

SECTION IX

Welding, Brazing, and Fusing Qualifications

2021

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

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AN INTERNATIONAL CODE

2021 ASME Boiler & Pressure Vessel Code

2021 Edition

July 1, 2021

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

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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 2021 Code Cases book: "Boilers and Pressure Vessels" or "Nuclear Components." Each Code Cases book is updated with seven Supplements. Supplements will be sent or made available automatically to the purchasers of the Code Cases books up to the publication of the 2023 Code. Annulments of Code Cases become effective six months after the first announcement of the annulment in a Code Case Supplement or Edition of the appropriate Code Case book. Code Case users can check the current status of any Code Case at <http://go.asme.org/BPVCCDatabase>. Code Case users can also view an index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases at <http://go.asme.org/BPVCC>.

FOREWORD*

In 1911, The American Society of Mechanical Engineers established the Boiler and Pressure Vessel Committee to formulate standard rules for the construction of steam boilers and other pressure vessels. In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees:

- (a) Committee on Power Boilers (I)
- (b) Committee on Materials (II)
- (c) Committee on Construction of Nuclear Facility Components (III)
- (d) Committee on Heating Boilers (IV)
- (e) Committee on Nondestructive Examination (V)
- (f) Committee on Pressure Vessels (VIII)
- (g) Committee on Welding, Brazing, and Fusing (IX)
- (h) Committee on Fiber-Reinforced Plastic Pressure Vessels (X)
- (i) Committee on Nuclear Inservice Inspection (XI)
- (j) Committee on Transport Tanks (XII)
- (k) Committee on Overpressure Protection (XIII)
- (l) Technical Oversight Management Committee (TOMC)

Where reference is made to “the Committee” in this Foreword, each of these committees is included individually and collectively.

The Committee’s function is to establish rules of safety relating only to pressure integrity, which govern the construction* of boilers, pressure vessels, transport tanks, and nuclear components, and the inservice inspection of nuclear components and transport tanks. The Committee also interprets these rules when questions arise regarding their intent. The technical consistency of the Sections of the Code and coordination of standards development activities of the Committees is supported and guided by the Technical Oversight Management Committee. This Code does not address other safety issues relating to the construction of boilers, pressure vessels, transport tanks, or nuclear components, or the inservice inspection of nuclear components or transport tanks. Users of the Code should refer to the pertinent codes, standards, laws, regulations, or other relevant documents for safety issues other than those relating to pressure integrity. Except for Sections XI and XII, and with a few other exceptions, the rules do not, of practical necessity, reflect the likelihood and consequences of deterioration in service related to specific service fluids or external operating environments. In formulating the rules, the Committee considers the needs of users, manufacturers, and inspectors of pressure vessels. The objective of the rules is to afford reasonably certain protection of life and property, and to provide a margin for deterioration in service to give a reasonably long, safe period of usefulness. Advancements in design and materials and evidence of experience have been recognized.

This Code contains mandatory requirements, specific prohibitions, and nonmandatory guidance for construction activities and inservice inspection and testing activities. The Code does not address all aspects of these activities and those aspects that are not specifically addressed should not be considered prohibited. The Code is not a handbook and cannot replace education, experience, and the use of engineering judgment. The phrase *engineering judgment* refers to technical judgments made by knowledgeable engineers experienced in the application of the Code. Engineering judgments must be consistent with Code philosophy, and such judgments must never be used to overrule mandatory requirements or specific prohibitions of the Code.

The Committee recognizes that tools and techniques used for design and analysis change as technology progresses and expects engineers to use good judgment in the application of these tools. The designer is responsible for complying with Code rules and demonstrating compliance with Code equations when such equations are mandatory. The Code neither requires nor prohibits the use of computers for the design or analysis of components constructed to the

* The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI’s requirements for an ANS. Therefore, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Code.

** *Construction*, as used in this Foreword, is an all-inclusive term comprising materials, design, fabrication, examination, inspection, testing, certification, and overpressure protection.

requirements of the Code. However, designers and engineers using computer programs for design or analysis are cautioned that they are responsible for all technical assumptions inherent in the programs they use and the application of these programs to their design.

The rules established by the Committee are not to be interpreted as approving, recommending, or endorsing any proprietary or specific design, or as limiting in any way the manufacturer's freedom to choose any method of design or any form of construction that conforms to the Code rules.

The Committee meets regularly to consider revisions of the rules, new rules as dictated by technological development, Code Cases, and requests for interpretations. Only the Committee has the authority to provide official interpretations of this Code. Requests for revisions, new rules, Code Cases, or interpretations shall be addressed to the Secretary in writing and shall give full particulars in order to receive consideration and action (see Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees). Proposed revisions to the Code resulting from inquiries will be presented to the Committee for appropriate action. The action of the Committee becomes effective only after confirmation by ballot of the Committee and approval by ASME. Proposed revisions to the Code approved by the Committee are submitted to the American National Standards Institute (ANSI) and published at <http://go.asme.org/BPVCPublicReview> to invite comments from all interested persons. After public review and final approval by ASME, revisions are published at regular intervals in Editions of the Code.

The Committee does not rule on whether a component shall or shall not be constructed to the provisions of the Code. The scope of each Section has been established to identify the components and parameters considered by the Committee in formulating the Code rules.

Questions or issues regarding compliance of a specific component with the Code rules are to be directed to the ASME Certificate Holder (Manufacturer). Inquiries concerning the interpretation of the Code are to be directed to the Committee. ASME is to be notified should questions arise concerning improper use of the ASME Single Certification Mark.

When required by context in this Section, the singular shall be interpreted as the plural, and vice versa, and the feminine, masculine, or neuter gender shall be treated as such other gender as appropriate.

The words "shall," "should," and "may" are used in this Standard as follows:

- *Shall* is used to denote a requirement.
- *Should* is used to denote a recommendation.
- *May* is used to denote permission, neither a requirement nor a recommendation.

STATEMENT OF POLICY ON THE USE OF THE ASME SINGLE CERTIFICATION MARK AND CODE AUTHORIZATION IN ADVERTISING

ASME has established procedures to authorize qualified organizations to perform various activities in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. It is the aim of the Society to provide recognition of organizations so authorized. An organization holding authorization to perform various activities in accordance with the requirements of the Code may state this capability in its advertising literature.

Organizations that are authorized to use the ASME Single Certification Mark for marking items or constructions that have been constructed and inspected in compliance with the ASME Boiler and Pressure Vessel Code are issued Certificates of Authorization. It is the aim of the Society to maintain the standing of the ASME Single Certification Mark for the benefit of the users, the enforcement jurisdictions, and the holders of the ASME Single Certification Mark who comply with all requirements.

Based on these objectives, the following policy has been established on the usage in advertising of facsimiles of the ASME Single Certification Mark, Certificates of Authorization, and reference to Code construction. The American Society of Mechanical Engineers does not “approve,” “certify,” “rate,” or “endorse” any item, construction, or activity and there shall be no statements or implications that might so indicate. An organization holding the ASME Single Certification Mark and/or a Certificate of Authorization may state in advertising literature that items, constructions, or activities “are built (produced or performed) or activities conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code,” or “meet the requirements of the ASME Boiler and Pressure Vessel Code.” An ASME corporate logo shall not be used by any organization other than ASME.

The ASME Single Certification Mark shall be used only for stamping and nameplates as specifically provided in the Code. However, facsimiles may be used for the purpose of fostering the use of such construction. Such usage may be by an association or a society, or by a holder of the ASME Single Certification Mark who may also use the facsimile in advertising to show that clearly specified items will carry the ASME Single Certification Mark.

STATEMENT OF POLICY ON THE USE OF ASME MARKING TO IDENTIFY MANUFACTURED ITEMS

The ASME Boiler and Pressure Vessel Code provides rules for the construction of boilers, pressure vessels, and nuclear components. This includes requirements for materials, design, fabrication, examination, inspection, and stamping. Items constructed in accordance with all of the applicable rules of the Code are identified with the ASME Single Certification Mark described in the governing Section of the Code.

Markings such as “ASME,” “ASME Standard,” or any other marking including “ASME” or the ASME Single Certification Mark shall not be used on any item that is not constructed in accordance with all of the applicable requirements of the Code.

Items shall not be described on ASME Data Report Forms nor on similar forms referring to ASME that tend to imply that all Code requirements have been met when, in fact, they have not been. Data Report Forms covering items not fully complying with ASME requirements should not refer to ASME or they should clearly identify all exceptions to the ASME requirements.

SUBMITTAL OF TECHNICAL INQUIRIES TO THE BOILER AND PRESSURE VESSEL STANDARDS COMMITTEES (21)

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) Interpretations will be issued only if existing Code text is ambiguous or conveys conflicting requirements. If a 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. This information should include a statement indicating why the included paragraphs, figures, or tables are ambiguous or convey conflicting requirements. 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 ASME Single 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 include a statement indicating why the included paragraphs, figures, or tables are ambiguous or convey conflicting requirements. 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>.

PERSONNEL

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January 1, 2021

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INTRODUCTION

(21)

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. The supplementary essential variables apply only when toughness testing is required by the referencing code, standard, or specification.

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 referencing code, standard, or specification, the supplementary essential variables become additional essential variables, and a change in these variables requires requalification of the WPS.

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 [Table 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.

In the 2009 Addenda, S-Number base metals listed in Table QW/QB-422 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 website 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, **(21)**, placed next to the affected area.

<i>Page</i>	<i>Location</i>	<i>Change</i>
x	List of Sections	(1) Listing for Section III updated (2) Section XIII added (3) Code Case information updated
xii	Foreword	(1) Subparagraph (k) added and subsequent subparagraph redesignated (2) Second footnote revised (3) Last paragraph added
xv	Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees	Paragraphs 1(a)(3)(-b), 2(b), and 5(a)(3) revised
xviii	Personnel	Updated
xxxix	Introduction	Fourth paragraph under "Introduction," first paragraph under "Procedure Qualifications," and fourth paragraph under "Welding, Brazing, and Fusing Data" revised
1	QG-100	In subpara. (d), "becomes" revised to "become"
1	QG-101	In second paragraph, "Code" revised to "code"
1	QG-102	Second paragraph revised
2	QG-104	Last paragraph revised
2	QG-105.3	Revised
2	QG-106	Subparagraph (a) revised
2	QG-106.1	Subparagraphs (a), (b), and (c) revised
3	QG-106.2	In subpara. (g), first sentence revised
3	QG-106.3	In subpara. (b), "jointing" revised to "joining"
4	QG-106.4	Added
4	QG-107	First paragraph and subpara. (c) revised
4	QG-108	Last paragraph revised
5	QG-109.2	(1) Definitions of <i>backing</i> and <i>interpass temperature</i> revised (2) Definitions of <i>quality program</i> and <i>welding, explosion (EXW)</i> added (3) Definition of <i>welding gun, electron beam</i> deleted
15	QW-101	Third paragraph revised
19	QW-162.1	Last paragraph added

<i>Page</i>	<i>Location</i>	<i>Change</i>
20	QW-184	Revised
21	QW-191.1.2.1	Subparagraph (c) added
21	QW-191.1.2.2	(1) First paragraph added (2) Subparagraphs (a)(2)(-a), (a)(2)(-b), (a)(2)(-c), (a)(3), and (b)(1) revised
23	QW-191.2.1	Subparagraph (c) added
23	QW-191.2.2	(1) First paragraph added (2) Subparagraphs (b)(1), (b)(2), and (b)(3) revised
24	QW-192.1.4	Revised in its entirety
25	QW-196.1.2	(1) In first paragraph and throughout in-text table, “ <i>t</i> ” revised to “ <i>T</i> ” (2) In in-text table, “ <i>T</i> ” added to first column heading
26	QW-199.1.3	In equations and nomenclature, “ <i>t</i> ” revised to “ <i>T</i> ”
29	QW-200.1	Subparagraphs (b) and (c) revised
29	QW-200.2	Subparagraph (d) revised
30	QW-200.4	Subparagraphs (a), (a)(2), and (b) revised
31	QW-202.1	Fourth paragraph revised
31	QW-202.2	Subparagraph (c) revised
32	QW-202.5	Last sentence revised
33	QW-215.4	Added
34	QW-217	Subparagraph (a) revised, and title added to subpara. (b)
35	QW-218.3	Cross-reference revised
35	QW-251.2	Revised
39	Table QW-253	QW-404.7 deleted
43	Table QW-255	QW-403.10 and QW-404.32 deleted
49	Table QW-257	QW-410.12 deleted
59	Table QW-264	(1) For QW-409.21, entry under “Brief of Variables” revised (2) QW-410.7 deleted, and QW-410.86 added
60	Table QW-264.1	(1) For QW-409.21, entries under “Essential Variables” revised (2) QW-410.7 and QW-410.14 deleted (3) QW-410.86 added
61	Table QW-264.2	For QW-409.10, entry under “Brief of Variables” revised
67	Table QW-288.1	(1) Former QW-403.33 entry deleted by errata, and QW-403.34 corrected by errata to QW-403.33 (2) For QW-409.10, entry under “Brief of Variables” corrected by errata to “ ϕ Amperage” (3) “> Amperage” deleted from Legend by errata
67	Table QW-288.2	QW-403.35 corrected by errata to QW-403.34
68	QW-290	First paragraph, QW-290.1 through QW-290.3, and QW-290.5(b) revised
72	QW-301.2	Second paragraph revised, and last paragraph added

<i>Page</i>	<i>Location</i>	<i>Change</i>
72	QW-301.4	Revised
73	QW-304	In first paragraph, penultimate sentence revised
74	QW-305	In first paragraph, penultimate sentence revised
75	QW-322	(1) QW-322.1 revised in its entirety (2) QW-322.2 added, and subsequent paragraph redesignated
77	QW-361.2	Subparagraph (f) revised
79	QW-387	Subparagraphs (b) and (c) revised, and subparagraph (c)(3) added
80	Table QW-388	Title, QW-409.10 entry, and Legend revised
81	QW-401.1	Third paragraph revised
82	QW-402.20	Incorrectly deleted from 2019 Edition; reinstated by errata
82	QW-402.31	Incorrectly designated as QW-402.30 in 2019 Edition; designator corrected by errata
82	QW-402.32	Incorrectly designated as QW-402.31 in 2019 Edition; designator corrected by errata
83	QW-403.5	Last paragraph revised
83	QW-403.6	Last sentence revised
84	QW-403.32	Incorrectly designated as QW-403.31 in 2019 Edition; designator corrected by errata
84	QW-403.33	Incorrectly designated as QW-403.32 in 2019 Edition; designator corrected by errata
84	QW-403.34	Incorrectly designated as QW-402.33 in 2019 Edition; designator corrected by errata
85	QW-404.5	(1) Subparagraph (b) revised (2) Subparagraph (c) added, and subsequent subparagraphs revised and redesignated
85	QW-404.7	Deleted
86	QW-404.36	Revised
88	QW-406.3	Last sentence revised
88	QW-407.2	In second paragraph, last sentence added
89	QW-409.1	Last paragraph revised
90	QW-409.4	Last sentence added
90	QW-409.20	Revised
90	QW-409.21	Revised
91	QW-410.7	Revised
91	QW-410.9	Last sentence revised
92	QW-410.12	Deleted
92	QW-410.14	Revised
94	QW-410.86	Added
96	QW-420	Revised in its entirety

<i>Page</i>	<i>Location</i>	<i>Change</i>
98	Table QW/QB-422	(1) Revised and rows added (2) AWS B2.2 BM-Numbers for A/SA-182 F904L and A/SA-182 F6a, Cl. 1, corrected by errata to 420 and 150, respectively (3) ISO 15608 Group Number for A/SA-494 CX2MW and for B/SB-366, B/SB-462, B/SB-564, B/SB-619, B/SB-622, and B/SB-626 UNS No. N06022 corrected by errata to 43 (4) A/SA-1011 SS 36 1 added by errata
175	QW-423.2	First sentence revised
176	Table QW-432	(1) Under “Steel and Steel Alloys,” SFA-5.36 deleted and SFA-3.9 added (2) Under “Aluminum and Aluminum Alloys,” AWS Classification R3101 revised to R3103 (3) Under “Nickel and Nickel Alloys,” SFA-5.11 UNS Nos. W86056 and N10362, and SFA-5.14 UNS Nos. N07740, N07208, N06056, N06680, N10362, and N09946 added
187	Table QW-451.1	Note (1) revised
188	Table QW-451.2	Note (1) revised
199	QW-462	Last paragraph added
202	Figure QW-462.1(e)	Note (1) added
203	Figure QW-462.2	Item (2) editorially revised
204	Figure QW-462.3(a)	In table, first entry under “ <i>T</i> , in. (mm)” revised
205	Figure QW-462.3(b)	In table, first entry under “ <i>T</i> , in. (mm)” revised
227	Figure QW-466.1	In both “U.S. Customary Units” and “SI Units” tables, third and fourth column headings, last row, and values for <i>C</i> and <i>D</i> revised
235	QW-500	Revised in its entirety
239	QB-153.2	Cross-reference revised
240	QB-180	QB-181 and QB-182 revised
247	QB-301.2	Revised
248	QB-305	Revised in its entirety
254	Table QB-451.3	Note (1) revised
254	Table QB-451.4	Note (2) editorially revised
257	QB-460	QB-461 and QB-462 designators and titles added
265	Figure QB-462.4	General Note revised
278	QF-142.1.1	Subparagraph (d) revised
283	QF-201.1	Subparagraph (b) revised
283	QF-201.2	Subparagraph (a)(2) revised
286	QF-202.2.3	Title and subparagraph (a) revised
288	QF-221.2	Subparagraphs (d) and (f) revised
289	Table QF-221.2	Title revised
292	Table QF-257	QF-403.8 replaced by QF-403.2
295	Table QF-362	In section (c), QF-403.7 replaced by QF-403.2

<i>Page</i>	<i>Location</i>	<i>Change</i>
296	QF-403.7	Deleted
297	Table QF-422	Entries for D3035 and F714 corrected by errata
298	Table QF-452.3	Section (c) title revised, and section (d) added
336	Form QB-484	Editorially revised
337	Nonmandatory Appendix D	Deleted
338	Mandatory Appendix E	Revised in its entirety
348	K-301	Last paragraph revised
350	L-200	Subparagraph (d) revised

LIST OF CHANGES IN RECORD NUMBER ORDER

DELETED

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

(21) 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 qualification 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 become 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.

(21) 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 shall be available for reference and review at the fabrication site.

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 (21)

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 by the referencing code, standard, or specification for qualification of the procedure, 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 program. The PQR shall be available for review. 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).