

SUMMARY OF CHANGES TO THE

ASME**BOILER AND PRESSURE VESSEL
CODE, SECTION IX, 2023 EDITION****Learn what's been modified in this publication**

This article discusses the significant changes that appear in the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*, Section IX, 2023 edition. All changes can also be found in “Summary of Changes” in the front matter of Section IX. Note: Opinions expressed in this article are the author's, not the official opinion of ASME BPV Standards Committee IX. These changes become mandatory for new qualifications on January 1, 2024.

Part QG, General Requirements

The white paper “Guidance on Complying with Section IX, QG-106” was updated to match changes that were made in the 2021 edition (cstools.asme.org/csconnect/FileUpload.cfm?View=yes&ID=62700). Also, in QG-106.1, the requirement that states the welder who welds the procedure qualification test coupon must be your employee was formally deleted in 2021, but that sentence was not deleted when the code was printed. It has been removed in this edition.

QG-108 deals with qualifications that meet earlier editions of Section IX. It has been simplified to eliminate reference to the 1962 edition. Welding procedure specifications (WPSs), procedure qualification records (PQRs), and performance

qualifications made to previous editions of Section IX remain valid without updating to later editions. The revision also added that WPSs may be updated to later editions using PQRs qualified under earlier editions provided the essential and applicable supplementary essential variables required by the later edition are recorded on the PQR. While WPSs may continue to be used indefinitely, any requirements of the construction code you are working with (e.g., toughness testing) must be met.

**Welding Procedure (QW-200)
Changes**

When using gas metal arc welding (GMAW), you will now be able to change shielding gas mixtures in your WPS without requalifying by using oxygen equivalents (OE). Very simply, oxygen interacts with other elements in the weld pool, converting some of them to oxides; this affects the weld metal's properties. You can see those oxides on the surface of a weld as slag islands. CO₂ decomposes in the welding arc, releasing some oxygen, and that oxygen has the same effect as ordinary oxygen. But on a volume basis, it is only half as potent a deoxidizer as oxygen. The oxygen equivalent of a shielding gas is the percent oxygen plus one-half of the percent CO₂. How will this be used? Filler metal manufacturers will

be adding an OE designation to the AWS classifications for most filler metals (e.g., ER70S-6 OE 50/4). If you qualified your WPS using argon with 10% CO₂ shielding gas, and the wire you buy has an OE of 50/4, you will be able to write a WPS using that wire and specify a shielding gas of argon with anywhere between 8 and 100% CO₂ and anywhere between 4 and 50% oxygen without requalification of the WPS. (See the article titled “A Prospect for More Flexibility in Shielding Gas Substitution” in the August 2021 *Welding Journal* for further explanation.)

In the 2021 edition, the thickness range for procedure qualification when using GMAW in the short-circuiting transfer mode was changed from 1.1 times the thicknesses of the base metal and the weld deposit to 2 times those thicknesses. In this edition, transfer mode was changed from an essential to a nonessential variable. The WPS must specify the transfer mode(s) to be used, but qualification of the WPS in any transfer mode qualifies all transfer modes. That is, if you have WPSs that were qualified using the short-circuiting transfer mode for the part of the weld and some other transfer mode for the rest of the weld, instead of considering each transfer mode separately in the WPS as you have in the past, you can use the total GMAW deposit thickness in the test coupon to determine the maximum weld deposit thickness qualified for all transfer modes. You must, however, specify in the WPS the maximum thickness limits for each transfer mode that you want the welder to use in production. This change does not apply to welders. Welders who use GMAW with short-circuiting transfer still have to qualify using the short-circuiting transfer mode, and the qualified deposit thickness is limited to 1.1 times the thickness of the weld metal deposited in the welder’s test coupon using short-circuiting transfer.

QW-200 began with the following: “Each organization shall prepare a written welding procedure specification . . .”, implying to some users that organizations had to write WPSs themselves. Section IX has never intended that organizations write WPSs or PQRs without assistance. This statement was removed from this paragraph, from QW-200.2, and from similar paragraphs in Parts QB and QF.

QW-202.4(b)(1) allows one side of a production joint to be of unlimited thickness for specific materials where the cooling rate does not affect mechanical properties of those materials provided the procedure was qualified using a test coupon that was ¼ in. thick or greater. That provision was limited to “similar” materials, but it was unclear what “similar” meant. “Similar” was deleted in this edition, so this expanded thickness rule applies to all materials that are listed in this paragraph, including combinations where only one side of a joint is one of the listed materials (e.g., the P-8 side of a P-1 to P-8 joint).

QW-202.2 has always stated that the base metal and weld metal thicknesses qualified were based on QW-451, and that

is true for most processes but not all. This revision clarifies that QW-451 is applicable only when referenced in the tables of variables for a process.

When depositing corrosion-resistant weld metal overlay, the heat input used for the first layer of weld metal is limited to 110% of the heat input qualified. In the 2017 edition, how heat input is measured when using strip cladding was addressed by making the strip width part of the heat input formula. This edition makes the weave width part of that formula. This led to a proposal to consider weave width as part of the usual formula for measuring heat input, but those changes did not make the cutoff date for this edition.

For those who use laser welding, WPSs have always been limited to the P-number(s) of the base metals that were used on the test coupon. This edition tightens that up by imposing a carbon equivalent limit for base metals listed in P-No. 1 through P-No. 7 and P-No. 9A through P-No. 15F.

Personnel Qualification (QW-300) Changes

Some of you may have seen semiautomatic laser beam welding (LBW) at FABTECH. This edition of Section IX added Table QW-358 so that you can qualify welders using LBW. The table has the same variables as gas tungsten arc welding plus four new essential variables:

- A change from keyhole LBW to low-energy LBW and vice versa
- Addition or deletion of torch-controlled oscillation
- Change from pulsed mode of operation to continuous mode of operation and vice versa
- A change in the welding equipment type (e.g., YAG, TAG, etc.).

The welder qualification form has also been revised to show the new variables.

QW-304 had a paragraph buried at the end that stated a welder who was qualified to weld following one WPS was qualified to weld following other WPSs using the same welding process within the limits of the essential variables of QW-350. Similar paragraphs were found in QW-305. To give greater visibility to the fact that welders and welding operators are qualified to use a welding process and are not limited to the WPS they followed when they tested, these paragraphs were moved to QW-300. QW-300 now says that welders and welding operators may follow any WPS specifying the process they used within the limits of the essential variables for which they are qualified based on the test coupon they welded. Similar changes were made in QB-300 and QF-300.

QW-322 on maintaining qualifications has been revised again. In the previous edition, a welding operator using automatic welding did not prolong that operator's qualifications for machine welding; in this edition, using a process with either machine or automatic welding prolongs that operator's qualifications for both.

QW-306 allows welders to qualify using more than one process on a test coupon. This revision prohibits using that option when a welder tests using fillet welds because one of the key skills that a welder has to demonstrate is the ability to fuse into the corner of the joint when making fillet welds. That skill would not be demonstrated if the welder used a second process on the test coupon.

Appendix L covers what you must do when qualifying personnel to ISO 9606-1 or ISO 14732 to be sure they are also qualified to Section IX. This appendix was revised from a guidance document that identified where the differences are between the standards to specifically indicate the steps required to achieve that goal.

Base Metals and Filler Metals

Section IX is published every two years along with the rest of the *Boiler and Pressure Vessel Code*. When a new material is adopted and assigned a P-number by the committee, users have to wait for the next edition to be published to consider that material the assigned P-number. This edition will have a web link to an official listing of materials that are assigned P-numbers, and that listing will be updated as soon as a new material has been officially assigned a P-number. The website *pnumbers.com* will remain available to all.

The base metal designations in QW-422 were changed from "A/SA-XXX" to "A or SA-XXX" to make it clear that materials produced to both the ASTM and ASME versions of materials specifications are assigned the designated P-number.

The following AWS filler metal specifications were adopted by ASME and will appear in Section II Part C:

AWS A5.10/A5.10M:2021, ***Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods***

AWS A5.29/A5.29M:2021, ***Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding***

AWS A5.13/A5.13M:2021, ***Specification for Surfacing Electrodes for Shielded Metal Arc Welding***

AWS A5.18/A5.18M:2021, ***Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding***

AWS A5.20/A5.20M:2021, ***Specification for Carbon Steel Electrodes for Flux Cored Arc Welding***

AWS A5.23/A5.23M:2021, ***Specification for Low-Alloy and High Manganese Steel Electrodes and Fluxes for Submerged Arc Welding***

AWS A5.24/A5.24M:2014, ***Specification for Zirconium and Zirconium Alloy Welding Electrodes and Rods***

AWS A5.25/A5.25M-97 (Reaffirmed), ***Specification for Carbon and Low-Alloy Steel Electrodes and Fluxes for Electroslag Welding***

AWS A5.15:1990 (Reaffirmed), ***Specification for Welding Electrodes and Rods for Cast Iron***

AWS A5.32/A5.32M:2021, ***Welding Consumables – Gases and Gas Mixtures for Fusion Welding and Allied Processes***

There is a very useful change in SFA5.18. For those who use ER70S-6 filler metals (which are not automatically A-number 1 chemical composition due to high manganese and silicon limits), this specification will now list ER70S-6A. This new classification will limit manganese and silicon content of the wire to the limits for A-1 analysis in QW-442. That means that you will be able to write a WPS permitting use of ER70S-6A that is supported by a qualification test where ER70S-3 filler metal was used on the procedure qualification test coupon.

For those who weld Grade 91, AWS classification EXXX-B9 has been replaced with EXXX-B91. This change was made because filler metal manufacturers now make filler metal for welding Grade 92, and that filler metal is assigned AWS classification EXXX-B92. You will need to update your WPSs that specify EXXX-B9 filler metals with EXXX-B91.

Testing (QW-400)

The radiographic acceptance criteria for welder qualification testing in QW-191.1 have been reformatted. Rounded indication criteria were revised slightly to match up better with construction code criteria, and the dimension below, which an indication can be considered irrelevant, was defined. This change does not affect existing welder qualifications.

QW-162 has been revised to allow use of the larger bend radius when a test coupon is made from dissimilar materials, and one of those materials specifies a larger bend radius than the other.

Historically, personnel who have performed liquid penetrant examinations on tube-to-tube sheet and overlay qualification test coupons did not have to have any qualifi-

cations. QW-195.3 now imposes some personnel qualification requirements for those activities.

Additive Manufacturing (QW-600)

This edition has a new Part: QW-600 — Material Manufacturing Using Wire-Additive Welding. It provides rules for qualifying welding procedures for making products using robotically controlled GMAW. Multiple test assemblies must be welded using the following:

- The highest heat input and highest interpass temperature you want to use in production
- The lowest heat input and lowest interpass temperature you want to use in production.

The WPS will be limited to welding within the qualified heat input and interpass temperature ranges. In addition, you will have to qualify both of those conditions for the thinnest material that you will build and for the thickest, except that once the test assembly is at least eight beads wide and 2 in. wide, that will qualify making parts of unlimited thickness.

The welding process variables are largely the same variables that are used for ordinary GMAW. Additional welding processes will be added to QW-600 in future editions.

Test assemblies consist of welding “walls” of weld metal one or more passes wide that are tall and long enough to extract the tension, bend, and impact specimens. Those specimens will be all weld metal specimens unless the product will be built directly on a component (integrated backing); in that case, additional mechanical testing across the backing/weld metal interface will be required. (See the article titled “Weld Metal Additive Manufacturing for Large 3D Parts” by Teresa Melfi and Badri K. Narayanan in the September 2022 *Welding Journal* and my article titled “Additive Manufacturing and Section IX” in the June 2023 issue for further discussion of the basis for this approach.)

The required mechanical properties will be established by the manufacturer who will select a target base metal specification, such as SA-516-70. The manufacturer will then select the filler metal classification, heat input, interpass temperature, and thicknesses to qualify, weld the test assemblies, and perform the required testing. If all the tests’ results meet the properties of the selected base metal specification, the designer may use the allowable stress and other physical properties of the selected base metal specification for design purposes, and the manufacturer must produce parts within the thickness limits, heat input, and interpass temperature limits qualified. Be sure to verify that this approach has been accepted by the construction code (Section VIII, B31, etc.) you are working to before creating your own parts.

What is the P-number of a product made from weld metal? The updated P-number table has filler metal classifications for products made using electrodes conforming to the common

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carbon, low-alloy, and stainless steel welding electrode specifications (e.g., material manufactured using ER70S-2 has been assigned P-number 1). Other alloys will be added in future editions.

Despite the buzz about additive manufacturing, it has been used by the welding industry for more than 100 years, but we called it “weld metal buildup.” Go to sperkoengineering.com and click on the welding articles tab for a review of that history.

Brazing (QB) Changes

In 2015, the committee asked the AWS C3 Committee on Brazing and Soldering to verify that the criteria we used for grouping materials for brazing was technically sound. They provided revised criteria that were used to create a new column, AWS B2.2 BM, in QW/QB-422 in the 2017 edition. To provide a transition period, you have been permitted to use either column’s assignment, but after January 1, 2024, only the new grouping system will be permitted. Notably,


- Copper was P-107. It is now P-300.
- Carbon steel was P-101. It is now P-100.
- Stainless steel was P-102. It is now P-130.

Revised PQRs must be recertified by signature and date. I recommend annotating them to record what was changed and why.

QB-322 was revised to make the requirements for maintaining brazing personnel qualifications consistent with the requirements for welding personnel.

Coming Attractions

Additional welding processes will be added to QW-600. Measurement of heat input when using weaving will be addressed.

Readers are advised that ASME Code Committee meetings are open to the public. The schedule is available on the writer’s website and at asme.org (search for committee meetings). 

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