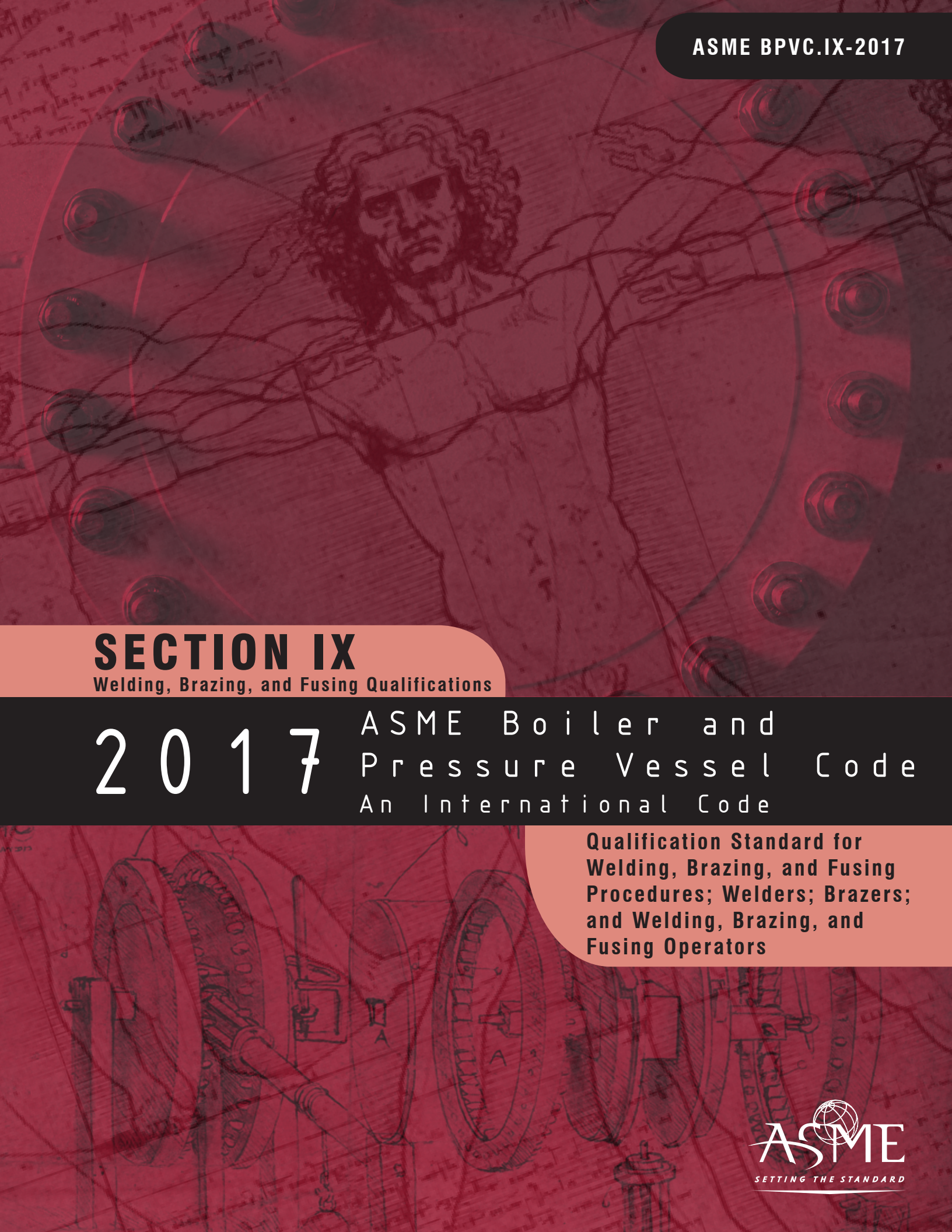

ASME BPVC.IX-2017

SECTION IX

Welding, Brazing, and Fusing Qualifications

2017 ASME Boiler and Pressure Vessel Code

An International Code

Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators

ASME

SETTING THE STANDARD

AN INTERNATIONAL CODE

2017 ASME Boiler & Pressure Vessel Code

2017 Edition July 1, 2017

IX

QUALIFICATION STANDARD FOR WELDING, BRAZING, AND FUSING PROCEDURES; WELDERS; BRAZERS; AND WELDING, BRAZING, AND FUSING OPERATORS

ASME Boiler and Pressure Vessel Committee
on Welding, Brazing, and Fusing

The American Society of Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: July 1, 2017

This international code or standard was developed under procedures accredited as meeting the criteria for American National Standards and it is an American National Standard. The Standards Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment that provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

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The endnotes and preamble in this document (if any) are part of this American National Standard.

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Certification Mark

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[*] The 2015 Edition of Section III was the last edition in which Section III, Division 1, Subsection NH, *Class 1 Components in Elevated Temperature Service*, was published. The requirements located within Subsection NH were moved to Section III, Division 5, Subsection HB, Subpart B for the elevated temperature construction of Class A components.

INTERPRETATIONS

Interpretations are issued in real time in ASME's Interpretations Database at http://go.asme.org/Interpretations. Historical BPVC interpretations may also be found in the Database.

CODE CASES

The Boiler and Pressure Vessel Code committees meet regularly to consider proposed additions and revisions to the Code and to formulate Cases to clarify the intent of existing requirements or provide, when the need is urgent, rules for materials or constructions not covered by existing Code rules. Those Cases that have been adopted will appear in the appropriate 2017 Code Cases book: "Boilers and Pressure Vessels" or "Nuclear Components." Supplements will be sent or made available automatically to the purchasers of the Code Cases books up to the publication of the 2019 Code.

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) 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 pressure relief.

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 an ASME 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.

STATEMENT OF POLICY ON THE USE OF THE 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 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 Certification Mark for the benefit of the users, the enforcement jurisdictions, and the holders of the 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 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 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 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 Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the Certification Mark. General usage is permitted only when all of a manufacturer's items are constructed under the rules.

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 official Certification Mark described in the governing Section of the Code.

Markings such as "ASME," "ASME Standard," or any other marking including "ASME" or the 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.

SUBMITTAL OF TECHNICAL INQUIRIES TO THE BOILER AND PRESSURE VESSEL STANDARDS COMMITTEES (17)

1 INTRODUCTION

(a) The following information provides guidance to Code users for submitting technical inquiries to the applicable Boiler and Pressure Vessel (BPV) Standards Committee (hereinafter referred to as the Committee). See the guidelines on approval of new materials under the ASME Boiler and Pressure Vessel Code in Section II, Part D for requirements for requests that involve adding new materials to the Code. See the guidelines on approval of new welding and brazing materials in Section II, Part C for requirements for requests that involve adding new welding and brazing materials ("consumables") to the Code.

Technical inquiries can include requests for revisions or additions to the Code requirements, requests for Code Cases, or requests for Code Interpretations, as described below:

(1) Code Revisions. Code revisions are considered to accommodate technological developments, to address administrative requirements, to incorporate Code Cases, or to clarify Code intent.

(2) Code Cases. Code Cases represent alternatives or additions to existing Code requirements. Code Cases are written as a Question and Reply, and are usually intended to be incorporated into the Code at a later date. When used, Code Cases prescribe mandatory requirements in the same sense as the text of the Code. However, users are cautioned that not all regulators, jurisdictions, or Owners automatically accept Code Cases. The most common applications for Code Cases are as follows:

(-a) to permit early implementation of an approved Code revision based on an urgent need

(-b) to permit use of a new material for Code construction

(-c) to gain experience with new materials or alternative requirements prior to incorporation directly into the Code

(3) Code Interpretations

(-a) Code Interpretations provide clarification of the meaning of existing requirements in the Code and are presented in Inquiry and Reply format. Interpretations do not introduce new requirements.

(-b) If existing Code text does not fully convey the meaning that was intended, or conveys conflicting requirements, and revision of the requirements is required to support the Interpretation, an Intent Interpretation will be issued in parallel with a revision to the Code.

(b) Code requirements, Code Cases, and Code Interpretations established by the Committee 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 requirements.

(c) Inquiries that do not comply with the following guidance or that do not provide sufficient information for the Committee's full understanding may result in the request being returned to the Inquirer with no action.

2 INQUIRY FORMAT

Submittals to the Committee should include the following information:

(a) Purpose. Specify one of the following:

(1) request for revision of present Code requirements

(2) request for new or additional Code requirements

(3) request for Code Case

(4) request for Code Interpretation

(b) Background. The Inquirer should provide the information needed for the Committee's understanding of the Inquiry, being sure to include reference to the applicable Code Section, Division, Edition, Addenda (if applicable), paragraphs, figures, and tables. Preferably, the Inquirer should provide a copy of, or relevant extracts from, the specific referenced portions of the Code.

(c) Presentations. The Inquirer may desire to attend or be asked to attend a meeting of the Committee to make a formal presentation or to answer questions from the Committee members with regard to the Inquiry. Attendance at a BPV Standards Committee meeting shall be at the expense of the Inquirer. The Inquirer's attendance or lack of attendance at a meeting will not be used by the Committee as a basis for acceptance or rejection of the Inquiry by the Committee. However, if the Inquirer's request is unclear, attendance by the Inquirer or a representative may be necessary for the Committee to understand the request sufficiently to be able to provide an Interpretation. If the Inquirer desires to make a presentation at a Committee meeting, the Inquirer should provide advance notice to the Committee Secretary, to ensure time will be allotted for the presentation in the meeting agenda. The Inquirer should consider the need for additional audiovisual equipment that might not otherwise be provided by the Committee. With sufficient advance notice to the Committee Secretary, such equipment may be made available.

3 CODE REVISIONS OR ADDITIONS

Requests for Code revisions or additions should include the following information:

(a) Requested Revisions or Additions. For requested revisions, the Inquirer should identify those requirements of the Code that they believe should be revised, and should submit a copy of, or relevant extracts from, the appropriate requirements as they appear in the Code, marked up with the requested revision. For requested additions to the Code, the Inquirer should provide the recommended wording and should clearly indicate where they believe the additions should be located in the Code requirements.

(b) Statement of Need. The Inquirer should provide a brief explanation of the need for the revision or addition.

(c) Background Information. The Inquirer should provide background information to support the revision or addition, including any data or changes in technology that form the basis for the request, that will allow the Committee to adequately evaluate the requested revision or addition. Sketches, tables, figures, and graphs should be submitted, as appropriate. The Inquirer should identify any pertinent portions of the Code that would be affected by the revision or addition and any portions of the Code that reference the requested revised or added paragraphs.

4 CODE CASES

Requests for Code Cases should be accompanied by a statement of need and background information similar to that described in 3(b) and 3(c), respectively, for Code revisions or additions. The urgency of the Code Case (e.g., project underway or imminent, new procedure) should be described. In addition, it is important that the request is in connection with equipment that will bear the Certification Mark, with the exception of Section XI applications. The proposed Code Case should identify the Code Section and Division, and should be written as a Question and a Reply, in the same format as existing Code Cases. Requests for Code Cases should also indicate the applicable Code Editions and Addenda (if applicable) to which the requested Code Case applies.

5 CODE INTERPRETATIONS

(a) Requests for Code Interpretations should be accompanied by the following information:

(1) Inquiry. The Inquirer should propose a condensed and precise Inquiry, omitting superfluous background information and, when possible, composing the Inquiry in such a way that a "yes" or a "no" Reply, with brief limitations or conditions, if needed, can be provided by the Committee. The proposed question should be technically and editorially correct.

(2) Reply. The Inquirer should propose a Reply that clearly and concisely answers the proposed Inquiry question. Preferably, the Reply should be "yes" or "no," with brief limitations or conditions, if needed.

(3) Background Information. The Inquirer should provide any need or background information, such as described in 3(b) and 3(c), respectively, for Code revisions or additions, that will assist the Committee in understanding the proposed Inquiry and Reply.

If the Inquirer believes a revision of the Code requirements would be helpful to support the Interpretation, the Inquirer may propose such a revision for consideration by the Committee. In most cases, such a proposal is not necessary.

(b) Requests for Code Interpretations should be limited to an Interpretation of a particular requirement in the Code or in a Code Case. Except with regard to interpreting a specific Code requirement, the Committee is not permitted to consider consulting-type requests such as the following:

(1) a review of calculations, design drawings, welding qualifications, or descriptions of equipment or parts to determine compliance with Code requirements

(2) a request for assistance in performing any Code-prescribed functions relating to, but not limited to, material selection, designs, calculations, fabrication, inspection, pressure testing, or installation

(3) a request seeking the rationale for Code requirements

6 SUBMITTALS

(a) Submittal. Requests for Code Interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt. If the Inquirer is unable to use the online form, the Inquirer may mail the request to the following address:

Secretary
ASME Boiler and Pressure Vessel Committee
Two Park Avenue
New York, NY 10016-5990

All other Inquiries should be mailed to the Secretary of the BPV Committee at the address above. Inquiries are unlikely to receive a response if they are not written in clear, legible English. They must also include the name of the Inquirer and the company they represent or are employed by, if applicable, and the Inquirer's address, telephone number, fax number, and e-mail address, if available.

(b) Response. The Secretary of the appropriate Committee will provide a written response, via letter or e-mail, as appropriate, to the Inquirer, upon completion of the requested action by the Committee. Inquirers may track the status of their Interpretation Request at http://go.asme.org/Interpretations.

(17)

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January 1, 2017

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INTRODUCTION

The following is provided as a brief introduction to Section IX, and cannot be considered as a substitute for the actual review of the document. However, this introduction is intended to give the reader a better understanding of the purpose and organization of Section IX.

Section IX of the ASME Boiler and Pressure Vessel Code relates to the qualification of welders, welding operators, brazers, brazing operators, and fusing operators, and the procedures employed in welding, brazing, or plastic fusing in accordance with the ASME Boiler and Pressure Vessel Code and the ASME B31 Code for Pressure Piping. As such, this is an active document subject to constant review, interpretation, and improvement to recognize new developments and research data. Section IX is a document referenced for the qualification of material joining processes by various construction codes such as Section I, III, IV, VIII, XII, etc. These particular construction codes apply to specific types of fabrication and may impose additional requirements or exemptions to Section IX qualifications. Qualification in accordance with Section IX is not a guarantee that procedures and performance qualifications will be acceptable to a particular construction code.

Section IX does not contain rules for production joining, nor does it contain rules to cover all factors affecting production material joining properties under all circumstances. Where such factors are determined by the organization to affect material joining properties, the organization shall address those factors in the Procedure Specification to ensure that the required properties are achieved in the production material joining process.

The purpose of the Procedure Specification and the Procedure Qualification Record (PQR) is to ensure the material joining process proposed for construction is capable of producing joints having the required mechanical properties for the intended application. Personnel performing the material joining procedure qualification test shall be sufficiently skilled. The purpose of the procedure qualification test is to establish the mechanical properties of the joint produced by the material joining process and not the skill of the personnel using the material joining process. In addition, special consideration is given when toughness testing is required by other Sections of the Code. The toughness supplementary essential variables do not apply unless referenced by the construction codes.

The purpose of Performance Qualification is to determine the ability of the person using a material joining process to produce a sound joint. In Operator Performance Qualification, the basic criterion is to determine the ability of the operator to properly operate the equipment to produce a sound joint.

In developing Section IX, each material joining process that is included was reviewed with regard to those factors (called variables) which have an effect upon the material joining operations as applied to procedure or performance criteria.

The user of Section IX should be aware of how Section IX is organized. It is divided into four Parts: general requirements, welding, brazing, and plastic fusing. Each Part addressing a material joining process is then divided into Articles. The Articles for each material joining process deal with the following:

(a) general requirements specifically applicable to the material joining process (Article I Welding, Article XI Brazing, and Article XXI Plastic Fusing)

(b) procedure qualifications (Article II Welding, Article XII Brazing, and Article XXII Plastic Fusing)

(c) performance qualifications (Article III Welding, Article XIII Brazing, and Article XXIII Plastic Fusing)

(d) data (Article IV Welding, Article XIV Brazing, and Article XXIV Plastic Fusing)

(e) standard welding procedure specifications (Article V Welding)

These articles contain general references and guides that apply to procedure and performance qualifications such as positions, type and purpose of various mechanical tests, acceptance criteria, and the applicability of Section IX, which previously appeared in the Preamble of the 1980 Edition of Section IX (the Preamble has since been deleted). The general requirement articles reference the data articles for specific details of the testing equipment and removal of the mechanical test specimens.

PROCEDURE QUALIFICATIONS

Each material joining process that has been evaluated and adopted by Section IX is listed separately with the essential and nonessential variables as they apply to that particular process. In general, the Procedure Specifications are required to list all essential and nonessential variables for each process that is included under that particular procedure

specification. When an essential variable must be changed beyond the range qualified and the change is not an editorial revision to correct an error, requalification of the procedure specification is required. If a change is made in a nonessential variable, the procedure need only be revised or amended to address the nonessential variable change. When toughness testing is required for Welding Procedure Specification (WPS) qualification by the construction code, the supplementary essential variables become additional essential variables, and a change in these variables requires requalification of the procedure specification.

In addition to covering various processes, there are also rules for procedure qualification of corrosion-resistant weld metal overlay and hard-facing weld metal overlay.

Beginning with the 2000 Addenda, the use of Standard Welding Procedure Specifications (SWPSs) was permitted. Article V provides the requirements and limitations that govern the use of these documents. The SWPSs approved for use are listed in Mandatory Appendix E.

In the 2004 Edition, rules for temper bead welding were added.

With the incorporation of the new Creep-Strength Enhanced Ferritic (CSEF) alloys in the 1986 Edition, using the existing P-Number groupings to specify PWHT parameters can lead to variations in heat treatments that may significantly degrade the mechanical properties of these alloys. CSEF alloys are a family of ferritic steels whose creep strength is enhanced by the creation of a precise condition of microstructure, specifically martensite or bainite, which is stabilized during tempering by controlled precipitation of temper-resistant carbides, carbo-nitrides, or other stable phases.

In the 2007 Edition of the Code, only P-No. 5B, Group 2 base metals met this definition and were approved for Code construction. Looking forward, a number of CSEF alloys are already in use in Code Cases and drawing near to incorporation. To facilitate addressing their special requirements, P-No. 15A through P-No. 15F have been established for CSEF alloys.

In the 2013 Edition, Part QG General Requirements and Part QF Plastic Fusing were added.

PERFORMANCE QUALIFICATIONS

These articles list separately the various processes with the essential variables that apply to the performance qualifications of each process. The performance qualifications are limited by essential variables.

The performance qualification articles have numerous paragraphs describing general applicable variables for all processes. QW-350, QB-350, and QF-360 list additional essential variables that are applicable for specific processes. The QW-350 variables do not apply to welding operators. QW-360 lists the additional essential variables for welding operators.

Generally, a welder or welding operator may be qualified by mechanical bending tests, or volumetric NDE of a test coupon, or the initial production weld. Brazers or brazing operators and fusing operators may not be qualified by volumetric NDE.

WELDING, BRAZING, AND FUSING DATA

The data articles include the variables grouped into categories such as joints, base materials and filler materials, positions, preheat/postweld heat treatment, gas, electrical characteristics, and technique. They are referenced from other articles as they apply to each process.

These articles are frequently misused by selecting variables that do not apply to a particular process. Variables only apply as referenced for the applicable process in Article II or III for welding, Article XII or XIII for brazing, and Article XXII or XXIII for plastic fusing. The user of Section IX should not apply any variable that is not referenced for that process.

These articles also include assignments of welding and brazing P-Numbers to particular base materials and F-Numbers to filler materials. Article IV also includes A-Number tables for reference by the Code user.

Beginning with the 1994 Addenda, welding P-Numbers, brazing P-Numbers, and nonmandatory S-Numbers were consolidated into one table identified as QW/QB-422. Both the QB-422 table (brazing P-Numbers) and Appendix C table (S-Numbers) were deleted. The new Table QW/QB-422 was divided into ferrous and nonferrous sections. Metals were listed in numerical order by material specification number to aid users in locating the appropriate grouping number. An abbreviated listing of metals grouped by P-Numbers, Nonmandatory Appendix D, has been included for users still wishing to locate groupings of metals by welding P-Number.

In the 2009 Addenda, S-Number base metals listed in the QW/QB-422 table were reassigned as P-Numbers and the S-Number listings and references were deleted.

The QW-451 and QB-451 tables for procedure qualification thickness requirements and the QW-452 and QB-452 tables for performance qualification thickness are given and may be used only as referenced by other paragraphs. Generally, the appropriate essential variables reference these tables.

Revisions to the 1980 Edition of Section IX introduced new definitions for position and added a fillet-weld orientation sketch to complement the groove-weld orientation sketch. The new revision to position indicates that a welder qualifies in the 1G, 2G, 3G, etc., position and is then qualified to weld, in production, in the F, V, H, or O positions as appropriate. QW-461.9 is a revised table that summarizes these new qualifications.

The data articles also give sketches of coupon orientations, removal of test specimens, and test jig dimensions. These are referenced by Articles I, XI, and XXI.

QW-470 describes etching processes and reagents.

Within Part QG is a list of general definitions applicable to Section IX–adopted material joining processes. These may differ slightly from other welding documents.

Nonmandatory Forms for documenting procedure and performance qualifications are provided for the aid of those who do not wish to design their own forms. Any form(s) that address all applicable requirements of Section IX may be used.

SUMMARY OF CHANGES

Errata to the BPV Code may be posted on the ASME Web site to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in the BPV Code. Such Errata shall be used on the date posted.

Information regarding Special Notices and Errata is published by ASME at http://go.asme.org/BPVCerrata.

Changes given below are identified on the pages by a margin note, **(17)**, placed next to the affected area.

The Record Numbers listed below are explained in more detail in "List of Changes in Record Number Order" following this Summary of Changes.

Page	*Location*	*Change (Record Number)*
x	List of Sections	Updated
xv	Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees	Revised in its entirety *(13-2222)*
xviii	Personnel	Updated
1	QG-100	Subparagraph (f) added *(11-1399)*
1	QG-101	Last two paragraphs deleted *(15-638)*
2	QG-105.1	First sentence revised *(15-247)*
2	QG-105.5	Last sentence deleted *(15-2726)*
2	QG-106.1	Subparagraph (c) revised *(14-1118)*
2	QG-106.2	Subparagraph (g) revised *(14-1118)*
3	QG-106.3	Revised in its entirety *(16-227)*
4	QG-107	Subparagraph (c) revised *(14-1118)*
4	QG-109.1	Last line revised *(14-1118)*
4	QG-109.2	*(1)* Definitions of *build-up of base metal (restoration of base metal thickness)*; *flux (welding or brazing)*; *melt-in*; *test specimen*; and *welding, laser beam (LBW)* revised *(14-1028, 15-201, 15-247, 15-1829)* *(2)* Definitions of *trailing gas* and *welding, low-power density laser beam (LLBW)* added *(14-1028, 16-933)*
15	QW-101	In last paragraph, last sentence revised *(15-247)*
17	QW-141.4	Revised *(15-247)*
19	QW-170	Revised in its entirety *(15-247)*
21	QW-191.1.1	Subparagraph (a) revised *(16-888)*
23	QW-191.2.1	Subparagraph (a) revised *(15-2663)*
23	QW-191.2.2	*(1)* Subparagraph (b) revised *(15-418)* *(2)* Subparagraphs (c) and (d) deleted *(15-418)*
28	QW-200.2	*(1)* In subpara. (b), last sentence of third paragraph revised *(15-247)* *(2)* In subpara. (f), title revised *(14-1118)*

Page	*Location*	*Change (Record Number)*
29	QW-200.3	Revised *(15-247)*
29	QW-200.4	*(1)* In subpara. (a), second paragraph revised *(14-2381)* *(2)* In subpara. (b), first line revised *(14-1028, 14-2381)*
30	QW-202.2	In subpara. (a), penultimate sentence revised *(15-247)*
31	QW-211.1	Added *(15-1852)*
31	QW-215	Title and paras. QW-215.1 and QW-215.3 revised *(14-1028)*
33	QW-251.2	Second paragraph revised *(15-247)*
34	Table QW-252	*(1)* For QW-410.1, entry under "Brief of Variables" revised *(14-1118)* *(2)* Legend revised *(14-1118)*
35	Table QW-252.1	*(1)* For QW-408.19, entry under "Hard-Facing Spray Fuse" revised *(14-1118)* *(2)* Legend revised *(14-1118)*
36	Table QW-253	*(1)* For QW-403.6, entry under "Brief of Variables" revised *(15-247)* *(2)* QW-407.4, third row deleted *(15-1961)* *(3)* For QW-410.1, entry under "Brief of Variables" revised *(14-1118)* *(4)* Legend revised *(14-1118)*
37	Table QW-253.1	*(1)* QW-409.8 added *(15-2720)* *(2)* For QW-410.1, entry under "Nonessential Variables for HFO and CRO" revised *(14-1118)* *(3)* Legend revised *(14-1118)*
38	Table QW-254	*(1)* For QW-404.9 and QW-404.35, entry under "Brief of Variables" revised *(14-1118)* *(2)* For QW-404.24, entry under "Brief of Variables" editorially revised *(3)* QW-407.4 deleted *(15-1961)* *(4)* For QW-410.1 and QW-410.9, entry under "Brief of Variables" revised *(14-1118)* *(5)* Legend revised *(14-1118)*
39	Table QW-254.1	*(1)* QW-409.8 added *(15-2720)* *(2)* For QW-410.1, entry under "Nonessential Variables for HFO and CRO" revised *(14-1118)* *(3)* Legend revised *(14-1118)*
40	Table QW-255	*(1)* QW-407.4 deleted *(15-1961)* *(2)* For QW-408.10, entry under "Brief of Variables" revised *(15-961)* *(3)* For QW-410.1 and QW-410.9, entry under "Brief of Variables" revised *(14-1118)* *(4)* Legend revised *(14-1118)*
42	Table QW-255.1	*(1)* QW-409.8 added *(15-2720)* *(2)* For QW-410.1 and QW-410.3, entry under "Brief of Variables" revised *(14-1118)* *(3)* Legend revised *(14-1118)*

Page	*Location*	*Change (Record Number)*
43	Table QW-256	*(1)* QW-407.4 deleted *(15-1961)* *(2)* For QW-408.10, entry under "Brief of Variables" revised *(15-961)* *(3)* For QW-410.1 and QW-410.9, entries under "Brief of Variables" revised *(14-1118)* *(4)* Legend revised *(14-1118)*
45	Table QW-256.1	*(1)* QW-409.8 added *(15-2720)* *(2)* For QW-410.1 and QW-410.3, entry under "Nonessential Variables for HFO and CRO" revised *(14-1118)* *(3)* Legend revised *(14-1118)*
46	Table QW-257	*(1)* For QW-403.12, entry under "Brief of Variables" revised *(14-1118)* *(2)* QW-407.4 deleted *(15-1961)* *(3)* For QW-408.10, entry under "Brief of Variables" revised *(15-961)* *(4)* For QW-410.1 and QW-410.9, entries under "Brief of Variables" revised *(14-1118)* *(5)* Legend revised *(14-1118)*
48	Table QW-257.1	*(1)* For QW-408.19, entry under "Hard-Facing Spray Fuse" revised *(14-1118)* *(2)* QW-409.8 added *(15-2720)* *(3)* For QW-410.1 and QW-410.3, entry under "Nonessential Variables for HFO and CRO" revised *(14-1118)* *(4)* Legend revised *(14-1118)*
50	Table QW-258	*(1)* QW-407.4 deleted *(15-1961)* *(2)* Legend revised *(14-1118)*
51	Table QW-258.1	*(1)* QW-409.8 added *(15-2720)* *(2)* Legend revised *(14-1118)*
52	Table QW-259	*(1)* QW-407.4 deleted *(15-1961)* *(2)* For QW-410.9, entry under "Brief of Variables" revised *(14-1118)* *(3)* Legend revised *(14-1118)*
53	Table QW-260	Legend revised *(14-1118)*
54	Table QW-261	Legend revised *(14-1118)*
55	Table QW-262	Legend revised *(14-1118)*
56	Table QW-263	Legend revised *(14-1118)*
57	Table QW-264	Legend revised *(14-1118)*
58	Table QW-264.1	*(1)* For QW-404.47, entries revised *(14-1118)* *(2)* For QW-410.17, entries revised *(14-1118)* *(3)* Legend revised *(14-1118)*
59	Table QW-264.2	Added *(14-1028)*
61	Table QW-265	*(1)* For QW-406.7, entry under "Brief of Variables" revised *(15-176)* *(2)* For QW-410.17, entry under "Brief of Variables" revised *(14-1118)* *(3)* Legend revised *(14-1118)*

Page	*Location*	*Change (Record Number)*
62	Table QW-266	Legend revised *(14-1118)*
63	Table QW-267	*(1)* For QW-403.19, entry under "Brief of Variables" revised *(14-1118)* *(2)* Legend revised *(14-1118)*
64	QW-286.1	Revised *(15-201)*
65	QW-288.1	Subparagraph (c) revised *(14-2273)*
66	QW-290.1	Last paragraph revised *(13-1072)*
66	QW-290.2	First and third sentences revised *(13-1072, 14-1028, 15-247)*
66	QW-290.3	Revised *(13-1072, 15-247)*
67	Table QW-290.4	Revised *(11-1218, 13-1072, 14-1118)*
68	QW-290.5	Subparagraphs (b), (c), (c)(3), and (d) revised *(13-1072, 15-247)*
70	QW-301.4	First line revised *(14-1118)*
71	QW-303.1	Revised *(14-2063)*
71	QW-303.2	Revised *(14-2063)*
72	QW-305	In first paragraph, second sentence revised *(14-1028)*
73	QW-322	Revised in its entirety *(15-2719)*
74	Table QW-355	For QW-408.8, entry under "Brief of Variables" revised *(15-994)*
75	Table QW-356	For QW-408.8, entry under "Brief of Variables" revised *(15-994)*
75	Table QW-357	For QW-408.8, entry under "Brief of Variables" revised *(15-994)*
78	QW-401.1	Second and third paragraphs revised *(15-247)*
79	QW-402.30	Deleted *(15-2048)*
80	QW-403.5	Last paragraph revised *(15-247)*
80	QW-403.6	Revised *(16-934)*
80	QW-403.16	Subparagraphs (a) and (b) added *(15-2682)*
80	QW-403.17	Revised *(14-1118)*
81	QW-403.25	Revised *(15-201, 15-2718)*
81	QW-403.31	Deleted *(15-2048)*
82	QW-404.12	Subparagraphs (e) and (f) revised *(15-247)*
83	QW-404.33	Revised *(15-247)*
83	QW-404.35	Revised *(14-1118, 15-247)*
84	QW-404.52	Revised *(13-1072)*
84	QW-404.54	Deleted *(15-2048)*
85	QW-406.8	Deleted *(11-1218)*
85	QW-406.9	Revised *(11-1218)*
85	QW-407.4	Deleted *(15-1961)*
85	QW-408.1	Revised *(15-961)*
85	QW-408.5	Revised *(15-994)*

Page	*Location*	*Change (Record Number)*
86	QW-408.8	Revised *(15-994)*
86	QW-408.10	Revised *(15-961)*
86	QW-408.11	Subparagraph (b) revised *(15-961)*
86	QW-408.12	Revised *(15-961)*
86	QW-408.23	Subparagraph (b) revised *(15-961)*
86	QW-409.1	*(1)* First paragraph revised *(14-1028)* *(2)* Subparagraph (d) added *(14-1028)*
88	QW-409.29	Subparagraph (a)(4) revised *(15-247)*
89	QW-410.61	Revised *(15-247)*
90	QW-410.75	Subparagraph (b)(8) revised *(14-1118)*
91	Table QW-416	Note (1) revised *(16-1564)*
92	QW-420	Third paragraph revised *(15-247)*
93	Table QW/QB-422	Revised and rows added *(13-1311, 14-899, 14-1821, 14-1946, 15-201, 15-320, 15-423, 15-568, 15-665, 15-666, 15-723, 15-744, 15-845, 15-1281, 15-1282, 15-1283, 15-1468, 15-1481, 15-1571, 15-2580, 15-2717, 16-242, 16-361, 16-759, 16-890, 17-438, 17-475)*
164	Table QW-432	Last row in "Steel and Steel Alloys" and penultimate row in "Titanium and Titanium Alloys" added *(15-1571, 15-1722, 16-1677)*
175	Table QW-451.1	Notes (1) and (3) revised *(14-1028, 15-1961)*
176	Table QW-451.2	Note (1) revised *(15-1961)*
176	Table QW-451.4	General Note revised *(15-247)*
177	Table QW-452.1(b)	Note (1) revised *(14-2128)*
179	Table QW-452.6	Final entry in final column revised *(14-1118)*
179	Table QW-453	*(1)* Title revised *(14-1118)* *(2)* Note (2) corrected by errata *(16-611)*
182	Figure QW-461.4	Illustration (a) subcaption revised *(16-343)*
186	Table QW-461.9	*(1)* Final column head revised *(14-2063)* *(2)* Note (2) added *(14-2063)*
187	QW-462	Final paragraph and subparas. (a) through (i) added *(15-178)*
188	Figure QW-462.1(a)	Caption in upper left corner revised *(15-1731, 16-665)*
188	Figure QW-462.1(b)	*(1)* Caption in upper left corner revised *(16-665)* *(2)* General Note added *(14-2165, 15-441)*
191	Figure QW-462.2	(1a) and (2) editorially revised
193	Figure QW-462.3(b)	Illustration for "Root Bend" revised *(15-2845)*
194	Figure QW-462.4(b)	General Note revised *(15-201)*
195	Figure QW-462.5(a)	Notes (1), (2), and (3) added by errata *(15-2338, 16-611)*
210	Figure QW-463.1(f)	Title revised *(15-247)*
214	Figure QW-463.2(g)	General Note deleted *(15-1398)*

Page	Location	Change (Record Number)
218	Figure QW-466.1	*(1)* Presentation of values editorially revised *(2)* General Note (e) revised *(15-177)*
220	Figure QW-466.2	General Note (b) revised *(15-177)*
226	QW-500	Last paragraph revised *(15-247)*
229	QB-151.3	Last sentence added *(14-2484)*
232	QB-200.2	Subparagraph (f) revised *(14-1118)*
241	QB-409.1	Subparagraph (a) revised and subpara. (b) added *(16-410)*
267	QF-131.1	Subparagraph (e) revised *(15-201)*
268	QF-132.1	Subparagraph (d) revised *(15-201)*
270	QF-143.2.1	Subparagraph (b) revised *(13-467)*
270	QF-143.2.3.2	Revised *(13-467)*
271	QF-144.1.4	Subparagraph (h) revised *(15-201)*
273	QF-201.5	Subparagraph (f) revised *(14-1118)*
276	QF-221.1	Subparagraph (f) revised *(14-137)*
280	QF-302.2	Subparagraph (a) revised in its entirety *(13-469)*
288	Figure QF-463	Callouts in illustrations (c) and (d) revised *(13-467)*
304	Form QF-484(a)	"Date Coupon" line added *(16-226)*
305	Form QF-484(b)	"Date Coupon" line added *(16-226)*
306	Form QF-485	"Gauge Pressure During Fusing," "Elapsed Time During Fusing," and "Review of the Recorded Pressure" lines revised *(15-201)*
308	B-101	Third paragraph revised *(15-201)*
308	B-102	Third paragraph revised *(15-201)*
309	Form QW-482	*(1)* "Sketches may be attached" and "Specification and type" lines revised *(15-201)* *(2)* Spelling of "Maximum" corrected by errata *(16-611)*
311	Form QW-483	*(1)* "Type or Grade" line and "Toughness Values" column head revised *(15-201, 15-247)* *(2)* Four lines added in "Electrical Characteristics" box *(14-1708)*
313	Form QW-484A	*(1)* "Date welded" line added *(16-226)* *(2)* "Filler Metal Product Form," "Use of backing gas," "Transfer mode," "GTAW current type," and "Macro examination" lines revised *(15-201, 15-994)*
314	Form QW-484B	*(1)* "Date welded" line added *(16-226)* *(2)* "Filler metal used," "Backing," and "Macro examination" lines revised *(15-201)*
315	Form QW-485	*(1)* "Date of Demonstration" line added *(16-226)* *(2)* "Specification and type," "Backing," and "Current Type" lines revised *(15-201)*
317	Form QB-483	"Plate or Pipe" and "Brazer's or Brazing" lines and "Width or Diameter" column head revised *(15-201)*

Page	*Location*	*Change (Record Number)*
318	Form QB-484	*(1)* Title and “Brazer’s or Brazing” and “Filler Metal F-Number” lines revised *(15-201)* *(2)* “Date Coupon” line added *(16-226)*
319	Nonmandatory Appendix D	Revised *(13-1311, 14-899, 14-1821, 15-423, 15-568, 15-665, 15-666, 15-723, 15-744, 15-845, 15-1481, 15-1571, 15-2717, 16-180, 16-242, 16-361, 16-759, 16-890)*
345	H-200	Last two paragraphs revised *(16-2260)*
350	L-400	Subparagraph (d) revised *(15-2663)*

LIST OF CHANGES IN RECORD NUMBER ORDER

Record Number	Change
11-1218	Deleted variable in QW-406.8 as being overkill and partially redundant. Revised QW-406.9 limitation on the minimum preheat when hardness testing is required to limit the minimum preheat to the temperature during the qualification welding without a further reduction of 100°F.
11-1399	Added QG-100(f).
13-467	Revised QF-143.2.1(b) and QF-143.2.3.2 and Figures QF-463(c) and (d). Revised the "*t*" dimension in Figure QF-463(d) to "width" to be consistent with the other figures and text.
13-469	Revised QF-302.2.
13-1072	Revisions were proposed to hold hardness testing, toughness testing, and no additional testing independent and to require the method of acceptance and the acceptance criteria to be specified by the Construction Code or the Design Specification if required to be either hardness or toughness. If hardness or toughness are not specified, the qualification test requirement is bend testing. Table QW-290.4 was revised to include a new essential variables column for cases where the Construction Code or Design Specification does not specify or require hardness or impact testing. Examples of this type of application are previous multipass repair methodologies in the NBIC. Revised QW-290.5(b) to clarify that only bend tests are required for the additional qualification for temper bead when either hardness or impact toughness testing is specified. Full QW-451 testing is required (tensile and bend tests) when no hardness or impact toughness testing is specified. The essential variables when no hardness or impact toughness testing is required duplicate the EVs for impact toughness with the additional EV for QW-403.27 covering thickness limits. QW-404.52 (diffusible hydrogen) was made as an EV for all methods of acceptance and removed as an NEV.
13-1311	Revised QW/QB-422 to include all forms of UNS S38815.
13-2222	Revised the front guidance on interpretations in its entirety.
14-137	Deleted the first sentence in QF-221.1(f). Added the word "the" to the last sentence so it reads, "...for the joint prior to fusing."
14-899	Added ASTM A1066 to Table QW/QB-422 and Nonmandatory Appendix D.
14-1028	Added Table QW-264.2 and a definition of low-power density laser beam welding. Revised the definition of "melt-in." Added "LBW" and "LLBW" in QW-200.4. Referenced Table QW-264.2 in QW-215.3. Added "LLBW" in QW-290.2, QW-305, and Note (3) of Table QW-451.1. Added a heat input equation for LLBW in QW-409.1. Added Table QW-264.2 in QW-250.
14-1118	Replaced slashes with the appropriate word, which was "or" in most cases.
14-1708	Revised Form QW-483 to include references of Waveform Control, Power or Energy, Arc Time, and Weld Bead Length.
14-1821	Added A/SA-240, UNS S44100 to Table QW/QB-422 and Nonmandatory Appendix D. Revised Nominal Composition from "18Cr-Ti" to "18Cr-Cb-Ti."
14-1946	Revised A/SA-36 UNS number designation in Table QW/QB-422.
14-2063	Added text to QW-303.1, QW-303.2, and Table QW-461.9 to clarify the intent of Section IX regarding performance qualification requirements for welders depositing tack welds.
14-2128	Revised Note (1) in Table QW-452.1(b) to eliminate the use of "and/or" and add that use of more than one set of essential variables impacts the determination of thickness of weld metal qualified.
14-2165	Added General Note to Figure QW-462 stating that reduced section widths can be greater than $^{3}/_{4}$ in. (19 mm).
14-2273	Revised QW-288.1(c) to read, "For tubes of specified wall thickness of 0.100 in. (2.5 mm) or less, an increase or decrease of 10% of the specified wall thickness. For tests conducted on tubes of specified wall thickness greater than 0.100 in. (2.5 mm), one qualification test qualifies all thicknesses greater than 0.100 in. (2.5 mm)."
14-2381	Revised QW-200.4(a) and (b).
14-2484	Revised QB-151.3.
15-176	Revised Tables QW-265 and QW-268 and paragraph QW-406.8.
15-177	Revised the General Notes in Figures QW-466.1 and QW-466.2 as described in the explanation.

Record Number	Change
15-178	Added a new paragraph to QW-462 listing the specific standards whose tension specimens would be acceptable for Section IX use.
15-201	Replaced slash with “and,” comma, “or,” or space in QW-286.1, QW-403.25, title of QW/QB-422 (“Ferrous/Nonferrous”), Figure QW-462.4(b), QF-131(e), QF-132, QF-144.4(h), B-101, B-102, and various welding, brazing, and fusing forms. Replaced slash with parentheses in definition of “build-up of base metal.” Replaced slash with “combination” or “combination(s)” and replaced “side” with “member” in QW-403.25. Replaced parenthetical list of examples with reference to QW-404.23 in Form QW-484A.
15-247	Revised QG-105.1, QG-109.2, QW-101, QW-141.4, QW-170, QW-171, QW-172, QW-172.3, QW-200.2(b), QW-200.3(b), QW-202.2(a), QW-251.2, Table QW-253, QW-290.2, QW-290.3, Table QW-290.4, QW-290.5(d), QW-401.1, QW-403.5, QW-404.12, QW-404.33, QW-404.35, QW-409.29, QW-410.61, QW-420, Table QW-451.4, Figure QW-461.3(f), QW-500, Form QW-482, and Form QW-483 to revise all references to “Notch Toughness Testing” and “Charpy V-Notch Testing” to “toughness testing.”
15-320	Revised the column title in QW/QB-422 from “Product Form” to “Typical Product Form.”
15-418	Revised QW-191.2.2(b), and deleted QW-191.2.2(c) and (d).
15-423	Revised Table QW/QB-422 and Nonmandatory Appendix D.
15-441	Added the word “nominal” in front of “widths” so that the General Note reads, “Specimens having a reduced section nominal width (W) that is greater than the nominal $^{3}/_{4}$ in. (19 mm) width may be used.”
15-568	Deleted “CW” suffix from Table QW/QB-422 and Nonmandatory Appendix D for ASTM A108.
15-638	Deleted the last two paragraphs of QG-101.
15-665	Revised Table QW/QB-422 and Nonmandatory Appendix D to include select grades of Australian material specifications AS 1448 and AS 4728.
15-666	Added SA-572 and SA-1011 to QW/QB-422 and Nonmandatory Appendix D.
15-723	Added SA/EN 10028-3, P355NL2 in Table QW/QB-422 and Nonmandatory Appendix D.
15-744	Added the UNS S82441 grade to specifications A/SA-240, A/SA-479, A/SA-789, and A/SA-790 in Table QW/QB-422 and Nonmandatory Appendix D.
15-845	Revised QW/QB-422 and Nonmandatory Appendix D to add UNS N02201 and UNS N04400 welded pipe made to ASTM B725 as P-No. 41 and P-No. 42 materials, respectively; UNS N02200 and UNS N02201 welded tube made to ASTM B730 as P-No. 41 materials; and UNS N04400 welded tube made to ASTM B730 as a P-No. 42 material.
15-961	Revised the listing of variable QW-408.10 in each of the three variable tables (QW-255, QW-256, and QW-257) to “Deletion or Change in Composition of Trailing” using the minus sign for “deletion of.” Deleted the word “shielding” from variable QW-408.10 and the term “trailing shielding gas” in variables QW-408.1, QW-408.11, QW-408.12, and QW-408.23.
15-994	Revised the variable QW-408.8 to say “the omission of backing gas...,” deleting the word “inert.” Revised performance qualification Tables QW-355, QW-356, and QW-357 to change QW-408.8 “deletion of inert backing” to “deletion of backing,” using the minus sign for “deletion of.” Revised variable QW-408.5 to change “gas backing” to “backing gas” for consistency. Revised Form QW-484A to change “Inert gas backing” to “Use of backing gas.”
15-1281	Revised the nominal composition of A/SA-203, Grades A and B in Table QW/QB-422 from “2.5Ni” to “2.25Ni.”
15-1282	Revised the Aluminum nominal composition of UNS S40500 for specifications A/SA-240, A/SA-268, A/SA-479, and SA/JIS G4303 in Table QW/QB-422 from “1Al” to “Al.”
15-1283	Revised the Chromium nominal composition of A/SA-451, Grade CPF3M in Table QW/QB-422 from “16Cr” to “18Cr.”
15-1398	Deleted General Note in Figure QW-463.2(g).
15-1468	Revised the nominal composition of B/SB-366, UNS N06002 in Table QW/QB-422.
15-1481	Added A/SA-240, UNS S43940 to Table QW/QB-422 and Nonmandatory Appendix D.
15-1571	Revised Tables QW/QB-422 and QW-432 and Nonmandatory Appendix D to assign a P-Number to the base material UNS R54250 and an F-Number to the corresponding filler material UNS R54251.
15-1722	Added A5.36 to QW-432 as F-No. 6.

Record Number	Change
15-1731	Revised Figure QW-462.1(a) to accurately show the distortion and removal of material to make the two surfaces approximately parallel.
15-1829	Revised the definition of “LBW” in QG-109.2.
15-1852	Deleted the existing wording for QW-211, and added QW-211 and QW-211.1.
15-1961	Deleted QW-407.4 and all references to it.
15-2048	Deleted QW-402.30, QW-403.31, and QW-404.54.
15-2338	Errata correction. See Summary of Changes for details.
15-2580	Corrected operators in Product Form column of A/SA-385, N08367. Split A/SA-358, S31254 line entry into two separate product form thickness ranges, and corrected Minimum Specified Tensile value and Product Form entry.
15-2663	Revised QW-191.2.1(a) and L-400(d) to reduce the minimum thickness for applicability of UT examination from $\frac{1}{2}$ in. (13 mm) to $\frac{1}{4}$ in. (6 mm).
15-2682	Revised QW-403.16 to define welder qualification diameter limits for set-on and set-in nozzle or branch connections.
15-2717	Added B/SB-148, C95800 with a P-No. assignment of 35 to Table QW/QB-422 and Nonmandatory Appendix D.
15-2718	Replaced the word “side” with “member” in QW-403.25. Replaced the word “and” with “vs.” in Form QE-485. Added comma after “grade” in Form QW-482. Added “and for DC the polarity” in Forms QW-484A and QW-485.
15-2719	Revised QW-322, QW-322.1, and QW-322.2.
15-2720	Revised Tables QW-253.1, 254.1, 255.1, 256.1, 257.1, and 258.1 to add QW-409.8 as a nonessential variable for HFO and CRO.
15-2726	Deleted the last sentence of QG-105.5.
15-2845	Revised Figure QW-462.3(b) by removing the sketch of the root bend with one showing the excess material removal on the face side, instead of the root side.
16-180	Deleted the B/SB-26 rows of Nonmandatory Appendix D, assigning A03560 and A24430 as P-No. 21.
16-226	Revised Forms QF-484(a), QF-484(b), QW-484A, QW-484B, QW-485, and QB-484 to be able to differentiate between the date the procedure or personnel qualification coupon is welded (or fused) and the date the PQR, WPQ, WOPQ, or FOPQ is certified.
16-227	Revised QG-106.3 in its entirety for improved clarity.
16-242	Added SA/EN 10028-3, P355NH to Table QW/QB-422 and Nonmandatory Appendix D.
16-343	Revised “1G Rotated” to “1G (Rotated)” in Figure QW-461.4(a).
16-361	Added A/SA-240, UNS S32654 to Table QW/QB-422 and Nonmandatory Appendix D.
16-410	Revised (a) and (b) in QB-409.1.
16-611	Errata correction. See Summary of Changes for details.
16-665	Revised text information in Figures QW-462.1(a) and (b) to improve consistency between these figures.
16-759	Added UNS S82012 and UNS S82031 to Table QW-422 and Nonmandatory Appendix D with a P-Number of 10H.
16-888	Revised QW-191.1(a) to remove implication that only film radiography is acceptable.
16-890	Added B/SB-148, C95820 to Table QW/QB-422 and Nonmandatory Appendix D.
16-933	Added the definition of “trailing gas” to QG-109.2.
16-934	Revised QW-403.6 from “less than $\frac{1}{4}$ in. (6 mm)” to “$\frac{1}{4}$ in. (6 mm) or less.”
16-1564	Revised Note (1) of Table QW-416 to refer to “Article IV,” instead of “Section IV.”
16-1677	Incorporated Code Case 2846 into Table QW-432, SFA-5.36.
16-2260	Added words in H-200 to clarify that instantaneous power is measured as an average, which then requires travel speed to calculated heat input, and that instantaneous energy is an accumulated value, which then requires weld length to calculated heat input.
17-438	Errata correction. See Summary of Changes for details.
17-475	Errata correction. See Summary of Changes for details.

CROSS-REFERENCING AND STYLISTIC CHANGES IN THE BOILER AND PRESSURE VESSEL CODE

There have been structural and stylistic changes to BPVC, starting with the 2011 Addenda, that should be noted to aid navigating the contents. The following is an overview of the changes:

Subparagraph Breakdowns/Nested Lists Hierarchy

- First-level breakdowns are designated as (a), (b), (c), etc., as in the past.
- Second-level breakdowns are designated as (1), (2), (3), etc., as in the past.
- Third-level breakdowns are now designated as (-a), (-b), (-c), etc.
- Fourth-level breakdowns are now designated as (-1), (-2), (-3), etc.
- Fifth-level breakdowns are now designated as (+a), (+b), (+c), etc.
- Sixth-level breakdowns are now designated as (+1), (+2), etc.

Footnotes

With the exception of those included in the front matter (roman-numbered pages), all footnotes are treated as endnotes. The endnotes are referenced in numeric order and appear at the end of each BPVC section/subsection.

Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees

Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees has been moved to the front matter. This information now appears in all Boiler Code Sections (except for Code Case books).

Cross-References

It is our intention to establish cross-reference link functionality in the current edition and moving forward. To facilitate this, cross-reference style has changed. Cross-references within a subsection or subarticle will not include the designator/identifier of that subsection/subarticle. Examples follow:

- *(Sub-)Paragraph Cross-References.* The cross-references to subparagraph breakdowns will follow the hierarchy of the designators under which the breakdown appears.
  - If subparagraph (-a) appears in X.1(c)(1) and is referenced in X.1(c)(1), it will be referenced as (-a).
  - If subparagraph (-a) appears in X.1(c)(1) but is referenced in X.1(c)(2), it will be referenced as (1)(-a).
  - If subparagraph (-a) appears in X.1(c)(1) but is referenced in X.1(e)(1), it will be referenced as (c)(1)(-a).
  - If subparagraph (-a) appears in X.1(c)(1) but is referenced in X.2(c)(2), it will be referenced as X.1(c)(1)(-a).
- *Equation Cross-References.* The cross-references to equations will follow the same logic. For example, if eq. (1) appears in X.1(a)(1) but is referenced in X.1(b), it will be referenced as eq. (a)(1)(1). If eq. (1) appears in X.1(a)(1) but is referenced in a different subsection/subarticle/paragraph, it will be referenced as eq. X.1(a)(1)(1).

PART QG
GENERAL REQUIREMENTS

(17) QG-100 SCOPE

(a) This Section contains requirements for the qualification of welders, welding operators, brazers, brazing operators, plastic fusing operators, and the material joining processes they use during welding, brazing, and fusing operations for the construction of components under the rules of the ASME Boiler and Pressure Vessel Code, the ASME B31 Codes for Pressure Piping, and other Codes, standards, and specifications that reference this Section. This Section is divided into four parts.

(1) Part QG contains general requirements for all material-joining processes.

(2) Part QW contains requirements for welding.

(3) Part QB contains requirements for brazing.

(4) Part QF contains requirements for plastic fusing.

(b) Whenever the referencing Code, standard, or specification imposes requirements different than those given in this Section, the requirements of the referencing Code, standard, or specification shall take precedence over the requirements of this Section.

(c) Some of the more common terms relating to material joining processes are defined in QG-109. Whenever the word "pipe" is used, "tube" shall also be applicable.

(d) New editions to Section IX may be used beginning with the date of issuance and becomes mandatory 6 months after the date of issuance.

(e) Code Cases are permissible and may be used, beginning with the date of approval by ASME. Only Code Cases that are specifically identified as being applicable to this Section may be used. At the time a Code Case is applied, only the latest revision may be used. Code Cases that have been incorporated into this Section or have been annulled shall not be used for new qualifications, unless permitted by the referencing Code. Qualifications using the provisions of a Code Case remain valid after the Code Case is annulled. The Code Case number shall be listed on the qualification record(s).

(f) Throughout this Section, references are made to various non-ASME documents. Unless a specific date is referenced, the latest edition of the reference document in effect at the time of performance or procedure qualification is to be used.

(17) QG-101 PROCEDURE SPECIFICATION

A procedure specification is a written document providing direction to the person applying the material joining process. Details for the preparation and qualification of procedure specifications for welding (WPS), brazing (BPS), and fusing (FPS) are given in the respective Parts addressing those processes. Procedure specifications used by an *organization* (see QG-109.2) having responsibility for operational control of material joining processes shall have been qualified by that organization, or shall be a standard procedure specification acceptable under the rules of the applicable Part for the joining process to be used.

Procedure specifications address the conditions (including ranges, if any) under which the material joining process must be performed. These conditions are referred to in this Section as "variables." When a procedure specification is prepared by the organization, it shall address, as a minimum, the specific essential and nonessential variables that are applicable to the material joining process to be used in production. When the referencing Code, standard, or specification requires toughness qualification of the material joining procedure, the applicable supplementary essential variables shall also be addressed in the procedure specification.

QG-102 PROCEDURE QUALIFICATION RECORD

The purpose of qualifying the procedure specification is to demonstrate that the joining process proposed for construction is capable of producing joints having the required mechanical properties for the intended application. Qualification of the procedure specification demonstrates the mechanical properties of the joint made using a joining process, and not the skill of the person using the joining process.

The procedure qualification record (PQR) documents what occurred during the production of a procedure qualification test coupon and the results of testing that coupon. As a minimum, the PQR shall document the essential procedure qualification test variables applied during production of the test joint, and the results of the required tests. When toughness testing is required for qualification of the procedure specification, the applicable supplementary essential variables shall be recorded for each process. The organization shall certify the PQR by a signature or other means as described in the organization's Quality Control System. The PQR shall be accessible to the Authorized Inspector. A procedure specification may be supported by one or more PQR(s), and one PQR may be used to support one or more procedure specification(s).