



METRIC AEROSPACE STANDARD

MA3374™**REV. E**

Issued 1986-02
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Revised 2020-10

Superseding MA3374D

Bolts and Screws, UNS S66286, Corrosion and Heat
Resistant Steel, Procurement Specification, Metric

FSC 5306

RATIONALE

Figure 1 replaced with correct Figure 1 from previous issue and other minor changes to revision letters.

1. SCOPE

1.1 Type

This document covers metric bolts and screws made from a corrosion and heat resistant, age hardenable iron base alloy of the type identified under the Unified Numbering System as UNS S66286. The following specification designations and their properties are covered:

MA3374 900 MPa minimum ultimate tensile strength at room temperature
480 MPa stress-rupture strength at 650 °C

MA3374-1 900 MPa minimum ultimate tensile strength at room temperature
590 MPa minimum ultimate shear strength at room temperature

1.2 Application

Primarily for aerospace propulsion system applications where a combination of fatigue strength, tensile strength, stress-rupture strength and resistance to relaxation at elevated temperatures 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 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.

AMS2759/3	Heat Treatment Precipitation-Hardening Corrosion-Resistant, Maraging, and Secondary Hardening Steel Parts
AMS5731	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution Heat Treated
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
MA1370	Screw Threads - MJ Profile, Metric
MA1518	Bolts, Screws and Nuts - External Wrenching, Metric Threads - Design Parameters for
MA1520	Areas for Calculating Stress or Load Values for Metric MJ Externally Threaded Fasteners
MA1566	Gaging Practice and Gage Requirements for MJ Metric Screw Threads

2.1.2 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
NASM1312-10	Fastener Test Methods, Method 10, Stress-Rupture
NASM1312-13	Fastener Test Methods, Method 13, Double Shear Test
NASM1312-108	Fastener Test Methods, Metric Method 108, Tensile Strength

2.1.3 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)
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2.1.4 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 A967	Chemical Passivation for Stainless Steel Parts
ASTM D3951	Commercial Packaging
ASTM E8/E8M	Standard Test Methods for Tension Testing of Metallic Materials
ASTM E112	Determining Average Grain Size
ASTM E139	Conducting Creep, Creep-Rupture, and Stress-Rupture Test of Metallic Materials
ASTM E140	Standard Hardness 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

2.2 Definitions

Refer to AS6416.

2.3 Unit Symbols

°C	degree Celsius
°F	degree Fahrenheit
mm	millimeter
cm ³	cubic centimeter
g	gram (mass)
h	hour
HRC	hardness, Rockwell C scale
%	percent (1% = 1/100)
kN	kilonewton (force)
MPa	megapascal (stress)
sp gr	specific gravity

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5731 steel heading stock.

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 shall apply after plating but before coating with dry 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

Metric screw thread MJ profile and dimensions shall be in accordance with MA1370, unless otherwise specified on the part drawing.

3.2.3.1 Incomplete Lead and Runout Threads

Incomplete threads are permissible at the entering end and the juncture of the unthreaded portion of the shank or adjacent to the head as specified in AS3062.

3.2.3.2 Chamfer

The entering end of the thread 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; machined heads are not permitted, except lightening holes may be produced by any suitable method. Wrenching recesses may be forged or machined. Flash or chip clearance in machined recesses shall not cause recess dimensions to exceed the specified limits. Heading stock to be hot forged shall not be heated to a temperature higher than 1150 °C.

3.3.2 Heat Treatment

Shall conform to the technical requirements and other provisions specified in AMS2759/3 for A-286, 980 °C solution treatment and 720 °C ageing treatment.

3.3.2.1 Solution Heat Treatment

Headed blanks of AMS5731 shall, before finishing the shank and the bearing surface of the head, cold rolling the head-to-shank fillet radius, and rolling the threads, be solution heat treated as in 3.3.2.

3.3.2.2 Ageing Treatment

After solution heat treatment as in 3.3.2.1, blanks shall be heat treated by ageing as in 3.3.2.

3.3.3 Oxide Removal

Surface oxide and oxide penetration resulting from prior heat treatment shall be removed from the full body diameter and bearing surface of the head of the solution and aged heat treated blanks prior to cold rolling the fillet radius and rolling the threads. The oxide removal process shall produce no intergranular attack or corrosion of the blanks. The metal removed from the bearing surface of the head and the full body diameter of the shank shall be as little as practicable to obtain a clean, smooth surface.

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 throughout the circumference of the part, shall be cold rolled. The cold rolling shall be sufficient 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 rolling shall conform to Figure 1, unless otherwise specified on the part drawing. No raised metal (excrecence) is permitted on the head bearing surface (face) or depressed metal more than 0.025 mm below the fillet radius contour as shown in Figure 1; the unthreaded shank at the position shown in Figure 1, inclusive of distortion, shall not exceed the unthreaded shank diameter by an amount more than that specified in Figure 1. In configurations having an undercut connected with the fillet radius, the cold rolling 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. 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. 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

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

3.3.6 Passivation Treatment

Parts, after finishing, shall be degreased and then subjected to the passivation treatment and copper sulfate test in accordance with ASTM A967.

3.4 Product Marking

Each part shall be identification marked as specified by the part drawing. The markings may be formed by forging or stamping, raised or depressed 0.25 mm maximum, with rounded root form on depressed characters.

3.5 Mechanical Properties

Where MA3374 is specified, parts shall conform to the requirements of 3.5.1, 3.5.2, and 3.5.4. Where MA3374-1 is specified, parts shall conform to the requirements of 3.5.1, 3.5.2, and 3.5.3. Threaded members of gripping fixtures for tensile and stress-rupture tests 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 the tensile and stress-rupture tests.

MA3374 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-1312-108 in accordance with NASM1312-108.
- c. Stress-Rupture Strength at 650 °C: MIL-STD-1312-10, in accordance with NASM1312-10.

MA3374-1 finished parts shall be tested in accordance with the following test methods:

- a. Hardness: MIL-STD-1312-6 in accordance with NASM312-6.
- b. Ultimate Tensile Strength at Room Temperature: MIL-STD-1312-108 in accordance with NASM1312-108.
- c. Room Temperature Ultimate Shear Strength: 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 bolts shall have an ultimate tensile load not lower than that specified in Table 1 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 1; screws need not be tested to failure, however, the maximum tensile load achieved shall be measured and recorded. 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 strength requirements of 3.5.1.2; for such parts, the diameter of the area on which stress is based shall be the actual measured minimum diameter of the part. Tension fasteners with hexagon, double hexagon or spline drive heads having a minimum metal condition in the head equal to the design parameters specified in MA1518, 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 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 4.4.7. Specimens may be required by the purchaser to perform confirmatory tests. Such specimens shall meet the following requirements:

- a. Ultimate Tensile Strength, minimum: 900 MPa
- b. Yield Strength at 0.2% Offset, minimum: 590 MPa
- c. Elongation in 5D, minimum: 15%
- d. Reduction of Area, minimum: 20%

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

3.5.2 Hardness

Shall be uniform and within the range 24 to 36 HRC (see 8.1), but hardness of the threaded section and of the head-to-shank fillet area may be higher as a result of the cold rolling operations. Parts shall not be rejected on the basis of hardness if the tensile strength properties specified in 3.5.1 are met.

3.5.3 Ultimate Shear Strength

Finished bolts having a close toleranced full shank as in MA1518 shall have an ultimate double shear load not lower than that specified in Table 1. The double shear test may be discontinued without a complete shear failure after the ultimate double shear load has been reached, first measuring and recording the maximum double shear load achieved. Shear bolts having special shank diameters shall have the minimum ultimate double shear load based on 590 MPa minimum shear strength. Shear tests are not required for screws, such as 100-degree flush head, having a grip less than 2.5 times the nominal diameter or protruding head screws, such as pan head and fillister head, having a grip less than 2 times the nominal diameter. Shear test is not required for the following conditions:

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