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R 1641

END MILLS WITH PARALLEL SHANKS

AND WITH MORSE TAPER SHANKS

STANDARD SERIES AND LONG SERIES

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Morse taper shanks
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CONTENTS

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END MILLS WITH PARALLEL SHANKS AND WITH MORSE TAPER SHANKS

STANDARD SERIES AND LONG SERIES

1. SCOPE

This ISO Recommendation relating to end mills with parallel shanks and with Morse taper shanks deals with the four following types of mills :

(1) with parallel shanks, standard series (see Tables 1 to 3);

(2) with parallel shanks, long series (see Tables 4 to 6);

(3) with Morse taper shanks, standard series (see Tables 7 to 9);

(4) with Morse taper shanks, long series (see Tables 10 to 12).

For each of the above-mentioned types of mills, this ISO Recommendation includes three tables giving respectively

- recommended dimensions in millimetres,
- recommended dimensions in inches,
- corresponding dimensions in millimetres and in inches, defined with respect to ranges of diameters.

2. INTERCHANGEABILITY

Numerical tables have been established so as to ensure the greatest possible correspondence between standard dimensions in millimetres and in inches.

For this purpose, the whole scale of outside diameters d has been divided into a number of ranges whose limits are taken from the R 40 series of preferred numbers for values in millimetres. Inch values are obtained by direct conversion of metric values. Lengths and Morse taper number remain constant within any one range, for values in millimetres and values in inches.

The recommended diameters for the two systems of units of measurement differ from one another, in conformity with ISO Recommendation R 523, *Recommended range of outside diameters for milling cutters.* The number of diameters retained in a determined range may also be different.

For the same purpose of interchangeability, the values in inches of diameter d_1 of the parallel shank are the exact conversions, to four decimal places, of corresponding values in millimetres, in conformity with ISO Recommendation R 237, *Diameters of shanks and sizes of driving squares for rotating tools with parallel shanks.*

3. END MILLS WITH PARALLEL SHANKS

3.1 Standard series

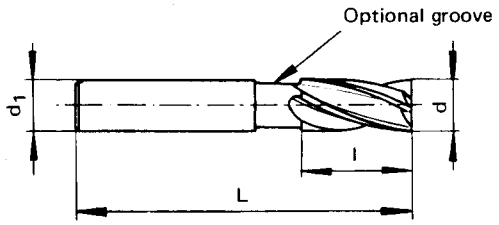

FIG. 1

TABLE 1 – **Standard series in millimetres**

Recommended dimensions in millimetres				Conversion into inches			
d j_s14	d_1 h8	l	L	d	d_1	l	L
2.00	4.0	7	39	0.079	0.1575	$\frac{9}{32}$	$1\frac{17}{32}$
2.50		8	40	0.098		$\frac{5}{16}$	$1\frac{9}{16}$
3.15*		10	42	0.124		$\frac{3}{8}$	$1\frac{5}{8}$
4.00		11	43	0.157		$\frac{7}{16}$	$1\frac{11}{16}$
5.00	5.0	13	47	0.197	0.1968	$\frac{1}{2}$	$1\frac{7}{8}$
6.30*	6.3	16	52	0.248	0.2480	$\frac{5}{8}$	$2\frac{1}{16}$
7.10*				0.279			
8.00	8.0	19	59	0.315	0.3150	$\frac{3}{4}$	$2\frac{5}{16}$
9.00				0.354			
10.00	10.0	22	67	0.394	0.3937	$\frac{7}{8}$	$2\frac{5}{8}$
11.20*				0.441			
12.50*	12.5	26	76	0.492	0.4921	1	3
14.00				0.551			
16.00	16.0	32	88	0.630	0.6299	$1\frac{1}{4}$	$3\frac{1}{2}$
18.00				0.709			
20.00	20.0	38	101	0.788	0.7874	$1\frac{1}{2}$	4
22.40*				0.882			
25.00	25.0	45	116	0.984	0.9842	$1\frac{3}{4}$	$4\frac{1}{2}$
28.00				1.102			

* In conformity with ISO Recommendation R 523, the dimensions marked with an asterisk may be replaced by more rounded values, i.e. 3 – 6 – 7 – 11 – 12 and 22 respectively.

NOTES

1. *Intermediate diameters.* Should intermediate diameters be required, refer to Table 3 for shank diameters and lengths.
2. *Tolerances.* For inch values, use a direct conversion to inches of the j_s14 and h8 metric values.
3. *Designation.* The values in millimetres in column *d* are used for the designation of these end mills.

TABLE 2 – **Standard series in inches**

Recommended dimensions in inches				Conversion into millimetres			
d	d_1	l	L	d j_s14	d_1 h8	l	L
$\frac{1}{16}$	0.1575	$\frac{9}{32}$	$1\frac{17}{32}$	1.59	4.0	7	39
$\frac{5}{64}$				1.98			
$\frac{3}{32}$		$\frac{5}{16}$	$1\frac{9}{16}$	2.38		8	40
$\frac{7}{64}$				2.78			
$\frac{1}{8}$		$\frac{3}{8}$	$1\frac{5}{8}$	3.18		10	42
$\frac{9}{64}$				3.57			
$\frac{5}{32}$		$\frac{7}{16}$	$1\frac{11}{16}$	3.97		11	43
$\frac{11}{64}$				4.37			
$\frac{3}{16}$	0.1968	$\frac{1}{2}$	$1\frac{7}{8}$	4.76	5.0	13	47
$\frac{7}{32}$				5.56			
$\frac{1}{4}$	0.2480	$\frac{5}{8}$	$2\frac{1}{16}$	6.35	6.3	16	52
$\frac{9}{32}$				7.14			
$\frac{5}{16}$	0.3150	$\frac{3}{4}$	$2\frac{5}{16}$	7.94	8.0	19	59
$\frac{11}{32}$				8.73			
$\frac{3}{8}$	0.3937	$\frac{7}{8}$	$2\frac{5}{8}$	9.52	10.0	22	67
$\frac{7}{16}$				11.11			
$\frac{1}{2}$	0.4921	1	3	12.70	12.5	26	76
$\frac{9}{16}$				14.29			
$\frac{5}{8}$	0.6299	$1\frac{1}{4}$	$3\frac{1}{2}$	15.88	16.0	32	88
$\frac{11}{16}$				17.46			
$\frac{3}{4}$	0.7874	$1\frac{1}{2}$	4	19.05	20.0	38	101
$\frac{7}{8}$				22.22			
1	0.9842	$1\frac{3}{4}$	$4\frac{1}{2}$	25.40	25.0	45	116
$1\frac{1}{8}$				28.58			

NOTES

1. *Intermediate diameters.* Should intermediate diameters be required, refer to Table 3 for shank diameters and lengths.

2. *Tolerances.* For inch values, use a direct conversion to inches of the j_s14 and h8 metric values.

3. *Designation.* The values in inches in column d are used for the designation of these end mills.

TABLE 3 – **Standard series – General table giving shank diameters and corresponding lengths in millimetres and in inches, defined with respect to cutting portion diameter ranges**

Ranges of diameters d				d_1		l		L	
from (over)	to (incl.)	from (over)	to (incl.)						
mm		in		mm	in	mm	in	mm	in
1.50	1.90	0.0591	0.0748	4.0	0.1575	7	$\frac{9}{32}$	39	$1\frac{17}{32}$
1.90	2.36	0.0748	0.0929						
2.36	3.00*	0.0929	0.1181			8	$\frac{5}{16}$	40	$1\frac{9}{16}$
3.00	3.75	0.1181	0.1476			10	$\frac{3}{8}$	42	$1\frac{5}{8}$
3.75	4.75	0.1476	0.1870			11	$\frac{7}{16}$	43	$1\frac{11}{16}$
4.75	6.00*	0.1870	0.2362	5.0	0.1968	13	$\frac{1}{2}$	47	$1\frac{7}{8}$
6.00	7.50	0.2362	0.2953	6.3	0.2480	16	$\frac{5}{8}$	52	$2\frac{1}{16}$
7.50	9.50	0.2953	0.3740	8.0	0.3150	19	$\frac{3}{4}$	59	$2\frac{5}{16}$
9.50	11.80	0.3740	0.4646	10.0	0.3937	22	$\frac{7}{8}$	67	$2\frac{5}{8}$
11.80	15.00	0.4646	0.5906	12.5	0.4921	26	1	76	3
15.00	19.00	0.5906	0.7480	16.0	0.6299	32	$1\frac{1}{4}$	88	$3\frac{1}{2}$
19.00	23.60	0.7480	0.9291	20.0	0.7874	38	$1\frac{1}{2}$	101	4
23.60	30.00	0.9291	1.1811	25.0	0.9842	45	$1\frac{3}{4}$	116	$4\frac{1}{2}$

* The limits indicated for diameter ranges in millimetres notwithstanding, end mills with cutting diameters of 3 and 6 mm (usable according to ISO Recommendation R 523 as substitutes for diameters 3.15 and 6.3 mm respectively) have the same dimensional characteristics as end mills with cutting diameters of 3.15 and 6.3 mm respectively.

NOTE. – Tables 1 and 2 give recommended diameters, in millimetres and in inches.

3.2 Long series

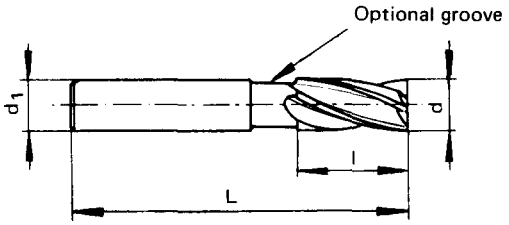

FIG. 2

TABLE 4 – Long series in millimetres

Recommended dimensions in millimetres				Conversion into inches			
d j_s14	d_1 h8	l	L	d	d_1	l	L
2.00	4.0	10	42	0.079	0.1575	$\frac{3}{8}$	$1\frac{5}{8}$
2.50		12	44	0.098		$\frac{15}{32}$	$1\frac{23}{32}$
3.15*		15	47	0.124		$\frac{19}{32}$	$1\frac{27}{32}$
4.00		19	51	0.157		$\frac{3}{4}$	2
5.00	5.0	24	58	0.197	0.1968	$\frac{15}{16}$	$2\frac{5}{16}$
6.30*	6.3	30	66	0.248	0.2480	$1\frac{3}{16}$	$2\frac{5}{8}$
7.10*				0.279			
8.00	8.0	38	78	0.315	0.3150	$1\frac{1}{2}$	$3\frac{1}{16}$
9.00				0.354			
10.00	10.0	45	90	0.394	0.3937	$1\frac{3}{4}$	$3\frac{1}{2}$
11.20*				0.441			
12.50*	12.5	53	103	0.492	0.4921	$2\frac{1}{8}$	$4\frac{1}{8}$
14.00				0.551			
16.00	16.0	63	119	0.630	0.6299	$2\frac{1}{2}$	$4\frac{3}{4}$
18.00				0.709			
20.00	20.0	75	138	0.788	0.7874	3	$5\frac{1}{2}$
22.40*				0.882			
25.00	25.0	90	161	0.984	0.9842	$3\frac{1}{2}$	$6\frac{1}{4}$
28.00				1.102			

* In conformity with ISO Recommendation R 523, the dimensions marked with an asterisk may be replaced by more rounded values, i.e. 3 – 6 – 7 – 11 – 12 and 22 respectively.

NOTES

1. *Intermediate diameters.* Should intermediate diameters be required, refer to Table 6 for shank diameters and lengths.
2. *Tolerances.* For inch values, use a direct conversion to inches of the j_s14 and the h8 metric values.
3. *Designation.* The values in millimetres in column d are used for the designation of these end mills.

TABLE 5 – Long series in inches

Recommended dimensions in inches				Conversion into millimetres			
d	d_1	l	L	d j_s14	d_1 h8	l	L
$\frac{1}{16}$	0.1575	$\frac{3}{8}$	$1\ \frac{5}{8}$	1.59	4.0	10	42
$\frac{5}{64}$				1.98			
$\frac{3}{32}$		$\frac{15}{32}$	$1\ \frac{23}{32}$	2.38		12	44
$\frac{7}{64}$				2.78			
$\frac{1}{8}$		$\frac{19}{32}$	$1\ \frac{27}{32}$	3.18		15	47
$\frac{9}{64}$				3.57			
$\frac{5}{32}$		$\frac{3}{4}$	2	3.97		19	51
$\frac{11}{64}$				4.37			
$\frac{3}{16}$	0.1968	$\frac{15}{16}$	$2\ \frac{5}{16}$	4.76	5.0	24	58
$\frac{7}{32}$				5.56			
$\frac{1}{4}$	0.2480	$1\ \frac{3}{16}$	$2\ \frac{5}{8}$	6.35	6.3	30	66
$\frac{9}{32}$				7.14			
$\frac{5}{16}$	0.3150	$1\ \frac{1}{2}$	$3\ \frac{1}{16}$	7.94	8.0	38	78
$\frac{11}{32}$				8.73			
$\frac{3}{8}$	0.3937	$1\ \frac{3}{4}$	$3\ \frac{1}{2}$	9.52	10.0	45	90
$\frac{7}{16}$				11.11			
$\frac{1}{2}$	0.4921	$2\ \frac{1}{8}$	$4\ \frac{1}{8}$	12.70	12.5	53	103
$\frac{9}{16}$				14.29			
$\frac{5}{8}$	0.6299	$2\ \frac{1}{2}$	$4\ \frac{3}{4}$	15.88	16.0	63	119
$\frac{11}{16}$				17.46			
$\frac{3}{4}$	0.7874	3	$5\ \frac{1}{2}$	19.05	20.0	75	138
$\frac{7}{8}$				22.22			
1	0.9842	$3\ \frac{1}{2}$	$6\ \frac{1}{4}$	25.40	25.0	90	161
$1\ \frac{1}{8}$				28.58			

NOTES

1. *Intermediate diameters.* Should intermediate diameters be required, refer to Table 6 for shank diameters and lengths.

2. *Tolerances.* For inch values, use a direct conversion to inches of the j_s14 and the h8 metric values.

3. *Designation.* The values in inches in column d are used for the designation of these end mills.

TABLE 6 – Long series – General table giving shank diameters and corresponding lengths in millimetres and in inches, defined with respect to cutting portion diameter ranges

Ranges of diameters d				d_1		l		L	
from (over)	to (incl.)	from (over)	to (incl.)						
mm		in		mm	in	mm	in	mm	in
1.50	1.90	0.0591	0.0748	4.0	0.1575	10	$\frac{3}{8}$	42	$1\ \frac{5}{8}$
1.90	2.36	0.0748	0.0929						
2.36	3.00*	0.0929	0.1181			12	$\frac{15}{32}$	44	$1\ \frac{23}{32}$
3.00	3.75	0.1181	0.1476			15	$\frac{19}{32}$	47	$1\ \frac{27}{32}$
3.75	4.75	0.1476	0.1870			19	$\frac{3}{4}$	51	2
4.75	6.00*	0.1870	0.2362	5.0	0.1968	24	$\frac{15}{16}$	58	$2\ \frac{5}{16}$
6.00	7.50	0.2362	0.2953	6.3	0.2480	30	$1\ \frac{3}{16}$	66	$2\ \frac{5}{8}$
7.50	9.50	0.2953	0.3740	8.0	0.3150	38	$1\ \frac{1}{2}$	78	$3\ \frac{1}{16}$
9.50	11.80	0.3740	0.4646	10.0	0.3937	45	$1\ \frac{3}{4}$	90	$3\ \frac{1}{2}$
11.80	15.00	0.4646	0.5906	12.5	0.4921	53	$2\ \frac{1}{8}$	103	$4\ \frac{1}{8}$
15.00	19.00	0.5906	0.7480	16.0	0.6299	63	$2\ \frac{1}{2}$	119	$4\ \frac{3}{4}$
19.00	23.60	0.7480	0.9291	20.0	0.7874	75	3	138	$5\ \frac{1}{2}$
23.60	30.00	0.9291	1.1811	25.0	0.9842	90	$3\ \frac{1}{2}$	161	$6\ \frac{1}{4}$

* The limits indicated for diameter ranges in millimetres notwithstanding, end mills with cutting diameters of 3 and 6 mm (usable according to ISO Recommendation R 523 as substitutes for diameters of 3.15 and 6.3 mm respectively) have the same dimensional characteristics as end mills with cutting diameters of 3.15 and 6.3 mm respectively.

NOTE. – Tables 4 and 5 give recommended diameters, in millimetres and in inches.

4. END MILLS WITH MORSE TAPER SHANKS

4.1 Standard series

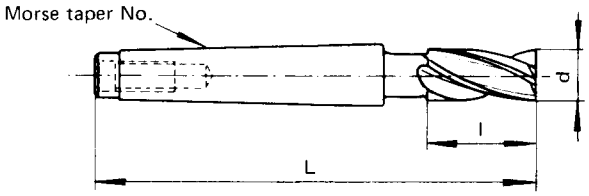

FIG. 3

TABLE 7 – **Standard series in millimetres**

Recommended dimensions in millimetres							Conversion into inches						
d j_s14	l	L, for Morse tapers					d	l	L, for Morse tapers				
		No. 1	No. 2	No. 3	No. 4	No. 5			No. 1	No. 2	No. 3	No. 4	No. 5
6.30*	16	82					0.248	$\frac{5}{8}$	$3\frac{1}{4}$				
7.10*							0.279						
8.00	19	85					0.315	$\frac{3}{4}$	$3\frac{3}{8}$				
9.00							0.354						
10.00	22	88					0.394	$\frac{7}{8}$	$3\frac{1}{2}$				
11.20*							0.441						
12.50*	26	92	108				0.492	1	$3\frac{5}{8}$	$4\frac{1}{4}$			
14.00							0.551						
16.00	32		114				0.630	$1\frac{1}{4}$		$4\frac{1}{2}$			
18.00							0.709						
20.00	38		120	137			0.788	$1\frac{1}{2}$		$4\frac{3}{4}$	$5\frac{3}{8}$		
22.40*							0.882						
25.00	45			144			0.984	$1\frac{3}{4}$			$5\frac{5}{8}$		
28.00							1.102						
31.50*	53			152	178		1.240	$2\frac{1}{8}$			6	$7\frac{1}{16}$	
35.50*							1.398						
40.00	63				188	218	1.575	$2\frac{1}{2}$				$7\frac{7}{16}$	$8\frac{11}{16}$
45.00							1.772						
50.00	75				200	230	1.968	3				$7\frac{15}{16}$	$9\frac{3}{16}$
56.00							2.205						
63.00	90					245	2.480	$3\frac{1}{2}$					$9\frac{11}{16}$

* In conformity with ISO Recommendation R 523, the dimensions marked with an asterisk may be replaced by more rounded values, i.e. 6 – 7 – 11 – 12 – 22 – 32 and 36 respectively.

NOTES

1. *Intermediate diameters.* Should intermediate diameters be required, refer to Table 9 for corresponding lengths and tapers.
2. *Tolerances.* For inch values, use a direct conversion to inches of the j_s14 metric value.
3. *Morse taper shank.* In conformity with ISO Recommendation R 296, *Self-holding tapers for tool shanks.*
4. *Designation.* The values in millimetres in column *d* are used for the designation of these end mills.

TABLE 8 – Standard series in inches

Recommended dimensions in inches							Conversion into millimetres						
d	l	L, for Morse tapers					d j_s14	l	L, for Morse tapers				
		No. 1	No. 2	No. 3	No. 4	No. 5			No. 1	No. 2	No. 3	No. 4	No. 5
$\frac{1}{4}$	$\frac{5}{8}$	$3\frac{1}{4}$					6.35	16	82				
$\frac{9}{32}$							7.14						
$\frac{5}{16}$	$\frac{3}{4}$	$3\frac{3}{8}$					7.94	19	85				
$\frac{11}{32}$							8.73						
$\frac{3}{8}$	$\frac{7}{8}$	$3\frac{1}{2}$					9.52	22	88				
$\frac{7}{16}$							11.11						
$\frac{1}{2}$	1	$3\frac{5}{8}$	$4\frac{1}{4}$				12.70	26	92	108			
$\frac{9}{16}$							14.29						
$\frac{5}{8}$	$1\frac{1}{4}$		$4\frac{1}{2}$				15.88	32		114			
$\frac{11}{16}$							17.46						
$\frac{3}{4}$	$1\frac{1}{2}$		$4\frac{3}{4}$	$5\frac{3}{8}$			19.05	38		120	137		
$\frac{7}{8}$							22.22						
1	$1\frac{3}{4}$			$5\frac{5}{8}$			25.40	45			144		
$1\frac{1}{8}$							28.58						
$1\frac{1}{4}$	$2\frac{1}{8}$			6	$7\frac{1}{16}$		31.75	53			152	178	
$1\frac{3}{8}$							34.92						
$1\frac{1}{2}$	$2\frac{1}{2}$				$7\frac{7}{16}$	$8\frac{11}{16}$	38.10	63				188	218
$1\frac{3}{4}$							44.45						
2	3				$7\frac{15}{16}$	$9\frac{3}{16}$	50.80	75				200	230

NOTES

1. *Intermediate diameters.* Should intermediate diameters be required, refer to Table 9 for corresponding lengths and tapers.

2. *Tolerances.* For inch values, use a direct conversion to inches of the j_s14 metric value.

3. *Morse taper shank.* In conformity with ISO Recommendation R 296, *Self-holding tapers for tool shanks.*

4. *Designation.* The values in inches in column d are used for the designation of these end mills.

TABLE 9 – Standard series – General table giving Morse tapers and corresponding lengths, in millimetres and in inches, defined with respect to cutting portion diameter ranges

Ranges of diameters d				l	L, in mm, for Morse tapers					l	L, in inches, for Morse tapers				
from (over)	to (incl.)	from (over)	to (incl.)		No. 1	No. 2	No. 3	No. 4	No. 5		No. 1	No. 2	No. 3	No. 4	No. 5
mm		in		mm						in					
6.00*	7.50	0.2362	0.2953	16	82					$\frac{5}{8}$	$3\frac{1}{4}$				
7.50	9.50	0.2953	0.3740	19	85					$\frac{3}{4}$	$3\frac{3}{8}$				
9.50	11.80	0.3740	0.4646	22	88					$\frac{7}{8}$	$3\frac{1}{2}$				
11.80	15.00	0.4646	0.5906	26	92	108				1	$3\frac{5}{8}$	$4\frac{1}{4}$			
15.00	19.00	0.5906	0.7480	32		114				$1\frac{1}{4}$		$4\frac{1}{2}$			
19.00	23.60	0.7480	0.9291	38		120	137			$1\frac{1}{2}$		$4\frac{3}{4}$	$5\frac{3}{8}$		
23.60	30.00	0.9291	1.1811	45			144			$1\frac{3}{4}$			$5\frac{5}{8}$		
30.00	37.50	1.1811	1.4764	53			152	178		$2\frac{1}{8}$			6	$7\frac{1}{16}$	
37.50	47.50	1.4764	1.8701	63				188	218	$2\frac{1}{2}$				$7\frac{7}{16}$	$8\frac{11}{16}$
47.50	60.00	1.8701	2.3622	75				200	230	3				$7\frac{15}{16}$	$9\frac{3}{16}$
60.00	75.00	2.3622	2.9528	90					245	$3\frac{1}{2}$					$9\frac{11}{16}$

* The limits indicated for diameter ranges in millimetres notwithstanding, the end mill with a cutting diameter of 6 mm (usable according to ISO Recommendation R 523, as a substitute for diameter of 6.3 mm) has the same dimensional characteristics as the end mill with a cutting diameter of 6.3 mm.

NOTE. – Tables 7 and 8 give recommended diameters, in millimetres and in inches.