AEROSPACE STANDARD

AS7466™ REV. F

Issued 1992-05
Reaffirmed 2001-10
Revised 2021-03

Superseding AS7466E

# (R) Bolts and Screws, Nickel Alloy, UNS N07718 Tensile Strength 185 ksi, Fatigue Rated, Procurement Specification



RATIONALE

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

## 1. SCOPE

### 1.1 Type

This procurement specification covers aircraft-quality bolts and screws made of corrosion and heat resistant, age hardenable nickel base alloy of the type identified under the Unified Numbering System as UNS N07718. The following specification designations and their properties are covered:

AS7466 185 ksi minimum ultimate tensile strength at room temperature.
155 ksi minimum ultimate tensile strength at 800 °F.
105 to 10.5 ksi tension fatigue at room temperature.

AS7466-1 185 ksi minimum ultimate tensile strength at room temperature.
111 ksi minimum ultimate shear strength at room temperature.

### 1.2 Application

Primarily for aerospace propulsion systems applications where a good combination of tensile strength and fatigue resistance are required; also, where a good combination of tensile strength and shear strength are 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.



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**For more information on this standard, visit**
https://www.sae.org/standards/content/AS7466F/

## 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.

##### 2.1.1.1 Aerospace Material Specifications

AMS2700 Passivation of Corrosion Resistant Steels

AMS2750 Pyrometry

AMS5662 Nickel Alloy, Corrosion and Heat-Resistant, Bars, Forgings, and Rings, 52.5Ni - 19Cr - 3.0Mo - 5.1Cb (Nb) - 0.90Ti - 0.50Al - 18Fe, Consumable Electrode or Vacuum Induction Melted, 1775 °F (968 °C), Solution Heat Treated, Precipitation-Hardenable



##### 2.1.1.2 Aerospace Standards

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

NASM1312-11 Fastener Test Methods, Method 11, Tension Fatigue

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

NASM1312-18 Fastener Test Methods, Method 18, Elevated Temperature Tensile Strength

#### 2.1.3 ASME Publication

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 A380 | Practice for Cleaning and Descaling of Stainless Steel Parts |
| ASTM A967 | Chemical Passivation Treatment for Stainless Steel |
| ASTM D3951 | Standard practice for Commercial Packaging |
| ASTM E8/E8M | Standard Test Methods for Tension Testing of Metallic Materials |
| ASTM E21 | Elevated Temperature Tension Tests for Metallic Materials |
| ASTM E112 | Determining Average Grain Size |
| ASTM E140 | Standard Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness |
| ASTM E1417/E1417M | Standard Practice for Liquid Penetrant Testing |



2.2 Definitions

Refer to AS6416.

2.3 Unit Symbols

| | |
|---|---|
| °C | degree Celsius |
| °F | degree Fahrenheit |
| HRC | hardness Rockwell C scale |
| lbf | pound-force |
| % | percent (1% = 1/100) |
| sp gr | specific gravity |
| ksi | kips (1000 pounds) per square inch |

3. TECHNICAL REQUIREMENTS

3.1 Material

Shall be AMS5662 heading stock.

3.2 Design

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

3.2.1 Dimensions

The dimensions shall conform to 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 part drawing, determined in accordance with ASME B46.1.

3.2.3 Threads

Threads UNJ 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 or cold forging; temperature for hot forging blanks shall be within the range of 1650 to 2000 °F. Machined heads are not permitted, except lightening holes may be produced by any suitable method. Wrenching recesses may be forged or machined. Flash or chip clearance in machined recesses shall not cause recess dimensions to exceed the specified limits.

3.3.2 Heat Treatment

Headed blanks, before finishing the shank and the bearing surface of the head, shall be solution heat treated and precipitation 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 temperature controllers and data recorders conforming to AMS2750. The heating medium or atmosphere shall cause no surface hardening by carburizing or nitriding.

3.3.2.2 Solution Heat Treatment

Headed blanks shall be solution heat treated by heating to a temperature within the range 1725 to 1850 °F, holding at the selected temperature within ±25 °F for 1 hour ± 0.1 hour, and quenching in oil, water, or an inert gas.

3.3.2.3 Precipitation Heat Treatment

After solution heat treatment as in 3.3.2.2, blanks shall be precipitation heat treated by heating to 1325 °F ± 15 °F in a controlled atmosphere, holding at heat for 8 hours ± 0.25 hour, furnace cooling at 100 °F ± 15 °F per hour to 1150 °F ± 15 °F, holding at 1150 °F ± 15 °F for 8 hours ± 0.25 hour and cooling at a rate equivalent to air cool. Instead of the 100 °F per hour cooling rate to 1150 °F ± 15 °F, blanks may be furnace cooled at any rate provided the time at 1150 °F ± 15 °F is adjusted to give a total precipitation heat treatment time of approximately 18 hours.

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 and precipitation heat treated blanks prior to cold working the under head fillet radius and rolling the threads. The oxide removal process shall produce no intergranular attack or corrosion of the blanks. The metal removed from the bearing surface of the head and the full body diameter of the shank shall be as little as practicable to obtain a clean, smooth surface.

3.3.4 Cold Rolling of Fillet Radius

After removal of oxide as in 3.3.3, the head-to-shank fillet radius of 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 inches above the contour at “A” or depress metal more than 0.002 inches 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.

3.3.4.1 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 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

Where required, bolts shall be plated as specified by the part drawing; plating thickness determined in accordance with the plating specification.

## 3.5 Mechanical Properties

Bolts for tensile and fatigue 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 a minimum of two to three full threads from the thread runout exposed between the loading fixtures during tensile test.

AS7466 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. Ultimate Tensile Strength at Room Temperature: MIL-STD-1312-8 in accordance with NASM1312-8

c. Ultimate Tensile Strength at 800 °F: MIL-STD-1312-18 in accordance withNASM1312-18

d. Fatigue Strength at Room Temperature: MIL-STD-1312-11 in accordance with NASM1312-11

AS7466-1 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 Shear Strength 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.

#### 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 4.2.7. Such specimens shall meet the following requirements:

a. Ultimate Tensile Strength, minimum: 185 ksi

b. Yield Strength at 0.2% Offset, minimum: 150 ksi

c. Elongation in 4D, minimum: 12%

d. Reduction of Area, minimum: 15%

3.5.2 Ultimate Tensile Strength at 800 °F

3.5.2.1 Finished Parts

Tension bolts heated to 800 °F ± 5 °F, held at heat for 20 minutes before testing, and tested at 800 °F ± 5 °F, shall have an ultimate tensile load not lower than the value 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. If the size or the shape of the part is such that failure would occur outside the threaded section but the part can be tested satisfactorily, such as parts having a shank diameter equal to or less than the minimum pitch diameter or having an undercut, parts shall have an ultimate tensile strength not lower than 155 ksi, for such as parts, the diameter of the area on which stress is based shall be the actual measured minimum diameter of the part. Tension fasteners with either standard hexagon, double hexagon, or spline drive type heads having a minimum metal condition in the head equal to the design parameters specified in AS1132 shall not fracture in the head-to-shank fillet radius except when this radius is connected with an undercut or with a shank diameter less than the minimum pitch diameter of the thread. Screws, such as 100 degree flush head, pan head, and fillister head, are not required to be tested for tensile strength at 800 °F.

3.5.2.2 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 E21 on specimens prepared as in 4.5.7. Such specimens shall meet the following requirements when heated to 800 °F ± 5 °F, held at heat for not less than 20 minutes before testing, and tested at 800 °F ± 5 °F.

a. Ultimate Tensile Strength, minimum: 155 ksi

b. Yield Strength at 0.2% Offset, minimum: 130 ksi

c. Elongation in 4D, minimum: 12%

d. Reduction of Area, minimum: 15%

3.5.3 Hardness

Shall be within the range 36 to 46 HRC (see 8.1), but hardness of the threaded section and the head-to-shank fillet may be higher as a result of the cold rolling operations. Bolts shall not be rejected on the basis of hardness if the tensile property requirements of the part are met.

3.5.4 Fatigue Strength

Finished tension bolts tested in tension-tension fatigue at room temperature with maximum load as specified in Table 2A and minimum load equal to 10% of maximum load shall have average life of not less than 65000 cycles with no part having life less than 45000 cycles. Tests need not be run beyond 130000 cycles. Life of parts which do not fail in less than 130000 cycles shall be taken as 130000 for purposes of computing average life. If the shank diameter of the bolt is less than the minimum pitch diameter of the thread, bolts shall withstand fatigue testing as above using loads sufficient to produce a maximum stress of 105 ksi and a minimum stress of 10.5 ksi. The above requirements apply to tension bolts, such as hexagon, double hexagon, or spline drive type heads per design parameters specified in AS1132, 0.164 inch and larger in nominal thread size, and having a head-to shank fillet radius equal to or larger than that specified in AS1132, and not having an undercut; for all parts to which the above requirements do not apply, fatigue test requirements shall be as specified on the part drawing.

3.5.5 Ultimate Shear Strength

Finished bolts having a close tolerance full shank as in AS1132 shall have an ultimate double shear load not lower than that specified in Table 2A. The double shear test may be discontinued without a complete shear failure after the ultimate shear load has been reached, and recording the load achieved. Shear bolts having special diameters shall have the shear load based on 111 ksi minimum shear strength. Shear tests are not required for the following conditions:

a. Bolts and screws threaded to head.

b. Protruding head bolts and screws having coarse tolerance full shank.

c. Protruding head bolts and screws having PD or relieved shank.

3.6 Quality

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

3.6.1 Macroscopic Examination, Headed Blank

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

3.6.1.1 Flow Lines

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 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.

3.6.2 Microscopic Examination, Finished Parts, or Other Conditions Detrimental to Intended Performance

Specimens cut from finished parts shall be polished, etched Kalling's reagent, Marble's reagent, or other suitable etchant, and examined 100X magnification to determine conformance to the requirements of 3.6.2.1, 3.6.2.2, 3.6.2.3, and 200X magnification to determine conformance to the requirements of 3.6.2.5.

3.6.2.1 Flow Lines, Threads

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

3.6.2.2 Internal Defects

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

3.6.2.3 Microstructure

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

3.6.2.4 Grain Size

The grain size shall be ASTM No. 3 or finer, determined in accordance with the comparative method of ASTM E112. In the case of disagreement, the intercept (Heyn) procedure shall be used.

3.6.2.5 Threads

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

3.6.2.5.2 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).

3.6.2.5.3 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.

3.6.2.5.4 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).

3.6.2.5.5 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 1, Sensitivity Level 2 minimum.

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

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 3.6.2.5.

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 Classification of Tests

a. Acceptance tests which are to be performed on each production inspection lot. A summary of acceptance tests is specified in Table 3.

b. Periodic tests which are to be performed periodically on production lots at the discretion of the vendor or purchaser. Ultimate tensile strength test at 800 °F as in 3.5.2 is classified as a periodic test and shall be performed when requested by the purchaser.

### 4.2 Acceptance Test Sampling

#### 4.2.1 Material

Sampling for material composition on each heat shall be in accordance with AMS5662.

#### 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 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.

#### 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 Macroscopic Examination

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

### 4.3 Periodic Test Sampling

As agreed upon by purchaser and vendor.

### 4.4 Reports

The vendor of parts shall furnish with each shipment a report for all tests. This report shall include the purchase order number, AS7466F, lot number, contractor or other direct supplier of material, part number, nominal size, and quantity.

4.5 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:

FASTENERS, NICKEL BASE ALLOY, UNS N07718, FATIGUE RATED
AS7466 (OR AS7466-1, as applicable)
PART NUMBER
LOT NUMBER
PURCHASE ORDER NUMBER
QUANTITY
MANUFACTURER'S IDENTIFICATION

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

## 6. ACKNOWLEDGMENT

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

## 7. REJECTIONS

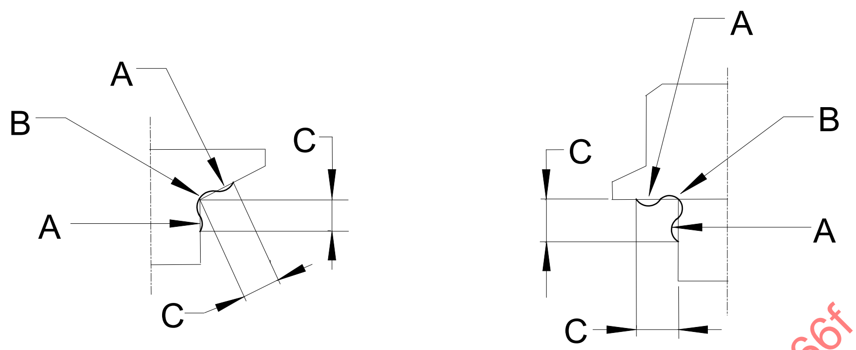
Parts not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.

## 8. NOTES

8.1 Hardness conversion tables 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 Inch |
|---|---|
| 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***

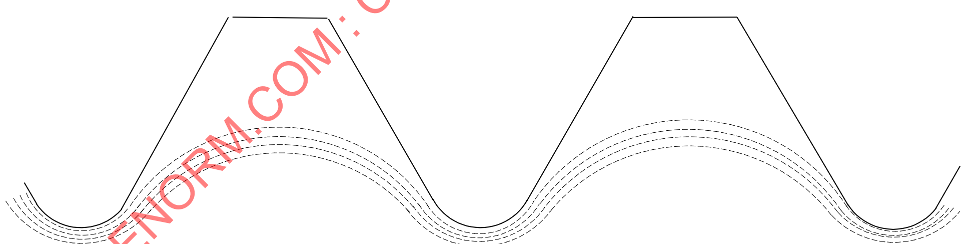


***Figure 2 - Flow lines, rolled thread***

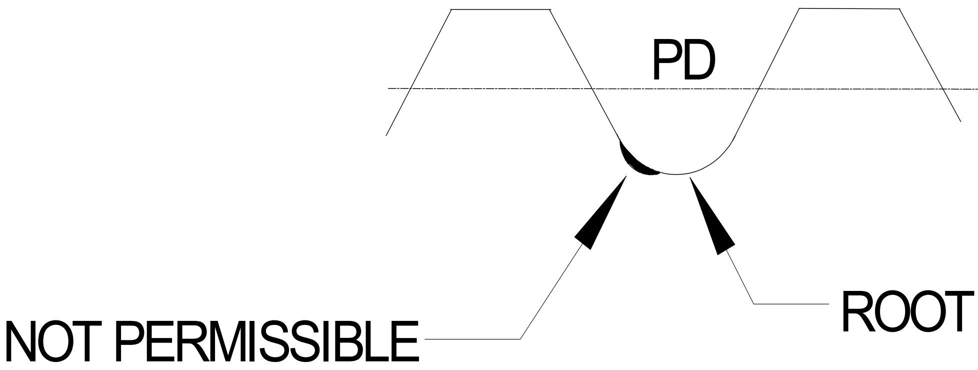



*Figure 3 - Root defects, rolled thread*

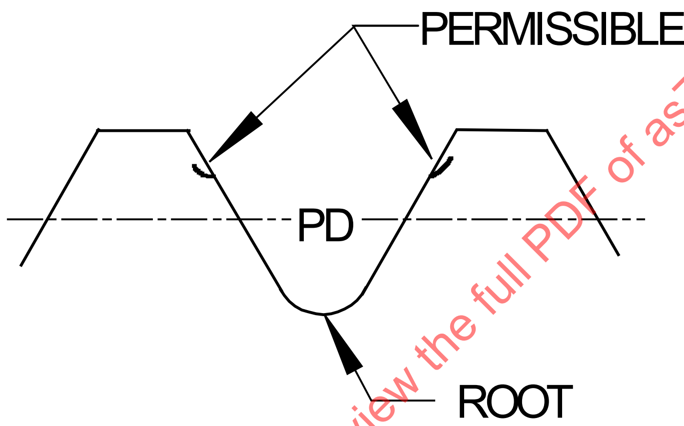



*Figure 4 - Laps above pitch diameter extending towards crest, rolled thread*

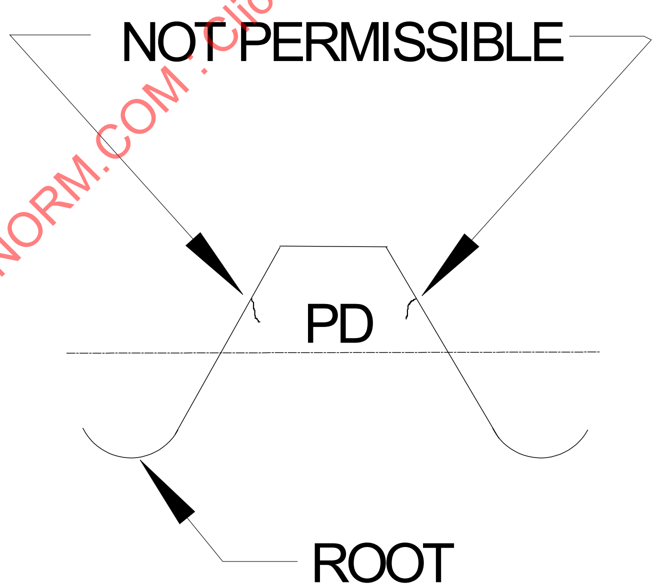



*Figure 5 - Laps above pd extending toward root, rolled thread*

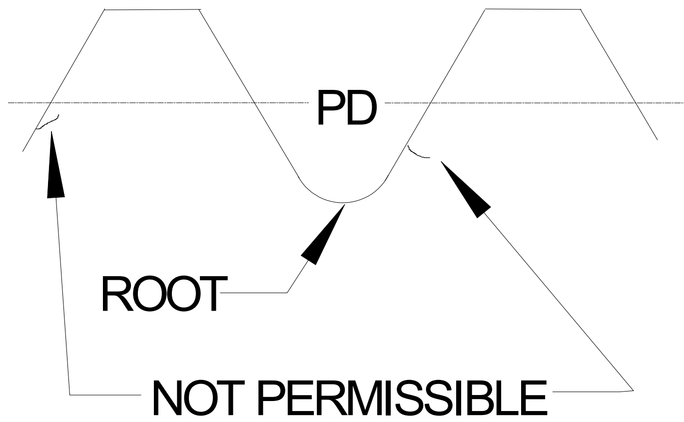
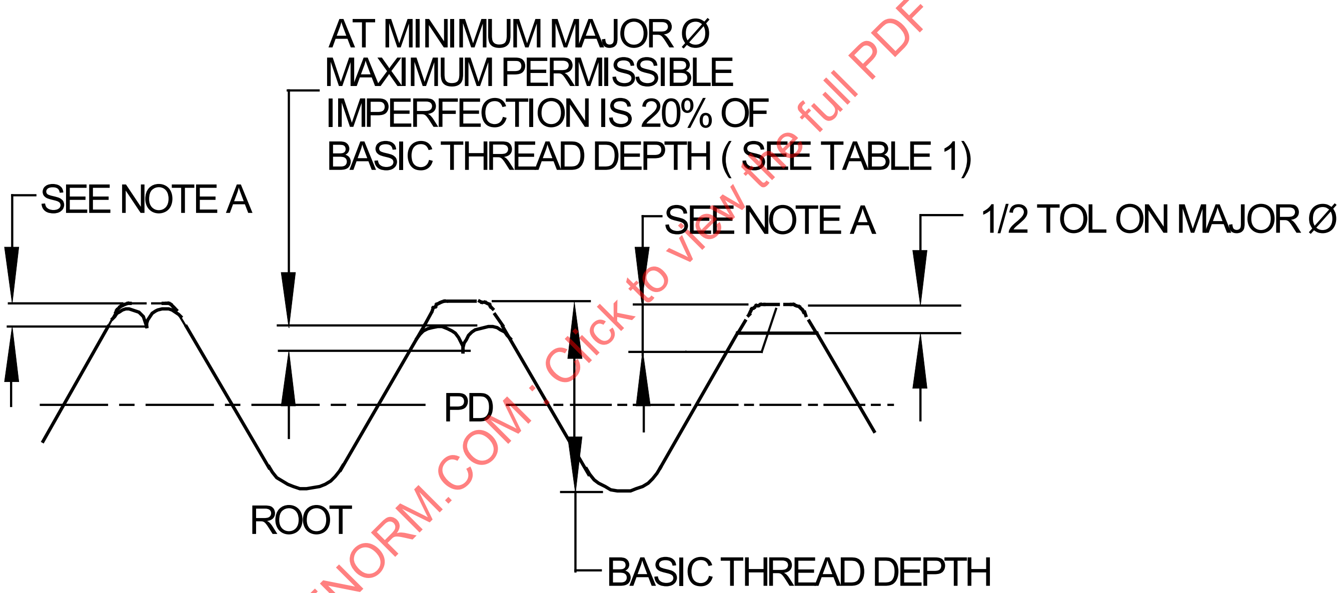



*Figure 6 - Laps below pd extending in any direction, rolled thread*






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 depths***

| Thread Pitches Per Inch n | UNJ External Thread Depth at 2H/3 Inch | Allowable Thread Lap Depth /1/ 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 |

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 2A - Test loads for bolts*

| Thread Size UNJC, UNJF Class 3A | Ultimate Tensile Strength Test Load lbf Min Room Temperature | Ultimate Tensile Strength Test Load lbf Min at 800 °F | Fatigue Strength Test Load lbf Max at Room Temperature | Ultimate Double Shear Test Load lbf Min Room Temperature |
|---|---|---|---|---|
| 0.112 -40 | 1120 | 930 | --- | 2190 |
| 0.112 -48 | 1220 | 1020 | --- | 2190 |
| 0.138 -32 | 1680 | 1410 | --- | 3320 |
| 0.138 -40 | 1880 | 1570 | --- | 3320 |
| 0.164 -32 | 2590 | 2170 | 1350 | 4690 |
| 0.164 -36 | 2720 | 2280 | 1430 | 4690 |
| 0.190 -32 | 3700 | 3100 | 1950 | 6290 |
| 0.250 -28 | 6730 | 5640 | 3590 | 10900 |
| 0.3125-24 | 10740 | 9000 | 5760 | 17030 |
| 0.375 -24 | 16250 | 13610 | 8810 | 24520 |
| 0.4375-20 | 21960 | 18400 | 11890 | 33370 |
| 0.500 -20 | 29590 | 24790 | 16130 | 43590 |
| 0.5625-18 | 37550 | 31460 | 20480 | 55170 |
| 0.625 -18 | 47350 | 39670 | 25940 | 68110 |
| 0.750 -16 | 69000 | 57810 | 37890 | 98080 |
| 0.875 -14 | 94250 | 78970 | 51800 | 133500 |
| 1.000 -12 | 122700 | 102800 | 67360 | 174400 |

NOTE 1: Requirements above apply to parts with UNJC or UNJF threads as applicable for thread sizes shown, to Class 3A tolerances. 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:

$$A_1 = .7854(d - 1.125H)^2 = 0.7854[d - (0.9743/n)]^2 \qquad \text{(Eq.1)}$$

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

The diameter of the area upon which stress for fatigue strength test load requirements is based is the area at the maximum minor (root) diameter for UNJ thread at 2H/3 thread depth, calculated from Equation 2:

$$A_2 = 0.7854[d - (4H/3)]^2 = 0.7854[d - (1.1547/n)]^2 \qquad \text{(Eq.2)}$$

where, $A_2$ = area at maximum minor (root) diameter of UNJ thread at 2H/3 thread depth
d = maximum major diameter
H = height of sharp V-thread = (cos 30°)/n
n = number of thread pitches per inch

*Table 2A - Test loads for bolts (continued)*

NOTE 1 (Continued):

The diameter of the area upon which stress for ultimate double shear test load requirements is based is 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 the nominal close tolerance shank diameter
$d$ = nominal diameter of close tolerance full shank

Load requirements are based on:

185 ksi for ultimate tensile strength test load, minimum, room temperature
155 ksi for ultimate tensile strength test load, minimum, 800 °F
105 ksi for fatigue strength maximum test load, room temperature minimum test load equals 10% of maximum test load
111 ksi for ultimate double shear test load, minimum, room temperature

Test loads are computed as follows:

$185000A_1$ = bolt ultimate tensile strength test load at room temperature
$155000A_1$ = bolt ultimate tensile strength test load at 800 °F
$105000A_2$ = bolt fatigue maximum test load at room temperature
$111000(2A_3)$ = bolt and screw ultimate double shear test load at room temperature

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