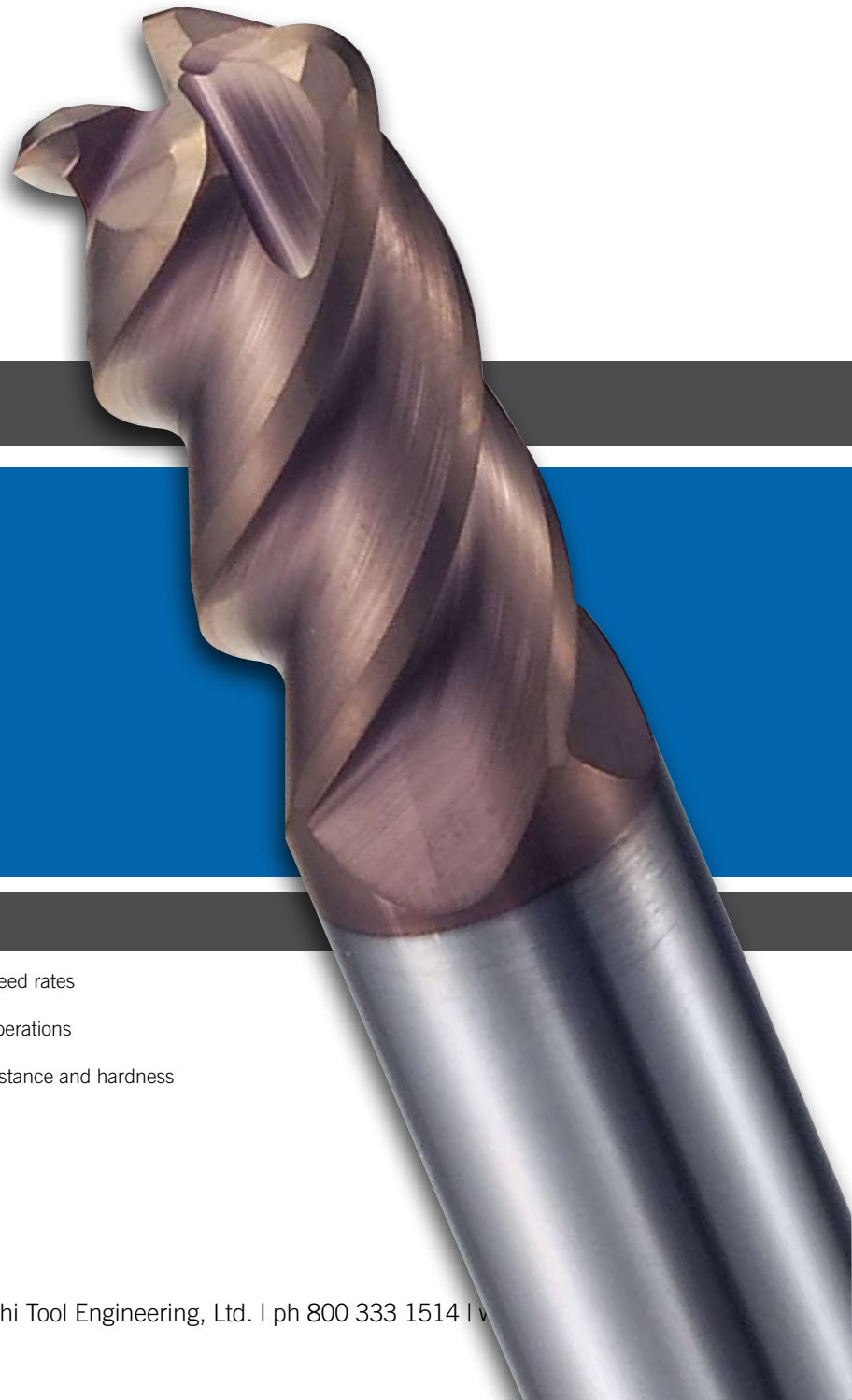


ETM



High Feed Corner Radius End Mills for Hardened Steels



FEATURES

- The unique high strength cutting radius enables high feed per tooth feed rates
- The special oval flute shape reduces vibration even in deep cutting operations
- The new nano-composite TH Coating provides extraordinary heat resistance and hardness

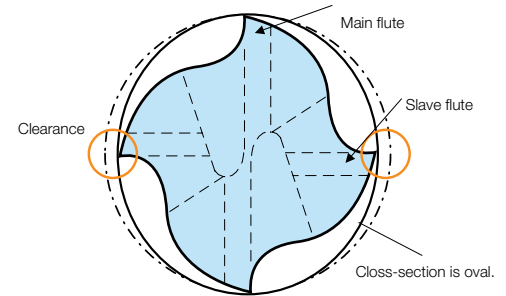
INTRODUCTION

The ETM End Mills are designed for low RPM, high-feed applications. Even though it has four flutes, it maintains sufficient chip pockets for superior chip removal at high feed rates. Roughing and semi-finishing can be performed at highly accelerated rates, improving your overall machining efficiency.

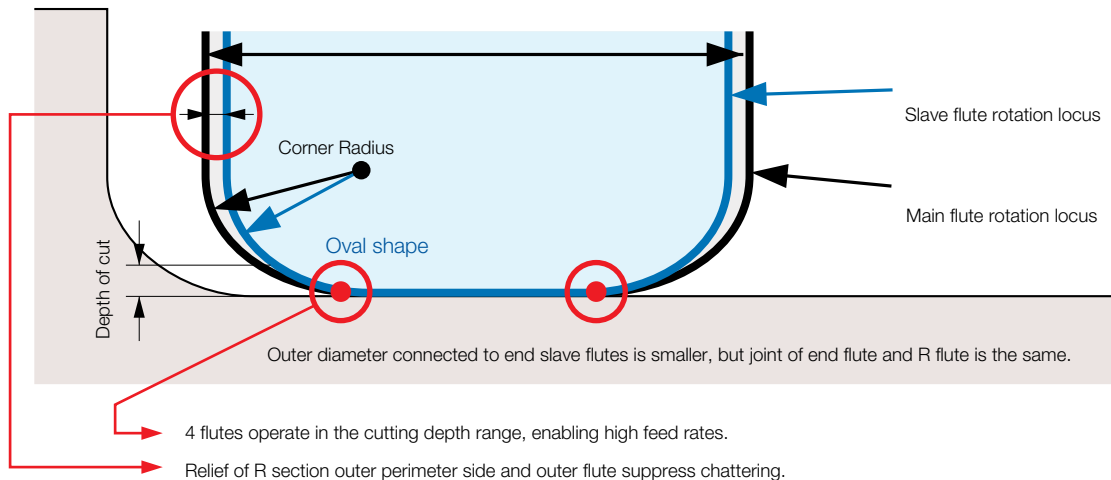
FEATURES

1. Oval Effect

To suppress chattering during deep milling or the machining of unstable corner sections, ETM end mills incorporate a “double oval” shape. The two slave flutes are shorter than the main flutes, and the cutting tool appears as an oval when viewed as a cross section.



Turbo mill axial cross-section diagram



The different cutting amounts of the main flutes and slave flutes produce two types of chips, varying the periodicity of cutting resistance and suppressing chattering. (Chattering occurs due to uniform cutting periodicity.)

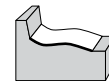
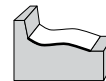
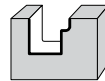
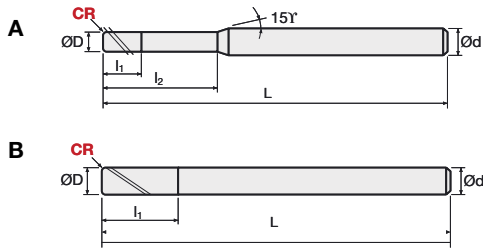


Epoch Turbo Mill



Competitor's 4 flutes Radius End Mill

ETM



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Part No.

TH Coating

Part No.	TH Coating	ØD	Corner Radius	l_2	l_1	L	Ød	Type
ETM4020-05-TH		2	0.5	6	4	70	6	A
ETM4030-08-TH		3	0.8	9	6	70	6	A
ETM4040-10-TH		4	1.0	12	8	70	6	A
ETM4050-12-TH		5	1.2	15	10	70	6	A
ETM4060-15-TH		6	1.5	-	12	90	6	B
ETM4080-20-TH		8	2.0	-	16	100	8	B
ETM4100-20-TH		10	2.0	-	20	110	10	B
ETM4120-20-TH		12	2.0	-	24	120	12	B

Helix Angle	45°
R	±0.015
D	0/-0.015
d	h5

ETM



ETM Cutting Conditions Metric



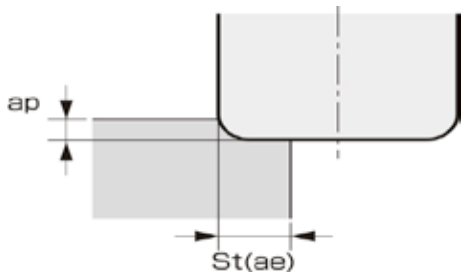
Standard Conditions (Low RPM/High Feed)

Work Materials	Cutting Conditions	Ratio to standard DOC	Mill Dia. (D) xRadius (mm)							
			2xR0.5	3xR0.8	4xR1	5xR1.2	6xR1.5	8xR2	10xR2	12x2
Cast Iron/ Carbon Steel / Alloy Steel 150 250HB	N (RPM)	1	12,000	8,000	6,000	4,800	4,000	3,000	2,400	2,000
	fz (mm/tooth)		0.11	0.19	0.27	0.33	0.42	0.56	0.7	0.8
	Vf (mm/min)		5,380	6,050	6,380	6,380	6,720	6,720	6,720	6,380
Tool Steel 25 35HRC	N (RPM)	1	11,000	7,400	5,600	4,500	3,700	2,800	2,200	1,900
	fz (mm/tooth)		0.1	0.17	0.24	0.3	0.38	0.51	0.64	0.73
	Vf (mm/min)		4,510	5,110	5,450	5,470	5,680	5,730	5,630	5,540
Pre-Hardened Steels 35 45HRC	N (RPM)	1	10,000	6,900	5,200	4,100	3,400	2,600	2,100	1,700
	fz (mm/tooth)		0.08	0.14	0.19	0.24	0.3	0.4	0.5	0.57
	Vf (mm/min)		3,200	3,730	3,950	3,900	4,080	4,160	4,200	3,880
Hardened Steels 45 55HRC	N (RPM)	0.7	8,000	5,300	4,000	3,200	2,700	2,000	1,600	1,300
	fz (mm/tooth)		0.08	0.14	0.19	0.24	0.3	0.4	0.5	0.57
	Vf (mm/min)		2,560	2,860	3,040	3,040	3,240	3,200	3,200	2,960
Hardened Steel 55 60HRC	N (RPM)	0.5	8,000	5,300	4,000	3,200	2,700	2,000	1,600	1,300
	fz (mm/tooth)		0.03	0.05	0.08	0.1	0.12	0.16	0.2	0.23
	Vf (mm/min)		1,020	1,140	1,220	1,220	1,300	1,280	1,280	1,190

High Speed Conditions (High RPM/High Feed)

Work Materials	Cutting Conditions	Ratio to standard DOC	Mill Dia. (D) xRadius (mm)							
			2xR0.5	3xR0.8	4xR1	5xR1.2	6xR1.5	8xR2	10xR2	12x2
Cast Iron/ Carbon Steel / Alloy Steel 150 250HB	N (RPM)	0.8	20,000	13,300	9,900	8,000	6,600	5,000	4,000	3,300
	fz (mm/tooth)		0.11	0.19	0.27	0.33	0.42	0.56	0.7	0.8
	Vf (mm/min)		8,960	10,050	10,530	10,640	11,090	11,200	11,200	10,530
Tool Steel 25 35HRC	N (RPM)	0.8	18,000	11,700	8,800	7,000	5,800	4,400	3,500	2,900
	fz (mm/tooth)		0.1	0.17	0.24	0.3	0.38	0.51	0.64	0.73
	Vf (mm/min)		7,370	8,090	8,560	8,510	8,910	9,010	8,960	8,460
Pre-Hardened Steels 35 45HRC	N (RPM)	0.7	16,000	10,600	8,000	6,400	5,300	4,000	3,200	2,700
	fz (mm/tooth)		0.08	0.14	0.19	0.24	0.3	0.4	0.5	0.57
	Vf (mm/min)		5,120	5,720	6,080	6,080	6,360	6,400	6,400	6,160
Hardened Steels 45 55HRC	N (RPM)	0.6	12,700	8,500	6,400	5,100	4,200	3,200	2,500	2,100
	fz (mm/tooth)		0.08	0.14	0.19	0.24	0.3	0.4	0.5	0.57
	Vf (mm/min)		4,060	4,590	4,860	4,850	5,040	5,120	5,000	4,790
Hardened Steel 55 60HRC	N (RPM)	0.4	11,100	7,400	5,600	4,500	3,700	2,800	2,200	1,900
	fz (mm/tooth)		0.03	0.05	0.08	0.1	0.12	0.16	0.2	0.23
	Vf (mm/min)		1,420	1,600	1,700	1,710	1,780	1,790	1,760	1,730

Ratio to Depth of Cut and Projection



St Step over
St Radius at end (Mill Dia 2)-Radius (mm)
ap Table below

Ratio to Projection	ap Step down	Ratio to Projection	ap Step down
5D or less	0.3xR xRatio to standard depth of cut	8D	0.23xR xRatio to standard depth of cut
6D	0.27xR xRatio to standard depth of cut	9D	0.19xR xRatio to standard depth of cut
7D	0.25xR xRatio to standard depth of cut	10D	0.15xR xRatio to standard depth of cut

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ETM Cutting Conditions Metric



Large Depth of Cut Low RPM Large Depth of Cut

Work Materials	Cutting Conditions	Ratio to standard DOC	Mill Dia. (D) xRadius (mm)							
			2xR0.5	3xR0.8	4xR1	5xR1.2	6xR1.5	8xR2	10xR2	12x2
Cast Iron/ Carbon Steel / Alloy Steel 150 250HB	N (RPM)	2	12,000	8,000	6,000	4,800	4,000	3,000	2,400	2,000
	fz (mm/tooth)		0.05	0.09	0.12	0.15	0.19	0.26	0.32	0.36
	Vf (mm/min)		2,460	2,760	2,920	2,920	3,070	3,070	3,070	2,920
Tool Steel 25 35HRC	N (RPM)	1.8	11,000	7,400	5,600	4,500	3,700	2,800	2,200	1,900
	fz (mm/tooth)		0.05	0.08	0.11	0.14	0.18	0.24	0.3	0.34
	Vf (mm/min)		2,110	2,400	2,550	2,570	2,660	2,690	2,640	2,600
Pre-Hardened Steels 35 45HRC	N (RPM)	1.6	10,000	6,900	5,200	4,100	3,400	2,600	2,100	1,700
	fz (mm/tooth)		0.04	0.07	0.1	0.12	0.15	0.2	0.25	0.29
	Vf (mm/min)		1,600	1,860	1,980	1,950	2,040	2,080	2,100	1,940
Hardened Steels 45 55HRC	N (RPM)	1.2	8,000	5,300	4,000	3,200	2,700	2,000	1,600	1,300
	fz (mm/tooth)		0.04	0.07	0.1	0.12	0.15	0.2	0.25	0.29
	Vf (mm/min)		1,280	1,430	1,520	1,520	1,620	1,600	1,600	1,480
Hardened Steel 55 60HRC	N (RPM)	0.7	8,000	5,300	4,000	3,200	2,700	2,000	1,600	1,300
	fz (mm/tooth)		0.02	0.03	0.05	0.06	0.07	0.1	0.12	0.14
	Vf (mm/min)		610	690	730	730	780	770	770	710

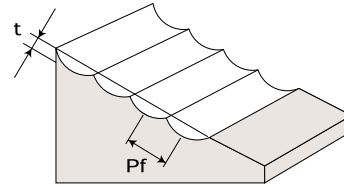
High Speed Conditions High RPM High Feed

Work Materials	Cutting Conditions	Ratio to standard DOC	Mill Dia. (D) xRadius (mm)							
			2xR0.5	3xR0.8	4xR1	5xR1.2	6xR1.5	8xR2	10xR2	12x2
Cast Iron/ Carbon Steel / Alloy Steel 150 250HB	N (RPM)	1	15,000	10,100	7,600	6,000	5,000	3,800	3,000	2,500
	fz (mm/tooth)		0.09	0.15	0.21	0.26	0.32	0.43	0.54	0.62
	Vf (mm/min)		5,180	5,890	6,240	6,160	6,480	6,570	6,480	6,160
Tool Steel 25 35HRC	N (RPM)	1	14,000	9,500	7,200	5,700	4,800	3,600	2,900	2,400
	fz (mm/tooth)		0.08	0.13	0.18	0.23	0.29	0.38	0.48	0.55
	Vf (mm/min)		4,300	4,920	5,250	5,200	5,530	5,530	5,570	5,250
Pre-Hardened Steels 35 45HRC	N (RPM)	1	14,000	9,000	6,800	5,400	4,500	3,400	2,700	2,300
	fz (mm/tooth)		0.06	0.1	0.14	0.18	0.23	0.3	0.38	0.43
	Vf (mm/min)		3,400	3,690	3,930	3,900	4,100	4,130	4,100	3,990
Hardened Steels 45 55HRC	N (RPM)	0.7	10,300	6,900	5,200	4,100	3,400	2,600	2,100	1,700
	fz (mm/tooth)		0.06	0.09	0.13	0.17	0.21	0.28	0.35	0.4
	Vf (mm/min)		2,310	2,610	2,770	2,730	2,860	2,910	2,940	2,710
Hardened Steel 55 60HRC	N (RPM)	0.5	9,500	6,400	4,800	3,800	3,200	2,400	1,900	1,600
	fz (mm/tooth)		0.02	0.04	0.06	0.07	0.09	0.12	0.15	0.17
	Vf (mm/min)		910	1,040	1,090	1,080	1,150	1,150	1,140	1,090

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ETM Cutting Conditions Metric



$t=0.05\text{mm}\sim 0.1\text{mm}$
 $Pf=0.1R$

Finishing

Mill Dia. (D) x Radius (mm)

Work Materials	Cutting Conditions	Mill Dia. (D) x Radius (mm)							
		2xR0.5	3xR0.8	4xR1	5xR1.2	6xR1.5	8xR2	10xR2	12x2
Cast Iron/ Carbon Steel / Alloy Steel 150 250HB	N (RPM)	29,000	19,100	14,300	11,500	9,500	7,200	5,700	4,800
	fz (mm/tooth)	0.02	0.03	0.04	0.05	0.06	0.08	0.1	0.11
	Vf (mm/min)	1,860	2,060	2,170	2,190	2,280	2,300	2,280	2,190
Tool Steel 25 35HRC	N (RPM)	24,000	15,900	11,900	9,500	8,000	6,000	4,800	4,000
	fz (mm/tooth)	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09
	Vf (mm/min)	1,230	1,370	1,450	1,440	1,540	1,540	1,540	1,460
Pre-Hardened Steels 35 45HRC	N (RPM)	19,000	12,700	9,500	7,600	6,400	4,800	3,800	3,200
	fz (mm/tooth)	0.01	0.02	0.02	0.03	0.04	0.05	0.06	0.07
	Vf (mm/min)	730	820	870	870	920	920	910	880
Hardened Steels 45 55HRC	N (RPM)	14,300	9,500	7,200	5,700	4,800	3,600	2,900	2,400
	fz (mm/tooth)	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06
	Vf (mm/min)	460	510	550	540	580	580	580	550
Hardened Steel 55 60HRC	N (RPM)	11,100	7,400	5,600	4,500	3,700	2,800	2,200	1,900
	fz (mm/tooth)	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05
	Vf (mm/min)	280	320	340	340	360	360	350	350