

SECTION IX

Welding, Brazing, and Fusing Qualifications

2015

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

AN INTERNATIONAL CODE

2015 ASME Boiler & Pressure Vessel Code

2015 Edition

July 1, 2015

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, 2015

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Library of Congress Catalog Card Number: 56-3934
Printed in the United States of America

Adopted by the Council of The American Society of Mechanical Engineers, 1914; latest edition 2015.

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

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

INTERPRETATIONS

Interpretations of the Code have historically been posted in January and July at <http://cstools.asme.org/interpretations.cfm>. Interpretations issued during the previous two calendar years are included with the publication of the applicable Section of the Code in the 2015 Edition. Interpretations of Section III, Divisions 1 and 2 and Section III Appendices are included with Subsection NCA.

Following the 2015 Edition, interpretations will not be included in editions; they will be 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 2015 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 2017 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 judgement* 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 (15)

1 INTRODUCTION

(a) The following information provides guidance to Code users for submitting technical inquiries to the committees. See Guideline on the Approval of New Materials Under the ASME Boiler and Pressure Vessel Code in Section II, Parts C and D for additional requirements for requests involving adding new materials to the Code. Technical inquiries include requests for revisions or additions to the Code rules, requests for Code Cases, and requests for Code Interpretations, as described below.

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

(2) *Code Cases.* Code Cases represent alternatives or additions to existing Code rules. 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 jurisdictions or owners automatically accept Code Cases. The most common applications for Code Cases are:

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

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

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

(3) *Code Interpretations.* Code Interpretations provide clarification of the meaning of existing rules in the Code, and are also presented in question and reply format. Interpretations do not introduce new requirements. In cases where existing Code text does not fully convey the meaning that was intended, and revision of the rules is required to support an interpretation, an Intent Interpretation will be issued and the Code will be revised.

(b) The Code rules, Code Cases, and Code Interpretations established by the committees 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 rules.

(c) Inquiries that do not comply with these provisions or that do not provide sufficient information for a committee's full understanding may result in the request being returned to the inquirer with no action.

2 INQUIRY FORMAT

Submittals to a committee shall include:

(a) *Purpose.* Specify one of the following:

(1) revision of present Code rules

(2) new or additional Code rules

(3) Code Case

(4) Code Interpretation

(b) *Background.* 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, provide a copy of the specific referenced portions of the Code.

(c) *Presentations.* The inquirer may desire 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 committee meeting shall be at the expense of the inquirer. The inquirer's attendance or lack of attendance at a meeting shall not be a basis for acceptance or rejection of the inquiry by the committee.

3 CODE REVISIONS OR ADDITIONS

Requests for Code revisions or additions shall provide the following:

(a) *Proposed Revisions or Additions.* For revisions, identify the rules of the Code that require revision and submit a copy of the appropriate rules as they appear in the Code, marked up with the proposed revision. For additions, provide the recommended wording referenced to the existing Code rules.

(b) *Statement of Need.* Provide a brief explanation of the need for the revision or addition.

(c) *Background Information.* 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 proposed revision or addition. Sketches, tables, figures, and graphs should be submitted as appropriate. When applicable, identify any pertinent paragraph in the Code that would be affected by the revision or addition and identify paragraphs in the Code that reference the paragraphs that are to be revised or added.

4 CODE CASES

Requests for Code Cases shall provide a Statement of Need and Background Information similar to that defined 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, etc.) must be defined and it must be confirmed 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 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 proposed Code Case applies.

5 CODE INTERPRETATIONS

(a) Requests for Code Interpretations shall provide the following:

(1) *Inquiry.* Provide a condensed and precise question, omitting superfluous background information and, when possible, composed in such a way that a “yes” or a “no” *Reply*, with brief provisos if needed, is acceptable. The question should be technically and editorially correct.

(2) *Reply.* Provide a proposed *Reply* that will clearly and concisely answer the *Inquiry* question. Preferably, the *Reply* should be “yes” or “no,” with brief provisos if needed.

(3) *Background Information.* Provide any background information that will assist the committee in understanding the proposed *Inquiry* and *Reply*.

(b) Requests for Code Interpretations must be limited to an interpretation of a particular requirement in the Code or a Code Case. The committee cannot 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

Submittals to and responses from the committees shall meet the following:

(a) *Submittal.* Inquiries from Code users shall be in English and preferably be submitted in typewritten form; however, legible handwritten inquiries will also be considered. They shall include the name, address, telephone number, fax number, and e-mail address, if available, of the inquirer and be mailed to the following address:

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

As an alternative, inquiries may be submitted via e-mail to: SecretaryBPV@asme.org or via our online tool at <http://go.asme.org/InterpretationRequest>.

(b) *Response.* The Secretary of the appropriate committee shall acknowledge receipt of each properly prepared inquiry and shall provide a written response to the inquirer upon completion of the requested action by the committee.

PERSONNEL

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January 1, 2015

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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

After publication of the 2015 Edition, 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, **(15)**, 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.

<i>Page</i>	<i>Location</i>	<i>Change (Record Number)</i>
x	List of Sections	Revised
xii	Foreword	(1) Revised (2) New footnote added by errata (13-860)
xv	Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees	In last line of 6(a), URL revised
xvii	Personnel	Updated
xxxiv	Introduction	Replaced all occurrences of <i>fusing machine operators</i> with <i>fusing operators</i> (13-466)
1	QG-100	(1) Subparagraph (a) revised (13-466) (2) Subparagraphs (d) and (e) added (13-2004, 13-2103)
2	QG-105	(1) QG-105.1 revised (14-897) (2) New QG-105.2 added and subsequent paragraphs redesignated (14-897) (3) QG-105.4 (former QG-105.3) revised (13-1374)
2	QG-106.1	Subparagraph (a) revised (13-2128)
3	QG-106.2	(1) First paragraph revised (13-2287) (2) Subparagraph (a) revised (13-2128)
4	QG-109.2	(1) Definitions of <i>butt-fusing cycle</i> ; <i>control specimen</i> ; <i>data acquisition record</i> ; <i>drag resistance</i> ; <i>electrode, bare</i> ; <i>heat soak cycle</i> ; <i>heat soak time</i> ; <i>heater removal (dwell) time</i> ; <i>heater temperature</i> ; <i>melt bead size</i> ; and <i>test coupon, fusing</i> revised (13-466, 14-1020) (2) Definitions of <i>butt-fusion (BF)</i> , <i>electrofusion (EF)</i> , <i>electrofusion manufacturer</i> , <i>fusing operator</i> , <i>fusing procedure specification</i> , <i>Manufacturer Qualified Electrofusion Procedure Specification (MEFPS)</i> , and <i>Standard Butt-Fusing Procedure Specification (SFPS)</i> added (13-466) (3) Definitions of <i>fusing machine operator</i> and <i>fusing procedure</i> deleted (13-466)
16	QW-124	Added (14-332)
16	QW-133	Added (14-332)
19	QW-171.1	Revised (14-452)

<i>Page</i>	<i>Location</i>	<i>Change (Record Number)</i>
19	QW-172.1	Revised (14-452)
32	QW-220	Revised in its entirety (12-1133)
40	Table QW-254.1	QW-404.57 row added (13-2043)
49	Table QW-257.1	Paragraph QW-404 section revised (13-1447)
52	Table QW-258.1	QW-404.57 row added (13-2043)
54	Table QW-260	QW-410.5 row revised (14-1022)
60	Table QW-265	QW-406.7 row revised (14-1022)
62	Table QW-267	QW-404 section added (13-1048)
62	Table QW-268	Deleted (12-1133)
62	Table QW-269	Deleted (12-1133, 13-1448)
62	Table QW-269.1	Deleted (12-1133, 13-1448)
70	QW-304	Second sentence corrected by errata (13-1868)
72	QW-322.1	Subparagraphs (a)(1) and (a)(2) corrected by errata (13-1868)
74	QW-361.1	Subparagraph (d) revised (12-1133)
77	QW-401	(1) QW-401.1 and 401.2 deleted (14-897) (2) QW-401.3 redesignated as QW-401.1 and revised (14-897) (3) QW-401.4 deleted (14-897) (4) QW-401.5 redesignated as QW-401.2 (14-897)
78	QW-403.3	Revised (14-474)
82	QW-404.35	Revised (13-1857)
82	QW-404.45	Deleted (13-1447)
83	QW-404.55	Added (13-1048)
83	QW-404.56	Added (13-1048)
83	QW-404.57	Added (13-2043)
85	QW-409	(1) QW-409.1: first paragraph revised (13-1519, 14-618) (2) QW-409.5, QW-409.6, QW-409.7, QW-409.15, QW-409.19, QW-409.23, QW-409.26, and QW-409.29 revised (12-1494, 13-1519, 14-618)
89	QW-410.64	First sentence revised (14-1022)
89	QW-410.78	Deleted (13-1793)
89	QW-410.79	Deleted (13-1793)
90	QW-410.81	Deleted (13-1793)
90	QW-410.82	Deleted (13-1793)
90	QW-410.83	Deleted (13-1793)
90	QW-410.84	Deleted (13-1793)
93	Table QW/QB-422	(1) Revised and rows reordered throughout table (13-116, 13-293, 13-650, 13-822, 13-1701, 13-1812, 13-1906, 13-2040, 13-2104, 14-42, 14-135, 14-395, 14-834) (2) Corrected by errata (13-1868, 14-217)

<i>Page</i>	<i>Location</i>	<i>Change (Record Number)</i>
161	QW-423.1	In in-text table, last three rows added (13-1071)
162	Table QW-432	Revised (13-823)
171	QW-433	In bottom portion of in-text table, second row revised (13-823)
172	Table QW-442	Entries under “Cr,” “Ni,” and “Si” corrected by errata (14-1947)
177	Table QW-453	Typo in Note (9) corrected by errata (14-1113)
179	Figure QW-461.1	General Note broken down to General Notes (a), (b), (c) for clarity
185	Table QW-461.9	In Note (1), SP position added (14-332)
190	Figure QW-462.2	(1) Cross-reference in (1a) and (2) corrected by errata (14-493) (2) Table below first illustration revised (13-823)
191	Figure QW-462.3(a)	In-text table below second illustration revised (13-823)
206	Figure QW-462.12	Corrected by errata (13-1868)
217	Figure QW-466.1	(1) In in-text table below illustration, first entry under “Material” revised for both U.S. Customary and SI Units (13-823) (2) General Note (e) added (14-17)
219	Figure QW-466.2	General Note revised (14-17)
225	QW-500	In second paragraph, last sentence revised (13-2005)
233	Table QB-252	QB-403.3 row added (12-1810)
234	Table QB-253	QB-403.3 and QB-411 added (12-1810, 14-231)
234	Table QB-254	QB-403.3 and QB-411 added (12-1810, 14-231)
235	Table QB-255	QB-403.3 and QB-411 added (12-1810, 14-231)
235	Table QB-256	QB-403.3 and QB-411 added (12-1810, 14-231)
236	Table QB-257	QB-403.3 and QB-411 added (12-1810, 14-231)
238	QB-351.1	Subparagraph (b)(3) added (12-1810)
239	QB-403.3	Added (12-1810)
239	QB-403.4	Added (12-1810)
240	QB-410.1	Revised (14-231)
240	QB-411	Added (14-231)
253	Figure QB-462.1(f)	Circled numbers replaced with callouts for ease of use
266	Part QF	(1) Revised (13-466, 13-468, 13-1698, 14-473, 14-897) (2) Tables QF-202.2.2, QF-222.1, and QF- 255 added (13-466) (3) Forms 482, 483, and 484 revised and redesignated as Forms 482(a), 483(a), and 484(a), respectively (13-466) (4) Forms 482(b), 483(b), and 484(b) added (13-466) (5) Figures QF-466 through QF-470 added (13-466)
307	Form QW-482	Revised (13-277)
309	Form QW-483	Revised (13-277)
311	Form QW-484A	Revised (13-277)
312	Form QW-484B	Revised (13-277)
313	Form QW-485	Revised (13-277)

<i>Page</i>	<i>Location</i>	<i>Change (Record Number)</i>
317	Nonmandatory Appendix D	Revised (13-116, 13-293, 13-650, 13-822, 13-1701, 13-1812, 13-2104, 14-42, 14-135, 14-395, 14-834)
335	Mandatory Appendix E	Designations of Carbon Steel to Austenitic Stainless Steel revised (12-1139)
345	K-200	Revised (13-275, 14-1021)
346	K-303	Second paragraph revised (13-275)
347	Nonmandatory Appendix L	Added (14-1679)

NOTE: Volume 63 of the Interpretations to Section IX of the ASME Boiler and Pressure Vessel Code follows the last page of Section IX.

LIST OF CHANGES IN RECORD NUMBER ORDER

Record Number	Change
12-1133	Removed QW-220 and Table QW-268 for Hybrid Laser-GMAW. Removed QW-221 and Tables QW-269 and QW-269.1 for Hybrid Plasma-GMAW. Added new paragraph for Hybrid Welding Procedure Variables.
12-1139	Reaffirmed SWPSs in Mandatory Appendix E.
12-1494	Revised QW-409.26.
12-1810	Added brazing filler metal variables QB-403.3 and QB-403.4 and updated Tables QB-252, QB-253, QB-254, QB-255, QB-256, and QB-257, and QB-351.1(b).
13-116	Added A/SA-213 (UNS S30432) to Table QW/QB-422 and Nonmandatory Appendix D. Corrected minimum specified tensile to 86 (595), [was 85 (590)]. Added "3Cu" to nominal composition, (was "18Cr-9Ni-Cu-Cb-N").
13-275	Replaced the terms "manufacturer," "contractor," and "fabricator" with "organization" in several places. Provided parenthetical "(PWHT)" and "(WPS)" after the first non-acronymed use of each term. In the paragraph entitled "Scope of Section IX and What Referencing Documents Must Address," the term "brazed" added to the first sentence to make it clear that Nonmandatory Appendix K is not limited to welded and fused products. In that same paragraph, the sentence starting with the word "Accordingly..." was split into two shorter sentences and corrected grammatically. In the last paragraph on the first page of the Appendix, the term "WPS" was replaced by "procedures" to reflect the fact that this Appendix refers to procedures for welding, brazing, and fusing, not just welding. In the last section, "Recommended Wording —Temper Bead Welding," the term "welding procedures" modified to be more specific to say "Temper bead welding procedures."
13-277	Revised Forms QW-482, QW-483, QW-484A, QW-484B, and QW-485.
13-293	Deleted SA-202 Grade A and SA-202 Grade B from Table QW/QB-422 and Nonmandatory Appendix D.
13-466	Revised Part QF Articles QF-100, QF-200, QF-300, and QF-400 to incorporate requirements for procedure and performance qualification testing for electrofusion of polyethylene piping using socket-type and saddle-type electrofusion fittings.
13-468	Revised Figure QF-464 for greater clarity.
13-650	Revised Table QW/QB-422 with the addition of N06025.
13-822	Added A928 to Table QW/QB-422 and Nonmandatory Appendix D.
13-823	Revised Table QW-432 Aluminum and Aluminum Alloys (F-No. 21 through F-No. 25) and added F-No. 26. Revised Table QW-433, and Figures QW-462.2, QW-462.3(a), and QW-466.1.
13-860	In the Foreword, the subtitle has been deleted and replaced with an ANSI disclaimer as a footnote.
13-1048	Revised Table QW-267 to add QW-404.14 as an essential variable for addition or deletion of filler and added a new essential variable QW-404.55 to address an increase in the width of pre-placed filler strips. Created a new essential variable QW-404.55 requiring requalification of the WPS when the width of preplaced filler strips (when used) is increased over that used in qualification. Created a new essential variable QW-404.56 requiring requalification of the WPS for a change to another type or grade of preplaced filler metal.
13-1071	Revised the table in QW-423.1 to address welder qualifications for unassigned base metals.
13-1374	Revised the definition of <i>nonessential variables</i> in QG-105.3.
13-1447	Deleted QW-404.45. Revised Table QW-257.1.
13-1448	Tables QW-269 and QW-269.1 brief of variables editorially revised. See 12-1133.
13-1519	Revised QW-409 to remove the phrase "over that qualified" and similar references to "qualified." The intent is to remove ambiguity and make the text consistent with other existing text within QW-409.
13-1698	Revised QF-142 to include size and specimen length requirements for testing fused pipe.
13-1701	Revised Table QW/QB-422 and Nonmandatory Appendix D to include ASTM A860 material.
13-1793	Deleted QW-410.78, QW-410.79, QW-410.81, QW-410.82, QW-410.83, and QW-410.84.

Record Number	Change
13-1812	Added UNS N08367 for specifications A/SA-182, A403, and A/SA-479 in Table QW/QB-422 and Nonmandatory Appendix D.
13-1857	Modified QW-404.35 to expressly allow a higher digit in the impact test temperature of a flux/wire classification (testing at a lower temperature) to be used where a flux/wire classified at a higher test temperature was qualified. Intent interpretation to also permit this.
13-1868	Errata correction. See Summary of Changes for details.
13-1906	Revised Table QW/QB-422 to change the plate thickness from 0.250 in. to 0.187 in. as shown in the proposal file for SA-240 UNS No. 32101.
13-2004	Added paragraph to QG-100.
13-2005	Revised QW-500.
13-2040	For Table QW/QB-422, revised ISO 15608 Group for B/SB-265,-338,-348,-363,-367,-381,-861, and -862, and the UNS number for B/SB-367.
13-2043	Added new essential variable to QW-404 and Tables QW-254.1 and QW-258.1, to put a maximum on strip width or electrode diameter.
13-2103	Added new paragraph to QG-100 to include the effective date.
13-2104	Added A/SA-403 N08904 to Table QW/QB-422 and Nonmandatory Appendix D.
13-2128	Revised QG-106.1(a) and QG-106.2(a) as shown in the proposal file.
13-2287	Revised QG-106.2 to insert verbiage (previously present in the 2011 and earlier editions) stating that the reason for requiring the qualifying organization to exercise supervision and control of welding personnel during performance qualification was to ensure that they determine that the welders and welding operators they employ are capable of developing the minimum requirements specified for an acceptable weldment.
14-17	Revised Figures QW-466.1 and QW-466.2.
14-42	Revised Table QW/QB-422 and Nonmandatory Appendix D to include UNS N10362 for B/SB-366, -462, -564, -574, -575, -619, -622, and -626.
14-135	Added A694 Grades F48 and F50 to Table QW/QB-422 and Nonmandatory Appendix D.
14-217	Errata correction. See Summary of Changes for details.
14-231	Revised QB-410.1 and added QB-411 as shown in the proposal file.
14-332	Added new paragraphs QW-124 and QW-133 to define special position, and added a footnote to Table QW-461.9 to identify special positions.
14-395	Added A/SA-182, A/SA-240, and A/SA-358 UNS S31266 to Table QW/QB-422 and Nonmandatory Appendix D.
14-452	Revised QW-171.1 and QW-172.1, the Charpy V-notch impact tests and drop weight test paragraphs to permit use of other referencing Code requirements for Procedures.
14-473	Revised Forms QF-482 and QF-483.
14-474	Revised QW-403.3.
14-493	Errata correction. See Summary of Changes for details.
14-618	Revised QW-409.1.
14-834	Added A/SA-403 WPS31726 to Table QW/QB-422 and Nonmandatory Appendix D.
14-897	Added new paragraph QG-105.2, which is the definition of essential variables (performance), copied from the current QW-401.2. Renumbered the remainder of QG-105. Deleted paragraphs QW-401.1, QW-401.2, and QW-401.4. Revised QW-401.3. Deleted QF-401.1, QF-401.2, and QF-401.3.
14-1020	Revised definition of <i>bare electrode</i> in QG-109.2.
14-1021	For K-200, changed the phrase "manufacturer or contractor" to "organization" to be consistent with verbiage used elsewhere throughout Section IX.
14-1022	Editorially revised Section IX.
14-1113	Errata correction. See Summary of Changes for details.
14-1679	Added new Nonmandatory Appendix L.
14-1947	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).

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PART QG

GENERAL REQUIREMENTS

(15) 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).

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.

Procedure specifications written and qualified in accordance with the rules of this Section and personnel whose performance has been qualified to use the procedure specification in accordance with these rules may be used to construct components that comply with the requirements of the ASME Boiler and Pressure Vessel Code or the ASME B31 Codes for Pressure Piping.

However, other Sections of the Code state the rules under which Section IX requirements are mandatory, in whole or in part, and may give additional requirements. The reader is advised to take these provisions into consideration when using this Section.

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