

Milling cutters —

Part 3: Specification for milling cutters except screwed shank cutters

Committees responsible for this British Standard

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- British Gear Manufacturers Association
- Gauge and Tool Makers' Association
- Machine Tool Industry Research Association
- Milling Cutter Association
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Foreword

This Part of BS 122 has been prepared under the direction of the Machine, Engineers and Hand Tools Standards Committee.

It supersedes BS 122-3:1980, which is withdrawn.

The dimensions of the various cutters dealt with in this standard are in agreement with the following standards or related Parts of the following standards prepared by the International Organization for Standardization (ISO).

ISO 240, *Milling cutters — Interchangeability dimensions for cutter arbors or cutter mandrels — Metric series and inch series.*

ISO 299, *Machine tool tables — T-slots and corresponding bolts.*

ISO 523, *Milling cutters — Recommended range of outside diameters.*

ISO 1641-1, *End mills and slot drills — Part I Milling cutters with parallel shanks.*

ISO 1641-3, *End mills and slot drills — Part III Milling cutters with 7/24 taper shanks.*

ISO 2296, *Metal slitting saws with fine and coarse teeth — Metric series.*

ISO 2584, *Cylindrical cutters with plain bore and key drive — Metric series.*

ISO 2585, *Slotting cutters with plain bore and key drive — Metric series.*

ISO 2586, *Shell end mills with plain bore and tenon drive — Metric series.*

ISO 2587, *Side and face milling cutters with plain bore and key drive — Metric series.*

ISO 2780, *Milling cutters with tenon drive — Interchangeability dimensions with cutter arbors — Metric series.*

ISO 2940-2, *Milling cutters mounted on centring arbors having a 7/24 taper — Inserted tooth cutters.*

ISO 3337, *T-slot cutters with plain or flatted parallel shanks and with Morse taper shanks having tapped hole — Metric series.*

ISO 3338-1, *Parallel shanks for milling cutters — Part I Dimensional characteristics of plain parallel shanks.*

ISO 3338-2, *Parallel shanks for milling cutters — Part II Dimensional characteristics of flatted parallel shanks.*

ISO 3855, *Milling cutters — Nomenclature.*

ISO 3859, *Inverse dovetail cutters and dovetail cutters with parallel shanks.*

ISO 3860, *Bore cutters with key drive — Form milling cutters with constant profile.*

ISO 3940, *Tapered die-sinking cutters with parallel shanks.*

ISO 6108, *Double equal angle cutters with plain bore and key drive.*

Definitions for the various types of cutter, and requirements and information on some matters of detail such as side clearance and provision of a radius or flat, have been included. It will be appreciated, however, that there are certain constructional features, e.g. limitation of shape of teeth in relation to size of cutter, which it is not practical to standardize, and these are left to the discretion of the manufacturer.

It is intended that the dimensions of cutters given in this Part of BS 122 will eventually supersede the imperial dimensions given in Part 1 and therefore the dimensions given in Part 1 should be considered as obsolescent and should not be used for new designs.

Appendix A contains a nomenclature of terms in English and French and equivalent terms in German and Italian which are identical with those in ISO 3855.

The revision of this standard was prompted by the need to incorporate technical changes made to the ISO standards upon which this British Standard is based. The opportunity has been taken to revise the presentation of the contents of the standard, so that it is now in line with current BSI practice. As well as typographical changes, the definitions of the various types of cutter have been brought together into a “Definitions” clause, the tables have been cross-referenced to the figures, and informative matter previously in the main body of the text has been incorporated into notes. As a result of the typographical revision, references in the appendix have acquired the prefix letter “A”. These references otherwise correspond to those given in ISO 3855.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 48, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS 122 specifies the following types of cutter: cylindrical, side and face, slotting, tee slot (with parallel and Morse taper shanks), metal slitting saws, shell end mills, end mills and slot drills with parallel shanks, end mills and slot drills with 7/24 taper shanks, inserted tooth cutters mounted on centring arbors with 7/24 taper shanks, dovetail cutters and inverse dovetail cutters with parallel shanks, convex, concave and corner rounding cutters (bore type with key drive), and tapered die-sinking cutters with parallel shanks, and shows metric dimensions for these tools.

General requirements, dimensions and tolerances are specified for the various types of cutters. The dimensions of keys for arbors and the corresponding keyways are specified as are the dimensions of spigots and related parts of standard arbors for shell end mills.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this Part of BS 122 the following definitions apply.

2.1

right-hand cutting

the anti-clockwise rotation of a cutter when viewed facing the spindle nose

2.2

left-hand cutting

the clockwise rotation of a cutter when viewed facing the spindle nose

2.3

cylindrical cutter

a cutter primarily used for surfacing, with teeth on the periphery only

2.4

high helix cylindrical cutter

a cutter primarily used for heavy surfacing cuts, having a steep angle of helix relative to the axis of the cutter, and a small number of teeth on the periphery only

2.5

side and face cutter

a cutter with teeth on the periphery and both sides

2.6

staggered tooth side and face cutter

a cutter with teeth on the periphery and both sides, the teeth being alternately right-hand and left-hand angled, with a positive rake and with alternate side teeth removed

2.7

slotting cutter

a cutter with teeth on the periphery only, and having side clearance

2.8

metal slitting saw

a cutter with teeth on the periphery only, not exceeding 6 mm in width and having side clearance

2.9

metal slitting saw with side chip clearance: type A (staggered teeth)

a cutter having teeth on the periphery and both sides, the teeth being alternately right-hand and left-hand angled, with alternate side teeth removed

2.10

metal slitting saw with side chip clearance: type B (straight teeth)

a cutter having as many teeth on each side as on the periphery

2.11

shell end mill

a cutter with teeth on the periphery and one end provided with a back face key slot drive for use on an arbor

2.12

tee slot cutter

a cutter having the characteristics of a side and face cutter, integral with a taper shank for holding and driving, and designed for cutting tee slots (See BS 2485.)

2.13

tee slot cutter with plain and flatted parallel shanks

a cutter having the characteristics of a side and face cutter, integral with a parallel shank for holding and driving and designed for cutting tee slots

2.14

end mill

a cutter with teeth on the periphery and end and integral with a parallel shank for holding and driving

2.15

end mill with 7/24 taper shank

a cutter with teeth on the periphery and end, and integral with a 7/24 taper shank for holding and driving

2.16

slot drill with plain and flatted parallel shanks

a cutter with teeth on the periphery and end, integral with a parallel shank for holding and driving, designed primarily for the purpose of milling shallow slots or keyways, having two teeth and designed to cut whilst sinking or traversing

2.17

slot drill with 7/24 taper shanks

a cutter with teeth on the periphery and end, integral with a 7/24 taper shank for holding and driving designed primarily for the purpose of milling shallow slots or keyways, having two teeth and designed to cut whilst sinking or traversing

2.18

dovetail cutter

a cutter having teeth on the conical surface and the front end face, integral with a parallel shank for holding and driving, designed to cut in a radial direction only for milling angular recesses

2.19

inverse dovetail cutter

a cutter having teeth, generally on the conical surface only, integral with a parallel shank for holding and driving, designed to cut in a radial direction only for milling angular recesses

2.20

tapered die-sinking cutter

a special purpose cutter of the end mill type, having teeth on the conical surface and the end, which can be flat or ball nosed, integral with a parallel shank for holding and driving, designed to cut in both radial and axial directions for the milling of impressions in moulds and dies

2.21

convex milling cutter

a cutter having a convex half circle in the form and having top relief only

2.22

concave milling cutter

a cutter having a concave half circle in the form and having top relief only

2.23

corner rounding concave milling cutter

a cutter having a concave quarter circle in the form and having top and side relief

2.24**inserted tooth milling cutter**

a cutter of the face milling type, having replaceable mechanically retained teeth or blades, which can be fixed or adjustable to facilitate regrinding or setting

NOTE In general the cutter is suitable for bolting directly on to the milling machine spindle nose usually in conjunction with a centring arbor.

2.25**double equal angle milling cutter**

a cutter with teeth on the conical surfaces and with equal angles between the conical faces and the plane of intersection of the two cones

2.26**milling**

a machining operation in which the tool has a circular primary motion and the workpiece a suitable feed motion and in which the axis of rotation of the primary motion retains its position to the tool independently of the feed motion

3 Keys and keyways

3.1 The dimensions of keys shall be as given in Table 1 (see Figure 1), subject to the tolerances h6 on dimension d , h9 on dimension b and, on dimension h , either:

- a) for general purposes, h11; or
- b) for free keying, H9; or
- c) for close keying, N9.

(See BS 4500-1.)

NOTE Dimensions of keys relating to a full range of arbors have been included in Table 1 for reference purposes; the standard bore sizes for the various types of cutter are those given in the individual tables.

3.2 The dimensions of keyways shall be as given in Table 2 (see Figure 2), subject to the tolerances H7 for dimension d and C11 for dimension b (see BS 4500-1).

NOTE Dimensions of keyways relating to a full range of bore sizes have been included in Table 2 for reference purposes; the standard bore sizes for the various types of cutter are those given in the individual tables.

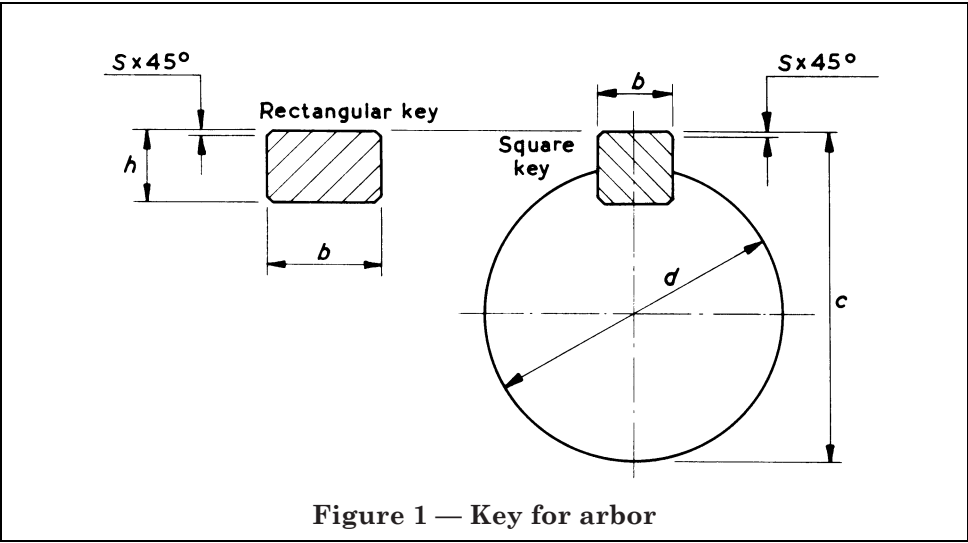


Table 1 — Keys for arbors (see Figure 1)

Diameter of arbor <i>d</i> (tolerance h6) ^a	Nominal size of key		Diameter plus height of key <i>c</i>	Chamfer <i>S</i>
	<i>b</i> (tolerance h9) ^a	<i>h</i> (tolerances h11, H9, N9) ^a		
mm	mm	mm	mm	mm
8	2		8.7 ⁺⁰ _{−0.}	0.16 ^{+0.09} _{−0}
10	3		11.2 ⁺⁰ _{−0.1}	
13	3		14.2 ⁺⁰ _{−0.1}	
16	4		17.2 ⁺⁰ _{−0.1}	
(19)	(5)		(20.6) ⁺⁰ _{−0.1}	0.25 ^{+0.15} _{−0}
22	6		23.6 ⁺⁰ _{−0.1}	
27	7		29.0 ⁺⁰ _{−0.2}	
32	8	7	34.0 ⁺⁰ _{−0.2}	0.40 ^{+0.20} _{−0}
40	10	8	42.5 ⁺⁰ _{−0.2}	
50	12	8	52.5 ⁺⁰ _{−0.2}	
60	14	9	63.0 ⁺⁰ _{−0.2}	
70	16	10	73.5 ⁺⁰ _{−0.2}	
80	18	11	84.0 ⁺⁰ _{−0.2}	
100	25	14	105.0 ⁺⁰ _{−0.2}	0.60 ^{+0.20} _{−0}

NOTE Dimensions in parentheses are least preferred.
^a See 3.1 and BS 4500-1.

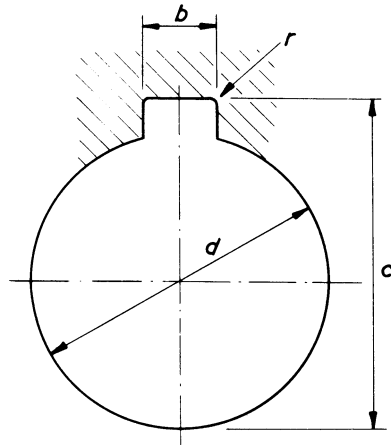
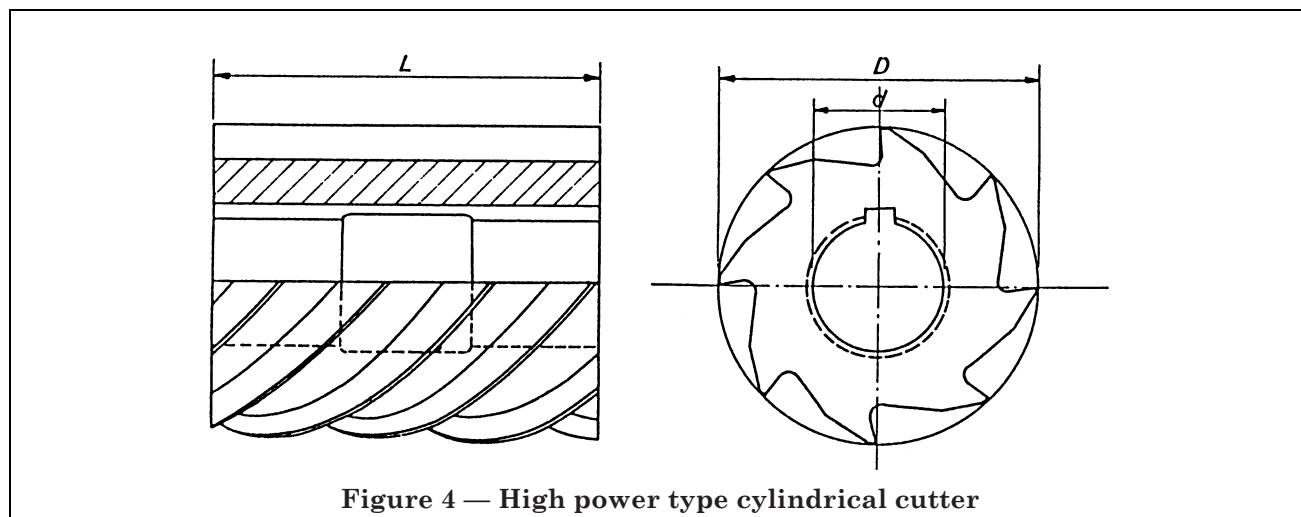
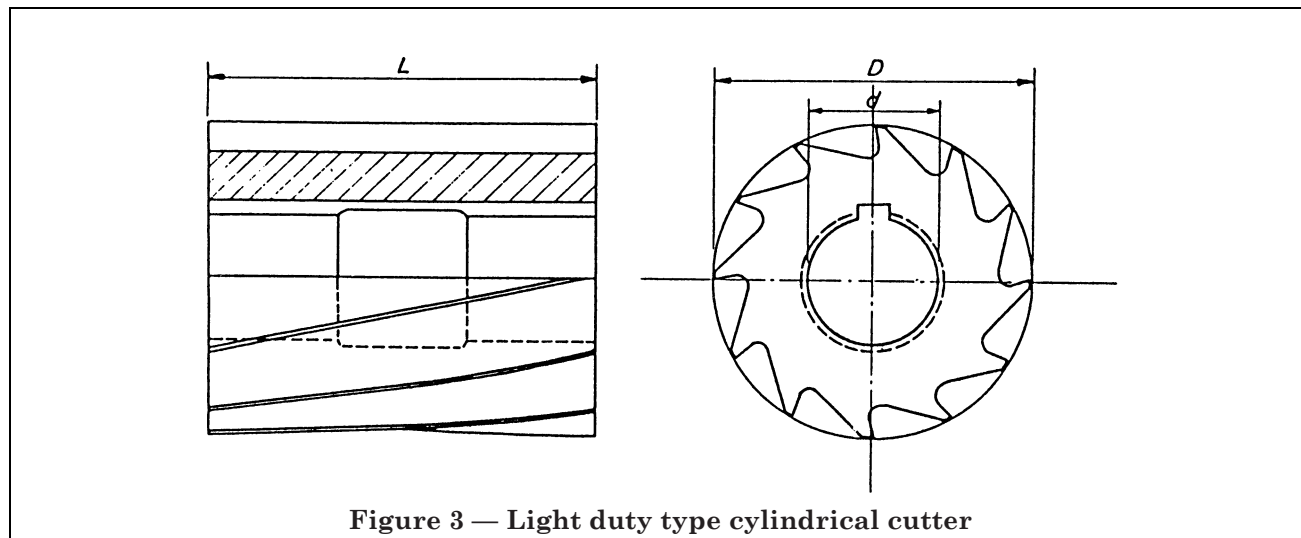


Figure 2 — Keyway

Table 2 — Keyways (see Figure 2)

Diameter of bore d (tolerance H7) ^a	Width of keyway b (tolerance C11) ^a	Diameter plus height of keyway c	Corner radii of keyway r
mm	mm	mm	mm
8	2	$8.9^{+0.1}_{-0}$	$0.4^{+0}_{-0.1}$
10	3	$11.5^{+0.1}_{-0}$	
13	3	$14.6^{+0.1}_{-0}$	
16	4	$17.7^{+0.1}_{-0}$	$0.6^{+0}_{-0.2}$
(19)	(5)	$(21.1)^{+0.1}_{-0}$	$1.0^{+0}_{-0.3}$
22	6	$24.1^{+0.1}_{-0}$	
27	7	$29.8^{+0.2}_{-0}$	$1.2^{+0}_{-0.3}$
32	8	$34.8^{+0.2}_{-0}$	
40	10	$43.5^{+0.2}_{-0}$	
50	12	$53.5^{+0.2}_{-0}$	$1.6^{+0}_{-0.5}$
60	14	$64.2^{+0.2}_{-0}$	
70	16	$75.0^{+0.2}_{-0}$	$2.0^{+0}_{-0.5}$
80	18	$85.5^{+0.2}_{-0}$	
100	25	$107.0^{+0.2}_{-0}$	$2.5^{+0}_{-0.5}$
NOTE Dimensions in parentheses are least preferred.			
^a See 3.2 and BS 4500-1.			

4 Cylindrical cutters



4.1 Light duty and high power cylindrical cutters

4.1.1 The dimensions of light duty or high power type cylindrical cutters shall be as given in Table 3 (see Figure 3 and Figure 4), subject to the tolerances js16 on dimension D , H7 on dimension d and js15 on dimension L (see BS 4500-1).

NOTE These cutters are normally supplied with left-hand helix as shown in Figure 3 and Figure 4.

4.1.2 Light duty and high power cylindrical cutters shall have keyways in accordance with 3.2.

Table 3 — Light duty and high power cylindrical cutters (see Figure 3 and Figure 4)

Diameter of cutter D (tolerance js16) ^a	Diameter of bore d (tolerance H7) ^a	Lengths L (tolerance js15) ^a
mm	mm	mm
50	22	40, 63, 80
63	27	50, 70
80	32	63, 80, 100, 125
100	40	70, 100, 125, 160
125	50	125, 200

^a See 4.1.1 and BS 4500-1.

4.2 High helix cylindrical cutters

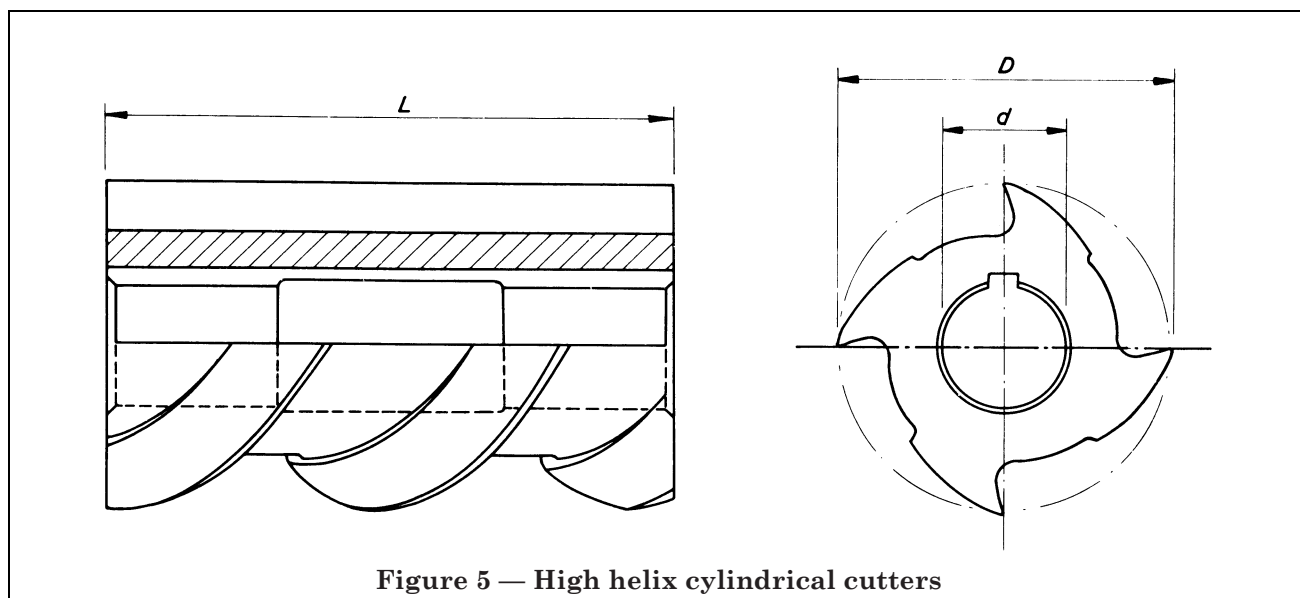


Figure 5 — High helix cylindrical cutters

4.2.1 The dimensions of high helix cylindrical cutters shall be as given in Table 4 (see Figure 5), subject to the tolerances js16 on dimension D , H7 on dimension d and js15 on dimension L (see BS 4500-1).

NOTE These cutters are normally supplied with left-hand helix as shown in Figure 5.

4.2.2 High helix cylindrical cutters shall have keyways in accordance with 3.2.

Table 4 — High helix cylindrical cutters
(see Figure 5)

Diameter of cutter D (tolerance js16) ^a	Diameter of bore d (tolerance H7) ^a	Lengths L (tolerance js15) ^a
80	32	70, 100, 160
100	40	70, 100, 160
125	50	70, 100, 160

^a See 4.2.1 and BS 4500-1.

5 Side and face cutters

5.1 Light duty and high power side and face cutters

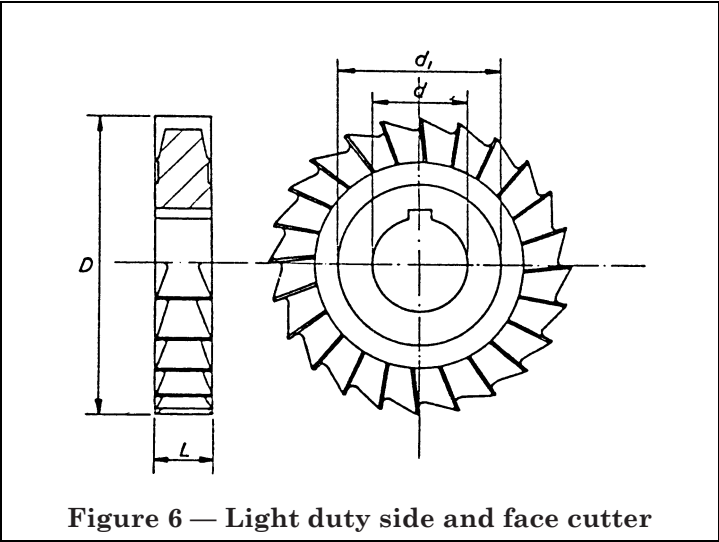


Figure 6 — Light duty side and face cutter

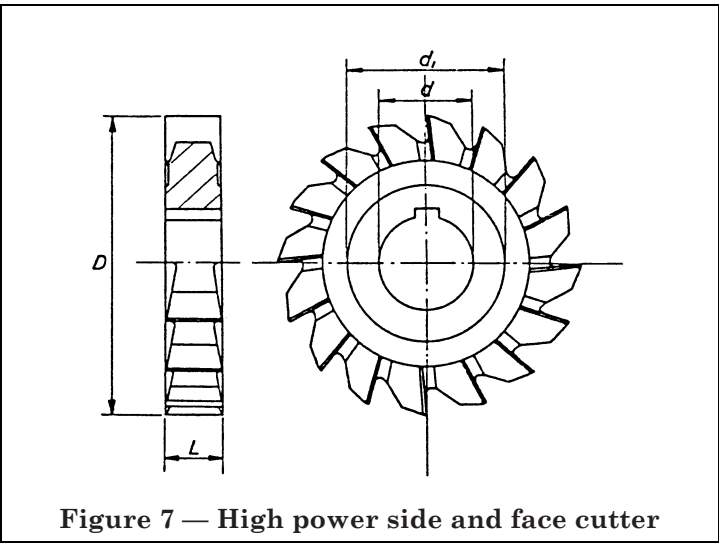


Figure 7 — High power side and face cutter

Table 5 — Side and face cutters (see Figure 6 and Figure 7)

Diameter of cutter <i>D</i> (tolerance js16) ^a	Diameter of boss <i>d</i> ₁ (min.)	Diameter of bore <i>d</i> (tolerance H7) ^a	Width of cutting edges and boss <i>L</i> (tolerance k11) ^a
mm	mm	mm	mm
50	27	16	6, 8, 10
63	34	22	6, 8, 10, 12, (14), 16
80	41	27	6, 8, 10, 12, (14), 16, (18), 20
100	47	32	6, 8, 10, 12, (14), 16, (18), 20, (22), 25
125	47	32	6, 8, 10, 12, (14), 16, (18), 20, (22), 25, (28)
160	55	40	10, 12, (14), 16, (18), 20, (22), 25, (28), 32
200	55	40	12, (14), 16, (18), 20, (22), 25, (28), 32, (36), 40

NOTE Dimensions in parentheses are least preferred.
^a See 5.1.1 and BS 4500-1.

5.1.1 The dimensions of high power or light duty type side and face cutters shall be as given in Table 5 (see Figure 6 and Figure 7), subject to the tolerances js16 on dimension D , H7 on dimension d and k11 on dimension L (see BS 4500-1).

5.1.2 Light duty and high power side and face cutters shall have keyways in accordance with 3.2.

5.1.3 Each side of a side and face cutter shall be either:

- a) ground to provide $\frac{1}{4}^\circ$ side clearance, when the clearance shall be amplified by recessing; or
- b) not ground to provide side clearance.

5.2 Staggered tooth side and face cutters

5.2.1 The dimensions of staggered tooth side and face cutters shall be as given in Table 6 (see Figure 8), subject to the tolerances js16 on dimension D , H7 on dimension d and k11 on dimension L (see BS 4500-1).

5.2.2 Staggered tooth side and face cutters shall have keyways in accordance with 3.2.

5.2.3 Each side of a staggered tooth side and face cutter shall be either:

- a) ground to provide $\frac{1}{4}^\circ$ side clearance, when the clearance shall be amplified by recessing; or
- b) not ground to provide side clearance.

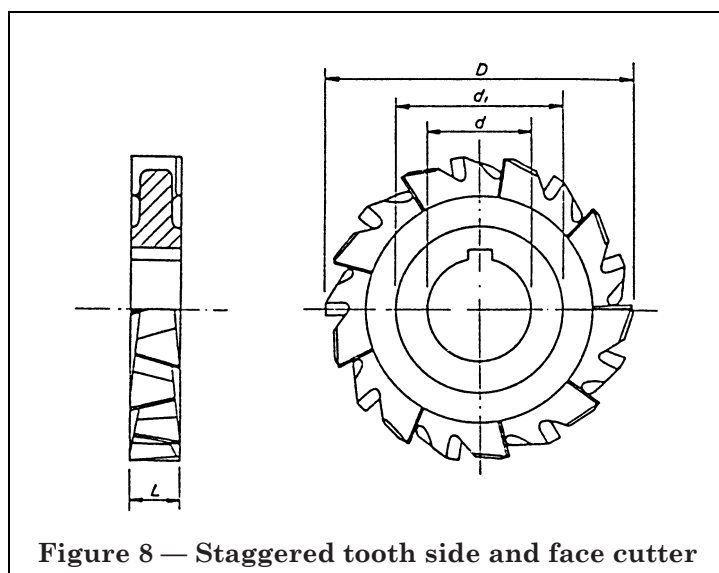


Figure 8 — Staggered tooth side and face cutter

Table 6 — Staggered tooth side and face cutters (see Figure 8)

Diameter of cutter D (tolerance js 16) ^a	Diameter of boss d_1 (min.)	Diameter of bore d (tolerance H7) ^a	Width L (tolerance k11) ^a
mm	mm	mm	mm
63	34	22	6, 8, 10, 12, (14), 16
80	41	27	6, 8, 10, 12, (14), 16, (18), 20
100	47	32	6, 8, 10, 12, (14), 16, (18), 20, (22), 25
125	47	32	8, 10, 12, (14), 16, (18), 20, (22), 25, (28)
160	55	40	10, 12, (14), 16, (18), 20, (22), 25, (28), 32
200	55	40	12, (14), 16, (18), 20, (22), 25, (28), 32, (36), 40

NOTE Dimensions in parentheses are least preferred.

^a See 5.2.1 and BS 4500-1.

6 Slotting cutters

6.1 The dimensions of slotting cutters shall be as given in Table 7 (see Figure 9), subject to the tolerances js16 on dimension D , H7 on dimension d and js14 on dimension L (see BS 4500-1).

6.2 Slotting cutters shall have each side ground to provide side clearance and the clearance shall, where the width and diameter of the cutter permit, be amplified by recessing.

6.3 Slotting cutters shall have keyways in accordance with 3.2.

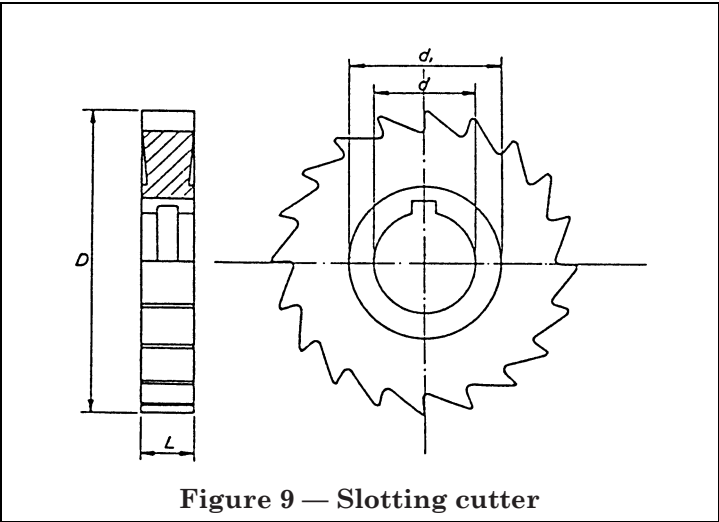


Table 7 — Slotting cutters (see Figure 9)

Diameter of cutter <i>D</i> (tolerance js16) ^a	Diameter of boss <i>d</i> ₁ (min.)	Diameter of bore <i>d</i> (tolerance H7) ^a	Width <i>L</i> (tolerance js4) ^a
mm	mm	mm	mm
50	27	16	6, 7, 8, 10
63	34	22	6, 7, 8, 10, 12, 14
80	41	27	6, 7, 8, 10, 12, 14, 16, 18
100	47	32	6, 7, 8, 10, 12, 14, 16, 18, 20, (22), 25
125	47	32	8, 10, 12, 14, 16, 18, 20, (22), 25
160	55	40	10, 12, 14, 16, 18, 20, (22), 25, (28), 32
200	55	40	12, 14, 16, 18, 20, (22), 25, (28), 32, (36), 40

NOTE 1 The use of these cutters for cutting keyways is not recommended as the width of the slot produced cannot be guaranteed. If, however, the cutters are required for cutting keyways to BS 46-1, the special tolerances should be agreed between the purchaser and the manufacturer.

NOTE 2 Dimensions in parentheses are least preferred.

^a See 6.1 and BS 4500-1.

7 Metal slitting saws

7.1 Metal slitting saws (without side chip clearance)

7.1.1 The dimensions of metal slitting saws (without side chip clearance) referenced in Figure 10 shall be as given in Table 8 or Table 9, subject to the tolerances js16 on dimension *D*, H7 on dimension *d* and js11 on dimension *L* (see BS 4500-1).

NOTE The value for the tooth pitch in relation to the number of teeth of a metal slitting saw (without side chip clearance) of a given diameter is expressed in Table 8 and Table 9 as an approximate rounded figure.

7.1.2 Metal slitting saws (without side chip clearance) shall have side clearance either:

- a) up to the bore; or
- b) up to the boss.

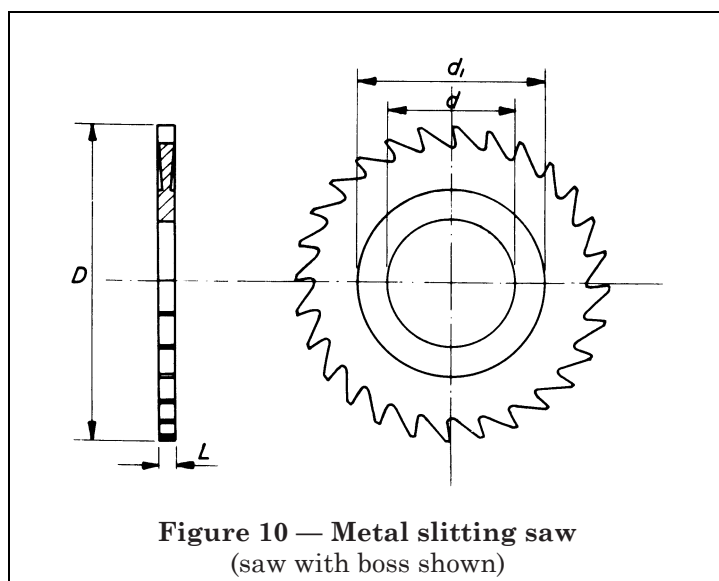


Table 8 — Metal slitting saws with fine teeth (see Figure 10)

		mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
Diameter of saw <i>D</i> (tolerance js16) ^a		20	25	32	40	50	63	80	100	125	160	200	315
Diameter of boss <i>d</i> ₁ (min.)		—	—	—	—	—	—	34	34	34	47	63	80
Diameter of bore <i>d</i> (tolerance H7) ^a		5	8	8	10	13	16	22	22	22	32	32	40
Width <i>L</i> (tolerance js11) ^a	Tooth pitch	Number of teeth											
0.2	0.8	80			128								
0.25				100	128								
0.3	1.0	64	80		100								
0.4				80		128							
0.5			64		100								
0.6	1.25	48			80		128	160					
0.8			64			100		160					
1.0			48		80		128		160				
1.2	1.6	40			64		100		160				
1.6			48			80		128		160			
2.0		32	40		64		100		160	200			
2.5	2.0			48		80		128		200			
3.0			40			64		100		160			
4.0				40	48		80		128		160		
5.0	2.5					64		100		128		160	
6.0					48		64	80	100		128		
			3.15		4.0		5.0		6.3				

^a See 7.1 and BS 4500-1.