

Conical Tapers

DIN
254

Kegel

This Standard agrees essentially with the Recommendation ISO/R 1119-1969 issued by the International Organization for Standardization (ISO) but contains in addition the definitions of the terms conical taper, setting angle and setting value as well as certain additional tapers denoted by \odot in Tables 1 and 2. See also Explanations.

1. Scope and purpose

1.1. This Standard applies to conical tapers with taper angle α up to 165° for general ranges of application. It does not apply to special cases such as bevel gear tooth systems.

1.2. It is the purpose of these provisions to secure a reduction in the range of tools, gauges and measuring instruments required for manufacturing and testing through application of the recommended preferred values for conical tapers.

2. Symbols

C rate of taper
d minor diameter of conical taper
D major diameter of conical taper
h setting height
L length (height) of conical taper (between d and D)
 α taper angle
 $\alpha/2$ setting angle

3. Definitions

3.1. Conical tapers - within the meaning of this Standard - are conical workpieces with circular cross-section.

The definition "conical taper" for this purpose comprises complete tapers and frusta of tapers.

3.2. The taper angle α (see Figure 1) is the included angle between the generators as measured in the axial plane section.

3.3. The setting angle $\alpha/2$ (see Figure 1) is half the taper angle. In manufacture and testing it is used for setting the workpiece and/or the tool or the testing apparatus.

3.4. The setting height h (see Figure 2) is the side of the triangle opposite the setting angle $\alpha/2$ assuming the use of a sine bar with a length of 100 mm. The following relationship

applies: $h = 100 \sin \frac{\alpha}{2}$.

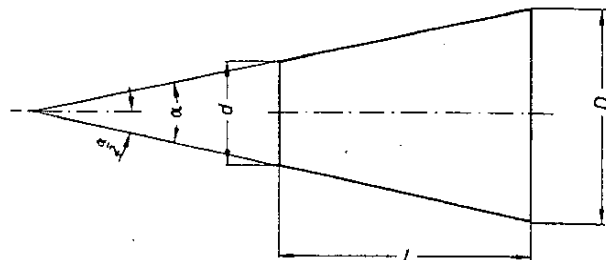


Figure 1. Conical taper dimensions

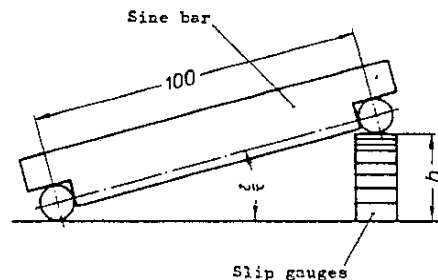


Figure 2. Representation of setting angle by sine bar and setting height

3.5. The rate of taper C is the ratio of the diameter difference of two cross-sections of the taper to the distance between these cross-sections (see Figure 1). The rate of taper is expressed by the following formula

$$C = \frac{D - d}{L} = 2 \tan \frac{\alpha}{2} = 1 : \frac{1}{2} \cot \frac{\alpha}{2}$$

The rate of taper C is a dimensionless quantity.

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Note: The rate of taper is usually expressed as the ratio $C = 1 : x$.

Hence, the meaning of, e.g., $C = 1 : 20$ is that, assuming a distance $L = 20$ mm between the cross-section having diameter D and the cross-section having diameter d , the diameter difference $D - d = 1$ mm so that

$$\frac{1}{2} \cot \frac{\alpha}{2} = 20.$$

For any given rate of taper $1 : x$, the taper angle is $\alpha = 2 \frac{180^\circ}{\pi} \arctan \frac{1}{2x}$.

In some cases the rate of taper is given as the ratio $C = a : b$, e.g. conical taper $7 : 24$.

4. Designation

Designation of a conical taper with a taper angle $\alpha = 30^\circ$:

Conical taper 30°

Designation of a conical taper with rate of taper $C = 1 : 10$:

Conical taper $1 : 10$

5. Preferred values for conical tapers

The conical tapers listed in Table 1 are intended for general application, the conical tapers of Series 1 being preferred to those of Series 2.

6. Conical tapers for special applications

Conical tapers differing from those indicated in Table 1 should only be used if specified in standards for special applications. For examples of such conical tapers and their application, see Table 2.

Table 1. Preferred values for conical tapers

Conical taper		Taper angle α 1)	Rate of taper C	Setting angle $\frac{\alpha}{2}$ 2)	Setting height h mm
Series 1	Series 2				
	○ 165°	165°	1 : 0,065 826 2	82° 30'	99,144
	○ 150°	150°	1 : 0,133 974 6	75°	96,593
	○ 135°	135°	1 : 0,207 106 8	67° 30'	92,388
120°		120°	1 : 0,288 675 1	60°	86,603
	○ 105°	105°	1 : 0,383 663 5	52° 30'	79,335
90°		90°	1 : 0,500 000 0	45°	70,711
	75°	75°	1 : 0,651 612 7	37° 30'	60,876
60°		60°	1 : 0,866 025 4	30°	50,000
45°		45°	1 : 1,207 106 8	22° 30'	38,268
30°		30°	1 : 1,866 025 4	15°	25,882
1 : 3		18° 55' 28,7199" 18,924 644 43°	1 : 3	9° 27' 44"	16,440
	1 : 4	14° 15' 0,1177" 14,250 032 69°	1 : 4	7° 7' 30"	12,403
1 : 5		11° 25' 16,2706" 11,421 186 27°	1 : 5	5° 42' 38"	9,950
	1 : 6	9° 31' 38,2202" 9,527 283 38°	1 : 6	4° 45' 49"	8,305
	1 : 7	8° 10' 16,4408" 8,171 233 55°	1 : 7	4° 5' 8"	7,125
	1 : 8	7° 9' 9,6075" 7,152 668 75°	1 : 8	3° 34' 35"	6,238
1 : 10		5° 43' 29,3176" 5,724 810 45°	1 : 10	2° 51' 45"	4,994
	1 : 12	4° 46' 18,7970" 4,771 888 05°	1 : 12	2° 23' 9"	4,163
	1 : 15	3° 49' 5,8975" 3,818 304 86°	1 : 15	1° 54' 33"	3,331
1 : 20		2° 51' 51,0925" 2,864 192 37°	1 : 20	1° 25' 56"	2,499
	1 : 30	1° 54' 34,8570" 1,909 682 50°	1 : 30	57' 17"	1,666
1 : 50		1° 8' 45,1586" 1,145 877 39°	1 : 50	34' 23"	1,000
1 : 100		34' 22,6309" 0,572 953 02°	1 : 100	17' 11"	0,500
1 : 200		17' 11,3219" 0,286 478 30°	1 : 200	8' 36"	0,250
1 : 500		6' 52,5295" 0,114 591 52°	1 : 500	3' 26"	0,100

○ These conical tapers are not contained in Recommendation ISO/R 1119-1969.

*) At present still circulating as draft.

1) The values for α in degrees, minutes and seconds are rounded to ten-thousandths of seconds. Decimal values of α in degrees are rounded to eight places behind the decimal point.

2) The values for $\alpha/2$ are rounded to seconds.

3) IEC-Publication 95-3.

4) A corresponding recommendation is at present being prepared under the auspices of ISO/TC 121.

Table 2. Conical tapers for special applications (examples)

Conical taper	Taper angle α 1)	Rate of taper C	Setting angle $\frac{\alpha}{2}$ 2)	Setting height h mm	Specified in		Application
					DIN	ISO/R	
O 80°	80°	1 : 0,595 876 8	40°	64,279	7972	1482	Countersunk (flat) head tapping screws
					7973	1483	
O 40°	40°	1 : 1,373 738 7	20°	34,202	6341	—	Drawback collets
O 25°	25°	1 : 2,255 354 3	12° 30'	21,644	86 140 to 86 143	—	Pipe unions with 25° taper sockets for brazing and welding
					86 145 86 148 86 149	—	
O 24°	24°	1 : 2,352 315 1	12°	20,791	2353 3861 3867	—	Solderless pipe unions with olive
					3900 to 3914 3951 to 3954	—	
18° 30'	18° 30'	1 : 3,070 115 1	9° 15'	16,074	64 626	110	Winding cones for winding machines
					729 2079, 2080 6355 6360, 6361 6363, 6364	297 839	
7 : 24 (3,5 : 12)	16° 35' 39,4437" 16,594 289 93°	1 : 3,428 571 4	8° 17' 50"	14,431	64 637	326	Quick-release tapers for milling spindle heads, milling machine arbors, tool shanks and reduction sleeves
					64 400	324	
11° 54'	11° 54'	1 : 4,797 451 1	5° 57'	10,366	64 401	575	Winding cones for winding machines
					64 420 Part 3)	325	
8° 40'	8° 40'	1 : 6,598 441 5	4° 20'	7,556	64 617	112	Dyeing cones
					477 Part 1	327	
7°	7°	1 : 8,174 927 7	3° 30'	6,105	64 401	575	Transfer cones for winding machines
					64 420 Part 3)	325	
3 : 25	6° 52' 2,1386" 6,867 260 71°	1 : 8,333 333 3	3° 26' 1"	5,989	64 420 Part 3)	111	Cones for weaving yarns
					477 Part 1	325	
1 : 9	6° 21' 34,7768" 6,359 660 23°	1 : 9	3° 10' 47"	5,547	64 617	112	Winding cones for winding machines
					477 Part 1	327	
1 : 12,262	4° 40' 12,1514" 4,670 042 05°	1 : 12,262	2° 20' 6"	4,074	72 311 Part 4	3)	Tapered threads for gas cylinders
					—	239	
1 : 12,972	4° 24' 52,9039" 4,414 695 52°	1 : 12,972	2° 12' 26"	3,852	—	239	Terminals for starter batteries
					—	239	
					—	239	Jacobs drill chuck taper No. 2
					—	239	Jacobs drill chuck taper No. 1

O, *, 1), 2) and 3) see on page 3

Table 2 (continued)

Conical taper	Taper angle α 1)	Rate of taper C	Setting angle $\frac{\alpha}{2}$ 2)	Setting height h mm	Specified in		Application
					DIN	ISO/R	
1 : 15.748	3° 38' 13.4429" 3.637 067 47°	1 : 15.748	1° 49' 7"	3.173	—	239	Jacobs drill chuck taper No. 33
1 : 16	3° 34' 47.3564" 3.579 821 22°	1 : 16	1° 47' 24"	3.123	158 2999 4941	7	Metric taper thread. Tapered Whitworth external thread for tubes and fittings. Drill pipe thread for water and rock drilling
6 : 100	3° 26' 12.1776" 3.436 715 99°	1 : 16,666 666 7	1° 43' 6"	2.999	—	594	Tapers for syringes, canuli and other medical appliances
1 : 18.779	3° 3' 1.2070" 3.050 335 26°	1 : 18.779	1° 31' 31"	2.662	—	239	Jacobs drill chuck taper No. 3
1 : 19.002	3° 0' 52.3956" 3.014 554 33°	1 : 19.002	1° 30' 26"	2.630	228 Part 1 and Part 2 (Morse tapers), 204, 1895 (taper shank reamers for Morse tapers), 229 Part 1 and Part 2, 230 Part 1 and Part 2, 221 (Morse taper gauges)	296	Horse taper 5 Horse taper 6 Horse taper 0 Horse taper 4
1 : 19.180	2° 59' 11.7257" 2.986 590 48°	1 : 19.180	1° 29' 36"	2.606	—	—	Tool tapers, tool shanks, receiving tapers of machine tool spindles
1 : 19.212	2° 58' 53.8255" 2.981 618 19°	1 : 19.212	1° 29' 27"	2.602	—	—	—
1 : 19.254	2° 58' 30.4217" 2.975 117 13°	1 : 19.254	1° 29' 15"	2.596	—	—	—
1 : 19.264	2° 58' 24.8643" 2.973 573 43°	1 : 19.264	1° 29' 12"	2.595	—	239	Jacobs drill chuck taper No. 6
1 : 19.922	2° 52' 31.4463" 2.875 401 75°	1 : 19.922	1° 26' 16"	2.509	228 Part 1 and 2 (Morse tapers), 204, 1895 (taper shank reamers for Morse tapers), 229 Part 1 and 2, 230 Part 1 and 2, 221 (Morse taper gauges)	296	Horse taper 3 Horse taper 2 Horse taper 1
1 : 20.020	2° 51' 40.7960" 2.861 332 22°	1 : 20.020	1° 25' 50"	2.497	—	—	—
1 : 20.047	2° 51' 26.9283" 2.857 480 08°	1 : 20.047	1° 25' 43"	2.493	—	—	—
1 : 20.288	2° 49' 24.7802" 2.823 550 06°	1 : 20.288	1° 24' 42"	2.464	—	239	Jacobs drill chuck taper No. 0
1 : 23.904	2° 23' 47.6243" 2.396 562 31°	1 : 23.904	1° 11' 54"	2.091	—	296	Brown & Sharp tool tapers Nos. 1 to 3
1 : 40	1° 25' 56.3516" 1.432 319 89°	1 : 40	42' 58"	1.250	—	4)	Anaesthetics apparatus

1), 2) and 4) see on page 3

Other relevant standards

- DIN 406 Part 2 Dimensioning in drawings, rules
- DIN 7178 Part 1 Taper tolerance and taper fit system for conical tapers with rate of taper $C = 1 : 3$ to $1 : 500$ and lengths from 6 to 630 mm; taper tolerance system (at present still circulating as draft)
- DIN 7178 Part 1 Supplementary Sheet 1 Taper tolerance and taper fit system for conical tapers with rate of taper $C = 1 : 3$ to $1 : 500$ and lengths from 6 to 630 mm; methods of testing internal and external tapers

Explanations

The present new issue of the Standard DIN 254 agrees essentially with the Recommendation ISO/R 1119-1969 issued by the International Organization for Standardization (ISO):

Series of conical tapers and taper angles
Série d'angles de cônes et de conicités

These are obtainable from the DIN Deutsches Institut für Normung e.V. (DIN German Institute for Standardization e.V.), Berlin.

Introduction of the denomination "rate of taper" makes a clear distinction between the conical taper as an element and the geometrical expression $(D - d)/L$ and abolishes the use of the same term "taper" for both denominations (as in the July 1962 issue).

As an addition to ISO/R 1119-1969, the denominations conical taper, setting angle and setting height are explained and examples of designations for conical tapers have been included.

In accordance with the ISO Recommendation, the conical tapers are divided into two tables. Table 1 contains conical tapers standardized for general application in two preferred series. In this Table the conical tapers 135° , 150° and 165° contained in the earlier issue have been retained, beyond the scope of the ISO Recommendation, in order to preserve the completeness of the series. Since the conical tapers of Table 1 are intended for general application, no examples of application are given here.

A second Table contains examples of conical tapers intended only for special applications and specified in other standards. In this Table, examples from Recommendation ISO/R 1119 and examples from DIN standards have been jointly presented. In this connection, ISO/R 1119-1969 contains only examples from Recommendations published up to 1969. The 20° , $1 : 1.5$ and $1 : 7.5$ conical tapers from DIN 254, July 1962 issue have been deleted either because they are no longer specified in standards or because they are of minor importance. Since Table 2 only contains examples it does not make any claim to completeness.

For DIN 254, July 1962 issue, the exact values of the taper angles were determined by an approximate calculation using the series $\arctan \frac{1}{2x}$. By contrast, the values indicated in the present Standard have been calculated by electronic computer which gives the trigonometric functions with an accuracy of $\pm 3 \cdot 10^{-9}$ of the argument. The computer error is thus outside the accuracy stated in the Standard. Thus, compared with the previous issue, the values of the taper angle have been altered by an order of 10^{-3} seconds or 10^{-7} degree.

The new values have been notified to the Technical Committee ISO/TC 3 so that they can be included in a revision of Recommendation ISO/R 1119.