ASME BPVC.IX-2023

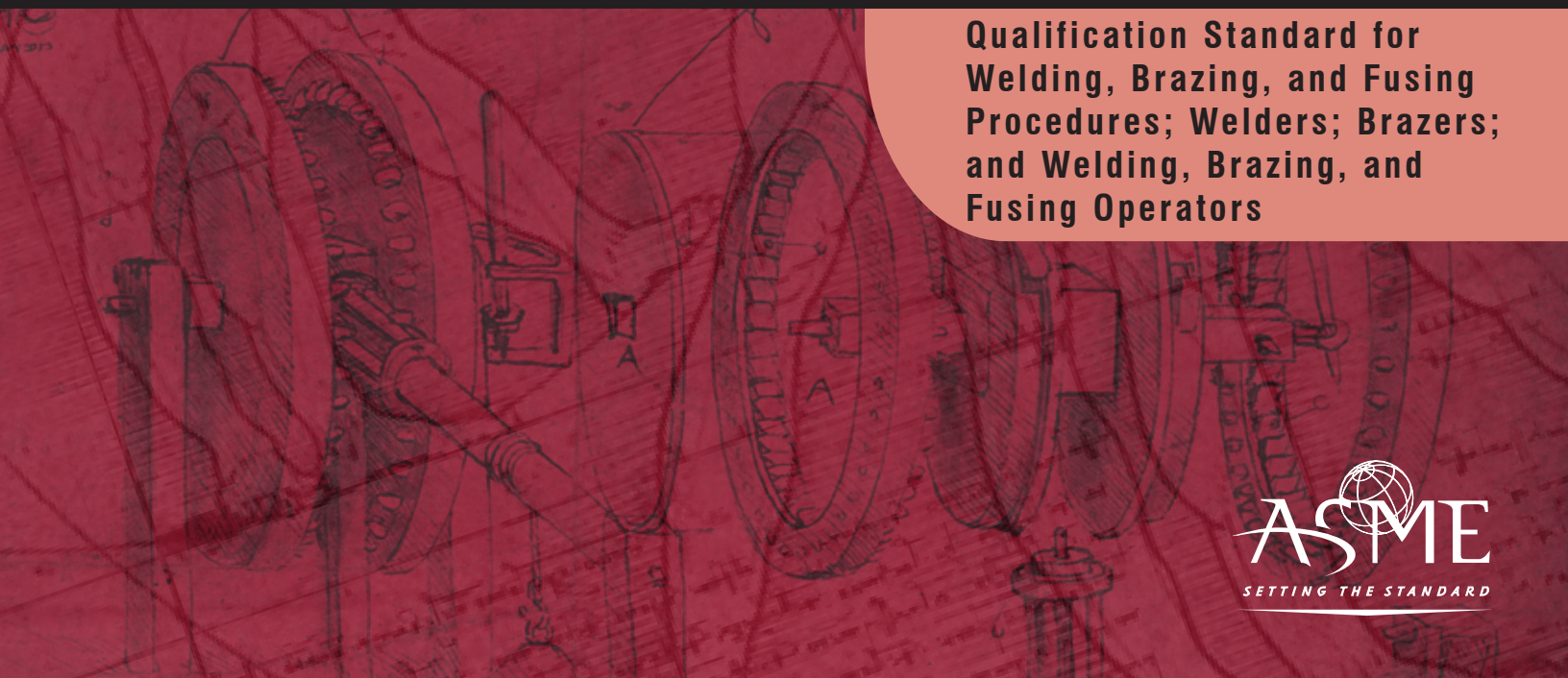
# SECTION IX

Welding, Brazing, and Fusing Qualifications

# 2023 ASME Boiler and Pressure Vessel Code

An International Code

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



ASME

SETTING THE STANDARD

AN INTERNATIONAL CODE

# 2023 ASME Boiler & Pressure Vessel Code

2023 Edition July 1, 2023

# 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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Date of Issuance: July 1, 2023

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

ASME Collective Membership Mark

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Library of Congress Catalog Card Number: 56-3934

Adopted by the Council of The American Society of Mechanical Engineers, 1914; latest edition 2023.

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# FOREWORD*

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 In 2009, the Boiler and Pressure Vessel Committee was superseded by the following committees:

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

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

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

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

The Committee recognizes that tools and techniques used for design and analysis change as technology progresses and expects engineers to use good judgment in the application of these tools. The designer is responsible for complying with Code rules and demonstrating compliance with Code equations when such equations are mandatory. The Code neither requires nor prohibits the use of computers for the design or analysis of components constructed to the requirements of the Code. However, designers and engineers using computer programs for design or analysis are cautioned that they are responsible for all technical assumptions inherent in the programs they use and the application of these programs to their design.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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January 1, 2023

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# CORRESPONDENCE WITH THE COMMITTEE

## General

ASME codes and standards are developed and maintained by committees with the intent to represent the consensus of concerned interests. Users of ASME codes and standards may correspond with the committees to propose revisions or cases, report errata, or request interpretations. Correspondence for this Section of the ASME Boiler and Pressure Vessel Code (BPVC) should be sent to the staff secretary noted on the Section's committee web page, accessible at https://go.asme.org/CSCommittees.

NOTE: See ASME BPVC Section II, Part D for guidelines on requesting approval of new materials. See Section II, Part C for guidelines on requesting approval of new welding and brazing materials ("consumables").

## Revisions and Errata

The committee processes revisions to this Code on a continuous basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Code. Approved revisions will be published in the next edition of the Code.

In addition, the committee may post errata and Special Notices at http://go.asme.org/BPVCerrata. Errata and Special Notices become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata and Special Notices.

This Code is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

## Cases

*(a)* The most common applications for cases are

*(1)* to permit early implementation of a revision based on an urgent need

*(2)* to provide alternative requirements

*(3)* to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Code

*(4)* to permit use of a new material or process

*(b)* Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Code.

*(c)* The committee will consider proposed cases concerning the following topics only:

*(1)* equipment to be marked with the ASME Single Certification Mark, or

*(2)* equipment to be constructed as a repair/replacement activity under the requirements of Section XI

*(d)* A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

*(1)* a statement of need and background information

*(2)* the urgency of the case (e.g., the case concerns a project that is underway or imminent)

*(3)* the Code Section and the paragraph, figure, or table number(s) to which the proposed case applies

*(4)* the edition(s) of the Code to which the proposed case applies

*(e)* A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Cases that have been approved will appear in the next edition or supplement of the Code Cases books, "Boilers and Pressure Vessels" or "Nuclear Components." Each Code Cases book is updated with seven Supplements.

Supplements will be sent or made available automatically to the purchasers of the Code Cases books until the next edition of the Code. Annulments of Code Cases become effective six months after the first announcement of the annulment in a Code Case Supplement or Edition of the appropriate Code Case book. The status of any case is available at http://go.asme.org/BPVCCDatabase. An index of the complete list of Boiler and Pressure Vessel Code Cases and Nuclear Code Cases is available at http://go.asme.org/BPVCC.

## Interpretations

*(a)* Interpretations clarify existing Code requirements and are written as a question and reply. Interpretations do not introduce new requirements. If a revision to resolve conflicting or incorrect wording is required to support the interpretation, the committee will issue an intent interpretation in parallel with a revision to the Code.

*(b)* Upon request, the committee will render an interpretation of any requirement of the Code. An interpretation can be rendered only in response to a request submitted through the online Interpretation Submittal Form at http://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic e-mail confirming receipt.

*(c)* ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Code requirements. If, based on the information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers may track the status of their requests at http://go.asme.org/Interpretations.

*(d)* ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME committee or subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

*(e)* Interpretations are published in the ASME Interpretations Database at http://go.asme.org/Interpretations as they are issued.

## Committee Meetings

The ASME BPVC committees regularly hold meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the applicable committee. Information on future committee meetings can be found at http://go.asme.org/BCW.

# 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. 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) that 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. Table 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

Changes listed below are identified on the pages by a margin note, **(23)**, placed next to the affected area.

| *Page* | *Location* | *Change* |
|---|---|---|
| xii | List of Sections | (1) Under Section III, Division 4 added<br>(2) Title of Section XI and subtitle of Section XI, Division 2 revised<br>(3) Information on interpretations and Code cases moved to "Correspondence With the Committee" |
| xvi | Personnel | Updated |
| xxxviii | Correspondence With the Committee | Added (replaces "Submittal of Technical Inquiries to the Boiler and Pressure Vessel Standards Committees") |
| xlvii | Cross-Referencing in the ASME BPVC | Updated |
| 1 | QG-101 | Second paragraph revised |
| 2 | QG-106.1 | In subpara. (a), last sentence deleted by errata |
| 4 | QG-106.4 | First paragraph revised |
| 4 | QG-108 | Revised in its entirety |
| 5 | QG-109.2 | (1) Definitions of *bracketed qualification*, *initial heating interfacial pressure*, *integrated backing*, *material-joining processes*, and *wire-additive welding* added<br>(2) Definitions of *fusing gauge pressure*, *fusing operator*, *fusing procedure specification*, *heat soak cycle*, *heat soak time*, *heater removal (dwell) time*, *heater temperature*, *interfacial pressure*, *Manufacturer Qualified Electrofusion Procedure Specification (MEFPS)*, *melt bead size*, and *organization* revised |
| 15 | QW-101 | Third paragraph revised |
| 19 | QW-162.1 | Second and fourth paragraphs revised |
| 20 | QW-181.1 | Revised |
| 21 | QW-191.1.2.1 | Subparagraph (c) revised |
| 21 | QW-191.1.2.2 | Subparagraphs (a) and (b) revised in their entirety |
| 25 | QW-193.1.2 | Revised |
| 25 | QW-195.1 | Revised |
| 26 | QW-195.3 | Added |
| 29 | QW-200.1 | First paragraph and subpara. (b) revised |
| 29 | QW-200.2 | First paragraph revised |
| 31 | QW-202.4 | Subparagraph (b)(1) revised |
| 32 | QW-214.2 | Subparagraph (a) revised |
| 33 | QW-216.2 | Subparagraph (a) revised |
| 34 | QW-217 | Subparagraphs (a)(2) and (b) revised |
| 35 | QW-218.2 | Revised |
| 36 | QW-251.4 | Revised |
| 39 | Table QW-253 | (1) "Supplementary Essential" entries for QW-409.4 and QW-410.9 deleted<br>(2) QW-409.30 and QW-410.87 added |
| 41 | Table QW-254 | (1) "Supplementary Essential" entries for QW-409.4 and QW-410.9 deleted<br>(2) QW-409.30 and QW-410.87 added |
| 44 | Table QW-255 | (1) QW-409.2 and "Supplementary Essential" entries for QW-409.4 and QW-410.9 deleted<br>(2) QW-409.30, QW-409.32, and QW-410.87 added |
| 47 | Table QW-256 | (1) "Supplementary Essential" entries for QW-409.4 and QW-410.9 deleted<br>(2) QW-409.30 and QW-410.87 added |
| 50 | Table QW-257 | (1) "Supplementary Essential" entries for QW-409.4 and QW-410.9 deleted<br>(2) QW-409.30 and QW-410.87 added |

| *Page* | *Location* | *Change* |
|---|---|---|
| 54 | Table QW-258 | (1) QW-410.7 deleted<br>(2) QW-410.86 added |
| 56 | Table QW-259 | (1) “Supplementary Essential” entries for QW-409.4 and QW-410.9 deleted<br>(2) QW-409.30 and QW-410.87 added |
| 57 | Table QW-260 | (1) QW-410.7 deleted<br>(2) QW-410.86 added |
| 61 | Table QW-264 | (1) QW-403.1 deleted<br>(2) QW-403.35 added |
| 74 | QW-300.1 | Third paragraph added |
| 75 | QW-304 | Second paragraph deleted |
| 76 | QW-305 | Second paragraph deleted |
| 76 | QW-306 | First paragraph revised |
| 77 | QW-322.1 | Second paragraph revised |
| 79 | Table QW-358 | Added |
| 79 | QW-361.1 | Subparagraph (e) revised |
| 80 | QW-362 | First sentence revised |
| 80 | QW-381.1 | Revised in its entirety |
| 80 | QW-382.1 | (1) Subparagraphs (c), (d), and (g) revised<br>(2) Subparagraph (h) deleted |
| 83 | QW-401.1 | Third paragraph revised |
| 85 | QW-403.10 | Deleted |
| 86 | QW-403.35 | Added |
| 87 | QW-403.36 | Added |
| 87 | QW-404.12 | Revised |
| 90 | QW-406.12 | Added |
| 91 | QW-408.2 | Revised in its entirety |
| 92 | QW-409.1 | Editorially revised |
| 92 | QW-409.4 | Revised |
| 93 | QW-409.26 | Revised in its entirety |
| 94 | QW-409.30 | Added |
| 94 | QW-409.31 | Added |
| 94 | QW-409.32 | Added |
| 94 | QW-410.9 | Revised in its entirety |
| 95 | QW-410.38 | Revised |
| 98 | Table QW-416 | (1) Last column and QW-410 paragraphs added<br>(2) “Brief of Variables” entry for QW-408.8 revised |
| 97 | QW-410.87 | Added |
| 97 | QW-410.88 | Added |
| 97 | QW-410.89 | Added |
| 97 | QW-410.90 | Added |
| 99 | QW-421.1 | Revised in its entirety |
| 99 | QW-421.3 | Subparagraph (a) revised |
| 99 | QW-421.4 | Revised |
| 101 | Table QW/QB-422 | (1) Title revised<br>(2) ISO column moved under “Welding”<br>(3) Under “Brazing,” “P-No.” column deleted and “AWS B2.2 BM” column relabeled as “P-No.”<br>(4) “A/SA–” replaced with “A or SA–” and “B/SB–” replaced with “B or SB–” throughout<br>(5) Rows added and revised<br>(6) General Note added |
| 190 | QW-424.3 | Added |

| *Page* | *Location* | *Change* |
|---|---|---|
| 207 | Table QW-452.4 | General Note (a) revised |
| 216 | Figure QW-462.1(a) | Bottom callout revised |
| 217 | Figure QW-462.1(b) | Bottom callout revised |
| 222 | Figure QW-462.4(a) | (1) Shading added to left fillet weld<br>(2) General Note revised |
| 225 | Figure QW-462.5(b) | Note (2) revised |
| 236 | Figure QW-463.2(a) | Bottom image revised |
| 236 | Figure QW-463.2(b) | Bottom image revised |
| 237 | Figure QW-463.2(c) | Bottom image revised |
| 243 | Figure QW-466.1 | (1) Under "*D*, in.," penultimate entry corrected by errata from "$^{3}/_{16}$ max." to "$1^{3}/_{16}$ max."<br>(2) General Note (c) revised |
| 245 | Figure QW-466.3 | General Note (d) deleted |
| 252 | Article VI | Added |
| 258 | QB-161.2 | Last sentence revised |
| 260 | QB-200.1 | First paragraph and subpara. (b) revised |
| 260 | QB-200.2 | First paragraph revised |
| 262 | QB-211 | Second paragraph revised |
| 262 | QB-212 | Revised |
| 262 | Table QB-252 | Second and third column heads revised |
| 263 | Table QB-253 | Second and third column heads revised |
| 263 | Table QB-254 | Second and third column heads revised |
| 264 | Table QB-255 | Second and third column heads revised |
| 264 | Table QB-256 | Second and third column heads revised |
| 265 | Table QB-257 | Second and third column heads revised |
| 266 | QB-300.1 | Second paragraph revised |
| 267 | QB-304 | Second paragraph deleted |
| 267 | QB-322 | Revised and QB-322.1 added |
| 267 | QB-351.2 | Title revised |
| 270 | Table QB-432 | First column deleted |
| 274 | Table QB-451.4 | Last column head revised |
| 274 | Table QB-451.5 | Last column head revised |
| 275 | Table QB-452.1 | Last column head revised |
| 275 | Table QB-452.2 | (1) Last column head revised<br>(2) Note (1) added |
| 279 | Figure QB-462.1(a) | Bottom callouts on each image revised |
| 280 | Figure QB-462.1(b) | Bottom callouts on first two images revised |
| 281 | Figure QB-462.1(c) | Bottom callouts on first two images revised |
| 303 | QF-200 | Revised |
| 303 | QF-201.1 | Subparagraph (b) revised |
| 303 | QF-201.2 | Subparagraph (b)(1) revised |
| 303 | QF-201.5 | First paragraph revised |
| 308 | QF-221.2 | Subparagraphs (d)(1) and (d)(2) revised |
| 309 | QF-222.1 | (1) Subparagraph (e) revised<br>(2) Subparagraph (g) added and subsequent subparagraphs redesignated |
| 310 | Table QF-254 | "Brief of Variables" entry for QF-405.9 revised |
| 312 | Table QF-257 | "Brief of Variables" entry for QF-405.9 revised |
| 313 | QF-300 | Revised |
| 313 | QF-301.2 | Third sentence deleted |
| 316 | QF-402.3 | Revised |
| 316 | QF-405.9 | Revised |
| 334 | Form QF-482(c) | "Thermal Conditions (QF-405)" box revised |

| *Page* | *Location* | *Change* |
|---|---|---|
| 340 | Form QF-483(c) | “Thermal Conditions (QF-405)” box revised |
| 347 | B-101 | First sentence revised |
| 350 | Form QW-483 | Fill-in field for “QG-106.4 Group Qualification” added |
| 352 | Form QW-484A | “Welding Variables (QW-350)” column revised |
| 358 | E-300 | In in-text table, edition year for AWS B2.1-1-209 updated |
| 367 | J-100 | First sentence revised |
| 371 | Nonmandatory Appendix L | Revised in its entirety |

# CROSS-REFERENCING IN THE ASME BPVC (23)

Paragraphs within the ASME BPVC may include subparagraph breakdowns, i.e., nested lists. The following is a guide to the designation and cross-referencing of subparagraph breakdowns:

*(a) Hierarchy of Subparagraph Breakdowns*

*(1)* First-level breakdowns are designated as (a), (b), (c), etc.

*(2)* Second-level breakdowns are designated as (1), (2), (3), etc.

*(3)* Third-level breakdowns are designated as (-a), (-b), (-c), etc.

*(4)* Fourth-level breakdowns are designated as (-1), (-2), (-3), etc.

*(5)* Fifth-level breakdowns are designated as (+a), (+b), (+c), etc.

*(6)* Sixth-level breakdowns are designated as (+1), (+2), etc.

*(b) Cross-References to Subparagraph Breakdowns.* Cross-references within an alphanumerically designated paragraph (e.g., PG-1, UIG-56.1, NCD-3223) do not include the alphanumerical designator of that paragraph. The crossreferences to subparagraph breakdowns follow the hierarchy of the designators under which the breakdown appears. The following examples show the format:

*(1)* If X.1(c)(1)(-a) is referenced in X.1(c)(1), it will be referenced as (-a).

*(2)* If X.1(c)(1)(-a) is referenced in X.1(c)(2), it will be referenced as (1)(-a).

*(3)* If X.1(c)(1)(-a) is referenced in X.1(e)(1), it will be referenced as (c)(1)(-a).

*(4)* If X.1(c)(1)(-a) is referenced in X.2(c)(2), it will be referenced as X.1(c)(1)(-a).

# PART QG
# GENERAL REQUIREMENTS

## 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.

## QG-101 PROCEDURE SPECIFICATION (23)

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." A procedure specification shall address, as a minimum, the specific essential and nonessential variables that are applicable to the material-joining process to be used in production. When the referencing code, standard, or specification requires toughness qualification of the material-joining procedure, the applicable supplementary essential variables shall also be addressed in the procedure specification.

## QG-102 PROCEDURE QUALIFICATION RECORD

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

The procedure qualification record (PQR) documents what occurred during the production of a procedure qualification test coupon and the results of testing that coupon. As a minimum, the PQR shall document the essential procedure qualification test variables applied during production of the test joint, and the results of the required tests. When toughness testing is required by the referencing code, standard, or specification for qualification of the