

AWS D1.1/D1.1M:2010
An American National Standard

Structural Welding Code— Steel



American Welding Society®



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An American National Standard

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Structural Welding Code— Steel

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Prepared by the
American Welding Society (AWS) D1 Committee on Structural Welding

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This code covers the welding requirements for any type of welded structure made from the commonly used carbon and low-alloy constructional steels. Clauses 1 through 8 constitute a body of rules for the regulation of welding in steel construction. There are nine normative and twelve informative annexes in this code. A Commentary of the code is included with the document.



American Welding Society®

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Dedication

The D1 Committee on Structural Welding and the D1Q Subcommittee on Steel Structures humbly dedicate this edition of D1.1/D1.1M, *Structural Welding Code—Steel*, to the memory of two longstanding volunteers.

FRED C. BREISMEISTER

1940–2009

Since 1985, Fred tirelessly helped improve several D1 Structural Welding Codes, including the D1.1, *Structural Welding Code—Steel*, D1.6, *Structural Welding Code—Stainless Steel*, and most recently the D1.8, *Structural Welding Code—Seismic Supplement*. For many years, he chaired the D1B Prequalification Subcommittee. The D1 Committee will unquestionably miss a dear friend and contributor to the team.

DONALD A. SHAPIRA

1956–2009

Since 1996, Don enthusiastically contributed to several D1 Codes, including D1.1, *Structural Welding Code—Steel*, D1.6, *Structural Welding Code—Stainless Steel*, and the D1.8, *Structural Welding Code—Seismic Supplement*. As an officer of the D1K Subcommittee, he oversaw the latest publication of D1.6, *Structural Welding Code—Stainless Steel*. The D1 Committee remembers Don's efforts with warm thoughts and appreciation.

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Foreword

This foreword is not part of AWS D1.1/D1.1M:2010, *Structural Welding Code—Steel*, but is included for informational purposes only.

The first edition of the *Code for Fusion Welding and Gas Cutting in Building Construction* was published by the American Welding Society in 1928 and called Code 1 Part A. It was revised and reissued in 1930 and 1937 under the same title. It was revised again in 1941 and given the designation D1.0. D1.0 was revised again in 1946, 1963, 1966, and 1969. The 1963 edition published an amended version in 1965, and the 1966 edition published an amended version in 1967. The code was combined with D2.0, *Specifications for Welding Highway and Railway Bridges*, in 1972, given the designation D1.1, and retitled *AWS Structural Welding Code*. D1.1 was revised again in 1975, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, and 2008. From 1972 to 1988, the D1.1 code covered the welding of both buildings and bridges. In 1988, AWS published its first edition of AASHTO/AWS D1.5, *Bridge Welding Code*; coincident with this, the D1.1 code changed references of buildings and bridges to statically loaded and dynamically loaded structures, respectively, in order to make the document applicable to a broader range of structural applications. This 2010 edition is the 22nd edition of D1.1.

Underlined text in the subclauses, tables, or figures indicates an editorial or technical change from the 2008 edition. A vertical line in the margin indicates a revision from the 2008 edition.

The following is a summary of the most significant technical revisions contained in D1.1/D1.1M:2010:

Clause 1.7—Revised for clarification.

Clause 2.3.3—Revised for clarification on ESW and EGW limitations.

Clause 3.3 Table—Revisions made to clarify differences between matching and under-matching filler metal strengths.

Clause 3.6—Revised in order to clarify prequalified essential variables.

Clause 3.7.3—Reference to “ASTM A 588” replaced to “weathering.”

Clause 3.13.2—New section added in order to clarify acceptable prequalified backing for CJP groove welds.

Table 3.1—Updated in accordance with the latest ASTM, ABS, and API specifications. Added ASTM A 709 HPS 50W material to Group II.

Table 3.2—Added ASTM A 709 Grade HPS 50W to Group B.

Table 3.3—Deleted note restricting its use to ASTM A 588 and A 709 only.

Table 3.8—New table added in order to clarify and list the essential variables for prequalified WPSs.

Figures 3.3 and 3.4 Note (c)—Revised to match verbiage in 2.18.2.

Clause 4.36.3—Revised to clarify when new CVN PQRs and WPSs are necessary.

Table 4.9—Added ASTM A 1043 Grades 36 and 50.

Table 4.10—Notes (1) and (2) have been deleted.

Table 4.12—Notes (3) and (4) have been deleted.

Clause 5.2.2.2—Revised to include shelf bar requirements.

Clause 5.10.2—Revised in order to clarify the requirements for full length backing in statically loaded applications.

Clause 5.15.4.3—Roughness requirements changed to meet the criteria in AWS C4.1.

Clause 5.17—Extensively revised provisions for beam copes and access holes. Added section for galvanized shapes.

Clause 5.24—Extensively revised section to address shelf bars and modified acceptable weld profiles.

Table 5.9—New table added to clarify applicable weld profiles.

Table 5.10—New table added to determine allowable convexity based on weld profile schedule thickness.

Figure 5.2—Notes and sketch changed to clarify web to flange access holes geometry.

Figure 5.4—Extensively revised to illustrate acceptable and unacceptable weld profiles for groove welds in butt joints, corner joints, T-joints, lap joints, as well as to address welds on shelf bars.

Clause 6.17.7—Modified to address pipe welds and steel backing.

Clause 6.22.7.7—Revised to cover other IIW type blocks.

Clause 6.23.1—Revised to allow the use of any IIW UT type blocks conforming to ASTM E 164.

Clause 6.29.2.3—Revised to address the number of indications for IIW type UT blocks.

Table 6.1(2)—Verbiage revised for clarification on acceptable fusion.

Table 6.6.—Notes (1) and (2) were deleted from table and incorporated into Clause 6.17.7.

Figure 6.19—Modified to address typical IIW type blocks.

Clause 6.26.6.4—Calculation for Attenuation Factor corrected in SI units.

Clause 7.2.5—Revised to specify unacceptable defects on stud finishes.

Clause 7.2.5.2—New section added to clarify acceptable and unacceptable cracks in headed studs.

Table 7.1—Note b modified to address concrete anchorage design.

Figure 7.1—Shank diameters for headed studs revised to be less restrictive. Also added 3/8 in [10 mm] studs.

Table I.2—Thickness range revised to be inclusive of 3/8 in [10 mm] and corrected metric values.

Annex K—Added new term for “shelf bar” and modified term for “NDT” to relate to the context of the D1 code only. The term “machine welding” was deleted and replaced with the standard term “mechanized welding” in the annex and throughout the code. The definitions for “tubular” and “pipe” have also been modified.

Annex N—Revised sample form for stud welding application N-9. Form N-3 has been corrected.

Clause C-3.7.3—Modified to address weathering steel in general instead of restricting to ASTM A 588 only.

C-Table 3.8—New commentary added to explain Table 3.8 on prequalified essential variables.

Clause C-5.4.1—New commentary section added concerning ESW and EGW processes.

Clause C-5.10.2—Commentary revised to address discontinuities in backing.

Clause C- 5.16—Commentary added regarding minimum radii for reentrant corners.

Clause C-5.17—Commentary content deleted and moved into Clause C-5.16.

Clause C-6.22.7.2—Revised to explain parameters of Tables 6.2 and 6.3.

Clause C-6.23—Modified to clarify the code’s allowance of IIW type blocks.

Clause 6.26.6—Commentary added to explain scanning techniques required by Tables 6.2 and 6.3.

Clause C-7.2.5—New calculation added to determine crack length or burst for headed studs.

Figure C-7.1—New figure added illustrating crack length calculation.

AWS B4.0, *Standard Methods for Mechanical Testing of Welds*, provides additional details of test specimen preparation and details of test fixture construction.

Commentary. The Commentary is nonmandatory and is intended only to provide insightful information into provision rationale.

Normative Annexes. These annexes address specific subjects in the code and their requirements are mandatory requirements that supplement the code provisions.

Informative Annexes. These annexes are not code requirements but are provided to clarify code provisions by showing examples, providing information, or suggesting alternative good practices.

Index. As in previous codes, the entries in the Index are referred to by subclause number rather than by page number. This should enable the user of the Index to locate a particular item of interest in minimum time.

Errata. It is the Structural Welding Committee's Policy that all errata should be made available to users of the code. Therefore, any significant errata will be published in the Society News Section of the *Welding Journal* and posted on the AWS web site at: <http://www.aws.org/technical/d1/>.

Suggestions. Your comments for improving AWS D1.1/D1.1M:2010, *Structural Welding Code—Steel* are welcome. Submit comments to the Managing Director, Technical Services Division, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126; telephone (305) 443-9353; fax (305) 443-5951; e-mail info@aws.org; or via the AWS web site <<http://www.aws.org>>.

Errata

The following Errata have been identified and will be incorporated into the next reprinting of this document.

Page 8—2.4.3.6—Correct “2.3.2.8” reference to “2.4.2.8.”

Page 23—2.27.1.1—Correct “2.24” reference to “2.25.”

Page 132—4.19.1.1—Correct “Table 4.11” reference to “Table 4.10.”

Page 150—Note e—Correct “(see 4.12.4.2)” reference to “(see 4.13.4.2).”

Page 152—Table 4.11—Under the Qualified Dimensions category for Production T-, Y-, or K-Connection CJP Groove Welds, correct “Nominal Wall or Plate Thickness Qualified, in” to “Nominal Wall or Plate Thickness^d Qualified, in.”

Page 152—Table 4.11—Under the Qualified Dimensions category for Production T-, Y-, or K-Connection CJP Groove Welds, correct “Dihedral Angles Qualified^g” to “Dihedral Angles Qualified^h.”

Page 152—Table 4.11—Under the Qualified Dimensions category for Production T-, Y-, or K-Connection Fillet Welds, correct “Dihedral Angles Qualified^g” to “Dihedral Angles Qualified^h.”

Page 190—Figure 4.38—Correct metric dimension for 3/4 in from “[75 mm]” to “[20 mm].”

Page 192—Table 4.40—Correct metric dimension for 1/2 in from “[1/2 mm]” to “[12 mm].”

Page 200—5.18.2(1)—Correct “2.16.2” reference to “2.17.2.”

Page 202—5.22.1.1—Correct “2.13” reference to “2.14.”

Page 207—5.27—Correct “2.20.6.6(3)” reference to “2.21.6.6(3).”

Page 231—6.26.6.4—First sentence, fourth line, correct “...or be...” to “...or by....”

Page 281—7.1—Correct “C7.6.1” reference to “C-7.6.1.”

Page 496—C-Table 6.7—Correct three “Table 6.6” references to “Table 6.7.”

Page 497—C-6.26.6—This paragraph appears twice. Delete the first appearance.

Page 507—C-7.2.5—Correct last entry “CL ≤ 0.125 in” to read “CL ≤ 0.125 in [3.2 mm].”

Page 533—Index—PJP groove welds—Correct entry “4.14.4.20” to read “4.14, 4.21.”

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