



METRIC AEROSPACE STANDARD	MA1370™	REV. A
	Issued 1990-01 Reaffirmed 2018-08 Stabilized 2024-04 Superseding MA1370	
Screw Threads - MJ Profile, Metric		

RATIONALE

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

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FOREWORD

Change in Document Prefix Letters: This design standard was formerly numbered AS1370A; and with this document, the prefix letters are changed to MA to be consistent with SAE format practice for metric design standards. Because of the change in document prefix letters, MA1370 is issued without a revision letter and treated as a new document. The design requirements in this standard, including dimensions and tolerances, are the same as in the superseded AS1370A.

ISO Equivalent Standards: ISO/TC 20/SC 4 developed MJ profile screw thread documents based on SAE AS1370 which are identical to the threads for fastener sizes. The original issues were identified as:

ISO 5855/1 – Aerospace construction - MJ threads - Part 1: Basic profile

ISO 5855/2 – Aerospace construction - MJ threads - Part 2: Dimensions for bolts and nuts

In addition, ISO/TC 20/SC 4 and SC 10 developed the following document to provide MJ screw threads for fluid system fittings, which are also specified in MA1370:

ISO 5855-3 – Aerospace - MJ threads - Part 3: Dimensions for fittings for fluid systems

ISO 5855/1 and /2 have since been revised and re-identified as ISO 5855-1 and -2, respectively.

In addition to the above ISO screw thread requirements, MA1370 includes standard thread sizes up to 200 mm nominal diameter (see Table 2, standard series).

MJ Profile vs UNJ Profile: The basic profile and design profiles, in proportion to the triangular height H and pitch P, are the same for MA1370 MJ profile and MIL-S-8879 UNJ profile; however, the diameter-pitch combinations and tolerances in MA1370 are metric module values based on ISO/TC 1 metric standards, whereas, MIL-S-8879 UNJ threads are based on the Unified inch standard for these features. Thus, MJ and UNJ threads are not interchangeable.

FOREWORD (Continued):

FED-STD-H28 vs MA1370: FED-STD-H28/21 includes the requirements of ANSI B1.21M-1978, Metric Screw Threads - MJ Profile, and FED-STD-H28/20 includes ANSI/ASME B1.3M-1986, Screw Thread Gaging Systems for Dimensional Acceptability.

The original issue of AS1370, May 1976, was submitted to ANSI for approval as the American National Standard for MJ metric screw threads. AS1370 was used by ASME B1 as the basis for ANSI B1.21M-1978. The dimensional requirements of ANSI B1.21M-1978 are identical to this standard.

ANSI/ASME B1.3M-1986 includes several screw thread gaging systems for acceptability requiring that a system be selected consistent with application requirements which permits the selection of gaging systems that would not inspect certain critical design requirements, such as, root radius and root diameter of the external thread; thus, constant quality practice in aerospace industry could be compromised. MA1566-1980 was issued by SAE for the referee gaging practice of the dimensional requirements specified in AS1370 in order to assure that a constant inspection level would be used for acceptability.

1. SCOPE:

1.1 Purpose:

To establish a metric module version of the UNJ profile, MIL-S-8879 inch screw thread standard, predominantly used in aerospace inch designs.

1.2 Scope:

This standard specifies the characteristics of the MJ profile metric series of screw threads, altered from ISO 68 M Profile, to include a mandatory controlled radius of 0.18042P to 0.15011P at the root of the external thread and with the minor diameter of both external and internal threads increased to provide a basic thread height of 0.5625H in order to accommodate the external thread maximum root radius. The following detailed requirements are included:

- a. MJ basic profile and design profiles
- b. Standard series of diameter-pitch combinations for nominal thread diameters from 1.6 to 200 mm
- c. Standard thread classes and form tolerances
- d. Formulae for thread dimensions and tolerances
- e. Method of designating MJ threads
- f. Inspection requirement
- g. Tables for selected diameter-pitch combinations for aerospace screws, bolts, nuts, shaft and bearing retaining screw threads, and fluid fittings thread sizes
- h. Tables for MJ screw threads limiting dimensions and tolerances
- i. Symbols for MJ thread dimensions and tolerances

1.3 Field of Application:

The MJ profile metric screw thread is intended for use in aerospace metric designs requiring metric threaded parts, and for other highly stressed metric applications requiring high fatigue strength.

2. REFERENCES:

2.1 Applicable Documents:

The following publications form a part of this standard to the extent specified herein. The latest issue of Metric Aerospace Standard (MA) and ISO Recommendations shall apply.

2.1.1 SAE Publications: Available from SAE, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

MA1566 Gaging Practice and Gage Requirements for MJ Metric Screw Threads

2.1.2 ISO Publications: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

ISO/R 1501 ISO Miniature Screw Threads

2.2 Reference Documents:

The following documents are referred in this standard for reference purposes only.

2.2.1 SAE Publications:

AS1337 Selected Aerospace Diameter-Pitch Combinations of Metric 60° Screw Threads for Nuts and Bolts
AS1338 Aerospace Metric 60° Screw Thread Profile and Tolerance Classes
AS1421 Aerospace Selected Diameter-Pitch Combinations of Metric 60° Screw Threads for Shaft or Bearing Retaining Screw Threads

2.2.2 ISO Publications:

ISO 68 ISO general purpose screw threads - Basic profile
ISO 261 ISO general purpose metric screw threads - General plan
ISO 965/1 ISO general purpose metric screw threads - Tolerances - Part 1: Principles and basic data
ISO 965/3 ISO general purpose metric screw threads - Tolerances - Part 3: Deviations for constructional threads

2.3 Symbols & Terms, MJ Thread Dimensions & Tolerances:

Symbol	Dimension	Symbol	Dimension
D	MAJOR DIAMETER, internal thd	d	MAJOR DIAMETER, external thd
D bsc	basic major dia	d bsc	basic major dia
D min	minimum major (form) dia	d max	maximum major dia
		d min	minimum major dia
D ₁	MINOR DIAMETER, internal thd	d ₁	MINOR DIAMETER, external thd
D ₁ bsc	basic minor dia	d ₁ bsc	basic minor dia
D ₁ max	maximum minor dia	d ₁ max	maximum minor (form) dia
D ₁ min	minimum minor dia		
D ₂	PITCH DIAMETER, internal thd	d ₂	PITCH DIAMETER, external thd
D ₂ bsc	basic pitch dia	d ₂ bsc	basic pitch dia
D ₂ max	maximum pitch dia	d ₂ max	maximum pitch dia
D ₂ min	minimum pitch dia	d ₂ min	minimum pitch dia
D ₃	ROOT DIAMETER, internal thd	d ₃	ROOT DIAMETER, external thd
D ₃ max	maximum root dia	d ₃ max	maximum root dia
		d ₃ min	minimum root dia
		R	ROOT RADIUS, external thd
		R max	maximum root rad
		R min	minimum root rad
T	TOLERANCE	T	TOLERANCE
TD ₁	minor dia tol, int thd	Td	major dia tol, ext thd
TD ₂	pitch dia tol, int thd	Td ₂	pitch dia tol, ext thd
		Td ₃	root dia tol, ext thd
Tf'	cumulative form tol, int thd	Tf	cumulative form tol, ext thd
Tr'	runout tol, int thd	Tr	runout tol, ext thd
δ	VARIATION	δ	VARIATION
δα'	flank angle, int thd	δα	flank angle, ext thd
δP'	pitch, int thd	δP	pitch, ext thd
H	HEIGHT, sharp vee thd	Le	LENGTH OF THD ENGAGEMENT
P	PITCH	Le bsc	basic length, thd engagement
α	FLANK HALF-ANGLE	Le max	max length, thd engagement
h	BASIC THREAD DEPTH	Le min	min length, thd engagement
MJ	THREAD PROFILE SYMBOL		

3. TECHNICAL REQUIREMENTS:

3.1 Profile of Thread:

Thread profiles in this standard conform with AS1338.

- 3.1.1 Basic Profile: The basic profile is the theoretical profile corresponding to the basic dimensions (without tolerance) of the thread major diameter, pitch diameter, and minor diameter. The deviations are applied from the basic dimensions. For basic profile, see Figure 1.

- 3.1.1.1 The symbols used in the basic profile shown in Figure 1 represent the thread dimensions in 2.3.

- 3.1.2 **Design Profiles:** The design profile for the internal thread at maximum material condition is the same as the basic profile, except in practice the root is cleared above the basic major (form) diameter, D_{bsc} . See Figure 2. The design profile for the external thread at maximum material condition is the basic profile with a maximum radiused root, tangent to the flanks, as shown in Figure 3 for the maximum limit profile.

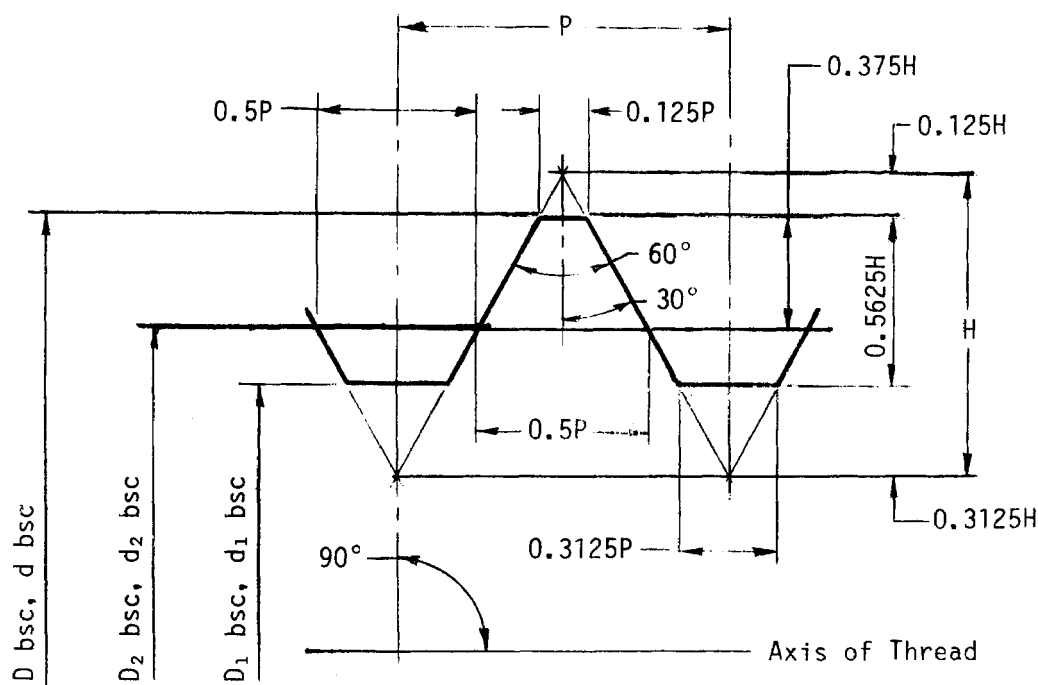


FIGURE 1 - Basic Profile

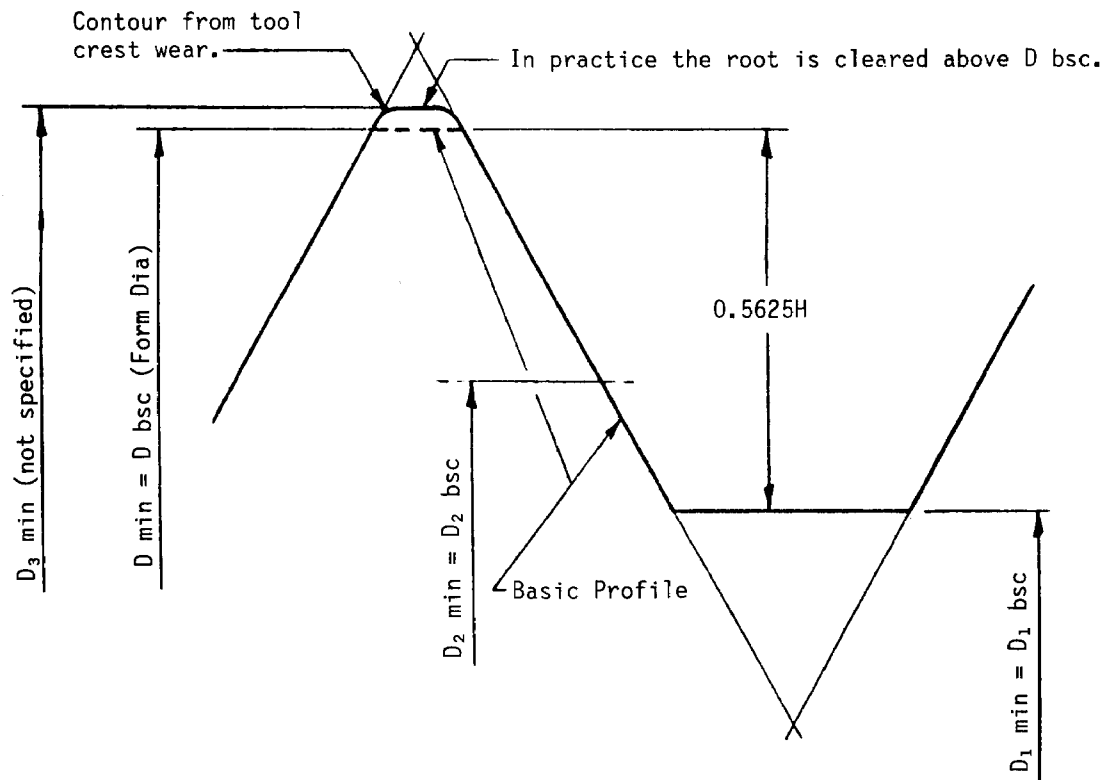


FIGURE 2 - Internal MJ Thread Design Profile

3.2 Series of Threads:

This standard includes a selected series of diameter-pitch combinations of threads extracted from ISO 261 plus additional sizes in the constant pitch series. Also, it includes the standard series of diameter-pitch combinations listed in AS1337 for aerospace screws, bolts and nuts, the standard series of diameter-pitch combinations listed in AS1421 for shaft or bearing retaining screw threads, and the standard series of diameter-pitch combinations for aerospace fluid fittings.

3.3 Thread Classes (Tolerances):

- 3.3.1 Length of Thread Engagement: The pitch diameter tolerances specified herein are based on a length of thread engagement with the GO gaging member having nine pitches or a length equal to the basic major diameter, whichever is the smaller. The actual thread engagement of the product threads are normally applicable for lengths of engagement up to 1.5 diameters for those thread sizes based on one diameter gaging length, and up to 15 pitches for those thread sizes based on nine pitches of gaging length. Where the length of thread engagement exceeds that for which standard tolerances are applicable, refer to 3.4.4 for pitch diameter tolerance increase.

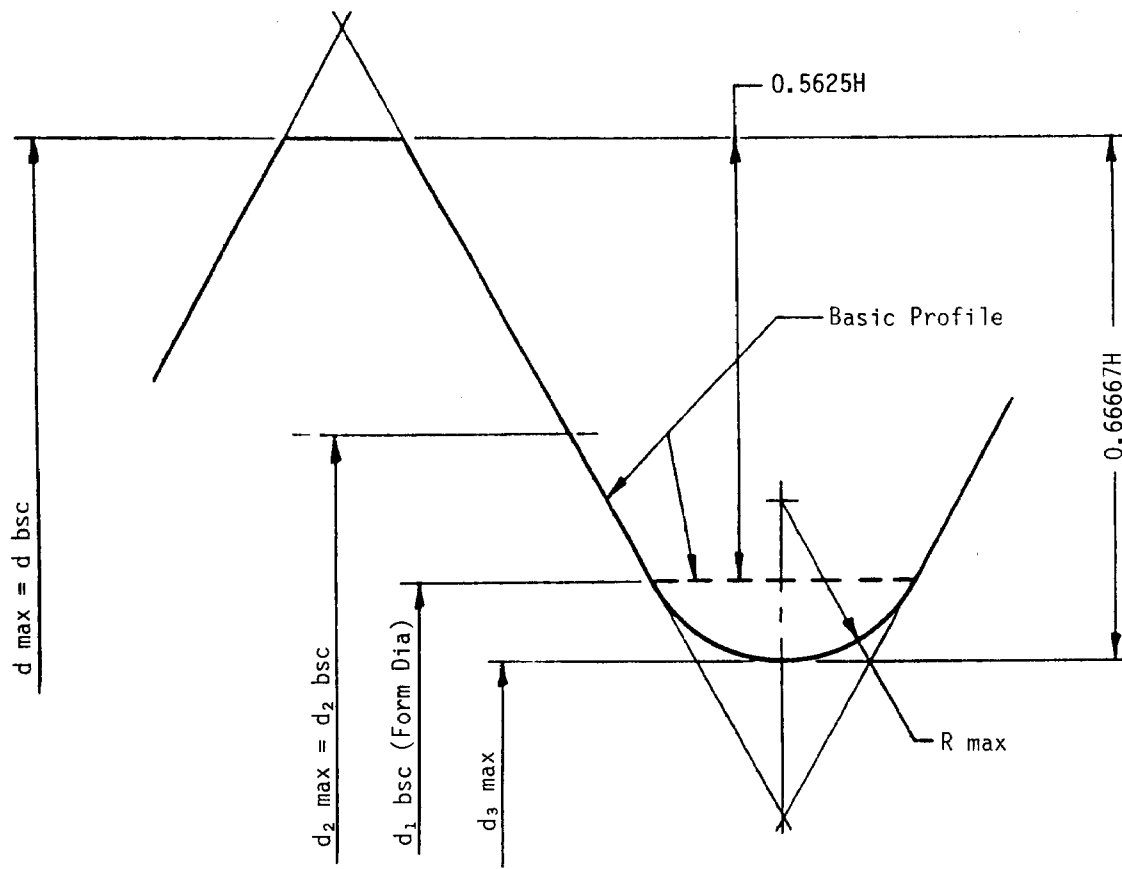


FIGURE 3 - External MJ Thread Design Profile

3.3.2 Tolerance System: The thread tolerance system is based on the International Standard ISO 965/1 metric screw thread system of tolerance positions and grades using, where applicable, tolerances included in ISO 965/3.

3.3.2.1 The tolerance classes selected for this standard conforms with AS1338.

3.3.3 External Thread Class: Except for fluid fittings external threads mating with tube coupling nuts, one class of threads is specified in this standard for all sizes of threads, including fluid fittings external threads mating with port internal threads, as follows after all processing has been completed, including coating or plating:

Tolerance Class 4h6h

The tolerance position h provides zero allowance, the pitch diameter tolerance is grade 4, and the major diameter tolerance is grade 6. The limits of size for tolerance class 4h6h external threads are in Table 6.

3.3.3 (Continued):

Fluid fittings external threads mating with tube coupling nuts have the following thread class after all processing has been completed, including coating or plating:

Tolerance Class 4g6g

The tolerance position g provides an allowance as specified in Table 5, the pitch diameter tolerance is grade 4, and the major diameter tolerance is grade 6.

- 3.3.3.1 Except for fluid fittings external threads mating with tube coupling nuts, the tolerance class for coated or plated external threads having pitches 3 mm and smaller is as follows before the processing has been applied:

Tolerance Class 4g6g

For these external threads, the tolerance position g provides an allowance for coating or plating only. The amount of this allowance for each thread pitch is specified in Table 5. This allowance is the amount of reduction permitted below the limits of size for diameters d , d_2 and d_3 specified in Table 6. For pitches larger than 3 mm, use the allowances specified in 3.4.2.2.

Fluid fittings external threads mating with tube coupling nuts require the tolerance class 4g6g after all processing has been applied. Where these threads require coating or plating, use the allowance specified in 3.4.2.2 below the g allowance required on the finished thread.

- 3.3.4 Internal Thread Class: The following classes of threads are specified in this standard for internal threads after all processing has been completed, including coating or plating:

Tolerance Class 4H6H for sizes 1 thru 5 mm
Tolerance Class 4H5H for sizes 6 mm and larger

The tolerance position H provides zero allowance, the pitch diameter tolerance is grade 4 for all sizes, and the minor diameter tolerance is grade 6 for 5 mm size and smaller, grade 5 for 6 mm size and larger. The limits of size for these tolerance class threads are in Table 6.

- 3.3.4.1 For coated or plated internal threads having pitches 3 mm and smaller, the tolerance class, before the processing has been applied, is as follows:

Tolerance Class 4G6G for sizes 1 thru 5 mm
Tolerance Class 4G5G for sizes 6 mm and larger

The tolerance position G provides an allowance for coating or plating. The amount of this allowance for each thread pitch is specified in Table 5. This allowance is the amount of increase permitted above the limits of size for diameters D , D_1 , and D_2 specified in Table 6. For pitches larger than 3 mm, use the allowances in 3.4.2.2.

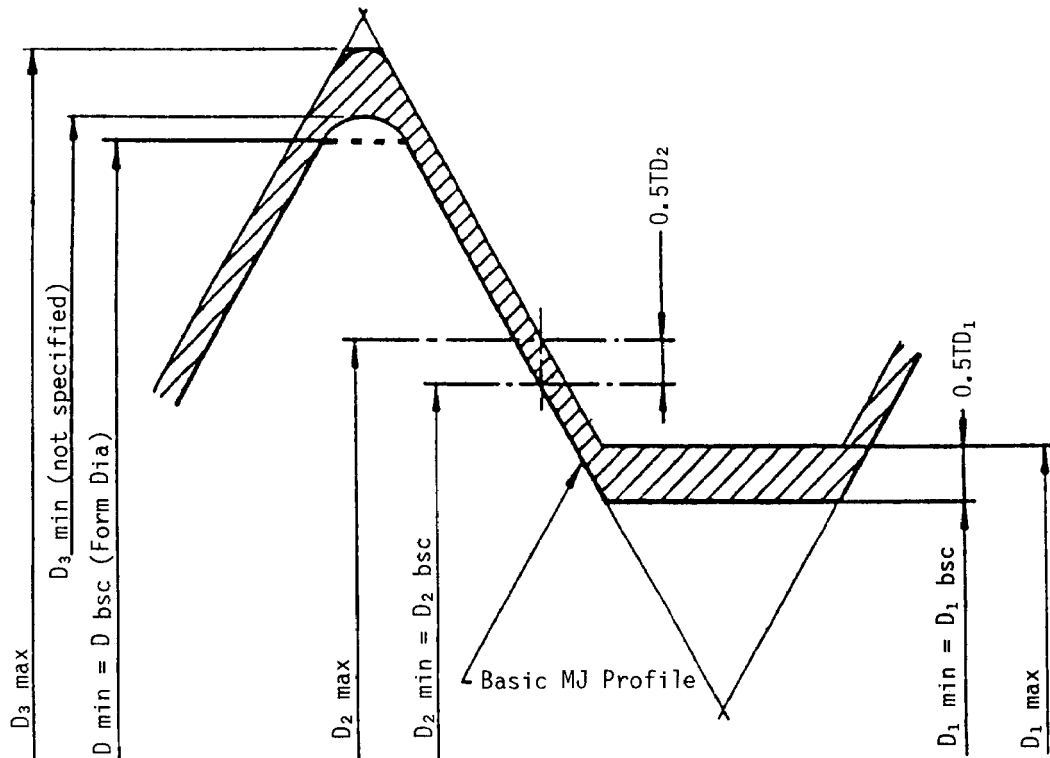


FIGURE 4 - Internal Thread Tolerances

- 3.3.5 Position of Tolerances: The class tolerances are positive for internal threads and negative for external threads, that is, in the direction of minimum material. See Figures 4 and 5.
- 3.3.6 Cumulative Form Tolerance: The cumulative form variation is the combined effect on functional size due to individual thread form variations in lead (pitch), helix, flank angle, taper, roundness, and other form variations of the thread. The allowable amount of cumulative form variation shall not exceed 0.5 times the pitch diameter tolerance.
- 3.3.7 Runout of External Thread Major Diameter and Internal Thread Minor Diameter: The runout of the external thread major diameter and internal thread minor diameter relative to their respective pitch cylinders shall be within the full indicator movement equal to the pitch diameter tolerance.
- 3.3.8 Profile Dimensions and Tolerances: The thread profile theoretical data is given in Table 1. The profile dimensions and tolerances (T) shown in Figures 4 and 5 and their values are specified in Table 6. For special threads for which there are no calculated values, use the formulae listed in 3.3.8.1 and 3.3.8.2.

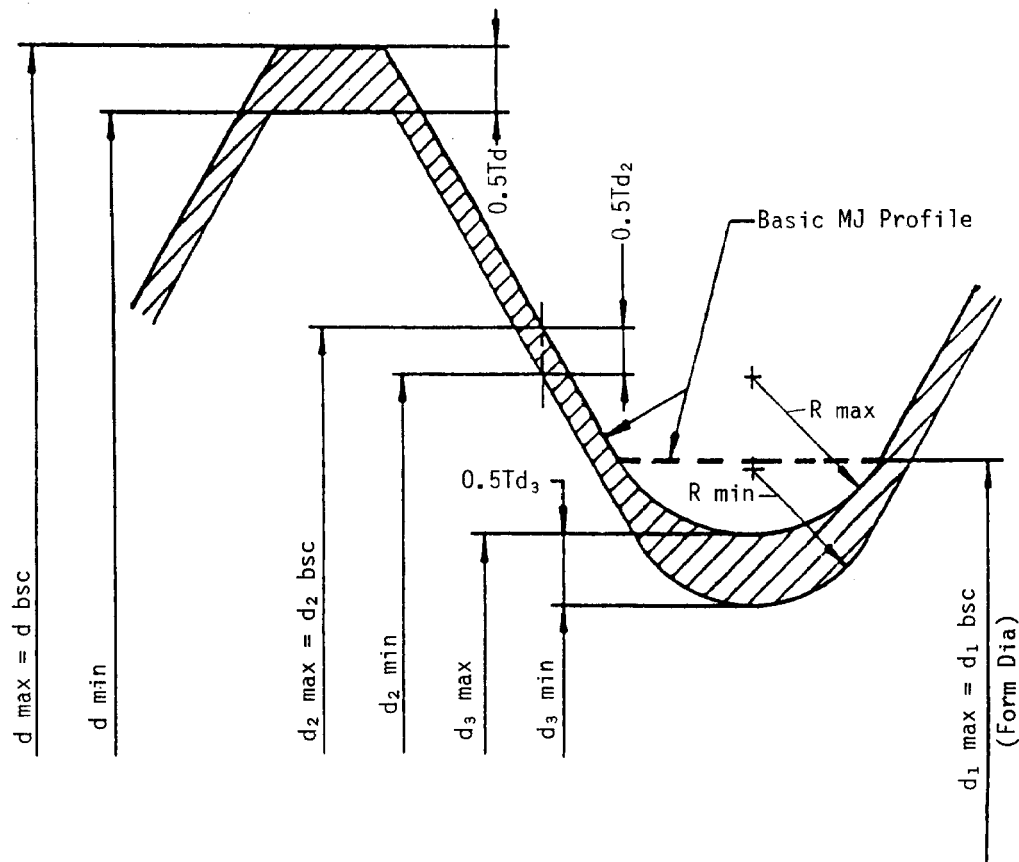


FIGURE 5 - External Thread Tolerances

3.3.8.1 External Thread Formulae:

$$\begin{aligned}
 d_{\max} &= d_{\text{bsc}} - \text{allowance} \\
 d_{\min} &= d_{\max} - T_d(6), \text{ where } T_d(6) = 0.180 \sqrt[3]{P^2} - 0.00315 \times 1 / \sqrt{P} \text{ (See Table 8)} \\
 d_1_{\max} &= D_1_{\max} \\
 d_2_{\max} &= d_{\max} - 0.649519P \text{ (See Table 1)} \\
 d_2_{\min} &= d_2_{\max} - T_{d_2}(4), \text{ where } T_{d_2}(4) = 0.63 \times 0.090P^{0.4}d^{0.1} \text{ (See Table 10)} \\
 d_3_{\max} &= d_2_{\max} - 0.5051815P \text{ (See Table 1)} \\
 d_3_{\min} &= d_2_{\min} - 0.565805P \text{ (See Table 1)} \\
 T_{d_3} &= d_3 - d_3_{\min} \\
 R_{\max} &= 0.18042P \text{ (See Table 4)} \\
 R_{\min} &= 0.15011P \text{ (See Table 4)}
 \end{aligned}$$

3.3.8.2 Internal Thread Formulae:

$$D_{\min} = D_{\text{bsc}} + \text{allowance}$$

$$D_3 \text{ max} = D_2 \text{ max} + 0.7938566P \text{ (See Table 1)}$$

$$D_2 \text{ min} = D_{\min} - 0.649519P \text{ (See Table 1)}$$

$$D_2 \text{ max} = D_2 \text{ min} + TD_2(4), \text{ where } TD_2(4) = 0.85 \times 0.090^{0.4} d^{0.1} \text{ (See Table 10)}$$

$$D_1 \text{ min} = D_{\min} - 0.9742786P \text{ (See Table 1)}$$

$$D_1 \text{ max} = D_1 \text{ min} + TD_1(6) \text{ for pitches 0.2 thru 0.8 mm where } TD_1(6) = 0.433P - 0.190P^{1.22}$$

$$D_1 \text{ max} = D_1 \text{ min} + TD_1(5) \text{ for pitches 1 mm and larger where } TD_1(5) = 0.8 \times 0.230P^{0.7} \text{ (See Table 9)}$$

3.3.9 Pitch and Flank Angle Variation: For the maximum permissible pitch and flank angle variation, the following formulae and their values in Table 7 are provided for reference only. (The flank half-angle $\alpha = 30^\circ$.)

3.3.9.1 External Thread:

$$\text{Pitch Variation, } \delta P = \delta d_2 / \tan \alpha = 0.4TD_2/1.7321$$

$$\text{Flank Half-Angle Variation, } \delta \alpha' = \tan^{-1}(0.3TD_2/1.125P)$$

3.3.9.2 Internal Thread:

$$\text{Pitch Variation, } \delta P' = \delta D_2 / \tan \alpha = 0.4TD_2/1.7321$$

$$\text{Flank Half-Angle Variation, } \delta \alpha' = \tan^{-1}(0.3TD_2/1.125P)$$

3.3.10 Root Radius of the Thread:

3.3.10.1 Internal Thread: For internal threads, the profile of the actual root of the thread shall at no point be below the basic major (form) diameter or above the maximum root diameter, $D_3 \text{ max}$. No root radius is specified.

3.3.10.2 External Thread: For external threads, the profile of the actual root of the thread shall lie within the root radius tolerance zone shown in Figures 5 and 6. The limit values of the root radius R are specified in Table 4. The profile shall be a continuous smoothly blended nonreversing curve no part of which shall have a radius of less than $0.15011P$ and which is tangent to the thread flanks at not less than $0.5625H$ thread depth. The profile may comprise circular arcs that are tangent to the flanks and a flat at the root provided that the root diameter, d_3 , is within the zone established by the formulae in 3.3.8.1.

3.4 Designation of Threads:

3.4.1 Basic Designation: ISO metric threads are identified by the letter "M" in the thread designation. This aerospace metric screw thread is designated by the letters "MJ" to identify the metric J thread profile, followed by the nominal size and the pitch in millimeters (separated by the sign "x"), and followed by the tolerance class (separated by a dash from the pitch). Unless otherwise specified in the designation, the screw thread helix is right hand.