

Supplement
To
Aws D1.0-66,
CODE FOR WELDING
IN BUILDING CONSTRUCTION
And
AWS D2.0-66, SPECIFICATIONS FOR
WELDED HIGHWAY AND RAILWAY BRIDGES
On Requirements FOR
STUD WELDING



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AWS SUP. 2-68

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WELDED HIGHWAY AND RAILWAY BRIDGES
on
Requirements for**

Stud Welding

SEPTEMBER 1968

Prepared by
AWS Structural Welding Committee

Under the Direction of
AWS Technical Activities Committee

Edward A. Fenton
Technical Director

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Foreword

This Supplement covers stud welding, which is an arc welding process wherein coalescence is produced by heating with an electric arc drawn between a metal stud, or similar part, and the other work part until the surfaces to be joined are properly heated, when they are brought together under pressure. Partial shielding may be obtained by the use of a ceramic ferrule surrounding the stud.

1. Scope

This Supplement contains additional provisions applicable to the Code for Welding in Building Construction, D1.0, and Specifications for Welded Highway and Railway Bridges, D2.0. It is intended for the installation and inspection of steel studs welded to steel, to connect members and connection devices to concrete (as concrete anchors and as shear connectors in composite steel-concrete construction) and to fasten other members and appurtenances.

2. Definitions

(a) Where the term Building Commissioner or Engineer is used herein, it shall have the same meaning as defined in AWS D1.0 and D2.0.

(b) *Stud base* as used herein shall be considered as the stud tip at the welding end, including flux and container, and $\frac{1}{8}$ -inch of the body of the stud adjacent to the tip.

(c) The angle of bend in testing studs as used herein shall be measured between the original axis of the stud and a line passing through the centers of the two ends of the bent stud.

3. General Requirements

(a) Studs shall be of a design suitable for arc-welding to steel members with automatically timed stud welding equipment. The type, size or diameter, and length of stud shall be as specified by the plans, specifica-

tions, or special provisions as approved by the Building Commissioner (Engineer). (See Figure 1 for dimensions and tolerances of standard type *shear connectors*.)

(b) An arc shield (ferrule) of heat-resistant ceramic or other suitable material shall be furnished with each stud.

(c) A suitable deoxidizing and arc stabilizing flux for welding shall be furnished with each stud of 5/16-inch diameter or larger. Studs less than 5/16-inch in diameter may be furnished with or without flux.

(d) Only studs with qualified stud bases shall be used. A stud base, to be qualified, shall have passed the tests prescribed in Section 8 of this Supplement. The arc shield used in production shall be the same as used in the qualification tests. Qualification of stud bases in accordance with Section 8 shall be at no expense to the Owner.

(e) Finish shall be produced by cold heading, cold rolling, or machining. Finished studs shall be of uniform quality and condition, free of injurious laps, fins, seams, cracks, twists, bends, or other injurious defects. A stud with cracks or bursts deeper than one-half the distance from the periphery of the head to the shank may be cause for rejection.¹

(f) Only studs qualified under Section 8 of this Supplement shall be used. When requested by the Building Commissioner (Engineer), the contractor shall provide the following information:

- (1) A description of the stud and arc shield to be furnished.
- (2) A certification from the manufacturer that the stud base is qualified as specified in Par. 3(d). Qualification test data shall be retained in the files of the manufacturer. Copies of the data shall be furnished on written request of the Building Commissioner (Engineer).

4. Mechanical Requirements

(a) Studs shall be made from cold drawn bar stock conforming to the requirements of the Specification for Cold Finished Carbon Steel Bars and Shafting, ASTM Designation A108, Grades 1010, 1015, 1017 or 1020, either semi- or fully-killed.

¹ Heads of shear connector or anchor studs are subject to cracks or bursts, which are names for the same thing. Cracks and bursts designate an abrupt interruption of the periphery of the head of the stud by radial separation of the metal. Such interruptions do not adversely affect the structural strength, corrosion resistance or other functional requirements of shear connectors or anchor studs.

- (1) Tensile requirements of *shear connector studs*, as determined by tests of bar stock after drawing, or of full diameter finished studs, at the manufacturers option, shall conform to the following:

Tensile strength (min.)	60,000 psi
Elongation (min.)	20% in 2-in.
Reduction of area (min.)	50%

- (2) *Studs other than shear connectors* shall have a minimum tensile strength of 55,000 psi and a minimum elongation of 20% in 2 inches. Tests may be made on bar stock after drawing or on full diameter finished studs, at the manufacturer's option.

(b) Tensile requirements shall be determined in accordance with the applicable sections of ASTM A370, Mechanical Testing of Steel Products. When the tensile requirements of Par. 4(a)(1) are determined from finished studs the tensile tests may be made on studs welded to test plates of ASTM A36 steel, using a test fixture similar to that shown in Figure 2. When the tensile requirements of Par. 4(a)(2) are determined from finished studs, the ends of the studs may be gripped in the jaws of a tensile testing machine. Plates of adequate size may be fillet welded to the unwelded end for studs without heads. If fracture occurs outside the middle half of the gage length, the test shall be repeated.

(c) Upon request, the contractor shall furnish the manufacturer's certification that the studs as delivered are in accordance with the applicable requirements of Sections 3 and 4. Certified copies of the manufacturer's test reports of the last completed set of in-plant quality control mechanical tests for the requirements of Sections 3 and 4, of studs or material for the studs of the diameters to be provided, shall be furnished to the Building Commissioner (Engineer) upon request. The quality control tests shall have been made not more than 6 months prior to delivery of the studs. If quality control test reports are not available, the contractor shall furnish in lieu thereof, reports of mechanical tests for the requirements of Sections 3 and 4, on studs or bars for the studs of the diameters to be provided, selected from the material to be provided. The number of tests shall be as directed by the Building Commissioner (Engineer).

(d) The Building Commissioner (Engineer) may, at the contractor's expense, select studs of each type and size used under the contract as necessary for checking the requirements of Sections 3 and 4. These check tests shall be at the Owner's expense.

5. Workmanship

(a) Studs shall be welded to steel members with automatically timed stud welding equipment connected to a suitable power source.

(b) If two or more stud welding guns are to be operated from the same power source, they shall be interlocked so that only one gun can operate at a time, and so that the power source has fully recovered from making one weld before another weld is started.

(c) While in operation, the welding gun shall be held in position without movement until the weld metal has solidified.

(d) At the time of welding, the studs shall be free from rust, rust pits, scale, oil or other deleterious matter that would adversely affect the welding operation.

(e) The stud base shall not be painted, galvanized or cadmium plated prior to welding.

(f) The areas on the member to which the studs are to be welded shall be free of scale, rust or other injurious material to the extent necessary to obtain satisfactory welds. These areas may be cleaned by wire brushing, peening, prick-punching or grinding.²

(g) Welding shall not be done when the base metal temperature is below 0°F., or when the surface is wet or exposed to falling rain or snow. When the temperature of the base metal is below 32°F., one stud in each 100 studs welded shall be tested by the methods specified in Pars. 7(a) and 7(b), as applicable, in addition to the first two tested as specified in Pars. 6(a) and 6(b).

(h) Longitudinal and lateral spacings of *stud shear connectors* with respect to each other and to edges of beam or girder flanges may vary a maximum of 1-inch from the location shown on the plans provided the adjacent studs are not closer than 2½ inches center to center. The minimum distance from the edge of a stud base to the edge of a flange shall be the diameter of the stud plus ⅛-inch, but preferably not less than 1½ inches. The accuracy of location of *other types of studs* shall be such as to permit a workmanlike assembly of attachments without alterations or reaming.

(i) Arc shields shall be broken free from the studs after welding.

(j) The studs, after welding, shall be free from any defect or substance that would interfere with their intended function.

²Extreme care should be exercised when welding through metal decking.

6. Quality Control

(a) The first two stud *shear connectors* welded on each member, after being allowed to cool, shall be tested by bending to an angle of 45° by striking the stud with a hammer. If failure occurs in the weld zone of either stud, the procedure shall be corrected and two more studs shall be welded to the member and tested. If either of the second two studs fail, additional welding shall be continued on separate material until two consecutive studs are tested and found to be satisfactory. Two consecutive studs shall then be welded to the member, tested and found to be satisfactory before any more production studs are welded to the member. The foregoing testing shall be performed after any change in the welding procedure. If failure occurs in the stud shank, an investigation shall be made to ascertain and correct the cause before further welds are made.

(b) For applications *other than shear connectors*, before starting the welding operations or at the request of the Building Commissioner (Engineer), two stud connectors shall be welded to separate material in the same general position (flat, vertical, overhead, sloping) and of similar thickness and material as the member. After being allowed to cool, these studs shall be tested by bending to an angle of 30° by striking the stud with a hammer. If failure occurs in the weld zone of either stud, the procedure shall be corrected and two successive studs successfully welded and tested before any studs are welded to the member. The foregoing testing shall be performed after any change in the welding procedure. If failure occurs in the stud shank, an investigation shall be made to ascertain and correct the cause before further welds are made.

(c) Studs on which a full 360° weld fillet is not obtained may, at the option of the stud-welding contractor, be repaired by adding a 3/16 inch fillet weld in place of the missing weld fillet, using the shielded metal-arc process with low-hydrogen welding electrodes in accordance with the requirements of AWS D1.0 or AWS D2.0 as applicable.

(d) If the reduction in the length of studs as they are welded becomes less than normal, i.e., the length of stud is more than 1/16-inch greater than specified, welding shall be stopped immediately and not resumed until the cause has been corrected.

(e) The areas of all components subjected to tensile stresses where a defective stud has been removed shall be made smooth and flush. Where in such areas base metal has been pulled out in the course of stud removal, a shielded metal arc welding process with low-hydrogen electrodes in accordance with the requirements of AWS D1.0 or AWS D2.0, as applicable, shall be used to fill the pockets and the weld surface ground flush. In compression areas of members where stud failures are

confined to shanks of studs or fusion zones of studs, a new stud may be welded adjacent to the defective area in lieu of repair and replacement on existing weld area (see Par. 5(h)). If metal is pulled from the base metal of such areas the repair provisions shall be the same as for tensile areas except that, when the depth of defect is not more than the lesser of $\frac{1}{8}$ -inch or 7% of the base metal thickness, the defect may be faired by grinding in lieu of filling the defective area with weld metal. Where a replacement stud is to be placed in the defective area, the above repair shall be made prior to welding the replacement stud. Replacement *shear connector* studs shall be tested by bending to an angle of 15° . The areas of components exposed to view in completed structures shall be made smooth and flush where a stud has been removed.

7. Inspection Requirements

(a) If visual inspection reveals any stud *shear connector* that does not show a full 360° weld fillet, any stud that has been repaired by welding, or any stud in which the reduction in length due to welding is less than normal, such stud shall be struck with a hammer and bent to an angle of 15° . For studs showing less than 360° weld fillet, the direction of bending shall be opposite to the missing weld fillet. Studs that crack either in the weld, the base metal, or the shank under inspection or subsequent straightening shall be replaced.

(b) For studs *other than shear connectors*, at least one stud in every 100 shall be struck with a hammer and bent to an angle of 15° ; or, if threaded, the stud shall be torque tested with a calibrated torque wrench to the value shown in the table on Figure 4 for the diameter and thread of the stud, in a device similar to that shown in Figure 4. If the stud fails, the procedure shall be checked in accordance with Par. 6(b) and two more of the existing studs shall be bent or torque tested. If either of these two studs fails, all of the studs represented by the tests shall be torque tested, bend tested or rejected. For critical structural connections the Building Commissioner (Engineer) shall designate the type and extent of additional inspection in the contract.

(c) The Building Commissioner's (Engineer's) inspector, where conditions warrant, may select a reasonable number of additional studs to be subjected to the tests specified in Pars. 7(a) and 7(b).

(d) The bent stud shear connectors and concrete anchors that show no sign of failure shall be left in the bent position if no portion of the stud is less than 1-inch from a proposed concrete surface. All required bending and straightening shall be done without heating before completion of the stud welding operation on the job, except as otherwise provided in the contract.

(e) If during the progress of the work, inspection and testing indicates in the judgment of the Building Commissioner (Engineer) that the stud welds being produced are not in accordance with this Supplement, the contractor will be required at his expense to make changes (such as welding procedure, welding equipment and stud base) necessary to secure satisfactory results on subsequent studs to be welded.

(f) At the option and the expense of the Owner, the contractor may be required at any time to submit studs of the types used under the contract for check qualification in accordance with the procedures of Section 8.

8. Stud Base Qualification Requirements

(a) *Purpose.* The purpose of these requirements is to prescribe tests for manufacturers certification of a stud base for welding under shop or field conditions.

(b) *Responsibility For Tests.* The manufacturer shall be responsible for the performance of the qualification tests. These tests may be performed by the manufacturer or a university, independent laboratory or other testing agency satisfactory to the Building Commissioner (Engineer). An agency performing the tests shall submit a certified report to the manufacturer of the stud giving procedures and results for all tests including the information listed under Par. 8(j).

(c) *Extent of Qualification.* Qualification of a stud base shall constitute qualification of stud bases with the same geometry, material, flux and arc shield, of the same diameter and down to, but not including, 1/8-inch smaller nominal diameters.

(d) *Duration of Qualification.* A size of stud base with arc shield, once qualified, is considered qualified until the manufacturer makes any change in the stud base geometry, material, flux, or arc shield which affects the welding characteristics.

(e) *Preparation of Specimens.*

- (1) Test specimens shall be prepared by welding representative studs to suitable specimen plates of ASTM A36 steel. Tests for threaded studs shall be on blanks (studs without threads).
- (2) Studs shall be welded with power source, welding gun and automatically controlled equipment as recommended by the manufacturer. Welding voltage, current and time (See Par. 8(f)) shall be measured and recorded for each specimen. Lift and plunge shall be at the optimum setting as recommended by the manufacturer.



(f) *Number of Test Specimens.*

- (1) Thirty test specimens shall be welded consecutively with constant optimum time but with current 10% above optimum. Optimum current and time shall be the mid-point of the range normally recommended by the manufacturer for production welding.
- (2) Thirty test specimens shall be welded consecutively with constant optimum time but with current 10% below optimum.

(g) *Tests.*

- (1) *Tensile Tests.* Ten of the specimens welded in accordance with Par 8(f)(1) and ten in accordance with Par. 8(f)(2) shall be subjected to a tensile test in a fixture similar to that shown in Figure 2, except that studs without heads may be gripped on the unwelded end in the jaws of the tensile testing machine. A stud base shall be considered as qualified if all test specimens have a tensile strength equal to or above the minimum specified in Par 4(a)(1).
- (2) *Bend Tests.* Twenty of the specimens welded in accordance with Par. 8(f)(1) and twenty in accordance with Par. 8(f)(2) shall be bend tested by being bent alternately 30° in opposite directions until failure occurs. Studs shall be bent in a bend testing device as shown in Figure 5 except that studs less than 1/2-inch diameter, optionally, may be bent using a device as shown in Figure 3. A stud base shall be considered as qualified if, on all test specimens, fracture occurs in the shank of the stud or plate material and not in the weld or heat affected zone.

(h) *Retests.* If failure occurs in a weld or heat affected zone in any of the bend test groups of Par. 8(g)(2) or at less than the specified minimum tensile strength of the stud in any of the tensile test groups of Par. 8(g)(1), a new test group as specified in Pars. 8(f)(1) or 8(f)(2) as applicable, shall be made up and retested. If such failure repeats, the stud base shall fail to qualify.

(i) *Acceptance.* For a manufacturer's stud base and arc shield combination to be qualified, each stud of each group of thirty studs shall, by test or retest, meet the requirements prescribed in Par 8(g). Qualification of a given diameter of stud base shall be considered qualification for stud bases of the same nominal diameter (See Par. 8(c)), stud base geometry, material, flux and arc shield.

(j) *Manufacturers Qualification Test Data.* The data shall include the following:

- (1) Drawings that show shapes and dimensions with tolerances of studs, arc shields, and, where used, of sheet flux.
- (2) A complete description of materials used in the studs, including the quantity and analysis of the flux, and a description of the arc shields.
- (3) Certified results of laboratory tests required by this Section.

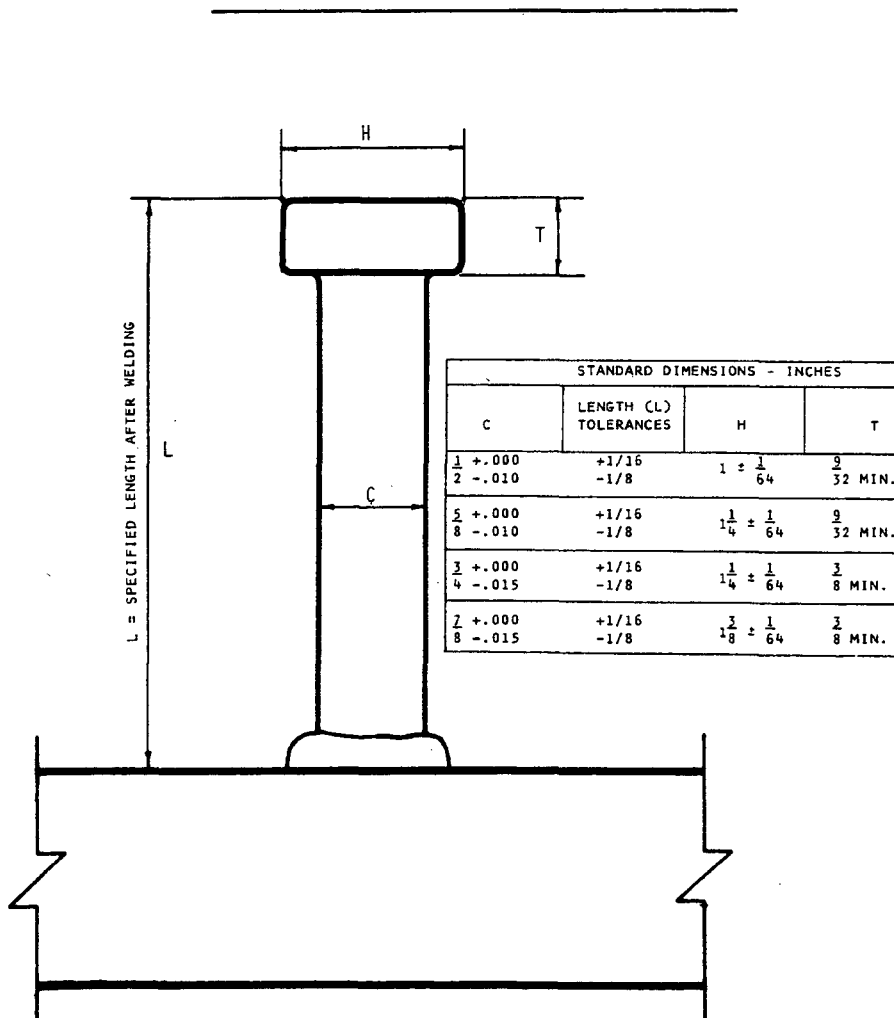


Fig. 1 – Dimensions and tolerances, standard type shear connectors

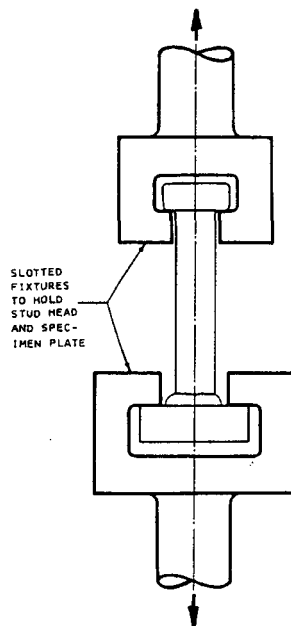


Fig. 2 (left) - Typical tensile test fixture

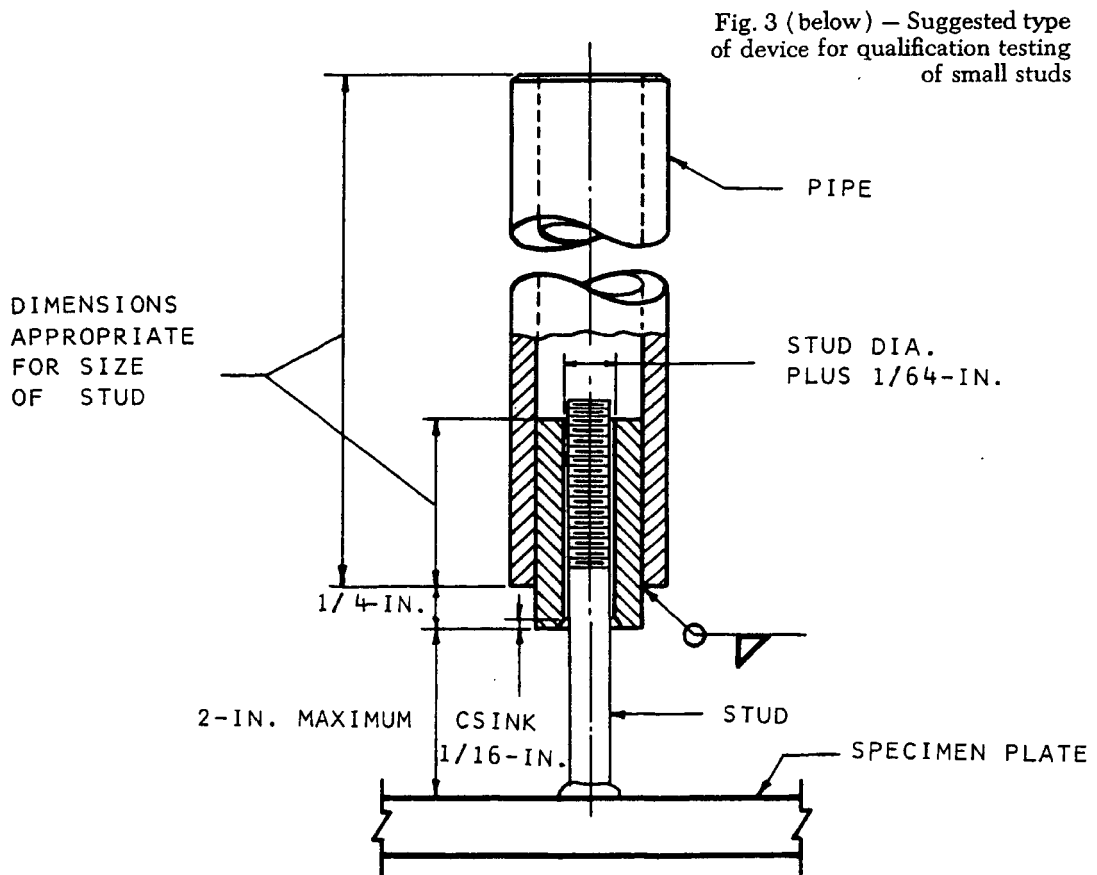
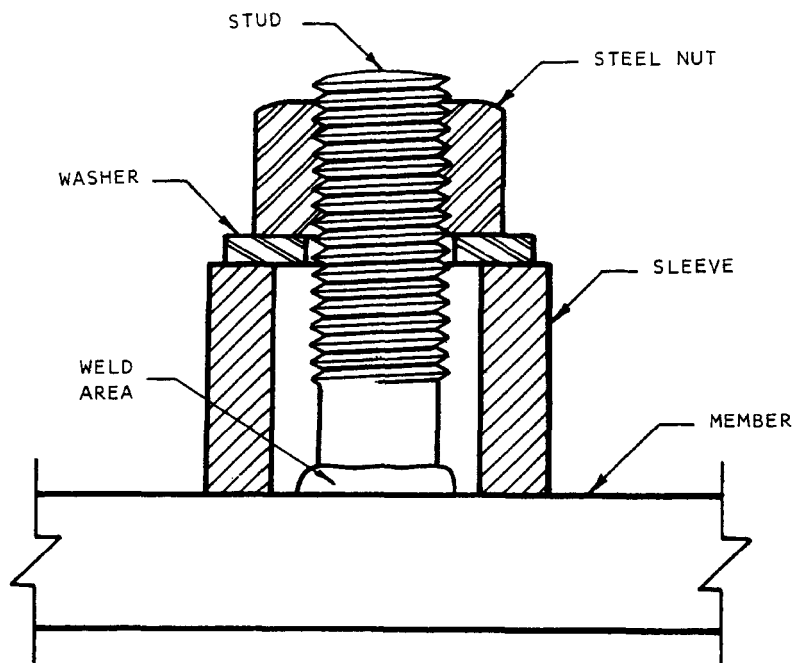


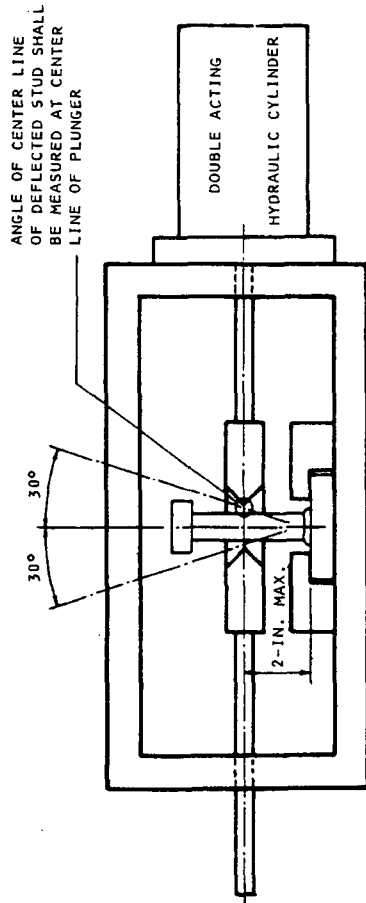
Fig. 3 (below) - Suggested type of device for qualification testing of small studs



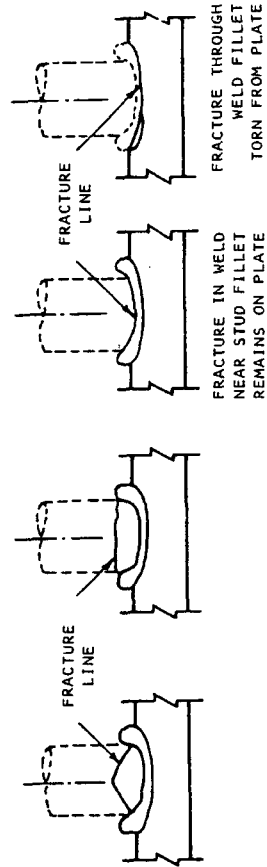
DIMENSIONS ARE APPROPRIATE TO THE SIZE OF THE STUD.
 THREADS OF THE STUD SHALL BE CLEAN AND FREE OF LU-
 BRICANT OTHER THAN FOR THE RESIDUE OF CUTTING OIL.

REQUIRED TORQUE FOR TESTING THREADED STUDS		
NOMINAL DIAMETER OF STUDS, INCHES	THREADS PER INCH AND SERIES DESIGNATED	TESTING TORQUE FOOT - POUNDS
1/4	28 UNF	5.0
1/4	20 UNC	4.2
5/16	24 UNF	9.5
5/16	18 UNC	8.6
3/8	24 UNF	17.
3/8	16 UNC	15.
7/16	20 UNF	27.
7/16	14 UNC	24.
1/2	20 UNF	42.
1/2	13 UNC	37.
9/16	18 UNF	60.
9/16	12 UNC	54.
5/8	18 UNF	84.
5/8	11 UNC	74.
3/4	16 UNF	147.
3/4	10 UNC	132.
7/8	14 UNF	234.
7/8	9 UNC	212.
1	12 UNF	348.
1	8 UNC	318.

Fig. 4 – Torque testing arrangement and table of testing torques



Fixture holds specimen and stud is bent 30° in opposite directions alternately. Load can be applied with hydraulic cylinder (shown) or fixture adapted for use with tensile test machine.



TYPICAL WELD FAILURES

TYPICAL FRACTURES IN SHANK OF STUD

Fig. 5 — Bend testing device



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Technical Director



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Citation

Where Building Code officials desire that welding be performed in accordance with the provisions of this Code, but do not wish to include this Code in its entirety in their own Building Code, the following citation is suggested:

"Welding in Building Construction"

"Welding may be used, either alone or in combination with other connecting methods permitted under the Building Code, for fabrication and erection of structural steel for buildings, or for strengthening and repair of existing buildings, provided that such work is performed in accordance with the *Code for Welding in Building Construction* (AWS D1.0), latest edition, of the American Welding Society."

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Foreword

Sections 1 through 7 of this Code constitute a body of rules for the regulation of welding in steel building construction, suitable for inclusion in a master building code. Appendices A through G contain additional material pertinent to the regulation of welding.

The Code does not treat of such design considerations as loading and the computation of stresses for the purpose of proportioning the load carrying members of a structure and their connections. Such considerations, it is assumed, are elsewhere covered in a general Building Code which would be supplemented by this Code for the control of welding.

Certain welding procedures and types of joints that have been thoroughly tested and have a long record of satisfactory performance are designated as prequalified, and may be employed without presentation of further evidence (see Art. 208). These procedures and joints include most of those that are commonly used. When other processes, procedures or joints are proposed, they are subject to qualifying tests performed in accordance with the requirements of Appendix D of this Code. In the same appendix, the procedure for qualification of welders and welding operators is also given.

This Code covers the general features essential to adequate inspection of welded work, but does not stipulate a detailed procedure since this logically depends on the scope of the project. For small, relatively unimportant work, certification by the Contractor will often suffice. On the other hand, systematic checking by competent, independent inspectors is obviously required for large, heavily loaded structures. The extent of inspection required for a particular project is a matter to be determined by the administrative authority governing the work.

It is not intended that this Code should serve as a textbook on welding. The endeavor has been to produce a useful document, suitable in language, form and coverage for adoption as administrative law for the regulation of welding in steel building construction.

Comments or inquiries pertaining to this Code are welcome. They should be addressed to: Secretary, Structural Welding Committee, AMERICAN WELDING SOCIETY, United Engineering Center, 345 East 47th Street, New York, New York 10017.



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Note: By publication of this Code, the American Welding Society does not insure anyone utilizing the Code against liability arising from the use of such Code. The publication of a Code by the American Welding Society does not carry with it any right to make, use or sell any patented items. Each prospective user should make an independent investigation.



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Code for

WELDING IN
BUILDING CONSTRUCTION

Section 1 General Provisions

101. Application

(a) This Code is to be used in conjunction with the prescribed Building Code* for the design and construction of steel structures.

(b) Structural parts and members that will be subjected to many repetitions of a large range of stress shall be designed and constructed in accordance with the prescribed Building Code.*

(c) All references to the need for approval shall be interpreted to mean "approval by the Building Commissioner" unless otherwise specified.

102. Processes and Procedures

(a) Manual shielded metal-arc and submerged arc welding procedures which conform with the provisions of Sections 2, 3 and 4 shall be deemed as prequalified and are therefore approved for use without

*The term "Building Code," wherever the expression occurs in this Code, refers to building law or specifications or other construction regulations in conjunction with which this Code is applied. In the absence of any locally applicable building law or specifications or other construction regulations, it is recommended that the construction be required to comply with the *Specification for the Design, Fabrication and Erection of Structural Steel for Buildings* of the American Institute of Steel Construction.

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performing procedure qualification tests.

(b) Other welding processes¹ and procedures may be used provided the Contractor² qualifies them in accordance with the requirements of Art. 502.

103. Base Metal

(a) Steel base metal to be welded under this Code shall conform with the requirements of the latest edition of one of the following specifications:

1. *Specification for Steel for Bridges and Buildings* (ASTM A7)
2. *Specification for Structural Steel* (ASTM A36)
3. *Specification for Structural Steel for Welding* (ASTM A373)
4. *Specification for High-Strength Low Alloy Structural Manganese Vanadium Steel* (ASTM A441)
5. *Specification for High Strength Low Alloy Steel* (ASTM A242), with properties suitable for welding.

(b) ASTM A7 steel shall not be used in simple or semi-rigid frame construction in thicknesses over 1½ in. or in rigid frame construction in thicknesses over 1 inch. These limitations shall not apply to bearing plates.

(c) When a structural steel other than those listed in Par. 103 (a) is approved under the provisions of the general building code and such steel is proposed for welded construction, the weldability of the steel and the procedure for welding it shall be established by qualification in accordance with the requirements of Art. 502 and such other requirements as prescribed by the Building Commissioner.

(d) Extension bars, run-off plates and backings used for the welding of any of the steels permitted by Par. 103 (a) may be of any of the listed steels; when used for any steel specially qualified in accordance with Par. 103 (c) such extension bars, run-off plates and backings may be of the steel qualified or any of the steels listed in Par. 103 (a). Spacers shall be of the same material as the base metal.

(e) The provisions of this Code are not intended for use with steels having a minimum specified yield point or yield strength over 60,000 psi.

¹See SR1-65, issued by the American Welding Society, regarding the use of gas metal-arc welding using CO₂ shielding.

²The term "Contractor" refers to the fabricator or erector who performs the welding.

104. Definitions

(a) The welding terms used in this Code are defined in the AWS *Definitions – Welding and Cutting* (AWS A3.0).

105. Symbols

(a) Welding symbols shall be those shown in *Standard Welding Symbols* (AWS A2.0). Special conditions shall be fully explained by notes or details.

106. Safety

(a) Safety precautions shall conform to American Standard Z49.1, *Safety in Welding and Cutting*.

Section 2 Design of Welded Connections

Part I General Requirements

201. Drawings*

(a) Complete information regarding location, type, size and length of all welds shall be clearly shown on the drawings. The drawings shall distinguish between shop and field welds.

(b) The drawings shall designate joints in which it is important that the welding sequence and technique be controlled to minimize shrinkage stresses and distortion.

(c) Weld lengths specified on the drawings shall be the effective lengths as defined in Art. 207.

202. Welds in Combination with Rivets and Bolts

(a) Rivets or bolts used in bearing-type connections shall not be considered as sharing the stress in combination with welds. Welds, if used, shall be provided to carry the entire stress in the connection. However, connections that are welded to one member and riveted or bolted to the other member are permitted. High strength bolts properly

*The term "Drawings" refers both to erection plans and detail drawings.

installed as a friction-type connection prior to welding may be considered as sharing the stress with the welds.

203. Combinations of Welds

(a) If two or more of the general types of welds (groove, fillet, plug, slot) are combined in a single joint, the allowable capacity of each shall be separately computed with reference to the axis of the group, in order to determine the allowable capacity of the combination.

Part II Permissible Unit Stresses

204. Base Metal Stresses

(a) The base metal stresses shall be those specified in the applicable Building Code.

205. Unit Stresses in Welds

(a) The permissible unit stresses in welds shall be as shown on page 5.

(b) Fiber stresses due to bending shall not exceed the values prescribed above for tension and compression.

(c) Plug or slot welds shall not be ascribed any value in resistance to stress other than shear in the plane of the faying surface.

206. Increased Unit Stresses

(a) Where the Building Code permits the use of increased unit stresses in the base metal for any reason, a corresponding increase shall be applied to the allowable unit stresses for welds.

207. Effective Weld Areas, Lengths and Throat Thicknesses

(a) *Groove Welds:* The effective area shall be the effective weld length multiplied by the effective throat thickness.

- (1) The effective weld length for any groove weld, square or skewed, shall be the width of the part joined, perpendicular to the direction of stress.
- (2) The effective throat thickness of a complete-penetration groove weld shall be the thickness of the thinner part joined. (No increase is permitted for weld reinforcement.)
- (3) The effective throat thickness of a partial-penetration groove weld shall be as specified in Arts. 210 and 212.

KIND OF STRESS*	PERMISSIBLE UNIT STRESS
Tension and Compression parallel to axis of any groove or fillet weld	Same as for base metal
Tension normal to effective throat of complete-penetration groove weld	Same as allowable tensile stress for base metal
Compression normal to effective throat of complete or partial-penetration groove welds	Same as allowable compressive stress for base metal
Shear on effective throat of complete-penetration groove weld	Same as allowable shear stress for base metal
Shear stress on effective throat of fillet weld and partial-penetration groove weld regardless of direction of application of load; tension normal to the axis on the effective throat of a partial-penetration groove weld; and shear stress on effective area of a plug or slot weld	13,600 psi using E60XX electrodes or Grade SAW-1 submerged arc welding on ASTM A7, A36 or A373
	13,600 psi using E60XX low hydrogen electrodes or Grade SAW-1 submerged arc welding on ASTM A242 (weldable grade) or A441
	13,600 psi using E70XX electrodes or Grade SAW-2 submerged arc welding on ASTM A7 or A373
	15,800 psi using E70XX electrodes or Grade SAW-2 submerged arc welding on ASTM A36
	15,800 psi using E70XX low hydrogen electrodes or Grade SAW-2 submerged arc welding on ASTM A242 (weldable grade) or A441

*See Par. 101 (b) for design of structures subject to dynamic loads.

