



AEROSPACE STANDARD

AS7456™**REV. C**

Issued 1991-02
Revised 2016-04
Reaffirmed 2021-08

Superseding AS7456B

Studs, Steel, Low Alloy
Heat Treated, Roll Threaded

RATIONALE

Revise and update sampling and inspection requirements and general editorial update.

1. SCOPE

1.1 Type

This procurement specification covers aircraft quality studs made from a low alloy steel of the type identified under the Unified Numbering System as UNS G87400, and of a series of room temperature tensile strengths ranging from 125000 to 185000 psi.

1.2 Application

Primarily for aerospace propulsion system applications in light alloys where good strength is required and the part is protected against corrosion.

1.3 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of the other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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Documents
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2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2750	Pyrometry
AMS6322	Steel Bars, Forgings, and Rings, 0.50Cr - 0.55Ni - 0.25Mo (0.38 - 0.43C) (SAE 8740)
AMS6327	Steel Bars and Forgings, 0.50Cr - 0.55Ni - 0.25Mo (0.38 - 0.43C) (SAE 8740), Heat Treated, 125 ksi (862 MPa) Tensile Strength
AS3062	Bolts, Screws, and Studs, Screw Thread Requirements
AS3063	Bolts, Screws, and Studs, Geometric Control Requirements

2.1.2 U.S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-STD-2073-1 Military Packaging, Standard Practice for

2.1.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E140	Standard Hardness Tables for Metals
ASTM E1444/E1444M	Magnetic Particle Examination
ASTM E8/E8M	Tension Testing of Metallic Materials

2.1.4 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

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

2.1.5 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NASM1312-6	Fastener Test Methods, Method 6, Hardness
NASM1312-8	Fastener Test Methods, Method 8, Tensile Testing
NASM1312-12	Fastener Test Methods, Method 12, Plating Thickness

2.2 Definitions

BURR: A rough edge or ridge left on the metal due to cutting, grinding, piercing, or blanking operation.

COLD ROLLING: Forming material below the recrystallization temperature.

CRACK: Rupture in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character.

DEFECT: Any nonconformance of the unit or the product with specified requirements.

DEFECTIVE: A unit of the product which contains one or more defects.

DISCONTINUITY: An interruption in the normal physical structure or configuration of a part; such as a lap, seam, inclusion, crack, machining tear, or stringer.

HEAT PATTERN: A discernible difference in etched appearance between the head and the shank caused by forming of the head.

INCLUSION: Nonmetallic particles originating from the material making process. They may exist as discrete particles or strings of particles extending longitudinally.

LAP: Surface imperfection caused by folding over metal fins or sharp corners and then rolling or forging them into the surface. The allowable lap depth shall not exceed the limit specified herein. The minimum condition that shall be rated as a lap is a fold having its length equal to or greater than three times its width with a depth of 0.0005 inch when viewed at 200X magnification.

MACHINING TEAR: A pattern of short jagged individual cracks, generally at right angles to the direction of machining, frequently the result of improperly set cutting tools, or dull cutting tools.

PRODUCTION INSPECTION LOT: Shall be all finished parts of the same part number, made from a single heat of alloy, heat treated at the same time to the same specified condition, produced as one continuous run, and submitted for manufacturer's inspection at the same time.

SEAM: Longitudinal surface imperfection in the form of an unwelded, open fold in the material.

STRINGER: A solid nonmetallic impurity in the metal bar, often the result of an inclusion that has been extended during the rolling process.

TIGHT BURR: A burr closely compacted and binding in the periphery of a part without loose ends and is within the dimensional limits of the part.

2.3 Unit Symbols

A - ampere
°F - degree Fahrenheit
% - percent (1% = 1/100)
lbf - pounds force
psi - pounds force per square inch
sp gr - specific gravity

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS6322 or AMS6327 steel, unless otherwise specified on the part drawing.

3.2 Design

Finished (completely manufactured) parts shall conform to the following requirements.

3.2.1 Dimensions

The dimensions of finished parts, after all processing, including plating, shall conform to the part drawing. Dimensions apply after plating but before coating with solid film lubricants.

3.2.2 Surface Texture

Surface texture of finished parts, prior to plating or coating, shall conform to the requirements as specified on the part drawing, determined in accordance with ASME B46.1.

3.2.3 Threads

Screw thread UNJ profile and dimensions shall be in accordance with AS8879, unless otherwise specified on the part drawing. Tolerances for pitch diameter of stud end threads shall be as specified on the part drawing. The special stud end thread requirements shall be in accordance with AS3062 for the following requirements:

- a. Lead and half-angle variations
- b. Taper
- c. Out-of-roundness
- d. Stud lead threads
- e. Stud thread runout

3.2.3.1 The requirements for thread crest variations, locking holes in the nut end thread, incomplete lead thread, and thread runout on nut end thread shall be as specified in AS3062.

3.2.3.2 Chamfer

The entering end of the thread (both ends) shall be chamfered as specified on the part drawing.

3.2.4 Geometric Tolerances

Part features shall be within the geometric tolerances specified on the part drawing and, where applicable, controlled in accordance with AS3063.

3.3 Fabrication

3.3.1 Blanks

Shall be machined sufficiently to remove surface defects and decarburization except as noted in 3.7.2.3. Blanks may be produced by machining, upsetting, extruding, or by a combination of these methods.

3.3.1.1 When a shoulder or shoulders are produced by upsetting, the metal removed from the bearing surface shall be as little as practicable to provide a clean, smooth surface.

3.3.2 Heat Treatment

Unless machined from heat treated stock, blanks shall, before finishing the shank and rolling the threads, be heat treated as follows

3.3.2.1 Heating Equipment

Furnaces may be any type ensuring uniform temperature throughout the parts being heated and shall be equipped with, and operated by, automatic temperature controllers and data recorders conforming to AMS2750. The heating medium or atmosphere shall cause no surface hardening by carburizing or nitriding nor decarburization other than that permitted by 3.7.2.2 and 3.7.2.3.

3.3.2.2 Hardening

Blanks of AMS6322 shall be uniformly heated to 1550 °F, held at heat for not less than 15 minutes, and quenched in oil. For other steels, when specified, the temperature shall be as agreed upon by purchaser and vendor.

3.3.2.3 Tempering

Hardened blanks shall be tempered by heating uniformly to the temperature necessary to produce the specified hardness and microstructure, holding at heat for not less than 1 hour, and cooling.

3.3.3 Oxide and Decarburization Removal

Surface oxide, oxide penetration, and decarburization except as permitted in 3.7.2.3, resulting from prior heat treatment, shall be removed from the full body diameter and the bearing surfaces, as applicable, of the heat treated blanks prior to rolling the threads. The removal process shall produce no intergranular attack or corrosion of the blanks.

3.3.4 Thread Rolling

Threads shall be formed on the heat treated and finished blanks by a single rolling process for each end after removal of oxide and decarburization as in 3.3.3.

3.4 Product Marking

Each part shall be marked for oversize on stud end thread and for material code on the nut end as specified on the part drawing. The markings may be formed by stamping, depressed 0.010 inch maximum, with rounded root form on depressed characters.

3.5 Plating

When required, any protective treatment shall be as specified on the part drawing.

3.6 Mechanical Properties

Parts shall conform to the requirements of 3.6.1 and 3.6.2. Threaded members of gripping fixtures for tensile test shall be of sufficient size and strength to develop the full strength of the part without stripping the thread. The loaded portion of the shank shall have two to three full thread turns from the thread runout exposed between the loading fixtures during tensile test. Finished parts shall be tested in accordance with the following applicable test methods

- a. Hardness: MIL-STD-1312-6 in accordance with NASM1312-6.
- b. Room Temperature Ultimate Tensile Strength: MIL-STD-1312-8 in accordance with NASM1312-8.

3.6.1 Ultimate Tensile Strength at Room Temperature

3.6.1.1 Finished Parts

Parts having hardness not lower than 26 HRC shall have an ultimate tensile load not lower than that specified in Table 3 and shall be tested to failure, first measuring and recording the maximum tensile load achieved. If the size or shape of the part is such that failure would occur outside the threaded section but the part can be tested satisfactorily, such as parts having a shank diameter equal to or less than the thread root diameter or having an undercut, parts shall conform to only the ultimate tensile requirements of 3.6.1.2; for such parts, the diameter of the area on which stress is based shall be the actual measured minimum diameter of the part.

3.6.1.2 Machined Test Specimens

If the size or shape of the part is such that a tensile test cannot be made on the part, tensile tests shall be conducted in accordance with ASTM E8/E8M on specimens prepared as in 4.5. Such specimens shall meet the following requirements in Table 1 for the applicable hardness:

Table 1 - Tensile properties of specimens

Minimum Hardness of Specific Range HRC	Ultimate Tensile Strength psi, Minimum	Elongation in 2 inches or 4D %, Minimum	Reduction of Area %, Minimum
26	125000	15	52
32	145000	13	50
36	165000	12	47
40	185000	10	43

3.6.1.2.1 When permitted by purchaser, hardness tests on the end of parts may be substituted for tensile tests of machined specimens.

3.6.2 Hardness

Shall be uniform within the range 26 to 32 HRC, unless otherwise specified on the part drawing, but hardness of the threaded sections may be higher as a result of the cold working operations.

3.7 Quality

Parts shall be uniform in quality and condition, clean, sound, smooth, and free from burrs and foreign materials, and from imperfections detrimental to their performance.

3.7.1 Macroscopic Examination

Parts or sections of parts, as applicable, shall be etched in a solution consisting of approximately 50% hydrochloric acid (sp gr 1.19), and 50% water for sufficient time to reveal flow lines but not longer than 15 minutes, and then be examined at a magnification of approximately 20X to determine conformance to the requirements of 3.7.1.1, 3.7.1.2, and 3.7.1.3, except that examination for thread imperfections as specified in 3.7.1.3 should be made by microscopic examination of specimens polished and etched as in 3.7.2.

3.7.1.1 Flow Lines

Flow lines in threads shall be continuous, shall follow the general thread contour, and shall be of maximum density at the root of the thread (see Figure 1). Below the thread roots, flow lines not affected by forming shall be parallel to the axis except that on the nut end of studs formed by extruding, the flow lines may be oblique to the axis for a distance from the end of the larger diameter to the smaller diameter equal to 1.5 times the "B" dimension of Table 2 of AS3062.