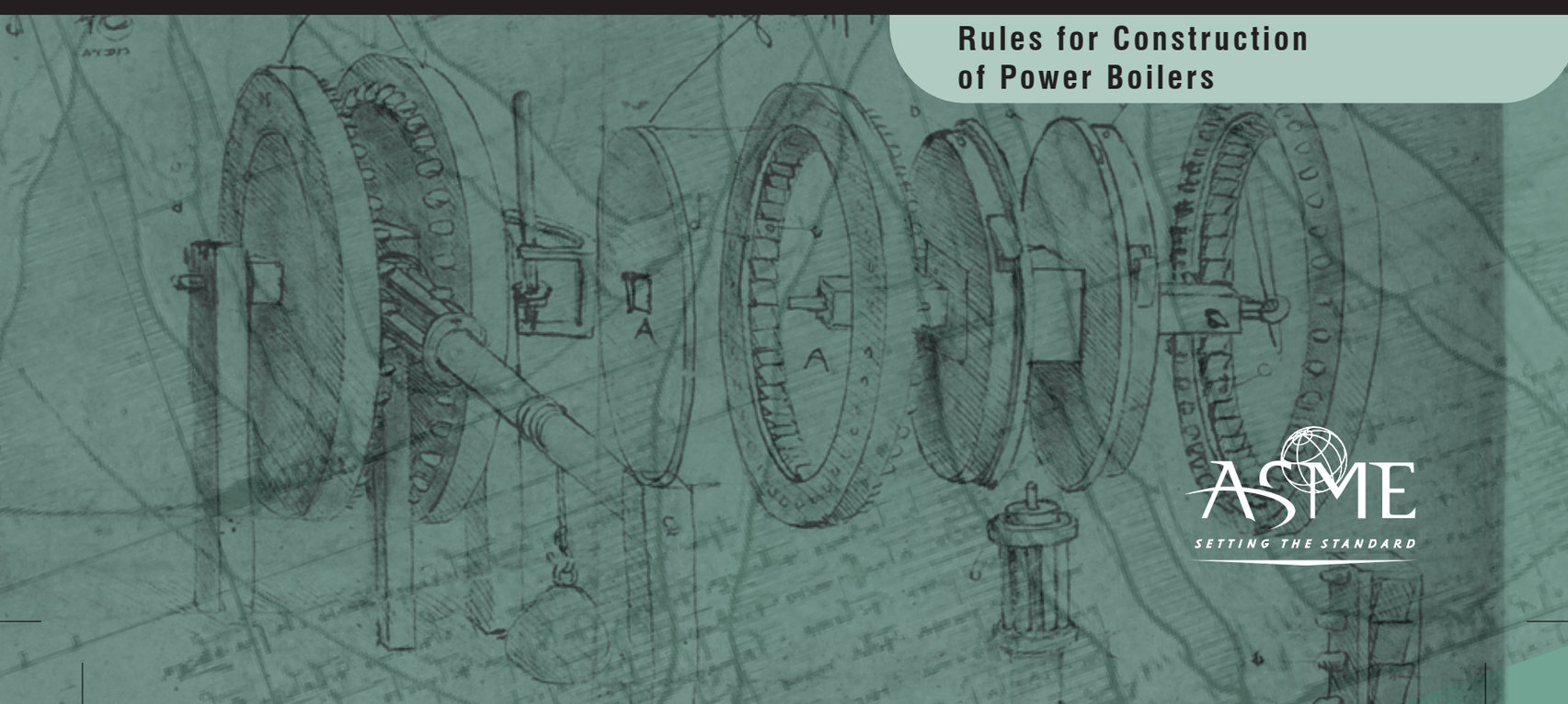
ASME BPVC.I-2023

SECTION I

2023 ASME Boiler and Pressure Vessel Code

An International Code

Rules for Construction of Power Boilers



ASME

SETTING THE STANDARD

AN INTERNATIONAL CODE

2023 ASME Boiler & Pressure Vessel Code

2023 Edition July 1, 2023

I

RULES FOR CONSTRUCTION OF POWER BOILERS

ASME Boiler and Pressure Vessel Committee
on Power Boilers

The American Society of Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

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ASME Collective Membership Mark

ASME Single Certification Mark

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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 In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees: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 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 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 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.

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.

(23)

PREAMBLE

This Code covers rules for construction of power boilers,[1] electric boilers,[2] miniature boilers,[3] high-temperature water boilers,[4] heat recovery steam generators,[5] solar receiver steam generators,[6] certain fired pressure vessels,[7] and liquid phase thermal fluid heaters[8] to be used in stationary service and includes those power boilers used in locomotive, portable, and traction service. Reference to a paragraph includes all the subparagraphs and subdivisions under that paragraph.

The Code does not contain rules to cover all details of design and construction. Where complete details are not given, it is intended that the manufacturer, subject to the acceptance of the Authorized Inspector, shall provide details of design and construction which will be as safe as otherwise provided by the rules in the Code.

The scope of jurisdiction of Section I applies to the boiler proper and to the boiler external piping.

Superheaters, economizers, and other pressure parts connected directly to the boiler without intervening valves shall be considered as parts of the boiler proper, and their construction shall conform to Section I rules.

Boiler external piping shall be considered as that piping which begins where the boiler proper or isolable superheater or isolable economizer terminates at:

(a) the first circumferential joint for welding end connections; or

(b) the face of the first flange in bolted flanged connections; or

(c) the first threaded joint in that type of connection; and which extends up to and including the valve or valves required by this Code.

ASME Code Certification (including Data Forms and stamping the Certification Mark[9] with appropriate Designator[10]), and/or inspection by the Authorized Inspector, when required by this Code, is required for the boiler proper and the boiler external piping.

Construction rules for materials, design, fabrication, installation, and testing of the boiler external piping are contained in ASME B31.1, Power Piping. Piping beyond the valve or valves required by Section I is not within the scope of Section I.

The material for forced-circulation boilers, boilers with no fixed steam and water line, and high-temperature water boilers shall conform to the requirements of the Code. All other requirements shall also be met except where they relate to special features of construction made necessary in boilers of these types, and to accessories that are manifestly not needed or used in connection with such boilers, such as gage glasses and water columns.

Reheaters receiving steam which has passed through part of a turbine or other prime mover and separately fired steam superheaters which are not integral with the boiler are considered fired pressure vessels and their construction shall comply with Code requirements for superheaters, including safety devices. Piping between the reheater connections and the turbine or other prime mover is not within the scope of the Code. Steam piping to the inlet connections and from the outlet connections of nonintegral separately fired superheaters is not within the scope of this Code.

Economizers that are located outside the limits of boiler external piping are considered fired pressure vessels. Piping to and from the connections to such economizers is not within the scope of this Code.

A pressure vessel in which steam is generated by the application of heat resulting from the combustion of fuel (solid, liquid, or gaseous) or from solar radiation shall be classed as a fired steam boiler.

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[1] Power boiler — a boiler in which steam or other vapor is generated at a pressure of more than 15 psi (100 kPa) for use external to itself.

[2] Electric boiler — a power boiler or a high-temperature water boiler in which the source of heat is electricity.

[3] Miniature boiler — a power boiler or a high-temperature water boiler in which the limits specified in PMB-2 are not exceeded.

[4] High-temperature water boiler — a water boiler intended for operation at pressures in excess of 160 psi (1.1 MPa) and/or temperatures in excess of 250°F (120°C).

[5] Heat recovery steam generator (HRSG) — a boiler that has as its principal source of thermal energy a hot gas stream having high-ramp rates and temperatures such as the exhaust of a gas turbine.

[6] Solar receiver steam generator — a boiler system in which water is converted to steam using solar energy as the principal source of thermal energy. The solar energy is typically concentrated onto the solar receiver through the use of an array of mirrors that focuses solar radiation on the heat transfer surface.

[7] Fired pressure vessel — reheaters, isolable superheaters, economizers located outside the limits of boiler external piping, and nonintegral separately fired superheaters.

[8] Liquid phase thermal fluid heater — a pressure vessel where a fluid other than water is heated but in which no vaporization of the fluid takes place.

[9] Certification Mark — an ASME symbol identifying a product as meeting Code requirements.

[10] Certification Designator (Designator) — the symbol used in conjunction with the Certification Mark for the scope of activity described in a Manufacturer's Certificate of Authorization.

Unfired pressure vessels in which steam is generated shall be classed as unfired steam boilers with the following exceptions:

(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

Unfired steam boilers shall be constructed under the provisions of Section I or Section VIII.

Liquid phase thermal fluid heaters may be constructed under the provisions of Section I or Section VIII.

Expansion tanks connected to high-temperature water boilers without intervening valves shall be constructed to the requirements of Section I or Section VIII.

A pressure vessel in which an organic fluid is vaporized by the application of heat resulting from the combustion of fuel (solid, liquid, or gaseous) or from solar radiation shall be constructed under the provisions of Section I. Vessels in which vapor is generated incidental to the operation of a processing system, containing a number of pressure vessels such as used in chemical and petroleum manufacture, are not covered by the rules of Section I. Liquified petroleum gas vaporizers are not covered by the rules of Section I.

SUMMARY OF CHANGES

Changes listed below are identified on the pages by a margin note, **(23)**, placed next to the affected area. In addition, gender pronouns have been eliminated throughout Section I.

Page	*Location*	*Change*
xxiv	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"
xxviii	Personnel	Updated
l	Correspondence With the Committee	Added (replaces "Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees")
lii	Preamble	In last paragraph, last sentence added
lviii	Cross-Referencing in the ASME BPVC	Updated
1	PG-1	Revised
2	Table PG-4-1	(1) Second and third columns revised
		(2) Notes added
2	PG-5.1	Last sentence revised
3	PG-5.5	Revised
10	PG-11.5	Revised
10	PG-11.5.2	First Sentence revised
10	PG-11.5.8	Revised
12	PG-19	Revised in its entirety
13	Table PG-19	General Note revised
14	Table PG-20	General Note revised
22	PG-27.4.6	In-text table revised in its entirety
28	Figure PG-31	Illustration (a) revised
39	PG-42.1	Endnote 12 revised (see Endnotes)
40	PG-42.2	Revised
47	PG-53	Revised in its entirety
49	Figure PG-53.2.2-1	Deleted
49	PG-56.1.1	Nomenclature revised
49	PG-56.1.2	Nomenclature revised
53	Figure PG-58.2-2	Revised
55	Figure PG-58.2-4	Revised
56	Figure PG-58.2-5	Revised
58	PG-58.4	(1) PG-58.4.3 revised
		(2) PG-58.4.4 added and subsequent paragraph redesignated
64	PG-67.1	Revised
65	PG-67.2.1.4	"lb" revised to "lbm"
65	PG-67.2.1.6	"lb" revised to "lbm"
67	PG-67.4.3.1	"lb" revised to "lbm"
68	PG-67.5	(1) Revised
		(2) Tables PG-67.5 and PG-67.5M moved to Nonmandatory Appendix A, redesignated as Tables A-400 and A-400M, respectively, and revised in their entirety
68	PG-68	(1) PG-68.1, PG-68.2, PG-68.3, and PG-68.7 revised
		(2) Tables PG-68.7 and PG-68.7M moved to Nonmandatory Appendix A and redesignated as Tables A-401 and A-401M, respectively

Page	*Location*	*Change*
69	PG-69	(1) First sentence revised
		(2) PG-69.1.2, PG-69.1.3, PG-69.1.5, and PG-69.6 deleted
		(3) PG-69.2 revised
70	PG-71.3	Revised in its entirety
75	PG-73.5.3	Subparagraph (a)(3) added
76	PG-75	Revised
77	PG-76.1	Revised
81	PG-104.1	Last paragraphs and Note (2) revised
81	PG-105	Subparagraph (g) revised
82	Figure PG-105.1	Illustration (g) revised
84	PG-106.7	PG-106.7.1 and PG-106.7.2 revised
84	PG-106.8.1	Revised
87	PG-110	Subparagraphs (e) and (h) revised
89	PG-112.2.5	Revised
89	PG-112.2.8	"lb" revised to "lbm"
95	Table PW-11	General Notes (g) and (h) revised
98	Figure PW-16.1	Callout for illustrations (a) and (c) revised
107	PW-26	Revised
107	PW-27	PW-27.4 added and subsequent paragraphs redesignated
108	PW-28	Revised in its entirety
110	PW-35	PW-35.1 and PW-35.4 revised
112	PW-38.6	Revised
114	PW-39.2	Revised
115	Table PW-39-1	In General Note (b)(2), last sentence deleted by errata
118	Table PW-39-4	In General Note (a), (6)(d) revised
119	Table PW-39-5	(1) Third column deleted by errata
		(2) General Note (a) corrected by errata
124	Table PW-39.2	In columns 5A and 5B, third entry "1,250–1,300 (675–705)" corrected by errata to "1,250–1,350 (675–730)"
127	PW-41.2.2	Revised
131	PW-50	Revised in its entirety
131	PW-51	Revised in its entirety
132	PW-52	PW-52.1, PW-52.2, and PW-52.3 revised
139	PR-7	Revised
141	PR-15.4	Definition of L_R revised
142	PR-17.2	Subparagraph (a) revised
155	PL-17	Cross-reference revised
157	PL-21.2.2	Subparagraph (b) revised
173	PL-36.9.1	In nomenclature, definition of W revised
177	PL-49	Added
192	PFT-26.1	Revised
194	PFT-29	(1) Title revised
		(2) Existing paragraph designated as PFT-29.1 and PFT-29.2 added
203	PMB-5	(1) PMB-5.1 revised
		(2) PMB-5.5 added and subsequent paragraph redesignated
206	PEB-5.3	Revised
208	PEB-15.2	"lb" revised to "lbm"
210	PVG-12.1	First sentence revised
211	PVG-12.6	Definitions of C and h revised
212	PFE-3.1	Cross-reference to Section VIII revised
219	Figure PHRSG-4	Revised

Page	*Location*	*Change*
220	Mandatory Appendix III	(1) Revised in its entirety (2) Form III-1A deleted
225	V-2.2	In nomenclature, definition of *P* revised
228	V-6	Subparagraph (b) revised
231	VII-1	Subparagraph (d) added
243	VIII-8	In subpara. (a), "lb" revised to "lbm"
250	Braced and Stayed Surfaces	(1) In A-12, nomenclature revised (2) In A-13, A-14, A-15, and A-17, "lb" revised to "lbm"
253	Figure A-8	Cross-reference to "PW-11.4" corrected by errata to "PW-11" in three places
260	A-22.6.1.4	Revised
260	A-22.6.2.4	Second paragraph revised
261	A-22.6.3.2	Revised
262	A-44	First paragraph revised
262	Table A-44	In column heads below U.S. Customary Units, "pounds" revised to "pound mass"
264	A-66	"lb" revised to "lbf" in four places
265	A-67	"lb" revised to "lbf" in four places
268	A-69	"lb" revised to "lbf" in five places
276	A-70.2.4	"lb" revised to "lbf" in three places
276	A-71	"lb" revised to "lbf" in four places
277	Figure A-71	"lb" revised to "lbf"
277	Figure A-72	"lb" revised to "lbf"
277	Figure A-73	"lb" revised to "lbf"
277	Figure A-74	"lb" revised to "lbf" in two places
277	A-72	"lb" revised to "lbf" in five places
277	A-73	"lb" revised to "lbf" in six places
278	A-74	"lb" revised to "lbf" in four places
279	A-75	"lb" revised to "lbf" in six places
281	A-76	Added
282	Figure A-76-1	Added
284	Method for Magnetic Particle Examination (MT)	(1) Note added (2) A-260 revised in its entirety
284	Methods for Liquid Penetrant Examination	(2) A-270 revised in its entirety (1) Note revised
292	A-302.11	First cross-reference updated
292	A-311	Deleted
293	A-317.1	Cross-references to PG updated
295	Form P-2	Second page revised
299	Form P-2A	Second and third pages revised
304	Form P-2B	Revised
308	Form P-3	Second and third pages revised
312	Form P-3A	Revised
314	Table A-353	In item (7), "lb" revised to "lbf"
315	Form P-4	Second page revised
318	Table A-354	(1) Items (12) and (20) revised (2) Items (35) through (37) added
320	Form P-4A	(1) Revised (2) For "P-4A ID No.," circled number "31" corrected by errata to "22"
322	Table A-354.1	Item (15) revised
323	Form P-4B	Deleted
323	Table A-354.2	Deleted
324	Form P-5	Under "Certificate of Compliance," parenthesized text below "Name" revised
329	Table A-356	Items (1) and (19) revised

Page	*Location*	*Change*
330	Table A-357	Revised
333	Form PL-1	Third and fourth pages revised
339	Table A-360	Revised
346	A-393	In-text table revised
346	A-400	Added
363	Nonmandatory Appendix C	Deleted
382	Nonmandatory Appendix G	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 crossreferences 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 PG
GENERAL REQUIREMENTS FOR ALL METHODS OF CONSTRUCTION

GENERAL

(23) PG-1 SCOPE

The requirements of Part PG apply to the following:

(a) power boiler

(b) high-pressure, high-temperature water boilers

(c) liquid phase thermal fluid heaters

(d) parts and appurtenances of the above

These shall be used in conjunction with the specific requirements in the applicable Parts of this Section that pertain to the methods of construction used.

PG-2 SERVICE LIMITATIONS

PG-2.1 The rules of this Section are applicable to the following services:

(a) boilers in which steam or other vapor is generated at a pressure of more than 15 psig (100 kPa) for use external to itself

(b) high-temperature water boilers intended for operation at pressures exceeding 160 psig (1.1 MPa) and/or temperatures exceeding 250°F (120°C)

PG-2.2 For services below those specified in PG-2.1 it is intended that rules of Section IV apply; however, boilers for such services may be constructed and stamped in accordance with this Section provided all applicable requirements are met.

PG-2.3 Coil-type hot water boilers where the water can flash into steam when released directly to the atmosphere through a manually operated nozzle may be exempted from the rules of this Section provided the following conditions are met:

(a) There is no drum, header, or other steam space.

(b) No steam is generated within the coil.

(c) Tubing outside diameter does not exceed 1 in. (25 mm).

(d) Pipe size does not exceed NPS $^{3}/_{4}$ (DN 20).

(e) Nominal water capacity does not exceed 6 gal (23 L).

(f) Water temperature does not exceed 350°F (175°C).

(g) Adequate pressure relief valves and controls are provided.

PG-3 REFERENCED STANDARDS

The Manufacturer shall establish the effective Code Edition, Addenda, and Code Cases for boilers and replacement parts in accordance with Mandatory Appendix VI. Specific editions of standards referenced in this Section are shown in Table A-360.

PG-4 UNITS OF MEASURE

(a) Either U.S. Customary, SI, or any local customary units may be used to demonstrate compliance with all 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 Section. 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, subject to 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.

(c) For any single equation, all variables shall be expressed in a single system of units. Calculations using any material data published in this Section or Section II, Part D (e.g., allowable stresses, physical properties, external pressure design factor B, etc.) shall be carried out in one of the standard units in Table PG-4-1. 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 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,