



Designation: A563/A563M – 21a

Standard Specification for Carbon and Alloy Steel Nuts (Inch and Metric)¹

This standard is issued under the fixed designation A563/A563M; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

NOTE—Corrections were made to Table 1 and throughout the standard. The year date was changed on July 26, 2021

1. Scope*

1.1 This specification² covers chemical and mechanical requirements for eleven grades of carbon and alloy steel nuts for general structural and mechanical uses on bolts, studs, and other externally threaded parts.

NOTE 1—See [Appendix X1](#) for guidance on suitable application of nut grades.

1.2 The requirements for any grade of nut may, at the supplier's option, and with notice to the purchaser, be fulfilled by furnishing nuts of one of the stronger grades specified herein unless such substitution is barred in the inquiry and purchase order.

1.3 Terms used in this specification are defined in Terminology [F1789](#) unless otherwise defined herein.

1.4 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.5 *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.*

¹ This specification is under the jurisdiction of ASTM Committee [F16](#) on Fasteners and is the direct responsibility of Subcommittee [F16.02](#) on Steel Bolts, Nuts, Rivets and Washers.

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² For *ASME Boiler and Pressure Vessel Code* applications see related Specification SA – 563 in Section II of that Code.

2. Referenced Documents

2.1 ASTM Standards:³

- [A194/A194M](#) Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
- [A307](#) Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
- [A354](#) Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
- [A394](#) Specification for Steel Transmission Tower Bolts, Zinc-Coated and Bare
- [A449](#) Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
- [A751](#) Test Methods and Practices for Chemical Analysis of Steel Products
- [B695](#) Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
- [F606/F606M](#) Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
- [F812](#) Specification for Surface Discontinuities of Nuts, Inch and Metric Series
- [F1136/F1136M](#) Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
- [F1470](#) Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
- [F1554](#) Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- [F1789](#) Terminology for F16 Mechanical Fasteners
- [F1941/F1941M](#) Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric

³ 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.

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

F2329/F2329M Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

F2833 Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type

F3019/F3019M Specification for Chromium Free Zinc-Flake Composite, with or without Integral Lubricant, Corrosion Protective Coatings for Fasteners

F3125/F3125M Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

F3148 Specification for High Strength Structural Bolt Assemblies, Steel and Alloy Steel, Heat Treated, 144ksi Minimum Tensile Strength, Inch Dimensions

F3393 Zinc-Flake Coating Systems for Fasteners

G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels

2.2 ASME Standards:⁴

ASME B1.1 Unified Screw Threads

ASME B18.2.2 Square and Hex Nuts

ASME B18.2.6 Fasteners for Use in Structural Applications

ASME B18.2.6M Metric Fasteners for Use in Structural Applications

ASME B1.13M Metric Screw Threads-M Profile

2.3 SAE Standard:⁵

SAE J995 Mechanical and Material Requirements for Steel Nuts

3. Ordering Information

3.1 Orders for nuts under this specification shall include the following:

3.1.1 Quantity (number of nuts),

3.1.2 Nominal size and thread series of nuts,

3.1.3 Style of nut (for example, heavy hex),

3.1.4 Grade of nut,

3.1.5 *Coatings or finishes*—If other than plain finish, specify the coating process or finish required, see 4.4 and **Annex A1**.

3.1.6 ASTM designation and year of issue, and

3.1.7 Any special observation or inspection requirements shall be specified at the time of inquiry and at the time of order. See 11.2.

3.1.8 Supplementary or special requirements.

NOTE 2—An example of an ordering description follows: 1000 7/8-9 heavy hex nuts, Grade DH, hot-dip zinc-coated, and lubricated, ASTM A563-XX.

4. Materials and Manufacture

4.1 Steel for nuts shall be made by the open-hearth, basic-oxygen, or electric-furnace process except that steel for Grades A and B nuts may be made by the acid-bessemer process.

4.2 Manufacturing Method:

4.2.1 Nuts may be made cold or hot by forming, pressing, or punching or may be machined from bar stock.

4.2.2 Threads shall be formed by tapping or machining.

4.3 Heat Treatment:

4.3.1 Grades DH, DH3, 10S, and 10S3 nuts shall be heat treated by quenching in a liquid medium from a temperature above the transformation temperature and tempering at a temperature of at least 800 °F or 425 °C.

4.3.2 Grades C, C3, and D nuts made of any steel permitted for these grades may be heat treated by quenching in a liquid medium from a temperature above the transformation temperature and tempering at a temperature of at least 800 °F or 425 °C.

4.4 Coatings and Other Finishes:

4.4.1 Permitted coatings, including supplementary lubrication and nut overlap requirements are provided in **Annex A1**.

4.4.2 When coated fasteners are required, the purchaser shall specify the process and any additional special requirements.

4.4.3 Hot-dip and mechanically deposited zinc threaded components (bolts and nuts) shall be coated by the same process, limited to one process per item with no mixed processes in a lot.

4.4.4 Hot-dip and mechanical deposited zinc and Zn/Al coating overlap allowances are specified in 7.4.

4.5 Lubricant:

4.5.1 Hot-dip and mechanically deposited zinc-coated Grade DH and 10S nuts shall be provided with an additional lubricant which shall be clean and dry to the touch (see Supplementary Requirement S1 to specify lubrication requirements for plain finish nuts).

4.5.2 See Supplementary Requirement S2 for option to specify a dye in the lubricant.

5. Chemical Composition

5.1 Grades A, B, C, D, DH, 8S, and 10S shall conform to the chemical composition specified in **Table 1**.

5.2 Grades C3, DH3, 8S3, and 10S3 shall be weathering steel and conform to the chemical composition specified in **Table 1**. Compositions A or B may be used for grades C3 and 8S3. Optionally, a chemical composition based on a corrosion index may be used provided the steel meets the chemical requirements in **Table 1** column headed “Based on Corrosion Index”. When certifying based on the corrosion index the steel shall have a corrosion index of 6 or greater, as calculated from the heat analysis, and as described in Guide **G101**, using the predictive method based on the data of Larabee and Coburn, or the predictive method based on the data of Townsend. See Guide **G101** for methods of estimating the atmospheric corrosion resistance of low alloy steels.

5.3 If performed, product analysis made on finished nuts representing each lot shall be within 10 % of the value required of the heat analysis. For example heat analysis C 0.30-0.52 = product analysis C 0.27-0.57.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

⁵ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

TABLE 1 Chemical Requirements^A

Nut Grade	A, B, C, 8S		C3, 8S3	D	DH, 10S	DH3, 10S3	
Heat Analysis	Composition %	Composition A %	Composition B %	Based on Corrosion Index ^C	Composition %	Composition %	Based on Corrosion Index ^C
Carbon	0.55 max	0.33-0.40	0.38-0.48	0.30-0.53	0.55 max	0.20-0.55	0.30-0.53
Manganese	...	0.90-1.20	0.70-0.90	0.60 min	0.30 min	0.60 min	0.60 min
Phosphorus, max	0.12	0.035	0.035	0.035	0.04	0.04	0.035
Sulfur, max	0.15 ^D	0.040	0.040	0.040	0.05 ^E	0.05 ^E	0.040
Silicon	^B	0.15-0.35	0.30-0.50	^B	^B	^B	^B
Copper	^B	0.25-0.45	0.20-0.40	0.20-0.60	^B	^B	0.20 min
Nickel	^B	0.25-0.45	0.50-0.80	0.20 ^F min	^B	^B	0.20 min
Chromium [†]	^B	0.45-0.65	0.50-0.75	0.45 min	^B	^B	0.45 min
Vanadium	^B	^B	^B	^B	^B	^B	^B
Molybdenum	^B	^B	0.06 max [†]	0.10 ^F min	^B	^B	0.15 min
Titanium	^B	^B	^B	^B	^B	^B	0.10 ^F min

^A Based on heat analysis. See 5.3 for product analysis requirements.

^B Not specified.

^C See 5.2.

^D For Grades A, B, and 8S a sulfur content of 0.23 % max is acceptable with the purchasers approval.

^E For Grades D, DH, and 10S a sulfur content of 0.05 – 0.15 % is acceptable provided the manganese is 1.35 % min.

^F Either Nickel or Molybdenum must be present in the amount specified.

[†] Editorially corrected in July 2021.

5.4 Resulfurized or rephosphorized steel, or both, are not subject to rejection based on product analysis for sulfur or phosphorus.

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

5.6 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology A751.

6. Mechanical Properties

6.1 Hardness:

6.1.1 Nuts shall conform to the hardness in Table 2.

6.1.2 Jam nuts, slotted nuts, nuts smaller in width across flats or thickness than standard hex nuts (7.1), and nuts that would require a proof load in excess of 160 000 lbf may be furnished on the basis of minimum hardness requirements specified for the grade in Table 2, unless proof load testing is specified in the inquiry and purchase order.

6.2 Proof Load:

6.2.1 Nuts of each grade, except those listed in 6.1.2, shall withstand the proof load stress specified for the grade, size, style, thread series, and surface finish of the nut in Table 2, Table 3, and Table 4.

6.2.2 Nuts overtapped to accommodate coating thickness in accordance with 7.4 shall be proof load tested after coating and overtapping.⁶

6.2.3 Proof load testing shall be performed by the manufacturer on all grades having a specified proof load up to 160 000 lbf or 705 kN. Unless Supplementary Requirement S5 is invoked in the purchase order or contract, nuts having specified proof load greater than 160 000 lbf or 705 kN shall be proof load tested or cross-sectional hardness tested by the manufacturer in accordance with Test Methods F606/F606M. In all

⁶ Rotational capacity test procedures, nut rotations, and acceptance criteria are a function of the bolt with which the nuts will be used. When required, they are covered by the applicable bolt specification.

cases, proof load testing shall take precedence over hardness testing in the event a conflict exists relative to minimum strength.

7. Dimensions

7.1 Unless otherwise specified, nuts shall be plain (uncoated). Inch nuts shall conform to the dimensions specified in ASME B18.2.2. Heavy Hex Inch Nuts for use in structural applications in Grades C, C3, D, DH, and DH3 shall conform to the dimensions specified in ASME B18.2.6. Metric structural nuts shall conform to the dimensions specified in ASME B18.2.6M.

7.2 Hex-slotted nuts over 1½ to 2 in. inclusive shall have dimensions conforming to ASME B18.2.2 calculated using the formulas for the ¼ through 1½-in. size range in Appendix A (Formulas for Nut Dimensions) of ASME B18.2.2.

7.3 Threads: Plain (Uncoated) Nuts

7.3.1 Unless otherwise specified, inch threads shall conform to the dimensions for coarse threads with Class 2 B tolerances specified in ASME B1.1. Metric threads shall conform to the dimensions for coarse series threads with Class 6H tolerances specified in ASME B1.13M.

7.4 Threads: Nuts Hot Dip and mechanically Zinc Coated and Zn/Al Coated:

7.4.1 Nuts to be used on bolts with Class 2A threads before hot-dip zinc coating, and then hot-dip zinc coated in accordance with Specification F2329/F2329M, shall be overtapped after coating, to the minimum and maximum thread dimensions in Table 5. The major and minor diameters shall also be increased by the allowance to provide the corresponding minimum and maximum major and minor diameters. When specified by the purchaser, lower overlap values are permitted as long as it is sufficient to permit free assembly with hot-dip zinc coated bolts.

7.4.2 Nuts to be used on bolts with Class 2A threads before mechanical deposited zinc coating and then mechanical deposited zinc coated in accordance with Specification B695 Class