

SECTION VIII

Rules for Construction of Pressure Vessels

2023

ASME Boiler and
Pressure Vessel Code
An International Code

Division 1

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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 1

ASME Boiler and Pressure Vessel Committee
on Pressure Vessels



The American Society of
Mechanical Engineers

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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 In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees: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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January 1, 2023

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General

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/CSCcommittees>.

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.

<i>Page</i>	<i>Location</i>	<i>Change</i>
xxxii	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”
xxxvi	Personnel	Updated
lviii	Correspondence With the Committee	Added (replaces “Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees”)
lxvi	Cross-Referencing in the ASME BPVC	Updated
4	U-2(j)	Added
6	Table U-3	Updated and Note (4) added
10	UG-10	Revised
13	UG-11(e)	Throughout, “welding” revised to “joining”
15	UG-19	In subpara. (a)(3), title revised
38	UG-35.2	Subparagraphs (b)(2), (b)(2)(-b), and (b)(2)(-c) revised
47	Figure UG-39	Revised
56	Table UG-44-1	In Note (1), brackets deleted by errata from equation
56	UG-46	In subpara. (a), third paragraph and subpara. (2) revised
64	UG-79	In subpara. (d)(1), second cross-reference updated
67	UG-84	Revised
69	Figure UG-84.1	Revised
70	Figure UG-84.1M	Revised
73	Table UG-84.6	Deleted
73	Figure UG-84.6	Added
74	UG-85	First paragraph revised
77	UG-93(d)(3)	Second sentence revised
77	UG-98	Subparagraph (c) revised
78	UG-99	Subparagraph (h) revised in its entirety
80	UG-100	Subparagraph (c) revised in its entirety
81	UG-101	(1) Subparagraph (a)(5) added (2) In subpara. (m)(2)(-c) nomenclature, definition of $S_{\mu \text{ avg}}$ revised
87	UG-116	“PRT” revised to “PRT VIII-1”
87	Figure UG-116	In sketch (c), “PRT” revised to “PRT VIII-1”
89	UG-117	“PRT” revised to “PRT VIII-1”

<i>Page</i>	<i>Location</i>	<i>Change</i>
91	Figure UG-118	“PRT” revised to “PRT VIII-1”
91	UG-119	Subparagraph (c) revised in its entirety
92	UG-120	Subparagraph (b)(3) revised
94	Overpressure Protection	Revised
94	UG-150	Subparagraph (e) revised
94	UG-151	Subparagraph (e) added
95	UG-153	In subpara. (a), cross-reference to “UG-54(c)” corrected by errata to “UG-154(c)”
98	UW-2	Subparagraph (a)(3)(-b)(-3) revised
99	UW-3	Subparagraph (c) revised
104	UW-12	In subpara. (f), cross-reference to “UW-27(b)” corrected by errata to “UW-27”
110	Figure UW-13.2	General Note (a) revised
117	Figure UW-16.1	Text below sketches (i) and (j) revised
122	UW-16(d)	Subparagraph (1) revised
122	UW-16(f)	Subparagraph (1) revised
127	UW-20	(1) Revised in its entirety (2) Figures UW-20.2 and UW-20.3 (formerly Figures A-2 and A-3, respectively) added
139	UW-28	Last paragraph added
141	UW-35	Revised
141	UW-36	Revised
147	UW-55	Added
161	UCS-6	Subparagraph (b) revised
163	Table UCS-23	(1) For SA-283, entry for Type/Grade revised (2) SA-557 deleted (3) SA/IS 2062 added (4) Note (1) added
166	Table UCS-56-1	Under “Minimum Holding Time,” second column head revised, and third column deleted
167	Table UCS-56-2	(1) Under “Minimum Holding Time,” second column head revised, and third column deleted (2) General Note (d)(2) revised
168	Table UCS-56-3	(1) Under “Minimum Holding Time,” first and second column heads revised (2) General Notes (b)(1) through (b)(4) revised
169	Table UCS-56-4	(1) Under “Minimum Holding Time,” first and second column heads revised (2) General Notes (b)(1) through (b)(4) revised
170	Table UCS-56-5	Third column revised
171	Table UCS-56-6	Third column revised

<i>Page</i>	<i>Location</i>	<i>Change</i>
172	Table UCS-56-7	Third column revised
172	Table UCS-56-8	Third column revised
173	Table UCS-56-9	Third column revised
175	Table UCS-56.1	Revised
187	UCS-66(c)	In subparagraph (1)(-a), last sentence added
176	Figure UCS-66	Note (1)(d) added and Note (2)(b) revised
179	Figure UCS-66M	Note (1)(d) added and Note (2)(b) revised
186	Figure UCS-66.2	(1) Step 6 revised (2) Note (6) deleted and subsequent Notes renumbered
188	Figure UCS-66.3	In sketch (f), for definition of t_{g3} , t_A corrected by errata to t_B
191	UCS-67	Subparagraph (a)(3) revised
193	UCS-85	Revised in its entirety
197	UNF-19	Subparagraph (g) added
199	Table UNF-23.3	(1) For SB-626, UNS No. N06617 added (2) For SB-649, UNS No. N08904 deleted (3) For SB-673 and SB-674, UNS No. N08354 added
200	Table UNF-23.5	Revised
200	UNF-56	(1) In subpara. (c), last line editorially revised (2) In subpara. (d)(1), third line revised
208	Table UHA-23	(1) For SA-213 and SA-312, UNS No. S31002 added (2) For SA-240, UNS No. S43932 added (3) For SA-249 and SA-479, UNS No. N08904 added (4) SA-731 deleted (5) For SA-789 and SA-790, UNS No. S32707 added
210	Table UHA-32-1	(1) Under “Minimum Holding Time,” second column head revised, and third column deleted (2) General Note (a) revised in its entirety
211	Table UHA-32-2	(1) Under “Minimum Holding Time,” second column head revised, and third column deleted (2) General Note (a) revised in its entirety
211	Table UHA-32-3	Under “Minimum Holding Time,” column heads deleted
212	Table UHA-32-4	Under “Minimum Holding Time,” column heads deleted
212	Table UHA-32-5	Under “Minimum Holding Time,” column heads deleted
212	Table UHA-32-6	Under “Minimum Holding Time,” column heads deleted
213	Table UHA-32-7	Under “Minimum Holding Time,” column heads deleted
217	UHA-51(d)	Subparagraph (4) added
217	UHA-51(f)	(1) Subparagraph (3) revised (2) Subparagraph (4) revised in its entirety
227	UCL-27	Revised
241	Table UHT-56	Note (3) added
244	UHT-82(k)	Added

<i>Page</i>	<i>Location</i>	<i>Change</i>
244	UHT-84	Cross-references updated
244	UHT-115	“PRT” revised to “PRT VIII-1”
266	ULW-75	Revised
267	ULW-90	“PRT” revised to “PRT VIII-1”
277	Part UHX	(1) UHX-1 revised in its entirety (2) UHX-3 through UHX-17 and related tables and figures deleted (3) Figures UHX-11-5.2-1 and UHX-11-5.2-2 revised and moved to Mandatory Appendix 41
306	UIG-116	“PRT” revised to “PRT VIII-1”
306	UIG-120	“PRT” revised to “PRT VIII-1”
338	2-3	Definition of A_b revised
340	2-5	(1) In subpara. (b)(1), cross-reference to “eq. (d)(3)” corrected by errata to “eq. (e)(4)” (2) In subpara. (b)(2), cross-reference to “eq. (e)(4)” corrected by errata to “eq. (e)(5)”
346	2-7	Subparagraph (a) revised
355	2-8	Subparagraph (a) revised
372	Figure 5-1	Revised
371	5-3	Subparagraphs (a) and (f) revised
388	9-5(c)(8)	Revised
393	10-13	(1) Subparagraph (b)(7) revised (2) Subparagraph (b)(16) added
394	10-16	Former 10-16 deleted and subsequent paragraph redesignated as 10-16
395	Mandatory Appendix 11	Deleted
442	19-3	Revised
443	20-2	(1) In second paragraph, penultimate sentence revised (2) Last paragraph revised
446	22-5	Last sentence revised
456	Mandatory Appendix 26	(1) 26-1 revised in its entirety (2) Table 26-1.1 added (3) Former Table 26-2-1 redesignated as Table 26-1.2 (4) 26-2 through 26-4, 26-6, 26-7, 26-8, 26-9, 26-12.1, 26-15 and related tables and figures deleted (5) 26-5 and 26-12.2(b) revised
469	Table 31-1	For nominal composition $2\frac{1}{4}\text{Cr}-1\text{Mo}$, new entries added
494	41-7	(1) Step 2 revised (2) In Step 8 equation, numerator revised
496	Figure 41-7-1	Added (former Figure UHX-11.5.2-1)
497	Figure 41-7-2	Added (former Figure UHX-11.5.2-2)
495	41-10.1	(1) In subpara. (b), third sentence revised (2) In Step 1, the value for “Actual h_r ” revised

<i>Page</i>	<i>Location</i>	<i>Change</i>
		(3) In Steps 8 through 11, equations revised
499	Mandatory Appendix 42	Deleted
501	44-5	Subparagraph (i) added
505	45-4	Revised
505	45-5	Subparagraph (a) deleted and subsequent subparagraphs redesignated
506	45-6	Revised in its entirety
510	47-1	(1) Endnote 79 revised (see Endnotes) (2) Subparagraph (d) added
510	47-2	First paragraph and subpara. (b)(1) revised
510	47-3	Revised
511	47-4	First paragraph revised
511	Table 47-5-1	In first column, first entry revised
511	47-6	Subparagraph (b) revised
515	Nonmandatory Appendix A	Deleted
531	M-5	(1) M-5.1 merged with M-5 (2) M-5.2 through M-5.8 deleted
535	P-1	Last paragraph revised
538	S-1	In fifth paragraph, S_t corrected by errata to S_i
550	Form U-2	On third page, under "Certificate of Shop/Field Compliance," "PRT" revised to "PRT VIII-1"
553	Form U-2A	On second page, under "Certificate of Shop/Field Compliance," "PRT" revised to "PRT VIII-1"
581	Y-7	In subpara. (a), S_t corrected by errata to S_i
595	HH-1	Revised
596	HH-5.2	Revised
596	HH-5.3	Revised
596	HH-6.2	Revised
601	Form QEXP-2	Second page revised
606	Figure JJ-1.2-3	Revised
615	LL-1	First paragraph revised
625	NN-3	Subparagraph (c) revised
626	NN-4	Subparagraph (c) added
628	Table NN-6-1	Revised
630	Table NN-6-5	Revised
631	Table NN-6-6	Revised

<i>Page</i>	<i>Location</i>	<i>Change</i>
631	Table NN-6-7	Revised
632	Table NN-6-9	For “Pressure relief devices,” second entry in second column revised
634	Nonmandatory Appendix PP	Deleted

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).

INTRODUCTION

U-1 SCOPE

(a) See below.

(1) The Foreword provides the basis for the rules described in this Division.

(2) For 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, or any combination thereof.

(3) This Division contains mandatory requirements, specific prohibitions, and nonmandatory guidance for pressure vessel materials, design, fabrication, examination, inspection, testing, certification, and pressure relief. The Code does not address all aspects of these activities, and those aspects which are not specifically addressed should not be considered prohibited. Engineering judgment must be consistent with the philosophy of this Division, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of this Division.

(b) This Division is divided into three Subsections, Mandatory Appendices, and Nonmandatory Appendices. **Subsection A** consists of **Part UG**, covering the general requirements applicable to all pressure vessels. **Subsection B** covers specific requirements that are applicable to the various methods used in the fabrication of pressure vessels. It consists of **Parts UW, UF, and UB** dealing with welded, forged, and brazed methods, respectively. **Subsection C** covers specific requirements applicable to the several classes of materials used in pressure vessel construction. It consists of **Parts UCS, UNF, UHA, UCI, UCL, UCD, UHT, ULW, ULT, and Part UIG** dealing with carbon and low alloy steels, nonferrous metals, high alloy steels, cast iron, clad and lined material, cast ductile iron, ferritic steels with properties enhanced by heat treatment, layered construction, low temperature materials, and impregnated graphite, respectively. Section II, Part D also contains tables of maximum allowable stress values for these classes of materials, except for impregnated graphite.

The Mandatory Appendices 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. The Nonmandatory Appendices provide information and suggested good practices.

(c) See below.

(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 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 their 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.

(2) Based on the Committee's consideration, the following classes of vessels are not included in the scope of this Division; however, any pressure vessel which meets all the applicable requirements of this Division may be stamped with the Certification Mark with the U Designator:

(-a) those within the scope of other Sections;

(-b) fired process tubular heaters;

(-c) pressure containers which 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 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;

(-e) piping components, such as pipe, flanges, bolting, gaskets, valves, expansion joints, and fittings, and the pressure-containing parts of other components, such as strainers and devices which 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 water¹ 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 300 psi (2 MPa);

(-2) a design temperature of 210°F (99°C);

(-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 200,000 Btu/hr (58.6 kW);

(-2) a water temperature of 210°F (99°C);

(-3) a nominal water containing capacity of 120 gal (450 L);

(-h) vessels not exceeding the design pressure (see [Mandatory Appendix 3, 3-2](#)), at the top of the vessel, limitations below, with no limitation on size [see [UG-28\(f\)](#) and [Mandatory Appendix 9, 9-1\(c\)](#)]:

(-1) vessels having an internal or external pressure not exceeding 15 psi (100 kPa);

(-2) combination units having an internal or external pressure in each chamber not exceeding 15 psi (100 kPa) and differential pressure on the common elements not exceeding 15 psi (100 kPa) [see [UG-19\(a\)](#)];

(-i) vessels having an inside diameter, width, height, or cross section diagonal not exceeding 6 in. (152 mm), with no limitation on length of vessel or pressure;

(-j) pressure vessels for human occupancy.²

(d) The rules of this Division have been formulated on the basis of design principles and construction practices applicable to vessels designed for pressures not exceeding 3,000 psi (20 MPa). For pressures above 3,000 psi (20 MPa), deviations from and additions to these rules usually are necessary to meet the requirements of design principles and construction practices for these higher pressures. Only in the event that after having applied these additional design principles and construction practices the vessel still complies with all of the requirements of this Division may it be stamped with the applicable Certification Mark with the Designator.

(e) In relation to the geometry of pressure-containing parts, the scope of this Division shall include the following:

(1) where external piping; other pressure vessels including heat exchangers; or mechanical devices, such as pumps, mixers, or compressors, are to be connected to the vessel:

(-a) the welding end connection for the first circumferential joint for welded connections [see [UW-13\(i\)](#)];

(-b) the first threaded joint for screwed connections;

(-c) the face of the first flange for bolted, flanged connections;

(-d) the first sealing surface for proprietary connections or fittings;

(2) where nonpressure parts are welded directly to either the internal or external pressure-retaining surface of a pressure vessel, this scope shall include the design, fabrication, testing, and material requirements established for non-pressure-part attachments by the applicable paragraphs of this Division;³

(3) pressure-retaining covers for vessel openings, such as manhole or handhole covers, and bolted covers with their attaching bolting and nuts;

(4) the first sealing surface for proprietary fittings or components for which rules are not provided by this Division, such as gages, instruments, and nonmetallic components.

(f) The scope of the Division includes requirements for overpressure protection in [UG-150](#) through [UG-156](#).

(g) *Vessels That Generate Steam*

(1) Unfired steam boilers shall be constructed in accordance with the rules of Section I or this Division [see [UG-120\(f\)](#), [UG-150\(d\)](#), and [UW-2\(c\)](#)].

(2) The following pressure vessels in which steam is generated shall not be considered as unfired steam boilers, and shall be constructed in accordance with the rules of this Division:

(-a) vessels known as evaporators or heat exchangers;

(-b) 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;

(-c) vessels in which steam is generated but not withdrawn for external use.

(h) Pressure vessels or parts subject to direct firing from the combustion of fuel (solid, liquid, or gaseous), which are not within the scope of Sections I, III, or IV may be constructed in accordance with the rules of this Division [see [UW-2\(d\)](#)].

(i) Gas fired jacketed steam kettles with jacket operating pressures not exceeding 50 psi (345 kPa) may be constructed in accordance with the rules of this Division (see [Mandatory Appendix 19](#)).

(j) Pressure vessels exclusive of those covered in (c), (g), (h), and (i) that are not required by the rules of this Division to be fully radiographed, that are not provided with quick-actuating or quick-opening closures (see [UG-35.2](#) and [UG-35.3](#), respectively), and that do not exceed the following volume and pressure limits may be exempted from inspection by Inspectors, as defined in [UG-91](#), provided that they comply in all other respects with the requirements of this Division:

(1) 5 ft³ (0.14 m³) in volume and 250 psi (1.7 MPa) design pressure; or

(2) 3 ft³ (0.08 m³) in volume and 350 psi (2.4 MPa) design pressure;

(3) 1½ ft³ (0.04 m³) in volume and 600 psi (4.1 MPa) design pressure.

In an assembly of vessels, the limitations in (1) through (3) above apply to each vessel and not the assembly as a whole. Straight line interpolation for intermediate volumes and design pressures is permitted. Vessels fabricated in accordance with this rule shall be marked with the "UM" Symbol in [Figure UG-116](#), sketch (b) and with the data required in [UG-116](#). Certificates of Compliance shall satisfy the requirements of [UG-120\(a\)](#).