



AEROSPACE STANDARD

AS7467™**REV. C**

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Revised 2021-04

Superseding AS7497B

(R) Bolts and Screws, Nickel Alloy, UNS N07718
Tensile Strength 185 ksi
Stress Rupture Rated
Procurement Specification

FSC 5306

RATIONALE

AS6416 added, many paragraphs updated or deleted, specs updated, figures redrawn, notes updated, usage note added, table values rounded up or down.

1. SCOPE

1.1 Type

This procurement specification covers bolts and screws made from a corrosion and heat resistant, age hardenable nickel base alloy of the type identified under the Unified Numbering System as UNS N07718. The following specification designations and their properties are covered:

AS7467 185 ksi minimum ultimate tensile strength at room temperature
145 ksi minimum ultimate tensile strength at 1200 °F
100 ksi stress rupture strength at 1200 °F

AS7467-1 185 ksi minimum ultimate tensile strength at room temperature
111 ksi minimum ultimate shear strength at room temperature

1.2 Application

Primarily for aerospace propulsion systems bolt applications where a good combination of tensile strength, stress rupture strength, and resistance to relaxation is required for use up to approximately 1200 °F; also, where a good combination of tensile strength and shear strength is required.

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 take necessary precautionary measures to ensure the health and safety of all personnel involved.

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Full document details: SAE AS7467C

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Documents

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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.

AMS2700	Passivation of Corrosion Resistant Steels
AMS2750	Pyrometry
AMS5662	Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings, 52.5Ni - 19Cr - 3.0Mo - 5.1Cb (Nb) - 0.90Ti - 0.50Al - 18Fe, Consumable Electrode or Vacuum Induction Melted, 1775 °F (968 °C) Solution Heat Treated, Precipitation-Hardenable
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 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 10, Stress Rupture
NASM1312-13	Fastener Test Methods, Method 13, Double Shear Test
NASM1312-18	Fastener Test Methods, Method 18, Elevated Temperature Tensile Strength

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 A380	Practice for Cleaning and Descaling of Stainless Steel Parts
ASTM A967	Chemical Passivation Treatment for Stainless Steel
ASTM D3951	Standard Practice for Commercial Packaging

ASTM E8/E8M	Standard Test Methods for Tension Testing of Metallic Materials
ASTM E21	Elevated Temperature Tension Tests of Metallic Materials
ASTM E112	Determining Average Grain Size
ASTM E139	Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E140	Standard Hardness Conversion Tables for Metals, Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness
ASTM E1417/E1417M	Standard Practice for Liquid Penetrant Testing

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 and Abbreviations

°C	Degree, Celsius
°F	Degree, Fahrenheit
HRC	Hardness Rockwell C scale
lbf	Pounds force
%	Percent (1% = 1/100)
sp gr	Specific gravity
ksi	Kips (1000 pounds) per square inch

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5662 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 coating lubrication.

3.2.2 Surface Texture

Surface texture of finished parts, prior to plating or coating, shall conform to the 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 runouts and threads are 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, controlled in accordance with AS3063.

3.3 Fabrication

3.3.1 Blanks

Heads shall be formed by hot or cold forging; temperature for hot forging blanks shall be within the range of 1650 to 2000 °F. Machined heads are not permitted, except lightening holes and wrenching recesses 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

Headed blanks, before finishing the shank and the bearing surface of the head, cold rolling the head-to-shank fillet radius, and rolling the threads, shall be solution heat treated as follows: precipitation heat treatment shall follow cold working of the fillet radius and rolling the threads.

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.

3.3.2.2 Solution Heat Treatment

Headed blanks shall be solution heat treated by heating to a temperature within the range 1725 to 1850 °F, holding at the selected temperature within ± 25 °F for 1 hour ± 0.1 hour, and quenching in oil, water, or an inert gas.

3.3.2.3 Precipitation Heat Treatment

After cold working the fillet radius as in 3.3.4 and rolling the threads as in 3.3.5, parts shall be precipitation heat treated by heating to $1325\text{ °F} \pm 15\text{ °F}$ in a controlled atmosphere, holding at heat for 8 hours ± 0.25 hour, furnace cooling at $100\text{ °F} \pm 15\text{ °F}$ per hour to $1150\text{ °F} \pm 15\text{ °F}$, holding at $1150\text{ °F} \pm 15\text{ °F}$ for 8 hours ± 0.25 hour, and cooling at a rate equivalent to air cool. Instead of the 100 °F per hour cooling rate to $1150\text{ °F} \pm 15\text{ °F}$, parts may be furnace cooled at any rate, provided the time at $1150\text{ °F} \pm 15\text{ °F}$ is adjusted to give a total precipitation heat treatment time of approximately 18 hours.

3.3.3 Oxide Removal

Surface oxide and oxide penetration resulting from prior heat treatment shall be removed from the full body diameter thread roll diameter and bearing surface of the head of the solution heat treated blanks prior to cold working the underhead fillet radius and rolling the threads. The oxide removal process shall produce no intergranular attack or corrosion of the blanks.

3.3.4 Cold Rolling 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 inch 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. 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 fillet arc, starting at the point of tangency of the fillet radius and the shouldered surface of the unthreaded shank.

3.3.5 Thread Rolling

Threads shall be formed on the finished, solution heat treated 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:

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

3.4 Plating

Where required, bolts shall be plated as specified by the part drawing; plating thickness determined in accordance with the plating specification.

3.5 Mechanical Properties

Bolts for tensile and stress rupture tests shall be of sufficient size to develop the full strength of the bolt without stripping the thread.

AS7467 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. Ultimate tensile strength at room temperature: | MIL-STD-1312-8 in accordance with NASM1312-8 |
| c. Ultimate tensile strength at 1200 °F: | MIL-STD-1312-18 in accordance with NASM1312-18 |
| d. Stress rupture strength at 1200 °F: | MIL-STD-1312-10 in accordance with NASM1312-10 |

AS7467-1 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 shear strength 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 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. 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. Tension bolts, such as hexagon, double hexagon, and spline drive head, shall have an ultimate tensile load not lower than that specified in Table 2A and shall be tested to failure in order to observe fracture location, first measuring and recording the maximum tensile load achieved. Screws, such as 100 degree flush head, pan head, and fillister head, shall have an ultimate tensile load not lower than that specified in Table 2B.

3.5.1.2 Machine 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 as in 4.3.8. Specimens may be required by purchaser to perform confirmatory tests. Such specimens shall meet the following requirements:

- a. Ultimate tensile strength, minimum: 185 ksi
- b. Yield strength at 0.2% offset, minimum: 150 ksi
- c. Elongation in 4D, minimum: 12%
- d. Reduction of area, minimum: 15%

3.5.2 Ultimate Tensile Strength at 1200 °F

3.5.2.1 Finished Parts

Tension bolts heated to 1200 °F ± 5 °F, held at heat for 20 minutes before testing, and tested at 1200 °F ± 5 °F, shall have an ultimate tensile load not lower than the value specified in Table 2A and shall be tested to failure in order to observe fracture location, 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 minimum pitch diameter or having an undercut, parts shall have an ultimate tensile strength not lower than 145 ksi; for such parts, the diameter of the area on which stress is based shall be the actual measured minimum diameter of the part. Tension fasteners with either standard hexagon, double hexagon, or spline drive type heads having a minimum metal condition in the head equal to the design parameters specified in AS1132 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. Screws, such as 100 degree flush head, pan head, and fillister head, are not required to be tested for tensile strength at 1200 °F.