

welding of those two M-Numbers and Group Numbers to themselves as well as to each other using the variables qualified.

2.3.12 Base metals listed in Annex IV or listed in ASME *Boiler and Pressure Vessel Code*, Section IX, shall be considered as listed materials. Base metals not listed shall require qualification testing. PQRs for unlisted base metals shall not be used to support a WPS for welding listed base metals or vice versa. Qualification requirements for cast iron materials are given in AWS D11.2, *Guide for Welding Iron Castings*. Qualification requirements for reinforcing bar are given in AWS D1.4, *Structural Welding Code—Reinforcing Steel*.

2.3.13 When fracture toughness is a requirement and a qualified procedure exists which satisfies all requirements except fracture toughness, it is necessary only to prepare an additional test weldment with sufficient material to provide the required fracture toughness specimens. The test plate shall be welded using that procedure, plus those variables applicable to fracture toughness. A new or revised PQR shall be prepared and the WPS shall then be revised or a new WPS issued to accommodate the qualification variables for fracture toughness applications listed in 2.14 Procedure Qualification Variables.

2.3.14 Cladding and hardfacing require separate qualification for each base metal M-Number, and filler metal combination. Welds made to join clad metals to other clad metals or to unclad metals shall be separately qualified or may be qualified by a combination of a PQR for joining an unclad metal and a PQR for applying the cladding.

2.3.15 For stud welding, the nominal chemical composition of the stud material shall be used to classify the stud as an M-Number material for purposes of procedure qualification.

2.3.16 During the welding of procedure qualification weldments, welders and welding operators shall be under the full control and supervision of the employer. Only activities 1, 5, 6, and 7 listed below may be subcontracted by the employer.

- (1) Preparation of test materials for welding
- (2) Instruction of the welder or welding operator on use of the welding procedure
- (3) Performance of welding
- (4) Recording of actual qualification variables used in the test (see 2.1.4)
- (5) Preparation of test specimens from the completed weldment

- (6) Performance of examinations and tests
- (7) Documenting of test results
- (8) Certification of the final PQR

2.4 Evaluation of Test Weldments

Test weldments shall be subjected to the applicable tests in Table 2.1. The type, number, location, and evaluation criteria for tests shall be as given in 2.6 through 2.12, except that for special test weldments the evaluation of the weldment shall be in accordance with the Referencing Document.

2.5 Qualification Thickness Limitations

2.5.1 Limitations on the thickness ranges qualified by procedure qualification tests are given in the following tables:

Table 2.2 Thickness and Size Limitations for Fillet Welds for Procedure Qualification

Table 2.3 Thickness Limitations of Plate and Pipe for Groove Welds for Procedure Qualification

Table 2.4 Thickness Limitations for Cladding and Hardfacing for Procedure Qualification

Table 2.5 Thickness Limitations for Procedure Qualification—Sheet Metal Groove Welds

2.5.2 The limitations in the tables above are based upon the following criteria:

- (1) the size and number of passes of a fillet weld
- (2) the base metal and weld metal thicknesses for groove welds
- (3) the base metal thickness for weld cladding and hardfacing, or
- (4) the base metal thickness for sheet metals.

2.5.3 Complete penetration groove welds shall also qualify partial penetration groove welds within the qualification limits given in Table 2.3, and fillet welds in all thicknesses and diameters.

2.5.4 In addition to the welding data required to be included in the WPS by 2.13 Welding Procedure Specification Data, when multiple process or multiple filler metal classifications are used in a single test weldment, the thickness ranges permitted for use in the WPS shall apply separately to each welding process and filler metal classification. The weld deposit thickness for each welding process and each filler metal classification used in the qualification test shall be recorded on the PQR.

2.5.5 In addition to the procedure qualification variables required to be recorded on the PQR by 2.14 Procedure Qualification Variables, the weld deposit thickness for

Table 2.1
Test Methods Required for Procedure Qualification

	Fillet Welds					
	Groove Weld	Bend-Break Test	Alternate Shear Test	Stud Welds	Weld Cladding	Hard-Facing
Visual Examination	Yes	Yes	Yes	[Note (2)]	[Note (2)]	[Note (2)]
Guided bend tests	Yes ⁽¹⁾	—	—	—	Yes	—
Tension tests	Yes	—	—	Yes, or Torque	—	—
Macro-examination	[Note (1)]	Yes	Yes	Yes ⁽³⁾	—	[Note (2)]
Bend-Break	—	Yes	—	—	—	—
Bend tests	[Note (1)]	Yes	—	Yes	—	—
Torque tests	—	—	—	Yes, or Tension	—	—
Fracture toughness tests	[Note (2)]	—	—	—	—	—
Shear tests	—	—	Yes	—	—	—
Penetrant examination	—	—	—	—	Yes	[Note (2)]
Chemical analysis	—	—	—	—	Yes	[Note (2)]
Hardness test	—	—	—	—	—	Yes

Notes:

- (1) The use of a macro examination in lieu of bend tests shall be permitted only for welds made in M-26, M-81, and M-83 base materials.
- (2) If specified in referencing document.
- (3) Except that unclad, unpainted M-1 materials are exempted.

Table 2.2
Thickness and Size Limitations for Fillet Welds for Procedure Qualification

Fillet Test Weldment	Thickness and Size Range Qualified	
	Base Metal Thickness ^{(1),(2),(3),(5)}	Fillet Size (leg) ⁽⁴⁾
Single Pass	Unlimited	Maximum welded single-pass fillet size and smaller
Multiple Pass	Unlimited	1/2 of that welded during qualification to unlimited

Notes:

- (1) For OFW, the maximum base metal thickness qualified is the thickness of the test weldment.
- (2) For GMAW-S, the maximum base metal thickness qualified is 1.1 times the test weldment thickness.
- (3) For fracture toughness applications less than 5/8 in. thick, the base metal thickness of the test weldment is the minimum base metal thickness qualified.
- (4) For M-11 steels, the fillet size qualified shall be equal to or less than the fillet size used in the test.
- (5) If a test weldment receives a postweld heat treatment exceeding the lower transformation temperature, the maximum base metal thickness qualified is 1.1 times the base metal thickness of the test weldment.