MOLDINO
The Edge To Innovation

Small-diameter deep-cutting corner radius end mill for high-efficient machining

ETR(P)-TH, ETM(LN/P)-TH

Epoch Turbo Rib & Epoch Turbo Mill

MOLDINO Tool Engineering, Ltd.
New Product News | No.0801E-15 | 2023-11

From now on, deep cutting is ...

Deeper!! From electrodischarge machining to direct machining

Faster!! To higher-efficient direct machining

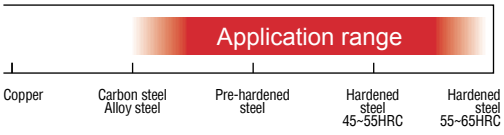
Features of ETR(P)-TH

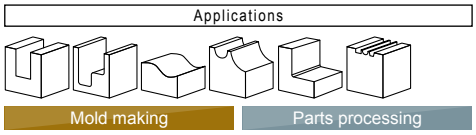
Small-diameter deep-cutting corner radius end mill for high-efficient machining
responds to demands for shortening mold delivery times.

Deeper **Neck shape of Deep Series has proven results for deep machining.**

Faster **Flute shape of Turbo Mills has proven results for high-efficient machining.**

Strong support for electrodischargeless direct machining!

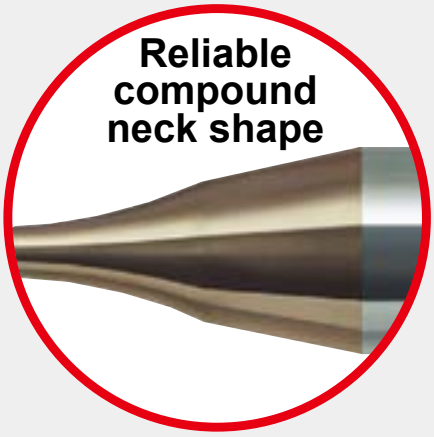




ETR-TH	φ1～φ3	[44 Items]
ETRP-TH	φ1～φ3	[49 Items]
ETM-TH	φ2～φ20	[10 Items]
ETMLN-TH	φ4～φ16	[16 Items]
ETMP-TH	φ2～φ16	[25 Items]

Features 01 Compound neck shape

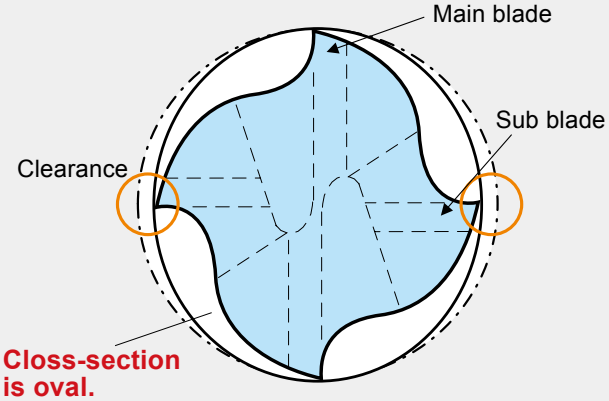
The compound neck shape with results proven by the Epoch Deep Series is used.
Breakage resistance is improved even for end mills with long below-neck lengths, so that stable deep machining can be performed.



Features 02 Oval effect

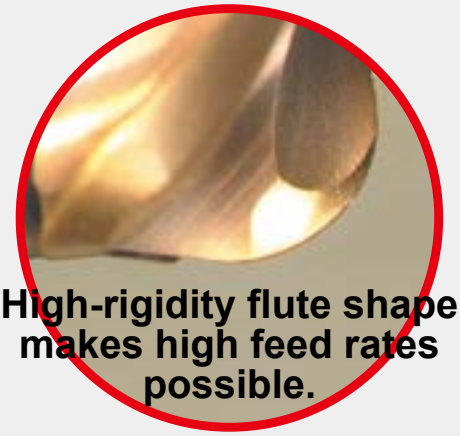
The flute cross-section is the oval shape with results proven by Epoch Turbo Mills.
It suppresses vibrations, particularly when machining corner areas, so that stable high-efficient cutting can be performed.

Reliable oval shape



Features 03 High-rigidity flute shape

The corner R flute shape used is the same chipping-resistant high-rigidity flute type by Epoch Turbo Mills. Because of this, machining with high per-flute feed amounts is possible and high-efficient machining can be achieved.



High-rigidity flute shape makes high feed rates possible.

Features 04 TH Coating

New PVD Nano Technology

Epoch Super Coating TH

- A newly developed nanocomposite coating material that achieves unprecedented withstand temperatures and provides higher hardness through the use of a new structure made up of nanocrystal material.
- Enables high-quality machining with long life of hardened steel
(45 to 65HRC), pre-hardened steel, etc.

Quick lookup table for tools (Tool dia./Under neck length: ℓ_2)

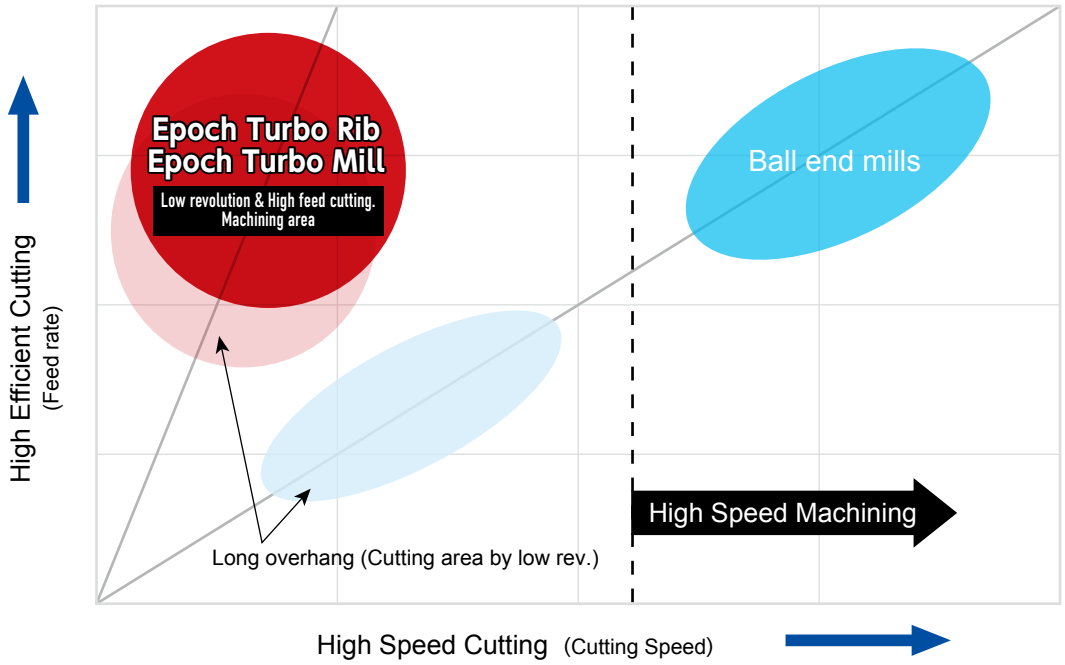
(mm)

φ1.0			φ1.25			φ1.5			φ1.75			φ2			φ2.5			φ3		
LU	Straight	Pencil	LU	Straight	Pencil	LU	Straight	Pencil	LU	Straight	Pencil	LU	Straight	Pencil	LU	Straight	Pencil	LU	Straight	Pencil
2.5			2.5			2.5			2.5			2.5			2.5			2.5		
5	●	●	5	●		5	●		5			5	●(6)		5			5		
7.5	●	●	7.5			7.5			7.5			7.5			7.5			7.5	●(9)	
10	●	●	10	●	●	10	●	●	10	●	●	10	●		10	●		10	●	
12.5	●		12.5			12.5			12.5			12.5		●(12)	12.5			12.5		
15	●	●	15	●	●	15	●	●	15		●	15	●	●	15			15		
17.5	●		17.5			17.5			17.5			17.5		●(16)	17.5			17.5		●(18)
20	●	●	20	●	●	20	●	●	20	●	●	20	●	●●	20	●	●	20	●	●
22.5	●		22.5			22.5			22.5			22.5			22.5			22.5		
25	●	●	25	●		25	●		25			25	●	●	25			25		●(24)
27.5	●		27.5			27.5			27.5			27.5			27.5			27.5		
30	●	●	30	●	●	30	●	●	30	●	●	30	●	●	30	●	●	30	●	●●
32.5			32.5			32.5			32.5			32.5			32.5			32.5		
35		●	35			35			35			35	●	●	35			35		
37.5			37.5			37.5			37.5			37.5			37.5			37.5		
40		●	40		●	40		●	40	●	●	40	●	●	40	●	●	40	●	●
42.5			42.5			42.5			42.5			42.5			42.5			42.5		
45		●	45			45			45			45		●	45			45		
47.5			47.5			47.5			47.5			47.5			47.5			47.5		
50		●	50		●	50		●	50		●	50		●	50	●	●	50	●	●
52.5			52.5			52.5			52.5			52.5			52.5			52.5		
55			55			55			55			55		●	55			55		
57.5			57.5			57.5			57.5			57.5			57.5			57.5		
60			60			60			60			60		●	60		●	60		●
62.5			62.5			62.5			62.5			62.5			62.5			62.5		

※For items larger than φ4, refer to catalog pages 10 and 11.

● : indicates Turbo Mill lineup. ( ) shows Under neck length.

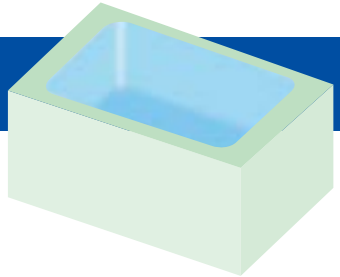
Overview diagram of cutting regions for Epoch Turbo Rib and Turbo Mill



Epoch Turbo Rib and Turbo Mill enable high-efficient machining even at low rotation speeds.

Comparison with high-speed cutting (Ball End Mill)

Cutting examples for Epoch Turbo Mill low-speed, high-feed-rate tools



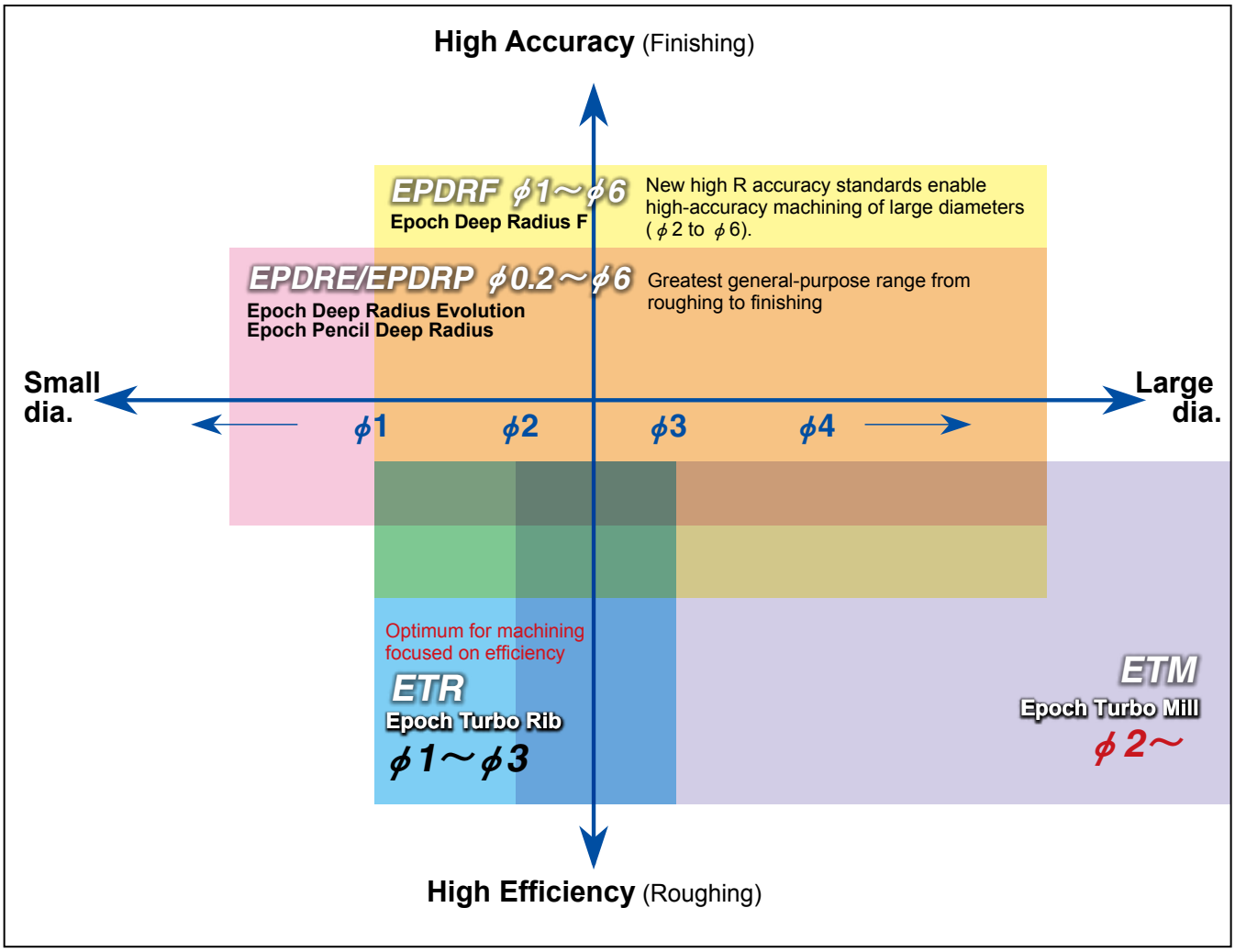
Tool ： ϕ10 Ball End Mill vs Turbo Mill
Machine ：Vertical M/C HSK-A63
Work ：DAC(45HRC)
Shape ：80mm×120mm×Depth 45mm, Incline angle 3°

※The values in the table are the measured values of the cutting test conducted in our company.

	High Speed Ball End Mill	Low speed, high feed ETM4100-20-TH
Cutting condition	n=7,500min^{-1} (v_c=236m/min) v_f=2,300mm/min (f_z=0.15mm/t) a_p×a_e=0.8mm×2.4mm	n=2,500min^{-1} (v_c=79m/min) v_f=5,000mm/min (f_z=0.5mm/t) a_p×a_e=0.42mm×3mm
Metal removal rate	Q=4.42cm^3/min	Q=6.3cm^3/min
Cutting time	49min. 43sec.	38min. 1sec.
Power consumption(w) (Power consumed per hour)	**4.71kw**	**3.79kw (20% reduction)**
Power consumption amount(wh) (Power quantity used)	**3.9kwh**	**2.4kwh (38% reduction)**

Using Turbo Mills reduces electrical power consumption by 38%!
Low rotation speeds can reduce electrical power consumption.

Positioning of small-diameter deep-cutting Corner R End Mills



Requests for Epoch Turbo Rib & Turbo Mill's re-grinding and re-coating are also accepted.

Reproduces accuracy and performance equivalent to a new product.

Recycling kills two birds with one stone by reducing costs and being environmentally friendly.

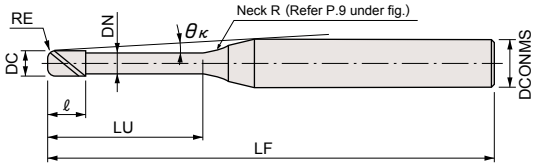
- Regrinding of the oval shape to be equivalent to that of new products is possible, without changing the tool diameter of course.
- Regrinding and recoating is performed according to processing knowhow and design standards based on new products.
- Since reprocessing is performed under the same environment using the same processing software, coating, and quality control mechanisms as when manufacturing new products, accuracy and tool life equivalent to that of new products can be reproduced.
- Although flute length is shorter when reprocessing is performed, on the other hand rigidity is a benefit.

Line Up, Epoch Turbo Rib

Straight Neck type

Tolerance on RE : ±0.01

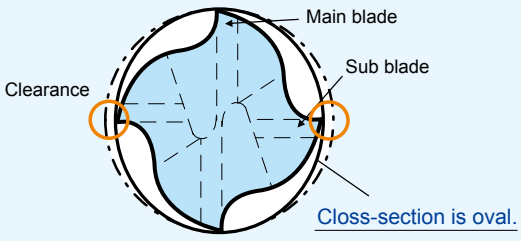
Tolerance on Shank : h5



ETR4○○○○-○○-○○-TH

Item code	Stock	Size (mm)									The effective under-neck length for the various draft angles				
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.	Neck R	Interference angle					
		DC	RE	LU	ℓ	DN	LF	DCONMS		θκ	0.5°	1°	1.5°	2°	3°
ETR4010-5-02-TH	●	1	0.2	5	1	0.94	50	6	4	8.52	5.79	6.01	6.21	6.38	6.75
ETR4010-7.5-02-TH	●			7.5	1	0.94	50	6	4	7.42	8.39	8.68	8.91	9.11	10.07
ETR4010-10-02-TH	●			10	1	0.94	50	6	4	6.58	10.98	11.32	11.58	12.09	13.39
ETR4010-12.5-02-TH	●			12.5	1	0.94	60	6	4	5.90	13.57	13.94	14.38	15.08	16.71
ETR4010-15-02-TH	●			15	1	0.94	60	6	4	5.35	16.15	16.55	17.24	18.07	20.03
ETR4010-17.5-02-TH	●			17.5	1	0.94	60	6	4	4.90	18.72	19.20	20.09	21.07	23.35
ETR4010-20-02-TH	●			20	1	0.94	60	6	4	4.51	21.29	21.92	22.94	24.06	26.66
ETR4010-22.5-02-TH	●			22.5	1	0.94	70	6	4	4.19	23.85	24.64	25.79	27.05	29.98
ETR4010-25-02-TH	●			25	1	0.94	70	6	4	3.90	26.41	27.37	28.64	30.04	33.30
ETR4010-27.5-02-TH	●			27.5	1	0.94	70	6	4	3.65	28.97	30.09	31.49	33.03	36.62
ETR4010-30-02-TH	●			30	1	0.94	70	6	4	3.44	31.52	32.82	34.34	36.02	39.94
ETR40125-5-02-TH	●	1.25	0.2	5	1.25	1.18	50	6	4	8.38	5.81	6.03	6.22	6.39	6.79
ETR40125-10-02-TH	●			10	1.25	1.18	50	6	4	6.42	11.00	11.33	11.59	12.12	13.42
ETR40125-15-02-TH	●			15	1.25	1.18	60	6	4	5.20	16.16	16.56	17.26	18.10	20.06
ETR40125-20-02-TH	●			20	1.25	1.18	60	6	4	4.37	21.30	21.95	22.97	24.09	26.69
ETR40125-25-02-TH	●			25	1.25	1.18	70	6	4	3.77	26.42	27.39	28.67	30.07	33.33
ETR40125-30-02-TH	●			30	1.25	1.18	70	6	4	3.31	31.54	32.84	34.37	36.05	39.97
ETR4015-5-03-TH	●	1.5	0.3	5	1.5	1.42	50	6	4	8.28	5.83	6.05	6.23	6.40	6.79
ETR4015-10-03-TH	●			10	1.5	1.42	50	6	4	6.28	11.02	11.34	11.60	12.13	13.42
ETR4015-15-03-TH	●			15	1.5	1.42	60	6	4	5.05	16.18	16.57	17.28	18.11	20.06
ETR4015-20-03-TH	●			20	1.5	1.42	60	6	4	4.23	21.31	21.96	22.98	24.09	26.69
ETR4015-25-03-TH	●			25	1.5	1.42	70	6	4	3.63	26.43	27.41	28.68	30.08	33.33
ETR4015-30-03-TH	●			30	1.5	1.42	70	6	4	3.19	31.55	32.86	34.38	36.06	39.97
ETR40175-10-03-TH	●	1.75	0.3	10	1.75	1.65	50	6	4	6.09	11.06	11.37	11.63	12.18	13.48
ETR40175-20-03-TH	●			20	1.75	1.65	60	6	4	4.07	21.34	22.01	23.03	24.15	26.76
ETR40175-30-03-TH	●			30	1.75	1.65	70	6	4	3.05	31.57	32.91	34.44	36.12	40.03
ETR40175-40-03-TH	●			40	1.75	1.65	80	6	4	2.44	41.94	43.80	45.84	48.08	No interference
ETR4020-10-05-TH	●	2	0.5	10	2	1.92	50	6	4	5.98	11.01	11.33	11.59	12.09	13.36
ETR4020-15-05-TH	●			15	2	1.92	60	6	4	4.75	16.17	16.56	17.25	18.07	19.99
ETR4020-20-05-TH	●			20	2	1.92	60	6	4	3.94	21.31	21.95	22.95	24.06	26.63
ETR4020-25-05-TH	●			25	2	1.92	70	6	4	3.36	26.43	27.39	28.65	30.04	33.27
ETR4020-30-05-TH	●			30	2	1.92	70	6	4	2.93	31.54	32.84	34.36	36.02	No interference
ETR4020-35-05-TH	●			35	2	1.92	80	6	4	2.60	36.67	38.29	40.06	42.00	No interference
ETR4020-40-05-TH	●			40	2	1.92	80	6	4	2.34	41.88	43.73	45.76	47.99	No interference
ETR4025-10-05-TH	●	2.5	0.5	10	2.5	2.4	50	6	4	5.57	11.05	11.36	11.61	12.15	13.42
ETR4025-20-05-TH	●			20	2.5	2.4	60	6	4	3.59	21.34	22.00	23.00	24.11	26.69
ETR4025-30-05-TH	●			30	2.5	2.4	70	6	4	2.64	31.57	32.89	34.41	36.08	No interference
ETR4025-40-05-TH	●			40	2.5	2.4	80	6	4	2.09	41.93	43.79	45.81	48.04	No interference
ETR4025-50-05-TH	●			50	2.5	2.4	90	6	4	1.73	52.36	54.68	57.22	No interference	No interference
ETR4030-10-08-TH	●	3	0.8	10	3	2.86	50	6	4	5.17	11.12	11.40	11.66	12.20	13.45
ETR4030-20-08-TH	●			20	3	2.86	60	6	4	3.23	21.39	22.07	23.07	24.17	26.72
ETR4030-30-08-TH	●			30	3	2.86	70	6	4	2.35	31.61	32.97	34.47	36.13	No interference
ETR4030-40-08-TH	●			40	3	2.86	80	6	4	1.85	42.02	43.86	45.88	No interference	No interference
ETR4030-50-08-TH	●			50	3	2.86	90	6	4	1.52	52.45	54.76	57.28	No interference	No interference

Attention



Be careful of the newly developed flute shape when measuring tool diameter or run out.

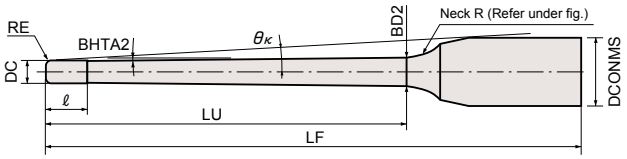
The tool is designed with a smaller outer diameter connected to end sub blades. When measuring tool diameter or run out, measure the main blades.

● : Stocked items.

Pencil Neck type

Tolerance on RE : ±0.01

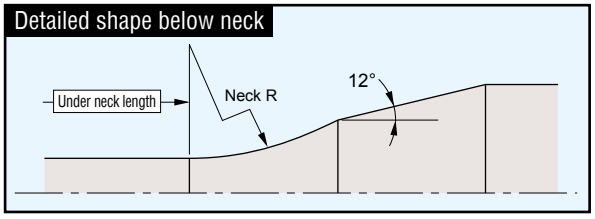
Tolerance on Shank : h5



ETRP4○○○○-○○-○○○○-TH

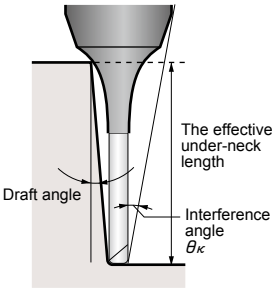
Item code	Stock	Size (mm)										The effective under-neck length for the various draft angles				
		Tool dia.	Corner radius	Under neck length	Neck angle	Flute length	Under neck dia.	Overall length	Shank dia.	Neck R	Interference angle					
		DC	RE	LU	BHTA2	ℓ	BD2	LF	DCONMS		θκ	0°	1°	1.5°	2°	3°
ETRP4010-5-0902-TH	●	1	0.2	5	0.9	1	1.066	60	6	4	8.67	2.91	5.70	5.96	6.17	6.51
ETRP4010-7.5-0902-TH	●			7.5	0.9	1	1.144	60	6	7	7.61	2.91	8.50	8.97	9.34	9.93
ETRP4010-10-0902-TH	●			10	0.9	1	1.223	60	6	7	6.78	2.91	11.04	11.60	12.03	12.70
ETRP4010-15-0902-TH	●			15	0.9	1	1.380	60	6	10	5.57	2.91	16.35	17.25	17.89	18.89
ETRP4010-20-0902-TH	●			20	0.9	1	1.537	70	6	10	4.72	2.91	21.42	22.49	23.22	24.80
ETRP4010-25-0902-TH	●			25	0.9	1	1.694	70	6	10	4.10	2.91	26.49	27.70	28.52	30.95
ETRP4010-30-0902-TH	●			30	0.9	1	1.851	80	6	10	3.62	2.91	31.55	32.90	33.79	37.09
ETRP4010-35-0902-TH	●			35	0.9	1	2.008	80	6	10	3.24	2.91	36.61	38.08	39.03	43.24
ETRP4010-40-0902-TH	●			40	0.9	1	2.165	90	6	10	2.94	2.91	41.67	43.25	44.54	No interference
ETRP4010-45-0902-TH	●			45	0.9	1	2.322	90	6	10	2.68	2.91	46.73	48.41	50.08	No interference
ETRP4010-50-0902-TH	●			50	0.9	1	2.480	100	6	10	2.47	2.91	51.78	53.56	55.62	No interference
ETRP40125-10-0902-TH	●	1.25	0.2	10	0.9	1.25	1.455	60	6	7	6.62	3.47	11.10	11.65	12.06	12.73
ETRP40125-15-0902-TH	●			15	0.9	1.25	1.612	60	6	10	5.41	3.47	16.42	17.29	17.92	18.91
ETRP40125-20-0902-TH	●			20	0.9	1.25	1.769	70	6	10	4.57	3.47	21.49	22.52	23.25	24.86
ETRP40125-30-0902-TH	●			30	0.9	1.25	2.083	80	6	10	3.49	3.47	31.61	32.93	33.81	37.15
ETRP40125-40-0902-TH	●			40	0.9	1.25	2.397	90	6	10	2.82	3.47	41.73	43.28	44.59	No interference
ETRP40125-50-0902-TH	●			50	0.9	1.25	2.712	100	6	10	2.37	3.47	51.83	53.59	55.67	No interference
ETRP4015-10-0903-TH	●	1.5	0.3	10	0.9	1.5	1.687	60	6	7	6.47	4.04	11.15	11.67	12.08	12.74
ETRP4015-15-0903-TH	●			15	0.9	1.5	1.844	60	6	7	5.26	4.04	16.21	16.89	17.40	18.73
ETRP4015-20-0903-TH	●			20	0.9	1.5	2.001	70	6	10	4.43	4.04	21.54	22.55	23.27	24.88
ETRP4015-30-0903-TH	●			30	0.9	1.5	2.315	80	6	10	3.36	4.04	31.66	32.95	33.83	37.17
ETRP4015-40-0903-TH	●			40	0.9	1.5	2.630	90	6	10	2.71	4.04	41.77	43.30	44.62	No interference
ETRP4015-50-0903-TH	●			50	0.9	1.5	2.944	100	6	10	2.27	4.04	51.88	53.60	55.70	No interference
ETRP40175-10-0903-TH	●	1.75	0.3	10	0.9	1.75	1.909	60	6	7	6.28	4.93	11.24	11.74	12.13	12.77
ETRP40175-15-0903-TH	●			15	0.9	1.75	2.066	60	6	7	5.07	4.93	16.29	16.95	17.44	18.82
ETRP40175-20-0903-TH	●			20	0.9	1.75	2.223	70	6	10	4.26	4.93	21.64	22.61	23.32	24.97
ETRP40175-30-0903-TH	●			30	0.9	1.75	2.538	80	6	10	3.22	4.93	31.75	33.00	33.86	37.26
ETRP40175-40-0903-TH	●			40	0.9	1.75	2.852	90	6	10	2.59	4.93	41.86	43.34	44.70	No interference
ETRP40175-50-0903-TH	●			50	0.9	1.75	3.166	100	6	10	2.16	4.93	51.95	53.64	55.78	No interference
ETRP4020-15-0905-TH	●	2	0.5	15	0.9	2	2.328	60	6	7	4.95	4.54	16.23	16.91	17.40	18.72
ETRP4020-20-0905-TH	●			20	0.9	2	2.486	70	6	7	4.12	4.54	21.29	22.10	22.67	24.86
ETRP4020-25-0905-TH	●			25	0.9	2	2.643	70	6	10	3.54	4.54	26.63	27.77	28.57	31.01
ETRP4020-30-0905-TH	●			30	0.9	2	2.800	80	6	10	3.1	4.54	31.69	32.96	33.83	37.16
ETRP4020-35-0905-TH	●			35	0.9	2	2.957	80	6	10	2.75	4.54	36.75	38.14	39.09	No interference
ETRP4020-40-0905-TH	●			40	0.9	2	3.114	90	6	10	2.48	4.54	41.80	43.31	44.63	No interference
ETRP4020-45-0905-TH	●			45	0.9	2	3.271	90	6	10	2.25	4.54	46.85	48.46	50.17	No interference
ETRP4020-50-0905-TH	●			50	0.9	2	3.428	100	6	10	2.07	4.54	51.90	53.61	55.71	No interference
ETRP4020-55-0905-TH	●			55	0.9	2	3.585	100	6	10	1.91	4.54	56.95	58.75	No interference	No interference
ETRP4020-60-0905-TH	●			60	0.9	2	3.742	110	6	10	1.77	4.54	62.00	63.89	No interference	No interference
ETRP4025-20-0905-TH	●	2.5	0.5	20	0.9	2.5	2.950	70	6	7	3.76	5.68	21.39	22.16	22.72	24.98
ETRP4025-30-0905-TH	●			30	0.9	2.5	3.264	80	6	10	2.79	5.68	31.80	33.02	33.88	No interference
ETRP4025-40-0905-TH	●			40	0.9	2.5	3.578	90	6	10	2.22	5.68	41.90	43.36	44.73	No interference
ETRP4025-50-0905-TH	●			50	0.9	2.5	3.892	100	6	10	1.85	5.68	52.00	53.66	No interference	No interference
ETRP4025-60-0905-TH	●			60	0.9	2.5	4.207	110	6	10	1.58	5.68	62.09	63.93	No interference	No interference
ETRP4030-20-0908-TH	●	3	0.8	20	0.9	3	3.394	70	6	7	3.39	7.45	21.50	22.22	22.76	25.05
ETRP4030-30-0908-TH	●			30	0.9	3	3.708	80	6	7	2.49	7.45	31.59	32.54	33.74	No interference
ETRP4030-40-0908-TH	●			40	0.9	3	4.022	90	6	10	1.96	7.45	42.03	43.42	No interference	No interference
ETRP4030-50-0908-TH	●			50	0.9	3	4.337	100	6	10	1.62	7.45	52.12	53.72	No interference	No interference
ETRP4030-60-0908-TH	●			60	0.9	3	4.651	110	6	10	1.37	7.45	62.20	No interference	No interference	No interference

Detailed shape below neck



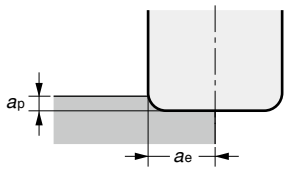
【Note】

If the workpiece has draft angle, the interference length will be longer than the under-neck length.Please refer to the effective under-neck length for the various draft angles.
In addition, the angle at which the tool will interfere with the workpiece is shown as the "interference angle θκ", and should also be referred to.



Recommended Cutting Condition, Epoch Turbo Rib

Straight Neck type ETR



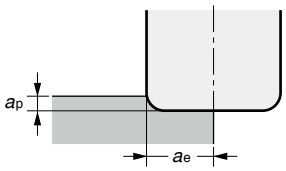
Work material		Cast irons, Carbon steels, Alloy steels (150～250HB) FC S50C SCM				Tool steels (25～35HRC) SKD				Pre-hardened steels (35～45HRC) NAK80 CENA1				Hardened steels (45～55HRC) SKD61 SKT4				Hardened steels (55～60HRC) SKD11 SKH51			
Tool dia. mm	Under neck length mm	Revolution min^{-1}	Feed rate mm/min	a_p mm	a_e mm	Revolution min^{-1}	Feed rate mm/min	a_p mm	a_e mm	Revolution min^{-1}	Feed rate mm/min	a_p mm	a_e mm	Revolution min^{-1}	Feed rate mm/min	a_p mm	a_e mm	Revolution min^{-1}	Feed rate mm/min	a_p mm	a_e mm
1	05	32,000	5,820	0.040	0.50	27,100	4,510	0.040	0.50	22,300	2,900	0.032	0.50	19,100	2,480	0.020	0.50	15,900	830	0.012	0.50
	07.5	32,000	5,820	0.027	0.50	27,100	4,510	0.027	0.50	22,300	2,900	0.021	0.50	19,100	2,480	0.013	0.50	15,900	830	0.008	0.50
	10	32,000	5,820	0.020	0.50	27,100	4,510	0.020	0.50	22,300	2,900	0.016	0.50	19,100	2,480	0.010	0.50	15,900	830	0.006	0.50
	12.5	28,800	5,240	0.016	0.50	24,400	4,060	0.016	0.50	20,100	2,610	0.013	0.50	17,200	2,230	0.008	0.50	14,300	750	0.005	0.50
	15	28,800	5,240	0.013	0.50	24,400	4,060	0.013	0.50	20,100	2,610	0.011	0.50	17,200	2,230	0.007	0.50	14,300	750	0.004	0.50
	17.5	25,600	4,660	0.011	0.50	21,700	3,610	0.011	0.50	17,800	2,320	0.009	0.50	15,300	1,980	0.006	0.50	12,700	660	0.003	0.50
	20	25,600	4,660	0.010	0.50	21,700	3,610	0.010	0.50	17,800	2,320	0.008	0.50	15,300	1,980	0.005	0.50	12,700	660	0.003	0.50
	22.5	22,400	4,070	0.009	0.50	19,000	3,160	0.009	0.50	15,600	2,030	0.007	0.50	13,400	1,740	0.004	0.50	11,100	580	0.003	0.50
	25	22,400	4,070	0.008	0.50	19,000	3,160	0.008	0.50	15,600	2,030	0.006	0.50	13,400	1,740	0.004	0.50	11,100	580	0.002	0.50
	27.5	19,200	3,490	0.007	0.50	16,300	2,710	0.007	0.50	13,400	1,740	0.006	0.50	11,500	1,490	0.004	0.50	9,500	500	0.002	0.50
	30	19,200	3,490	0.007	0.50	16,300	2,710	0.007	0.50	13,400	1,740	0.005	0.50	11,500	1,490	0.003	0.50	9,500	500	0.002	0.50
1.25	05	25,000	6,130	0.063	0.62	21,600	4,840	0.063	0.62	17,800	3,120	0.050	0.62	15,300	2,680	0.031	0.62	12,700	890	0.019	0.62
	10	25,000	6,130	0.031	0.62	21,600	4,840	0.031	0.62	17,800	3,120	0.025	0.62	15,300	2,680	0.016	0.62	12,700	890	0.009	0.62
	15	22,500	5,520	0.021	0.62	19,400	4,360	0.021	0.62	16,000	2,810	0.017	0.62	13,800	2,410	0.010	0.62	11,400	800	0.006	0.62
	20	20,000	4,900	0.016	0.62	17,300	3,870	0.016	0.62	14,200	2,500	0.013	0.62	12,200	2,140	0.008	0.62	10,200	710	0.005	0.62
	25	20,000	4,900	0.013	0.62	17,300	3,870	0.013	0.62	14,200	2,500	0.010	0.62	12,200	2,140	0.006	0.62	10,200	710	0.004	0.62
	30	17,500	4,290	0.010	0.62	15,100	3,390	0.010	0.62	12,500	2,180	0.008	0.62	10,700	1,880	0.005	0.62	8,900	620	0.003	0.62
1.5	05	21,000	6,620	0.090	0.75	18,000	5,180	0.090	0.75	14,900	3,350	0.072	0.75	12,700	2,860	0.045	0.75	10,600	950	0.027	0.75
	10	21,000	6,620	0.045	0.75	18,000	5,180	0.045	0.75	14,900	3,350	0.036	0.75	12,700	2,860	0.023	0.75	10,600	950	0.014	0.75
	15	21,000	6,620	0.030	0.75	18,000	5,180	0.030	0.75	14,900	3,350	0.024	0.75	12,700	2,860	0.015	0.75	10,600	950	0.009	0.75
	20	18,900	5,960	0.023	0.75	16,200	4,660	0.023	0.75	13,400	3,020	0.018	0.75	11,400	2,570	0.011	0.75	9,500	860	0.007	0.75
	25	16,800	5,300	0.018	0.75	14,400	4,140	0.018	0.75	11,900	2,680	0.014	0.75	10,200	2,290	0.009	0.75	8,500	760	0.005	0.75
	30	16,800	5,300	0.015	0.75	14,400	4,140	0.015	0.75	11,900	2,680	0.012	0.75	10,200	2,290	0.008	0.75	8,500	760	0.005	0.75
1.75	10	18,000	7,060	0.061	0.87	15,500	5,560	0.061	0.87	12,700	3,560	0.049	0.87	10,900	3,050	0.031	0.87	9,100	1,020	0.018	0.87
	20	16,200	6,350	0.031	0.87	14,000	5,000	0.031	0.87	11,400	3,200	0.025	0.87	9,800	2,750	0.015	0.87	8,200	920	0.009	0.87
	30	14,400	5,650	0.020	0.87	12,400	4,450	0.020	0.87	10,200	2,850	0.016	0.87	8,700	2,440	0.010	0.87	7,300	820	0.006	0.87
	40	12,600	4,940	0.015	0.87	10,900	3,890	0.015	0.87	8,900	2,490	0.012	0.87	7,600	2,140	0.008	0.87	6,400	710	0.005	0.87
2	10	16,000	7,620	0.080	1.00	13,500	5,880	0.080	1.00	11,100	3,770	0.064	1.00	9,500	3,230	0.040	1.00	8,000	1,090	0.024	1.00
	15	16,000	7,620	0.053	1.00	13,500	5,880	0.053	1.00	11,100	3,770	0.043	1.00	9,500	3,230	0.027	1.00	8,000	1,090	0.016	1.00
	20	16,000	7,620	0.040	1.00	13,500	5,880	0.040	1.00	11,100	3,770	0.032	1.00	9,500	3,230	0.020	1.00	8,000	1,090	0.012	1.00
	25	14,400	6,860	0.032	1.00	12,200	5,290	0.032	1.00	10,000	3,390	0.026	1.00	8,600	2,910	0.016	1.00	7,200	980	0.010	1.00
	30	14,400	6,860	0.027	1.00	12,200	5,290	0.027	1.00	10,000	3,390	0.021	1.00	8,600	2,910	0.013	1.00	7,200	980	0.008	1.00
	35	12,800	6,100	0.023	1.00	10,800	4,700	0.023	1.00	8,900	3,020	0.018	1.00	7,600	2,580	0.011	1.00	6,400	870	0.007	1.00
	40	12,800	6,100	0.020	1.00	10,800	4,700	0.020	1.00	8,900	3,020	0.016	1.00	7,600	2,580	0.010	1.00	6,400	870	0.006	1.00
2.5	10	13,000	8,190	0.125	1.25	10,800	6,220	0.125	1.25	8,900	4,010	0.100	1.25	7,600	3,420	0.063	1.25	6,400	1,150	0.038	1.25
	20	13,000	8,190	0.063	1.25	10,800	6,220	0.063	1.25	8,900	4,010	0.050	1.25	7,600	3,420	0.031	1.25	6,400	1,150	0.019	1.25
	30	11,700	7,370	0.042	1.25	9,700	5,600	0.042	1.25	8,000	3,610	0.033	1.25	6,800	3,080	0.021	1.25	5,800	1,040	0.013	1.25
	40	10,400	6,550	0.031	1.25	8,600	4,980	0.031	1.25	7,100	3,210	0.025	1.25	6,100	2,740	0.016	1.25	5,100	920	0.009	1.25
	50	10,400	6,550	0.025	1.25	8,600	4,980	0.025	1.25	7,100	3,210	0.020	1.25	6,100	2,740	0.013	1.25	5,100	920	0.008	1.25
3	10	10,600	8,460	0.180	1.40	9,000	6,570	0.180	1.40	7,400	4,220	0.144	1.40	6,400	3,650	0.090	1.40	5,300	1,210	0.054	1.40
	20	10,600	8,460	0.090	1.40	9,000	6,570	0.090	1.40	7,400	4,220	0.072	1.40	6,400	3,650	0.045	1.40	5,300	1,210	0.027	1.40
	30	10,600	8,460	0.060	1.40	9,000	6,570	0.060	1.40	7,400	4,220	0.048	1.40	6,400	3,650	0.030	1.40	5,300	1,210	0.018	1.40
	40	9,540	7,610	0.045	1.40	8,100	5,910	0.045	1.40	6,700	3,800	0.036	1.40	5,800	3,290	0.023	1.40	4,800	1,090	0.014	1.40
	50	8,480	6,770	0.036	1.40	7,200	5,260	0.036	1.40	5,900	3,380	0.029	1.40	5,100	2,920	0.018	1.40	4,200	970	0.011	1.40

【Note】

① Use a machine having as high rigidity and high accuracy as possible.
② Use the appropriate coolant for the work material and machining shape.
③ The cutting conditions shown in this table are intended as general criteria and should be adjusted according to the cutting shape, purpose, machine used, etc.
④ If the rotation speed of the machine is insufficient, reduce the rotation speed and feed rate by the same ratios.
⑤ For cutting in, set the ramp introduction angle to 1° and set the feed rate to 60 to 70% of the above values.
⑥ In the case of using tools with L/D = 15 or more length from the first process, in order to suppress the chattering vibration of the tools and stabilize the cutting, it is recommended to make suitable guides by using short neck type or ball end mills.

Pencil Neck type

ETRP

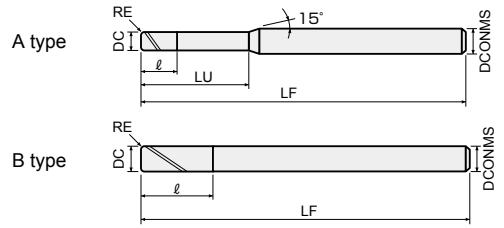


Work material		Cast irons, Carbon steels, Alloy steels (150～250HB) FC S50C SCM				Tool steels (25～35HRC) SKD				Pre-hardened steels (35～45HRC) NAK80 CENA1				Hardened steels (45～55HRC) SKD61 SKT4				Hardened steels (55～60HRC) SKD11 SKH51			
Tool dia. mm	Under neck length mm	Revolution min-1	Feed rate mm/min	ap mm	ae mm	Revolution min-1	Feed rate mm/min	ap mm	ae mm	Revolution min-1	Feed rate mm/min	ap mm	ae mm	Revolution min-1	Feed rate mm/min	ap mm	ae mm	Revolution min-1	Feed rate mm/min	ap mm	ae mm
1	5	32,000	5,820	0.060	0.50	27,100	4,510	0.060	0.50	22,300	2,900	0.048	0.50	19,100	2,480	0.030	0.50	15,900	830	0.018	0.50
	7.5	32,000	5,820	0.045	0.50	27,100	4,510	0.045	0.50	22,300	2,900	0.036	0.50	19,100	2,480	0.023	0.50	15,900	830	0.013	0.50
	10	32,000	5,820	0.030	0.50	27,100	4,510	0.030	0.50	22,300	2,900	0.024	0.50	19,100	2,480	0.015	0.50	15,900	830	0.009	0.50
	15	28,800	5,240	0.020	0.50	24,400	4,060	0.020	0.50	20,100	2,610	0.016	0.50	17,200	2,230	0.010	0.50	14,300	750	0.006	0.50
	20	28,800	5,240	0.015	0.50	24,400	4,060	0.015	0.50	20,100	2,610	0.012	0.50	17,200	2,230	0.008	0.50	14,300	750	0.005	0.50
	25	25,600	4,660	0.012	0.50	21,700	3,610	0.012	0.50	17,800	2,320	0.010	0.50	15,300	1,980	0.006	0.50	12,700	660	0.004	0.50
	30	24,000	4,370	0.010	0.50	20,300	3,380	0.010	0.50	16,700	2,180	0.008	0.50	14,300	1,860	0.005	0.50	11,900	620	0.003	0.50
	35	22,400	4,070	0.009	0.50	19,000	3,160	0.009	0.50	15,600	2,030	0.007	0.50	13,400	1,740	0.004	0.50	11,100	580	0.003	0.50
	40	20,800	3,780	0.008	0.50	17,600	2,930	0.008	0.50	14,500	1,890	0.006	0.50	12,400	1,610	0.004	0.50	10,300	540	0.002	0.50
	45	19,200	3,490	0.007	0.50	16,300	2,710	0.007	0.50	13,400	1,740	0.005	0.50	11,500	1,490	0.003	0.50	9,500	500	0.002	0.50
	50	16,000	2,910	0.006	0.50	13,600	2,260	0.006	0.50	11,200	1,450	0.005	0.50	9,600	1,240	0.003	0.50	8,000	420	0.002	0.50
1.25	10	25,000	6,130	0.047	0.62	21,600	4,840	0.047	0.62	17,800	3,120	0.038	0.62	15,300	2,680	0.023	0.62	12,700	890	0.014	0.62
	15	23,800	5,830	0.035	0.62	20,500	4,600	0.035	0.62	16,900	2,965	0.029	0.62	14,550	2,545	0.018	0.62	12,050	845	0.011	0.62
	20	22,500	5,520	0.023	0.62	19,400	4,360	0.023	0.62	16,000	2,810	0.019	0.62	13,800	2,410	0.012	0.62	11,400	800	0.007	0.62
	30	20,000	4,900	0.016	0.62	17,300	3,870	0.016	0.62	14,200	2,500	0.013	0.62	12,200	2,140	0.008	0.62	10,200	710	0.005	0.62
	40	17,500	4,290	0.012	0.62	15,100	3,390	0.012	0.62	12,500	2,180	0.009	0.62	10,700	1,880	0.006	0.62	8,900	620	0.004	0.62
	50	16,300	3,980	0.009	0.62	14,000	3,150	0.009	0.62	11,600	2,030	0.008	0.62	9,900	1,740	0.005	0.62	8,300	580	0.003	0.62
1.5	10	21,000	6,620	0.068	0.75	18,000	5,180	0.068	0.75	14,900	3,350	0.054	0.75	12,700	2,860	0.034	0.75	10,600	950	0.020	0.75
	15	21,000	6,620	0.051	0.75	18,000	5,180	0.051	0.75	14,900	3,350	0.041	0.75	12,700	2,860	0.026	0.75	10,600	950	0.015	0.75
	20	18,900	5,960	0.034	0.75	16,200	4,660	0.034	0.75	13,400	3,020	0.027	0.75	11,400	2,570	0.017	0.75	9,500	860	0.010	0.75
	30	18,900	5,960	0.023	0.75	16,200	4,660	0.023	0.75	13,400	3,020	0.018	0.75	11,400	2,570	0.011	0.75	9,500	860	0.007	0.75
	40	15,800	4,970	0.017	0.75	13,500	3,890	0.017	0.75	11,200	2,510	0.014	0.75	9,500	2,150	0.008	0.75	8,000	710	0.005	0.75
	50	14,700	4,630	0.014	0.75	12,600	3,630	0.014	0.75	10,400	2,350	0.011	0.75	8,900	2,000	0.007	0.75	7,400	670	0.004	0.75
1.75	10	18,000	7,060	0.092	0.87	15,500	5,560	0.092	0.87	12,700	3,560	0.074	0.87	10,900	3,050	0.046	0.87	9,100	1,020	0.028	0.87
	15	18,000	7,060	0.069	0.87	15,500	5,560	0.069	0.87	12,700	3,560	0.056	0.87	10,900	3,050	0.035	0.87	9,100	1,020	0.021	0.87
	20	16,200	6,350	0.046	0.87	14,000	5,000	0.046	0.87	11,400	3,200	0.037	0.87	9,800	2,750	0.023	0.87	8,200	920	0.014	0.87
	30	16,200	6,350	0.031	0.87	14,000	5,000	0.031	0.87	11,400	3,200	0.025	0.87	9,800	2,750	0.015	0.87	8,200	920	0.009	0.87
	40	14,400	5,650	0.023	0.87	12,400	4,450	0.023	0.87	10,200	2,850	0.018	0.87	8,700	2,440	0.011	0.87	7,300	820	0.007	0.87
	50	13,500	5,300	0.018	0.87	11,600	4,170	0.018	0.87	9,500	2,670	0.015	0.87	8,200	2,290	0.009	0.87	6,800	770	0.006	0.87
2	15	16,000	7,620	0.080	1.00	13,500	5,880	0.080	1.00	11,100	3,770	0.064	1.00	9,500	3,230	0.040	1.00	8,000	1,090	0.024	1.00
	20	16,000	7,620	0.060	1.00	13,500	5,880	0.060	1.00	11,100	3,770	0.048	1.00	9,500	3,230	0.030	1.00	8,000	1,090	0.018	1.00
	25	14,400	6,860	0.048	1.00	12,200	5,290	0.048	1.00	10,000	3,390	0.038	1.00	8,600	2,910	0.024	1.00	7,200	980	0.014	1.00
	30	14,400	6,860	0.040	1.00	12,200	5,290	0.040	1.00	10,000	3,390	0.032	1.00	8,600	2,910	0.020	1.00	7,200	980	0.012	1.00
	35	14,400	6,860	0.034	1.00	12,200	5,290	0.034	1.00	10,000	3,390	0.027	1.00	8,600	2,910	0.017	1.00	7,200	980	0.010	1.00
	40	14,400	6,860	0.030	1.00	12,200	5,290	0.030	1.00	10,000	3,390	0.024	1.00	8,600	2,910	0.015	1.00	7,200	980	0.009	1.00
	45	12,800	6,100	0.027	1.00	10,800	4,700	0.027	1.00	8,900	3,020	0.021	1.00	7,600	2,580	0.013	1.00	6,400	870	0.008	1.00
	50	12,800	6,100	0.024	1.00	10,800	4,700	0.024	1.00	8,900	3,020	0.019	1.00	7,600	2,580	0.012	1.00	6,400	870	0.007	1.00
	55	12,000	5,720	0.022	1.00	10,100	4,410	0.022	1.00	8,300	2,830	0.017	1.00	7,100	2,420	0.011	1.00	6,000	820	0.007	1.00
	60	12,000	5,720	0.020	1.00	10,100	4,410	0.020	1.00	8,300	2,830	0.016	1.00	7,100	2,420	0.010	1.00	6,000	820	0.006	1.00
2.5	20	13,000	8,190	0.094	1.25	10,800	6,220	0.094	1.25	8,900	4,010	0.075	1.25	7,600	3,420	0.047	1.25	6,400	1,150	0.028	1.25
	30	11,700	7,370	0.063	1.25	9,700	5,600	0.063	1.25	8,000	3,610	0.050	1.25	6,800	3,080	0.031	1.25	5,800	1,040	0.019	1.25
	40	11,700	7,370	0.047	1.25	9,700	5,600	0.047	1.25	8,000	3,610	0.038	1.25	6,800	3,080	0.023	1.25	5,800	1,040	0.014	1.25
	50	11,700	7,370	0.038	1.25	9,700	5,600	0.038	1.25	8,000	3,610	0.030	1.25	6,800	3,080	0.019	1.25	5,800	1,040	0.011	1.25
	60	10,400	6,550	0.031	1.25	8,600	4,980	0.031	1.25	7,100	3,210	0.025	1.25	6,100	2,740	0.016	1.25	5,100	920	0.009	1.25
3	20	10,600	8,460	0.135	1.40	9,000	6,570	0.135	1.40	7,400	4,220	0.108	1.40	6,400	3,650	0.068	1.40	5,300	1,210	0.041	1.40
	30	10,600	8,460	0.090	1.40	9,000	6,570	0.090	1.40	7,400	4,220	0.072	1.40	6,400	3,650	0.045	1.40	5,300	1,210	0.027	1.40
	40	9,500	7,610	0.068	1.40	8,100	5,910	0.068	1.40	6,700	3,800	0.054	1.40	5,800	3,290	0.034	1.40	4,800	1,090	0.020	1.40
	50	9,500	7,610	0.054	1.40	8,100	5,910	0.054	1.40	6,700	3,800	0.043	1.40	5,800	3,290	0.027	1.40	4,800	1,090	0.016	1.40
	60	9,500	7,610	0.045	1.40	8,100	5,910	0.045	1.40	6,700	3,800	0.036	1.40	5,800	3,290	0.023	1.40	4,800	1,090	0.014	1.40

Line Up, Epoch Turbo Mill

Straight Neck type

Tolerance on RE : ±0.015　　Tolerance on shank : h5

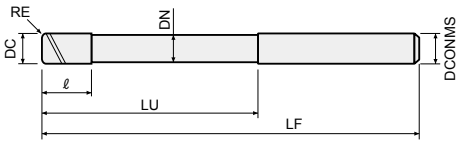


ETM4○○○-○○-TH

Item code	Stock	Size (mm)						Shape
		Tool dia.	Corner radius	Under neck length	Flute length	Overall length	Shank dia.	
		DC	RE	LU	ℓ	LF	DCONMS	
ETM4020-05-TH	●	2	0.5	6	4	70	6	A
ETM4030-08-TH	●	3	0.8	9	6	70	6	
ETM4040-10-TH	●	4	1.0	12	8	70	6	
ETM4050-12-TH	●	5	1.2	15	10	70	6	
ETM4060-15-TH	●	6	1.5	—	12	90	6	B
ETM4080-20-TH	●	8	2.0	—	16	100	8	
ETM4100-20-TH	●	10	2.0	—	20	110	10	
ETM4120-20-TH	●	12	2.0	—	24	120	12	
ETM4160-30-TH	●	16	3.0	—	32	140	16	
ETM4200-30-TH	●	20	3.0	—	40	150	20	

Long Neck type

Tolerance on RE : ±0.015　　Tolerance on shank : h5



ETMLN4○○○-○○○-○○-TH

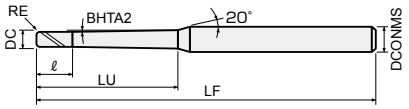
Item code	Stock	Size (mm)						
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.
		DC	RE	LU	ℓ	DN	LF	DCONMS
ETMLN4040-20-10-TH	●	4	1.0	20	6	3.8	70	4
ETMLN4040-28-10-TH	●			28	6	3.8	70	4
ETMLN4060-30-15-TH	●	6	1.5	30	9	5.7	75	6
ETMLN4060-42-15-TH	●			42	9	5.7	90	6
ETMLN4060-54-15-TH	●			54	9	5.7	100	6
ETMLN4080-40-20-TH	●	8	2.0	40	12	7.6	85	8
ETMLN4080-56-20-TH	●			56	12	7.6	100	8
ETMLN4080-72-20-TH	●			72	12	7.6	120	8
ETMLN4100-50-20-TH	●	10	2.0	50	15	9.5	100	10
ETMLN4100-70-20-TH	●			70	15	9.5	120	10
ETMLN4100-90-20-TH	●			90	15	9.5	140	10
ETMLN4120-60-20-TH	●	12	2.0	60	18	11.5	110	12
ETMLN4120-84-20-TH	●			84	18	11.5	135	12
ETMLN4120-108-20-TH	●			108	18	11.5	160	12
ETMLN4160-80-30-TH	●	16	3.0	80	24	15.5	140	16
ETMLN4160-120-30-TH	●			120	24	15.5	175	16

● : Stocked items.

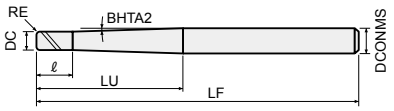
Pencil Neck type

Tolerance on RE : ±0.015　　Tolerance on shank : h5

A type



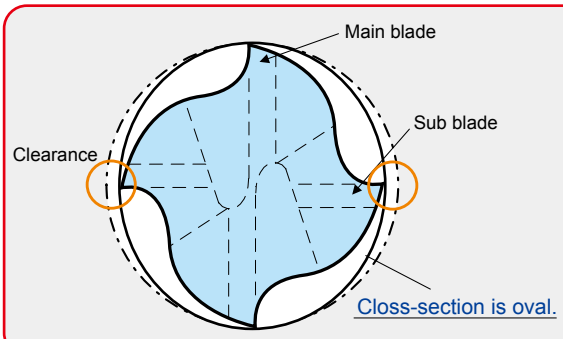
B type



ETMP4○○○-○○○-○○-TH

Item code	Stock	Size (mm)							Shape
		Tool dia.	Corner radius	Under neck length	Flute length	Neck angle	Overall length	Shank dia.	
		DC	RE	LU	ℓ	BHTA2	LF	DCONMS	
ETMP4020-12-05-TH	●	2	0.5	12	3	1°	70	6	A
ETMP4020-16-05-TH	●			16	3	1°	70	6	A
ETMP4020-20-05-TH	●			20	3	1°	70	6	A
ETMP4030-18-08-TH	●	3	0.8	18	4.5	1°	80	6	A
ETMP4030-24-08-TH	●			24	4.5	1°	80	6	A
ETMP4030-30-08-TH	●			30	4.5	1°	80	6	A
ETMP4040-24-10-TH	●	4	1.0	24	6	1°	90	6	A
ETMP4040-32-10-TH	●			32	6	1°	90	6	A
ETMP4040-40-10-TH	●			40	6	1°	90	6	A
ETMP4050-30-12-TH	●	5	1.2	30	7.5	1°	90	6	A
ETMP4050-40-12-TH	●			40	7.5	1°	100	8	A
ETMP4050-50-12-TH	●			50	7.5	1°	110	8	A
ETMP4060-40-15-TH	●	6	1.5	40	9	1°	100	8	A
ETMP4060-55-15-TH	●			55	9	1°	110	8	A
ETMP4060-67-15-TH	●			67	9	1°	125	8	B
ETMP4080-55-20-TH	●	8	2.0	55	12	1°	110	10	A
ETMP4080-70-20-TH	●			70	12	1°	130	10	B
ETMP4080-90-20-TH	●			90	12	1°	145	12	A
ETMP4100-73-20-TH	●	10	2.0	73	15	1°	135	12	B
ETMP4100-95-20-TH	●			95	15	1°	150	16	A
ETMP4100-115-20-TH	●			115	15	1°	170	16	A
ETMP4120-80-20-TH	●	12	2.0	80	18	1°	135	16	A
ETMP4120-105-20-TH	●			105	18	1°	160	16	A
ETMP4160-105-30-TH	●	16	3.0	105	24	1°	160	20	A
ETMP4160-140-30-TH	●			140	24	1°	200	20	B

Attention



Be careful of the newly developed flute shape when measuring tool diameter or run out.

The tool is designed with a smaller outer diameter connected to end sub blades. When measuring tool diameter or run out, measure the main blades.

Recommended Cutting Condition, Epoch Turbo Mill

Standard conditions (Low revolution, High feed)

General-purpose condition for low-speed use. Provides stable high-efficiency cutting with the longest tool life.

Work material	Cast Irons Carbon steels, Alloy steels (150～250HB) FC, S50C, SCM			Tool steels (25～35HRC) SKD			Pre-hardened steels (35～45HRC) NAK80, CENA1			Hardened steels (45～55HRC) SKD61,SKT4			Hardened steels (55～60HRC) SKD11,SKH51		
Ratio to standard depth of cut	100%			100%			100%			70%			50%		
Tool dia DC (mm)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)
ϕ2	12,000	0.11	5,380	11,000	0.1	4,510	10,000	0.08	3,200	8,000	0.08	2,560	8,000	0.03	1,020
ϕ3	8,000	0.19	6,050	7,400	0.17	5,110	6,900	0.14	3,730	5,300	0.14	2,860	5,300	0.05	1,140
ϕ4	6,000	0.27	6,380	5,600	0.24	5,450	5,200	0.19	3,950	4,000	0.19	3,040	4,000	0.08	1,220
ϕ5	4,800	0.33	6,380	4,500	0.3	5,470	4,100	0.24	3,900	3,200	0.24	3,040	3,200	0.1	1,220
ϕ6	4,000	0.42	6,720	3,700	0.38	5,680	3,400	0.3	4,080	2,700	0.3	3,240	2,700	0.12	1,300
ϕ8	3,000	0.56	6,720	2,800	0.51	5,730	2,600	0.4	4,160	2,000	0.4	3,200	2,000	0.16	1,280
ϕ10	2,400	0.7	6,720	2,200	0.64	5,630	2,100	0.5	4,200	1,600	0.5	3,200	1,600	0.2	1,280
ϕ12	2,000	0.8	6,380	1,900	0.73	5,540	1,700	0.57	3,880	1,300	0.57	2,960	1,300	0.23	1,190
ϕ16	1,500	0.9	5,380	1,400	0.82	4,590	1,300	0.64	3,330	1,000	0.64	2,560	1,000	0.26	1,020
ϕ20	1,200	0.91	4,370	1,100	0.83	3,660	1,000	0.65	2,600	800	0.65	2,080	800	0.26	830

High speed conditions (High revolution, High feed)

Condition for use with high-performance high-speed machines capable of high feed rates. Enables ultra-high-efficiency cutting by enabling higher feed rates due to higher rotation speeds.

Work material	Cast Irons Carbon steels, Alloy steels (150～250HB) FC, S50C, SCM			Tool steels (25～35HRC) SKD			Pre-hardened steels (35～45HRC) NAK80, CENA1			Hardened steels (45～55HRC) SKD61,SKT4			Hardened steels (55～60HRC) SKD11,SKH51		
Ratio to standard depth of cut	80%			80%			70%			60%			40%		
Tool dia DC (mm)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Revolution *n* (min⁻¹)	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)
ϕ2	20,000	0.11	8,960	18,000	0.1	7,370	16,000	0.08	5,120	12,700	0.08	4,060	11,100	0.03	1,420
ϕ3	13,300	0.19	10,050	11,700	0.17	8,090	10,600	0.14	5,720	8,500	0.14	4,590	7,400	0.05	1,600
ϕ4	9,900	0.27	10,530	8,800	0.24	8,560	8,000	0.19	6,080	6,400	0.19	4,860	5,600	0.08	1,700
ϕ5	8,000	0.33	10,640	7,000	0.3	8,510	6,400	0.24	6,080	5,100	0.24	4,850	4,500	0.1	1,710
ϕ6	6,600	0.42	11,090	5,800	0.38	8,910	5,300	0.3	6,360	4,200	0.3	5,040	3,700	0.12	1,780
ϕ8	5,000	0.56	11,200	4,400	0.51	9,010	4,000	0.4	6,400	3,200	0.4	5,120	2,800	0.16	1,790
ϕ10	4,000	0.7	11,200	3,500	0.64	8,960	3,200	0.5	6,400	2,500	0.5	5,000	2,200	0.2	1,760
ϕ12	3,300	0.8	10,530	2,900	0.73	8,460	2,700	0.57	6,160	2,100	0.57	4,790	1,900	0.23	1,730
ϕ16	2,500	0.9	8,960	2,200	0.82	7,210	2,000	0.64	5,120	1,600	0.64	4,100	1,400	0.26	1,430
ϕ20	2,000	0.91	7,280	1,800	0.83	5,990	1,600	0.65	4,160	1,300	0.65	3,380	1,100	0.26	1,140

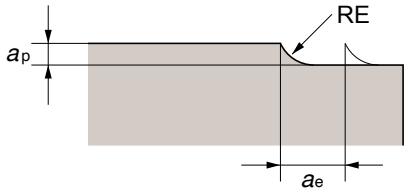
【Note】
① Use a highly rigid and accurate machine as possible.
② These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③ If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.

Low load conditions (Medium revolution, high feed)

Condition which reduces cutting load by reducing the per-flute feed rate. Since cutting resistance can be reduced, it enables use even on machines with low rigidity.

Work material	Cast Irons Carbon steels, Alloy steels (150～250HB) FC, S50C, SCM			Tool steels (25～35HRC) SKD			Pre-hardened steels (35～45HRC) NAK80, CENA1			Hardened steels (45～55HRC) SKD61,SKT4			Hardened steels (55～60HRC) SKD11,SKH51		
Ratio to standard depth of cut	100%			100%			100%			70%			50%		
Tool dia DC (mm)	Revolution n (min^{-1})	Feed per tooth f_z (mm/t)	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed per tooth f_z (mm/t)	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed per tooth f_z (mm/t)	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed per tooth f_z (mm/t)	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed per tooth f_z (mm/t)	Feed rate v_f (mm/min)
ϕ2	15,000	0.09	5,180	14,000	0.08	4,300	14,000	0.06	3,400	10,300	0.06	2,310	9,500	0.02	910
ϕ3	10,100	0.15	5,890	9,500	0.13	4,920	9,000	0.1	3,690	6,900	0.09	2,610	6,400	0.04	1,040
ϕ4	7,600	0.21	6,240	7,200	0.18	5,250	6,800	0.14	3,930	5,200	0.13	2,770	4,800	0.06	1,090
ϕ5	6,000	0.26	6,160	5,700	0.23	5,200	5,400	0.18	3,900	4,100	0.17	2,730	3,800	0.07	1,080
ϕ6	5,000	0.32	6,480	4,800	0.29	5,530	4,500	0.23	4,100	3,400	0.21	2,860	3,200	0.09	1,150
ϕ8	3,800	0.43	6,570	3,600	0.38	5,530	3,400	0.3	4,130	2,600	0.28	2,910	2,400	0.12	1,150
ϕ10	3,000	0.54	6,480	2,900	0.48	5,570	2,700	0.38	4,100	2,100	0.35	2,940	1,900	0.15	1,140
ϕ12	2,500	0.62	6,160	2,400	0.55	5,250	2,300	0.43	3,990	1,700	0.4	2,710	1,600	0.17	1,090
ϕ16	1,900	0.69	5,250	1,800	0.61	4,420	1,700	0.49	3,310	1,300	0.45	2,330	1,200	0.19	920
ϕ20	1,500	0.7	4,210	1,400	0.62	3,490	1,400	0.49	2,770	1,000	0.46	1,820	1,000	0.2	780

Relation between the depth of cut and overhang.



ae:Half of flat length on bottom edge=(Tool dia.DC/2)−Corner radius RE

ap:Below table

Overhang	a_p : Z pick mm	Overhang	a_p : Z pick mm
5DC or less	0.3× RE × cutting depth ratio	**8DC**	0.23× RE × cutting depth ratio
6DC	0.27× RE × cutting depth ratio	**9DC**	0.19× RE × cutting depth ratio
7DC	0.25× RE × cutting depth ratio	**10DC**	0.15× RE × cutting depth ratio

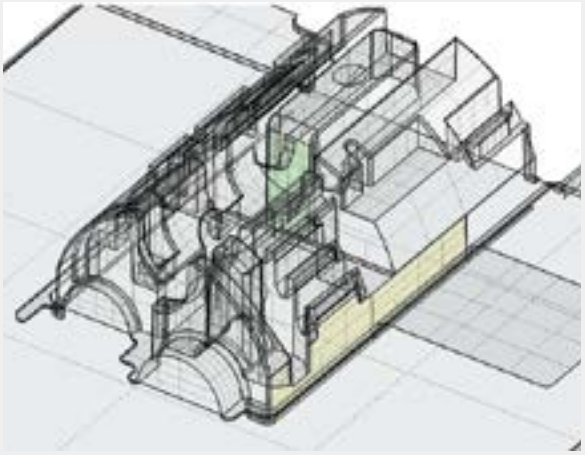
① Feed rates for pencil-neck types are shown for 6DC and higher in the above table. For straight type and long-neck type of 6DC or higher, cutting depth in the Z direction should be set about 10% lower than the above values.
② Use for cutting contour lines or down cutting. In Z direction, cut at an incline (incline angle: 1°) and reduce feed rate to between 60% and 70%.
③ It is recommended that speed reduction for corners be set. The speed reduction distance should be approximately 1/2 the diameter of the tool being used, and the feed rate should be reduced to between 50% and 60%.

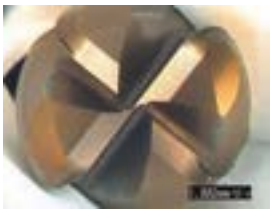
Field data

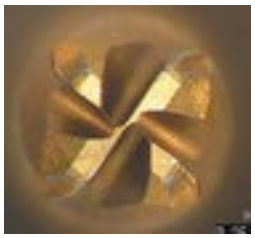
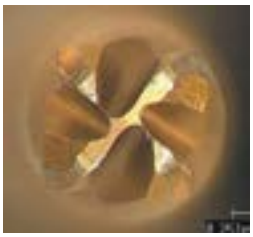
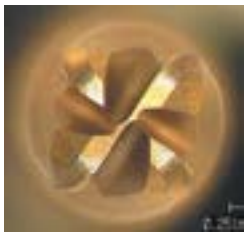
Cutting example 1

Work material : DAC(48HRC) 60mm×70mm×50mm
Incline angle : 1° Groove width : 2.7mm Groove depth : 30mm

Cutting work shape

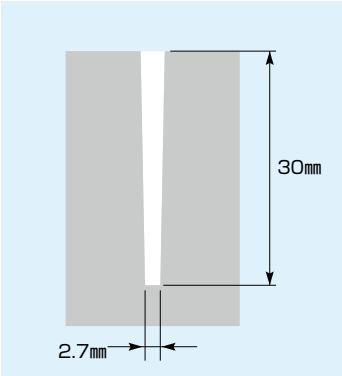


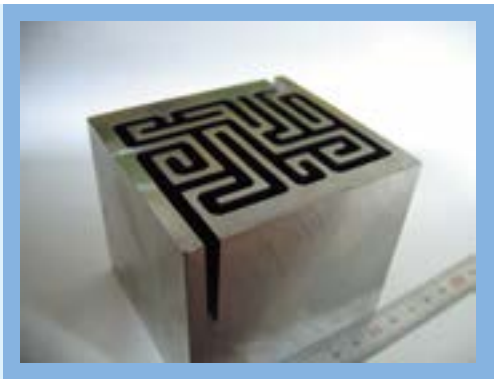
	Process 1	Process 2
Use tool	ETM4120-20-TH	ETM4060-15-TH
Revolution	2100min^{-1} (79m/min)	4200min^{-1} (79m/min)
Feed rate	4790mm/min (0.57mm/t)	5040mm/min (0.3mm/t)
Depth of cut	a_p×a_e = 0.35mm×6mm	a_p×a_e = 0.25mm×1mm
Cutting time	**25** min.	**15** min.
		

	Process 3	Process 4	Process 5
Use tool	ETRP4020-15-0905-TH	ETRP4020-20-0905-TH	ETRP4020-30-0905-TH
Revolution	12700min^{-1}(80m/min)	12700min^{-1} (80m/min)	12700min^{-1} (80m/min)
Feed rate	4060mm/min(0.08mm/t)	4060mm/min (0.08mm/t)	4060mm/min (0.08mm/t)
Depth of cut	a_p×a_e = 0.07mm×1mm	a_p×a_e = 0.04mm×1mm	a_p×a_e = 0.03mm×1mm
Cutting time	**55** min.	**75** min.	**45** min.
			

Cutting example 2

Work material :
DAC(48HRC)
80mm×70mm×50mm
Incline angle : 1°
Groove width : 2.7 (Bottom)
Groove depth : 30mm





No.	Tool name	Tool dia.	Corner radius RE	Under neck	Revolution min⁻¹	Feed rate mm/min	ap	ae	Cooling method	Cutting depth	Cutting time
1	ETR4025-10-05-TH	2.5	0.5	10	10,200	4,340	0.063	1.250	Water base	−10.0	54min.
2	ETRP4025-20-0905-TH	2.5	0.5	20	10,200	4,340	0.047	1.250	Water base	−20.0	1hr.10min.
3	ETRP4025-30-0905-TH	2.5	0.5	30	10,200	4,340	0.031	1.250	Water base	−25.0	54min.
4	ETRP4025-30-0905-TH	2.5	0.5	30	10,200	4,340	0.031	1.250	Water base	−30.0	54min.

Total machining time : **3hr. 52min.**

■ Comparison of machining cost compared to ball end mills

When using a ball end mill

Process 1 **RE1.25×under neck 10**
n=16000min⁻¹、v_f=2500㎜/min、a_p×a_e=0.2㎜×0.35㎜
Cutting time：1hr. 25min. Cutting cost：¥9,989

Process 2 **RE1.25×under neck 20**
n=12000min⁻¹、v_f=1500㎜/min、a_p×a_e=0.08㎜×0.15㎜
Cutting time：8hr. 51min. Cutting cost：¥62,392

Process 3 **RE1.25× under neck 25**
n=10000min⁻¹、v_f=930㎜/min、a_p×a_e=0.05㎜×0.1㎜
Cutting time：12hr. 56min. Cutting cost：¥91,183

Process 4 **RE1.25×under neck 30**
n=8000min⁻¹、v_f=680㎜/min、a_p×a_e=0.02㎜×0.06㎜
Cutting time：57hr. 14min. Cutting cost：¥403,496

Total machining time: 80 hr. 26 min.
Total machining cost: ￥567,060

Because using a ball end mill takes too much time, in reality electrodischarge machining is used.

When using Epoch Turbo Rib

Process 1 **φ2.5×RE0.5×under neck 10**
n=10200min⁻¹、v_f=4340㎜/min、a_p×a_e=0.063㎜×1.25㎜
Cutting time：54min. Cutting cost：¥8,148

Process 2 **φ2.5×RE0.5×under neck 20**
n=10200min⁻¹、v_f=4340㎜/min、a_p×a_e=0.047㎜×1.25㎜
Cutting time：1hr.10min. Cutting cost：¥10,559

Process 3 **φ2.5×RE0.5× under neck 30**
n=10200min⁻¹、v_f=4340㎜/min、a_p×a_e=0.031㎜×1.25㎜
Cutting time：54min. Cutting cost：¥8,145

Process 4 **φ2.5×RE0.5×under neck 30**
n=10200min⁻¹、v_f=4340㎜/min、a_p×a_e=0.031㎜×1.25㎜
Cutting time：54min. Cutting cost：¥8,145

Total machining time: 3 hr. 52 min.
Total machining cost: ￥34,997

Cutting can be performed with Turbo Rib!
Machining time is reduced!

※Processing cost is calculated by our Production 50 Solution sheet.

MOLDINO

The Edge To Innovation

The diagrams and table data are examples of test results, and are not guaranteed values.
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⚠ Attentions on Safety

1. Cautions regarding handling

(1) When removing the tool from its case (packaging), be careful that the tool does not pop out or is dropped. Be particularly careful regarding contact with the tool flutes.
(2) When handling tools with sharp cutting flutes, be careful not to touch the cutting flutes directly with your bare hands.

2. Cautions regarding mounting

(1) Before use, check the outside appearance of the tool for scratches, cracks, etc. and that it is firmly mounted in the collet chuck, etc.
(2) If abnormal chattering, etc. occurs during use, stop the machine immediately and remove the cause of the chattering.

3. Cautions during use

(1) Before use, confirm the dimensions and direction of rotation of the tool and milling work material.
(2) The numerical values in the standard cutting conditions table should be used as criteria when starting new work. The cutting conditions should be adjusted as appropriate when the cutting depth is large, the rigidity of the machine being used is low, or according to the conditions of the work material.
(3) Cutting tools are made of a hard material. During use, they may break and fly off. In addition, cutting chips may also fly off. Since there is a danger of injury to workers, fire, or eye damage from such flying pieces, a safety cover should be attached when work is performed and safety equipment such as safety goggles should be worn to create a safe environment for work.
(4) There is a risk of fire or inflammation due to sparks, heat due to breakage, and cutting chips. Do not use where there is a risk of fire or explosion. **Please caution of fire while using oil base coolant, fire prevention is necessary.**
(5) Do not use the tool for any purpose other than that for which it is intended.

4. Cautions regarding regrinding

(1) If regrinding is not performed at the proper time, there is a risk of the tool breaking. Replace the tool with one in good condition, or perform regrinding.
(2) Grinding dust will be created when regrinding a tool. When regrinding, be sure to attach a safety cover over the work area and wear safety clothes such as safety goggles, etc.
(3) This product contains the specified chemical substance cobalt and its inorganic compounds. When performing regrinding or similar processing, be sure to handle the processing in accordance with thelocal laws and regulations regarding prevention of hazards due to specified chemical substances.

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