



Designation: A1044/A1044M – 22a

# 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

## 1. Scope\*

1.1 This specification covers steel stud assemblies for shear reinforcement of concrete. Stud assemblies consist of either single-headed studs (Type 1) attached to a structural steel base rail by structural welding or stud welding, or double-headed studs (Type 2) mechanically crimped into a non-structural steel shape or attached to a steel plate by spot welding or tack welding. These stud assemblies are not intended for use as shear connectors in steel-concrete composite construction.

NOTE 1—The configuration of the studs for stud assemblies is much different than the configuration of the headed-type studs prescribed in Clause 9, Figure 9.1 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 Clause 9, Figure 9.1 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 shall be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

<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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## 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

A615/A615M Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

A706/A706M Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement

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

AWS D1.1/D1.1M-2020 Structural Welding Code—Steel

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 Specification:*

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

3.1.1.1 *Discussion*—Stud assemblies comprised of single-headed studs (Type 1) 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 (Type 2) are mechanically crimped into a steel shape, 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

<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 St., #130, Miami, FL 33166-6672, <http://www.aws.org>.

<sup>4</sup> Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

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

**TABLE 1 Tensile Requirements—Stud Material—Type 1 and Type 2 Studs**

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

in the appropriate location, direction, and spacing until the concrete is cast. For stud assemblies in which double-headed studs (Type 2) are attached to a steel plate by spot welding or tack welding, the steel plate is not required to provide anchorage to the concrete; the purpose of the steel plate is to hold the studs in the appropriate location, direction, and spacing until the concrete is cast.

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

#### 4. Ordering Information

4.1 Orders for steel stud assemblies under this specification shall contain the following information:

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 Requirements for inspection ([11.1](#)),

4.1.8 Packaging, and

4.1.9 ASTM designation A1044 [A1044M] and year of issue.

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

5.1.1 Type 1 single-headed studs and Type 2 double-headed studs shall be manufactured from steel conforming to Specification [A29/A29M](#), Grades 1010 through 1020. The stud material and base rail material shall conform to the requirements for tensile properties prescribed in [Table 1](#).

5.1.2 For Type 2 double-headed studs manufactured from deformed steel reinforcing bars, the deformed bars shall conform to Specification [A615/A615M](#) or Specification [A706/A706M](#), Grade 60 [420].

##### 5.2 Base Rails:

5.2.1 For stud assemblies in which the studs (Type 1) 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

**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> Type 1 studs welded to base rail.

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 single-headed (Type 1) 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.

5.2.3 For stud assemblies in which double-headed studs (Type 2) are mechanically crimped into a steel shape, the steel shape shall be sufficiently stiff to hold the studs in the appropriate location, direction, and spacing.

5.2.4 For stud assemblies in which double-headed studs (Type 2) are attached to a steel plate by spot welding or tack welding, the steel plate shall be sufficiently stiff to hold the studs in the appropriate location, direction and spacing.

##### 5.3 Dimensions:

5.3.1 Minimum dimensions of Type 1 single-headed studs and plate base rails shall conform to [Table 3](#).

5.3.2 Minimum dimensions of Type 2 double-headed studs shall conform to [Table 4](#).

NOTE 3—The configurations of stud assemblies are shown in [Fig. 1](#).

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

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 Clause 9.3.2 and Figure 9.2 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

**TABLE 3 Minimum Dimensions—Type 1 Single-Headed Studs and Base Rails**

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

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

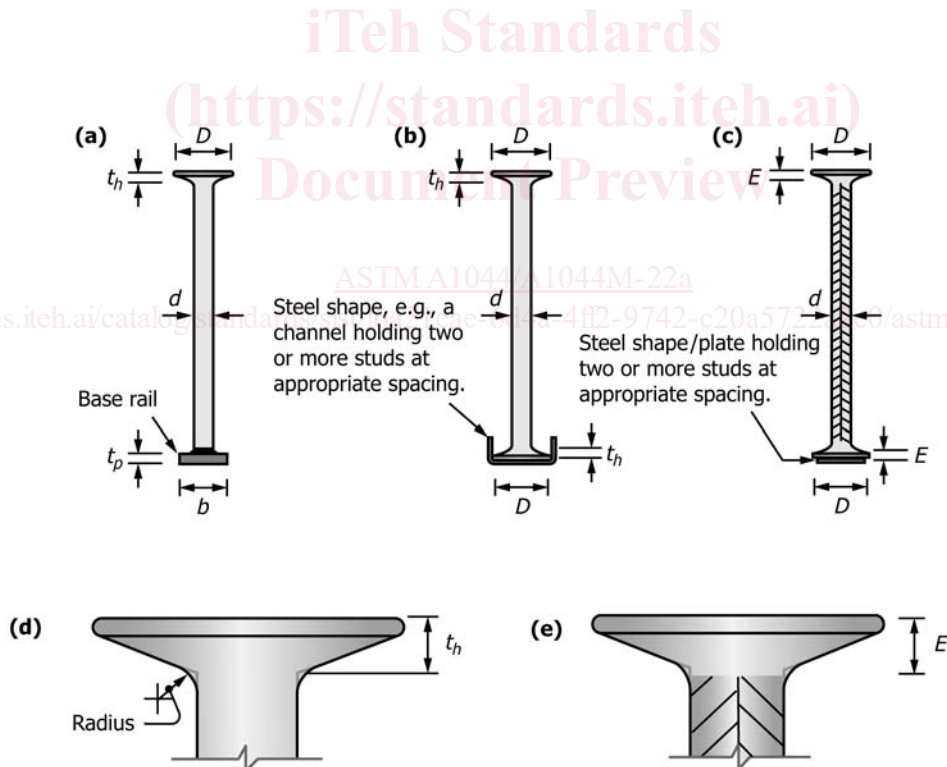
<sup>B</sup> Tolerance: -0.010 in. [-0.25 mm].

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

**TABLE 4 Minimum Dimensions—Type 2 Double-Headed Studs**

Stud Shank	Stud Head		
Bar Designation No.	Diameter ( <i>d</i> ), in. [mm]	Minimum Cross-Sectional Area, <sup>A</sup> in. [mm]	Thickness ( <i>E</i> )
3 [10]	0.375 [9.5]	1.10 [710]	Thickness required to meet minimum tensile strength and acceptance criteria
4 [13]	0.500 [12.7]	2.00 [1290]	
5 [16]	0.625 [15.9]	3.10 [1990]	
6 [19]	0.750 [19.1]	4.40 [2840]	
8 [25]	1.000 [25.4]	7.90 [5100]	
Tolerances	Specification <b>A615/A615M</b> or <b>A706/A706M</b>	Specification <b>A615/A615M</b> or <b>A706/A706M</b>	+0.08 in./-0.12 in. [+2 mm/-3 mm]

<sup>A</sup> Stud head may be any shape: round, square, or rectangular.



**FIG. 1 Stud Assemblies: (a) Type 1 Single-Headed Studs Welded to a Base Rail; (b) Type 2 Double-Headed Studs Crimped into a Steel Channel; (c) Type 2 Double-Headed Studs Spot Welded or Tack Welded to a Steel Plate; (d) Detail of Type 1 Head; (e) Detail of Type 2 Head**

stud weld, or the stud-to-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 the 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 specified yield strength of the stud material.