AASHTO/AWS D1.5M/D1.5:2010
An American National Standard

Bridge Welding Code

A Joint Publication of

American Association of State Highway and Transportation Officials

American Welding Society

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Bridge Welding Code

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Prepared by the
American Welding Society (AWS) D1 Committee on Structural Welding
AASHTO Highway Subcommittee on Bridges and Structures

Under the Direction of the
AWS Technical Activities Committee
AASHTO Executive Committee

Approved by the
AWS Board of Directors
AASHTO Board of Directors/Policy Committee

Abstract

This code covers the welding requirements for AASHTO welded highway bridges made from carbon and low-alloy constructional steels. This 2010 edition contains dimensions in metric SI Units and U.S. Customary Units. Clauses 1 through 7 constitute a body of rules for the regulation of welding in steel construction. The provisions for Clause 9 have been distributed throughout the D1.5 code. Clauses 8, 10, and 11 do not contain provisions, as their analogue D1.1 sections are not applicable to the D1.5 code. Clause 12 contains the requirements for fabricating fracture critical members.

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Foreword

This foreword is not part of AASHTO/AWS D1.5M/D1.5:2010,
Bridge Welding Code, but is included for informational purposes only.

The preparation of this specification was undertaken in response to a need for a common welding specification for the fabrication of steel highway bridges by welding. The departments of highways and transportation in the 50 states, the District of Columbia, and Puerto Rico that make up the American Association of State Highway and Transportation Officials have routinely used the specifications of the American Welding Society Structural Welding Committee, with appropriate modifications, to produce contract documents suitable for the construction of bridges using Federal Highway funds. The proliferation of requirements by the 50 states, District of Columbia and Puerto Rico that make up AASHTO (American Association of State Highway and Transportation Officials) resulted in the recognition of the need for a single document that could produce greater economies in bridge fabrication, while at the same time addressing the issues of structural integrity and public safety.

The first AWS code for *Fusion Welding and Gas Cutting in Building Construction* was published in 1928. In 1934, a committee was appointed to prepare specifications for the design, construction, alteration, and repair of highway and railway bridges. The first bridge specification was published in 1936. Until 1963, there were separate AWS committees for bridges and buildings. These two committees joined in 1963 to form the Structural Welding Committee of the American Welding Society. The committee has since promulgated standards for the application of welding to the design and construction of structures.

The Federal Highway Administration of the United States Department of Transportation requires states using federal funds for the construction of welded highway bridges to conform to specified standards for design and construction. Conformance to the AWS *Specification for Welded Highway and Railway Bridges* was first specified in the third edition of the AASHTO *Standard Specifications for Highway Bridges* in 1941. In 1962, the Bureau of Public Roads, now the Federal Highway Administration (FHWA), required conformance to a Circular Memorandum, dated November 13, 1962, which transmitted additional provisions for welding A36 steel pending publication of an AWS specification which would contain certain essential provisions not then in the code. Another Circular Memorandum, dated February 11, 1965, specified requirements for CVN testing, and a further Circular Memorandum, dated August 19, 1966, modified provisions of the 1966 Edition of the AWS D2.0-66, *Specification for Welded Highway and Railway Bridges*.

In 1974, AASHTO published the first edition of the *Standard Specification for Welding of Structural Steel Highway Bridges.* The Eleventh Edition of the AASHTO *Standard Specifications for Highway Bridges*, dated 1977, directed "Welding shall conform to the requirements of the AASHTO *Standard Specifications for Welding of Structural Steel Highway Bridges* 1974 and subsequent interim specifications…" AASHTO published the Second and Third editions of the *Standard Specifications for Welding of Structural Steel Highway Bridges* in 1977 and 1981. All of the AASHTO specifications were required to be part of the Contract Documents as modifications or additions to the AWS *Structural Welding Code—Steel.* This was a cumbersome procedure.

In 1982, a subcommittee was formed jointly by AASHTO and AWS, with equal representation from both organizations, to seek accommodation between the separate and distinct requirements of bridge Owners and existing provisions of AWS D1.1. The *Bridge Welding Code* is the result of an agreement between AASHTO and AWS to produce a joint AASHTO/AWS *Structural Welding Code* for steel highway bridges that addresses essential AASHTO needs and makes AASHTO revisions mandatory.

The 1988 version of the *Bridge Welding Code* provided for the qualification of welding procedures by test to assure that weld had the strength, ductility, and toughness necessary for use in redundant structures. Nonredundant fracture critical

bridge members were not provided for in the first edition of the code. While qualification of welding procedures is required, a major effort has been made to specify the minimum number of tests and the simplest tests that give reasonable assurance of required mechanical properties. Efforts are made to discourage individual States from requiring duplication of weld testing unless that testing is specified in the bid documents. Special attention is directed to avoidance of unnecessary hardening of base metal HAZs and the avoidance of hydrogen and other items that can lead to weld or base-metal cracking.

Consequently, while the D1.5-88 document has a superficial resemblance to D1.1 in its general format, there are significant differences that users should be aware of, among them the lack of provisions relating to statically loaded structures, tubular construction or the modification of existing structures. Users are encouraged to develop their own requirements for these applications or use existing documents (e.g., D1.1) with the appropriate modifications.

The publication of AASHTO/AWS D1.5M/D1.5:2010 was justified by the need to monitor, revise, and update code provisions based on the needs of AASHTO member states and industry. The following is a list of the major revisions in the 2010 edition:

(1) New material 345S [50S] was added to the code.

(2) ESW requirements were separated from EGW.

(3) ESW requirements now include ESW-NG (Narrow gap improved Electroslag Welding).

(4) Tables 4.1 and 4.2 were consolidated into one new Table 4.1. Table 4.2 as it previously existed in older editions of the code has been deleted.

(5) 5.7 was revised in its entirety to reflect the revisions in the new Table 4.1.

(6) 5.7.6 was extensively revised for clarification and now includes a subclause covering exceptions for combining FCAW WPSs.

(7) 5.12 was revised to specify heat input requirements for nonstandard groove weld details.

(8) Provisions were added to the code to address qualification of hybrid joints (joint involving two base metals of different strength, e.g., 50W to HPS 50W).

(9) Qualification methods of 5.12 and 5.13 were consolidated under the newly revised 5.12 with modified and improved language.

(10) Table 5.2 was updated to reflect the newly revised Table 4.1 as well as to clarify which joint details can be used for EGW and ESW.

(11) Table 5.3 was revised to omit ESW.

(12) 6.1.3.7 was revised to accept only Jaeger J-2 vision acuity for Inspection Personnel.

(13) 6.17 was modified to require test equipment qualification every two months instead of every forty hours.

(14) 6.18.3 was modified to require recalibration after change of operators every two hours instead of every thirty minutes.

(15) Grades 345S [50S] and HPS 345W [HPS 50W] were added to Table 12.1.

(16) New normative Annex I was added to address ESW electrode consumable requirements.

(17) New normative Annex J was added to address guidelines for alternative ESW process.

(18) New informative Annex Q was introduced to guide users on the use of ESW-NG.

(19) Commentary for Clause 4 was added to address all the remaining provisions of Clause 4.

(20) Commentary in C-5.7.4 and C-5.7.4.1 were deleted in their entirety.

(21) Commentary for new Annex I was added.

Changes in Code Requirements. Changes to the text of the 2010 edition are indicated by underlining. Changes to illustrations are highlighted by vertical lines in the margin.

Future revisions to this code will be made based on proposals from the Joint AASHTO/AWS Committee as well as those from document users. It should be re-emphasized here that the Joint Committee is the primary agency for receiving feedback from industry, and requires this input in order to produce a quality document. Other documents that do not receive the ANSI/AASHTO/AWS accreditation should not be relied on as substitutes for the Joint Committee's interpretation of D1.5 provisions.

While the D1.1 and D1.5 codes do share a number of common provisions, it should not be assumed that revisions to one document provision automatically revises its analogous provision in the other; therefore, users are encouraged to treat each code as an independent document.

This code was prepared by the AASHTO/AWS Bridge Welding Committee operating as a Subcommittee of the AWS Structural Welding Committee. The Committee is made up of representatives from the AWS Structural Welding Committee and the AASHTO Technical Committee for Welding. Accommodation was sought on all items where there was disagreement between AASHTO and AWS members. Specific issues considered essential by AASHTO were included in this code to eliminate the need for supplemental exclusions or additions by AASHTO.

The AASHTO/AWS D1.5, *Bridge Welding Code*, will be subject to regular review by the Bridge Welding Committee and will be republished or reaffirmed on an as-needed basis, at intervals not to exceed five years. All proposed changes to this code will be subject to approval by AWS and AASHTO prior to publication.

Comments or inquiries pertaining to this code are welcome (see Annex O). They should be sent to the Secretary, AWS D1 Committee on Structural Welding, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126, or to the Chairman of the AASHTO Technical Committee for Welding, American Association of State Highway and Transportation Officials, 444 N. Capitol Street, N.W., Suite No. 225, Washington, DC 20001.

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Bridge Welding Code

1. General Provisions

1.1 Application

1.1.1 This code covers welding fabrication requirements applicable to welded highway bridges. The code is applicable to both shop and field fabrication of steel bridges and bridge components. The code is to be used in conjunction with the *AASHTO Standard Specification for Highway Bridges* or the *AASHTO LRFD Bridge Design Specifications*.

The code is not intended to be used for the following:

(1) Steels with a minimum specified yield strength greater than 690 MPa [100 ksi]

(2) Pressure vessels or pressure piping

(3) Base metals other than carbon or low alloy steels

(4) Structures composed of structural tubing

Fabrication of structures or components not specifically addressed by this code shall be performed in conformance with the special provisions of the contract or in conformance with the written directives of the Engineer who may choose to reference an alternate applicable welding standard.

1.1.2 The fundamental premise of the code is to provide general stipulations applicable to any routine bridge situation. Acceptance criteria for production welds different from those described in the code may be used for a particular application, provided they are suitably documented by the proposer and approved by the Engineer.

Such alternate acceptance criteria may be based upon evaluation of suitability for service using past experience, experimental evidence, or engineering analysis considering material type, service load effects, and environmental factors.

1.1.3 The term *Engineer* as used in this code shall mean the State Bridge Engineer, or the Bridge Engineer's designated representative. The Engineer acts on behalf of the State or Owner and unless otherwise specified, shall be the Owner's official representative. All references to acceptance or approval shall mean acceptance or approval by the Engineer.

1.1.4 The term *Contractor* as used in this code indicates the party responsible for performing the work as required by the contract documents. The term Contractor is used collectively to mean contractor, manufacturer, fabricator, erector, or other party performing the work.

1.2 Base Metal

1.2.1 Specified Base Metal. The contract documents shall designate the specification and classification of base metals to be used.

1.2.2 Approved Base Metals. Unless otherwise specified, base metals to be welded under this code shall meet the requirements of the latest edition of AASHTO M 270M/M 270 (ASTM A 709/A 709M) for the grade of steel shown on the plans or described in the specifications. All Grade 345 (50) steel that is to be welded shall be Type 1, 2, or 3. Other steels may be approved by the Engineer. Thickness limitations shall not apply to bearing components.

M 270M/M 270 steels of a designated grade are essentially the same as ASTM A 709/A 709M steels of the same grade. The provisions of this code are not intended for use with steels having a minimum specified yield strength over 690 MPa [100 ksi].

1.2.3 Thickness Limitations. The provisions of this code do not apply to welding base metals less than 3 mm [1/8 in] thick. Where base metals thinner than 3 mm [1/8 in] are to be welded, the requirements of AWS D1.3/D1.3M, *Structural Welding Code—Sheet Steel*, should apply. When used in conjunction with AWS D1.3/D1.3M, the applicable provisions of this code shall be observed.