AEROSPACE STANDARD

AS7458™ REV. C

Issued 1991-02
Reaffirmed 2006-06
Revised 2022-07

Superseding AS7458B

(R) Studs, Steel, Low Alloy, Heat-Resistant Normalized and Tempered, Roll Threaded 135000 psi Tensile Strength

RATIONALE

AS6416 added, figures updated, many paragraphs renumbered and updated, specs updated.

1. SCOPE

1.1 Type

This procurement specification covers aircraft quality studs made from a low-alloy, heat-resistant steel of the type identified under the Unified Numbering System as UNS K14675.

AS7458 135000 psi ultimate tensile strength at room temperature.

AS7458-1 135000 psi ultimate tensile strength at room temperature, nickel-cadmium plated.

1.2 Application

Primarily for aerospace propulsion system stud applications where good strength at temperatures up to approximately 900 °F is required and the part is protected against corrosion.

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.

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https://www.sae.org/standards/content/AS7458C/

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2416	Plating, Nickel-Cadmium, Diffused
AMS2750	Pyrometry
AMS6304	Low-Alloy Steel, Heat-Resistant Bars, Forgings, Mechanical Tubing, and Forging Stock, 0.95Cr - 0.55Mo - 0.30V (0.40 - 0.50C)
AS3062	Bolts, Screws, and Studs, Screw Thread Requirements
AS3063	Bolts, Screws, and Studs, Geometric Control Requirements
AS6416	Bolts, Screws, Studs and Nuts, Definitions for Design, Testing, and Procurement
AS8879	Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter

2.1.2 U.S. Government Publications

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

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

2.1.3 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 E140	Standard Hardness Tables for Metals
ASTM E1444/E1444M	Magnetic Particle Examination
ASTM E8/E8M	Tension Testing of Metallic Materials

2.1.4 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

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

2.1.5 AIA Publications

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

NASM1312-6	Fastener Test Methods, Method 6, Hardness
NASM1312-8	Fastener Test Methods, Method 8, Tensile Testing
NASM1312-12	Fastener Test Methods, Method 12, Plating Thickness

2.2 Definitions

Refer to AS6416.

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2.3 Unit Symbols

A	ampere
°F	degree Fahrenheit
%	percent (1% = 1/100)
lbf	pounds force
psi	pounds force per square inch
sp gr	specific gravity

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS6304 steel, 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 shall conform to the part drawing. Dimensions apply after plating but before coating.

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

Threads shall be in accordance with AS8879, unless otherwise specified on the part drawing. Tolerances for pitch diameter of stud end threads shall be as specified on the part drawing. The special stud end thread requirements shall be in accordance with AS3062 for the following requirements:

a. Lead and half-angle variations

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 thread, and thread runout on nut end thread shall be as specified in AS3062.

3.2.3.2 Chamfer

The entering end of the thread (both ends) shall be chamfered as specified on the part drawing.

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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

Blanks shall be machined sufficiently to remove surface defects and decarburization except as noted in 3.7.2.3. Blanks may be produced by machining, upsetting, extruding, or by a combination of these methods.

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

Blanks, unless machined from heat treated stock, shall, before finishing the shank and rolling the threads, be heat treated as follows:

3.3.2.1 Heating Equipment

Furnaces may be any type ensuring uniform temperature throughout the parts being heated and shall be equipped with, and operated by, automatic controllers and data recorders conforming to AMS2750. The heating medium or atmosphere shall cause no surface hardening by carburizing or nitriding nor decarburization other than that permitted by 3.9.2.2.

3.3.2.2 Normalizing

Blanks of AMS6304 shall be uniformly heated to 1750 °F ± 25 °F, held at heat for 60 to 90 minutes, and cooled in still air or in a cooling chamber or the furnace.

3.3.2.3 Tempering

Normalized blanks of AMS6304 shall be tempered by heating uniformly to the temperature necessary to produce the specified hardness and microstructure but not lower than 1100 °F, holding at heat for not less than 6 hours, and cooling in air.

3.3.2.4 For steels other than AMS6304, heat treatment shall be as agreed upon by purchaser and manufacture.

3.3.3 Oxide and Decarburization Removal

Surface oxide, oxide penetration, and decarburization except as permitted in 3.7.2.3, resulting from prior heat treatment, shall be removed from the full body diameter and the bearing surfaces, as applicable, of the heat treated blanks prior to rolling the threads. The 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 rolling process after removal of oxide and decarburization as in 3.3.3.

3.4 Plating

Where AS7458 is specified, any protective treatment shall be as specified on the part drawing. Where AS7458-1 is specified, parts shall be nickel-cadmium plated in accordance with AMS2416.

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3.5 Mechanical Properties

Studs for tensile test shall be of sufficient size and strength to develop the full strength of the stud 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 test. Finished parts shall be tested in accordance with the following applicable test methods:

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

b. Room temperature ultimate tensile strength: 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, 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 or having an undercut, parts shall conform to only the ultimate tensile strength requirements of 3.6.1.2; 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 E8/E8M on specimens prepared as in 4.2. Such specimens shall meet the following requirements:

a. Ultimate tensile strength, minimum: 135000 psi

b. Yield strength at 0.2% offset, minimum: 115000 psi

c. Elongation in 2 in or 4D, minimum: 15%

d. Reduction of area, minimum: 40%

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 and within the range 30 to 38 HRC, but hardness of the threaded sections may be higher as a result of the cold working operations.

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3.6 Quality

Studs shall be uniform in quality and condition, clean, sound, smooth, and free from burrs and foreign materials, and from imperfections detrimental to usage of the parts.

3.6.1 Macroscopic Examination

Studs or sections of parts, as applicable, shall be etched in a solution consisting of approximately 50% hydrochloric acid (sp gr 1.19), and 50% water for sufficient time to reveal flow lines but not longer than 15 minutes, and then be examined at a magnification of approximately 20X or greater to determine conformance to the requirements of 3.6.1.1, and 200X magnification to determine conformance to the requirements of 3.7.1.1, 3.7.1.3, and 3.7.2.

3.6.1.1 Flow Lines

Flow lines in threads shall be continuous, shall follow the general thread contour, and shall be of maximum density at the root of the 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 studs 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 Imperfections

Examination of longitudinal sections of parts shall reveal no cracks, laps, or porosity except laps in threads as permitted in 3.8.1.2.3 and 3.8.1.2.4.

3.6.1.3 Threads

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

3.6.1.3.2 Multiple laps on the flanks of threads are not permissible regardless of location. Single laps on the flanks of threads that extend toward the root are not permissible (see Figures 3 and 4).

3.6.1.3.3 There shall be no laps along the flank of the thread below the pitch diameter (see Figure 5). A single lap is permissible along the flank of the thread above the pitch diameter on either the pressure or non-pressure flank (one lap at any cross-section through the thread) provided it extends toward the crest and generally parallel to the flank (see Figure 5).

3.6.1.3.4 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 size is 0.0005-inch length or depth when viewed at 200X magnification.

3.6.1.3.5 There shall be no laps along the flank of the thread below the pitch diameter (see Figure 5). A single lap is permissible along the flank of the thread above the pitch diameter on either the pressure or non-pressure flank (one lap at any cross-section through the thread) provided it extends toward the crest and generally parallel to the flank (see Figure 5).

3.6.1.3.6 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 20% of the basic thread height (see 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 the actual major diameter as measured on the part.

3.6.2 Microscopic Examination

Specimens cut from parts shall be polished, etched in 2% Nital, and examined at a magnification not lower than 100X to determine conformance to the requirements of 3.8.1.1, 3.9.2, and 3.9.2.1.

3.6.3 Microstructure

Parts shall have a normalized and tempered structure with finely divided carbides. Ferrite may be in a typical Widmanstatten pattern or randomly dispersed. Presence of tempered martensite, particularly in small diameter parts, will be acceptable.

3.6.3.1 Surface Hardening

Parts shall have no change in hardness from core to surface except as produced during rolling of threads. There shall be no evidence of carburization, recarburization, 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 within 0.003 inch of an unrolled surface, which exceeds the reading in the core by more than 30 points shall be evidence of nonconformance to this requirement.

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3.6.3.2 Decarburization

3.6.3.2.1 The bearing surface of the shoulder, the shoulder-to-shank fillet radius, the shank, and the threads shall be free from decarburization.

3.6.3.2.2 The periphery of the shoulder of shouldered parts may be decarburized to a depth not exceeding that permitted by the applicable material specification for the size of stock used to make the part.

3.6.3.2.3 Depth of decarburization at any point on the surface not covered by 3.9.2.2.1 shall not exceed 0.002 inch.

3.6.4 Magnetic Particle Inspection

Parts shall be subject to magnetic particle inspection in accordance with ASTM E1444/E1444M; any method may be used but resolution of disputed rejections shall be based upon the wet, continuous, fluorescent suspension method using amperages shown in 3.9.2.

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

3.6.4.1.1 Sides of Shoulders

There shall be not more than six surface or subsurface 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 basic thread height (see Table 1), whichever is less.

3.6.4.1.2 Shank or Stem

There shall be not more than ten subsurface and hairline surface 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.

3.6.4.1.3 Threads

There shall be no indications, except as permitted in 3.7.1.3.

3.6.4.1.4 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 3.8.1.1, shall break over an edge.

3.6.5 Procedures

3.6.5.1 Circular Magnetization

800 to 1000 A per square inch of contact area passed through the part longitudinally.

3.6.5.2 Longitudinal Magnetization

Sufficient to provide 5000 A-turns per inch of shank diameter with the part placed in a standard solenoid of appropriate size.

4. QUALITY ASSURANCE PROVISIONS

4.1 Acceptance Test Sampling

4.1.1 Nondestructive Test - Visual and Dimensional

A random sample of parts shall be taken from each production inspection lot; the size of the sample shall 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.

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4.1.2 Hardness Test (see 3.6.2)

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 visual and dimensional inspection, with additional units selected at random from the production inspection lot as necessary.

4.1.3 Magnetic Particle Inspection

A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table 4 shall be as classified 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.

4.1.4 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 magnetic particle inspection, with additional units selected at random from the production inspection lot as necessary.

4.1.5 Acceptance Quality

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

4.2 Test Specimens

Specimens for tensile testing of machined test specimens shall be of standard proportions in accordance with ASTM E8/E8M with either 0.250 inch diameter at the reduced parallel gage section or smaller specimens 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 parts or coupons.

4.3 Reports

The manufacture of parts shall furnish with each shipment a report, this report shall include the purchase order number, AS7458 and revision letter, lot number, contractor or other direct supplier of material, part number, nominal size, and quantity.

4.4 Resampling and Retesting

If a production inspection lot is rejected, the vendor of parts may perform corrective action to screen out or rework the defective parts, and 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 Parts having different part numbers shall be packed in separate containers.

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

FASTENERS, STEEL, LOW ALLOY, HEAT RESISTANT
AS7458 AND REVISION LETTER
PART NUMBER
PURCHASE ORDER NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

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5.1.1 Threaded fasteners shall be suitably protected 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 shall be subject to rejection.

8. NOTES

NOTICE

This document makes references a part which contains cadmium as a plating material. Consult local officials if you have questions concerning cadmium's use.

8.1 Revision Indicator

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.

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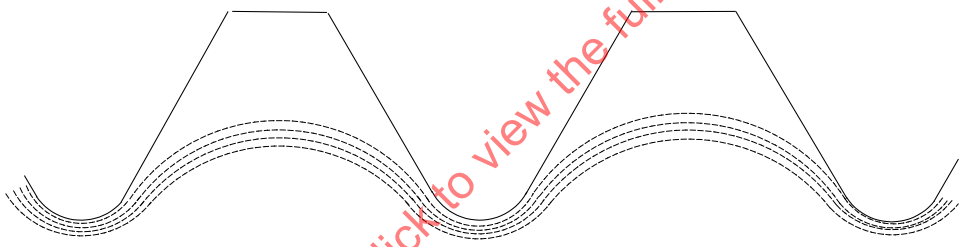

Figure 1 - Flow lines, rolled thread

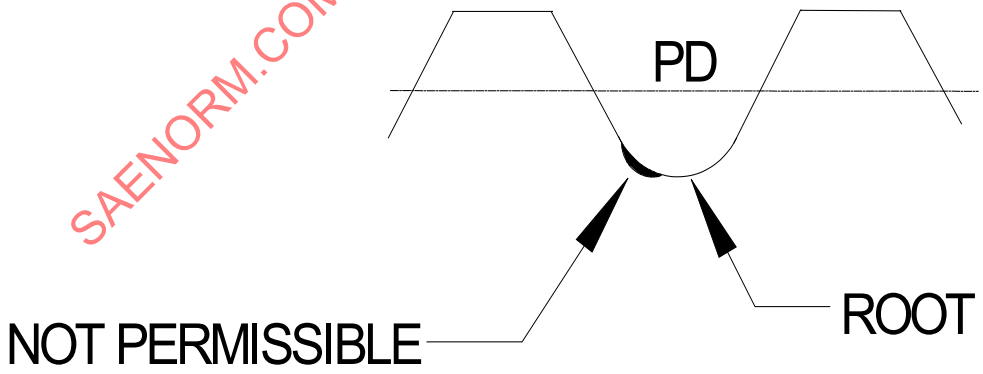

Figure 2 - Root defects, rolled thread

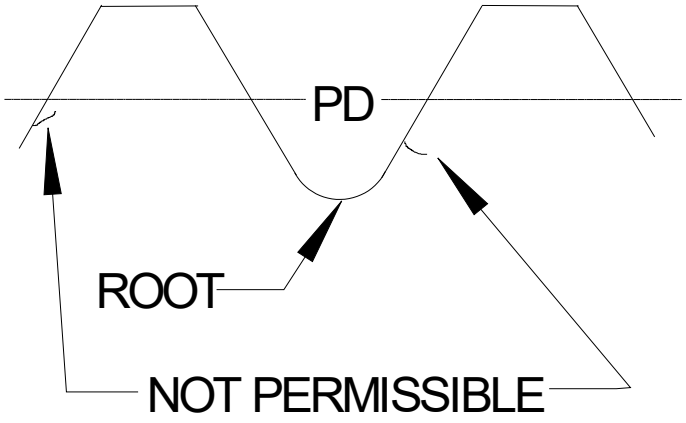

Figure 3 - Laps below PD extending toward root, rolled thread

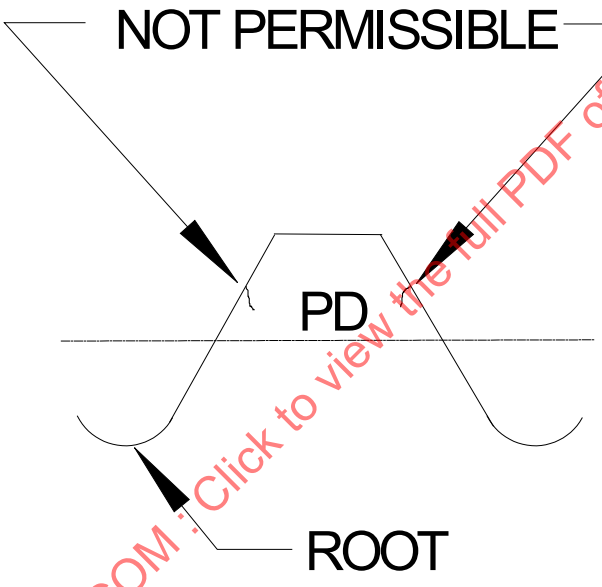

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Figure 4 - Laps above PD extending toward root, rolled thread

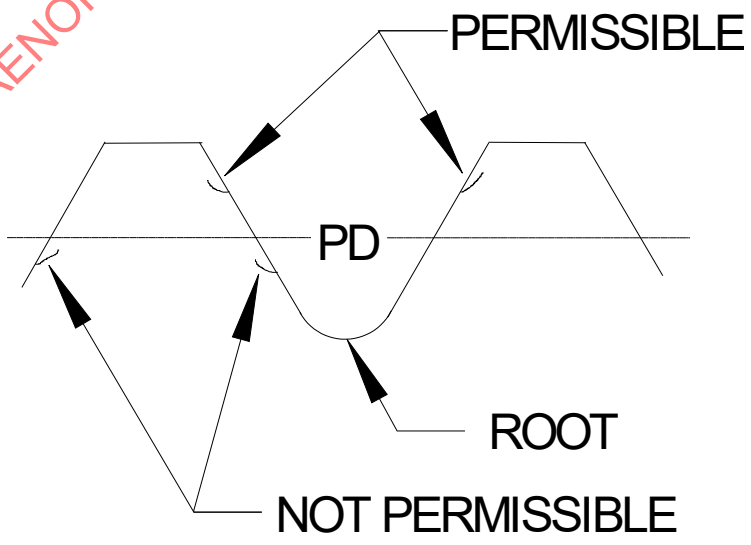
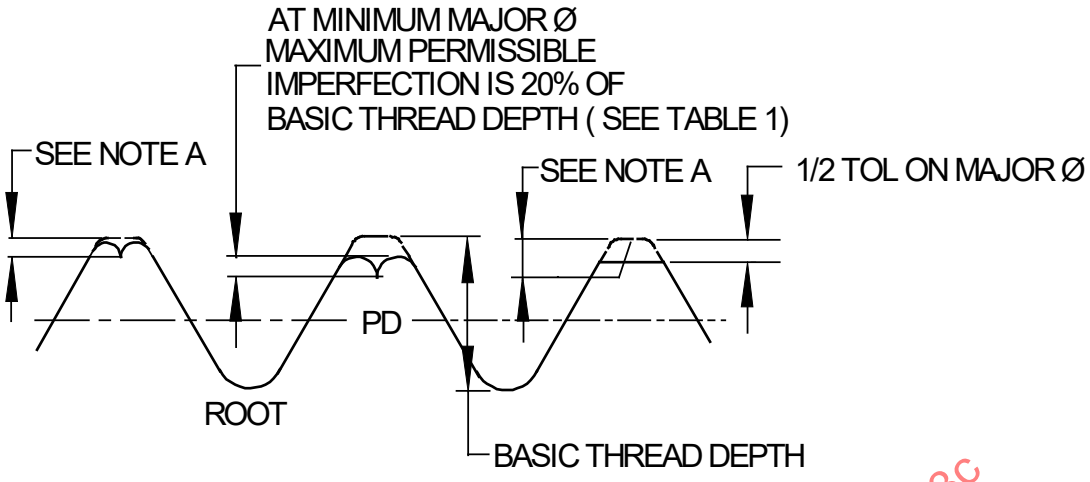


Figure 5 - Laps extending towards crest, rolled thread



NOTE A
MAXIMUM DEPTH OF IMPERFECTION EQUALS 20% OF 2H/3 BASIC 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 - Thread height

Thread Pitches per Inch n	Basic Thread Height Ref (See Note 1) Inches	20% Basic Thread Height Inches
80	0.0081	0.0016
72	0.0090	0.0018
64	0.0102	0.0020
56	0.0116	0.0023
48	0.0135	0.0027
44	0.0148	0.0030
40	0.0163	0.0033
36	0.0181	0.0036
32	0.0203	0.0041
28	0.0232	0.0046
24	0.0271	0.0054
20	0.0325	0.0065
18	0.0361	0.0072
16	0.0406	0.0081
14	0.0464	0.0093
13	0.0500	0.0100
12	0.0542	0.0108
11	0.0591	0.0118
10	0.0650	0.0130
9	0.0722	0.0144
8	0.0813	0.0163

NOTE 1: Basic thread height is defined as being equivalent to 0.650 times the pitch, where pitch equals 1/n.

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Table 2 - Test loads

Thread Size	Ultimate Tensile Strength Test Load lbf, Minimum Standard Pitch Dia UN and UNJ Threads	Ultimate Tensile Strength Test Load lbf, Minimum Reduced Pitch Dia UN Threads Only
0.112-40	930	880
0.112-48	990	930
0.138-32	1410	1340
0.138-40	1510	1440
0.164-32	2100	2020
0.164-36	2170	2060
0.190-24	2700	2600
0.190-32	2930	2830
0.250-20	4820	4690
0.250-28	5240	5100
0.3125-18	7780	7610
0.3125-24	8300	8120
0.375-16	11900	11600
0.375-24	12800	12600
0.4375-14	16200	16000
0.4375-20	17400	17100
0.500-13	21500	21200
0.500-20	23200	22900
0.5625-12	27400	27100
0.5625-18	29400	29000
0.625-11	34000	33600
0.625-18	36800	36400
0.750-10	49800	49300
0.750-16	53400	52900
0.875-9	68300	67800
0.875-14	72800	72300
1.000-8	89500	88900
1.000-12	94900	94300

NOTE 1: Requirements above apply to parts with UNC, UNF, UNJC, or UNJF threads, as applicable to the sizes shown and having hardness within the range of 30 to 38 HRC; requirements for reduced pitch diameter threads are based on 0.003 inch reduction below standard. For nominal thread major diameter 0.3125 inch and smaller, area upon which stress for room temperature ultimate tensile strength test load requirements is based is 98% of the maximum pitch diameter, calculated from Equation 1:

$$A = 0.7854[0.98(D - (0.6495/n))]^2 \quad \text{(Eq. 1)}$$

where:

A = area at 98% of maximum PD
D = maximum major diameter
N = number of thread pitches per inch

For nominal thread major diameter greater than 0.3125 inch, area upon which stress is based is the maximum pitch diameter, calculated from Equation 2:

$$A = 0.7854[D - (0.6495/n)]^2 \quad \text{(Eq. 2)}$$

Load requirements are based on 135000 psi for ultimate tensile strength test load at room temperature.

NOTE 2: For sizes not shown, ultimate tensile strength test load at room temperature for parts tested as parts, not as specimens machined from parts or from coupons of the stock, shall be based upon the respective areas and stresses given in Note 1.

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