AEROSPACE STANDARD

AS7482	REV. B
Issued 1991-10 Revised 2009-09 Reaffirmed 2015-04 Superseding AS7482A	

Studs, Corrosion and Heat Resistant Steel, UNS S66286
Tensile Strength 130 ksi
1800 °F Solution Heat Treated, Aged Before Roll Threading
Procurement Specification

FSC 5307

RATIONALE

AS7482B has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE

1.1 Type

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

AS7482 — 130 ksi minimum ultimate tensile strength at room temperature
70 ksi stress-rupture strength at 1200 °F

AS7482-1 — 130 ksi minimum ultimate tensile strength at room temperature
78 ksi minimum ultimate shear strength at room temperature

AS7482-2 — 130 ksi minimum ultimate tensile strength at room temperature

1.2 Application

Primarily for aerospace propulsion system applications where a good combination of strength and resistance to corrosion are required. AS7482 studs are intended for use at elevated temperatures in corrosion resistant steel parts. AS7482-1 studs are intended for studs loaded in shear. AS7482-2 studs are intended for use where the coefficient of expansion of the stud is more compatible for use in aluminum or magnesium alloys.

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

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 and Canada), www.sae.org.

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

AMS5731 Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings 15Cr – 25.5Ni – 1.2Mo – 2.1Ti – 0.006B - 0.30V Consumable Electrode Melted, 1800 °F (982 °C) Solution Heat Treated

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 Precipitaion 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 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 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

2.1.3 AIA Publications

Available from Aerospace Industries Association, Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 973-358-1000, aia-aerospace.org.

NASM1312-6 Fastener Test Methods, Method 6, Hardness

NASM1312-8 Fastener Test Methods, Method 8, Tensile Strength

NASM1312-10 Fastener Test Methods, Method 10, Stress Rupture

NASM1312-13 Fastener Test Methods, Method 13, Double Shear Test

2.2 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.

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 manufacturer'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.

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- pounds force

ksi- kips (1000 pounds) per square inch

sp gr- specific gravity

HRC- hardness Rockwell C scale

PD- pitch diameter

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5731 corrosion and heat resistant steel heading stock or AMS 5732 corrosion and heat resistant steel.

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 or coating, shall conform to the part drawing. Dimensions apply after plating but before coating with solid 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 shall be UNJ profile and dimensions shall be in accordance with AS8879, unless otherwise specified on the part drawing. Tolerances for pitch diameter of the stud end thread shall be as specified on the part drawing. The special stud end thread variations shall be in accordance with AS3062 for the following requirements:

a. Lead and half-angle variation

b. Taper

c. Out-of-roundness

d. Stud lead threads

e. Stud thread runout

3.2.3.1 The requirements for thread crest variations, locking holes in the nut end thread, incomplete lead threads and thread runout in the nut end threads shall be 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 machined sufficiently to remove surface defects. Blanks may be produced by machining, upsetting, extruding or a combination of these methods. Heading stock to be upset shall not be heated to a temperature higher than 2100 °F.

3.3.1.1 When a shoulder or shoulders are produced by upsetting, the metal removed from the bearing surface shall be as little as practicable to provide a clean, smooth surface.

3.3.2 Heat Treatment

Shall conform to the technical requirements and other provisions specified in AMS2759/3 for A-286, 1800 °F solution treatment, and 1325 °F aging treatment.

3.3.2.1 Solution Heat Treatment: Blanks, unless machined from solution heat treated stock or AMS5732 steel, shall be solution heat treated as in 3.3.2.

3.3.2.2 Aging Treatment: Solution heat treated 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 shoulders, as applicable, of the solution heat treated and aged blanks prior to rolling the threads. The oxide removal process shall produce no intergranular attack or corrosion of the blanks.

3.3.4 Thread Rolling

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

3.3.5 Cleaning

Parts, after finishing, shall be degreased and submerged 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.

3.3.5.1 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 marked for oversize on the stud end thread and for material code on the nut end thread as specified by the part drawing. The markings may be formed by stamping, depressed 0.010 inch maximum, with rounded root form on depressed characters.

3.5 Mechanical Properties

Where AS7482 is specified, parts shall conform to the requirements of 3.5.1, 3.5.2, and 3.5.4. Where AS7482-1 is specified, parts shall conform to the requirements of 3.5.1, 3.5.2, and 3.5.3. Where AS7482-2 is specified, parts shall conform to the requirements of 3.5.1 and 3.5.2. Threaded members of gripping fixtures for tensile and stress-rupture tests shall be of sufficient size and strength to develop the full strength of the part without stripping the thread. The loaded portion of the shank shall have two to three full thread turns from the thread runout exposed between the loading fixtures during the tensile and stress-rupture tests.

AS7482 finished parts shall be tested in accordance with the following test methods:

a. Hardness: MIL-STD-1312-6 in accordance with NASM1312-6

b. Ultimate Tensile Strength at Room Temperature: MIL-STD-1312-8 in accordance with NASM1312-8

c. Stress-Rupture Strength at 1200 °F: MIL-STD-1312-10 in accordance with NASM1312-10

AS7482-1 finished parts shall be tested in accordance with the following test methods:

a. Hardness: MIL-STD-1312-6 in accordance with NASM1312-6

b. Ultimate Tensile Strength at Room Temperature: MIL-STD-1312-8 in accordance with NASM1312-8

c. Ultimate Double Shear Strength at Room Temperature: MIL-STD-1312-13 in accordance with NASM1312-13

AS7482-2 finished parts shall be tested in accordance with the following test methods:

a. Hardness: MIL-STD-1312-6 in accordance with NASM1312-6

b. Ultimate Tensile Strength at Room Temperature: MIL-STD-1312-8 in accordance with NASM1312-8

3.5.1 Ultimate Tensile Strength at Room Temperature

3.5.1.1 Finished Parts: Parts shall have an ultimate tensile load not lower than that specified in Table 2 and shall be tested to failure in order to observe fracture location, first measuring and recording the maximum tensile load achieved. 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 (smaller thread root diameter for studs with unequal size threads) 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.

3.5.1.2 Machined Test Specimens: If the size or shape of the part is such that a tensile test cannot be made on the part, tensile tests shall be conducted in accordance with ASTM 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%

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

3.5.2 Hardness

Shall be uniform within the range 24 to 37 HRC (see 8.1), but hardness of the threaded section may be higher as a result of the cold rolling operations. Parts shall not be rejected on the basis of hardness if the tensile strength properties specified in 3.5.1 are met.

3.5.3 Ultimate Shear Strength

Finished parts having a close toleranced full shank as in AS1132 shall have an ultimate double shear load not lower than that specified in Table 2. 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 studs having special shank diameters shall have the minimum ultimate double shear load based on 78 ksi minimum shear strength. Shear tests are not required for studs having a grip less than 2 times the nominal diameter. Shear test is not required for the following conditions:

a. Studs fully threaded.

b. Studs having coarse toleranced full shank.

c. Studs having a PD or relieved shank.

3.5.4 Stress-Rupture Strength at 1200 °F

3.5.4.1 Finished Parts: Parts, maintained at 1200 °F ± 3 °F while the tensile load specified in Table 2 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 3.5.4.1.1.

3.5.4.1.1 Parts having a shank diameter less than the maximum minor (root) diameter of the thread shall be tested as in 3.5.4.1, except that the load shall be as specified in 3.5.4.2. The diameter of the area on which stress is based shall be the actual measured minimum diameter of the part.

3.5.4.2 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 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 part.

3.6.1 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 3.6.1.1, 3.6.1.2, 3.6.1.3, 3.6.1.4, 3.6.1.5 and 3.6.1.6.

3.6.1.1 Flow Lines: Examination of a longitudinal section through the threaded ends shall show evidence that the threads were formed by rolling. This evidence shall include traces of flow lines that follow the general thread contour, and shall be of maximum density at root of thread (see Figure 1). Below the thread roots, flow lines not affected by forming shall be parallel to the axis, except that on the nut end of parts formed by extruding, the flow lines may be oblique to the axis for a distance from the end of the larger diameter to the smaller diameter equal to 1.5 times the "B" dimension of Table 2 of AS3062.

3.6.1.2 Internal Defects: Examination of longitudinal section of the part shall reveal no cracks, laps, or porosity. Thread imperfections shall meet the requirements in 3.6.1.6.

3.6.1.3 Microstructure: Parts shall have microstructure of completely recrystallized material except in the area of the threads.

3.6.1.4 Grain Size: Shall be ASTM No. 5 or finer as determined by the comparison method of ASTM E 112. Up to 25% of the areas 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 intercept (Heyn) method shall be used.

3.6.1.5 Surface Hardening: Parts shall have no change in hardness from core to surface except as produced during cold 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.

3.6.1.6 Threads

3.6.1.6.1 Root defects such as laps, seams, notches, slivers, folds, roughness, and oxide scale are not permissible (see Figure 2).

3.6.1.6.2 Multiple laps on thread flanks are not permissible regardless of location.

3.6.1.6.3 Single Lap on Thread Profile: Shall conform to the following:

a. Thread Flank Above the Pitch Diameter: A slight 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 3). 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 4).

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 5).

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 6). 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.

3.6.2 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.

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

3.6.2.1.1 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.

3.6.2.1.2 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.

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

3.6.2.2.1 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 3.6.2.2.2 through 3.6.2.2.5 provided the separation between indications is not less than 0.062 inch in all directions.

3.6.2.2.2 Sides of Shoulders: There shall be not more than three indications per shoulder. 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.

3.6.2.2.3 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.

3.6.2.2.4 Threads: There shall be no indications, except as permitted in 3.6.1.6.

3.6.2.2.5 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 3.6.2.2.2 shall break over an edge.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The manufacturer 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 AMS5731 or AMS5732.

4.4.2 Nondestructive Test - 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. Defects not classified in Table 5 shall be classified as Minor B defects. 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

The manufacturer 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, ultimate shear property where applicable, hardness, and stress-rupture requirements, and stating that the parts conform to the other technical requirements. This report shall include the purchase order number, AS7482 (or AS7482-1 or AS7482-2, as applicable), lot number, contractor or other direct supplier of material, part number, nominal size, and quantity.

4.6 Rejected Lots

If a production inspection lot is rejected, the manufacturer 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 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:

FASTENERS, STEEL, CORROSION AND HEAT RESISTANT
AS7482 (or AS7482-1 or AS7482-2, 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 manufacturer shall mention this specification 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 Hardness Conversion Tables

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

8.2 A change bar (|) 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.

FIGURE 1 - FLOW LINES, ROLLED THREAD

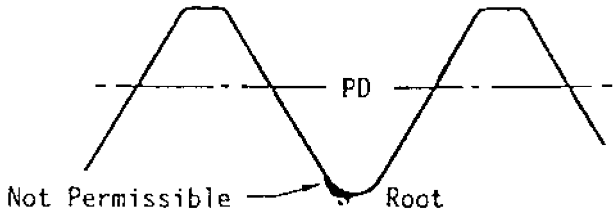


FIGURE 2 - ROOT DEFECTS, ROLLED THREAD

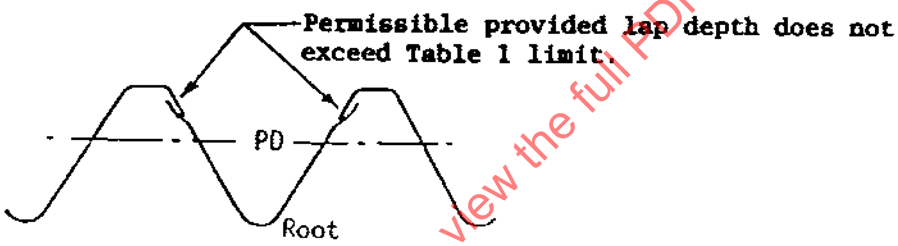


FIGURE 3 - LAPS ABOVE PITCH DIAMETER EXTENDING TOWARDS CREST, ROLLED THREAD

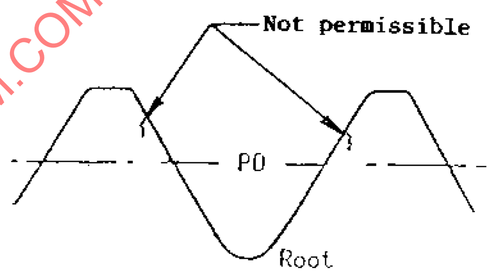


FIGURE 4 - LAPS ABOVE PD EXTENDING TOWARD ROOT, ROLLED THREAD

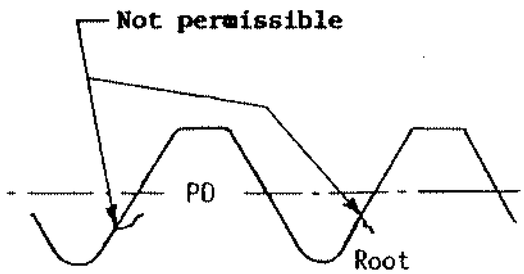
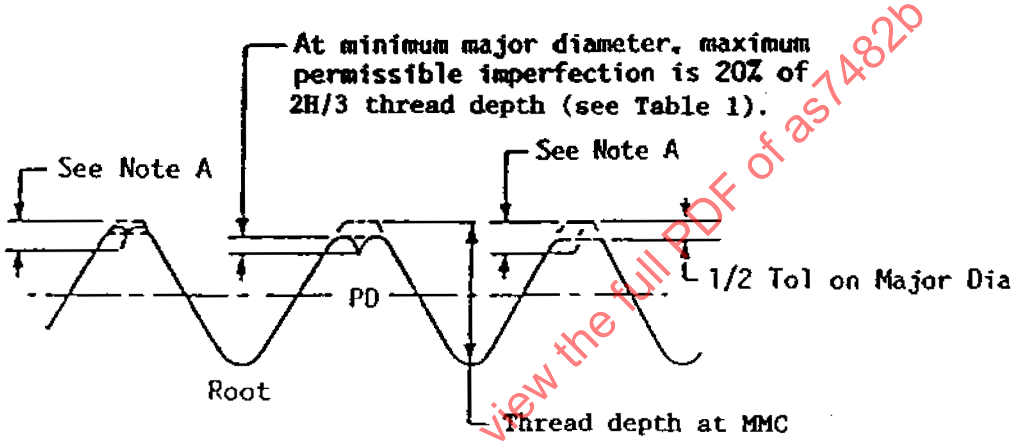


FIGURE 5 - LAPS BELOW PD EXTENDING IN ANY DIRECTION, ROLLED THREAD



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

FIGURE 6 - CREST CRATERS AND CREST LAPS, ROLLED THREAD

TABLE 1 - UNJ EXT 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 1 - Allowable lap depth is based on 20% of UNJ external thread depth at 2H/3 in accordance with AS8879, and is calculated as follows:

Ext thread depth = 2H/3 = (2/3) (cos 30°)/n = 0.57735/n
Lap depth = 0.2(2H/3) = 0.2(2/3)(cos 30°)/n = 0.115447/N

TABLE 2 - TEST LOADS

Thread Size	Ultimate Tensile Strength Test Load, lbf, minimum	Stress-Rupture Strength Test Load, lbf	Ultimate Double Shear Strength Test Load lbf, minimum
0.1900 - 24	2279	1060	4423
0.1900 - 32	2599	1265	4423
0.2500 - 20	4137	1957	7658
0.2500 - 28	4729	2337	7658
0.3125 - 18	6816	3282	11965
0.3125 - 24	7549	3756	11965
0.3750 - 16	10070	4893	17230
0.3750 - 24	11420	5767	17230
0.4375 - 14	13820	6730	23452
0.4375 - 20	15430	7779	23452
0.5000 - 13	18450	9046	30631
0.5000 - 20	20790	10580	30631
0.5625 - 12	23650	11650	38767
0.5625 - 18	26390	13440	38767
0.6250 - 11	29380	14500	47860
0.6250 - 18	33280	17050	47860
0.7500 - 10	43480	21640	68919
0.7500 - 16	48480	24920	68919
0.8750 - 9	60020	30000	93806
0.8750 - 14	66230	34080	93806
1.0000 - 8	78750	39410	122522
1.0000 - 12	86200	44310	122522

NOTE 1: Requirements above apply to parts with UNC, UNF, UNJC, or UNJF threads, as applicable for the sizes shown. The diameter of the area upon which stress for ultimate tensile strength test load is based is the UNJ basic minor diameter at 0.5625H thread depth, where H is the height of sharp V-thread, calculated from Equation 1:

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

where: A_1 = area at the UNJ basic minor diameter at 0.5625H thread depth, in^2
d = maximum major diameter of external thread
H = height of sharp V-thread = (cos 30°)/n
n = number of thread pitches per inch

Area upon which stress for stress-rupture strength test load requirements is based is the area at 17H/24 thread depth below the basic major diameter and calculated from Equation 2:

$$A_2 = 0.7854\,[d - (17H/12)]^2 = 0.7854\,[d - (1.2269/n)]^2 \qquad \text{(Eq. 2)}$$

where: A_2 = area at 17H/24 thread depth below basic major diameter (maximum rounded root diameter of UN thread profile) in^2
d = basic (maximum) major diameter
H = height of sharp V-thread = (cos 30°)/n
n = number of thread pitches per inch

Area upon which stress for ultimate double shear test load is based is at the nominal diameter of the close tolerance full shank bolt (see AS1132), calculated from Equation 3:

$$A_3 = 0.7854(d)^2 \qquad \text{(Eq. 3)}$$

where:

A_3 = area of nominal close tolerance shank diameter, in^2
d = nominal diameter of close tolerance full shank