ASME BPVC.VIII.2-2023

SECTION VIII

Rules for Construction of Pressure Vessels

2023 ASME Boiler and Pressure Vessel Code

An International Code

Division 2

Alternative Rules

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AN INTERNATIONAL CODE

2023 ASME Boiler & Pressure Vessel Code

2023 Edition July 1, 2023

VIII

RULES FOR CONSTRUCTION OF PRESSURE VESSELS

Division 2

Alternative Rules

ASME Boiler and Pressure Vessel Committee
on Pressure Vessels

The American Society of Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

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FOREWORD[*]

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 In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees: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) Committee on Overpressure Protection (XIII)
(l) 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.

requirements of the Code. However, designers and engineers using computer programs for design or analysis are cautioned that they are responsible for all technical assumptions inherent in the programs they use and the application of these programs to their design.

The rules established by the Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design, or as limiting in any way the manufacturer's freedom to choose any method of design or any form of construction that conforms to the Code rules.

The Committee meets regularly to consider revisions of the rules, new rules as dictated by technological development, Code Cases, and requests for interpretations. Only the Committee has the authority to provide official interpretations of this Code. Requests for revisions, new rules, Code Cases, or interpretations shall be addressed to the Secretary in writing and shall give full particulars in order to receive consideration and action (see Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees). Proposed revisions to the Code resulting from inquiries will be presented to the Committee for appropriate action. The action of the Committee becomes effective only after confirmation by ballot of the Committee and approval by ASME. Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute (ANSI) and published at http://go.asme.org/BPVCPublicReview to invite comments from all interested persons. After public review and final approval by ASME, revisions are published at regular intervals in Editions of the Code.

The Committee does not rule on whether a component shall or shall not be constructed to the provisions of the Code. The scope of each Section has been established to identify the components and parameters considered by the Committee in formulating the Code rules.

Questions or issues regarding compliance of a specific component with the Code rules are to be directed to the ASME Certificate Holder (Manufacturer). Inquiries concerning the interpretation of the Code are to be directed to the Committee. ASME is to be notified should questions arise concerning improper use of the ASME Single Certification Mark.

When required by context in this Section, the singular shall be interpreted as the plural, and vice versa, and the feminine, masculine, or neuter gender shall be treated as such other gender as appropriate.

The words "shall," "should," and "may" are used in this Standard as follows:

- *Shall* is used to denote a requirement.
- *Should* is used to denote a recommendation.
- *May* is used to denote permission, neither a requirement nor a recommendation.

STATEMENT OF POLICY ON THE USE OF THE ASME SINGLE CERTIFICATION MARK AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use the ASME Single Certification Mark for marking items or constructions that have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the ASME Single Certification Mark for the benefit of the users, the enforcement jurisdictions, and the holders of the ASME Single Certification Mark who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the ASME Single Certification Mark, Certificates of Authorization, and reference to Code construction. The American Society of Mechanical Engineers does not "approve," "certify," "rate," or "endorse" any item, construction, or activity and there shall be no statements or implications that might so indicate. An organization holding the ASME Single Certification Mark and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities "are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code," or "meet the requirements of the ASME Boiler and Pressure Vessel Code." An ASME corporate logo shall not be used by any organization other than ASME.

The ASME Single Certification Mark shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of the ASME Single Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the ASME Single Certification Mark.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the ASME Single Certification Mark described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the ASME Single Certification Mark shall not be used on any item that is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME that tend to imply that all Code requirements have been met when, in fact, they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

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ASME codes and standards are developed and maintained by committees with the intent to represent the consensus of concerned interests. Users of ASME codes and standards may correspond with the committees to propose revisions or cases, report errata, or request interpretations. Correspondence for this Section of the ASME Boiler and Pressure Vessel Code (BPVC) should be sent to the staff secretary noted on the Section's committee web page, accessible at https://go.asme.org/CSCommittees.

NOTE: See ASME BPVC Section II, Part D for guidelines on requesting approval of new materials. See Section II, Part C for guidelines on requesting approval of new welding and brazing materials ("consumables").

Revisions and Errata

The committee processes revisions to this Code on a continuous basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Code. Approved revisions will be published in the next edition of the Code.

In addition, the committee may post errata and Special Notices at http://go.asme.org/BPVCerrata. Errata and Special Notices become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata and Special Notices.

This Code is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Code

(4) to permit use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Code.

(c) The committee will consider proposed cases concerning the following topics only:

(1) equipment to be marked with the ASME Single Certification Mark, or

(2) equipment to be constructed as a repair/replacement activity under the requirements of Section XI

(d) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Code Section and the paragraph, figure, or table number(s) to which the proposed case applies

(4) the edition(s) of the Code to which the proposed case applies

(e) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Cases that have been approved will appear in the next edition or supplement of the Code Cases books, "Boilers and Pressure Vessels" or "Nuclear Components." Each Code Cases book is updated with seven Supplements. Supplements will be sent or made available automatically to the purchasers of the Code Cases books until the next edition of the Code. Annulments of Code Cases become effective six months after the first announcement of the annulment in a Code Case Supplement or Edition of the appropriate Code Case book. The status of any case is available at http://go.asme.org/BPVCCDatabase. An index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases is available at http://go.asme.org/BPVCC.

Interpretations

(a) Interpretations clarify existing Code requirements and are written as a question and reply. Interpretations do not introduce new requirements. If a revision to resolve conflicting or incorrect wording is required to support the interpretation, the committee will issue an intent interpretation in parallel with a revision to the Code.

(b) Upon request, the committee will render an interpretation of any requirement of the Code. An interpretation can be rendered only in response to a request submitted through the online Interpretation Submittal Form at http://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic e-mail confirming receipt.

(c) ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers may track the status of their requests at http://go.asme.org/Interpretations.

(d) ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME committee or subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

(e) Interpretations are published in the ASME Interpretations Database at http://go.asme.org/Interpretations as they are issued.

Committee Meetings

The ASME BPVC committees regularly hold meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the applicable committee. Information on future committee meetings can be found at http://go.asme.org/BCW.

SUMMARY OF CHANGES

Changes listed below are identified on the pages by a margin note, **(23)**, placed next to the affected area.

Page	*Location*	*Change*
xxvii	List of Sections	*(1)* Under Section III, Division 4 added *(2)* Title of Section XI and subtitle of Section XI, Division 2 revised *(3)* Information on interpretations and Code cases moved to "Correspondence With the Committee"
xxxi	Personnel	Updated
liii	Correspondence With the Committee	Added (replaces "Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees")
lx	Cross-Referencing in the ASME BPVC	Updated
3	1.2.4.2	In subpara. (b), cross-reference to API updated
5	Table 1.1	*(1)* Updated *(2)* Note (2) added
15	2.2.1	Reformatted and former 2.2.1.2 deleted
17	2.3.1	In 2.3.1.2 and 2.3.1.3, "PRT" revised to "PRT VIII-2"
18	2.3.3	*(1)* 2.3.3.1 revised *(2)* 2.3.3.2 deleted and subsequent paragraph redesignated
21	2-A.2.1	In first paragraph, first cross-reference updated
23	2-B.1	In subpara. (b), last cross-reference updated
23	2-B.2.1	In first paragraph, first cross-reference updated
25	2-C.1.1	In subpara. (c), "PRT" revised to "PRT VIII-2"
26	2-C.3.1	Subparagraph (d)(13) added
36	Form A-2	Under "Certificate of Shop Compliance," "PRT" revised to "PRT VIII-2"
44	2-E.16	Deleted
45	2-F.1	"PRT" revised to "PRT VIII-2"
46	2-F.3	"PRT" revised to "PRT VIII-2"
46	2-F.4.1	"PRT" revised to "PRT VIII-2"
46	2-F.5	Subparagraph (a)(3) revised in its entirety
49	Figure 2-F.1	In illustration (b), "PRT" revised to "PRT VIII-2"
50	2-G.1	"PRT" revised to "PRT VIII-2"
50	2-G.6.2	"PRT" revised to "PRT VIII-2"
58	3.2.7.1	In subpara. (c), first sentence revised
64	3.3.6.6	Added
75	3.11.2.1	Subparagraph (b)(1) revised

Page	*Location*	*Change*
76	3.11.2.3	Subparagraph (a) revised
77	3.11.2.4	Revised
77	3.11.2.5	*(1)* Steps 2 and 3 revised *(2)* In subpara. (d), first sentence revised
79	3.11.2.9	In subpara. (b), second sentence revised
82	3.11.4.5	Subparagraph (c) revised
83	3.11.6.1	Revised
85	3.11.8	*(1)* In 3.11.8.1, subpara. (b) revised *(2)* In 3.11.8.2, title and subparas. (a) through (c) revised *(3)* 3.11.8.3 revised in its entirety *(4)* In 3.11.8.4, title and subparas. (a), (b), and (c)(1)(-c) revised
89	Table 3.1	*(1)* Entries for $2\frac{1}{4}$Cr–1Mo revised *(2)* Note (1) added
90	Table 3.4	Revised
91	Table 3.5	*(1)* For SA-320, cross-references in last column revised *(2)* For SA-453, entries revised
93	Table 3.12	Title revised
94	Table 3.13	Title revised
97	Table 3.18	Deleted
100	Figure 3.3	Title revised
101	Figure 3.3M	Title revised
102	Figure 3.4	Title revised
103	Figure 3.4M	Title revised
105	Figure 3.6	Arrowhead added by errata
105	Figure 3.6M	Arrowhead added by errata
106	Figure 3.7	Title revised
108	Figure 3.7M	Title revised
110	Figure 3.8	Title revised
112	Figure 3.8M	Title revised
123	Figure 3.17	Added
125	Table 3-A.1	For SA-283, Grade B deleted
138	Table 3-A.5	Revised
151	Table 3-D.1	*(1)* Revised *(2)* Note (1) added
151	Table 3-D.2	"$2\frac{1}{4}$Cr–$\frac{1}{2}$Mo" revised to "$2\frac{1}{4}$Cr–1Mo"
153	Table 3-D.2M	"$2\frac{1}{4}$Cr–$\frac{1}{2}$Mo" revised to "$21\frac{1}{4}$Cr–1Mo"
156	3-F.1.2	Subparagraph (b) revised
158	3-F.2.1	Subparagraph (b) revised
163	Figure 3-F.3	Title revised

Page	*Location*	*Change*
163	Figure 3-F.3M	Title revised
174	4.1.8.2	Title of subpara. (b) revised
178	4.2.5.3	In subpara. (a)(2), cross-reference updated
178	4.2.5.4	In subpara. (a)(2), cross-reference updated
179	4.2.5.5	In subpara. (a)(2), cross-reference updated
182	4.2.5.7	*(1)* Added *(2)* Former 4.2.5.7 redesignated as 4.2.5.8 *(3)* Former 4.2.5.8 deleted
183	Table 4.2.1	*(1)* Description for Weld Category C revised *(2)* Weld Category F added
184	Table 4.2.3	For Material Type 1, description for P-No. 4, Group 1 revised
190	Table 4.2.9	For Detail 9, entry in “Design Notes” column revised
197	Table 4.2.12	For Details 1 through 5, “DIN” corrected by errata to “DN” in “Design Notes” column
202	Figure 4.2.1	Title and illustration revised
207	4.3.6.1	In Step 2, last sentence added
212	4.3.11.3	Revised
225	Table 4.3.7	For “Stress Calculation in the Non-Compact Knuckle Region,” breaks added between equations for clarity
243	4.4.12.1	Revised
279	Table 4.5.1	In first column, “DIN” corrected by errata to “DN”
323	Table 4.11.1	*(1)* For Detail 6, entry for “Requirements” revised *(2)* For Detail 6, illustrations (a), (b), and (c) revised
404	4.15.3.5	Subparagraphs (c), (d), and (e) revised
408	4.15.6	In definitions of S_{hy} and S_y, cross-reference updated
410	Table 4.15.1	Note (4) editorially revised
413	Figure 4.15.3	Illustration (c) revised
414	Figure 4.15.4	In illustration (a), bottom image revised
423	4.16.13	Definition of A_b revised
429	Table 4.16.4	Equations for X_h revised
433	Table 4.16.7	Equations for h_p revised
455	4.18.4	*(1)* Subparagraph (d) revised *(2)* Subparagraphs (f) and (g) added and subsequent subparagraphs redesignated
458	4.18.7.4	Revised and equations renumbered
464	4.18.8.4	Revised and equations renumbered
471	4.18.8.5	*(1)* Last sentence in (c)(2) revised *(2)* Equations renumbered
471	4.18.8.6	Equations renumbered

Page	*Location*	*Change*
472	4.18.8.7	*(1)* Subparagraph (b) and last equation revised *(2)* Equations renumbered
473	4.18.8.8.3	Subparagraph (b)(1) revised
477	4.18.9.4	Revised and equations renumbered
483	4.18.9.5	Equations renumbered
484	4.18.9.6	Last equation revised and equations renumbered
488	4.18.15	*(1)* In subpara. (b), nomenclature revised *(2)* In subpara. (d), ℓ_t added
510	Figure 4.18.15	*(1)* cross-reference to Note (3) added to illustration (b) *(2)* Illustration (d) and Note (4) added
548	4.20.2	Subparagraph (d) revised
549	4.20.7	Definition of L_{limit} added
550	Figure 4.20.1	Revised
587	5.4	Revised in its entirety
589	5.5	Equations renumbered
591	5.5.2.4	Revised in its entirety
604	5.13	Revised
615	Table 5.7	*(1)* Revised *(2)* Note (4) added
616	Table 5.10	Revised in its entirety
701	6.2.2.2	Second paragraph added
711	6.4.6.2	First sentence revised
730	Table 6.8	In second column, entries for SI Units revised
731	Table 6.9	*(1)* In first column, (c)(2) revised *(2)* In second column, entries for SI Units revised
732	Table 6.10	Revised
733	Table 6.11	Revised
735	Table 6.12	In second column, entries for SI Units revised
736	Table 6.13	*(1)* Under “PWHT Requirements,” first cross-reference in (c) revised *(2)* In second column, entries for SI Units revised
737	Table 6.14	In second column, entries for SI Units revised
739	Table 6.15	In second column, entries for SI Units revised
742	Table 6.16	Revised
759	7.4.2.1	In subpara. (a), first sentence revised
762	7.4.9.2	Second sentence revised
774	Table 7.2	For Joint Category D, last row revised and redesignated as F
778	Table 7.3	Under “Shell Thickness,” column heads revised
809	8.1.4	In subpara. (a), first sentence revised

Page	*Location*	*Change*
810	8.2.4	Revised
810	8.2.5	Title and subpara. (a) revised
812	Part 9	Note revised
812	9.1	Subparagraph (c) revised
821	Annex 9-B	Deleted

(**23**)

CROSS-REFERENCING IN THE ASME BPVC

Paragraphs within the ASME BPVC may include subparagraph breakdowns, i.e., nested lists. The following is a guide to the designation and cross-referencing of subparagraph breakdowns:

(a) Hierarchy of Subparagraph Breakdowns

(1) First-level breakdowns are designated as (a), (b), (c), etc.

(2) Second-level breakdowns are designated as (1), (2), (3), etc.

(3) Third-level breakdowns are designated as (-a), (-b), (-c), etc.

(4) Fourth-level breakdowns are designated as (-1), (-2), (-3), etc.

(5) Fifth-level breakdowns are designated as (+a), (+b), (+c), etc.

(6) Sixth-level breakdowns are designated as (+1), (+2), etc.

(b) Cross-References to Subparagraph Breakdowns. Cross-references within an alphanumerically designated paragraph (e.g., PG-1, UIG-56.1, NCD-3223) do not include the alphanumerical designator of that paragraph. The cross-references to subparagraph breakdowns follow the hierarchy of the designators under which the breakdown appears. The following examples show the format:

(1) If X.1(c)(1)(-a) is referenced in X.1(c)(1), it will be referenced as (-a).

(2) If X.1(c)(1)(-a) is referenced in X.1(c)(2), it will be referenced as (1)(-a).

(3) If X.1(c)(1)(-a) is referenced in X.1(e)(1), it will be referenced as (c)(1)(-a).

(4) If X.1(c)(1)(-a) is referenced in X.2(c)(2), it will be referenced as X.1(c)(1)(-a).

PART 1
GENERAL REQUIREMENTS

1.1 GENERAL

1.1.1 INTRODUCTION

1.1.1.1 This Division contains mandatory requirements, specific prohibitions, and nonmandatory guidance for the design, materials, fabrication, examination, inspection, testing, overpressure protection, and certification of pressure vessels.

1.1.1.2 The Code does not address all aspects of these activities. Those aspects that are not specifically addressed should not be considered prohibited and shall be addressed by appropriate engineering judgment. Engineering judgment shall be consistent with the philosophy of this Division, and such judgments shall never be used to overrule mandatory requirements or specific prohibitions of this Division.

1.1.2 ORGANIZATION

1.1.2.1 The requirements of this Division are contained in the nine Parts listed below. Each of these Parts and Annexes is composed of paragraphs that are identified by an alphanumeric numbering system in accordance with the ISO Standard Template for the Preparation of Normative-Type Documents. References to paragraphs are made directly by reference to the paragraph number. For example, the Scope is referenced as 1.2.

(a) Part 1 – General Requirements, provides the scope of this division and establishes the extent of coverage

(b) Part 2 – Responsibilities and Duties, sets forth the responsibilities of the user and Manufacturer, and the duties of the Inspector

(c) Part 3 – Materials Requirements, provides the permissible materials of construction, applicable material specification and special requirements, physical properties, allowable stresses, and design fatigue curves

(d) Part 4 – Design by Rule Requirements, provides requirements for design of vessels and components using rules

(e) Part 5 – Design by Analysis Requirements, provides requirements for design of vessels and components using analytical methods

(f) Part 6 – Fabrication Requirements, provides requirements governing the fabrication of vessels and parts

(g) Part 7 – Examination and Inspection Requirements, provides requirements governing the examination and inspection of vessels and parts

(h) Part 8 – Pressure Testing Requirements, provides pressure testing requirements

(i) Part 9 – Pressure Vessel Overpressure Protection, provides overpressure protection requirements

1.1.2.2 Mandatory and nonmandatory requirements are provided as normative and informative annexes, respectively, to the specific Part under consideration. The Normative Annexes address specific subjects not covered elsewhere in this Division and their requirements are mandatory when the subject covered is included in construction under this Division. Informative Annexes provide information and suggested good practices.

1.1.2.3 The materials, design, fabrication, examination, inspection, testing, overpressure protection, and certification of pressure vessels shall satisfy all applicable Parts and Normative Annexes shown above in order to qualify the construction in accordance with this Division.

1.1.3 DEFINITIONS

The definitions for the terminology used in this Part are contained in Annex 1-B.

1.2 SCOPE

1.2.1 OVERVIEW

1.2.1.1 In the scope of this Division, pressure vessels are containers for the containment of pressure, either internal or external. This pressure may be obtained from an external source or by the application of heat from a direct or indirect source as a result of a process, or any combination thereof.

1.2.1.2 Vessels with an internal or external design pressure not exceeding 103 kPa (15 psi) and multichambered vessels of which the design pressure on the common elements does not exceed 103 kPa (15 psi) were not considered when the rules of this Division were developed and are not considered within the scope.

1.2.1.3 The rules of this Division may be used for the construction of the following pressure vessels. These vessels shall be designated as either a Class 1 or Class 2 vessel in conformance with the User's Design Specification required in Part 2.

(a) Vessels to be installed at a fixed (stationary) location for a specific service where operation and maintenance control is retained during the useful life of the vessel by the user and is in conformance with the User's Design Specification required by Part 2.

(b) Pressure vessels installed in ocean-going ships, barges, and other floating craft or used for motor vehicle or rail freight. For these applications it is necessary that prior written agreement with the jurisdictional authority be established covering operation and maintenance control for a specific service. This operation and maintenance control must be retained during the useful life of the pressure vessel by the user in conformance with the User's Design Specification required in Part 2. Such a pressure vessel as described above may be constructed and stamped within the scope of this Division, provided it meets all other requirements as specified with the following additional provisions.

(1) Loading conditions imposed by movement of the pressure vessel during operation and by relocation of the pressure vessel between work sites or due to loading and discharge, as applicable, shall be considered in the design.

(2) The User's Design Specification shall include the agreements that define those aspects of operation and maintenance control unique to the particular pressure vessel.

(c) Pressure vessels or parts subject to direct firing from the combustion of fuel (solid, liquid, or gaseous), that are not within the scope of Section I, III, or IV may be constructed in accordance with the rules of this Division.

(d) Unfired steam boilers shall be constructed in accordance with the rules of Section I or Section VIII, Division 1.

(e) The following pressure vessels in which steam is generated shall be constructed in accordance with the rules of Section VIII, Division 1 or this Division:

(1) Vessels known as evaporators or heat exchangers;

(2) Vessels in which steam is generated by the use of heat resulting from operation of a processing system containing a number of pressure vessels such as used in the manufacture of chemical and petroleum products; and

(3) Vessels in which steam is generated but not withdrawn for external use.

1.2.1.4 The scope of this Division has been established to identify components and parameters considered in formulating the rules given in this Division. Laws or regulations issued by municipality, state, provincial, federal, or other enforcement or regulatory bodies having jurisdiction at the location of an installation establish the mandatory applicability of the Code rules, in whole or in part, within the jurisdiction. Those laws or regulations may require the use of this Division of the Code for vessels or components not considered to be within its scope. These laws or regulations should be reviewed to determine size or service limitations of the coverage which may be different or more restrictive than those given here.

1.2.2 ADDITIONAL REQUIREMENTS FOR VERY HIGH PRESSURE VESSELS

1.2.2.1 The rules of this Division do not specify a limitation on pressure but are not all-inclusive for all types of construction. For very high pressures, some additions to these rules may be necessary to meet the design principles and construction practices essential to vessels for such pressures. However, only in the event that, after application of additional design principles and construction practices, the vessel still complies with all of the requirements of the Code, may it be stamped with the Certification Mark.

1.2.2.2 As an alternative to this Division, Section VIII, Division 3 should be considered for the construction of vessels intended for operating pressures exceeding 68.95 MPa (10,000 psi).

1.2.3 GEOMETRIC SCOPE OF THIS DIVISION

The scope of this Division is intended to include only the vessel and integral communicating chambers, and shall include the following:

(a) Where external piping, other pressure vessels including heat exchangers, or mechanical devices (i.e., pumps, mixers, or compressors) are to be connected to the vessel:

(1) The welding end connection for the first circumferential joint for welded connections (see 4.2.5.9).

(2) The first threaded joint for screwed connections.

(3) The face of the first flange for bolted and flanged connections. Optionally, when the first flange is welded to the nozzle neck, the weld connecting the flange to the nozzle neck may be considered as the first circumferential joint, provided this construction is documented in the User's Design Specification and is properly described on the vessel drawing and the Manufacturer's Data Report Form.

(4) The first sealing surface for proprietary connections or fittings.

(b) Where non-pressure parts are welded directly to either the internal or external pressure-retaining surface of a pressure vessel, the scope of this Division shall include the design, fabrication, testing, and material requirements established for non-pressure-part attachments by the applicable paragraphs of this Division (see 4.2.5.6).

(c) Pressure-retaining covers and their fasteners (bolts and nuts) for vessel openings, such as manhole and handhole covers.

(d) The first sealing surface for proprietary connections, fittings or components that are designed to rules that are not provided by this Division, such as gages, instruments, and nonmetallic components.

1.2.4 CLASSIFICATIONS OUTSIDE THE SCOPE OF THIS DIVISION

1.2.4.1 The scope of this Division has been established to identify the components and parameters considered in formulating the rules given in this Division. Laws or regulations issued by a Jurisdictional Authority at the location of an installation establish the mandatory applicability of the Code rules, in whole or in part, within that jurisdiction. Those laws or regulations may require the use of this Division of the Code for vessels or components not considered to be within its Scope. These laws or regulations should be reviewed to determine size or service limitations that may be more restrictive than those given here.

1.2.4.2 The following vessels are not included in the scope of this Division. However, any pressure vessel, with the exception of (a) below, that is not excluded from the scope of this Division by 1.2.1.3 and that meets all applicable requirements of this Division may be stamped with the Certification Mark with the U2 Designator and vessel class. (**23**)

(a) Vessels within the scope of other Sections.

(b) Fired process tubular heaters as defined in API STD 560.

(c) Pressure containers that are integral parts or components of rotating or reciprocating mechanical devices, such as pumps, compressors, turbines, generators, engines, and hydraulic or pneumatic cylinders where the primary design considerations and/or stresses are derived from the functional requirements of the device.

(d) Structures consisting of piping components, such as pipe, flanges, bolting, gaskets, valves, expansion joints, and fittings whose primary function is the transport of fluids from one location to another within a system of which it is an integral part, that is, piping systems, including the piping system between a pressure relief device and the vessel it protects, see Part 9.

(e) Pressure-containing parts of components, such as strainers and devices that serve such purposes as mixing, separating, snubbing, distributing, and metering or controlling flow, provided that pressure-containing parts of such components are generally recognized as piping components or accessories.

(f) A vessel for containing water under pressure, including those containing air the compression of which serves only as a cushion, when none of the following limitations are exceeded:

(1) A design pressure of 2.07 MPa (300 psi)

(2) A design temperature of 99°C (210°F)

(g) A hot water supply storage tank heated by steam or any other indirect means when none of the following limitations is exceeded:

(1) A heat input of 58.6 kW (200,000 Btu/hr)

(2) A water temperature of 99°C (210°F)

(3) A nominal water containing capacity of 454 L (120 gal)

(h) Vessels with an internal or external design pressure not exceeding 103 kPa (15 psi) with no limitation on size, for multi-chambered vessels, the design pressure on the common elements shall not exceed 103 kPa (15 psi).

(i) Vessels with an inside diameter, width, height, or cross section diagonal not exceeding 150 mm (6 in.), with no limitation on length of vessel or pressure.

(j) Pressure vessels for human occupancy (requirements for pressure vessels for human occupancy are covered in ASME PVHO-1).

1.2.5 COMBINATION UNITS

When a pressure vessel unit consists of more than one pressure chamber, only the chambers that come within the scope of this Division need be constructed in compliance with its provisions (see 4.1.8).

1.2.6 FIELD ASSEMBLY OF VESSELS

1.2.6.1 Field assembly of vessels constructed to this Division may be performed as follows.

(a) The Manufacturer of the vessel completes the vessel in the field, completes the Form A-1 or Form A-1P Manufacturer's Data Report, and stamps the vessel.

(b) The Manufacturer of parts of a vessel to be completed in the field by some other party stamps these parts in accordance with Code rules and supplies the Form A-2 Manufacturer's Partial Data Report to the other party. The other party, who must hold a valid U2 Certificate of Authorization, makes the final assembly, performs the required NDE, performs the final pressure test, completes the Form A-1 or Form A-1P Manufacturer's Data Report, and stamps the vessel.

(c) The field portion of the work is completed by a holder of a valid U2 Certificate of Authorization other than the vessel Manufacturer. The Certificate holder performing the field work is required to supply a Form A-2 Manufacturer's Partial Data Report covering the portion of the work completed by his organization (including data on the pressure test if conducted by the Certificate holder performing the field work) to the Manufacturer responsible for the Code vessel. The vessel Manufacturer applies his Certification Mark with U2 Designator in the presence of a representative from his Inspection Agency and completes the Form A-1 or Form A-1P Manufacturer's Data Report with his Inspector.

1.2.6.2 In all three alternatives, the party completing and signing the Form A-1 or Form A-1P Manufacturer's Data Report assumes full Code responsibility for the vessel. In all three cases, each Manufacturer's Quality Control System shall describe the controls to assure compliance by each Certificate holder.

1.2.7 OVERPRESSURE PROTECTION

The scope of this Division includes provisions for overpressure protection necessary to satisfy the requirements of Part 9.

1.3 STANDARDS REFERENCED BY THIS DIVISION

(a) Throughout this Division, references are made to various standards, such as ASME standards, which describe parts or fittings or which establish dimensional limits for pressure vessel parts. These standards, with the year of the acceptable edition, are listed in Table 1.1.

(b) Rules for the use of these standards are stated elsewhere in this Division.

1.4 UNITS OF MEASUREMENT

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

(b) A single system of units shall be used for all aspects of design except where otherwise permitted by this Division. 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 within the limitations given in (c). 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 within the limitations given in (c).

(c) For any single equation, all variables shall be expressed in a single system of units. Calculations using any material data published in this Division or Section II, Part D (e.g., allowable stresses, physical properties, external pressure design factor B) shall be carried out in one of the standard units given in Table 1.2. When separate equations are provided for U.S. Customary and SI units, those equations shall 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 or any other calculations carried out in either U.S. Customary or SI units may be converted to other units.

(d) 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:

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

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

(e) 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 Annex 1-C. 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.

(f) Dimensions shown in the text, tables and figures, whether given as a decimal or a fraction, may be taken as a decimal or a fraction and do not imply any manufacturing precision or tolerance on the dimension.