SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS3071 | REV. B

Issued 1971-10
Revised 2000-12
Reaffirmed 2012-11

Superseding AS3071A

Acceptance Criteria - Magnetic Particle, Fluorescent Penetrant, and Contrast Dye Penetrant Inspection

RATIONALE

AS3071B has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

1.1 Purpose:

To establish the acceptance criteria for discontinuities as revealed by magnetic particle or liquid penetrant examination of aircraft utility parts as in 1.2.

1.2 Application:

Primarily for use on aerospace propulsion system parts, such as pins, couplings, and fluid fittings. These criteria may be applied to any applicable item, except that the requirements of AS1177 shall apply to bolts, screws and studs, and AS5447 shall apply to nuts, both free-running and self-locking nuts. Discontinuities revealed by non-destructive test methods other than those in 1.1 shall have the acceptance criteria specified on the part standard or drawing.

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, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS1177	Nondestructive Inspection Standards for Bolt and Screws
AS5447	Acceptance Criteria for Nuts - Magnetic Particle, Fluorescent Penetrant, and Visible Penetrant Examination
AS8879	Screw Threads - UNJ Profile, Inch

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SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AS3071B

2.1.2 ASTM Publications: Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 1417 Liquid Penetrant Examination
ASTM E 1418 Visible Penetrant Examination Using the Water-Washable Process
ASTM E 1444 Magnetic Particle Examination

2.2 Definitions:

For the purposes of this standard the following definitions apply:

DISCONTINUITY: An interruption in the normal physical structure or configuration of the part; such as a crack, inclusion, machining tear, lap, seam, or stringer.

INDICATION: An indication is visual evidence of a discontinuity, as revealed by magnetic particle or liquid penetrant examination.

RATEABLE INDICATION: Any discontinuity, regardless of location, with a depth greater than 0.0005 in.

NON-RATEABLE INDICATION: Any discontinuity, regardless of location, with a depth less than or equal to 0.0005 in.

BURR: A rough edge or ridge left on the metal due to cutting, grinding, piercing, or blanking.

CRACK: A crystalline fracture passing through or across grain boundaries without inclusion of foreign elements. Cracks are normally caused by over-stressing the metal during forming, or during heat treatment.

COLD SHUT: A cold shut is a portion of a part that is partially separated from the main body of metal by oxide, or by the failure of two streams of metal to unite.

SEAM: Open surface imperfection that is narrow and continuous, usually straight, running generally parallel to the bar axis. Seams are generally inherent in the bar from which the part is formed.

LAP: A surface imperfection appearing as a seam or crack, caused by folding of the material during operations as forming, forging, rolling, or drawing.

INCLUSION: Nonmetallic particles inherent in the material when it was made. These particles may be isolated or distributed in the form of longitudinal stringers.

2.2 (Continued):

GRINDING CHECK: Fine thermal cracks that develop from overheating of the area being ground. Such cracks are generally at right angles to the direction of grinding but may appear as a complete network.

MACHINING TEAR: A pattern of short, jagged individual cracks, generally at right angles to the direction of machining. Frequently the result of improperly set cutting tools, or dull cutting tools.

LAMINATIONS: Found only in plate steel, and are thin flat discontinuities seen only at the edge of the plate.

PIPE: A discontinuity in the center of a rolled bar. It is caused by internal cavities in the ingot formed during solidification and which have become elongated or stretched in the rolling operations.

POROSITY: Is the lack of soundness, usually in the form of gas holes or shrinkage voids that have the character of gas holes.

STRINGER: A solid nonmetallic impurity in the parent metal, often the result of inclusions that have been extended during the rolling process.

3. TECHNICAL REQUIREMENTS:

3.1 General Indications:

Where this standard is specified as the acceptance criteria for nondestructive examination of discontinuities, it shall apply in support of ASTM E 1444 for magnetic particle examination, ASTM E 1417 for fluorescent penetrant examination, and ASTM E 1418 for visible penetrant examination.

3.1.1 Indications in themselves shall not be cause for rejection. Representative samples shall be taken from those parts having indications and examined metallurgically at 10X magnification to determine if the discontinuities are outside the limits permitted for rateable indications.

3.1.2 Parts shall be uniform in quality and condition, and free from imperfections detrimental to their performance. The requirements in the following paragraphs shall be applicable as indicated in Table 1.

TABLE 1 - Acceptance Criteria for Type of Part

Applicable Paragraph	3.2	3.3	3.4	3.5	3.6
Parts made from castings (a)	X		X	X	
Parts made from bar, rod, or forgings (b)	X	X	X		
Fluid fittings (c)	X	X	X	X	
Pins	X				X
Bolts and screws	See AS1177				
Nuts	See AS5447				

Note: (a) For other than fluid fittings.
(b) For other than pins.
(c) Including but not limited to caps, tees, elbows, plugs and sleeves.

3.2 Acceptance Criteria:

Unless otherwise specified, parts with rateable or non-rateable indications shall show no indications of cracks, cold shuts, laminations, machining tears, pipes, or grinding checks. Parts with non-rateable indications are acceptable. Parts shall show no rateable indications of seams, laps, or metallic inclusions except as allowed in 3.3 through 3.6 or laps as related to the applicable manufacturing process.

3.2.1 External Thread Discontinuities:

3.2.1.1 Root defects such as laps, notches, slivers, folds, roughness, and oxide scale are not permissible, see Figure 1.

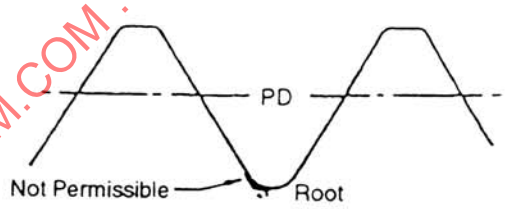


FIGURE 1 - Root Defects

3.2.1.2 Multiple laps on the flanks of the threads are not permissible regardless of location.

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

a. Lap: See definition under 2.2.

b. Thread Flank Above the Pitch Diameter: A slight lap is permissible along the flank of the thread above the pitch diameter on either the pressure or the non-pressure flank (one lap at any cross-section through the thread) provided it extends towards the crest and is generally parallel to the flank, see Figure 2. The lap depth shall not exceed the limit specified in Table 2 for the applicable thread pitch. A lap extending towards the root is not permissible, see Figure 3.

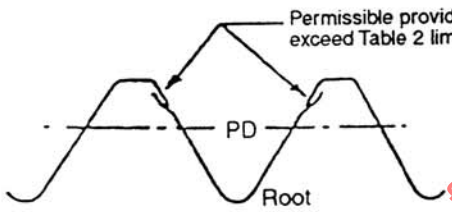


FIGURE 2 - Laps Above Pitch Diameter Extending Towards Crest

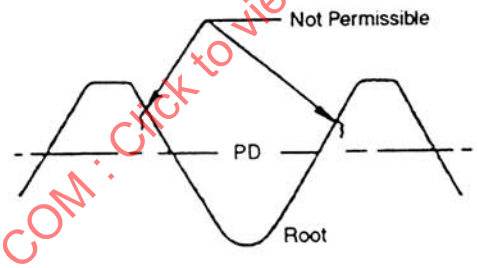


FIGURE 3 - Laps Above Pitch Diameter Extending Towards Root

TABLE 2 - UNJ External Thread Depth at 2H/3 and Allowable Thread Lap Depth

Thread Pitches Per Inch n	External Thread Depth at 2H/3 Ref inches	Allowable Thread Lap Depth (See Note 1) inches
80	0.0072	0.0014
72	0.0080	0.0016
64	0.0090	0.0018
56	0.0100	0.0021
48	0.0120	0.0024
44	0.0131	0.0026
40	0.0144	0.0029
36	0.0160	0.0032
32	0.0180	0.0036
28	0.0206	0.0041
24	0.0241	0.0048
20	0.0289	0.0058
18	0.0321	0.0064
16	0.0361	0.0072
14	0.0412	0.0082
13	0.0444	0.0089
12	0.0481	0.0096
11	0.0525	0.0105
10	0.0577	0.0115
9	0.0642	0.0128
8	0.0722	0.0144

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

External thread depth = 2H/3 = (2/3) (cos 30°)/n = 0.57735/n

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

3.2.1.3 (Continued):

c. Thread Flank Below the Pitch Diameter: A lap along the thread flank below the pitch diameter, regardless of direction it extends, is not permissible, see Figure 4.

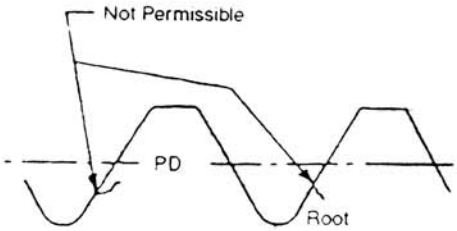
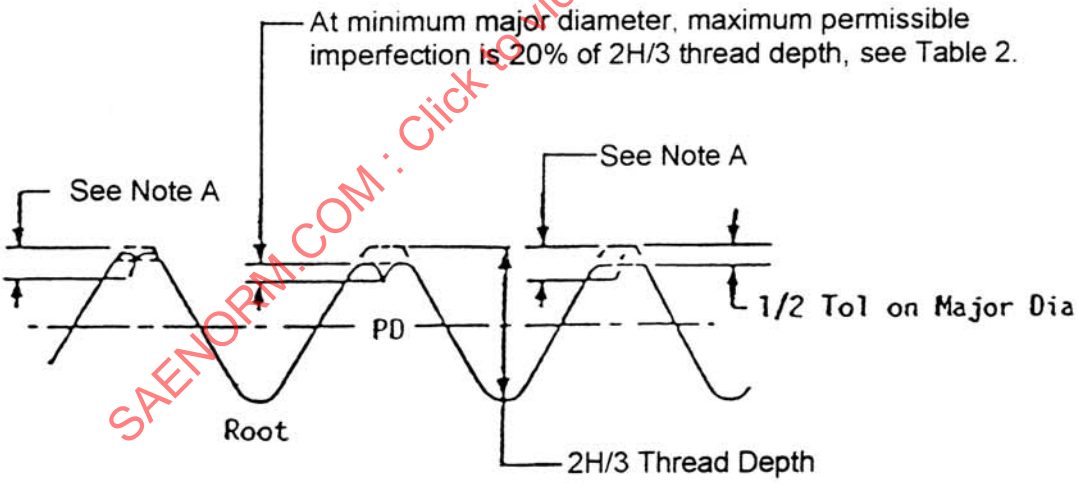


FIGURE 4 - Laps Below Pitch Diameter Extending in Any Direction

d. Crest craters, crest laps, or crest lap in combination with a crest crater are permissible provided that the imperfections do not extend deeper than the limit specified in Table 2 as measured from the thread crest when the thread major diameter is at a minimum size, see Figure 5. The major diameter of the thread shall be measured prior to sectioning. As the major diameter of the thread approaches maximum size, values for the 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 actual major diameter as measured on the part.



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

FIGURE 5 - Crest Craters and Crest Laps

3.2.2 Internal Thread Discontinuities: Discontinuities within the limits specified in Table 3 are permitted providing they do not impair the function or the fit of the thread.

TABLE 3 - Permissible Surface Discontinuities - Internal Threads
(Laps, Seams, and Inclusions)

Dimensions in inches

Nominal Thread Diameter	Discontinuity Depth – Maximum	Nominal Thread Diameter	Discontinuity Depth – Maximum
0.1120	0.004	0.6250	0.010
0.1250	0.004	0.7500	0.010
0.1380	0.005	0.8750	0.010
0.1640	0.005	1.0000	0.011
0.1900	0.005	1.1250	0.011
0.2500	0.005	1.2500	0.012
0.3125	0.006	1.3750	0.012
0.3750	0.006	1.5000	0.012
0.4375	0.007	1.7500	0.012
0.5000	0.008	2.0000	0.012
0.5625	0.009	---	---

3.2.3 Microscopic Examination: Specimens cut from finished parts shall be etched in Kalling's reagent, Marble's reagent or other suitable etchant, and examined at 100X magnification to determine conformance to 3.2.

3.3 Stringer Indications:

Indications shall not exceed a length of 0.125 in for surface indications; and, in the case of magnetic particle examination, indications shall not exceed a length of 0.188 in for subsurface indications. Stringers shall be no closer to each other than 0.500 in lineally and 0.250 in apart laterally, and shall not extend over an edge.

3.4 General Discontinuities:

Permissible discontinuities, other than porosity and stringers shall not exceed a length of 0.047 in or surface indications; and, in the case of magnetic particle examination, shall not exceed 0.062 in for subsurface indications. Discontinuities shall not be acceptable if:

a. The discontinuities are closer to each other by less than three times the length of the largest of adjacent indications.

b. More than three discontinuities appear within any one square inch area.

c. Indications of surface and subsurface discontinuities are in a common line.