Designation: A563/A563M – 23

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.

1. Scope*

1.1 This specification[2] covers chemical, mechanical, and dimensional 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.*

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
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

[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, Studs and Nuts.

Current edition approved Dec. 1, 2023. Published January 2024. Originally approved in 1966. Last previous edition approved in 2021 as A563/A563M – 21a[ε1]. DOI: 10.1520/A0563_A0563M-23.

[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.

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

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 Specification for 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 ⅞-9 heavy hex nuts, Grade DH, hot-dip zinc-coated, and lubricated, ASTM A563/A563M–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 overtap 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 zinc coated nuts shall be installed with hot-dip zinc coated bolts. Hot-dip zinc coated nuts and bolts shall be coated per F2329/F2329M.

4.4.4 Mechanically deposited zinc coated nuts shall be installed with mechanically deposited zinc coated bolts. Mechanically deposited zinc coated nuts and bolts shall be coated per B695.

4.4.5 Hot-dip and mechanically deposited zinc and Zn/Al coating overtap allowances are specified in 7.3.

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.

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.

[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	0.20-0.53	0.30-0.53
Manganese	[B]	0.90-1.20	0.70-0.90	0.60 min	0.30 min	0.60 min	0.40 min	0.60 min
Phosphorus, max	0.12	0.035	0.035	0.035	0.04	0.04	0.035	0.035
Sulfur, max	0.15[D]	0.040	0.040	0.040	0.05[E]	0.05[E]	0.040	0.040
Silicon	[B]	0.15-0.35	0.30-0.50	[B]	[B]	[B]	[B]	[B]
Copper	[B]	0.25-0.45	0.20-0.40	0.20-0.60	[B]	[B]	0.20 min	0.20-0.60
Nickel	[B]	0.25-0.45	0.50-0.80	0.20[F] min	[B]	[B]	0.20[F] min	0.20[F] min
Chromium	[B]	0.45-0.65	0.50-0.75	0.45 min	[B]	[B]	0.45 min	0.45 min
Vanadium	[B]	[B]	[B]	[B]	[B]	[B]	[B]	[B]
Molybdenum	[B]	[B]	0.06 max	0.10[F] min	[B]	[B]	0.15[F] min	0.10[F] min
Titanium	[B]	[B]	[B]	[B]	[B]	[B]	[B]	[B]

[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.

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.

6.2 *Proof Load:*

6.2.1 Nuts of each grade, except those listed in 6.2.3, shall withstand the proof load stress specified for the grade, size, style, thread series, and surface finish of the nut in Table 3, Table 4, and Table 5.

6.2.2 Nuts overtapped to accommodate coating thickness in accordance with 7.3 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 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 1¼ through 1½-in. size range in Appendix A (Formulas for Nut Dimensions) of ASME B18.2.2.

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

7.3.1 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 6. The major and minor diameters shall also be

[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.

TABLE 2 Hardness Requirements

Grade of Nut	Nominal Nut Size	Hardness			
		Brinell		Rockwell	
		min	max	min	max
A	#6(0.138) to 4 in.	116	302	B68	C32
B	#6(0.138) to 1 ½ in.	121	302	B69	C32
C and C3	½ to 4 in.	143	352	B78	C38
D	¼ to 4 in.	159	352	B84	C38
DH	#6(0.138) to 4 in.	248	352	C24	C38
DH3	½ to 4 in.	248	352	C24	C38
		Vickers		Rockwell	
		min	max	min	max
8S and 8S3	M12 to M36	188	372	B89	C38
10S and 10S3	M12 to M36	272	372	C26	C38

TABLE 3 Proof Load Requirements

Grade of Nut	Nominal Nut Size, in.	Proof Load Stress, ksi[A,G]			
		Non-Overtapped[B]	Overtapped[B]	Non-Overtapped[B]	Overtapped[B]
		Square		Heavy Square	
A	¼ to 1 ½	90	68	100	75
B[F]	¼ to 1	105	79	133	100
B[F]	1 ⅛ to 1 ½	92	70	116	87
DH	¼ to 1 ½	132	100	165	123
		Hex		Heavy Hex	
A	¼ to 4	90	68	100	75
B[F]	¼ to 1	120	90	133	100
B[F]	1 ⅛ to 1 ½	105	79	116	87
C[C]	½ to 4	130	...	144	...
C3	½ to 4	...	...	144	...
D[C]	¼ to 4	135	...	150	...
DH[D]	¼ to 4	150	115	175	150[E]
DH3	¼ to 4	150	...	175	150[E]
		Hex Thick			
A	¼ to 1 ½	100	75		
B[F]	¼ to 1	133	100		
B[F]	1 ⅛ to 1 ½	116	87		
DH[D]	¼ to 1 ½	175	150		
		Hex Flange			
A	#6 to ¾	90	68		
B[F]	#6 to ¾	120	90		
DH[D]	#6 to ¾	150	115		
		Nuts with UNF, 12 UN, and Finer Pitch Threads			
		Proof Load Stress, ksi[G]			
Grade of Nut	Nominal Nut Size, in.	Non-Overtapped[B]	Overtapped[B]	Non-Overtapped[B]	Overtapped[B]
		Square		Heavy Square	
A	¼ to 1 ½	80	60	90	68
B[F]	¼ to 1	96	72	116	87
B[F]	1 ⅛ to 1 ½	84	63	105	78
DH[D]	¼ to 1 ½	132	99	165	123
		Hex		Heavy Hex	
A	¼ to 4	80	60	90	68
B[F]	¼ to 1	109	82	120	90
B[F]	1 ⅛ to 1 ½	94	70	105	79
C[C]	½ to 4	...	...	...	...
D[C]	¼ to 4	135	...	150	...
DH[D]	¼ to 4	150	115	175	150
		Hex Thick			
A	¼ to 1 ½	90	68		
B[F]	¼ to 1	120	90		
B[F]	1 ⅛ to 1 ½	105	70		
DH[D]	¼ to 1 ½	175	150		
		Hex Flange			
A	#6 to ¾	80	60		
B[F]	#6 to ¾	109	82		
DH[D]	#6 to ¾	150	115		
		Proof Load Stress, MPa[A]			
Grade of Nut	Nominal Nut Size, metric	Non-Overtapped[B]	Overtapped[B]		
		Heavy Hex			
8S and 8S3	M12 to M36	1075	...		
10S and 10S3	M12 to M36	1245	1165[E]		

[A] To determine nut proof load in pounds or Newtons, multiply the appropriate nut proof load stress by the tensile stress area of the thread. Stress areas for UNC, UNF, and 8 UN thread series are given in Table 4. Stress areas for metric threads are given in Table 5.

[B] Non-overtapped nuts are nuts intended for use with externally threaded fasteners which have a plain (nonplated or noncoated) finish or have a plating or coating of insufficient thickness to necessitate overtapping the nut thread per the galvanized requirements in Table 6 to provide assemblability. Overtapped nuts are nuts intended for use with externally threaded fasteners which are hot-dip zinc-coated per 7.3.1, mechanically zinc-coated per 7.3.2, or have a plating or coating of sufficient thickness to necessitate overtapping the nut thread per the galvanized requirements in Table 6 to provide assemblability.

[C] Nuts made in accordance to the requirements of Specification A194/A194M, Grade 2 or Grade 2H, and marked with their grade symbol are acceptable equivalents for Grades C heavy hex and hex and D nuts. When A194/A194M zinc-coated inch series nuts are supplied, the zinc coating, overtapping, and lubrication shall be in accordance with the requirements of this specification. Rotational Capacity test procedures, nut rotations, and acceptance criteria are a function of the bolt with which the nuts will be used. When required, testing for the assembly in which the nut is used shall be in accordance with the applicable bolt specification.

[D] Nuts made in accordance with the requirements of Specification A194/A194M, Grade 2H, and marked with its grade symbol are an acceptable equivalent for Grade DH nuts. When A194/A194M zinc-coated inch series nuts are supplied, the zinc coating, overtapping, and lubrication shall be in accordance with the requirements with this specification. Rotational Capacity test procedures, nut rotations, and acceptance criteria are a function of the bolt with which the nuts will be used. When required, testing for the assembly in which the nut is used shall be in accordance with the applicable bolt specification.

[E] Grade DH and DH3 heavy hex overtapped nuts intended to be used with Specification F3125/F3125M 150 ksi bolts or equivalent shall be proof load tested at 175 ksi. Metric 10S or 10S3 heavy hex overtapped nuts intended to be used with Specification F3125/F3125M 1040 MPa bolts or equivalent shall be proof load tested at 1245 MPa. When overtapped nuts will be used with 150 ksi bolts or equivalent, proof load requirements for overtapped nuts shall be specified by the purchaser in the inquiry and purchase order.

[F] Nuts made in accordance with the requirements of SAE J995 Grade 5 and marked with its grade symbol are an acceptable equivalent for Grade B nuts.

[G] The proof load for jam nuts shall be 60 % of the full size value listed. The proof load for slotted nuts shall be 80 % of the full size value listed.

TABLE 4 Tensile Stress Areas—Inch

Nominal Size–Threads per Inch	UNC Tensile Stress Area,[A] A_s in.^{2}	Nominal Size-Threads per Inch	UNF Tensile Stress Area[A] A_s in.^{2}	Nominal Size–Threads per Inch	8 UN Tensile Stress Area,[A] A_s in.^{2}
#6–32	0.00909	#6–40	0.01015		
#8–32	0.0140	#8–36	0.01474		
#10–24	0.0175	#10–32	0.0200		
#12–24	0.0242	#12–28	0.0258		
¼ –20	0.0318	¼ –28	0.0364	...	...
5⁄16 –18	0.0524	5⁄16 –24	0.0580	...	...
3⁄8 –16	0.0775	3⁄8 –24	0.0878	...	...
7⁄16 –14	0.1063	7⁄16 –20	0.1187	...	...
½ –13	0.1419	½ –20	0.1599	...	...
9⁄16 –12	0.182	9⁄16 –18	0.203	...	...
5⁄8 –11	0.226	5⁄8 –18	0.256	...	...
¾ –10	0.334	¾ –16	0.373	...	...
7⁄8 –9	0.462	7⁄8 –14	0.509	...	...
1–8	0.606	1–12	0.663	1–8	0.606
1⅛ –7	0.763	1⅛ –12	0.856	1⅛ –8	0.790
1¼ –7	0.969	1¼ –12	1.073	1¼ –8	1.000
1⅜ –6	1.155	1⅜ –12	1.315	1⅜ –8	1.233
1½ –6	1.405	1½ –12	1.581	1½ –8	1.492
1¾ –5	1.90	...	...	1¾ –8	2.08
2–4½	2.50	...	...	2–8	2.77
2¼ –4½	3.25	...	...	2¼ –8	3.56
2½ –4	4.00	...	...	2½ –8	4.44
2¾ –4	4.93	...	...	2¾ –8	5.43
3–4	5.97	...	...	3–8	6.51
3¼ –4	7.10	...	...	3¼ –8	7.69
3½ –4	8.33	...	...	3½ –8	8.96
3¾ –4	9.66	...	...	3¾ –8	10.34
4–4	11.08	...	...	4–8	11.81

[A] A_s The inch stress area is calculated as follows:
$A_s = 0.7854\,(D - (0.9743/n))^2$
where: A_s = stress area, in.^{2}, D = nominal size, (in.), and n = threads per in.

TABLE 5 Tensile Stress Areas - Metric

Nominal size and thread pitch	Tensile stress area[A] A_s, mm^2
M12×1.75	84.3
M16×2.0	157
M20×2.5	245
M22×2.5	303
M24×3.0	353
M27×3.0	459
M30×3.5	561
M36×4.0	817

[A] A_s the metric stress area is calculated as follows:
$A_s = 0.7854\,(D - 0.9382P)^2$
where: A_s = Stress Area (mm^2), D = Nominal Nut Size (mm) , and P = thread pitch (mm)

increased by the allowance to provide the corresponding minimum and maximum major and minor diameters. When specified by the purchaser, lower overtap values are permitted as long as it is sufficient to permit free assembly with hot-dip zinc coated bolts.

7.3.2 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 50 and higher shall be overtapped prior to zinc coating to the minimum and maximum dimensions in Table 6. 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 overtap values are permitted as long as it is sufficient to permit free assembly with mechanically deposited zinc coated bolts.

7.3.3 Zn/Al coated nuts to be used with Zn/Al coated F3125/F3125M bolts shall be overtapped prior to zinc coating to the minimum and maximum dimensions in Table 6. 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 overtap values are permitted as long as it is sufficient to permit free assembly with Zn/Al coated bolts.

NOTE 3—It is the intent of this specification that coated nuts and bolts assemble freely when ordered together. It is recognized that the batch nature of the coating process and the cumulative effect of coating thickness may create intermittent assembly problems. Staying within the material limits is important for assembly strength. Users are encouraged to use the smallest nut overtap amount which permits consistent free assembly.

7.4 *Threads: Nuts With Other Coatings*

7.4.1 Nuts to be used on bolts mechanically zinc coated or on bolts hot-dip zinc-coated to a specification other than Specification F2329/F2329M, or otherwise hot-dip coated, shall be overtapped by a diametral amount sufficient to permit assembly on the coated bolt thread, unless other requirements are specified in the inquiry or purchase order.

7.4.2 When specifically permitted by the purchaser, nuts for bolts with electrodeposited coating, such as cadmium, zinc, and so forth, or with chemically applied coating may be overtapped by a diametral amount sufficient to permit assembly on the coated bolt thread.

7.4.3 The allowable overtap amount shall not exceed that specified in Table 6.

8. Testing Lot and Control

8.1 *Testing Responsibility:*

8.1.1 Each lot shall be tested by the manufacturer prior to shipment in accordance with the lot control and identification quality assurance plan in 8.2 – 8.5.

8.1.2 When supplied by a source other than the manufacturer, the responsible party shall assure all tests have been performed and the nuts conform to this specification.

8.2 Nuts shall be processed in accordance with a lot control and identification quality assurance plan. The manufacturer, secondary processors, and distributors shall identify and maintain the integrity of each production lot from raw material through all processing operations to final packing and shipment. Each lot shall be assigned a unique lot identification number, each lot shall be tested, and the lot inspection test reports retained.

8.3 Secondary processing shall maintain lot integrity and shall be traceable to the original lot at time of manufacture.

8.4 A lot shall be a quantity of uniquely identified nuts of the same nominal size produced consecutively at the initial operation from a single mill heat of material and processed at one time, by the same process, in the same manner so that statistical sampling is valid.

NOTE 4—The purpose of a lot inspection and control program is to ensure that each lot conforms to this specification and that lot integrity is maintained to the point of use. It is essential that secondary processors,

TABLE 6 Thread Dimensions and Overtapping Allowances for Coated Nuts

Nominal Nut Size, in. and Pitch	Galvanized F2329/F2329M/B695 Diametral Allowance, in.[A]	Galvanized F2329/F2329M/B695 Pitch Diameter, in. min	Galvanized F2329/F2329M/B695 Pitch Diameter, in. max	Zn/Al Coatings F3393[B] Diametral Allowance, in.[A]	Zn/Al Coatings F3393[B] Pitch Diameter, in. min	Zn/Al Coatings F3393[B] Pitch Diameter, in. max
0.250-20	0.016	0.2335	0.2384			
0.312-18	0.017	0.2934	0.2987			
0.375-16	0.017	0.3514	0.3571			
0.437-14	0.018	0.4091	0.4152			
0.500-13	0.018	0.4680	0.4745	0.009	0.4590	0.4655
0.562-12	0.020	0.5284	0.5352			
0.625-11	0.020	0.5860	0.5932	0.010	0.5760	0.5832
0.750-10	0.020	0.7050	0.7127	0.010	0.6950	0.7027
0.875-9	0.022	0.8248	0.8330	0.011	0.8138	0.8220
1.000-8	0.024	0.9428	0.9516	0.012	0.9308	0.9396
1.125-8	0.024	1.0678	1.0768			
1.125-7	0.024	1.0562	1.0656	0.012	1.0442	1.0536
1.250-8	0.024	1.1928	1.2020			
1.250-7	0.024	1.1812	1.1908	0.012	1.1692	1.1888
1.375-8	0.027	1.3208	1.3301			
1.375-6	0.027	1.2937	1.3041	0.014	1.2807	1.2911
1.500-8	0.027	1.4458	1.4553			
1.500-6	0.027	1.4187	1.4292	0.014	1.4057	1.4162
1.750-5	0.050	1.6701	1.6817			
2.000-4.5	0.050	1.9057	1.9181			
2.250-4.5	0.050	2.1557	2.1683			
2.500-4	0.050	2.3876	2.4011			
2.750-4	0.050	2.6376	2.6513			
3.000-4	0.050	2.8876	2.9015			
3.250-4	0.050	3.1376	3.1517			
3.500-4	0.050	3.3876	3.4019			
3.750-4	0.050	3.6376	3.6521			
3.750-4	0.050	3.6376	3.6521			
4.000-4	0.050	3.8876	3.9023			
Nominal Nut Size, in. and Pitch	Diametral Allowance, µm.[A]	Pitch Diameter, mm min	Pitch Diameter, mm max	Diametral Allowance, µm[A]	Pitch Diameter, mm min	Pitch Diameter, mm max
M12×1.75	365	11.228	11.428	230	11.093	11.293
M16×2	420	15.121	15.333	250	14.951	15.163
M20×2.5	530	18.906	19.130	250	18.626	18.850
M22×2.5	530	20.906	21.130	280	20.656	20.880
M24×3	640	23.141	22.956	300	22.351	22.616
M27×3	640	25.691	25.956	300	25.351	25.616
M30×3.5	750	28.477	28.757	350	28.077	28.357
M36×4	860	34.262	34.562	350	33.752	34.052

[A] These allowances also apply to the minimum and maximum major and minor diameters.
[B] Zn/Al allowances apply to nuts used with F3125/F3125M bolts. Guidance for other applications is provided in F3393.

distributors, and users maintain lot identification and integrity until installation.

8.5 *Number of Tests:*

8.5.1 The minimum number of tests required from each lot shall be in accordance with Practice F1470. These tests and sample numbers are for final inspection only and shall be in addition to the manufacturer's established internal quality control system and in-process inspection procedures.

8.5.2 Disposition of non-conforming product shall be in accordance with Practice F1470.

NOTE 5—Section 8.5.1 is intended to identify a statistically large number of non-conformances but does not assure 100 % freedom from non-conforming product.

9. Test Methods

9.1 Tests shall be conducted in accordance with Test Methods F606/F606M.

10. Test Report

10.1 When specified on the inquiry and purchase order, the manufacturer or supplier, whichever is the responsible party, as defined in Section 14, shall furnish the purchaser a test report that includes the following, as applicable.

10.2 *Information:*

10.2.1 Lot number.

10.2.2 Purchase order number, job number, sequence number, or other special identifiers if specified.

10.2.3 Mailing address of responsible party.

10.2.4 Title and signature of the individual assigned test report responsibility.

10.2.5 Date and ASTM standard, including revision number.

10.3 *Results*—Report results of all required tests.

10.3.1 Heat analysis, heat number, and calculated Corrosion Index for Type 3 material if not from Composition A or B.

10.3.2 Results of hardness and proof load tests.

10.3.3 Results of coating thickness for coated nuts; if required.

10.3.4 Results of inspection for surface discontinuities.

10.4 *Statements:*

10.4.1 Statement of conformance with dimensional and thread fit requirements.

10.4.2 Statement certifying that steel heats having the elements listed in 5.5 intentionally added were not used.

11. Other Quality Assurance Requirements

11.1 *Workmanship:*

11.1.1 The allowable limits, inspection, and evaluation of surface discontinuities shall be in accordance with Specification F812.

11.2 *Special Inspection:*

11.2.1 If observation or inspection is required by the purchaser, it shall be specified in the inquiry and order. Such observation or inspection requirements shall be specified and agreed upon by all parties.

11.2.2 The purchaser's representative shall have free entry to all parts of the manufacturer's or subcontractor's works, or supplier's place of business that concern the manufacture or supply of the material ordered.

11.2.3 The manufacturer or supplier shall afford the purchaser's representative all reasonable facilities to satisfy them that the material is being furnished in accordance with this specification.

11.2.4 All tests and inspections required by the purchaser's representative shall be made before shipment, and conducted so as not to interfere unnecessarily with the operation.

11.3 *Rejection and Rehearing:*

11.3.1 Disposition of nonconforming nuts shall be in accordance with Practice F1470 section titled "Disposition of Nonconforming Lots".

12. Product Marking

12.1 Nuts made to the requirements of Grades A and B are not required to be marked unless individual marking is specified in the inquiry and order. When individual marking is required, the mark shall be the grade letter symbol on one face of the nut.

12.2 Heavy hex nuts made to the requirements of Grade C (Note 6) shall be marked on one face with three circumferential marks 120° apart.

12.3 Heavy hex nuts made to the requirements of Grade C3 shall be marked on one face with three circumferential marks 120° apart and the numeral 3. In addition, the manufacturer may add other distinguishing marks indicating that the nut is atmospheric corrosion resistant and of a weathering type.

12.4 Nuts made to the requirements of Grade D shall be marked with the grade symbol, D (Note 6) on one face.

12.5 Nuts made to the requirements of Grade DH shall be marked with the grade symbol, DH (Note 6) on one face.

12.6 Heavy hex nuts made to the requirements of Grade DH3 shall be marked with the grade symbol DH3 on one face. Hex nuts made to the requirements of DH3 shall be marked with the symbol HX3 on one face. In addition, the manufacturer may add other distinguishing marks indicating that the nut is atmospheric corrosion resistant and of a weathering type.

12.7 Heavy hex nuts made to the requirements of Grade 8S shall be marked with the grade symbol, 8S (Note 6) on one face.

12.8 Heavy hex nuts made to the requirements of Grade 8S3 shall be marked with the grade symbol 8S3 on one face. In addition, the manufacturer may add other distinguishing marks indicating that the nut is atmospheric corrosion resistant and of a weathering type.

12.9 Heavy hex nuts made to the requirements of Grade 10S shall be marked with the grade symbol, 10S (Note 6) on one face.

12.10 Heavy hex nuts made to the requirements of Grade 10S3 shall be marked with the grade symbol 10S3 on one face. In addition, the manufacturer may add other distinguishing marks indicating that the nut is atmospheric corrosion resistant and of a weathering type.

12.11 In addition, nuts of Grades C, C3, D, DH, DH3, 8S, 8S3, 10S, and 10S3 shall be marked with a symbol to identify the manufacturer or private label distributor, as appropriate.

12.12 Marks may be raised or depressed at the option of the manufacturer. However, for nuts that do not have a washer face, markings shall be depressed. For nuts with a washer face, markings shall be located on the opposite side of the washer face.

12.13 Grade and manufacturer's or private label distributor's identification shall be separate and distinct. The two identifications shall preferably be in different locations and, when on the same level, shall be separated by at least two spaces.

NOTE 6—See Table 3 for marking of equivalent nuts made in accordance with requirements of Specification A194/A194M.

13. Packaging and Package Marking

13.1 *Packaging:*

13.1.1 Unless otherwise specified, packaging shall be in accordance with the manufacturers practice to prevent damage before and during shipment.

13.1.2 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

13.2 *Package Marking:*

13.2.1 Each shipping unit shall include or be plainly marked with the following information:

13.2.1.1 ASTM designation and grade,

13.2.1.2 Size,

13.2.1.3 Name and brand or trademark of the manufacturer,

13.2.1.4 Number of pieces,

13.2.1.5 Purchase order number, and

13.2.1.6 Country of origin.

14. Responsibility

14.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

15. Keywords

15.1 alloy steel; carbon steel; nuts; steel; weathering steel

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirement shall be applied only when specified by the purchaser on the contract or order. Details of these supplementary requirements shall be agreed upon in writing between the manufacturer and purchaser. This supplementary requirement shall in no way negate any requirement of the specification itself.

S1. Supplementary Lubricant Requirements for Nuts

S1.1 Nuts, regardless of specified finish, shall be provided with an additional lubricant that shall be clean and dry to the touch.

S2. Lubricant Dye

S2.1 In addition to the requirements of Supplementary Requirement S1, the lubricant shall have a contrasting color so that its presence is visually obvious.

S3. Lubricant Placement

S3.1 The lubricant shall be applied to specified surfaces on the nuts, such as (*1*) principally only those portions which are threaded, or (*2*) on threaded portions and either only one bearing face or both bearing faces, as required, or (*3*) such other specific lubricant placement criteria as are agreed to between the purchaser and the user.

S4. Nuts used with A394 hot-dipped zinc-coated Transmission Tower Bolts

S4.1 Hot dip zinc-coated nuts shall be hot-dip zinc-coated in accordance with the requirements of Specification F2329/F2329M, except the minimum average weight (thickness) of zinc coating shall be 1.65 oz/ft^2 (0.0028 in.) and the minimum weight of zinc coating on any one item shall be 1.50 oz/ft^2 (0.0025 in.).

S5. Proof Load Testing of Large Nuts

S5.1 Proof load testing of nuts requiring proof loads of over 160 000 lbf or 705 kN is required. Testing shall be performed in accordance with 6.2 and shall be able to withstand the proof load stress specified for grade, size, style, thread series, and surface finish of the nut in Table 3. The maximum load will be based entirely on the equipment available.

ANNEX

(Mandatory Information)

A1. COMMONLY APPLIED COATINGS

A1.1 This annex provides guidance for the selection of protective coatings for carbon and alloy steel nuts. Table A1.1 is a listing of commonly applied coatings for steel nuts and is not intended to be an all-inclusive list. Other coatings may be used if the purchaser is confident the fastener performance will not be compromised. Overtap requirements for Hot dip and mechanically deposited zinc and Zn/Al coatings are listed in 7.3.

TABLE A1.1 Commonly Applied Coatings

Coating Type	Specification	Grade or Class	Classification Codes[A] Corrosion	Appearance	Coefficient of Friction
Hot-dip zinc	F2329/F2329M	0.002 in. (50 µm)	– – –	– – –	– – –
Mechanically deposited zinc	B695	Class 55	– – –	– – –	– – –
Zn/Al Coating	F3393[B]	– – –	D	1	R
Zinc Electroplate	F1941/F1941M	Fe/Zn 5AN Fe/Zn 5C	– – –	– – –	– – –

[A] Classification Code applies to F3393 Zn/Al Coatings.
[B] Specification F3393 is a consolidation and replacement of three ASTM standards which included qualified coatings F1136/F1136M Grade 5, F2833 Grade 1, and F3019/F3019M Grade 4.

APPENDIX

(Nonmandatory Information)

X1. INTENDED APPLICATION

X1.1 Table X1.1 gives additional information for the intended application of nuts.

X1.2 Grades C3, DH3, 8S3, and 10S3 nuts are manufactured using weathering steel. 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.

TABLE X1.1 Nut and Bolt Suitability Guide

Grade of Bolt[D]	Surface Finish[E]	Nominal Size, in.	Grade and ASME Nut Style[A]					
			Recommended[B]		Suitable[C]			
			Hex	Heavy Hex	Square	Hex	Heavy Hex	Hex Thick
A307 Grade A	non-zinc-coated and zinc-coated	¼ to 1½	**A**	...	A	B, D, DH	A, B, C, D, DH, DH3	A, B, D, DH
		>1½ to 2	...	**A**	...	A[F]	C, D, DH, DH3	...
		>2 to 4	...	**A**	...	...	C, D, DH, DH3	...
A307 Grade B	non-zinc-coated and zinc-coated	¼ to 1½	...	**A**	A	B, D, DH	B, C, D, DH, DH3	A, B, D, DH
		>1½ to 2	...	**A**	...	A[F]	C, D, DH, DH3	...
		>2 to 4	...	**A**	...	...	C, D, DH, DH3	...
F3125/F3125M Grades A325/ F1852 Type 1	non-zinc-coated	½ to 1½	...	**C**	...	...	C3, D, DH, DH3	...
	zinc-coated	½ to 1½	...	**DH**	...	...	DH3	...
F3125/F3125M/ Grades A325/ F1852 Type 3	non-zinc-coated	½ to 1½	...	**C3**	...	...	DH3	...
A354 Grade BC	non-zinc-coated	¼ to 1½	...	**C**	...	D, DH	C3, D, DH, DH3	D, DH
		>1½ to 4	...	**C**	...	...	C3, D, DH, DH3	...
	zinc-coated	¼ to 1½	...	**DH**	...	...	...	DH
		>1½ to 4	...	**DH**	...	...	...	...
A354 Grade BD	non-zinc-coated	¼ to 1½	...	**DH**	...	DH	D, DH, DH3	D, DH
		>1½ to 4	...	**DH**	...	...	DH3	...
	zinc-coated	¼ to 1½		**DH**	...	DH	D, DH, DH3	D, DH
		>1½ to 4	...	**DH**	...	...	DH3	...
A394 Type 0	zinc-coated	½ to 1	**A**	...	...	B, D	...	...
A394 Type 1	zinc-coated	½ to 1	**DH**	...	...	D	...	...
A394 Type 3	non-zinc-coated	½ to 1	**DH3**	...	...	...	C3	...
A449 Type 1	non-zinc-coated	¼ to 1½	**B**	...	...	D, DH	B, C, C3, D, DH, DH3	B, D, DH
		>1½ to 3	...	**A**	...	...	C, C3, D, DH, DH3	...
	zinc-coated	¼ to 1½	...	**DH**	...	D, DH	D	D, DH
		>1½ to 3	...	**DH**	...	...	D	...
F3125/F3125M Grades A490/ F2280 Type 1	non-zinc-coated	½ to 1½	...	**DH**	...	...	DH3	...
	zinc-coated	½ to 1½	...	**DH**	...	...	DH3	...
F3125/F3125M Grades A490/ F2280 Type 3	non-zinc-coated	½ to 1½	...	**DH3**	...	...	...	...
F3125/F3125M Grade A325M Type 1	non-zinc-coated	M12 to M36	...	**8S**	...	...	8S3, 10S, 10S3	...
	zinc-coated	M12 to M36	...	**10S**	...	...	10S3	...
F3125/F3125M Grades A325M Type 3	non-zinc-coated	M12 to M36	...	**8S3**	...	...	10S3	...
F3125/F3125M Grade A490M Type 1	non-zinc-coated	M12 to M36	...	**10S**	...	...	10S3	...
	zinc-coated	M12 to M36	...	**10S**	...	...	10S3	...

TABLE X1.1 *Continued*

Grade of Bolt[D]	Surface Finish[E]	Nominal Size, in.	Grade and ASME Nut Style[A]					
			Recommended[B]		Suitable[C]			
			Hex	Heavy Hex	Square	Hex	Heavy Hex	Hex Thick
F3125/F3125M Grade A490M Type 3	non-zinc-coated	M12 to M36	...	**10S3**	...	...	...	...
F3148 Type 1	non-zinc-coated	½ to 1¼	...	**DH**	...	...	**DH3**	
	zinc-coated	½ to 1¼	...	**DH**	...	...	**DH3**	
F3148 Type 3	non-zinc-coated	½ to 1¼	...	**DH3**	...	...	...	...
F1554 Grade 36	Plain	½ to 1½	**A**	...	...	B,C,D,DH	A,B,C,C3,D,DH, DH3	...
		Over 1½	...	**A**			B,C,C3,D,DH, DH3	
	zinc-coated	½ to 1½	**A**	...	...	B,C,D,DH	A,B,C,D,DH	...
		Over 1½	...	**A**			B,C,D,DH	
F1554 Grade 55	Plain	½ to 1½	**A**	...	...	B,C,D,DH	A,B,C,C3,D,DH, DH3	...
		Over 1½		**A**			B,C,C3,D,DH, DH3	
	zinc-coated	½ to 1½	...	**A**	...	...	B,C,D,DH	...
		Over 1½		**A**			B,C,D,DH	
F1554 Grade 105	Plain zinc-coated	All	...	**DH**	...	...	**DH3**	...

[A] Nuts made in accordance to the requirements of Specification A194/A194M, Grade 2 or Grade 2H, and marked with their grade symbol are acceptable equivalents for Grades C heavy hex and D nuts. Nuts made in accordance with the requirements of Specification A194/A194M, Grade 2H, and marked with its grade symbol are an acceptable equivalent for Grade DH nuts.

[B] "Recommended" denotes a commercially available nut having the most suitable mechanical properties and dimensional configuration (style) that will make it possible to tension the bolt to the required load when used in combination with the nut.

[C] "Suitable" denotes nuts having mechanical properties that will make it possible to tension the bolt to the required load when used in combination with the nut; but, which require consideration of dimensional configuration (style) suitability and availability. Others are not suitable.

[D] The term "bolt" includes all externally threaded types of fasteners.

[E] Non-zinc-coated nuts are nuts intended for use with externally threaded fasteners, which have a plain (nonplated or noncoated) finish or a have a plating or coating of insufficient thickness to necessitate overtapping the nut thread to provide assembiability. Zinc-coated nuts are nuts intended for use with externally threaded fasteners which are hot-dip zinc-coated, mechanically zinc-coated, or have a plating or coating of sufficient thickness to necessitate overtapping the nut thread to provide assembiability.

[F] Hex nuts in nominal sizes over 1½ to 2 in. inclusive are not covered in the tables of tabulated sizes in ASME B18.2.2 but are commercially available. Such nuts are suitable. See 7.2 for dimensions.

SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue (A563/A563M – 21a[ε1]) that may impact the use of this standard. (Approved Dec. 1, 2023)

(1) Add the word "dimensional" to the Scope in 1.1.

(2) Reworded 4.4.3 to improve clarity and intent, and added 4.4.4 to break up Hot-Dip zinc coated and Mechanically deposited zinc into two different paragraphs.

(3) Removed unneeded space in Table 2[C] .

(4) Note 3 was added to give guidance for assembly of coated nuts and bolts. The language in Note 3 was borrowed from 4.3 of F3125/F3125M to give the reader a better understanding of the cumulative effects coatings may have with the assembly of coated nuts and bolts.

(5) Replaced F1136/F1136M, F2833, and F3019/F3019M with F3393 in Table 6.

(6) Added reference for overtapping applies to Zn/Al nuts used with F3125/F3125M bolts in 7.3.3 (formerly 7.4.3).

(7) Replaced F1136/F1136M, F2833, and F3019/F3019M with combined coating standard F3393 in Table A1.1.

(8) Added Classification Code heading with coating equivalency ratings for the former standards (F1136/F1136M, F2833, and F3019/F3019M) in Table A1.1.

(9) Added[A] to Table A1.1 to add clarity applicability for the Classification Code.

(10) Added[B] to Table A1.1 to add clarity for F3393 applicability.

(11) Table 2 Mechanical Requirements has been separated into Table 2 Hardness Requirements and Table 3 Proof Load Requirements.

(12) Hex flange nuts have been included in the Proof Load table.

(13) Applicable jam and slotted nuts would require a proof load test per 6.2.1.
(14) Added Zn/Al F3393 reference.
(15) Added a reference to Footnote F for Nickel and Molybdenum in Table 1 under the DH3, 10S3 Composition % heading.