# AEROSPACE STANDARD

| AS7478™ | REV. E |
|---|---|
| Issued 1991-01<br>Reaffirmed 2006-05<br>Revised 2021-04<br><br>Superseding AS7478D | |

(R) Bolts and Screws, Steel, UNS S66286
Classification: 130 ksi/1200 °F
1800 °F Solution Heat Treated, Aged After Roll Threaded
Procurement Specification for

FSC 5306



RATIONALE

AS6416 added, many paragraphs updated or deleted, specs updated, figures redrawn, notes updated.

## 1. SCOPE

This procurement specification covers bolts and screws made from a corrosion and heat resistant, age hardenable iron base alloy of the type identified under the Unified Numbering System as UNS S66286.

### 1.1 Type

The following specification designations and their properties are covered:

AS7478: 130 ksi minimum ultimate tensile strength at room temperature
65 ksi stress-rupture strength at 1200 °F

AS7478-2: 130 ksi minimum ultimate tensile strength at room temperature
78 ksi minimum ultimate shear strength at room temperature

#### 1.1.1 Classification

130 ksi minimum tensile strength at room temperature
1200 °F maximum test temperature of parts

### 1.2 Application

Primarily for aerospace propulsion system applications where stress-rupture strength and creep resistance are required at elevated temperature.

### 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.



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https://www.sae.org/standards/content/AS7478E/

## 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 +1 724-776-4970 (outside USA), www.sae.org.

| | |
|---|---|
| AMS2759/3 | Heat Treatment, Precipitation-Hardening Corrosion-Resistant, Maraging, and Secondary Hardening 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 |
| 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 AIA/NAS 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 Strength |
| NASM1312-10 | Fastener Test Methods, Method 10, Stress-Rupture |
| NASM1312-13 | Fastener Test Methods, Method 13, Double Shear Test |

#### 2.1.3 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) |

2.1.4 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 D3951 Standard Practice for Commercial Packaging

ASTM E8/E8M Standard Test Methods for Tension Testing of Metallic Materials

ASTM E112 Determining Average Grain Size

ASTM E139 Conducting Creep, Creep-Rupture, and Stress-Rupture Test of Metallic Materials

ASTM E140 Standard Hardness Conversion Tables for Metals

ASTM E1417/E1417M Standard Practice for Liquid Penetrant Inspection

2.2 Definitions

Refer to AS6416.

2.3 Unit Symbols

° degree, angle

°C degree Celsius

°F degree Fahrenheit

% percent (1% = 1/100)

lbf pound-force

ksi kips (1000 pounds) per square inch

sp gr specific gravity

HRC hardness, Rockwell C scale



3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5731 steel heading stock, unless otherwise specified on part drawing.

3.2 Design

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

3.2.1 Dimensions

The dimensions shall conform to the requirements as specified on the part drawing unless otherwise stated. Dimensions apply after plating but before lubrication or coating with dry film lubricants.

3.2.2 Surface Texture

Surface texture of finished parts, prior to plating or coating, shall conform to 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.

3.2.3.1 Incomplete Lead and Runout Threads

Incomplete threads and runouts are permissible as specified in AS3062.

3.2.3.2 Chamfer

Bolts 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 forging, cold forging, or machining. Heading stock to be hot forged shall be heated to a temperature not higher than 2100 °F. 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 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 A-286, 1800 °F solution heat treatment and 1325 °F aging treatment.

3.3.2.1 Solution Heat Treatment

Headed and machined blanks of AMS5731, unless machined from solution heat treated stock, shall, before finishing the shank and the bearing surface of the head, cold rolling the head-to-shank fillet radius when specified, and rolling the threads, be solution heat treated as in 3.3.2. Blanks of other materials shall be solution heat treated in accordance with the applicable material specification. If blanks are machined from solution heat treated stock, only the aging treatment as in 3.3.2.2 is necessary.

3.3.2.2 Aging Treatment

After cold rolling the fillet radius as in 3.3.4 when specified and rolling the threads as in 3.3.5, parts of AMS5731 shall be heat treated by aging as in 3.3.2. Parts of other materials shall be heat treated by aging after cold rolling the fillet radius as in 3.3.4 when specified and rolling the threads as in 3.3.5, in accordance with the applicable material specification.

3.3.3 Oxide Removal

Surface oxide resulting from prior heat treatment shall be removed from the full body diameter, thread roll diameter and bearing surface of the head of the solution heat treated blanks prior to cold rolling the fillet radius when specified and rolling the threads by a method such as (e.g., centerless grinding). 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 headed 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. If there is no visual evidence of grinding or tool marks prior to cold working, the fillet shall still be cold worked. Distortion due to cold rolling 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. 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 working 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.

3.3.4.1 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.

3.3.4.2 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.

3.3.4.3 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.

3.3.5 Thread Rolling

Threads shall be formed on the finished blanks by a single cold rolling process after removal of oxide as in 3.3.3.

3.3.6 Cleaning

Bolts, after finishing, shall be cleaned in one of the following solutions for the time and temperature shown and then thoroughly rinsed:

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).

3.4 Plating or Coating

Where required, bolts shall be plated or dry film lubricated as specified by the part drawing.

3.5 Mechanical Properties

Bolts for tensile and stress-rupture tests shall be of sufficient size to develop the full strength of the bolt without stripping the thread. The loaded portion of the shank shall have a minimum of two to three full threads from the thread runout exposed between the loading fixtures during tensile test.

AS7478 finished parts shall be tested in accordance with the following 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.

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

AS7478-2 finished parts shall be tested in accordance with the following test methods:

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

b. Room temperature ultimate tensile strength: MIL-STD-1312-8 in accordance with NASM1312-8.

c. Ultimate double shear at room temperature: MIL-STD-1312-13 in accordance with NASM1312-13.

3.5.1 Ultimate Tensile Strength at Room Temperature

3.5.1.1 Finished Parts

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. The loaded portion of the shank shall have a minimum of two to three full threads from the thread runout exposed between the loading fixtures during tensile test. 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.



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 as in 4.2.7. Specimens may be required by 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%.

3.5.2 Hardness

Shall be d within the range 24 to 35 HRC (see 8.1), 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. Bolts shall not be rejected on the basis of hardness if the tensile strength properties of the part, specified in 3.6.1 are met.

3.5.3 Ultimate Shear Strength

Finished bolts 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, recording the load achieved. Shear bolts having special diameters shall have the double shear load based on 78 ksi minimum shear strength. Shear test is not required for the following conditions:

a. Bolts having a grip less than two times the nominal diameter.

b. Bolts or screws having coarse tolerance full shank.

c. Bolts or screws having a PD or relieved shank.

3.5.4 Stress-Rupture Strength at 1200 °F

3.5.4.1 Finished Parts

Finished tension bolts, maintained at 1200 °F ± 3 °F while the stress rupture 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 Screws, such as 100 flush head, pan head, and fillister head, are not required to be tested for stress-rupture strength at 1200 °F.

3.5.4.1.1 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 65 ksi is applied continuously, shall not rupture in less than 23 hours. Tests shall be conducted in accordance with ASTM E139.

3.6 Quality

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

3.6.1 Macroscopic Examination, Headed Blank

A specimen from headed blank shall be etched and examined at a magnification of 20X or greater to determine conformance to the requirements of 3.6.1.1 and 3.6.1.2.

3.6.1.1 Flow Lines Head to Shank Forged Bolts Only

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

3.6.1.2 Internal Imperfections

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

3.6.2 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 100X magnification to determine conformance to the requirements of 3.6.2.1, 3.6.2.2, 3.6.2.3, and 3.7.2.6. and 200X magnification to determine conformance to the requirements of 3.6.2.4.

3.6.2.1 Internal Imperfections

Examination of longitudinal sections of the head and shank shall reveal no cracks, laps, or porosity. Thread imperfections shall conform to the requirements of 3.6.2.4.

3.6.2.2 Microstructure

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

3.6.2.3 Grain Size

Shall be ASTM No. 5 or finer as determined by comparison of the specimen with the chart in ASTM E112. Up to 25% of the area examined may exhibit a grain size as large as ASTM No. 2. Such areas shall be separated by at least 0.025 inch. Bands of fine or coarse grains are not permitted. In case of disagreement on grain size by comparison method, the intercept (Heyn) procedure shall be used.

3.6.2.4 Threads

3.6.2.4.1 Root defects such as laps, seams, notches, slivers, folds, roughness, and oxide scale are not permissible (see Figure 3).

3.6.2.4.2 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 4 and 5).

3.6.2.4.3 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.

3.6.2.4.4 There shall be no laps along the flank of the thread below the pitch diameter (see Figure 4). 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 towards the crest and generally parallel to the flank (see Figure 4).

3.6.2.4.5 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 1) as measured from the thread crest when the thread major diameter is at minimum size (see Figure 7). 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 1/2 of the difference between the minimum major diameter and the actual major diameter as measured on the part.

3.6.3 Fluorescent Penetrant Inspection



Prior to any required plating or coating, parts shall be subject to fluorescent penetrant inspection in accordance with ASTM E1417/E1417M, Type I, Sensitivity Level 2 minimum for 100% of parts. Any discontinuity to be reviewed by a metallurgist or skilled metallographer.

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

3.6.3.1.1 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 2H/3 thread depth (see Table 1), whichever is less.

3.6.3.1.2 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.

3.6.3.1.3 Threads

There shall be no indications, except as permitted in 3.6.2.4. Rateable lap indications shall conform to 3.7.2.6.3.

3.6.3.1.4 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 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 Acceptance Test Sampling

#### 4.2.1 Material

Sampling for material composition on each heat shall be in accordance with AMS5731.

#### 4.2.2 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. All dimensional characteristics are considered defective when out of tolerance.

#### 4.2.3 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.

#### 4.2.4 Stress-Rupture Test

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

#### 4.2.5 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.

#### 4.2.6 Acceptance Quality

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

#### 4.2.7 Test Specimens

Specimens for tensile and stress-rupture testing of machined test specimens shall be of standard proportions in accordance with ASTM E8/E8M. 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.

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

### 4.3 Reports

The vendor of parts shall furnish with each shipment a report for all tests This report shall include the purchase order number, AS7478 and revision letter, lot number, contractor or other direct supplier of material, part number, nominal size, and quantity.

### 4.4 Rejected Lots

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 Packaging shall be in accordance with ASTM D3951.

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
AS7478 (or AS7478-2), as applicable
PART NUMBER
LOT NUMBER
PURCHASE ORDER NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

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

## 6. ACKNOWLEDGMENT

A vendor 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.

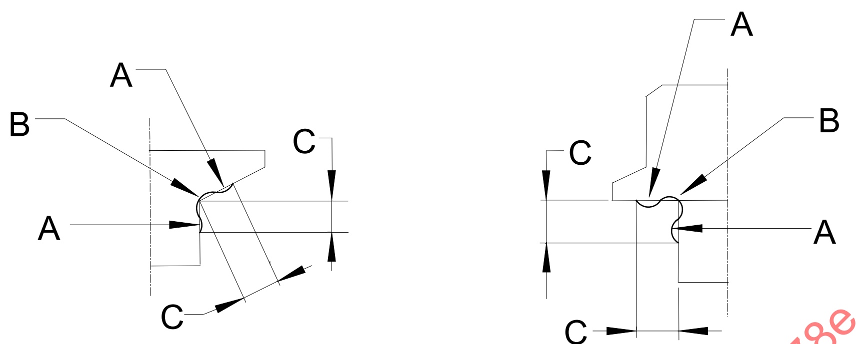
## 8. NOTES

### 8.1 Hardness Conversion Tables

Hardness conversion tables for metals are presented in ASTM E140.

### 8.2 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.




| 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***

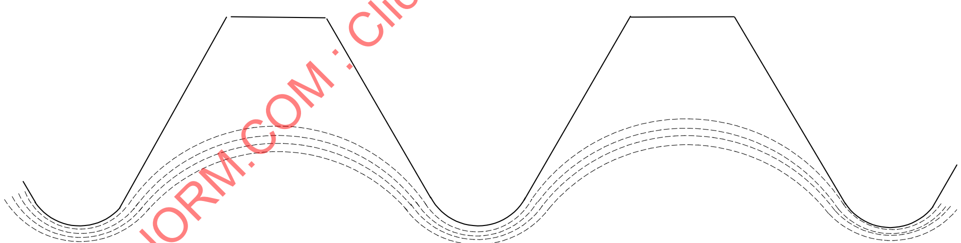


***Figure 2 - Flow lines, rolled thread***

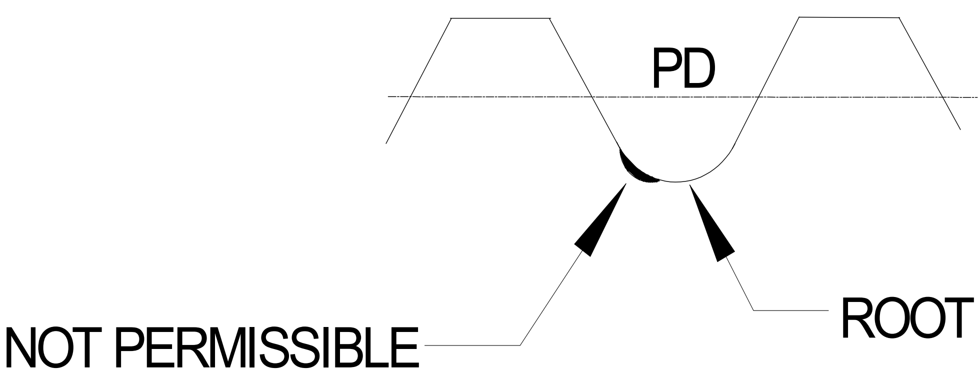



***Figure 3 - Root defects, rolled thread***

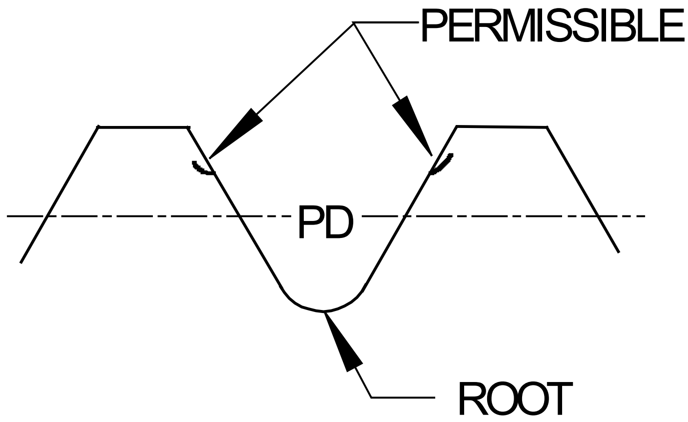



***Figure 4 - Laps above pitch diameter extending towards crest, rolled thread***

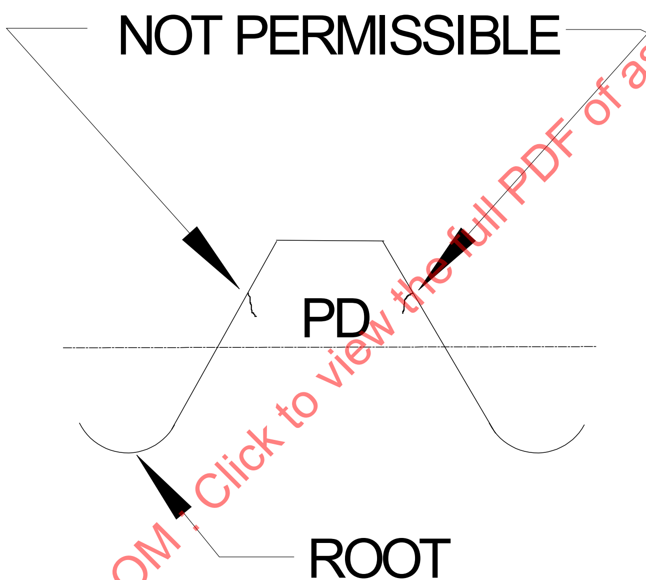



***Figure 5 - Laps above PD extending toward root, rolled thread***

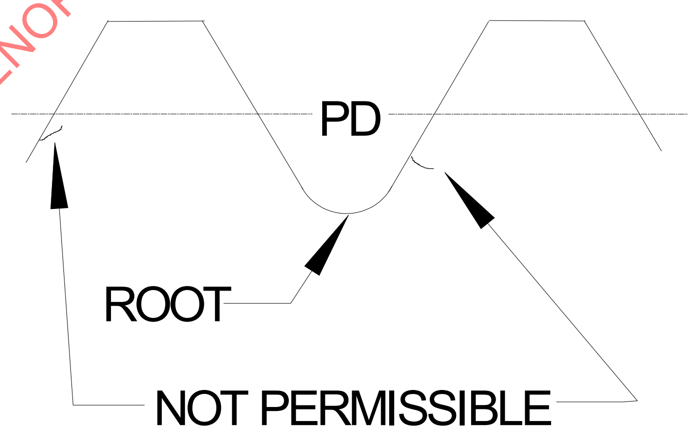
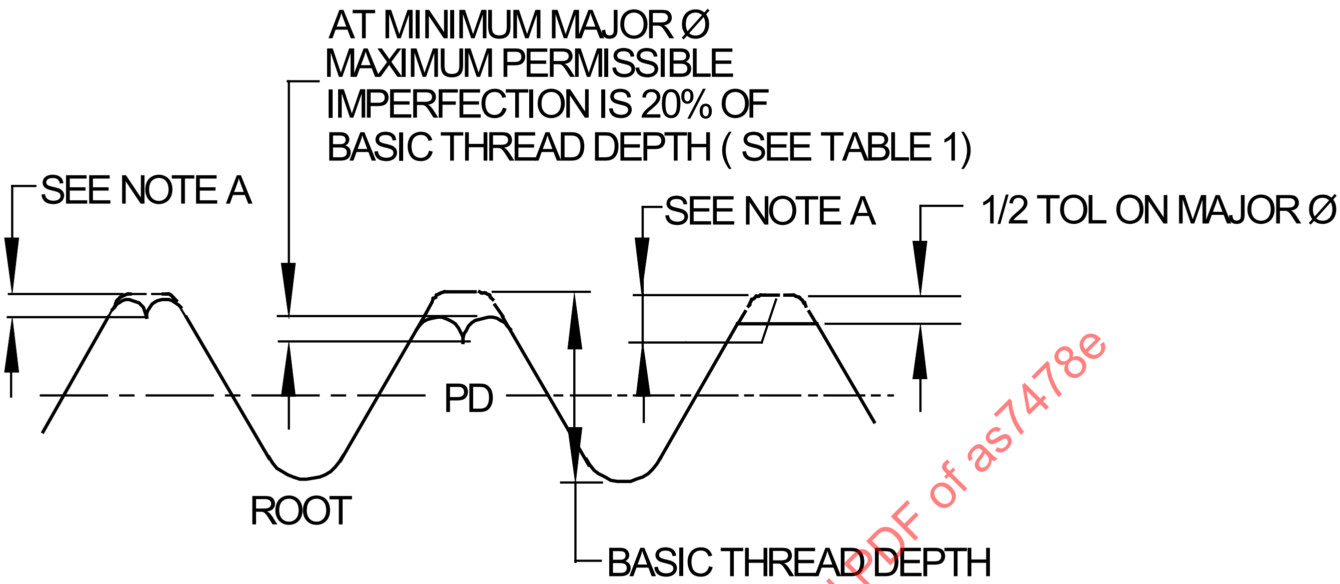



***Figure 6 - Laps below PD extending in any direction, rolled thread***




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 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 Inches | Allowable Thread Lap Depth /1/ Inches |
|---|---|---|
| 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 |

NOTE:

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

Ext thd depth = 2H/3 = (2/3)(cos 30 degrees)/n = 0.57735/n

Lap depth = 0.2(2H/3) = 0.2(2/3)(cos 30 degrees)/n = 0.11547/n

***Table 2 - Test loads***

| Nominal Thread Size | Ultimate Tensile Strength Test Load, lbf Min Room Temp Bolt, Std PD UN and UNJ Threads | Ultimate Tensile Strength Test Load, lbf Min Room Temp Bolt, Red PD UN THD Only | Ultimate Tensile Strength Test Load, lbf Min Room Temp Screw, Std PD UN and UNJ Threads | Stress-Rupture Strength Test Load, lbf at 1200 °F Bolt, Std PD UN and UNJ Thread | Stress-Rupture Strength Test Load, lbf at 1200 °F Bolt, Red PD UN THD Only | Ultimate Double Shear Test Load lbf Min Room Temp |
|---|---|---|---|---|---|---|
| 0.112 -40 | 780 | 730 | 630 | 340 | 310 | 1540 |
| 0.112 -48 | 860 | 800 | 690 | 380 | 350 | 1540 |
| 0.138 -32 | 1180 | 1120 | 940 | 510 | 480 | 2330 |
| 0.138 -40 | 1320 | 1250 | 1060 | 590 | 560 | 2330 |
| 0.164 -32 | 1820 | 1740 | 1467 | 810 | 770 | 3300 |
| 0.164 -36 | 1920 | 1830 | 1530 | 860 | 820 | 3300 |
| 0.190 -32 | 2600 | 2500 | 2080 | 1170 | 1130 | 4420 |
| 0.250 -28 | 4730 | 4600 | 3780 | 2170 | 2110 | 7660 |
| 0.3125-24 | 7550 | 7380 | 6040 | 3490 | 3410 | 12000 |
| 0.375 -24 | 11400 | 11200 | 9130 | 5360 | 5260 | 17200 |
| 0.4375-20 | 15400 | 15200 | -- | 7220 | 7110 | 23500 |
| 0.500 -20 | 20800 | 20500 | -- | 9820 | 9690 | 30600 |
| 0.5625-18 | 26400 | 26100 | -- | 12500 | 12300 | 38800 |
| 0.625 -18 | 33300 | 32900 | -- | 15800 | 15700 | 47900 |
| 0.750 -16 | 48500 | 48100 | -- | 23100 | 22900 | 68900 |
| 0.875 -14 | 66200 | 65700 | -- | 31600 | 31400 | 93800 |
| 1.000 -12 | 86200 | 85600 | -- | 41100 | 40900 | 122500 |

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

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

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

where:

$A_1$ = area at 0.5625H thread depth, standard PD

$A_2$ = area at 0.5625H thread depth, reduced PD

d = maximum major diameter

H = height of sharp V-thread = (cos 30 degrees)/n

n = number of thread pitches per inch