AEROSPACE STANDARD

AS4108	
Issued 1991-07 Reaffirmed 2015-06 Superseding AS4108	

T-bolt and Eye Bolt, A-286 CRES, 1000 °F Fatigue Rated

RATIONALE

AS4108 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 This specification defines the requirements for A-286 cres T-bolts and eye bolts, with room temperature tensile strength of 160 000 to 190 000 psi, for use with clamps and V-band couplings at 1000°F maximum ambient temperature.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification 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.

2.1 Specifications:

2.1.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2350 Standards and Test Methods
AMS 5731 Steel Bars, Forgings, Tubing and Rings, Corrosion and Heat Resistant
AMS 5732 Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant
AMS 5737 Steel Bars, Forging, and Tubing, Corrosion and Heat Resistant

2.1.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 112-63 Estimating the Average Grain Size of Metals

2.1.3 ANSI Publications: Available from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

ANSI B18.6.3 Header Points for Machine Screws Before Threading
ANSI/ASME B46.1 Surface Texture, Surface Roughness, Waviness, and Lay

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http://www.sae.org/technical/standards/AS4108

2.1.4 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094.

2.1.4.1 Federal Specifications:

FED-STD-151	Metric, Test Method
QQ-P-35	Passivation Treatments for Corrosion-Resisting Steel

2.1.4.2 Military Specifications:

MIL-H-6875	Heat Treatment of Steels (Aerospace Practice, Process for)
MIL-N-7873	Nut, Self-Locking, 1200°F
MIL-S-8879	Screw Threads, Controlled Radius Root with Increased Minor Diameter; General Specifications For
MIL-N-25027	Nut, Self-Locking, 250°F, 450°F, and 800°F

2.1.4.3 Military Standards:

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-753	Corrosion Resistant Steel Parts: Sampling, Inspection, and Testing for Surface Passivation
MIL-STD-1312	Fastener Test Method
MIL-STD-6866	Inspection, Liquid Penetrant

2.2 Definitions:

2.2.1 SUPPLIER: The supplier is the design activity supplying or quoting on the bolts described in this specification.

2.2.2 CLAMP SUPPLIER: The clamp supplier is the design 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 the clamp or coupling manufacturer.

3. REQUIREMENTS:

3.1 Qualification:

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 qualification tests specified herein.

3.2 Material:

The bolt shall be made from A-286 corrosion resistant steel conforming to specification AMS 5731 Precipitation Hardened per MIL-H-6875, AMS 5732, or AMS 5737 cold worked to a tensile strength of 160 000 to 190 000 psi. Grain size after heat treatment shall be five or finer, by comparison of polished and etched specimens with the chart in the issue of ASTM E 112-63 as specified in AMS 2350. 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 3.11 without adverse effect on the required metallurgical properties as defined in 3.12. Before rolling the threads, the precipitation heat treated blanks shall be cleaned free from all surface oxide and oxide penetration caused by prior treatment in accordance with 3.8 and 3.9.

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 .030 in radius for T-bolts (Figure 1A) and .100 in radius (Figure 1B) for eye-bolts, shall be provided between head and shank surfaces. Flow lines in the finished part when examined as indicated by 4.7.1.4 shall follow the contour of the head, head to shank, fillet, and bearing surface as illustrated by Figure 1. Slight cutting of the flow lines by the oxide removal process is permissible but in no case shall re-entrant angles greater than 35° be acceptable in the fillet area.

3.6 Straightness of Shank:

The straightness of the bolt shank shall be within the values specified in Table 1.

TABLE 1 - Straightness of Shank

Bolt Size (Dia) (Inch)	Deviation of Bolt Shank from Plate Inch/Inch of Bolt Length (max)
.1900, .2500, .3125	.0030
.3750, .4375	.0025
.5000	.0020

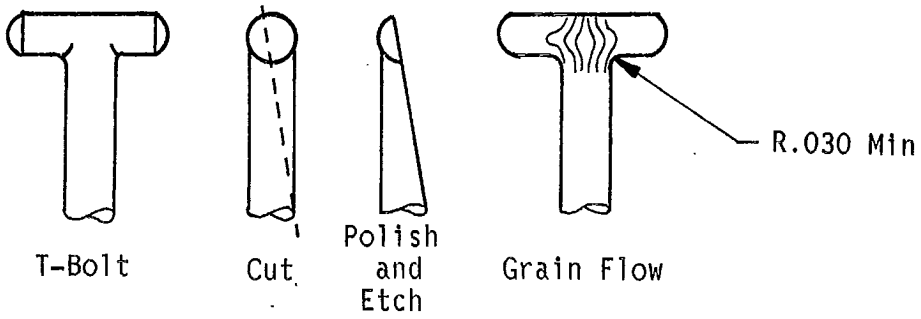


FIGURE 1A - T-bolt Microsectioning

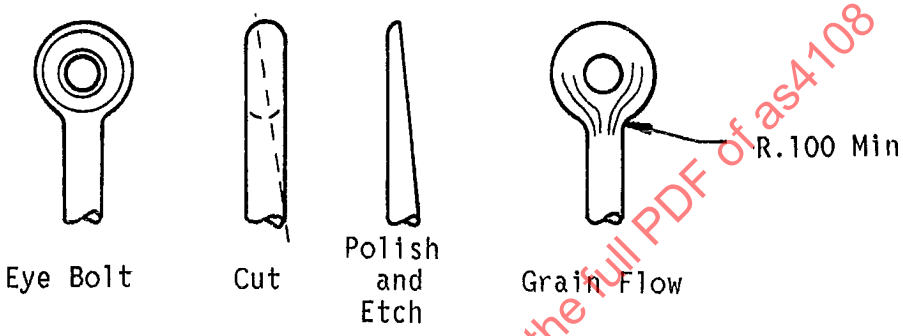


FIGURE 1B - Eye Bolt Microsectioning

FIGURE 1 - Bolt Microsectioning

3.6.1 Squareness of Shank and Threads with Head: The bearing surfaces of the bolt heads shall be as specified on the AS part standard.

3.6.2 Surfaces of Head and Shank: Surfaces of head and shank shall conform to ANSI/ASME B46.1 and shall be smooth, with a roughness average (Ra) value less than Ra 125 min. 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 threads. Discontinuities exceeding .50 inch in length are rejectable.

3.7 Threads:

The threads shall be right hand. Thread dimensions, form, and contour shall conform to specification MIL-S-8879.

3.7.1 Forming and Grain Flow: Threads shall be fully formed by a single rolling process after hardening by heat treatment. Grain flow lines shall be continuous, shall follow the thread contour, and shall be of maximum density at the roots of the threads as illustrated by Figure 2.

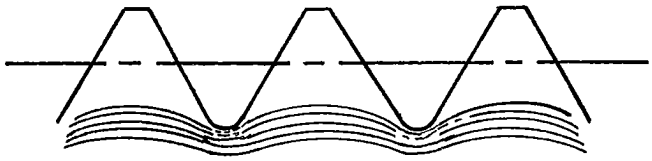


FIGURE 2 - Grain Flow in Thread

3.7.2 Incomplete Threads: Incomplete threads, within the following limits, are permitted between the last full thread and the unthreaded shank and at the chamfered end of the bolt as illustrated by Figure 3. Thread run out adjacent to the grip shall be a minimum of one pitch length and maximum of two pitch lengths. The run out shall fair into the shank, thereby eliminating abrupt changes in cross-sectional area. Bottom and sides of threads contained in run out may deviate from true form but shall be smooth and free from tool marks. The header points shall be chamfered per ANSI B18.6.3. Threads adjacent to the chamfer may be incomplete at pitch diameter and major diameter, but shall be complete and within tolerance at a distance of two pitch lengths from the point end of the bolt.

3.7.3 Thread Surfaces: Surfaces of threads shall be smooth and free from notches, slivers, folds, laps, and scale. Surface finish of thread and thread root areas shall not exceed Ra 32 min.

3.8 Finish:

All surfaces shall be passivated per QQ-P-35. Verify passivation with the copper sulfate test per MIL-STD-753B Method 102.

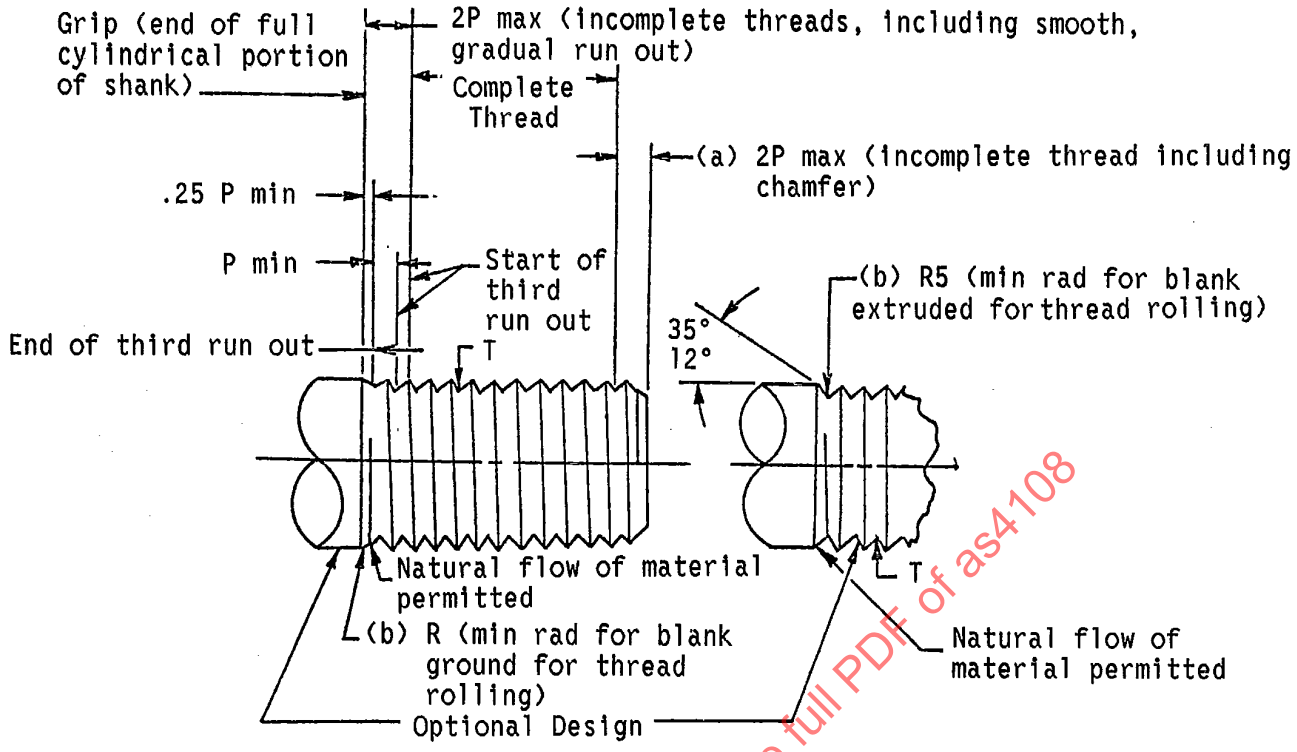
3.9 Surface Treatment and Cleanliness:

Surface treatments on the bolts such as vapor honing, glass bead liquid honing, grit blastings, or other treatments or platings, if performed, must be done before the final machining of the thread area and bearing surfaces. No lubricant, coating, or other foreign substance shall be applied to the bolt other than required by the AS standards drawing.

3.9.1 Surface Contaminants: The hardened blanks shall be free from surface contamination or penetration by oxygen, nitrogen, 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.

3.10 Run Out of Thread Pitch Diameter:

The run out of thread pitch diameter in relation to shank diameter shall be within the limits specified on the detail part standard.



a. Point to be flat and chamfered. Chamfer to be a minimum of approximately .5 pitch. Threads adjacent to chamfer may be incomplete at pitch diameter or major diameter at a distance of two pitch from flat end of the bolt. Threads shall be complete so that the pitch diameter and major diameter are within tolerance.

b. Not applicable after thread rolling.

Thread Size	P (Pitch of Thread)	.25P	2P	R (Run out Radius)	R.5	T (Min Root Radius)
.1900-32	.031	.008	.062	.012	.006	.0047
.2500-28	.036	.009	.072	.013	.006	.0054
.3125-24	.042	.010	.084	.015	.008	.0063
.3750-24	.042	.010	.084	.01	.008	.0063
.4375-20	.050	.012	.100	.018	.009	.0075
.5000-20	.050	.012	.100	.018	.009	.0075

FIGURE 3 - Incomplete Threads, Run Out Radius, and Root Radius

3.11 Mechanical Properties:

3.11.1 Ultimate Tensile Load: The finished bolt shall withstand the ultimate tensile loads shown in Table 2.

TABLE 2 - Minimum Ultimate Tensile Load

Thread Size	Tensile Area in^2	Minimum Ultimate Tensile Load in lb T-bolt	Minimum Ultimate Tensile Load in lb Eye Bolt
.1900-32	.0226	3 610	
.2500-28	.0404	6 460	4 730
.3125-24	.0640	10 240	7 200
.3750-24	.0951	15 210	
.4375-20	.1288	20 600	
.5000-20	.1717	27 470	

NOTE: Ftu = Stress Tensile Min Ultimate = 160 000 psi
Ultimate Tensile Load = Ftu × Tensile Area
Tensile Area = Cross-Sectional Area Based on Basic Pitch Diameter.

3.11.2 Fatigue Strength: The finished bolts, fabricated in accordance with this specification, shall be capable of withstanding an average of 65 000 fatigue cycles when loaded in accordance with Table 3. No individual bolt tested shall fail at less than 45 000 fatigue cycles. The bolts need not be fatigue tested in excess of 130 000 cycles if failure has not occurred before that time.

3.11.3 Stress Rupture: The bolts shall be capable of meeting the stress rupture test of 4.6.4 when tested at the loads specified in Table 4.

TABLE 3 - Fatigue Load

Thread Size	Root Area in^2	Fatigue Load T-bolt Minimum lb +2%	Fatigue Load T-bolt Maximum lb +2%	Fatigue Load Eye Bolt Minimum lb +2%	Fatigue Load Eye Bolt Maximum lb +2%
.1900-32	.0186	135	1 350	-	-
.2500-28	.0342	248	2 480	214	2 140
.3125-24	.0549	398	3 980	326	3 260
.3750-24	.0839	608	6 080	-	-
.4375-20	.1132	821	8 210	-	-
.5000-20	.1536	1110	11 100	-	-

NOTE: Tension fatigue load is based on 72 500 psi maximum at minor diameter area per MIL-S-8879.

TABLE 4 - Minimum Required Stress Rupture Load

Thread Size	Root Area in^2	Stress Rupture in lb T-bolts	Stress Rupture in lb Eye Bolts
.1900-32	.0186	1 300	-
.2500-28	.0342	2 390	2 070
.3125-24	.0549	3 840	3 150
.3750-24	.0839	5 870	-
.4375-20	.1132	7 920	-
.5000-20	.1536	10 800	-

NOTE: Stress rupture load is based on 70 000 psi maximum at minor diameter.

3.11.4 Bend Test: The bolt shall be capable of being bent over a mandrel per Table 5 per Figure 4 with no evidence of cracks.

TABLE 5 - Bend Mandrel Size

Thread Size	2D Figure 4 Mandrel Diameter Max
.1900-32	.380
.2500-28	.500
.3125-24	.625
.3750-24	.750
.4375-20	.875
.5000-20	1.000

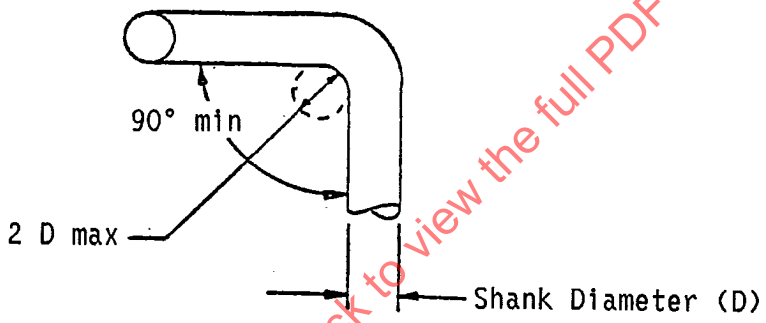


FIGURE 4 - Bolt Bend Test

3.12 Metallurgical Properties:

3.12.1 Work Effect: The threads shall show evidence of cold working when tested as specified in 4.7.1.4

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

3.12.2.1 Inclusions: The bolts shall show no evidence of surface or subsurface inclusions at the thread root or head-to-shank fillet when tested as specified in 4.7.1. Inclusions that are not indicative of unsatisfactory quality and do not extend into the thread root or head-to-shank fillet shall be permitted.

3.12.2.2 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, without the inclusion of foreign elements.

3.12.2.3 Laps and Seams: The bolts shall not possess laps or seams less than .062 in 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:

3.12.2.3.1 Crossbar or Head: Laps or seams are permitted in the top, sides, or ends of the head that are not greater than .032 inch in length and that do not exceed twice the depth limits of Table 6. Laps or seams in the underside or bearing surface of the head shall be permitted providing they do not exceed .032 inch in length and are not greater in depth than the depth limits of Table 6. There shall be a maximum of three laps or seams per head.

TABLE 6 - Limits for Seam Depth

Bolt Size	.1900 through .3125	.3750	.4375	.5000
Depth	.005	.006	.007	.008

3.12.2.3.2 Head-to-Shank Junction: There shall be no laps in the head-to-shank junction.

3.12.2.3.3 Shank: The shank may possess longitudinal laps or seams provided the depth does not exceed the depth limits of Table 6. 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.

3.12.2.3.4 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.

3.12.2.3.5 Surface Contamination: The threads, thread root, and shank shall contain no surface contamination. Other surfaces may contain surface contamination provided it does not exceed .003.

3.12.3 Hardness: The bolts shall have a minimum Rockwell hardness of C 28, but hardness of the threaded portion may be higher as a result of the thread rolling.

3.13 Identification of Product: Each bolt shall be identified by the manufacturer's trademark and part number impression stamped or electrically chem etched on a noncritical stressed or low stressed area of the bolt as shown on the parts standard.

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. Qualification tests (4.3)
b. Quality conformance test and verification (4.4)

4.3 Qualification Tests:

4.3.1 Sampling Instruction: The following sequence of tests and samples noted in Table 7 and 4.7 shall constitute the qualification test specified herein.

TABLE 7 - Qualification Tests

Test	Samples	Requirement Paragraph	Method Paragraph
Examination of product	12	---	4.5.1
Ultimate tensile load	5	3.11.1	4.6.2
Fatigue strength	3	3.11.2	4.6.3
Stress rupture	1	3.11.3	4.6.4
Bend test	3	3.11.4	4.6.5

4.4 Quality Conformance Test and Verification:

All bolts shall be examined and tested to the extent necessary to verify that all requirements of the controlling drawing and this specification have been met. As a minimum, quality conformance tests shall consist of the following tests in conjunction with Table 8:

a. Examination of product (4.5.1)
b. Mechanical properties tests (4.6.1, 4.6.2, 4.6.3, 4.6.4, & 4.6.5) with no allowable failures
c. Metallurgical inspection (4.7)