SECTION 9—WELDING PROCEDURE AND WELDER QUALIFICATIONS

9.1 Definitions

In this standard, terms relating to welding shall be interpreted as defined in Section IX of the ASME *Code*. Additional terms are defined in 9.1.1 and 9.1.2.

9.1.1 An angle joint is a joint between two members that intersect at an angle between 0 degrees (a butt joint) and 90 degrees (a corner joint).

9.1.2 Porosity refers to gas pockets or voids in metal.

9.2 Qualification of Welding Procedures

9.2.1 General Requirements

• **9.2.1.1** The erection Manufacturer and the fabrication Manufacturer if other than the erection Manufacturer, shall prepare welding procedure specifications and shall perform tests documented by procedure qualification records to support the specifications, as required by Section IX of the ASME *Code* and any additional provisions of this standard. If the Manufacturer is part of an organization that has, to the Purchaser's satisfaction, established effective operational control of the qualification of welding procedures and of welder performance for two or more companies of different names, then separate welding procedure qualifications are not required, provided all other requirements of 9.2, 9.3, and Section IX of the ASME *Code* are met. Welding procedures for ladder and platform assemblies, handrails, stairways, and other miscellaneous assemblies, but not their attachments to the tank, shall comply with either AWS D1.1, AWS D1.6, or Section IX of the ASME *Code*, including the use of standard WPSs.

9.2.1.2 The welding procedures used shall produce weldments with the mechanical properties required by the design.

9.2.1.3 Material specifications listed in Section 4 of this standard but not included in Table QW-422 of Section IX of the ASME *Code* shall be considered as P-No. 1 material with group numbers assigned as follows according to the minimum tensile strength specified:

a) less than 485 MPa (70 ksi)—Group 1;

b) equal to or greater than 485 MPa (70 ksi) but less than 550 MPa (80 ksi)—Group 2;

c) equal to or greater than 550 MPa (80 ksi)—Group 3.

Separate welding procedures and performance qualifications shall be conducted for A841M/A841 material.

9.2.1.4 Welding variables (including supplementary essential variables when impact tests are required by 9.2.2), as defined by QW-250 of Section IX of the ASME *Code*, shall be used to determine the welding procedure specifications and the procedure qualification records to be instituted.

9.2.1.5 When impact tests of the heat-affected zone are required, the heat-treated condition of the base material shall be a supplementary essential variable. Plates produced by the controlled-rolled process are not to be considered as having received any heat treatment.

9.2.1.6 If a protective coating has been applied to surfaces to be welded, the coating shall be included as an essential variable of the welding procedure specification. Procedure qualification tests shall be required for each coating brand formulation and for the maximum thickness of coating to be applied.

9.2.2 Impact Tests

9.2.2.1 Impact tests for the qualification of welding procedures shall comply with the applicable provisions of 4.2.9 and shall be made at or below the design metal temperature.

9.2.2.2 When impact testing of a material is required by 4.2.9, 4.2.10, or 4.5.4 impact tests of the heat-affected zone shall be made for all machine, automatic, and semiautomatic welding procedures.

9.2.2.3 For all materials to be used at a design metal temperature below 10 °C (50 °F), the qualification of the welding procedure for vertical joints shall include impact tests of the weld metal. If vertical joints are to be made by a machine, automatic, or semiautomatic process, impact tests of the heat-affected zone shall also be made.

9.2.2.4 When the design metal temperature is below –7 °C (20 °F), impact tests of the weld metal shall be made for all procedures used for welding the components listed in 4.2.10.1, for welding attachments to these components, and for fabricating shell nozzles and manholes from pipe and forgings listed in 4.5.

9.2.2.5 Impact tests shall show minimum values for acceptance in accordance with 4.2.9.3 and the following:

a) for P-No. 1, Group 1, materials—20 J (15 ft-lbf), average of three specimens;

b) for P-No. 1, Group 2, materials—27 J (20 ft-lbf), average of three specimens;

c) for P-No. 1, Group 3, materials—34 J (25 ft-lbf), average of three specimens.

For shell plates thicker than 40 mm ($1^1/_2$ in.), these values shall be increased by 7 J (5 ft-lbf) for each 13 mm ($^1/_2$ in.) over 40 mm ($1^1/_2$ in.). Interpolation is permitted.

9.2.2.6 Weld-metal impact specimens shall be taken across the weld with one face substantially parallel to and within 1.5 mm ($^1/_{16}$ in.) of the surface of the material. The notch shall be cut normal to the original material surface and with the weld metal entirely within the fracture zone.

9.2.2.7 Heat-affected-zone impact specimens shall be taken across the weld and as near the surface of the material as is practicable. Each specimen shall be etched to locate the heat-affected zone, and the notch shall be cut approximately normal to the original material surface and with as much heat-affected-zone material as possible included in the fracture zone.

9.2.2.8 Production welding shall conform to the qualified welding procedure, but production-weld test plates need not be made.

9.3 Qualification of Welders

9.3.1 The erection Manufacturer and the fabrication Manufacturer, if other than the erection Manufacturer, shall conduct tests for all welders assigned to manual and semiautomatic welding and all welding operators assigned to machine and automatic welding to demonstrate the welders' and welding operators' ability to make acceptable welds. Tests conducted by one Manufacturer shall not qualify a welder or welding operator to do work for another Manufacturer.

9.3.2 The welders and welding operators who weld pressure parts and join nonpressure parts, such as all permanent and temporary clips and lugs, to pressure parts shall be qualified in accordance with Section IX of the ASME *Code*.

9.3.3 The records of the tests for qualifying welders and welding operators shall include the following.

a) Each welder or welding operator shall be assigned an identifying number, letter, or symbol by the fabrication or erection Manufacturer.

b) The fabrication or erection Manufacturer shall maintain a record of the welders or welding operators employed that shows the date and results of the tests for each welder or operator and the identifying mark assigned to each welder or operator. This record shall be certified by the fabrication or erection Manufacturer and shall be accessible to the inspector.

9.4 Identification of Welded Joints

The welder or welding operator's identification mark shall be stamped, either by hand or machine, on all tanks. The mark shall be adjacent to and at intervals of not more than 1 m (3 ft) along the following welds: liquid-containing welds, including all opening welds and all opening reinforcements. Flange-to-nozzle-neck welds do not require welder identification. In lieu of stamping, the manufacturer may keep a written record that identifies the welder or welding operator employed for these welded joints. The written and/or stamped records shall be kept and maintained by the manufacturer until accepted by the inspector or the owner/operator, and they shall be submitted with the post-construction document package.