

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.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2012 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

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>

**SAE values your input. To provide feedback
on this Technical Report, please visit
<http://www.sae.org/technical/standards/MA4284>**

TABLE 1 - Areas for Internally Threaded Fasteners
With Metric MJ Threads, mm²

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

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:

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

where:

- A = Area, mm²
- L_e = Length of thread engagement, mm
- d_{min} = Minimum major diameter of external thread, 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 thread engagement, minimum
- Factor = $\frac{3.1416 d_{\min}}{P} [0.5P + 0.57735(d_{\min} - D_{2\max})]$

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, mm²
- d₂ = Maximum pitch diameter of bolt, mm
- d₃ = Maximum root diameter of bolt, mm