AEROSPACE STANDARD

AS5054™	REV. B

Issued 1998-11
Revised 2005-06
Reaffirmed 2018-08
Stabilized 2024-03

Superseding AS5054A

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

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

This document has been declared “STABILIZED” by SAE E-25 General Standards for Aerospace and Propulsion Systems Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AS5054B/

1. SCOPE:

1.1 Purpose:

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

1.2 Application:

Areas for the UNJ screw thread series per AS8879 normally used for aerospace fasteners (see AS1132) are established for the following conditions:

1.2.1 Bolts, Screws, 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. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other documents shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this specification and references cited herein, the text of this specification takes precedence. Nothing in this specification, 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.

2.1.1.1 Aerospace Standards:

AS1132	Bolts, Screws, and Nuts - External Wrenching, UNJ Thread, Inch - Design Standard
AS8879	Screw Threads - UNJ Profile, Inch, Controlled Radius Root with Increased Minor Diameter

3. REQUIREMENTS:

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 areas. Table 2 provides thread data to facilitate calculating areas for special threads.

3.1 Bolt, Screw 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 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

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

3.1.2.1 Cross-sectional stress areas for tensile stress or load in externally threaded tension headed fasteners (hexagon, double hexagon, spline drive, etc.) are based on UNJ thread 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 sharp V-thread (see Figure 1) = $(\cos 30^o)/n$

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 sharp V-thread (see Figure 1) = $(\cos 30^o)/n$

n = Number of threads per inch

p = Pitch (1/n)

3.1.2.3 The tensile stress or load applied when testing fasteners in 3.1.2.2 is normally adjusted based on Equation 4:

$$\text{Load} = A \times S \times k_1 \times k_2 \qquad \text{(Eq. 4)}$$

where:

A = Area, in^2

S = Stress, ksi

k_1 = 1.0 - For protruding head fasteners

= 0.8 - For normal countersunk head fasteners

= 0.5 - For reduced countersunk head fasteners without drive recess in head

= 0.4 - For reduced countersunk head fasteners with drive recess in head

k_2 = 1.0 - For fasteners manufactured from non-cold worked materials

= 0.8 - For fasteners manufactured from cold worked materials

3.1.3 Areas for Stress Durability Test Load in the Thread: Areas based on Equation 3. The test load is derived by using a percentage of the ultimate tensile stress as defined in the applicable procurement specification.

3.1.4 Areas for Stress Rupture Test Load at Elevated Temperature: Areas upon which stress for stress rupture test load is based is the area at the maximum minor (root) diameter for UNJ threads at 0.6667H thread depth, as follows in Equation 5:

$$A = 0.7854\,(d - 1.3333H)^2 = 0.7854\,[d - (1.1547/n)]^2 = 0.7854\,[d - 1.1547p]^2 \qquad \text{(Eq. 5)}$$

where:

A = Area at the maximum minor (root) diameter for UNJ at 0.6667H thread depth, in^2

d = Maximum major diameter

H = Height of sharp V-thread (see Figure 1) = $(\cos 30^\circ)/n$

n = Number of threads per inch

p = Pitch $(1/n)$

3.1.5 Areas for Tension -Tension Fatigue Test Load: Areas based on Equation 5. High test load is derived by using a percentage of the ultimate tensile stress as defined in the procurement specification.

Low test load is normally 10% of the high test load.

3.2 Nuts:

3.2.1 Cross-sectional areas to be used for calculation of axial loads for tensile testing of the nut are based on the tensile stress area as defined by Equation 2, when using bolts with threads rolled before heat treatment or after heat treatment.

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	0.007202	0.006033	0.005428
0.1120 – 48UNJF	0.009852	0.007615	0.006605	0.006074
0.1380 – 32UNJC	0.014957	0.010881	0.009085	0.008158
0.1380 – 40UNJF	0.014957	0.011644	0.010143	0.009354
0.1640 – 32UNJC	0.021124	0.016219	0.014009	0.012851
0.1640 – 36UNJF	0.021124	0.016732	0.014727	0.013669
0.1900 – 32UNJF	0.028353	0.022619	0.019994	0.018606
0.2500 – 28UNJF	0.049088	0.040401	0.036374	0.034229
0.3125 – 24UNJF	0.076699	0.063990	0.058066	0.054900
0.3750 – 24UNJF	0.110447	0.095081	0.087828	0.083924
0.4375 – 20UNJF	0.150330	0.128841	0.118716	0.113272
0.5000 – 20UNJF	0.196350	0.171672	0.159953	0.153623
0.5625 - 18UNJF	0.248505	0.217645	0.202981	0.195056
0.6250 - 18UNJF	0.306797	0.272394	0.255958	0.247050
0.7500 – 16UNJF	0.441788	0.395257	0.372961	0.360856
0.8750 – 14UNJF	0.601322	0.539246	0.509474	0.493302
1.0000 - 12UNJF	0.785400	0.702680	0.663042	0.641522
1.1250 – 12UNJF	0.994022	0.900673	0.855721	0.831250
1.2500 – 12UNJF	1.227187	1.123211	1.072945	1.045522
1.3750 – 12UNJF	1.484897	1.370293	1.314713	1.284337
1.5000 – 12UNJF	1.797150	1.641918	1.581024	1.547697

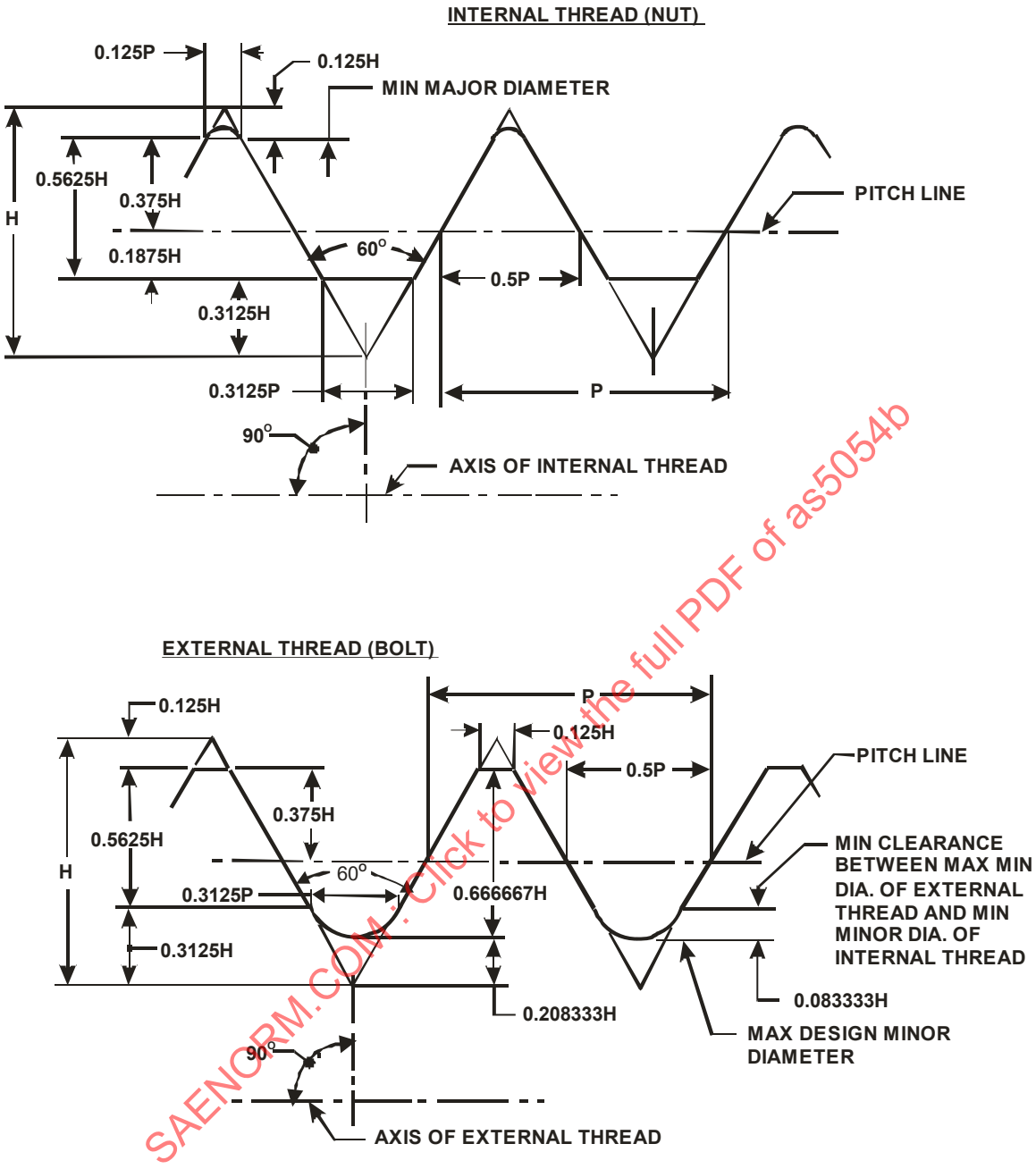

FIGURE 1 - Controlled Radius Root Screw Thread (UNJ) Design Forms
(Maximum Material Condition)