Designation: A563 – 15

Standard Specification for Carbon and Alloy Steel Nuts[1]

This standard is issued under the fixed designation A563; 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.

1. Scope*

1.1 This specification[2] covers chemical and mechanical requirements for eight 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 Grades C3 and DH3 nuts have atmospheric corrosion resistance and weathering characteristics comparable to that of the steels covered in Specifications A242/A242M, A588/A588M, and A709/A709M. The atmospheric corrosion resistance of these steels is substantially better than that of carbon steel with or without copper addition (see 5.2). When properly exposed to the atmosphere, these steels can be used bare (uncoated) for many applications.

NOTE 2—A complete metric companion to Specification A563 has been developed—A563M; therefore, no metric equivalents are presented in this specification.

1.4 Terms used in this specification are defined in Terminology F1789 unless otherwise defined herein.

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

A242/A242M Specification for High-Strength Low-Alloy Structural Steel

A307 Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

A325 Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum 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

A490 Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

A563M Specification for Carbon and Alloy Steel Nuts (Metric)

A588/A588M Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance

A687 Specification for High-Strength Nonheaded Steel Bolts and Studs (Withdrawn 1999)[4]

A709/A709M Specification for Structural Steel for Bridges

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

B695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel

D3951 Practice for Commercial Packaging

F606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric) F0606_F0606M

F812/F812M Specification for Surface Discontinuities of Nuts, Inch and Metric Series

F1789 Terminology for F16 Mechanical Fasteners

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

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

[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.

[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.

[4] The last approved version of this historical standard is referenced on www.astm.org.

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

2.2 *ANSI Standards:*
ANSI B1.1 Unified Screw Threads[5]
ANSI B18.2.2 Square and Hex Nuts[5]

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 *Zinc Coating*—Specify the zinc-coating process required, for example, hot-dip, mechanically deposited, or no preference (see 4.7),

3.1.6 *Other Finishes*—Specify other protective finish if required,

3.1.7 ASTM designation and year of issue, and

3.1.8 Supplementary or special requirements.

NOTE 3—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 O, A, and B nuts may be made by the acid-bessemer process.

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

4.3 Grades DH and DH3 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.

4.4 Grades C and D nuts made of steel having carbon content not exceeding 0.20 %, phosphorus not exceeding 0.04 %, and sulfur not exceeding 0.05 % by heat analysis may be heat treated by quenching in a liquid medium from a temperature above the transformation temperature and need not be tempered. When this heat treatment is used, there shall be particular attention to the requirements in 6.1.1.

4.5 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.

4.6 Threads shall be formed by tapping or machining.

4.7 *Zinc Coatings, Hot-Dip and Mechanically Deposited:*

4.7.1 When zinc-coated fasteners are required, the purchaser shall specify the zinc coating process, for example, hot-dip, mechanically deposited, or no preference.

4.7.2 When hot-dip is specified, the fasteners shall be zinc-coated by the hot-dip process in accordance with the requirements of Specification F2329.

4.7.3 When mechanically deposited is specified, the fasteners shall be zinc coated by the mechanical deposition process in accordance with the requirements of Class 55 of Specification B695.

4.7.4 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification F2329, or a mechanically deposited zinc coating in accordance with Specification B695, Class 55. Threaded components (bolts and nuts) shall be coated by the same zinc-coating process and the supplier's option is limited to one process per item with no mixed processes in a lot.

4.7.5 Hot-dip zinc-coated nuts shall be tapped after zinc coating.

4.7.6 Mechanically deposited zinc-coated nuts for assembly with mechanically deposited zinc-coated bolts shall be tapped oversize prior to zinc coating and need not be retapped afterwards.

4.8 *Lubricant:*

4.8.1 Hot-dip and mechanically deposited zinc-coated Grade DH 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).

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

5. Chemical Composition

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

5.2 Grades C3 and DH3 shall conform to the chemical composition specified in Table 2. See Guide G101 for methods of estimating the atmospheric corrosion resistance of low alloy steels.

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

5.4 Application of heats of steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted for Grades D, DH, and DH3.

TABLE 1 Chemical Requirements for Grades O, A, B, C, D, and DH Nuts

Grade of Nut	Composition, %				
	Analysis	Carbon	Manganese, min	Phosphorus, max	Sulfur, max
O, A, B, C	heat	0.55 max	...	0.12	0.15[A]
	product	0.58 max	...	0.13[B]	...
D[C]	heat	0.55 max	0.30	0.04	0.05
	product	0.58 max	0.27	0.048	0.058
DH[C]	heat	0.20–0.55	0.60	0.04	0.05
	product	0.18–0.58	0.57	0.048	0.058

[A] For Grades O, A, and B a sulfur content of 0.23 % max is acceptable with the purchasers approval.
[B] Acid bessemer steel only.
[C] For Grades D and DH a sulfur content of 0.05 – 0.15 % is acceptable provided the manganese is 1.35 % min.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

TABLE 2 Chemical Requirements for Grades C3 and DH3 Nuts

Element	Composition, %							
	Classes for Grade C3 Nuts[A]							Grade DH3 Nuts
	N	A	B	C	D	E	F	
Carbon:								
Heat analysis	...	0.33–0.40	0.38–0.48	0.15–0.25	0.15–0.25	0.20–0.25	0.20–0.25	0.20–0.53
Product analysis	...	0.31–0.42	0.36–0.50	0.14–0.26	0.14–0.26	0.18–0.27	0.19–0.26	0.19–0.55
Manganese:								
Heat analysis	...	0.90–1.20	0.70–0.90	0.80–1.35	0.40–1.20	0.60–1.00	0.90–1.20	0.40 min
Product analysis	...	0.86–1.24	0.67–0.93	0.76–1.39	0.36–1.24	0.56–1.04	0.86–1.24	0.37 min
Phosphorus:								
Heat analysis	0.07–0.15	0.040 max	0.06–0.12	0.035 max	0.040 max	0.040 max	0.040 max	0.046 max
Product analysis	0.07–0.155	0.045 max	0.06–0.125	0.040 max	0.045 max	0.045 max	0.045 max	0.052 max
Sulfur:								
Heat analysis	0.050 max	0.050 max	0.050 max	0.040 max	0.050 max	0.040 max	0.040 max	0.050 max
Product analysis	0.055 max	0.055 max	0.055 max	0.045 max	0.055 max	0.045 max	0.045 max	0.055 max
Silicon:								
Heat analysis	0.20–0.90	0.15–0.35	0.30–0.50	0.15–0.35	0.25–0.50	0.15–0.35	0.15–0.35	...
Product analysis	0.15–0.95	0.13–0.37	0.25–0.55	0.13–0.37	0.20–0.55	0.13–0.37	0.13–0.37	...
Copper:								
Heat analysis	0.25–0.55	0.25–0.45	0.20–0.40	0.20–0.50	0.30–0.50	0.30–0.60	0.20–0.40	0.20 min
Product analysis	0.22–0.58	0.22–0.48	0.17–0.43	0.17–0.53	0.27–0.53	0.27–0.63	0.17–0.43	0.17 min
Nickel:								
Heat analysis	1.00 max	0.25–0.45	0.50–0.80	0.25–0.50	0.50–0.80	0.30–0.60	0.20–0.40	0.20 min[B]
Product analysis	1.03 max	0.22–0.48	0.47–0.83	0.22–0.53	0.47–0.83	0.27–0.63	0.17–0.43	0.17 min
Chromium:								
Heat analysis	0.30–1.25	0.45–0.65	0.50–0.75	0.30–0.50	0.50–1.00	0.60–0.90	0.45–0.65	0.45 min
Product analysis	0.25–1.30	0.42–0.68	0.47–0.83	0.27–0.53	0.45–1.05	0.55–0.95	0.42–0.68	0.42 min
Vanadium:								
Heat analysis	...	...	...	0.020 min	...	...	...	...
Product analysis	...	...	...	0.010 min	...	...	...	...
Molybdenum:								
Heat analysis	...	...	0.06 max	...	0.10 max	...	...	0.15 min[B]
Product analysis	...	...	0.07 max	...	0.11 max	...	...	0.14 min
Titanium:								
Heat analysis	...	...	...	...	0.05 max	...	...	...
Product analysis	...	...	...	...	...	...	...	...

[A] C3 nuts may be made of any of the above listed material classes. Selection of the class shall be at the option of the manufacturer.
[B] Nickel or molybdenum may be used.

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

6. Mechanical Properties

6.1 *Hardness:*

6.1.1 The hardness of nuts of each grade shall not exceed the maximum hardness specified for the grade in Table 3.

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 3, 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 3 and Table 4.

6.2.2 Nuts hot dip or mechanically zinc coated in accordance with 4.7.2 or 4.7.3 shall be proof load tested after zinc coating and overtapping.[6]

[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.

7. Dimensions

7.1 Unless otherwise specified, nuts shall be plain (uncoated) and shall conform to the dimensions prescribed in ANSI B18.2.2.

7.2 Hex and hex-slotted nuts over 1½ to 2 in. inclusive shall have dimensions conforming to ANSI B18.2.2 calculated using the formulas for the 1¼ through 1½-in. size range in Appendix III (Formulas for Nut Dimensions) of ANSI B18.2.2.

7.3 *Threads: Plain (Uncoated) Nuts*

7.3.1 Unless otherwise specified, the threads shall conform to the dimensions for coarse threads with Class 2 B tolerances prescribed in ANSI B1.1.

7.4 *Threads: Nuts Hot Dip Zinc Coated* Specification F2329(4.7.2)

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, shall be tapped oversize 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.

7.5 *Threads: Nuts With Other Coatings*

7.5.1 Nuts to be used on bolts mechanically zinc coated or on bolts hot-dip zinc-coated to a specification other than