



AEROSPACE STANDARD

AS7468™**REV. C**

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Superseding AS7468B

(R) Bolts, Cobalt-Chromium-Nickel Alloy UNS R30035,
Tensile Strength 260 ksi, Procurement Specification

RATIONALE

AS6416 added, many paragraphs updated or deleted, specs updated, photo of bolt head deleted, figures redrawn, notes updated, usage note added.

1. SCOPE

This procurement specification covers bolts made from a corrosion resistant, work-strengthened, cobalt-chromium-nickel alloy of the type identified under the Unified Numbering System as UNS R30035.

1.1 Type

The following specification designations and their properties are covered:

AS7468 260 ksi minimum ultimate tensile strength at room temperature
135 to 13.5 ksi tension fatigue at room temperature

AS7468-1 260 ksi minimum ultimate tensile strength at room temperature
145 ksi minimum ultimate shear strength at room temperature

1.2 Application

Primarily for use in aerospace propulsion system bolt applications where an excellent combination of strength, fatigue, and corrosion resistance is required at temperatures up to 700 °F.

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.

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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 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.

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
AMS5844	Alloy, Corrosion-Resistant, Round Bars 20Cr - 35Ni - 35Co - 10Mo Vacuum Induction Plus Consumable Electrode Vacuum Remelted Solution Heat Treated and Work Strengthened
AS1132	Bolts, Screws and Nuts - External Wrenching UNJ Thread, Inch - Design Standard
AS3062	Bolts, Screws, and Studs, Screw Thread Requirements
AS3063	Bolts, Screws, and Studs, Geometric Control Requirements
AS6416	Bolts, Screws, Studs and Nuts, Definitions for Design, Testing and Procurement
AS8879	Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9285, www.astm.org.

ASTM E8/E8M	Standard Test Methods for Tension Testing of Metallic Materials
ASTM E112	Determining Average Grain Size
ASTM E140	Standard Hardness Conversion Tables for Metals
ASTM E1417/1417M	Standard Practice for Liquid Penetrant Inspection
ASTM D3951	Standard Practice for Commercial Packaging

2.1.3 AIA/NAS 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 Strength
NASM1312-11	Fastener Test Methods, Method 11, Tension Fatigue
NASM1312-12	Fastener Test Methods, Method 12, Thickness of Metallic coatings
NASM1312-13	Fastener Test Methods, Method 13, Double Shear Test

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)

2.2 Definitions

Refer to AS6416.

2.3 Unit Symbols

° degree, angle

°F degree Fahrenheit

% percent (1% = 1/100)

lbf pounds force

ksi kips (1000 pounds) per square inch

sp gr specific gravity

HRC hardness Rockwell C scale

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5844 alloy heading stock.

3.2 Design

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

3.2.1 Dimensions

The dimensions, shall conform to the part drawing. Unless otherwise specified, dimensions apply after plating but before lubrication.

3.2.2 Surface Texture

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

3.2.3 Threads

Threads shall be in accordance with AS8879, unless otherwise specified on the part drawing.

3.2.3.1 Incomplete Lead and Runout Threads

Incomplete threads are permissible as specified in AS3062.

3.2.3.2 Chamfer

Bolts 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, in accordance with AS3063.

3.3 Fabrication

3.3.1 Blanks

Heads shall be formed by hot or cold forging; machined heads are not permitted, except lightening holes and wrenching recess may be forged or machined. Flash or chip clearance in machined recesses shall not cause recess dimensions to exceed the specified limits.

3.3.2 Heat Treatment

Before finishing the shank and bearing surface of the head, cold working the head-to-shank fillet radius, and rolling the threads, headed blanks shall be aged by heating to a temperature within the range 1000 to 1200 °F, holding at the selected temperature within ± 25 °F for 4 to 4.5 hours, and cooling in air to room temperature. Pyrometry shall be in accordance with AMS2750.

3.3.3 Oxide Removal

Surface oxide resulting from prior heat treatment shall be removed from the full body diameter, thread roll diameter, and bearing surface of the head, work-strengthened, and aged blanks prior to cold working the fillet radius and rolling the threads by a method such as centerless grinding. The oxide removal process shall produce no intergranular attack or corrosion of the blanks.

3.3.4 Cold Working of Fillet Radius

After removal of oxide as in 3.3.3, the head-to-shank fillet radius of headed parts having the radius complete through the circumference of the part shall be cold worked. The fillet shall be cold worked sufficiently to remove all visual evidence of grinding or tool marks. If there is no visual evidence of grinding or tool marks prior to cold working, the fillet shall still be cold worked. Distortion due to cold working shall conform to Figure 1, unless otherwise specified on the part drawing. It shall not raise metal more than 0.002 inches above the contour at "A" or depress metal more than 0.002 inch below the contour at "B" as shown in Figure 1; distorted areas shall not extend beyond "C" as shown in Figure 1.

3.3.4.1 Undercut Bolt Heads

In configurations having an undercut connected with the fillet radius, the cold working will be required only for 90 degrees of fillet arc, starting at the point of tangency of the fillet radius and the bearing surface of the head.

3.3.4.2 Shouldered Bolts

For shouldered bolts, having an unthreaded shank diameter larger than the thread major diameter and having an undercut connected with a fillet between the threaded shank and the shoulder of the unthreaded shank, the cold working will be required only for 90 degrees of the fillet arc, starting at the point of tangency of the fillet radius and the shouldered surface of the unthreaded shank.

3.3.4.3 Close Tolerance Bolts

The shank diameter on full shank close tolerance bolts shall not exceed its maximum diameter limit after cold rolling the head to shank fillet radius.

3.3.5 Thread Rolling

Thread shall be formed on the finished blanks by a single cold rolling process after removal of oxide as in 3.3.3.

3.3.6 Cleaning

Bolts, after finishing, shall be cleaned in one of the following solutions for the time and temperature shown and then thoroughly rinsed:

- a. One volume of nitric acid (sp gr 1.42) and nine volumes of water for not less than 20 minutes at room temperature.
- b. One volume of nitric acid (sp gr 1.42) and four volumes of water for 30 to 40 minutes at room temperature.
- c. One volume of nitric acid (sp gr 1.42) and four volumes of water for 10 to 15 minutes at 140 to 160 °F.
- d. ASTM A967, ASTM A380, or AMS2700 for cleaning parts only, excluding any additional verification requirements (such as salt spray).

3.4 Plating or Coating

Where required bolts, shall be plated or coated as specified by the part drawing. Where coating with solid film lubricants is required, the under head bearing surface, the unthreaded shank and the threads shall be coated as specified on the part drawing; other surfaces are optional to coat, unless otherwise specified. Plating or coating thickness shall be determined in accordance with the requirements in the applicable plating or coatings specification.

3.5 Mechanical Properties

Bolts for tensile tests and fatigue tests shall be of sufficient size to develop the full strength of the bolt without stripping the thread. The loaded portion of the shank shall have a minimum of two to three full threads from the thread runout exposed between the loading fixtures during tensile test.

AS7468 finished parts shall be tested in accordance with the following test methods:

- a. Hardness: MIL-STD-1312-6 in accordance with NASM1312-6
- b. Ultimate Tensile Strength at Room Temperature: MIL-STD-1312-8 in accordance with NASM1312-8
- c. Fatigue Strength at Room Temperature: MIL-STD-1312-11 in accordance with NASM1312-11
- d. Ultimate Double Shear at Room Temperature: MIL-STD-1312-13 in accordance with NASM1312-13

AS7468-1 finished parts shall be tested in accordance with the following test methods:

- a. Hardness: MIL-STD-1312-6 in accordance with NASM1312-6
- b. Ultimate Tensile Strength at Room Temperature: MIL-STD-1312-8 in accordance with NASM1312-8
- c. Ultimate Double Shear at Room Temperature: MIL-STD-1312-13 in accordance with NASM1312-13

3.5.1 Ultimate Tensile Strength at Room Temperature

3.5.1.1 Finished Parts

Tension fasteners with either standard double hexagon or spline drive heads having a minimum metal condition in the head equal to the design parameters specified in AS1132 (260 ksi configuration) shall not fracture in the head-to-shank fillet radius except when this radius is connected with an undercut or with a shank diameter less than the minimum pitch diameter of the thread.

3.5.1.2 Machined Test Specimens

If the size and the 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 4.5.7. Specimens may be required by the purchaser to perform confirmatory tests. Such specimens shall meet the following room temperature requirements:

- a. Ultimate Tensile Strength, minimum: 260 ksi
- b. Yield Strength at 0.2% Offset, minimum: 230 ksi
- c. Elongation in 4D, minimum: 8%
- d. Reduction of Area, minimum: 35%

3.5.2 Hardness

Shall not be lower than 44 HRC (see 8.1), but hardness of the threaded section and of the head-to-shank fillet area may be higher than other areas as a result of the cold working operations. Bolts shall not be rejected on the basis of hardness if the tensile strength properties are met.

3.5.3 Fatigue Strength

Finished tension bolts tested in tension-tension fatigue at room temperature with maximum load as specified in Table 2 and minimum load equal to 10% of the maximum load shall have an average life of not less than 65000 cycles with no part having less than 45000 cycles. Tests need not be run beyond 130000 cycles. The 130000 cycles is used for computing average life. If the shank diameter of the bolt is less than the minimum pitch diameter of thread, bolts shall withstand fatigue testing as above using loads sufficient to produce a maximum stress of 135 ksi and a minimum stress of 13.5 ksi. The above requirements apply to tension bolts, such as double hexagon and spline drive heads per design parameters specified in AS1132, 0.190 inch and larger in nominal thread size, having a head-to-shank fillet radius equal to or larger than that specified in AS1132, and not having an undercut; for all parts to which the above requirements do not apply, fatigue test requirements shall be as specified on the part drawing. Fatigue testing not required for bolts having a nominal grip length of less than two times the nominal diameter or threads with lockwire holes.

3.5.4 Ultimate Shear Strength

Finished bolts having a close toleranced full shank as in AS1132 shall have an ultimate double shear load no lower than that specified in Table 2. The double shear test may be discontinued after the ultimate double shear load has been reached, recording the load achieved. Shear bolts having special shank diameters shall have the double shear load based on 145 ksi shear strength. Shear tests are not required for the following conditions:

- a. Bolts threaded to head
- b. Protruding head bolts having coarse tolerance full shank
- c. Protruding head bolts having PD or relieved shank

3.6 Quality

Parts shall be uniform in quality and condition, free from burrs, foreign materials, and from imperfections detrimental to the usage of the parts.

3.6.1 Macroscopic Examination, Headed Blanks

A specimen from a headed blank shall be etched and examined at a magnification of 20X or greater to determine conformance to the requirements of 3.6.1.1 and 3.6.1.2.