

SECTION II
MATERIALS

2025

ASME Boiler and
Pressure Vessel Code
An International Code

Part D
Properties (Customary)

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AN INTERNATIONAL CODE

2025 ASME Boiler & Pressure Vessel Code

2025 Edition

July 1, 2025

II MATERIALS

Part D

Properties (Customary)

ASME Boiler and Pressure Vessel Committee
on Materials



The American Society of
Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: July 1, 2025

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Library of Congress Catalog Card Number: 56-3934

Approved by the Council of The American Society of Mechanical Engineers, 1914; latest edition 2025.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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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 In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees: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. The rules govern the construction** of boilers, pressure vessels, transport tanks, and nuclear components, and the inservice inspection of nuclear components and transport tanks. For nuclear items other than pressure-retaining components, the Committee also establishes rules of safety related to structural integrity. 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. The 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 and, for nuclear items other than pressure-retaining components, structural 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 components addressed by the Code. 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.

The 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

* 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.

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 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 the Code. Requests for revisions, new rules, Code cases, or interpretations shall be addressed to the staff secretary in writing and shall give full particulars in order to receive consideration and action (see the Correspondence With the Committee page). 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 the Code, the singular shall be interpreted as the plural, and vice versa.

The words "shall," "should," and "may" are used in the Code 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, 2025

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Working Group on Design (SG Div 2) (BPV III)

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Subgroup on Component Design (SC-D) (BPV III)

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T. R. Liszkai	G. Z. Tokarski, <i>Contributing Member</i>
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D. E. Matthews	C. A. Sanna
B. McGlone	V. Sehgal
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S. B. Parkash	

Task Group to Improve Section III/XI Interface (SG-CD) (BPV III)

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A. Cardillo	A. T. Roberts III
D. Chowdhury	J. Sciulli
J. Honcharik	A. Udyawar
J. Hurst	S. Willoughby-Braun
J. Lambin	

Working Group on Core Support Structures (SG-CD) (BPV III)

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D. Keck	Y. Wong
T. R. Liszkai	K. Hsu, <i>Alternate</i>
M. Nakajima	H. S. Mehta, <i>Contributing Member</i>

Working Group on Design of Division 3 Containment Systems (SG-CD) (BPV III)

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J. Bignell	R. Sypulski
G. Bjorkman	R. Williamson
V. Broz	X. Zhai
D. D. Imholte	X. Zhang
D. W. Lewis	J. Smith, <i>Alternate</i>
A. Rigato	J. C. Minichiello, <i>Contributing Member</i>
P. Sakalaukus, Jr.	

Working Group on HDPE Design of Components (SG-CD) (BPV III)

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P. Krishnaswamy	R. Stakenborghs
M. Kuntz	B. Lin, <i>Alternate</i>

Working Group on Piping (SG-CD) (BPV III)

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J. Catalano	T. B. Littleton, <i>Contributing Member</i>
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D. Lieb	C.-I. Wu, <i>Contributing Member</i>
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I.-K. Nam	
K. E. Reid II	
B. Still	
D. Vlaicu	

Working Group on Pressure Relief (SG-CD) (BPV III)

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Working Group on Pumps (SG-CD) (BPV III)

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L. Constantinescu	M. R. Breach, <i>Alternate</i>
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D. Molitoris	X. Zhang
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J. Hakii	M. Yagodich
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M. Bashir	Y. Song
J. P. Blanchard	D. White
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J. Brister	S. Krishnan
A. A. Campbell	W. K. Sowder, Jr.
V. Chugh	N. Young
T. P. Davis	

Working Group on General Requirements (SG-FED) (BPV III)

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T. P. Davis	W. K. Sowder, Jr.
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Working Group on In-Vessel Components (SG-FED) (BPV III)

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Working Group on Magnets (SG-FED) (BPV III)

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Working Group on Vacuum Vessels (SG-FED) (BPV III)

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Y.-S. Kim	
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Working Group on General Requirements for Graphite and Ceramic Composite Core Components and Assemblies (SG-GR) (BPV III)

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A. A. Campbell	S. Sekar
C. Cruz	R. Spuhl
Y. Diaz-Castillo	W. Windes
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K. Kimura	L. Shi, <i>Contributing Member</i>
G. H. Koo	R. W. Swindeman, <i>Contributing Member</i>
W. Li	
M. C. Messner	

Special Working Group on High Temperature Reactor Stakeholders (SG-HTR) (BPV III)

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R. W. Barnes	M. N. Mitchell
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N. Broom	J. Roll
K. Burnett	B. Song
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V. Chugh	X. Wei
W. Corwin	G. L. Zeng
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Task Group on Alloy 709 Code Case (SG-HTR) (BPV III)

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Working Group on Allowable Stress Criteria (SG-HTR) (BPV III)

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M. McMurtrey, <i>Secretary</i>	T. Patterson
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Task Group on Class A Rewrite (SG-HTR) (BPV III)

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M. E. Cohen	T. Nguyen
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S. McKillop	J. Young

Working Group on Analysis Methods (SG-HTR) (BPV III)

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H. Mahajan, <i>Secretary</i>	Yanli Wang
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R. W. Barnes	S. X. Xu
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P. Carter	J. Bass, <i>Alternate</i>
R. I. Jetter	M. R. Breach, <i>Contributing Member</i>
G. H. Koo	Y.-J. Gao, <i>Contributing Member</i>
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M. Petkov	S. Krishnamurthy, <i>Contributing Member</i>
K. Pigg	M. J. Swindeman, <i>Contributing Member</i>
H. Qian	
T. Riordan	

Task Group on Division 5 AM Components (SG-HTR) (BPV III)

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Z. Feng	B. Sutton
S. Lawler	I. J. Van Rooyen
X. Lou	Yanli Wang
M. McMurtrey	X. Wei
M. C. Messner	R. Bass, <i>Alternate</i>

Working Group on Creep-Fatigue and Negligible Creep (SG-HTR) (BPV III)

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P. Carter	R. Rajasekaran
M. E. Cohen	M. Shah
J. I. Duo	Yanli Wang
R. I. Jetter	X. Wei
G. H. Koo	J. Young
H. Mahajan	R. Bass, <i>Alternate</i>

Task Group on Graphite Design Analysis (SG-HTR) (BPV III)

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S. Baylis	J. Quick
G. Beirnaert	M. Saitta
O. Booler	A. Walker

Working Group on Nonmetallic Design and Materials (SG-HTR) (BPV III)

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J. Potgieter, <i>Secretary</i>	J. Podhiny
G. Beirnaert	J. Roll
A. A. Campbell	A. Tzelepi
C. Chen	A. Walker
A. N. Chereskin	Yanli Wang
V. Chugh	G. L. Zeng
C. Contescu	J. Bass, <i>Alternate</i>
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K. Harris	S.-H. Chi, <i>Contributing Member</i>
M. G. Jenkins	Y. Katoh, <i>Contributing Member</i>
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J. Lang	J. Quick, <i>Contributing Member</i>
A. Mack	M. Saitta, <i>Contributing Member</i>
M. P. Metcalfe	
M. N. Mitchell	

Task Group on High Temperature Piping Design (SG-HTR) (BPV-III)

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T. D. Al-Shawaf	Yanli Wang
D. Bankston, Jr.	C. D. Weary
R. P. Deubler	T.-L. Sham, <i>Contributing Member</i>
R. I. Jetter	

Subgroup on Materials, Fabrication, and Examination (BPV III)

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G. R. Cannell	J. F. Strunk
A. Cardillo	W. Windes
S. Cho	R. Wright
P. J. Coco	H. Xu
R. H. Davis	S. Yee
D. B. Denis	J. Wise, Jr., <i>Alternate</i>
B. D. Frew	S. Wolbert, Jr., <i>Alternate</i>
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S. E. Gingrich	S. Levitus, <i>Contributing Member</i>
M. Golliet	H. Michael, <i>Contributing Member</i>
L. S. Harbison	

Working Group on Advanced Manufacturing (SG-MFE) (BPV III)

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P. J. Coco	J. Sulley
B. D. Frew	S. Tate
J. Grimm	J. Wise
J. Lambin	S. Wolbert
T. Lippucci	H. Xu
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J. B. Ossmann, <i>Secretary</i>	J. O'Sullivan
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Subgroup on Reliability and Integrity Management Program (BPV XI)

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P. J. Hennessey	R. W. Youngblood
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Working Group on Design and Programs (SG-RRR) (BPV XI)

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M. J. Constable	A. Pridmore
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CORRESPONDENCE WITH THE COMMITTEE

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 email 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, 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 to which the proposed case applies

(4) the editions 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 Inquiry Submittal Form at <http://go.asme.org/InterpretationRequest>. Upon submitting the form, the inquirer will receive an automatic email 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>.