Summary of Changes in

ASME Section IX, 2007 Edition, 2008 Addenda

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Changes to ASME Section IX, 2008 Addenda

The following is a summary of the changes that appear in 2007 Edition, 2008 Addenda of ASME Section IX. Significant changes and related discussion are reported by Walter J. Sperko, P.E., Vice-chairman of Subcommittee IX; minor changes, such as editorial corrections, are readily identified in the "Summary of Changes" which begins on page (c) of the Addenda. Readers are advised that the opinions expressed in this article are those of Mr. Sperko and not the official opinion of Subcommittee IX. These changes become mandatory January 1, 2009.

Welding Procedure Qualifications Are Good for Forever Most of the Time

Since the earliest days of Section IX, it has been understood that Welding Procedure Specifications (WPSs) meeting the requirements of previous editions or addenda of Section IX were permitted to be followed when constructing boilers, pressure vessels and piping even when the component being build was constructed to a later edition or addenda than that under which the WPS was qualified. The rational for allowing the use of "old" WPSs is twofold: first, if WPS was good enough for Code construction when it was qualified, it's good enough for Code construction today, and second, the quality and properties of both base metals and welding consumables are better today than they used to be. QW-100.3, which addresses this, will continue to permit use of WPSs meeting the requirements of the 1962 or later edition without being updated to meet later code changes, but these addenda add one exception: when Subcommittee IX reassigns a material to a different P-number than the one to which it was previously assigned. When this happens, the WPS and supporting Procedure Qualification Records (PQRs) must be reviewed for the following:

1) If the test coupon material recorded on the PQR is a material that was among the materials that were reassigned, the PQR must be revised to show the new P-number assignment.
2) If a PQR supporting the WPS is revised, the WPS must be revised to show the new P-number assignment; this may require writing additional WPSs when more than one PQR supports a WPS and the test coupon materials shown on the PQRs are not the same in all PQRs.
3) PQRs and WPSs need to be revised for only for new construction. The old WPS and PQR are still valid for repair work to previous editions of the Code where the old P-Number assignment was in effect.

To illustrate, in 1990, Subcommittee IX reassigned all materials previously assigned to P-5 into three new P-number groupings, P-5A, P-5B or P-5C; further, the related rules were adjusted to require separate qualification for materials assigned to P-5A, P-5B or P-5C. As a result, if an existing PQR recorded the test coupon material as SA-387 Grade 22 (2-1/4% Cr, 1% Mo), annealed condition, previously assigned to P-5, that PQR would be revised to show the new assignment as P-5A and the WPS would be revised to limit the range of materials permitted to be welded to those assigned P-5A. Under the old material assignments, one could weld all P-5 materials, which included a broad range of materials including 2-1/4% Cr-1%Mo, 3%Cr-1%Mo, 5%Cr-1/2%Mo, 7%Cr-1/2%Mo, 9%Cr-1%Mo and 9%Cr-1%Mo-V-Nb-N and all combinations thereof. Under the new assignments, qualification with 2-1/4% Cr, 1% Mo only qualified 2-1/4% Cr, 1% Mo and 3% Cr, 1% Mo materials.

While most Code users recognized that the above was appropriate, it was not *required* that the changes to PQRs and WPSs described above be made; this addenda simply adds a reference in QW-100.3 to QW-420 where the requirement to make the appropriate changes are contained.

The basis for this change is purely technical; when Subcommittee IX reassigns a material to a different or new P-number, that material (or collection of materials as was the case for P-5) has been recognized as having sufficiently different weldability characteristics that they simply do not belong in the P-number that they were previously assigned to. This change does not invalidate any PQRs, but it usually results in more restrictive WPSs.

The reason that this is important is that in the 2009 addenda, creep strength enhanced ferritic steels such as Grades 91, 92, 911, 23 and 24, some of which are currently assigned to P-5B, Group 2, will be assigned to P-15A through P-15E, the specific assignment depending on the alloy's nominal chromium content. As readers have seen from my previous articles, these high-performance creep-strength enhanced chromium-molybdenum steels are exceedingly sensitive to conditions such as inadequate preheating or hydrogen control, stress corrosion cracking in the as-welded condition, filler metals that crater-crack due to tramp elements, uncontrolled PWHT and local torch heating during fabrication which can lead to failures; to make it easier to identify and control these materials in both Section IX and in the Construction Codes, they will be assigned to their own special P-number family.

Welding Procedure (QW-200) Changes

When performing bend tests, QW-466.1 provides a figure and a table that specifies the dimensions of the test fixture and, most importantly, the diameter "A" around which the bend test specimen of thickness "t" must be bent. For most materials, the applicable line is near the bottom of the table, "All others with greater than or equal to 20% ductility." It specifies a B/t ratio of 4:1 which results in a strain in the metal on the convex surface of the specimen of 20%. The other lines on the table specify B/t ratios as large as 16-1/2 for materials that have been assigned P-numbers that exhibit less than 20% ductility. The last line of the table covers materials that are not assigned P-numbers that also exhibit less than 20% ductility by referring one to footnote (b) which provides the following formula:

$$\text{thickness of specimen (t)} = \frac{\text{A X (percent elongation)}}{\text{[100- (percent elongation)]}}$$

If one has a fixture where "A" is known and a material of known tensile elongation, this formula allows one to calculate the minimum thickness "t" to which the bend test specimen must be machined. For example, if one has a standard fixture where A = 1-1/2 in. (38 mm) and the material being qualified has a minimum ductility of 8% according to the base metal specification, the formula requires the specimen to be machined to 0.113 in. (2.8 mm) minimum thickness.

Note that one can always bend a specimen over a smaller radius or use a thicker specimen for a given radius than that specified in QW-466.1 since that results in more strain in the outer fibers of the specimen than that which occurs when the specified A/t ratio is used.

The last line of the table in QW-466.1 confuses most people who, on casual examination, attempt to apply it the same as they would apply the upper portion of the table; careful examination, however, shows that the dimensions are *maximum* dimensions, so if one conducts a bend test, the minimum elongation that the material must exhibit is 3%. The changes in these addenda add footnote (e) which allows use of a macro-etch specimen in accordance with QW-183(a) in lieu of each required bend test, so for procedure qualification, four macro-etch specimens would be required.

A new welding process has been added to those covered by ASME – Friction Stir Welding. It is not in Section IX yet, but is incorporated as Code Case 2593, Use of Friction Stir Welding (FSW) for Appendix 26 Bellows Constructed of 5052 Aluminum Alloy Plate, Section VIII, Division 1. The Case contains a full set of essential and nonessential variables for friction stir welding. As with most code cases, this one was adopted with limited applicability so that a manufacturer could utilize this new technology without waiting a full code publication cycle which can be as long as 2 years depending on timing; it will undoubtedly be incorporated into Section IX in the near future.

Several SFA filler metal specifications contain electrode or filler metal classifications that are identified as "G" in the suffix (e.g., E8018-G). While such a~~n~~ classified electrode or filler metal will have an F-number, the chemical composition of the weld metal for a "G" classification is "as agreed between the supplier and the purchaser." As a result, different suppliers can supply electrodes or filler metals under the same AWS classification– but the chemical composition of the weld deposit could be significantly different! That would allow one to establish an A-number using one manufacturer's E8018-G then use another manufacturer's E8018-G – possibly of a~~n~~ different chemical analysis – in production. Changes were made in this addenda to QW-404.5 (basic A-number variable) and QW-404.12 (supplementary essential variable restricting the AWS Classification to that used to weld the test coupon) to further limit "G" designation electrodes to the manufacturer's trade name used during qualification.

Several supplementary essential variables such as QW-404.12 contain a sentence that says: "This limitation does not apply when a WPS is qualified with a PWHT above the upper transformation temperature or when an austenitic material is solution annealed after welding." To clarify the intent, the word "limitation" was changed to "variable," making it clear that the whole variable, not just portions of it did not apply when one of these heat treatments was performed. The main reason for mentioning it here is simply to make it easier for those who work with these variables to identify them quickly.

All the welding procedure and performance qualification forms in nonmandatory Appendix B were revised. While the forms are helpful in preparing WPSs and PQRs and welder qualification records, they are not a substitute for properly recording and addressing essential and nonessential variables as required by code.

Welder Qualification (QW-300) Changes

No changes were made to the requirements for welder or welding operator qualification.

Base Metals and Filler Metals

Various grades of materials were added and deleted from QW/QB-422. Those changes are most easily identified in the "Summary of Changes" that begin on page (c) of Section IX. An aluminum casting alloy that is manufactured to EN 1706, Alloy CA43000 was added as P-No. 26, so at all paragraphs and tables where "P-No. 21 through P-No. 25" is mentioned, P-No. 25 will be bumped up to P-No. 26. In addition, two EN grades and one JIS grade have been added.

Several filler metal specifications have been revised and issued. One new one is SFA 5.34, *Specification for Nickel Alloy Electrodes for Flux Core Arc Welding,* and the other is SFA 5.02 *Filler Metal Standard Sizes and Packaging*. The first is self-explanatory by its title, while the second reflects a move by AWS to consolidated information that is repeated in every specification into a single specification which others will refer to. As the other SFA specifications are revised, information on packaging and standard sizes will no longer be in each specification; instead, they will refer to SFA 5.02 for that information.

SFA 5.23, *Low Alloy Submerged Arc Electrodes and Fluxes,* was revised to tighten up composition ranges for B9 electrodes in response to concerns raised by ASME. SFA 5.7, *Copper and Copper Alloy Bare Electrodes and Wire*, added some new classifications. Several other SFA specifications were simply reaffirmed.

Brazing (QB) Changes

There were no significant changes to the rules on Brazing.

Inquiries

There were several inquiries of interest that are informative to users of Section IX. Inquiry BC07-1041 asked if QW-409.2, the GMAW transfer mode variable, applies to the flux cored arc welding process? The reply was "yes" since ASME considers flux cored arc welding to be a subset of GMAW. The transfer modes commonly found when using flux cored wire are spray or globular, and when writing a WPS using flux cored wire, one can specify either or both transfer modes. To the best of the writer's knowledge, no flux cored wire operates in the short-circuiting transfer mode, but the manufacturer's literature should be checked if there is doubt.

Item BC07-1343 addresses QW-404.23 which covers solid, metal cored and flux cored wire for GMAW. The background is that some AWS classifications for filler metal include a portion of the designation showing that the filler metal is solid or metal cored wire (e.g., in classification ER80S-B3, the "S" indicates that the wire is solid, whereas in the classification ER80C-B3, the "C" indicates a metal core (composite) wire.) The question was -- if one specified a filler metal classification that included a designation showing that the filler metal was solid wire (e.g., ER80S-B2) -- does one need to *also* specify that the wire is solid wire to satisfy the requirement to address QW-404.23. The reply was "no" since the AWS classification clearly specified solid or metal cored wire. If an unclassified wire is used, then the WPS has to specify that the wire be solid or metal cored in addition to the trade name.

The question of when a heat treatment not required by a construction code has to be qualified was addressed in item 06-285. A manufacturer fabricated a multi-convolution bellows of SB-409 UNS N08800, and, although the Code does not require it, the manufacturer performed heat treatment at 1750°F subsequent to completing all welding and forming. The question was: does Section IX consider that heat treatment to be a postweld heat treatment for the purpose of procedure qualification in accordance with Section IX, paragraph QW-407.1(b). The reply was "yes." A similar question was asked many years ago when a manufacturer of glass-lined water heaters heated asked if heating a Section VIII pressure vessel to 1800°F for the purpose of sintering the glass lining was considered to be a postweld heat treatment "above the upper transformation temperature" as described in QW-407.1(a)(3) even though such a heat treatment was not required by Section VIII. The reply was also "yes" for this case.

Coming Attractions

As mentioned above, due to significant concerns over abuse of Grade 91 and similar creep-strength enhanced ferritic steel such as Grades 92, 911, 23, etc., these materials will be assigned to P-15A through P-15G to distinguish them from the older P-5A through P-5C materials. All materials currently assigned S-numbers will be magically converted to P-number and all references to S-numbers will disappear from Section IX. Finally, a new column will be added to QW-QB-422 providing the group number assigned to ASME materials in accordance with ISO 15608, the ISO material grouping system; however, there will be no provisions to allow use of the ISO groupings in lieu of the P-number groupings at this time.

Readers are advised that ASME Code Committee meetings are open to the public; the schedule is available on the writer's web site and at www.asme.org.

Mr. Sperko is President of Sperko Engineering, a company that provides consulting services in welding, brazing, metallurgy, corrosion and ASME Code issues located at www.sperkoengineering.com. He also teaches publicly offered seminars sponsored by ASME on how to efficiently and competently use Section IX. He can be reached at 336-674-0600, FAX at 336-674-0202 and by e-mail at: sperko@asme.org.