

# Summary of Changes in ASME Section IX, 2000 Addenda

Prepared by

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## Changes to ASME Section IX, 2000 Addenda

The following is a summary of the changes that appear in the 2000 Addenda of ASME Section IX. These changes and related discussion are reported by Walter J. Sperko, P.E., Vice-chairman of Subcommittee IX; readers are advised that the opinions expressed in this article are those of Mr. Sperko and not the official opinion of Subcommittee IX.

### Major Changes

Two major changes to Section IX have been in the works for some time, and they appear in the 2000 Addenda. The changes are:

- AWS Standard Welding Procedure Specifications will be permitted to be used without the user being required to provide supporting PQRs.
- The thickness of weld that a welder will have to deposit on a test coupon to be qualified for unlimited thickness is reduced from 3/4 to 1/2 inch..

### Standard Welding Procedure Specifications

Use of AWS Standard Welding Procedure Specifications (SWPSs) will be permitted. Instead of performing one or more procedure qualification tests, each manufacturer or contractor will have to perform and document a demonstration weld following a typical SWPS. The purpose of this demonstration weld is to require the manufacturer or contractor to demonstrate and document that he knows enough about welding to follow the SWPS. Inclusion of this demonstration as part of the SWPS adoption process was critical to passage of SWPSs because of the disheartening experiences of the writer and others in dealing with small manufacturers, fabricators and contractors whose knowledge of welding technology was miniscule. After welding and testing one demonstration coupon, many other SWPSs may typically be used without further demonstrations.

The specific requirements regarding the adoption, demonstration weld and production application of SWPSs are covered in Article V (i.e., QW-500) of Section IX. A convenient recommended form for documenting the demonstration weld will be found in nonmandatory Appendix B as Form QW-485.

It should be noted that, although QW-500 does not specifically address using a demonstration test to simultaneously qualify a welder, QW-500 does not prohibit it. The astute manufacturer can comply with the demonstration requirements and also qualify a welder simply by completing both forms QW-484 (for the welder) and QW-485 (for the demonstration weld) upon successful welding and testing of the demonstration coupon.

The permitted SWPSs are listed in a new Appendix E of Section IX. These SWPSs cover welding of P/S-1 and P/S-8 metals using SMAW, GTAW and GMAW-FC. Typical thickness ranges permitted are 1/8 to 1-1/2 inches and both as-welded and postweld heat treated procedures (for P/S-1 metals) are available.

Those who elect to use SWPSs will have to purchase them from AWS (1-800-443-9373). In addition to purchasing individual copies of SWPSs, AWS has site license purchase arrangements available.

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### Thickness of Welder Test Coupons

The thickness that a welder will have to deposit on his test coupon to be qualified for unlimited thickness will be reduced from 3/4 to 1/2 inch provided the welder deposits at least 3 layers of weld metal with a single welding process and set of variables. This change appears in the revisions to the table and notes in QW-452.1.

When the test coupon is welded with a single welding process and set of variables, the new table is easy to apply; however, when the test coupon is welded using more than one process or set of essential variables, QW-306 requires that the deposit thickness for each process and set of variables be considered separately when determining the thickness for which the welder is qualified.

### Examples of Welder Qualification Thicknesses Qualified

That is, if a welder tests using E308L-16 on a test coupon 1/2 inch thick, and he deposits at least 3 layers of weld metal for a deposit thickness of 1/2 inch, he is qualified to deposit unlimited thickness using E308L-16 and all F-5 electrodes within the range of the other variables qualified. However, if he tests on the same coupon thickness using GTAW and E308L-16, he would no longer be qualified for unlimited F-5 deposit thickness since the deposit thickness of each process must be considered separately.

If the test coupon is welded using E6010 (F-3 electrode) followed by E7018 (F-4 electrode), the approximate thickness of E6010 is measured and that thickness is used to determine the thickness for which the welder is qualified using F-3 electrodes. Similarly, the approximate thickness of E7018 is measured and that thickness is used to determine the thickness that the welder is qualified to deposit using F-4 electrodes. (Note: Table QW-433 expands the F-numbers for which the welder is qualified for this example.)

If the test coupon is welded using GMAW-S and the root is made using downhill progression and the fill passes are made using uphill progression, the thickness of each progression must be determined and used separately to determine the thickness that the welder is qualified to weld uphill and the thickness that the welder is qualified to weld downhill.

### Documenting Multiple Sets of Variables

It should be noted that, when two processes or variations of a process are used, other variables, such as backing, backing gas, filler metal type, transfer mode, etc. may be different for each process and should be documented separately for each process and variation of process. A workable method for doing this is to separate variations on a line by a slash (/). For example, one might record backing on a record for a test using GTAW/SMAW as follows:

<u>Variable</u>	<u>Actual Value</u>	<u>Range Qualified</u>
Welding Process:	<u>GTAW/SMAW</u>	<u>GTAW/SMAW</u>
Backing:	<u>None/Used</u>	<u>Optional/Required</u>
Filler metal Specification:	<u>SFA-5.18/5.1</u>	
Filler metal Classification:	<u>ER70S-2/E7018</u>	
F-number of filler metal:	<u>6/4</u>	<u>6/1 through 4</u>
Gas Backing for GTAW:	<u>None</u>	<u>Optional</u>

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### Supplemental Essential Variables

Although experienced users of Section IX understand when supplemental variables have to be addressed on a WPS and documented on a PQR, it has always been difficult to identify the specific words that invoke supplemental essential variables. Paragraph QW-100.1, which was revised to incorporate SWPSs, was also revised to clearly say when supplementary essential variables are mandatory. QW-100.1 now says that essential and nonessential variables applicable to any welding process must always be addressed on the WPS, and, when the WPS is qualified with notch-toughness testing (i.e. Charpy or Drop Weight tests), the supplemental essential variables must also be addressed. Similarly for PQRs, the paragraph now says that essential variables applicable to any welding process must be recorded on the PQR, and, when notch-toughness testing is required, the supplemental essential variables must also be recorded.

### Laser Beam Welding

The requirements of a Section III Code Case permitting lap joint welding using laser beams was incorporated into Section IX. The Code Case provided for qualification of lap joints by tension shear testing and by metallographic examination of cross-sections. These provisions have been incorporated into Section IX in QW-197. In addition, a new joint design variable covering lap joints was added as QW-402.18, and new figures were added as QW-464.

### Weave Bead and Stringer Bead

Weave and stringer bead have been redefined to match the definitions in AWS A3.0. The new definitions are:

**Stringer bead:** A weld bead formed without appreciable weaving.

**Weave bead:** A weld bead formed using weaving.

**Weaving:** A welding technique in which the energy source is oscillated transversely as it progresses along the weld path.

These definitions use the term “appreciable” to describe the permitted weaving when a stringer bead is required; “slight” weaving is permitted when using the stringer bead technique. When some control of weave is desirable, or when the definition of a stringer bead needs to be addressed, one can use the “classic” approach of specifying “appreciable weaving” as not greater than 3X or 5X the electrode core wire diameter. A more practical approach is to simply limit the width of the weld bead as it is deposited. For example, one could define a stringer bead as a weld bead not wider than 3/8 inches, and one could limit weave width for weave beads to weld beads not wider than 3/4 inches. This eliminates having to know what size electrode the welder used when he may have multiple sizes, and it provides simple guidance to both the welder and inspectors.

### Simplification of QW/QB-422 Tables for Nonferrous Metals

Three columns will be deleted from the nonferrous portion of QW/QB-422 (the P/S-number table). Specifically,

- The column for “Alloy” was combined with the “Type and Grade” column.

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- The “Thickness” column was combined with the “Product Form” column.
- The column “Condition” was also deleted. This column identified heat treatment conditions such as annealed, hot worked, cold worked, solution hardened, etc.

These changes will allow the font in the table to be increased in size, making it easier to read. As a result of deleting the “Condition” column, many lines of materials where multiple “conditions” existed were deleted, particularly for copper and aluminum alloys; as a result, the only line remaining for any material is that of the annealed or hot rolled condition, and only one tensile strength value is given for any material. This is important since the tensile strength shown in QW/QB-422 is the minimum tensile strength that tension test specimens must meet in accordance with QW-153, and when more than one tensile strength was shown for a material, selection of the correct value could be confusing. As a result moving footnotes from QW/QB-422, QW-153 is now quite cluttered, but editorial changes that are being worked on for the 2001 addenda will simplify QW-153..

### Format Changes the F-number Table

There will be a major format change to QW-432, the F-number table. Each AWS classification of electrode and filler metal will be listed on its own line with its corresponding F-number. Where all classifications within an SFA Specification are the same F-number, such as in SFA5.18, the AWS classification will simply be “All Classifications.” This will make the table longer but easier to read, and it will eliminate the constant questions and corrections regarding the number of “XXXs” for SAW and FCAW filler metals that the Subcommittee has to deal with.

### Aluminum SMAW

Those who weld aluminum using SMAW will be pleased to know that the latest version of AWS A5.3, *Specifications for Aluminum and Aluminum-Alloy Electrodes for Shielded Metal Arc Welding* has been approved.

### Hard Facing Overlay

The lead paragraph in QW-216 was revised to indicate that the purpose of hard facing weld metal overlay is to deter the effects of wear and/or abrasion.

This definition does not help much if the weld metal is not only wear and/or abrasion resistant but is also load bearing. An example of this is when P-1 piping that has been worn away by wet steam erosion is repaired with weld metal containing a small amount of chromium. The addition of 1% chromium or more can dramatically improve erosion resistance in wet steam. Should one qualify this overlay following the groove welding rules or following the hardfacing rules?

If the added weld metal is required to restore the part to the design thickness, the rules for groove weld qualification should be followed since the weld metal is necessary to carry design load. If the weld metal is being added to increase the dimensions of the part beyond the design thickness, then the hardfacing rules should be followed. What if both occur -- some restoration of design dimensions and some added thickness? Clearly, if a groove welding qualification is adequate for restoration of design thickness, it would also be adequate for weld build-up, and an additional hardfacing qualification is not necessary. The essential question in this

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case is whether or not the hardness of the overlay is critical to the performance of the weld metal in service. Since the erosion resistance in this example is gained primarily by modification of the surface oxide layers of the metal by chromium, hardfacing qualification is not appropriate or necessary.

### **“Defects” Purged**

Many years ago, ASME recognized that part of the legal definition of the term “defect” was that a part was unacceptable if it contained defects. When this was recognized, various acceptance standards, particularly those associated with nondestructive examination and inspection, were changed to recognize that flaws and discontinuities in materials could be acceptable if they did not exceed certain acceptance criteria, but that a defect was -- by definition -- rejectable. Accordingly, the term “defect” was largely purged from various Code Sections, and the terms “flaw” and “discontinuity” were promulgated to describe product conditions that may or may not be acceptable. In this addenda, Subcommittee IX has caught up with the other Sections and purged the term “defect” from all acceptance criteria, such as in QW-163 for bend tests, and replacing “defect” with “discontinuity.” This is not a technical change except in a purely legalistic manner.

### **Ultrasonic Examination of Welder Test Coupons**

A Code Case was passed to permit use of ultrasonic examination in lieu of radiography for welder qualification. The Case is complex and limited in application because of the following restrictions:

- The material thickness must be 0.20 inches minimum.
- The pipe must be not less than 4.5 inches outside diameter.
- The thickness may not exceed 0.062 times the pipe outside diameter.

The Case is quite useful for plate; however for pipe, NPS 6 Schedule 40 (0.218 wall) pipe fits these criteria but Schedule 80 and heavier do not. The code case is not much use for pipe coupons, but ASME’s NDE wizards were of opinion that the procedures and techniques need to be clearly specified and able to be used without expensive, state-of-the-art equipment. It is possible that, after some experience with UT on welder test coupons, some of the restrictions may be lifted.

### **Written Radiography Procedure Not Required**

The radiographic method requirements in QW-191 have been revised to address recent changes to ASME Section V.

Section IX has never required that a written procedure for radiographic examination be followed; all that was required was that the film show the proper density, penetrometer and essential hole.

ASME Section V, similarly, never required that a written procedure be prepared and followed; however, in the 2000 Addenda, Section V was revised to require that nondestructive examinations be performed following a written procedure. Because of this change in Section V, Section IX was revised in parallel to specifically take exception to Section V’s new requirement, and

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that was done by revising QW-191 to say that a written procedure for radiography is not required. This kept things the same, although the revisions appear to make a change.

### **Brazer and Brazing Operator Qualifications**

The requirements for qualification of brazing personnel have been changed significantly. Section IX has never distinguished between brazers and brazing operators like the welding section distinguishes between welders and brazers. That oversight has been corrected in these addenda. Since the variables for brazer qualification have always been the same regardless of process, the variables have been consolidated into a single table for manual, semi-automatic and machine brazing. For automatic brazing (where the operator has no control over the process once a brazing cycle has begun), the only variables are a change in brazing process and a change from automatic brazing to machine brazing.

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