



AMERICAN NATIONAL
STANDARD

ANSI/ASTM A 449 - 78a

Standard Specification for QUENCHED AND TEMPERED STEEL BOLTS AND STUDS¹

This standard is issued under the fixed designation A 449; 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.

1. Scope

1.1 This specification covers the chemical and mechanical requirements for quenched and tempered, medium carbon steel bolts and studs 3 in. and under in diameter for general applications where high strength is required.

1.2 Suitable nuts are covered in Specification A 563. Unless otherwise specified, the grade and style of nut shall be as follows:

Fastener Size and Surface Finish	Nut Grade and Style ⁴
¼ to 1½ in., plain (or with a coating of insufficient thickness to require over-tapped nuts)	B, hex
over 1½ to 3 in., plain (or with a coating of insufficient thickness to require over-tapped nuts)	A, heavy hex
¼ to 3 in., galvanized (or with a coating thickness requiring over-tapped nuts)	C, heavy hex

⁴ Nuts of other grades and styles having specified proof load stresses (Specification A 563, Table 3) greater than the specified grade and style of nut are suitable.

NOTE 1—The values stated in U.S. customary units are to be regarded as the standard.

2. Applicable Documents

2.1 ASTM Standards:

A 153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware²

A 370 Methods and Definitions for Mechanical Testing of Steel Products.³

A 563 Specification for Carbon and Alloy Steel Nuts⁴

2.2 American National Standards:⁵

ANSI B1.1 Unified Screw Threads

ANSI B18.2.1 Square and Hex Bolts and Screws

3. Material and Manufacture

3.1 Steel for bolts and studs shall be made by the open-hearth, basic-oxygen, or electric-furnace process.

3.2 The bolts and studs shall be heat treated by quenching in a liquid medium from above the transformation temperature and then tempering by reheating to a temperature of not less than 800°F (427°C).

3.3 Threads of bolts and studs shall be rolled, cut, or ground.

3.4 When specified, galvanized fasteners shall be hot-dip galvanized in accordance with the requirements of Class C of Specification A 153. When specified by the purchaser to be mechanically galvanized, fasteners covered by this specification shall be mechanically zinc-coated, and the coating shall conform to requirements for Class 50 of Specification B 454, or to the coating thickness, adherence, and quality requirements for Class C of Specification A 153.

NOTE 2—When the intended application requires that assembled tension exceeds 50 % of minimum bolt or stud proof load, an anti-galling lubricant may be needed. Application of such a lubricant to nuts and a test of the lubricant efficiency are provided in Supplementary Requirement S1 of Specification A 563 and should be specified when required.

4. Chemical Requirements

4.1 The bolts and studs shall conform to requirements as to the chemical composition specified in Table 1.

4.2 Product analyses may be made by the

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² *Annual Book of ASTM Standards*, Part 3.

³ *Annual Book of ASTM Standards*, Parts 1 to 5 and 10.

⁴ *Annual Book of ASTM Standards*, Parts 1 and 4.

⁵ May be obtained from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.



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purchaser from finished material representing each lot. The chemical composition thus determined shall conform to the requirements prescribed for product analysis in Table 1.

4.3 Application of heats of steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted.

5. Mechanical Requirements

5.1 Bolts and studs shall not exceed the maximum hardness specified in Table 2. Bolts less than three diameters in length and studs less than four diameters in length shall have hardness values not less than the minimum nor more than the maximum hardness limits required in Table 2, as hardness is the only requirement.

5.2 Bolts and studs 1¼ in. in diameter or less, other than those excepted in 4.1, shall be tested full size and shall conform to the tensile strength and either the proof load or yield strength requirements specified in Tables 3 and 4.

5.3 Bolts and studs larger than 1¼ in. in diameter as above, other than those excepted in 5.1, shall preferably be tested full size and when so tested, shall conform to the tensile strength and either the proof load or yield strength requirements specified in Tables 3 or 4 respectively. When equipment of sufficient capacity for full-size testing is not available, or when the length of the bolt or stud makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements of Table 5. In the event that bolts are tested by both full size and by the machined test specimen methods, the full-size test shall govern if a controversy between the two methods exists.

5.4 For bolts and studs on which both hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence over low readings of hardness tests.

6. Dimensions

6.1 Unless otherwise specified, the bolts shall be finished hexagon head with dimensions conforming to the latest issue of ANSI B18.2.1.

6.2 Studs shall have dimensions conforming to those specified by the purchaser.

6.3 Unless otherwise specified, threads shall be Coarse Thread Series as specified in the

latest issue of ANSI B1.1, and shall have Class 2A tolerances.

6.4 Unless otherwise specified, bolts to be used with nuts or tapped holes that have been tapped oversize, in accordance with Specification A 563, shall have Class 2A threads before hot dip or mechanical galvanizing. After galvanizing, the maximum limit of pitch and major diameter may exceed the Class 2A limit by the following amount:

Diameter, in.	Oversize Limit, in. (mm) ⁴
Up to ⅜, incl	0.016(0.41)
Over ⅜ to 1, incl	0.021(0.53)
Over 1	0.031(0.79)

⁴ These values are the same as the minimum overapping required for galvanized nuts in Specification A 563.

6.5 The gaging limit for bolts shall be verified during manufacture or use by assembly of a nut tapped as nearly as practical to the amount oversize shown above. In case of dispute, a calibrated thread ring gage of that same size (Class X tolerance, gage tolerance plus) is to be used. Assembly of the gage, or the nut described above, must be possible with hand effort following application of light machine oil to prevent galling and damage to the gage. These inspections, when performed to resolve disputes, are to be performed at the frequency and quality described in Table 6.

7. Test Methods

7.1 Bolts and studs shall be tested in accordance with Supplement III of Methods A 370.

7.2 The wedge test shall be applicable only to square and hexagon head bolts.

7.3 Studs shall be tested by the Axial Tension Method as described in S11.1.3.1, Supplement III of Methods A 370.

8. Number of Tests and Retests

8.1 The requirements of this specification shall be met in continuous mass production for stock, and the manufacturer shall make sample inspections to ensure that the product conforms to the specified requirements. Additional tests of individual shipments of material are not ordinarily contemplated. Individual heats of steel are not identified in the finished product.

8.2 When specified in the order, the manufacturer shall furnish a test report certified to be the last completed set of mechanical tests for each stock size in each shipment.