

**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.

Federal Standards

FED-STD-H28/21 Screw-Thread Standards for Federal Services  
FED-STD-H28/20 Screw-Thread, Inspection Method for Acceptability

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)

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

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](http://www.asq.org)

ASTM International

ASTM E1444 Inspection Process, Magnetic Particle  
ASTM E112 Standard Test Methods for Determining Average Grain Size

Copies can be obtained from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959. [www.astm.org](http://www.astm.org)

Aerospace Industries Association

NAM1312 Fasteners, Test Methods, Metric  
NASM1312 Fasteners, Test Methods

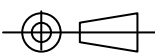
Copies can be obtained from the Aerospace Industries Association, 1000 Wilson Blvd., Suite 1700, Arlington, VA 22209. [www.aia-aerospace.org](http://www.aia-aerospace.org)

ASME

ASME B46.1 Surface Texture (Metric)

Copies can be obtained from ASME, Three Park Ave., New York, NY 10016-5990. [www.asme.org](http://www.asme.org)

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| THIRD ANGLE PROJECTION  | CUSTODIAN<br>NATIONAL AEROSPACE STANDARDS COMMITTEE                                                                                    | REVISION<br><b>3</b>                                               |
| PROCUREMENT SPECIFICATION<br><br>NONE                                                                      | TITLE<br><b>PROCUREMENT SPECIFICATION,<br/>METRIC FASTENERS, ALLOY STEEL, EXTERNALLY<br/>THREADED, 1100 MPa TENSILE, 660 MPa SHEAR</b> | CLASSIFICATION SPECIFICATION<br><br><b>NA0008</b><br>SHEET 1 OF 13 |

SAE International

~~AS3062 Bolts, Screws and Stud, 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

Copies can be obtained from SAE International, 400 Commonwealth Dr., Warrendale, PA 15096-0001. [www.sae.org](http://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 texture. Surface texture shall be in accordance with the requirements of the detail drawing.

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 and not more than two pitches.

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 and Paragraph 3.7.2.3 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 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).

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.** 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 lines shall be continuous and shall not terminate in the head to shank fillet, but may show minor interruption resulting from finish machining operation. Grain size in 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.
- 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.
- 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.
- 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  $1x\varnothing D$  from the point where the thread runout meets the shank. When the shank length is less than  $2x\varnothing D$ , coaxiality shall be measured at a distance midway between the head and the thread runout.

TABLE I – SHANK STRAIGHTNESS

| NOMINAL SHANK<br>DIAMETER | MAXIMUM DEVIATION<br>(mm PER 10 mm OF LENGTH) |
|---------------------------|-----------------------------------------------|
| 8 mm and under            | 0,02                                          |
| 10 mm and larger          | 0,015                                         |

- 3.4 **Heat treat.** Fasteners shall be heat treated 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 in accordance with MIL-STD-1312-6. Only lots having Rockwell hardness readings in the range of 36-40 HRC for sample per 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.** When tested in accordance with 4.4.2.1, the minimum ultimate tensile strength shall conform to the requirements of Table II and 4.4.2.3. 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 nominal diameter. Tensile strength shall apply to fasteners prior to drilling.
- 3.6.2 **Ultimate double shear strength.** When tested in accordance with 4.4.2.2, the minimum ultimate double shear strength shall conform to the requirements of Table II and 4.4.2.3. Shear tests are not applicable to protruding head fasteners whose grip is less than two times the nominal diameter, not to flush head fasteners whose nominal grip is less than two and one half times the nominal diameter.
- 3.6.3 **Fatigue life.** When tested in accordance with 4.4.2.4, the fatigue life shall conform to 4.4.2.5. High force and low force shall be as specified in Table III. 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.

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TABLE II – TENSILE AND SHEAR PROPERTIES

| THREAD<br>DIA<br>mm | PITCH<br>mm | TENSILE<br>STRESS<br>AREA (A <sub>tu</sub> )<br>mm <sup>2</sup> /a/ | MINIMUM TENSILE FORCE<br>N |                      | AREA OF<br>SHANK AT<br>NOM DIA (A <sub>tu</sub> )<br>mm <sup>2</sup> /c/ | MINIMUM<br>DOUBLE<br>SHEAR FORCE<br>N /c/ |
|---------------------|-------------|---------------------------------------------------------------------|----------------------------|----------------------|--------------------------------------------------------------------------|-------------------------------------------|
|                     |             |                                                                     | HEX HEAD/PAN HEAD<br>/a/   | STD 100° HEAD<br>/b/ |                                                                          |                                           |
| 3                   | 0,5         | 5,6                                                                 | 6 160                      | 4 930                | 7,1                                                                      | 9 370                                     |
| 3,5                 | 0,6         | 7,6                                                                 | 8 360                      | 6 690                | 9,6                                                                      | 12 700                                    |
| 4                   | 0,7         | 9,9                                                                 | 10 900                     | 8 720                | 12,6                                                                     | 16 600                                    |
| 5                   | 0,8         | 15,8                                                                | 17 400                     | 13 900               | 19,6                                                                     | 25 900                                    |
| 6                   | 1,0         | 22,5                                                                | 24 800                     | 19 800               | 28,3                                                                     | 37 400                                    |
| 7                   | 1,0         | 31,7                                                                | 34 900                     | 27 900               | 38,5                                                                     | 50 800                                    |
| 8                   | 1,0         | 42,4                                                                | 46 600                     | 37 300               | 50,3                                                                     | 66 400                                    |
| 10                  | 1,25        | 66,3                                                                | 72 900                     | 58 300               | 78,5                                                                     | 104 000                                   |
| 12                  | 1,25        | 98,3                                                                | 108 000                    | 86 400               | 113                                                                      | 149 000                                   |
| 14                  | 1,5         | 133,3                                                               | 147 000                    | 117 000              | 154                                                                      | 203 000                                   |
| 16                  | 1,5         | 177,3                                                               | 195 000                    | 156 000              | 201                                                                      | 265 000                                   |
| 18                  | 1,5         | 227,7                                                               | 250 000                    | 200 000              | 254                                                                      | 335 000                                   |
| 20                  | 1,5         | 284,3                                                               | 313 000                    | 250 000              | 314                                                                      | 414 000                                   |
| 22                  | 1,5         | 347,2                                                               | 382 000                    | 306 000              | 380                                                                      | 502 000                                   |
| 24                  | 2,0         | 404,7                                                               | 445 000                    | 356 000              | 452                                                                      | 597 000                                   |

/a/ Tensile stress area is the area at the basic pitch diameter. Tensile force for hex head and pan head is calculated from the formula  $A_{tu} \times 1100 \text{ MPa} = T$ .

/b/ Tensile face for standard 100° head is based on 80% of hex head values.

/c/ Single shear cross sectional area is the area at the nominal shank diameter. Double shear force is calculated from the formula  $A_{su} \times 2 (660 \text{ MPa}) = S$ .

TABLE III – FATIGUE LOADING

| THREAD    |             | TENSION-TENSION FATIGUE FORCE N |           |                        |           |
|-----------|-------------|---------------------------------|-----------|------------------------|-----------|
| DIA<br>mm | PITCH<br>mm | HEX HEAD/PAN HEAD /d/           |           | STANDARD 100° HEAD /e/ |           |
|           |             | HIGH FORCE                      | LOW FORCE | HIGH FORCE             | LOW FORCE |
| 5         | 0,8         | 7 830                           | 783       | 5 210                  | 521       |
| 6         | 1,0         | 11 100                          | 1 110     | 7 430                  | 743       |
| 7         | 1,0         | 15 700                          | 1 570     | 10 500                 | 1 050     |
| 8         | 1,0         | 21 000                          | 2 100     | 14 000                 | 1 400     |
| 10        | 1,25        | 32 800                          | 3 280     | 21 900                 | 2 190     |
| 12        | 1,25        | 48 600                          | 4 860     | 32 400                 | 3 240     |
| 14        | 1,5         | 66 100                          | 6 610     | 43 900                 | 4 390     |
| 16        | 1,5         | 87 700                          | 8 770     | 58 500                 | 5 850     |
| 18        | 1,5         | 112 000                         | 11 200    | 75 000                 | 7 500     |
| 20        | 1,5         | 141 000                         | 14 100    | 93 800                 | 9 380     |
| 22        | 1,5         | 172 000                         | 17 200    | 115 000                | 11 500    |
| 24        | 2,0         | 200 000                         | 20 000    | 134 000                | 13 400    |

/d/ High fatigue force is 45% of ultimate tensile force listed in Table II. Low force is 10% of high force.

/e/ High fatigue force is 37.5% of ultimate tensile force listed in Table II. Low force is 10% of high force.

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