AS7477

ADOPTION NOTICE

AS7477, "Bolts and Screws, Steel, Corrosion and Heat Resistant, 1800 F Solution Heat Treated, Aged Before Roll Threaded, Procurement Specification for" was adopted on 03 February 1994 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Defense Industrial Supply Center, ATTN: DISC-EFB, Building 3A, Philadelphia, PA 19111-5096. DoD activities may obtain copies of this standard from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. The private sector and other Government agencies may purchase copies from the Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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Military Coordinating Activity:
DLA - IS
(Project 5306-1703)

FSC 5306

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AEROSPACE STANDARD

SAE AS7477 | REV. B

Issued 1990-12
Revised 1995-11
Superseding AS7477A

Submitted for recognition as an American National Standard

(R) BOLTS AND SCREWS, STEEL, UNS S66286 TENSILE STRENGTH 130 ksi, PROCUREMENT SPECIFICATION

FSC 5306

1. SCOPE:

1.1 Type:

(R)

This document covers bolts and screws made from a corrosion and heat resistant, precipitation 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:

AS7477: 130 ksi minimum ultimate tensile strength at room temperature
70 ksi stress-rupture strength at 1200 °F
AS7477-1 130 ksi minimum ultimate tensile strength at room temperature
85 ksi minimum ultimate shear strength at room temperature

1.2 Application:

Primarily for aerospace propulsion system applications where a good combination of fatigue resistance, tensile strength, shear 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.

2. REFERENCES:

2.1 Applicable Documents:

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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 documents shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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

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AMS 2759/3	Heat Treatment of Precipitation Hardening, Corrosion Resistant and Maraging Steel Parts
AMS 5731	Steel Bars, Forgings, Tubing, and Rings, Corrosion and Heat Resistant, 15Cr 25.5Ni 1.2Mo 2.1Ti 0.006B 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution Heat Treated
AS1132	Design Parameters for Bolts and Screws, External Wrenching, Unified Thread Inch Series
AS3062	Bolts, Screws, and Studs, Screw Thread Requirements
AS3063	Bolts, Screws, and Studs, Geometric Control Requirements

2.1.2 U.S. Government Publications: Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA, 19111-5094.

(R)

QQ-P-35	Passivation Treatments for Corrosion Resistant Steel
MIL-S-8879	Screw Threads, Controlled Radius Root With Increased Minor Diameter; General Specification For
MIL-STD-1312-6	Fastener Test Methods, Method 6, Hardness
MIL-STD-1312-8	Fastener Test Methods, Method 8, Tensile Strength
MIL-STD-1312-10	Fastener Test Methods, Method 10, Stress-Rupture
MIL-STD-1312-12	Fastener Test Methods, Method 12, Thickness of Metallic Coatings
MIL-STD-1312-13	Fastener Test Methods, Method 13, Double Shear Test

2.1.3 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

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ASTM E 8	Tension Testing of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 139	Conducting Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E 140	Standard Hardness Tables for Metals
ASTM E 1417	Liquid Penetrant Examination
ASTM D 3951	Commercial Packaging

2.1.4 ANSI Publication: Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI/ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

2.2 Definitions:

(R)

BURR: A rough edge or ridge left on the metal due to a cutting, grinding, piercing or blanking operation.

TIGHT BURR: A burr closely compacted and binding in the periphery of a part without any loose ends and is within the dimensional limits of the part.

DEFECTIVE: A unit of product which contains one or more defects.

PRODUCTION INSPECTION LOT: Shall be all finished parts of the same part number, made from a single heat of alloy, heat treated at the same time to the same specified condition, produced as one continuous run, and submitted for vendor's inspection at the same time.

2.3 Unit Symbols and Abbreviations:

°	degree, angle
°C	degree Celsius
°F	degree Fahrenheit
cm^3	cubic centimeter
g	gram (mass)
%	percent (1% = 1/100)
lbf	pound-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 AMS 5731 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 ANSI/ASME B46.1.

3.2.3 Threads: Screw Thread UNJ profile and dimensions shall be in accordance with MIL-S-8879, 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 be heated to a temperature not higher than 2100 °F.

3.3.2 Heat Treatment: Shall conform to the technical requirements and other provisions specified in AMS 2759/3 for A-286, 1800 °F solution treatment and aging treatment.

3.3.2.1 Solution Heat Treatment: Headed blanks of AMS 5731 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 Aging Treatment: After solution heat tratment as in 3.3.2.1, blanks shall be heat treated by aging as in 3.3.2.

3.3.3 (R) 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 (R) 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 worked sufficiently to remove all visual evidence of grinding or tool marks. Distortion due to cold rolling shall conform to Figure 2, unless otherwise specified on part drawing. No raised metal (excrescence) is permitted on the head bearing surface (face) or depressed metal more than 0.001 inch below the fillet radius contour as shown in Figure 2; the unthreaded shank at the position shown in Figure 2, inclusive of distortion, shall not exceed the unthreaded shank diameter by an amount more than that specified in Figure 2. In configurations having an undercut connected with the fillet radius, the cold rolling will be required only for 90° 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 rolling will be required only for 90° 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 the maximum thread diameter after cold rolling the head-to-shank fillet radius.

3.3.5 (R) 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 (R) Passivation Treatment: Parts, after finishing, shall be degreased and then subjected to the passivation treatment and copper sulfate test in accordance with QQ-P-35.

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 0.010 inch maximum, with rounded root form on depressed characters.

3.5 (R) Plating:

Where required, surfaces shall be plated as specified by the part drawing. Where coating with solid film lubricants is required, the under-head bearing surface, unthreaded shank, and threads shall be coated as specified on the part drawing; other surfaces are optional to coat, unless otherwise specified. Plating thickness determined in accordance with MIL-STD-1312-12.

3.6 (R) Mechanical Properties:

Where AS7477 is specified, parts shall conform to the requirements of 3.6.1, 3.6.2, and 3.6.3. Where AS7478-1 is specified, parts shall conform to the requirements of 3.6.1, 3.6.2, and 3.6.4. 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 a minimum of three full thread turns form the thread runout exposed between the loading fixtures during tensile and stress-rupture tests.

3.6 (Continued):

AS7477 finished parts shall be tested in accordance with the following test methods:

a.	Hardness:	MIL-STD-1312-6
b.	Ultimate Tensile Strength at Room Temperature:	MIL-STD-1312-8
c.	Stress-Rupture Strength at 1200 °F:	MIL-STD-1312-10

AS7477-1 finished parts shall be tested in accordance with the following test methods:

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

3.6.1 Ultimate Tensile Strength at Room Temperature:

3.6.1.1 (R) Finished Parts: Parts 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° 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 have an ultimate tensile strength not lower than 130 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 hexagon, 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.

3.6.1.2 (R) 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 E 8 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:	130 ksi
b.	Yield Strength at 0.2% Offset, minimum:	85 ksi
c.	Elongation in 2 inches or 4D, minimum:	15%
d.	Reduction of Area, minimum:	20%

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

3.6.2 (R) Hardness: Shall be uniform and within the range 24 to 35 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 3.6.1 are met.

3.6.3 Stress-Rupture Strength at 1200 °F:

3.6.3.1 (R) Finished Parts: Finished tension bolts, maintained at 1200 °F ± 3 °F while the tensile load specified in Table 1 is applied continuously, shall not rupture in less than 23 hours. If the shank diameter of the part is less than the maximum minor (root) diameter of the thread but the part can be tested satisfactorily, parts shall conform to the requirements of 3.6.3.1.1. Screws, such as 100° flush head, pan head, and fillister head, are not required to be tested for stress-rupture strength at 1200 °F.

3.6.3.1.1 Parts having a shank diameter less than the maximum minor (root) diameter of the thread shall be tested as in 3.6.3.1 except that the load shall be as specified in 3.6.3.2. The diameter of the area on which stress is based shall be the actual measured minimum diameter of the part.

3.6.3.2 Machined Test Specimens: If the size or shape of the part is such that a stress-rupture test cannot be made on the part, a test specimen prepared as in 4.4.7, maintained at 1200 °F ± 3 °F while a load sufficient to produce an initial axial stress of 70 ksi is applied continuously, shall not rupture in less than 23 hours. Tests shall be conducted in accordance with ASTM E 139. Specimens may be required by purchaser to perform confirmatory tests.

3.6.4 (R) Ultimate Shear Strength: Finish bolts having a close toleranced full shank as in AS1132 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 85 ksi minimum shear strength. Shear tests are not required for screws, such as 100° 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 having a grip less than 2 times the nominal diameter.
b. Bolts and screws having coarse tolerance full shank.
c. Bolts and screws having a PD or relieved shank.

3.7 (R) Quality:

Parts shall be uniform in quality and condition, free from burrs (tight burrs may be acceptable if part performance is not affected), foreign materials, and from imperfections detrimental to the usage of the parts.

3.7.1 (R) Macroscopic Examination: Specimens cut from headed blanks and from finished parts shall be etched in a suitable etchant and examined at a magnification of approximately 20X to determine conformance to the requirements of 3.7.1.1 and 3.7.1.2. The head and shank section shall extend not less than D/2 from the bearing surface of the head and the threaded shank section shall extend not less than D/2 beyond the thread runout where "D" is the nominal diameter of the shank after heading. If the two sections would overlap, the entire length of the part shall be sectioned and examined as a whole.

3.7.1.1 Flow Lines:

3.7.1.1.1 (R) Head-To-Shank, Headed Blanks: After heading and prior to heat treatment, examination of an etched section taken longitudinally through the blank shall show flow lines in the shank, head-to-shank fillet, and bearing surface which follow the contour of the blank as shown in Figure 1. Flow lines in headed blanks having special heads, such as Dee- or Tee-shaped heads or thinner than AS1132 standard heads, shall be as agreed upon by purchaser and vendor.

3.7.1.1.2 (R) Head-To-Shank, Finished Part: Examination of a longitudinal section through the part shall show evidence that the heads were formed by forging (see Figure 1A).

3.7.1.1.3 (R) Threads: Examination of a longitudinal section through the threaded portion of the shank shall show evidence that the threads were rolled. This evidence shall include traces of flow lines as shown in Figure 3.

3.7.1.2 (R) Internal Defects: Examination of longitudinal sections of the head and shank shall reveal no cracks, laps, or porosity. Thread imperfections as in 3.7.2.4 shall be examined in accordance with 3.7.2.

3.7.2 (R) Microscopic Examination: Specimens cut from parts shall be polished, etched in Kalling's reagent [100 cm^3 of absolute ethyl alcohol, 100 cm^3 of hydrochloric acid (sp gr 1.19), and 5 g of cupric chloride]. Marble's reagent [20 cm^3 of hydrochloric acid (sp gr 1.19), 20 cm^3 of water, and 4 g of cupric sulfate pentahydrate], or other suitable etchant, and examined at a magnification not lower than 100X to determine conformance to the requirements of 3.7.2.1, 3.7.2.2, 3.7.2.3 and 3.7.2.4.

3.7.2.1 Microstructure: Parts shall have microstructure of completely recrystallized material except in the area of the threads and the head-to-shank fillet radius.

3.7.2.2 (R) Grain Size: Shall be ASTM No. 5 or finer as determined by comparison of the specimen with the chart in ASTM E 112. Up to 25% of the area examined may exhibit a grain size as large as ASTM No. 2. Such areas shall be separated by at least 0.025 inch. Bands of fine or coarse grains are not permitted. In case of dispute, the itercept (Heyn) method shall be used.

3.7.2.3 (R) Surface Hardening: Parts shall have no change in hardness from core to surface except as produced during cold rolling of the head-to-shank fillet radius and during rolling of threads. There shall be no evidence of carburization or nitriding. In case of dispute over results of the microscopic examination, microhardness testing shall be used as a referee method; a Vickers hardness reading of an unrolled surface which exceeds the reading in the core by more than 30 points shall be evidence of nonconformance to this requirement.

3.7.2.4 Threads:

3.7.2.4.1 Root defects such as laps, seams, notches, slivers, folds, roughness, and oxide scale are not permissible (see Figure 4).

3.7.2.4.2 Multiple laps on the flanks of threads are not permissible regardless of location.

3.7.2.4.3 (R) Single Lap on Thread Profile: Shall conform to the following:

a. Rateable Lap: Shall have its length equal to or greater than three times its width. The minimum interpretable lap depth is 0.0005 inch when viewed at 200X magnification.

b. Thread Flank Above the Pitch Diameter: A single lap is permissible along the flank of the thread above the pitch diameter on either the pressure or nonpressure flank (one lap at any cross-section through the thread) provided it extends towards the crest and generally parallel to the flank (see Figure 5). The lap depth shall not exceed the limit specified in Table 2 for the applicable thread pitch. A lap extending toward the root is not permissible (see Figure 6).

c. Thread Flank Below the Pitch Diameter: A lap along the thread flank below the pitch diameter, regardless of direction it extends, is not permissible (see Figure 7).

d. Crest craters, crest laps, or a crest lap in combination with a crest crater are permissible provided that the imperfections do not extend deeper than the limit specified in Table 2 as measured from the thread crest when the thread major diameter is at minimum size (see Figure 8). The major diameter of the thread shall be measured prior to sectioning. As the major diameter of the thread approaches maximum size, values for depth of crest crater and crest lap imperfections listed in Table 2 may be increased by one-half of the difference between the minimum major diameter and actual major diameter as measured on the part.

3.7.3 (R) Fluorescent Penetrant Inspection: Prior to any required plating or coating, parts shall be subject to fluorescent penetrant inspection in accordance with ASTM E 1417, Type I, Sensitivity Level 2.

3.7.3.1 The following conditions shall be cause for rejection of parts inspected.

3.7.3.1.1 Discontinuities transverse to grain flow (i.e., at an angle of more than 10° to the axis of the shank), such as grinding checks and quench cracks.

3.7.3.1.2 Longitudinal indications (i.e., at an angle of 10° or less to the axis of the shank) due to imperfections other than seams, forming laps, and nonmetallic inclusions.

3.7.3.2 The following conditions shall be considered acceptable on parts inspected.

3.7.3.2.1 Parts having longitudinal indications (i.e., at an angle of 10° or less to the axis of the shank) of seams and forming laps parallel to the grain flow that are within the limits specified in 3.7.3.2.2 through 3.7.3.2.5 provided the separation between indications in all directions is not less than 0.062 inch.

3.7.3.2.2 Sides of Head: There shall be not more than three indications per head. The length of each indication may be the full height of the surface but no indication shall break over either edge to a depth greater than 0.031 inch or the equivalent of the 2H/3 thread depth (see Table 2), whichever is less.

3.7.3.2.3 Shank or Stem: There shall be not more than five indications. The length of any indication may be the full length of the surface but the total length of all indications shall not exceed twice the length of the surface. No indication shall break into a fillet or over an edge.

3.7.3.2.4 (R) Threads: There shall be no indications, except as permitted in 3.7.2.4. Rateable lap indications shall conform to 3.7.2.4.3(a).

3.7.3.2.5 Top of Head and End of Stem: The number of indications is not restricted but the depth of any individual indication shall not exceed 0.010 inch as shown by sectioning representative samples. No indication, except those of 3.7.3.2.2. shall break over an edge.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of parts shall supply all samples and shall be responsible for performing all required tests. Purchaser reserves the right to perform such confirmatory testing deemed necessary to ensure that the parts conform to the requirements of this specification.

4.2 Responsibility For Compliance:

The manufacturer's system for parts production shall be based on preventing product defects, rather than detecting the defects at final inspection and then requiring corrective action to be invoked. An effective manufacturing in-process control system shall be established, subject to the approval of the purchaser, and used during production of parts.

4.3 Production Acceptance Tests:

The purpose of production acceptance tests is to check, as simply as possible, using a method which is inexpensive and representative of the part usage, with the uncertainty inherent in random sampling, that the parts comprising a production inspection lot satisfy the requirements of this specification.

4.3.1 Tests for all technical requirements are acceptance tests and shall be performed on each production inspection lot. A summary of acceptance tests is specified in Table 3.

4.4 Acceptance Test Sampling:

4.4.1 (R) Material: Sampling for material composition on each heat shall be in accordance with AMS 5731.

4.4.2 Nondestructive Tests, Visual and Dimensional: A random sample of parts shall be taken from each production inspection lot; the size of the sample to be as specified in Table 4. The classification of dimensional characteristics shall be as specified in Table 5. All dimensional characteristics are considered defective when out of tolerance.

4.4.3 Fluorescent Penetrant Inspection: A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table 4 and classified as in Table 5. The sample units may be selected from those that have been subjected to and passed the visual and dimensional inspection, with additional units selected at random from the production inspection lot as necessary.

4.4.4 Stress-Rupture Test: A random sample of one part (or one specimen where required) shall be selected from each production inspection lot.

4.4.5 Destructive Tests: A random sample shall be selected from each production inspection lot, the size of the sample shall be as specified in Table 6. The sample units may be selected from those that have been subjected to and passed the nondestructive tests and the fluorescent penetrant inspection, with additional units selected at random from the production inspection lot as necessary.

4.4.6 Acceptance Quality: Of random samples tested, acceptance quality shall be based on zero defectives.

4.4.7 Test Specimens: Specimens for tensile and stress-rupture testing of machined test specimens shall be of standard proportions in accordance with ASTM E 8 with either 0.25 inch diameter at the reduced parallel gage section or smaller specimen proportional to the standard when required. Specimens shall be machined from finished parts or coupons of the same lot of alloy and be processed together with the parts they represent. Specimens shall be machined from the center of parts 0.750 inch and under in nominal diameter, from the center of coupons 0.800 inch and under in nominal diameter or distance between parallel sides, and from mid-radius of larger size parts or coupons.

4.5 Reports:
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The vendor of parts shall furnish with each shipment a report stating that the chemical composition of the parts conforms to the applicable material specification, and showing the results of tests to determine conformance to the room temperature ultimate tensile property, hardness, double shear test (if required), and stress-rupture requirements, and stating that the parts conform to the other technical requirements. This report shall include the purchase order number, AS7477, lot number, contractor or other direct supplier of material, part number, nominal size, and quantity.

4.6 Rejected Lots:
(R)

If a production inspection lot is rejected, the vendor of parts shall perform corrective action to screen out or rework the defective parts, resubmit for acceptance tests inspection as in Table 3, or scrap the entire lot. Resubmitted lots shall be clearly identified as reinspected lots.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 (R) Packaging shall be in accordance with ASTM D 3951.

5.1.2 Parts having different part numbers shall be packed in separate containers.

5.1.3 Each container of parts shall be marked to show not less than the following information:

BOLTS (SCREWS), STEEL, CORROSION AND HEAT RESISTANT
AS7477 (or AS7477-1 as applicable)
PART NUMBER
LOT NUMBER
PURCHASE ORDER NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

5.1.4 Threaded fasteners shall be protected from abrasion and chafing during handling, transportation, and storage.

6. ACKNOWLEDGMENT:

A vendor shall mention this inspection number in all quotations and when acknowledging purchase orders.

7. REJECTIONS:

Parts not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

8. NOTES:

8.1 (R) Hardness Conversion Tables:

Hardness conversion tables for metals are presented in ASTM E 140.

8.2 Key Words:

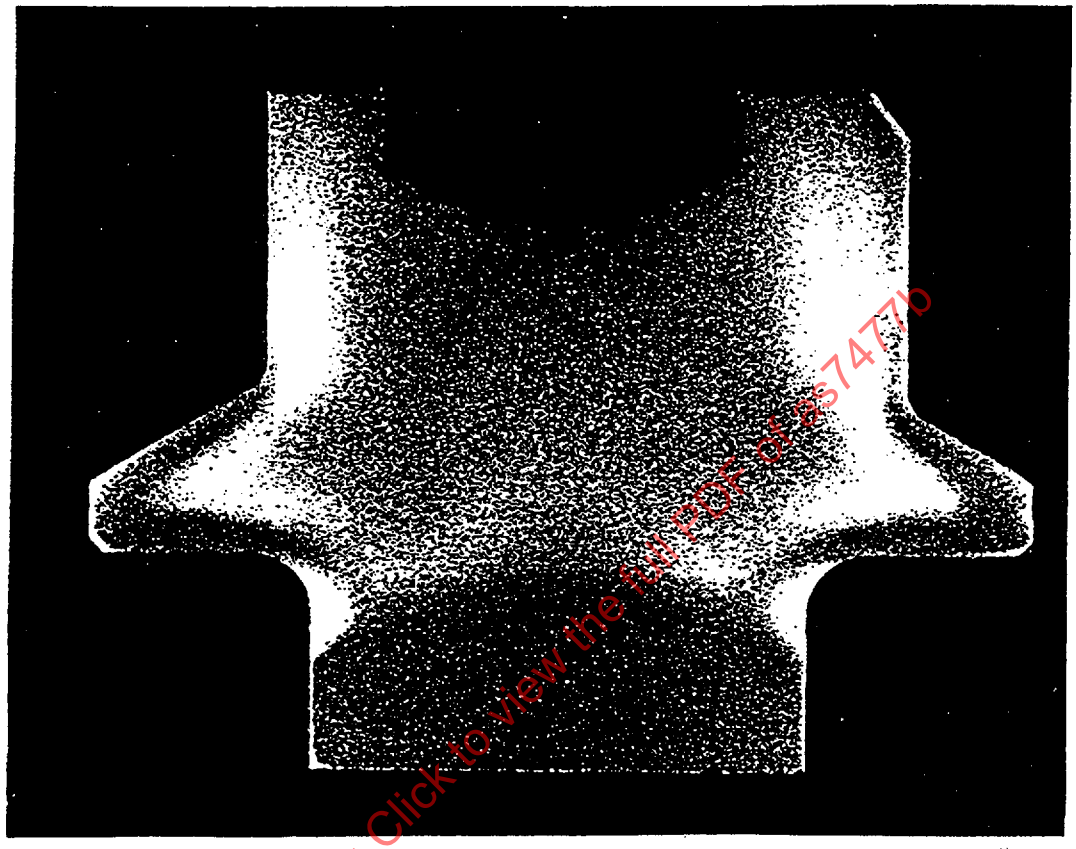
Bolts, screws, procurement specification

8.3 The (R) symbol is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this specification.

PREPARED BY SAE COMMITTEE E-25, GENERAL STANDARDS FOR AEROSPACE PROPULSION SYSTEMS

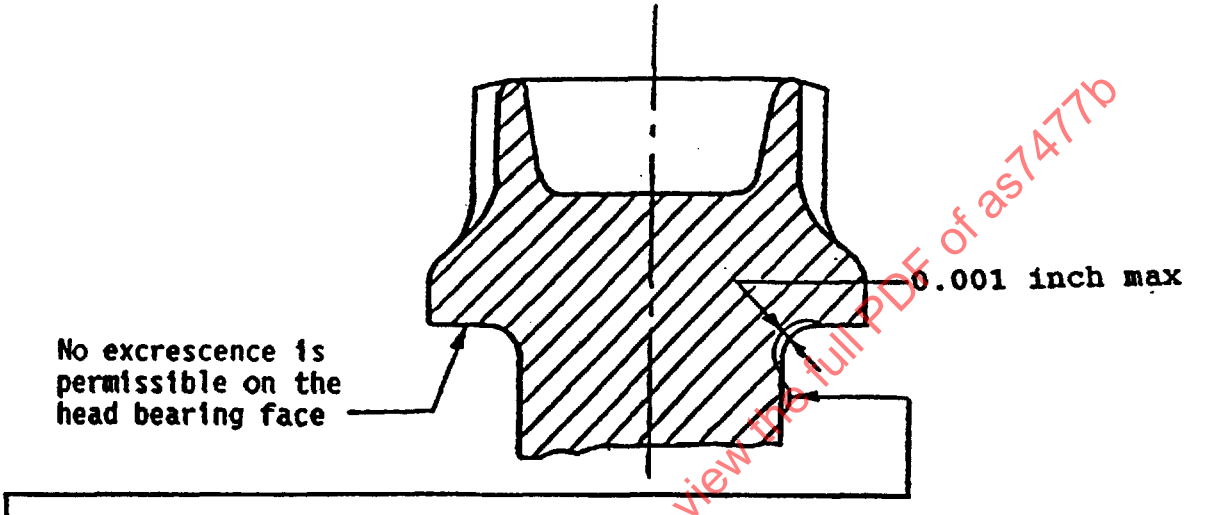
(R) FIGURE 1 - Satisfactory Grain Flow, Headed Blank, Before Heat Treatment

Showing a smooth, well formed grain flow following the contour of the head-to-shank fillet radius.



(R) FIGURE 1A - Head-to-Shank Section Through Finished Part

Shows evidence that head was formed by forging.



The shank diameter at this position, inclusive of distortion shall:

a. On full shank close tolerance bolts, not to exceed the maximum thread diameter.
b. On full shank coarse tolerance bolts, not to exceed the actual shank diameter, prior to distortion, by more than 0.0024 inch on diameter.
c. On PD shank bolts, not to exceed the actual PD shank diameter, prior to distortion, by more than 0.0024 inch on diameter.

FIGURE 2 - Permissible Distortion from Fillet Working

FIGURE 3 - Flow Lines, Rolled Thread

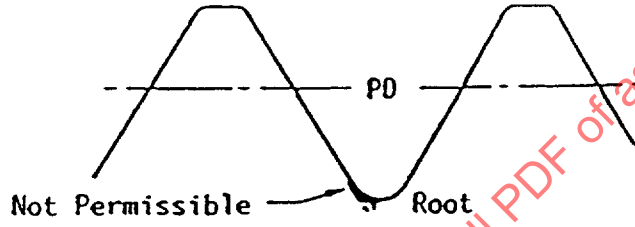
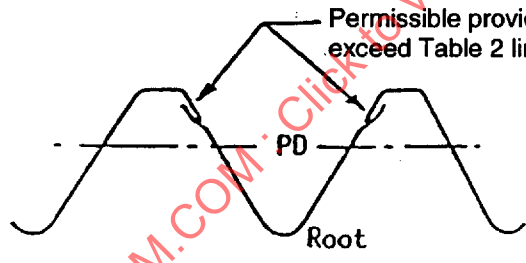
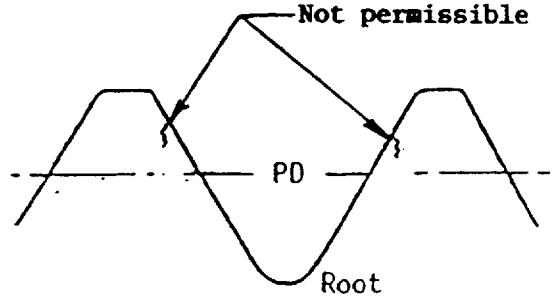


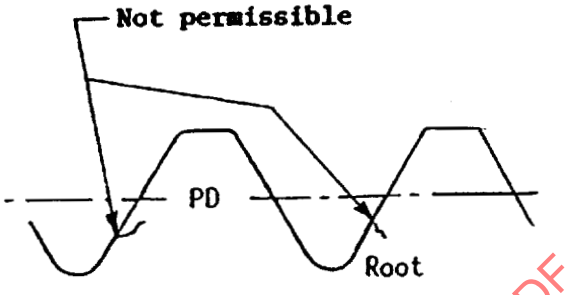
FIGURE 4 - Root Defects, Rolled Thread



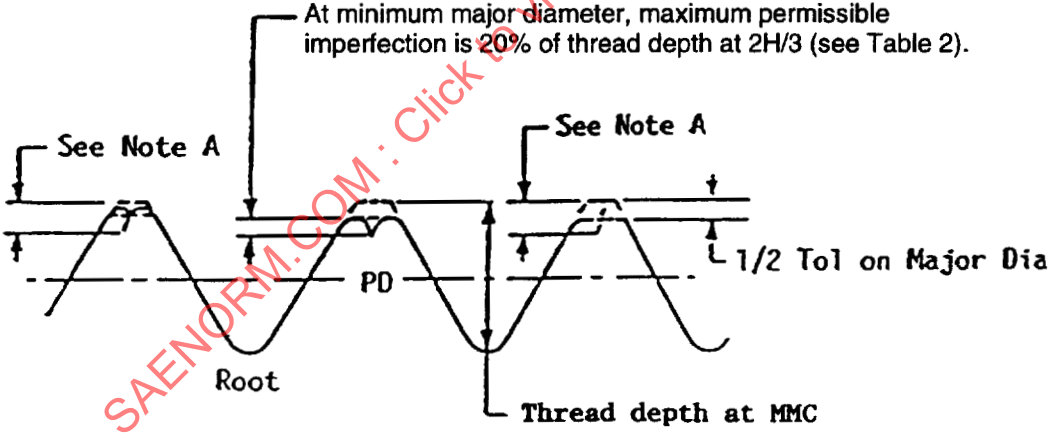
(R) FIGURE 5 - Laps Above Pitch Diameter Extending Towards Crest, Rolled Thread



(R) FIGURE 6 - Laps Above PD Extending Toward Root, Rolled Thread



(R) FIGURE 7 - Laps Below PD Extending in Any Direction, Rolled Thread



Note A: **Maximum depth of imperfection equals 20% of thread depth at 2H/3 plus 1/2 the difference of the actual major diameter and minimum major diameter.**

(R) FIGURE 8 - Crest Craters and Crest Laps, Rolled Thread

(R) TABLE 1 - Test Loads

Nominal Thread Size	Ultimate Tensile Strength Test Load, lbf min Room Temp Bolt, Std PD UN and UNJ Threads	Ultimate Tensile Strength Test Load, lbf min Room Temp. Bolt, Red PD UN THD Only	Ultimate Tensile Strength Test Load, lbf min Room Temp. Screw , Std PD UN & UNJ Threads	Stress-Rupture Strength Test Load, lbf at 1200 °F Bolt, Std PD UN & UNJ Thread	Stress-Rupture Strength Test Load, lbf at 1200 °F Bolt, Red PD UN THD Only	Ultimate Double Shear Test Load lbf min Room Temp
0.112 -40	784	731	627	364	337	1680
0.112 -48	859	803	687	411	383	1680
0.138 -32	1180	1120	945	546	514	2540
0.138 -40	1320	1250	1060	633	598	2540
0.164 -32	1820	1740	1467	868	827	3590
0.164 -36	1920	1830	1530	928	886	3590
0.190 -32	2600	2500	2080	1260	1220	4820
0.250 -28	4730	4600	3780	2340	2270	8340
0.3125-24	7550	7380	6040	3760	3670	13000
0.375 -24	11400	11200	9130	5770	5660	18800
0.4375-20	15400	15200	--	7780	7660	25600
0.500 -20	20800	20500	--	10600	10400	33400
0.5625-18	26400	26100	--	13400	13300	42200
0.625 -18	33300	32900	--	17000	16900	52200
0.750 -16	48500	48100	--	24900	24700	75100
0.875 -14	66200	65700	--	34100	33800	102000
1.000 -12	86200	85600	--	44300	44000	134000

NOTE 1: Requirements above apply to parts with UNC, UNF, UNJC, or UNJF threads, as applicable to the sizes shown, to Class 3A tolerances; requirements for reduced pitch diameter parts are based on 0.003 inch reduction below standard. Area upon which stress for ultimate tensile strength test load requirements is based is at 0.5625H thread depth, where H is height of sharp V-thread, calculated as follows:

$$\text{Std PD, } A_1 = 0.7854(d - 1.125H)^2 = 0.7854[d - (0.9743 / n)]^2 \qquad \text{(Eq.1)}$$

$$\text{Red PD, } A_2 = 0.7854[d - (0.9743 / n) - 0.003]^2 \qquad \text{(Eq.2)}$$

where:

A_1 = area at 0.5625H thread depth, standard PD
A_2 = area at 0.5625H thread depth for reduced PD
d = maximum major diameter
H = height of sharp V-thread = (cos 30°)/n
n = number of thread pitches per inch