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Standard Specification for Stainless Steel Nuts[1]

This standard is issued under the fixed designation F 594; 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 Department of Defense.

ε[1] NOTE—Table 1 was editorially corrected in October 2001.

1. Scope

1.1 This specification covers the requirements for stainless steel nuts 0.25 to 1.50 in. in nominal diameter inclusive in a number of alloys in common use and intended for service applications requiring general corrosion resistance.

1.2 Seven groups of stainless steel alloys are covered, including ten austenitic, two ferritic, four martensitic, and one precipitation hardening.

Group	Alloys[A]		Condition[B]
1	304, 305, 304L	(CW)	cold worked[D]
	384, XM7[C]		
2	316, 316L	(CW)	cold worked[D]
3	321, 347	(CW)	cold worked[D]
4	430[E]	(CW)	cold worked[D]
5	410[F]	(H)	hardened and tempered
6	431	(H)	hardened and tempered
7	630	(AH)	aged hardened

[A] Unless otherwise specified on the inquiry and order, the choice of an alloy from within a group shall be at the discretion of the fastener manufacturer (see 6.1).
[B] See 4.2 for options.
[C] When approved by the purchaser, alloys 303, 303Se, or XM1 may be furnished.
[D] Sizes 0.75 in. and larger may be hot worked and solution annealed.
[E] When approved by the purchaser, alloy 430F may be furnished.
[F] When approved by the purchaser, alloy 416 or 416Se may be furnished.

1.3 Supplementary requirements of an optional nature are provided, applicable only when agreed upon by the manufacturer and the purchaser at the time of the inquiry and order.

1.4 Suitable bolts, hex cap screws, and studs for use with nuts included in this specification are covered by Specification F 593. Unless otherwise specified, all bolts, hex cap screws, and studs used with these nuts shall conform to the requirements of Specification F 593 and shall be of the same alloy group.

2. Referenced Documents

2.1 *ASTM Standards:*

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels[2]
A 276 Specification for Stainless Steel Bars and Shapes[2]
A 342 Test Methods for Permeability of Feebly Magnetic Materials[3]
A 380 Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems[2]
A 484 Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings[2]
A 493 Specification for Stainless and Heat-Resisting Steel for Cold Heading and Cold Forging Wire[2]
A 555/A 555M Specification for General Requirements for Stainless and Heat-Resisting Steel Wire and Wire Rods[2]
A 564/A 564M Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars, Wire, and Shapes[2]
A 571 Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service[4]
A 582/A 582M Specification for Free-Machining Stainless Steel Bars[2]
A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[2]
D 3951 Practice for Commercial Packaging[5]
E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[6]
E 353 Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys[7]
F 593 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs[8]
F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets[8]
F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection[8]

2.2 *ANSI/ASME Standards:*[9]

[1] This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.04 on Nonferrous Fasteners.

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[2] *Annual Book of ASTM Standards*, Vol 01.03.
[3] *Annual Book of ASTM Standards*, Vol 03.04.
[4] *Annual Book of ASTM Standards*, Vol 01.02.
[5] *Annual Book of ASTM Standards*, Vol 15.09.
[6] *Annual Book of ASTM Standards*, Vol 14.02.
[7] *Annual Book of ASTM Standards*, Vol 03.05.
[8] *Annual Book of ASTM Standards*, Vol 01.08.
[9] Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

B1.1 Unified Inch Screw Threads
B18.2.2 Square and Hex Nuts

NOTE 1—The following ASTM standards are noted for information only as suitable sources of material for the manufacture of nuts to this specification:
Specifications A 493, A 564/A 564M, and A 582/A 582M.

3. Ordering Information

3.1 Orders for nuts under this specification shall include the following:
3.1.1 Quantity (number of pieces of each item and size),
3.1.2 Name of item,
3.1.3 Size (diameter and threads per inch),
3.1.4 Alloy group number (see 6.2.1),
3.1.5 Condition (see 4.2),
3.1.6 Orders for nuts under this specification may include the following optional requirements.
3.1.6.1 Forming (see 4.1.1),
3.1.6.2 Composition (see 6.2),
3.1.6.3 Corrosion resistance (see 8.1),
3.1.6.4 Thread class (see 9.2),
3.1.6.5 Finish (see 10.3),
3.1.6.6 Test report (see 17.2),
3.1.6.7 Rejection (see 16.1),
3.1.6.8 Test rejection (see 16.1), and
3.1.6.9 Special packaging (see 19.2).
3.1.7 Supplementary requirements, if any, to be specified on the order (see S1 through S8), and
3.1.8 ASTM specification and date of issue. When date of issue is not specified, fasteners shall be furnished to the latest issue.

NOTE 2—*Example:* 10 000 pieces, Hex Nut, 0.250 in. −20, Alloy Group 1, Condition CW, Furnish Test Report, Supplementary Requirement S3.

4. Manufacture

4.1 *Manufacture*:
4.1.1 *Forming*—Unless otherwise specified, the nuts shall be hot formed, cold formed, or machined from suitable material, at the option of the manufacturer.
4.2 *Condition*—The fasteners shall be furnished in the following conditions, unless specified to be furnished in one of the optional conditions:

Alloy Group	Condition Furnished Unless Otherwise Specified	Optional Conditions (must be specified)
1, 2, 3	CW	AF, A, SH
4	CW	A
5	H	HT
6	H	HT
7	AH	none

A— Machined from annealed or solution annealed stock thus retaining the properties of the original material; or hot formed and solution annealed.
AF— Annealed after all threading is completed.
AH— Solution annealed and age hardened after forming.
CW— Annealed and cold worked. Sizes 0.75 in. and larger may be hot worked and solution annealed.
H— Hardened and tempered at 1050°F (565°C) minimum.
HT— Hardened and tempered at 525°F (274°C) minimum.
SH— Machined from strain hardened stock.

5. Heat Treatment

5.1 *Alloy Groups 1, 2, and 3 (Austenitic Alloys 303, 303Se, 304, 304L, 305, 316, 316L, 321, 347, 384, XM1, and XM7)* :
5.1.1 *Condition A*—When Condition A is specified, the austenitic alloys shall be heated to 1900 ± 50°F (1038 ± 28°C) at which time the chromium carbide will go into the solution, held for a sufficient time, then cooled at a rate sufficient to prevent precipitation of the carbide and to provide the specified properties.
5.1.2 *Condition CW*—When Condition CW is specified, the austenitic alloys shall be annealed as specified in 5.1.1, then cold worked to develop the specified properties.
5.1.3 *Condition AF*—When Condition AF is specified, the austenitic alloys shall be annealed as specified in 5.1.1 after all cold working including forming and threading.
5.2 *Alloy Group 4 (Ferritic Alloys 430 and 430F)*:
5.2.1 *Condition A*—The ferritic alloys shall be heated to a temperature of 1450 ± 50°F (788 ± 28°C), held for an appropriate time, and then air cooled to provide the specified properties.
5.2.2 *Condition CW*—When Condition CW is specified, the ferritic alloys shall be annealed in accordance with 5.2.1, generally by the raw material manufacturer, then cold worked to develop the specified properties.
5.3 *Alloy Group 5 (Martensitic Alloys 410, 416, and 416Se)*:
5.3.1 *Condition H*—When Condition H is specified, the martensitic alloys 410, 416, and 416Se shall be hardened and tempered by heating to 1850 ± 50°F (1010 ± 28°C) sufficient for austenitization, held for at least ½ h and rapid air- or oil-quenched, then reheating to 1050°F (565°C) minimum for at least 1 h and air cooled, to provide the specified properties.
5.3.2 *Condition HT*—When Condition HT is specified, the martensitic alloys 410, 416, and 416Se shall be hardened and tempered by heating to 1850 ± 50°F (1010 ± 28°C) sufficient for austenitization, held for at least ½ h and rapid air- or oil-quenched then reheating to 525°F (274°C) minimum for at least 1 h and air cooled to provide the specified properties.
5.4 *Alloy Group 6 (Martensitic Alloy 431)*:
5.4.1 *Conditions H and HT*—The martensitic alloy 431 shall be hardened and tempered as specified in 5.3.1 and 5.3.2 as applicable.
5.5 *Alloy Group 7 (Precipitation Hardening Alloy 630)*:
5.5.1 *Condition AH*—The precipitation hardening alloy 630 shall be solution annealed and aged by heating to 1900 ± 25°F (1038 ± 14°C) for at least ½ h and rapid air or oil quenched to 80°F (27°C) maximum, then reheating to a temperature of 1150 ± 15°F (621 ± 8°C) for 4 h and air cooled to provide the specified properties.

6. Chemical Composition

6.1 *Alloy Groups*—It is the intent of this specification that fasteners shall be ordered by alloy group numbers which include alloys considered to be chemically equivalent for general purpose use. The alloy groupings are as shown below. When required, however, a specific alloy may be specified as permitted by 6.2.2.

Alloy Group	Alloys
1	304, 305, 304L 384[A], XM7
2	316, 316L
3	321, 347
4	430[B]
5	410[C]
6	431
7	630

[A]When approved by the purchaser, alloys 303, 303Se, or XM1 may be furnished.
[B]When approved by the purchaser, alloy 430F may be furnished.
[C]When approved by the purchaser, alloys 416 or 416Se may be furnished.

6.2 *Chemical Composition Limits*:

6.2.1 *Ordering by Alloy Group*—Unless otherwise specified on the inquiry and order (see Supplementary Requirement S4), the choice of an alloy from within a group shall be at the discretion of the fastener manufacturer as required by his method of fastener fabrication and material availability. The specific alloy used by the fastener manufacturer shall be clearly identified on any certification required by the order and shall have a chemical composition conforming to the requirements of Table 1 for the specific alloy.

6.2.2 *Ordering by Specific Alloy*—When ordered by a specific alloy number, the fasteners shall conform to the chemical composition limits of Table 1 for the specific alloy.

6.3 *Product Analysis*:

6.3.1 Product analysis may be made by the purchaser from finished nuts representing each lot. The chemical composition thus determined shall conform to the requirements of Table 1 for the specific alloy subject to the Product Analysis Tolerance in Specification A 555/A 555M.

TABLE 1 Chemical Requirements

Alloy Group	UNS Designation	Alloy	Composition, % maximum except as shown									
			Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Copper	Molybdenum	Others
Austenitic Alloys												
1	S30300	303	0.15	2.00	0.20	0.15 min	1.00	17.0 to 19.0	8.0 to 10.0		0.60 max[A]	
1	S30323	303Se	0.15	2.00	0.20	0.060	1.00	17.0 to 19.0	8.0 to 10.0			Se 0.15 min
1	S30400	304	0.08	2.00	0.045	0.030	1.00	18.0 to 20.0	8.0 to 10.5	1.00		
1	S30403	304L	0.03	2.00	0.045	0.030	1.00	18.0 to 20.0	8.0 to 12.0	1.00		
1	S30500	305	0.12	2.00	0.045	0.030	1.00	17.0 to 19.0	10.5 to 13.0	1.00		
1	S38400	384	0.08	2.00	0.045	0.030	1.00	15.0 to 17.0	17.0 to 19.0			
1	S20300	XM1	0.08	5.0 to 6.5	0.040	0.18 to 0.35	1.00	16.0 to 18.0	5.0 to 6.5	1.75 to 2.25	0.50 max[A]	
1	S30430	XM7	0.10	2.00	0.045	0.030	1.00	17.0 to 19.0	8.0 to 10.0	3.0 to 4.0		
2	S31603	316L	0.03	2.00	0.045	0.030	1.00	16.0 to 18.0	10.0 to 14.0		2.00–3.00†	
2	S31600	316	0.08	2.00	0.045	0.030	1.00	16.0 to 18.0	10.0 to 14.0		2.00–3.00	
3	S32100	321	0.08	2.00	0.045	0.030	1.00	17.0 to 19.0	9.0 to 12.0			Ti 5 × C min
3	S34700	347	0.08	2.00	0.045	0.030	1.00	17.0 to 19.0	9.0 to 13.0			Cb + Ta 10 × C min
Ferritic Alloys												
4	S43000	430	0.12	1.00	0.040	0.030	1.00	16.0 to 18.0				
	S43020	430F	0.12	1.25	0.060	0.15 min	1.00	16.0 to 18.0			0.60 max[A]	
Martensitic Alloys												
5	S41000	410	0.15	1.00	0.040	0.030	1.00	11.5 to 13.5				
5	S41600	416	0.15	1.25	0.060	0.15 min	1.00	12.0 to 14.0			0.60 max[A]	
5	S41623	416Se	0.15	1.25	0.060	0.060	1.00	12.0 to 14.0				Se 0.15 min
6	S43100	431	0.20	1.00	0.040	0.030	1.00	15.0 to 17.0	1.25 to 2.50			
Precipitation Hardening Alloy												
7	S17400	630	0.07	1.00	0.040	0.030	1.00	15.0 to 17.5	3.0 to 5.0	3.0 to 5.0		Cb + Ta 0.15–0.45

[A]At manufacturer's option, determined only when intentionally added.
†Editorially corrected.