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-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:
   - knowledge of the requirements of this Section for the application of the Certification Mark with HV designator
   - knowledge of the Manufacturer’s quality program
   - 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

(c) 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:

\[
K_D = \frac{\text{Actual steam flow}}{\text{Theoretical steam flow}} = \text{Coefficient of discharge}
\]

The average of the coefficients \(K_D\) 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 × 0.975). The stamped capacity for all sizes and pressures shall not exceed the value determined from the following equations:

For 45 deg seat,

(U.S. Customary Units) \[ W = 51.5 \, \pi DLP \times 0.707K \]

(SI Units) \[ W = 5.25 \, \pi DLPK \]

For flat seat,

(U.S. Customary Units) \[ W = 51.5 \, \pi DLPK \]

(SI Units) \[ W = 5.25 \, \pi DLP \]
For nozzle,

\[ W = 5.25 APK \]  

where

\( A \) = nozzle-throat area  
\( D \) = seat diameter  
\( K \) = coefficient of discharge for the design  
\( L \) = lift  
\( P \) = \((1.10 \times \text{set pressure + 14.7}) \) psia or \((1.10 \times \text{set pressure + 0.101}) \) MPa, for hot water applications or  
\( W \) = weight of steam/hr

NOTE: The maximum and minimum coefficient determined by the tests of a valve design shall not vary more than \( \pm 5\% \) 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 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:

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

All values derived from the testing must fall within \( \pm 5\% \) 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:

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

(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 \( \pm 5\% \) 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-402.9  **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.
ARTICLE 5
TESTS, INSPECTION, AND STAMPING

HG-500 PROOF TESTS TO ESTABLISH
DESIGN PRESSURE

HG-501 GENERAL

HG-501.1 Types of Tests. Provision is made for two
types of tests for determining the internal design
pressure:

(a) tests based on yielding of the part to be tested;
these tests are limited to materials with a ratio of mini-
mum specified yield to minimum specified ultimate
strength of 0.625 or less. If a proof tested part shows no
evidence of permanent yielding per HG-502.1 and
HG-502.2, it may be Code stamped.

(b) tests based on bursting of the part. The part proof-
tested under the burst test provisions shall not be Code
stamped.

marked with the Certification Mark

The Certification Mark shall not be applied on the
part proof tested under the burst test provisions.
HG-510  HYDROSTATIC TESTS

(a) Cast iron boilers shall be tested in accordance with HC-410.

(b) For boilers with integrally finned tubes and a design pressure of 160 psi (1.1 MPa), both the pneumatic test required in HF-204.1(e) and the hydrostatic test of (c) may be alternatively met by a hydrostatic test on the boiler under the following conditions:

1. A hydrostatic test pressure of at least 240 psi (1.9 MPa) is applied to the tubes and boiler.
2. A hold time of 5 min is maintained on the boiler at the required internal test pressure.
3. The test pressure may then be reduced to maximum allowable working pressure for inspection.
4. The tubes must be readily visible for inspection while under pressure.

(c) All other boilers shall be subjected to a hydrostatic test pressure that is not less than the greater of 60 psi (0.400 MPa) or 1½ times the design pressure, except if a boiler made of material in Part HF has its maximum allowable working pressure limited by a Part HC cast iron part the test pressure may be extended to 2½ times the design pressure of the cast iron part or 1½ times the design pressure of the next limiting part, whichever is less.

Close visual inspection is not required during this stage. The hydrostatic test pressure may then be reduced to the maximum allowable working pressure to be stamped on the boiler and maintained at this pressure while close visual inspection for leakage is made of all joints and connections. In making hydrostatic pressure tests, the pressure shall be under such control that the test pressure established shall not be exceeded by more than 10 psi (70 kPa). The visual inspection of joints and connections that are hidden by assembly may be waived during the hydrostatic test provided the following conditions are met:

1. A suitable pressure test, as agreed upon by the Manufacturer and the Authorized Inspector, is applied to the hidden joints.
2. The hidden joints are given a visual examination by the Authorized Inspector for workmanship prior to final assembly.
HG-515 INSPECTION TESTS AND CERTIFICATION OF BOILERS

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-202.5)

(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.**

(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)
performing internal and external inspections and witnessing hydrostatic tests (see HG-510)

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)

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 may be used to include the serial numbers in uninterrupted sequence of identical boilers completed, inspected, and stamped in a continuous 8 hr period. Form H-2 or Form H-3 shall be used.

(a) The boiler 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.

(b) The Manufacturer shall either keep a copy of the Manufacturer’s Data Report on file for at least 5 years, or the boiler may be registered and the original Data Report filed with the National Board of Boiler and Pressure Vessel Inspectors, 1055 Crupper Avenue, Columbus, Ohio 43229.

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)
NOTE: The year built may be incorporated into the serial number as a prefix consisting of the last two digits of the year.

(b) The information listed in (a) above, including the Certification Mark, shall be applied by stamping, etching, or laser annealing that leaves a permanent, legible mark.

(1) The process controls for etching or laser annealing shall be described in the Quality Control System and shall be acceptable to the Authorized Inspector.

(2) The process controls shall be established so that the etched characters shall be at least 0.004 in. (0.10 mm) deep.

(3) The surface condition where etching is applied shall be clean, uncoated, and unpainted.

(4) Laser annealing is allowed only on stainless steel and aluminum.

(5) No coating that obscures the laser annealing marking shall be allowed.

(c) Items (a)(1) through (a)(7) listed in (a) above, with the markings arranged substantially as shown in Figure HG-530.2 or Figure HG-530.3, shall be marked with letters at least 0.004 in. (0.10 mm) deep.

(3) The surface condition where etching is applied shall be clean, uncoated, and unainted.

(4) Laser annealing is allowed only on stainless steel and aluminum.

(5) No coating that obscures the laser annealing marking shall be allowed.

(d) The location of the marking shall be as follows:

(1) Horizontal Tubular Flue Type Boilers: on the front head above the central rows of tubes or flues.

(2) Locomotive Firebox, Compact, or Vertical Firetube Type Boilers: over or near the fire door or handhole or washout plug opening on the front end or side.

(3) Watertube Type Boilers: on a head of the top outlet drum. Waterwalls and headers shall carry identifying markings.

(4) Split-Section and Section Firebox Type Wrought Boilers: over or near the fire door or handhole or washout plug opening on the front end or side. Each section shall carry identifying markings.

(5) Scotch Type Boilers: on either side of the shell near the normal water level line adjacent to the front tubesheet.

(e) On any of the above type boilers where there is not sufficient space in the places designated and on other types and new designs of boilers, the marking shall be located in a conspicuous place.

(f) When there is insufficient space for the marking required above, smaller letter dimensions may be used, provided

(1) marking shall be as required in (a) through (c) above, and

(2) character size shall be no smaller than 1/32 in. (4 mm)

(g) The marking on the boiler proper shall not be covered with insulating or other material unless

(1) the required markings are duplicated and stamped directly on the boiler casing in some conspicuous place using letters and numerals at least 1/16 in. (8 mm) high

(2) an opening with a removable cover is provided in the jacket or other form of casing so that, when removed, the marking or nameplate on the boiler proper can be viewed

(3) the required data are duplicated by stamping, etching, or permanent marking with letters at least 1/6 in. (3 mm) high on a nonferrous nameplate at least 3 in. × 4 in. (75 mm × 100 mm) size and permanently

Figure HG-530.1
Official Certification Mark to Denote the American Society of Mechanical Engineers’ Standard

Figure HG-530.2
Steam and Water Boilers Form of Marking on Completed Boilers or Their Nameplates (Not Applicable for Boilers Constructed Primarily of Cast Iron)

Certified by
____________________________
(Name of Manufacturer)
1MAWP, Steam _________
1MAWP, Water _________
1Maximum Water Temp. _________
2Heating surface _________ boiler
3Heating surface _________ water wall
Minimum relief valve capacity _________
Manufacturer’s serial no. ____________
4Year built ____________

GENERAL NOTE: Acceptable abbreviations of any of the stamp wording may be used.

NOTES:
(1) For steam only boilers, MAWP Water and Maximum Water Temperature markings are optional.
(2) Kilowatt power input for electric boilers.
(3) List each type of surface separately. May be omitted if type heating surface is not present.
(4) May be omitted when year built is prefix to serial number (see HG-530.1).
attaching the nameplate to the casing in some conspicu-
ous place by mechanical means or by an adhesive system
meeting the requirements of Mandatory Appendix 3

(h) The Certification Mark may be preapplied to a
nameplate. The nameplate may be attached to the boiler
after the final fabrication and examination sequence but
before the hydrostatic test, provided the procedure for se-
quence of marking is described in the manufacturer's ac-
cepted quality control system.

(i) The Certification Mark shall not be used by an orga-
nization to which it was not issued.
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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

(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
(-b) the part manufacturer’s serial number

(b) The markings for the completed part or accessory shall be arranged substantially as shown in Figure HG-531.1 or Figure HG-531.2.

(c) No part or accessory of a boiler may be marked with the Certification Mark shown in Figure HG-530.1 unless so specified in the Code. The markings "ASME" or "ASME standard" shall not be used.

(d) Manufacturers and assemblers of parts or accessories who do not perform or assume any design responsibility for the parts or accessories they manufacture shall identify on the Partial Data Report the organization responsible for the design of the part or accessory.

HG-532 STAMPING OF FIELD ASSEMBLED WROUGHT BOILERS

HG-533 INSPECTION AND STAMPING OF FIELD ASSEMBLED BOILER PRESSURE PARTS

HG-533.1 Authorized Assemblers and Welders. The assembly of any parts or subassemblies of the unit that requires welding shall be made by one possessing a heating boiler stamp. The welding of any parts or subassemblies during field assembly shall be done by persons who meet the requirements of HW-610.

HG-533.4 Application of Assembler’s Certification Mark. The Assembler’s Certification Mark with H designator, together with the assembler’s name or an acceptable abbreviation, shall be applied in the field on the boiler near the stamping called for in HG-530.1, when the assembly is accepted by the Authorized Inspector.
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-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).

(c) The minimum pressure rating of all check valves, stop valves, cocks, or backflow preventers with check valve(s) shall be at least equal to the pressure stamped upon the boiler, and the temperature rating of such check valves, stop valves, cocks, or backflow preventers including all internal components, shall be not less than 250°F (120°C).
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.
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).
HW-820.8 Welding (Brazing) by Non-Certificate Holders.

(a) Welders, including brazers, and welding and brazing operators not in the employ of the manufacturer (Certificate of Authorization Holders) may be used to fabricate boilers or parts thereof constructed in accordance with the Section, provided all of the following conditions are met:

1) All Code construction shall be the responsibility of the Manufacturer.

2) All welding shall be performed in accordance with the Manufacturer’s welding procedure specifications which have been qualified by the Manufacturer in accordance with the requirements of Section IX and this Section.

3) All welders shall be qualified by the Manufacturer in accordance with the requirements of Section IX and this Section.

4) The Manufacturer’s quality control system shall include as a minimum the following:

   - (a) a requirement for complete and exclusive administrative and technical supervision of all welders by the Manufacturer

   - (b) evidence of the Manufacturer’s authority to assign and remove welders at his discretion without involvement of any other organization

   - (c) a requirement for Assignment of Welder Identification symbols

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(d) evidence that this program has been accepted by the Manufacturer's Authorized Inspection Agency which provides the inspection service

(5) The Manufacturer shall be responsible for Code compliance of the completed boiler or part, including Certification Mark stamping and providing Data Report Forms properly executed and countersigned by the Inspector.

**HW-820.9 Flash Welding.** If tube butt welds are made using the flash welding process, production testing shall be performed in accordance with Section IX, QW-199.7.3 as follows:

(a) one example shall be tested at the start of production

(b) one sample shall be tested at the beginning, midpoint, and end of each work shift

(c) when production shifts are consecutive, a test at the end of the shift may serve as the test for the beginning of the next shift

(d) when a welding operator is replaced during production

(e) if any machine's settings are changed

When any production run weld fails to pass the required tests, the welding parameters shall be adjusted until two consecutive welds pass the bend test. In addition, all welds that were made subsequent to the previous successful test shall be either cut out and rewelded or cut out and tested in reverse sequence of welding until two successive welds pass the tests.
Boilers shall be stamped according to the requirements of HG-530 or the stamping may be placed on a nonferrous plate, irremovably attached to a visible part of the boiler.
MANDATORY APPENDIX 5
VACUUM BOILERS

5-300 DESIGN PARAMETERS

(a) The thickness of cylindrical shells under external pressure shall be calculated in accordance with HG-312, except that, when boilers are designed for noncorrosive service at a maximum pressure difference between outside and inside of 15 psi (100 kPa), the thickness shall be not less than 1/8 in. (3 mm).

(b) Rectangular boilers under external pressure shall have thicknesses calculated in accordance with Section VIII, Division 1, Mandatory Appendix 13, 13-8 and 13-9. For noncorrosive service only, the thickness shall be not less than 1/8 in. (3 mm).

(c) Stays in compression shall meet the requirements of the following:

\[ \frac{l}{r} \leq 50 \]

where

\[ l = \text{length} \]

\[ r = \text{radius of gyration} \]

(d) The furnace thickness shall be calculated in accordance with HG-301, using 15 psi (100 kPa) design pressure. For noncorrosive service only, the thickness shall be not less than 1/8 in. (3 mm).

(e) Head thickness shall be calculated in accordance with HG-305, HG-306, or HG-307, using 15 psi (100 kPa) design pressure, except that, when boilers are designed for noncorrosive service at a maximum pressure difference between outside and inside of 15 psi (100 kPa), the thickness shall be not less than 1/8 in. (3 mm).

(f) Tube thickness shall be calculated in accordance with HG-315.

(g) As an alternative to the calculations in (a) through (f), the vessel may be

(1) designed and constructed to Code requirements for an internal pressure of 30 psig (200 kPa) using the proof test requirements of HG-501 or HG-502. However, no external pressure rating may be shown with the Code stamping unless Code requirements for external pressure are met (see HG-503).

(2) designed and constructed as a vacuum vessel for an external pressure of 15 psia (100 kPa) using the proof test requirements of HG-503.
MANDATORY APPENDIX 8
CRITERIA FOR REAPPLICATION OF A CERTIFICATION MARK

8-100 INTRODUCTION

After an item has been certified under ASME Section IV, if the Certification Mark with appropriate Designator stamping becomes indistinct or the nameplate is illegible or lost, but traceability to the original certification can be established, the Certification Mark may be reapplied to the item.
9-200 DESIGN

The Manufacturer of the completed boiler shall establish the Code edition, addenda, and Code Cases to be used for design of a boiler, including parts thereof, or a replacement part to be stamped with the ASME certification mark required by this Section.

(a) Except as provided in (b) and (c), the Code edition and addenda used to design a boiler, parts thereof, or a replacement part shall be either those that are mandatory on the date the boiler or replacement part is contracted or those that have been approved and issued by ASME prior to the contract date but are not yet mandatory (refer to 9-100 above).

(b) Existing pressure parts that have been stamped and certified to an earlier or later edition and addenda than those used for design and that have never been placed in service (i.e., placed in stock for future use) may be used, provided they are acceptable to the Manufacturer.

(c) It is permitted to provide a replacement part “in kind” (i.e., identical in fit and material to the part being replaced) for an existing boiler and to certify the part as meeting the Code edition and addenda to which the existing boiler is certified.
MANDATORY APPENDIX 10
REQUIREMENTS FOR FEEDWATER ECONOMIZERS

10-300 PRESSURE RELIEF

(a) The Section IV economizer shall be provided with pressure relief valves sized in accordance with HG-400.2. Nonisolable economizers shall be provided with pressure relief valves in accordance with 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, 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 marking.