



Designation: **F 594 – 042**

## Standard Specification for Stainless Steel Nuts<sup>1</sup>

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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

### 1. Scope

1.1 This specification covers the requirements for stainless steel nuts 0.25 to 1.50 in., inclusive, in nominal diameter 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 <sup>A</sup>		Condition <sup>B</sup>
4	<del>304, 305, 304L</del> <del>384, XM7<sup>C</sup></del>	(CW)	<del>cold worked<sup>D</sup></del>
1	<u>304, 305, 304L</u> <u>384, 18-9LW, 302HQ<sup>C</sup></u>	(CW)	<u>cold worked<sup>D</sup></u>
2	316, 316L	(CW)	cold worked <sup>D</sup>
3	321, 347	(CW)	cold worked <sup>D</sup>
4	430 <sup>E</sup>	(CW)	cold worked <sup>D</sup>
5	410 <sup>F</sup>	(H)	hardened and tempered
6	431	(H)	hardened and tempered
7	630	(AH)	aged hardened

<sup>A</sup> 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).

<sup>B</sup> See 4.2 for options.

<sup>C</sup> When approved by the purchaser, alloys 303, 303Se, or XM1 may be furnished.

<sup>D</sup> Sizes 0.75 in. and larger may be hot worked and solution annealed.

<sup>E</sup> When approved by the purchaser, alloy 430F may be furnished.

<sup>F</sup> 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 Inter-

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granular Attack in Austenitic Stainless Steels<sup>2</sup>

A 276 Specification for Stainless Steel Bars and Shapes<sup>2</sup>

A 342/A 342M Test Methods for Permeability of Feebly Magnetic Materials<sup>3</sup>

A 380 Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems<sup>2</sup>

A 484/A 484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings<sup>2</sup>

A 493 Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging<sup>2</sup>

A 555/A 555M Specification for General Requirements for Stainless and Heat-Resisting Steel Wire and Wire Rods<sup>2</sup>

A 564/A 564M Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars, and Shapes<sup>2</sup>

A 571 Specification for Austenitic Ductile Iron Castings for Pressure-Containing Parts Suitable for Low-Temperature Service<sup>4</sup>

A 582/A 582M Specification for Free-Machining Stainless Steel Bars<sup>2</sup>

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products<sup>2</sup>

D 3951 Practice for Commercial Packaging<sup>5</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>6</sup>

E 353 Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys<sup>7</sup>

F 593 Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs<sup>8</sup>

F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets<sup>8</sup>

F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection<sup>8</sup>

2.2 *ASME Standards*:<sup>9</sup>

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), and

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.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 01.03.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.04.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 01.02.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 01.08.

<sup>9</sup> Available from Global Engineering Documents, 15 Inverness Way, East Englewood, CO 80112.

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, 18-9LW, and ~~XM7~~ 302HQ)* :

5.1.1 *Condition A*—When Condition A is specified, the austenitic alloys shall be heated to 1900 ± 50°F (1038 ± 28°C)<sub>2</sub> at which time the chromium carbide will go into the solution, be held for a sufficient time, and then be 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 and 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, and 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 that 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
4	<del>304, 305, 304L</del> <del>384<sup>A</sup>, XM7</del>
1	304, 305, 304L <del>384, 18-9LW, 302HQ<sup>A</sup></del>
2	316, 316L

3	321, 347
4	430 <sup>B</sup>
5	410 <sup>C</sup>
6	431
7	630

<sup>A</sup> When approved by the purchaser, alloys 303, 303Se, or XM1 may be furnished.

<sup>B</sup> When approved by the purchaser, alloy 430F may be furnished.

<sup>C</sup> 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.

6.3.2 In the event of discrepancy, a referee chemical analysis of samples from each lot shall be made in accordance with 14.1.

## 7. Mechanical Properties

7.1 The finished fasteners shall meet the applicable mechanical properties of Table 2 for the specified alloy group and condition when tested in accordance with the mechanical property requirements as specified herein (see also Table 3).

## 8. Corrosion Resistance

### 8.1 Carbide Precipitation:

8.1.1 Rod, bar, and wire in the austenitic Alloy Groups 1, 2, and 3, except the free-machining grades, 303 and 303Se used to make fasteners in accordance with this specification, shall be capable of passing the test for susceptibility to intergranular corrosion as specified in Practice E of Practice A 262.

8.1.2 As stated in Practice A 262, samples may be subjected to the faster and more severe screening test in accordance with Practice A. Failing Practice A, specimens may be tested in accordance with Practice E and be considered satisfactory if passing Practice E.

## 9. Dimensions

### 9.1 Nuts:

9.1.1 Unless otherwise specified, the dimensions shall be in accordance with the requirements of ASME B18.2.2 for Hex Nuts.

9.1.2 When specified, the dimensions of nuts shall be in accordance with the requirements of ASME B18.2.2 (type as specified), or such other dimensions as may be specified.

9.2 *Threads* (see Table 4) —Unless otherwise specified, the nuts shall have Class 2B threads in accordance with ASME B1.1.

## 10. Workmanship, Finish, and Appearance

10.1 *Workmanship*—The nuts shall have a workmanlike finish, free of injurious burrs, seams, laps, irregular surfaces, and other defects affecting serviceability.

10.2 *Surface Finish*—The nuts shall have a surface finish produced in accordance with Practice A 380.

10.3 *Protective Finishes*—Unless otherwise specified, the nuts shall be furnished without an additive chemical or metallic finish.

## 11. Sampling

11.1 A lot, for the purposes of selecting test specimens, shall consist of not more than 100 000 pieces offered for inspection at one time having the following common characteristics:

11.1.1 One type of item,

11.1.2 Same alloy and condition, and

11.1.3 One nominal diameter and thread series.

## 12. Number of Tests and Retests

### 12.1 Number of Tests:

12.1.1 *Mechanical Tests*—The mechanical requirements of this specification shall be met in continuous mass production for stock. The manufacturer shall make sample inspections as specified below to ensure the product conforms to the specified requirements. When tests of individual shipments are required, Supplementary Requirement S1 must be specified in the inquiry and order.

**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												
4	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 <sup>A</sup>	...
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 <sup>A</sup>	...
4	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	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
4	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	S30400	304	0.08	2.00	0.045	0.030	1.00	18.0 to 20.0	8.0 to 10.5	1.00	...	...
4	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	S30403	304L	0.03	2.00	0.045	0.030	1.00	18.0 to 20.0	8.0 to 12.0	1.00	...	...
4	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	S30500	305	0.12	2.00	0.045	0.030	1.00	17.0 to 19.0	10.5 to 13.0	1.00	...	...
4	S38400	384	0.08	2.00	0.045	0.030	1.00	15.0 to 17.0	17.0 to 19.0	...	...	...
1	S38400	384	0.08	2.00	0.045	0.030	1.00	15.0 to 17.0	17.0 to 19.0	...	...	...
4	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 <sup>A</sup>	...
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 <sup>A</sup>	...
4	S30430	XM7	0.03	2.00	0.045	0.030	1.00	17.0 to 19.0	8.0 to 10.0	3.0 to 4.0	...	...
1	S30430	18-9LW	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	...	...
1	S30433	302HQ	0.03	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	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	...
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	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
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	...	...	0.60 max <sup>A</sup>	...
	S43020	430F	0.12	1.25	0.060	0.15 min	1.00	16.0 to 18.0	...	...	0.60 max <sup>A</sup>	...
4	S43000	430	0.12	1.00	0.040	0.030	1.00	16.0 to 18.0	...	...	0.60 max <sup>A</sup>	...
	S43020	430F	0.12	1.25	0.060	0.15 min	1.00	16.0 to 18.0	...	...	0.60 max <sup>A</sup>	...
Martensitic Alloys												
5	S41000	410	0.15	1.00	0.040	0.030	1.00	11.5 to 13.5	...	...	...	...
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 <sup>A</sup>	...
5	S41600	416	0.15	1.25	0.060	0.15 min	1.00	12.0 to 14.0	...	...	0.60 max <sup>A</sup>	...
5	S41623	416Se	0.15	1.25	0.060	0.060	1.00	12.0 to 14.0	...	...	...	Se 0.15 min
5	S41623	416Se	0.15	1.25	0.060	0.060	1.00	12.0 to 14.0	...	...	...	Se 0.15 min

**TABLE 2 Mechanical Property Requirements<sup>A</sup>**

Stainless Alloy Group	Condition <sup>B</sup>	Alloy Mechanical Property Marking	Nominal Diameter, in.	Proof Stress, ksi, min	Rockwell Hardness
Austenitic Alloys					
1 (303, 304, 304L 305, 384, XM1, XM7, XM1, 18–9LW, 303Se) 302HQ, 303Se)	AF	F594A	¼ to 1½, incl	70	B85 max
	A	F594B	¼ to 1½, incl	75	B65 to 95, incl
	CW1	F594C	¼ to ⅝, incl	100	B95 to C 32, incl
	CW2	F594D	¾ to 1½, incl	85	B80 to C 32, incl
	SH1	<del>F594A</del>	<del>¼ to ⅝, incl</del>	<del>420</del>	<del>C24 to C 36, incl</del>
	SH1	F594A	¼ to ⅝, incl	120	C24 to C 36, incl
	SH2	<del>F594B</del>	<del>¾ to 1, incl</del>	<del>440</del>	<del>C20 to C 32, incl</del>
	SH2	F594B	¾ to 1, incl	110	C20 to C 32, incl
	SH3	F594C	1⅞ to 1¼, incl	100	B95 to C 30, incl
	SH4	F594D	1⅞ to 1½, incl	85	B90 to C 28, incl
2 (316) 316L	AF	F594E	¼ to 1½, incl	70	B85 max
	A	F594F	¼ to 1½, incl	75	B65 to 95, incl
	CW1	F594G	¼ to ⅝, incl	100	B95 to C 32, incl
	CW2	F594H	¾ to 1½, incl	85	B80 to C 32, incl
	SH1	F594E	¼ to ⅝, incl	120	C24 to C 36, incl
	SH2	F594F	¾ to 1, incl	110	C20 to C 32, incl
	SH3	F594G	1⅞ to 1¼, incl	100	B95 to C 30, incl
	SH4	F594H	1⅞ to 1½, incl	85	B90 to C 28, incl
3 (321, 347)	AF	F594J	¼ to 1½, incl	70	B85 max
	A	F594K	¼ to 1½, incl	75	B65 to 95, incl
	CW1	F594L	¼ to ⅝, incl	100	B95 to C 32, incl
	CW2	F594M	¾ to 1½, incl	85	B80 to C 32, incl
	SH1	F594J	¼ to ⅝, incl	120	C24 to C 36, incl
	SH2	F594K	¾ to 1, incl	110	C20 to C 32, incl
	SH3	F594L	1⅞ to 1¼, incl	100	B95 to C 30, incl
	SH4	F594M	1⅞ to 1½, incl	85	B90 to C 28, incl
Ferritic Alloys					
4 (430, 430F)	A	F594N	¼ to 1½, incl	55	85 max
	CW1	F594V	¼ to ⅝, incl	60	B75 to 98, incl
	CW2	F594W	¾ to 1½, incl	55	B65 to 95, incl
Martensitic Alloys					
5 (410, 416, 416Se)	H	F594P	¼ to 1½, incl	100	C20 to 30, incl
	HT	F594R	¼ to 1½, incl	160	C34 to 45, incl
6 (431)	H	F594S	¼ to 1½, incl	125	C25 to 32, incl
	HT	F594T	¼ to 1½, incl	180	C40 to 48, incl
Precipitation Hardening Alloys					
7 (630)	AH	F594U	¼ to 1½, incl	135	C28 to 38, incl

<sup>A</sup> Minimum values except where shown as maximum or as a range.

<sup>B</sup> Legend of conditions:

A—Machined from annealed or solution annealed stock thus retaining the properties of the original stock; 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 (566°C) min.

HT—Hardened and tempered at 525°F (274°C) min.

SH—Machined from strain hardened stock.

Number of Pieces in Lot	Number of Tests	Acceptance Criteria	
		Acceptance Number	Rejection Number
2 to 50	2	0	1
51 to 500	3	0	1
501 to 35 000	5	0	1
35 001 to 100 000	8	0	1

### 12.1.2 Corrosion Resistance Tests :

12.1.2.1 Unless otherwise specified, tests for corrosion resistance shall be in accordance with the manufacturer's standard quality control practices. A specific number of tests is not required, but the fasteners shall be produced by manufacturing practices and subjected to tests and inspection to assure compliance with the specified requirements.

12.1.2.2 When specified on the purchase order, not less than one corrosion test to determine freedom from precipitated carbides shall be made to represent each lot.

**TABLE 3 Mechanical Test Requirements on Nuts**

Product	Proof Stress, psi	Tests Conducted using Full Size Product	
		Hardness	Proof Load
Jam, slotted, castle nuts	all	A	B
All other nuts	up to 120 000	A	A
	Over 120 000	option A <sup>A</sup>	option B

<sup>A</sup> Denotes mandatory tests; where options are given, all the tests under an option shall be performed. Option B tests should be made whenever feasible. Option B is the referee test in case of arbitration.

<sup>B</sup> Tests that are not mandatory.

**TABLE 4 Tensile Stress Areas and Threads per Inch**

Nominal Size, in. ( <i>D</i> )	Coarse Threads—UNC		Fine Threads—UNF		8 Thread Series—8 UN	
	Threads/in.	Stress Area, <sup>A</sup> in. <sup>2</sup>	Threads/in.	Stress Area, <sup>A</sup> in. <sup>2</sup>	Threads/in.	Stress Area, <sup>A</sup> in. <sup>2</sup>
¼ (0.250)	20	0.0318	28	0.0364	...	...
⅝ (0.3125)	18	0.0524	24	0.0580	...	...
¾ (0.375)	16	0.0775	24	0.0878	...	...
⅞ (0.4375)	14	0.1063	20	0.1187	...	...
1½ (0.500)	13	0.1419	20	0.1599	...	...
9/16 (0.5625)	12	0.1820	18	0.2030	...	...
5/8 (0.625)	11	0.2260	18	0.2560	...	...
¾ (0.750)	10	0.3340	16	0.3730	...	...
7/8 (0.875)	9	0.4620	14	0.5090	...	...
1.000	8	0.6060	12	0.6630	...	...
1⅛ (1.125)	7	0.7630	12	0.8560	8	0.790
1¼ (1.250)	7	0.9690	12	1.0730	8	1.000
1⅜ (1.375)	6	1.1550	12	1.3150	8	1.233
1½ (1.500)	6	1.4050	12	1.5810	8	1.492

<sup>A</sup> Tensile stress areas are computed using the following equation:

$$A_s = 0.7854 \left[ D - \frac{0.9743}{n} \right]^2$$

where:

- $A_s$  = tensile stress area, in.<sup>2</sup>,
- $D$  = nominal size (basic major diameter), in., and
- $n$  = number of threads per inch.

## 12.2 Retests:

12.2.1 When tested in accordance with the required sampling plan, a lot shall be subject to rejection if any of the test specimens fail to meet the applicable test requirements.

12.2.2 If the failure of a test specimen is due to improper preparation of the specimen or to incorrect testing technique, the specimen shall be discarded and another specimen substituted.

## 13. Specimen Preparation

13.1 *Chemical Tests*—When required, samples for chemical analysis shall be taken by drilling, sawing, milling, turning, clipping, or other such methods capable of producing representative samples.

### 13.2 Mechanical Tests:

13.2.1 Nuts shall be tested in full section.

13.2.2 The hardness shall be determined on the top or bottom face of the nut.

13.3 *Corrosion Resistance*—Test specimens shall be prepared in accordance with Practices A 262.

## 14. Test Methods

14.1 *Chemical Analysis*—Chemical analysis shall be performed in accordance with Test Methods, Practices, and Terminology A 751.

### 14.2 Mechanical Tests:

14.2.1 The proof load or proof stress shall be determined on each sample in accordance with Test Methods F 606.

14.2.2 The hardness shall be determined in accordance with Test Methods F 606 at the top or bottom face of the nut. A minimum of two readings shall be made on each sample, each of which shall conform to the specified requirements.

14.3 *Corrosion Resistance*—Corrosion tests to determine freedom from precipitated carbides shall be performed in accordance

with Practices A 262, Practices A or E as applicable.

### **15. Significance of Numerical Limits**

15.1 For the purposes of determining compliance with the specified limits for properties listed in this specification, an observed value or calculated value shall be rounded in accordance with Practice E 29.

### **16. Rejection and Rehearing**

16.1 Unless otherwise specified, any rejection based on tests specified herein and made by the purchaser shall be reported to the manufacturer within 30 working days from the receipt of the product by the purchaser.

### **17. Certification and Test Reports**

17.1 *Certificate of Compliance*—Unless otherwise specified in the purchase order, the manufacturer shall furnish certification that the product was manufactured and tested in accordance with this specification and the customer's order and conforms to all specified requirements.

17.2 *Test Report*—When specified on the order, the manufacturer shall furnish a test report showing the results of the last completed set of mechanical tests for each stock size in the shipment.

17.3 All certification shall indicate the purchase order number and the applicable requirements of Section 3.

### **18. Product Marking**

18.1 *Individual Nuts*— All products shall be marked with a symbol identifying the manufacturer. In addition, they shall be marked with the alloy/mechanical property marking specified in Table 2. The manufacturer may at his option add the specific stainless alloy designation from Table 1. However, marking of the stainless alloy designation does not signify compliance with this standard. The marking shall be raised or depressed at the option of the manufacture.

18.2 The marking shall be on the top of the nut or on one of the wrenching flats.

18.3 Markings located on the wrenching flats shall be depressed. Markings on all other locations shall be raised or depressed at the option of the manufacturer.

### **19. Packaging and Package Marking**

19.1 *Package Marking*—Each shipping unit shall include or be plainly marked with the following:

19.1.1 ASTM specification,

19.1.2 Alloy number,

19.1.3 Alloy/mechanical property marking,

19.1.4 Size,

19.1.5 Name and brand or trademark of manufacturer,

19.1.6 Number of pieces,

19.1.7 Country of origin, and

19.1.8 Purchase order number.

19.2 When special packaging requirements are specified by the purchaser, they shall be defined at the time of inquiry and order.

19.3 Unless otherwise specified, packaging shall be in accordance with Practice D 3951.

## **SUPPLEMENTARY REQUIREMENTS**

One or more of the following supplementary requirements shall be applied when specified by the purchaser in the inquiry and order (see 3.1.7). Supplementary requirements shall in no way negate any requirement of the specification itself.

### **S1. Shipment Lot Testing**

S1.1 When Supplementary Requirement S1 is specified on the order, the manufacturer shall make sample tests on the individual lots for shipment to ensure that the product conforms to the specified requirements.

S1.2 The manufacturer shall make an analysis of a randomly selected finished nut from each lot of product to be shipped. Heat or lot control shall be maintained. The analysis of the starting material from which the nuts have been manufactured may be reported in place of the product analysis.

S1.3 The manufacturer shall perform mechanical property tests in accordance with this specification and Guide F 1470 on the individual lots for shipment.

S1.4 The manufacturer shall furnish a test report for each lot in the shipment showing the actual results of the chemical analysis and mechanical property tests performed in accordance with Supplementary Requirement S1.



**S2. Additional Tests**

S2.1 When additional tests of mechanical properties, corrosion resistance, etc; are desired by the purchaser, the test(s) shall be made as agreed upon between the manufacturer and the purchaser at the time of the inquiry or order.

**S3. Source Inspection**

S3.1 When Supplementary Requirement S3 is specified on the inquiry and order, the product shall be subject to inspection by the purchaser at the place of manufacture before shipment. The manufacturer shall afford the inspector all reasonable facilities to satisfy that the product is being furnished in accordance with this specification. All inspections and tests shall be so conducted so as not to interfere unnecessarily with the operations of the manufacturer.

**S4. Alloy Control**

S4.1 When Supplementary Requirement S4 is specified on the inquiry and order, the manufacturer shall supply that alloy specified by the customer on his order with no group substitutions permitted without the written permission of the purchaser.

**S5. Heat Control**

S5.1 When Supplementary Requirement S5 is specified on the inquiry and order, the manufacturer shall control the product by heat analysis and identify the finished product in each shipment by the actual heat number.

S5.2 When Supplementary Requirement S5 is specified on the inquiry and order, Supplementary Requirements S1 and S4 shall be considered automatically invoked with the addition that the heat analysis shall be reported to the purchaser on the test reports.

**S6. Permeability**

S6.1 When supplementary requirement S7 is specified on the inquiry and order, the permeability of nuts of Groups 1, 2, and 3 alloys in Conditions A or F shall not exceed 1.5 at 100 oersteds when determined by Test Methods A 342.

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