to ASME CSD-1 requirements, the installing contractor shall operationally test the controls and safety devices prior to scheduling the first acceptance inspection with the department, and record the results on form CG-500, ASME CSD-1 (Exhibit 4, titled, "Manufacturer's/Installing Contractor's Report for ASME CSD-1", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter), and file a copy with the department;
 - (3) Additional inspection requirements may be conducted at the inspector's discretion, e.g. internal inspections, pressure tests, and non-destructive exams (NDEs);

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- (4) The installing contractor shall test the boiler as directed and witnessed by the chief boiler inspector or designated deputy inspector;
 - (5) The chief boiler inspector or designated deputy inspector shall conduct the first data inspection, acceptance, and mark the state serial number on the heating boiler pursuant to section 12-220-29.1; and
 - (6) The installer shall complete and certify the NB Boiler Installation Report I-1 (NB-365, see Exhibit 3, titled, "Form I-1 Report of Boiler Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter), after the completion, inspection, and acceptance of the installation by an inspector employed by the department. The NB Boiler Installation Report I-1 shall be submitted to the owner and the department.
- (c) The following shall apply to heating boiler clearances:
- (1) Heating boilers shall have a minimum distance of at least thirty-six (36) inches between the top of the heating boiler and any overhead structure and at least thirty-six (36) inches between all sides of the heating boiler and adjacent walls, structures, or other equipment. Heating boilers with manholes shall have at least eighty-four (84) inches of clearance between the manhole opening and any wall, ceiling, piping, or other equipment that may prevent a person from entering the heating boiler. Alternative clearances in accordance with the manufacturer's recommendations are subject to acceptance by the department;
 - (2) Modular heating boilers that require individual units to be set side by side, front to back, or by stacking shall provide clearances in accordance with the manufacturer's recommendations and subject to acceptance by the department;
 - (3) Heating boilers shall be located so that adequate space is provided for proper

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- (4) Modular boiler: a steam or hot-water heating assembly consisting of a group of individual heating boilers called modules, without intervening stop valves in between the modules, intended to be installed as a system unit, with a single inlet and single

- outlet. Modules may be under one jacket or may be individually jacketed;
- (5) Pool heater: a boiler in which no steam is generated, from which hot water is circulated to a swimming pool, hot tub, or spa and returned to the boiler, and which operates at a pressure not exceeding 160 psig or a temperature not exceeding 250 degrees Fahrenheit;
 - (6) Potable water heaters: a corrosion resistant appliance that includes the controls and safety devices to supply potable hot water at pressure not exceeding 160 psig and temperature not more than 210 degrees Fahrenheit and includes the following types:
 - (A) Fired storage water heater: a potable water heater in which water is heated by electricity, the combustion of solid, liquid, or gaseous fuels, and stores water within the same appliance;
 - (B) Indirect fired water heater: a potable water heater in which water is heated by an internal coil or heat exchanger that receives its heat from an external source. Indirect fired water heaters provide water directly to the system or store water within the same appliance; and
 - (C) Circulating water heater: a potable water heater which furnishes water directly to the system or to a separate storage tank. Circulating water heaters may be either natural or forced flow; and
 - (7) Modular water heaters: a hot-water heating assembly consisting of a group of individual water heaters called modules having an aggregate input value greater than 200,000 Btu per hour (58.6 KW), with or without intervening stop valves in between the modules, intended to be installed as a system unit, with a single inlet and single outlet. Modules may be under one jacket or

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12-223.1-2 General requirements for heating

boilers. (a) The following shall apply to all heating
boilers:

- (1) All heating boilers in operation in this jurisdiction shall have a current and valid operating permit issued to a specific location by the department;
- (2) Changes in location or ownership shall require department notification and may require reinspection;
- (3) Heating boilers shall bear the ASME Code Symbol Stamp "H", "HLW" or ASME certification mark with "H", "HLW" designator and the NB registration number;
- (4) ASME and NB stamping shall be legible and not be concealed by insulation or paint; and
- (5) Upon completion of the installation of a new heating boiler, it shall be marked by the inspector employed by the department with a state serial number, consisting of letters and figures to be not less than 5/16 inch in height and arranged as HHB####-Year.

(b) Steam heating boilers not in use for a period of one year or more, for any reason, shall be inspected internally and externally before being placed into operation.

(c) Replacement of an existing heating boiler shall be in accordance with the requirements for new heating boiler installations.

(d) Replacement of a heating boiler at an existing location with a used or secondhand boiler shall comply with the requirements of new heating boiler installations. The following shall apply to used or secondhand heating boilers:

- (1) Used or secondhand heating boilers when installed in this jurisdiction, shall be

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equipped with fittings and appurtenances that comply with new installations; and

- (2) Weld repairs, alterations, and inspection records shall be submitted with the installation application for used or second-hand heating boilers.

(e) Replacement or repairs to boiler fittings, appurtenances or appliances, controls and safety devices, shall comply with the requirements for new installations and applicable ASME BPVC and NBIC sections.

(f) Galvanized pipe shall not be used for steam supply and blowdown piping.

(g) State specials: applicable provisions include sections 12-220-2(b) and 12-220-16(e)(6). [Eff and comp 12/21/19; am and comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

12-223.1-3 Responsibility of owners and users.

The following are requirements of owners and users:

- (1) The owner or user of the pressure retaining item is responsible for ensuring that all equipment meets all the requirements of the department at the point of installation including licensing, registration, and certification of those performing installations. The department may require additional safety standards and when a conflict arises, the rules of the department shall prevail;
- (2) Owners or users shall ensure heating boilers are operated only with a valid operating permit. The operation of a heating boiler with an expired operating permit is not allowed and may be subject to penalties as described in this part. Changes in location or ownership shall require notification of the department and may require reinspection;
- (3) Owners or users shall ensure operating permit renewal inspections are completed prior to the permit expiration date. It is the

responsibility of the owner or user to schedule boiler permit renewal inspections. Permit renewal inspections shall include boiler shutdown, dismantling, internal inspection where applicable, and testing of controls and safety devices;

- (4) Additional inspection requirements may be conducted at the inspector's discretion, e.g., internal inspections, pressure tests, and non-destructive exams (NDEs);
- (5) Request for the extension of the operating permit expiration date may be considered for valid reasons by submitting a written request to the chief boiler inspector;
- (6) The unavailability of the special inspector to conduct inspections is not a valid reason for requesting permit extensions; deputy inspectors may perform the inspection in the absence of the special inspectors;
- (7) When a boiler task is required, it is the owner or the owner's designee that is expected to perform such task, however, the owner retains responsibility for compliance; and
- (8) Owners or users are responsible to ensure compliance with the preventive maintenance requirements as specified in 12-223.1-14. [Eff and comp 12/21/19; comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

§12-223.1-4 Inspections. (a) Initial heating boiler acceptance inspections shall be conducted and witnessed by the chief boiler inspector or a deputy inspector designee. The initial inspection shall include internal inspection where construction permits, post-installation pressure test, and operational testing of controls and safety devices in accordance with ASME CSD-1, NBIC, and this chapter by the installer, contractor, or owner.

(b) Permit renewal inspections. The following shall apply to permit renewal inspections:

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- (1) Steam or vapor heating boilers shall have an external inspection every two years, or where construction permits, an internal inspection at the discretion of the inspector;
- (2) Steam or vapor heating boilers with a heating surface greater than twenty (20) square feet and less than or equal to one hundred (100) square feet shall be internally inspected at least every four years;
- (3) Steam or vapor heating boilers with any one of the following criteria: a manway, a Btu per hour input greater than 400,000, or a heating surface greater than one hundred (100) square feet, shall be internally inspected annually. They shall be externally inspected and operationally tested approximately six months after the internal inspection;
- (4) Hot-water heating, hot-water supply heating boilers, potable water heaters (including modular installations) shall have an external inspection every two years, or where construction permits, an internal inspection at the discretion of the inspector;
- (5) Pool heaters shall have an external inspection every two years;
- (6) State special: see sections 12-220-2(b) and 12-220-16(e) (6); and
- (7) Based upon actual service conditions by the owner or user of the operating equipment, the department may, at its discretion, permit variations in the inspection frequency requirements. [Eff and comp 12/21/19; am and comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

12-223.1-5 Technical installation requirements.

- (a) General requirements. The following shall apply to all heating boilers:
 - (1) Heating boilers shall be installed pursuant to sections 12-220-2, 12-220-2.1, 12-220-5, 12-220-6, 12-220-15, and this chapter;

- (2) Owners and users shall adhere to the heating boiler installation requirements as specified in the NBIC Part 1;
 - (3) An application for installation permit shall be submitted to the department prior to commencement of work;
 - (4) Heating boilers installed without an installation permit may be subject to penalties of up to \$10,000 per day pursuant to section 12-220-22;
 - (5) Only contractors holding a valid Hawaii C-4 contractor license shall install steam heating, hot-water heating, hot-water supply heating boilers, and water heaters with more than 200,000 Btu per hour (58.6 KW);
 - (6) Contractors holding a valid Hawaii C-37 contractor license may install water heaters up to 200,000 Btu per hour; and
 - (7) All heating boilers shall be equipped with controls and safety devices based upon the Btu per hour burner input, as specified in the original code of construction.
- (b) First acceptance inspection and certification requirements shall include the following:
- (1) The owner and contractor shall comply with section 12-220-2.1 and upon completion of the installation, shall arrange for an acceptance inspection by the department;
 - (2) For heating boilers subject to ASME CSD-1 requirements, the installing contractor shall operationally test the controls and safety devices prior to scheduling the first acceptance inspection with the department, and record the results on form CG-500, ASME CSD-1 (Exhibit 4, titled, "Manufacturer's/Installing Contractor's Report for ASME CSD-1", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter), and file a copy with the department;
 - (3) Additional inspection requirements may be conducted at the inspector's discretion, e.g. internal inspections, pressure tests, and non-destructive exams (NDEs);

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- (4) The installing contractor shall test the boiler as directed and witnessed by the chief boiler inspector or designated deputy inspector;
 - (5) The chief boiler inspector or designated deputy inspector shall conduct the first data inspection, acceptance, and mark the state serial number on the heating boiler pursuant to section 12-220-29.1; and
 - (6) The installer shall complete and certify the NB Boiler Installation Report I-1 (NB-365, see Exhibit 3, titled, "Form I-1 Report of Boiler Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter), after the completion, inspection, and acceptance of the installation by an inspector employed by the department. The NB Boiler Installation Report I-1 shall be submitted to the owner and the department.
- (c) The following shall apply to heating boiler clearances:
- (1) Heating boilers shall have a minimum distance of at least thirty-six (36) inches between the top of the heating boiler and any overhead structure and at least thirty-six (36) inches between all sides of the heating boiler and adjacent walls, structures, or other equipment. Heating boilers with manholes shall have at least eighty-four (84) inches of clearance between the manhole opening and any wall, ceiling, piping, or other equipment that may prevent a person from entering the heating boiler. Alternative clearances in accordance with the manufacturer's recommendations are subject to acceptance by the department;
 - (2) Modular heating boilers that require individual units to be set side by side, front to back, or by stacking shall provide clearances in accordance with the manufacturer's recommendations and subject to acceptance by the department;
 - (3) Heating boilers shall be located so that adequate space is provided for proper

- operation, maintenance, and inspection of equipment and appurtenances, which shall include the removal of tubes if applicable;
- (4) Heating boilers with a top opening manhole shall have at least eighty-four (84) inches of unobstructed clearance above the manhole to the ceiling of the equipment room; and
 - (5) Heating boilers with a bottom opening used for inspection or maintenance shall have at least twelve (12) inches of unobstructed clearance.
- [Eff and comp 12/21/19; am and comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

12-223.1-6 Controls and safety devices. Where applicable, steam heating, hot-water heating, and hot-water supply heating boilers, shall be equipped with controls and safety devices as specified in the original code of construction, and in accordance with ASME CSD-1. [Eff and comp 12/21/19; comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

- 12-223.1-7 Instruments, fittings, and controls.**
- (a) The following shall apply to steam heating boilers:
 - (1) Gages. The following shall apply to gages:
 - (A) Each steam boiler shall have a steam gage, or a compound steam gage connected to its steam space or to its water column or to its steam connection. The gage or connection shall contain a siphon or equivalent device that will develop and maintain a water seal that will prevent steam from entering the gage tube. The connection shall be so arranged that the gage cannot be shut off from the boiler except by a cock placed in the pipe at the gage and provided with a tee-handle or lever-handle arranged to be parallel to the pipe in which it is located when

the cock is open. The connections to the boiler shall be not less than NPS 1/4. Where steel or wrought iron pipe or tubing is used, the connection and external siphon shall be not less than NPS 1/2. The minimum size of a siphon, if used, shall be NPS 1/4. Ferrous and nonferrous tubing having inside diameters at least equal to that of standard pipe sizes listed above may be substituted for pipe; and

- (B) The scale on the dial of a steam boiler gage shall be graduated to not less than thirty (30) psig nor more than sixty (60) psig. The travel of the pointer from zero (0) psig to thirty (30) psig pressure shall be at least three (3) inches;
- (2) Water gage glasses. The following shall apply to water gage glasses:
- (A) Each steam boiler shall have one or more water-gage glasses attached to the water column or boiler by means of valved fittings not less than NPS 1/2, with the lower fitting provided with a drain valve of a type having an unrestricted drain opening not less than NPS 1/4 to facilitate cleaning. Gage glass replacement shall be possible under pressure. Water glass fittings may be attached directly to a boiler. Heating boilers having an internal vertical height of less than ten (10) inches should be equipped with a water level indicator of the glass bulls-eye type provided the indicator is of sufficient size to show the water at both normal operating and low-water cutoff levels;
 - (B) The lowest visible part of the water-gage glass shall be at least one (1) inch above the lowest permissible water level recommended by the boiler manufacturer. With the boiler operating at this lowest permissible water level, there shall be

- no danger of overheating any part of the boiler;
- (C) In electric heating boilers of the submerged electrode type, the water-gage glass shall be so located to indicate the water levels both at startup and under maximum steam load conditions as established by the manufacturer;
 - (D) In electric heating boilers of the resistance element type, the lowest visible part of the water gage shall be located at least one (1) inch above the lowest permissible water level specified by the manufacturer. Each electric boiler of this type shall also be equipped with an automatic low-water cutoff on each boiler so located as to automatically cut off the power supply to the heating elements before the surface of the water falls below the visible part of the glass;
 - (E) Tubular water glasses on electric heating boilers having a normal water content not exceeding 100 gallons shall be equipped with a protective shield; and
 - (F) Transparent material other than glass may be used for the water gage provided that the material will remain transparent and has proved suitable for the pressure, temperature, and corrosive conditions expected in service;
- (3) Water column and water level control pipes. The following shall apply to water column and water level control pipes:
- (A) The minimum size of ferrous or nonferrous pipes connecting a water column to a steam boiler shall be NPS 1. No outlet connections, except for damper regulator, feedwater regulator, steam gages, or apparatus that does not permit the escape of any steam or water except for manually operated blowdown, shall be attached to a water column or the piping connecting a

- water column to a boiler for introduction of feedwater into a boiler. If the water column, gage glass, low-water fuel cutoff, or other water level control device is connected to the boiler by pipe and fittings, no shutoff valves of any type shall be placed in such pipe and a cross or equivalent fitting to which a drain valve and piping may be attached shall be placed in the water piping connection at every right angle turn to facilitate cleaning and inspection. The water column drain pipe and valve shall be not less than 3/4-inch diameter; and
- (B) The steam connections to the water column of a horizontal firetube wrought boiler shall be taken from the top of the shell or the upper part of the head, and the water connection shall be taken from a point not above the center line of the shell. For a cast-iron boiler, the steam connection to the water column shall be taken from the top of an end section or the top of the steam header, and the water connection shall be made on an end section not less than six (6) inches below the bottom connection to the water-gage glass;
- (4) Pressure control. The following shall apply to pressure control:
- (A) Each automatically fired steam boiler shall be protected from overpressure by two pressure-operated controls. Each individual steam boiler or each system of commonly connected steam heating boilers shall have a control that will cut off the fuel supply when the steam pressure reaches an operating limit, which shall be less than the maximum allowable pressure;
- (B) Each individual automatically fired steam boiler shall have a safety limit control, with a manual reset that will cut off the

fuel supply to prevent steam pressure from exceeding the fifteen (15) psig maximum allowable working pressure of the boiler. Each control shall be constructed to prevent a pressure setting above fifteen (15) psig;

- (C) Shutoff valves of any type shall not be placed in the steam pressure connection between the boiler and the controls described in subparagraphs (A) and (B). These controls shall be protected with a siphon or equivalent means of maintaining a water seal that will prevent steam from entering the control. The connections to the boiler shall not be less than NPS 1/4 for lengths up to five (5) feet, but where steel or wrought iron pipe or tubing is used, they shall not be less than NPS 1/2 for lengths up to five (5) feet, and not less than NPS 1 for lengths over five (5) feet. The minimum size of an external siphon shall be NPS 1/4 or 3/8 inch outside diameter nonferrous tubing. For manifold connections, the minimum size shall be as specified in the original code of construction; and
- (D) Pressure controls should have separate connections, however, manifolding is permitted. When multiple pressure controls are connected to the boiler with a common manifold, the connection at the boiler up to and including the entire manifold, for pipe of nonferrous material, shall not be less than NPS 1/2 for lengths up to five (5) feet, and not less than NPS 3/4 for lengths over five (5) feet. For manifolds using ferrous material, the connection at the boiler up to and including the entire manifold shall not be less than NPS 3/4 for lengths up to five (5) feet, and not less than NPS 1-1/4 for lengths over five (5) feet. Individual controls are to be piped

- from the manifold according to the provisions of subparagraph (C);
- (5) Automatic low-water fuel cutoff and water feeding devices. The following shall apply to automatic low-water fuel cutoff and water feeding devices:
- (A) Each automatically fired steam boiler shall have an automatic low-water fuel cutoff. The low-water fuel cutoffs must be located to automatically cut off the fuel supply when the surface of the water falls to a level not lower than the lowest visible part of the water-gage glass. If a water feeding device is installed, it shall be so constructed that the water inlet valve cannot feed water into the boiler through the float chamber and so located as to supply requisite feedwater;
- (B) Such a fuel cutoff or water feeding device may be attached directly to a boiler. A fuel cutoff or water feeding device may also be installed in the tapped openings available for attaching a water glass directly to a boiler, provided the connections are made to the boiler with nonferrous tees or Y fittings not less than NPS 1/2 between the boiler and water glass so that the water glass is attached directly and as close as possible to the boiler; the run of the tee or Y-fitting shall take the water glass fittings, and the side outlet or branch of the tee or Y-fittings shall take the fuel cutoff or water feeding device. The ends of all nipples shall be reamed to full-size diameter;
- (C) In addition to the requirements in subparagraphs (A) and (B), a secondary low-water fuel cutoff with manual reset shall be provided on each automatically fired steam boiler; and

- (D) Fuel cutoffs and water feeding devices embodying a separate chamber shall have a vertical drain pipe and a blowoff valve not less than NPS 3/4, located at the lowest point in the water equalizing pipe connections so that the chamber and the equalizing pipe can be flushed and the device tested.

(b) Hot-water heating or hot-water supply boilers. The following shall apply to hot-water heating or hot-water supply boilers:

- (1) Pressure or altitude gages:
 - (A) Each hot-water heating or hot-water supply boiler shall have a pressure or altitude gage connected to it or to its flow connection in such a manner that it cannot be shut off from the boiler except by a cock with tee or lever handle, placed on the pipe near the gage. The handle of the cock shall be parallel to the pipe in which it is located when the cock is open;
 - (B) The scale on the dial of the pressure or altitude gage shall be graduated approximately to not less than one and a half (1-1/2) nor more than three and a half (3-1/2) times the pressure at which the safety relief valve is set; and
 - (C) Piping or tubing for pressure or altitude gage connections shall be of nonferrous metal when smaller than NPS 1;
- (2) Thermometers: each hot-water heating or hot-water supply boiler shall have a thermometer so located and connected that it shall be easily readable. The thermometer shall be so located that it shall always indicate the temperature of the water in the boiler at or near the outlet;
- (3) Temperature controls. Each automatically fired hot-water heating or hot-water supply boiler shall be protected from over-temperature by two temperature-operated controls. The following shall apply to automatically fired

hot-water heating and hot-water supply boilers:

- (A) Each individual hot-water heating or hot-water supply boiler or each system of commonly connected heating boilers shall have at least one control that will cut off the fuel supply when the water temperature reaches an operating limit, which shall be less than the maximum allowable temperature; and
 - (B) Each individual automatically fired hot-water heating or hot-water supply boiler shall have a safety limit control with manual reset that will cut off the fuel supply to prevent the water temperature from exceeding the maximum allowable temperature at the boiler outlet;
 - (C) Each operating and safety limit control shall have its own sensing element and operating switch; and
 - (D) Alternately, integrated controls with multiple sensors may be used to meet the requirements of subparagraphs (A) and (B);
- (4) Low-water fuel cutoff. The following shall apply to automatically fired hot-water heating boilers:
- (A) Each automatically fired hot-water heating boiler shall have an automatic low-water fuel cutoff with manual reset. The low-water fuel cutoff shall be designed for hot-water service, and it shall be so located as to automatically cut off the fuel supply when the surface of the water falls to the level established in subparagraph (B);
 - (B) As there is no normal waterline to be maintained in a hot-water boiler, any location of the low-water fuel cutoff above the lowest safe permissible water level established by the boiler manufacturer is satisfactory;

- (C) In lieu of the requirements for low-water fuel cutoffs in subparagraph (A), heating boilers requiring forced circulation to prevent overheating of the tubes, coils, or vessel, shall have an accepted flow-sensing or temperature-sensing device to prevent burner operation at a flow rate inadequate to protect the boiler unit against overheating at all allowable firing rates. This safety control(s) shall shut down the burner and prevent restarting until an adequate flow is restored and shall be independent of all other controls; and
 - (D) A means shall be provided for testing the operation of the external low-water fuel cutoff without resorting to draining the entire system. Such means shall not render the device inoperable except as follows: if the means temporarily isolates the device from the boiler during this testing, it shall automatically return to its normal position. The connection may be so arranged that the device cannot be shut off from the boiler except by a cock placed at the device and provided with a tee or lever-handle arranged to be parallel to the pipe in which it is located when the cock is open;
- (c) Potable water heaters. The following shall apply to potable water heaters:
- (1) Temperature controls. The following shall apply to the temperature controls of potable water heaters:
 - (A) Each individual automatically fired water heater, in addition to the operating control used for normal water heater operation, shall have a separate high limit temperature actuated combustion control that will automatically cut off the fuel supply. The temperature range of the high limit temperature actuated

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- control shall not allow a setting over 210 degrees Fahrenheit;
- (B) Gas-fired water heaters: the high limit temperature control when actuated shall shut off the fuel supply with a shutoff means other than the operating control valve. Separate valves may have a common body;
 - (C) Electrically heated water heaters: the high limit temperature control when actuated shall cut off all power to the operating controls;
 - (D) Oil-fired water heaters: the high limit temperature control when actuated shall cut off all current flow to the burner mechanism; and
 - (E) Indirect water heating systems: the high limit temperature control when activated shall cut off the source of heat;
- (2) Pressure or altitude gages. The following shall apply to pressure or altitude gages:
- (A) Each potable water heater shall have a pressure or altitude gage connected to it or to its flow connection in such a manner that it cannot be shut off from the boiler except by a cock with tee or lever handle placed on the pipe near the gage. The handle of the cock shall be parallel to the pipe in which it is located when the cock is open;
 - (B) The scale on the dial of the pressure or altitude gage shall be graduated approximately to not less than one and a half (1-1/2) nor more than three (3) times the maximum allowable working pressure; and
 - (C) Piping or tubing for pressure or altitude gage connections shall be of nonferrous metal when smaller than 1-inch pipe size;
- (3) Thermometers: each installed water heater shall have a thermometer so located and

connected that it shall be easily readable. The thermometer shall be so located that it shall always indicate the temperature of the water in the water heater at or near the outlet; and

- (4) Flow-sensing device: potable water heaters requiring forced circulation to prevent overheating of the tubes, coils, or vessel should have an acceptable flow-sensing device or temperature-sensing device to prevent burner operation at a flow rate inadequate to protect the water heater unit against overheating at all allowable firing rates. This safety controls shall shut down the burner and prevent restarting until an adequate flow is restored and shall be independent of all other controls.
[Eff and comp 12/21/19; am and comp SEP - 8 2024] (Auth: HRS §397-4)
(Imp: HRS §397-4)

12-223.1-8 Modular steam heating, modular hot-water heating boilers, and modular water heaters. (a) Individual modules. The following shall apply to individual modules:

- (1) The individual modules shall comply with all the requirements of the code of construction and this subsection. The individual modules shall be limited to a maximum input of 400,000 Btu per hour (117 kw/hr) for gas, 3 gallons/hour (11.4 l/hr) for oil, or 117 kw for electricity;
- (2) Each module of a modular steam heating boiler shall be equipped with a:
- (A) Safety valve, see section 12-223.1-9(a)(1);
 - (B) Blowoff valve, see section 12-223.1-13(o)(1); and
 - (C) Drain valve, see section 12-223.1-13(o)(2); and

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- (3) Each module of a modular hot-water heating boiler shall be equipped with a:
 - (A) Safety relief valve, see section 12-223.1-9(a)(2); and
 - (B) Drain valve, see section 12-223.1-13(o)(2).
- (b) Assembled Modular Heating boilers. The following shall apply to assembled modular heating boilers:
 - (1) The individual modules shall be manifolded together at the job site without any intervening valves;
 - (2) The assembled modular steam heating boiler shall also be equipped with a:
 - (A) Feedwater connection, see Exhibit 5, titled, "Steam Boilers in Battery - Pumped Return Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter, and Exhibit 6, titled, "Steam Boilers in Battery - Gravity Return Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter; and
 - (B) Return pipe connection, see Exhibit 5, titled, "Steam Boilers in Battery - Pumped Return Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter, and Exhibit 6, titled, "Steam Boilers in Battery - Gravity Return Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter; and
 - (3) The assembled modular hot-water boiler shall also be equipped with a:
 - (A) Makeup water connection, see Exhibit 7, titled, "Hot Water Boilers in Battery Acceptable Piping Installation", dated October 1, 2023, which is made a part of

this chapter and located at the end of this chapter;

- (B) Provision for thermal expansion, see Exhibit 7, titled, "Hot Water Boilers in Battery Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter, and Exhibit 8, titled, "Expansion Tank Capacities for Gravity Hot-Water Systems", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter; and
- (C) Stop valves (treating the assembled modular boiler as a single unit), see Exhibit 7, titled, "Hot Water Boilers in Battery Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter.

(c) Modular hot-water heating boilers. The following shall apply to modular hot-water heating boilers:

- (1) Each module of a modular hot-water heating boiler shall be equipped with a:
 - (A) Pressure or altitude gage, see section 12-223.1-7(b)(1);
 - (B) Thermometer, see section 12-223.1-7(b)(2); and
 - (C) Temperature control, see section 12-223.1-7(b)(3)(A); and
- (2) The assembled modular hot-water heating boiler shall be equipped with a:
 - (A) Temperature control, see 12-223.1-7(b)(3)(B); and
 - (B) Low-water fuel cutoff, see 12-223.1-7(b)(4).

(d) Modular steam heating boilers. The following shall apply to modular steam heating boilers:

- (1) Each module of a modular steam boiler shall be equipped with a:
 - (A) Steam gage, see section 12-223.1-7(a)(1);

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- (B) Water-gage glass, see section 12-223.1-7(a)(2);
 - (C) Pressure control, see section 12-223.1-7(a)(4)(A); and
 - (D) Low-water cutoff, see section 12-223.1-7(a)(5); and
- (2) The assembled modular steam heating boiler shall also be equipped with a pressure control, see section 12-223.1-7(a)(4)(B).
- (e) Modular water heaters. The individual modules shall comply with all the requirements of the code of construction and this paragraph. Each module of a modular water heater shall be equipped with a:
- (1) Safety relief valve, see section 12-223.1-9(a)(3);
 - (2) Drain valve, see section 12-223.1-13(o)(2);
 - (3) Pressure or altitude gage, see section 12-223.1-7(c)(2);
 - (4) Thermometer, see section 12-223.1-7(c)(3);
 - (5) Temperature control, see section 12-223.1-7(c)(1); and
 - (6) Flow-sensing device, see section 12-223.1-7(c)(4).
- (f) Assembled modular water heaters having an aggregate input value greater than 200,000 Btu per hour or aggregate water containing capacity greater than 120 gallons. The individual modules shall be manifolded together at the job site with or without any intervening valves. The assembled modular potable water heater shall be equipped with a:
- (1) Safety relief valve, see section 12-223.1-9(a)(3);
 - (2) Drain valve, see section 12-223.1-13(o)(2);
 - (3) Pressure/altitude gage, see 12-223.1-7(c)(2);
 - (4) Thermometer, see section 12-223.1-7(c)(3);
 - (5) Temperature control, see section 12-223.1-7(c)(1); and
 - (6) Flow-sensing device, see 12-223.1-7(c)(4).
- [Eff and comp 12/21/19; am and comp SEP - 8 2024]
(Auth: HRS §397-4) (Imp: HRS §397-4)

§12-223.1-9 Pressure relief valves for steam heating, hot-water heating, hot-water supply boilers, and potable water heaters. Pressure relief valves for steam heating, hot-water heating, hot-water supply boilers, and potable water heaters shall be ASME and NB certified and marked with the ASME certification mark and "HV" designator, and National Board "NB" symbols. The following shall apply to these objects:

- (1) Pressure relief valve requirements for steam heating boilers shall include the following:
 - (A) Pressure relief valves shall be manufactured in accordance with a national or international standard;
 - (B) Each steam boiler shall have one or more NB capacity certified pressure relief valves of the spring pop type adjusted and sealed to discharge at a pressure not to exceed fifteen (15) psig;
 - (C) No pressure relief valve for a steam boiler shall be smaller than NPS 1/2. No pressure relief valve shall be larger than NPS 4. The inlet opening shall have an inside diameter equal to or greater than the seat diameter;
 - (D) The minimum valve capacity in lbs./hr. shall be the greater of that determined by dividing the maximum Btu per hour output at the boiler nozzle obtained by the firing of any fuel for which the unit is installed by 1,000 Btu per hour/lbs., or shall be determined based on the lbs. of steam/hr/square feet of boiler heating surface. For cast iron heating boilers, the minimum valve capacity shall be determined by the maximum output method. In many cases a greater relieving capacity of valves will have to be provided than the minimum specified in this chapter (see Exhibit 9, titled, "Minimum Pounds of Steam Per Hour Per Square Foot of Heating Surface", dated October 1, 2023, which is made a part of this chapter and located at the end of

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- this chapter). In every case the requirements of subparagraph (E) shall be met;
- (E) The pressure relief valve capacity for each steam boiler shall be such that with the fuel burning equipment installed, and operated at maximum capacity, the pressure cannot rise more than five (5) psig above the maximum allowable working pressure; and
 - (F) When operating conditions are changed, or additional boiler heating surface is installed, the valve capacity shall be increased, if necessary, to meet the new conditions and be in accordance with section 12-223.1-9(a)(2)(G). The additional valves required, because of changed conditions, may be installed on the outlet piping provided there is no intervening valve; and
- (2) Pressure relief valve requirements for hot-water heating or hot-water supply heating boilers shall include the following:
- (A) Each hot-water heating or hot-water supply boiler shall have at least one NB capacity certified pressure relief valve, of the automatic reseating type set to relieve at or below the maximum allowable working pressure of the boiler;
 - (B) Hot-water heating or hot-water supply heating boilers limited to a water temperature not more than 210 degrees Fahrenheit may have, in lieu of the valve(s) specified in subparagraph(A), one or more NB capacity certified temperature and pressure relief valves of the automatic reseating type set to relieve at or below the maximum allowable working pressure of the boiler;
 - (C) When more than one pressure relief valve is used on either hot-water heating or hot-water supply heating boilers, the additional valves shall be NB capacity

certified and may have a set pressure within a range not to exceed six (6) psig above the maximum allowable working pressure of the boiler up to and including sixty (60) psig, and five per cent (5%) for those having a maximum allowable working pressure exceeding sixty (60) psig;

- (D) No pressure relief valve shall be smaller than NPS 3/4 nor larger than NPS 4, except that heating boilers having a heat input not greater than 15,000 Btu per hour should be equipped with a rated pressure relief valve of NPS 1/2;
- (E) The required relieving capacity, in lbs./hr, of the pressure relief device or devices on a boiler shall be the greater of that determined by dividing the maximum output in Btu per hour at the boiler nozzle obtained by the firing of any fuel for which the unit is installed by 1,000 Btu per hour/lb., or shall be determined on the basis of lbs. steam/hr/square feet as given in Exhibit 9 titled, "Minimum Pounds of Steam Per Hour Per Square Foot of Heating Surface", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter. For cast iron heating boilers, the minimum valve capacity shall be determined by the maximum output method. In many cases a greater relieving capacity of valves will have to be provided than the minimum specified in this chapter. In every case the requirements of subparagraph (G) shall be met;
- (F) When operating conditions are changed, or additional boiler heating surface is installed, the valve capacity shall be increased, if necessary, to meet the new conditions and shall be in accordance with NBIC Part 1. The additional valves

- required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve; and
- (G) Pressure relief valve capacity for each boiler with a single pressure relief valve shall be such that, with the fuel burning equipment installed and operated at maximum capacity, the pressure cannot rise more than ten per cent (10%) above the maximum allowable working pressure. When more than one pressure relief valve is used, the over pressure shall be limited to ten per cent (10%) above the set pressure of the highest set valve; and
- (3) Pressure relief valve requirements for potable water heaters shall include the following:
- (A) Each water heater shall have at least one NB capacity certified temperature and pressure relief valve. No temperature and pressure relief valve shall be smaller than NPS 3/4;
 - (B) Pressure relief valves for potable water heaters shall be ASME and NB certified marked with the ASME certification mark and "HV" designator, and National Board "NB" symbols;
 - (C) The pressure setting shall be less than or equal to the maximum allowable working pressure of the water heater. However, if any of the other components in the hot-water supply system (such as valves, pumps, expansion, storage tanks, or piping) have a lesser working pressure rating than the water heater, the pressure setting for the temperature and pressure relief valve(s) shall be based upon the component with the lowest maximum allowable working pressure rating. If more than one temperature and pressure relief valve is used, the additional valve(s) may be set within a

- range not to exceed ten per cent (10%) over the set pressure of the first valve;
- (D) The required relieving capacity in Btu per hour of the temperature and pressure relief valve shall not be less than the maximum allowable input unless the water heater is marked with the rated burner input capacity of the water heater on the casing in a readily visible location, in which case the rated burner input capacity may be used as a basis for sizing the temperature pressure relief valves. The relieving capacity for electric water heaters shall be 3,500 Btu per hour per kw of input;
 - (E) The relieving capacity for electric water heaters shall be 3,500 Btu per hour (1.0 kw) per kw of input. In every case, the temperature and pressure relief valve capacity for each water heater shall be such that with the fuel burning equipment installed and operated at maximum capacity, the pressure cannot rise more than ten per cent (10%) above the maximum allowable working pressure;
 - (F) Many temperature and pressure relief valves have a NB capacity certified rating which was determined according to ASME BPVC requirements, and a lower Canadian Standards Association (CSA) rating value. Where the ASME BPVC is the only referenced code of construction the NB capacity certified rating may be used; and
 - (G) If operating conditions are changed or additional heating surface is installed, the temperature and pressure relief valve capacity shall be increased, if necessary, to meet the new conditions and shall be in accordance with the above provisions. In no case shall the increased input capacity exceed the maximum allowable input capacity. The

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additional valves required, because of changed conditions, may be installed on the outlet piping providing there is no intervening valve. [Eff and comp 12/21/19; am and comp SEP - § 2024]
(Auth: HRS §397-4) (Imp: HRS §397-4)

§12-223.1-10 Acceptable installation of pressure relief valves for steam heating, hot-water heating, hot-water supply boilers. The following shall apply to the installation of pressure relief valves for steam heating, hot-water heating, and hot-water supply boilers:

- (1) Pressure relief valves shall be located at the top side of the boiler. The top side of the boiler shall mean the highest practicable part of the boiler proper but in no case shall the safety valves be located below the normal operating level and in no case shall the pressure relief valve be located below the lowest permissible water level. They shall be connected directly to a tapped or flanged opening in the boiler, to a fitting connected to the boiler by a short nipple, to a Y-base, or to a valveless header connecting steam or water outlets on the same boiler. Coil or header type heating boilers shall have the pressure relief valve located on the steam or hot-water outlet end. Pressure relief valves shall be installed with their spindles vertical. The opening or connection between the boiler and any pressure relief valve shall have at least the area of the valve inlet;
- (2) When a boiler is fitted with two or more pressure relief valves on one connection, this connection shall have a cross-sectional area not less than the combined areas of inlet connections of all the pressure relief valves with which it connects;
- (3) When a Y-base is used, the inlet area shall be not less than the combined outlet areas. When

the size of the boiler requires a pressure relief valve larger than NPS 4, two or more valves having the required combined capacity shall be used. When two or more valves are used on a boiler, they may be single, directly attached, or installed on a Y-base;

- (4) A threaded connection may be used for attaching a valve;
- (5) Pressure relief valves shall not be connected to an internal pipe in the boiler;
- (6) No shutoff valve of any description shall be placed between the pressure relief valve and the boiler or on discharge pipes between such valves and the atmosphere;
- (7) A discharge pipe shall be used. It shall be not less than the nominal size of the valve outlet. Where multiple valves relieve into a common discharge pipe, the cross-sectional flow area of the common discharge pipe shall be equal to or greater than the sum of the individual temperature and pressure relief valve discharge pipe areas. Discharge pipes shall be securely anchored and supported, as short and straight as possible and arranged as to avoid undue stress on the valve or valves. A union may be installed in the discharge piping close to the valve outlet. When an elbow is placed on a pressure relief valve discharge pipe, it shall be located close to the valve outlet downstream of the union to minimize reaction moment stress;
- (8) The discharge from pressure relief valves shall be so arranged that there will be no danger of scalding attendants. The pressure relief valve discharge shall be piped away from the boiler to a safe point of discharge, and there shall be provisions made for properly draining the piping. The size and arrangement of discharge piping shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the relieving devices below that required to protect the boiler; and

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- (9) Hot-water heating or hot-water supply heating boilers limited to a water temperature of 210 degrees Fahrenheit may have one or more NB capacity certified temperature and pressure relief valve(s) installed. The requirements of paragraphs (1) through (8) shall be met, except as follows:
- (A) A Y-type fitting shall not be used; and
 - (B) If additional valves are used, they shall be temperature and pressure relief valves, and when the temperature and pressure relief valve is installed directly on the boiler with no more than four (4) inches maximum interconnecting piping, the valve may be installed in the horizontal position with the outlet pointed down. [Eff and comp 12/21/19; comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

12-223.1-11 Acceptable installation of temperature and pressure relief valves for potable water heaters.

The following shall apply to the installation of temperature and pressure relief valves for potable water heaters:

- (1) Temperature and pressure relief valves shall be installed by either the water heater manufacturer or installer before a water heater is placed in operation;
- (2) Temperature and pressure relief valves shall be connected directly to a tapped or flanged opening in the top of the water heater, or to a fitting connected to the water heater by a short nipple;
- (3) Temperature and pressure relief valves shall be installed with their spindles upright and vertical with no horizontal connecting pipe, except when the temperature and pressure relief valve is connected directly on the water heater vessel with no more than four (4) inches maximum interconnecting piping, the

- valve may be installed in the horizontal position with the outlet pointed down. The center line of the temperature and pressure relief valve connection shall be no lower than four (4) inches from the top of the shell;
- (4) No piping or fitting used to install the temperature and pressure relief valve shall be of nominal pipe size less than that of the valve inlet;
 - (5) When a potable water heater is fitted with two or more temperature and pressure relief valves on one connection, this connection shall have a cross-sectional area not less than the combined areas of inlet connections of all the temperature and pressure release valves with which it connects;
 - (6) When a Y-base is used, the inlet area shall be not less than the combined outlet areas;
 - (7) When the size of the water heater requires a temperature and pressure relief valve larger than NPS 4 two or more valves having the required combined capacity shall be used;
 - (8) When two or more valves are used on a water heater, they may be single, directly attached, or installed on a Y-base;
 - (9) A threaded connection may be used for attaching a temperature and pressure relief valve;
 - (10) Temperature and pressure relief valves shall not be connected to an internal pipe in the water heater or a cold-water feed line connected to the water heater;
 - (11) No shutoff valve of any description shall be placed between the temperature and pressure relief valve and the water heater or on discharge pipes between such valves and the atmosphere; and
 - (12) The discharge from temperature and pressure relief valves shall be so arranged that there will be no danger of scalding attendants. When the temperature and pressure relief valve discharge is piped away from the water heater to the point of discharge, there shall be

provisions for properly draining the piping and valve body. The size and arrangement of discharge piping shall be such that any pressure that may exist or develop will not reduce the relieving capacity of the relieving devices below that required to protect the water heater. The following shall apply to discharge pipes:

- (A) When a discharge pipe is used, it shall be not less than the nominal size of the valve outlet, and shall be as short and straight as possible, properly supported and so arranged as to avoid undue stress on the valve. When an elbow is placed on a temperature and pressure relief discharge pipe, it shall be located close to the valve outlet;
- (B) Where multiple valves relieve into a common discharge pipe, the cross-sectional flow area of the common discharge pipe shall be equal to or greater than the sum of the individual temperature and pressure relief valve discharge pipe areas;
- (C) Discharge piping shall be rated for the discharge fluid conditions of pressure and temperature including a minimum and maximum design temperature. Material selection for the discharge piping shall consider the reduction in material toughness at the low end of design temperature and the reduction in material strength at the high end of design temperature. Rigid pipe or tubing should be used for discharge lines that carry hot water or steam;
- (D) Plastic discharge pipe and fittings are permitted (when compatible with the process fluid, system design temperatures, and other ambient conditions such as light and humidity) and shall conform to NSF/ANSI 14 Plastics

Piping System Components and Related Materials; and

- (E) Discharge piping shall be rated for any static pressure present and the back pressure that may develop when the pressure relief device is at full capacity. Where multiple pressure relief devices or vents discharge into common piping, the back pressure that could develop due to simultaneous flow from all sources shall be considered. [Eff and comp 12/21/19; am and comp SEP - § 2024]
(Auth: HRS §397-4) (Imp: HRS §397-4)

§12-223.1-12 Heating boiler room and operating area. (a) The following shall apply to the care of heating boiler rooms:

- (1) The heating boiler room shall be free from accumulation of rubbish, and materials that obstruct access to the boiler, its setting, or firing equipment;
- (2) The storage of flammable material or gasoline-powered equipment in the heating boiler room is prohibited;
- (3) The roof over heating boilers designed for indoor installations shall be free from leaks and maintained in good condition;
- (4) All exit doors shall open outward; and
- (5) It is recommended that the ASME BPVC Section VI, covering the care and operation of heating boilers be used as a guide for proper and safe operating practices.

(b) Foundation, supports, and settings. Each heating boiler, potable water heater, and thermal fluid heater and its associated piping must be safely supported. Design of supports, foundations, and settings shall consider vibration (including seismic where necessary), movement (including thermal expansion and contraction), grounding/bonding to minimize electrolytic corrosion, and loadings (including the weight of the fluid in the system during a pressure test) in

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accordance with jurisdictional requirements, manufacturers recommendations, and other industry standards, as applicable.

(c) Exit. Two means of exit shall be provided for equipment rooms exceeding 500 square feet of floor area and containing one or more heating boilers, potable water heaters, or thermal fluid heaters having a combined fuel capacity of 1,000,000 Btu per hour or more (or equivalent electrical heat input). Each elevation shall be provided with at least two means of exit, each to be remotely located from the other. A platform at the top of a single heating boiler is not considered an elevation.

(d) The following shall apply to ladders and runways:

- (1) All walkways, runways, and platforms shall be of metal construction or equivalent material;
- (2) Provided between or over the top of heating boilers that are more than eight (8) feet above the operating floor to afford accessibility for normal operation, maintenance, and inspection;
- (3) Constructed of safety treads, standard grating, or similar material and have a minimum width of thirty (30) inches of bolted, welded, or riveted construction, and equipped with handrails forty-two (42) inches high with an intermediate rail and four (4) inches toe board; and
- (4) Stairways that serve as a means of access to walkways, runways, or platforms shall not exceed an angle of forty-five (45) degrees from the horizontal and be equipped with handrails forty-two (42) inches high with an intermediate rail.

(e) Drains. At least one floor drain shall be installed in the equipment room. Drains receiving blowdown water should be connected to the sanitary sewer by way of an acceptable blowdown tank or separator or an air gap that will allow the blowdown water to cool to at least 140 degrees Fahrenheit and reduce the pressure to five (5) psig or less.

(f) Water. The following shall apply to water:

- (1) A means to add water to or fill the boiler, while not under pressure, shall be provided. A valve or threaded plug may be used to shut off the fill connection when the boiler is in service;
- (2) Water fill connections shall be installed. A means shall be provided at or near the boiler to prevent back-feeding. Such means shall be rated for the boiler design pressure and temperature; and
- (3) Provision should also be made in every equipment room for a convenient water supply that can be used to flush out the boiler and to clean the equipment room floor. [Eff and comp 12/21/19; am and comp SEP - 8 2024]
(Auth: HRS §397-4) (Imp: HRS §397-4)

§12-223.1-13 Operating systems. (a) Feedwater.

- (1) Steam heating boilers. Feedwater or water treatment shall be introduced into a boiler through the return piping system. Alternatively, feedwater or water treatment shall be introduced through an independent connection. A cross or equivalent fitting shall be placed in the water piping connection at every right angle turn to facilitate cleaning and inspection. The water flow from the independent connection shall not discharge directly against parts of the boiler exposed to direct radiant heat from the fire. Feedwater or water treatment shall not be introduced through openings or connections provided for inspection or cleaning, safety valve, water column, water-gage glass, or pressure gage. The feedwater pipe shall be provided with a check valve, or a backflow preventer containing a check valve, near the boiler and a stop valve or cock between the check valve and the boiler, or between the check valve and the return pipe system;

- (2) Hot-water heating boilers. Makeup water may be introduced into a boiler through the piping system or through an independent connection. The water flow from the independent connection shall not discharge directly against parts of the boiler exposed to direct radiant heat from the fire. Makeup water shall not be introduced through openings or connections provided exclusively for inspection or cleaning, safety relief valve, pressure gage, or temperature gage. The makeup water pipe shall be provided with a check valve, or a backflow preventer containing a check valve, near the boiler and a stop valve or cock between the check valve and the boiler, or between the check valve and the piping system; and
- (3) The following shall apply to potable water heaters:
 - (A) Water supply shall be introduced into a water heater through an independent water supply connection. Feedwater shall not be introduced through openings or connections provided for cleaning, safety relief valves, drain, pressure gage, or temperature gage; and
 - (B) If the water supply pressure to a water heater exceeds seventy-five per cent (75%) of the set pressure of the safety relief valve, a pressure reducing valve is required.

(b) Stop valves. Stop valves shall conform with the applicable portions of an acceptable code of construction and may be ferrous or nonferrous. The minimum pressure rating of all stop valves shall be at least equal to the pressure stamped upon the boiler, and the temperature rating of such stop valves shall be not less than 250 degrees Fahrenheit.

- (1) The following shall apply to steam heating, hot-water heating, and hot-water supply boilers:
 - (A) When a stop valve is used in the supply pipe connection of a single steam boiler,

there shall be one installed in the return pipe connection;

- (B) Stop valves for single hot-water heating and hot-water supply heating boilers shall be located at an accessible point in the supply and return pipe connections as near to the boiler as possible, to permit draining the boiler without emptying the system; and
 - (C) Stop valves shall be used in each supply and-return pipe connection for boiler installations of two or more heating boilers connected to a common system; and
- (2) Potable water heaters. Stop valves shall be installed in the supply and discharge pipe connections of a water heater installation to permit draining the water heater without emptying the system.

(c) Fuel. Fuel systems shall be installed in accordance with jurisdictional and environmental requirements, manufacturer's recommendations, and industry standards, as applicable.

(d) Electrical. The following shall apply to steam heating, hot-water heating, and hot-water supply boilers:

- (1) All wiring for controls, heat generating apparatus, and other appurtenances necessary for the operation of the heating boilers shall be installed in accordance with the provisions of national or international standards and shall comply with the applicable local electrical codes;
- (2) A disconnecting means capable of being locked in the open position shall be installed at an accessible location at the boiler so that the boiler can be disconnected from all sources of potential. This disconnecting means shall be an integral part of the boiler or adjacent to it;
- (3) A manually operated remote shutdown switch or circuit breaker shall be located just outside the equipment room door and marked for easy identification. Consideration should also be

- given to the type and location of the switch to safeguard against tampering;
- (4) If the equipment room door is on the building exterior, the shutdown switch should be located just inside the door. If there is more than one door to the equipment room, there shall be a shutdown switch located at each door of egress;
 - (5) For atmospheric-gas burners, and oil burners where a fan is on a common shaft with the oil pump, the complete burner and controls should be shut off; and
 - (6) For power burners with detached auxiliaries, only the fuel input supply to the firebox need be shut off.
- (e) Potable water heaters. The following shall apply to potable water heaters:
- (1) All wiring for controls, heat generating apparatus, and other appurtenances necessary for the operation of the potable water heaters shall be installed in accordance with the provisions of national or international standards and comply with the applicable local electrical codes;
 - (2) A disconnecting means capable of being locked in the open position should be installed at an accessible location at the heater so that the heater can be disconnected from all sources of potential. This disconnecting means shall be an integral part of the heater or adjacent to it;
 - (3) For atmospheric-gas burners, and oil burners where a fan is on a common shaft with the oil pump, the complete burner and controls should be shut off;
 - (4) For power burners with detached auxiliaries, only the fuel input supply needs be shut off;
 - (5) A manually operated remote shutdown switch or circuit breaker shall be located just outside the equipment room door and marked for easy identification. Consideration should also be given to the type and location of the switch to safeguard against tampering; and

- (6) If the equipment room door is on the building exterior, the switch should be located just inside the door. If there is more than one door to the equipment room, there should be a switch located at each door of egress.
- (f) Controls and heat generating apparatus. The following shall apply to controls and heat generating apparatus:
 - (1) Oil and gas-fired and electrically heated heating boilers and water heaters shall be equipped with suitable primary (flame safeguard) safety controls, safety limit controls, and burners or electric elements as required by a nationally or internationally recognized standard;
 - (2) The symbol of the certifying organization that has investigated such equipment as having complied with a nationally recognized standard shall be affixed to the equipment and shall be considered as evidence that the unit was manufactured in accordance with that standard; and
 - (3) These devices shall be installed in accordance with jurisdictional and environmental requirements, manufacturer's recommendations, and industry standards, as applicable.
- (g) Ventilation and combustion air. The following shall apply to ventilation and combustion air:
 - (1) The equipment room shall have an adequate air to permit clean, safe combustion, minimize soot formation, and maintain a minimum of nineteen and a half per cent (19.5%) oxygen in the air of the equipment room and sufficient to maintain ambient temperatures as recommended by the boiler, heater, or vessel manufacturer;
 - (2) When combustion air is supplied to the boiler, heater, or vessel by an independent duct, with or without the employment of power ventilators or fans, the duct shall be sized and installed in accordance with the manufacturer's recommendations. However, ventilation for the equipment room must still be considered;

- (3) Unobstructed air openings shall be sized based on the manufacturer's recommendations, or as specified by the National Fire Protection Association (NFPA) standards for oil and gas burning installations for the particular job conditions, or one (1) square inch of free area per 2000 Btu per hour (586 W) maximum fuel input of the combined burners located in the equipment room. The equipment room supply openings shall be kept clear at all times;
- (4) Power ventilators or fans shall be sized based on 0.2 cfm for each 1000 Btu per hour (293 W) of maximum fuel input for the combined burners of all heating boilers and heaters located in the equipment room. Additional capacity may be required for other fuel burning equipment in the equipment room;
- (5) When power ventilators or fans are used to supply combustion air, they shall be installed with interlock devices so that burners will not operate without an adequate number of ventilators/fans in operation;
- (6) When power ventilators or fans are used to supply combustion air, they shall be installed with interlock devices so that burners will not operate without an adequate number of ventilators/fans in operation;
- (7) The size of openings specified in paragraph (3) may be reduced when special engineered air supply systems approved by the department are used; and
- (8) Care should be taken to ensure that steam, water and fluid lines are not routed across combustion air openings, where freezing may occur.

(h) Breeching and dampers. Breeching and dampers shall be installed in accordance with jurisdictional and environmental requirements, manufacturer's recommendations, and industry standards, as applicable.

(i) Burners and stokers. Burners and stokers shall be installed in accordance with jurisdictional and environmental requirements, manufacturer's recommendations, and industry standards, as applicable.

(j) Lighting. The equipment room shall be well-lit and have an emergency light source for use in the case of a power failure.

(k) Emergency valves and controls. All emergency shut-off valves and controls shall be accessible from a floor, platform, walkway, or runway. Accessibility shall mean within a six (6) feet elevation of the standing space and not more than twelve (12) inches horizontally from the standing space edge.

(l) Chimney or stack. Chimneys or stacks shall be installed in accordance with the department's requirements, manufacturer's recommendations, and industry standards, as applicable.

(m) Ash removal. Ash removal systems shall be installed in accordance with jurisdictional and environmental requirements, manufacturer's recommendations, and industry standards, as applicable.

(n) Return pipe connections. The following shall apply to return pipe connections:

- (1) The return pipe connections of each boiler supplying a gravity return steam heating system shall be so arranged as to form a loop so that the water in each boiler cannot be forced out below the safe water level; and
- (2) Provision shall be made for cleaning the interior of the return piping at or close to the boiler. Washout openings should be used for return pipe connections and the washout plug placed in a tee or a cross so that the plug is directly opposite and as close as possible to the opening in the boiler.

(o) Bottom blowoff and drain valves. The following shall apply to bottom blowoff and drain valves of steam heating, hot-water heating, and hot-water supply heating boilers:

- (1) Each steam boiler shall have a bottom blowoff connection fitted with a valve or cock connected to the lowest water space practicable with a minimum size as shown in the NBIC. The discharge piping shall be full size to the point of discharge. Heating boilers having a capacity of twenty-five (25) gallons or less are exempt from the above

- requirements, except that they shall have a NPS three-fourths (3/4) minimum drain valve;
- (2) Each steam or hot-water boiler shall have one or more drain connections, fitted with valves or cocks connecting to the lowest water containing spaces. All parts of the boiler must be capable of being drained (the boiler design will dictate the number and size of drains). The minimum size of the drain piping, valves, and cocks shall be NPS 3/4. The discharge piping shall be full size to the point of discharge. When the blowoff connection is located at the lowest water containing space, a separate drain connection is not required; and
 - (3) The minimum pressure rating of valves and cocks used for blowoff or drain purposes shall be at least equal to the pressure stamped on the boiler but in no case less than thirty (30) psig. The temperature rating of such valves and cocks shall not be less than 250 degrees Fahrenheit.

(p) Each potable water heater shall have a bottom drain pipe connection fitted with a valve or cock connected with the lowest water space practicable. The minimum size bottom valve shall be NPS three-fourths (3/4). Any discharge piping connected to the bottom drain connection shall be full size to the point of discharge.

(q) Provisions for thermal expansion of expansion tanks and piping for steam heating, hot-water heating, and hot-water supply heating boilers shall comply with the following:

- (1) Expansion tanks for hot-water heating and hot-water supply heating boilers shall be installed so that all hot-water heating systems incorporating hot-water tanks or fluid relief columns prevent freezing under normal operating conditions;
- (2) Heating systems with an open expansion tank shall have an indoor overflow from the upper portion of the expansion tank in addition to an open vent, the indoor overflow shall be

carried within the building to a suitable plumbing fixture or drain;

- (3) In closed heating systems an expansion tank shall be installed in a closed heating system that will be consistent with the volume and capacity of the system. If the system is designed for a working pressure of thirty (30) psig or less, the tank shall be suitably designed for a minimum hydrostatic test pressure of seventy-five (75) psig. Expansion tanks for systems designed to operate above thirty (30) psig shall be constructed in accordance with an acceptable code of construction. Provisions shall be made for draining the tank without emptying the system except for pressurized tanks. The minimum capacity of the closed-type expansion tank should be determined from NBIC Part 1, Tables 3.7.9.1-a and 3.7.9.1-b or from the following formula where the necessary information is available:

US Customary:

$$V_t = (0.00041T - 0.0466)V_s \left(\frac{P_a}{P_f} - \frac{P_a}{P_o} \right)$$

where,

V_t = minimum volume of tanks, gallons

V_s = volume of system, not including tanks, gallons

T = average operating temperature, °F

t_1 = lower temperature

t_2 = higher temperature

P_a = atmospheric pressure, psia

P_f = fill pressure, psia

P_o = maximum operating pressure, psia

Metric:

$$V_t = (0.000738T - 0.3348)V_s \left(\frac{P_a}{P_f} - \frac{P_a}{P_o} \right)$$

where,

V_t = minimum volume of tanks, liters

V_s = volume of system, not including tanks, liters

T = average operating temperature, °C

P_a = atmospheric pressure, kPa

Pf = fill pressure, kPa

Po = maximum operating pressure, kPa; and

- (4) Hot-water supply systems. If a system is equipped with a check valve or pressure-reducing valve in the cold-water inlet line, consideration should be given to the installation of an airtight expansion tank or other suitable air cushion. Otherwise, due to the thermal expansion of the water, the safety relief valve may lift periodically. If an expansion tank is provided, it shall be constructed in accordance with an acceptable code of construction. Except for pre-pressurized tanks, which should be installed on the cold-water side, provisions shall be made for draining the tank without emptying the system (for a typical acceptable installation see Exhibit 7, titled, "Hot Water Boilers in Battery Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter).

(r) Piping for steam heating, hot-water heating, and hot-water supply boilers. Provisions shall be made for the expansion and contraction of steam and hot water mains connected to boiler(s) so there will be no undue strain transmitted to the boiler(s) (for typical schematic arrangements of piping incorporating strain absorbing joints for steam and hot-water heating boilers see Exhibit 5, titled, "Steam Boilers in Battery - Pumped Return Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter, Exhibit 6, titled, "Steam Boilers in Battery - Gravity Return Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter, and Exhibit 7, titled, "Hot Water Boilers in Battery Acceptable Piping Installation", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter).

(s) Expansion tanks and piping for potable water heaters. The following shall apply to expansion tanks and piping for potable water heaters:

- (1) If a system is equipped with a check valve or pressure-reducing valve in the cold-water inlet line, consideration should be given to the installation of an airtight expansion tank or other suitable air cushion. Otherwise, due to the thermal expansion of the water, the safety relief valve may lift periodically. If an expansion tank is provided, it shall be constructed in accordance with an acceptable code of construction. Except for pre-pressurized diaphragm-type tanks, which should be installed on the cold-water side, provisions shall be made for draining the tank without emptying the system; and
- (2) Piping. Provisions shall be made for the expansion and contraction of hot water mains connected to potable water heater(s) so that there will be no undue stress transmitted to the potable water heater(s).

TABLE 3.7.9.1-a

EXPANSION TANK CAPACITIES FOR GRAVITY HOT-WATER SYSTEMS

Based on a two-pipe system with average operating water temperature 170°F (77°C), using cast-iron column radiation with heat emission rate 150 Btu/hr/ft ² (473 W/m ²) equivalent direct radiation.		
Installed Equivalent Direct Radiation, ft ² (m ²) (Note)	No.	Tank Capacity, gallon (l)
up to 350 (33)	1	18 (68)
up to 450 (42)	1	21 (79)
up to 650 (60)	1	24 (91)
up to 900 (84)	1	30 (114)
up to 1,100 (102)	1	35 (132)
up to 1,400 (130)	1	40 (151)
up to 1,600 (149)	2	60 (227)
up to 1,800 (167)	2	60 (227)
up to 2,000 (186)	2	70 (265)
up to 2,400 (223)	2	80 (303)

Note:

For systems with more than 2,400 ft² (223 m²) of installed equivalent direct water radiation, the required capacity of the cushion tank shall be increased on the basis of 1 gallon (3.79 l) tank capacity/33 ft² (3.1 m²) of additional equivalent direct radiation.

TABLE 3.7.9.1-b

EXPANSION TANK CAPACITIES FOR FORCED HOT-WATER SYSTEMS

Based on average operating water temperature 195°F [91°C], fill pressure 12 psig [83 kPa], and maximum operating pressure 30 psig [200 kPa]		
Tank Capacities, gallon (l)		
System Volume	Pressurized Diaphragm Type	Nonpressurized Type
100 (379)	9 (34)	15 (57)
200 (757)	17 (64)	30 (114)
300 (1136)	25 (95)	45 (170)
400 (1514)	33 (125)	60 (227)
500 (1893)	42 (159)	75 (284)
1,000 (3785)	83 (314)	150 (568)
2,000 (7571)	165 (625)	300 (1 136)

Note: System volume includes volume of water in boiler, radiation, and piping, not including the expansion tank. Expansion tank capacities are based on an acceptance factor of 0.4027 for pre-pressurized types and 0.222 for non-pressurized types. For other cases or metric calculations see Chapter 12 of the 1996 HVAC Systems and Equipment Volume of the ASHRAE Handbook.

(t) Carbon monoxide (CO) detector/alarm. The owner or user shall install a carbon monoxide detector/alarm in equipment rooms where fuel fired boilers are located in accordance with manufacturer's recommendation, and industry standards, as applicable.

(u) Testing and final acceptance. The completed boiler shall be pressure tested in the shop or in the field in accordance with the original code of construction and documented on the appropriate manufacturer's data report.

- (1) The installer shall exercise care during installation to prevent loose weld material, welding rods, small tools, and miscellaneous scrap metal from getting into the vessel. Prior to making the final closure, the installer shall inspect the interior of the vessel and its appurtenances for the presence of foreign debris, and if present it shall be removed;
- (2) Subject to the department's requirements, a leak test may be performed on any components

whose pressure test is not documented under the items' manufacturer's data report. This leak test should not exceed ninety (90%) of the lowest pressure relief device setpoint. The test data shall be recorded, and the data made available as required;

- (3) Prior to final acceptance, an operational test shall be performed on the completed installation. The test shall include operating controls, limit controls and safety devices, and witnessed as required by the department. The test data shall be recorded, and the data made available to the department as evidence that the installation complies with provisions of the governing code(s) of construction; and
- (4) All fuel fired boiler and fuel fired pressure vessel combustion air-fuel ratios shall be analyzed, adjusted, and values documented during commissioning to meet emission requirements and limits of the manufacturer.
[Eff and comp 12/21/19; am and comp SEP - § 2024] (Auth: HRS §397-4)
(Imp: HRS §397-4)

§12-223.1-14 Preventive maintenance schedule.

Maintenance. The owner or user of the pressure retaining item is responsible for ensuring that all equipment is maintained as listed in this section. Steam boiler maintenance shall be performed as per ASME BPVC Section VI, Steam Boiler - Sec 7.7 Maintenance, and ASME CSD-1, Part CM (see Exhibit 1, titled, "Recommended Preventative Maintenance Schedule", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter, and Exhibit 2, titled, "Table D-1-1 Periodic Testing Recommended Checklist", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter). Hot-water boiler and hot-water heating boiler maintenance shall be performed as per ASME BPVC Section VI, Hot-Water Boiler and Hot-Water Heating Boiler - Sec 8.7 Maintenance, and Exhibit 1, titled, "Recommended

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Preventative Maintenance Schedule", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter, and Exhibit 2, titled, "Table D-1-1 Periodic Testing Recommended Checklist", dated October 1, 2023, which is made a part of this chapter and located at the end of this chapter. [Eff and comp 12/21/19; am and comp SEP - 8 2024] (Auth: HRS §397-4) (Imp: HRS §397-4)

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EXHIBIT 1 October 1, 2023

Recommended Preventive Maintenance Schedule

D-1 INTRODUCTION

Operation and maintenance instructions in this Appendix are intended for general applications. Table D-1-1 presents a periodic checklist for these recommended preventive maintenance tasks. For specific operating and maintenance instructions, consult the equipment manufacturer.

D-2 DAILY

- (a) Check gages, monitors, and indicators.
- (b) Check instrument and equipment settings.
- (c) For high-pressure boilers, test all low-water fuel cutoff devices and alarms.
- (d) Check burner flame.

D-3 WEEKLY

- (a) For low-pressure boilers, test all low-water fuel cutoff devices and alarms.
- (b) Check igniter.
- (c) Check flame signal strength.
- (d) Check flame failure detection system.
- (e) Check firing rate control.
- (f) Make aural and visual check of pilot and main fuel valves.

D-4 MONTHLY

- (a) Check flue, vent, stack, or outlet dampers.
- (b) Test low draft, fan air pressure, and damper position interlocks.
- (c) Check low fire start interlock.
- (d) Test high and low oil pressure and oil temperature interlocks.
- (e) Test high and low gas-pressure interlocks.

D-5 SEMIANNUALLY

- (a) Recalibrate all indicating and recording gages.
- (b) For steam boilers, perform a slow drain test of all the low-water fuel cutoff devices.
- (c) Check flame failure detection system components.
- (d) Check firing rate control.
- (e) Check piping and wiring of all interlocks and shutoff valves.
- (f) Inspect burner components.
- (f) Test safety/safety relief valves in accordance with ASME Boiler and Pressure Vessel Code, Sections VI and VII.
- (g) For parallel positioning systems, verify actuator-to-fuel-valve couplings and actuator-to-damper couplings are properly connected.

D-6 ANNUALLY

- (a) Flame failure detection system, conduct pilot turn-down test.
- (b) Flame failure detection system, test for hot refractory hold-in.
- (c) Check dual fuel change over control.
- (d) Test high-limit and operating temperature or steam pressure controls.
- (e) Replace vacuum tubes, scanners, or flame rods in accordance with manufacturer's instructions.
- (f) Conduct a combustion test.
- (g) Check all coils and diaphragms; test other operating parts of all safety shutoff and control valves.
- (h) Test safety shutoff valve proof-of-closure switch(es) in accordance with manufacturer's instructions.
- (i) Perform leakage test on pilot and main gas and/or oil fuel valves and valve proving systems in accordance with manufacturer's instructions.
- (j) Test purge air switch in accordance with manufacturer's instructions.
- (k) Test air/steam interlock in accordance with manufacturer's instructions.
- (l) Test burner position interlock in accordance with manufacturer's instructions.
- (m) Test rotary cup interlock in accordance with manufacturer's instructions.
- (n) Test low fire start interlock in accordance with manufacturer's instructions.
- (o) Test for gas leakage on all threaded and flanged connections.
- (p) Verify burner is operating within manufacturer's specifications.

D-7 AS REQUIRED

- (a) Recondition or replace low-water fuel cutoff device.
- (b) For oil-fired burners, clean atomizers and oil strainers.
- (c) For gas-fired burners, check sediment trap and gas strainers.
- (d) Flame failure detection system, conduct pilot turn-down test.
- (e) Flame failure detection system, test for hot refractory hold-in.
- (h) For combustion air fan variable frequency drive applications, test interlocks wired to the primary flame safety device including drive fault interlocks and improper speed control interlocks.

EXHIBIT 2 October 1, 2023

Table D-1-1 Periodic Testing Recommended Checklist

Frequency [Note (1)]						Component/Item	Recommended Test	Accomplished By	
D	W	M	S/A	A	A/R			Boiler Operator	Service Technician
X	...	...	...	...	...	Gages, monitors, and indicators	Make visual inspection and record readings in boiler log.	X	...
...	...	...	X	...	...	Gages, monitors, and indicators	Recalibrate all indicating and recording gages.	...	X
X	...	...	...	...	...	Instrument and equipment settings	Make visual check against factory-recommended specifications.	X	...
X	...	...	...	...	...	Low-water fuel cutoff devices (high-pressure boilers)	Test all low-water fuel cutoff devices according to manufacturer's instructions.	X	...
...	X	...	...	...	...	Low-water fuel cutoff devices (low-pressure boilers)	Test all low-water fuel cutoff devices according to manufacturer's instructions.	X	...
...	...	...	X	...	...	Low-water fuel cutoff devices (steam boilers)	For steam boilers, perform a slow drain test in accordance with ASME Boiler and Pressure Vessel Code, Section VI.	...	X
...	...	...	...	...	X	Low-water fuel cutoff devices	Recondition or replace each low-water fuel cutoff device.	...	X
...	...	...	...	X	...	Operating and/or limit controls	Test high-limit and operating temperature or steam pressure controls.	...	X
...	...	...	...	...	X	Safety/safety relief valves	Test safety/safety relief valves in accordance with ASME Boiler and Pressure Vessel Code, Sections VI and VII.	...	X
...	...	X	...	...	...	Flue vent, stack, or outlet dampers	Make visual inspection of linkage, and check for proper operation.	X	...
X	...	...	...	...	...	Burner flame	Make visual inspection of burner flame [Note (2)].	X	...
...	X	...	...	...	...	Igniter	Make visual inspection, and check flame signal strength if meter-fitted.	X	...
...	X	...	...	...	...	Flame signal strength	If flame signal meter is installed, read and log. For both pilot and main flames, notify service organization if readings are very high, very low, or fluctuating (refer to manufacturer's instructions).	X	...
...	X	Flame failure detection system	Close manual fuel supply for (1) pilot, (2) main fuel cock, and/or (3) valve(s). Check safety shutdown timing and log.	X	...

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EXHIBIT 2 Continued

Frequency [Note (1)]						Component/Item	Recommended Test	Accomplished By	
D	W	M	S/A	A	A/R			Boiler Operator	Service Technician
...	X	...	...	Flame failure detection system	Check flame failure detection system components, such as vacuum tubes, amplifier, and relays.	...	X
...	X	...	Flame failure detection system	Replace vacuum tubes, scanners, or flame rods in accordance with manufacturer's instructions.	...	X
...	X	X	Flame failure detection system (pilot turndown test)	Conduct pilot turndown test according to manufacturer's instructions. This test is required annually and after any adjustments to flame scanner mount or pilot burner.	...	X
...	X	X	Flame failure detection system (hot refractory hold in test)	Test for hot refractory hold-in. This test is required annually and after any adjustments to the flame scanner mount or pilot burner.	...	X
...	X	...	...	...	...	Firing rate control	Check firing rate control, and verify factory settings (refer to manufacturer's instructions).	X	...
...	X	...	...	Firing rate control	Check firing rate control, and verify factory settings (refer to manufacturer's instructions).	...	X
...	X	...	Firing rate control	Conduct a combustion test, and verify settings are in accordance with manufacturer's instructions.	...	X
...	X	...	...	...	...	Pilot and/or main fuel valves	Open limit switch, and make aural and visual check. Check valve position indicators, and check fuel meters if so fitted.	X	...
...	X	...	Pilot and/or main fuel valves	Check all coils and diaphragms. Test other operating parts of all safety shutoff and control valves.	...	X
...	X	...	Pilot and/or main fuel valves	Test fuel valve interlock switch in accordance with manufacturer's instructions.	...	X
...	X	...	Pilot and/or main fuel valves	Perform leakage test on pilot and main gas and/or oil fuel valves, in accordance with manufacturer's instructions.	...	X
...	...	X	...	...	...	Low draft fan air pressure and damper position interlocks	Test low draft fan air pressure, and damper position interlocks according to manufacturer's instructions.	X	...

EXHIBIT 2 Continued

Frequency [Note (1)]						Component/Item	Recommended Test	Accomplished By	
D	W	M	S/A	A	A/R			Boiler Operator	Service Technician
...	X	...	Low draft, fan air pressure, and damper position interlocks	Test purge switch in accordance with manufacturer's instructions.	...	X
...	...	X	...	...	...	Low fire start interlock	Check low fire start interlock according to manufacturer's instructions.	X	...
...	X	...	Low fire start interlock	Test low fire start interlock according to manufacturer's instructions.	...	X
...	...	X	...	...	...	Oil pressure and temperature interlocks	Test high and low oil pressure and temperature interlocks according to manufacturer's instructions.	X	...
...	...	X	...	...	...	Gas pressure interlocks	Test high and low gas-pressure interlocks according to manufacturer's instructions.	X	...
...	X	...	...	Interlocks and valves	Check piping and wiring of all interlocks and shutoff valves.	...	X
...	X	...	Atomizing air/steam interlock	Test air/steam interlock in accordance with manufacturer's instructions.	...	X
...	X	...	Burner position interlock	Test burner position interlock in accordance with manufacturer's instructions.	...	X
...	X	...	Rotary cup burner interlock	Test rotary cup interlock in accordance with manufacturer's instructions.	...	X
...	X	...	...	Burner components	Inspect burner components according to manufacturer's instructions.	...	X
...	X	X	Burner components	Check dual fuel change over control. If automatically controlled by gas utility perform test under the supervision of gas utility.	...	X
...	X	Burner components	For oil-fired burners, clean atomizers and oil strainers.	...	X
...	X	Burner components	For gas-fired burners, check sediment trap and gas strainer.	...	X

GENERAL NOTE: See manufacturer's instructions.

NOTES:

(1) D = daily; W = weekly; M = monthly; S/A = semiannually; A = annually; A/R = as-required.

(2) Caution should be used when viewing burner flame. Personal protective equipment, such as filtered eyewear, may be necessary.

EXHIBIT 3 October 1, 2023

FORM I-1 REPORT OF BOILER INSTALLATION
in accordance with provisions of the *National Board Inspection Code*

INSTALLATION: New Reinstalled Second Hand Date ____/____/____

INSTALLER	OWNER-USER	OBJECT LOCATION
Name	Name	Name
Street	Street, PO Box, RR	Street
City, State, ZIP	City, State, ZIP	City, State, ZIP

Jurisdiction No.	National Board No.	Manufacturer		Mfg. Serial No.	Year Built	Boiler Type	Boiler Use
Fuel	Method of Firing	Btu/kW input	Btu/kW output	Operating PSI	ASME Code Designator(s)	<input type="checkbox"/> A <input type="checkbox"/> S <input type="checkbox"/> U <input type="checkbox"/> HLW <input type="checkbox"/> M <input type="checkbox"/> E <input type="checkbox"/> H <input type="checkbox"/> Other	
Stamped MAWP	Heating Surface, Sq. Ft.	Cast Iron	Manhole	Specific On-Site Location i.e., Utility Room			
Pressure Relief Valve Size	Pressure Relief Valve Set Pressure	Pressure Relief Valve Capacity <input type="checkbox"/> Btu/hr <input type="checkbox"/> Lb/hr	Manufacturer	Low-Water Fuel Cutoff Mfg. _____ No. _____			
1. _____ 2. _____ 3. _____ 4. _____	1. _____ 2. _____ 3. _____ 4. _____	1. _____ 2. _____ 3. _____ 4. _____	1. _____ 2. _____ 3. _____ 4. _____	Probe Type _____ Flow Switch _____ Float & Chamber _____ Other (Specify) _____			

PRESSURE/ALTITUDE GAGE: Dial Graduation _____ Valve/Cock Size _____ MAWP _____ Pipe Connection Size _____ Siphon or Equivalent Device <input type="checkbox"/> Yes <input type="checkbox"/> No	EXPANSION TANK: ASME Constructed <input type="checkbox"/> Yes <input type="checkbox"/> No Other _____ MAWP _____ No. Gallons _____	VENTILATION AND COMBUSTION AIR Unobstructed Opening (sq. in.) _____ Power Ventilator Fan (CFM) _____
WATER LEVEL INDICATORS: Number of Gage Glasses _____ Number of Remote Indicators _____ Size of Connection Piping _____	FEED WATER SUPPLY: Number of Feeding Means _____ Pipe Size _____ Stop Valve Size _____ MAWP _____ Check Valve Size _____ MAWP _____	
STOP VALVES: Number of Valves _____ Valve Size _____	EXTERNAL PIPING ASME CODE: <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Other _____	FUEL TRAIN: <input type="checkbox"/> CSD-1 <input type="checkbox"/> NFPA-85 <input type="checkbox"/> Other _____
BOTTOM BLOWDOWN CONNECTIONS: Number of Valves _____ Valve Size _____ MAWP _____ Piping Run Full Size <input type="checkbox"/> Yes <input type="checkbox"/> No	POTABLE WATER HEATER UNIQUE REQUIREMENTS <input type="checkbox"/> Yes <input type="checkbox"/> No Inlet Stop Valve Size _____ MAWP _____ Outlet Stop Valve Size _____ MAWP _____ Drain Valve Size _____ Thermometer <input type="checkbox"/> Yes	
Manufacturer's Certification Attached <input type="checkbox"/> Yes <input type="checkbox"/> No Does boiler replace existing one: <input type="checkbox"/> Yes <input type="checkbox"/> No	Clearance from walls and floors: Side _____ Bottom _____ Top _____	

Additional recommendations and remarks by installer:	
Installer Name (PRINT) _____ Registration # _____	I HEREBY CERTIFY THAT THE INSTALLATION COMPLIES WITH NBIC, Part 1 Installer Signature _____

EXHIBIT 3 Continued

1.4.5.1.1 GUIDE FOR COMPLETING NATIONAL BOARD BOILER INSTALLATION REPORT (21)

- 1) INSTALLATION: Indicate the type and date of installation — new, reinstalled, or second hand.
- 2) INSTALLER: Enter the installer's name and physical address.
- 3) OWNER-USER: Enter the name and mailing address of the owner-user of the boiler.
- 4) OBJECT LOCATION: Enter the name of the company or business and physical address where the installation was made.
- 5) JURISDICTION NO.: Enter the Jurisdiction number if assigned at the time of installation.
- 6) NATIONAL BOARD NO.: Enter the assigned National Board number.
Note:
Cast section boilers do not require National Board registration.
- 7) MANUFACTURER: Enter the boiler manufacturer's name.
- 8) MFG. SERIAL NO.: Enter the assigned boiler manufacturer's serial number.
- 9) YEAR BUILT: Enter the year the boiler was manufactured.
- 10) BOILER TYPE: Enter the type of boiler, e.g., watertube, firetube, cast, electric, etc.
- 11) BOILER USE: Enter the service for which or for how the boiler will be used, e.g., heating (steam or water), potable water, etc.
- 12) FUEL: Enter the type of fuel, e.g., natural gas, diesel, wood, etc. If more than one fuel type, enter the types for which the boiler is equipped.
- 13) METHOD OF FIRING: Enter the method of firing, e.g., automatic, hand, stoker, etc.
- 14) Btu/kW INPUT: Enter the Btu/hr or kW input of the boiler.
- 15) Btu/kW OUTPUT: Enter the Btu/hr or kW output of the boiler.
- 16) OPERATING PSI: Enter the allowed operating pressure.
- 17) ASME CODE DESIGNATOR'S: Check the ASME Code designator shown on the code nameplate or stamping of other certification mark (specify).
- 18) STAMPED MAWP: Enter the maximum allowable working pressure shown on the nameplate or stamping.
- 19) HEATING SURFACE SQ. FT.: Enter the boiler heating surface shown on the stamping or nameplate.
Note:
This entry is not required for electric boilers.

EXHIBIT 3 Continued

- 20) CAST BOILER: Enter the total number of sections for cast boilers.
Note:
Not all cast boilers are sectional. Mono-block cast boilers should be described as having one (1) section.
- 21) MANHOLE: Indicate whether the boiler has a manway.
- 22) SPECIFIC ON-SITE LOCATION: Enter the on-site location of the boiler in sufficient detail to allow location of that boiler.
- 23) PRESSURE RELIEF VALVE SIZE: Enter the inlet and outlet size of all installed boiler safety or safety relief valves.
- 24) PRESSURE RELIEF VALVE SET PRESSURE: Enter the set pressure of all installed boiler safety or safety relief valves.
- 25) PRESSURE RELIEF VALVE CAPACITY: Enter the capacity in either lbs. of steam per hour or Btu/hr for each installed boiler safety or safety relief valve.
- 26) MANUFACTURER: Enter the manufacturer of each installed boiler safety and safety relief valve.
- 27) LOW-WATER FUEL CUTOFF: Enter the manufacturer's name, type, number, and maximum allowable working pressure of all installed low-water fuel cutoff devices.
- 28) PRESSURE/ALTITUDE GAGE: Enter the dial range of the installed pressure or altitude gage, cutout valve or cock size, a maximum allowable working pressure, and gage pipe connection size. For steam boilers, indicate gage siphon or equivalent device installed.
- 29) EXPANSION TANK: Indicate code of construction of installed expansion tank, tank maximum allowable working pressure, and tank capacity in gallons.
- 30) VENTILATION AND COMBUSTION AIR: Indicate total square inches of unobstructed opening or total cubic feet per minute of power ventilator fan(s) available for ventilation and combustion air.
- 31) WATER LEVEL INDICATORS: Enter the number of gage glasses and/or remote indicators and connecting pipe size.
- 32) FEEDWATER SUPPLY: Enter the total number of feeding means, connecting pipe size, stop and check valve size, and maximum allowable working pressure.
- 33) STOP VALVE(S): Enter the number of stop valves installed, valve size, and maximum allowable working pressure.
- 34) POTABLE WATER HEATER UNIQUE REQUIREMENTS: Indicate if stop valves are installed and, if so, enter size and maximum allowable working pressure. Enter drain valve size and indicate installation of thermometer at or near boiler outlet.
- 35) MANUFACTURER'S CERTIFICATION ATTACHED: Indicate if manufacturer's certificate is attached (mandatory for new installations).
- 36) CLEARANCE REQUIREMENTS AND REPLACEMENT OF EXISTING BOILER: Indicate clearances and whether the installation replaced an existing boiler.
- 37) ADDITIONAL REMARKS: Enter any remarks or comments you deem appropriate.
- 38) INSTALLER'S NAME AND SIGNATURE: Print installer's name and registration number and sign completed report.

EXHIBIT 4 October 1, 2023

**MANUFACTURER'S/INSTALLING CONTRACTOR'S REPORT FOR
ASME CSD-1**

Certification and Reporting (CG-500) for Controls and Safety Devices
(This form is a guideline and not part of ASME CSD-1-2021.)

Unit Manufacturer

Name _____

Address _____ Zip _____

Telephone _____ Fax _____

Unit Identification (Boiler)

Manufacturer's Model # _____ Year Built _____

ASME Section I _____ Section IV _____ Nat. Bd. # _____

UL # _____ CSA # _____

Jurisdiction _____

Steam

Maximum W.P. _____ psig

Minimum Safety Valve Cap. _____ lb/hr

Hot Water

Maximum W.P. _____ psig

Maximum Temp. _____ °F

Minimum Safety Relief Valve Cap. _____ lb/hr or Btu/hr

Boiler Unit Description (type) _____

If Modular (no. of modules) _____

Boiler Unit Capacity (output) _____

Burner

Manufacturer _____ Model _____

UL or CSA # _____ Serial # _____

Fuels (as shipped) _____

Indicate Units (where not applicable, indicate "N/A")

Gas Manifold Pressure _____

Oil Nozzle/Delivery Pressure (at maximum input) _____

High Gas Pressure Switch Setting _____

Low Oil Pressure Switch Setting _____

Installation Location (if known)

Customer Name _____

Address _____

City _____ State _____ Zip _____

Telephone _____ Fax _____

EXHIBIT 4 Continued

Certification and Reporting (CG-500) for Controls and Safety Devices (Cont'd)
 (This form is a guideline and not part of ASME CSD-1-2021.)

Control/Device	Manufacturer	Model #	Operational Test Performed, Date
Operating Controls			
Low-Water Fuel Cutoff CW-120(a), CW-140	_____	_____	_____
Forced Circulation CW-210	_____	_____	_____
Steam Pressure CW-310(b)	_____	_____	_____
Water Temperature CW-410(b)	_____	_____	_____
Safety Controls			
Low-Water Fuel Cutoff CW-120(a), CW-120(b), CW-130, CW-140	_____	_____	_____
Forced Circulation CW-210(c)	_____	_____	_____
High Steam Pressure Limit CW-310(c)	_____	_____	_____
High Water Temperature Limit CW-410(b)	_____	_____	_____
Fuel Safety Shutoff Valve, Main CF-180(b)	_____	_____	_____
Pilot Safety Shutoff Valve CF-180(e)	_____	_____	_____
Atomizing Medium Switch CF-450(b)	_____	_____	_____
Combustion Air Switch CF-220	_____	_____	_____
High Gas Pressure CF-162	_____	_____	_____
Low Gas Pressure CF-162	_____	_____	_____
Low Oil Pressure CF-450(a)	_____	_____	_____
High Oil Temperature CF-450(c)	_____	_____	_____
Low Oil Temperature CF-450(d)	_____	_____	_____
Purge Air Flow CF-210	_____	_____	_____
Flame Safeguard (Primary) CF-310, CF-320	_____	_____	_____
Flame Detector CF-310, CF-320	_____	_____	_____
Low Fire Start			
Low Fire Start Switch CF-610	_____	_____	_____
Safety or Safety Relief Valve(s) CW-510, CW-520	_____	_____	_____



EXHIBIT 4 Continued

Certification and Reporting (CG-500) for Controls and Safety Devices (Cont'd)
(This form is a guideline and not part of ASME CSD-1-2021.)

Manufacturer _____ Operational Test Performed, Date _____ / _____ / _____

Model _____

Size _____

Capacity _____ lb/hr of Steam

Representing Equipment Manufacturer, Name _____

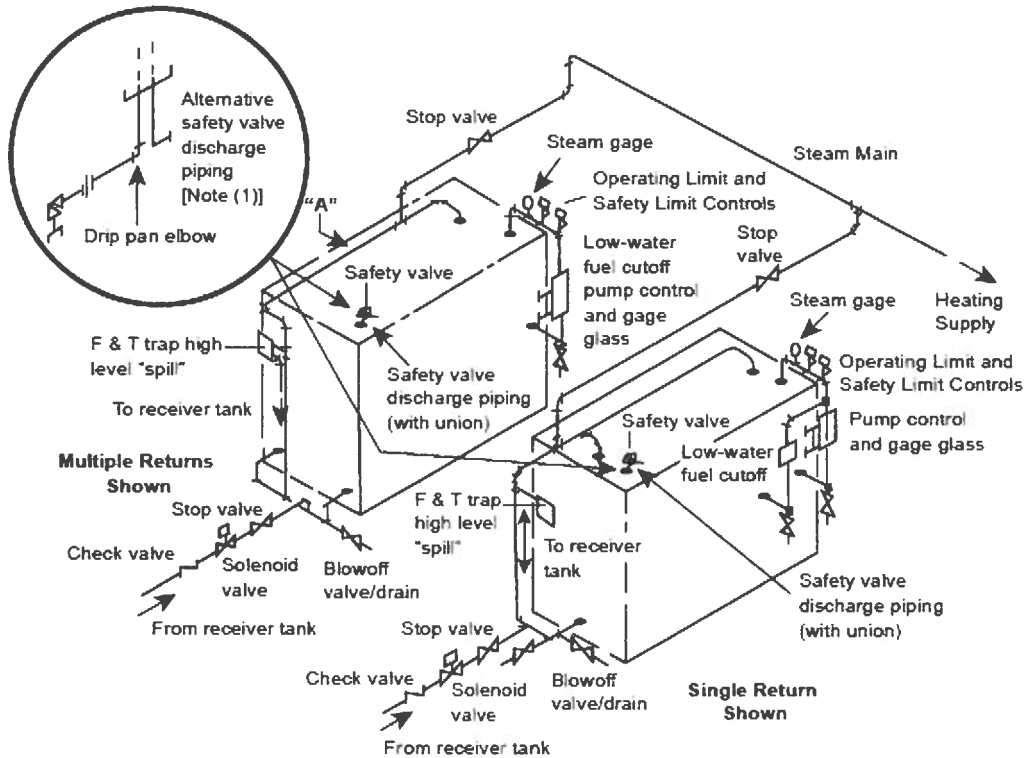
Signature _____ Date _____

Representing Installing Contractor, Name _____

Signature _____ Date _____

EXHIBIT 5 October 1, 2023

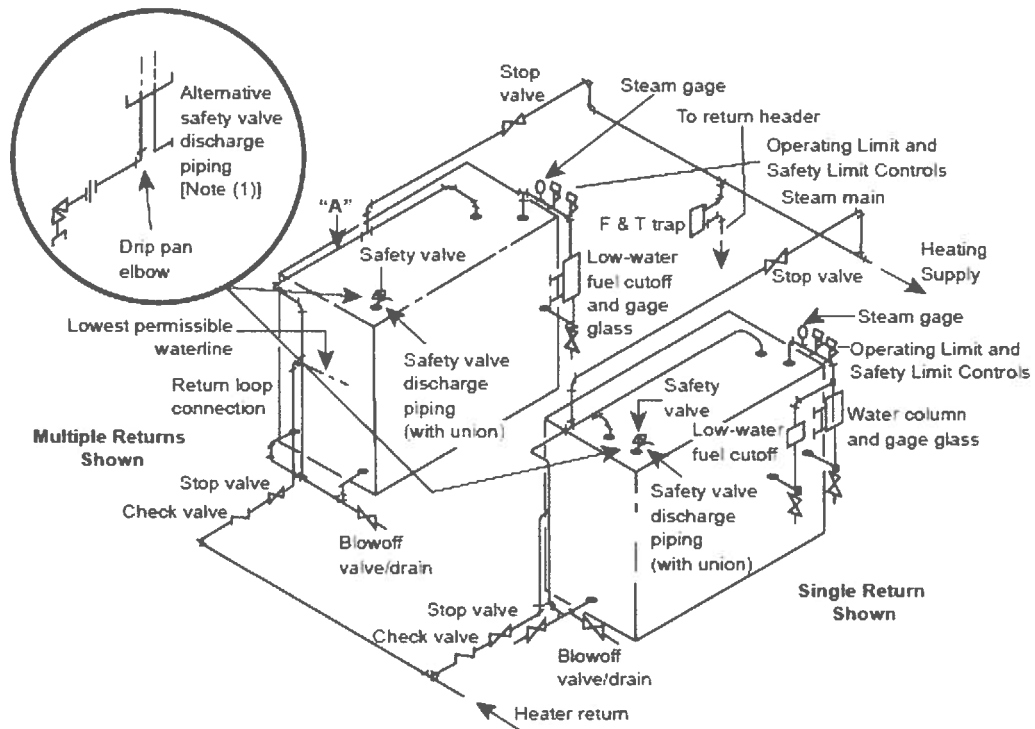
**Steam Boilers in Battery - Pumped Return
Acceptable Piping Installation**



General Note:
Return connections shown for multiple boiler installation may not always ensure that the system will operate properly. In order to maintain proper water levels in multiple boiler installations, it may be necessary to install supplementary controls or suitable devices.

Note:
(1) Recommended for 1 in. (25mm) and larger safety valve discharge.

**Steam Boilers in Battery - Gravity Return
Acceptable Piping Installation**

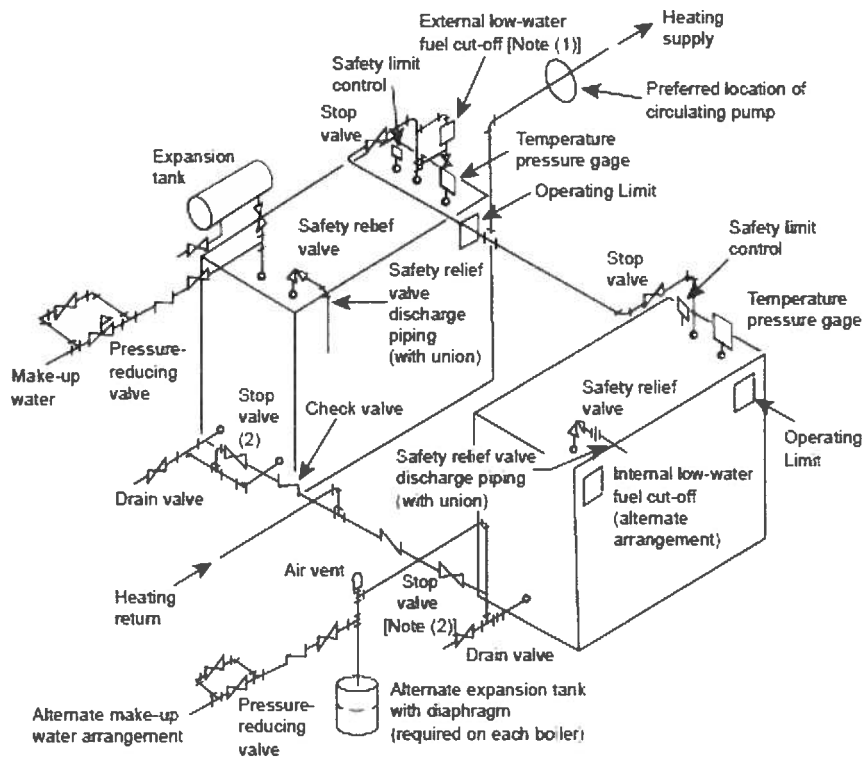


General Note:
Return connections shown for multiple boiler installation may not always ensure that the system will operate properly. In order to maintain proper water levels in multiple boiler installations, it may be necessary to install supplementary controls or suitable devices.

Note:
(1) Recommended for 1 in. (25mm) and larger safety valve discharge.

EXHIBIT 7 October 1, 2023

**Hot Water Boilers in Battery
Acceptable Piping Installation**



General Notes:

(1) Recommended control. See ASME Section IV, HG-614. Acceptable shutoff valve or cocks in the connecting piping may be installed for convenience or control testing and/or service.

(2) The common return header stop valves may be located on either side of the check valves.

EXHIBIT 8 October 1, 2023

EXPANSION TANK CAPACITIES FOR GRAVITY HOT-WATER SYSTEMS

Based on two-pipe system with average operating water temperature 170°F (77°C), using cast-iron column radiation with heat emission rate 150 Btu/hr/ft² (473 W/m²) equivalent direct radiation.		
Installed Equivalent Direct Radiation, ft² (m²) (Note)	No.	Tank Capacity, gallon (l)
up to 350 (33)	1	18 (68)
up to 450 (42)	1	21 (79)
up to 650 (60)	1	24 (91)
up to 900 (84)	1	30 (114)
up to 1,100 (102)	1	35 (132)
up to 1,400 (130)	1	40 (151)
up to 1,600 (149)	2	60 (227)
up to 1,800 (167)	2	60 (227)
up to 2,000 (186)	2	70 (265)
up to 2,400 (223)	2	80 (303)

Note:

For systems with more than 2,400 ft² (223 m²) of installed equivalent direct water radiation, the required capacity of the cushion tank shall be increased on the basis of 1 gallon (3.79 l) tank capacity/33 ft² (3.1 m²) of additional equivalent direct radiation.

EXHIBIT 9 October 1, 2023

MINIMUM POUNDS OF STEAM PER HOUR PER SQUARE FOOT OF HEATING SURFACE
lb steam/hr ft² (kg steam/hr m²)

	Firetube Boiler	Watertube Boiler
Boiler Heating Surface		
Hand-fired	5 (24)	6 (29)
Stoker-fired	7 (34)	8 (39)
Oil, gas, or pulverized coal	8 (39)	10 (49)
Waterwall Heating Surface		
Hand-fired	8 (39)	8 (39)
Stoker-fired	10 (49)	12 (59)
Oil, gas, or pulverized coal	14 (68)	16 (78)
Copper-finned Watertubes		
Hand-fired		4 (20)
Stoker-fired		5 (24)
Oil, gas, or pulverized coal		6 (29)

Notes:

- When a boiler is fired only by a gas having a heat value not in excess of 200 Btu/ft³ (7.5MJ/m³), the minimum relieving capacity should be based on the values given for hand-fired boilers above.
- The heating surface shall be computed for that side of the boiler surface exposed to the products of combustion, exclusive of the superheating surface. In computing the heating surface for this purpose only the tubes, fireboxes, shells, tubesheets, and the projected area of headers need to be considered, except that for vertical firetube steam boilers, only that portion of the tube surface up to the middle gage cock is to be computed.
- For firetube boiler units exceeding 8,000 Btu/ft² (9,085 J/cm²) (total fuel Btu (J) input divided by total heating surface), the factor from the table will be increased by 1 (4.88) for every 1,000 Btu/ft² (1,136 J/cm²) above 8,000 Btu/ft² (9,085 J/cm²). For units less than 7,000 Btu/ft² (7,950 J/cm²), the factor from the table will be decreased by 1 (4.88).
- For watertube boiler units exceeding 16,000 Btu/ft² (18,170 J/cm²) (total fuel Btu input divided by the total heating surface) the factor from the table will be increased by 1 (4.88) for every 1,000 Btu/ft² (1,136 J/cm²) above 16,000 Btu/ft² (18,170 J/cm²). For units with less than 15,000 Btu/ft² (17,034 J/cm²), the factor in the table will be decreased by 1 (4.88) for every 1,000 Btu/ft² (1,136 J/cm²) below 15,000 Btu/ft² (17,034 J/cm²).