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Tapered end mills

ICS 25.100.20

Descriptors : end mills, tapered, milling cutters

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B 4210:1997

Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of International Trade and Industry through deliberations at Japanese Industrial Standards Committee in accordance with the Industrial Standardization Law.

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Tapered end mills

Introduction This Japanese Industrial Standard has been prepared on the basis of **ISO 3940, Tapered die-sinking cutters with parallel shanks**, published as the first edition in 1977, without making any modification on the corresponding technical contents, but supplements those provisions not specified in the International Standard for the classification, shape and dimensions. Further, it supplements the items not specified in the corresponding International Standard (quality, material, test method, inspection, designation of products and marking) as Japanese Industrial Standard.

1 Scope This Standard specifies tapered end mills of which the minor diameter is over 0.95 mm up to and including 20 mm and taper half-angle is 30' to 10° (hereafter referred to as "end mill").

Remarks 1 The following standards are normative references to this Standard:

- JIS B 0021 *Indications of geometrical tolerances on drawings*
- JIS B 0172 *Glossary of terms for milling cutters*
- JIS B 0405 *General tolerances—Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*
- JIS B 0601 *Surface roughness—Definitions and designation*
- JIS B 0659 *Roughness comparison specimens*
- JIS B 1011 *Centre holes*
- JIS B 1501 *Steel balls for ball bearings*
- JIS B 4005 *Milling cutters—Parallel shanks—Dimensional characteristics*
- JIS B 7503 *Dial gauges*
- JIS B 7513 *Precision surface plates*
- JIS B 7540 *V-blocks*
- JIS B 7725 *Vickers hardness testing machines*
- JIS B 7726 *Rockwell and Rockwell superficial hardness testing machines*
- JIS G 4051 *Carbon steels for machine structural use*
- JIS G 4403 *High speed tool steels*
- JIS Z 2244 *Method of Vickers hardness test*
- JIS Z 2245 *Method of Rockwell and Rockwell superficial hardness test*

2 The International Standard corresponding to this Standard is shown below.

ISO 3940 : 1977 *Tapered die-sinking cutters with parallel shanks*

2 Definitions For the purpose of this Standard, the definitions of main terms given in **JIS B 0172** apply.

3 Classification End mills shall be classified into three types of normal types I and II and roughing type I by the use, into two types of plain cylindrical shank and flatted cylindrical shank by the shape of shank, into two types of two-flute and multi-flute by the number of cutting flutes, into two types of fsquare end end ball end by the shape of end cutting edge, and into four types of SS (stub), S (short), R (regular) and L (long) for type I and three types of S, M (medium) and L for type II by each flute length, as shown in Table 1.

Remarks 1 Multi-flute means those having cutting flutes of three pieces or more.

2 Type II means those with shape and dimensions according to ISO 3940.

Table 1 Classification

Classification					Name of type
Use	Shape of shank	Num-ber of flutes	Shape of end cutting edge	Flute length	
Normal tapered end mill type I	Plain cylindrical shank	Two-flute	Square end	SS	Two-flute tapered end mill with cylindrical shank type I-SS
				S	Two-flute tapered end mill with cylindrical shank type I-S
				R	Two-flute tapered end mill with cylindrical shank type I-R
				L	Two-flute tapered end mill with cylindrical shank type I-L
		Ball end		SS	Ball-nosed two-flute tapered end mill with cylindrical shank type I-SS
				S	Ball-nosed two-flute tapered end mill with cylindrical shank type I-S
				R	Ball-nosed two-flute tapered end mill with cylindrical shank type I-R
				L	Ball-nosed two-flute tapered end mill with cylindrical shank type I-L
		Multi-flute	Square end	SS	Multi-flute tapered end mill with cylindrical shank type I-SS
				S	Multi-flute tapered end mill with cylindrical shank type I-S
				R	Multi-flute tapered end mill with cylindrical shank type I-R
				L	Multi-flute tapered end mill with cylindrical shank type I-L
			Ball end	SS	Ball-nosed multi-flute tapered end mill with cylindrical shank type I-SS
				S	Ball-nosed multi-flute tapered end mill with cylindrical shank type I-S
				R	Ball-nosed multi-flute tapered end mill with cylindrical shank type I-R
				L	Ball-nosed multi-flute tapered end mill with cylindrical shank type I-L
	Flatted cylindrical shank	Two-flute	Square end	SS	Two-flute tapered end mill with flatted cylindrical shank type I-SS
				S	Two-flute tapered end mill with flatted cylindrical shank type I-S
				R	Two-flute tapered end mill with flatted cylindrical shank type I-R
				L	Two-flute tapered end mill with flatted cylindrical shank type I-L
		Ball end		SS	Ball nosed two-flute tapered end mill with flatted cylindrical shank type I-SS
				S	Ball nosed two-flute tapered end mill with flatted cylindrical shank type I-S
				R	Ball nosed two-flute tapered end mill with flatted cylindrical shank type I-R
				L	Ball nosed two-flute tapered end mill with flatted cylindrical shank type I-L

Table 1 (continued)

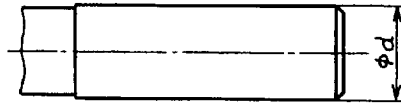
Classification					Name of type
Use	Shape of shank	Num-ber of flutes	Shape of end cut-ting edge	Flute length	
Normal tapered end mill type I	Flatted cylindrical shank	Multi-flute	Square end	SS	Multi-flute tapered end mill with flatted cylindrical shank type I-SS
				S	Multi-flute tapered end mill with flatted cylindrical shank type I-S
				R	Multi-flute tapered end mill with flatted cylindrical shank type I-R
				L	Multi-flute tapered end mill with flatted cylindrical shank type I-L
			Ball end	SS	Ball-nosed multi-flute tapered end mill with flatted cylindrical shank type I-SS
				S	Ball-nosed multi-flute tapered end mill with flatted cylindrical shank type I-S
				R	Ball-nosed multi-flute tapered end mill with flatted cylindrical shank type I-R
				L	Ball-nosed multi-flute tapered end mill with flatted cylindrical shank type I-L
Normal tapered end mill type II	Plain cylindrical shank	Two-flute	Square end	S	Two-flute tapered end mill with cylindrical shank type II-S
				M	Two-flute tapered end mill with cylindrical shank type II-M
				L	Two-flute tapered end mill with cylindrical shank type II-L
			Ball end	S	Ball nosed two-flute tapered end mill with cylindrical shank type II-S
				M	Ball nosed two-flute tapered end mill with cylindrical shank type II-M
				L	Ball nosed two-flute tapered end mill with cylindrical shank type II-L
		Multi-flute	Square end	S	Multi-flute tapered end mill with cylindrical shank type II-S
				M	Multi-flute tapered end mill with cylindrical shank type II-M
				L	Multi-flute tapered end mill with cylindrical shank type II-L
			Ball end	S	Ball-nosed multi-flute tapered end mill with cylindrical shank type II-S
				M	Ball-nosed multi-flute tapered end mill with cylindrical shank type II-M
				L	Ball-nosed multi-flute tapered end mill with cylindrical shank type II-L

Table 1 (concluded)

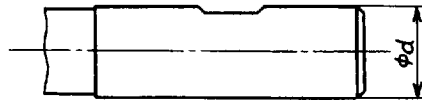
Classification					Name of type	
Use	Shape of shank	Num-ber of flutes	Shape of end cut-ting edge	Flute length		
Normal tapered end mill type II	Flatted cylindrical shank	Two-flute	Square end	S	Two-flute tapered end mill with flatted cylindrical shank type II—S	
				M	Two-flute tapered end mill with flatted cylindrical shank type II—M	
				L	Two-flute tapered end mill with flatted cylindrical shank type II—L	
			Ball end	S	Ball-nosed two-flute tapered end mill with flatted cylindrical shank type II—S	
				M	Ball-nosed two-flute tapered end mill with flatted cylindrical shank type II—M	
				L	Ball-nosed two-flute tapered end mill with flatted cylindrical shank type II—L	
		Multi-flute	Square end	S	Multi-flute tapered end mill with flatted cylindrical shank type II—S	
				M	Multi-flute tapered end mill with flatted cylindrical shank type II—M	
				L	Multi-flute tapered end mill with flatted cylindrical shank type II—L	
			Ball end	S	Ball-nosed multi-flute tapered end mill with flatted cylindrical shank type II—S	
				M	Ball-nosed multi-flute tapered end mill with flatted cylindrical shank type II—M	
				L	Ball-nosed multi-flute tapered end mill with flatted cylindrical shank type II—L	
Roughing end mill class I	Plain cylindrical shank	Multi-flute	Square end	S	Roughing multi-flute tapered end mill with cylindrical shank type I—S	
				R	Roughing multi-flute tapered end mill with cylindrical shank type I—R	
				L	Roughing multi-flute tapered end mill with cylindrical shank type I—L	
			Ball end	S	Roughing ball-nosed multi-flute tapered end mill with cylindrical shank type I—S	
				R	Roughing ball-nosed multi-flute tapered end mill with cylindrical shank type I—R	
				L	Roughing ball-nosed multi-flute tapered end mill with cylindrical shank type I—L	
			Flatted cylindrical shank	Square end	S	Roughing multi-flute tapered end mill with flatted cylindrical shank type I—S
					R	Roughing multi-flute tapered end mill with flatted cylindrical shank type I—R
					L	Roughing multi-flute tapered end mill with flatted cylindrical shank type I—L
	Ball end			S	Roughing ball-nosed multi-flute tapered end mill with flatted cylindrical shank type I—S	
				R	Roughing ball-nosed multi-flute tapered end mill with flatted cylindrical shank type I—R	
				L	Roughing ball-nosed multi-flute tapered end mill with flatted cylindrical shank type I—L	

4 Shape and dimensions The shape and dimensions shall be as given in Fig. 1, Tables 2-1 to 2-7, Fig. 2 and Tables 3-1 to 3-3.

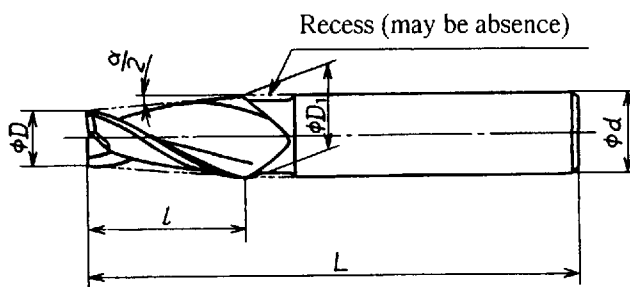
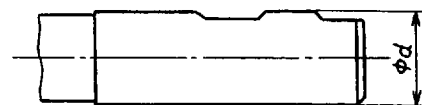
Plain cylindrical shank



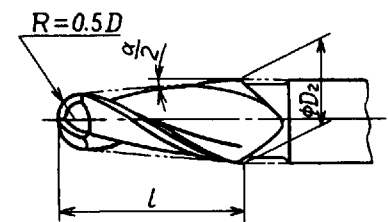
Flatted cylindrical shank single flat



Double flat

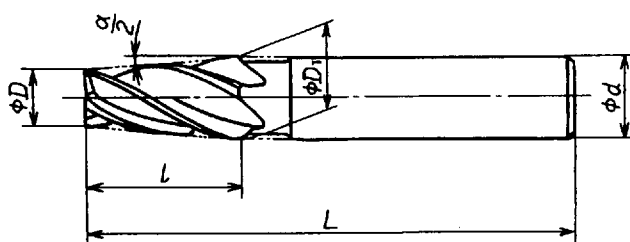


Square end

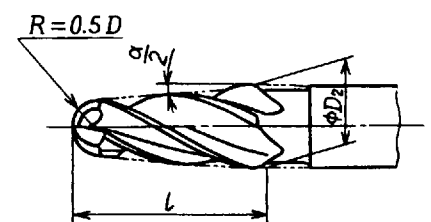


Ball end

Two-flute



Square end



Ball end

Multi-flute

Fig. 1 Shape of tapered end mill with cylindrical shank

**Table 2-1 Shape of tapered end mill with
cylindrical shank type I-SS**

Unit: mm

Taper half-angle $\alpha/2$		Shape of end cutting edge				Shank diameter d			Flute length l	Over- all length L	Informative reference		
		Square end		Ball end		Basic size	Tolerance				Major end dia.		
		Minor end dia. D		Ball radius R			Cylindrical shank h8	Flatted cylindrical shank h6			D_1	D_2	
Basic size	Toler- ance	Basic size	Tolerance js 12	Basic size	Tolerance js 13								
30°	±10'	1	±0.050	0.5	±0.070	6	0 -0.018	0 -0.008	2.5	47	1.04	1.04	
		1.6		0.8					3		1.65	1.64	
		2		1					6		50	2.11	2.09
		2.5		1.25							2.61	2.58	
		3		1.5							3.11	3.08	
		4	±0.060	2		7	51	4.12	4.09				
		5		2.5		8	52	5.14	5.10				
		6		3		8	0 -0.022	0 -0.009			6.14	6.09	
		8	±0.075	4	±0.090				10		60	8.17	8.11
		10		5					12	0 -0.027	0 -0.011		67
1°		1	±0.050	0.5	±0.070	6	0 -0.018	0 -0.008	3.5	48	1.12	1.11	
		1.6		0.8					4		1.74	1.71	
		2		1					8		52	2.28	2.25
		2.5		1.25							2.78	2.74	
		3		1.5							3.28	3.23	
		4	±0.060	2		9	53	4.31	4.25				
		5		2.5		11	55	5.38	5.30				
		6		3		8	0 -0.022	0 -0.009			6.38	6.28	
		8	±0.075	4	±0.090				10		63	8.45	8.32
		10		5					12	0 -0.027	0 -0.011		70
1°30'		1	±0.050	0.5	±0.070	6	0 -0.018	0 -0.008	3.5	48	1.18	1.16	
		1.6		0.8					4		1.81	1.77	
		2		1					8		52	2.42	2.37
		2.5		1.25							2.92	2.85	
		3		1.5							3.42	3.34	
		4	±0.060	2		9	53	4.47	4.37				
		5		2.5		11	55	5.58	5.45				
		6		3		8	0 -0.022	0 -0.009			6.68	6.42	
		8	±0.075	4	±0.090				10		63	8.68	8.47
		10		5					12	0 -0.027	0 -0.011		70

Table 2—1 (continued)

Unit: mm

Taper half-angle $\alpha/2$		Shape of end cutting edge				Shank diameter d			Flute length l	Over- all length L	Informative reference	
		Square end		Ball end		Basic size	Tolerance				Major end dia.	
		Minor end dia. D		Ball radius R			Cylindrical shank h8	Flatted cylindrical shank h6			D_1	D_2
Basic size	Toler- ance	Basic size	Tolerance js 12	Basic size	Tolerance js 13							
2°	±10'	1	±0.050	0.5	±0.070	6	0 −0.018	0 −0.008	5	49	1.35	1.32
		1.6		0.8					6	50	2.02	1.96
		2		1					10	54	2.70	2.63
		2.5		1.25							3.20	3.11
		3		1.5							3.70	3.60
		4		2					12	56	4.84	4.70
		5	±0.060	2.5		8	0 −0.022	0 −0.009	15	59	6.05	5.88
		6		3							7.05	6.84
		8	±0.075	4	±0.090	10			18	68	9.26	8.98
		10		5		12	0 −0.027	0 −0.011			75	11.26
2°30'		1	±0.050	0.5	±0.070	6	0 −0.018	0 −0.008	5	49	1.44	1.39
		1.6		0.8					6	50	2.12	2.06
		2		1					10	54	2.87	2.79
		2.5		1.25							3.37	3.27
		3		1.5							3.87	3.75
		4		2					12	56	5.05	4.88
		5	±0.060	2.5		8	0 −0.022	0 −0.009	15	59	6.31	6.10
		6		3							7.31	7.05
		8	±0.075	4	±0.090	10			18	68	9.57	9.23
		10		5		12	0 −0.027	0 −0.011			75	11.57
3°		1	±0.050	0.5	±0.070	6	0 −0.018	0 −0.008	5	49	1.52	1.47
		1.6		0.8					6	50	2.23	2.15
		2		1					10	54	3.05	2.95
		2.5		1.25							3.55	3.42
		3		1.5							4.05	3.90
		4		2					12	56	5.26	5.05
		5	±0.060	2.5		8	0 −0.022	0 −0.009	15	59	6.57	6.32
		6		3							65	7.57
		8	±0.075	4	±0.090	10			18	68	9.89	9.48
		10		5		12	0 −0.027	0 −0.011			75	11.89

Table 2-1 (concluded)

Unit: mm

Taper half-angle $\alpha/2$		Shape of end cutting edge				Shank diameter d			Flute length l	Over- all length L	Informative reference	
		Square end		Ball end		Basic size	Tolerance				Major end dia.	
		Minor end dia. D		Ball radius R			Cylindrical shank h8	Flatted cylindrical shank h6			D_1	D_2
Basic size	Toler- ance	Basic size	Tolerance js 12	Basic size	Tolerance js 13							
4°	$\pm 10'$	1	± 0.050	0.5	± 0.070	6	0 −0.018	0 −0.008	5	49	1.70	1.63
		1.6		0.8					6	50	2.44	2.33
		2		1					10	54	3.40	3.26
		2.5		1.25							3.90	3.73
		3		1.5							4.40	4.20
		4		2					12	56	5.68	5.41
		5	± 0.060	2.5	± 0.090	8	0 −0.022	0 −0.009	15	59	7.10	6.76
		6		3		10				65	8.10	7.69
		8	± 0.075	4	± 0.090	12	0 −0.027	0 −0.011	18	75	10.52	9.98
		10		5							12.52	11.84
5°	$\pm 10'$	1	± 0.050	0.5	± 0.070	6	0 −0.018	0 −0.008	5	49	1.88	1.79
		1.6		0.8					6	50	2.65	2.52
		2		1					10	54	3.75	3.58
		2.5		1.25							4.25	4.04
		3		1.5							4.75	4.50
		4		2					8	0 −0.022	0 −0.009	12
		5	± 0.060	2.5	± 0.090	10	15	59	7.63			7.21
		6		3				65	8.63			8.12
		8	± 0.075	4	± 0.090	12	0 −0.027	0 −0.011	18	75	11.15	10.48
		10		5							13.15	12.31

- Remarks 1 Tolerances of flute length, l and overall length, L shall be tolerance class c (coarse) specified in JIS B 0405.
- 2 For the center holed type, JIS B 1011 shall be applied.
- 3 The shape and dimensions of shank shall be according to type R of JIS B 4005.

Table 2-2 Shape of tapered end mill with cylindrical shank type I-S

Unit: mm

Taper half-angle $\alpha/2$		Shape of end cutting edge				Shank diameter d			Flute length l	Over-all length L	Informative reference	
		Square end		Ball end		Basic size	Tolerance				Major end dia.	
		Minor end dia. D		Ball radius R			Cylindrical shank h8	Flatted cylindrical shank h6			D_1	D_2
Basic size	Tolerance	Basic size	Tolerance js 12	Basic size	Tolerance js 13							
30°	±10'	2	±0.050	1	±0.070	6	0 -0.018	0 -0.008	10	54	2.17	2.16
		2.5		1.25							2.67	2.65
		3		1.5							3.17	3.15
		4	±0.060	2					12	56	4.21	4.18
		5		2.5					14	58	5.24	5.20
		6		3		8	0 -0.022	0 -0.009			6.24	6.19
		8	±0.075	4	±0.090	10			17	67	8.30	8.23
		10		5		12	0 -0.027	0 -0.011		74	10.30	10.21
1°		2	±0.050	1	±0.070	6	0 -0.018	0 -0.008	13	57	2.45	2.42
		2.5		1.25							2.95	2.91
		3		1.5							3.45	3.40
		4	±0.060	2					16	60	4.56	4.49
		5		2.5					19	63	5.66	5.58
		6		3		8	0 -0.022	0 -0.009			6.66	6.56
		8	±0.075	4	±0.090	10			22	72	8.77	8.63
		10		5		12	0 -0.027	0 -0.011		79	10.77	10.60
1°30'		2	±0.050	1	±0.070	6	0 -0.018	0 -0.008	13	57	2.68	2.63
		2.5		1.25							3.18	3.12
		3		1.5							3.68	3.60
		4	±0.060	2					16	60	4.84	4.73
		5		2.5					19	63	6.00	5.87
		6		3		8	0 -0.022	0 -0.009			7.00	6.84
		8	±0.075	4	±0.090	10			22	72	9.15	8.95
		10		5		12	0 -0.027	0 -0.011		79	11.15	10.89
2°		2	±0.050	1	±0.070	6	0 -0.018	0 -0.008	18	62	3.26	3.19
		2.5		1.25							3.76	3.67
		3		1.5							4.26	4.15
		4		2					21	65	5.47	5.33
		5	±0.060	2.5		8	0 -0.022	0 -0.009	25	69	6.75	6.57
		6		3							7.75	7.54
		8	±0.075	4	±0.090	12	0 -0.027	0 -0.011	30	87	10.10	9.82
		10		5							12.10	11.75