AEROSPACE STANDARD

AS4108™ REV. D

Issued 1991-07
Reaffirmed 2015-06
Revised 2021-09

Superseding AS4108C

T-Bolt and Eye Bolt, A286 CRES, 1000 °F Fatigue Rated

RATIONALE

NADCAP QML accredited manufacturer requirements added. “Qualification” changed to “performance requirements” where applicable. Figure 1 redrawn.

1. SCOPE

This specification defines the requirements for A286 CRES T-bolts and eye bolts, with room temperature tensile strength of a minimum of 160000 psi, for use with clamps and V-band couplings at 1000 °F maximum ambient temperature.

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
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
AMS5732	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 and Precipitation Heat Treated
AMS5737	Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, and Tubing, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1650 °F (899 °C) Solution and Precipitation Heat Treated

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AS4108D/

AMS5853 Steel, Corrosion and Heat-Resistant, Bars and Wire, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution Treated and Work-Strengthened, Capable of 160 ksi (1103 MPa) Tensile Strength

AMS-QQ-P-35 Passivation Treatments for Corrosion-Resistant Steel

AMS-STD-753 Corrosion-Resistant Steel Parts: Sampling, Inspection and Testing for Surface Passivation

AS7479 Bolts and Screws, Steel, UNS S66286 1650 °F Solution Heat Treated, Precipitation Heat Treated Before Roll Threaded

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: 610-832-9585, www.astm.org.

ASTM A967/A967M Chemical Passivation Treatments for Stainless Steel Parts

ASTM E1417/E1417M Standard Practice for Liquid Penetrant Testing

ASTM F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners

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

2.1.4 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

AC7112 NADCAP Audit Criteria for Fluid Systems Component Manufacturers

AC7112/2 NADCAP Audit Criteria for Fittings and other Machined Components

PD1100 Nadcap Program Requirements

2.1.5 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

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

2.1.6 NAS Publications

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

NASM1312-11 Fastener Test Methods, Method 11, Tension Fatigue

2.2 Definitions

2.2.1 SUPPLIER

Manufacturing activity supplying or quoting on the bolts described in this specification.

2.2.2 CLAMP SUPPLIER

Manufacturing activity supplying or quoting the clamp or coupling that contains the bolts described in the specification.

2.2.3 CONTRACT

The purchase order between the user and the clamp supplier.

2.2.4 USER

The procuring activity purchasing the clamp or coupling; also could be the clamp or coupling manufacturer.

3. REQUIREMENTS

3.1 Performance

The bolts furnished under this specification shall be products that are in accordance with the applicable standards and have been tested and have passed the performance requirement tests specified herein.

3.1.1 Manufacturer Accreditation

A manufacturer producing a product in conformance to this procurement specification shall be accredited in accordance with the requirements of AC7112 and shall be listed in a NADCAP Qualified Manufacturers List (QML). The QML is available at www.eAuditNet.com.

3.1.2 Accreditation of Special Processes

Manufacturers of threaded items are to be accredited to PRI NADCAP AC7112/2 (see 3.8).

3.2 Material

The bolt shall be made from A286 corrosion resistant steel conforming to specifications AMS5731, AMS5732, AMS5737, or AMS5853, then cold worked and precipitation heat treated to a minimum tensile strength of 160000 psi. The material shall be capable of being cold headed without the formation of discontinuities or defects.

3.3 Heat Treatment

Heat treatment of the bolts shall be in conformance with 3.2, as applicable, to develop the mechanical properties as defined in 3.10.

3.4 Design and Construction

The dimensions of the finished bolt shall conform to the applicable AS standard drawing and this specification.

3.5 Head Forming

The heads shall be warm or cold forged. A fillet of not less than 0.030 inch radius for T-bolts (Figure 1A) and 0.100 inch radius (Figure 1B) for eye-bolts shall be provided between head and shank surfaces.

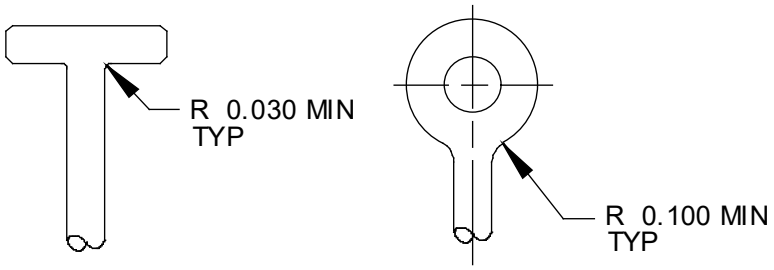

FIGURE 1A - T-BOLT FIGURE 1B - EYE-BOLT

Figure 1

3.6 Surface Treatment and Cleanliness

3.6.1 Surface Treatment

Surface treatments on the bolts such as vapor honing, glass bead liquid honing, grit blasting, or other treatments if performed shall be done before the final forming of the thread area. No lubricant, coating, or other foreign substance shall be applied to the bolt other than required by the AS part standard drawings.

3.6.2 Surface Contaminants

The hardened blanks shall be free from surface contamination or other undesirable elements prior to thread rolling. The processes employed to avoid or remove surface oxides or other contaminants shall not affect the resistance to corrosion, stress corrosion, or fatigue.

3.7 Shank Form and Surface

3.7.1 Squareness and Straightness of Shank and Thread Area with Head

The bearing surfaces of the bolt heads shall be as specified on the AS part standard. The straightness of the shank shall be as specified on the AS part standard and the straightness of the thread area shall be within the tolerance of the pitch diameter or the major diameter.

NOTE: If the bolt requires a bent shank, the bend can be performed after the bolt is threaded ensuring that there is no damage to the threads.

3.7.2 Surfaces of Head and Shank

Surfaces of head and shank shall be smooth, with a roughness average (Ra) value less than 125 µin as measured per ASME B46.1. Surfaces shall be free from longitudinally oriented scratches, notches, folds, scale, or other discontinuities of a depth greater than 1% of the shank diameter and shall be free from all discontinuities having transverse orientation with regard to the centerline of the shank or head, respectively, or extending across the thread area. Bolts with discontinuities exceeding 0.50 inch in length are rejectable.

3.8 Threads

The threads shall be right hand. Thread dimensions, form, and contour shall conform to specification AS8879.

3.8.1 Forming

Threads shall be fully formed by a single rolling process after hardening by heat treatment. Before rolling the threads, the precipitation heat treated blanks shall be clean in accordance with 3.6.

3.8.2 Incomplete Threads

The incomplete threads shall comply with the paragraphs concerning “Incomplete Threads” in AS8879.

3.8.3 Thread Surfaces

Surfaces of threads shall be smooth and free from notches, slivers, folds, laps, cracks, and scale, as addressed in AS7479 in the sub-paragraph labeled “Threads” under “Quality.” The threaded portion of the bolts shall be sectioned such that a cross-section of the threads can be viewed. This section shall be mounted, ground, and polished to look for imperfections (mentioned above) in the surface of the thread flanks.

3.9 Finish

All surfaces shall be passivated per AMS2700, Method 1, Type 2 unless Method 2 is authorized by the purchaser or per AMS-QQ-P-35. Verify passivation with the copper sulfate test per ASTM A967/A967M or AMS-STD-753.

3.10 Mechanical Properties

3.10.1 Ultimate Tensile Load

The finished bolt shall withstand the ultimate tensile loads shown in Table 1.

Table 1 - Minimum ultimate tensile load

Bolt Size Inches	Threads per Inch	Tensile Area in^2	T-Bolt Minimum Ultimate Tensile Load Pounds	Eye Bolt Minimum Ultimate Tensile Load Pounds
0.190	32	0.0226	3610	3600
0.250	28	0.0404	6460	4730
0.312	24	0.0640	10240	7200
0.375	24	0.0951	15210	-
0.437	20	0.1288	20600	-
0.500	20	0.1717	27470	-

NOTES:
1. Tensile area = Cross-sectional area based on maximum pitch diameter per AS8879.
2. T-bolt ultimate tensile load = Tensile area x 160000.
3. Eye bolt ultimate tensile load = Based on application requirements.

3.10.2 Fatigue Strength

The finished bolts shall withstand an average of 65000 fatigue cycles when loaded in accordance with Table 2. No individual bolt tested shall fail at less than 45000 fatigue cycles. The bolts need not be fatigue tested in excess of 130000 cycles if failure has not occurred before that time. The fatigue test is a tension-tension test.

Table 2 - Fatigue strength

Bolt Size Inches	Threads per Inch	Root Area in^2	T-Bolt Fatigue Load Minimum Pounds	T-Bolt Fatigue Load Maximum Pounds	Eye Bolt Fatigue Load Minimum Pounds	Eye Bolt Fatigue Load Maximum Pounds
0.190	32	0.0186	135	1350	90	900
0.250	28	0.0342	248	2480	167	1670
0.312	24	0.0549	398	3980	254	2540
0.375	24	0.0839	608	6080	-	-
0.437	20	0.1132	821	8210	-	-
0.500	20	0.1536	1110	11100	-	-

NOTES:
1. Root area = Cross-sectional area based on the maximum minor diameter per AS8879.
2. T-bolt maximum tension fatigue load = Root area x 72000 psi T-bolt minimum.
   Tension fatigue load = 0.1 x Maximum tension fatigue load.
3. Eye bolt maximum fatigue load = Based on application requirements of eye bolt.
   Minimum tension fatigue load = 0.1 x Maximum tension fatigue load.

3.10.3 Stress Rupture

The finished bolts shall withstand the stress rupture test of 4.6.3 when tested at the loads specified in Table 3.

Table 3 - Minimum required stress rupture load

Bolt Size Inches	Threads per Inch	Root Area in^2	T-Bolts Stress Rupture Pounds	Eye Bolts Stress Rupture Pounds
0.190	32	0.0186	1300	1200
0.250	28	0.0342	2390	2070
0.312	24	0.0549	3840	3150
0.375	24	0.0839	5870	-
0.437	20	0.1132	7920	-
0.500	20	0.1536	10800	-

NOTES:
1. Root area = Cross-sectional area based on the maximum minor diameter per AS8879.
2. T-bolt stress rupture load = Root area x 70000.
3. Eye bolt stress rupture load = Based on application requirements.

3.10.4 Bend Test

The unthreaded shank of the finished bolts, unthreaded bolt, or a suitable unthreaded length of wire from the same manufacturing, material, and heat treat lot shall withstand being bent over a mandrel or other suitable bending device per Table 4 and per Figure 4 with no evidence of cracks. The bolt shall be bent at least 90 degrees from straight so that the internal angle is 90 degrees or less.

Table 4 - Bend mandrel size

Bolt Size Inches	Threads per Inch	Mandrel Diameter Max 2D per Figure 4 Inches
0.190	32	0.380
0.250	28	0.500
0.312	24	0.625
0.375	24	0.750
0.437	20	0.875
0.500	20	1.000

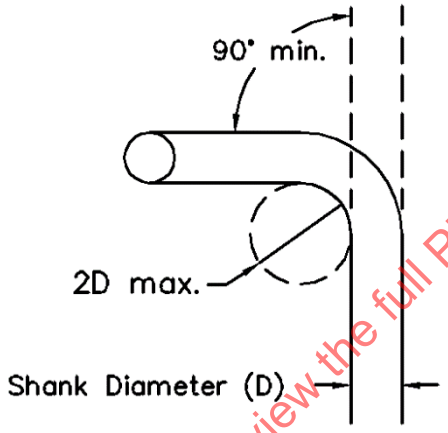

Figure 4 - Bolt bend test

3.11 Discontinuities and Surface Contamination

3.11.1 Discontinuities

The bolts shall not contain discontinuities that equal or exceed the values specified herein.

3.11.2 Cracks

The bolts shall be free from cracks in any direction or location. A crack is defined as a clean crystalline break passing through a grain or grain boundary and appearing on a surface. The bolts will be Fluorescent Penetrant Inspected (FPI) as specified in 4.6.5 if needed.

3.11.3 Laps and Seams

The bolts shall not possess laps or seams less than 0.062 inch apart in any direction. The number of laps or seams, locations, depths, and lengths shall conform to the following requirements unless otherwise specified on the AS part standard.

3.11.4 Crossbar or Head

Laps or seams are permitted in the top, sides, or ends of the head that are not greater than 0.032 inch in length and that do not exceed twice the depth limits of Table 5. Laps or seams in the underside or bearing surface of the head shall be permitted providing they do not exceed 0.032 inch in length and are not greater in depth than the depth limits of Table 5. There shall be a maximum of three laps or seams per head.

Table 5 - Limits for seam depth

Bolt Size (Inches)	0.1900 through 0.3125	0.3750	0.4375	0.5000
Depth (Inches)	0.005	0.006	0.007	0.008

3.11.5 Head-to-Shank Junction

There shall be no laps in the head-to-shank junction.

3.11.6 Shank

The shank may possess longitudinal laps or seams provided the depth does not exceed the depth limits of Table 5. Any one of the laps or seams may extend the total length of the shank so long as the total of all the laps or seams does not exceed twice the length of the shank. There shall be a maximum of four laps or seams on any one bolt.

3.11.7 Other Discontinuities

Discontinuities not covered above and all discontinuities transverse to the grain flow such as pipes, grinding checks, and quench cracks shall not be allowed.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

Unless otherwise specified in the contract, the supplier or clamp supplier is responsible for the performance of all inspection and testing requirements as specified herein. Except as otherwise specified, the supplier or the clamp supplier may utilize his own facilities or any acceptable commercial laboratory. The user reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure the parts conform to prescribed requirements.

4.2 Classification of Tests

The inspection and testing shall be classified as:

a. Performance requirement tests (4.3)

b. Quality conformance test and verification (4.4)

4.3 Performance Requirement Tests

The following sequence of tests and samples noted in Table 6 shall constitute the performance requirement test specified herein.

Table 6 - Performance requirement tests

Test	Samples	Requirement Paragraph	Method Paragraph
Examination of product	12	3.4 through 3.9 and 3.11	4.5
Fluorescent penetrant inspection	Per Table 4, Sample Data, of AS7479 for Major A	3.11	4.6.5
Cross-section of threads	8	3.8	4.6.6
Ultimate tensile load	5	3.10.1	4.6.1
Fatigue strength	3	3.10.2	4.6.2
Stress rupture	1	3.10.3	4.6.3
Bend test	3	3.10.4	4.6.4