ARTICLE 6 — INSPECTION AND STAMPING

Inspection and marking stamping requirements for water heaters are given. The Certification Mark with HLW designer 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 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 MARKING STAMPING

Any water heater or storage tank that meets all of the requirements of Part HLW, including those for inspection, may be marked stamped with the Code HLW Symbol even though exempted from such marking 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 over-pressure 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.
HLW-305.3 Torispherical Heads. When the provisions of HLW-501 to HLW-504 are not used, the required thickness and the maximum allowable working pressure of a torispherical head shall be calculated by the following formulas:

\[
t = \frac{0.885PL}{SE - 0.1P}
\]

\[
p = \frac{SEt}{0.885L + 0.1t}
\]

HLW-305.4 Inside Crown Radius of Unstayed Heads. The inside crown radius to which an unstayed formed head is dished shall be not greater than the outside diameter of the skirt of the head. The inside knuckle radius of a torispherical head shall be not less than 6% of the outside diameter of the skirt of the head but in no case less than three times the head thickness.

HLW-305.5 Hemispherical Heads. Because of the complexity of joint design, hemispherical heads are not permitted.

HLW-306 BLANK UNSTAYED DISHEd Heads, PRESSURE ON CONVEX SIDE

HLW-306.1 When the provisions of HLW-501 to HLW-504 are not used, unstayed dished heads with the pressure on the convex side shall have a maximum allowable working pressure equal to 60% of that for heads of the same dimension with the pressure on the concave side.

HLW-306.2 Hemispherical Heads. Because of the complexity of joint design, hemispherical heads are not permitted.

(19) HLW-307 TUBES

When the provisions of HLW-501 to HLW-504 are not used, the thickness of seamless or welded tubes shall be in accordance with HG-301.2.

HLW-308 OPENINGS

(19) HLW-308.1 Single openings in water heaters do not require reinforcement under the following conditions:

(a) welded connections attached in accordance with the applicable rules and not larger than NPS 3 (DN 80) in shells or heads 3/8 in. (10 mm) or less; NPS 2 (DN 50) in shells or heads over 3/8 in. (10 mm)

(b) threaded, studded, or expanded connections in which the hole cut in the shell or head is not greater than NPS 2 (DN 50)

HLW-308.2 When the provisions of HLW-501 to HLW-504 are not used, all other openings shall be reinforced in accordance with HG-321 of this Section.

HLW-309 TUBES ATTACHED BY ROLLING

(a) The tube hole in the head or tubesheet shall be formed either:

(1) to the full size diameter by a method that will not produce irregularities that would interfere with proper rolling and sealing, or

(2) to a lesser diameter, then enlarged to full diameter by a secondary drilling, cutting, or reaming operation to remove such irregularities.

(b) The sharp edges of tube holes shall be taken off both sides with a file or other tool.

(b) The minimum thickness of any tubesheet with tubes installed by rolling shall be 3/16 in. (5 mm).

HLW-310 STORAGE TANKS

HLW-310.1 Tank Construction. If a system is to utilize a storage tank that exceeds the capacity exceptions of HLW-101, the tank shall be constructed in accordance with the requirements of this Part; the requirements of Section VIII, Division 1; or the requirements of Section X. Regardless of the Code Section governing construction of the vessel, all storage tanks used in applications under this Part shall be provided with a corrosion-resistant lining or constructed with corrosion-resistant materials that are suitable for use in potable hot water at 210°F (99°C) and are marked stamped for a maximum allowable working pressure of 160 psig (1,100 kPa) or less. Heat exchangers installed in HLW-stamped vessels shall be made of corrosion-resistant materials.

HLW-310.2 Inspection Openings. Storage tanks constructed to the rules of this Part shall be provided with suitable manhole, handhole, fitting, or other openings for internal inspection and cleaning.

(a) All vessels less than 18 in. (450 mm) and over 12 in. (300 mm) I.D. shall have at least two handholes or two plugged threaded inspection openings of not less than NPS 11/2 (DN 40).

(1) A handhole opening shall not be less than 2 in. x 3 in. (50 mm x 75 mm) but should be as large as is consistent with the size of the vessel and location of the opening.

(b) All vessels 18 in. (450 mm) to 36 in. (900 mm), inclusive, I.D. shall have a manhole or at least two handholes or two plugged, threaded openings of not less than NPS 2 (DN 50).

(1) A manhole shall not be less than 12 in. x 16 in. (300 mm x 400 mm), and those of the type in which internal pressure forces the cover plate against a flat gasket shall have a gasket bearing width of at least 11/16 in. (17 mm).
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]

(b) 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 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.

(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 submit evidence to the Inspector that those 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 marked/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
of the Manufacturer's Data Report on file for at least 5 yr, or the vessel 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.

**HLW-601.2 Partial Data Reports.**
(a) Manufacturer's Partial Data Reports for those parts of a vessel requiring inspection under this Code, which are furnished by other than the shop of the manufacturer responsible for the completed heater, shall be executed by the parts manufacturer and shall be forwarded in duplicate, to the manufacturer of the finished vessel.
(b) Partial Data Reports (Form HLW-7) 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 vessel, regardless of whether individual Manufacturer's Data Reports are compiled for the completed units. These Partial Data Reports, together with his own inspection, shall be the final Inspector's authority to witness the application of a Certification Mark to the completed vessel.
(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.

**HLW-601.3 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.

**HLW-601.4 Multiple Page Data Reports.** Requirements for completing multiple pages of Data Report Forms are shown in Mandatory Appendix 4.

**HLW-602 MARKING STAMPING OF WATER HEATERS AND STORAGE TANKS**

**HLW-602.1 Marking/Stamping Requirements for Vessels.** All vessels to which the Certification Mark is to be applied shall be built according to the rules of this Part by a manufacturer who is in possession of a Certification Mark and a valid Certificate of Authorization per procedure of HG-540. Each vessel shall be marked or stamped with the Certification Mark with the HLW designator shown in Figure HLW-602.1 and the form of stamping as shown in Figure HLW-602.2 with the HLW designator with the following data:
(a) the manufacturer's name, preceded by the words "Certified by:"
(b) maximum allowable working pressure.
(c) maximum water temperature.
(d) maximum allowable input in Btu/hr; electric heaters may use kW or Btu/hr (expressed at the rate of 3,500 Btu/hr/kW) or both. In lieu of the input markings storage tanks shall be marked "Storage Only."
(e) manufacturer's serial number (this may be a serial number or a combination model and serial number).
(f) year built (the year built may be incorporated into the serial number as a prefix containing the last two digits of the year).

**HLW-602.2 MARKING Stamp a Proof Tested Vessel.** A completed vessel or one tested prior to lining may have the required Certification Mark and marking applied, provided
(a) the proof test was stopped before any visible yielding
(b) all welding was qualified as required by HLW-451

Figure HLW-602.2

Form of Marking Stamp on Completed Water Heaters

Certified by

(Name of Manufacturer)

Max. Allowable W. P. ________

Max. Water Temp. ________

Max. Allowable Input ________

Manufacturer's Serial No. ________

Year built ________

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

**NOTES:**
(1) May be listed as psi or kPa.
(2) May be listed as °F or °C.
(3) Kilowatt (kW) power input for electric boilers.
(c) the MAWP is calculated by the method of HLW-502.1(d)(2)

(d) the interior of a lined vessel must be inspected to verify that it was not damaged, and

(e) the completed vessel is subjected to the hydrostatic test provisions of HLW-505

**HLW-602.3** When the Certification Mark and marking required by HLW-602.1(a) through HLW-602.1(f), is applied directly to the water heater vessel, it shall be marked with letters and figures at least \( \frac{5}{16} \) in. (8 mm) high or on a stamping nameplate at least \( \frac{3}{64} \) in. (1.2 mm) thick permanently fastened to the water heater vessel. Stamping nameplates bearing the stamping and marking required in HLW-602.1 may be used in lieu of marking these data directly on the water heater vessel if the stamping nameplates are permanently attached to the water heater vessel. In this case the required data on the stamping nameplate shall be in characters not less than \( \frac{1}{8} \) in. (3 mm) high.

If the required marking or stamping is to be covered by insulation, jacket, or other form of casing, one of the following shall be provided:

(a) an opening with a removal cover for viewing the marking or stamping

(b) a nameplate, located in a conspicuous place on the jacket, duplicating the required Certification Mark and data. This plate shall be at least 3 in. \( \times \) 4 in. (75 mm \( \times \) 100 mm) in size marked with letters and numerals at least \( \frac{7}{64} \) in. (3 mm) high and of either metallic material attached by mechanical means or of any material attached by an adhesive system meeting the requirements of Mandatory Appendix 3.

**HLW-602.3.1** When there is insufficient space for the nameplate required in HLW-602.3, smaller letter dimensions may be used, provided:

(a) stamping marking shall be as required in HLW-602.1,

(b) character size shall be no smaller than \( \frac{5}{32} \) in. (4 mm), and

(c) the information, including the Certification Mark, shall be applied by stamping or etching that leaves a permanent legible mark. Characters shall either be indented or raised at least 0.004 in. (0.10 mm).

**HLW-602.4** Parts for which a Partial Data Report, Form HLW-7, is required by HLW-601.2, shall be marked with the following:

(a) the official Certification Mark shown in Figure HLW-602.1 with the HLW designator above the word "Part." The HLW designator and the word "Part" may be replaced with the PRT designator.

(b) the part manufacturer's name.

(c) the part manufacturer's serial number. In lieu of marking this stamping these data directly on the vessel, a stamping nameplate, as described in HLW-602.3, may be used.

**HLW-602.5** Water heaters fabricated of austenitic stainless steel material listed in Table HLW-301 shall have a precautionary statement warning that the water heaters are to be operated only on deionized water having a minimum specific resistivity of 1.0 M\(\Omega\)/cm clearly marked and located on the water heater so that it will be readily visible.
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 MARKING 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.