SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

AS7479	REV. B
Issued 1991-01 Revised 2008-08 Reaffirmed 2012-11 Superseding AS7479A	

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

FSC 5306

RATIONALE

AS7479B has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Type

This specification 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, and of 130 000 psi tensile strength at room temperature, with maximum test temperature of parts at 1200 °F.

1.2 Application

Primarily for aerospace propulsion system applications where a good combination of strength and resistance to relaxation at elevated temperatures is required.

1.3 Safety - Hazardous Materials

While the materials, 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

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 724-776-4970 (outside USA), www.sae.org.

AMS2759/3 Heat Treatment Precipatation-Hardening, Corrosion-Resistant and Maraging Steel Parts

AMS5734 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 Heat Treated

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

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.

NASM 1312-6 Fastener Test Methods, Method 6, Hardness

NASM 1312-8 Fastener Test Methods, Method 8, Tensile Strength

NASM 1312-10 Fastener Test Methods, Method 10, Stress-Rupture

2.1.3 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

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

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 E 8 Tension Testing of Metallic Materials

ASTM E 140 Standard Testing of Metallic Materials

ASTM E 1417 Liquid Penetrant Examination

ASTM D 3951 Commercial Packaging

2.2 Unit Symbols

° - degree, angle

°C - degree Celsius

°F - degree Fahrenheit

% - percent (1% = 1/100)

lbf - pounds force

ksi - kips (1000 pounds) per square inch

sp gr - specific gravity

HRC - hardness, Rockwell C scale

2.3 Definitions

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

COLD ROLLING: Forming material below the recrystallation temperature.

CRACK: Rupture in the material which may extend in any direction and which may be intercrystalline or transcrystalline in character.

DEFECT: Any nonconformance of the unit of product with specified requirements.

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

DISCONTINUITY: An interruption in the normal physical structure or configuration of a part; such as a lap, seam, inclusion, crack, machining tear, or stringer.

HEAT PATTERN: A discernible difference in etched appearance between the head and shank caused by the plastic forming of the head.

INCLUSION: Nonmetallic particles originating from the material making process. They may exist as discrete particles or strings of particles extending longitudinally.

LAP: Surface imperfection caused by folding over metal fins or sharp corners and then rolling or forging them into the surface. The allowable lap depth shall not exceed the limit specified herein. The minimum condition that shall be rated as a lap is a fold having its length equal to or greater than three times its width with a depth of 0.0005 inch when viewed at 200X magnification.

MACHINING TEAR: A pattern of short, jagged individual cracks, generally at right angles to the direction of machining, frequently the result of improperly set cutting tools, or dull cutting tools.

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.

SEAM: Longitudinal surface imperfection in the form of an unwelded, open fold in the material.

STRINGER: A solid nonmetallic impurity in the metal bar, often the result of inclusions that have been extended during the rolling process.

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.

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5734 steel heading stock, unless otherwise specified on the part drawing.

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 requirements as specified on the part drawing. Dimensions shall apply after plating but before coating with solid 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

Screw thread UNJ profile and dimensions shall be in accordance with AS8879, 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 in accordance with 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-cold forging at a temperature not higher than 2100 °F, by cold forging or machining. 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.

3.3.2 Heat Treatment

Shall conform to the technical requirements and other provisions specified in AMS2759/3 for A286, 1650 °F solution treatment and aging treatment.

3.3.2.1 Solution Heat Treatment

Headed blanks of AMS5734 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 treatment as in 3.3.2.1, blanks shall be heat treated by aging 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 blanks prior to cold rolling the under head fillet radius when specified 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 parts having the radius complete throughout the circumference of the part, when specified, shall be cold rolled 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 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 2; distorted areas shall not extend beyond “C” as shown in Figure 2. 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 rolling 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 heat treated and finished blanks by a single cold rolling process after removal of oxide as in 3.3.3.

3.3.6 Cleaning

Parts, after finishing, shall be degreased and immersed in one of the following solutions for the time and temperature shown:

a. One volume of nitric acid (sp gr 1.42) and 9 volumes of water for not less than 20 minutes at room temperature.

b. One volume of nitric acid (sp gr 1.42) and 4 volumes of water for 30 to 40 minutes at room temperature.

c. One volume of nitric acid (sp gr 1.42) and 4 volumes of water for 10 to 15 minutes at 140 to 160 °F.

3.3.6.1 Water Rinse

Immediately after removal from the cleaning solution, the parts shall be thoroughly rinsed in (70 to 200 °F) water.

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 Plating or Coating

Where required, surfaces shall be plated or coated as specified by the part drawing. Where coating with solid dry 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 plating specification.

3.6 Mechanical Properties

Parts shall conform to the requirements of 3.6.1, 3.6.2 and 3.6.3. 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. Finished parts shall be tested in accordance with the following applicable test methods:

a. Hardness: MIL-STD-1312-6 in accordance with NASM 1312-6

b. Room Temperature Ultimate Tensile Strength: MIL-STD-1312-8 in accordance with NASM 1312-8

c. Stress-Rupture Strength at 1200 °F: MIL-STD-1312-10 in accordance with NASM 1312-10

3.6.1 Ultimate Tensile Strength at Room Temperature

3.6.1.1 Finished Parts

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; 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 minimum pitch 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 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.

3.6.1.2 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 E 8 on specimens as in 4.4.8. 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 Hardness

Shall be uniform and within the range 24 to 35 HRC, but hardness of the threaded section and of the head-to-shank fillet area when cold rolling of this area is specified, may be higher as a result of the cold rolling operations.

3.6.3 Stress-Rupture Strength at 1200 °F

3.6.3.1 Finished Parts

Finished parts, maintained at 1200 °F ± 3 °F while the tensile load specified in Table 2A 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.

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 4.4.8, maintained at 1200 °F ± 3 °F while a load sufficient to produce an initial axial stress of 65 ksi is applied continuously, shall not rupture in less than 23 hours. Tests shall be conducted in accordance with ASTM E 139.

3.7 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 Macroscopic Examination, Headed Blank

A longitudinal specimen cut from a headed blank shall be etched in a suitable etchant and examined at a magnification of 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, where “D” is the nominal diameter of the shank after heading.

3.7.1.1 Flow Lines

If the blanks have forged heads, and prior to heat treatment, examination of an etched section taken longitudinally through the blank as in 3.7.1 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 or Figure 1A. Flow lines or heat pattern in headed blanks having special heads, such as Dee- or Tee-shaped heads, or thinner than AS1132 standard, shall be as agreed upon by purchaser and vendor.

3.7.1.2 Internal Defects

Examination of longitudinal sections of the head and shank shall reveal no cracks, laps, or porosity.

3.7.2 Microscopic Examination, Finished Parts

Specimens cut from finished parts shall be polished, etched in Kalling’s reagent, Marble’s reagent, 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, 3.7.2.4, 3.7.2.5, and 3.7.2.6.

3.7.2.1 Flow Lines, Threads

Examination of a longitudinal section through the threaded portion of the shank shall show evidence that the threads were rolled (see Figure 3).

3.7.2.2 Internal Defects

Examination of longitudinal sections of the head and shank shall reveal no cracks, laps, or porosity. Thread imperfections shall conform to the requirements of 3.7.2.6.

3.7.2.3 Microstructure

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

3.7.2.4 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. Bands of fine or coarse grains are not permitted. In case of dispute, the intercept (Heyn) method shall be used.

3.7.2.5 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, when specified, 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.

3.7.2.6 Threads

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

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

3.7.2.6.3 Single Lap on Thread Profile

Shall conform to the following:

a. Thread Flank Above the Pitch Diameter: A single lap is permissible along the flank of the thread above the pitch line 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 1 for the applicable thread pitch. A lap extending toward the root is not permissible (see Figure 6).

b. 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).

c. 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 1 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 1 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 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 minimum.

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 degrees to the axis of the shank), such as grinding checks and cracks.

3.7.3.1.2 Longitudinal indications (i.e., at an angle of 10 degrees 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 degrees 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 is not less than 0.062 inch in all directions.

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 1), 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 Threads

There shall be no indications, except as permitted in 3.7.2.6.

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 as 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 Material

Sampling for material composition on each heat shall be in accordance with AMS5734.

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 Macroscopic Examination

A random sample of one part shall be selected from each production inspection lot.

4.4.5 Stress-Rupture Test

A random sample of a minimum of one part (or one test specimen where required) shall be selected from each production inspection lot.

4.4.6 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.

4.4.7 Acceptance Quality

Of random samples tested, acceptance quality shall be based on zero defectives.

4.4.8 Test Specimens

Specimens for tensile and stress-rupture testing of machined test specimens shall be of standard proportions in accordance with ASTM E 8. 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.

4.5 Reports

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, showing the results of tests to determine conformance to the room temperature ultimate tensile property, hardness, and stress-rupture requirements, and stating that the parts conform to the other technical requirements of this specification. This report shall include the purchase order number, AS7479B, lot number, contractor or other direct supplier of material, part number, nominal size, and quantity.

4.6 Rejected Lots

Failure of a destructive test requirement as specified in Table 3 shall constitute scrapping of the entire lot; failure of a non-destructive test requirement as specified in Table 3 will require the vendor of parts to perform corrective action to screen out or rework the defective parts and resubmit for acceptance tests inspection as in Table 3. Resubmitted lots shall be clearly identified as reinspected lots.

5. PREPARATION FOR DELIVERY

5.1 Packaging and Identification

5.1.1 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, UNS S66286
AS7479B
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 supplier shall mention this specification number in all quotations and when acknowledging purchase orders.

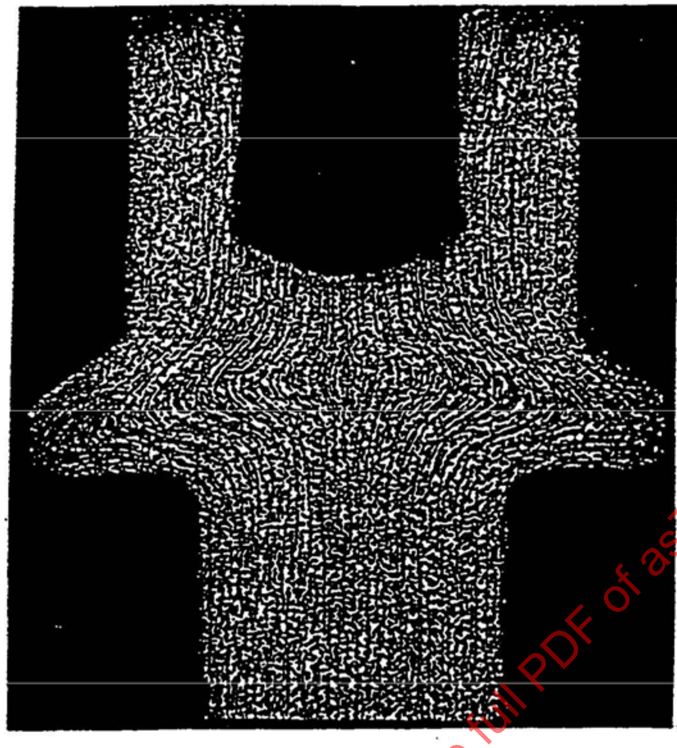
7. REJECTIONS

Parts not conforming to this specification, will be subject to rejection.

8. NOTES

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

8.2 A change bar (l) located in the left margin 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 document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.



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

FIGURE 1 - SATISFACTORY GRAIN FLOW, HEADED BLANK, BEFORE HEAT TREATMENT

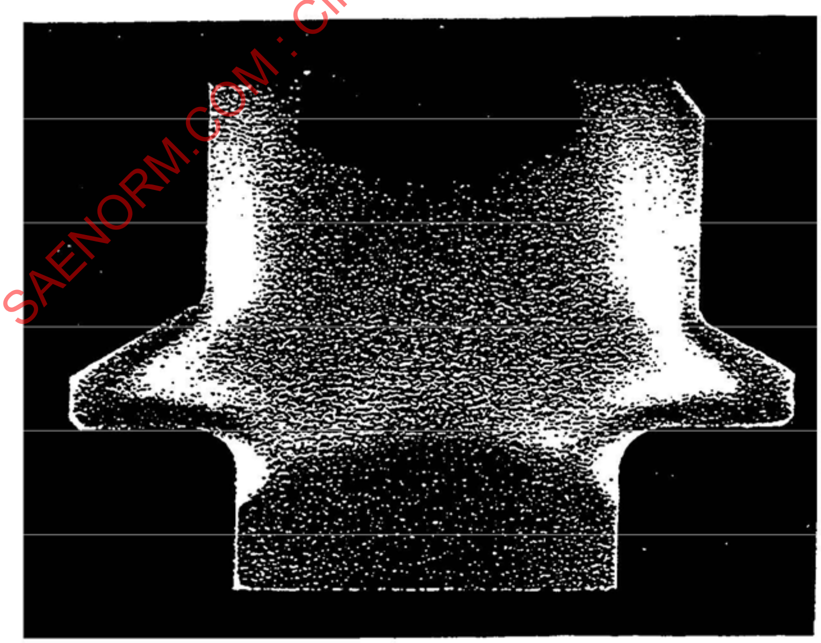
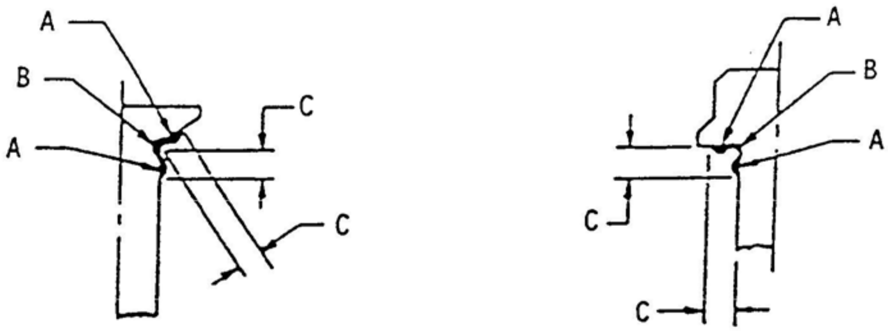


FIGURE 1A - SATISFACTORY HEAT PATTERN, HEADED BLANK, BEFORE HEAT TREATMENT



Nominal Bolt Diameter, inch	C, max inch
Up to 0.3125, excl	0.062
0.3125 & 0.375	0.094
0.4375 to 0.625, include	0.125
0.750 to 1.000, include	0.156
Over 1.000	0.188

FIGURE 2 - PERMISSIBLE DISTORTION FROM FILLET WORKING

FIGURE 3 - FLOW LINES, ROLLED THREAD

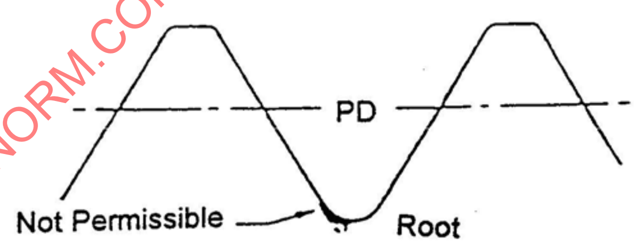


FIGURE 4 - ROOT DEFECTS, ROLLED THREAD

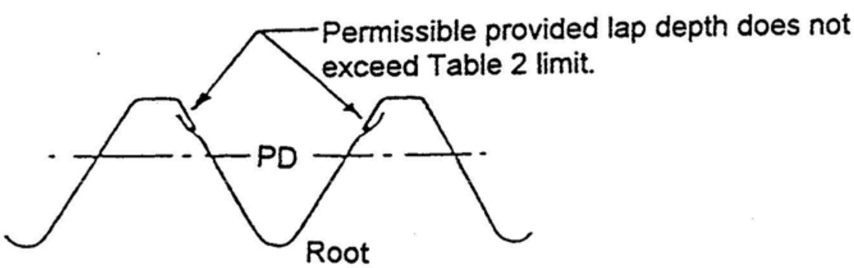


FIGURE 5 - LAPS ABOVE PITCH DIAMETER EXTENDING TOWARDS CREST, ROLLED THREAD

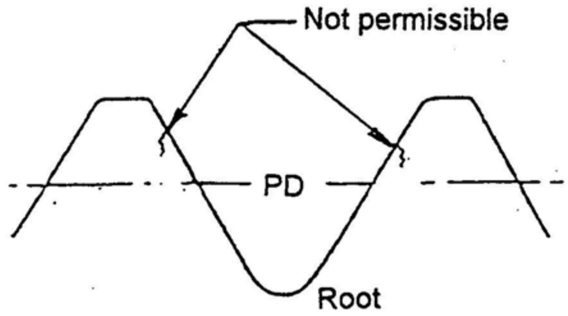


FIGURE 6 - LAPS ABOVE PD EXTENDING TOWARD ROOT, ROLLED THREAD

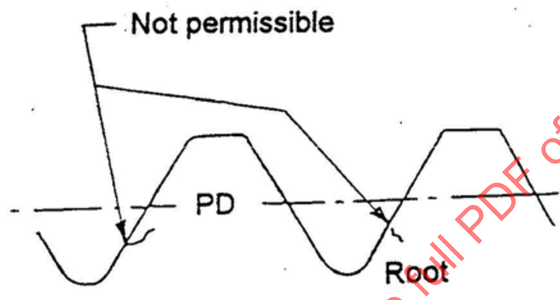


FIGURE 7 - LAPS BELOW PD EXTENDING IN ANY DIRECTION, ROLLED THREAD

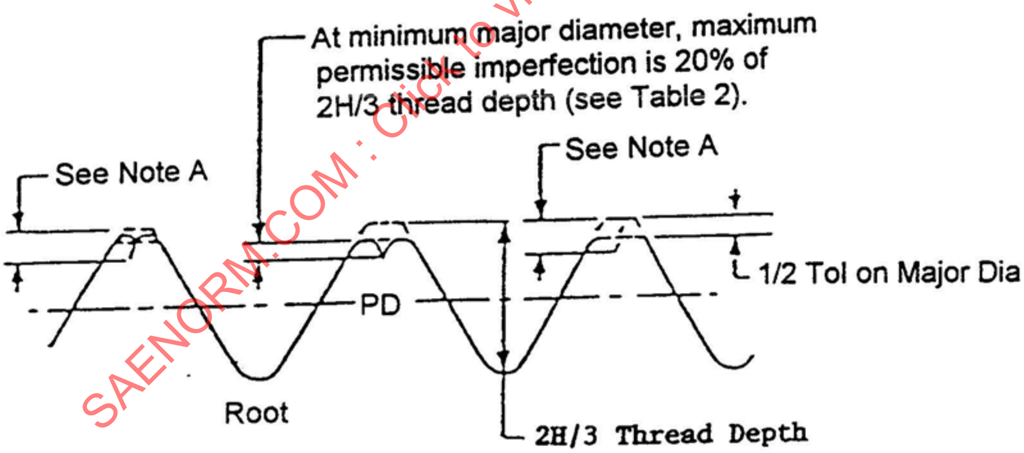


FIGURE 8 - CREST CRATERS AND CREST LAPS, ROLLED THREAD

TABLE 1 - UNJ EXTERNAL THREAD DEPTH AT 2H/3 AND ALLOWABLE THREAD LAP DEPTH

Thread Pitches Per Inch n	UNJ External Thread Depth at 2H/3 inch	Allowable Thread Lap Depth inch
40	0.0144	0.0029
36	0.0160	0.0032
32	0.0180	0.0036
28	0.0206	0.0041
24	0.0241	0.0048
20	0.0289	0.0058
18	0.0321	0.0064
16	0.0361	0.0072
14	0.0412	0.0082
13	0.0444	0.0089
12	0.0481	0.0096
11	0.0525	0.0105
10	0.0577	0.0115
9	0.0642	0.0128
8	0.0722	0.0144

NOTE: Allowable lap depth is based upon 20% of UNJ external thread depth at 2H/3 in accordance with AS8879, and is calculated as follows:

$$\text{Ext thd depth} = 2H/3 = (2/3)(\cos 30°)/n = 0.57735/n$$
$$\text{Lap depth} = 0.2(2H/3) = 0.2(2/3)(\cos 30°)/n = 0.11547/n$$

TABLE 2A - TEST LOADS FOR BOLTS

Nominal Thread Size	Ultimate Tensile Strength Test Load, lbf min Std PD UN and UNJ Threads	Ultimate Tensile Strength Test Load, lbf min Red PD UN THD Only	Stress-Rupture Strength Test Load, lbf Std PD UN and UNJ Threads	Stress-Rupture Strength Test Load, lbf Red PD UN THD Only
0.1120-40	801	747	338	313
0.1120-48	873	817	381	355
0.1380-32	1210	1140	507	477
0.1380-40	1340	1270	588	556
0.1640-32	1850	1770	806	768
0.1640-36	1940	1860	862	822
0.1900-32	2640	2540	1170	1130
0.2500-28	4790	4650	2170	2110
0.3125-24	7630	74 700	3490	3410
0.3750-24	11 500	11 300	5360	5260
0.4375-20	15 600	15 300	7220	7110
0.5000-20	21 000	20 700	9820	9690
0.5625-18	26 600	26 300	12 500	12 300
0.6250-18	33 500	33 200	15 800	15 700
0.7500-16	48 800	48 400	23 100	22 900
0.6750-14	66 700	66 200	31 600	31 400
1.0000-12	86 800	86 200	41 100	40 900

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 threads are based on 0.003 inch reduction below standard. The diameter of the area upon which stress for ultimate tensile strength test load requirements is based is one-half of the sum of the maximum pitch diameter and the maximum minor (root) diameter for UN threads, calculated as follows:

$$\text{Std PD, } A_1 = 0.7854\,[d - (0.9382/n)]^2 \quad \text{(Eq. 1)}$$

$$\text{Red PD, } A_2 = 0.7854\,[d - (0.9782/n) - 0.003]^2 \quad \text{(Eq. 2)}$$

where:

A_1 = area at [PD max + minor dia max]/2, Std PD
A_2 = area at [(PD max - 0.003) + (minor dia max - 0.003)]/2, Red PD
d = basic (maximum) major diameter
n = number of thread pitches per inch
n = number of thread pitches per inch