

FED. SUPPLY CLASS

5306

1. SCOPE

- 1.1 Scope. This specification defines the requirements for titanium alloy fasteners procured under part numbers listed on drawings which refer to this specification. Purchaser may reject any lot which does not conform. Consistent rejection or flagrant violations of these requirements may result in removal of manufacturer's product from purchaser's list of approved products.
- 1.2 Recommendations for improvements or correction of this specification should be directed to National Aerospace Standards Committee, Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA, 22209.

2. APPLICABLE DOCUMENTS

- 2.1 Documents listed herein of the issue in effect on date of price inquiry are a part of this specification to the extent indicated. In the event of conflict between the requirements of this specification and referenced documents, the requirements herein shall govern.

INDUSTRY STANDARDS

SAE International

AMS2801	Heat Treatment of Titanium Alloy Parts
AMS4967	Titanium Alloy Bars and Forgings, 6AL-4V Annealed, Heat Treatable
AS8879	Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Dia.

Copies can be obtained from SAE International, 400 Commonwealth Dr., Warrendale, PA 15096-0001. www.sae.org

ASME

ASME B46.1	Surface Texture (Surface Roughness, Waviness and Lay)
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Copies can be obtained from ASME, Two Park Ave., New York, NY 10016-5990. www.asme.org

American Society for Quality

ASQ Z1.4	Sampling Procedures and Tables for Inspection by Attributes
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Copies can be obtained from the American Society for Quality, 600 North Plankinton Ave., Milwaukee, WI 53203. www.asq.org

ASTM International

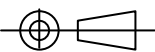
ASTM E 1417	Standard Practice for Liquid Penetrant Testing
ASTM D 5118/D 5118M	Standard Practice for Fabrication of Fiberboard Shipping Boxes

Copies can be obtained from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. www.astm.org

Aerospace Industries Association

NAS179	Collar, Hi-Shear Rivet
NAS518	Gage, 100° Flat Head Flushness
NAS519	Stylus, 100° Flat Head Gage
NAS526	Flushness Gage and Stylus For 100° Countersunk Flush Fasteners
NAS528	Collar (High Strength) Hi-Shear Rivet
NAS1080	Collar, Swage Locking For Pull-Type or Stump-Type Lockbolts
NASM1312-8	Fasteners, Test Methods, Method 8, Tensile Strength
NASM1312-11	Fasteners, Test Methods, Method 11, Tension Fatigue
NASM1312-13	Fasteners, Test Methods, Method 13, Double Shear Test
NAS1806-1816	Rivet, Hi-Shear, Flat Head, Interference Fit, Titanium Alloy

THIRD
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PROCUREMENT
SPECIFICATION

TITLE

**FASTENERS, TITANIUM ALLOY
PROCUREMENT SPECIFICATION**

CLASSIFICATION
SPECIFICATION

NONE



Documents
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NAS1906-1916	Rivet, Hi-Shear, 100° Head, Interference Fit, Titanium Alloy
NAS2005-2012	Bolt-Lock, Tension, Protruding Head, Standard and Oversize, Pull-Type, Titanium Alloy
NAS2105-2112	Bolt-Lock, Tension, 100° Head (MS24694), Pull-Type, Titanium Alloy
NAS2115-2122	Bolt-Lock, Tension, 100° Head (MS20426), Standard and Oversize Pull-Type, Titanium Alloy
NAS2125-2132	Bolt-Lock, Tension, 100° Crown Head, Standard and Oversize Pull-Type, Titanium Alloy
NAS2205-2212	Bolt-Lock, Tension, Protruding Head, Stump Type, Titanium Alloy
NAS2306-2312	Bolt-Lock, Tension, 100° Head (MS24694), Stump-Type, Titanium Alloy
NAS2315-2322	Bolt-Lock, Tension, 100° Head (MS20426), Stump-Type, Titanium Alloy
NAS2325-2332	Bolt-Lock, Tension, 100° Crown Head, Stump-Type, Titanium Alloy
NAS2406-2412	Bolt-Lock, Shear, Protruding Head, Standard and Oversize, Pull-Type, Titanium Alloy
NAS2506-2512	Bolt-Lock, Shear, 100° Head, Standard and Oversize, Pull-Type, Titanium Alloy
NAS2605-2612	Bolt-Lock, Shear, Protruding Head, Stump Type, Titanium Alloy
NAS2705-2712	Bolt-Lock, Shear, 100° Head, Stump-Type, Titanium Alloy
NAS9800	Head Protrusion Gaging, 100° Flush Head Fasteners, Gage Block, Gage Diameters and Stylus

Copies can be obtained from the Aerospace Industries Association, 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209. www.aia-aerospace.org

FEDERAL STANDARDS

FED-STD-H28	Screw Thread Standards for Federal Services
FED-STD-H28/2	Screw Thread Standards for Federal Services, Section 2, Unified Inch Screw Threads UN and UNR Thread Forms
FED-STD-H28/4	Screw Thread Standards for Federal Services, Section 4, Controlled Radius Root, Screw Threads UNJ Symbol
MIL-S-7742	Screw Threads, Standard, Optimum Selected Series

Copies can be obtained from DLA Document Services, Bldg 4/D, 700 Robbins Ave, Philadelphia, PA 19111. <http://quicksearch.dla.mil/>

TECHNICAL REFERENCES

McGraw-Hill book Company, "Sampling Inspection by Variables" by Bowker and Goode

3. REQUIREMENTS

- 3.1 General. Fasteners supplied to this specification shall comply with all of the requirements of this specification and shall have passed all of the applicable tests herein.
- 3.2 Material. Fasteners shall be fabricated from titanium alloy conforming to chemical composition limits of AMS4967.
- 3.2.1 ~~Hydrogen. When tested in accordance with 4.6.4.1, the hydrogen content shall not exceed the specified maximum~~

TABLE I — MATERIAL COMPOSITION

ELEMENT	COMPOSITION BY PERCENT 6Al-4V ALLOY
Aluminum	5.0–5.7
Manganese	—
Vanadium	3.5–4.5
Carbon	.10 Max
Iron	.30 Max
Nitrogen	.07 Max
Oxygen	.20 Max
Hydrogen	.0125 Max (125 ppm)
Others	.40 Max
Titanium	Remainder

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Documents
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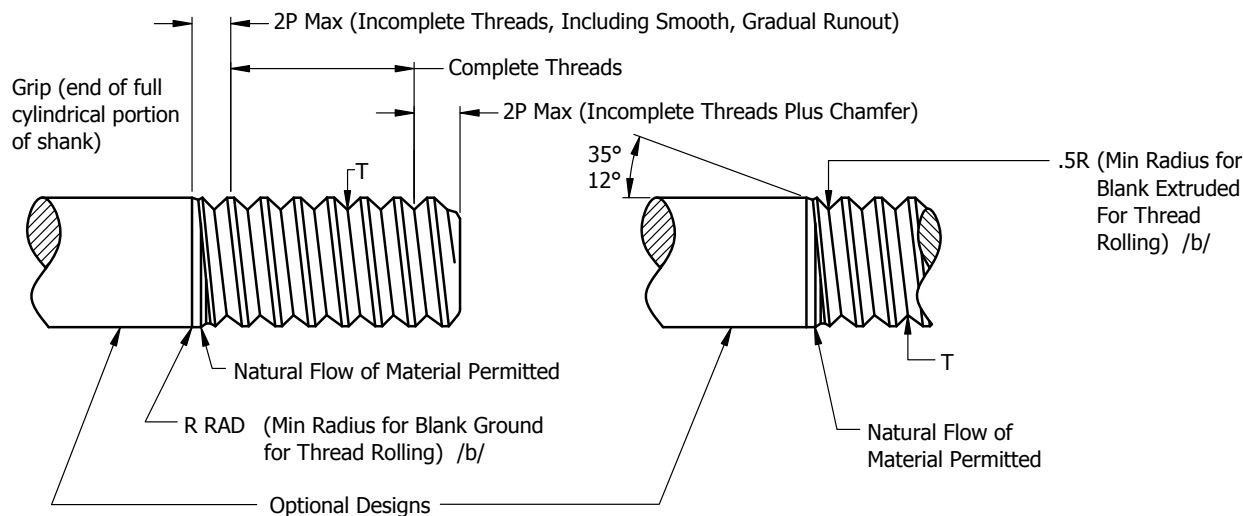
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- 3.3 Design and Construction. Fastener Design and Construction shall conform to the following requirements.
- 3.3.1 Dimensions. Dimensions shall be in accordance with the applicable detail drawing. Dimensions shall include the chemically applied or electroplated finishes designated on the detailed drawing. Dimensions shall exclude paint and similar coatings, metallic dips and dry film lubricants. Measurements shall be made per 4.6.1
- 3.3.2 Surface Roughness. Surface roughness shall be in accordance with the requirements of the detail drawing. Surface roughness shall be measured in accordance with ASME B46.1.
- 3.3.3 Thread Form (Threaded Fasteners Only). Thread form and dimensions shall conform to handbook FED-STD-H28, MIL-S-7742 or AS8879.
- 3.3.3.1 Thread Locking Groove and Breakneck Groove Forming. Threads, locking grooves and breakneck grooves shall be fully formed after final heat treatment. Threads shall be formed by a single rolling process. Locking and breakneck grooves shall be formed by a single rolling process or machined.
- 3.3.3.2 Incomplete Threads (Threaded Fasteners Only). Incomplete thread pitches are permissible at the chamfered end and at the juncture of the unthreaded portion of the shank as illustrated in Figure 1. The incomplete thread pitch next to the shank shall include a thread runout at least one pitch wide and not more than two pitches wide. This runout shall terminate not less than .25 pitches from the grip dimension when grip length is specified on the applicable detail drawing, or the end of the full cylindrical portion of the shank in the case of full threaded fasteners.
- 3.3.3.3 Chamfer (Threaded Fasteners Only). The entering point of the thread shall be chamfered as specified in the applicable detail drawing.



- (a) Point to be flat and chamfered. Threads adjacent to chamfer may be incomplete at pitch diameter or major diameter. At a distance of 2 pitches from flat end of bolt, threads shall be complete so that pitch diameter and major diameter are within tolerance.
- /b/ Not applicable after thread rolling. Surface irregularities at crest of complete or incomplete thread are permitted as illustrated in Figure 4.

Acceptability of dimensions for root radius and runout shall be based on comparator measurement. Incomplete threads adjacent to grip may be out of tolerance at major, pitch, and minor diameters. At a distance of 2 pitches from grip, threads shall be sufficiently complete to enter a "Go" ring gage and actual measurement of pitch diameter shall not be less than minimum. Acceptability of other thread dimensions at

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maximum metal condition shall be based on virtual (or effective) diameter gaging with "Go" ring gages. Acceptability of other thread dimensions at minimum metal condition shall be based on actual gaging. Acceptability of grain flow or discontinuities shall be based on metallurgical examination and/or fatigue test.

FIGURE 1 – INCOMPLETE THREADS, RUNOUT RADIUS, AND ROOT RADIUS

Thread Size	P (Pitch of Thread)	2P	R (Runout Radius)	.5R	T (Min Root Radius)
.1120-40	.025	.050	.009	.005	.003
.1380-32	.031	.062	.012	.006	.003
.1640-32	.031	.062	.012	.006	.003
.1900-32	.031	.062	.012	.006	.003
.2500-28	.036	.072	.013	.006	.004
.3125-24	.042	.084	.015	.008	.005
.3750-24	.042	.084	.015	.008	.005
.4375-20	.050	.100	.018	.009	.006
.5000-20	.050	.100	.018	.009	.006
.5625-18	.056	.112	.020	.010	.006
.6250-18	.056	.112	.020	.010	.006
.7500-16	.062	.124	.023	.011	.007
.8750-14	.071	.142	.025	.011	.008
1.0000-12	.083	.166	.025	.013	.009
1.0000-14	.071	.142	.025	.011	.008

FIGURE 1 – INCOMPLETE THREADS, RUNOUT RADIUS, AND ROOT RADIUS (Continued)

- 3.3.3.4 Irregular Flank (Threaded Fastener Only). The flank of the incomplete thread closest to the grip, or head, may be irregular due to natural flow of material that is not controlled by thread rolling dies. Folds or laps in excess of those permitted by Figure 4 shall not be considered "Natural Flow". The roots and sides of threads in the runout area shall be filleted, smooth and devoid of abrupt tool marks.
- 3.3.3.5 Grain Flow. The grain flow in the threads of threaded fasteners shall be continuous and shall follow the general thread contour with the maximum density at the bottom of the root radius as illustrated in Figure 2.
- 3.3.3.6 Sealant Groove Option. The sealant escape groove cut in non-threaded fasteners is through the locking groove in accordance with Figure 7. Part number codes for sealant escape groove pins are shown on the applicable NAS standards and shall be inspected as specified in 4.6.1.4.
- 3.3.4 Heads. Fastener heads shall be formed by forging before heat treatment on all sizes larger than .1380 thread size. Recesses may be forged or machined. Flash or chip clearance in machined recesses shall not cause recess dimensions to exceed the specified limits.
- 3.3.4.1 Bearing Surfaces. The bearing surface of fastener heads shall be oriented relative to the shank within the limits shown on the detail drawing.
- 3.3.4.2 Head Structure and Grain Flow. A metallographic cross section of the head shall show no detrimental defects (see section 4.6.3) and shall exhibit grain flow lines substantially as illustrated in Figure 2 (sizes larger than .1380 thread). The flow lines may be broken by finish machining or grinding operation. Evaluation to be conducted at 50X to 60X.
- 3.3.5 Head-to-Shank Fillet. The juncture of the fastener head and shank shall be cold worked by a rolling process in thread size .1380 and larger in grips greater than nominal diameter after completion of all machining, grinding and thermal treatments. Fillet radius shall conform to the requirements of the detail drawing and shall show no evidence of seams or inclusions. Distortion from the smooth contour resulting from cold working shall not extend beyond the

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limits in Figure 3. A short tapered lead into the fillet area is permissible providing the dimensions do not exceed the limits of the detail drawing.

- 3.3.6 Concentricity (Threaded Fasteners Only). The concentricity of the thread pitch diameter with the shank shall be within .005 inch per inch of length, FIM, taken directly beneath the head. The concentricity of the shank with the head diameter shall be within .006 inch, FIM, or 2% of the fastener nominal shank diameter, whichever is greater.
- 3.3.7 Straightness. The straightness of the fastener shank shall be within the limits of Table II when the fastener shank is rolled in the "V" blocks (max width each block .250) placed on surface plates and the greatest deviation is measured with a dial indicator graduated in .001.

TABLE II – SHANK STRAIGHTNESS

Nominal Shank Diameter	Maximum Deviation (Inches per Inch of Length)
.312 and Under	.0030
.313 to .499	.0025
.500 and Larger	.0020

- 3.4 Mechanical Properties. Mechanical properties of fasteners shall conform to the following requirements.
- 3.4.1 Ultimate Tensile Strength. Tensile test per MIL-STD-1312-8. Minimum ultimate tensile strength shall conform to the requirements of Table III. For capability certification tensile test per 4.6.2.1. Tensile tests are not applicable to full threaded fasteners whose nominal length is less than twice the diameter, to grip-type threaded fasteners with nominal grip less than 3/4 of nominal diameter, bolts or screws with 100° head or for bolts with short threads. For tensile capability of lockbolts having a nominal grip less than 1 1/2 times the nominal diameter, test a longer grip lockbolt of the same diameter to qualify the collar. With collars qualified, from the same collar production lot, check a collar on the shorter lockbolts for completeness of drive. Lockbolt tensile testing is a test of the installed collar only, any other type of failure is unacceptable.
- 3.4.2 Ultimate Double Shear Strength. Shear test per MIL-STD-1312-13. Minimum ultimate double shear shall conform to the requirements of Table III. For capability certification shear test per 4.6.2.1. Shear tests are not applicable to protruding head fasteners whose nominal grip is less than twice the nominal diameter, nor to flush head fasteners whose nominal grip is less than 2 1/2 times the nominal diameter.
- 3.4.3 Fatigue Life. When tested in accordance with 4.6.2.2, the fatigue life shall conform to 4.6.2.3. Fatigue testing of threaded fasteners is required for both capability certification and acceptance inspection. Fasteners with drilled shanks must be tested prior to drilling. Non-threaded fasteners require fatigue testing for capability certification only. Fatigue tests are not applicable to threaded fasteners smaller than .1900 thread size or to fasteners having a grip less than twice the nominal diameter.
- 3.5 Metallurgical Properties. Metallurgical properties of fasteners shall conform to the following requirements. Examination shall be conducted in accordance with 4.6.3.

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TABLE III – SHEAR AND TENSILE PROPERTIES

Nominal Diameter	Shear (All Types)		Threaded Fasteners Ultimate Tensile	
	Double Shear Lbs Min	Load Rate Max Lbs per Minute	Ultimate Tensile Lbs Min	Load Rate Max Lbs per Minute
.0600	–	–	290	100
.0860	–	–	590	200
.1120	1,800	900	970	330
.1380	2,900	1,500	1,450	500
.1560	3,610	1,800	–	–
.1640	4,000	2,000	2,240	750
.1900	5,380	2,800	3,180	1,000
.2500	9,300	4,900	5,820	1,800
.3125	14,600	7,700	9,200	2,900
.3750	21,000	11,000	14,000	4,300
.4375	28,600	15,000	18,900	6,000
.5000	37,300	20,000	25,600	8,000
.5625	47,200	25,000	32,400	10,000
.6250	58,300	31,000	41,000	12,700
.7500	83,900	44,000	59,500	18,500
.8750	114,200	60,000	81,500	25,200
1.0000-12	149,200	85,000	106,000	32,800
1.0000-14	149,200	85,000	108,200	33,600

TABLE III – SHEAR AND TENSILE PROPERTIES (continued)

Nominal Diameter	Non-Threaded Fasteners Ultimate Tensile			
	Tension Type			
	Ultimate Tensile Lbs Min	Load Rate Max Lbs per Minute	Pull Type NAS2005 THRU NAS2012 Test Collar /d/	Stump Type NAS2205 THRU NAS2312 Test Collar /d/
.0600	–	–	–	–
.0860	–	–	–	–
.1120	–	–	–	–
.1380	–	–	–	–
.1560	–	–	–	–
.1640	1,100	1,100	NAS1080-05	NAS1080-05
.1900	2,210	2,200	NAS1080-06	NAS1080-06
.2500	4,080	4,100	NAS1080-08	NAS1080-08
.3125	6,500	6,500	NAS1080P10	NAS1080-10
.3750	10,100	10,100	NAS1080P12	NAS1080-12
.4375	–	–	–	–
.5000	–	–	–	–
.5625	–	–	–	–
.6250	–	–	–	–
.7500	–	–	–	–
.8750	–	–	–	–
1.0000-12	–	–	–	–
1.0000-14	–	–	–	–