AEROSPACE STANDARD

AS7472™	REV. B

Issued 1991-01
Reaffirmed 2015-04
Revised 2021-11

Superseding AS7472A

(R) Bolts and Screws, Steel, Corrosion Resistant 125000 psi Tensile Strength Roll Threaded

FSC 5306

RATIONALE

AS6416 added, all figures redrawn and some figures deleted, changes to many paragraphs, and specs updated.

1. SCOPE

1.1 Type

This procurement specification covers aircraft quality bolts and screws made from a corrosion resistant austenitic iron base alloy of the type identified as SAE 30302 and of 125000 psi tensile strength at room temperature.

1.2 Application

Primarily for aerospace propulsion system bolt applications where a good corrosion resistance and moderate strength 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

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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For more information on this standard, visit
https://www.sae.org/standards/content/AS7472B/

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.

AMS2248	Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly Alloyed Steels, and Iron Alloys
AMS2750	Pyrometry
AMS5637	Steel, Corrosion Resistant, Bars and Wire, 18Cr - 9.0Ni (302), Solution Heat Treated, Cold Drawn and Stress Relieved, 125 ksi (862 MPa) Tensile Strength
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
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	DOD Materiel, Procedures for Development and Application of Packaging Requirements

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 E353	Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E1417/E1417M	Liquid Penetrant Examination

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.

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

2.2 Definitions

Refer to AS6416.

2.3 Unit Symbols

°F degree Fahrenheit

h hour

in inch

min minute of time

% percent (1% = 1/100)

lbf pounds force

psi pounds force per square inch

sp gr specific gravity

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the following percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E353, by spectrochemical methods, or by other methods acceptable to purchaser:

Table 1 - Composition

Element	% by Weight min	max
Carbon	---	0.15
Manganese	---	2.00
Silicon	---	1.00
Phosphorus	---	0.040
Sulfur	---	0.030
Chromium	17.00	20.00
Nickel	7.00	12.00

3.1.1 Check Analysis

Composition variations shall meet the requirements of AMS2248.

3.2 Material

Heading stock shall have composition specified in 3.1. Stock for machining shall be AMS5637.

3.3 Design

Finished (completely manufactured) parts shall conform to the following requirements:

3.3.1 Dimensions

The dimensions of finished parts, shall conform to the part drawing. Dimensions apply after plating but before coating.

3.3.2 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.

3.3.3 Threads

Threads shall be in accordance with AS8879, unless otherwise specified on the part drawing.

3.3.3.1 Incomplete Threads

Incomplete threads and runouts are permissible as specified in AS3062.

3.3.3.2 Chamfer

Bolts shall be chamfered as specified on the part drawing.

3.3.4 Geometric Tolerances

Part features shall be within the geometric tolerances specified on the part drawing and, where applicable, controlled in accordance with AS3063.

3.4 Fabrication

3.4.1 Blanks

Heads shall be formed by cold forging or machining. When heads are machined, AMS5637 steel shall be used. Lightening holes on forged or machined heads 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.

3.4.2 Oxide Removal

The blanks, before cold working the fillet radius when specified and rolling the threads, shall have surface oxide and oxide penetration removed from the full body diameter and bearing surface of the head. 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 and, in no case shall be so great as to produce more cutting of flow lines in the head-to-shank junction than shown in Figure 1.

3.4.3 Cold Working of Fillet Radius

After removal of oxide as in 3.4.2, the head-to-shank fillet radius of headed parts having the radius shall be cold worked, if called for on the product standard. Distortion due to cold working shall conform to Figure 1, 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 1; distorted areas shall not extend beyond “C” as shown in Figure 1 unless otherwise specified on the part drawing.

3.4.3.1 Undercut Bolt Heads

In configurations having an undercut connected with the fillet radius, the cold working 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.

3.4.3.2 Shouldered Bolts

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 working will be required only for 90 degrees of the fillet arc, starting at the point of tangency of the fillet radius and the shouldered surface of the unthreaded shank.

3.4.3.3 Close Tolerance Bolts

The shank diameter on full shank close tolerance bolts shall not exceed its maximum diameter limit after cold rolling the head to shank fillet radius.

3.4.4 Thread Rolling

Threads shall be formed on the finished blanks by a single rolling process after removal of oxide as in 3.4.2.

3.4.5 Stress Relieving

Bolts, after thread rolling, shall be stress relieved by heating to 700 °F ± 10 °F, holding at heat for 3 hours, and cooling, except that parts made of AMS5637 steel need not be so treated. Furnaces may be any type ensuring uniform temperature throughout the parts being heated and shall be equipped with, and operated by, automatic temperature controllers and data recorders conforming to AMS2750.

3.4.6 Cleaning

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

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

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

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

d. ASTM A967, ASTM A380, or AMS2700 for cleaning parts only, excluding any additional verification requirements (such as salt spray).

3.5 Plating

Where required, surfaces shall be plated as specified by the part drawing.

3.6 Mechanical Properties

Bolts for proof load and tensile tests shall be of sufficient size and strength to develop the full strength of the bolt without stripping the thread. The loaded portion of the shank shall have two full thread turns from the thread runout exposed between the loading fixtures during the proof load and tensile tests. Finished parts shall be tested per MIL-STD-1312-8 in accordance with NASM1312-8 at room temperature for the proof load and tensile tests.

3.6.1 Proof Load

Parts shall be subjected to the load specified in Table 3 for not less than 1 minute. After removing the load, the length shall have increased not more than 0.001 inch. If the size or shape of the part is such that this elongation requirement would not be met but the part can be tested satisfactorily, such as parts having a shank diameter equal to or less than the thread minor (root) diameter or having an undercut, parts shall be subjected to a stress of 70000 psi for not less than 1 minute; for such parts, the diameter of the area on which stress is based shall be the actual measured minimum diameter of the part. After removing the load, parts shall have increased in length not more than 0.002 inch.

3.6.2 Ultimate Tensile Strength at Room Temperature

Tension fasteners with either standard 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.

Parts shall have an ultimate tensile load not lower than that specified in Table 3 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 have an ultimate tensile strength not lower than 125000 psi with reduction of area not less than 20%; for such parts, the diameter of the area on which stress is based shall be the actual measured minimum diameter of the part. When specified, heads formed by forging and head-to-shank fillet is cold worked, tension fasteners with either standard double hexagon or hexagon 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 associated with an undercut or with a shank diameter less than the minimum pitch diameter of the thread.

3.7 Quality

Parts shall be uniform in quality and condition, clean, sound, smooth, and free from burrs and foreign materials, and from imperfections detrimental to their performance.

3.7.1 Macroscopic Examination

Bolts 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, or other suitable etchant, 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 3.7.1.1, 3.7.1.2, and 200X magnification to determine conformance to the requirements of 3.7.1.3.3, except that examination for thread imperfections as specified in 3.7.1.3 should be made by microscopic examination of specimens polished and etched.

3.7.1.1 Flow Lines

3.7.1.1.1 Head-to-Shank

After heading and prior to heat treatment examination of an etched section taken longitudinally through the sample shall show lines or heat pattern in the shank, head-to-shank fillet, and the bearing surface which are representative of a forging process and shall follow the head contour, if headed.

3.7.1.1.2 Threads

Flow lines in threads shall be continuous, shall follow the general thread contour, and shall be of maximum density at root of thread (see Figure 3).

3.7.1.2 Internal Imperfections

Examination of longitudinal sections of the head and shank and of the threads shall reveal no cracks, laps, porosity, or other conditions detrimental to intended performance.

3.7.1.3 Threads

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

3.7.1.3.2 Multiple laps on the flanks of threads are not permissible regardless of location. Single laps on the flank of threads that extend toward the root are not permissible (see Figures 5 and 6).

3.7.1.3.3 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.

3.7.1.3.4 There shall be no laps along the flank of the thread below the pitch diameter (see Figure 7). 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 7).

3.7.1.3.5 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 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 the actual major diameter as measured on the part.

3.7.2 Fluorescent Penetrant Inspection

Parts shall be subject to fluorescent penetrant inspection in accordance with ASTM E1417/E1417M type 1, sensitivity level 2.

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

3.7.2.1.1 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 basic thread height (see Table 2), whichever is less.

3.7.2.1.2 Shank

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.

3.7.2.1.3 Threads

There shall be no indications, except as permitted in 3.7.1.3. Ratable lap indications shall conform to 3.7.1.3.3

3.7.2.1.4 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 shall break over an edge.

4. QUALITY ASSURANCE PROVISIONS

4.1 Acceptance Test Sampling

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 4.

4.1.1 Nondestructive Test - Visual and Dimensional

A random sample will be selected from each production inspection lot; the size of the sample to be as specified in Table 5. The classification of defects for parts shall be as specified in Table 6. Defects not classified in Table 6 shall be classified as Minor B defects. All dimensional characteristics are considered defective when out of tolerance.

4.1.2 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 5 shall be as classified 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 Destructive Tests

A random sample shall be selected from each production inspection lot; the size of the sample shall be as specified in Table 7. 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.

4.1.4 Acceptance Quality

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

4.2 Reports

The manufacturer of parts shall furnish with each shipment a report for all tests. This report shall include the purchase order number, AS7472B, lot number, contractor or other direct supplier of material, part number, nominal size, and quality.

4.3 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, CORROSION RESISTANT
AS7472B
PART NUMBER
PURCHASE ORDER NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

5.1.3 Threaded fasteners shall be protected during handling, transportation, and storage.

6. ACKNOWLEDGMENT

A manufacturer shall mention this specification number in all quotations and when acknowledging purchase orders.

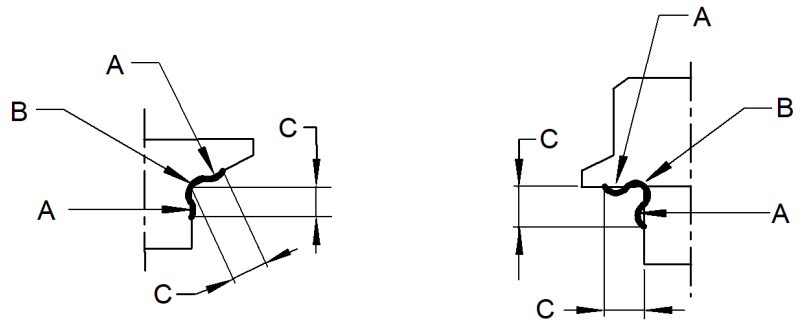
7. REJECTIONS

Parts not conforming to this specification shall be subject to rejection.

8. NOTES

8.1 Revision Indicator

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.



Nominal Bolt Diameter	C Max Inches
Up to 0.3125	0.062
0.3125 and 0.375	0.094
0.4375 to 0.625	0.125
0.750 to 1.000	0.156
Over 1.000	0.188

Figure 1 - Permissible distortion from fillet working

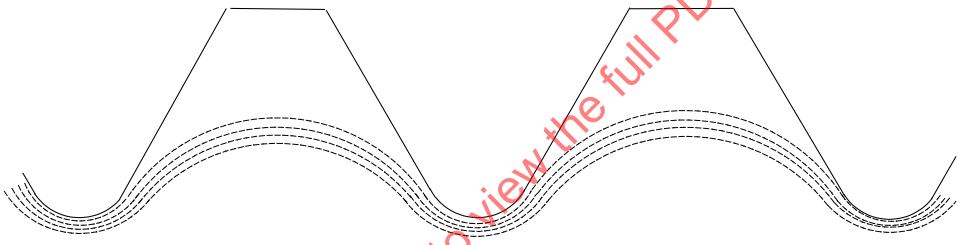


Figure 2 - Flow lines, rolled thread

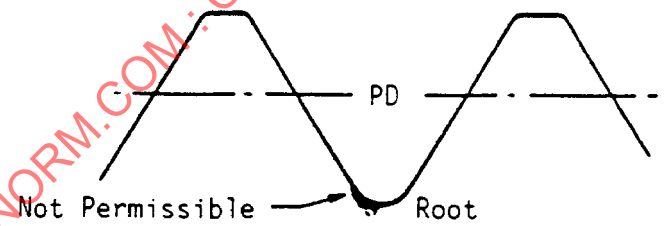


Figure 3 - Root defects, rolled thread

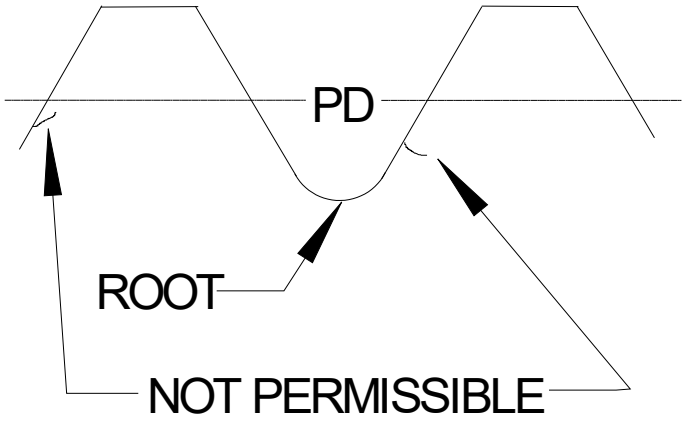


Figure 4 - Laps below pd extending in any direction

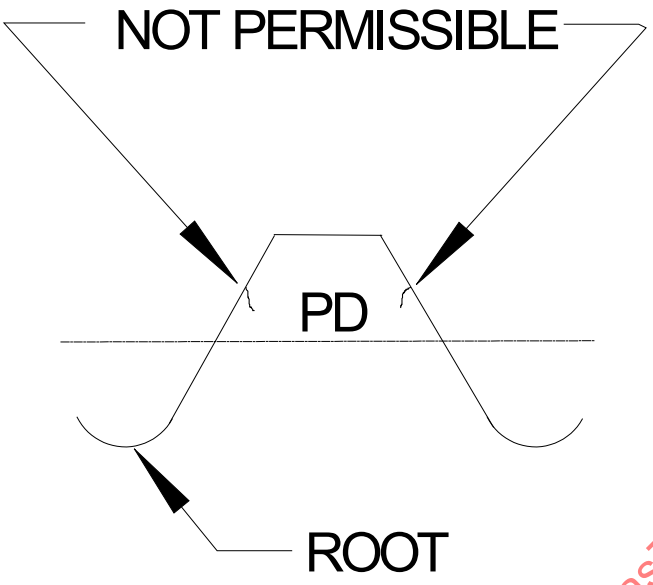


Figure 5 - Laps above pd extending toward root, rolled thread

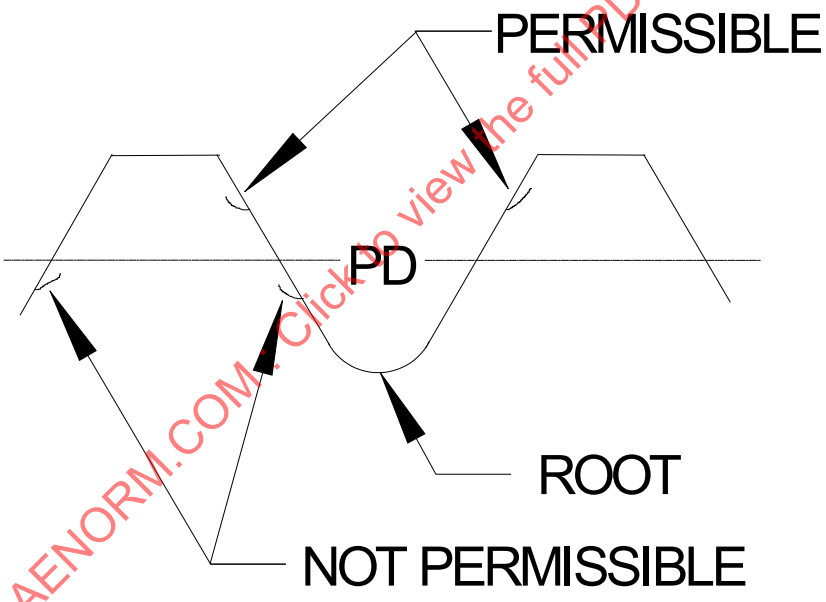
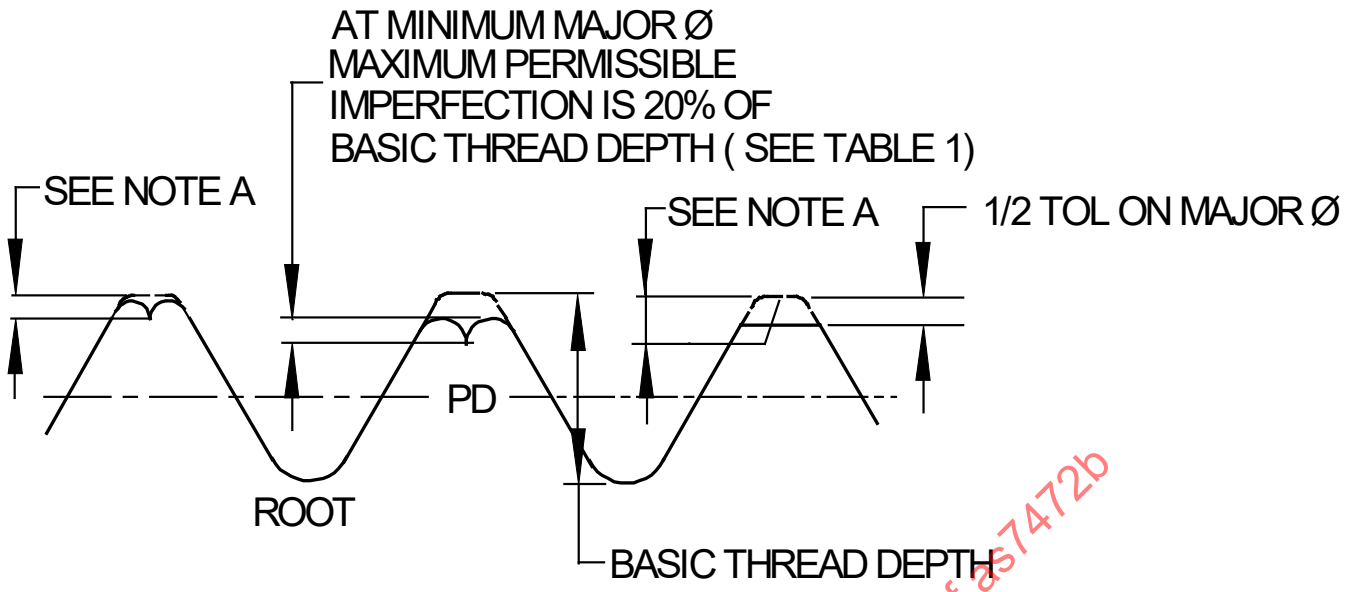


Figure 6 - Laps extending towards crest, rolled thread



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 7 - Crest craters and crest laps, rolled thread

Table 2 - Thread height

Thread Pitches Per Inch n	Basic Thread Height Ref (See Note 1) inch	20% Basic Thread Height inch
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.

Note 1. (Continued):

Load requirements are based on:

70 000 psi for proof test load
125 000 psi minimum ultimate tensile strength test load

Note 2: For sizes not shown and for parts having other than Class 3A thread tolerances, proof loads and ultimate tensile strength test loads 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.