



# Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete<sup>1</sup>

This standard is issued under the fixed designation A1044/A1044M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers steel stud assemblies for shear reinforcement of concrete. Stud assemblies consist of either single-headed studs attached to a steel base rail by welding, or double-headed studs mechanically crimped into a steel shape.

NOTE 1—The configuration of the studs for stud assemblies is much different than the configuration of the headed-type studs prescribed in Section 7, Figure 7.1 of AWS D1.1/D1.1M. Ratios of the cross-sectional areas of the head-to-shank of the AWS D1.1/D1.1M studs range from about 2.5 to 4. In contrast, this specification requires the area of the head of the studs for stud assemblies to be at least 10 times the area of the shank. Thus, the standard headed-type studs in Section 7, Figure 7.1 of AWS D1.1/D1.1M do not conform to the requirements of this specification for use as stud assemblies for shear reinforcement.

1.2 This specification is applicable for orders in either inch-pound units or in SI units.

1.3 The values stated either in inch-pound or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

[A29/A29M Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought](#)

[A36/A36M Specification for Carbon Structural Steel](#)

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

### 2.2 AWS Standard:<sup>3</sup>

[AWS D1.1/D1.1M-2004 Structural Welding Code—Steel](#)

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from American Welding Society (AWS), 8669 NW 36 Street, #130, Miami, FL 33166-6672, <http://www.aws.org>.

### 2.3 U.S. Military Standards:<sup>4</sup>

[MIL-STD-129 Marking for Shipment and Storage](#)

[MIL-STD-163 Steel Mill Products Preparation for Shipment and Storage](#)

### 2.4 U.S. Federal Standard:<sup>4</sup>

[Fed. Std. No. 123 Marking for Shipment \(Civil Agencies\)](#)

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *headed stud, n*—a steel bar used in the reinforcement of concrete that has a head formed at one or both ends.

3.1.2 *base rail, n*—the steel shape or plate that a group of headed studs is attached to by welding or other means.

3.1.2.1 *Discussion*—Stud assemblies comprised of single-headed studs require a base rail; the base rail acts as a structural element to provide anchorage to the concrete. For stud assemblies in which double-headed studs are mechanically crimped into a base rail, for example, into a steel channel, the base rail is not required to provide anchorage to the concrete; the purpose of the base rail is to hold the studs in the appropriate location, direction, and spacing until the concrete is cast.

## 4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for material ordered to this specification. Such requirements shall include but are not limited to the following:

4.1.1 Name of product: stud assemblies for shear reinforcement of concrete,

4.1.2 Quantity of studs by diameter,

4.1.3 Number of heads per stud,

4.1.4 Dimensions of base rail, if included,

4.1.5 Overall height of stud assembly,

4.1.6 Number of studs per each assembly and their spacing (see [Note 2](#)),

4.1.7 Packaging, and

4.1.8 ASTM designation and year of issue.

NOTE 2—In the case of ordering studs rather than assemblies, the length

<sup>4</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

\*A Summary of Changes section appears at the end of this standard

of the studs should be specified such that the appropriate height of the stud assembly is achieved.

## 5. Materials and Manufacture

5.1 Headed studs shall be manufactured from steel conforming to Specification **A29/A29M**, Grades 1010 through 1020. The stud material shall conform to the requirements for tensile properties prescribed in **Table 1**.

### 5.2 Base Rails:

5.2.1 For stud assemblies in which the studs are welded to a base rail, the base rail material shall conform to **5.2.1.1**, **5.2.1.2**, or **5.2.1.3**.

5.2.1.1 The base rail material, except for tensile properties, shall conform to Specification **A36/A36M** or equivalent. The base rail material shall conform to the requirements for tensile properties prescribed in **Table 2**.

5.2.1.2 Base rail material conforming to the minimum required tensile properties in Specification **A36/A36M** shall be permitted provided the base rail thickness is increased by a factor equal to the minimum yield strength specified in **Table 2** divided by the minimum yield strength required by Specification **A36/A36M**.

5.2.1.3 Base rail material selected by the manufacturer shall be permitted subject to agreement with the purchaser. The manufacturer shall furnish documentation to the purchaser in the form of test reports that confirms the suitability of the selected base rail material for: (1) manufacturing stud assemblies; and (2) structural adequacy of the stud assemblies for the intended application.

5.2.2 For stud assemblies in which double-headed studs are mechanically crimped into a steel shape, the steel shape shall be sufficiently stiff to hold the studs in appropriate location, direction, and spacing.

5.3 For stud assemblies in which the studs are attached to base rails by stud welding, the stud welding shall conform to AWS D1.1/D1.1M, including the provisions for production control, and fabrication and verification requirements.

### 5.4 Dimensions:

5.4.1 Minimum dimensions of headed studs and plate base rails shall conform to **Table 3**.

NOTE 3—The configurations of stud assemblies are shown in **Fig. 1**.

5.4.2 Headed studs with heads that have variable thickness shall be permitted, provided they meet the tensile requirements of this specification.

## 6. Tensile Tests

6.1 At periodic intervals, tensile tests of the headed stud with a single or double head formed at one or both ends of the shank or welded to the base rail shall be performed as specified in the quality assurance program of the manufacturer and agreed upon by the purchaser. Tensile tests on the studs shall be

**TABLE 1 Tensile Requirements—Stud Material**

Tensile strength, min, psi [MPa]	65 000 [450]
Yield strength, min, psi [MPa]	51 000 [350]
Elongation in 2 in. [50 mm], min, %	20
Reduction of area, min, %	50

**TABLE 2 Tensile Requirements—Base Rail Material<sup>A</sup>**

Tensile strength, min, psi [MPa]	65 000 [450]
Yield strength, min, psi [MPa]	44 000 [300]
Elongation in 8 in. [200 mm], min, %	20

<sup>A</sup> Studs welded to base rail.

conducted by the assembly manufacturer, or an inspection agency, or the stud supplier.

6.2 Tensile testing shall be performed in accordance with the requirements described in Test Methods and Definitions **A370**. Tensile testing of headed studs shall be performed using a test fixture as described in Section 7.3.2 of AWS D1.1/D1.1M.

## 7. Acceptance Criteria

7.1 In addition to meeting the strength requirements of **5.1** and **5.2**, no observed partial or total fracture of the head, the stud weld, or other stud-base rail connection shall be permitted. The failure shall occur either in the stud material a minimum of one-half shank diameter from the head-to-shank or stud-to-base rail connection, or by tearing a hole in the base rail. Failure of the head or stud-to-base rail connection within the attachment region shall be cause for rejection. The tensile force at which failure occurs shall exceed the minimum yield strength of the stud.

## 8. Number of Tests

8.1 A minimum of two tensile tests shall be conducted during a production shift or period. It shall be permissible to test separate base rail material of the same thickness, chemical composition, and configuration of the base rails used in production. One test at the start and one test at the end of each 8-h production shift or less than 8-h production period, or at random intervals during the production period, shall be conducted.

8.2 In the event different heats of stud or base rail material within the same material specification are used to produce stud assemblies during a production run, a minimum of two tensile tests in accordance with Section **6** shall be conducted to verify the production method, product quality, and weldability of the heats of materials prior to continuing production.

8.3 Any identified procedural or performance deficiencies shall be corrected and testing repeated until the tensile test results meet the requirements of this specification.

## 9. Retests

9.1 If the tension test fails before meeting the specified minimum yield strength of the headed stud material in accordance with **Table 1**, but is within 2000 psi [14 MPa] of the required tensile strength, and if the fracture is not located within one-half shank diameter from the head-to-shank or stud-to-base rail connection, then a retest shall be allowed. Two specimens taken at random from the production lot shall be tested during a retest. Both assembled specimens shall pass the minimum yield strength requirements of Section **6** or the lot shall be rejected.

TABLE 3 Minimum Dimensions—Headed Studs and Base Rails

Stud Shank	Stud Head			Base Rail <sup>A</sup>	
Diameter ( $d$ ), in. [mm] <sup>B</sup>	Diameter ( $D$ ), in. [mm] <sup>C</sup>	Thickness ( $t_h$ ), in. [mm]	Radius at Connection of Stud Shank with Stud Head, in. [mm]	Width ( $b$ ), in. [mm]	Thickness ( $t_p$ ), in. [mm]
0.375 [9.5]	1.19 [30.1]	0.21 [5.3]	0.25 [6.4]	1.00 [25.4]	$\frac{3}{16}$ [4.8]
0.500 [12.7]	1.58 [40.2]	0.28 [7.1]	0.25 [6.4]	1.25 [31.8]	$\frac{1}{4}$ [6.5]
0.625 [15.9]	1.98 [50.2]	0.35 [8.9]	0.25 [6.4]	1.75 [44.5]	$\frac{5}{16}$ [7.9]
0.750 [19.1]	2.37 [60.2]	0.42 [10.7]	0.375 [9.5]	2.00 [50.8]	$\frac{3}{8}$ [9.5]

<sup>A</sup> Length of base rail specified by purchaser.

<sup>B</sup> Tolerance: -0.010 in. [-0.25 mm].

<sup>C</sup> Tolerance: -0.015 in. [-0.38 mm].

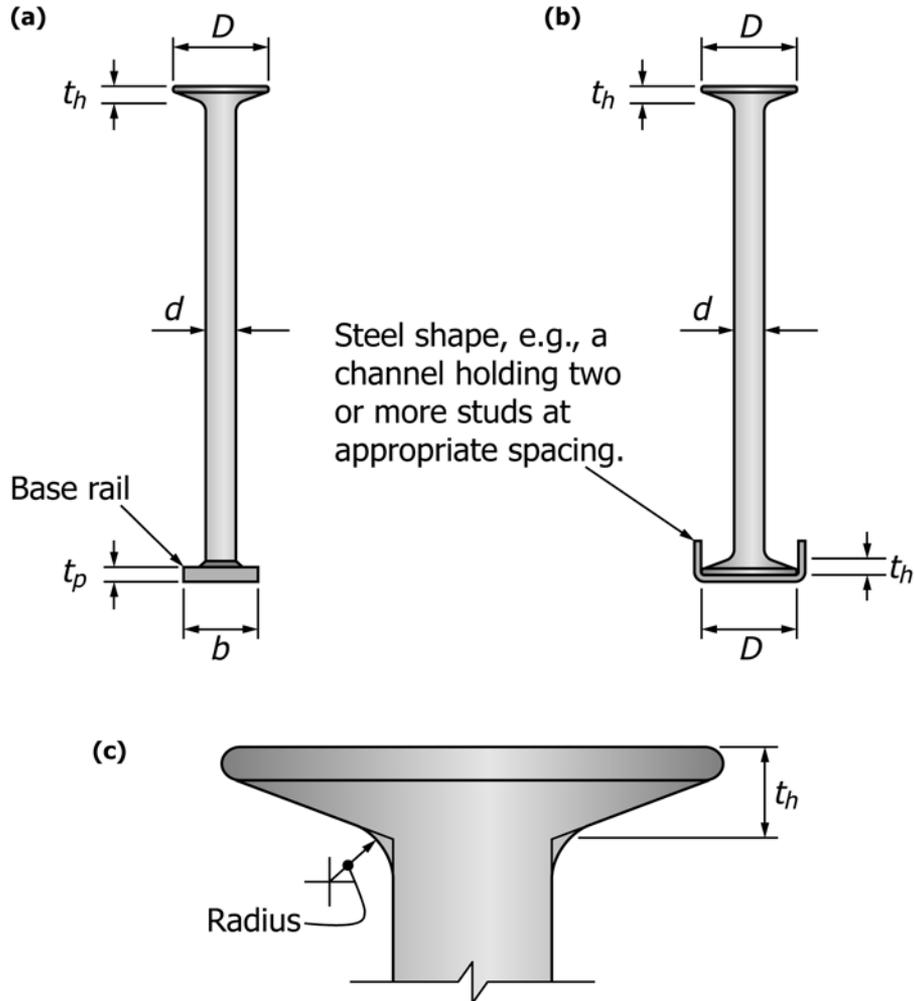


FIG. 1 Stud Assemblies: (a) Single-Headed Studs Welded to a Base Rail; (b) Double-Headed Studs Crimped into a Steel Channel; (c) Detail of Connection of Stud Shank with Stud Head

9.2 If any test specimen fails because of mechanical reasons such as failure of the testing equipment or from flaws caused by specimen preparation, shipment or other damage unrelated to fabrication or testing, it shall be discarded and another specimen from the same production lot substituted.

## 10. Finish

10.1 Finished studs shall be of uniform quality and condition, free of discontinuous laps, seams, fins, or other

discontinuities that would adversely affect welding or structural strength of the studs. Radial cracks or bursts in the head(s) of the studs shall not be cause for rejection provided that the length of cracks or bursts do not exceed the value 0.25 times (head diameter - shank diameter), or using the notation in Fig. 1:  $0.25 (D - d)$ . Surface rust and mill scale shall not be cause for rejection provided they do not adversely affect welding or structural strength of the stud assembly.

NOTE 4—Heads of studs are subject to cracks or bursts, which are terms



for the same thing. Cracks or bursts designate an abrupt interruption of the periphery of the stud head by radial separation of the metal.

## 11. Inspection

11.1 The inspector representing the purchaser shall have free entry while work on the contract of the purchaser is being performed, to the parts of the manufacturer's facilities that concern manufacture of the material ordered. The manufacturer shall afford the inspector reasonable access to the facilities to satisfy the inspector that the materials and procedures are in accordance with this specification. Inspection at the place of manufacture shall be conducted so as not to interfere unnecessarily with the operation of the manufacturer's facilities.

11.2 *For Government Procurement Only*—Except as otherwise specified in the contract, the manufacturer shall be responsible for the performance of inspection and test requirements specified herein, unless otherwise agreed by the purchaser at the time of purchase, and shall use his/her own or other suitable facilities for the performance of the inspection and test requirements specified herein.

## 12. Rejection

12.1 The purchaser shall have the right to perform any of the inspections and tests as set forth in this specification as deemed necessary. Unless otherwise specified, any rejection based on tests made in accordance with this specification shall be reported to the manufacturer within five working days from the receipt of samples by the purchaser.

12.2 Material which does not meet the requirements of this specification subsequent to its acceptance at the manufacturer's facilities shall be subject to rejection, and the manufacturer shall be promptly notified.

## 13. Rehearing

13.1 Samples tested in accordance with this specification which represent rejected material shall be preserved for two weeks from the date rejection is reported to the manufacturer. In case of dissatisfaction with the results of the test, the manufacturer shall make claim for a rehearing within that time.

## 14. Certification and Test Reports

14.1 A manufacturer's product certificate shall accompany stud assemblies when they are shipped from the manufacturer's facilities to the purchaser. The certificate shall include a statement of compliance to this specification, copies of test reports required by 14.2 and 14.3, and a statement of compliance with AWS D1.1/D1.1M in the case of stud-welded rails.

14.2 A certified mill test report shall be furnished by the manufacturer containing, on a per heat basis, the chemical analysis of the stud material, as well as the base rail, if present.

14.3 A test report shall be required of the manufacturer for the production of stud assemblies as described in Section 6. A copy of the test report shall be provided to the purchaser upon request.

14.4 A Material Test Report, Certificate of Inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document shall meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the manufacturer. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 5—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X12.

## 15. Packaging and Marking

15.1 Headed studs shall be packaged in suitable containers, clearly marked with the stud part number, description, heat number, and manufacturing code or production card number. Stud assemblies shall be shipped color coded with paint indicating the base rail type by width, thickness and length, and the number of headed studs and their diameter per rail type. The color coding used for each assembly, which shall be agreed upon in advance between the purchaser and manufacturer, shall be shown in the shipping documents.

15.2 Each manufacturer shall identify the symbols of its marking system for headed studs.

15.3 All headed studs produced under this specification shall be identified by a distinguishing set of marks legibly stamped onto the flat outer side of the head, away from the shank, to denote the manufacturer.

15.4 The finished stud assembly shall be marked to identify its manufacturer if different from the manufacturer of the headed studs.

15.5 *For Government Procurement Only*—When specified in the contract or order, and for direct procurement by or direct shipment to the U.S. government, material shall be preserved, packaged, and packed in accordance with the requirements of MIL-STD-163. The applicable levels shall be as specified in the contract. Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

## 16. Keywords

16.1 base rail; concrete reinforcement; headed studs; shear reinforcement; steel; stud assemblies



**SUMMARY OF CHANGES**

Committee A01 has identified the location of selected changes to this standard since the last issue (A1044/A1044M – 05 (2010)) that may impact the use of this standard. (Approved March 1, 2015.)

*(1) Revised Section 14.*

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