

FED. SUPPLY CLASS

5306

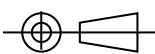
1. SCOPE AND CLASSES
 - 1.1 This specification defines the requirements for titanium alloy externally threaded fasteners procured under part numbers listed on drawings which refer to this specification. Typically these fasteners are used for tension, shear, and tension-fatigue applications where 160 KSI Ft_u and 95 KSI Fs_u is desired with a service temperature capability to 450 °F.
 - 1.2 Requirements stipulated in purchase contracts, purchase orders, part standards and/or part drawings shall take precedence over requirements stated herein. Receiving contractors may reject any lot which does not conform.
 - 1.3 The specification includes mechanical property requirements for three classes of fasteners, Types I, II and III.
 - Type I - Tension head (hex, double hex, etc.) without a recess drive, long thread (i.e. NAS6803-6820)
 - Type II - Tension head (hex, double hex, etc.) without a recess drive, short thread, (i.e. NAS6403-6420)
 - 100° Full flush head, long or short thread (i.e. NAS1580V)
 - Pan head, long or short thread (i.e. NAS1578V)
 - Fillister head, long or short thread (i.e. NAS1121V-1128V)
 - Full thread (threaded to the head) (i.e. NAS1101V)
 - Type III -100° Reduced flush head, long or short thread (i.e. NAS1581)
 - 1.4 Workmanship of fasteners shall be in conformance with aircraft fastener manufacturing processes.
 - 1.5 Recommendations for improvements or corrections to this specification should be directed to an NASC representative of a using company or to the Executive Secretary of the National Aerospace Standards Committee.
 - 1.6 Specifications listed herein, of the issue in effect on date of inquiry, are a part of this specification to the extent indicated. In the case of conflict, the requirements herein shall take precedence.
 - 1.7 Should a using company require qualification testing for any product specifying this document, a report for the specific product and product diameter shall be generated by the product manufacturer from product of sufficient shank and thread length to yield inspection and test data for all requirements in TABLE I including tests categorized as not mandatory. Inspection and test data shall be generated in accordance with the prescribed test methods, utilizing the sampling plan specified for a twenty-five (25) piece manufacturing lot and submitted by the product manufacturer to the product user.
 - 1.8 Unless otherwise specified, part inventory manufactured to previous revisions of the applicable drawing or specification may be procured and used until stock is depleted.

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.
1000 WILSON BLVD.
ARLINGTON, VA 22209

THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SAME
PRODUCT AND SHALL BECOME EFFECTIVE NO LATER THAN SIX MONTHS FROM THE LAST
REVISION DATE.

REVISION DATE: DECEMBER 18, 2015

ISSUE DATE: DECEMBER 1968

FORM 12-01	THIRD ANGLE PROJECTION		CUSTODIAN NATIONAL AEROSPACE STANDARDS COMMITTEE	REVISION 16
	PROCUREMENT SPECIFICATION NONE		TITLE FASTENER, 6AL-4V TITANIUM ALLOY, EXTERNALLY THREADED, 160 KSI Ft_u, 95 KSI Fs_u, 450 °F	CLASSIFICATION SPECIFICATION NAS4004 SHEET 1 OF 21

2. APPLICABLE DOCUMENTS

2.1. Industry Standards

2.1.1 ASME

ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

Copies can be obtained from ASME, Three Park Ave., New York, NY 10016-5990. www.asme.org

2.1.2 American Society for Metals

ASM Handbook "Atlas of Micro Structures of Industrial Alloys"

Copies can be obtained from ASM World Headquarters, 9639 Kinsman Road, Materials Park, OH 44073.
www.asminternational.org

2.1.3 American Society for Quality

ASQ Z1.4 Sampling Procedures and Tables for Inspection by Attributes

Copies can be obtained from the American Society for Quality, 600 North Plankinton Ave., Milwaukee, WI 53203.
www.asq.org

2.1.4 ASTM International

ASTM E340, Standard Test Method for Macroetching Metals and Alloys

ASTM E407, Standard Test Practice for Microetching Metals & Alloys

ASTM E1417, Standard Practice for Liquid Penetrant Inspection

ASTM E1447, Standard Test Method for Determination of Hydrogen in Titanium

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

2.1.5 Aerospace Industries Association

NAS9800, Head Protrusion Gaging 100° Flush Head Fastener Gage Block, Gage Diameters, and Stylus

NASM1312, Fastener Test Methods

NASM1312-8, Fastener Test Methods, Method 8, Tension Test

NASM1312-11, Fastener Test Methods, Method 11, Fatigue Test

(16) NASM1312-13, Fastener Test Methods, Method 13, Double Shear Test

NASM1312-20, Fastener Test Methods, Method 20, Single Shear Test

NASM1312-25, Fastener Test Methods, Method 25, Driving Recess Torque,

NASM14191, Recess, Offset Cruciform, Ribbed, Dimensions of Recess, Gage and Quality Conformance Test

NASM33750, Recess, Dovetail and Conical Dovetail, Dimensions of Recess, Gage Driver for

NASM33781, Recess, Offset Cruciform, Dimensions of Recess, Gage and Driver for

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

2.1.6 SAE International

AMS2801, Heat Treatment of Titanium Alloy Parts

AMS4928, Titanium Alloy, Bars, Wire, Forgings and Rings, 6Al-4V Annealed

AMS4967, Titanium Alloy, Bars, Wire, Forgings and Rings, 6.0Al-4.0V Annealed and Heat Treatable

AMS-H-81200 Heat Treatment of Titanium and Titanium Alloys

(16) ARP9013, Statistical Product Acceptance Requirements

AS8879, Screw Threads - UNJ Profile, Inch Controlled Radius Root with Increased Minor Diameter

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

REVISION

16

NAS4004

SHEET 2



Document Sharing Hub

USE OF OR RELIANCE UPON THIS DOCUMENT OR ANY NATIONAL AEROSPACE STANDARD IS ENTIRELY VOLUNTARY. AIA DOES NOT QUALIFY SUPPLIERS OR CERTIFY

Copyright Aerospace Industries Association of America Inc. MS PRODUCED UNDER NATIONAL AEROSPACE STANDARD: AIA MAKES NO REPRESENTATION OR CLAIM RESPECTING (1) THE SUITABILITY OF
Provided by IHS under license with AIA/NAS. Licensee= www.sepana.ir/5991803002, User=sam, albert
No reproduction or networking permitted without license from IHS. Not for Resale, 01/04/2016 02:41:38 MST. IHS MAKES NO REPRESENTATION OR CLAIM RESPECTING (1) THE SUITABILITY OF

Full document details: AIA NAS4004 2015

TABLE I – BASIC REQUIREMENTS

CHARACTERISTICS	ENGINEERING REQUIREMENTS	TESTING REQUIREMENTS (SEE 3.1)	
		TEST METHOD	SAMPLING PLAN
MATERIAL	6Al-4V Titanium Alloy per AMS4928 or AMS4967.	Verify material alloy type or grade using any one of the following methods: x-ray fluorescence, optical emission spectrometry or similar methods. Trace elements analysis is not required.	Manufacturer shall verify, or contract for verification, a sample of each heat of raw material utilized for the production of fasteners specifying NAS4004 and shall retain documentation of such verification results.
DIMENSIONS	Per fastener drawing.	Conventional measuring methods.	Per TABLE II.
HEAD PROTRUSION 100° FLUSH HEAD		Per NAS9800.	
WRENCHING RECESSES		Per applicable part standard for recess.	
IDENTIFICATION		Visual examination to assure legibility. Control stamp depth to assure .010 maximum is not exceeded.	Per TABLE XII, 4.0% AQL.
THREADS	Shall be rolled subsequent to all thermal treatment (see grain flow below). Size per drawing. Unless otherwise specified, form, dimensions and processing per AS8879 except major diameter may be limited by part standard. Incomplete threads per FIGURES 1A, 2 and 3. Surface irregularities per FIGURE 1.	See FIGURES 1, 1A, 2 and 3.	Per TABLE XII, 0.65% AQL.
HEAD TO SHANK FILLET AREA	Unless otherwise specified, on .1900" Dia. and larger fasteners, head to shank fillet radius shall be cold worked subsequent to all thermal treatment. Fillet radius after cold working shall conform to applicable drawing. Fasteners threaded to the head do not require fillet cold working. Fillet area may be distorted per FIGURE 6 & TABLE VII.	Comparator measurement in a minimum of two places using 10X to 50X.	TABLE XI.
SURFACE TEXTURE	Per fastener drawing.	Per ASME B46.1 by visual or fingernail comparison. In case of controversy, check accessible surface areas using a profilometer.	Per TABLE XII, 4.0% AQL.
HEAT TREATMENT	Per AMS-H-81200 or AMS2801. Shall develop mechanical properties as defined herein without adverse effect on metallurgical properties as defined herein.	Test of mechanical and metallurgical properties verifies heat treatment.	As indicated for each test requirement.

REVISION

16

NAS4004
SHEET 3



Document Sharing Hub

USE OF OR RELIANCE UPON THIS DOCUMENT OR ANY NATIONAL AEROSPACE STANDARD IS ENTIRELY VOLUNTARY. AIA DOES NOT QUALIFY SUPPLIERS OR CERTIFY

Copyright Aerospace Industries Association of America Inc. MS PRODUCED UNDER NATIONAL AEROSPACE STANDARD: Licensee= www.sepana.ir/5991803002, User=sam, albert
Provided by IHS under license with AIA/NAS. ANY PARTICULAR APPLICATION OR (2) THE EXISTENCE OF OR APPLIC
No reproduction or networking permitted without license from IHS
Not for Resale, 01/04/2016 02:41:38 MST TRADEMARK RIGHTS.

Full document details: AIA NAS4004 2015

TABLE I – BASIC REQUIREMENTS (CONTINUED)

CHARACTERISTICS	ENGINEERING REQUIREMENTS	TESTING REQUIREMENTS (SEE 3.1)	
		TEST METHOD	SAMPLING PLAN
TENSILE STRENGTH	TABLE III. Limitations per note /a/ under TABLE III.	Test per MIL-STD-1312-8 in accordance with NASM1312-8	TABLE VIII
SHEAR STRENGTH	Minimum strength per TABLE III. Limitations per Note /h/ under TABLE III.	Double shear test per MIL-STD-1312-13 in accordance with NASM1312-13. Single shear test per MIL-STD-1312-20 in accordance with NASM1312-20.	
FATIGUE TEST	Fasteners shall meet the test cycle requirements per TABLE X when subjected to the loads per TABLE IV.	Test per MIL-STD-1312-11 in accordance with NASM1312-11.	
RECESS TORQUE	Fasteners with a recess conforming to NASM14191, NASM33750 or NASM33781 documents shall develop the torque values as specified in TABLE XIII. See Recess Torque Sampling Plan.	Torque test with specified driver in both installation and removal directions per MIL-STD-1312-25 in accordance with NASM1312-25 and TABLE XIII. Axial end load shall not exceed 20 lbf in the installation direction and 40 lbf in the removal direction $\pm 10\%$.	TABLE XI.
METALLURGICAL	No cracks permitted in any location. A crack is a clean crystalline break passing through the grain or grain boundary. Other discontinuities permitted only as described in TABLE V.	Penetrant inspection per ASTM E1417, Type I, Method B or D, Sensitivity Level 2, 3, or 4. Fasteners shall not be marked for identification of penetrant inspection. Penetrant inspection is not required on fasteners with thread size smaller than .1900-32. Fastener penetrant inspection shall be performed prior to coating processing or application.	Sample per TABLE XII, .15% AQL. Increase to 100% if any indications which exceed permissible discontinuity limits are found in samples during the inspection process.
SURFACE CONTAMINATION	Permitted in non-bearing head surfaces and the point end of the fastener to a max. depth of .003 inch. None permitted on all other surfaces.	Examine fasteners for surface contamination during metallurgical examination.	Per TABLE IX. Use samples for metallurgical exam.
GRINDING BURNS/DAMAGE	Altered microstructure consisting of continuous intermittent disturbed material (layer) or heat affect zone is considered grinding damage and is rejectable. None permitted on the shank, head to shank fillet or threads. Grinding burns allowed on the head of the fastener and head bearing surface to a maximum depth of .003 in.	Examine fasteners for grinding burns during metallurgical examination.	Use samples for metallurgical examination.

REVISION

16

NAS4004
SHEET 4



Document Sharing Hub

USE OF OR RELIANCE UPON THIS DOCUMENT OR ANY NATIONAL AEROSPACE STANDARD IS ENTIRELY VOLUNTARY. AIA DOES NOT QUALIFY SUPPLIERS OR CERTIFY

Copyright Aerospace Industries Association of America Inc. MS PRODUCED UNDER NATIONAL AEROSPACE STANDARD: AIA MAKES NO REPRESENTATION OR CLAIM RESPECTING (1) THE SUITABILITY OF
Provided by IHS under license with AIA/NAS Licensee= www.sepana.ir/5991803002, User=sam, albert
No reproduction or networking permitted without license from IHS
Not for Resale, 01/04/2016 02:41:38 MST TRADEMARK RIGHTS.

Full document details: AIA NAS4004 2015

TABLE I – BASIC REQUIREMENTS (CONTINUED)

CHARACTERISTICS	ENGINEERING REQUIREMENTS	TESTING REQUIREMENTS (SEE 3.1)	
		TEST METHOD	SAMPLING PLAN
MICROSTRUCTURE	Shall be solution treated and aged. Microstructure shall be free from bursts and voids and shall exhibit primary Alpha grains in aged transformed Beta matrix per ASM Handbook "Atlas of Microstructures of Industrial Alloys". Alloy segregation which adversely affects the mechanical or physical properties is not acceptable. Any indications of heating above the Beta transus temperature range without the subsequent mechanical reduction in alpha-beta temperature range shall be limited to .003 inch max depth on the head non-bearing surface and the point end of the fastener. All other areas of the microstructure with outlines of equiaxed prior all-beta grains and no primary alpha shall be considered overheated and is unacceptable.	Metallurgical examination. See 3.3	Per TABLE IX.
HYDROGEN	Head to shank fillet area of finished titanium fasteners shall not have a hydrogen content exceeding .0125% (125 PPM) when tested per ASTM E1447.		Check one random part per lot. If hydrogen is below max limit, accept lot. If not, select a sample per TABLE IX. Reinspect for high element(s). Reject if one additional part shows excessive hydrogen. Not mandatory.
OXYGEN	Areas of the fastener not influenced by hot forging shall not have an oxygen content exceeding .2% (2000 PPM).	Determine material oxygen content from a test specimen produced from the thread end of a finished fastener. Use procedures and equipment that are capable of measuring the oxygen content to an accuracy of .0100% (100 PPM).	Check one random part per lot. If oxygen is below max limit, accept lot. If not, select a sample per TABLE IX. Reinspect for high element(s). Reject if one additional part shows excessive oxygen. Not mandatory.
GRAIN FLOW - THREADS	Per Figure 5. Formed by single rolling process after all thermal treatment.	Metallurgical examination. See 3.3	Per TABLE IX.
GRAIN FLOW - HEADS	Heads must be forged. Grain flow in a specific part may have various characteristics depending on configuration and/or processing; however, any metallurgical condition which adversely affects the mechanical properties of the part is not acceptable.		

REVISION

16

NAS4004
SHEET 5



Document Sharing Hub

USE OF OR RELIANCE UPON THIS DOCUMENT OR ANY NATIONAL AEROSPACE STANDARD IS ENTIRELY VOLUNTARY. AIA DOES NOT QUALIFY SUPPLIERS OR CERTIFY

Copyright Aerospace Industries Association of America, Inc. MS PRODUCED UNDER NATIONAL AEROSPACE STANDARD: AIA MAKES NO REPRESENTATION OR CLAIM RESPECTING (1) THE SUITABILITY OF
Provided by IHS under license with AIA/NAS Licensee= www.sepana.ir/5991803002, User=sam, albert
No reproduction or networking permitted without license from IHS Not for Resale, 01/04/2016 02:41:38 MST TRADEMARK RIGHTS.

Full document details: AIA NAS4004 2015

AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC
1000 WILSON BLVD.
ARLINGTON, VA 22209

THIS DRAWING SUPERSEDES ALL ANTECEDENT STANDARD DRAWINGS FOR THE SAME
PRODUCT AND SHALL BECOME EFFECTIVE NO LATER THAN SIX MONTHS FROM THE LAST
REVISION DATE.

FORM 12-01

TABLE I – BASIC REQUIREMENTS (CONTINUED)

CHARACTERISTICS	ENGINEERING REQUIREMENTS	TESTING REQUIREMENTS (SEE 3.1)	
		TEST METHOD	SAMPLING PLAN
FINISH	Per fastener drawing or part standard. Non-coated fastener surfaces shall be clean and free of processing fluids. Requirements for coated fasteners shall be as specified by the coating specification.	As specified in the coating specification for non-destructive tests.	Per TABLE XI if not stated in the coating specification.
		As specified in the coating specification for destructive tests.	
PACKAGING	Package to prevent nicking, scratching of threads or ground surfaces, or other damage during handling, transportation or storage. Unit packages must contain fasteners of one part number from one inspection lot only. Assortment of unit packages may be in larger packages. Packaging must allow for economical transportation and conform to consolidated freight classification rules.	Visual examination.	Not applicable.
MARKING	Fasteners shall be identified in accordance with the applicable part standard. Shipping packages and containers shall be marked in a durable and legible manner, located so it will not be damaged. Marking on shipping packages will include, at a minimum, the following data; part number, purchase order number and manufacturer's name/logo and inspection lot number.	Visual examination.	Not applicable.

3. INSPECTION

- 3.1. **INSPECTION LOT:** An inspection lot shall consist of parts which are of the same configuration, head style and diameter, fabricated from the same mill heat of material; heat treated and finished in one continuous process or single batch, and submitted for the manufacturer's inspection at the same time. Each Manufacturing Lot shall be identified by a number to be included in the packaging marking. For the purpose of reducing the number of destructive tests, it will be permissible to manufacture one or more sub lots of fasteners. All such produced sub lots shall incorporate the same product head style and diameter as the primary lot, but different grip lengths, shall be produced from the same heat lot of material and shall be processed with the primary lot as one large lot through all the manufacturing processes utilized in the production of the primary lot. Specimens shall be selected from the primary lot and each sub lot on a proportional basis and each sub lot shall be represented by at least one part. The number of test specimens for the destructive tests shall be based upon the combined total of the primary lot and all sub lots. When parts of the primary lot are too short for certain mechanical tests, a sub lot of longer parts may be produced and utilized for the product verification tests providing the sub lot was produced as stated above.
- 3.2. **INSPECTION TESTS:** The fastener manufacturer shall conduct the Inspection tests listed in TABLE I on each Inspection Lot as defined in 3.1 except those tests listed as "Not mandatory". However, each Inspection Lot shall be capable of meeting the requirements of all Inspection Tests including those Inspection Tests which indicate "Not mandatory". The Receiving Contractor may conduct verification tests on all Characteristics listed in Table I including those listed as "Not Mandatory". The Inspection Lot is rejectable if the testing of any characteristic fails to verify that the Inspection Lot is compliant with all requirements listed.

REVISION

16

NAS4004
SHEET 6



Document Sharing Hub

USE OF OR RELIANCE UPON THIS DOCUMENT OR ANY NATIONAL AEROSPACE STANDARD IS ENTIRELY VOLUNTARY. AIA DOES NOT QUALIFY SUPPLIERS OR CERTIFY

Copyright Aerospace Industries Association of America Inc. MS PRODUCED UNDER NATIONAL AEROSPACE STANDARD: AIA MAKES NO REPRESENTATION OR CLAIM RESPECTING (1) THE SUITABILITY OF
Provided by IHS under license with AIA/NAS. ANY PARTICULAR APPLICATION OR (2) THE EXISTENCE OF OR APPLICABLE LICENSEE: www.sepana.ir/5991803002, User=sam, albert
No reproduction or networking permitted without license from IHS. Not for Resale, 01/04/2016 02:41:38 MST. TRADEMARKS RIGHTS.

Full document details: AIA NAS4004 2015

- 3.2.1 **SAMPLING:** Samples for inspection shall be selected at random except as noted under TABLE IX, Attribute Sampling Plan for Metallurgical Characteristics. The same sample(s) may be used for inspection of dimensions, surface texture, identification, and thread dimensions. If a sample(s) passes these inspections, the sample(s) for destructive test(s) may be selected at random from this group. A separate sample is necessary for metallurgical examination. Penetrant indications of themselves shall not be cause for rejection and lack of indications shall not be cause for acceptance. Acceptance or rejection for metallurgical properties shall be based upon metallurgical examinations per Paragraph 3.3.
- 3.2.2 **SCREENING:** 100% Inspection (accompanied by rejection of defective parts) may be applied at the inspectors discretion to any lot which is not acceptable by sampling plans described herein. Screening may be applied only to characteristics inspected by non-destructive tests. For characteristics inspected by destructive tests, the entire lot shall be accepted or rejected according to test results of the prescribed sampling plan.
- 3.3 **METALLURGICAL EXAMINATION:** Specimens shall be machined from parts as shown in FIGURE 4, etched in accordance with ASTM E340 and ASTM E407, and examined at magnification stated below.
- | | |
|--|----------------------------------|
| Thread Grain Flow | Micro examination (50X to 100X) |
| Head Grain Flow | Macro examination (6X to 50X) |
| Microstructure | Micro examination (200X to 500X) |
| Surface Contamination | Micro examination (200X to 500X) |
| Discontinuities and Grain Growth | Micro examination (50X to 100X) |
- Measurements of discontinuities may be performed at higher magnifications as required for accurate measurement.
- 3.4 **INSPECTION REPORT:** Each shipment shall be accompanied by an inspection report as a part of or separate from the shipment notice. If more than one inspection lot is included in the shipment, a separate inspection report is necessary for each inspection lot and unit packages must clearly identify the applicable lot. The report(s) shall be in duplicate and be signed by an authorized employee of the shipper. This report shall provide the following:
1. A statement substantially as follows: "The parts contained in this shipment have been manufactured and inspected in accordance with applicable drawings and specifications."
 2. Customers name (and division, if applicable).
 3. Purchase order number and date.
 4. Part number and Revision Level (manufacturer's part number may also be included).
 5. Part name and type.
 6. Inspection lot size(s) and lot number.
 7. Quantity shipped.
 8. Material heat number.
 9. Material composition (include mill heat report, independent lab test or part manufacturer's test - state which).
 10. Mechanical test results (individual test results, averages or statistical analysis as required) and required minimums.
 11. Discontinuities and metallurgical evaluation.
 12. Deviations, if any (explanation required).
 13. Procurement specification number and revision level.
 14. Other data desired by purchaser.

REVISION

16

NAS4004
SHEET 7



Document Sharing Hub

USE OF OR RELIANCE UPON THIS DOCUMENT OR ANY NATIONAL AEROSPACE STANDARD IS ENTIRELY VOLUNTARY. AIA DOES NOT QUALIFY SUPPLIERS OR CERTIFY

Copyright Aerospace Industries Association of America Inc. THIS DOCUMENT IS PRODUCED UNDER NATIONAL AEROSPACE STANDARD: AIA MAKES NO REPRESENTATION OR CLAIM RESPECTING (1) THE SUITABILITY OF
Provided by IHS under license with AIA/NAS Licensee= www.sepana.ir/5991803002, User=sam, albert
No reproduction or networking permitted without license from IHS Not for Resale, 01/04/2016 02:41:38 MST TRADEMARKS RIGHTS.

Full document details: AIA NAS4004 2015