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Toleranced dimensions – Conversion from inches into millimetres and vice versa

Dimensions tolérancées – Conversion d'inches en millimètres et réciproquement

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published VIEW as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 3 has reviewed ISO Recommendation R 370 and found it technically suitable for transformation. International Standard ISO 370 therefore replaces ISO Recommendation R 370-1964 to which it is technically identical.

ISO Recommendation R 370 was approved by the Member Bodies of the following countries :

Australia	Greece	Poland
Austria	Hungary	Portugal
Belgium	India	Romania
Canada	Iran	Spain
Chile	Ireland	Sweden
Czechoslovakia	Italy	Switzerland
Egypt, Arab Rep. of	Japan	Turkey
Finland	Netherlands	United Kingdom
France	New Zealand	Yugoslavia
Germany	Norway	

The Member Bodies of the following countries expressed disapproval of the Recommendation on technical grounds :

U.S.A. U.S.S.R.

The Member Body of the following country disapproved the transformation of ISO/R 370 into an International Standard :

France

Printed in Switzerland

Toleranced dimensions – Conversion from inches into millimetres and vice versa

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies methods of conversion of toleranced dimensions from inches into millimetres and vice versa, which ensure, under the most suitable conditions, practical regard for interchangeability corresponding to the specified tolerances.

2 GENERALITIES

2.1 The use of the conversion factor 1 in = 25.4 mm from inche (exactly)¹⁾ generally produces converted values containing the conversion of the desired accuracy.

It is therefore necessary to round these values suitably, in a conversion of increase accordance with the degree of accuracy of the toleranced 1975 dimensions, which depends solution in the imagination of the tolerance specified.

2.2 Application of the rules for rounding, as given in tables 1 and 2, guarantees that even in the most unfavourable extreme cases neither of the two specified limits will be exceeded by more than 2 to 2,5 % of the value of the tolerance.

2.2.1 In *method A*, which is generally applicable, unless expressly indicated to the contrary, the rounding is effected to the nearest rounded value so that, on the average, the converted tolerances remain statistically identical with the original tolerances.

The limits converted by this method are considered acceptable for interchangeability and serve as a basis for inspection.

2.2.2 In *method B*, rounding is effected systematically *towards the interior* of the tolerance zone so that, on the average, the converted tolerances are smaller than the original tolerances.

Consequently this method should be employed only when, by special agreement, the original limits have to be respected absolutely (in particular, when components are to be inspected by means of original²⁾ gauges).

These two methods are specified in clauses 3 and 4, which relate respectively to the conversion of inches into millimetres and vice versa. They are supplemented by various special methods of application (see clause 5).

Finally, there are annexes containing conversion tables from inches/into millimetres and vice versa, on the basis of the conversion factor 1 in = 25.4 mm.

3 CONVERSION OF INCHES INTO MILLIMETRES

a) For each dimension in inches, consider only its two limits, maximum and minimum.

b) Convert the corresponding two values exactly into millimetres by means of the conversion factor: 1 in = 25.4 mm (see annex A).

c) Round the results obtained in this way to the nearest rounded value as indicated in table 1, depending on the original tolerance in inches, i.e. on the difference between the two limits in inches.³⁾

The use of this method guarantees that even in the most unfavourable extreme cases neither of the two original limits will be exceeded by more than 2 % of the value of the tolerance.

3.2 Method B (by special agreement)

As method A, except that the rounding is not effected to the nearest rounded value, but towards the interior of the tolerance (i.e. to the next lower value for the upper limit and to the next higher value for the lower limit).

¹⁾ See ISO/R 31, Part I, No. 1-3.h.

²⁾ Gauges in the dimension to be converted.

³⁾ This amounts to rounding each of the two values converted into millimetres to a whole number of 1×10^{-n} mm, when the original tolerance in inches lies between 1×10^{-n} and less than 10×10^{-n} in.

This method shall be employed only when the original limits have to be respected absolutely (in particular, when components are to be inspected by means of original gauges).

-	-		-	
IA	в	L	E	

Original toler	Round off to a whole number of		
not less than and below			
in	in	mm	
0.000 01	0.000 1	0,000 01	
0.000 1	0.001	0,000 1	
0.001	0.01	0,001	
0.01	0.1	0,01	
0.1 1		0,1	

3.3 Example

Suppose that a dimension is expressed in inches as follows :

1.950 ± 0.016 (= 1.966, 1.934)

Conversion of the two limits into millimetres gives TAND

49,123 6 and 49,936 4

(standards.iteh.ai) As the tolerance equals 0.032 in and thus lies between 0.01

and 0.1 in, it is necessary, employing method A, to round ISO Supposes that a dimension is expressed in millimetres as these values to the nearest 0,01 mm. The values in https://siandards.jte/hat/catalog/stafellews/st/daeaf63b-d4fb-4bee-ade4millimetres to be employed for these two limits are thus 2fc45fc54630/iso-370-1975 49,5 ± 0,4 (= 49,1, 49,9)

49,12 and 49,94

(Rounding towards the interior of the tolerance, according to method B, would give limits of 49,12 mm and 49,93 mm, i.e. a tolerance reduced to 0,80 mm instead of 0,82 mm, as given by method A.)

4 CONVERSION OF MILLIMETRES INTO INCHES

4.1 Method A (general rule)

a) For each dimension in millimetres consider only its two limits, maximum and minimum.

b) Convert the corresponding two values into inches by means of the table in annex B (based on the conversion factor : 1 mm = 1/25.4 in).

c) Round the results obtained in this way to the nearest rounded value as indicated in table 2, depending on the original tolerance in millimetres, i.e. on the difference between the two limits in millimetres.¹⁾

The use of this method guarantees that even in the most unfavourable extreme cases neither of the two original limits will be exceeded by more than 2,5 % of the value of the tolerance.

4.2 Method B (by special agreement)

As method A, except that the rounding is not effected to the nearest rounded value, but towards the interior of the tolerance (i.e. to the next lower value for the upper limit and to the next higher value for the lower limit).

This method shall be employed only when the original limits have to be respected absolutely (in particular, when components are to be inspected by means of original gauges).

T٨	١В	L	Е	2
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Original tolerance	Round off to a			
not less than and below		whole number of		
mm mm		in		
0,000 5	0,005	0.000 001		
0,005	0,05	0.000 01		
0,05	0,5	0.000 1		
0,5	5	0.001		
5 50		0.01		

Conversion of the two limits into inches gives

1.933 070 9 and 1.964 567 0

As the tolerance equals 0,8 mm, and thus lies between 0,5 and 5 mm, it is necessary, employing method A, to round these values to the nearest 0.001 in. The values in inches to be employed for these two limits are thus

1.933 and 1.965

(Rounding towards the interior of the tolerance, according to method B, would give limits of 1.934 in and 1.964 in, i.e. a tolerance, reduced to 0.030 in instead of 0.032 in as given by method A.)

5 SPECIAL METHODS OF APPLICATION

5.1 Rounding to the nearest rounded value

If the value to be rounded lies exactly half-way between the two nearest rounded values, it is preferable to take the even value.

¹⁾ For tolerances equal to at least 0,000 5 mm, this is the same as rounding each of the two values converted into inches to a whole number of $1 \times 10^{-(n+2)}$ in, when the original tolerance in millimetres lies between 5×10^{-n} and less than 50×10^{-n} mm.

5.2 Basic size and deviations

In order to avoid any accumulation of rounding errors, it is essential to convert the limits of size themselves, and in cases where they are indicated by a basic size and two deviations it is thus first of all necessary to calculate the limits.

However, (except when method B is specified), the manufacturer is free to make separate conversions, based on the original tolerance, of the basic size to the nearest rounded value and of each of the deviations towards the interior of the tolerance. This method, which gives the same guarantee of interchangeability as method A, may sometimes simplify the conversion procedure, but results in practice in smaller converted tolerances.

5.3 Limitation imposed by accuracy of measurement

If the degree of rounding given for the smallest tolerances in tables 1 and 2 is too fine for the available accuracy of measurement, the limits which are acceptable in regard to interchangeability should be determined separately in each case for those dimensions to which these tolerances apply.

(*Example* – If the accuracy of measurement is limited to 0,001 mm, the study of the particular case shows that the values converted from 1 ± 0.0005 in can be rounded to P 25,413 mm and 25,387 mm instead of 25,4127 mm and 25,3873 mm without any disadvantage, since neither of the two original limits is exceeded by more than 1,2% of the tolerance).

dimension, the reference dimension should be separately converted to the nearest rounded value and each of the two deviations of the tolerance should be separately converted towards the interior of the latter, all these conversions depending on the original tolerance.

5.5 Toleranced dimension associated with a non-toleranced reference dimension

If the toleranced dimension is situated in a plane the position of which is given by a non-toleranced reference dimension (dimensioning of certain conical surfaces, for example) :

a) round the reference dimension arbitrarily, to the nearest rounded value;

b) calculate exactly, in the new unit of measurement, the maximum and minimum limits of the specified tolerance zone, in the plane defined by the new reference dimension obtained in this way;

c) round these limits in conformity with this International Standard.

(Example – Suppose that a cone of taper 0,05 has a diameter 1 ± 0.002 in in a reference plane defined by the non-toleranced positional dimension 0.93 in. By virtue of the taper of the cone, the limits of the tolerance zone depend on the position of the reference plane. Consequently, if we round the dimension 0.93 in = 23,622 mm to 23,6 mm, i.e. a reduction of 0,022 mm, each of the two original limits, when converted

5.4 Positional tolerance https://standards.iteh.ai/catalog/standards

2fc45fc54630/iso-If the dimensioning consists solely of a positional tolerance round a point defined by a non-toleranced reference

exactly into millimetres, should be corrected by $0,022 \text{ mm} \times 0,05 = 0,0011 \text{ mm}$ in the appropriate sense before being rounded).

ANNEX A

TABLES FOR CONVERSION FROM INCHES INTO MILLIMETRES¹⁾

A.1 INCHES IN FRACTIONS

	in	mm		in	mm
^{1/} 64 ¹ /32 ³ /64	0.015 625 0.031 250 0.046 875	0,396 875 0,793 750 1,190 625	$\begin{array}{c c} & 33/64 \\ & 17/32 \\ & 35/64 \end{array}$	0.515 625 0.531 250 0.546 875	13,096 875 13,493 750 13,890 625
¹ /16	0.062 500	1,587 500	⁹ /16	0.562 500	14,287 500
⁵ /64 ³ /32 ⁷ /64	0.078 125 0.093 750 0.109 375	1,984 375 2,381 250 2,778 125	^{37/64} 19/ ₃₂ ^{39/64}	0.578 125 0.593 750 0.609 375	14,684 375 15,081 250 15,478 125
¹ /8	0.125 000	3,175 000	⁵ /8	0.625 000	15,875 000
^{9/64} ⁵ /32 ¹¹ /64	0.140 625 0.156 250 0.171 875	S 3,571 875 3,968 750 4,365 625	$\begin{array}{c} 41/64\\ 21/32\\ 43/64\\ 43/64\\ 43/64\\ 44\\ 43/64\\ 44\\ 43/64\\ 44\\ 44\\ 43/64\\ 44\\ 44\\ 44\\ 44\\ 44\\ 44\\ 44\\ 44\\ 44\\ $	0.640 625 0.656 250 0.671 875	V 16,271 875 16,668 750 17,065 625
³ /16	0.187 500	4,762 500	11/16	0.687 500	17,462 500
¹³ /64 ⁷ / ₃₂ ¹⁵ /64	0.203 125 0.218 750 0.234 375	5,159 375 <u>ISO</u> 5,556 250 ds.ite <u>5,953 129 g</u> /sta	<u>370;15645</u> ndard;/Sist/d	0.703 125 0.718 750 0.734 375 bee-	17,859 375 18,256 250 ade4 18,653 125
1/4	0.250 000	6,350 000	10/180-3/0-1 ³ /4	0.750 000	19,050 000
^{17/} 64 ^{9/} 32 ^{19/} 64	0.265 625 0.281 250 0.296 875	6,746 875 7,143 750 7,540 625	⁴⁹ / ₆₄ ²⁵ / ₃₂ ⁵¹ / ₆₄	0.765 625 0.781 250 0.796 875	19,446 875 19,843 750 20,240 625
5/16	0.312 500	7,937 500	¹³ /16	0.812 500	20,637 500
$\frac{21}{64}$ $\frac{11}{32}$ $\frac{23}{64}$	0.328 125 0.343 750 0.359 375	8,334 375 8,731 250 9,128 125	⁵³ /64 ²⁷ /32 ⁵⁵ /64	0.828 125 0.843 750 0.859 375	21,034 375 21,431 250 21,828 125
³ /8	0.375 000	9,525 000	7/8	0.875 000	22,225 000
$\frac{25}{64}$ $\frac{13}{32}$ $\frac{27}{64}$	0.390 625 0.406 250 0.421 875	9,921 875 10,318 750 10,715 625	⁵⁷ / ₆₄ ²⁹ / ₃₂ ⁵⁹ / ₆₄	0.890 625 0.906 250 0.921 875	22,621 875 23,018 750 23,415 625
7/16	0.437 500	11,112 500	15/16	0.937 500	23,812 500
$\frac{29}{64}$ $\frac{15}{32}$ $\frac{31}{64}$	0.453 125 0.468 750 0.484 375	11,509 375 11,906 250 12,303 125	$ \begin{array}{r} ^{61}/_{64} \\ ^{31}/_{32} \\ ^{63}/_{64} \end{array} $	0.953 125 0.968 750 0.984 375	24,209 375 24,606 250 25,003 125
1/2	0.500 000	12,700 000	1	1.000 000	25,400 000

¹⁾ On the basis of the conversion factor 1 in = 25.4 mm. (All the values in the tables in this annex are exact.)

A.2 INCHES IN DECIMALS AND INCHES

			in	mm	in	mm
1n	mm					
0.001 0.002 0.003 0.004 0.005 0.006	0,0254 0,0508 0,0762 0,1016 0,1270 0 1524		1 2 3 4 5	25,4 50,8 76,2 101,6 127,0	51 52 53 54 55	1295,4 1320,8 1346,2 1371,6 1397,0
0.007 0.008 0.009	0,1778 0,2032 0,2286		6 7 8 9 10	152,4 177,8 203,2 228,6 254,0	56 57 58 58 60	1422,4 1447,8 1473,2 1498,6 1524,0
	1	1	11 12 13 14 15	279,4 304,8 330,2 355,6 381,0	61 62 63 64 65	1549,4 1574,8 1600,2 1625,6 1651,0
in 0.01 0.02 0.03	0,254 0,508 0,762	STANDARI (standards.i	16 17 18 19 20	406,4 431,8 457,2 482,6 508,0	66 67 68 69 70	1676,4 1701,8 1727,2 1752,6 1778,0
0.04 0.05 0.06 0.07 0.08	1,016 https://2700dar 1,524 1,778 2,032 2,286	I <u>SO 370:197</u> ds.iteh.ai/catalog/standards/s 2fc45fe54630/iso-3	21 ist/22ea 10-237: 24 25	533,4 63b-558,84b 584,2 609,6 635,0	71 7 <u>7</u> 204 73 74 75	1803,4 1828,8 1854,2 1879,6 1905,0
0.09	2,200		26 27 28 29 30	660,4 685,8 711,2 736,6 762,0	76 77 78 79 80	1930,4 1955,8 1981,2 2006,6 2032,0
in	mm	-	31 32 33 34 35	787,4 812,8 838,2 863,6 889,0	81 82 83 84 85	2057,4 2082,8 2108,2 2133,6 2159,0
0.1 0.2 0.3 0.4 0.5 0.6	2,54 5,08 7,62 10,16 12,70 15,24		36 37 38 39 40	914,4 939,8 965,2 990,6 1016,0	86 87 88 89 90	2184,4 2209,8 2235,2 2260,6 2286,0
0.7 0.8 0.9	17,78 20,32 22,86		41 42 43 44 45	1041,4 1066,8 1092,2 1117,6 1143,0	91 92 93 94 95	2311,4 2336,8 2362,2 2387,6 2413,0
			46 47 48 49 50	1168,4 1193,8 1219,2 1244,6 1270,0	96 97 98 99 100	2438,4 2463,8 2489,2 2514,6 2540,0

ANNEX B

mm	in		mm	in	mm	in
0,001 0,002 0,003 0,004 0,005 0,006 0,007 0,008 0,009	0.000 039 4 0.000 078 7 0.000 118 1 0.000 157 5 0.000 196 9 0.000 236 2 0.000 275 6 0.000 315 0 0.000 354 3		1 2 3 4 5 6 7 8 9	0.039 370 1 0.078 740 2 0.118 110 2 0.157 480 3 0.196 850 4 0.236 220 5 0.275 590 6 0.314 960 6 0.354 330 7	51 52 53 54 55 56 57 58 59	2.007 874 0 2.047 244 1 2.086 614 2 2.125 984 2 2.165 354 3 2.204 724 4 2.244 094 5 2.283 464 6 2.322 834 6
			10 11 12 13 14 15	0.393 700 8 0.433 070 9 0.472 440 9 0.511 811 0 0.551 181 1 0.590 551 2	60 61 62 63 64 65	2.362 204 7 2.401 574 8 2.440 944 9 2.480 315 0 2.519 685 0 2.559 055 1
0,01 0,02 0,03 0,04 0,05 0,06 0,07	0.000 393 7 0.000 787 4 0.001 181 1 0.001 574 8 0.001 968 5 0.002 362 2 0.002 755 9	eh STANDA (standard	16 17 19 20 21 21 22 0:235	0.629 921 3 0.669 291 3 0.708 661 4 0.748 031 5 0.787 401 6 0.826 771 7 0.866 141 7 0.905 511 8	66 67 68 69 70 71 72 73	2.598 425 2 2.637 795 3 2.677 165 4 2.716 535 4 2.755 905 5 2.795 275 6 2.834 645 7 2.874 015 7
0,08 0,09	0.003 149.6/s 0.003 543 3	andards.iteh.ai/catalog/stand 2fc45fe54630,	24 is is 25 7(26 27 28 29 30	0.944 881 9 0.984 252 0 1.023 622 0 1.062 992 1 1.102 362 2 1.141 732 3 1.181 102 4	b 74 ad 75 76 77 78 79 80	2.913 385 8 2.952 755 9 2.992 126 0 3.031 496 1 3.070 866 1 3.110 236 2 3.149 606 3
mm 0,1 0,2	in 0.003 937 0 0.007 874 0		31 32 33 34 35	1.220 472 4 1.259 842 5 1.299 212 6 1.338 582 7 1.377 952 8	81 82 83 84 85	3 188 976 4 3.228 346 5 3.267 716 5 3.307 086 6 3.346 456 7
0,3 0,4 0,5 0,6 0,7 0,8 0,9	0.011 811 0 0.015 748 0 0.019 685 0 0.023 622 0 0.027 559 1 0.031 496 1 0.035 433 1		36 37 38 39 40 41 42	1.417 322 8 1.456 692 9 1.496 063 0 1.535 433 1 1.574 803 1 1.614 173 2 1.653 543 3	86 87 88 89 90 91 92	3.385 826 8 3.425 196 8 3.464 566 9 3.503 937 0 3.543 307 1 3.582 677 2 3 622 047 2
			43 44 45 46 47 48 49 50	1.692 913 4 1.732 283 5 1.771 653 5 1.811 023 6 1.850 393 7 1.889 763 8 1.929 133 9 1.968 503 9	93 94 95 96 97 98 99 100	3.661 417 3 3.700 787 4 3.740 157 5 3.779 527 6 3.818 897 6 3.858 267 7 3.897 637 8 3.937 007 9

TABLES FOR CONVERSION FROM MILLIMETRES INTO INCHES¹⁾

1) On the basis of the conversion factor 1 mm = 1/25.4 in. (The inch values in these tables are rounded to the nearest value in the 7th decimal place.)

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