

HAWAII ADMINISTRATIVE RULES

TITLE 12

DEPARTMENT OF LABOR AND INDUSTRIAL RELATIONS

SUBTITLE 8

HAWAII OCCUPATIONAL SAFETY AND HEALTH DIVISION

PART 10

BOILER AND PRESSURE VESSELS

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;
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§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]
(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 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 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 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 secondhand 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] (Auth: §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

post-installation pressure test in accordance with the requirements of the original code of construction, 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:

- (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]
(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), 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);
 - (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) after the completion, inspection, and acceptance of the installation by an inspector employed by the department. The NB Boiler Installation Report I-1 (NB365, see Exhibit 3) 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 jurisdiction;
 - (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]
(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] (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; and
 - (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, but where steel or wrought iron pipe or tubing is used, they shall not be less than NPS 1/2. 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
- (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 or vapor system boiler shall have an automatic low-water fuel cutoff so located as to automatically cut off the fuel supply when the surface of the water falls to 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 or vapor system 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 a 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; and
- (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 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

(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] (Auth: HRS §397-4) (Imp: HRS §397-4)

- (1) The individual modules shall comply with all the requirements of the code of construction. 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
- (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 and 6; and
 - (B) Return pipe connection, see Exhibit 5 and 6; and
 - (3) The assembled modular hot-water boiler shall also be equipped with a:
 - (A) Makeup water connection, see Exhibit 7;
 - (B) Provision for thermal expansion, see Exhibit 7 and Exhibit 8; and
 - (C) Stop valves, see Exhibit 7 (treating the assembled modular boiler as a single unit).
- (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);
 - (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 1 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] (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 10). 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. 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,

- 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
- (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] (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 installer or the

manufacturer 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, to a fitting connected to the water heater by a short nipple, to a Y-base, or to a valve-less header connecting water outlets on the same heater;
- (3) Temperature and pressure relief valves shall be installed with their spindles upright and vertical with no horizontal connecting pipe, except that, when the temperature and pressure relief valve is installed 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; and
 - (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. [Eff and

comp] (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 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), and loadings (including the weight of the fluid in the system during a pressure test) in 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 floor area and containing one or more heating boilers having a combined fuel capacity of 1,000,000 Btu per hour or more. 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] (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; and
 - (4) For power burners with detached auxiliaries, only the fuel input supply needs be shut off.
- (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. The combustion and ventilation air should be supplied by either an unobstructed air opening or by power ventilation or fans. When combustion air is supplied to the boiler 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;
 - (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 (3) may be reduced when special engineered air supply systems approved by the jurisdiction 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 jurisdictional and environmental 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; 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.

(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).

(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). [Eff and comp] (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 Exhibits 1 and 2). 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 ASME CSD-1, Part CM (see Exhibits 1 and 2). [Eff and comp] (Auth: HRS §397-4) (Imp: HRS §397-4)

RECOMMENDED PREVENTIVE MAINTENANCE SCHEDULE

(Operation and maintenance instructions in this safety standard are intended for general applications. For specific operating and maintenance instructions, consult the equipment manufacturer.)

D-1 DAILY

- (a) Check gages, monitors, and indicators.
- (b) Check instrument and equipment settings.
- (c) For high-pressure boilers, test low-water fuel cut-off device and alarm.
- (d) Check burner flame.

D-2 WEEKLY

- (a) For low-pressure boilers, test low-water fuel cut-off device and alarm.
- (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-3 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 temperature interlocks.
- (e) Test high and low gas pressure interlocks.

D-4 SEMI-ANNUALLY

- (a) Recalibrate all indicating and recording gages.
- (b) For steam boilers, perform a slow drain test of the low-water fuel cut-off device.
- (c) Check flame failure detection system components.
- (d) Check firing rate control.
- (e) Check piping and wiring of all interlocks and shut-off valves.
- (f) Inspect burner components.

D-5 ANNUALLY

- (a) Flame failure detection system, pilot turndown 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 fuel valve interlock switch in accordance with manufacturer's instructions.

- (i) Perform leakage test on pilot and main gas and/or oil fuel valves.

- (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.

D-6 AS REQUIRED

- (a) Recondition or replace low-water fuel cut-off 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, pilot turndown test.

- (e) Flame failure detection system, test for hot refractory hold in.

- (f) Test safety/safety relief valves in accordance with ASME Boiler and Pressure Vessel Code, Sections VI and VII.

EXHIBIT 2 September 1, 2019

Table D-1 Periodic Testing Recommended Checklist (See Manufacturer's Instructions)

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 cut-off device (high-pressure boilers)	Test low-water fuel cut-off device according to manufacturer's instructions.	X	...
...	X	...	...	...	...	Low-water fuel cut-off device (low-pressure boilers)	Test low-water fuel cut-off device according to manufacturer's instructions.	X	...
...	...	...	X	...	...	Low-water fuel cut-off device (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 cut-off device	Recondition or replace low-water fuel cut-off 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	...

Table D-1 Periodic Testing Recommended Checklist (Cont'd)

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	...
...	...	...	...	X	...	Low draft, fan, air pressure, and damper position interlocks	Test purge switch in accordance with manufacturer's instructions.	...	X

EXHIBIT 2 Continued

Table D-1 Periodic Testing Recommended Checklist (Cont'd)

Frequency [Note (1)]							Accomplished By		
D	W	M	S/A	A	A/R	Component/Item	Recommended Test	Boiler Operator	Service Technician
...	...	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 in accordance with 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

NOTES:

(1) D, daily; W, weekly; M, monthly; S/A, semi-annually; 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 September 1, 2019

BOILER INSTALLATION REPORT I-1

INSTALLATION: ① ☐ New ☐ Reinstalled ☐ Second Hand Date ____/____/____

② INSTALLER	③ OWNER-USER	④ OBJECT LOCATION
Name	Name	Name
Street	Street, PO Box, RR	Street
City, State, ZIP	City, State, ZIP	City, State, ZIP

Jurisdiction No. ⑤	National Board No. ⑥	Manufacturer ⑦	Mfg. Serial No. ⑧	Year Built ⑨	Boiler Type ⑩	Boiler Use ⑪
Fuel ⑫	Method of Firing ⑬	Btu/hr input ⑭	Btu/hr output ⑮	Operating PSI ⑯	Code Stamp(s) ⑰	☐ A ☐ S ☐ U ☐ HDW ☐ M ☐ B ☐ H ☐ Other
Storage/MAWP ⑱	Heating Surface, Sq. Ft. ⑲	Cut In ⑳	Manhole ㉑	Specific On-Site Location, i.e., Utility Room ㉒		
Pressure Relief Valve Size ㉓	Pressure Relief Valve Set Pressure ㉔	Pressure Relief Valve Capacity ☐ BTU/hr ☐ Lb/hr 1. _____ 2. _____ 3. _____ 4. _____	Manufacturer ㉕	Low-Water Fuel Cutoff Mfg. No. ㉖ Probe Type _____ Reset Switch _____ Reset & Chamber _____ Other (Specify) _____		

PRESSURE/ALTITUDE GAGE ②8 Dial Graduation _____ Valve/Cock Size _____ MAWP _____ Pipe Connection Size _____ Siphon or Equivalent Device ☐ Yes ☐ No	EXPANSION TANK ②9 ASME Constructed ☐ Yes ☐ No Other _____ MAWP _____ No. Gallons _____	VENTILATION AND COMBUSTION AIR ③0 Unobstructed Opening (sq. in.) _____ Forced Ventilator Fan (CFM) _____
WATER LEVEL INDICATORS ③1 Number of Gage Glasses _____ Number of Remote Indicators _____ Size of Connection Piping _____	FRESHWATER SUPPLY ③2 Number of Feeding Mains _____ Pipe Size _____ Stop Valve Size _____ MAWP _____ Check Valve Size _____ MAWP _____	EXTERNAL PIPING ASME CODE ☐ Yes ☐ No ☐ Other ④0 FUEL TRAINING ☐ CSD-1 ☐ NFPA-48 ☐ Other
STOP VALVES ③3 Number of Valves _____ Valve Size _____ Piping Run Full Size ☐ Yes ☐ No	POTABLE WATER HEATER UNIQUE REQUIREMENTS ☐ Yes ☐ No Inlet Stop Valve Size _____ MAWP _____ Outlet Stop Valve Size _____ MAWP _____ Drain Valve Size _____ Thermometer ☐ Yes ③4	Clearance from walls and floors: Side _____ Bottom _____ Top ③5
Manufacturer's Certification Attached: ☐ Yes ☐ No ③5 Does boiler replace existing ones: ☐ Yes ☐ No ③6		

Additional recommendations and remarks by installer: ③7	
③8 Installer Name (PRINT) _____ Registration # _____	I HEREBY CERTIFY THAT THE INSTALLATION COMPLIES WITH APPENDIX I ③9 Installer Signature _____

This form may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Crapper Ave., Columbus, OH 43229

NB-305 Rev. 2

EXHIBIT 4 September 1, 2019

ASME CSD-1-2012

NONMANDATORY APPENDIX C 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-1-2012.)

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. _____ PPH

Hot Water

Maximum W.P. _____ psig

Maximum Temp. _____ °F

Minimum Safety Relief Valve Cap. _____ PPH or Btu

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 5 September 1, 2019

ASME CSD-1-2012

Certification and Reporting (CG-500) for Controls and Safety Devices (Cont'd) (This Form is a guideline and not part of ASME CSD-1-2012.)

Control/Device	Manufacturer	Model #	Operational Test Performed, Date
Operating Controls			
Low-Water Fuel Cutoff CW-120(a), CW-140			
Forced Circulation CW-210(a)			
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(b)			
High Steam Pressure Limit CW-310(c)			
High Water Temperature Limit CW-410(b)			
Fuel Safety Shutoff Valve, Main CF-180(b)(2), CF-180(b)(3)			
Pilot Safety Shutoff Valve CF-180(c)			
Atomizing Medium Switch CF-450(b)			
Combustion Air Switch CF-210			
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 5 Continued

ASME CSD-1-2012

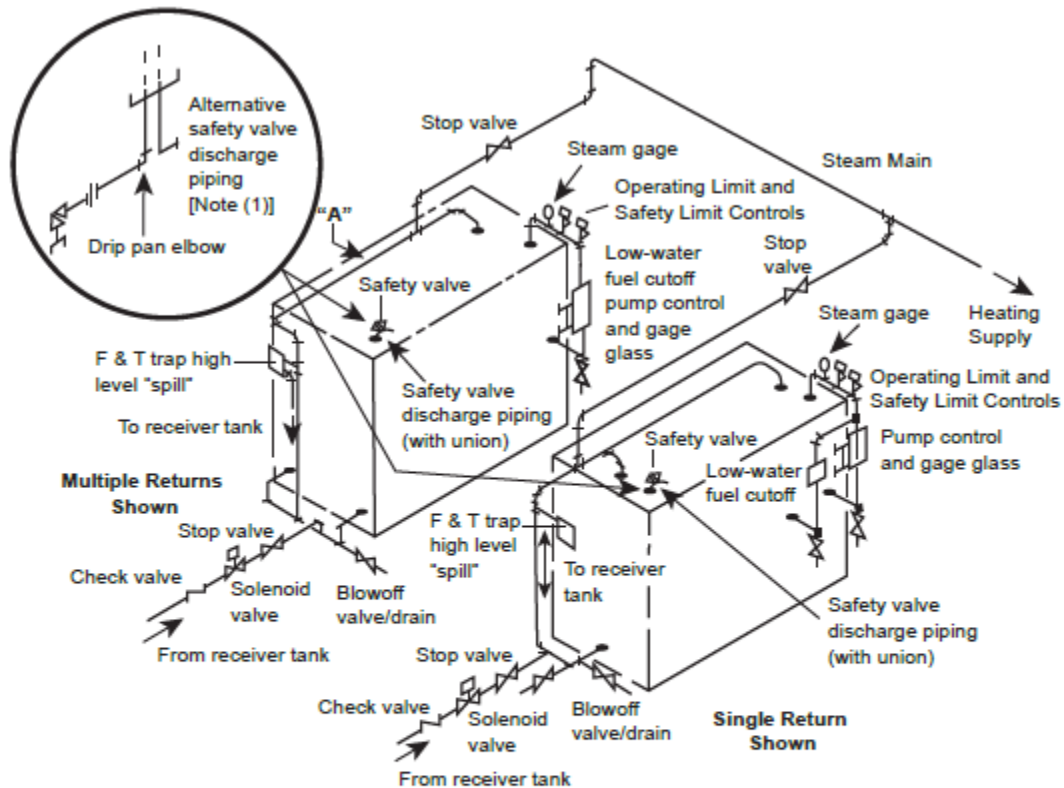
Certification and Reporting (CG-500) for Controls and Safety Devices (Cont'd)
(This Form is a guideline and not part of ASME CSD-1-2012.)

Manufacturer _____ Operational Test Performed, Date _____ / _____ / _____
Model _____
Size _____
Capacity _____ FPH/Btu/hr

Representing Equipment Manufacturer, Name _____
Signature _____ Date _____

Representing Installing Contractor, Name _____
Signature _____ Date _____

EXHIBIT 6 September 1, 2019



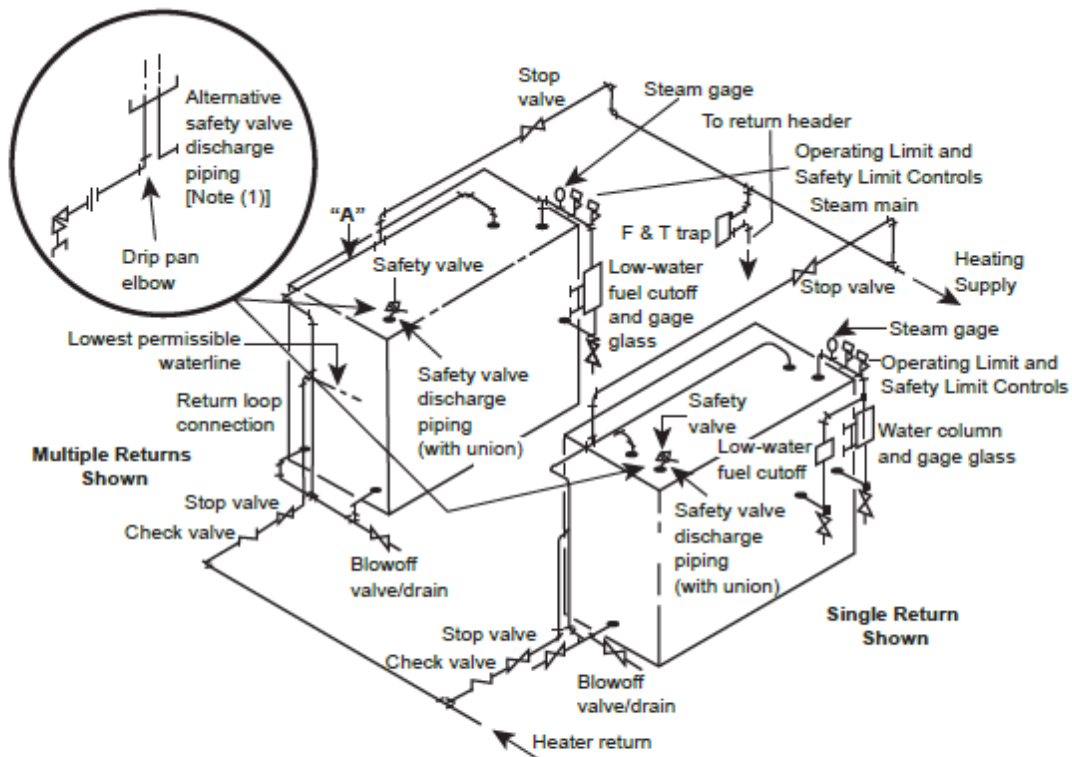
General Note:

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 September 1, 2019



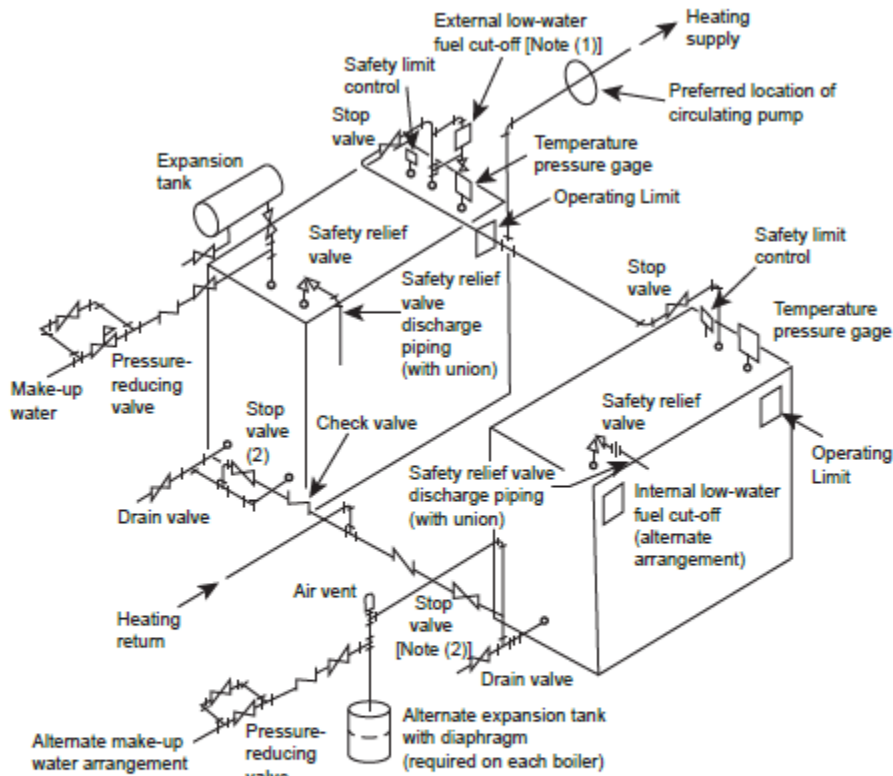
General Note:

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 8 September 1, 2019



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 9 September 1, 2019

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/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.

EXHIBIT 10 September 1, 2019

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/ft.³(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/ft.² (9,085 J/cm.²) (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/ft.² (1,136 J/cm.²) above 8,000 Btu/ft.² (9,085 J/cm.²) For units less than 7,000 Btu/ft.² (7,950 J/cm.²), the factor from the table will be decreased by 1 (4.88).
- For watertube boiler units exceeding 16,000 Btu/ft.² (18,170 J/cm.²)(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/ft.² (1,136 J/cm.²) above 16,000 Btu/ft.² (18,170 J/cm.²). For units with less than 15,000 Btu/ft.² (17,034 J/cm.²), the factor in the table will be decreased by 1 (4.88) for every 1,000 Btu/ft.² (1,136 J/cm.²) below 15,000 Btu/ft.² (17,034 J/cm.²).