Designation: ~~F467 – 13ε2~~ F467 – 13ε2

Standard Specification for Nonferrous Nuts for General Use[1]

This standard is issued under the fixed designation F467; 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.

ε[1] NOTE—~~Table 2~~Table 2 was editorially corrected in February 2014.
ε[2] NOTE—17.1 was editorially corrected in May 2014.

1. Scope*

1.1 This specification covers the requirements for commercial wrought nonferrous nuts 0.250 to 1.500 in. inclusive in diameter in a number of alloys in common use and intended for general service applications.

1.2 Applicable bolts, cap screws, and studs for use with nuts covered by this specification are covered by Specification F468.

1.3 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

NOTE 1—This specification is the inch-pound companion to Specification F467M; therefore, no SI equivalents are presented in the specification.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

B154 Test Method for Mercurous Nitrate Test for Copper Alloys
B574 Specification for Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Molybdenum-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod
D3951 Practice for Commercial Packaging
E18 Test Methods for Rockwell Hardness of Metallic Materials
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys (Withdrawn 2017)[3]
E38 Methods for Chemical Analysis of Nickel-Chromium and Nickel-Chromium-Iron Alloys (Withdrawn 1989)[3]
E53 Test Method for Determination of Copper in Unalloyed Copper by Gravimetry
E54 Test Methods for Chemical Analysis of Special Brasses and Bronzes (Withdrawn 2002)[3]
E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition
E62 Test Methods for Chemical Analysis of Copper and Copper Alloys (Photometric Methods) (Withdrawn 2010)[3]
E75 Test Methods for Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys (Withdrawn 2010)[3]
E76 Test Methods for Chemical Analysis of Nickel-Copper Alloys (Withdrawn 2003)[3]
E92 Test Methods for Vickers Hardness and Knoop Hardness of Metallic Materials
E101 Test Method for Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique (Withdrawn 1996)[3]
E120 Test Methods for Chemical Analysis of Titanium and Titanium Alloys (Withdrawn 2003)[3]
E165 Practice for Liquid Penetrant Examination for General Industry
E227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique (Withdrawn 2002)[3]
E354 Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

[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] 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.

[3] 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**

E478 Test Methods for Chemical Analysis of Copper Alloys
E1409 Test Method for Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by Inert Gas Fusion
F468 Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use
F606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets (Metric) F0606_F0606M
F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

2.2 *ASME Standards:*[4]
B 1.1 Unified Inch Screw Threads (UN and UNR Thread Form)
B 18.2.2 Square and Hex Nuts

3. Ordering Information

3.1 Orders for nuts under this specification shall include the following information:
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 number (Table 1);
3.1.5 Stress relieving, if required (4.2.3);
3.1.6 "Shipment lot" testing, as required (Section 9);
3.1.7 Source inspection, if required (Section 14);
3.1.8 Certificate of compliance or test report, if required (Section 16);
3.1.9 Additional requirements, if any, to be specified on the purchase order (4.2.1, 7.2, 8.2, 12.1, and 13.1),
3.1.10 Supplementary requirements, if any; and
3.1.11 ASTM designation (including year or published date).

NOTE 2—A typical ordering description is as follows: 10 000 pieces, Hex Nut, 0.250" -20, Alloy 270, Furnish Certificate of Compliance, Supplementary Requirement S 1, ASTM Specification F 467-XX

4. Materials and Manufacture

4.1 *Materials:*
4.1.1 The nuts shall be manufactured from material having a chemical composition conforming to the requirements in Table 2 and capable of developing the required mechanical properties for the specified alloy in the finished fastener. See Specification B574 for nickel alloys.
4.1.2 The starting condition of the raw material shall be at the discretion of the fastener manufacturer but shall be such that the finished products conform to all the specified requirements.
4.2 *Manufacture:*
4.2.1 *Forming*—Unless otherwise specified, the nuts shall be hot pressed, cold formed, or machined from suitable material at the option of the manufacturer.
4.2.2 *Condition*—Except as provided in 4.2.3, the nuts shall be furnished in the condition specified below:

Alloy	Condition
Copper (all alloys)	As formed or stress relieved at manufacturer's option
Nickel alloys 400 and 405	As formed or stress relieved at manufacturer's option
Nickel alloy 500	Solution annealed and aged
Aluminum alloys:	
2024-T4	Solution treated and naturally aged
6061-T6	Solution treated and artificially aged
6262-T9	Solution treated, artificially aged, and cold worked
Titanium	As formed
625	Annealed

4.2.3 *Stress Relieving*—When required, stress relieving shall be specified by the purchaser for all copper alloys and nickel alloys 400 and 405.

5. Chemical Composition

5.1 *Chemical Composition*—The nuts shall conform to the chemical composition specified in Table 1 for the specified alloy.
5.2 *Manufacturer's Analysis:*

[4] Available from Global Engineering Documents, 15 Inverness Way, East Englewood, CO 80112-5704, http://global.ihs.com.

TABLE 1 Chemical Requirements

UNS Designation Number	Composition, %												
	Copper and Copper-Base Alloys												
	Alloy	General Name	Aluminum	Copper, min	Iron, max	~~Manganese,~~Manganese, max	Nickel, max	Phosphorus	Silicon	Zinc, max[A]	Lead, max	Tin	Arsenic, max
C11000	110	ETP copper		99.9									
C26000	260	brass		68.5–71.5	0.05					balance	0.07		
C27000	270	brass		63.0–68.5	0.07					balance	0.10		
C46200	462	naval brass		62.0–65.0	0.10					balance	0.20	0.5–1.0	
C46400	464	naval brass		59.0–62.0	0.10					balance	0.20	0.5–1.0	
C51000	510	phosphor bronze		balance[A]	0.10			0.03–0.35		0.30	0.05	4.2–5.8	
C61300	613	aluminum bronze	6.0–7.5	[B]	2.0–3.0	0.10	0.15[C]	0.015	0.10	0.05	0.01	0.20–0.50	
C61400	614	aluminum bronze	6.0–8.0	88.0[D]	1.5–3.5	1.0							
C63000	630	aluminum bronze	9.0–11.0	78.0[D]	2.0–4.0	1.5	4.0–5.5		0.25 max			0.20 max	
C64200	642	aluminum silicon bronze	6.3–7.6	88.65[D]	0.30	0.10	0.25		1.5–2.2[E]	0.50	0.05	0.20 max	0.15
C65100	651	silicon bronze		96.0[D]	0.8	0.7			0.8–2.0	1.5	0.05		
C65500	655	silicon bronze		94.8[D]	0.8	1.5	0.6		2.8–3.8	1.5	0.05		
C66100	661	silicon bronze		94.0[D]	0.25	1.5			2.8–3.5	1.5	0.20–0.8		
C67500	675	manganese bronze	0.25 max	57.0–60.0	0.8–2.0	0.05–0.5				balance	0.20	0.5–1.5	
C71000	710	cupro-nickel		74.0[D]	0.60	1.00	19.0–23.0[C]			1.00	0.05		
C71500	715	cupro-nickel		65.0[D]	0.40–0.7	1.00	29.0–33.0[C]			1.00	0.05		

[A] Elements shown as balance shall be arithmetically computed by deducting the sum of the other named elements from 100.
[B] Copper plus specified elements = 99.8 min; copper plus silver = 88.5–91.5.
[C] Cobalt is to be counted as nickel.
[D] Minimum content of copper plus all other elements with specified limits shall be 99.5 %.
[E] An alloy containing as high as 2.6 % silicon is acceptable provided the sum of all the elements other than copper, silicon, and iron does not exceed 0.30 %.

TABLE 1 *Continued*

UNS Designation Number	Nickel and Nickel-Base Alloys																	
	Alloy	General Name	Aluminum	Carbon, max	Chromium	Copper[A]	Iron, max	~~Manganese,~~Manganese, max	Nickel[A]	~~Phosphous,~~Phosphous, max	Silicon, max	Titanium	Cobalt, max	Molybdenum	Sulfur, max	Vanadium	Tungsten	Niobium[†]
N10001	335	Ni-Mo		0.05	1.0 max		4.0–6.0	1.0	balance	0.025	1.00		2.50	26.0–30.0	0.030	0.2–0.4		
N10276	276	Ni-Mo-Cr		0.02	14.5–16.5		4.0–7.0	1.00	balance	0.040	0.08		2.50	15.0–17.0	0.030	0.35 max	3.0–4.5	
N04400	400	Ni-Cu Class A		0.3		balance	2.5	2.0	63.0–70.0		0.5		[B]		0.024			
N04405	405	Ni-Cu Class B		0.3		balance	2.5	2.0	63.0–70.0		0.5		[B]		0.025–0.060			
N05500	500	Ni-Cu-Al	2.30–3.15	0.25		balance	2.0	1.5	63.0–70.0		0.5	0.35–0.85	[B]		0.01			
N06059	59	Ni–Cr-Mo	0.1–0.4	0.010 max	22.0–24.0	0.5 max	1.5 max	0.5 max	balance	0.015 max	0.10 max		0.3 max	15.0–16.5	0.010 max			

TABLE 3.1.4 *Continued*

TABLE 1 *Continued*

Nickel and Nickel-Base Alloys

UNS Designation Number	Alloy	General Name	Aluminum	Carbon, max	Chromium	Copper[A]	~~Manganese~~,Manganese, max	Iron, max	~~Phosphous~~,Phosphous, max	Nickel[A]	Silicon, max	Titanium	Cobalt, max	Molybdenum	Sulfur, max	Vanadium	Tungsten	Niobium†
N06625	625[C]	Ni-Cr-Mo-Cb	0.40 max	0.10†	20.0–23.0		0.50	5.0 max	0.015	58.0 min	0.50 max	0.40 max	1.00 max	8.0–10.0	0.015			3.2–4.2
N06686	686	Ni-Cr-Mo-W		0.010 max	19.0–23.0		0.75 max	5.0 max	0.04 max	balance	0.08 max	0.02–0.25		15.0–17.0	0.02 max		3.0–4.4	

[A] Elements shown as balance shall be arithmetically computed by deducting the sum of the other named elements from 100.
[B] Cobalt is to be counted as nickel.
[C] Alloy 625 material shall be refined using the electroslag remelting process (ESR), or the vacuum arc remelting process (VAR).
† Editorially corrected in January 2008.

TABLE 1 *Continued*

Composition, %

Aluminum-Base Alloys[A]

UNS Designation Number	Alloy	General Name	Aluminum[A]	Chromium	Copper	Iron, max	Manganese, max	Silicon, max	Titanium, max	Zinc, max	Magnesium	Other Elements, max	
												Each	Total
A92024	2024	Aluminum 2024	balance	0.10 max	3.8–4.9	0.50	0.30–0.9	0.50	0.15[B]	0.25	1.2–1.8	0.05	0.15
A96061	6061	Aluminum 6061	balance	0.04–0.35	0.15–0.40	0.7	0.15	0.40–0.8	0.15	0.25	0.8–1.2	0.05	0.15
A96262	6262	Aluminum 6262	balance	0.04–0.14	0.15–0.40	0.7	0.15	0.40–0.8	0.15	0.25	0.8–1.2	[C]	

[A] Analysis shall regularly be made only for the elements specified in this table. If, however, the presence of other elements is suspected or indicated in amounts greater than the specified limits, further analysis shall be made to determine that these elements are not present in excess of the specified limits.
[B] Titanium + zirconium 0.20 %, max.
[C] Lead 0.4–0.7 %; bismuth 0.4–0.7 %.

TABLE 1 *Continued*

Titanium and Titanium-Base Alloys[A]

UNS Designation Number	Alloy	General Name	Aluminum, Al	Carbon, C	Iron, Fe	Titanium, Ti	Hydrogen, H	Nitrogen, N	Oxygen, O	Palladium, Pd	Vanadium, V	Chromium, Cr	Molybdenum, Mo	Zirconium, Zr	Tin, Sn	Silicon, Si	Ruthenium, Ru	Residuals[B]	
																		each, max	total, max
R50250	1	Titanium Gr 1		0.10	0.20	balance	0.0125	0.05	0.18									0.1	0.4
R50400	2	Titanium Gr 2		0.10	0.30	balance	0.0125	0.05	0.25									0.1	0.4
R50700	4	Titanium Gr 4		0.10	0.50	balance	0.0125	0.07	0.40									0.1	0.4
R56400	5	Titanium Gr 5	5.5–6.75	0.10	0.40	balance	0.0125	0.05	0.20		3.5–4.5							0.1	0.4
R56401	23	Titanium Ti-6Al-4V ELI	5.5–6.5	0.08	0.25	balance	0.0125	0.05	0.13		3.5–4.5							0.1	0.4
R52400	7	Titanium Gr 7		0.10	0.30	balance	0.0125	0.05	0.25	0.12–0.25								0.1	0.4
R58640	19	Titanium Ti-38-6-44	3.0–4.0	0.05	0.30	balance	0.0200	0.03	0.12	0.10[A]	7.5–8.5	5.5–6.5	3.5–4.5	3.5–4.5			0.10[C]	0.15	0.4
R55111	32	Titanium Ti-5-1-1-1	4.5–5.5	0.08	0.25	balance	0.0125	0.03	0.11		0.6–1.4		0.6–1.2	0.6–1.4	0.6–1.4	0.06–0.14		0.1	0.4

[A] All reported values are maximums, unless a range is specified.

[B] A residual is an element present in a metal or an alloy in small quantities inherent to the manufacturing process but not added intentionally. Residual elements need not be reported unless a report is specifically required by the purchaser.

[C] Ruthenium and Palladium, or both, may be added to Grade 19 for enhanced corrosion resistance as negotiated between purchaser and vendor. Chemical analysis is not required unless specifically negotiated.

TABLE 2 Mechanical Property Requirements

Alloy	Mechanical Property Marking	Hardness, min[A]	Proof Stress, Hex Nut min, ksi	Proof Stress, Heavy Hex Nut min, ksi[B]
Cu 110	F 467A	65 HRF	30	32
Cu 260	F 467AB	55 HRF	60	65
Cu 270	F 467B	55 HRF	60	65
Cu 462	F 467C	65 HRB	50	54
Cu 464	F 467D	55 HRB	50	54
Cu 510	F 467E	60 HRB	60	65
Cu 613	F 467F	70 HRB	80	86
Cu 614	F 467G	70 HRB	75	81
Cu 630	F 467H	85 HRB	100	108
Cu 642	F 467J	75 HRB	75	81
Cu 651	F 467K	75 HRB	70	76
Cu 655	F 467L	60 HRB	50	54
Cu 661	F467M	75 HRB	70	76
Cu 675	F 467N	60 HRB	55	59
Cu 710	F 467P	50 HRB	45	49
Cu 715	F 467R	60 HRB	55	59
Ni 59 Grade 1	F 467FN	21HRC	120	130
Ni 59 Grade 2	F 467GN	23HRC	135	146
Ni 59 Grade 3	F 467HN	25HRC	160	173
Ni 59 Grade 4	F 467JN	80HRB	100	108
Ni 335	F 467S	20 HRC	115	124
Ni 276	F 467T	20 HRC	110	119
Ni 400	F 467U	75 HRB	80	86
Ni 405	F 467V	60 HRB	70	76
Ni 500	F 467W	24 HRC	130	140
Ni 625 Grade 1‡	F 467AC†	85 HRB-35 HRC	60	65
Ni 625 Grade 2‡	F 467AD	85 HRB-35 HRC	120	130
Ni 686 Grade 1	F 467BN	21 HRC	120	130
Ni 686 Grade 2	F 467CN	23 HRC	135	146
Ni 686 Grade 3	F 467DN	25 HRC	160	173
Ni 686 Grade 4	F 467EN	65 HRB-25HRC	100	108
Al 2024-T4[C]	F 467X	70 HRB	55	59
Al 6061-T6	F 467Y	40 HRB	40	43
Al 6262-T9	F 467Z	60 HRB	52	56
Ti 1	F 467AT	140 HV	40	43
Ti 2	F 467BT	150 HV	55	59
Ti 4	F 467CT	200 HV	85	92
Ti 5	F 467DT	30 HRC	135	146
Ti 7	F 467ET	160 HV	55	59
Ti-19	F 467FT	24 HRC	120	130
Ti 23	F 467GT	25 HRC	125	135
Ti-5-1-1-1	F 467HT	24 HRC	105	113

[A] For aluminum and titanium alloys hardness values are for information only.
[B] Proof stress values for heavy hex nuts are based on 1.08 times the value for corresponding regular hex nuts.
[C] Aluminum alloy 2024-T4 shall be supplied in naturally aged condition. This material is not recommended for nuts in sizes greater than ¼ (0.250) in.
†Editorially corrected in January 2008. Typographical error— should be F467AC; both F467AC or 647AC are acceptable Mechanical Property Mark.
‡Editorially corrected in February 2014.

5.2.1 Except as provided in 5.2.2, when test reports are required on the inquiry or purchase order (3.1.8), the manufacturer shall make individual analyses of randomly selected finished nuts from the product to be shipped and report the results to the purchaser. Alternatively, if heat and lot identities have been maintained, the analysis of the raw material from which the nuts have been manufactured may be reported instead of product analysis.

5.2.2 For aluminum nuts, instead of 5.2.1, the manufacturer may furnish a certificate of conformance certifying compliance with the chemical composition specified in Table 1.

5.3 *Product Analysis:*

5.3.1 Product analyses may be made by the purchaser from finished products representing each lot. The chemical composition thus determined shall conform to the requirements in Table 1.

5.3.2 In the event of disagreement, a referee chemical analysis of samples from each lot shall be made in accordance with 12.1 and 13.1.

6. Mechanical Properties

6.1 The nuts shall be tested in accordance with the mechanical testing requirements for the applicable type and shall meet the mechanical requirements in Table 2 for the specified alloy.

6.2 Where both proof load and hardness tests are performed, the proof load test results shall take precedence for acceptance purposes.