SAE Aerospace
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AEROSPACE STANDARD

SAE AS5054

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Areas for Calculating Stress or Load Values for Externally and Internally Threaded UNJ Fasteners

1. SCOPE:

1.1 Purpose:

This standard specifies the areas to be used in calculating stress or load values for use in externally and internally threaded fastener procurement specifications for bolts, nuts, and studs and for the information of designers.

1.2 Application:

Areas for the UNJ screw thread series normally used for aerospace fasteners (see AS1132) are established for the following conditions:

1.2.1 Bolts and Studs:

a. Areas for minimum ultimate shear or load in unthreaded shank.
b. Areas for minimum ultimate tensile stress or load in thread.
c. Areas for stress durability test load in thread.
d. Areas for stress rupture test load at elevated temperature.
e. Areas for tension-tension fatigue test load.

1.2.2 Nuts: Areas for minimum ultimate tensile stress in companion bolt thread.

2. 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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2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AS1132 Bolts, Screws and Nuts - External Wrenching UNJ Thread, Inch Series - Design Standard

3. REQUIREMENT:

The following areas are to be used in fastener procurement specifications for establishing the minimum mechanical properties which are specified in terms of allowable minimum test loads (unit stress rating times area). See Table 1 for calculated values. Table 2 provides thread data to facilitate calculating areas for special threads.

3.1 Bolt and Stud Procurement Specifications:

3.1.1 Cross-Sectional Areas for Minimum Ultimate Shear Stress or Load in Fastener Unthreaded Shank: For unthreaded shank greater or less than thread nominal diameter, use maximum shank diameter for 'd' in Equation 1. For unthreaded shank equal to the thread nominal diameter, use basic major diameter of thread for 'd' in Equation 1. The cross-sectional area values in Table 1 are based on the thread nominal diameter, as follows:

$$A = 0.7854(d)^2 \qquad \text{(Eq. 1)}$$

where:

A = Area at the thread nominal diameter, in^2
d = Thread nominal diameter, e.g., maximum major diameter

TABLE 1 - Cross-Sectional Areas for Externally Threaded Fasteners With UNJ Threads

Nominal Thread Diameter	Equation 1 Area - in^2	Equation 2 Area - in^2	Equation 3 Area - in^2	Equation 5 Area - in^2
0.1120-40UNJC	0.009852	0.007208	0.006033	0.004966
0.1120-48UNJF	0.009852	0.007620	0.006605	0.005667
0.1380-32UNJC	0.014957	0.010880	0.009470	0.007452
0.1380-40UNJF	0.014957	0.011652	0.010143	0.008745
0.1640-32UNJC	0.021124	0.016222	0.014009	0.011962
0.1640-36UNJF	0.021124	0.016742	0.014727	0.012852
0.1900-32UNJF	0.028353	0.022618	0.019994	0.017533
0.2500-28UNJF	0.049088	0.040400	0.036374	0.032560
0.3125-24UNJF	0.076699	0.063973	0.058066	0.052433
0.3750-24UNJF	0.11045	0.09506	0.08783	0.08091
0.4375-20UNJF	0.15033	0.12882	0.11872	0.10901
0.5000-20UNJF	0.19635	0.17165	0.15993	0.14865
0.5625-18UNJF	0.24850	0.21763	0.20298	0.18883
0.6250-18UNJF	0.30680	0.27238	0.25596	0.24004
0.7500-16UNJF	0.44179	0.39525	0.37296	0.35132
0.8750-14UNJF	0.60132	0.53924	0.50947	0.48055
1.0000-12UNJF	0.78540	0.70272	0.66304	0.62456
1.1250-12UNJF	0.99402	0.90072	0.85572	0.81193
1.2500-12UNJF	1.22719	1.12326	1.07294	1.02384
1.3750-12UNJF	1.48490	1.37034	1.31471	1.26030
1.5000-12UNJF	1.76715	1.64197	1.58102	1.52129

TABLE 2 - Basic Thread Data Calculations of Areas for Special Diameter Pitch Combinations of UNJ Threads

Threads per inch n	Pitch p = 1/n	0.750H 0.6495/n	1.125H 0.9743/n	1.3333H 1.1547/n
80	0.012500	0.00812	0.01218	0.01443
72	0.013889	0.00902	0.01353	0.01604
64	0.015625	0.01015	0.01522	0.01804
56	0.017857	0.01160	0.01740	0.02062
48	0.020833	0.01353	0.02030	0.02406
44	0.022727	0.01476	0.02214	0.02624
40	0.025000	0.01624	0.02436	0.02887
36	0.027778	0.01804	0.02706	0.03208
32	0.031250	0.02030	0.03045	0.03608
28	0.035714	0.02320	0.03480	0.04124
27	0.037037	0.02406	0.03609	0.04277
24	0.041667	0.02706	0.04060	0.04811
20	0.050000	0.03248	0.04872	0.05774
18	0.055556	0.03608	0.05413	0.06415
16	0.062500	0.04060	0.06089	0.07217
14	0.071429	0.04639	0.06959	0.08248
13	0.076923	0.04996	0.07495	0.08882
12	0.083333	0.05413	0.08119	0.09622
11	0.090909	0.05905	0.08857	0.10497
10	0.100000	0.06495	0.09743	0.11547
9	0.111111	0.07217	0.10826	0.12830
8	0.125000	0.08119	0.12179	0.14434
7	0.142857	0.09279	0.13919	0.16496
6	0.166667	0.10825	0.16238	0.19245
5	0.200000	0.12990	0.19486	0.23094
4	0.250000	0.16238	0.24358	0.28868

3.1.2 Cross-Sectional Areas for Minimum Ultimate Tensile Stress or Load in Threaded Portion:

3.1.2.1 Cross-sectional areas for tensile stress or load in externally threaded tension headed fasteners (hex, double hex, spline drive, etc.) are based on the UNJ basic pitch diameter (max PD) at 0.375H thread depth; using Equation 2:

$$A = 0.7854\ (d - 0.750H)^2 = 0.7854\ [d - (0.6495/n)]^2 = 0.7854\ [d - 0.6495p]^2 \qquad \text{(Eq. 2)}$$

where:

A = Area at the UNJ basic pitch diameter at 0.375H thread depth, in^2
d = Maximum major diameter
H = Height of the sharp V-thread (see Figure 1) = (cos30°)/n
n = Number of threads per inch
p = Pitch (1/n)

3.1.2.2 Cross-sectional areas for tensile stress or load in the externally threaded fasteners such as:

a. pan head, long and short thread
b. fillister head, long and short thread
c. 100° normal countersunk head fasteners

are based on the UNJ basic minor diameter at 0.5625H thread depth; using Equation 3:

$$A = 0.7854\ (d - 1.125H)^2 = 0.7854\ [d - (0.9743/n)]^2 = 0.7854\ [d - 0.9743p]^2 \qquad \text{(Eq. 3)}$$

where:

A = Area at the UNJ basic minor diameter at 0.5625H thread depth, in^2
d = Maximum major diameter
H = Height of the sharp V-thread (see Figure 1) = (cos30°)/n
n = Number of threads per inch
p = Pitch (1/n)

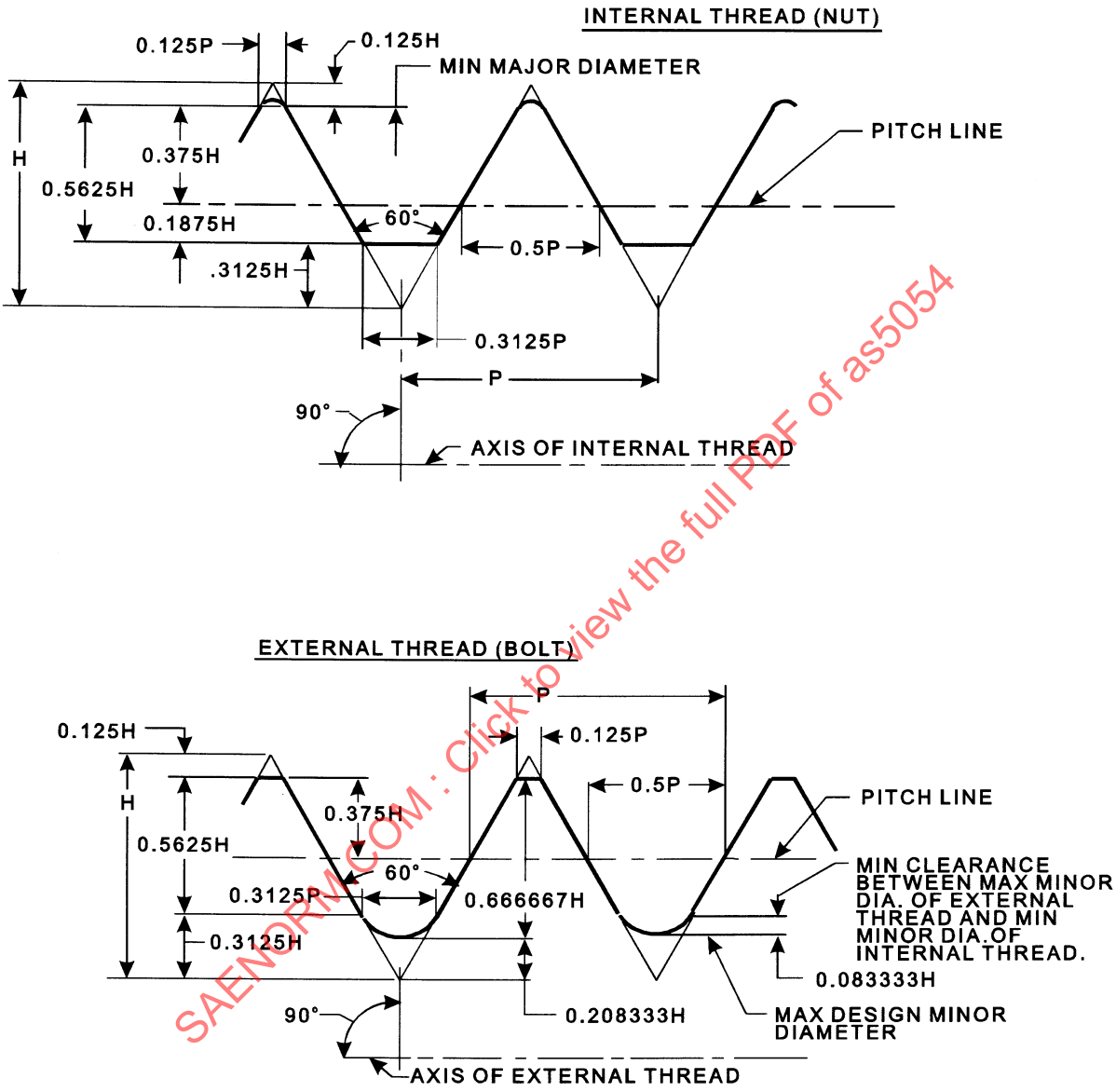

FIGURE 1 - Controlled Radius Root Screw Thread (UNJ) Design Forms
(Maximum Material Condition)