



Designation: **A1044/A1044M – 16a** A1044/A1044M – 16a^{ε1}

Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete¹

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 (ϵ) indicates an editorial change since the last revision or reappraisal.

^{ε1} NOTE—Editorial corrections were made throughout in August 2019.

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 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.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[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:*³

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

2.3 *U.S. Military Standards:*⁴

[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:*⁴

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

¹ 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 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the [standard's Document Summary page](#) on the ASTM website.

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

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>; 19111-5094, <http://quicksearch.dla.mil>.

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

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

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—

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

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

4.1.8 Packaging, and

4.1.9 ASTM designation 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 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.

TABLE 2 Tensile Requirements—Base Rail Material^A

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

^A Type 1 studs welded to base rail.

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 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 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.

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 [5.1](#), 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 [5.1](#) and [5.2](#) or the lot shall be rejected.

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.