In 1911, The American Society of Mechanical Engineers established the Boiler and Pressure Vessel Committee to formulate standard rules for the construction of steam boilers and other pressure vessels. In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees:

(a) Committee on Power Boilers (I)
(b) Committee on Materials (II)
(c) Committee on Construction of Nuclear Facility Components (III)
(d) Committee on Heating Boilers (IV)
(e) Committee on Nondestructive Examination (V)
(f) Committee on Pressure Vessels (VIII)
(g) Committee on Welding, Brazing, and Fusing (IX)
(h) Committee on Fiber-Reinforced Plastic Pressure Vessels (X)
(i) Committee on Nuclear Inservice Inspection (XI)
(j) Committee on Transport Tanks (XII)
(k) Technical Oversight Management Committee (TOMC)

Where reference is made to “the Committee” in this Foreword, each of these committees is included individually and collectively.

The Committee’s function is to establish rules of safety relating only to pressure integrity, which govern the construction of boilers, pressure vessels, transport tanks, and nuclear components, and the inservice inspection of nuclear components and transport tanks. The Committee also interprets these rules when questions arise regarding their intent. The technical consistency of the Sections of the Code and coordination of standards development activities of the Committees is supported and guided by the Technical Oversight Management Committee. This Code does not address other safety issues relating to the construction of boilers, pressure vessels, transport tanks, or nuclear components, or the inservice inspection of nuclear components or transport tanks. Users of the Code should refer to the pertinent codes, standards, laws, regulations, or other relevant documents for safety issues other than those relating to pressure integrity. Except for Sections XI and XII, and with a few other exceptions, the rules do not, of practical necessity, reflect the likelihood and consequences of deterioration in service related to specific service fluids or external operating environments. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property, and to provide a margin for deterioration in service to give a reasonably long, safe period of usefulness. Advancements in design and materials and evidence of experience have been recognized.

This Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities and inservice inspection and testing activities. The Code does not address all aspects of these activities and those aspects that are not specifically addressed should not be considered prohibited. The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment. The phrase engineering judgment refers to technical judgments made by knowledgeable engineers experienced in the application of the Code. Engineering judgments must be consistent with Code philosophy, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of the Code.

The Committee recognizes that tools and techniques used for design and analysis change as technology progresses and expects engineers to use good judgment in the application of these tools. The designer is responsible for complying with Code rules and demonstrating compliance with Code equations when such equations are mandatory. The Code neither requires nor prohibits the use of computers for the design or analysis of components constructed to the

The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Code.

Construction, as used in this Foreword, is an all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification, and overpressure protection.
PART HG
GENERAL REQUIREMENTS FOR ALL MATERIALS OF CONSTRUCTION

ARTICLE 1
SCOPE AND SERVICE RESTRICTIONS

HG-100 SCOPE

(a) The rules of Part HG apply to steam heating boilers, hot water heating boilers, hot water supply boilers, and to appurtenances thereto. They shall be used in conjunction with the specific requirements in Part HF (boilers of wrought materials), Part HC (cast iron boilers), and Part HA (cast aluminum boilers), as applicable. The Foreword provides the basis for these rules. Part HG is not intended to apply to potable water heaters except as provided for in Part HLW. Boilers with economizers shall follow the rules of Mandatory Appendix 10.

(b) This Part contains mandatory requirements, specific prohibitions, and nonmandatory guidance for materials, designs, fabrication, examination, inspection, testing, certification, and pressure relief. When detailed rules are not given in Section IV, the Manufacturer, subject to the acceptance of the Authorized Inspector, shall provide details of design that will be as safe as those provided by the rules of Section IV. This may be done by appropriate analytical methods, the appropriate use of rules from other design Codes or, as permitted in HG-500, by proof test.

(c) The Manufacturer shall establish the effective Code edition, addenda, and cases in accordance with Mandatory Appendix 9. Laws or regulations issued by a municipality, state, provincial, federal, or other enforcement or regulatory body having jurisdiction at the location of an installation, establish the mandatory applicability of these rules, in whole or in part.

HG-101 SERVICE RESTRICTIONS

HG-101.1 Service Restrictions. The rules of this Section are restricted to the following services:

(a) Steam boilers for operation at pressures not exceeding 15 psi (100 kPa)

(b) Hot water heating boilers and hot water supply boilers for operation at pressures not exceeding 160 psi (1100 kPa)

(c) Hot water heating boilers and hot water supply boilers for operation at temperatures not exceeding 250°F (120°C), at or near the boiler outlet, except that when some of the wrought materials permitted by Part HF are used, a lower temperature is specified.

HG-101.2 Services in Excess of Those Covered by This Section. For services exceeding the limits specified in HG-101.1, the rules of Section I shall apply.

HG-102 UNITS

Either U.S. Customary, SI, or any local customary units may be used to demonstrate compliance with all requirements of this edition (e.g., materials, design, fabrication, examination, inspection, testing, certification, and overpressure protection).

In general, it is expected that a single system of units shall be used for all aspects of design except where unfeasible or impractical. When components are manufactured at different locations where local customary units are different than those used for the general design, the local units may be used for the design and documentation of that component. Similarly, for proprietary components or those uniquely associated with a system of units different than that used for the general design, the alternate units may be used for the design and documentation of that component.

For any single equation, all variables shall be expressed in a single system of units. When separate equations are provided for U.S. Customary and SI units, those equations must be executed using variables in the units associated with the specific equation. Data expressed in other units shall be converted to U.S. Customary or SI units for use in these equations. The result obtained from execution of these equations may be converted to other units.
ARTICLE 3
DESIGN

HG-300 DESIGN PRESSURE

(a) The design pressure is the pressure used in the formulas of this Article, in conjunction with the allowable stress values, design rules, and dimensions specified for determining the minimum required thicknesses for the parts of a boiler. The design pressure for a heating boiler shall be at least 30 psi (200 kPa).

(b) The term maximum allowable working pressure refers to gage pressure, or the pressure in excess of the atmospheric pressure in the boiler. The maximum allowable working pressure, as stamped on the boiler per HG-530, must be less than or equal to the design pressure for any of its parts.

(c) No boiler shall be operated at a pressure higher than the maximum allowable working pressure except when the safety valves or relief valves are discharging, at which time the maximum allowable working pressure shall not be exceeded by more than the amount specified in HG-400.1 and HG-400.2.

HG-301 CYLINDRICAL PARTS UNDER INTERNAL PRESSURE

HG-301.1 General. The required thickness and the design pressure of cylindrical shells, tubes, pipe, and headers shall be determined in accordance with the following formulas:

\[ t = \frac{PR}{SE - 0.6P} \]

\[ P = \frac{SEt}{R + 0.6t} \]

where

\[ E = \text{efficiency of longitudinal joint or of ligament between tube holes, whichever is the lesser. For welded joints, use the efficiency specified in HW-702. For seamless shells, use } E = 1. \]

\[ P = \text{design pressure [but not less than 30 psi (200 kPa)]} \]

\[ R = \text{inside radius of cylinder} \]

\[ S = \text{maximum allowable stress value from Table HF-300.1 (HF-300.1M) or Table HF-300.2 (HF-300.2M)} \]

\[ t = \text{required wall thickness} \]

HG-301.2 Tubes.

(a) The wall thickness of tubes and pipes subject to internal pressure shall be determined in accordance with the formulas in HG-301.1.

(b) The wall thickness of tubes and pipes subject to external pressure shall be determined by the procedures outlined in HG-312.3.

(c) In no case shall a tube or a pipe used as a tube have a wall thickness less than 0.02 in. (0.5 mm).

(d) Tubes installed by rolling shall have an additional 0.04 in. (1 mm) of wall thickness added to the minimum required thickness as an allowance for rolling and structural stability.

(e) The design temperature of tubes shall be the mean metal temperature as determined by the boiler Manufacturer.

(f) For austenitic stainless steel materials, the water temperature shall not exceed 210°F (99°C). [See Table HF-300.1 (HF-300.1M), Note (12).]

(g) Welding or brazing shall be qualified in accordance with Section IX.

HG-305 FORMED HEADS, PRESSURE ON CONCAVE SIDE

HG-305.1 General. The required thickness at the thinnest point after forming\(^1\) of ellipsoidal, torispherical, and hemispherical heads under pressure on the concave side (plus heads) shall be computed by the appropriate formulas in this paragraph.

(a) Notation. The symbols used in this paragraph are defined as follows:

\[ D = \text{inside diameter of the head skirt; or inside length of the major axis of an ellipsoidal head; or inside diameter of a cone head at the point under consideration, measured perpendicular to the longitudinal axis} \]

\[ E = \text{lowest efficiency of any joint in the head. For welded joints, use the efficiency specified in HW-702. For seamless heads, use } E = 1, \text{ except for hemispherical heads furnished without a skirt, in which case use the efficiency of the head-to-shell joint.} \]

\[ L = \text{inside spherical or crown radius} \]
ARTICLE 4
PRESSURE-RELIEVING DEVICES

HG-400  PRESSURE-RELIEVING VALVE REQUIREMENTS

HG-400.1 Safety Valve Requirements for Steam Boilers.
(a) Each steam boiler shall have one or more officially rated safety valves that are identified with the Certification Mark with V or HV designator of the spring pop type adjusted and sealed to discharge at a pressure not to exceed 15 psi (100 kPa).
(b) No safety valve for a steam boiler shall be smaller than NPS 1/2 (DN 15) or larger than NPS 4 (DN 100). The inlet opening shall have an inside diameter equal to, or greater than, the seat diameter.
(c) The minimum relieving capacity of valve or valves shall be governed by the capacity marking on the boiler called for in HG-530.
(d) The minimum valve capacity in pounds per hour shall be determined by dividing the maximum Btu/hr (kW) output at the boiler nozzle obtained by the firing of any fuel for which the unit is installed by 1,000 (0.646). In every case, the requirement of (e) shall be met.
(e) The safety 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 5 psi (35 kPa) above the maximum allowable working pressure.
(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 (e). The additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.

HG-400.2 Safety Relief Valve Requirements for Hot Water Boilers.
(a) Each hot water heating or supply boiler shall have at least one officially rated safety relief valve, of the automatic reseating type, identified with the Certification Mark with V or HV designator, and set to relieve at or below the maximum allowable working pressure of the boiler.
(b) When more than one safety relief valve is used on either hot water heating or hot water supply boilers, the additional valves shall be officially rated and may have a set pressure within a range not to exceed 6 psi (40 kPa) above the maximum allowable working pressure of the boiler up to and including 60 psi (400 kPa), and 5% for those having a maximum allowable working pressure exceeding 60 psi (400 kPa).
(c) Safety relief valve capacity for each boiler with a single safety relief valve shall be such that, with the fuel burning equipment installed and operated at maximum capacity, the pressure cannot rise more than 10% above the maximum allowable working pressure.
(d) 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 (e). The additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.

HG-400.3 Safety and Safety Relief Valves for Tanks and Heat Exchangers.
(a) Steam to Hot Water Supply. When a hot water supply is heated indirectly by steam in a coil or pipe within the service limitations set forth in HG-101, the pressure of the steam used shall not exceed the safe working pressure of the hot water tank, and a safety relief valve at least NPS 1 (DN 25), set to relieve at or below the maximum allowable working pressure of the tank, shall be applied on the tank.
(b) High-Temperature Water-to-Water Heat Exchanger. When high-temperature water is circulated through the coils or tubes of a heat exchanger to warm water for space heating or hot water supply, within the service limitations set forth in HG-101, the heat exchanger shall be equipped with one or more officially rated safety relief valves that are identified with the Certification Mark with V or HV designator, set to relieve at or below the maximum allowable working pressure of the heat exchanger, and of sufficient rated capacity to prevent the heat exchanger pressure from rising more than 10% above the maximum allowable working pressure of the vessel.

(c) High-Temperature Water-to-Steam Heat Exchanger. When high-temperature water is circulated through the coils or tubes of a heat exchanger to generate low-pressure steam, within the service limitations set forth in HG-101, the heat exchanger shall be equipped with one or more officially rated safety valves that are identified with the Certification Mark with V or HV designator, set to relieve at a pressure not to exceed 15 psi (100 kPa), and of sufficient rated capacity to prevent the heat exchanger pressure from rising more than 5 psi (35 kPa) above the maximum allowable working pressure of the vessel. For heat exchangers requiring steam pressures greater than 15 psi (100 kPa), refer to Section I or Section VIII, Division 1.

HG-401. MINIMUM REQUIREMENTS FOR SAFETY AND SAFETY RELIEF VALVES

HG-401.1 Mechanical Requirements.

(a) The inlet opening shall have an inside diameter approximately equal to, or greater than, the seat diameter. In no case shall the maximum opening through any part of the valve be less than 3/8 in. (6 mm) in diameter or its equivalent area.

(b) Safety relief valves officially rated as to capacity shall have pop-action when tested by steam.

(c) O-rings or other packing devices when used on the stems of safety relief valves shall be so arranged as not to affect their operation or capacity.

(d) The design shall incorporate guiding arrangements necessary to insure consistent operation and tightness. Excessive lengths of guiding surfaces should be avoided. Bottom-guided designs are not permitted on safety relief valves.

(e) Safety valves shall have a controlled blowdown of 2 psi to 4 psi (15 kPa to 30 kPa) and this blowdown need not be adjustable.

(f) Safety valves shall be spring-loaded. The spring shall be designed so that the full lift spring compression shall be no greater than 80% of the nominal solid deflection. The permanent set of the spring (defined as the difference between the free height and height measured 10 min after the spring has been compressed solid three additional times after presetting at room temperature) shall not exceed 0.5% of the free height.

(g) There shall be a lifting device and a mechanical connection between the lifting device and the disk capable of lifting the disk from the seat a distance of at least 0.0625 in. (1.5 mm) with no pressure on the boiler.

(h) A body drain below seat level shall be provided by the Manufacturer for all safety valves and safety relief valves, except that the body drain may be omitted when the valve seat is above the bottom of the inside diameter of the discharge piping. For valves exceeding NPS 2 1/2 (DN 65) the drain hole or holes shall be tapped not less than NPS 3/8 (DN 10). For valves NPS 2 1/2 (DN 65) or smaller, the drain hole shall not be less than 1/8 in. (6 mm) in diameter. Body drain connections shall not be plugged during or after field installation. In safety relief valves of the diaphragm type, the space above the diaphragm shall be vented to prevent a buildup of pressure above the diaphragm. Safety relief valves of the diaphragm type shall be so designed that failure or deterioration of the diaphragm material will not impair the ability of the valve to relieve at the rated capacity.

(i) In the design of the body of the valve consideration shall be given to minimizing the effects of water deposits.

(j) Valves shall be provided with wrenching surfaces to allow for normal installation without damaging operating parts.

(k) The set pressure tolerances, plus or minus, of safety valves shall not exceed 2 psi (15 kPa), and for safety relief valves shall not exceed 3 psi (20 kPa) for pressures up to and including 60 psig (400 kPa) and 5% for pressures above 60 psig (400 kPa).

(l) Safety valves shall be arranged so that they cannot be reset to relieve at a higher pressure than the maximum allowable working pressure of the boiler.

HG-401.2 Material Selection.

(a) Cast iron seats and disks are not permitted.

(b) Adjacent sliding surfaces such as guides and disks shall both be of corrosion resistant material.

(c) Springs of corrosion resistant material or having a corrosion resistant coating are required.

(d) Material for seats and disks should be such as to provide a reasonable degree of resistance to steam cutting.

(e) Material for valve bodies and bonnets or their corresponding metallic pressure-containing parts shall be listed in Section II, except that in cases where a manufacturer desires to make use of materials other than those listed in Section II, he shall establish and maintain specifications requiring equivalent control of chemical and physical properties and quality.

(f) Synthetic disk inserts of O-ring or other types if used shall be compatible with the maximum design temperature established for the valve.
ASME BPVC.IV-2019

HG-401.4 Manufacturer’s Testing.
(a) Every safety valve shall be tested to demonstrate its popping point, blowdown, and tightness. Every safety relief valve shall be tested to demonstrate its opening point and tightness. Safety valves shall be tested on steam or air and safety relief valves on water, steam, or air. When the blowdown is nonadjustable, the blowdown test may be performed on a sampling basis.
(b) A Manufacturer shall have a well-established program for the application, calibration, and maintenance of test gages.
(c) Testing time on safety valves shall be sufficient, depending on size and design, to insure that test results are repeatable and representative of field performance.
(d) Test fixtures and test drums shall be of adequate size and capacity to assure representative pop-action and accuracy of blowdown adjustment.
(e) A tightness test shall be conducted at maximum expected operating pressure, but not at a pressure exceeding the resetting pressure of the valve.

HG-401.5 Design Requirements.
At the time of the submission of valves for capacity certification, or testing in accordance with this Section, the ASME Designee has the authority to review the design for conformity with the requirements of this Section, and to reject or require modification of designs that do not conform, prior to capacity testing.

HG-402 DISCHARGE CAPACITIES OF SAFETY AND SAFETY RELIEF VALVES

HG-402.1 Valve Markings.
Each safety or relief valve shall be plainly marked with the required data by the Manufacturer in such a way that the markings will not be obliterated in service. The markings shall be placed on the valve or a metal nameplate, which shall be securely fastened to the valve.

For units other than those included below, see HG-102.
(a) The markings shall include the following:
(1) the name or an acceptable abbreviation of the Manufacturer
(2) Manufacturer’s design or type number
(3) NPS _____ in. (DN) (the nominal pipe size of the valve inlet)
(4) set pressure _____ psi (kPa)
(5) capacity _____ lb/hr (kg/hr), or capacity _____ Btu/hr (kW) in accordance with HG-402.7
(6) year built or, alternatively, a coding may be marked on the valves such that the valve Manufacturer can identify the year the valve was assembled and tested
(7) Certification Mark with HV designator as shown in Figure HG-402 with the HV designator placed under the Certification Mark. A marking method other than the stamp issued by the Society may be used provided it is acceptable to the ASME Designated Organization.
HG-402.2 Authorization to Use ASME Certification Mark. Each safety valve to which the Certification Mark (Figure HG-402) is to be applied shall be produced by a Manufacturer and/or Assembler who is in possession of a valid Certificate of Authorization. (see HG-540.) For all valves to be stamped with the Certification Mark with HV designator, a Certified Individual (CI) meeting the current requirements of ASME QAI-1 shall provide oversight to ensure that the use of the Certification Mark with HV designator on a safety valve or safety relief valve is in accordance with this Section and that the use of the Certification Mark with HV designator is documented on a Certificate of Conformance Form, HV-1.

(a) Requirements for the Certified Individual (CI). The CI shall

1. be qualified in accordance with ASME CA-1.
2. have the following qualifications as a minimum:
   - (a) knowledge of the requirements of this Section for the application of the Certification Mark with HV designator
   - (b) knowledge of the Manufacturer’s quality program
   - (c) training commensurate with the scope, complexity, or special nature of the activities to which oversight is to be provided
3. have a record, maintained and certified by the Manufacturer, containing objective evidence of the qualifications of the CI and the training program provided

(b) Duties of the Certified Individual (CI). The CI shall

1. verify that each item to which the Certification Mark is applied meets all applicable requirements of this Section and has a current capacity certification for the Certification Mark with HV designator
2. review documentation for each lot of items to be stamped, to verify, for the lot, that the requirements of this Section have been completed
3. sign the Certificate of Conformance Form (HV-1) prior to release of control of the item
4. Certificate of Conformance Form (HV-1) (see Non-mandatory Appendix N)

HG-402.3 Determination of Capacity to Be Stamped on Valves. The Manufacturer of the valves that are to be stamped with the Certification Mark shall submit valves for testing to a place where adequate equipment and personnel are available to conduct pressure and relieving capacity tests which shall be made in the presence of and certified by an authorized observer. The place, personnel, and authorized observer shall be approved by the Boiler and Pressure Vessel Committee. The valves shall be tested in one of the following three methods.

(a) Coefficient Method. Tests shall be made to determine the lift, popping, and blowdown pressures, and the capacity of at least three valves each of three representative sizes (a total of nine valves). Each valve of a given size shall be set at a different pressure. However, safety valves for steam boilers shall have all nine valves set at 15 psig (100 kPa). A coefficient shall be established for each test as follows:

\[ K = \frac{W}{Q} \]

where:
- \( W \) is the actual steam flow in pounds per hour
- \( Q \) is the theoretical steam flow in pounds per hour

The average of the coefficients \( K \) of the nine tests required shall be multiplied by 0.90, and this product shall be taken as the coefficient \( K \) of that design. The coefficient \( K \) of the design shall not be greater than 0.878 (the product of 0.9 x 0.975). The stamped capacity for all sizes and pressures shall not exceed the value determined from the following equations:

For 45 deg seat,

\[ W = 51.5 \times DLP \times 0.707K \]

For flat seat,

\[ W = 52.5 \times DLP \times 0.707K \]
For nozzle,

(U.S. Customary Units)

\[
W = 51.5 \frac{APK}{\text{hr}}
\]

(SI Units)

\[
W = 5.25 \frac{APK}{\text{hr}}
\]

where

\[A = \text{nozzle-throat area}\]

\[D = \text{seat diameter}\]

\[K = \text{coefficient of discharge for the design}\]

\[L = \text{lift}\]

\[P = (1.10 \times \text{set pressure} + 14.7) \text{ psia or } (1.10 \times \text{set pressure} + 0.101) \text{ MPa, for hot-water applications or } \]

\[= (5.0 \text{ psi} + 15 \text{ psi set } + 14.7) \text{ psia or } (0.035 \text{ MPa } + 0.100 \text{ MPa set } + 0.101) \text{ MPa, for steam boilers}\]

\[W = \text{weight of steam/hr}\]

NOTE: The maximum and minimum coefficient determined by the tests of a valve design shall not vary more than ±5% from the average. If one or more tests are outside the acceptable limits, one valve of the Manufacturer’s choice shall be replaced with another valve of the same size and pressure setting or by a modification of the original valve. Following this test a new average coefficient shall be calculated, excluding the replaced valve test. If one or more tests are now outside the acceptable limits, as determined by the new average coefficient, a valve of the Manufacturer’s choice must be replaced by two valves of the same size and pressure setting as the rejected valve. A new average coefficient, including the replacement valves, shall be calculated. If any valve, excluding the two replaced valves, now falls outside the acceptable limits, the tests shall be considered unsatisfactory.

(b) Slope Method: If a Manufacturer wishes to apply the Certification Mark to a design of pressure-relief valves, four valves of each combination of pipe and orifice size shall be tested. These four valves shall be set at pressures that cover the approximate range of pressures for which the valve will be used, or that cover the range available at the certified test facility that shall conduct the tests. The capacities shall be based on these four tests as follows:

(1) The slope \((W/P)\) of the actual measured capacity versus the flow pressure for each test point shall be calculated and averaged:

\[
\text{slope} = \frac{W}{P} = \frac{\text{measured capacity}}{\text{absolute flow pressure, psia}}
\]

All values derived from the testing must fall within ±5% of the average value:

\[
\text{minimum slope} = 0.95 \times \text{average slope}
\]

\[
\text{maximum slope} = 1.05 \times \text{average slope}
\]

If the values derived from the testing do not fall between the minimum and maximum slope values, the Authorized Observer shall require that additional valves be tested at the rate of two for each valve beyond the maximum and minimum values with a limit of four additional valves.

(2) The relieving capacity to be stamped on the valve shall not exceed 90% of the average slope times the absolute accumulation pressure:

\[
\text{rated slope} = 0.90 \times \text{average slope}
\]

\[
\text{stamped capacity} \leq \text{rated slope} \times (1.10 \times \text{set pressure } + 14.7) \text{ psia or } (1.10 \times \text{set pressure } + 101) \text{ kPa, for hot-water applications}
\]

(c) Three-Valve Method: If a Manufacturer wishes to apply the Certification Mark to steam safety valves or safety relief valves of one or more sizes of a design set at one pressure, he shall submit three valves of each size of each design set at one pressure for testing and the stamped capacity of each size shall not exceed 90% of the average capacity of the three valves tested.

NOTE: The discharge capacity as determined by the test of each valve tested shall not vary by more than ±5% of the average capacity of the three valves tested. If one of the three valve tests falls outside of the limits, it may be replaced by two valves and a new average calculated based on all four valves, excluding the replaced valve.

HG-402.4 Pressures at Which Capacity Tests Shall Be Conducted. Safety valves for steam boilers shall be tested for capacity at 5 psi (35 kPa) over the set pressure.

Capacity certification tests of safety-relief valves for hot water heating and hot water supply boilers shall be conducted at 110% of the set pressure as determined in HG-402.5.

HG-402.5 Set-Pressure Tests of Safety-Relief Valves.

(a) For the purpose of determining the set-pressure of temperature and pressure safety-relief valves, the test medium shall be room-temperature water. The actual set-pressure is defined as the pressure at the valve inlet when the flow rate through the valve is 40 cc/min.

(b) For the purpose of determining the set-pressure of safety-relief valves other than temperature and pressure safety-relief valves, the set-pressure testing media and applicable operating characteristic to be displayed for a specific valve design shall be specified by the device manufacturer.

HG-402.6 Capacity Tests of Temperature and Pressure Safety Relief Valves. For the purpose of determining the capacity of temperature and pressure safety relief valves, dummy elements of the same size and shape as the regularly applied thermal element shall be substituted and the relieving capacity shall be based on the pressure element only. Valves selected to meet the
requirements of production testing. HG-401.3, shall have their temperature elements deactivated by the Manufacturer prior to or at the time of capacity testing.

HG-402.7 Fluid Medium for Capacity Tests. The tests shall be made with dry saturated steam. For test purposes the limits of 98% minimum quality and 20°F (10°C) maximum superheat shall apply. Correction from within these limits may be made to the dry saturated condition. The relieving capacity shall be measured by condensing the steam or with a calibrated steam flowmeter.

To determine the discharge capacity of safety relief valves in terms of Btu per hour, the relieving capacity in pounds of steam per hour is multiplied by 1,000.

HG-402.8 Where and by Whom Capacity Tests Shall Be Conducted.

(a) Testing shall be conducted and supervised as specified in ASME CA-1.

(b) Capacity test data reports for each valve model, type, and size, signed by the Manufacturer and the Authorized Observer witnessing the tests, shall be submitted to the ASME Designee for review and acceptance. When changes are made in the design, capacity certification tests shall be repeated.

HG-402.9 Test Record Data Sheet. A data sheet for each valve shall be filled out and signed by the authorized observer witnessing the test. Such data sheet will be the manufacturer’s authority to build and stamp valves of corresponding design and construction. When changes are made in the design of a safety or safety relief valve in such a manner as to affect the flow path, lift, or performance characteristics of the valve, new tests in accordance with this Section shall be performed.

HG-403 HEATING SURFACE

Heating surface, as part of a circulating system in contact on one side with water or wet steam being heated and on the other side with gas or refractory being cooled, shall be measured on the side receiving heat.

The heating surface shall be computed as follows:

(a) Boiler heating surface and other equivalent surface outside the furnace shall be measured circumferentially plus any extended surface.

(b) Waterwall heating surface and other equivalent surface within the furnace shall be measured as the projected tube area (diameter × length) plus any extended surface on the furnace side. In computing the heating surface for this purpose, only the tubes, fireboxes, shells, tube-sheets, and the projected area of headers need be considered, except that for vertical firetube steam boilers, only that portion of the tube surface up to the middle of the gauge glass is to be computed.

(c) Total heating surface is the sum of the boiler and waterwall heating surface.

HG-405 TEMPERATURE AND PRESSURE SAFETY RELIEF VALVES

The thermal sensing elements for temperature and pressure safety relief valves shall be so designed and constructed that they will not fail in any manner that could obstruct flow passages or reduce capacities of the valves when the elements are subjected to saturated steam temperature corresponding to capacity test pressure. Temperature and pressure safety relief valves incorporating these elements shall comply with a nationally recognized standard.

NOTE: See HG-512 for safety and safety relief valve accumulation test requirements. See HG-701 for safety and safety relief valve installation requirements.
ARTICLE 4A
OVERPRESSURE PROTECTION

HG-400A GENERAL REQUIREMENTS

(a) This article provides the acceptable methods and requirements for overpressure protection in heating boilers constructed to the requirements of this Section. It establishes the type, quantity and settings of acceptable devices and the relieving capacity requirements for the applicable heating boilers. Unless otherwise specified, the pressure relief valves shall be constructed, capacity certified, and bear the ASME Mark in accordance with Section XIII. See Article 7 for installation requirements.

(b) All heating boilers within the scope of this Section shall be provided with protection against overpressure in accordance with the requirements of this Article.

(c) Unless otherwise defined in Nonmandatory Appendix E, the definitions relating to pressure relief valves in Section XIII shall apply.

HG-401A RESPONSIBILITY

(a) It is the Manufacturer's responsibility to determine the minimum required relief rate and maximum allowable working pressure that meets the requirements of this Article. The Manufacturer is responsible for ensuring that the boiler connections allow for the different types of pressure relief devices that could be installed within the design of the boiler based on system pressure design.

(b) The installer or Manufacturer is responsible for sizing and selecting the pressure relief valve(s) that meet the requirements of this Article.

(c) Pressure relief valves shall be installed by either the installer or the Manufacturer before a boiler is placed in operation.
HG-402A PRESSURE RELIEF VALVE REQUIREMENTS

HG-402A.1 Pressure Relief Valve Requirements for Steam Boilers
(a) Each steam boiler shall have one or more pressure relief valves marked with either the Certification Mark and HV Designator in accordance with Section XIII or with the Certification Mark and V Designator in accordance with Section I.

(b) The pressure relief valve shall be of the spring-loaded safety valve type adjusted and sealed to discharge at a pressure not to exceed 15 psi (100 kPa). The set pressure tolerance shall not exceed +/-2 psi (15 kPa).

(c) The pressure 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 5 psi (35 kPa) above the maximum allowable working pressure.

(d) Pressure relief valves shall have a controlled blowdown of 2 psi to 4 psi (15 kPa to 30 kPa).

(e) No pressure relief valve for a steam boiler shall be smaller than NPS 1/2 (DN 15) or larger than NPS 4 (DN 100). The inlet opening shall have an inside diameter equal to, or greater than, the seat diameter.

(f) Pressure relief valves shall be arranged so that they cannot be reset to relieve at a higher pressure than the maximum allowable working pressure of the boiler.

(g) Body drain connections shall not be plugged during or after field installation.

(h) The minimum relieving capacity of valve or valves shall be governed by the capacity marking on the boiler called for in HG-530.
(i) The minimum valve capacity in pounds per hour shall be determined by dividing the maximum Btu/hr (kW) output at the boiler nozzle obtained by the firing of any fuel for which the unit is installed by 1,000 (0.646). In every case, the requirement of (e) shall be met.

(j) 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 (c). The additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.

HG-402A.2 Pressure Relief Valve Requirements for Hot Water Boilers.

(a) Each hot water heating or supply boiler shall have at least one pressure relief valve marked with either the Certification Mark and HV Designator in accordance with Section XIII or with the Certification Mark and V Designator in accordance with Section I.

(b) The pressure relief valve shall be of the spring-loaded safety relief valve type and set to relieve at or below the maximum allowable working pressure of the boiler. The set pressure tolerances shall not exceed 3 psi (20 kPa) for pressures up to and including 60 psig (400 kPa) and 5% for pressures above 60 psig (400 kPa).

(c) When more than one pressure relief valve is used on either hot water heating or hot water supply boilers, the additional valves shall be capacity certified and may have a set pressure within a range not to exceed 6 psi (40 kPa) above the maximum allowable working pressure of the boiler up to and including 60 psi (400 kPa), and 5% for those having a maximum allowable working pressure exceeding 60 psi (400 kPa).

(d) 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 10% above the maximum allowable working pressure. When more than one pressure relief valve is used, the overpressure shall be limited to 10% above the set pressure of the highest set valve allowed by (c).

(e) No pressure relief valve shall be smaller than NPS ¾ (DN 20) nor larger than NPS 4 (DN 100) except that boilers having a heat input not greater than 15,000 Btu/hr (4.4 kW) may be equipped with a capacity certified pressure relief valve of NPS 1/2 (DN 15).

(f) The required steam-relieving capacity, in pounds per hour (kilograms per hour), of the pressure-relieving device or devices on a boiler shall be determined by dividing the maximum output in Btu/hr (kW) at the boiler nozzle obtained by the firing of any fuel for which the unit is installed by 1,000 (0.646). In every case, the requirements of (d) shall be met.

(g) 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 (d). The additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.

(h) Hot water heating or supply boilers limited to a water temperature not in excess of 210°F (99°C) may have, in lieu of the valve(s) specified in (a) above, one or more temperature and pressure relief valves of the spring-loaded type marked with the
Certification Mark and HV Designator in accordance with Section XIII. The temperature and pressure relief valve shall be set to relieve at or below the maximum allowable working pressure of the boiler.

**HG-402A.3 Pressure Relief Valves for Tanks and Heat Exchangers**

(a) **Steam to Hot Water Supply.**

(1) When a hot water supply is heated indirectly by steam in a coil or pipe within the service limitations set forth in HG-101, the pressure of the steam used shall not exceed the safe working pressure of the hot water tank. Each tank shall have a pressure relief valve marked with either the Certification Mark and HV Designator in accordance with Section XIII or with the Certification Mark and V Designator in accordance with Section I.

(2) The pressure relief valve shall be of the spring-loaded safety relief valve type and set to relieve at or below the maximum allowable working pressure of the boiler.

(b) **High Temperature Water to Water Heat Exchanger.**

(1) When high temperature water is circulated through the coils or tubes of a heat exchanger to warm water for space heating or hot water supply, within the service limitations set forth in HG-101, the heat exchanger shall be equipped with one or more pressure relief valves marked with either the Certification Mark and HV Designator in accordance with Section XIII or with the Certification Mark and V Designator in accordance with Section I.

(2) The pressure relief valve shall be of the spring-loaded safety relief valve type and set to relieve at or below the maximum allowable working pressure of the heat exchanger. The set pressure tolerances shall not exceed 3 psi (20 kPa) for pressures up to and including 60 psig (400 kPa) and 5% for pressures above 60 psig (400 kPa).

(3) The pressure relief valves shall be of sufficient rated capacity to prevent the heat exchanger pressure from rising more than 10% above the maximum allowable working pressure of the vessel.

(4) No pressure relief valve shall be smaller than NPS ¾ (DN 20) nor larger than NPS 4 (DN 100).

(c) **High Temperature Water to Steam Heat Exchanger.**

(1) When high temperature water is circulated through the coils or tubes of a heat exchanger to generate low pressure steam, within the service limitations set forth in HG-101, the heat exchanger shall be equipped with one or more pressure relief valves marked with either the Certification Mark and HV Designator in accordance with Section XIII or with the Certification Mark and V Designator in accordance with Section I.

(2) The pressure relief valve shall be of the spring-loaded safety valve type and set to relieve at a pressure not to exceed 15 psi (100 kPa). The set pressure tolerance shall not exceed +/-2 psi (15 kPa).

(3) Pressure relief valves shall have a controlled blowdown of 2 psi to 4 psi (15 kPa to 30 kPa).
(4) No pressure relief valve for a steam boiler shall be smaller than NPS 1/2 (DN 15) or larger than NPS 4 (DN 100).

(5) For heat exchangers requiring steam pressures greater than 15 psi (100 kPa), refer to Section I or Section VIII, Division 1.

HG-402A.4 Pressure Relief Valves for Potable Water Heaters

See HLW-800

HG-403A HEATING SURFACE

Heating surface, as part of a circulating system in contact on one side with water or wet steam being heated and on the other side with gas or refractory being cooled, shall be measured on the side receiving heat.

The heating surface shall be computed as follows:

(a) Boiler heating surface and other equivalent surface outside the furnace shall be measured circumferentially plus any extended surface.

(b) Waterwall heating surface and other equivalent surface within the furnace shall be measured as the projected tube area (diameter × length) plus any extended surface on the furnace side. In computing the heating surface for this purpose, only the tubes, fireboxes, shells, tubesheets, and the projected area of headers need be considered, except that for vertical firetube steam boilers, only that portion of the tube surface up to the middle of the gage glass is to be computed.

(c) Total heating surface is the sum of the boiler and waterwall heating surface.
HG-511  PNEUMATIC TESTS

Pneumatic testing may be substituted for the hydrostatic test required in HG-510 provided the following requirements are met:

(a) The substitution of pneumatic testing shall be by agreement between the manufacturer and Authorized Inspector.

(b) Maximum material thickness of any component part shall not exceed 1/2 in. (12.7 mm). No components of the heating boiler that will be subject to pneumatic testing may be constructed of cast iron.

(c) When the boiler is under pneumatic pressure testing, its calculated potential energy, \( E \), shall be less than 1,000 ft-lb (1 356 J)

\[
E = C \times P_{at} \times V \left[ 1 - \left( \frac{P_{at}}{P_{at}} \right)^{0.286} \right]
\]

where

- \( C = \) constant, 360 in.\(^2\)/ft\(^2\) (2 500 Pa/kPa)
- \( E = \) stored energy, ft-lb (J)
- \( P_{at} = \) absolute atmospheric pressure, 14.7 psia (101 kPa)
- \( P_{at} = \) absolute test pressure, psia (kPa)
- \( V = \) total volume under test pressure, ft\(^3\) (m\(^3\))

NOTE: \( V \) includes the volume of the vessel and any connected volume to the pressure supply pump or valve.

(d) Nitrogen or clean, dry, oil-free air shall be used.

(e) The boiler shall be visually inspected for evidence of damage before pressurization.

(f) The boiler should be tested in such a manner as to ensure personnel safety from a release of the total internal energy of the vessel.

(g) The required test pressure shall be greater of 38 psi (262 kPa) or 1.1 times the MAWP.

(h) Overpressure relief protection shall be provided. The set pressure of a pressure relief device should not be more than the greater of

1. the test pressure plus 10 psi (70 kPa), or
2. 110% of the test pressure

(i) A minimum hold time of 5 min shall be maintained on the boiler at the required test pressure.

(j) The Manufacturer’s Data Report Forms shall state in the Remarks section, “Pneumatic test performed in lieu of hydrostatic test as prescribed in HG-510.”

(k) The pneumatic test method shall be immersed visual inspection.

1. The boiler shall be externally cleaned to prevent air bubble adherence while being tested to prevent leaks from being masked.

2. The uppermost portion of the boiler, as oriented in the test tank, shall be a minimum of 6 in. (150 mm) below the surface of the water, and the water shall have a minimum temperature of 60°F (16°C).

HG-512  SAFETY AND SAFETY RELIEF VALVE ACCUMULATION TESTS

If the safety valve or safety relief valve capacity cannot be computed or if it is desirable to prove the computations, it may be checked in any one of the following ways and, if found insufficient, additional capacity shall be provided:

(a) by making an accumulation test, that is, by shutting off all discharge outlets from the boiler and forcing the fires to the maximum, the safety valve equipment shall be sufficient to prevent an excess pressure beyond that specified in HG-400.1(f) and HG-400.2(f).

(b) by measuring the maximum amount of fuel that can be burned, and computing the corresponding evaporative capacity upon the basis the heating value of the fuel. (See B-100, B-101, and B-102.)

HG-515  INSPECTION TESTS AND CERTIFICATION OF BOILERS

HG-515.1  General. The inspection and testing of boilers to be marked with the Certification Mark with H designator shall conform to the general requirements for inspection and testing in the following paragraphs and, in addition, to the specific requirements for inspection and tests given in Parts HF and HC.

HG-515.2  Manufacturer’s Responsibility. The Manufacturer has the responsibility of providing the Inspector with all specified information and of assuring that the quality control, the detailed examination, and the tests required by this Section are performed at the stages of construction necessary to permit them to be meaningful (see F-202.5). These responsibilities shall include, but not be limited to, providing or making available for review the following:

(a) the Certificate of Authorization from the ASME Boiler and Pressure Vessel Committee authorizing the Manufacturer to fabricate the type of boiler being constructed (see HG-540)
(b) the drawings and design calculations for the boiler or part (see Part HG, Article 3; Part HF, Article 3; Subpart HW, Article 7; Subpart HB, Article 13; and Part HC, Article 3)

(c) identification for all materials used in the fabrication of the boiler or part (see Part HG, Article 2; Subpart HW, Article 5; Subpart HB, Article 11; and Part HC, Article 2)

(d) any Partial Data Reports when required (see HG-531)

(e) access for the Inspector to those parts of the plant concerned with the supply or fabrication of materials for the boiler; keeping the Inspector informed of the progress of the work so that the required inspections can be performed in the proper sequence (see HW-900, HB-1500, and F-202.4)

(f) evidence of examination of all material before and during fabrication to make certain it has the required thickness, has no unacceptable imperfections, is one of the acceptable materials permitted by this Section, and that traceability to the material identification has been maintained (see HG-201, HC-502.5, F-202.4, and HF-210)

(g) concurrence of the Inspector for correction of non-conformities in accordance with the Quality Control System (see F-202.6)

(h) evidence of qualification of the welding and/or brazing procedures before they are used in fabrication (see HW-610, HB-1001, HB-1202, and F-202.7)

(i) evidence of qualification of all welders, welding operators, or brazers before the welders, welding operators, or brazers are used in production work, except that performance qualification by radiography, in conformance with Section IX, QW-304 for welders or QW-305 for welding operators, may be performed within the first 3 ft (1 m) of the first production weld (see HW-401, HW-610, HB-1001, HB-1202, and F-202.7)

(j) records of examination of parts prior to joining to make certain that they have been properly fitted for welding or brazing and that the surfaces to be joined have been cleaned and the alignment tolerances are maintained (see Subpart HW, Article 8; Subpart HB, Article 14; and F-202.7)

(k) records of examination of parts as fabrication progresses for material marking, that surface defects are not evident, and that dimensional geometrics are maintained (see HG-515.1; HF-210; Subpart HW, Article 8; HC-200; HC-502.5; and HC-502.6)

(l) subjecting the boiler to the required hydrostatic test (see HG-510)

(m) affixing the required stamping and/or nameplate to the boiler and making certain it is affixed to the proper boiler (see HG-530)

(n) preparing the required Manufacturer’s Data Report and having it certified by the Inspector (see HG-520) for boilers and boiler parts constructed of wrought materials, and having it certified by a Certified Individual meeting the current requirements of ASME QAI-1 (see HC-502.12); if constructed of cast material (see HC-403)

(o) providing for retention of Manufacturer’s Data Reports [see HG-520.1(b), HC-403, and HC-502.10]

(p) the Certificates of Conformance for cast iron boiler sections (see HC-520)

HG-515.3 Inspection by an Authorized Inspector. (19)

(a) Except for cast iron boilers, cast aluminum boilers, or pressure relief devices, the inspection required by this Section shall be by an Inspector employed by an ASME Accredited Authorized Inspection Agency. These inspectors shall have been qualified in accordance with ASME QAI-1.

(b) The Inspector shall make all inspections specifically required of him plus such other inspections as he believes are necessary to enable him to certify that all boilers and boiler parts constructed of wrought material that he authorizes to be stamped with the Certification Mark have been designed and constructed in accordance with the requirements of this Code Section. The required inspections and verifications shall include, but not be limited to, the following:

1. checking to see that the Manufacturer has a valid Certificate of Authorization (see HG-540) and is working to the quality control system accepted by the Society (see HG-540.1)

2. checking to see that the design calculations, drawings, specifications, procedures, records, and test results are available (see HG-300, HG-200, HG-500, HF-200, and HW-700)

3. checking to see that material used in the construction of the boiler and parts complies with the requirements (see HG-200, HF-200, and HB-1100)

4. checking to see that all welding procedures have been qualified (see HW-910)

5. checking to see that all welders and welding operators have been qualified (see HW-911)

6. checking to see that all brazing procedures have been qualified (see HB-1501)

7. checking to see that all brazer and brazer operators have been qualified (see HB-1502)

8. checking to see that the proper joint factor is used for brazed joints that can only be inspected from one side (blind joint) (see HB-1503)

9. checking to see that material imperfections repaired by welding were acceptably repaired (see HW-830 and HB-1402)

10. visual inspection of boiler parts to confirm that the material identification numbers have been properly transferred (see HF-210)

11. witnessing of proof tests conducted to establish the maximum allowable working pressure of boilers (see HG-500)

12. inspecting each boiler and water heater during construction and after completion (see HG-515.3)
(13) performing internal and external inspections and witnessing hydrostatic tests (see HG-510)
(14) verifying that stamping and/or nameplate is proper and that it has been stamped and/or attached to the proper boiler (see HG-530 through HG-533)
(15) signing the certificate of inspection on the Manufacturer’s Data Report when the boiler or part is complete and in compliance with all the provisions of this Section (see HG-532.3, HG-533.6, and HG-520.2)

HG-515.4 Duty of Authorized Inspector.

(a) Each boiler shall be inspected during construction and after completion and, at the option of the Authorized Inspector, at such other stages of the work as he may designate. For specific requirements, see the applicable parts of this Section. Each Manufacturer or assembler is required to arrange for the services of Authorized Inspectors (see HG-515.2) to perform such inspections on all of this work within the scope of this Section, whether performed in the shop or in the field.

(b) When mass production of boilers or HLW-stamped vessels makes it impracticable for the Inspector to personally perform each of his required duties, the Manufacturer, in collaboration with the Inspector, shall prepare an inspection and quality control procedure setting forth, in complete detail, the method by which the requirements of this Section shall be maintained (for summaries of the responsibilities of the Manufacturer and the duties of the Inspector see HG-515.2 and HG-515.3 for boilers or HLW-600.2 and HLW-600.3 for HLW-stamped vessels). This procedure shall be included in the Manufacturer’s written Quality Control System. It shall be developed, accepted, and implemented in accordance with Mandatory Appendix 7.

HG-520 MASTER AND PARTIAL DATA REPORTS

HG-520.1 Manufacturer’s Master Data Report. Each manufacturer of heating boilers of wrought materials to which the Certification Mark with H designator is to be applied shall compile a Manufacturer’s Data Report for each boiler he produces, except that an individual Manufacturer’s Data Report shall be built according to the rules of this Section that are fabricated by a manufacturer other than the manufacturer of the completed boiler. These Partial Data Reports, together with his own inspection, shall be the final Authorized Inspector’s authority to witness the application of the Certification Mark to the completed boiler.

(c) Manufacturers with multiple locations, each with its own Certificate of Authorization, may transfer parts from one of their locations to another without Partial Data Reports, provided the Quality Control System describes the method of identification, transfer, and receipt of the parts.

HG-520.2 Partial Data Reports.

(a) Manufacturer’s Partial Data Reports for those parts of a boiler requiring inspection under this Code, which are furnished by other than the shop of the manufacturer responsible for the completed boiler, shall be executed by the parts manufacturer and shall be forwarded in duplicate to the manufacturer of the finished boiler.

(b) Partial Data Reports (Form H-4) shall be completed for all parts that require inspection under this Code that are fabricated by a manufacturer other than the manufacturer of the completed boiler. These Partial Data Reports, together with his own inspection, shall be the final Authorized Inspector’s authority to witness the application of the Certification Mark to the completed boiler.

(c) Manufacturers with multiple locations, each with its own Certificate of Authorization, may transfer parts from one of their locations to another without Partial Data Reports, provided the Quality Control System describes the method of identification, transfer, and receipt of the parts.

HG-520.3 Supplementary Sheet. Form H-6, Manufacturer’s Data Report Supplementary Sheet, shall be used to record additional data where space was insufficient on a Data Report Form. This Manufacturer’s Data Report Supplementary Sheet will be attached to the Manufacturer’s Data Report Form where used. If Form H-6 is used in conjunction with Form H-5 or H-5A, the Authorized Inspector’s certification is not applicable.

HG-520.4 Multiple Page Data Reports. Requirements for completing multiple pages of Data Report Forms are shown in Mandatory Appendix 4.

HG-530 MARKING OF BOILERS

HG-530.1 Marking Requirements for Boilers (and Economizers Built to Mandatory Appendix 10) Other Than Those Constructed Primarily of Cast Iron or Cast Aluminum (See HG-530.2).

(a) All boilers to which the Certification Mark is to be applied shall be built according to the rules of this Section by a manufacturer who is in possession of a Certification Mark and a valid Certificate of Authorization. Each boiler shall be stamped with the Certification Mark shown in Figure HG-530.1 with the H designator and with the following data except as permitted in (f) below:

1. the boiler manufacturer’s name, preceded by the words “Certified by”
2. maximum allowable working pressure
3. safety or safety relief valve capacity (minimum), as determined according to HG-400.1(d) and HG-400.2(e)
4. heating surface, as determined according to HG-403 (or power input for electric boilers)
5. manufacturer’s serial number
6. year built
7. maximum water temperature
8. for economizers, heat absorption in Btu/hr (kW)

HG-402A.1(i) and HG-402A.2(f).
In lieu of directly marking the castings, the data in items (b)(1), (b)(2), and (b)(5) may be stamped or etched on a permanently attached \( \frac{3}{64} \) in. (0.2 mm) thick nonferrous nameplate using letters and numerals at least \( \frac{1}{8} \) in. (3 mm) high.

Arrangement of data marked on sections or on a nameplate shall be substantially as shown in Figure HG-530.6 for cast aluminum hot water heating boilers.

The process controls for etching shall be described in the Quality Control System. Etched information shall have a minimum depth of 0.004 in. (0.1 mm) and shall not compromise the minimum wall thickness. The surface condition where etching is applied shall be clean, uncoated, and unpainted.

Other data may be cast, stamped, or etched on the sections. The marking “ASME” or “ASME standard” shall not be used.

(c) When the boiler size and number of sections have been decided, the completed boiler shall be marked with the Certification Mark shown in Figure HG-530.1 with the H designator and with the following data:

(1) the Shop Assembler’s name preceded by the words “Certified by”
(2) maximum allowable working pressure
(3) safety or safety relief valve capacity (minimum), as determined according to HG-400.1(d) and HG-400.2(e)
(4) maximum water temperature

(d) The Shop Assembler that is in possession of a Certification Mark and valid Certificate of Authorization shall be one of the following:

(1) the shop that assembles sections into boilers, performs the hydrostatic test, and installs the nameplate
(2) the shop that installs the nameplate on a boiler, previously assembled and hydrotested by another authorized Certificate Holder
(3) the shop that only installs the nameplate on a boiler.

(e) The markings for the completed boiler shall be arranged substantially as shown in Figure HG-530.7 or Figure HG-530.8.

(f) Data for more than one size boiler in a model series may be listed on the nameplate. When different model numbers having the same number of sections and jacket length have different minimum safety or safety relief valve capacities, the highest value shall be listed. The following additional information shall be included for each size listed:

(1) boiler model number
(2) number of sections
(3) jacket length
(4) the statement: “To determine boiler size, count the number of sections or measure the jacket length”

(g) The provisions of (c) above shall be met utilizing one of the following methods:

(1) stamping or etching the required markings on a nonferrous nameplate at least 3 in. \( \times \) 4 in. (75 mm \( \times \) 100 mm) in size and \( \frac{3}{64} \) in. (1.2 mm) thick using letters and numerals at least \( \frac{1}{8} \) in. (3 mm) high and permanently attaching the nameplate to the boiler proper in some conspicuous place. The nameplate shall not be covered with insulating or other material except that when a jacket...
or other form of casing is applied to a boiler, an opening with a removable cover shall be provided for viewing the required marking.

(2) stamping or etching the required markings directly into the boiler jacket in some conspicuous place using letters and numerals at least \( \frac{5}{16} \) in. (8 mm) high.

(3) stamping or etching the required data on a nonferrous nameplate at least 3 in. \( \times \) 4 in. (75 mm \( \times \) 100 mm) in size using letters and numerals at least \( \frac{1}{8} \) in. (3 mm) high and permanently attaching the nameplate to the casing in some conspicuous place by an adhesive system.

(4) marking the required data on a nonmetallic nameplate at least 3 in. \( \times \) 4 in. (75 mm \( \times \) 100 mm) in size using letters and numerals at least \( \frac{1}{8} \) in. (3 mm) high and permanently attaching the nameplate to the casing in some conspicuous place by mechanical means or by an adhesive system.

(5) the nameplate and the adhesive system shall meet the requirements of Mandatory Appendix 3. Other data may be marked on the jacket or the nameplate provided the required markings are distinct and separate from the other data. The marking “ASME” or “ASME standard” shall not be used.

(6) the Certification Mark may be preapplied to a nameplate.

(7) the nameplate may be attached to the casing of a cast iron or cast aluminum boiler by the Manufacturer or Shop Assembler at a plant other than that shown on his Certificate of Authorization provided the plant is owned by the Certificate Holder and the nameplate’s control and use is addressed in his Quality Control Manual.

(8) the Certification Mark shall not be used by an organization to which it was not issued.

**HG-530.3 Modular Boilers.** Modular boilers complying with HG-607, HG-615, HG-710.4, and HG-716 may be stamped and certified as follows:

(a) Individual modules are stamped and certified as complete boilers, each with its own nameplate stamping and Manufacturer’s Data Report. The heating surface and required minimum relief valve capacity of each module shall be stamped on the individual nameplates.

(b) Individual modules are combined together and provided with a single nameplate stamping and Manufacturer’s Data Report. When certified as a single boiler, the aggregate heating surface of all the modules and the combined minimum relief valve capacity shall be stamped on the nameplate. Additionally, the supply and return headers shall be constructed in accordance with Section IV and recorded on the Manufacturer’s Data Report.

(c) Modular boilers that are installed side by side, front to back, or by stacking in accordance with the Manufacturer’s recommendations shall have their nameplate stamping located to provide access for inspection in the assembled position.

**HG-531 MARKING OF PARTS AND ACCESSORIES (19)**

(a) Parts and accessories of boilers for which Partial Data Reports are required by HG-520.2 shall be marked in one of the following manners:

(1) the official Certification Mark shown in Figure HG-530.1 with the H designator above the word “Part” along with the following:

(-a) the part manufacturer's name

(-b) the part manufacturer's serial number

(2) the official Certification Mark shown in Figure HG-530.1 with the PRT designator along with the following:

(-a) the part manufacturer's name
show that the authorization to use the Certification Mark with H designator is limited to the field assembly of welded boilers constructed to Section IV (see HG-540).

**HG-533.6 Certificate of Field Inspection.** The certificate of field inspection on the Data Report shall be executed by the Authorized Inspector. The assembler or assembling organization shall have the responsibility for forwarding and filing of Manufacturer’s Data Reports as required by HG-520.1(a) and HG-520.1(b).

**HG-533.7 Mechanical Field Assembly.** For a boiler manufactured of wrought materials that has not been completed in the Manufacturer’s shop, field assembly involving no welding does not need to be performed by a Company possessing a heating boiler stamp. However, when a boiler is not assembled by a stamp holder, the Manufacturer assuming responsibility for the completed boiler is responsible for providing for field inspection by an Authorized Inspector employed by the Manufacturer’s Authorized Inspection Agency, and signature of the Certificate of Field Assembly Compliance by a representative of the Manufacturer, after the required hydrostatic test has been completed. Application of an assembler Certification Mark with H designator in accordance with HG-533.4 is not required.

**HG-534 FIELD-ASSEMBLED CAST IRON BOILERS**

**HG-534.1 Hydrostatic Tests.** Each individual section or boiler part shall be subjected to a hydrostatic test as required in HC-410 at the Manufacturer’s plant prior to shipment.

**HG-534.2 Marking.** The marking on cast iron boilers shall meet the requirements of HG-530.2. The nameplate shall be attached to the casing by the Manufacturer or Shop Assembler.

**HG-534.3 Assembly Instructions.** The Manufacturer shall provide printed instructions for the installer to follow when mechanically assembling the boiler, including instructions for performing the hydrostatic test of the assembled boiler in HC-410.1 and HC-410.2.

**HG-540 CERTIFICATION MARKS**

**HG-540.1 Authorization.** A Certificate of Authorization to use the Certification Mark with H, HLW, PRT, and/or HV designator will be granted by the Society pursuant to the provisions of the following paragraphs. Stamps for applying the Certification Mark shall be obtained from the Society.

**HG-540.2 Application for a Certificate of Authorization.** Any organization desiring a Certificate of Authorization shall apply to ASME in accordance with the certification process of ASME CA-1. Authorization to use Certification Marks may be granted, renewed, suspended, or withdrawn as specified in ASME CA-1.

**HG-540.3 Designated Oversight.** The Manufacturer shall comply with the requirements of ASME CA-1 for designated oversight by use of an Authorized Inspection Agency or Certified Individual, as applicable.

**HG-540.4 Quality Control System.** Any Manufacturer or Shop Assembler holding or applying for a Certificate of Authorization shall have and demonstrate a quality control program that meets the requirements of ASME CA-1 and establishes that all Code requirements, including material, design, fabrication, examination (by the Manufacturer), inspection of boilers, vessels, parts (by the Authorized Inspector), pressure testing, and certification will be met.

(a) The quality control system shall be in accordance with the requirements of Nonmandatory Appendix F, except for Cast Iron Boiler and Cast Aluminum Boiler Certificate Holders.

(b) The quality control system shall be in accordance with the requirements of Article 5 of Part HC and Part HA, respectively, for Cast Iron Boiler and Cast Aluminum Boiler Certificate Holders.

(c) For Manufacturers and Assemblers of parts who do not perform or assume any design responsibility for the parts they manufacture, the quality control system need only describe how the design documents, including specifications, drawings, and sketches that are received from the purchaser of the part, are controlled and how the parts are controlled when in the custody of the parts’ Manufacturer or Assembler.

**HG-540.5 Evaluation for Authorization and Re-authorization.** Before issuance or renewal of a Certificate of Authorization for use of the Certification Mark with the H, HLW, or PRT designator, the Manufacturer’s facilities and organization are subject to a joint review by his Authorized Inspection Agency and an ASME Designee who is selected by the concerned legal jurisdiction, except for Cast Iron Boiler and Cast Aluminum Boiler Certificate Holders.

Certificates of Authorization will be endorsed to indicate the scope of activity authorized.

**HG-540.6 Authorization of Changes.** Any changes to be made in the quality control system shall be made and accepted in accordance with the requirements specified in ASME CA-1. For Manufacturers of multiple duplicate pressure vessels, acceptance of these changes by the jurisdiction (if applicable) and an ASME Designee is also required.

For those areas where there is no jurisdiction, that function shall be performed by an ASME Designee selected by ASME. Where a jurisdiction does not review a Certificate of Authorization when mechanically assembling the boiler, including material, design, fabrication, examination (by the Manufacturer), inspection of boilers, vessels, parts (by the Authorized Inspector), pressure testing, and certification will be met.

(a) The quality control system shall be in accordance with the requirements of Nonmandatory Appendix F, except for Cast Iron Boiler and Cast Aluminum Boiler Certificate Holders.

(b) The quality control system shall be in accordance with the requirements of Article 5 of Part HC and Part HA, respectively, for Cast Iron Boiler and Cast Aluminum Boiler Certificate Holders.

(c) For Manufacturers and Assemblers of parts who do not perform or assume any design responsibility for the parts they manufacture, the quality control system need only describe how the design documents, including specifications, drawings, and sketches that are received from the purchaser of the part, are controlled and how the parts are controlled when in the custody of the parts’ Manufacturer or Assembler.

Certificates of Authorization will be endorsed to indicate the scope of activity authorized.

**HG-540.7 Authorization of Changes.** Any changes to be made in the quality control system shall be made and accepted in accordance with the requirements specified in ASME CA-1. For Manufacturers of multiple duplicate pressure vessels, acceptance of these changes by the jurisdiction (if applicable) and an ASME Designee is also required.

For those areas where there is no jurisdiction, that function shall be performed by an ASME Designee selected by ASME. Where a jurisdiction does not review a Manufacturer’s facility, that function shall be performed by an ASME Designee who is selected by the concerned legal jurisdiction. Where the jurisdiction is the
(c) 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 (DN 20), 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.

HG-607 MODULAR STEAM HEATING BOILERS

(a) Each module of a modular steam heating boiler shall be equipped with
   (1) steam gage, see HG-602
   (2) water gage glass, see HG-603
   (3) a pressure control that will cut off the fuel supply when the pressure reaches an operating limit, which shall be less than the maximum allowable pressure
   (4) low water cutoff, see HG-606

(b) The assembled modular steam boiler shall also be equipped with a safety limit control that will cut off the fuel supply to prevent steam pressure from exceeding the 15 psi (100 kPa) maximum allowable working pressure of the boiler. The control shall be constructed to prevent a pressure setting above 15 psi (100 kPa).

(c) When the assembled modular boiler is certified as a single boiler in accordance with HG-530.3(b), the steam gage required on each module by (a)(1) may be replaced by a single gage located on the supply header.

HG-610 FOR HOT WATER HEATING OR HOT WATER SUPPLY BOILERS

HG-611 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) Mechanical Gages (Analog). The scale on the dial of the pressure or altitude gage shall be graduated to not less than 1 1/2 nor more than 3 1/2 times the pressure at which the safety relief valve is set.

(c) Electronic gages used in lieu of mechanical gages shall meet the following requirements:
   (1) Gage shall be powered from the boiler power supply and it shall have a display that remains on at all times. The gage shall have a backup power supply.
   (2) The full scale range of the transducer must be a minimum of 70°F (20°C) to 320°F (160°C). It shall be accurate to within ±1 deg.
   (3) The sensor shall have a minimum operating temperature range of 32°F to 120°F (0°C to 50°C) unless otherwise required by the application.

HG-612 THERMOMETERS/TEMPERATURE SENSORS

Each hot water heating or hot water supply boiler shall have a thermometer or temperature sensor with display so located and connected that it shall be easily readable. The thermometer or sensor shall be so located that it shall at all times indicate the temperature of the water in the boiler at or near the outlet.

(a) Thermometer shall have a minimum reading of 70°F (20°C) or less.

(b) Thermometer shall have a maximum reading at least equal to 320°F (160°C) but not more than 400°F (205°C).

(c) Electronic temperature sensor used in lieu of a thermometer shall meet the following requirements:
   (1) The sensor shall be powered from the boiler power supply, and it shall have a display that remains on at all times. The sensor shall have a backup power supply.
   (2) The display shall have an ambient operating temperature range of 32°F to 120°F (0°C to 50°C) unless otherwise required by the application.

HG-613 TEMPERATURE CONTROL

Each automatically fired hot water heating or hot water supply boiler shall be protected from over-temperature by two temperature-operated controls. These temperature control devices shall conform to UL 353, Standard for Limit Controls, and shall be accepted by a nationally recognized testing agency.

(a) Each individual automatically fired hot water heating or hot water supply boiler shall have a high temperature limit control that will cut off the fuel supply at or below the marked maximum water temperature at the boiler outlet. This control shall be constructed to prevent a temperature setting above the maximum.

(b) Each individual hot water heating or hot water supply boiler shall have a control that will cut off the fuel supply when the system water temperature reaches a preset operating temperature, which shall be less than the maximum water temperature.
ARTICLE 7
INSTALLATION REQUIREMENTS

HG-700 INSTALLATION REQUIREMENTS, ALL BOILERS

HG-701 MOUNTING SAFETY AND SAFETY RELIEF VALVES

HG-701.1 Permissible Mounting. Safety valves and safety relief valves shall be located in the top or side of the boiler. 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 boilers shall have the safety valve or safety relief valve located on the steam or hot water outlet end. Safety valves and safety relief valves shall be installed with their spindles vertical. The opening or connection between the boiler and any safety valve or safety relief valve shall have at least an area equal to the nominal inside area of a Schedule 80 pipe (as defined by ASME B36.10M) of the same nominal pipe size as the inlet of the valve.

HG-701.2 Requirements for Common Connections for Two or More Valves.

(a) When a boiler is fitted with two or more safety valves on one connection, this connection shall have a cross-sectional area not less than the combined areas of inlet connections of all the safety valves with which it connects.

(b) 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 safety valve or safety relief valve larger than 4 1/2 in. (115 mm) in diameter, 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 mounted on a Y-base.

HG-701.3 Threaded Connections. A threaded connection may be used for attaching a valve.

HG-701.4 Prohibited Mountings. Safety and safety relief valves shall not be connected to an internal pipe in the boiler.

HG-701.5 Use of Shutoff Valves Prohibited. No shutoff of any description shall be placed between the safety or safety relief valve and the boiler, or on discharge pipes between such valves and the atmosphere.

HG-701.6 Safety and Safety Relief Valve Discharge Piping.

(a) A discharge pipe shall be used. Its internal cross-sectional area shall be not less than the full area of the valve outlet or of the total of the valve outlets discharging thereinto and shall be as short and straight as possible and so 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 safety or safety relief valve discharge pipe, it shall be located close to the valve outlet downstream of the union.

(b) The discharge from safety or safety relief valves shall be so arranged that there will be no danger of scalding attendants. The safety or safety relief valve discharge shall be piped away from the boiler to the point of discharge, and there shall be provisions made for properly draining the piping. The size and arrangement of discharge piping shall be independent of other discharge piping and 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.

HG-701.7 Temperature and Pressure Safety Relief Valves. Hot water heating or supply boilers limited to a water temperature of 210°F (99°C) may have one or more temperature and pressure safety relief valves installed. The requirements of HG-701.1 through HG-701.6 shall be met, except as follows:

(a) A Y-type fitting shall not be used.

(b) If additional valves are used they shall be temperature and pressure safety relief valves.

(c) When the temperature and pressure safety relief valve is mounted directly on the boiler with no more than 4 in. (100 mm) maximum interconnecting piping, the valve may be installed in the horizontal position with the outlet pointed down.

HG-703 PIPING

HG-703.1 Provisions for Expansion and Contraction. Provisions shall be made for the expansion and contraction of steam and hot water mains connected to boilers by providing substantial anchorage at suitable points and by providing swing joints when boilers are installed in batteries, so there will be no undue strain transmitted to the boilers. See Figures HG-703.1(a), HG-703.1(b), and HG-703.2 for typical schematic arrangements of piping incorporating strain absorbing joints for steam and hot water heating boilers.
Figure HG-703.1(a)
Steam Boilers in Battery — Pumped Return — Acceptable Piping Installation

GENERAL NOTES:
(a) Return connections shown for a multiple boiler installation may not always insure 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.
(b) Plumbing codes may require the installation of a reduced pressure principle backflow preventer on a boiler when the makeup water source is from a potable water supply.

NOTE:
(1) Recommended for 1 in. (DN 25) and larger safety valve discharge.
Figure HG-703.1(b)
Steam Boilers in Battery — Gravity Return — Acceptable Piping Installation

GENERAL NOTES:
(a) Return connections shown for a multiple boiler installation may not always insure 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.

(b) Plumbing codes may require the installation of a reduced pressure principle backflow preventer on a boiler when the makeup water source is from a potable water supply.

NOTE:
(1) Recommended for 1 in. (DN 25) and larger safety valve discharge.
**HG-703.2 Return Pipe Connections.**

(a) The return pipe connections of each boiler supplying a gravity return steam heating system shall be so arranged as to form a loop substantially as shown in Figure HG-703.1(b) so that the water in each boiler cannot be forced out below the safe water level.

(b) For hand-fired boilers with a normal grate line, the recommended pipe sizes detailed as “A” in Figures HG-703.1(a) and HG-703.1(b) are NPS 1 1/2 (DN 40) for 4 ft² (0.37 m²) or less firebox area at the normal grate line, NPS 2 1/2 (DN 65) for areas more than 4 ft² (0.37 m²) up to 14.9 ft² (1.4 m²), and NPS 4 (DN 100) for 15 ft² (1.4 m²) or more.

(c) For automatically fired boilers that do not have a normal grate line, the recommended pipe sizes detailed as “A” in Figures HG-703.1(a) and HG-703.1(b) are NPS 1 1/2 (DN 40) for boilers with minimum safety valve relieving capacity 250 lb/hr (113 kg/hr) or less, NPS 2 1/2 (DN 65) for boilers with minimum safety valve relieving capacity from 251 lb/hr (114 kg/hr) to 2,000 lb/hr (900 kg/hr), inclusive, and NPS 4 (DN 100) for boilers with more than 2,000 lb/hr (900 kg/hr) minimum safety valve relieving capacity.

(d) Provision shall be made for cleaning the interior of the return piping at or close to the boiler. Washout openings may 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.

**HG-705 FEEDWATER AND MAKEUP WATER CONNECTIONS**

(a) Steam Boilers. Feedwater or water treatment shall be introduced into a boiler through the return piping system. Alternatively, feedwater or water treatment may be introduced 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. 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. A stop valve or cock shall be installed either upstream or downstream of the check valve (or backflow preventer containing a check valve).

(b) Hot Water 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. A stop valve or cock shall be installed either upstream or downstream of the check valve (or backflow preventer containing a check valve).

**HG-707 OIL HEATERS**

(a) A heater for oil or other liquid harmful to boiler operation shall not be installed directly in the steam or water space within a boiler.

(b) Where an external type heater for such service is used, means shall be provided to prevent the introduction into the boiler of oil or other liquid harmful to boiler operation.

**HG-708 STORAGE TANKS FOR HOT WATER SUPPLY SYSTEMS**

If a system is to utilize a storage tank that exceeds the capacity exception of HLW-101, the tank shall be constructed in accordance with the rules of HLW, Section VIII, Division 1; or Section X. For tanks constructed to Section X, the maximum allowable temperature marked on the tank shall equal or exceed the maximum water temperature marked on the boiler.

**HG-709 PROVISIONS FOR THERMAL EXPANSION IN HOT WATER SYSTEMS**

All hot water heating systems incorporating hot water tanks or fluid relief columns shall be so installed as to prevent freezing under normal operating conditions.

**HG-709.1 Heating Systems With Open Expansion Tank.** An indoor overflow from the upper portion of the expansion tank shall be provided in addition to an open vent, the indoor overflow to be carried within the building to a suitable plumbing fixture or the basement.

**HG-709.2 Closed Heating Systems.** An expansion tank shall be installed that will be consistent with the volume and capacity of the system. If the system is designed for a working pressure of 30 psi (200 kPa) or less, the tank shall be suitably designed for a minimum hydrostatic test pressure of 75 psi (520 kPa). Expansion tanks for systems designed to operate above 30 psi (200 kPa) shall be constructed in accordance with Section VIII, Division 1. Alternatively, a tank built to Section X requirements may be used if the pressure and temperature ratings of the tank are equal to or greater than the pressure and temperature ratings of the system. Provisions shall be made for draining the tank without emptying the system, except for prepressurized tanks.
The minimum capacity of the closed type expansion tank may be determined from Table HG-709.2 or from the following formula where the necessary information is available:

\[
V_t = \left[ \frac{(0.000417 - 0.0466)V_s}{(P_a / P_f)} - \frac{P_a}{P_o} \right]
\]

\[
V_t = \left[ \frac{(0.000738T - 0.03348)V_s}{(P_a / P_f)} - \frac{P_a}{P_o} \right]
\]

where

- \(P_a\) = atmospheric pressure
- \(P_f\) = fill pressure
- \(P_o\) = maximum operating pressure
- \(T\) = average operating temperature
- \(V_s\) = volume of system, not including tanks
- \(V_t\) = minimum volume of tanks

**HG-709.3 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 Section VIII, Division 1 or Section X. Except for prepressurized tanks, which should be installed on the cold water side, provisions shall be made for draining the tank without emptying the system. See Figure HLW-809.1 for a typical acceptable installation.

**HG-710 STOP VALVES**

**HG-710.1 For Single Steam Boilers.** When a stop valve is used in the supply pipe connection of a single steam boiler, there shall be one used in the return pipe connection.

**HG-710.2 For Single Hot Water Heating Boilers.**

\(a\) Stop valves shall be located at an accessible point in the supply and return pipe connections as near the boiler nozzle as is convenient and practicable, of a single hot water heating boiler installation to permit draining the boiler without emptying the system.

\(b\) When the boiler is located above the system and can be drained without draining the system, stop valves may be eliminated.

**HG-710.3 For Multiple Boiler Installations.** A stop valve shall be used in each supply and return pipe connection of two or more boilers connected to a common system. See Figures HG-703.1(a), HG-703.1(b), and HG-703.2.

**HG-710.4 Modular Boilers.** Modular boilers shall be installed without stop valves between modules and shall be provided with a single set of stop valves on the common supply and return headers in accordance with HG-710.1 and HG-710.2. Flow control valves and circulating pumps may be located in the return line of each module.

**HG-710.5 Type of Stop Valve(s).**

\(a\) All valves or cocks shall conform with the applicable portions of HF-203 and may be ferrous or nonferrous.

\(b\) The minimum pressure rating of all valves or cocks shall be at least equal to the pressure stamped upon the boiler, and the temperature rating of such valves or cocks, including all internal components, shall be not less than 250°F (120°C).

\(c\) Valves or cocks shall be flanged, threaded, or have ends suitable for welding or brazing.

\(d\) All valves or cocks with stems or spindles shall have adjustable pressure type packing glands and, in addition, all plug type cocks shall be equipped with a guard or gland. The plug or other operating mechanism shall be distinctly marked in line with the passage to indicate whether it is opened or closed.

\(e\) All valves or cocks shall have tight closure when under boiler hydrostatic test pressure.

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**Table HG-709.2 Expansion Tank Capacities for Forced Hot Water Systems**

<table>
<thead>
<tr>
<th>System Volume, gal (m³)</th>
<th>Prepressurized Tank Capacities, gal (m³)</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prepressurized</td>
<td>Nonpressurized</td>
</tr>
<tr>
<td></td>
<td>Diaphragm Type</td>
<td>Type</td>
</tr>
<tr>
<td>100 (0.38)</td>
<td>9 (0.034)</td>
<td>15 (0.057)</td>
</tr>
<tr>
<td>200 (0.76)</td>
<td>17 (0.064)</td>
<td>30 (0.114)</td>
</tr>
<tr>
<td>300 (1.14)</td>
<td>25 (0.095)</td>
<td>45 (0.170)</td>
</tr>
<tr>
<td>400 (1.51)</td>
<td>33 (0.125)</td>
<td>60 (0.227)</td>
</tr>
<tr>
<td>500 (1.89)</td>
<td>42 (0.159)</td>
<td>75 (0.284)</td>
</tr>
<tr>
<td>1,000 (3.79)</td>
<td>83 (0.314)</td>
<td>150 (0.568)</td>
</tr>
<tr>
<td>2,000 (7.57)</td>
<td>165 (0.625)</td>
<td>300 (1.136)</td>
</tr>
</tbody>
</table>

**GENERAL NOTES:**

\(a\) The capacities in this Table are based on an average operating temperature of 195°F (90°C), a fill pressure of 12 psig, and a maximum operating pressure of 30 psig (200 kPa).

\(b\) 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 prepressurized types and 0.222 for nonprepressurized types. A procedure for estimating system volume and determining expansion tank sizes for other design conditions may be found in Chapter 12 of the 1996 HVAC Systems and Equipment Volume of the ASHRAE Handbook.
HG-715  BOTTOM BLOWOFF AND DRAIN VALVES

(a) Bottom Blowoff Valve. 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 Table HG-715. The discharge piping shall be full size to the point of discharge.

(b) Boilers having a capacity of 25 gal (95 L) or less are exempt from the above requirements, except that they must have an NPS 3/4 (DN 20) minimum drain valve.

(c) Drain Valve. Each steam or hot water boiler shall have one or more drain connections, fitted with valves or cocks. These shall be connected at the lowest practicable point on the boiler, or to the lowest point on piping connected to the boiler, at the lowest practicable point on the boiler. The minimum size of the drain piping, valves, and cocks shall be NPS 3/4 (DN 20). 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.

(d) Minimum Pressure Rating. 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 30 psi (200 kPa). The temperature rating of such valves and cocks shall not be less than 250°F (120°C).

HG-716  MODULAR BOILERS

(a) Individual Modules

(1) The individual modules shall comply with all the requirements of Part HG, except as specified in HG-607, HG-615, and this paragraph.

(2) Each module of a steam heating boiler shall be equipped with
   (-a) safety valve, see HG-701
   (-b) blowoff valve, see HG-715(a)
   (-c) drain valve, see HG-715(c)

(3) Each module of a modular hot water heating boiler shall be equipped with
   (-a) safety relief valve, see HG-701
   (-b) drain valve, see HG-715(c)

(b) Assembled Modular Boilers

(1) The individual modules shall be manifolded together at the job-site without any intervening valves. The header or manifold piping is field piping and is exempt from Article 2, Part HP, HF, HB, or HC.

(2) The assembled modular steam heating boiler shall also be equipped with
   (-a) feedwater connection, see HG-705(a)
   (-b) return pipe connection, see HG-703.2

(3) The assembled modular hot water heating boiler shall also be equipped with
   (-a) makeup water connection, see HG-705(b)
   (-b) provision for thermal expansion, see HG-709
   (-c) stop valves, see HG-710.2

(4) When the assembled modular boiler is certified as a single boiler in accordance with HG-530.3(b), the safety valve required on each module by (a)(2)(-a) and (a)(3)(-a) may be replaced by one or more safety valves located on the supply header.

HG-720  SETTING

Boilers of wrought materials of the wet-bottom type having an external width of over 36 in. (900 mm) shall have not less than 12 in. (300 mm) between the bottom of the boiler and the floorline, with access for inspection. When the width is 36 in. (900 mm) or less, the distance between the bottom of the boiler and the floorline shall be not less than 6 in. (150 mm), except that, when any part of the wet bottom is not farther from an outer edge than 12 in. (300 mm), this distance shall be not less than 4 in. (100 mm).

HG-725  METHODS OF SUPPORT

HG-725.1 Loadings.

(a) The design and attachment of lugs, hangers, saddles, and other supports shall take into account the stresses due to hydrostatic head in determining the minimum thicknesses required. Additional stresses imposed by effects other than working pressure or static head, which increase the average stress by more than 10% of the allowable working stress, shall also be taken into account. These effects include the weight of the component and its contents, and the method of support.

(b) In applying the requirements of (a) above, localized stresses due to concentrated support loads, temperature changes, and restraint against dilation of the boiler due to pressure shall be provided for. Lugs, hangers, brackets, saddles, and pads shall conform satisfactorily to the shape of the shell or surface to which they are attached or are in contact.

HG-725.2  Boilers Over 72 in. (1 800 mm) in Diameter. A horizontal-return tubular boiler over 72 in. (1 800 mm) in diameter shall be supported from steel
HA-405 RATING OF PRODUCTION BOILERS BASED ON TESTS

All boilers or boiler parts of the same material, design, and construction, whose design pressures are based on a test to destruction of a sample boiler or boiler part in accordance with HA-402, shall be considered to have design pressures equal to the maximum allowable working pressure thus determined and shall be subjected to a hydrostatic test pressure in conformity with rules of HA-406.

HA-406 HYDROSTATIC TEST

All completed boilers or boiler parts shall satisfactorily pass the hydrostatic test prescribed in this paragraph.

HA-406.1 Hot Water Boilers.
(a) Hot water heating boilers marked for maximum allowable working pressures not over 30 psi (200 kPa) shall have each individual section or boiler part subjected to a hydrostatic test of not less than 60 psi (400 kPa) at the shop where made.
(b) Hot water heating boilers marked for maximum allowable working pressures over 30 psi (200 kPa) shall have each individual section or boiler part subjected to a hydrostatic test of \(2\sqrt{2}\) times the maximum allowable working pressure at the shop where made.
(c) The assembled boiler shall be subjected to a hydrostatic test pressure not less than \(1\frac{1}{2}\) times the maximum allowable working pressure.

(1) Cast aluminum monoblock boilers, boilers with a single section design that do not require additional machining or assembly, do not require a second hydrostatic test at \(1\frac{1}{2}\) times the maximum allowable working pressure.

(-a) Any additional machining, shot blasting, or grinding after the hydrostatic test will require testing at \(1\frac{1}{2}\) times the maximum allowable working pressure.

HA-406.2 Required Test Pressure. In making hydrostatic pressure tests, the pressure shall be under such control that in no case shall the required test pressure be exceeded by more than 10 psi (70 kPa).

HA-407 PNEUMATIC TESTS

As an alternative to the hydrostatic test required in HA-406.1(c), cast aluminum boiler sections may be pneumatically tested, provided the following requirements are met:

(a) The use of pneumatic testing in lieu of hydrostatic testing shall be documented in the quality control system.

(b) Maximum material thickness of any component part shall not exceed \(1\frac{1}{2}\) in. (12.7 mm).

(c) When the boiler is under pneumatic pressure testing, its calculated potential energy, \(E\), shall be less than 1,000 ft-lb (1356 J).

\[
E = C \times P_{at} \times V \left[ 1 - \left( \frac{P_{at}}{P_{at}} \right) \right]^{0.286}
\]

where

- \(C\) = constant, 360 in.\(^2\)/ft\(^2\) (2 500 Pa/kPa)
- \(E\) = stored energy, ft-lb (J)
- \(P_{at}\) = absolute atmospheric pressure, 14.7 psia (101 kPa)
- \(P_{at}\) = absolute test pressure, psia (kPa)
- \(V\) = total volume under test pressure, ft\(^3\) (m\(^3\))

NOTE: \(V\) includes the volume of the vessel and any connected volume to the pressure supply pump or valve.

(d) Nitrogen or clean, dry, oil-free air shall be used.

(e) The boiler shall be visually inspected for evidence of damage before pressurization.

(f) The boiler should be tested in such a manner as to ensure personnel safety from a release of the total internal energy of the vessel.

(g) The required test pressure shall be the greater of 38 psi (262 kPa) or 1.1 times the MAWP.

(h) Overpressure relief protection shall be provided.

The set pressure of a pressure relief device shall not exceed the greater of the following:

(1) the test pressure plus 10 psi (70 kPa)

(2) 110% of the test pressure

(i) A minimum hold time of 5 min shall be maintained on the boiler at the required test pressure.

(j) The pneumatic test method shall be immersed visual inspection.

(1) The boiler shall be externally cleaned to prevent air bubble adherence while being tested to prevent leaks from being masked.

(2) The uppermost portion of the boiler, as oriented in the test tank, shall be a minimum of 6 in. (150 mm) below the surface of the water, and the water shall have a minimum temperature of 60°F (16°C).

(3) Before the holding period, the immersed boiler shall be rotated a minimum of 180 deg around a lateral axis to release any trapped air.

(4) After the holding period, the pressure may be reduced to the MAWP, but not less than 38 psi (262 kPa), and maintained at this pressure while a thorough visual inspection for leakage is made with the boiler submerged in water.

(5) After the holding period, and during the visual inspection, the immersed boiler shall be rotated a minimum of 180 deg around a lateral axis to permit easy visual detection of any leakage.

(6) Any evidence of air leaking from the vessel will indicate failure of the pneumatic pressure test.
ARTICLE 6 — INSPECTION AND STAMPING

Inspection and stamping requirements for water heaters are given. The Certification Mark with HLW designator is provided for water heaters made in accordance with Part HLW of Section IV.

ARTICLE 7 — CONTROLS

Each water heater is required to have an operating control and a separate high-limit temperature-actuated control that shuts off the fuel supply in case of operating control failure. Water heaters should be equipped with suitable primary safety controls, safety limit switches, burners, or electric elements as appropriate and as required by a nationally recognized standard. Examples of these nationally recognized standards are listed.

ARTICLE 8 — INSTALLATION

Some acceptable piping installations are shown. Provisions for the installation of safety relief valves and other valves are given.
ARTICLE 1
GENERAL

HLW-100  SCOPE

(a) The rules in Part HLW apply to water heaters and water storage tanks with corrosion resistance for supplying potable hot water. The Foreword provides the basis for these rules. Part HLW is not intended to apply to hot water heating boilers, hot water supply boilers, or water storage tanks without corrosion resistance.

(b) This Part contains mandatory requirements, specific prohibitions, and nonmandatory guidance for materials, designs, fabrication, examination, inspection, testing, certification, and pressure relief.

(c) Laws or regulations issued by a municipality, state, provincial, federal, or other enforcement or regulatory body having jurisdiction at the location of an installation, establish the mandatory applicability of these rules, in whole or in part.

HLW-101  SERVICE LIMITS

(a) The rules of Part HLW apply to

(1) potable water heaters that exceed an input greater than 200,000 Btu/hr (60 kW) or a nominal water-containing capacity of 120 gal (450 L)

(2) potable water storage tanks with a nominal water-containing capacity of 120 gal (450 L) or greater

(b) The rules of Part HLW apply to potable water heaters and water storage tanks designed for pressures not exceeding 160 psi (1 100 kPa) or water temperatures not exceeding 210°F (99°C).

HLW-102  PERMISSIBLE STAMPING

Any water heater or storage tank that meets all of the requirements of Part HLW, including those for inspection, may be stamped with the Code HLW Symbol even though exempted from such stamping.

HLW-103  UNITS

Either U.S. Customary, SI, or any local customary units may be used to demonstrate compliance with all requirements of this edition (e.g., materials, design, fabrication, examination, inspection, testing, certification, and overpressure protection).

In general, it is expected that a single system of units shall be used for all aspects of design except where unfeasible or impractical. When components are manufactured at different locations where local customary units are different than those used for the general design, the local units may be used for the design and documentation of that component. Similarly, for proprietary components or those uniquely associated with a system of units different than that used for the general design, the alternate units may be used for the design and documentation of that component.

For any single equation, all variables shall be expressed in a single system of units. When separate equations are provided for U.S. Customary and SI units, those equations must be executed using variables in the units associated with the specific equation. Data expressed in other units shall be converted to U.S. Customary or SI units for use in these equations. The result obtained from execution of these equations may be converted to other units.

Production, measurement and test equipment, drawings, welding procedure specifications, welding procedure and performance qualifications, and other fabrication documents may be in U.S. Customary, SI, or local customary units in accordance with the fabricator’s practice. When values shown in calculations and analysis, fabrication documents, or measurement and test equipment are in different units, any conversions necessary for verification of Code compliance and to ensure that dimensional consistency is maintained shall be in accordance with the following:

(a) Conversion factors shall be accurate to at least four significant figures.

(b) The results of conversions of units shall be expressed to a minimum of three significant figures.

Conversion of units, using the precision specified above shall be performed to assure that dimensional consistency is maintained. Conversion factors between U.S. Customary and SI units may be found in the Nonmandatory Appendix M, Guidance for the Use of U.S. Customary and SI Units in the ASME Boiler and Pressure Vessel Code. Whenever local customary units are used the Manufacturer shall provide the source of the conversion factors, which shall be subject to verification and acceptance by the Authorized Inspector or Certified Individual.

Material that has been manufactured and certified to either the U.S. Customary or SI material specification (e.g., SA-516M) may be used regardless of the unit system used in design. Standard fittings (e.g., flanges, elbows, etc.) that have been certified to either U.S. Customary units or SI units may be used regardless of the unit system used in design.
ARTICLE 6
INSPECTION AND STAMPING

HLW-600 INSPECTION AND CERTIFICATION

(19) HLW-600.1 Inspection by Authorized Inspector. Except for cast iron boilers, cast aluminum boilers, or pressure relief devices, the inspection required by this Section shall be by an Inspector employed by an ASME Accredited Authorized Inspection Agency. These inspectors shall have been qualified in accordance with ASME QAI-1.

HLW-600.2 Manufacturer’s Responsibility.

(a) The manufacturer who completes any vessel to be marked with the Certification Mark with HLW designator has the responsibility of complying with all requirements of this Part, and through proper certification of assuring that any work done by others also complies with the requirements of this Part.

(b) The manufacturer has the responsibility of providing the Authorized Inspector with all specified information and assurance that the quality control system is in compliance with that outlined in Nonmandatory Appendix F. These responsibilities shall include, but are not limited to, providing or making available for review the following:

1. a valid Certificate of Authorization for use of the Certification Mark with HLW designator from the ASME Boiler and Pressure Vessel Committee (see HLW-602)

2. the design calculations per Article 3 or the certified proof test results per Article 5 and associated drawings (see HLW-300 and HLW-500)

3. identification of materials to show compliance with Articles 2 and 3 and compliance with the provisions of Section IX (see HLW-200 and HLW-300)

4. evidence of qualification of welding and/or brazing procedures (see HLW-432 and HLW-450)

5. records of qualifications of each welder, welding operator, or brazer as evidence of compliance with the provisions of Section IX (see HLW-432 and HLW-450)

6. any Manufacturer’s Partial Data Reports when required by HLW-601.2

7. evidence of examination of all materials before and during fabrication to make certain it has the required thickness, has no unacceptable imperfections, and is one of the acceptable materials permitted by this Part and that traceability to the material identification has been maintained [see HLW-201(c) and F-202.4]

8. the manufacturer shall submit the vessel or other pressure part for inspection at such stages of the work as may be designated by the Inspector

HLW-600.3 Authorized Inspector’s Duty.

(a) The Authorized Inspector shall make such inspections as he believes are needed to enable him to certify that the vessels have been constructed in accordance with the rules of this Part. He shall assure himself that the manufacturer is complying with all of the requirements of this Part.

(b) It is the duty of the Inspector to assure himself that the welding procedures employed in construction are qualified under the provisions of Section IX. The manufacturer shall submit evidence to the Inspector that those requirements have been met.

(c) It is the duty of the Inspector to assure himself that all welding is done by welders or welding operators qualified under the provisions of Section IX. The manufacturer shall make available to the Inspector a certified copy of the record of performance qualification tests of each welder and welding operator as evidence that these requirements have been met.

The Inspector has the right at any time to call for and witness the test welding and testing although it is not mandatory that he witness the test welding and the testing unless he so desires.

(d) It is the duty of the Inspector to witness tests conducted to establish the maximum allowable working pressure of water heaters and storage vessels (see HLW-500).

(e) It is the duty of the Inspector to witness hydrostatic tests (see HLW-505).

(f) The provisions of HG-515.4(b) apply to the mass production of water heaters and storage tanks.

HLW-601 MANUFACTURER’S DATA AND PARTIAL DATA REPORTS

HLW-601.1 Manufacturer’s Data Report.

(a) Each manufacturer shall complete a Manufacturer’s Data Report for each vessel he produces. Form HLW-6 may be used. Individual manufacturer’s data reports, if used, will satisfy the requirements for the Manufacturer’s Data Report. The report may cover a single vessel or may include the serial numbers in uninterrupted sequence of identical vessels completed, inspected, and stamped in a continuous 8-hr period.

(b) The manufacturer shall have the responsibility of furnishing a copy of the completed Manufacturer’s Data Report at the place of installation to the inspection agency, the purchaser, and the state, municipal, or provincial authority. The manufacturer shall either keep a copy
ARTICLE 8
INSTALLATION REQUIREMENTS

HLW-800 SAFETY RELIEF VALVES

HLW-800.1 Safety Relief Valve Requirements for Water Heaters.

(a) Each water heater shall have at least one officially rated temperature and pressure safety relief valve or at least one officially rated safety relief valve. The valve(s) shall be marked with the Certification Mark with V or HV-designator to evidence compliance with the construction and rating requirements of the ASME Boiler and Pressure Vessel Code. No safety relief valve shall be smaller than NPS 3/4 (DN 20).

(b) 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 or storage tanks, or piping) have a lesser working pressure rating than the water heater, the pressure setting for the relief valve(s) shall be based upon the component with the lowest maximum allowable working pressure rating. If more than one safety relief valve is used, the additional valve(s) may be set within a range not to exceed 10% over the set pressure of the first valve.

(c) The required relieving capacity in Btu/hr of the safety 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 safety relief valves. The relieving capacity for electric water heaters shall be 3,500 Btu/hr (1.0 kW) per kW of input. In every case, the following requirements shall be met. Safety 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 10% of maximum allowable working pressures.

(d) If operating conditions are changed or additional heater heating surface is installed, the safety 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 additional valves required, on account of changed conditions, may be installed on the outlet piping provided there is no intervening valve.
ARTICLE 8
INSTALLATION REQUIREMENTS

HLW-801 MOUNTING SAFETY RELIEF VALVES

HLW-801.1 Installation. Safety relief valves shall be installed by either the installer or the manufacturer before a water heater is placed in operation.

HLW-801.2 Permissible Mountings. Safety relief valves shall be connected to the top of water heaters or directly to a tapped or flanged opening in the water heater, to a fitting connected to the water heater by a short nipple, to a Y-base, or to a valveless header connecting water outlets on the same heater. Safety relief valves shall be installed with their spindles upright and vertical with no horizontal connecting pipe, except that, when the safety relief valve is mounted directly on the water heater vessel with no more than 4 in. (100 mm) maximum interconnecting piping, the valve may be installed in the horizontal position with the outlet pointed down. The center line of the safety relief valve connection shall be no lower than 4 in. (100 mm) from the top of the shell. No piping or fitting used to mount the safety relief valve shall be of a nominal pipe size less than that of the valve inlet.

HLW-801.3 Requirements for Common Connection for Two or More Valves.

(a) When a water heater is fitted with two or more safety 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 safety relief valves with which it connects.

(b) When a Y-base is used, the inlet area shall be not less than the combined outlet areas. When the size of the water heater requires a safety relief valve larger than 4½ in. (114 mm) diameter, two or more valves having the required combined capacity shall be used. When two or more valves are used on a water heater, they may be single, directly attached, or mounted on a Y-base.

HLW-801.4 Threaded Connections. A threaded connection may be used for attaching a valve.

HLW-801.5 Prohibited Mountings. Safety 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.

HLW-801.6 Use of Shutoff Valves Prohibited. No shutoff of any description shall be placed between the safety relief valve and the water heater, or on discharge pipes between such valves and the atmosphere.
HLW-801.7 Safety Relief Valve Discharge Piping. 
(a) When a discharge pipe is used, its internal crosssectional area shall be not less than the full area of the valve outlet or of the total of the valve outlets discharging thereinto, and shall be as short and straight as possible and so arranged as to avoid undue stress on the valve or valves. When an elbow is placed on a safety relief discharge pipe, it shall be located close to the valve outlet. 
(b) The discharge from safety relief valves shall be so arranged that there will be no danger of scalding attendants. When the safety 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.

HLW-805 WATER SUPPLY
HLW-805.1 Connections. 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.

HLW-805.2 Pressure. If the water supply pressure to a water heater exceeds 75% of the set pressure of the safety relief valve, a pressure reducing valve is required.

HLW-805.3 Stop Valves. Stop valves should be placed in the supply and discharge pipe connections of a water heater installation to permit draining the water heater without emptying the system.

HLW-809 PROVISIONS FOR THERMAL EXPANSION IN HOT WATER SYSTEMS
HLW-809.1 Expansion Tank. 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 air tight 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 Section VIII, Division 1 or Section X. See Figure HLW-809.1 for a typical acceptable installation (and Table HLW-809.1 for expansion tank capacities). Except for prepressurized diaphragm type tanks, which should be installed on the cold water side, provisions shall be made for draining the tank without emptying the system.

Table HLW-809.1 Expansion Tank Capacities for a Water Heater

<table>
<thead>
<tr>
<th>System Volume, gal (m³)</th>
<th>Prepressurized Diaphragm Type</th>
<th>Nonprepressurized Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 (0.19)</td>
<td>1 (0.004)</td>
<td>3 (0.011)</td>
</tr>
<tr>
<td>100 (0.38)</td>
<td>2 (0.006)</td>
<td>6 (0.023)</td>
</tr>
<tr>
<td>200 (0.76)</td>
<td>3 (0.011)</td>
<td>12 (0.045)</td>
</tr>
<tr>
<td>300 (1.14)</td>
<td>4 (0.015)</td>
<td>18 (0.068)</td>
</tr>
<tr>
<td>400 (1.51)</td>
<td>5 (0.019)</td>
<td>24 (0.091)</td>
</tr>
<tr>
<td>500 (1.89)</td>
<td>6 (0.023)</td>
<td>30 (0.114)</td>
</tr>
<tr>
<td>1,000 (3.79)</td>
<td>12 (0.045)</td>
<td>60 (0.227)</td>
</tr>
<tr>
<td>2,000 (7.57)</td>
<td>24 (0.091)</td>
<td>120 (0.454)</td>
</tr>
</tbody>
</table>

GENERAL NOTES:
(a) Capacities in this Table are given as a guide to reduce or eliminate relief valve weeping under conditions of partial water system demands or occasional water draw during recovery.
(b) System volume includes water heater capacity plus all piping capacity for a recirculation system or water heater capacity only for a nonrecirculation system.
(c) The capacities are based upon a water temperature rise from 40°F to 180°F (4°C to 82°C), 60 psi (400 kPa) fill pressure, maximum operating pressure of 125 psi (850 kPa), 20% water recovery, and an acceptance factor of 0.465 for prepressurized types and 0.09156 for nonprepressurized types. A procedure for estimating system volume and for determining expansion tank sizes for other design conditions may be found in Chapter 12 of the 1996 HVAC Systems and Equipment Volume of the ASHRAE Handbook.

HLW-809.2 Piping. Provisions shall be made for the expansion and contraction of hot water mains connected to water heaters by providing substantial anchorage at suitable points and by providing swing joints when water heaters are installed in batteries, so that there will be no undue strain transmitted to the water heaters. See Figures HLW-809.1 and HLW-809.2 for typical schematic arrangements of piping incorporating strain absorbing joints.

HLW-810 BOTTOM DRAIN VALVE
(a) Each water heater shall have a bottom drain pipe connection fitted with a valve or cock. These shall be connected at the lowest practicable point on the water heater, or to the lowest point on piping connected to the water heater, at the lowest practicable point on the water heater. The minimum size bottom drain valve shall be 3/4 in. (DN 20).
(b) Any discharge piping connected to the bottom drain connection shall be full size to the point of discharge.
ARTICLE 9
MODULAR WATER HEATER REQUIREMENTS

HLW-900 GENERAL

The requirements of this Article are applicable to modular water heaters and parts thereof and shall be used in conjunction with the general requirements in Part HLW as well as the special requirements in the applicable Parts of this Section that apply to modular heaters.

HLW-901 STAMPING

Assembled modules shall be provided with a single nameplate stamping for the modular water heater, with the aggregate maximum input in Btu/hr (kW) noted on the nameplate stamping.

Individual modules shall be marked in a manner traceable to the assembled modular water heater nameplate and data report.

HLW-902 MANUFACTURER'S DATA REPORTS

A completed modular water heater shall be documented on a Master Manufacturer’s Data Report in accordance with HLW-601.1(a). When individual modules are certified on a single data report, the serial number of each individual module shall be listed in the “Remarks” section of the Master Manufacturer’s Data Report, Form HLW-6, with the single data report attached.

HLW-903 SAFETY RELIEF VALVES

The safety valve(s) required on each module by HLW-800.1(a) may be replaced by one or more safety valves located on the supply (distribution) header.

No valve of any kind shall be installed between any module heat exchanger and the safety valve.

HLW-904 STOP VALVES

The assembled modular water heater shall be installed without stop valves between modules and should be provided with a single set of stop valves on the common supply (distribution or discharge) and return headers in accordance with HLW-805.3. Flow control valves and circulating pumps may be in the inlet lines of the individual modules.

HLW-905 SUPPLY AND RETURN HEADERS

Supply (distribution) and cold-water return headers shall be constructed in accordance with this Section and recorded on the Manufacturer’s Data Report.

HLW-906 BOTTOM DRAIN VALVE

The bottom drain valve(s) required on each module by HLW-810(a) or HLW-810(b) may be replaced by one or more bottom drain valves located at the lowest practicable point on the water heater or to the lowest point on piping connected to the water heater.

HLW-907 THERMOMETERS

The thermometer required on each module per HLW-820 may be replaced by a single thermometer located on the supply (distribution) header.
MANDATORY APPENDIX 2
CODES, STANDARDS, AND SPECIFICATIONS REFERENCED IN TEXT

2-100  REFERENCE STANDARDS

Specific editions of standards incorporated in this Code are shown in Table 2-100. It is not practical to refer to a specific edition of each standard throughout the Code text, so edition references are centralized here. Table 2-100 will be revised at intervals and reissued as needed.

Listed below are the names, acronyms, and addresses of specific organizations referred to in this Code.

Publisher: American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036 (212) 642-4900 (http://www.ansi.org)

Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (877) 909-2726 (http://www.astm.org)

Publisher: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329 (800) 527-4723 (404) 636-8400 (http://www.ashrae.org)

Publisher: Canadian Standards Association (CSA), 5060 Spectrum Way, Mississauga, Ontario L4W 5N6, Canada (416) 747-4000 (404) 636-8400 (http://www.csa.ca)

<table>
<thead>
<tr>
<th>Document Designator</th>
<th>Document Title</th>
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</thead>
<tbody>
<tr>
<td>ASME Standards</td>
<td></td>
</tr>
<tr>
<td>B16.1</td>
<td>Gray Iron Pipe Flanges and Flanged Fittings</td>
</tr>
<tr>
<td>B16.5</td>
<td>Pipe Flanges and Flanged Fittings: NPS ( \frac{1}{2} ) Through NPS 24 Metric/Inch Standard</td>
</tr>
<tr>
<td>B16.9</td>
<td>Factory-Made Wrought Butt Welding Fittings</td>
</tr>
<tr>
<td>B16.11</td>
<td>Forged Fittings, Socket Welding and Threaded</td>
</tr>
<tr>
<td>B16.15</td>
<td>Cast Copper Alloy Threaded Fittings</td>
</tr>
<tr>
<td>B16.24</td>
<td>Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500</td>
</tr>
<tr>
<td>B16.42</td>
<td>Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300</td>
</tr>
<tr>
<td>B36.10M</td>
<td>Welded and Seamless Wrought Steel Pipe</td>
</tr>
<tr>
<td>CA-1</td>
<td>Conformity Assessment Requirements</td>
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<tr>
<td>QAI-1</td>
<td>Qualifications for Authorized Inspection</td>
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<table>
<thead>
<tr>
<th>ASME-Performance-Test-Code</th>
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</thead>
<tbody>
<tr>
<td>PTC-25</td>
<td>Pressure Relief Devices</td>
</tr>
</tbody>
</table>

National Sanitation Foundation International (NSFI) Standard
NSFI/ANSI 14 Plastic Piping Components and Related Materials

Underwriters Laboratories Standards for Safety
UL 353 Standard for Limit Controls
UL 969 Standard for Marking and Labeling Systems

American Society for Testing and Materials (ASTM)
ASTM B6 Standard Specification for Zinc
ASTM B733 Standard Specification for Autocatalytic (Electroless) Nickel-Phosphorus Coatings on Metal
ASTM D570 Standard Test Method for Water Absorption of Plastics
ASTM E9 Standard Test Methods of Compression Testing of Metallic Materials at Room Temperature

Deutsches Institut für Normung e. V. (DIN)
DIN 443 Sealing Push-in Caps

GENERAL NOTE: Unless otherwise noted, the latest edition shall apply.
Table 4-1
Guide for the Preparation of Section IV Manufacturer's Data Report Forms

<table>
<thead>
<tr>
<th>Applies to Form</th>
<th>Reference to Circled Numbers in the Forms</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-2 H-3 H-4 H-5 H-5A H-6 H-6H W-6 W-7 W-8</td>
<td>(1) Name and address of manufacturer (i.e., maker of all components not covered by Partial Data Reports).</td>
<td></td>
</tr>
<tr>
<td>X X X X X X X X</td>
<td>(2) Name and address of purchaser and/or owner.</td>
<td></td>
</tr>
<tr>
<td>X X X ... X X X ...</td>
<td>(3) Name and address of location where unit is to be installed. If not known, so indicate (e.g., “not known — built for stock”).</td>
<td></td>
</tr>
<tr>
<td>X X ... X X X ... X ... X</td>
<td>(4) Show type or model of unit documented by this data report.</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X X X ... X</td>
<td>(5) Identification of unit by applicable numbers. If intended for installation in Canada, indicate the Canadian design registration number and drawing number.</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X X X ... X</td>
<td>(6) Year in which fabrication was completed in shop.</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X X X ...</td>
<td>(7) Date (year) of Section IV edition to which boiler or part was designed.</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X X X ...</td>
<td>(8) Issue date of most recent addenda to Section IV to which boiler or part was designed (e.g., “December 1997”).</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X X X ...</td>
<td>(9) Code Case number, if applicable.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... X ...</td>
<td>(10) Show quantity and inside dimensions. If more than two shells or drums are used, enter data in line 14.</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X X X</td>
<td>(11) Show the complete ASME material specification number and grade as listed in the appropriate stress allowance table in Section IV (e.g., “SA-285-B”). Exception: A specification number for a material not identical to an ASME Specification may be shown only if such material has been approved for Section IV construction by an ASME interpretation case ruling and provided the applicable case number is also shown.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... X X X ...</td>
<td>(12) Indicate type of joint(s).</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... X X X ...</td>
<td>(13) Show joint efficiency for welded joints.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ...</td>
<td>(14) Show number of furnaces in boiler.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ...</td>
<td>(15) For cylindrical furnaces of the Adamson, ring-reinforced, and combined types, show total length only.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(16) For stayed (firebox) type furnace, complete line 12 also.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(17) If threaded, show diameter at root of thread.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(18) Minimum cross-sectional area after deducting for telltale hole.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(19) Maximum allowable working pressure for the stayed area calculated according to the rules contained in Part HG of Section IV.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(20) Type of stay or brace (e.g., diagonal, gusset, girder, through, etc.).</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(21) Minimum cross-sectional area of the stay or brace multiplied by the number of stays or braces supporting the area under consideration.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(22) See applicable paragraphs and figures in Part HG of Section IV.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(23) List parts not covered elsewhere on the data report. If insufficient space, attach a supplementary sheet.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(24) Tabulate data for parts listed on line 14.</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X ... ... ... ... ...</td>
<td>(25) Show data for main and auxiliary inlets and outlets, nozzles, inspection openings, safety valve openings, drains, and blowoffs. This does not apply to small openings for water column, controls, vents, etc.</td>
<td></td>
</tr>
<tr>
<td>X X X ... ... X X X ... ... ... ... ...</td>
<td>(26) Maximum allowable working pressure.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(27) Show Section IV paragraph that applies to the weakest part of the unit as established by calculation or deformation test.</td>
<td></td>
</tr>
<tr>
<td>X ... ... ... ... ... ... ... ... ...</td>
<td>(28) Boiler heating surface calculated in accordance with HG-403 of Section IV.</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- Section IV paragraph that applies to the weakest part of the unit as established by calculation or deformation test.
- Boiler heating surface calculated in accordance with HG-403 of Section IV.
FORM H-2 MANUFACTURER’S DATA REPORT FOR ALL TYPES OF BOILERS
EXCEPT WATERTUBE AND THOSE MADE OF CAST IRON
As Required by the Provisions of the ASME Code Rules, Section IV

1. Manufactured and certified by
   (name and address of manufacturer)

2. Manufactured for
   (name and address of purchaser)

3. Location of installation
   (name and address)

4. Unit identification
   (complete boiler, superheater, economizer, etc.)
   (manufacturer’s serial no.)
   (URN)
   (drawing no.)
   (National Bd. no.)
   (year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design conforms to ASME Code, Section IV,
   (year)
   (addenda as applicable)(date)
   (Code Case no.)

Manufacturer’s Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report
   (name of part, item number, manufacturer’s name, and identifying stamp)

6. Shells or drums
   (no.)
   (material spec., grad.)
   (thickness)
   (inside diameter)
   (length (overall))
   (inside diameter)
   (length (overall))

7. Joints
   (long. (seamless, welded))
   (eff. (compared to seamless))
   (girth (seamless, welded))
   (no. of shell courses)

8. Tubesheet
   (material spec., grade)
   (thickness)
   (number and diameter)

   (material spec., grade)
   (straight or bent)
   (if various, give max. and min.)
   (or thickness)

10. Heads
    (material spec., grad.)
    (thickness)

11. Furnace Seams
    (material spec., grad.)
    (thickness)
    (size (O.D. or W x H))
    (length (each section))
    (total)
    (type (plain, corrugated, etc.))
    (type (seamless, welded))

12. Staybolts
    (no.)

13. Stays or braces:

<table>
<thead>
<tr>
<th>Location</th>
<th>Material Spec.</th>
<th>Type</th>
<th>Number and Size</th>
<th>Pitch</th>
<th>Total Net Area</th>
<th>Fig. HG-343 L/f</th>
<th>Dist. Tubes to Shell</th>
<th>MAWP</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) F.H. above tubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) R.H. above tubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) F.H. below tubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) R.H. below tubes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) Through stays</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Other parts: 1.       2.       3.
   (brief description, i.e., dome, boiler piping)

1. 

2. 

3. 

(material spec., grade, size, material thickness, MAWP)

15. Nozzles, inspection, and safety valve openings:

<table>
<thead>
<tr>
<th>Purpose (inlet, outlet, drain, etc.)</th>
<th>No.</th>
<th>Diameter or Size</th>
<th>Type</th>
<th>How Attached</th>
<th>Material</th>
<th>Nominal Thickness</th>
<th>Reinforcement Material</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handhole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Manhole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(07/15)

pressure relief valve
# FORM H-3 MANUFACTURER'S DATA REPORT FOR WATERTUBE BOILERS AND ECONOMIZERS

As Required by the Provisions of the ASME Code Rules, Section IV

1. Manufactured and certified by
   
   [name and address of manufacturer]

2. Manufactured for
   
   [name and address of purchaser]

3. Location of installation
   
   [name and address]

4. Unit identification
   
   [complete boiler, superheater, waterwall, etc.]
   [manufacturer’s serial no.]
   [drawing no.]
   [CRN]
   [National Bd. no.]
   [year built]

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design conforms to ASME Code, Section IV,
   
   [year] [addenda (as applicable)/(date)]

6. (a) Drums:

<table>
<thead>
<tr>
<th>No.</th>
<th>Inside Diameter</th>
<th>Inside Length</th>
<th>Shell Plates</th>
<th>Tube Sheets</th>
<th>Tube Hole Ligament Efficiency, %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Material Spec. Grade</td>
<td>Thickness</td>
<td>Inside Radius</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. (b) Boiler tubes:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. (c) Headers no

<table>
<thead>
<tr>
<th>Heads or ends</th>
<th>Hydro. test</th>
</tr>
</thead>
<tbody>
<tr>
<td>(box or sinuous or round, material spec. no., thickness)</td>
<td></td>
</tr>
<tr>
<td>(shape, material spec. no., thickness)</td>
<td>(Code Case no.)</td>
</tr>
</tbody>
</table>

6. (d) Staybolts

<table>
<thead>
<tr>
<th>Pitch</th>
<th>Net area</th>
<th>Design pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. (e) Mud drum

<table>
<thead>
<tr>
<th>Heads or ends</th>
<th>Hydro. test</th>
</tr>
</thead>
<tbody>
<tr>
<td>(shape, material spec. no., thickness)</td>
<td>(supported by one bolt)</td>
</tr>
</tbody>
</table>

7. Waterwall headers:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. (a) Other parts or economizers

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

8. (b) Tubes for other parts or economizers

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. Nozzles, inspection, and safety valve openings:

<table>
<thead>
<tr>
<th>Purpose (inlet, outlet, drain, etc.)</th>
<th>No.</th>
<th>Diameter or Size</th>
<th>Type</th>
<th>How Attached</th>
<th>Material</th>
<th>Nom. Thickness</th>
<th>Reinforcement Material</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Handhole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manhole</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(07/17)

**Indicate if (1) seamless, (2) fusion welded.**
**Indicate if (1) flat, (2) dished, (3) ellipsoidal, (4) hemispherical.**

---

ASME BPV.CIV-2019
FORM H-3 (Back)

CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this data report are correct and that all details of design, material, construction, and workmanship of this boiler conform to Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.


Date Signed Name
(by representative) (manufacturer that constructed and certified boiler)

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by

have inspected parts of this boiler referred to as data items and

and state that, to the best of my knowledge and belief, the manufacturer has constructed this boiler in accordance with Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this Manufacturer’s Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date Signed Commission
(Authorized Inspector) (National Board Authorized Inspector Commission Number)

CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the field assembly construction of all parts of this boiler conforms with the requirements of Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.


Date Signed Name
(by representative) (assembler that certified and constructed field assembly)

CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by

have compared the statements in this Manufacturer’s Data Report with the described boiler and state that

the parts referred to as data items not included in the certificate of shop inspection, have been inspected by me and that to the best of my knowledge and belief the manufacturer and/or the assembler has constructed and assembled this boiler in accordance with Section IV of the ASME BOILER AND PRESSURE VESSEL CODE. The described boiler was inspected and subjected to a hydrostatic test of .

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the boiler described in this Manufacturer’s Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date Signed Commission
(Authorized Inspector) (National Board Authorized Inspector Commission Number)
CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this partial data report are correct and that all details of design, material, construction, and workmanship of these parts conform to Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.

"H" or "PRT" Certificate of Authorization no. _______ expires ______________. _________.

Date ___________________ Signed ___________________ Name ___________________ (manufacturer that constructed and certified boiler)

CERTIFICATE OF SHOP INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and employed by ______________________________, have inspected the part of a boiler described in this Manufacturer's Partial Data Report on ____________________, and state that to the best of my knowledge and belief, the manufacturer has constructed this part in accordance with Section IV of the ASME BOILER AND PRESSURE VESSEL CODE. By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the part described in this Manufacturer's Partial Data Report. Furthermore, neither the Inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date ___________________ Signed ___________________ Commission ___________________ (National Board Authorized Inspector Commission/Number)
FORM HLW-6 MANUFACTURER’S DATA REPORT FOR WATER HEATERS OR STORAGE TANKS
As Required by the Provisions of the ASME Code Rules

1. Manufactured and certified by
   (name and address of manufacturer)

2. Manufactured for
   (name and address of purchaser)

3. Location of installation
   (name and address)

4. Identification
   (manufacturer's serial no.)
   (drawing no.)
   (National Board no.)
   (year built)

5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design conforms to Part HLW, Section IV

6. Shell
   (no.)
   (material spec., gr.)
   (liner)
   (diameter)
   (length overall)

7. Joints
   (long, seamless, welded)
   (girth, seamless, welded)
   (no. of shell courses)

8. Heads

   Location
   Material Spec., Gr., Thickness
   Crown Radius
   Knuckle Radius
   Elliptical Ratio
   Flat Diameter
   Side Pressure (concave, convex)

9. Tubesheet
   (material spec., gr.)
   (no.)
   (size)
   (length overall)
   (thickness)
   (rolled or welded)

10. Nozzles, inspection, and safety valve openings:
    Handhole

11. MAWP

12. Manufacturer’s Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of this report

   (name of part, item no., manufacturer's name, identification stamps)

13. Remarks

(07/15)

ASME BPVC.IV-2019
5-500 ALTERNATIVE TO HYDROTEST

A helium leak test, conducted at the maximum vacuum to which the boiler will be exposed, may be used in lieu of the hydrostatic test requirements specified in HG-510. This test shall be witnessed by the authorized inspector. The test shall be conducted in accordance with Section V, Article 10, Mandatory Appendix IV or Mandatory Appendix V. Maximum acceptable leakage rate shall be as follows:

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Maximum Acceptable Leakage Rate (std cm³/sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV — Detector Probe</td>
<td>$1 \times 10^{-4}$</td>
</tr>
<tr>
<td>V — Tracer Probe</td>
<td>$1 \times 10^{-5}$</td>
</tr>
<tr>
<td>V — Hood</td>
<td>$1 \times 10^{-6}$</td>
</tr>
</tbody>
</table>

These exemptions are applicable only when the following devices are installed:

(a) **Pressure Control.** A pressure control that interrupts the burner operation in response to boiler pressure, and is set at 2.5 psig vacuum (12.2 psia) (17 kPa).

(b) **Temperature Control.** Two temperature controls responsive to boiler temperature that can interrupt burner operation, one shall operate at a temperature below 210°F (99°C), and the other shall prevent the temperature from exceeding 210°F (99°C) with no automatic recycle. The use of a fusible plug to perform the second of these two functions is permissible.

(c) **Safety Valve.** A safety valve without a test lever, set at 7.1 psig (22 psia) (49 kPa gage) maximum pressure and sized in accordance with HG-400.

5-600 INSTRUMENTS, FITTINGS, AND CONTROLS

Vacuum boilers shall be provided with instruments, fittings, and controls in accordance with Articles 6 and 7 of Part HG, but they are exempt from the following requirements if pressure and temperature controls are provided as described in (a), (b), and (c) below:

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG-603</td>
<td>Gauge Glass</td>
</tr>
<tr>
<td>HG-604</td>
<td>Water Column</td>
</tr>
<tr>
<td>HG-605</td>
<td>Pressure Control (second control only)</td>
</tr>
<tr>
<td>HG-606</td>
<td>Low Water Cut-Off</td>
</tr>
<tr>
<td>HG-703.2</td>
<td>Return Pipe Connection</td>
</tr>
<tr>
<td>HG-705</td>
<td>Feedwater Connection</td>
</tr>
<tr>
<td>HG-715</td>
<td>Blowoff and Drain Valves</td>
</tr>
</tbody>
</table>

5-700 INSPECTION OPENINGS

Heat exchanger coil openings may be used to satisfy the requirements for inspection and access.
MANDATORY APPENDIX 10
REQUIREMENTS FOR FEEDWATER ECONOMIZERS

10-100 GENERAL

A feedwater economizer is a heat exchanger in which feedwater to be supplied to a boiler or water heater is heated by flue gasses exiting the boiler or water heater. When such an economizer is supplied with a Section IV boiler or water heater, it shall be a certified pressure vessel, which may be constructed in accordance with Section IV or in accordance with Section VIII, Division I. Data reports for Section IV economizers shall be documented on Form H-3 Manufacturer’s Data Report.

10-200 DESIGN

(a) The maximum allowable working pressure (MAWP) of the primary (feedwater) side of the economizer shall not be less than the maximum feedwater supply pressure under any operating conditions.

(b) When used with a water heater certified in accordance with Part HLW, water-wetted surfaces shall be corrosion resistant material.

10-300 PRESSURE RELIEF

(a) The Section IV economizer shall be provided with pressure relief valves sized in accordance with \text{HG-402A.2}. Nonisolable economizers shall be provided with pressure relief valves in accordance with \text{HG-400.2} or the required economizer relief valve capacity shall be included in the total capacity of the relief valves on the boiler or water heater. The total relief valve capacity need not exceed the input of the boiler. Isolable economizers shall have the pressure relief valve installed on the economizer.

(b) Economizers constructed to Section VIII, Division I shall be provided with overpressure protection in accordance with the requirements of Section VIII, Division I, \text{UG-125 through UG-140}.

(c) In all cases, for both Section IV and Section VIII, Division I economizers, the heat absorption of the economizer shall be included in the economizer nameplate stamping.
A-100  GUIDE FOR ESTIMATING PRESSURE RELIEF VALVE CAPACITY BASED ON HEATING SURFACE

The minimum pressure relief valve relieving capacity, when provided in accordance with HG-400, may be estimated on the basis of the pounds of steam generated per hour per square foot (kilogram per hour per square meter) of boiler of heating surface, as given in Table A-100. In many cases, a greater relieving capacity of pressure relief valves will have to be provided than that estimated using Table A-100, in order to meet the requirements of HG-400.1(d) and HG-400.1(e) or HG-400.2(e) and HG-400.2(g).

HG-402A, HG-402A.1(i) and HG-402A.1(c) or HG-402A.2(f) and HG-402A.2(d).

### Table A-100

Guide for Estimating Steaming Capacity Based on Heating Surface

<table>
<thead>
<tr>
<th>Type of Surface</th>
<th>Boiler heating surface</th>
<th>Waterwall heating surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand fired</td>
<td>Firetube Boilers</td>
<td>5</td>
</tr>
<tr>
<td>Stoker fired</td>
<td>Firetube Boilers</td>
<td>7</td>
</tr>
<tr>
<td>Oil, gas, or pulverized fuel fired</td>
<td>Firetube Boilers</td>
<td>8</td>
</tr>
<tr>
<td>Hand fired</td>
<td>Watertube Boilers</td>
<td>8</td>
</tr>
<tr>
<td>Stoker fired</td>
<td>Watertube Boilers</td>
<td>10</td>
</tr>
<tr>
<td>Oil, gas, or pulverized fuel fired</td>
<td>Watertube Boilers</td>
<td>14</td>
</tr>
</tbody>
</table>

**U.S. Customary Units**

**SI Units**

<table>
<thead>
<tr>
<th>Type of Surface</th>
<th>Boiler heating surface</th>
<th>Waterwall heating surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand fired</td>
<td>Firetube Boilers</td>
<td>24</td>
</tr>
<tr>
<td>Stoker fired</td>
<td>Firetube Boilers</td>
<td>34</td>
</tr>
<tr>
<td>Oil, gas, or pulverized fuel fired</td>
<td>Firetube Boilers</td>
<td>39</td>
</tr>
<tr>
<td>Hand fired</td>
<td>Watertube Boilers</td>
<td>39</td>
</tr>
<tr>
<td>Stoker fired</td>
<td>Watertube Boilers</td>
<td>49</td>
</tr>
<tr>
<td>Oil, gas, or pulverized fuel fired</td>
<td>Watertube Boilers</td>
<td>68</td>
</tr>
</tbody>
</table>

**GENERAL NOTES:**

(a) When a boiler is fired only by a gas having a heat value not in excess of 200 Btu/ft³ (7 400 kJ/m³), the minimum safety valve or safety relief valve relieving capacity may be based on the values given for hand-fired boilers above.

(b) The minimum safety valve or safety relief valve relieving capacity for electric boilers shall be 3 1/2 lb/hr/kW (1.6 kg/h/kW) input.

(c) For heating surface determination, see HG-403.
NONMANDATORY APPENDIX B

METHOD OF CHECKING SAFETY VALVE AND SAFETY RELIEF VALVE CAPACITY BY MEASURING MAXIMUM AMOUNT OF FUEL THAT CAN BE BURNED

B-100 PROCEDURE

The maximum quantity of fuel $C$ that can be burned per hour at the time of maximum forcing is determined by a test. The maximum number of heat units per hour, or $CH$, is then determined, using the values of $H$ given in B-102. The weight of steam generated per hour is found by the formula:

(U.S. Customary Units)

$$ W = \frac{C \times H \times 0.75}{1,000} $$

(SI Units)

$$ W = \frac{C \times H \times 0.75}{2,326} $$

where

$C =$ total weight or volume of fuel burned/hr at time of maximum forcing, lb or ft$^3$

$H =$ heat of combustion of fuel, Btu/lb or Btu/ft$^3$ (see B-102)

$W =$ weight of steam generated/hr, lb

The sum of the safety valve capacities marked on the valves shall be equal to or greater than $W$.

B-101 EXAMPLES

Example 1. A boiler at the time of maximum forcing uses 2,150 lb of Illinois coal/hr of 12,100 Btu/lb.

$$ C \times H = 2,150 \times 12,100 = 26,015,000 $$

$$ W = \left( C \times H \times 0.75 \right) \div 1,000 = 19,511 $$

Example 2. Wood shavings of heat of combustion of 6,400 Btu/lb are burned under a boiler at the maximum rate of 2,000 lb/hr.

$$ C \times H = 2,000 \times 6,400 = 12,800,000 $$

$$ W = \left( C \times H \times 0.75 \right) \div 1,000 = 9,600 $$

Example 3. An oil-fired boiler at maximum forcing uses 1,000 lb of crude oil (Texas)/hr.

$$ C \times H = 1,000 \times 18,500 = 18,500,000 $$

$$ W = \left( C \times H \times 0.75 \right) \div 1,000 = 13,875 $$

Example 4. A boiler fired with natural gas consumes 3,000 ft$^3$/hr.

$$ C \times H = 3,000 \times 960 = 2,880,000 $$

$$ W = \left( C \times H \times 0.75 \right) \div 1,000 = 2,160 $$

B-102 HEATS OF COMBUSTION OF FUELS

For the purpose of checking the safety valve capacity as described in B-100, the following values of heats of combustion of various fuels may be used:

<table>
<thead>
<tr>
<th>Material</th>
<th>$H = \text{Btu/lb}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semibituminous coal</td>
<td>14,500</td>
</tr>
<tr>
<td>Anthracite</td>
<td>13,700</td>
</tr>
<tr>
<td>Screenings</td>
<td>12,500</td>
</tr>
<tr>
<td>Coke</td>
<td>13,500</td>
</tr>
<tr>
<td>Wood, hard or soft, kiln dried</td>
<td>7,700</td>
</tr>
<tr>
<td>Wood, hard or soft, air dried</td>
<td>6,200</td>
</tr>
<tr>
<td>Wood shavings</td>
<td>6,400</td>
</tr>
<tr>
<td>Peat, air dried, 25% moisture</td>
<td>7,500</td>
</tr>
<tr>
<td>Lignite</td>
<td>10,000</td>
</tr>
<tr>
<td>Kerosene</td>
<td>20,000</td>
</tr>
<tr>
<td>Petroleum, crude oil, Pennsylvania</td>
<td>20,700</td>
</tr>
<tr>
<td>Petroleum, crude oil, Texas</td>
<td>18,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Material</th>
<th>$H = \text{Btu/ft}^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural gas</td>
<td>960</td>
</tr>
<tr>
<td>Blast-furnace gas</td>
<td>100</td>
</tr>
<tr>
<td>Producer gas</td>
<td>150</td>
</tr>
<tr>
<td>Water gas, uncarbureted</td>
<td>290</td>
</tr>
</tbody>
</table>
**E-100 TERMS RELATING TO DESIGN**

**action, popping, or pop**: the action of a safety or safety relief valve when it opens under steam pressure. The disk of the valve is designed so that the force of the steam lifting the disk is increased when the disk is lifted slightly off its seat. The increase in force accelerates the rising action of the disk to the wide open position at or near the opening pressure.

**blowdown**: the difference between the opening and closing pressures of a safety or safety relief valve.

**boiler, automatically fired**: a boiler equipped with a means of introducing heat or of causing fuel, whether solid, liquid, gaseous, or electric, to be introduced into the boiler or boiler furnace, the means being so regulated by the rate of flow, the generating pressure, or temperature of the boiler fluid or of a vessel or space being heated as to maintain a determined, desired condition within a designated tolerance.

**boiler, electric, resistance heating element type**: electric boilers of the resistance heating element type are either:

(a) of a design where the electric resistance element is directly attached to the external surface of the pressure vessel; or

(b) an immersed type where the electric resistance element is inserted through an opening in the pressure vessel so that the element is in direct contact with the water.

**boiler, horizontal-return tubular**: a firetube boiler consisting of a cylindrical shell, with tubes inside the shell attached to both end closures. The products of combustion pass under the bottom half of the shell and return through the tubes.

**boiler, hot water heating**: a boiler designed to heat water for circulation through an external space heating system.

**boiler, hot water supply**: a boiler used to heat water for purposes other than space heating.

**boiler, modular**: a steam or hot-water heating assembly consisting of a grouping of individual boilers or individually fired sections called modules, intended to be installed and operated as a unit, with no intervening stop valves between the modules, with a single inlet and a single outlet. Modules may be under one jacket or may be individually jacketed.

**boiler, steam heating**: a boiler designed to convert water into steam that is supplied to an external space heating system.

**boiler, vacuum**: a factory-sealed steam boiler that is operated below atmospheric pressure.

**bottom blowoff valve**: a valve or cock located in the bottom blowoff connection of a boiler that, when opened, permits free passage of scale and sediment during the blowoff operation.

**column, fluid relief**: that piping, connected to the top of a hot water heating boiler, which is provided for the thermal expansion of the water. It will connect to either an open or a closed expansion tank.

**drain valve**: a valve or cock located in a boiler connection that, when opened, will drain the lowest water space practicable.

**electric boiler, submerged electrode type**: a submerged electrode type electric boiler incorporates a design wherein two or more metallic electrodes are directly suspended in the boiler water. When a source of electric power is connected to the electrodes, current will flow between the electrodes and through the water, thus raising the temperature of the water to produce steam.

**feedwater**: water introduced into a boiler during operation. includes makeup and return condensate or return water.

**flue**: passage through which gases pass from the combustion chamber or furnace to the venting system.

**furnace**: that part of a boiler in which combustion of fuel takes place or in which primary furnace gases are conveyed.

**gases, primary furnace**: gases in a zone where the anticipated temperature of the gas exceeds 850°F (450°C).

**joints, swing**: threaded, flanged, welded, or brazed pipe and fittings so arranged that the piping system that they comprise, when connected to a boiler, can expand and contract without imposing excessive force on it.

**makeup water**: water introduced into the boiler to replace that lost or removed from the system.
pressure, accumulation test: that steam pressure at which the capacity of a safety, safety relief, or a relief valve is determined. It is 33 1/3% over the steam safety valve set pressure and 10% over the safety relief valve set pressure.

pressure, design: the pressure used in the design of a boiler for the purpose of calculating the minimum permissible thickness or physical characteristics of the different parts of the boiler.

pressure, maximum allowable working: the maximum gage pressure permissible in a completed boiler or water heater, calendar life, or any other device to prevent their frequent opening.

pressure, rating, official: a safety or safety relief valve for use on a heating boiler that has been capacity rated in accordance with HG-402.

siphon: a bent pipe or tube, between a steam pressure gage and the steam connection on a boiler, so fabricated that it contains a water seal that prevents steam entering the Bourdon tube of the gage.

stress, maximum allowable: the maximum unit stress permitted in a given material used under these rules.

surface, heating, square feet of: that area of the boiler surface exposed to the products of combustion. In computing the heating surface for the purpose of determining the safety or relief valve requirements, only the tubes, fireboxes, shells, tubesheets, and the projected area of the headers need be considered, except that for vertical fire-tube boilers only that portion of the tube surface up to the middle point of the gage glass is to be computed.

thicknees, required: the minimum thickness determined by the formulas in this Code.

tube, fire: a hollow cylinder used for the conveyance of gases, flame, or hot air.

tube, water: a hollow cylinder used for the conveyance of liquids.

valve, safety: an automatic pressure-relieving device actuated by the static pressure upstream of the valve and characterized by full opening pop action. It is used for gas or vapor service.

valve, safety relief: an automatic pressure-relieving device actuated by the pressure upstream of the valve and characterized by opening pop action with further increase in lift with an increase in pressure over popping pressure. It normally refers to the amount of movement of the disk off the seat when the valve is discharging at rated pressure.

valve, temperature and pressure safety relief: a safety relief valve that also incorporates a thermal sensing element that is actuated by an upstream water temperature of 210°F (99°C) or less.

water heater: a vessel in which potable water is heated by the combustion of fuel, by electricity, or by any other source, and withdrawn for external use.

water heater, lined: a water heater with a corrosion resistant lining designed to heat potable water.

water heater, modular: a water heater assembly consisting of a grouping of individual water heaters called modules, intended to be installed and operated as a unit with no intervening stop valves between the modules, with a single inlet and a single outlet. Modules may be under one jacket or may be individually jacketed.

water heater, unlined: a water heater made from corrosion resistant materials designed to heat potable water.

water temperature, maximum: the maximum water temperature permissible in a completed boiler or water heater.

wet-bottom boiler: any type of boiler that has a stayed or self-supporting, partially or fully water-cooled, shell or furnace bottom.

pressure relief

E-101 TERMS RELATING TO WELDING

arc stud welding: an arc welding process wherein coalescence is produced by heating with an arc drawn between a metal stud, or similar part, until the surfaces to be joined are properly heated, when they are brought together under pressure. Partial shielding may be obtained by the use of a ceramic ferrule surrounding the stud. Shielding gas or flux may or may not be used.

arc welding: a group of welding processes wherein coalescence is produced by heating with an electric arc or arcs, with or without the application of pressure and with or without the use of filler metal.

atomic hydrogen welding: an arc welding process wherein coalescence is produced by heating with an electric arc maintained between two metal electrodes in an
F-100  GENERAL

F-100.1 Quality Control System. The manufacturer or assembler shall have and maintain a quality control system that will establish that all Code requirements including material, design, fabrication, examination (by the manufacturer), and inspection (by the Authorized Inspector) for boilers and water heaters constructed primarily of wrought materials will be met. The Quality Control System of the "HV" Stamp holder shall include duties of a Certified Individual, as required by this Section.

Provided that Code requirements are suitably identified, the system may include provisions for satisfying any requirements by the manufacturer or user that exceed minimum Code requirements and may include provisions for quality control of non-Code work. In such systems, the manufacturer may make changes in parts of the system that do not affect the Code requirements without securing acceptance by the Authorized Inspector.

Before implementation, revisions to quality control systems of manufacturers and assemblers of safety and safety relief valves shall have been found acceptable to the ASME Designee if such revisions affect Code requirements.

The system that the manufacturer uses to meet the requirements of this Section must be one suitable for his own circumstances. The necessary scope and detail of the system shall depend upon the complexity of the work performed and upon the size and complexity of the manufacturer’s organization. A written description of the system the manufacturer will use to produce a Code item shall be available for review. Depending upon the circumstances, the description may be brief or voluminous.

The written description may contain information of a proprietary nature relating to the manufacturer’s processes. Therefore, the Code does not require any distribution of this information, except for the Authorized Inspector or ASME Designee, as covered by F-202.10. It is intended that information learned about the quality control system in connection with evaluation will be treated as confidential and that all loaned descriptions will be returned to the manufacturer upon completion of the evaluation.

F-202  OUTLINE OF FEATURES TO BE INCLUDED IN THE WRITTEN DESCRIPTION OF THE QUALITY CONTROL SYSTEM

The following is a guide to some of the features that should be covered in the written description of the quality control system and that is equally applicable to both shop and field work.

F-202.1 Authority and Responsibility. The authority and responsibility of those in charge of the quality control system shall be clearly established. Persons performing quality control functions shall have sufficient and well-defined responsibility, the authority, and the organizational freedom to identify quality control problems and to initiate, recommend, and provide solutions.

F-202.2 Organization. An organization chart showing the relationship between management and engineering, purchasing, manufacturing, field assembling, inspection, and quality control, is required to reflect the actual organization. The purpose of this chart is to identify and associate the various organizational groups with the particular function for which they are responsible. The Code does not intend to encroach on the manufacturer’s right to establish, and from time to time, alter whatever form of organization the manufacturer considers appropriate for its Code work.

F-202.3 Drawings, Design Calculations, and Specification Control. The manufacturer’s or assembler’s quality control system shall provide procedures that will insure that the latest applicable drawings, design calculations, specifications, and instructions required by the Code, as well as authorized changes, are used for manufacture, assembly, examination, inspection, and testing.

F-202.4 Material Control. The Manufacturer or assembler shall include a system of receiving control that requires verification that the material received conforms to order requirements and that the identification of the materials corresponds to the material certifications or material test reports. The system shall ensure that only the intended material is used in Code construction.

F-202.5 Examination and Inspection Program. The Manufacturer’s quality control system shall describe the fabrication operations, including examinations, sufficiently to permit the Authorized Inspector to determine at what stages specific inspections are to be performed.
**F-202.6 Correction of Nonconformities.** There shall be a system agreed upon with the Authorized Inspector for correction of nonconformities. A nonconformity condition is a condition that does not comply with the applicable rules of this Section. Nonconformities must be corrected or eliminated in some way before the completed component can be considered to comply with this Section.

**F-202.7 Welding or Brazing.** The quality control system shall include provisions for indicating that welding or brazing conforms to requirements of Section IX as supplemented by this Section.

**F-202.8 Calibration of Measurement and Test Equipment.** The Manufacturer or assembler shall have a system for the calibration of examination, measuring, and testing of equipment used in fulfillment of requirements of this Section.

**F-202.9 Sample Forms.** The forms used in the quality control system and any detailed procedures for their use shall be available for review. The written description shall make necessary references to these forms.

**F-202.10 AUTHORIZED INSPECTOR**

**F-202.10.1 The Authorized Inspector is the ASME Code Inspector defined in HG-515.3.**

**F-202.10.2** The written description of the quality control system shall include reference to the Authorized Inspector.

**F-202.10.2.1** The Manufacturer shall make available to the Authorized Inspector at the Manufacturer’s plant a copy of the written description of the quality control system.

**F-202.10.2.2** The Manufacturer’s quality control system shall provide for the Authorized Inspector at the Manufacturer’s plant to have access to all drawings, calculations, specifications, procedures, process sheets, repair procedures, records, test results, and any other documents as necessary for the Authorized Inspector to perform his duties in accordance with this Section. The Manufacturer may provide such access either to his own files of such documents or by providing copies to the Authorized Inspector.

**F-202.11 Inspection During Manufacture of Safety and Safety Relief Valves.** See HG-401.3.

**F-202.12 Certifications.** Methods other than written signature may be used for indicating certifications, authorizations, and approval where allowed and as described elsewhere in this section. Where other methods are employed, controls and safeguards shall be provided and described to ensure the integrity of the certification, authorization, and approval.
## NONMANDATORY APPENDIX K
### GUIDE TO INFORMATION APPEARING ON CERTIFICATE OF AUTHORIZATION

Reference to Circled Numbers in Figure K-1 Description

<table>
<thead>
<tr>
<th>Reference to Circled Numbers in Figure K-1</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Certification Mark granted by the Society, i.e., H Heating Boilers; HLW Water Heaters; and HV Safety Valves.</td>
<td></td>
</tr>
</tbody>
</table>
| (2) a. The name of the Manufacturer or Assembler.  
  b. The full street address, city, state or province, country, and zip code. |
| (3) This section describes the scope and limitations, if any, on use of the Certification Mark and designators, as illustrated below by some examples of scope statements. Field site Certificate of Authorization applies to items that are fabricated or assembled at a field site and is not intended to apply to items at any shop location. |

### Certification Mark with H Designator
- Heating boilers, except cast iron and cast aluminum, at the above location only.  
- Heating boilers, except cast iron and cast aluminum, at the above location only. (This authorization includes multiple duplicate heating boilers.)  
- Heating boilers, except cast iron and cast aluminum, at the above location. (This authorization does not cover welding or brazing.)  
- Heating boilers, except cast iron and cast aluminum, at the above location and field sites controlled by the above location.  
- Heating boilers, cast iron only, at the above location only. (Assembly)  
- Heating boilers, cast iron only, at the above location only. (Foundry)  
- Heating boilers, cast iron only, at the above location only. (Foundry and Assembly)  
- Heating boilers, cast aluminum only, at the above location only. (Assembly)  
- Heating boilers, cast aluminum only, at the above location only. (Installation of nameplate only, does not include assembly and hydrostatic test.)  
- Heating boilers, cast aluminum only, at the above location only. (Installation of nameplate only, does not include assembly and hydrostatic test.)  
- Heating boilers, cast aluminum only, at the above location only. (Installation of nameplate only, does not include assembly and hydrostatic test.)  

### Certification Mark with HLW Designator
- Potable water heaters at the above location only.  
- Potable water heaters at the above location only. (This authorization includes multiple duplicate potable water heaters.)  
- Potable water heaters at the above location and field sites controlled by the above location.  
- Potable water heaters at the above location only. (This authorization does not cover welding or brazing.)  
- Potable water storage tanks at the above location only.  
- Potable water storage tanks at the above location only. (This authorization includes multiple duplicate potable water storage tanks.)  
- Potable water storage tanks at the above location and field sites controlled by the above location.  
- Potable water storage tanks at the above location only. (This authorization does not cover welding or brazing.)  
- Potable water heaters and potable water storage tanks at the above location only. (This authorization does not cover welding or brazing.)  

### Certification Mark with PRT Designator
[Note (1)]  
- Manufacture and assembly of parts without design responsibility at the above location only.  
- Manufacture and assembly of parts without design responsibility at the above location and field sites controlled by the above location.  

### Certification Mark with HV Designator
- Manufacturer of heating boiler safety valves and safety relief valves at the above location only.  
- Manufacturer of heating boiler safety valves and safety relief valves at the above location only. (This authorization does not cover welding or brazing.)
INTRODUCTION

The following pages are a guide for completing the Manufacturer’s Certificate of Conformance Form HV-1. The explanations included in the guide are keyed to the Form HV-1 in the following manner:

(a) Circled numbers on the form refer to the items listed in the guide (Table N-1). The parenthesized numbers in the guide (Table N-1) correspond to the circled numbers on the form.

(b) Numbers without circles appearing in the guide identify specific lines on the Manufacturer’s Certificate of Conformance Form.

Forms appearing in this section may be obtained from The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org).
### Table N-1
Guide for the Preparation of Section IV-Manufacturer’s Certificate of Conformance Form HV-1

<table>
<thead>
<tr>
<th>Reference to Circaled Numbers in Form HV-1</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Name and address of Manufacturer.</td>
</tr>
<tr>
<td>(2)</td>
<td>Pressure relief valve Manufacturer’s unique identification number, such as serial, work order number, or lot number.</td>
</tr>
<tr>
<td>(3)</td>
<td>The date of completion of production of the pressure relief valve.</td>
</tr>
<tr>
<td>(4)</td>
<td>The NB Certification Number.</td>
</tr>
<tr>
<td>(5)</td>
<td>The quantity of identical valves for this line item.</td>
</tr>
<tr>
<td>(6)</td>
<td>The Manufacturer’s Design or Type Number as marked on the nameplate.</td>
</tr>
<tr>
<td>(7)</td>
<td>The inlet size of the pressure relief valve (NPS).</td>
</tr>
<tr>
<td>(8)</td>
<td>The nameplate set pressure of the pressure relief valve.</td>
</tr>
<tr>
<td>(9)</td>
<td>The nameplate capacity of the pressure relief valve.</td>
</tr>
<tr>
<td>(10)</td>
<td>The fluid used for testing the pressure relief valve.</td>
</tr>
<tr>
<td>(11)</td>
<td>The year built or the pressure relief valve Manufacturer’s date code.</td>
</tr>
<tr>
<td>(12)</td>
<td>The Name of the Certified Individual.</td>
</tr>
<tr>
<td>(13)</td>
<td>The signature of the Certified Individual. Required for each line item.</td>
</tr>
<tr>
<td>(14)</td>
<td>The Number of the pressure relief valve Manufacturer’s Certificate of Authorization.</td>
</tr>
<tr>
<td>(15)</td>
<td>Expiration Date of the pressure relief valve Manufacturer’s Certificate of Authorization.</td>
</tr>
<tr>
<td>(16)</td>
<td>Date signed by the pressure relief valve Manufacturer Authorized Representative.</td>
</tr>
<tr>
<td>(17)</td>
<td>The Certificate of Shop Compliance block is to show the name of the Manufacturer as shown on his ASME Code Certificate of Authorization. This should be signed in accordance with the organizational authority defined in the Quality Control System.</td>
</tr>
<tr>
<td>(18)</td>
<td>Include any applicable remarks (referencing the identification number) that may pertain, such as identification of a Code Case that requires marking on the device.</td>
</tr>
</tbody>
</table>
FORM HV-1  MANUFACTURER’S CERTIFICATE OF CONFORMANCE FOR PRESSURE RELIEF VALVES  
As Required by the Provisions of the ASME Boiler and Pressure Vessel Code Rules

1. Manufactured by

2. Table of Code symbol stamped items:

<table>
<thead>
<tr>
<th>I.D. #</th>
<th>Date</th>
<th>Cert. B</th>
<th>Qty.</th>
<th>Type</th>
<th>Size (NPS)</th>
<th>Set Pressure</th>
<th>Capacity</th>
<th>Test Fluid</th>
<th>Date Code</th>
<th>CI Name</th>
<th>CI Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

3. Remarks

CERTIFICATE OF SHOP COMPLIANCE

By the signature of the Certified Individual (CI) noted above, we certify that the statements made in this report are correct and that all details for design, material, construction, and workmanship of the pressure relief valves conform with the requirements of Section IV of the ASME BOILER AND PRESSURE VESSEL CODE.

HV Certificate of Authorization No. __________ Expires __________

Date __________ Signed __________
(responsible representative) Name __________
(manufacturer)

(03/07)
P-1 GENERAL

(a) The 2021 Edition of this Section adopts the new BVPC Section XIII, Rules for Overpressure Protection. All Section IV pressure relief device requirements have been transferred from Article 4 to Section XIII, and the remaining Section IV overpressure protection requirements have been restructured within the new Article 4A. Table P-1-1 lists the new locations for all requirements formally located in Article 4.

(b) Article 4 has been revised to reference this Appendix. Article 4 and this Appendix will be deleted from the next Edition of this Section.

(c) Table P-1-1 may also be obtained in a spreadsheet format from:

https://cstools.asme.org/??????

Note - Link address is example only and to be specified by ASME Staff.

Table P-1-1 Cross-Reference List

<table>
<thead>
<tr>
<th>Section IV – 2019</th>
<th>Section IV – 2021</th>
</tr>
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<tbody>
<tr>
<td>HG-400.1(a)</td>
<td>HG-402A.1(b)</td>
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</tr>
<tr>
<td>HG-400.1(b)</td>
<td>HG-402A.1(e)</td>
</tr>
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<td>HG-402A.3(c)(4)</td>
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<td>HG-402A.1(h)</td>
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<td>HG-402A.1(j)</td>
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ENDNOTES

1 In order to ensure that a finished head is not less than the minimum thickness required, it is customary to use a thicker plate to take care of possible thinning during the process of forming. The neck of an opening in a head with an integrally flanged opening will thin out due to the fluing operation. This is permissible, provided the neck thickness is not less than the minimum thickness specified in HG-301 or the thickness required for a cylindrical shell having a diameter equal to the maximum diameter of the opening. (See HG-323.)

2 The formulas provide safe construction as far as stress is concerned. Greater thicknesses may be necessary if deflection would cause leakage at threaded or gasketed joints.

3 The rules governing openings as given in this Code are based on the stress intensification created by the existence of a hole in an otherwise symmetrical section. They are based on experience with vessels designed with a safety factor of five applied to the specified minimum tensile strength of the shell material. External loadings such as those due to thermal expansion or to unsupported weight of connecting piping have not been evaluated. These factors should be given attention in unusual designs or under conditions of cyclic loading.

4 Typical examples of the application of these rules are given in Nonmandatory Appendix D.

5 The opening made by a pipe or a circular nozzle, the axis of which is not perpendicular to the boiler wall or head, may be considered an elliptical opening for design purposes.

6 An obround opening is one that is formed by two parallel sides and semicircular ends.

7 Suggested installation practices for the secondary side of heat exchangers.

8 Valve capacities are published in “Pressure Relief Device Certifications.” This publication may be obtained from The National Board of Boiler and Pressure Vessel Inspectors, 1055 Grupper Avenue, Columbus, OH 43229.

9 An example of a nationally recognized standard is ANSI Z21.22/CSA 4.4, Relief Valves for Hot Water Supply Systems.

10 The foundry that casts the boiler parts or sections and that may shop assemble.

11 May be etched.

12 May be stamped.

13 See HG-515.4 for additional requirements applicable to multiple, duplicate pressure vessel fabrication.

14 Examples of these nationally recognized standards are:
   Underwriters Laboratories, Inc., UL 296, Standards for Safety, Oil Burners.
   Underwriters Laboratories, Inc., UL 726, Standards for Safety, Oil Fired Boiler Assemblies.

15 See Nonmandatory Appendix H.

16 A certifying organization is one that provides uniform testing, examination, and listing procedures under established, nationally recognized standards and that is acceptable to the authorities having jurisdiction.

17 The top or side of the boiler shall mean the highest practicable part of the boiler proper but in no case shall the safety valve be located below the normal operating level and in no case shall the safety relief valve be located below the lowest permissible water level.