SAE Aerospace
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# METRIC AEROSPACE STANDARD

SAE MA4284

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## Areas for Calculating Stress or Load Values for Metric MJ Internally Threaded Fasteners

RATIONALE

MA4284 has been reaffirmed to comply with the SAE five-year review policy.

1. SCOPE:

Areas for the standard metric series of threaded diameter-pitch combinations for aerospace internally threaded fasteners are established for the following conditions:

a. Area for shear stress or load in fastener thread
b. Area for ultimate tensile stress or load in thread

1.1 Purpose:

This document specifies the areas to be used in calculating stress or load values for use in metric internally threaded fasteners procurement specifications and for information of designers.

2. APPLICABLE DOCUMENTS:

2.1 SAE Publications:

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

| | |
|---|---|
| MA1520 | Areas for Calculating Stress or Load Values for Metric MJ Externally Threaded Fasteners |
| MA1370 | Screw Threads - MJ Profile, Metric |

3. REQUIREMENT:

The following areas are to be used in metric 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.

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TABLE 1 - Areas for Internally Threaded Fasteners
With Metric MJ Threads, $mm^2$

| Nominal Thread Size 4h6h | Shear Cross Section Area in $mm^2$ Formula 1 | Factor Formula 2 | Tension Cross Section Area in $mm^2$ Formula 3 | Tension Cross Section Area in $mm^2$ Formula 4 |
|---|---|---|---|---|
| MJ1,6 x 0,35 | 4.926 | 3.079 | 1.394 | 1.296 |
| MJ2 x 0,4 | 7.868 | 3.934 | 2.264 | 2.110 |
| MJ2,5 x 0,45 | 12.617 | 5.047 | 3.682 | 3.444 |
| MJ3 x 0,5 | 18.551 | 6.184 | 5.439 | 5.103 |
| MJ3,5 x 0,6 | 25.483 | 7.281 | 7.335 | 6.874 |
| MJ4 x 0,7 | 33.855 | 8.464 | 9.517 | 8.912 |
| MJ5 x 0,8 | 54.036 | 10.807 | 15.296 | 14.374 |
| MJ6 x 1,0 | 78.604 | 13.101 | 21.753 | 20.408 |
| MJ7 x 1,0 | 107.462 | 15.352 | 30.931 | 29.201 |
| MJ8 x 1,0 | 140.821 | 17.603 | 41.682 | 39.564 |
| MJ10 x 1,25 | 224.764 | 22.476 | 65.137 | 61.828 |
| MJ12 x 1,25 | 322.365 | 26.864 | 97.128 | 92.843 |
| MJ14 x 1,5 | 447.152 | 31.939 | 131.563 | 125.622 |
| MJ16 x 1,5 | 585.287 | 36.580 | 175.613 | 168.495 |
| MJ18 x 1,5 | 741.986 | 41.221 | 225.950 | 217.652 |
| MJ20 x 1,5 | 917.249 | 45.862 | 282.572 | 273.092 |
| MJ22 x 1,5 | 1111.076 | 50.503 | 345.479 | 334.815 |
| MJ24 x 2,0 | 1348.036 | 56.168 | 401.681 | 386.937 |
| MJ27 x 2,0 | 1708.346 | 63.272 | 515.709 | 498.601 |
| MJ30 x 2,0 | 2111.279 | 70.376 | 643.878 | 624.404 |
| MJ33 x 2,0 | 2556.835 | 77.480 | 786.187 | 764.344 |
| MJ36 x 2,0 | 3045.015 | 84.584 | 942.635 | 918.420 |
| MJ39 x 2,0 | 3575.819 | 91.688 | 1113.221 | 1086.634 |

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3.1 Area for Shear Stress or Load in Fastener Thread:

The shear area for internal thread at a diameter equal to the minimum major diameter of the external thread is based on the following formula:

$$A = \frac{3.1416 L_e d_{min}}{P}[0.5P + 0.57735(d_{min} - D_{2max})] \quad \text{(Eq. 1)}$$

where:

$A$ = Area, $mm^2$
$L_e$ = Length of thread engagement, mm
$d_{min}$ = Minimum major diameter of external thead, mm
$P$ = Thread pitch, mm
$D_{2max}$ = Maximum pitch diameter of internal thread, mm

Where length of thread engagement is not equivalent to nominal diameter, the following formula shall be used:

$$A = (\text{Factor}) L_e \quad \text{(Eq. 2)}$$

where:

$L_e$ = Length of thead engagement, minimum

$$\text{Factor} = \frac{3.1416 d_{min}}{P}[0.5P + 0.57735(d_{min} - D_{2max})]$$

3.2 Area for Ultimate Tensile Stress or Load in Threaded Portion:

3.2.1 Area to be used for calculation of axial loads for tensile test of nut is based on the tensile stress area as defined in MA1520, Formula 3, for companion bolt. Thread rolled after heat treatment, and calculated from the equation:

$$A = 0.7854 (d_3)^2 \left[2 - \frac{d_e}{d_2}\right]^2 \quad \text{(Eq. 3)}$$

where:

$A$ = Area, $mm^2$
$d_2$ = Maximum pitch diameter of bolt, mm
$d_3$ = Maximum root diameter of bolt, mm

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