

6.3.1 AWS A5 Specification Properties. Filler metals shall meet the requirements of Table 6.1 as determined from testing in accordance with the applicable AWS A5 specification.

6.3.2 Diffusible Hydrogen Level. All welding electrodes and electrode-flux combinations shall meet the requirements of Table 6.3.

6.3.3 Certification of AWS A5 Specification Properties and Diffusible Hydrogen. The manufacturer's typical Certificate of Conformance shall be considered adequate proof that the supplied electrode or electrode-flux combination meets the requirements of 6.3.1 and 6.3.2. No testing of filler metal samples or of production welds shall be required.

6.3.4 Intermix of FCAW-S Filler Metal. When FCAW-S filler metals are used in combination with filler metals for other processes, including FCAW-G, supplemental notch toughness testing shall be conducted in accordance with one or more of the following:

- (1) Tests as described in Annex B;
- (2) PQR tests that contain intermixed weld metal, wherein CVN test specimens have been taken from the intermixed zone;
- (3) Alternative tests, as approved by the Engineer.

Regardless of the testing method used, the testing shall demonstrate that the acceptance criteria of Annex B are met.

6.3.5 WPS Heat Input Envelope Testing Properties. Filler metals for Demand Critical welds shall provide the mechanical properties in Table 6.2, based upon the WPS Heat Input Envelope Testing prescribed in Annex A, except the following filler metals shall be exempted from the testing required by Annex A when LAST is equal to or greater than +50°F [+10°C]:

- (1) SMAW electrodes classified as E7018, E7018-X, in AWS A5.1/A5.1M, and E7018-C3L, E8018-C3 in AWS A5.5/A5.5M (see 6.3.8.2);
- (2) Solid GMAW electrodes (see 6.3.8.2);
- (3) Carbon steel FCAW electrodes classified with the "-D" designator as described in AWS A5.20/5.20M;
- (4) Low alloy FCAW electrodes, carbon steel and low alloy composite (metal cored) GMAW electrodes, and carbon steel and low alloy electrode/flux SAW combinations that have been optionally tested by the filler metal manufacturer in accordance with AWS A5.20/A5.20M:2005 Clause 17 for the "-D" designator. The test plate for the "-D" testing of SAW filler metals may be per-

formed on a 1 in [25 mm] test plate instead of the 3/4 in [18 mm] test plate mandated by AWS A5.20/A5.20M.

6.3.6 Lowest Anticipated Service Temperature Applications. For Demand Critical welds in applications where the Seismic Force Resisting System is subjected to service temperatures below +50°F [+10°C] following completion of the structure, the minimum CVN of 40 ft-lbf [54 J] as prescribed by 6.3.5 shall be provided at a test temperature not more than 20°F [10°C] above the Lowest Anticipated Service Temperature. The exceptions in 6.3.5 and 6.3.8.2 shall not apply when LAST is less than +50°F [+10°C].

6.3.7 Testing Source. The WPS Heat Input Envelope Testing of Filler Metals, required for Demand Critical welds and described in Annex A, shall be performed by the filler metal manufacturer, by the Contractor, or by a third party acceptable to the Engineer. The Contractor shall be responsible to ensure that this testing has been performed for the filler metals to be used, regardless of the testing source.

6.3.8 Filler Metal Production Lot Control. Each production lot of filler metal used to make Demand Critical welds shall be tested in conformance with the applicable AWS A5 specification filler metal classification tests. In addition to the standard AWS A5 specification testing, high and low heat input testing shall be performed in accordance with either Annex A, or A5.20/A5.20M:2005 Clause 17 for the "-D" designator, at the Contractor's option.

Production lots shall be as defined in AWS A5.01M/A5.01, Procurement Guidelines for Consumables—Welding and Allied Processes—Flux and Gas Shielded Electrical Welding Processes. Production lots shall meet the following requirements:

- (1) Class C3 or C4 for SMAW electrodes
- (2) Class S3 or S4 for solid electrodes for GMAW and SAW
- (3) Class T3 or T4 for FCAW and composite electrodes for GMAW and SAW
- (4) Class F2 for SAW fluxes

6.3.8.1 Alternative to Production Lot Testing. Filler metals produced by manufacturers audited and approved by one or more of the following agencies shall be exempt from production lot testing, provided a minimum of 3 different lots of material, as defined in 6.3.8, for each trade name and diameter to be used in production, are first tested in accordance with Annex A:

- (1) American Bureau of Shipping (ABS)
- (2) Lloyd's Register of Shipping
- (3) American Society of Mechanical Engineers (ASME)

Annex B (Normative)

Intermix CVN Testing of Filler Metal Combinations (where one of the filler metals is FCAW-S)

This annex is part of AWS D1.8/D1.8M:2009, *Structural Welding Code—Seismic Supplement*, and includes mandatory elements for use with this standard.

B1. Purpose

This annex provides testing procedures used to determine the suitability of combining FCAW-S with other welding processes in a single joint. The testing as required by this annex may be performed by the filler metal manufacturer, the Contractor, or an independent testing agency.

B2. Filler Metal Variables

Filler metal essential variables for the intermix CVN testing shall be as summarized in Tables B.1 and B.2. Changes in these essential variables shall require an additional test.

B3. Test Plate Details

A single test plate of ASTM A 36, A 572 Grade 50, or A 992 shall be used to evaluate E70 filler metal combinations, and ASTM A 572 Grade 65 or A 913 Grade 65 shall be used to evaluate E80 filler metal combinations. The test plate shall be 3/4 in [20 mm] thick, with either a 5/8 in [16 mm] root opening with a 20° included groove angle, or a 1/2 in [12 mm] root opening with a 45° included groove angle. The test plate and specimens shall be as shown in Figure B.1. Alternatively, a PQR test plate may be used in accordance with 6.3.4(2).

B4. Welding of Test Plate

The sequence of placement of weld metals shall be the same as that to be employed in production. The first material shall be known as the substrate/root material, and the subsequent material shall be known as the fill material. Approximately one-third the thickness of the test joint shall be welded with the substrate/root material. The balance of the joint shall be welded with the fill material.

B5. Test Specimens Required

Five or ten CVN test specimens shall be made from the test plate, depending on the required number of tests. CVN specimens shall be prepared in accordance with AWS B4.0, *Standard Methods for Mechanical Testing of Welds*, Clause A3.

B6. CVN Specimen Location

The CVN impact bar shall be located as follows:

(1) Transverse specimens from which CVN bars are to be machined shall be etched to reveal the cross section of the weld.

(2) A line shall be scribed on the etched cross section, at the interface of the two welding process deposits (see Figure B.2).

(3) The CVN specimen shall be taken from primarily material deposited by the second process. The interface location shall be included in the specimen, with the edge of the specimen within 1/16 in [1.5 mm] of the interface location (see Figure B.3).

B7. Acceptance Criteria—All Welds

For all welds governed by this code, the required CVN toughness value shall be 20 ft·lbs [27 J] at 0°F [-18°C]. The lowest and highest values obtained from the five test specimens shall be disregarded. Two of the remaining three values shall equal or exceed 20 ft·lbs [27 J] at the testing temperature. One of the three may be lower, but not lower than 15 ft·lbs [20 J] at 0°F [-18°C]. The average of the three shall not be less than 20 ft·lbs [27 J].

B8. Acceptance Criteria—Demand Critical Welds

For Demand Critical welds, in addition to the criteria of B7, the required notch toughness value shall be 40 ft·lbs [54 J] at 70°F [20°C], or at the temperature as required by 6.3.6. The lowest and highest values obtained from the five test specimens shall be disregarded. Two of the remaining three values shall equal or exceed 40 ft·lbs [54 J] at the testing temperature. One of the three may be lower, but not lower than 30 ft·lbs [40 J] at the testing temperature. The average of the three shall not be less than 40 ft·lbs [54 J]. For applications where LAST is below +50°F [+10°C], the CVN testing temperature shall be LAST plus 20°F [10°C].

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Table B.1
Filler Metal Essential Variables—FCAW-S Substrate/Root

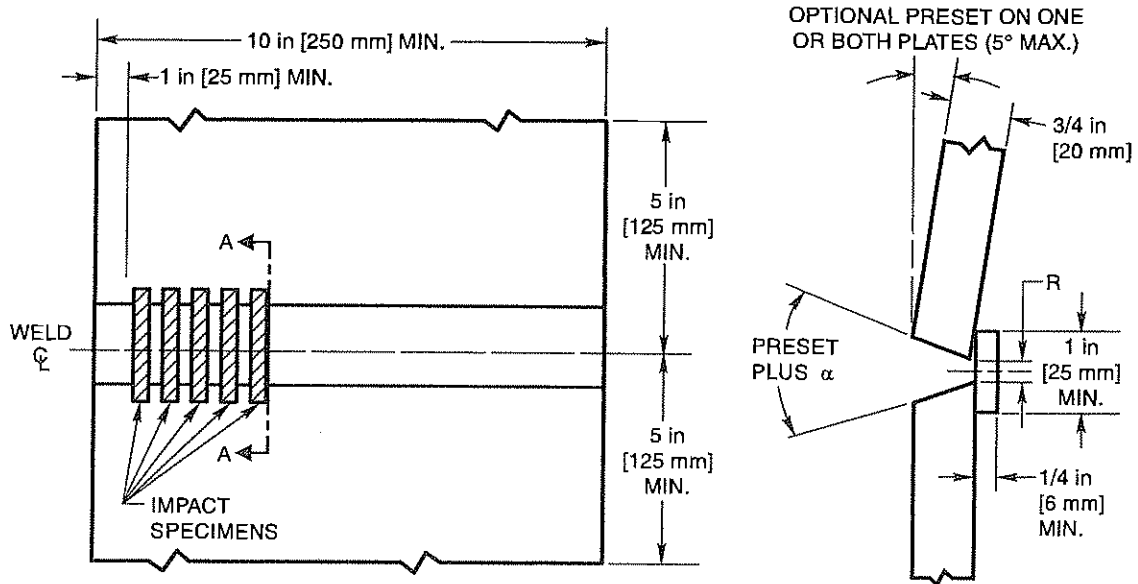
	Substrate/Root	Fill					
	FCAW-S	FCAW-S	FCAW-G	SMAW	GMAW	SAW	Other
AWS Classification	X		X	X	X	X	X
Manufacturer	X		X	X		X	X
Manufacturer's Brand and Trade Name	X		X	X		X	X
Diameter			X	X	X	X	X

Note: An "X" in the column indicates that the essential variable is applicable for the particular welding process and weld type.

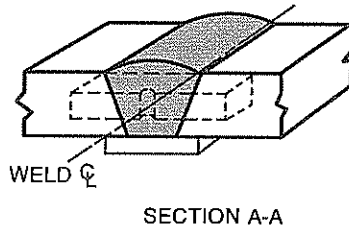
Table B.2
Filler Metal Essential Variables—FCAW-S Fill

	Substrate/Root						Fill
	FCAW-S	FCAW-G	SMAW	GMAW	SAW	Other	FCAW-S
AWS Classification	X	X		X	X	X	X
Manufacturer	X	X			X	X	X
Manufacturer's Brand and Trade Name	X	X			X	X	X
Diameter							X

Note: An "X" in the column indicates that the essential variable is applicable for the particular welding process and weld type.



(A) TEST PLATE SHOWING LOCATION OF TEST SPECIMENS



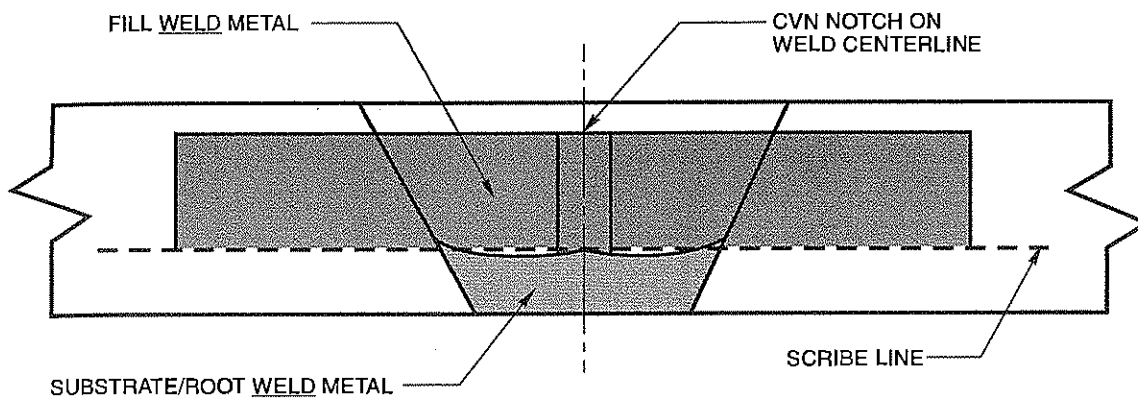
(B) ORIENTATION OF IMPACT SPECIMEN

Note: See Figures B.2 and B.3 for positioning of CVN specimen.

	Root Opening (R)	Groove Angle (α)
OPTION 1	1/2 in [12 mm]	45°
OPTION 2	5/8 in [16 mm]	20°

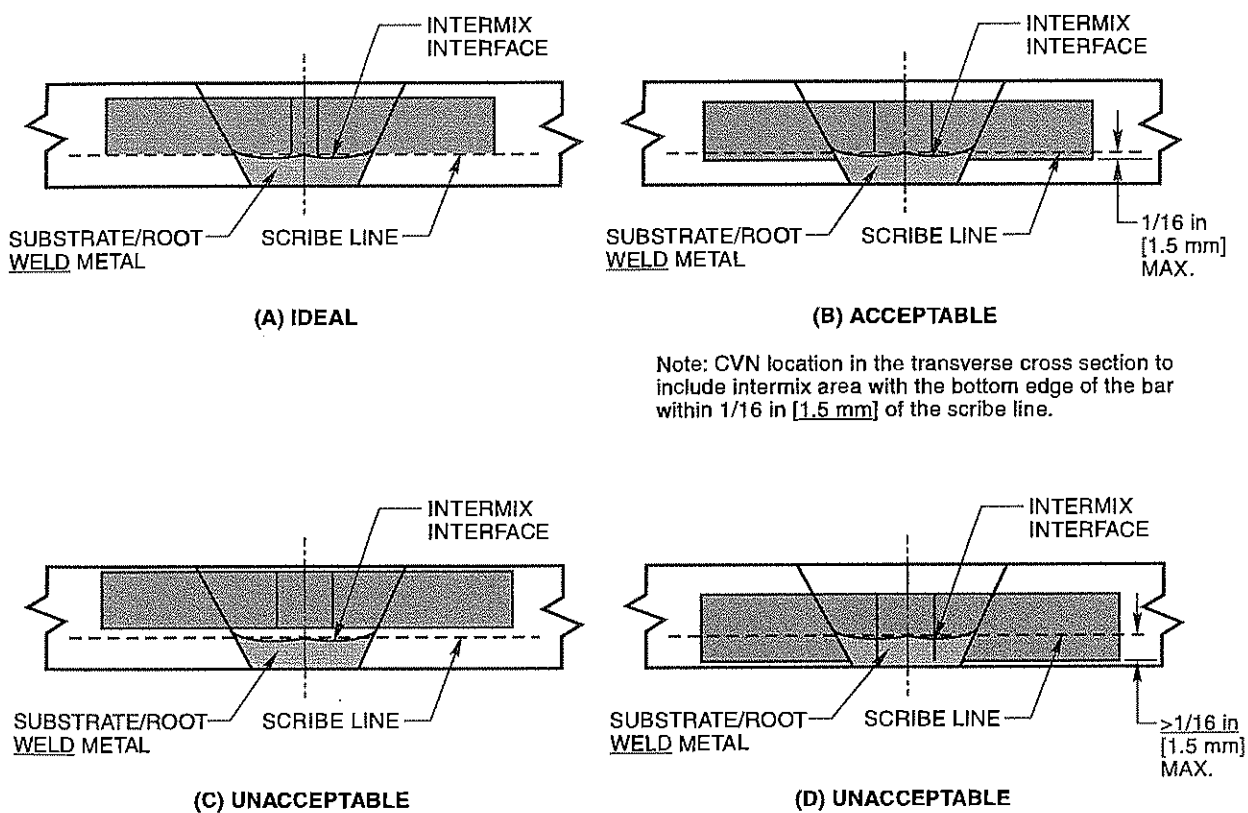
Note: CVN specimen edge to be adjacent to intermix scribe line (see Figure B.3).

Figure B.1—Intermix Test Plate (see B3)



Note: CVN specimen edge is on scribe line.

Figure B.2—Interface Scribe Line Location [see B6(2)]



Note: CVN location in the transverse cross section to include intermix area with the bottom edge of the bar within $1/16$ in [1.5 mm] of the scribe line.

Figure B.3—Intermix CVN Test Specimen Location [see B6(3)]