

Structural Welding Code— Reinforcing Steel

1. General Provisions

1.1 Scope

The code shall apply to the welding of:

- (1) Reinforcing steel to reinforcing steel, and
- (2) Reinforcing steel to carbon or low-alloy structural steel.

When the code is stipulated in contract documents, conformance with all provisions shall be required, except for those provisions that the Engineer or contract documents specifically modifies or exempts.

1.2 Application

1.2.1 This code shall be used in conjunction with the prescribed general building code requirements and is applicable to all welding of reinforcing steel, using the processes listed in 1.4, and performed as a part of reinforced concrete construction.

1.2.2 The weldments specified in this code shall not be used where impact properties are a requirement of the general specification. Impact testing requirements of welded reinforcing bars are not included in this code.

1.2.3 All references to the need for approval shall be interpreted to mean approval by the Engineer.

1.3 Reinforcing Steel Base Metal

1.3.1 Reinforcing steel base metal in this code shall conform to the requirements of the latest edition of one of the ASTM specifications listed within this paragraph. Combinations of any of these reinforcing steel base metals, when welded, shall use a WPS (welding procedure specification) qualified in conformance with Section 6.

- (1) ASTM A 82/A 82M
- (2) ASTM A 496/A 496M
- (3) ASTM A 615/A 615M
- (4) ASTM A 706/A 706M
- (5) ASTM A 767/A 767M
- (6) ASTM A 775/A 775M
- (7) ASTM A 934/A 934M

Manufacturing and testing requirements for mats and fabric are covered by the respective ASTM specification. For joining the ASTM A 82/A 82M and A 496/A 496M to other reinforcing wires, reinforcing bars, or structural steels, the Engineer shall specify filler metal and the provisions of this code shall apply.

1.3.2 When a reinforcing steel not listed in 1.3.1 is approved under the provisions of the general building code or by the Engineer, its chemical composition and carbon equivalent shall be provided and its weldability established by qualification in accordance with the requirements of 6.2 and all other requirements prescribed by the Engineer.

1.3.3 Base metal, other than those previously listed, shall be one of the structural steels listed in the latest edition of AWS D1.1, *Structural Welding Code—Steel*, or any steel stipulated in the contract documents or approved by the Engineer.

1.3.4 The carbon equivalent of reinforcing steel bars shall be calculated as shown in 1.3.4.1 or 1.3.4.2, as applicable.

1.3.4.1 For all steel bars, except those designated as ASTM A 706, the carbon equivalent shall be calculated using the chemical composition, as shown in the mill test report, by the following formula:

$$C.E = \%C + \%Mn/6 \quad (\text{Eq. 1})$$

1.3.4.2 For steel bars designated ASTM A 706/ A 706M, the carbon equivalent shall be calculated using the chemical composition, as shown in the mill test report, by the following formula:

$$\text{C.E.} = \%C + \%Mn/6 + \%Cu/40 + \%Ni/20 + \%Cr/10 - \%Mo/50 - \%V/10 \quad (\text{Eq. 2})$$

The carbon equivalent shall not exceed 0.55%.

1.3.4.3 If mill test reports are not available, chemical analysis may be made on bars representative of the bars to be welded. If the chemical composition is not known or obtained:

(1) For bars number 6 [19] or less, use a minimum preheat of 300°F [150°C].

(2) For bars number 7 [22] or larger, use a minimum preheat of 500°F [260°C].

(3) For all ASTM A 706/A 706M bar sizes, use Table 5.2 C.E. values of “over 0.45% to 0.55% inclusive.”

1.4 Welding Processes

1.4.1 Welding shall be performed with shielded metal arc welding (SMAW), gas metal arc welding (GMAW), or flux cored arc welding (FCAW).

1.4.2 Other welding processes may be used when approved by the Engineer, provided that any special qualification test requirements not covered here are met to ensure that welds satisfactory for the intended application will be obtained.

1.5 Definitions

The welding terms used in this code shall be interpreted in accordance with the definitions given in the latest edition of AWS A3.0, *Standard Welding Terms and Definitions*.

1.6 Welding Symbols

Welding symbols shall be those designated to the latest edition of AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*. Special conditions shall be fully explained by additional notes or details.

1.7 Safety Precautions

This technical document does not address all welding and health hazards. However, pertinent information can be found in the following documents:

(1) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

(2) Manufacturer’s safety literature on equipment and materials

(3) Other pertinent documents as appropriate.

These documents shall be referred to and followed as required (also see Annex D, Safe Practices).

Note: This code may involve hazardous materials, operations, and equipment. The code does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices. The user should determine the applicability of any regulatory limitations prior to use.

1.8 Standard Units of Measurement

This standard makes use of both U.S. Customary Units and the International System of Units (SI). The measurements may not be exact equivalents; therefore, each system shall be used independently of the other without combining in any way. The standard with the designation D1.4:2005 uses U.S. Customary Units. The standard designation D1.4M:2005 uses SI Units. The latter are shown within brackets [].

1.9 Reference Documents

The following standards contain provisions which, through reference in this text, constitute provisions of this AWS standard. For undated references, the latest edition of the referenced standard in use at the date of the contract bid submission shall apply. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

ASNT Standards¹

(1) ASNT Recommended Practice No. SNT-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*

1. ASNT standards are published by the American Society for Nondestructive Testing, 1711 Arlingate Lane, Columbus, OH 43228-0518.

ASME Standards²

- (1) ASME B46.1, Surface Texture
- (2) ASME Boiler and Pressure Vessel Code

ASTM Standards³

- (1) ASTM A 82/A 82M, Specification for Steel Wire, Plain, for Concrete Reinforcement
- (2) ASTM A 496/A 496M, Specification for Steel Wire, Deformed, for Concrete Reinforcement
- (3) ASTM A 615/A 615M, Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- (4) ASTM A 706/A 706M, Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
- (5) ASTM A 767/A 767M, Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- (6) ASTM A 775/A 775M, Specification for Epoxy-Coated Steel Reinforcing Bars
- (7) ASTM A 934/A 934M, Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
- (8) ASTM E 94, Standard Guide for Radiographic Examination
- (9) ASTM E 165, Standard Test Method for Liquid Penetrant Examination
- (10) ASTM E 709, Standard Guide for Magnetic Particle Examination
- (11) ASTM E 1032, Standard Test Method for Radiographic Examination of Weldments

2. ASME standards are published by the American Society of Mechanical Engineers, 3 Park Avenue, New York, NY 10017.

3. ASTM standards are published by the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

AWS Standards⁴

- (1) ANSI Z49.1:1999, Safety in Welding, Cutting, and Allied Processes
- (2) AWS A2.4-98, Standard Symbols for Welding, Brazing, and Nondestructive Examination
- (3) AWS A3.0:2001, Standard Welding Terms and Definitions
- (4) AWS A5.1:2004, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding Electrodes
- (5) AWS A5.5-96, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding Electrodes
- (6) AWS A5.18:2001, Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
- (7) AWS A5.20:2005, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding
- (8) AWS A5.28-96, Specification for Low Alloy Steel Filler Metals for Gas Shielded Arc Welding
- (9) AWS A5.29:1998, Specification for Low Alloy Steel Electrodes for Flux Cored Arc Welding
- (10) AWS D1.1:2004, Structural Welding Code—Steel
- (11) AWS D12.1-75, Reinforcing Steel Welding Code (obsolete, superseded by D1.4-79)
- (12) AWS QC1-96, Standard for AWS Certification of Welding Inspectors

CSA Standards⁵

- (1) CSA Standard W178.2, Certification of Welding Inspectors

4. AWS standards are published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

5. CSA standards are published by the Canadian Standards Association, 178 Rexdale Boulevard, Toronto, Ontario, Canada, M9W 1R3.