Summary of Changes in

ASME Section IX, 2003 Addenda

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Changes to ASME Section IX, 2003 Edition

The following is a summary of the changes that appear in 2003 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.

Welding Procedure (QW-200) Changes

For those WPSs qualified for welding on impact tested materials, a couple of significant clarifications have been made.

It has always been the intent of QW-403.5 that impact tested qualifications using ferrous metals assigned to a P-number and Group number qualified all other metals assigned to that P-number and Group. Since nonferrous metals did not have Group numbers, some assumed that all materials within a P-number were qualified. Careful reading of QW-403.5, however, says that where there are no group numbers assigned, qualification must be done using the same type and grade base metal to be used in production welding. Since there is no suitable way of creating meaningful subgroups within nonferrous metals as was done for ferrous metals, each nonferrous metal type and grade (but not specification) must be qualified by impact testing. This paragraph was changed to use subparagraphs to clarify and expand that the following must be separately qualified:

- ferrous base metal of the same P-number and Group number as the base metal to be welded
- nonferrous metal of the same P-Number and UNS number as the base metal to be welded.
- base metal of the same type and grade as the base metal to be welded

Note that the last item does not include the specification; this allows base metal made of the same material but of different product forms (e.g., plate, pipe, forging, etc.) to be welded without separate qualification for each product form.

The second change in impact testing was in QW-401.3. This paragraph allows one to upgrade an existing WPS that is not impact tested to one that is impact tested by welding an additional test coupon and only performing the required impact testing on that test coupon. Some uninitiated insisted that this "upgrade" test coupon also limited the essential variables, and that was not the intent. QW-401.3 was revised to add a sentence saying that supplementary essential variables are *in addition to* the essential variables for each welding process. A new paragraph was added to expand on this point, saying that, when essential variables are qualified by one or more PQRs and supplementary essential variables are qualified by other PQR(s), the ranges of essential variables established by the former PQR(s) are only affected by the latter to the extent specified in the applicable supplementary essential variable. For example, essential variable QW-403.8 governs the minimum and maximum thickness of base metal qualified. When supplementary essential variable QW-403.6 applies, it modifies only the minimum thickness qualified, not the maximum.

QW-202.1 has been revised to give guidance when a test specimen fails a test. As previously written, when a test specimen failed, a new test coupon had to be welded and tested. The revision allows one to evaluate the cause of failure, and if it was not related to welding parameters, additional specimens may be taken to replace the failed specimen. Some examples of conditions not related to welding parameters include cracking caused by inclusions or slivers in the test coupon material, improper specimen preparation and testing equipment failure. If the cause of failure was related to welding parameters, then additional specimens were not permitted and a new test coupon must be welded to qualify the WPS. This change was also added to the brazing section.

For those who write and qualify WPSs for corrosion-resistant and hard-facing weld metal overlay, a new column has been added to the tables in QW-250 to include nonessential variables for each process. It was realized that these special processes did not specify variables that would ordinarily be

required to be in a groove or fillet WPS, such as filler metal size, shielding gas flow rate and cup size, use of weave or stringer technique, cleaning, contact tube-to-work distance and peening. Astute readers will recall that, although these nonessential variables have been added to the requirements and must be addressed in new WPSs, existing WPSs do not have to be revised to include them unless one so chooses.

A new welding process has been added: flash welding. Flash welding is done by holding two parts (usually tubes) in light contact and running a lot of current between the parts. An arc flashes across the gap between the workpieces, quickly melting the square edges. After a short arcing time, the ends are pushed together and an internal and external expulsion of hot (but not liquid) metal occurs, making the weld by forging. The current is turned off and the weld is completed. This process was widely used in the boiler construction industry many years ago, but fell out of favor. It has enjoyed resurgence in Eastern Europe and the Far East, and since many boilers and boiler parts built to ASME Section I are shipped here, it was decided to include this process in Section IX. The changes include some new definitions, a table of variables, test methods and acceptance criteria.

Note 1 of QW-451, which is the table that gives the base metal and weld metal thickness limits and testing requirements for procedure qualification, has been clarified to make its interpretation clearer. This note was intended as a "heads-up" for users that there might be other variables that could change the ranges qualified for any given welding process to which they applied. Literal interpretation of the words, however, said that these very restictive variables applied across the board, making the table irrelevant. The new note was reworded to make it clear that the listed variables only need to be considered when they apply for the specific welding process qualified.

Welder Qualification (QW-300) Changes

QW-301.2, requires that a welder follow a WPS when he welds a test coupon. Although Standard Welding Procedures were permitted for use in the 2000 addenda, this paragraph did not permit them to be followed during welding of welder test coupons. That oversight has been corrected.

As the result of an inquiry, the lead-in paragraph and column headers of QW-423, the table that provides alternate base metal that may be used for welder qualification, have been changed to say that welders who qualify using base metals listed in the left-hand column may weld corresponding base metals listed in the right-hand column. This is less confusing than the present words which talk about substituting base metals in the WPS for other base metals. In addition, the revised lead-in paragraph specifically says that not only may base metals with the same P-number be welded, but dissimilar P-number combinations of metals may also be welded. Finally, the previous rules allowed unlisted base metals of chemical composition similar to those listed in P-1 through P-11, P-34 and P-41 through P-46 (carbon, low alloy and stainless steels and nickel and nickel alloys). This revision extends that concept to P-21 through P-25 (aluminum) P-51 through P-54 (titanium) and P-61 and P-62 (zirconium) metals.

Code Case 2326 that permits use of ultrasonic examination (UT) of welder test coupons in lieu of radiography (RT) has been renewed. Most Section IX users are unaware of this code case which permits substitution of UT for RT for materials over 0.2 inches (5 mm) thick, over 4.5 inches (113 mm) outside diameter and for pipe, not thicker than 6% of the pipe nominal diameter. Since this Code Case can only be renewed for an additional three years, the subcommittee would appreciate hearing from anybody who uses it in order to know if it should be dropped or incorporated into Section IX.

Table QW-452.2 which permits use of longitudinal bend test specimens for welder qualification, was incorporated into QW-452.1. This was done simply by adding the longitudinal bend Figure QW-462.3(b) reference to the face and root bend column headers in QW-452.1. A new note 3 was added limiting the use of face and root bends to test coupons welded by no more than two welders so that

each welder's work was tested. Another phrase was added to the General Note of QW-452.1 that the thickness of weld metal used in the tables was *exclusive* of reinforcement – an important addition since some Section IX users have been known to incorrectly include the reinforcement when measuring the weld deposit thickness on a test coupon.

A minor change was made to the groove weld pipe diameter table QW-252.3. The small-diameter transition for test coupon over 2-7/8 inches outside diameter (OD) was changed from "2-7/8 inches OD and over" to "over 2-7/8 inches OD." The minimum diameter qualified is still 2-7/8 inches OD. For an NPS 6 coupon, the minimum diameter that the welder is qualified to weld is unchanged -- 2-7/8 inches and larger. For the next-smaller size range, the test coupon column was changed from "1 to less than 2-7/8 in. OD" to "1 to 2-7/8 in. OD." The minimum diameter qualified is unchanged – 1 inch OD and larger.

Although the change is seems trivial, it does allow one to use commercially-available double-extra strong (XXS) NPS 2-1/2 pipe (0.552 in. nominal thickness) to test a welder using two processes and have one process qualified for unlimited thickness. That is, the root could be welded using GTAW of 0.052 inches in thickness followed by SMAW of 1/2 inch in thick using at least 3 layers of weld metal. This would qualify the welder to deposit 0.104 inches thick using GTAW and unlimited thickness using SMAW. One should be careful when using NPS 2-1/2 XXS since 0.552 in. is nominal thickness which could be as thin as 0.483 inches. In the writer's opinion, 2-3/4 inch OD tube with a minimum wall thickness of 5/8 inches is a better choice, although it is usually special order or available through some testing labs

Base Metals and Filler Metals

Some nickel alloys have been reassigned to different P-numbers. All the changes except one involve moving alloys of the Ni-Cr-Mo family from P-44 to P-43. P-44 will now contain only Ni-Mo-Cr types. Alloys moved to P-43 include commercial alloys C-22, C-276, C-4 and Alloy 59. The other change was to move the alloy in P-47 to P-43. P-47 metals contained tungsten (Ni-Cr-W) which the P-43 metals did not contain. Tungsten behaves like molybdenum during welding, so the only alloy in P-47 (Alloy 230) was moved to P-43.

Corresponding reassignments of nickel alloy filler of matching chemical analysis were also made in the F-number. UNS numbers were also added to the F-number table for all fillers that have such numbers.

It is permissible to update existing PQRs to reflect the reassigned P-numbers. See QW-200.2(c). It should be noted that existing WPSs that were previously qualified under the old P-number assignments are still acceptable for use without revising the PQRs or WPSs to the new assignment. See the penultimate paragraph of QW-100.3.

A money-saving change was made for those who are installing Grade 91 components : ASTM A-217 grade C12A, the cast version of Grade 91, was assigned to S-5B, Group 2. Also, ASTM A-992 which covers high-strength structural shapes, was assigned to S-1, Group 1.

For the convenience of users, UNS numbers were added to QW/QB-422 for all nonferrous metals.

For those with internet access, finding the P or S-number of a base metal can be done at www.pnumbers.com. This site is not an ASME-sanctioned site, but it contains a table of all the metals listed in QW/QB-422. This table can be sorted by any column in QW/QB-422 (i.e., by specification, grade, P-number, product form, etc.)

Standard Welding Procedure Specifications (SWPSs)

Fourteen new SPWS have been added to Appendix E and a superceded one has been deleted, bringing the total to 32. The new SWPSs are for FCAW of P-1, GTAW of P-1 and P-8 using consumable inserts and GTAW and SMAW of P-1 to P-8 metals.

A sentence was added to QW-500 allowing those who have SWPSs that have been superceded with later editions to continue to use the editions that they had already adopted.

Bend Tests

Readers of this column will recall that QW-163, acceptance criteria for bend test specimens, was change last year from describing a flaw as a "defect" (which is rejectable by definition) to "discontinuities." An inquiry asked if more than one flaw was required since "discontinuities" was plural. That inquirer was given a "No!" answer and this addenda changes "discontinuities" to the singular in the acceptance criteria.

Brazing (QB) Changes

A small but significant change related to flow positions was made in the brazing section. The definitions of flow positions used during testing were tightened up to ±15° from the nominal flow position. The definitions of the position used for production brazing joints, which previously did not exist, were developed, and a range of ±45° from nominal positions as agreed upon. These changes are defined in QB-110 and QB-120 and illustrative sketches are found in the figures of QB-460.

Coming Attractions

The question of the relationship between P-numbers and S-numbers has sometimes been contentious between regular users of Section IX and the uninitiated. Because QW-420.2 identifies base metals assigned S-numbers as nonmandatory, some have required that WPSs and welders welding on S-number materials be separately qualified. To resolve this, QW-423 will be revised to clarify that welders who qualify using either P-number or S-number metals are qualified to weld on corresponding P-number *and* S-number base metals, and QW-424 will be revised to clarify that WPSs qualified using P-number metals may also allow welding on corresponding S-number metals without requalification, but not vice-versa.

The subcommittee has been working on development of requirements for using temper bead welding. This technique, which depends on proper use of heat input and other controls to achieve a more-desirable microstructure or hardness, is permitted by other code sections as an alternate to performing postweld heat treatment. Since other code sections are written by different committees, temper bead rules developed differently in each code section, so they are different. This is an effort to standardize the rules. Like impact testing, the temper bead welding rules in Section IX must be invoked by other code sections in order to become mandatory.

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

Mr. Sperko is President of Sperko Engineering, a company that provides consulting services in welding, 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.