

FED. SUPPLY CLASS

53GP

1. SCOPE

- 1.1 This specification defines the requirements for alloy steel externally threaded fasteners procured under part numbers listed on drawings which refer to this specification. Drawings may carry notes which modify the requirements of this specification. Receiving contractors may reject any lot which does not conform.
- 1.2 Recommendations for improvements or correction of this specification should be directed to a NASC representative of a using aerospace company or 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.

Military Specifications

MIL S 5000 — Steel, Chrome-Nickel-Molybdenum (4340) Bars and Reforging Stock

MIL S 6049 — Steel, Chrome-Nickel-Molybdenum (8740) Bars, Rods and Forging Stock (for Aircraft Applications)

Federal Standards

FED-STD-H28/21 Screw Thread Standards for Federal Services, Section 21, Metric Screw Threads

Copies can be obtained from the Department of Defense Single Stock Point (DODSSP). <http://dodssp.daps.dla.mil>

Industry Standards

American Society for Quality

ANSI/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

ASTM International

ASTM E112 Grain Size, Average, of Metals, Estimating

ASTM E1444 Inspection Process, Magnetic Particle

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

NASM1312 Fasteners Test Methods (Metric)

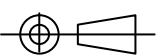
Copies can be obtained from the Aerospace Industries Association, 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209. www.aia-aerospace.org

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

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PROCUREMENT
SPECIFICATION

NONE

TITLE
**PROCUREMENT SPECIFICATION, METRIC FASTENERS,
ALLOY STEEL, EXTERNALLY THREADED,
1250 MPa TENSILE, 750 MPa SHEAR**

CLASSIFICATION
SPECIFICATION

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SAE International

AS3062	Bolts, Screws and Studs, Screw Thread Requirements
AMS6322	Steel Bars, Forgings, and Rings .50Cr - .55Ni - .25Mo (.38 - .43C) (SAE 8740) (UNS G87400)
AMS6325	Steel, Bars and Forgings .50Cr - .55Ni - .25Mo (.38 - .43C) (SAE 8740) Heat Treated, 105 KSI (724 MPa) Tensile Strength (UNS G87400)
AMS6327	Steel Bars and Forgings .50Cr - .55Ni - .25Mo (.38 - .43C) (SAE 8740) Heat Treated, 125 KSI (862 MPa) Tensile Strength
AMS6415	Steel, Bars, Forgings, and Tubing .80Cr - 1.8Ni - .25Mo (.38 - .43C) (SAE 4340) (UNS G43406)
AMS6484	Steel, Bars, Forgings, and Tubing .80Cr - 1.8Ni - .25Mo (.38 - .43C) (SAE 4340) Normalized and Tempered
AMS2759	Heat Treatment of Steels, Process for

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

www.sae.org

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 Materials. Fasteners shall be fabricated from alloy steel conforming to ~~MIL-S-5000~~ AMS6415, AMS6484, ~~MIL-S-6049~~ AMS6322, AMS6325, or AMS6327.
- 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 finishes designated on the detailed drawing. Dimensions shall exclude dry film lubricants. Measurements shall be made per 4.4.1.
- 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. Thread form and dimensions shall conform to FED-STD-H28/21 or as required by the applicable detail drawing.
- 3.3.3.1 Thread Forming. Threads shall be fully formed after final heat treatment. Threads shall be formed by a single rolling process.
- 3.3.3.2 Incomplete Threads. Incomplete thread pitches are permissible at the chamfered end and at the juncture of the unthreaded portion of the shank, per FED-STD-H28/21. The incomplete thread pitch next to the shank shall include a thread run-out at least one pitch wide and no more than two pitches wide.
- 3.3.3.3 Chamfer. The entering point of the thread shall be chamfered as specified in the applicable detail drawing.
- 3.3.3.4 Irregular Flank. 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 3 shall not be considered "Natural Flow". The roots and flanks of threads in the run-out area shall be filleted, smooth and devoid of abrupt tool marks.
- 3.3.3.5 Grain Flow. The grain flow in the threads 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 1.
- 3.3.3.5.1 Grain Size. Grain size in the vicinity of head or threads shall not differ from grain size in shank by more than one size (as defined in ASTM E112). Evaluation to be conducted at 50X to 60X magnification.
- 3.3.4 Heads. Fastener heads shall be formed by forging before heat treatment. Recesses may be forged or machined. Flash or chip clearance in machined recesses shall not cause recess dimensions to exceed the specified limits.

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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 Lines.** A metallographic cross section of the head shall show no detrimental defects (see Section 4.4.3) and shall exhibit grain flow lines substantially as illustrated in Figure 1 (sizes larger than 5 mm thread). Grain flow lines shall be continuous and shall not terminate in the head to shank fillet, but may show minor interruption resulting from finish machining operation.

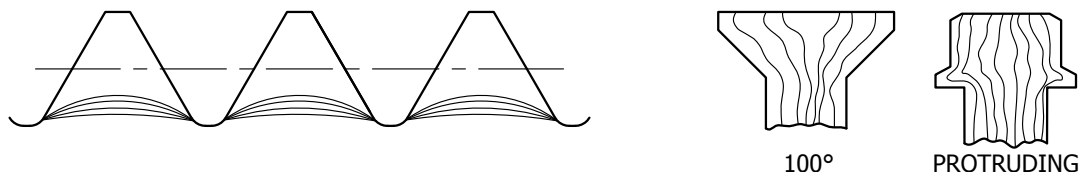
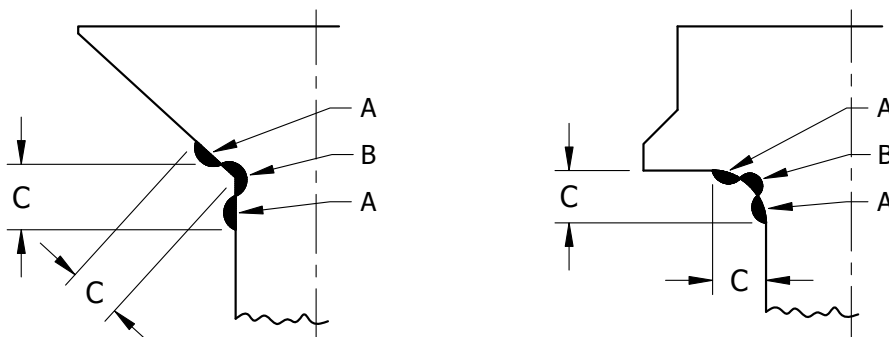


FIGURE 1 – GRAIN FLOW IN THREAD AND HEAD

3.3.5 **Head-Shank Fillet.** The juncture of the fastener head and shank shall be cold worked by a rolling process in thread size 5 mm 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 limits in Figure 2. A short tapered lead into the fillet area is permissible providing the dimensions do not exceed the limits of the detail drawing.



NOMINAL SIZE	5, 6 and 7 mm	8 and 10 mm	12, 14 and 16 mm	18 mm and larger
C MAX	1,5 mm	2,5 mm	3,2 mm	4,0 mm

Cold working of head to shank fillet may cause distortion of fillet area. Distortion shall not exceed 0,05 mm above "A" or below "B" contour shown on fastener drawing. Distorted area shall not extend beyond "C" as illustrated above.

FIGURE 2 – DISTORTION DUE TO FILLET ROLLING

3.3.6 **Straightness.** The straightness of the fastener shank shall be within the limits of Table I when the fastener shank is rolled in "V" blocks (max width each block 8 mm) placed on surface plates and the greatest deviation is measured with a dial indicator graduated in 0,025 mm.

TABLE I – SHANK STRAIGHTNESS

NOMINAL SHANK DIAMETER	MAXIMUM DEVIATION (mm PER 10 mm OF LENGTH)
8 mm AND UNDER	0,02
10 mm AND LARGER	0,015

3.3.7 **Coaxiality.** The coaxiality tolerance between the thread and the shank of bolts, which is the coaxiality of the shank with respect to the pitch diameter as the datum, shall be as specified on the detailed drawing. The position of measurement shall be at a distance of $1 \times \text{ØD}$ from the point where the thread runout meets the shank. When the shank length is less than $2 \times \text{ØD}$, coaxiality shall be measured at a distance midway between the head and the thread runout.

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- 3.4 Heat Treat. Fasteners shall be heat treated in accordance with AMS2759 to develop the mechanical properties specified herein, without adverse effect on metallurgical properties as defined herein.
- 3.5 Hardness. Fasteners shall be tested for hardness on the thread end after heat treatment and prior to thread roll per MIL-STD-1312-6 (Metric). Only lots having Rockwell hardness readings in the range of 40-43 HRC for sample per Paragraph 4.3.2.4 shall be subjected to further processing.
- 3.6 Mechanical Properties. Mechanical properties of fasteners shall conform to the following requirements.
- 3.6.1 Ultimate Tensile Strength. Tensile test per DOD-STD-1312-108. Minimum ultimate tensile strength shall conform to the requirements of Table II. Tensile tests are not applicable to full threaded fasteners whose length is less than three times the diameter, to grip-type threaded fasteners with grip less than two times the diameter. Tensile strength shall apply to fasteners prior to drilling.
- 3.6.2 Ultimate Double Shear Strength. Shear test per DOD-STD-1312-113. Minimum ultimate double shear shall conform to the requirements of Table II. Shear tests are not applicable to protruding head fasteners whose grip is less than twice the diameter, nor to flush head fasteners whose grip is less than 2 1/2 times the diameter.
- 3.6.3 Fatigue Life. When tested in accordance with 4.4.2.2, the fatigue life shall conform to 4.4.2.3. Fasteners with drilled shanks need not be fatigue tested. Fatigue tests are not applicable to fasteners smaller than 5 mm thread size or to fasteners having a grip less than twice the nominal diameter.

TABLE II – TENSILE AND SHEAR PROPERTIES

THREAD		A _{tu} TENSILE STRESS AREA mm ² /a/	MINIMUM TENSILE FORCE N		A _{su} AREA OF SHANK AT NOM DIA mm ² /c/	MINIMUM DOUBLE SHEAR FORCE N /c/
DIA mm	PITCH mm		EXTERNAL WRENCHING HEAD /a/	STD 100° HEAD /b/		
4	0,7	9,9	12 300	9 840	12,6	18 900
5	0,8	15,8	19 700	15 700	19,6	29 400
6	1,0	22,5	28 100	22 500	28,3	42 500
7	1,0	31,7	39 600	31 700	38,5	57 700
8	1,0	42,4	53 000	42 400	50,3	75 500
10	1,25	66,3	82 900	66 300	78,5	118 000
12	1,25	98,3	123 000	98 400	113	170 000
14	1,5	133,3	166 000	133 000	154	231 000
16	1,5	177,3	221 000	177 000	201	302 000
18	1,5	227,7	284 000	227 000	254	381 000
20	1,5	284,3	355 000	284 000	314	471 000
22	1,5	347,2	434 000	347 000	380	570 000
24	2,0	404,7	505 000	404 000	452	678 000

- /a/ Tensile stress area is the area at the basic pitch diameter. Tensile force for external wrenching heads is calculated from the formula $A_{tu} \times 1250 \text{ MPa} = N_{tu}$.
- /b/ Tensile force for standard 100° head is based on 80% of external wrenching head values.
- /c/ Single shear cross sectional area is the area at the nominal shank diameter. Double shear force is calculated from the formula $A_{su} \times 2 (750 \text{ MPa}) = N_{su}$.

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