



Summary of Significant Changes in the 2021 ASME Boiler and Pressure Vessel Code

Section XI
Section II
Section V
Section IX



Summary of Significant Changes in the 2021 ASME Boiler and Pressure Vessel Code

Sections XI, II, V, and IX



**The American Society of
Mechanical Engineers**

Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: April 23, 2021

ASME does not issue written replies to inquiries concerning this publication.

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

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FOREWORD

This book is a companion to the 2021 ASME Boiler and Pressure Vessel Code (BPVC). It explains only significant changes to Code requirements that have been approved since 2019 and that will be published in the 2021 Edition. It covers the following ASME BPVC Sections:

- Section XI, Divisions 1 and 2
- Section II, Parts A, B, C, and D
- Section V
- Section IX

For each of the above Sections, an Introduction describes the historical background, scope of coverage, and commercial application of that Section by industry and government organizations. The list of changes follows the Introduction. The “Explanation” for each change provides the reason for the action and the value to the Code user. The sequence of the changes follows the order of the Code requirements.

ACKNOWLEDGMENTS

This book is the work of the following ASME Standards and Certification (S&C) staff:

- Daniel Miro-Quesada, *S&C Project Engineer*, Section XI
- Colleen E. Rodrigues, *S&C Project Engineering Manager*, Section II, Parts A, B, and D
- Erika Lawson, *S&C Project Engineer*, Section II, Part C; and Section IX
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ASME Press's *Online Companion Guide to the ASME Boiler and Pressure Vessel Codes: Criteria and Commentary on Select Aspects of the Boiler & Pressure Vessel and Piping Codes* (January 2020) provided source material for the Introduction preceding each list of changes. The complete Guide is available in the ASME Digital Collection at <https://asmedigitalcollection.asme.org/ebooks/pages/onlinecompanionguide>.

ASME gratefully acknowledges the members of the following volunteer committees, who are responsible for development of the ASME Boiler and Pressure Vessel Code Sections noted in this book:

- BPV Committee on Nuclear Inservice Inspection (XI)
- BPV Committee on Materials (II)
- BPV Committee on Nondestructive Examination (V)
- BPV Committee on Welding, Brazing, and Fusing (IX)

SECTION XI

Introduction

1 DIVISION 1

Section XI, Division 1 of the ASME Boiler and Pressure Vessel Code (BPVC) provides requirements for examination, testing, and inspection of components and systems, and repair/replacement activities in light-water cooled nuclear power plants [e.g., pressurized water reactors (PWRs) and boiling water reactors (BWRs)]. The applicability of Section XI is limited to dealing with degradation detected by periodic inservice inspection, and to repair, replacement, and modification activities performed for any reason. Section XI is not applicable to flaws identified at times other than during periodic inservice inspection or repair/replacement activities. Application of Section XI begins when the requirements of the Construction Code have been satisfied. At such time, an item will have passed a specified preservice inspection to serve as a baseline for future inservice inspections. The item will be subject to inservice inspection again after a specified period, which includes specified nondestructive examination. Degradation of the item is evaluated against the flaw acceptance criteria of Section XI to determine if continued operation is acceptable or if repair/replacement activities are necessary to make the item in compliance with the Construction Code again.

Division 1 is divided into Subsections that provide graduated criteria for different Code classes of components, including steel vessels, piping, pumps, valves, and concrete structures. It is the responsibility of the Owner to categorize the Code class of the component and apply the respective Subsection as follows:

- Subsection IWA: General requirements (applicable to all classes of components and supports)
- Subsection IWB: Class 1 components
- Subsection IWC: Class 2 components
- Subsection IWD: Class 3 components
- Subsection IWE: Class MC and CC components
- Subsection IWF: Class 1, 2, 3, and MC component supports
- Subsection IWG: Core Internal structures (in the course of preparation)
- Subsection IWL: Class CC concrete components

Section XI assigns duties to an Authorized Nuclear Inservice Inspector to verify that the responsibilities of the Owner and the mandatory requirements of Section XI are met.

The first publication of Section XI was the 1970 Edition, Rules for Inservice Inspection of Nuclear Reactor Coolant Systems, which only covered rules for inservice inspection of the primary pressure boundary system of nuclear power plants. Section XI was later expanded to contain three Divisions as well as Mandatory and Nonmandatory Appendices. Division 1 provides requirements specifically for light-water cooled nuclear power plants. The former Division 2 covered gas-cooled reactors but was discontinued in 1995. A rewrite of Division 2 was later initiated to provide requirements for the next generation of high-temperature, modular, gas-cooled reactors. Division 2 was published as its own book for the 2019 Edition and is applicable to any reactor design. The former Division 3 covered requirements for liquid-metal-cooled plants but was deleted because it was not widely used by the industry. Section XI previously had testing requirements for pumps, valves, and snubbers in Subsections IWP and IWV, but those were removed in the 1998 Edition (with 2000 Addenda). These requirements are now in ASME OM, Operation and Maintenance of Nuclear Power Plants, and the U.S. Nuclear Regulatory Commission (NRC) references ASME OM for these requirements. Owner responsibilities are identified in IWA-1400 and further detailed elsewhere in Section XI.

Section XI is a voluntary consensus standard that becomes mandatory once it is imposed by law, such as by the applicable regulatory agency depending on the country. The NRC requires the use of certain voluntary consensus standards through incorporation by reference in 10 CFR 50.55a, which is periodically updated to include the latest editions of Section XI. The NRC identifies provisions by which use of Section XI is limited in 10 CFR 50.55a(b)(2). The use of Section XI

Code Cases is accepted for use with specified conditions as listed in NRC Regulatory Guide 1.147. Section XI Code Cases deemed not to be acceptable for use on a generic basis are listed in NRC Regulatory Guide 1.193. The NRC amended its regulations to incorporate by reference the 2015 and 2017 Editions of the ASME BPVC and the OM Code on June 3, 2020.

2 DIVISION 2

Section XI, Division 2 of the ASME Boiler and Pressure Vessel Code (BPVC) provides requirements for protecting pressure integrity of structures, systems, and components (SSCs) that affect reliability. Like Division 1, application of Division 2 begins when the requirements of the Construction Code have been satisfied. However, Division 2 is a technology-neutral standard that may be applied to any reactor design, including advanced reactor design. Division 2 uses the reliability and integrity management (RIM) methodology to establish criteria for inservice inspection of reactors; these criteria may be established by deterministic or probabilistic methods. While Division 1 has graduated criteria depending on the Code class of the SSC, Division 2 includes any SSC that is deemed risk-significant in the scope of its RIM program. RIM uses monitoring and nondestructive examination (MANDE) criteria for detection of degradation mechanisms that may result in failure of an SSC. The RIM Expert Panel (RIMEP) and Monitoring and NDE Expert Panel (MANDEEP) are responsible for determining and assigning MANDE.

After Division 2 was removed from Section XI in 1995, a rewrite of Division 2 was initiated to provide risk-informed inspection requirements for the next generation of high-temperature, modular, gas-cooled reactors. This rewrite was accelerated by the need to develop an inservice inspection program for a pebble bed modular reactor (PBMR) being designed for licensing and construction in South Africa. The South African project was later terminated in 2010, but the rewrite of Division 2 proceeded. Small modular integrated, pressurized water reactors (SMR/IPWR) became a focus of design and licensing efforts in 2011. The Joint Committee on Nuclear Risk Management (JCNRM) was formed and developed ASME/ANS RA-S-1.4-2013, Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants. In response to these developments, Section XI made efforts to address SMR/IPWR designs in Division 2 and worked with JCNRM to reclassify “non-LWR” as “technology neutral,” making the standard applicable to new SMR/IPWR designs. In 2019, Division 2 was published as its own book, replacing the 2017 Edition of Section XI, Division 2, Rules for Inspection and Testing of Components of Gas-Cooled Plants.

Division 2 is not currently listed in 10 CFR 50.55a. In contrast to the prescriptive requirements of Division 1, Division 2 provides a process for developing an inservice inspection program. Due to these differences, it is anticipated a Regulatory Guide may be used to endorse RIM as an acceptable process rather than it being mandated in 10 CFR 50.55a. The RIM process has also been pursued outside of the United States, particularly in Japan where there is an ASME/JSME Joint Working Group on RIM Processes and System Based Code.

Division 1

Location: IWA-2110

Subject: Duties of the Inspector and Authorized Nuclear Inservice Inspector Supervisor

Explanation: Paragraph IWA-2110(a) has been added to address the duties of the Authorized Nuclear Inservice Inspector Supervisor (ANIIS) by reference to ASME QAI-1. Paragraph IWA-2110(b) [renumbered from IWA-2110(a)] has been revised to reference ASME QAI-1 for duties of the inspector.

Location: IWA-2120

Subject: Qualification of Inspectors

Explanation: Paragraph IWA-2120 has been revised to recognize the three types of organizations that may qualify as an Authorized Inspection Agency (AIA), per ASME QAI-1. Only two types of AIAs were previously addressed: inspection organizations of jurisdictions and of insurance companies. This revision ensures the third type, a company in the business of providing third-party inspection services, is also addressed.

Location: IWA-2212

Subject: Use of Remote VT-2 Examinations

Explanation: Paragraph IWA-2212(c) has been revised to provide clarification regarding the use of remote VT-2 examinations in areas other than those that are inaccessible or harmful to the examiner. This revision clarifies that VT-2 examinations can be performed either directly or remotely to detect evidence of leakage when there are adequate resolution and lighting.

Location: IWA-3300 and Tables IWB-3510-1, IWB-3512-1, IWB-3514-1, IWB-3519.2-1, IWB-3519.2-2, IWC-3510-1, IWC-3511-1 and IWC-3514-1

Subject: Clarification of Flaw-to-Surface Proximity Factor Y

Explanation: Paragraph IWA-3300(b) has been revised to clarify what flaw dimensions are used to define the flaw-to-surface proximity factor Y when a combined subsurface flaw could interact with the free surface of a component. Note (4) in Tables IWB-3510-1, IWB-3512-1, IWB-3514-1, IWB-3519.2-1, IWB-3519.2-2, IWC-3510-1, IWC-3511-1 and IWC-3514-1 has been revised to note that factor Y of a combined single flaw shall be the smallest Y value of each individual flaw contained in the combined single flaw.

Location: IWA-4134

Subject: Purchase, Exchange, or Transfer of Material Between Owners

Explanation: Paragraph IWA-4134 has been revised to allow material to be procured by the supplying Owner in accordance with their Quality Assurance Program rather than with Section III, Subsection NA, NA-3700, or Subsection NCA, NCA-3800. This revision provides a means for non-NA-3700/NCA-3800 material to be used for applications requiring compliance with NA-3700 or NCA-3800. Paragraph IWA-4134 has also been retitled to "Purchase, Exchange, or Transfer of Material Between Owners."

Location: IWA-4142.1 and Article IWA-9000

Subject: Alternative Quality Assurance Program Requirements for Owners

Explanation: Paragraph IWA-4142.1 has been revised to allow an Owner to use their Quality Assurance Program to qualify material suppliers and qualify source material in the same manner allowed for non-Section III plants. This revision simplifies the requirements of IWA-4142.1 so that the Owner does not have to develop a separate program that will impact their Quality Assurance Program Manuals, quality assurance organizations, and supplier quality. Definitions for *qualified source material*, *audit*, and *unqualified source material* have been added to Article IWA-9000.

Location: IWA-4143

Subject: Removal of Fabrication Location Restriction

Explanation: Paragraph IWA-4143(a) has been revised to remove a limitation on where the fabrication of parts, appurtenances, piping subassemblies, and supports may be performed by the Owner's contracted Repair/Replacement Organization.

Location: IWA-4226.2

Subject: Use of Allowable Stresses

Explanation: Paragraph IWA-4226.2(c) has been added to clarify how to use allowable stresses from later Editions and Addenda with earlier materials, designs, and NDE.

Location: IWA-5241

Subject: Use of Remote VT-2 Examinations

Explanation: Paragraph IWA-5241(c) has been revised to remove reference to the use of remote visual equipment when performing VT-2 examinations on components in inaccessible areas.

Location: IWA-5244, IWA-6340, IWC-3516, IWD-3511, Article IWA-9000, and Tables IWC-2500-1 and IWD-2500-1
Subject: Pressure Testing Requirements for Buried Components

Explanation: Paragraph IWA-5244 has been revised to allow one of three pressure test options (i.e., ground surface examination, pressure drop test, or inventory reduction test) for buried Class 2 and Class 3 components to provide more flexibility to Owners. Section XI previously required both a ground surface examination and one of three test options (i.e., pressure drop test, unimpaired flow test, or difference in flow). Paragraphs IWC-3516 and IWD-3511 have been revised to address relevant conditions detected through the visual examination of a component in IWA-5240. The definition of *buried component or support* in Article IWA-9000 has been revised to refer to a component or support that is buried in direct contact with soil or backfill. Paragraph IWA-6340(k) has been added to address the practicality of conducting pressure testing of buried components. Tables IWC-2500-1 and IWD-2500-1 have been revised to add a note for the examinations/tests identified in IWA-5244.

Location: IWA-6230

Subject: Documentation Requirements

Explanation: Paragraph IWA-6230(b)(3) has been added to include documentation requirements associated with determination of the acceptability of inaccessible areas following containment examinations. Subsequent paragraphs have been renumbered. This revision has been made to address an NRC condition on documentation that affects Class MC, metal containments, and Class CC, concrete containments.

Location: Article IWA-9000

Subject: Definitions of Part, Piping Subassembly, and Appurtenance

Explanation: Article IWA-9000 has been revised to add definitions for *part* and *piping assembly* and revise the definition of *appurtenance*. Two definitions have been added for *part* to distinguish between components fabricated to Section III and components fabricated to other Construction Codes. The definition of *piping subassembly* has been added as it appears in Section III, Subsection NCA, Article NCA-9000. The definition of *appurtenance* has been revised to clarify that it is applicable to components fabricated to Section III. These definitions are similar to those in Article NCA-9000, except for the second definition of *part* since it is meant to address Construction Codes other than Section III.

Location: IWB-2420 and IWC-2420

Subject: Successive Inspections for Dissimilar Metal Butt Welds in Vessel Nozzles and Piping Butt Welds

Explanation: Paragraphs IWB-2420 and IWC-2420 have been revised to include the requirements of Code Case N-735 for successive inspections of dissimilar metal butt welds in vessel nozzles and piping butt welds.

Location: IWB-2420

Subject: Successive Examination of Welded Attachments for Identified Support Deformation

Explanation: Paragraphs IWB-2420(e) through IWB-2420(g) have been revised to delete a statement that no successive examinations are required if "there are no other welded attachments subject to the same apparent or root cause conditions." These revisions clarify that successive examinations should still apply to the original welded attachment that had the flaw or relevant conditions regardless of whether others are subject to the same cause.

Location: IWB-2500

Subject: Applicability of Visual Examinations to Pressurized Water Reactors (PWRs) and Boiling Water Reactors (BWRs)

Explanation: Paragraph IWB-2500(g) has been revised to allow VT-1 visual examination of full penetration welded nozzles in vessels in lieu of volumetric examination for both PWRs and BWRs, provided additional requirements are met for both preservice and inservice examinations.

Location: Table IWB-2500-1 (B-O)

Subject: Examination of Full Penetration Pressure-Retaining Welds

Explanation: Table IWB-2500-1 (B-O) has been revised to clarify that examination of full penetration welds is required whether the welds are located in control rod drive assemblies or in nozzles attached to the reactor vessel head.

Location: Tables IWB-2500-1 and IWC-2500-1

Subject: Alternative Surface Examination Boundaries for Examination Categories B-G-1 and C-D

Explanation: Table IWB-2500-1 (Category B-G-1) has been revised to reference Figure IWB-2500-12 in lieu of only Figure IWB-2500-12(a) to include boundaries of all examinations required by the table. Table IWC-2500-1 (Category C-D) has been revised to reference Figure IWC-2500-6 in lieu of only Figure IWC-2500-6(a) to include the required examination areas for the alternative surface examinations.

Location: Tables IWB-2500-1 and IWC-2500-1

Subject: Examination of Welds Repaired by Weld Overlay Methods

Explanation: Tables IWB-2500-1 (B-F and B-J) and IWC-2500-1 (C-F-1) have been revised to address examination of overlay repaired welds. This revision ensures that examinations of weld overlay repairs are appropriately completed.

Location: IWB-3134 and IWC-3125

Subject: Removal of Requirements for Submittal of Analytical Evaluations to the Regulatory Authority

Explanation: Paragraphs IWB-3134 and IWC-3125 have been deleted to eliminate requirements for submitting analytical evaluations of surface and volumetric examinations to the regulatory authority having jurisdiction at the plant site. Section XI does not require approval by the regulator prior to the continued operation of a plant. Analytical evaluations of examination results may be requested by the regulatory authority at any time; this revision removes an administrative requirement.

Location: IWB-3600

Subject: Characterization of Flaws in Clad Piping

Explanation: Paragraphs IWB-3600, IWB-3610, and IWB-3640 have been revised to add procedures for flaw characterization for piping similar to that for components when a flaw is detected at or near the clad interface and subject to evaluation in accordance with IWB-3640. There were previously no procedures for defining the flaw depth and length in a Class 1 clad pipe. Figure IWB-3610-1 has been revised to make the illustrations generic covering both components and piping.

Location: IWB-5221

Subject: Boiling Water Reactor (BWR) Class 1 System Leakage Test

Explanation: Paragraph IWB-5221(d)(3) has been added to prohibit the use of nuclear heat to conduct the BWR Class 1 system leakage test with certain exceptions. This revision provides a clarification to the requirements originally provided by Code Case N-795 and the existing requirement in 10 CFR 50, Appendix G.

Location: IWC-2500, IWC-3517, IWD-2500, IWD-3512, and Nonmandatory Appendix Z

Subject: Inspection Rules for Degradation of Class 2 and Class 3 Buried Piping and Components

Explanation: Paragraphs IWC-2500 and IWD-2500 have been revised along with the addition of Tables IWC-2500-1 (C-J) and IWD-2500-1 (D-C) to require the Owner to have a Buried Piping and Component Inspection Program. Paragraphs IWC-3517 and IWD-3512 have been added to note the acceptance standards for Examination Categories C-J and D-C, respectively. New Nonmandatory Appendix Z has been added to provide guidance for critical attributes that will be addressed in the Owner's inspection program. This Nonmandatory Appendix addresses a gap previously in Section XI relative to the inspection requirements for Class 2 and Class 3 buried piping and components.

Location: IWE-1241 and IWE-3511

Subject: Clarification of Substantial Corrosion and Pitting and Excessive Wear in Components, and Acceptance of Components

Explanation: Paragraphs IWE-1241(a) and IWE-1241(b) have been revised to clarify what is considered “substantial corrosion and pitting” and “excessive wear” to ensure consistent examination of items in accordance with Table IWE-2500-1 (E-C). Paragraph IWE-3511 has been revised to reference the criteria in IWE-1241 to determine when component acceptance in accordance with IWE-3122.2 or IWE-3122.3 is required.

Location: Table IWE-2500-1, Note (2)

Subject: Examination of a Disassembled Bolted Connection

Explanation: Table IWE-2500-1, Note (2) has been revised to clarify that a bolted connection that is disassembled during the inspection interval needs to be examined only once during the inspection interval in the disassembled state.

Location: IWE-3122.2

Subject: Acceptance by Corrective Measures or Repair/Replacement Activity

Explanation: Paragraph IWE-3122.2 has been revised to clarify that corrosion or erosion that exceeds the acceptance standards of IWE-3500 is required to be corrected by repair/replacement activity or accepted by engineering evaluation in accordance with IWE-3122.3.

Location: IWE-3200

Subject: Supplemental Examinations

Explanation: Paragraph IWE-3200 has been revised to clarify that supplemental examinations that detect flaws or evidence of degradation may be used to accept the flaws or degradation in accordance with IWE-3122. Thus, the supplemental examinations performed may be used to accept components for continued service.

Location: IWF-1230

Subject: Examination of Supports Not Connected to Piping

Explanation: Paragraph IWF-1230 has been revised to clarify that supports exempt from the examination requirements of Article IWF-2000 may include supports that are not physically connected to the piping. This revision ensures that the scope of supports subject to examination is clear.

Location: IWL-2512

Subject: Inaccessible Concrete Surfaces

Explanation: Paragraph IWL-2512(b) has been revised to incorporate the provisions of the NRC regulation in 10 CFR 50.55a(b)(2)(viii)(I) regarding evaluation and inspection of concrete surfaces exposed to foundation soil, backfill, or groundwater.

Location: Mandatory Appendix I, Supplement 7

Subject: Instrument Linearity Requirements

Explanation: Mandatory Appendix I, Supplement 7 has been revised to incorporate the requirements of Section V, Article 4, T-461 regarding performance of linearity verification, aligning Section XI with Section V for digital ultrasonic examination (UT) instruments.

Location: Mandatory Appendix III, III-3310

Subject: Instrument Linearity Requirements

Explanation: Paragraph III-3310 has been revised to incorporate the requirements of Section V, Article 4, T-461 regarding performance of linearity verification, aligning Section XI with Section V for digital UT instruments.

Location: Mandatory Appendix VII, VII-3130

Subject: Annual Practice

Explanation: In VII-3130, “Annual Training” has been changed to “Annual Practice” for consistency with previous changes made to VII-4240.

Location: Mandatory Appendix VIII, VIII-3110 and VIII-3120

Subject: Clarification for Grading Units

Explanation: Paragraphs VIII-3110(b) and VIII-3120(b) have been revised to remove wording specific to specimen identification due to some large samples used for automated examinations have identification stamped on the outside surface. To maintain confidentiality, the zero-reference point is varied after the automated data is collected. Therefore, the phrase “and specimen identification” has been deleted.

Paragraph VIII-3110(e) has been added to describe how grading units are applied for Mandatory Appendix VIII Supplements and to clarify the number of flaws allowed per grading unit for those Supplements utilizing grading units.

Location: Mandatory Appendix VIII, Supplement 15

Subject: Qualification Requirements for Pressurized Water Reactor (PWR) Upper Head Penetrations

Explanation: Supplement 15 has been added to Mandatory Appendix VIII to define the qualification requirements for procedures, personnel, and equipment used for the volumetric examination of PWR vessel upper head penetrations. This revision facilitates compliance with Code requirements by organizing the requirements in one location and reformatting them in a consistent manner.

Location: Tables A-3610-1 Through A-3610-6

Subject: Coefficient G Values for Subsurface Flaws

Explanation: Tables A-3610-1 through A-3610-6 were expanded to include coefficient G values for $d/t = 0.01$ and 0.1 in which the flaw is closer to the free surface of the component. This revision allows for crack tip stress intensity factors over a larger range of flaw depth to improve the analytical evaluation of flaws.

Location: Nonmandatory Appendix C, Subarticle C-2200

Subject: Characterization of Flaws in Clad Piping

Explanation: Subarticle C-2200 has been revised to define the depth and length of a flaw in a clad pipe as shown in Figure IWB-3600-1.

Location: Nonmandatory Appendix C, Subarticle C-2200

Subject: Subsurface-to-Surface Flaw Transformation Rule for Subcritical Crack Growth in Piping

Explanation: In Subarticle C-2200, the subsurface-to-surface flaw transformation rule for subcritical crack growth has been revised for piping. Correlations between fatigue crack growth experiments and calculations have highlighted that the subsurface-to-surface transformation is sensitive to the aspect ratio a/ℓ , mainly in piping. The subsurface-to-surface flaw proximity factor was previously defined by a constant value regardless of the aspect ratio.

Location: Nonmandatory Appendix C, C-8410, and Figures C-8410-1 and C-8410-1M

Subject: Fatigue Crack Growth Rate Threshold for Austenitic Stainless Steels in Air

Explanation: Paragraph C-8410(a) has been added to incorporate provisions for a fatigue crack growth rate threshold for austenitic stainless steels in air. The previous C-8410(a) and C-8410(b) have been redesignated as to C-8410(b) and C-8410(c), respectively. Figures C-8410-1 and C-8410-1M have been revised to update the relationship between the stress ratio, da/dN , and the fatigue crack growth threshold, ΔK_{th} .

Location: Nonmandatory Appendix L, Tables L-3210-1 and L-3210-2

Subject: Equivalent Single Crack (ESC) Sizes for Ferritic and Austenitic Piping

Explanation: Tables L-3210-1 and L-3210-2, for ferritic and austenitic piping, respectively, have been revised to replace the infinite stress ratio with finite stress ratio values in order to allow for linear interpolation. Tables L-3210-1 and L-3210-2 have also been revised to remove the arbitrary ESC value cap $a/\ell = 0.1667$.

Location: Nonmandatory Appendix Q

Subject: Delta Ferrite Requirements for Pressurized Water Reactors (PWRs) subject to Intergranular Stress Corrosion Cracking (IGSCC)

Explanation: Nonmandatory Appendix Q has been revised to address application of delta ferrite controls to weld overlays in PWRs where there is potential for IGSCC degradation. Reference to Nonmandatory Appendix R, Table R-S2-1 has been added to provide applicable attributes for IGSCC determination in a boiling water reactor (BWR) and a PWR.

Location: Nonmandatory Appendix Q, Article Q-2000

Subject: Ferrite Number (FN) Testing Requirement

Explanation: Paragraph Q-2000(d) has been revised to define how the FN of the weld overlay is determined. This revision also made the ferrite testing requirements applicable to boiling water reactors (BWRs) only. Additionally, Q-2000(d) has been revised to include an alternative to perform FN testing on a representative coupon taken from a mockup prepared in accordance with the welding procedure specification (WPS). The clarification of FN requirements should reduce the occurrence of in-situ testing. In-situ testing is a sequential operation to application of the welding and requires stoppage of the welding activity. Performance of FN testing on a mockup is a parallel path activity and may reduce overall duration and facility downtime.

Location: Nonmandatory Appendix Q, Article Q-3000

Subject: Design Consideration

Explanation: Paragraph Q-3000(a) has been revised to clarify that stress corrosion crack growth analysis is not required in the weld overlay material.

Location: Nonmandatory Appendix Q, Subarticle Q-4100

Subject: Examination and Testing

Explanation: Subarticle Q-4100 has been revised to reduce acceptance inspection volume when an overlay is extended axially for reasons other than design reinforcement. Figure Q-4100-1 has been revised to reduce the volume to be examined for planar flaws so that worker radiological exposure is reduced when exams are performed manually.

Location: Nonmandatory Appendix Y

Subject: Crack Growth Rate Curves

Explanation: Nonmandatory Appendix Y has been added to consolidate all existing and future crack growth rate curves used in Section XI. Nonmandatory Appendix Y shows the relationships between fatigue crack growth rates and stress corrosion crack growth rates for austenitic, ferritic, and nickel alloy steels for use in analytical evaluations.

Division 2

Location: RIM-1.6.1

Subject: Duties of the Inspector and Authorized Nuclear Inservice Inspector Supervisor

Explanation: Paragraph RIM-1.6.1(a) has been added to address the duties of the Authorized Nuclear Inservice Inspector Supervisor (ANIIS) by reference to ASME QAI-1. Paragraph RIM-1.6.1(b), renumbered from RIM-1.6.1(a), has been revised to reference ASME QAI-1 for duties of the inspector.

Location: RIM-7

Subject: Definition of Monitoring and Nondestructive Examination (MANDE) Program

Explanation: A definition for MANDE Program has been added to RIM-7 to clarify what constitutes the MANDE Program in Section XI, Division 2.

Location: Mandatory Appendix I, I-1.1 and Figures I-1.1-1 through I-1.1-6

Subject: Flowcharts for RIM Process

Explanation: Figures I-1.1-1 through I-1.1-6 have replaced the original Figures I-1.1-1 through I-1.1-7 to fully integrate the flowcharts to convey the RIM process more effectively. Paragraph I-1.1 has been revised to update the descriptions of the symbols used in the flowcharts.

SECTION II

Introduction

Section II, Materials, is a “service section” of the ASME Boiler and Pressure Vessel Code (BPVC). This Section provides specifications for ferrous and nonferrous materials, and for welding rods, electrodes, and filler metals. It also provides material properties, including allowable, design, tensile, and yield stress values; physical properties; and external pressure charts and tables. Section II is divided into four parts, as follows:

- Part A — Ferrous Material Specifications
- Part B — Nonferrous Material Specifications
- Part C — Specifications for Welding Rods, Electrodes, and Filler Metals
- Part D — Properties

(a) Part A and Part B contain material specifications published by ASTM International, Inc., and other national and international developers. These specifications have been modified as necessary for use in ASME BPVC construction. These specifications are designated with an “S” added to the beginning of the other organization’s specification designation (e.g., ASTM A105 becomes ASME SA-105). These specifications contain requirements for chemical and mechanical properties, heat treatment, manufacture, heat and product analyses, and methods of testing. Note that all materials contained within a specification adopted by ASME and included in Parts A and B are not necessarily permitted for use in ASME BPVC construction. This Summary of Significant Changes describes only significant specification changes affecting materials permitted by the ASME BPVC. It does not include specification changes affecting materials not permitted by ASME BPVC.

(b) Part C contains material specifications, most of which are identical to corresponding specifications published by AWS and other recognized national or international organizations. All adopted specifications are either reproduced in Part C, where permission to do so has been obtained from the originating organization, or so referenced and information about how to obtain them from the originating organization is provided. The ASME BPV Committee on Welding, Brazing, and Fusing (Section IX) reviews all material specifications submitted to it and, if the Committee feels a specification needs to be adapted for ASME BPVC purposes, they revise it accordingly. However, ASME, AWS, and other originating organizations communicate regularly in an effort to maintain identical specifications.

(c) Part D primarily comprises tables providing stress and property data for materials permitted for use in ASME BPVC construction. These tables contain allowable stresses; design stress intensities; mechanical properties, including tensile strength and yield strength; and physical properties, including thermal expansion, thermal conductivity and diffusivity, moduli of elasticity, and Poisson’s ratio. In addition to these tables, Part D provides charts and tables for determining shell thickness of components under external pressure.

Part A

Location: SA-134/SA-134M, Specification for Pipe, Steel, Electric-Fusion (ARC)-Welded (Sizes NPS 16 and Over); and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A134/A134M-19 has been adopted as the revised and redesignated ASME SA-134/SA-134M. The SA-134 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

(a) Section 4, Materials, has been revised to cite ASTM A1011/A1011M and ASTM A1018/A1018M rather than ASTM A570/A570M.

(b) Supplementary Requirement S1 has been added to address Section III construction.

Location: SA-135, Specification for Electric-Resistance-Welded Steel Pipe; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A135/A135M-19 has been adopted as the revised and redesignated ASME SA-135/SA-135M. The SA-135 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

(a) The specification has been revised to allow nondestructive electric testing in lieu of hydrostatic testing, when such alternative testing is accepted by the purchaser, for a broader range of pipe. In the 2019 Edition, nondestructive electric testing was permitted only for schedule 10 pipe, NPS $\frac{3}{4}$ to NPS 5, inclusive.

(b) ASTM E570 has been added as a nondestructive test option, and a weld seam nondestructive test requirement including hot-stretch reducing mill exception has been added.

Location: SA-213/SA-213M, Standard Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A213/A213M-18b has been adopted as the revised ASME SA-213/SA-213M. The SA-213/SA-213M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

(a) T93 (UNS K91359) has been added.

(b) Heat and product analysis limits for trace elements for K91060 have been added.

(c) In Table 3, the grain size requirement for UNS S31035 has been deleted.

Location: SA-234/SA-234M, Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High-Temperature Service; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A234/A234M-19 has been adopted as the revised ASME SA-234/SA-234M. The SA-234/SA-234M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: Grade WP115 (UNS K91060) and associated requirements have been added throughout the specification.

Location: SA-249/SA-249M, Specification for Welded Austenitic Steel Boiler, Superheater, Heat-Exchanger, and Condenser Tubes; and Part D Customary and Metric, Table 1A

Subject: Review of SA-249/SA-249M

Explanation: The title of Supplementary Requirement 9 in SA-249/SA-249M has been revised to "Additional Testing of Welded Tubing for ASME Requirements." In Part D Customary and Metric, Table 1A, Note W13 has been revised to add SA-1016 as a required specification for angle beam ultrasonic inspection as well as volumetric inspection.

Location: SA-312/SA-312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A312/A312M-19 has been adopted as the revised ASME SA-312/SA-312M. The SA-312/SA-312M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) S31655, N08028, and N08029 have been added.
- (b) The minimum nickel content for 316, 316H, 316N, and 316LN has been revised from 11.0% to 10.0%.
- (c) In Table 5, the grain size requirement for UNS S31035 has been deleted.

Location: SA-420/SA-420M, Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A420/A420M-19a has been adopted as the revised ASME SA-420/SA-420M. The SA-420/SA-420M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Section 17, Certification, and section 18, Product Marking, have been revised and test reports have been made mandatory.
- (b) Requirements have been clarified in several sections.
- (c) Supplementary Requirement S1 has been added to address Section III construction.

Location: SA-537/SA-537M, Standard Specification for Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A537/A537M-20 has been adopted as the revised ASME SA-537/SA-537M. The SA-537/SA-537M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: Thickness maximums have been removed.

Location: SA-671/SA-671M, Specification for Electric-Fusion-Welded Steel Pipe for Atmospheric and Lower Temperatures; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A671/A671M-19 has been adopted as the revised ASME SA-671/SA-671M. The SA-671/SA-671M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Paragraph reference in ASTM A370 test requirements has been revised.
- (b) Supplementary Requirement S15 has been added to address Section III construction.

Location: SA-672/SA-672M, Specification for Electric-Fusion-Welded Steel Pipe for High-Pressure Service at Moderate Temperatures; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A672/A672M-19 has been adopted as the revised ASME SA-672/SA-672M. The SA-672/SA-672M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: Supplementary Requirement S15 has been added to address Section III construction.

Location: SA-789/SA-789M, Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A789/A789M-18 has been adopted as the revised ASME SA-789/SA-789M. The SA-789/SA-789M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) S82441, S82031, and S83071 have been added.
- (b) Tensile and yield strengths for S32003 heavy wall tube product >0.187 in. have been reduced from 100 ksi and 70 ksi, respectively, to 95 ksi and 65 ksi.
- (c) Maximum carbon content for S32760 has been reduced from 0.05 to 0.030.

Location: SA-790/SA-790M, Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM A790/A790M-19 has been adopted as the revised ASME SA-790/SA-790M. The SA-790/SA-790M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) S82121, S83071, and S82441 have been added.
- (b) In Table 2, the maximum carbon content for S32760 has been reduced from 0.05 to 0.030.
- (c) In Table 3, a higher-strength light wall pipe product has been provided for S32003.

(d) In Table 3, the entry for S32808 has been divided into two parts: one for thicknesses <0.40 in. (<10 mm) and one for thicknesses ≥0.40 in. (≥10 mm). Thicknesses ≥0.40 in. (≥10 mm) have lower tensile and yield requirements.

Location: SA-988/SA-988M, Standard Specification for Hot Isostatically-Pressed Stainless Steel Flanges, Fittings, Valves, and Parts for High Temperature Service; and Table II-200-1

Subject: New ASME Specification

Explanation: ASTM A988/A988M-17 has been adopted as a new ASME specification, ASME SA-988/SA-988M. Table II-200-1 has been updated accordingly.

Location: SA-989/SA-989M, Standard Specification for Hot Isostatically Pressed Alloy Steel Flanges, Fittings, Valves, and Parts for High Temperature Service; and Table II-200-1

Subject: New ASME Specification

Explanation: ASTM A989/A989M-18 has been adopted as a new ASME specification, ASME SA-989/SA-989M. Table II-200-1 has been updated accordingly.

Location: SA/EN 10025-2, Specification for Hot Rolled Products of Structural Steels; and Table II-200-2

Subject: Revised Specification

Explanation: EN 10025-2:2019 has been adopted as the revised ASME SA/EN 10025-2. The SA/EN 10025-2 listing in Table II-200-2 has been updated accordingly. The revised specification includes the following changes:

(a) Grades S460JR, S460K0, S460J2, S460K2, and S4500J0 have been added for long products, and values have been added for heat and product analyses, maximum CEV, YS, TS, elongation, and impact energy.

(b) Grade S450J0 has been removed and TS, YS, elongation, and KV₂ values as well as heat and product analyses have been removed.

(c) TS, YS, elongation, and KV₂ values for JR and J0 grades for nominal thicknesses, t , >250 mm and ≤400 mm have been added.

(d) New paragraphs on weldability and hot forming have been added.

(e) A large number of other revisions have been made throughout the specification.

Location: SA/GB 713, Specification for Steel Plates for Boilers and Pressure Vessels; and Table II-200-2; Part D Customary and Metric, Tables 1A, U, and Y-1

Subject: Revised Specification

Explanation: Chinese Specification GB 713-2014 has been adopted as the revised ASME SA/GB 713. The SA/GB 713 listing in Table II-200-2 has been updated accordingly. The revised specification includes the following changes:

(a) Impact test requirements on Q345R, Q370R, and 15CRMnR have been raised from 34 to 41J, 34 to 47J, and 31 to 47J, respectively.

(b) The application thickness range maximum has been increased from 200 mm to 250 mm.

(c) For Q370R

(1) the mechanical properties at elevated temperature requirements (Table 3) for plate thicknesses >36 mm to 60 mm have been decreased as follows:

At Temperatures	Minimum Yield Decrease	
	From	To
200°C	280 MPa	275 MPa
250°C	270 MPa	260 MPa
300°C	255 MPa	250 MPa
350°C	240 MPa	235 MPa
400°C	225 MPa	220 MPa

(2) the mechanical properties (Table 2) and mechanical properties at elevated temperature (Table 3) for plate thicknesses >60 mm to 100 mm have been added

(d) In para. 6.2.2, “the reduction ratio of the electroslag remelting billet shall be no less than 2 in.” has been added.

(e) Paragraph 6.5 and Appendix have been added to give limits for hydrogen-induced cracking tests if requested.

(f) New lines have been added to Tables 1A, U, and Y-1 for SA-GB 183 Q370R Plate.

Location: SA/IS 2062, Specification for Hot Rolled Medium and High Tensile Structural Steel; Table II-200-2; and Part D Customary and Metric, Tables 1A, U, and Y-1

Subject: Revised Specification

Explanation: Indian Specification IS 2062:2011 has been adopted as the revised ASME SA/IS 2062. The SA/IS 2062 listing in Table II-200-2 has been updated accordingly. The revised specification includes the following changes:

- (a) Boron has been removed from the list of micro-alloying elements.
- (b) Grade B has been removed, and grades BR and B0 have been added. Semi-killed has been added to allowable deoxidation for Quality Levels BR and B0 and reheat treatment has been allowed if the mechanical properties are not met.
- (c) New lines have been added to Part D Customary and Metric, Tables 1A, U, and Y-1 in response to the grade changes in the specification.

Location: SA/NF A 36-215, Specification for Weldable Fine Grain Steels for Transportation of Dangerous Substances; Table II-200-2; and Part D Customary and Metric, Tables 5A, U, and Y-1

Subject: Withdrawn Specification

Explanation: NF A 36-215 has been officially withdrawn by AFNOR; therefore, ASME SA/NF A 36-215 has been deleted from Part A. Table II-200-2 has been updated accordingly. The corresponding lines for this specification have also been deleted from Part D Customary and Metric, Tables 5A, U, and Y-1.

Location: Parts A and B, Table II-200-1

Subject: Other Acceptable ASTM Editions

Explanation: For each updated ASME specification, the range of acceptable ASTM editions has been updated.

Location: Parts A and B, Table II-200-1

Subject: Table II-200-1

Explanation: A footnote has been added in Parts A and B, Table II-200-1, explaining the edition designations for revised ASTM specifications.

Location: Parts A and B, Mandatory Appendix IV; and Part D Customary and Metric, Mandatory Appendix 5

Subject: Physical Properties Testing Requirements

Explanation: In Parts A and B, Mandatory Appendix IV and Part D Customary and Metric, Mandatory Appendix 5, reference to ASTM C177 has been deleted and references to ASTM D2766, ASTM E289, ASTM E1225, and ASTM E1461 have been added.

Location: Parts A and B, Mandatory Appendix IV; and Part D Customary and Metric, Mandatory Appendix 5

Subject: Requirements for Stress-Strain Data

Explanation: Inclusion of stress-strain data has been made a requirement for all submissions of requests for new materials to be added to ASME BPVC.

Part B

Location: SB-61, Standard Specification for Steam or Valve Bronze Castings; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B61-15 has been adopted as the revised ASME SB-61. The SB-61 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: Note B (increasing maximum phosphorus levels for continuous cast product) has been added to Table 1.

Location: SB-75/SB-75M, Standard Specification for Seamless Copper Tube; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B75/75M-19 has been adopted as the revised and redesignated ASME SB-75/SB-75M. The SB-75 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: Temper 062 has been added in Tables 2 and 3, and para. 8.2.

Location: SB-163, Standard Specification for Seamless Nickel and Nickel Alloy Condenser and Heat Exchanger Tubes; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B163-19 has been adopted as the revised ASME SB-163. The ASME SB-163 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Alloys N06696, N06699, N06845, and N08635 have been added.
- (b) The manganese composition for UNS N06603 has been corrected from 15 to 0.15.

Location: SB-359/SB-359M, Standard Specification for Copper and Copper-Alloy Seamless Condenser and Heat Exchanger Tubes With Integral Fins; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B359/B359M-18 has been adopted as the revised ASME SB-359/SB-359M. The SB-359/SB-359M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: Temper 062 has been added in Tables 2 and 3, and paras. 8.1.1 and 8.1.1.2.

Location: SB-446, Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B446-19 has been adopted as the revised ASME SB-446. The SB-446 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Test reports and certification have been made mandatory.
- (b) Metric and tensile strength value conversions for alloy N06625 (Table 1) have been added.

Location: SB-523/SB-523M, Specification for Seamless and Welded Zirconium and Zirconium Alloy Tubes; Table II-200-1; and Part D Customary and Metric, Table 1B

Subject: Revised Specification

Explanation: ASTM B523/B523M-18 has been adopted as the revised ASME SB-523/SB-523M. The SB-523/SB-523M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Zr Grade R60705 has been removed from the specification.
- (b) 95.5Zr+ 2.5Nb R60705 alloy for “sml and weld tube” products SB-523 UNS R60705 has been deleted from Part D Customary and Metric, Table 1B.

Location: SB-463, Standard Specification for UNS N08020 Alloy Plate, Sheet and Strip; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B463-10 has been adopted as the revised ASME SB-463. The SB-463 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: UNS N08024 and N08026 have been removed.

Location: SB-622, Standard Specification for Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B622-17b has been adopted as the revised ASME SB-622. The SB-622 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) UNS N08034 and N06044 have been added.
- (b) In Table 1, the Si max for R20033 has been revised from “0.05” to “0.50” and “max” has been added for the Mn value for N06210.
- (c) The density values from low carbon nickel–chromium–molybdenum alloy in para. 9.1 have been deleted.

Location: SB-637, Specification for Precipitation-Hardening and Cold Worked Nickel Alloy Bars, Forgings, and Forging Stock for Moderate or High-Temperature Service; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B637-18 has been adopted as the revised ASME SB-637. The SB-637 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Instruction for the acceptance criteria of mechanical properties for cold-worked products has been added.
- (b) A Rockwell C hardness conversion has been added in Table 3, and a reference to the hardness conversion specification (ASTM E140) has been added.

Location: SB-673, Standard Specification for UNS N08925, UNS N08354, and UNS N08926 Welded Pipe; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B673-05(16) has been adopted as the revised ASME SB-673. The SB-673 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) UNS N08354 has been added and UNS N08904 has been removed.
- (b) General specification ASTM B775 has been added as a referenced document.

Location: SB-706, Standard Specification for Seamless Copper Alloy (UNS No. C69100) Pipe and Tube; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B706-18 has been adopted as the revised ASME SB-706. The SB-706 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: In Table 1, the amount of manganese has been changed from 0.1% minimum to 0.1% maximum.

Location: SB-709, Specification for Iron-Nickel-Chromium-Molybdenum Alloy (UNS N08028) Plate, Sheet, and Strip; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B709-17 has been adopted as the revised ASME SB-709. The SB-709 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following change: UNS N08028 nickel content has been corrected from 29.5–32.5 to 30.0–34.0.

Location: SB-752/SB-752M, Standard Specification for Castings, Zirconium-Base, Corrosion Resistant, for General Application; and Table II-200-1

Subject: New ASME Specification

Explanation: ASTM B752/B752M-18 has been adopted as a new ASME specification, ASME SB-752/SB-752M. Table II-200-1 has been updated accordingly.

Location: SB-829, Standard Specification for General Requirements for Nickel and Nickel Alloys Seamless Pipe and Tube; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM B829-19 has been adopted as the revised ASME SB-829. The SB-829 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Specification B445 has been removed from the listing in section 1 (Scope) since it has been discontinued.
- (b) Permissible variations for outside diameter and wall thickness of cold-worked pipe/tube that is 8.625 in. through 24 in. has been added to Table 2.
- (c) Permissible variations for outside diameter and wall thickness of hot-worked pipe that is less than 2.5 in. has been added to Table 4.
- (d) Requirements for new materials have been added to Annexes A1 and A2.

Location: SB-834, Standard Specification for Pressure Consolidated Powder Metallurgy Iron–Nickel–Chromium–Molybdenum (UNS N08367), Nickel–Chromium–Molybdenum–Columbium (Nb) (UNS N06625), Nickel–Chromium–Iron Alloys (UNS N06600 and N06690), and Nickel–Chromium–Iron–Columbium–Molybdenum (UNS N07718) Alloy Pipe Flanges, Fittings, Valves, and Parts; and Table II-200-1

Subject: New ASME Specification

Explanation: ASTM B834-17 has been adopted as a new ASME specification, ASME SB-834. Table II-200-1 has been updated accordingly.

Location: SB-858, Test Method for Ammonia Vapor Test for Determining Susceptibility to Stress Corrosion Cracking in Copper Alloys; and Table II-200-1

Subject: Withdrawn Specification

Explanation: Specification ASME SB-858 has been deleted from Part B. Table II-200-1 has been updated accordingly.

Location: SF-467, Standard Specification for Nonferrous Nuts for General Use; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM F467-13(2018) has been adopted as the revised ASME SF-467. The SF-467 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Alloys C26000 and N06059 have been added to Tables 1 and 2.
- (b) In Table 2, proof stress for heavy hex nuts has been added for all alloys.
- (c) In section 4, a reference has been added to ASTM B574.

Location: SF-467M, Standard Specification for Nonferrous Nuts for General Use (Metric); and Table II-200-1

Subject: Revised Specification

Explanation: ASTM F467M-06a(18) has been adopted as the revised ASME SF-467M. The SF-467M listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Alloys C26000 and N06059 have been added to Tables 1 and 2.
- (b) In section 4, a reference has been added to ASTM B574.

Location: SF-468, Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use; and Table II-200-1

Subject: Revised Specification

Explanation: ASTM F468-16 has been adopted as the revised ASME SF-468. The SF-468 listing in Table II-200-1 has been updated accordingly. The revised specification includes the following changes:

- (a) Requirements for socket head cap screws have been added.
- (b) Supplementary Requirement S5, which mandates that certain deferral specifications be followed when invoked on the purchase order, has been added.
- (c) An exception for the tensile requirements of button and flat countersunk head cap screws has been added.
- (d) Paragraph 4.2.4 has been expanded to include specifics about the manufacturing of each type of fastener; it no longer gives specifics concerning acceptance criteria of the various lot sizes but instead refers the user to the manufacturer's quality assurance plan.

Part C

Location: SFA-5.01M/SFA-5.01

Subject: Revised Specification

Explanation: AWS A5.01M/A5.01:2019 has been adopted as the revised ASME SFA-5.01M/SFA-5.01. This action has been taken to keep this ASME specification current with the latest AWS specification. Changes to AWS A5.01M/A5.01 have been made for better understanding and clarification of requirements; however, there have been no substantive changes overall.

Location: SFA-5.17/SFA-5.17M

Subject: Revised Specification

Explanation: AWS A5.17/A5.17M:2019 has been adopted as the revised ASME SFA-5.17/SFA-5.17M. There are no additions or deletions of alloys, classifications, or tests in this revision. AWS A5.17/A5.17M has been updated with the current practices and rules of the AWS A5 Committee on Filler Metals.

Location: SFA-5.26/SFA-5.26M

Subject: Revised Specification

Explanation: AWS A5.26/A5.26M:2020 has been adopted as the revised ASME SFA-5.26/SFA-5.26M. This action has been taken to keep this ASME BPVC filler metal specification current with the latest AWS revision. The revised specification includes the following changes:

(a) Metric equivalent to 70 000 psi has been changed from 480 MPa to 490 MPa, as has been done in other A5 and international specifications.

(b) Two additional options for impact test temperature have been added to the open Charpy V-notch classification system.

Location: SFA-5.28/SFA-5.28M

Subject: Revised Specification

Explanation: AWS A5.28/A5.28M:2020 has been adopted as the revised ASME SFA-5.28/SFA-5.28M. This action has been taken to keep Section II, Part C current with the latest AWS specification. The revised specification includes the following changes:

(a) New solid and metal-cored electrode or rod alloy types have been added to alloy groupings CrMo steel, MnMo steel, Ni steel, NiMo steel, and High Mn steel.

(b) A requirement has been added for boron and cobalt to be reported if present or intentionally added.

(c) The GTAW test requirements have been moved from an informative annex to the normative body of the specification.

(d) Several new alloys have been added; some of these alloys are available only in rod form (R) rather than electrode and rod (ER), and must be tested using the GTAW test method.

(e) A "J" optional, supplemental designator has been added, which indicates that manufacturers may test Charpy V-notch properties at a temperature 20°F (10°C) lower than the test temperature shown for that classification.

Location: SFA-5.34/SFA-5.34M

Subject: Revised Specification

Explanation: AWS A5.34/A5.34M:2018 has been adopted as the revised ASME SFA-5.34/SFA-5.34M. This action has been taken to keep this ASME BPVC filler metal specification current with the latest AWS revision. The revised specification includes the following change: Classification of metal-cored electrodes have been allowed. Metal-cored electrodes are classified based on chemical composition, as found in AWS A5.14/A5.14M, Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods.

Location: SFA-5.36/SFA-5.36M

Subject: Withdrawn Specification

Explanation: ASME SFA-5.36/SFA-5.36M has been withdrawn from Section II, Part C, and Section IX. This is in response to the withdrawal of A5.36/A5.36M by AWS and ANSI. The electrodes will continue to be listed in AWS A5.18/A5.18M, AWS A5.20/A5.20M, AWS A5.28/A5.28M, and AWS A5.29/A5.29M (ASME SFA-5.18/SFA-5.18M, ASME SFA-5.20/SFA-5.20M, ASME SFA-5.28/SFA-5.28M, and ASME SFA-5.29/SFA-5.29M.)

Location: SFA-5.39/SFA-5.39M

Subject: New ASME Specification

Explanation: AWS A5.39/A5.39M:2020 has been adopted as a new ASME specification, ASME SFA-5.39/SFA-5.39M. This action has been taken to add this AWS specification to Section II, Part C, and to update Section IX, Table QW-432 accordingly. This specification was requested by industry, including many ASME members and ASME BPVC users. It is anticipated that the existence of such a filler metal classification standard will enable future ASME BPVC rules to control more efficiently and effectively the use of submerged arc and electroslag stainless steel and nickel alloy welding consumables.

Part D

Customary and Metric

Location: Subpart 1, Guideline on Locating Materials in Stress Tables, and in Tables of Mechanical and Physical Properties

Subject: Anchoring of Trend Curves

Explanation: Language has been added to section 3 to explain how strengths at elevated temperatures are determined using trend curves.

Location: Tables 1A, U, and Y-1

Subject: Stress Values for SA-572 and SA-1011

Explanation: Stress values at temperatures up to 600°F (350°C) have been added to Tables 1A, U, and Y-1 for SA-572 and SA-1011.

Location: Tables 1A, 5A, U, and Y-1

Subject: Addition of Grade 91 Type 2 With Higher Allowable Stresses

Explanation: Existing stress lines for Grade 91 have been designated as “Type 1,” and new lines have been added for Grade 91 “Type 2” with higher allowable stresses.

Location: Table 1A

Subject: Section VIII Applicability for SA-212 S30432

Explanation: Applicability and a maximum temperature of 1,500°F (816°C) have been added to Table 1A for SA-212 S30432.

Location: Table 1A

Subject: Updates Per Latest Adoption of SA-789/SA-789M

Explanation: New stress lines have been added to Table 1A for UNS S32003 SA-789/SA-789M tubing with thicknesses $> \frac{3}{16}$ in. (5 mm), and a thickness restriction of $\leq \frac{3}{16}$ in. (5 mm) has been added to the existing lines.

Location: Tables 1A, 3, U, Y-1, TE-1, and TM-1, and Figure NDN-12

Subject: Addition of 23Cr–25Ni–5.5Mo–N, UNS S32053, Austenitic Stainless Steel

Explanation: Properties and stress values have been added for UNS S32053 welded pipe, bar, forgings, plate, seamless and welded pipe, welded tube, fittings, and bolting. This revision incorporates Code Case 2445-2.

Location: Tables 1A, U, Y-1, TE-1, TE-2, TM-1, and TCD, and Figure HA-5

Subject: Incorporation of Code Case 2543

Explanation: 25Cr–6Ni–Mo–N austenitic–ferritic duplex stainless steel, UNS S32506, in various product forms has been permitted for use at temperatures up to 600°F (316°C). It has been added to Tables 1A, U, Y-1, TE-1, TE-2, TM-1, and TCD, and Figure HA-5.

Location: Tables 1A, U, and Y-1

Subject: SA-789 and SA-790 UNS S32750 Size Limits

Explanation: Size limits for SA-789 and SA-790 for UNS S32750, 25Cr–7Ni–4Mo–N duplex stainless steel pipes and tubes have been deleted.

Location: Tables 1B, U, and Y-1

Subject: Addition of M20 Temper to SB-152 Alloys

Explanation: The M20 temper has been added to the O25 temper for SB-152 lines.

Location: Table 1B

Subject: Removal of Note G15 for SB-543 and SB-467 Alloys

Explanation: Note G15, which relates to castings, does not apply to welded tube and has been removed from the SB-543 and SB-467 lines.

Location: Tables 1B, 2B, 5B, U, and Y-1

Subject: Addition of M10 and O20 Tempers to SB-171 Entries

Explanation: The O20 (hot forged and annealed) temper has been added along with the O25 (hot rolled and annealed) temper and the M10 (hot forged) temper has been added along with the M20 (as-hot rolled) temper for the SB-171 entries.

Location: Table 1B

Subject: External Pressure Chart Designations for C60800

Explanation: In Table 1B, the External Pressure Chart designation for copper alloy C60800 has been revised from “NFC-3” to “NFC-2.”

Location: Tables 1B, 6B, and Y-1

Subject: Yield Strength for SB-315 C65500

Explanation: Yield Strength Values for SB-315 C65500 have been revised in the metric Tables 1B, 6B, and Y-1.

Location: Tables 1B, 2B, and 5B

Subject: Stress Line Modification for C70600, C70620, and C71520

Explanation: High stress lines have been added to Tables 1B, 2B, and 5B for C70620 and C71520. Corrections have been made to C70600 stress values in Tables 1B, 2B, and 5B.

Location: Tables 1B, 2B, U, and Y-1

Subject: Addition of Five Cast Copper Alloys to Tables U and Y-1

Explanation: Cast copper alloys C83600, C92200, C93700, C96200, and C97600 have been added to Tables U and Y-1. Related changes have been made to Tables 1B and 2B.

Location: Tables 1B, 2B, 3, and 4

Subject: Modifications in Accordance With SB-164

Explanation: The tables have been updated to better align with SB-164. These changes include modification to product forms, class/condition/temper, size/thickness, minimum tensile strength, and minimum yield strength, and addition of new product lines.

Location: Tables 1B, 2B, U, and Y-1

Subject: SB-443

Explanation: In Tables 1B, 2B, U, and Y-1, lines have been added and existing product forms, class/condition/temper entries, and grade designations have been revised for SB-443.

Location: Table 1B

Subject: SB-444 Gr. 1 (UNS N06625)

Explanation: Note G22 has been revised for clarity and added to the SB-444, SB-704, and SB-705 stress lines.

Location: Tables 1B, U, and Y-1

Subject: Section VIII, Division 1 Applicability

Explanation: Lines for SB-463 UNS N08024 and N08026 have been deleted, and the remaining UNS N08024 and N08026 entries are no longer permitted (NP) for Section VIII, Division 1 construction.

Location: Tables 1B, U, Y-1, TE-4, TCD, TM-4, and PRD

Subject: Incorporation of Code Case 2585-1

Explanation: The use of 35Ni-23Cr-7.5Mo-N austenitic alloy, UNS08354, in various product forms for the temperature range up to 800°F (427°C) has been permitted for Section VIII, Division 1 components.

Location: Table 1B

Subject: Titanium Castings

Explanation: Per SB-367, Note 12 (no welding or brazing permitted) has been deleted for all titanium casting grades.

Location: Tables 2A, 2B, and 4

Subject: Inclusion of Section III, Division 5 and All Classes of Section III, Division 3

Explanation: The titles of Tables 2A, 2B, and 4 have been revised to include Section III, Division 5 and all classes of Section III, Division 3.

Location: Table 2B

Subject: Addition of C71520 Lines and Corrections to C71500 Entries

Explanation: Standard and high strength stress lines for SB-395 C71520 and high stress lines for SB-111 and SB-171 C71520 have been added. Several other corrections have been made to the C71520 and C71500 lines.

Location: Tables 3, 4, U, and Y-1

Subject: Diameter Ranges for SA-540 in Tables 3, U, and Y-1

Explanation: Diameter ranges for SA-540 Grade B24 have been added to Tables U and Y-1 and diameter ranges for SA-540 Grades B23 and B24 have been added to Table 3.

Location: Tables 3, U, and Y-1

Subject: Add Missing Tempers of SB-150

Explanation: Missing tempers for SB-150 products have been added to Tables 3, U, and Y-1. Additionally, corrections have been made to certain size breaks, product forms, and specified minimum yield strength values in these tables.

Location: Table 4

Subject: SB-164 N04400 Allowable Stress Values

Explanation: Allowable stress values in Table 4 have been revised for several product forms of SB-164 N04400.

Location: Table 5B

Subject: Revisions to Stress Lines for SB-161 and SB-209

Explanation: Size/thickness values for both SB-161 and SB-209 have been revised as have mechanical properties, stress value, and notes for SB-209.

Location: Table 5B

Subject: UNS R53400 Grade 12

Explanation: Allowable stresses for Grade 12 Titanium Alloy UNS R53400 have been revised in Table 5B.

Location: Tables 6A, 6B, 6C, and 6D

Subject: Tables 6A through 6D

Explanation: Tables 6A through 6D have been made mandatory through the deletion of "For Information Only" from the titles as well as modifications to the introductory text to the stress tables.

Location: Tables 6B, U, and Y-1

Subject: Allowable Stress Values for SB-359/SB-359M C12200 Copper With an O62 Temper

Explanation: New lines have been added to Tables 6B, U, and Y-1 for SB-359/SB-359M C12200 with an O62 temper.

Location: Table U

Subject: Addition of SA-723 Class 2a

Explanation: New lines have been added to Table U for SA-723 Class 2a.

Location: Tables U and Y-1

Subject: High Temperature Strength Values

Explanation: In Tables U and Y-1, stress values at temperatures above 1,000°F (525°C) have been added for S30908, S30400, S30403, S30908, S31008, S31600, S31603, S31635, S31700, S31703, S32100, and S34700.

Location: Tables U and Y-1

Subject: Incorporation of Aluminum Alloy SB/EN 1706 AlSi12(Fe), AC44300

Explanation: AlSi12(Fe), AC44300 has been added to Section II, Part D, Table 6 under another revision. This action completes the incorporation with addition of the yield and tensile strength values to Tables U and Y-1.

Location: Tables U and Y-1

Subject: Higher Temperature Strength Values for Several Nickel Alloys and Addition of New Lines for Several Copper Alloys

Explanation: Values for temperatures higher than 1,000°F/525°C have been added for N02201, N06002, N06022, N06600, N06625, N08330, N08800, N08810, N08811, N10003, and N10276. Lines for C64200, C68700, C70400, and C71000 have been added.

Location: Tables U and Y-1

Subject: Stress Value Revisions

Explanation: Stress values for N02201, N06600, N06625, and N10003 in Tables U and Y-1 have been either revised and/or added at higher temperatures.

Location: Tables U and Y-1

Subject: SB-462 UNS N06059

Explanation: Lines have been added to Tables U and Y-1 for SB-462 UNS N06059.

Location: Tables CS-1 Through CS-4

Subject: Values for Factors A and B

Explanation: Tables CS-1 through CS-4 have been revised so that for each listed temperature or yield strength, the first line shows a Factor A of 0.00001 and the corresponding Factor B value, and the second line shows the smallest Factor B value from the applicable figure (i.e., Figure CS-1, CS-2, CS-3, or CS-4) and the corresponding Factor A value.

Location: Part D Metric, Tables 1B, 2B, 6B, U, and Y-1

Subject: Corrections Across Multiple Tables

Explanation: Revisions have been made to the metric stress tables so that they agree with the values given in the specification. The product term “forgings” has been added to SB-283 C70620 and C71520, and the allowable stress values in Table 2B have been revised for SB-187 C10200 and C11000 O60 temper.

Location: Part D Metric, Table Y-1

Subject: Yield Strength Values

Explanation: In Table Y-1, several yield strength values for annealed coppers at 65°C have been corrected.

SECTION V

Introduction

Section V of the ASME Boiler and Pressure Vessel Code (BPVC) contains requirements and methods for nondestructive examination (NDE), which are referenced and required by other ASME BPVC Sections or other referencing documents. These NDE methods are intended to detect surface and internal imperfections in materials, welds, fabricated parts, and components. They include requirements for radiographic examination, ultrasonic examination for welds and materials, liquid penetrant examination, magnetic particle examination, eddy current examination, visual examination, leak testing, acoustic emission examination, alternating current field measurement, and magnetic flux leakage. Article 1, Mandatory Appendix II covers supplemental personnel qualification requirements for NDE Certification to be included in the employer's written practice for NDE personnel certification, when the employer uses computed radiography, digital radiography, phased array ultrasonics, ultrasonic time of flight diffraction, and ultrasonic full matrix capture.

Section V is divided into two Subsections that include both Mandatory and Nonmandatory Appendices. Subsection A describes the methods of nondestructive examination to be used when referenced by other Code Sections or referencing documents. Subsection B includes ASME/ASTM standards covering various nondestructive examination methods. These standards are not mandatory unless specifically referenced in whole or in part by Subsection A or as indicated in other Code Sections or referencing documents.

Significant Changes

Location: Article 1, T-120

Subject: Incorporate Endnotes Into Main Text

Explanation: The text from Endnotes 1 and 2 has been incorporated into new notes following paras. T-120(c) and T-120(d), respectively, and the Endnotes have been deleted.

Location: Article 1, Mandatory Appendix I

Subject: Updated Definitions

Explanation: Article 1, Mandatory Appendix I has been revised as follows:

- (a) The definition of *bad pixel* has been revised.
- (b) The definitions of ultrasonic testing-related terms have been moved from I-130 to I-121.
- (c) Definitions relevant to total-focused-method imaging paths have been added to support revisions to Article 4, Mandatory Appendix XI, XI-421.2.1 and XI-462.8.2.
- (d) Definitions relevant to computed tomography (CT) have been added to support the new Article 20.
- (e) Definitions relevant to pulsed eddy current (PEC) examination have been added to support the new Article 21 and Nonmandatory Appendix A.
- (f) Definitions for the following terms, which have long been used in Section V but were not previously defined, have been added: *bad pixel map*, *bit depth*, *corrected image*, *gain correction*, *negative image format*, *offset correction*, *pixel correction*, *positive image format*, *time of flight diffraction (TOFD)*, *window level*, and *window width*.

Location: Article 1, Mandatory Appendix II

Subject: ANSI/ASNT CP-105

Explanation: Article 1, Mandatory Appendix II has been revised to reference the 2020 edition of ANSI/ASNT CP-105. In addition, Supplement A has been deleted; the 2020 edition of ANSI/ASNT CP-105 contains a training outline for ultrasonic full matrix capture, making Supplement A redundant.

Location: Article 1, Mandatory Appendix II, II-124.1, Endnote 3

Subject: Title of ANSI/ASNT CP-105

Explanation: The title of the referenced ANSI/ASNT CP-105 has been corrected. The incorrect title was cited when this reference was added to Endnote 3 in 2015.

Location: Article 1, Mandatory Appendix III

Subject: ASNT SNT-TC-1A

Explanation: Article 1, Mandatory Appendix III has been revised in its entirety to reflect the 2018 Addendum 1 to ASNT SNT-TC-1A-2016.

Location: Article 1, Mandatory Appendix IV

Subject: ASNT CP-189

Explanation: Article 1, Mandatory Appendix IV has been revised in its entirety to reflect the 2020 edition of ANSI/ASNT CP-189.

Location: Article 2, T-224

Subject: Radiograph Identification

Explanation: Paragraph T-224 has been revised to provide clarity on traceability and the required endurance of radiograph identification.

Location: Article 2, T-275

Subject: Location Markers

Explanation: The words “of interest” have been deleted and a new sentence has been added to T-275 to clarify that the location markers do not define the area of interest.

Location: Article 2, T-276.2 and T-283.1

Subject: Use of Small Diameter Wire and Visibility of the Material Identification Notches on a Radiograph

Explanation: Paragraph T-276.2 has been revised to specifically state that a wire of smaller diameter than the essential wire listed in Table T-276 may be used to demonstrate the required sensitivity of the image quality indicator (IQI). Wording to address material group identification notches for hole-type IQIs has been added to T-283.1.

Location: Article 2, T-277.1

Subject: Separate Image Quality Indicator (IQI) Blocks

Explanation: A reference to SE-747 has been added to T-277.1(a) to clarify the material requirements for separate IQI blocks. When it is not practical to place the IQI on the part or weld being examined, the user may place it on a separate block. Blocks to be used with a wire-type IQI shall be made of materials identified in SE-747.

Location: Article 2, T-291

Subject: Number of Radiographs

Explanation: In T-291(d), the phrase “number of radiographs (exposures)” has been simplified to “number of exposures.” “Radiographs” and “exposures” have different meanings. The number of exposures required to achieve the desired result is part of the radiographic technique; the number of radiographs may vary.

Location: Article 2, Mandatory Appendix VII, VII-293

Subject: Layout Details

Explanation: The information formerly in Endnote 7 has been revised slightly and moved to a Note following VII-293(b). Like the endnote, the new note references SE-1030, Appendix X1, which provides useful information regarding the radiographic shooting sketch for castings. However, the endnote’s reference to “Fig. X1.1” has been deleted.

Location: Article 2, Mandatory Appendices VIII and IX

Subject: Pixel Intensity and Image Brightness

Explanation: Article 2, Mandatory Appendices VIII and IX have been revised to increase the permitted pixel intensity variation from 2% to 15% for computed radiography and from 2% to 30% for digital radiography.

Location: Article 2, Mandatory Appendix VIII, Figure VIII-A-221-1

Subject: Length of Notches

Explanation: Figure VIII-A-221-1, General Note (c) has been revised to clarify the test block notch dimensions.

Location: Article 2, Mandatory Appendix VIII, VIII-282, and Mandatory Appendix IX, IX-282

Subject: Pixel Averaging and Limits for Averaging

Explanation: Paragraphs VIII-282 and IX-282 have been revised to clarify the permissibility of averaging and to establish the limits for averaging in the determination of pixel brightness deviation tolerances.

Location: Article 2, Mandatory Appendix IX

Subject: Bad Pixel Determination

Explanation: Article 2, Mandatory Appendix IX has been revised to clarify the method, frequency, and use of bad pixel maps.

Location: Article 2, Mandatory Appendix IX

Subject: “Digital Radiography” Versus “Direct Radiography”

Explanation: In Article 2, Mandatory Appendix IX, the term “direct radiography” has been corrected to “digital radiography.”

Location: Article 2, Mandatory Appendix IX, IX-277

Subject: Automated Examination Technique

Explanation: In IX-277, the term “in-motion technique” has been replaced by “automated examination technique” to clarify the intended examination technique. In addition, the definition of “automated examination technique” has been added to Article 1, Mandatory Appendix I, I-121.1.

Location: Article 4, T-410 and T-420

Subject: Clarify Article 4 Requirements

Explanation: Paragraphs T-410 and T-420 have been revised to clarify that Article 1 requirements are also to be used with Article 4 and to align the scope and general requirements of Article 4 with other Articles of Section V.

Location: Article 4, Mandatory Appendix III, III-434.2.2 and III-463.2

Subject: Calibration Block Thickness Tolerance

Explanation: In III-434.2.2, the tolerance on the thickness of the TOFD calibration block has been increased from $\pm 10\%$ to $\pm 25\%$ of the nominal thickness of the piece being examined. The previous $\pm 10\%$ tolerance is too tight of a tolerance for TOFD and also results in the need for a large number of blocks to cover a range of thicknesses. In addition, the thickness tolerance for the qualification block in Mandatory Appendix IX is $\pm 25\%$, and this difference in tolerance sometimes prevents incorporation of the TOFD calibration block into the qualification block, which is a common practice. Paragraph III-463.2 has been revised to clarify the reference sensitivity setting.

Location: Article 4, Mandatory Appendix III, III-463.5 and Figure III-463.5

Subject: Offset Scans

Explanation: Paragraph III-463.5 and Figure III-463.5 have been revised to clarify the intent of offset scans and the width of coverage confirmation. In the 2019 Edition, III-463.5 and Figure III-463.5 did not agree with each other.

Location: Article 4, Mandatory Appendix IX, IX-492

Subject: Documentation

Explanation: Paragraph IX-492 has been revised to clarify the information required to be documented in the procedure qualification record.

Location: Article 4, Mandatory Appendix XI, XI-421.2.1 and XI-462.8.2

Subject: Reference Block Guidance

Explanation: Paragraph XI-421.2.1 has been added to modify the type and location of subsurface flaw required on the demonstration block when the full matrix capture (FMC) ultrasonic technique is used. This revision is needed to guide the user in selecting the correct TFM path(s) from the many available, and reinforces the correct use of the reference reflectors in the FMC calibration block. In addition, XI-462.8.2 has been revised to clarify the specific purpose of the reflectors in the FMC calibration block.

Location: Article 4, Mandatory Appendix XI, XI-434.1.1

Subject: Additional Reflectors

Explanation: Paragraph XI-434.1.1 has been added to allow the installation of additional reflectors on the full matrix capture block. However, additional reflectors may not be used in lieu of the required reflectors.

Location: Article 4, Mandatory Appendix XI, XI-461 and XI-462

Subject: Use of Distance-Amplitude Curve (DAC)

Explanation: The requirement for amplitude fidelity formerly in XI-461 has been moved to XI-462.1. A new XI-461 covering annual instrument calibration has been added to align Mandatory Appendix XI with other subarticles and Appendices of Article 4. In addition, XI-462.7 has been added to clarify that correction for attenuations (e.g., distance-amplitude correction or time-corrected gain) is allowed but not required.

Location: Article 4, Mandatory Appendix XI, XI-471.3

Subject: Multiple Scans Using Full Matrix Capture (FMC)

Explanation: Paragraph XI-471.3(c) has been revised to require a minimum 10% overlap of the frame width when multiple scans are taken using FMC. This revision makes the FMC process consistent with other ultrasonic examination methods described in Section V.

Location: Article 4, Nonmandatory Appendices S and U

Subject: Transfer Correction for Calibration and Examination Differences in Surface Finish, Heat Treatment, and Other Conditions

Explanation: Nonmandatory Appendices S and U have been added to Article 4 to provide rules for the use of transfer correction for calibration and examination differences in surface finish, heat treatment, and other conditions.

Location: Article 6, T-610, and Article 24

Subject: Scope of Article 6

Explanation: The general reference to SE-165 has been deleted from T-610, Scope.

Location: Article 7, Mandatory Appendix I, I-741; and Article 8, Mandatory Appendix III, III-810 and III-820

Subject: Technique for Measuring Thickness of Coatings

Explanation: In I-741, III-810, and III-820, references to SD-1186 have been replaced with references to SD-7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.

Location: Article 10, Mandatory Appendix IX, IX-1071.5 and IX-1080

Subject: Upstream Pressure Compensation and Leakage Rate Acceptance Criteria

Explanation: Paragraph IX-1071.5 has been revised to provide a more specific trigger for calculation of upstream pressure compensation. This revision eliminates previously used broad terms such as “nominal” and “substantially less.” The revision also makes the requirement applicable when the acceptable leakage rate is stated with an upstream pressure other than 1 atm absolute. In the 2019 Edition, the requirement assumed that the acceptable helium leakage rate is stated with a 1 atm absolute upstream pressure, which meant it did not address cases where the upstream pressure is something other than the typical 1 atm absolute. Paragraph IX-1080 has been revised to clarify that leakage rate acceptance criteria may be from a Code Section, the product specification, or the product design, and to identify the correlation between the acceptable leakage rate, the specified upstream pressure, and the specified helium concentration.

Location: Article 21

Subject: Pulsed Eddy Current (PEC) Examination

Explanation: Article 21 has been added to describe PEC equipment and examination procedures. The Article also includes the following Nonmandatory Appendices:

(a) Nonmandatory Appendix A describes a number of PEC applications and some practices for proper use and characterization of equipment.

(b) Nonmandatory Appendix B provides recommendations for the content of training courses for Level II PEC examiners.

Location: Subsection B

Subject: Cautionary Note to All Subsection B Documents

Explanation: A cautionary note has been added to the cover of each document in Subsection B to emphasize that the document is mandatory only to the extent specified in Subsection A or as indicated in another ASME BPVC Section or referencing document. This note reinforces for Code users the provision stated in Article 1, T-120(d).

Location: Article 22, SE-94/SE-94M

Subject: Revised Standard Guide

Explanation: ASTM E94/E94M-17 has been adopted as the revised and redesignated ASME SE-94/SE-94M. Related cross-references in Article 2, T-231.2 and T-274.1 have been updated accordingly.

Location: Article 22, SE-747

Subject: Revised Standard Practice

Explanation: ASTM E747-18 has been adopted as the revised ASME SE-747.

Location: Article 22, SE-1025

Subject: Revised Standard Practice

Explanation: ASTM E1025-18 has been adopted as the revised ASME SE-1025.

Location: Article 22, SE-1165

Subject: Revised Standard Test Method

Explanation: ASTM E1165-12(R2017) has been adopted as the revised ASME SE-1165.

Location: Article 22, SE-1255

Subject: Revised Standard Practice

Explanation: ASTM E1255-16 has been adopted as the revised ASME SE-1255. Related cross-references in Article 2, Mandatory Appendix II, II-221 and II-286 have been updated accordingly.

Location: Article 22, SE-1475

Subject: New ASME Standard Practice

Explanation: ASTM E1475-13(R2018), Standard Guide for Data Fields for Computerized Transfer of Digital Radiological Examination Data, has been adopted as a new ASME standard practice, ASME SE-1475. Related cross-references have been added to Article 2, Mandatory Appendix VIII, VIII-291, and Mandatory Appendix IX, IX-291.

Location: Article 22, SE-1647

Subject: Revised Standard Practice

Explanation: ASTM E1647-16 has been adopted as the revised ASME SE-1647.

Location: Article 23, SA-388/SA-388M

Subject: Revised Standard Practice

Explanation: ASTM A388/A388M-19 has been adopted as the revised ASME SA-388/SA-388M.

Location: Article 23, SA-609/SA-609M

Subject: Revised Standard Practice

Explanation: ASTM A609/A609M-18 has been adopted as the revised ASME SA-609/SA-609M.

Location: Article 24, SD-129

Subject: Revised Standard Test Method

Explanation: ASTM D129-18 has been adopted as the revised ASME SD-129.

Location: Article 24, SE-165/SE-165M

Subject: Revised Standard Practice

Explanation: ASTM E165/E165M-18 has been adopted as the revised ASME SE-165/SE-165M.

Location: Article 24, SE-3022

Subject: Revised Standard Practice

Explanation: ASTM E3022-18 has been adopted as the revised ASME SE-3022.

Location: Article 29, SE-750

Subject: Revised Standard Practice

Explanation: ASTM E750-15 has been adopted as the revised ASME SE-750.

Location: Article 29, SE-976

Subject: Revised Standard Guide

Explanation: ASTM E976-15 has been adopted as the revised ASME SE-976.

Location: Article 29, SE-1419/SE-1419M

Subject: Revised Standard Practice

Explanation: ASTM E1419/E1419M-15a has been adopted as the revised ASME SE-1419/SE-1419M.

Location: Article 33, SE-2775

Subject: Revised Standard Practice

Explanation: ASTM E2775-16 has been adopted as the revised ASME SE-2775.

Location: Article 33, SE-2929

Subject: Revised Standard Practice

Explanation: ASTM E2929-18 has been adopted as the revised ASME SE-2929.

SECTION IX

Introduction

1 GENERAL

Section IX of the ASME Boiler and Pressure Vessel Code (BPVC) provides requirements for the qualification of welders, welding operators, brazers, brazing operators, and fusing operators. It also provides requirements for the procedures used in material-joining processes such as welding, brazing, or plastic fusing under construction Codes of the ASME BPVC and the ASME B31 Code for Pressure Piping.

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. The organization conducting the production joining shall determine such factors and address them in the Procedure Specification to ensure that the required properties are achieved in the production material-joining process.

Section IX provides requirements for the Procedure Specification and the Procedure Qualification Record (PQR), which are intended to ensure the material-joining process proposed for construction is capable of producing joints having the required mechanical properties for the intended application. 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.

Section IX provides requirements for Performance Qualification, which is intended to determine the ability of the person using a material-joining process to produce a sound joint.

Section IX is divided into four Parts: Part QG, General Requirements; Part QW, Welding; Part QB, Brazing; and Part QF, Plastic Fusing. Each Part addressing a material-joining process is 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. The general requirement Articles reference the data Articles for specific details of the testing equipment and removal of the mechanical test specimens.

2 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 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 postweld heat treatment 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.

3 PERFORMANCE QUALIFICATIONS

The performance qualification 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. Paragraphs 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. Paragraph 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 nondestructive examination (NDE) of a test coupon, or the initial production weld. Brazers or brazing operators and fusing operators may not be qualified by volumetric NDE.

4 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.

Users frequently misuse the data Articles by selecting variables that do not apply to a particular process. Variables apply only as referenced for the applicable process in Article II or Article III for welding, Article XII or Article XIII for brazing, and Article XXII or Article 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 Nonmandatory 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 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 summarizes these 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.

Paragraph 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 the definitions in 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.

Significant Changes

Location: Introduction; QG-101; QG-102; QG-105.3; QW-101; QW-200.1; QW-200.2; QW-200.4; QW-202.1; QW-251.2; QW-290; QW-290.1; QW-290.2; QW-290.3; QW-290.5; QW-401.1; QW-403.5; and Nonmandatory Appendix K, K-301

Subject: Supplemental Essential Variables

Explanation: Multiple paragraphs have been revised to clarify the circumstances under which supplementary essential variables are required. Supplementary essential variables become requirements for procedure qualification when toughness testing of the procedure qualification is required by the referencing code, standard, or specification. Previously in Section IX, most references to supplementary essential variables were followed by the words “when required.” The revisions in the 2021 Edition ensure that all references to supplementary essential variables clearly indicate when the variables are required.

Location: QG-102; QG-104; QG-106.1; QG-106.2; QG-109.2; and Nonmandatory Appendix L, L-200

Subject: Quality Program

Explanation: The phrase “Quality Control System or Quality Assurance System” has been replaced by the more generic term “quality program” in the listed paragraphs, and a definition of “quality program” has been added to QG-109.2.

Location: QG-106

Subject: Supervising Qualification Activities

Explanation: Paragraph QG-106(a) has been revised to clarify the responsibilities of the welding supervisor. This revision removes the requirement that persons who sign qualification records be qualified in accordance with QG-106(b) and instead requires the organization to designate those who will be responsible for supervision, control, evaluation, and acceptance of qualification testing.

Location: QG-106.1

Subject: Organization Qualification Requirements

Explanation: Paragraph QG-106.1(a) has been revised so that personnel performing supervisory activities are no longer designated with the responsibility for certifying qualification documents. The qualifying organization is required to provide supervision and control over the welder regardless of the welder’s employment status, and if the organization believes it is not exercising sufficient supervision or control over the welder, it is not obligated to continue the procedure qualification test using that individual.

Location: QG-106.4

Subject: Simultaneous Procedure Qualification

Explanation: Paragraph QG-106.4 has been added to allow group qualification of welding procedures when this practice is expressly permitted by the referencing code.

Location: QG-108

Subject: Qualifications Made to Previous Editions

Explanation: Paragraph QG-108 has been revised to clarify that the requirements of the effective edition of the referencing code, standard, or specification must be met in addition to the allowances in QG-108. This includes meeting any new requirements in the effective edition, which may have not been present when the Welding Procedure Specification was originally qualified.

Location: QG-109.2

Subject: Definitions

Explanation: The definitions in QG-109.2 have been updated as follows:

- (a) The phrase “so as to facilitate complete joint penetration” has been deleted from the definition of “backing.” The deleted phrase indicates an acceptance criterion. Acceptance criteria should not be specified in a definition.
- (b) A definition of “explosion welding” has been added for consistency with terms in AWS A3.0M/A3.0:2010.
- (c) The definition of “interpass temperature” has been revised to clarify that this temperature can be measured on the surfaces adjacent to the weld joint as well as in the weld joint itself and that it applies to multipass welds.
- (d) The definition of “welding gun, electron beam” has been deleted. The term “electron beam welding gun” is not used in Section IX.

Location: QW-162.1 and Figure QW-466.1

Subject: Bend-Test Jig Dimensions

Explanation: The equations for bend-test jig dimensions in Figure QW-466.1 have been revised. In the 2019 Edition, the equations for these dimensions were expressed solely in terms of the coupon thickness. They should be expressed in terms of the dimensions of the applicable component parts. In other words, the dimension for the distance between the rollers should not be solely a function of the coupon thickness; instead it should be a function of the width of the plunger plus twice the coupon thickness, plus the gap permitted between the two. There are no technical changes to the dimensions; only the way the dimensions are expressed has been revised. In addition, a statement has been added to QW-162.1 stating that the bend radii given in Figure QW-466.1 are maximums.

Location: QW-184

Subject: Linear Indications at the Root

Explanation: Paragraph QW-184 has been revised to clarify qualifications of linear indications at the root. In the 2019 Edition, the fillet weld performance qualification macro-examination requirements in QW-184(a) stated “visual examination of the cross section of the weld metal and heat-affected zone shall show complete fusion and freedom from cracks, except that linear indications at the root not exceeding $\frac{1}{32}$ in. (0.8 mm) shall be acceptable.” No other examination acceptance criteria in Section IX permit linear indications at the root, including the requirements in QW-183 for fillet weld procedure qualification. The exception formerly in QW-184(a) led to the belief by some Code users that incomplete fusion and cracks at the root that are less than $\frac{1}{32}$ in. are acceptable.

Location: QW-191.1.2.1, QW-191.1.2.2, and QW-191.2

Subject: RT and UT Qualification Acceptance Criteria

Explanation: Several paragraphs in QW-191 have been revised to clarify the thickness a welder is qualified to weld and to make acceptance criteria for radiographic examination (RT) and ultrasonic examination (UT) consistent.

Welders and welding operators may be qualified by RT or UT in some cases. In the 2019 Edition, QW-191.1.2.2(a), QW-191.1.2.2 (b), and QW-191.2.2(b) used the variable t rather than the word “thickness.” This caused some confusion about what t the welder was qualified to weld. In the 2021 Edition, QW-191.1.2.1(c) has been added to define the term “thickness,” and QW-191.1.2.2 and QW-191.2.2 have been revised to reference “thickness” rather than t . This revised wording is consistent with that used in Section VIII, Division 1. Additional revisions address minor inconsistencies between the acceptance criteria for RT and UT.

Location: QW-192.1.4 and QW-202.5

Subject: Macro-Examination

Explanation: Wording has been added to require specimens be smoothed and etched to give clear definition of the stud weld and heat-affected zones.

Location: QW-200.4

Subject: Combination of Welding Procedures

Explanation: Paragraph QW-200.4 has been revised to apply to Welding Procedure Specifications (WPSs) for the special processes of corrosion-resistant or hardfacing overlay. Multiple WPSs having different essential, supplementary essential, or nonessential variables may be used in a single production joint, and each WPS may include one or a combination of processes, filler metals, or other variables.

Location: QW-200.4 and Table QW-255

Subject: Short-Circuit Transfer Mode

Explanation: These revisions removed the requirements that limit the base metal and weld metal thickness to 1.1 times their respective thicknesses when using gas metal arc welding in the short-circuiting transfer mode for Welding Procedure Specifications. These limits were imposed decades ago because the risk of lack of fusion increases as thickness

increases. They were removed because the basis for making a variable essential assumes that the weld is sound — and this limitation is about soundness, not mechanical properties. The 1.1t limitation when qualifying welders remains in place since qualifying welders is about ensuring that the welder can deposit sound weld metal.

Location: QW-202.2 and QW-301.2

Subject: Pressure-Retaining Fillet Welds

Explanation: Paragraph QW-202.2(c) has been revised to clarify that pressure-retaining fillet welds shall be qualified by a groove weld. A new paragraph has been added to QW-301.2 to clarify the welder performance qualifications of a welder who has obtained qualification via a fillet-weld procedure qualification.

Location: QW-215.4

Subject: Partial Penetration Welds Using Laser Beam Welding or Electron Beam Welding

Explanation: Paragraph QW-215.4 incorporates Code Case 2868-1 as an option for qualifying partial-penetration laser beam welding and electron beam Welding Procedure Specifications (WPSs). The option requires the user to have a previously qualified groove weld WPS with all the required mechanical tests and a workmanship WPS qualified on the partial-penetration production parts.

Location: QW-217

Subject: Mechanical Property Acceptance Requirements

Explanation: Paragraph QW-217(a) has been revised to improve the wording. Mechanical property acceptance requirements have been added as well.

Location: QW-217 and QW-218.3

Subject: Chemical Analysis

Explanation: In QW-217(a) and QW-218.3, the cross-reference to Table QW-453 has been replaced with a cross-reference to QW-216.2(d). This revision restores a reference to the chemical analysis requirements for joining of clad metals and attachment of applied linings. In the 2019 Edition, the Notes to Table QW-453 were deleted, and the chemical analysis requirements referenced in the Table Notes were relocated. However, the references to Table QW-453 in QW-217(a) and QW-218.3 were not updated. This 2021 revision corrects the oversight.

Location: QW-251.2

Subject: Supplementary Essential Variables

Explanation: In the 2019 Edition, many table notes were moved into the body of Section IX because table and figure notes are not supposed to contain requirements. A note clarifying that supplementary essential variables apply to fillet welds when toughness qualification is required was deleted from table notes but not added to the body of Section IX. In the 2021 Edition, this requirement has been added to QW-251.2.

Location: Tables QW-253 and QW-257; and QW-404.7 and QW-410.12

Subject: Deletion of Variables

Explanation: Paragraphs QW-404.7 and QW-410.12 are outdated variables and thus have been deleted. Both were carry-overs from before Section IX had heat-input controls. Tables QW-253 and QW-257 have been updated accordingly.

Location: Table QW-264; and QW-409.19, QW-409.20, QW-409.21, and QW-410.14

Subject: Laser Beam Welding Variables

Explanation: The laser beam welding variables and low-power density laser beam welding variables in Table QW-264 and elsewhere have been revised to better represent current laser welding technology and controls. These revisions are intended to make Section IX consistent with AWS C7.4/C7.4M.

Location: QW-301.4

Subject: Welding Operator Performance Qualification

Explanation: Paragraph QW-301.4 has been revised to distinguish between the requirements for the record of tests for welders and the record of tests for welding operators. The paragraph previously required that QW-452 thickness and diameter limit qualifications be shown on welder and welding operator qualification records. Since there are no thickness or diameter limits applicable to welding operators, the paragraph has been revised to eliminate this requirement. Information on welding operators has been removed from the first sentence of QW-301.4 and restated in a new sentence.

Location: QW-304 and QW-305

Subject: Qualification for Welding Zirconium

Explanation: Paragraphs QW-304 and QW-305 have been revised to permit welders using gas tungsten arc welding (GTAW) to qualify by volumetric examination when welding zirconium. Such qualification is already permitted for welders using GTAW to weld titanium. Flaws found in zirconium welds made by GTAW are no different from those found in titanium welds. Therefore, qualification to weld zirconium by volumetric examination should also be permitted.

Location: QW-322

Subject: Continuity of Qualification

Explanation: Paragraph QW-322 has been revised to clarify the requirements for confirming continuity of qualification. In the 2019 Edition, use of the words “supervision and control” caused some users to think that those who update continuity must meet the qualification requirements of QG-106. That is not the intent; this revision resolves the issue. The paragraph also now requires welding operators who are qualified to use a welding process with both machine welding and automatic welding to be tracked separately.

Location: QW-403.6, QW-406.3, QW-407.2, QW-409.1, QW-409.4, and QW-410.9

Subject: Exemption of Materials Not Affected by Cooling Rate

Explanation: Paragraphs QW-403.6, QW-406.3, QW-407.2, QW-409.1, QW-409.4, and QW-410.9 have been revised to exclude P-No. 8, P-No. 21 through P-No. 26, and P-No. 41 through P-No. 49 materials. The toughness of these materials is not affected by cooling rate variables such as interpass temperature, thickness, and heat input.

Location: QW-404.5

Subject: Methods of Calculating A-Numbers

Explanation: This change specifies that when chemical analysis of the weld metal from the procedure qualification test coupon is not performed, SFA specification test assemblies be used to determine the chemical analysis of the weld metal when establishing an A-Number.

Location: QW-420

Subject: P-Number Introduction

Explanation: Paragraph QW-420 has expanded over the years to cover many issues related to P-Number assignments. In the 2021 Edition, topics have been grouped and additional paragraph designators and titles have been added to make the information easier to navigate. No technical changes have been made.

Location: Table QW/QB-422

Subject: Addition of Various Alloys

Explanation: Table QW/QB-422 has been revised as follows:

(a) The following were assigned P-No. 1: AS 1548; CSA-G40.21; GB 713; IS 2062; JIS G3118; JIS G4303; NF A 36-215; and EN10025-2 Grades S275J2, S355JR, and S355J2.

(b) The following was assigned P-No. 8: A/SA-240 S31655.

(c) The following was assigned P-No. 10H: UNS S82011.

(d) The following was assigned to P-No. 45: SB-674, UNS N08354.

(e) The remaining six grades of duplex castings in A890 and the remaining two grades in A/SA-995 (Grade 3A UNS J93371) have been added.

(f) P-No. 10H Group 1 has been assigned to A/SA-182, A/SA-240, A/SA-479, A/SA-789, and A/SA-790 UNS S32506. This revision is an incorporation of Code Case 2543.

Location: Table QW/QB-422

Subject: P-Number Assignments

Explanation: ASME-adapted international material specifications SA/AS 1548, SA/CSA-G40.21, SA/GB 713, SA/IS 2062, SA/JIS G3118, SA/JIS G4303, and SA/NF A 36-215 are listed in Table QW/QB-422 with an assigned P-Number and Group Number. However, in the 2019 and earlier Editions, the source material specifications (i.e., AS 1548, CSA-G40.21, GB 713, IS 2062, JIS G3118, JIS G4303, and NF A 36-215) were not listed and therefore were considered unassigned. The 2021 Edition adds these source materials to Table QW/QB-422, thereby assigning them P-Numbers and Group Numbers.

Location: Tables QW-451.1 and QW-451.2

Subject: Limits to Thickness Ranges

Explanation: A statement has been added to Note (1) of Tables QW-451.1 and QW-451.2 to clarify that supplementary essential variables may further limit thickness ranges in these Tables.

Location: QW-462

Subject: Dimensional Requirements of ISO 5173

Explanation: Since the 2017 Edition of Section IX, tension specimens meeting the dimensional requirements of various AWS and international codes and standards have been acceptable for welding procedure and performance qualifications. The 2021 Edition has been revised to make bend test specimens prepared according to EN ISO 5173 acceptable provided the ratio of test specimen thickness to the bend radius complies with the requirements of Figure QW-466.1. This brings Section IX into closer alignment with EN ISO 9606 for welders and EN ISO 14732 for welding operators.

Location: QW-500 and Mandatory Appendix E

Subject: Standard Welding Procedure Specifications (SWPSs)

Explanation: Paragraph QW-500 and SWPSs were added to Section IX in the 1998 Edition, 2000 Addenda. While new SWPSs are added to the list in Nonmandatory Appendix E, old ones are periodically updated. Paragraph QW-500 has been revised to clarify that an organization may continue to use previously adopted editions of SWPSs even though a later edition is shown in Nonmandatory Appendix E but that the organization must follow the currently listed edition if it has not previously adopted it. Introductory paragraphs were added to Nonmandatory Appendix E to provide guidance on adopting SWPSs. The table in the Appendix has been reformatted to make finding the desired SWPS easier.

Location: QB-305

Subject: Brazing Operator Qualification Requirements

Explanation: Paragraph QB-305 allows the operator to be qualified via procedure qualification with no mention of any limits; it has been revised to impose the essential variables of QB-350 on brazing operators. A reference to the workmanship coupon in QB-182 was added to QB-305(a) and a reference to QB-452 was added to give the number of specimens required. Finally, QB-305(b) added that the section specimen has to be visually evaluated to the acceptance criteria in QB-182.

Location: Nonmandatory Appendix D

Subject: Listing of Base Metals by P-Number

Explanation: Nonmandatory Appendix D has been deleted; the ability to electronically search Section IX and other resources made it superfluous.

Summary of Significant Changes in the 2021 ASME Boiler and Pressure Vessel Code

The ASME Boiler and Pressure Vessel Code (BPVC) is a globally recognized, trusted source of critical data and technical requirements, developed through a consensus-driven process. It provides the single largest source of technical data used in the design, manufacturing, and operation of boilers and pressure vessels. With each new edition, the ASME BPVC continues to evolve, prescribing new concepts, technologies, and methodologies to promote safety across pressure technology applications. This book summarizes the latest updates to specific Sections of this ever-evolving Code, which include

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