AWS Breaks New Ground with Soldering Specification

Qualification of solderers and soldering procedures are addressed in this new specification

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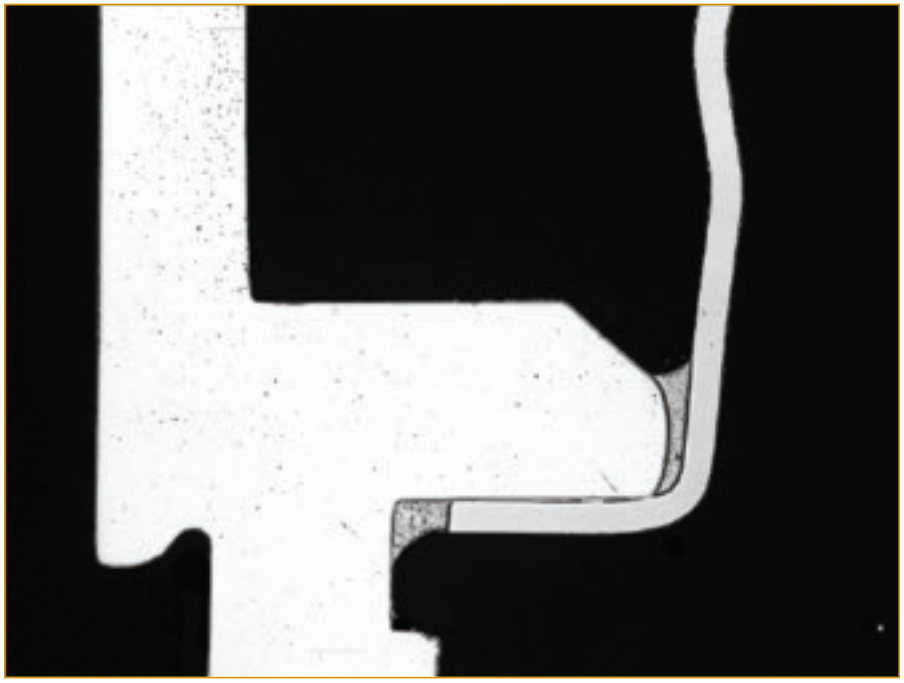
Joining technologies continue to advance with new materials, process innovations, and inspection techniques. An increasing number of high-valued, high-reliability applications — from boilers and ship hulls to rocket motors and medical devices — have required the development of industry standards and specifications in order to ensure that the best design and manufacturing practices are being used to produce safe, durable products and assemblies. Standards writing has always had an important role at the American Welding Society (AWS). The AWS standards and specifications cover such topics as filler materials, joining processes, inspection techniques, and qualification methods that are used in welding and brazing technologies. These AWS standards and specifications, all of which are approved by the American National Standards Institute (ANSI), have also provided the basis for many similar documents used in Europe and in Pacific Rim countries.



Complex lap joint made with Sn-Sb solder for a high-reliability assembly.

AWS B2.3/B2.3M:2008

This year, AWS broke ground in its standards and specifications efforts with its first approved document that addresses, specifically, soldering technology. That document is titled AWS B2.3/B2.3M:2008, *Specification for Soldering Procedure and Performance Qualification*. The AWS B2.3 specification is the result of efforts by the AWS B2 Committee on Procedure and Performance Qualification chaired by G. M. Wisbrock Jr. It began with document preparation by members of the AWS B2E Subcommittee on Soldering Qualification, chaired by E. W. Beckman. Consultation was provided by the AWS C3B Subcommittee on Soldering (F. M. Hosking, chair), under the auspices of the AWS C3 Committee on Brazing and Soldering (P. T. Vianco, chair).

The abstract to the AWS B2.3 document reads as follows:

"This specification provides the requirements for qualification of soldering procedure specifications, solderers, and soldering operators for manual, mechanized, and automatic soldering. The soldering processes included are torch soldering, furnace soldering, resistance soldering, dip soldering, infrared soldering, and induction soldering. Base metals, soldering filler metals, soldering fluxes, soldering atmospheres, and soldering joint clearances are also included."

Compilation of the AWS B2.3 document began by using AWS B2.2-91, *Standard for Brazing Procedure and Performance Qualification,* as the template. The AWS B2.2 document was selected for this role because, in terms of technical details,

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soldering has a greater similarity to brazing than it has to welding. Thus, committee members were able to minimize the extent of development required to create the new document. Nevertheless, there remained a sufficient number of technical distinctions between soldering and brazing that warranted a substantial revision to the AWS B2.2 document. For example, although the types of base materials used to make solder joints are similar to those used in brazing applications, it was necessary to replace brazing filler metals with solder alloys. Permission was granted by the American Society for Testing and Materials (ASTM, 100 Bar Harbor Dr., West Conshohocken, PA 19428) to directly reference ASTM B 32-04, *Standard Specification for Solder Metal,* for the solder materials used in the qualification activities. (ISO/DIS 9453, *Soft Solder Alloys — Chemical Composition and Forms*, is similar to the ASTM specification.) A second ASTM document, ASTM B 907-05, *Standard Specification for Zinc, Tin and Cadmium Base Alloys Used as Solders*, was used to round out the alloy listing for the AWS B2.3 specification.

AWS B2.3 also lists inorganic acid fluxes according to the applicable base material(s). The fact that this flux type is highlighted in the document by no means insinuates that only these fluxes can be used in qualification activities. Other flux types, including rosin-based materials, organic acid fluxes, and synthetic fluxes can be utilized; it is simply easier to specify them from other documents such as ASTM B813, *Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube*, and ANSI/J-STD 004, *Requirements for Soldering Fluxes*. A listing of additional flux standards are found in Tables 4.3 and 4.4 of the *Soldering Handbook,* third edition (2000, AWS). Although the ANSI/J-STD-004 and other flux specifications have their roots in electronic soldering, they can also be used to specify fluxes for structural soldering.

At the heart of the document are the two sections titled: "Soldering Procedure Qualification" and "Soldering Performance Qualification." The first section establishes the specimen geometry, fabrication procedures, and solder joint test and evaluation data that are used to accept the level of workmanship. Besides visual inspection, which is performed on all test specimens, the type of joint — butt, lap, and nonstandard configurations — dictates the mechanical test format, be it the tension test, bend test, or peel test as outlined in the appropriate subsections. Metallographic cross sections, together with macroetching techniques, are used to identify defects in the soldered joint. Acceptance criteria for all of the evaluation techniques are provided in those respective subsections.

The second section, "Soldering Performance Qualification," addresses the ability of a solderer, a person who performs the manual soldering process; or the soldering operator, a person who operates semiautomated or fully automated soldering equipment; to make a solder joint that passes the acceptance criteria. The test soldered joints are made by the solderer or soldering operator by an established soldering procedure specification (SPS).

Both the Soldering Procedure Qualification and Soldering Performance Qualification steps must be reperformed in the event that there is a change to any of the SPS critical variables (e.g., different base material types, base material thickness, solder alloy, or a host of other factors).

Future Soldering Specifications

An unforeseen consequence of the effort to produce AWS B2.3 was a review of the standards and specifications currently active in the soldering industry as a whole. By and large, soldering specifications have been dominated by those generated within the electronics industry. Although the fundamentals of soldering are the same, the details of electronic soldering are sufficiently different from those of structural soldering as to require separate specifications and standards. At this time, the discipline of structural soldering does not have standards and specifications that address the variety of joint geometries and process options. The C3B Subcommittee has been requested by the C3 Committee to assess the need for such documents and the resources that would be required to develop them.◆