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Third edition
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Aerospace — UNJ threads — General requirements and limit dimensions

Aéronautique et espace — Filetage UNJ — Exigences générales et dimensions limites

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 3161 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 4, *Aerospace fastener systems*.

This third edition cancels and replaces the second edition (ISO 3161:1996), which has been technically revised.

Aerospace — UNJ threads — General requirements and limit dimensions

1 Scope

This International Standard specifies the general requirements and limit dimensions of inch series UNJ threads with controlled root radius for aerospace construction.

It determines the basic triangular profile for this type of thread and gives a system for designating the diameter and number of threads per inch combinations. For all diameters 0,060 in (1,524 mm) to 6,000 in (152,4 mm), it offers in the form of tables the basic dimensions and tolerances for a selection of diameter and number of threads per inch combinations. It also provides the method of calculation for the dimensions and tolerances for any diameter and number of threads per inch combination not given in the tables, including threads with a diameter in excess of 6,000 in.

2 Normative reference

The following normative document contains provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent edition of the normative document indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 15872:—[1)], *Aerospace — UNJ threads — Gauging.*

3 Term and definition

For the purposes of this International Standard, the following term and definition apply.

3.1
basic profile
in an axial plan, the theoretical profile corresponding to the basic dimensions

See Figure 1.

4 Basic profile

4.1 Symbols

See Figure 1.

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1) To be published.

4.2 Basic profile dimensions

See Figure 1 and Table 1.

Values given in Table 1 have been calculated according to the following formulae:

$$P = \frac{1}{n}$$

$$n = \frac{1}{P}$$

$$H = \frac{\sqrt{3}}{2} \times P = 0{,}866\,025P = \frac{0{,}866\,025}{n}$$

$$\frac{9}{16}H = 0{,}487\,14P = \frac{0{,}487\,14}{n}$$

$$\frac{3}{8}H = 0{,}324\,76P = \frac{0{,}324\,76}{n}$$

$$\frac{5}{16}H = 0{,}270\,63P = \frac{0{,}270\,63}{n}$$

$$\frac{H}{8} = 0{,}108\,25P = \frac{0{,}108\,25}{n}$$

4.3 Basic dimensions of thread

Values given in Table 2 have been calculated according to the following formulae:

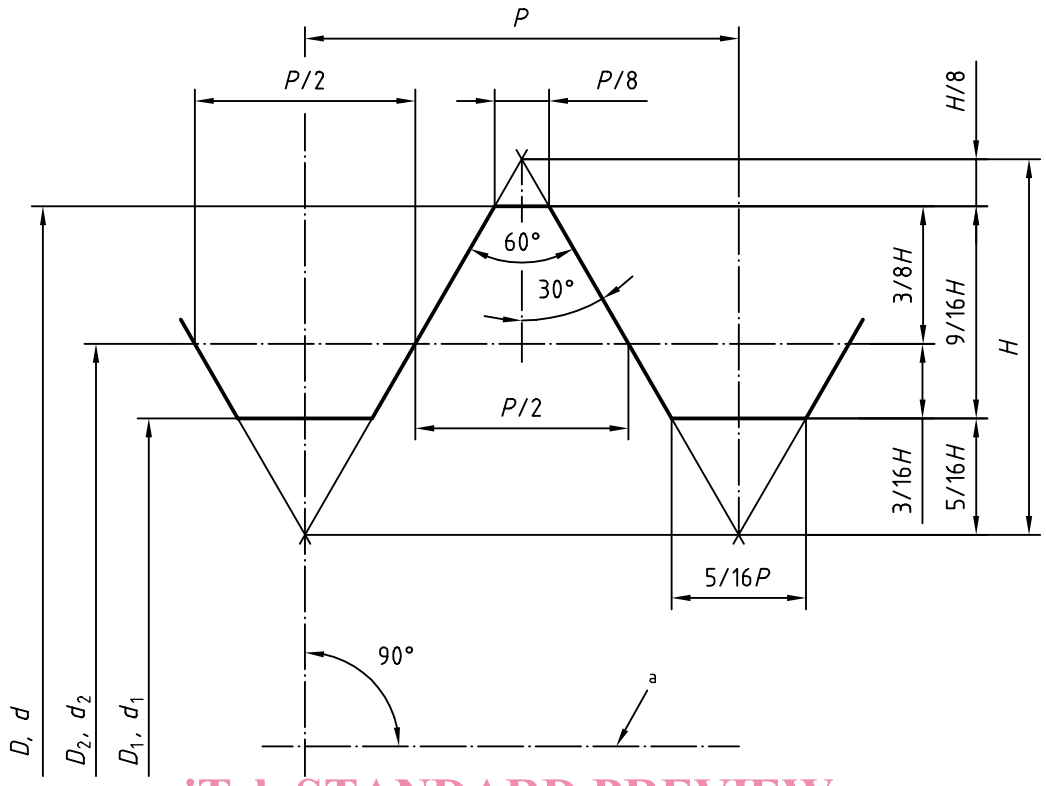
$$D_2 = D - \left(2 \times \frac{3}{8}H\right) = D - 0{,}649\,519P = D - \frac{0{,}649\,519}{n}$$

$$d_2 = d - \left(2 \times \frac{3}{8}H\right) = d - 0{,}649\,519P = d - \frac{0{,}649\,519}{n}$$

$$D_1 = D - \left(2 \times \frac{9}{16}H\right) = D - 0{,}974\,28P = D - \frac{0{,}974\,28}{n}$$

$$d_1 = d - \left(2 \times \frac{9}{16}H\right) = d - 0{,}974\,28P = d - \frac{0{,}974\,28}{n}$$

The tolerances shall be applied to the basic profile.



where

D is the basic major diameter of internal thread

D_2 is the basic pitch diameter of internal thread

D_1 is the basic minor diameter of internal thread

d is the basic major diameter of external thread

d_2 is the basic pitch diameter of external thread

d_1 is the basic minor diameter of external thread

H is the height of fundamental triangle

P is the pitch

n is the number of threads per inch

a Axis of thread

Figure 1 — Basic profile

5 Series of threads

5.1 General

This International Standard includes various series of threads, i.e. groups of diameter and number of threads per inch combinations distinguished from each other by the number of threads per inch associated with any given thread diameter. These series of threads are given in Table 3.

5.2 Diameters

Columns 1 and 2 of Table 3 give the primary and secondary series nominal sizes which satisfy current requirements.

5.3 Number of threads per inch (n)

5.3.1 General

Columns 3 to 9 (inclusive) of Table 3 give the numbers of threads per inch which are recommended to be associated with the diameters in columns 1 and 2. These columns of the numbers of threads per inch are divided into two groups:

— series with increasing (progressive) pitches: columns 3, 4 and 5;

— constant (uniform) pitch series: columns 6, 7, 8 and 9.

5.3.2 Series with increasing (progressive) pitches

There are three series of increasing pitches. They are headed "Coarse pitch", "Fine pitch" and "Extra fine pitch" in accordance with current practice.

These terms indicate the relative pitches of the three series for each given thread diameter and do not imply a difference in quality between the series.

5.3.3 Constant (uniform) pitch series

In addition to these three series of increasing pitches, Table 3 includes details of constant pitch series which have been selected from the range of 8 threads per inch to 20 threads per inch. Each of these series is limited to an appropriate range of diameters.

5.4 Threads outside selection

The threads specified in 5.3.2 and 5.3.3 and indicated in Table 3 meet most requirements. If other diameter and number of threads per inch combinations or threads larger than 6,000 in in diameter are required, then these shall be calculated using the formulae in 6.3.2.

6 Tolerances

6.1 Length of thread engagement used for calculating the pitch diameter tolerances

The length of thread engagement (L_e) (see Figure 2) used in this International Standard is equal to

— the basic major diameter for the series UNJC, UNJF and 8 UNJ. This is applicable for actual lengths of engagement between 1,0D and 1,5D;

— 9P for the series UNJEF, 12 UNJ, 16 UNJ, 20 UNJ and all UNJS. This is applicable for actual lengths of engagement between 5P and 15P.

For applications with lengths of engagement not within the above limits, the tolerances on the pitch diameter shall be calculated according to the calculation formulae for T_{d2} and T_{D2}, using the design length of engagement as L_e.

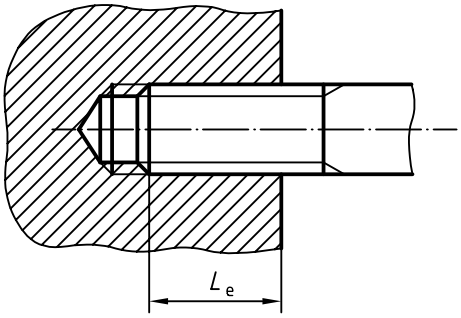


Figure 2 — Length of engagement

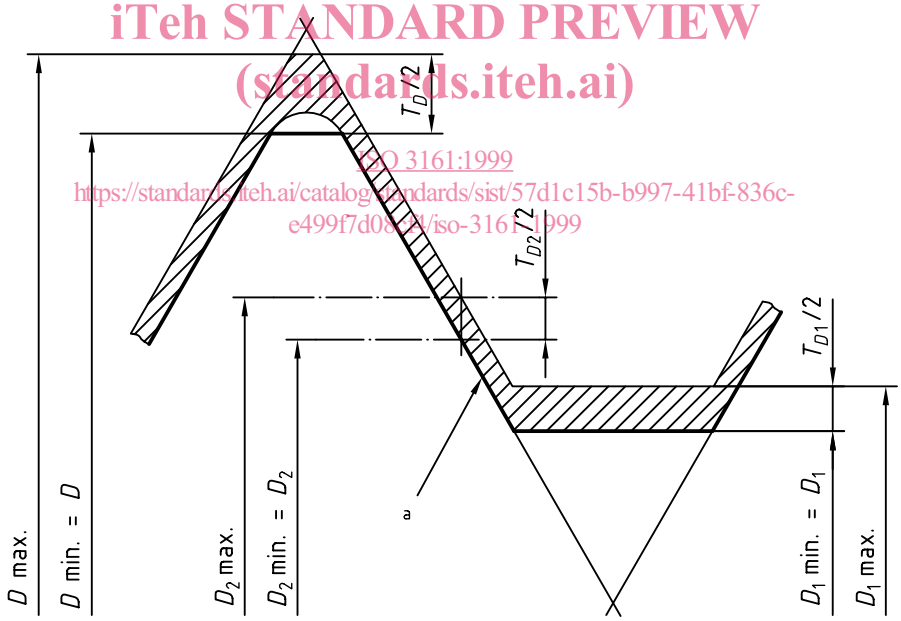
6.2 Position of tolerances

6.2.1 General

The tolerances are positive (+) for the internal threads and negative (–) for the external threads (that is, the tolerances are applied in the direction of minimum material).

6.2.2 Internal thread

See Figure 3.

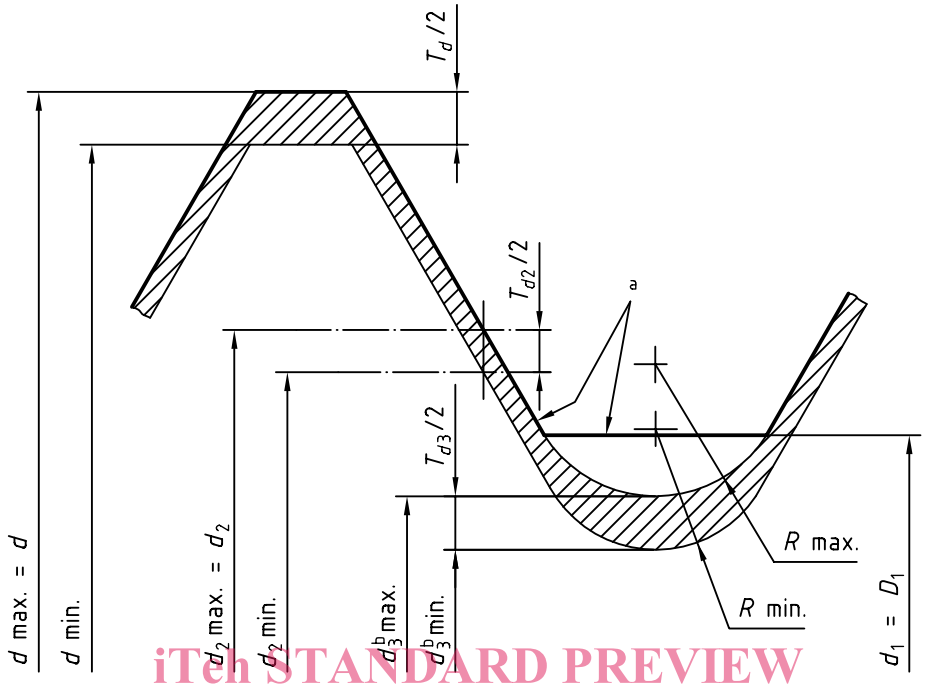


a Basic UNJ profile

Figure 3 — Internal thread tolerances

6.2.3 External thread

See Figure 4.



a Basic UNJ profile

b d_3 is the external thread profile minor diameter.

Figure 4 — External thread tolerances

6.3 Values of tolerances for profile dimensions and tolerances of the profile form

6.3.1 General

Values indicated in Tables 4, 5 and 6 have been calculated according to the formulae given in 6.3.2 and are based on the length of engagement equal to that shown in 6.1,

where

α	is the basic half-angle at the base of the thread side, i.e. 30°;
$\Delta\alpha$	is the maximum permissible variation of the half-angle;
T_D	is the internal thread basic major diameter tolerance;
T_{D1}	is the internal thread basic minor diameter tolerance;
T_{D2} and T_{d2}	are the basic pitch diameter tolerances;
T_d	is the external thread basic major diameter tolerance;
T_{d1}	is the external thread basic minor diameter tolerance;
T_{d3}	is the external thread profile minor diameter tolerance;
ΔP	is the maximum permissible pitch variation of external or internal threads;

ΔD_2 is the pitch diameter increment due to lead variation for the internal threads;

$\Delta D'_2$ is the pitch diameter increment due to variations in the half-angles for the internal threads;

Δd_2 is the pitch diameter increment due to lead variation for the external threads;

$\Delta d'_2$ is the pitch diameter increment due to variations in the half-angles for the external threads.

6.3.2 Calculation formulae

Limits of size for untabulated (UNJS) threads shall also be calculated using the formulae given in 6.3.2.1 and 6.3.2.2.

6.3.2.1 External threads

The formulae are as follows:

d max. = d

d min. = d max. – tolerance $0{,}060\ \sqrt[3]{P^2}$

$0{,}060\ \sqrt[3]{P^2}$: see Table 7, column 3.

d_2 max. = d_2 = d max. – value $0{,}649\ 519P$

$0{,}649\ 519P$: see Table 7, column 4.

d_2 min. = d_2 max. – T_{d2}

$T_{d2} = 0{,}750 \left(0{,}0015 \sqrt[3]{d} + 0{,}0015 \sqrt{L_e} + 0{,}015 \sqrt[3]{P^2} \right)$ (listed in Table 8)

d_3 max. = d_3 = d_2 max. – value $0{,}505\ 18P$

$0{,}505\ 18P$: see Table 7, column 5.

d_3 min. = d_2 min. – value $0{,}565\ 80P$

$0{,}565\ 80P$: see Table 7, column 6.

R max. = $0{,}180\ 42P$ (listed in Table 7, column 7)

$0{,}180\ 42P$: see Table 7, column 7.

R min. = $0{,}150\ 11P$ (listed in Table 7, column 8)

$0{,}150\ 11P$: see Table 7, column 8.

$$\Delta P = \frac{\Delta d_2}{\cot \alpha} = \frac{\Delta d_2}{1{,}732\,1} = \frac{0{,}4 T_{d2}}{1{,}732\,1}$$

$$\tan \Delta\alpha = \frac{\Delta d'_2}{1{,}5P} = \frac{0{,}4 T_{d2}}{1{,}5P}$$ [2)]

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2) The calculation formulae for the tangent of the variations of the half-angle of the thread pitch are approximations of the maximum effects when the two half-angles are equal.

6.3.2.2 Internal threads

The formulae are as follows:

D max. = D_2 max. + value 0,793 86P

0,793 86P: see Table 7, column 9.

D min. = D

D_2 max. = D_2 min. + T_{D2}

T_{D2} = 0,975 $\left(0{,}0015\sqrt[3]{d} + 0{,}0015\sqrt{L_e} + 0{,}015\sqrt[3]{P^2}\right)$ (listed in Table 9)

D_2 min. = D min. – value 0,649 519P

0,649 519P: see Table 7, column 4.

D_1 max. = D_1 min. + T_{D1}

T_{D1} for threads with more than 12 threads per inch = $\left(0{,}05\sqrt[3]{P^2} + 0{,}03P/d\right)$ –0,002 (listed in Table 10)

T_{D1} for threads with 12 threads per inch or less = 0,120P (listed in Table 10)

D_1 min. = D min. – value 0,974 28P

0,974 28P: see Table 7, column 10.

$$\Delta P = \frac{\Delta D_2}{\cot \alpha} = \frac{\Delta D_2}{1{,}732\,1} = \frac{0{,}4T_{D2}}{1{,}732\,1}$$

$$\tan \Delta\alpha = \frac{\Delta D_2'}{1{,}5P} = \frac{0{,}4T_{D2}}{1{,}5P}$$ [3)]

NOTE On completion of the calculations, round off to four decimal points, except values in Table 6 which shall be rounded to five decimal points. Round up if the fifth, or sixth decimal, as applicable, is $\geqslant 5$. Keep the fourth, or fifth decimal, as applicable, if the next one is < 5.

6.3.3 Root radius of the thread

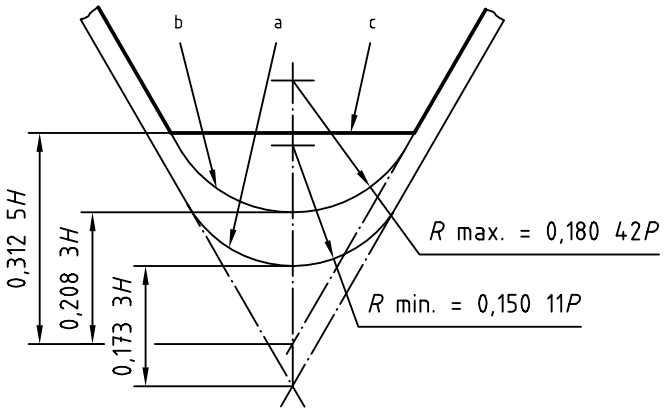
6.3.3.1 Internal threads

For internal threads, the profile of the actual root of the thread shall at no point be below the basic profile given in Figure 3. No particular radius is specified.

3) The calculation formulae for the tangent of the variations of the half-angle of the thread pitch are approximations of the maximum effects when the two half-angles are equal.

6.3.3.2 External threads

For external threads, the profile of the actual root of the thread shall lie within the tolerance zone shown in Figure 5. The limit values of the root radius R are specified in Table 4. The profile shall be a continuous blended curve, no part of which shall have a radius of less than 0,150 11P and which is tangential to the thread flanks at not less than 0,562 5H thread depth. The profile may comprise tangent flank radii that are only joined by a tangential flat at the root.



a Lower limit profile

b Upper limit profile

c Basic UNJ profile

Figure 5 — Radius at the root of the screw thread

6.4 Provisions for coated threads

Before coating, the dimensions of the threads shall be compatible with the thickness of the coating selected and with the limit dimensions for finished parts specified in Tables 5 and 6.

7 Gauging

See ISO 15872.

The radius of the thread root shall be checked by an appropriate method. In case of dispute, optical method shall be used as a referee method.

8 Designation of threads

8.1 General

Threads shall be designated as shown in 8.2, 8.3, 8.4 and 8.5 by indicating, in sequence, the nominal size in inch decimals, the number of threads per inch, the thread series symbol, the tolerance class[4)], the thread type (A external or B internal) and, if necessary, symbol LH put at the designation end for left-hand threads, followed by reference to this International Standard.

4) For this International Standard, there is only one tolerance class: 3.