MOLDINO
The Edge To Innovation

CUTTING TOOLS PRODUCTS CATALOGUE

New Products
Digest Version 2022
North America

MOLDINO Tool Engineering, Ltd.

MOLDINO
The Edge To Innovation

Technology thoroughly applies in the service of
people and goods
Technology that values the accumulation of results
Technology that brings marvels and smiles

MOLDINO Tool Engineering, innovative product
development
Our principles are to…
be embodied in our technology

Stand together with our customers
Respond to each and every challenge for as long as necessary
Use great ideas to the creation of unique, world-beating products
Be a step ahead in fulfilling customers' dreams and visions
Take a holistic view toward manufacturing innovation

As earnest in our approach as our technology itself
Committed to doing all we can do for
our customers here and now

At MOLDINO Tool Engineering…
We grow with our customers and share in their pride
Taking on the challenge of exploring
The Edge To Innovation

Index

Selection criteria table according to carbide end mill shape

Type	Item code / Shape	Product Applications	Coating	Specifications	No. of flutes / Tool dia.	P: Carbon steels, Alloy steels	P: Pre-harden Steels under 45 HRC	H: High-hardened over 45HRC to 55HRC	H: High-hardened over 55HRC to 65HRC	H: High-hardened over 65HRC	M: Stainless steels	S: Titanium alloy, Heat-resistant alloy	N: Copper alloy	N: Aluminium alloy	page
Ball	EPDBEH-TH3	Epoch Deep Ball Evolution Hard-TH3	TH3	Long neck	2	◎	◎	◎	◎	◎	○	◎	○	○	7
		Slotting Die-sinking Profiling R Miniature Semi Finish Finish Rib Miniature			0.1~12										
	EHHBE-TH3	Epoch High Hard Ball-TH3	TH3	Regular	4	○	◎	◎	◎	◎					39
		Adaptive Milling Die-sinking Profiling R Rough Semi Finish Finish			1~12										
Radius	EPDREH-TH3	Epoch Deep Radius Evolution Hard-TH3	TH3	Long neck	2 & 4	◎	◎	◎	◎	◎	○	◎	○	○	47
		Slotting Die-sinking Profiling R Miniature Best Material Machining Semi Finish Finish Rib Miniature			2Fl:0.2~1 4Fl:1~6										
	ETR-TH	Epoch Turbo Rib -Straight Neck	TH	Long neck	4	◎	◎	◎	◎	◎	○	◎	○	○	93
		Slotting Die-sinking Profiling R Miniature Best Material Machining Rough Semi Finish Finish Rib Miniature			1~3										
	ETRP-TH	Epoch Turbo Rib -Pencil Neck	TH	Long neck	4	◎	◎	◎	◎	◎	○	◎	○	○	93
		Slotting Profiling R Miniature Best Material Machining Rough Semi Finish Finish Rib Miniature			1~3										
	ETM-TH	Epoch Turbo Mill -Straight Neck	TH	Straight neck	4	◎	◎	◎	◎	○	○	◎	○	○	93
		Die-sinking Profiling R Rough Semi Finish			2~20										
	ETMLN-TH	Epoch Turbo Mill -Long Neck	TH	Long neck	4	◎	◎	◎	◎	○	○	◎	○	○	93
		Die-sinking Profiling R Rough Semi Finish			4~16										
	ETMP-TH	Epoch Turbo Mill -Pencil Neck	TH	Pencil neck	4	◎	◎	◎	◎	○	○	◎	○	○	93
		Die-sinking Profiling R Rough Semi Finish			2~16										
	EHHRE-TH3	Epoch High Hard Radius	TH3	Regular	4 & 6			○	◎	◎					111
		Die-sinking Profiling R Rough			4Fl:1~3 6Fl:4~12										
	ER8WB-ATH	8-flute End Mill for Vertical Wall/Bottom Face Finishing (Radius type)	ATH	Long neck	8	◎	◎	◎							119
		Planing Side Milling Slotting Die-sinking Profiling Semi Finish Finish			6~12										
Square	ES8WB-ATH	8-flute End Mill for Vertical Wall/Bottom Face Finishing (Square type)	ATH	Long neck	8	◎	◎	◎							119
		Planing Side Milling Slotting Die-sinking Profiling Semi Finish Finish			6~12										

Coating materials for solid end mills

PVD Technology ATH Coating

Features and characteristics

- Hardness and oxidation resistance of TH Coating is further improved.
  Enables longer life and higher efficient when cutting high-hardness materials. (Si nano composite coating with finer crystal particles)
- Exhibits amazing performance when cutting high-hardness materials (55HRC or higher)
- Long life for both dry cutting and wet cutting

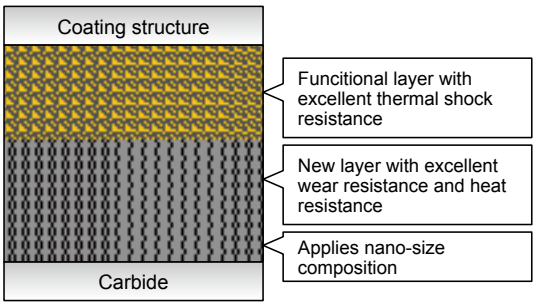
PVD Technology TH3 Coating

Features and characteristics

- High hardness coating with excellent wear resistance and heat resistance
- Has excellent thermal shock resistance enables to suppress sudden chipping
- Long tool life when cutting high-hardness materials (50HRC or higher) such as hardened steel

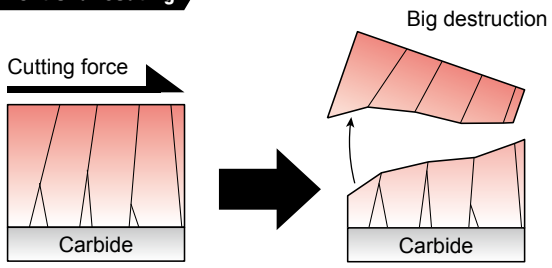
Target steel grade

- Hardened steel (especially 50HRC or higher), high-speed steel

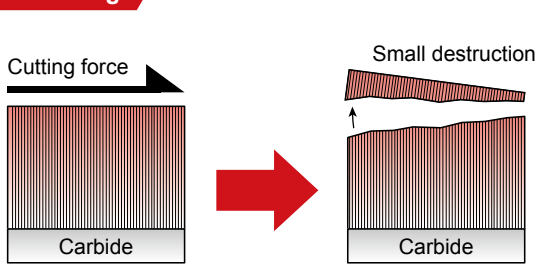


! Point New coating achieves to reduce destruction unit of layer by applying "nano-size composition".

Conventional coating



New coating



PVD Technology PN Coating

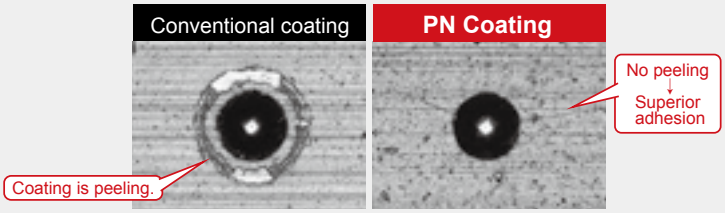
Features and characteristics

- A heat-resistant coating material with excellent adhesion to the tool substrate was achieved by optimizing the Al content.
- Exhibits with good wear resistance due to doping of the AlCr coating layer with Si.
- Exhibits excellent cutting life for cutting materials such as plastic molds, etc. where tool seizure often occurs.
  (2x the cutting life compared to conventional products.)
  Provides the long life in cutting processing of materials starting with HPM-MAGIC and including prehardened steel, carbon steel, alloy steel, SUS, SKD61, SKD11, etc.
- By improving heat resistance, long life are possible for both wet cutting and dry cutting.

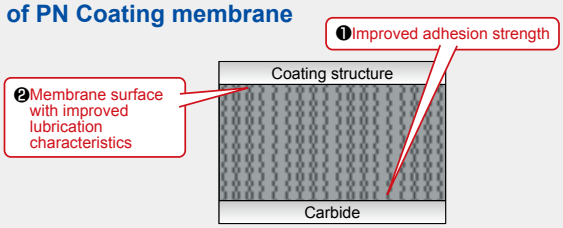
Note) This product obtains less electric conductivity. Therefore, Please caution of using electric transmitted measuring systems.

Adhesion of PN Coating

Substrate: Carbide alloy



Cross-sectional structure and characteristics of PN Coating membrane



Notes

NEW

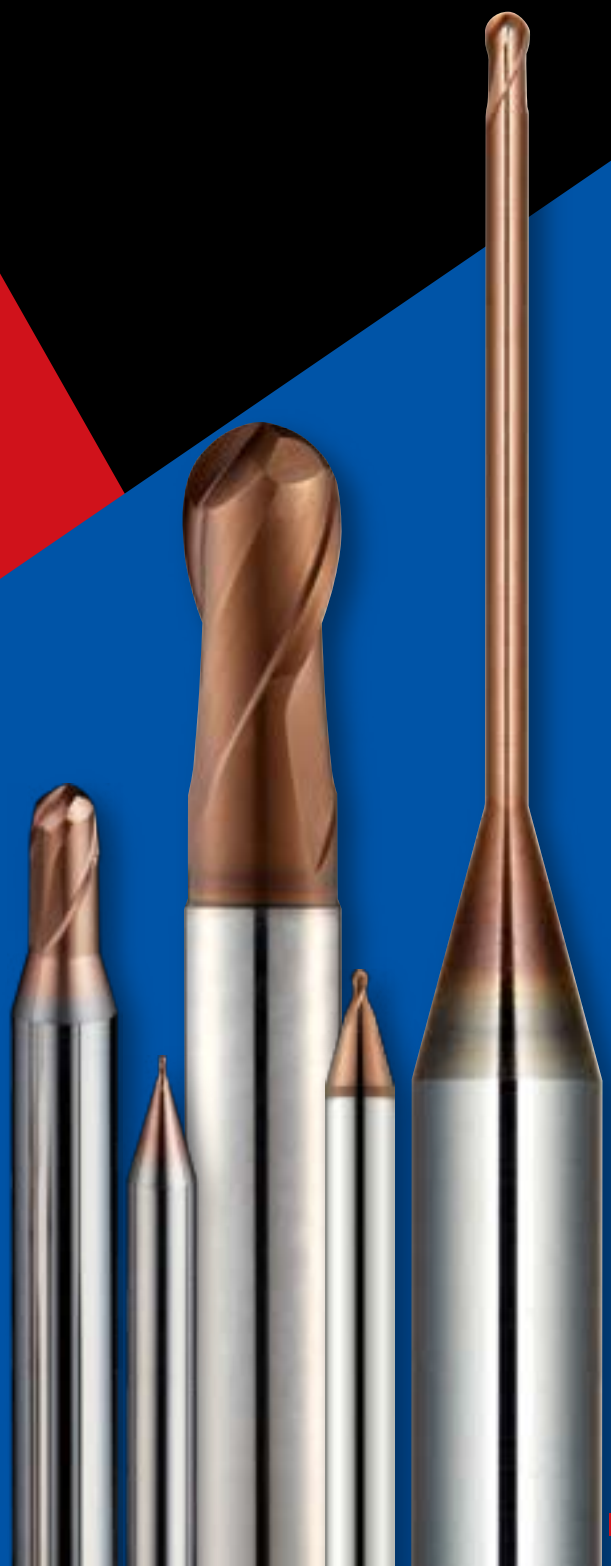
MOLDINO
The Edge To Innovation

Ball End Mill for Hardened Steel

EPDBEH-TH3

Epoch Deep Ball Evolution Hard-TH3

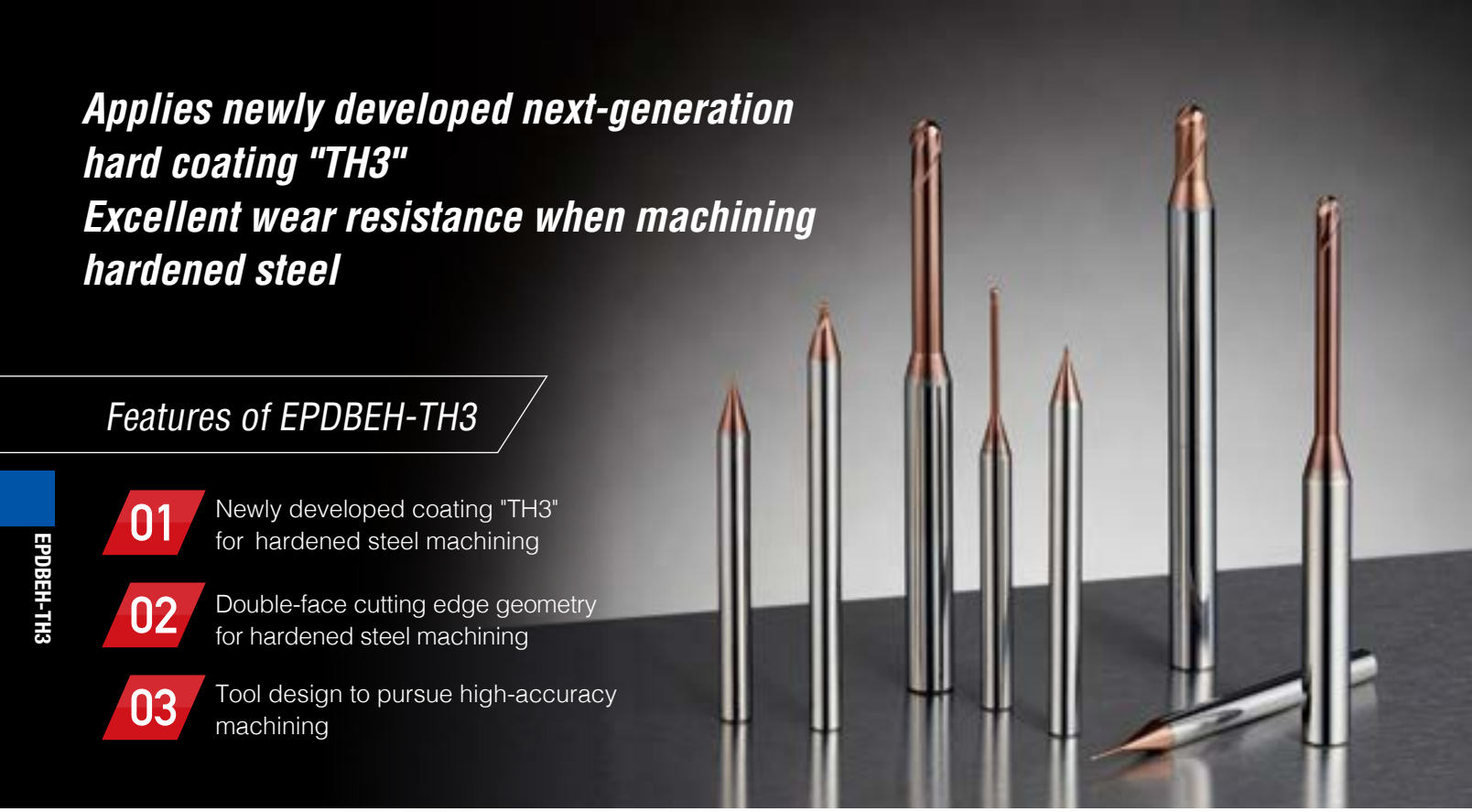
Lineup expanded with new strong neck type with the shortest neck length!



MOLDINO Tool Engineering, Ltd.

New Product News | No. H2206A-1 | 2022-07

Applies newly developed next-generation hard coating "TH3" Excellent wear resistance when machining hardened steel

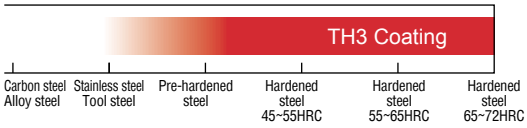


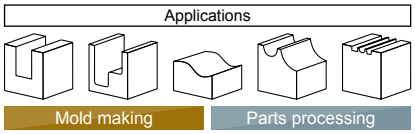
Features of EPDBEH-TH3

01 Newly developed coating "TH3" for hardened steel machining

02 Double-face cutting edge geometry for hardened steel machining

03 Tool design to pursue high-accuracy machining





EPDBEH-TH3

R0.05～R6 [231 Items]

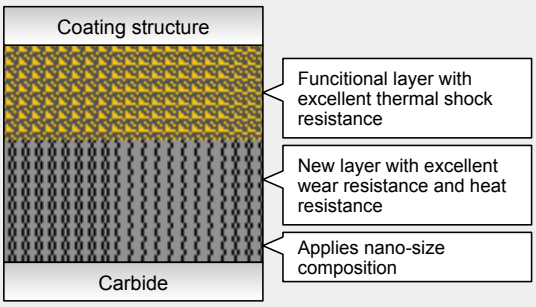
Features 01 Newly developed coating "TH3" for hardened steel machining

Features and performance

- High hardness coating with excellent wear resistance and heat resistance
- Has excellent thermal shock resistance enables to suppress sudden chipping
- Long tool life when cutting high-hardness materials (50HRC or higher) such as hardened steel

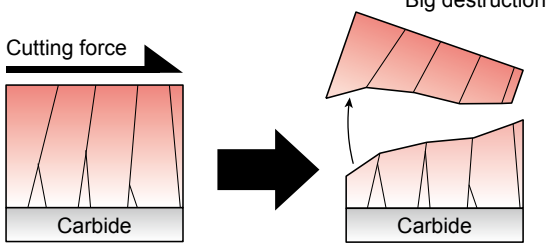
Target steel grade

- Hardened steel (especially 50HRC or higher), high-speed steel

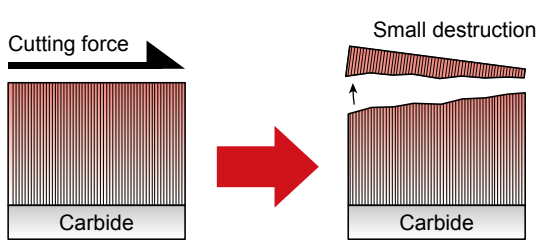


! Point New coating achieves to reduce destruction unit of layer by applying "nano-size composition".

Conventional coating



New coating



Features 02 Optimized cutting edge geometry "double-face" for hardened steel machining.

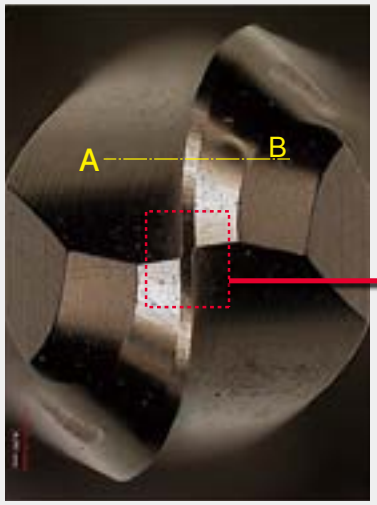
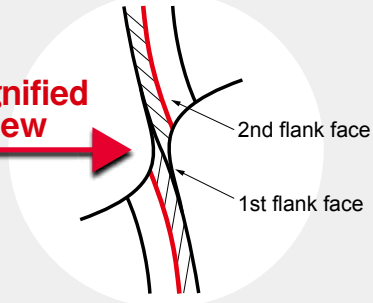


Figure Double Face geometry

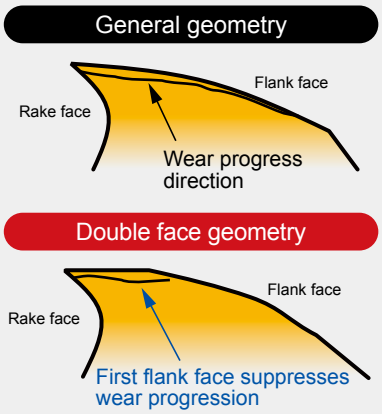
Flank of ball area has double face (two-stage flank)

Magnified view



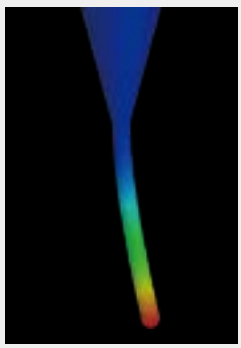
Double-face effect prevents shape from deteriorating

Figure A-B cross section view



※Double face geometry is not applied to R2 or larger size

Features 03 Tool design to pursue high-accuracy machining

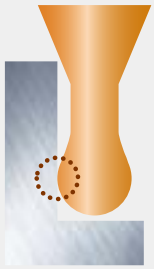


In case of R0.5
- under neck length 10mm,

10% of deflection is suppressed compared to conventional neck shape

(Theoretical value by our calculation)

Back draft effect

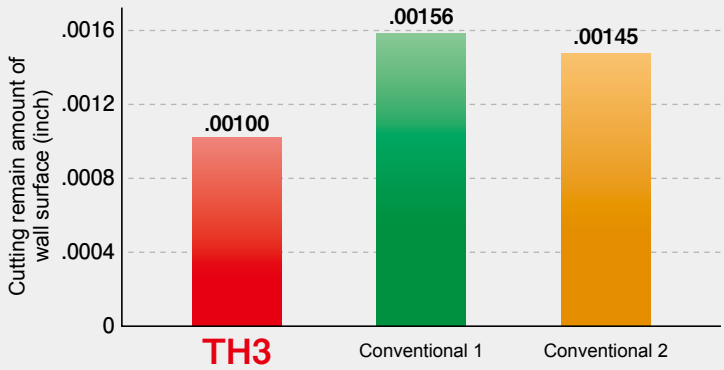


Backdraft effect enables good-quality processed surfaces to be achieved.

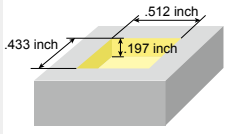
Inherits the reliable backdraft shape to enable chattering to be reduced by performing point cutting.

Evaluation of cutting remain in pocket wall finishing test

Figure Cutting remain amount of wall surface



Work material : YXR33(58HRC)
Machine : Vertical MC(HSK-E32)
Tool : EPDBEH2010-6-TH3
Cutting conditions : n=22,600min^{-1}
(v_c=233 SFM)
v_f=32.3 IPM
(f_z=.001 IPT)
a_p=.001 inch a_e=.0004 inch
OH=.709 inch Mist



Pocket size :
.512 x .433 x .197 inch (Wall)

By increasing the neck rigidity, it is possible to suppress deflection and reduce the cutting remain by 30% than conventional design

Effective neck length is shorter than existing Epoch Deep Evolution series (EPDBEH, EPDBE). Please use with checking interference area.

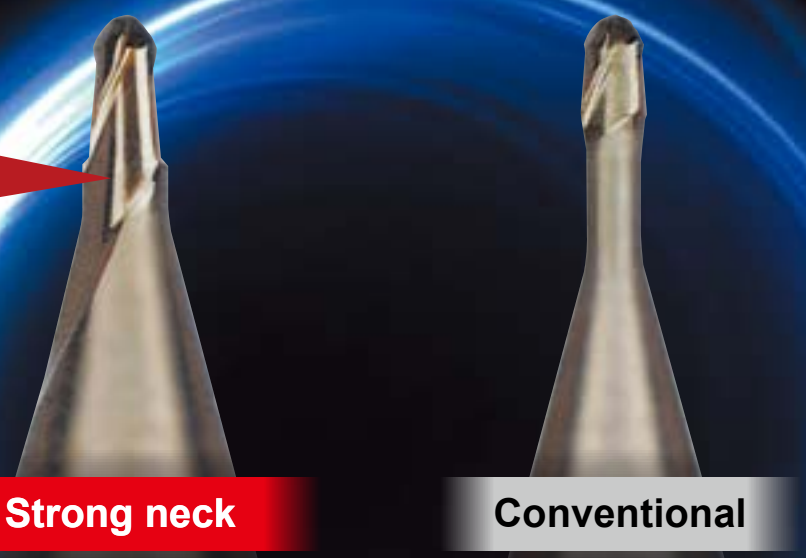
⇒Please use CAD/CAM Support Data Pack Vol.9 for checking interference area. For details, please visit our web site.
http://www.moldino.com/en/

Epoch Deep Ball Evolution Hard-TH3

EPDBEH-TH3

Shortest neck length, Strong neck type

Thicker and shorter neck shape than conventional lineup



Strong neck | Conventional

Please utilize for machining various precision molds and dies

Semiconductor | Light-Guide | Connector | Engraving

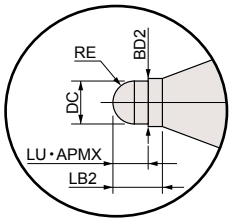
Lineup expanded with shortest under-neck length range that emphasizes rigidity in order to realize higher precision and stable machining

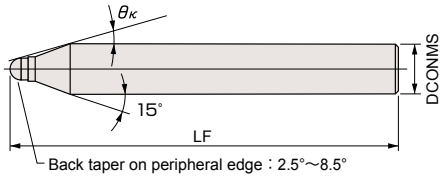
Needs to use tools with shorter neck length since small diameter end mills have a risk of breakage

Strong neck type with the shortest neck length

High tool rigidity improves stability and reliability.
Especially, it is more effective as the tool diameter becomes smaller.

2Flutes





(mm)

Ball radius RE	Tolerance on RE
0.05～0.25	±0.003
0.3～0.5	±0.005

EPDBEH2○○○-○○.○○-TH3

Carbide TH3 72 HRC Helix 30 h4

Item code	Stock	Size(mm)								Interference angle (°)
		Ball radius	Tool dia.	Under neck length	Flute length	Overall length	Shank dia.	Neck size		
		RE	DC	LU	APMX	LF	DCONMS	LB2	BD2	θK
EPDBEH2001-0.08-TH3	●	0.05	0.1	0.08	0.08	45	4	0.2	0.13	20.93
EPDBEH20015-0.12-TH3	●	0.075	0.15	0.12	0.12	45	4	0.3	0.18	15.25
EPDBEH2002-0.15-TH3	●	0.1	0.2	0.15	0.15	50	4	0.3	0.25	20.23
EPDBEH2003-0.25-TH3	●	0.15	0.3	0.25	0.25	50	4	0.5	0.35	14.45
EPDBEH2004-0.3-TH3	●	0.2	0.4	0.3	0.3	50	4	0.5	0.45	14.53
EPDBEH2005-0.35-TH3	●	0.25	0.5	0.35	0.35	50	4	0.75	0.55	14.1
EPDBEH2006-0.4-TH3	●	0.3	0.6	0.4	0.4	50	4	0.75	0.65	14.16
EPDBEH2007-0.45-TH3	●	0.35	0.7	0.45	0.45	50	4	0.8	0.75	14.13
EPDBEH2008-0.5-TH3	●	0.4	0.8	0.5	0.5	50	4	0.8	0.85	14.2
EPDBEH2009-0.6-TH3	●	0.45	0.9	0.6	0.6	50	4	1	0.95	13.84
EPDBEH2010-0.8-TH3	●	0.5	1	0.8	0.8	50	4	1.2	1.05	13.47

● : Inventory maintained in US

Comparative example of EPDBEH-TH3 and cBN

Our unique TH3 coating and cutting edge design that suppresses wear realize a long-life and high-quality machined surface in hardened steels finishing.

Tool life comparable with cBN, machining accuracy, and high-quality finished surfaces reduce the polishing man-hours.

Field data

Tools

R0.5 Ball end mill

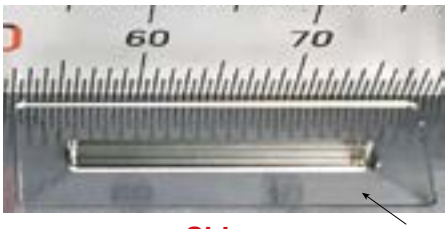
Machining environment

Machine: vertical MC (HSK-E32)
Work material：PD613 (60HRC)
Coolant : Mist-blow

Cutting conditions

n=40000min^{-1} (v_c=413 SFM)
v_f=63 IPM (f_z=.001 IPT)
$a_p \times a_e$=.001 inch × .001 inch

EPDBEH-TH3

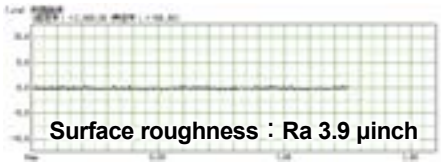


Shiny machined surface

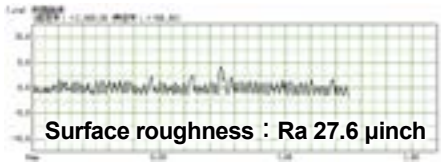
Measurement point

cBN

Cloudy machined surface



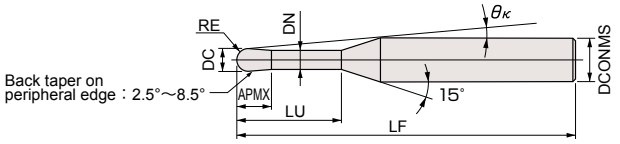
Surface roughness：Ra 3.9 μinch



Surface roughness：Ra 27.6 μinch

2Flutes

【Note】RE2 or higher does not have backdraft shape.



A type

(㎜)

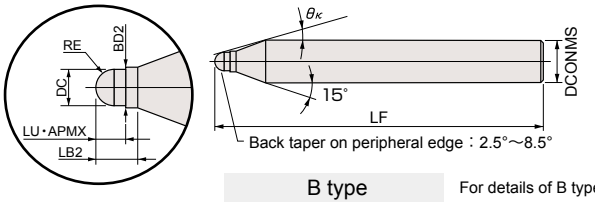
Ball radius RE	Tolerance on RE
0.05～0.25	±0.003
0.3～6	±0.005

EPDBEH2○○○-○○.○○-(S6)-TH3

Carbide TH3 Helix 30° h4 (ϕ4) h5 (ϕ6～ϕ12)

Item code	Stock	Size(mm) Ball radius RE	Tool dia. DC	Under neck length LU	Flute length APMX	Neck dia. DN	Overall length LF	Shank dia. DCONMS	Type	Interference angle (°) θκ	Effective under neck length with respect to draft angle 0.5°	1°	1.5°	2°	3°
EPDBEH2001-0.08-TH3	●	0.05	0.1	0.08	0.08	–	45	4	B	20.93	–	–	–	–	–
EPDBEH2001-0.2-TH3	●			0.2		0.08			A	14.64	0.24	0.25	0.25	0.26	0.28
EPDBEH2001-0.3-TH3	●			0.3					A	14.46	0.34	0.35	0.36	0.38	0.40
EPDBEH2001-0.5-TH3	●			0.5					A	14.1	0.55	0.57	0.59	0.61	0.65
EPDBEH20015-0.12-TH3	●	0.075	0.15	0.12	0.12	–	45	4	B	15.25	–	–	–	–	–
EPDBEH20015-0.3-TH3	●			0.3		0.13			A	14.5	0.34	0.35	0.36	0.37	0.40
EPDBEH20015-0.5-TH3	●			0.5					A	14.14	0.55	0.56	0.58	0.6	0.65
EPDBEH20015-0.75-TH3	●			0.75					A	13.71	0.81	0.83	0.86	0.89	0.96
EPDBEH20015-1-TH3	●			1					A	13.3	1.06	1.1	1.14	1.18	1.27
EPDBEH2002-0.15-TH3	●	0.1	0.2	0.15	0.15	–	50	4	B	20.23	–	–	–	–	–
EPDBEH2002-0.3-TH3	●			0.3		0.18			A	14.54	0.34	0.35	0.36	0.37	0.39
EPDBEH2002-0.5-TH3	●			0.5					A	14.17	0.55	0.56	0.58	0.60	0.64
EPDBEH2002-0.75-TH3	●			0.75					A	13.73	0.81	0.83	0.86	0.89	0.95
EPDBEH2002-1-TH3	●			1					A	13.32	1.06	1.10	1.13	1.17	1.26
EPDBEH2002-1.25-TH3	●			1.25					A	12.93	1.32	1.37	1.41	1.46	1.57
EPDBEH2002-1.5-TH3	●			1.5					A	12.56	1.58	1.63	1.69	1.75	1.88
EPDBEH2002-2-TH3	●			2					A	11.89	2.10	2.17	2.24	2.32	2.50
EPDBEH2002-2.5-TH3	●			2.5					A	11.28	2.61	2.70	2.80	2.90	3.13
EPDBEH2002-3-TH3	●			3					A	10.73	3.13	3.24	3.35	3.47	3.75
EPDBEH2003-0.25-TH3	●	0.15	0.3	0.25	0.25	–	50	4	B	14.45	–	–	–	–	–
EPDBEH2003-0.5-TH3	●			0.5		0.27			A	14.21	0.56	0.58	0.60	0.61	0.65
EPDBEH2003-0.75-TH3	●			0.75					A	13.76	0.82	0.85	0.87	0.90	0.96
EPDBEH2003-1-TH3	●			1					A	13.33	1.08	1.11	1.15	1.19	1.27
EPDBEH2003-1.25-TH3	●			1.25					A	12.93	1.34	1.38	1.43	1.47	1.58
EPDBEH2003-1.5-TH3	●			1.5					A	12.56	1.60	1.65	1.70	1.76	1.89
EPDBEH2003-2-TH3	●			2					A	11.86	2.12	2.18	2.26	2.34	2.52
EPDBEH2003-2.5-TH3	●			2.5					A	11.24	2.63	2.72	2.81	2.91	3.14
EPDBEH2003-3-TH3	●			3					A	10.68	3.15	3.25	3.37	3.49	3.76
EPDBEH2003-3.5-TH3	●			3.5					A	10.18	3.67	3.79	3.92	4.06	4.38
EPDBEH2003-4-TH3	●			4					A	9.72	4.18	4.32	4.47	4.64	5.00
EPDBEH2004-0.3-TH3	●	0.2	0.4	0.3	0.3	–	50	4	B	14.53	–	–	–	–	–
EPDBEH2004-0.5-TH3	●			0.5		0.37			A	14.28	0.56	0.58	0.59	0.60	0.64
EPDBEH2004-0.75-TH3	●			0.75					A	13.81	0.82	0.84	0.87	0.89	0.95
EPDBEH2004-1-TH3	●			1					A	13.37	1.08	1.11	1.14	1.18	1.26
EPDBEH2004-1.5-TH3	●			1.5					A	12.57	1.60	1.65	1.70	1.75	1.88
EPDBEH2004-2-TH3	●			2					A	11.86	2.11	2.18	2.25	2.33	2.50
EPDBEH2004-2.5-TH3	●			2.5					A	11.23	2.63	2.72	2.81	2.90	3.13
EPDBEH2004-3-TH3	●			3					A	10.65	3.15	3.25	3.36	3.48	3.75
EPDBEH2004-3.5-TH3	●			3.5					A	10.14	3.66	3.78	3.91	4.05	4.37
EPDBEH2004-4-TH3	●			4					A	9.67	4.18	4.32	4.47	4.63	4.99
EPDBEH2004-4.5-TH3	●			4.5					A	9.24	4.70	4.85	5.02	5.20	5.61
EPDBEH2004-5-TH3	●			5					A	8.85	5.21	5.39	5.58	5.78	6.23
EPDBEH2005-0.35-TH3	●	0.25	0.5	0.35	0.35	–	50	4	B	14.1	–	–	–	–	–
EPDBEH2005-0.75-TH3	●			0.75		0.47			A	13.88	0.82	0.84	0.86	0.88	0.94
EPDBEH2005-1-TH3	●			1					A	13.42	1.08	1.11	1.14	1.17	1.25
EPDBEH2005-1.5-TH3	●			1.5					A	12.59	1.59	1.64	1.69	1.75	1.87
EPDBEH2005-2-TH	●			2					A	11.86	2.11	2.18	2.25	2.32	2.49

● : Inventory maintained in US



B type

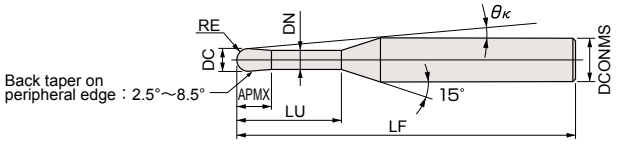
For details of B type, refer to page 11.

EPDBEH2○○○-○○.○○-(S6)-TH3

Item code	Stock	Size(mm) Ball radius RE	Tool dia. DC	Under neck length LU	Flute length APMX	Neck dia. DN	Overall length LF	Shank dia. DCONMS	Type	Interference angle (°) θκ	Effective under neck length with respect to draft angle 0.5°	1°	1.5°	2°	3°
EPDBEH2005-2.5-TH3	●	0.25	0.5	2.5	0.35	0.47	50	4	A	11.21	2.63	2.71	2.80	2.90	3.11
EPDBEH2005-3-TH3	●			3					A	10.62	3.15	3.25	3.36	3.47	3.73
EPDBEH2005-4-TH3	●			4					A	9.61	4.18	4.32	4.46	4.62	4.98
EPDBEH2005-5-TH3	●			5					A	8.78	5.21	5.39	5.57	5.77	6.22
EPDBEH2005-5.5-TH3	●			5.5					A	8.41	5.73	5.92	6.13	6.35	6.84
EPDBEH2005-6-TH3	●			6					A	8.08	6.25	6.46	6.68	6.92	7.46
EPDBEH2005-7-TH3	●			7					A	7.48	7.28	7.53	7.79	8.07	8.71
EPDBEH2005-8-TH3	●			8					A	6.96	8.31	8.60	8.90	9.22	9.95
EPDBEH2006-0.4-TH3	●	0.3	0.6	0.4	0.4	–	50	4	B	14.16	–	–	–	–	–
EPDBEH2006-0.75-TH3	●			0.75		0.57			A	13.94	0.82	0.84	0.86	0.88	0.93
EPDBEH2006-1-TH3	●			1					A	13.47	1.08	1.10	1.13	1.17	1.24
EPDBEH2006-1.5-TH3	●			1.5					A	12.61	1.59	1.64	1.69	1.74	1.86
EPDBEH2006-2-TH3	●			2					A	11.86	2.11	2.17	2.24	2.31	2.48
EPDBEH2006-2.5-TH3	●			2.5					A	11.19	2.63	2.71	2.80	2.89	3.10
EPDBEH2006-3-TH3	●			3					A	10.59	3.14	3.24	3.35	3.46	3.72
EPDBEH2006-3.5-TH3	●			3.5					A	10.05	3.66	3.78	3.90	4.04	4.34
EPDBEH2006-4-TH3	●			4					A	9.56	4.18	4.31	4.46	4.61	4.97
EPDBEH2006-4.5-TH3	●			4.5					A	9.12	4.69	4.85	5.01	5.19	5.59
EPDBEH2006-5-TH3	●			5					A	8.71	5.21	5.38	5.57	5.76	6.21
EPDBEH2006-5.5-TH3	●			5.5					A	8.34	5.73	5.92	6.12	6.34	6.83
EPDBEH2006-6-TH3	●			6					A	8	6.24	6.45	6.67	6.91	7.45
EPDBEH2006-7-TH3	●			7					A	7.4	7.28	7.52	7.78	8.06	8.70
EPDBEH2006-8-TH3	●			8					A	6.88	8.31	8.59	8.89	9.21	9.94
EPDBEH2006-9-TH3	●			9					A	6.43	9.35	9.66	10.00	10.36	11.18
EPDBEH2006-10-TH3	●			10					A	6.03	10.38	10.73	11.11	11.51	12.43
EPDBEH2006-12-TH3	●			12					A	5.37	12.45	12.87	13.32	13.81	14.91
EPDBEH2007-0.45-TH3	●	0.35	0.7	0.45	0.45	–	50	4	B	14.13	–	–	–	–	–
EPDBEH2007-2-TH3	●			2		0.67			A	11.85	2.11	2.17	2.24	2.31	2.47
EPDBEH2007-4-TH3	●			4					A	9.5	4.18	4.31	4.45	4.61	4.95
EPDBEH2007-6-TH3	●			6					A	7.92	6.24	6.45	6.67	6.91	7.44
EPDBEH2007-8-TH3	●			8					A	6.79	8.31	8.59	8.89	9.21	9.93
EPDBEH2008-0.5-TH3	●	0.4	0.8	0.5	0.5	–	50	4	B	14.2	–	–	–	–	–
EPDBEH2008-1-TH3	●			1		0.77			A	13.58	1.07	1.10	1.12	1.15	1.21
EPDBEH2008-1.5-TH3	●			1.5					A	12.66	1.59	1.63	1.68	1.73	1.83
EPDBEH2008-2-TH3	●			2					A	11.85	2.11	2.17	2.23	2.30	2.46
EPDBEH2008-2.5-TH3	●			2.5					A	11.14	2.62	2.70	2.79	2.88	3.08
EPDBEH2008-3-TH3	●			3					A	10.51	3.14	3.24	3.34	3.45	3.70
EPDBEH2008-4-TH3	●			4					A	9.44	4.17	4.31	4.45	4.60	4.94
EPDBEH2008-5-TH3	●			5					A	8.57	5.21	5.38	5.56	5.75	6.19
EPDBEH2008-6-TH3	●			6					A	7.84	6.24	6.45	6.66	6.90	7.43
EPDBEH2008-8-TH3	●			8					A	6.7	8.31	8.58	8.88	9.20	9.92
EPDBEH2008-10-TH3	●			10					A	5.85	10.38	10.72	11.10	11.50	12.40
EPDBEH2008-12-TH3	●			12					A	5.19	12.44	12.86	13.31	13.80	14.89
EPDBEH2009-0.6-TH3	●	0.45	0.9	0.6	0.6	–	50	4	B	13.84	–	–	–	–	–
EPDBEH2009-2-TH3	●			2		0.87			A	11.85	2.11	2.16	2.23	2.29	2.44
EPDBEH2009-4-TH3	●			4					A	9.38	4.17	4.30	4.44	4.59	4.93
EPDBEH2009-6-TH3	●			6					A	7.75	6.24	6.44	6.66	6.89	7.42
EPDBEH2009-8-TH3	●			8					A	6.61	8.31	8.58	8.88	9.19	9.90

2Flutes

【Note】RE2 or higher does not have backdraft shape.



A type

(㎜)

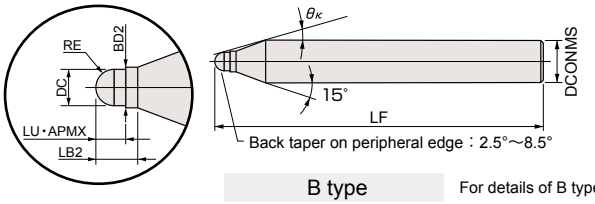
Ball radius RE	Tolerance on RE
0.05～0.25	±0.003
0.3～6	±0.005

EPDBEH2○○○-○○.○○-(S6)-TH3

Carbide TH3 Helix 30° h4 (ϕ4) h5 (ϕ6～ϕ12)

Item code	Stock	Size(mm) Ball radius RE	Tool dia. DC	Under neck length LU	Flute length APMX	Neck dia. DN	Overall length LF	Shank dia. DCONMS	Type	Interference angle (°) θκ	Effective under neck length with respect to draft angle 0.5°	1°	1.5°	2°	3°
EPDBEH2010-0.8-TH3	●			0.8		–			B	13.47	–	–	–	–	–
EPDBEH2010-1.5-TH3	●			1.5					A	12.67	1.61	1.64	1.69	1.73	1.83
EPDBEH2010-2-TH3	●			2					A	11.82	2.12	2.18	2.24	2.31	2.46
EPDBEH2010-2.5-TH3	●			2.5					A	11.07	2.64	2.71	2.80	2.88	3.08
EPDBEH2010-3-TH3	●			3					A	10.41	3.16	3.25	3.35	3.46	3.70
EPDBEH2010-4-TH3	●			4					A	9.29	4.19	4.32	4.46	4.61	4.94
EPDBEH2010-5-TH3	●			5			50		A	8.39	5.22	5.39	5.57	5.76	6.19
EPDBEH2010-6-TH3	●			6					A	7.65	6.26	6.46	6.67	6.91	7.43
EPDBEH2010-7-TH3	●			7					A	7.03	7.29	7.53	7.78	8.06	8.67
EPDBEH2010-8-TH3	●			8				4	A	6.5	8.32	8.60	8.89	9.21	9.91
EPDBEH2010-9-TH3	●			9					A	6.05	9.36	9.67	10.00	10.36	11.16
EPDBEH2010-10-TH3	●	0.5	1	10	0.8	0.96			A	5.65	10.39	10.74	11.11	11.51	12.40
EPDBEH2010-12-TH3	●			12			55		A	5	12.46	12.88	13.32	13.81	14.89
EPDBEH2010-13-TH3	●			13					A	4.72	13.49	13.95	14.43	14.96	16.13
EPDBEH2010-14-TH3	●			14					A	4.48	14.53	15.02	15.54	16.11	17.37
EPDBEH2010-16-TH3	●			16					A	4.06	16.59	17.16	17.76	18.40	19.86
EPDBEH2010-18-TH3	●			18			60		A	3.71	18.66	19.29	19.97	20.70	22.35
EPDBEH2010-20-TH3	●			20					A	3.42	20.73	21.43	22.19	23.00	24.83
EPDBEH2010-2-S6-TH3	●			2					A	12.92	2.12	2.18	2.24	2.31	2.46
EPDBEH2010-3-S6-TH3	●			3					A	11.86	3.16	3.25	3.35	3.46	3.70
EPDBEH2010-6-S6-TH3	●			6			50	6	A	9.53	6.26	6.46	6.67	6.91	7.43
EPDBEH2010-8-S6-TH3	●			8					A	8.42	8.32	8.60	8.89	9.21	9.91
EPDBEH2010-10-S6-TH3	●			10					A	7.54	10.39	10.74	11.11	11.51	12.40
EPDBEH2011-2-TH3	●			2					A	11.78	2.14	2.20	2.26	2.32	2.47
EPDBEH2011-4-TH3	●			4					A	9.2	4.21	4.34	4.47	4.62	4.95
EPDBEH2011-6-TH3	●	0.55	1.1	6	1	1.05	50	4	A	7.54	6.28	6.47	6.69	6.92	7.44
EPDBEH2011-8-TH3	●			8					A	6.39	8.34	8.61	8.91	9.22	9.93
EPDBEH2011-10-TH3	●			10					A	5.54	10.41	10.75	11.12	11.52	12.41
EPDBEH2012-2-TH3	●			2					A	11.78	2.14	2.19	2.25	2.31	2.46
EPDBEH2012-3-TH3	●			3					A	10.29	3.17	3.26	3.36	3.46	3.70
EPDBEH2012-4-TH3	●			4					A	9.13	4.21	4.33	4.47	4.61	4.94
EPDBEH2012-6-TH3	●			6			50		A	7.45	6.27	6.47	6.68	6.91	7.43
EPDBEH2012-8-TH3	●	0.6	1.2	8	1.1	1.15		4	A	6.29	8.34	8.61	8.90	9.21	9.91
EPDBEH2012-10-TH3	●			10					A	5.44	10.41	10.75	11.12	11.51	12.40
EPDBEH2012-12-TH3	●			12			55		A	4.79	12.48	12.89	13.33	13.81	14.89
EPDBEH2012-2-S6-TH3	●			2			50	6	A	12.94	2.14	2.19	2.25	2.31	2.46
EPDBEH2012-4-S6-TH3	●			4					A	10.92	4.21	4.33	4.47	4.61	4.94
EPDBEH2014-3-TH3	●			3			50		A	10.15	3.19	3.28	3.37	3.47	3.7
EPDBEH2014-8-TH3	●	0.7	1.4	8	1.3	1.34		4	A	6.06	8.36	8.62	8.91	9.22	9.91
EPDBEH2014-12-TH3	●			12			55		A	4.58	12.49	12.90	13.34	13.82	14.89
EPDBEH2014-16-TH3	●			16					A	3.68	16.63	17.18	17.78	18.42	19.86
EPDBEH2015-2-TH3	●			2					A	11.76	2.13	2.18	2.23	2.29	2.42
EPDBEH2015-2.5-TH3	●			2.5					A	10.88	2.65	2.72	2.79	2.87	3.04
EPDBEH2015-3-TH3	●	0.75	1.5	3	1.35	1.45	50	4	A	10.12	3.17	3.25	3.34	3.44	3.66
EPDBEH2015-4-TH3	●			4					A	8.88	4.20	4.32	4.45	4.59	4.91
EPDBEH2015-5-TH3	●			5					A	7.9	5.23	5.39	5.56	5.74	6.15

● : Inventory maintained in US



B type

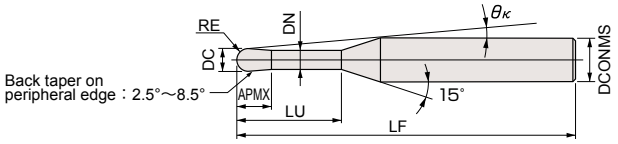
For details of B type, refer to page 11.

EPDBEH2○○○-○○.○○-(S6)-TH3

Item code	Stock	Size(mm)							Type	Interference angle (°)	Effective under neck length with respect to draft angle				
		Ball radius	Tool dia.	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.							
		RE	DC	LU	APMX	DN	LF	DCONMS		θκ	0.5°	1°	1.5°	2°	3°
EPDBEH2015-6-TH3	●	0.75	1.5	6	1.35	1.45	50	4	A	7.12	6.27	6.46	6.67	6.89	7.39
EPDBEH2015-8-TH3	●			8					A	5.95	8.34	8.60	8.88	9.19	9.88
EPDBEH2015-10-TH3	●			10					A	5.1	10.40	10.74	11.10	11.49	12.36
EPDBEH2015-12-TH3	●			12			55		A	4.47	12.47	12.88	13.32	13.79	14.85
EPDBEH2015-14-TH3	●			14					A	3.98	14.54	15.02	15.53	16.09	17.34
EPDBEH2015-16-TH3	●			16					A	3.58	16.60	17.16	17.75	18.39	19.82
EPDBEH2015-18-TH3	●			18			60		A	3.26	18.67	19.30	19.97	20.69	22.31
EPDBEH2015-20-TH3	●			20					A	2.99	20.74	21.44	22.18	22.99	No interference
EPDBEH2015-3-S6-TH3	●			3			50	6	A	11.84	3.17	3.25	3.34	3.44	3.66
EPDBEH2015-5-S6-TH3	●			5					A	10.02	5.23	5.39	5.56	5.74	6.15
EPDBEH2015-8-S6-TH3	●			8					A	8.14	8.34	8.60	8.88	9.19	9.88
EPDBEH2015-12-S6-TH3	●			12					A	6.51	12.47	12.88	13.32	13.79	14.85
EPDBEH2016-4-TH3	●	0.8	1.6	4	1.4	1.54	50	4	A	8.76	4.22	4.34	4.47	4.61	4.92
EPDBEH2016-8-TH3	●			8					A	5.82	8.35	8.62	8.90	9.20	9.89
EPDBEH2016-12-TH3	●			12			55		A	4.35	12.49	12.90	13.33	13.80	14.86
EPDBEH2016-16-TH3	●			16					A	3.47	16.62	17.17	17.77	18.40	19.84
EPDBEH2016-20-TH3	●			20			60		A	2.89	20.76	21.45	22.20	23.00	No interference
EPDBEH2018-4-TH3	●	0.9	1.8	4	1.6	1.73	50	4	A	8.53	4.23	4.35	4.48	4.61	4.92
EPDBEH2018-8-TH3	●			8					A	5.55	8.37	8.63	8.91	9.21	9.89
EPDBEH2018-12-TH3	●			12			55		A	4.11	12.50	12.91	13.34	13.81	14.86
EPDBEH2018-16-TH3	●			16					A	3.26	16.64	17.19	17.78	18.41	19.83
EPDBEH2018-20-TH3	●			20			60		A	2.7	20.77	21.47	22.21	23.01	No interference
EPDBEH2020-2.5-TH3	●	1	2	2.5	1.7	1.94	50	4	A	10.6	2.66	2.72	2.78	2.85	3.01
EPDBEH2020-3-TH3	●			3					A	9.72	3.18	3.25	3.34	3.43	3.63
EPDBEH2020-4-TH3	●			4					A	8.32	4.21	4.32	4.45	4.58	4.87
EPDBEH2020-5-TH3	●			5					A	7.27	5.25	5.39	5.55	5.73	6.11
EPDBEH2020-6-TH3	●			6					A	6.46	6.28	6.46	6.66	6.88	7.36
EPDBEH2020-8-TH3	●			8					A	5.27	8.35	8.60	8.88	9.18	9.84
EPDBEH2020-10-TH3	●			10					A	4.46	10.41	10.74	11.10	11.48	12.33
EPDBEH2020-12-TH3	●			12			55		A	3.86	12.48	12.88	13.31	13.77	14.82
EPDBEH2020-13-TH3	●			13					A	3.62	13.51	13.95	14.42	14.92	16.06
EPDBEH2020-14-TH3	●			14					A	3.4	14.55	15.02	15.53	16.07	17.30
EPDBEH2020-16-TH3	●			16					A	3.04	16.62	17.16	17.75	18.37	19.79
EPDBEH2020-18-TH3	●			18			60		A	2.75	18.68	19.30	19.96	20.67	No interference
EPDBEH2020-20-TH3	●			20					A	2.51	20.75	21.44	22.18	22.97	No interference
EPDBEH2020-22-TH3	●			22					A	2.31	22.82	23.58	24.40	25.27	No interference
EPDBEH2020-25-TH3	●			25			65		A	2.06	25.92	26.79	27.72	28.72	No interference
EPDBEH2020-30-TH3	●			30			70		A	1.75	31.09	32.14	33.26	No interference	No interference
EPDBEH2020-35-TH3	●			35			75		A	1.52	36.26	37.48	38.80	No interference	No interference
EPDBEH2020-40-TH3	●			40			80		A	1.34	41.42	42.83	No interference	No interference	No interference
EPDBEH2020-3-S6-TH3	●			3			50	6	A	11.8	3.18	3.25	3.34	3.43	3.63
EPDBEH2020-6-S6-TH3	●			6					A	9.04	6.28	6.46	6.66	6.88	7.36
EPDBEH2020-8-S6-TH3	●			8					A	7.82	8.35	8.60	8.88	9.18	9.84
EPDBEH2020-12-S6-TH3	●			12					A	6.15	12.48	12.88	13.31	13.77	14.82
EPDBEH2020-16-S6-TH3	●			16					A	5.07	16.62	17.16	17.75	18.37	19.79
EPDBEH2020-20-S6-TH3	●			20			60		A	4.31	20.75	21.44	22.18	22.97	24.76

2Flutes

【Note】RE2 or higher does not have backdraft shape.



A type

(mm)

Ball radius RE	Tolerance on RE
0.05～0.25	±0.003
0.3～6	±0.005

EPDBEH2○○○-○○.○○-(S6)-TH3

Carbide TH3 Helix 30° h4 (ϕ4) h5 (ϕ6～ϕ12)

Item code	Stock	Size(mm)							Type	Interference angle (°)	Effective under neck length with respect to draft angle				
		Ball radius	Tool dia.	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.							
		RE	DC	LU	APMX	DN	LF	DCONMS		θκ	0.5°	1°	1.5°	2°	3°
EPDBEH2025-6-TH3	●	1.25	2.5	6	2	2.4	50	4	A	5.54	6.35	6.53	6.72	6.92	7.39
EPDBEH2025-10-TH3	●			10					A	3.66	10.48	10.81	11.15	11.52	12.36
EPDBEH2025-15-TH3	●			15			55		A	2.57	15.65	16.15	16.69	17.27	No interference
EPDBEH2025-20-TH3	●			20			60		A	1.98	20.82	21.5	22.23	No interference	No interference
EPDBEH2025-25-TH3	●			25			65		A	1.61	25.99	26.85	27.78	No interference	No interference
EPDBEH2025-30-TH3	●			30			70		A	1.36	31.16	32.2	No interference	No interference	No interference
EPDBEH2030-6-TH3	●	1.5	3	6	2.5	2.88	50	6	A	8.27	6.38	6.55	6.73	6.93	7.38
EPDBEH2030-8-TH3	●			8			55		A	6.95	8.45	8.69	8.95	9.23	9.86
EPDBEH2030-10-TH3	●			10					A	5.98	10.51	10.83	11.17	11.53	12.35
EPDBEH2030-13-TH3	●			13			60		A	4.95	13.61	14.04	14.49	14.98	16.08
EPDBEH2030-16-TH3	●			16					A	4.23	16.71	17.25	17.82	18.43	19.81
EPDBEH2030-20-TH3	●			20			65		A	3.53	20.85	21.52	22.25	23.03	24.78
EPDBEH2030-25-TH3	●			25			70		A	2.93	26.02	26.87	27.79	28.78	No interference
EPDBEH2030-30-TH3	●			30			75		A	2.51	31.19	32.22	33.33	34.53	No interference
EPDBEH2030-35-TH3	●			35			80		A	2.19	36.35	37.57	38.87	40.28	No interference
EPDBEH2035-10-TH3	●	1.75	3.5	10	2.75	3.35	55	6	A	5.42	10.56	10.87	11.20	11.56	12.36
EPDBEH2035-15-TH3	●			15			60		A	3.94	15.73	16.22	16.74	17.31	18.58
EPDBEH2035-25-TH3	●			25			70		A	2.54	26.07	26.92	27.83	28.81	No interference
EPDBEH2035-35-TH3	●			35			80		A	1.88	36.4	37.61	38.91	No interference	No interference
EPDBEH2035-45-TH3	●			45			90		A	1.49	46.74	48.31	No interference	No interference	No interference
EPDBEH2040-8-TH3	●	2	4	8	3	3.85	55	6	A	5.71	8.49	8.71	8.96	9.22	9.81
EPDBEH2040-10-TH3	●			10					A	4.76	10.55	10.85	11.17	11.52	12.30
EPDBEH2040-12-TH3	●			12			60		A	4.09	12.62	12.99	13.39	13.82	14.79
EPDBEH2040-13-TH3	●			13					A	3.82	13.65	14.06	14.50	14.97	16.03
EPDBEH2040-16-TH3	●			16					A	3.18	16.76	17.27	17.82	18.42	19.76
EPDBEH2040-20-TH3	●			20			65		A	2.61	20.89	21.55	22.26	23.02	No interference
EPDBEH2040-25-TH3	●			25			70		A	2.13	26.06	26.9	27.80	28.77	No interference
EPDBEH2040-30-TH3	●			30			75		A	1.79	31.23	32.25	33.34	No interference	No interference
EPDBEH2040-35-TH3	●			35			80		A	1.55	36.4	37.6	38.88	No interference	No interference
EPDBEH2040-40-TH3	●			40					A	1.37	41.56	42.94	No interference	No interference	No interference
EPDBEH2040-45-TH3	●			45			90		A	1.22	46.73	48.29	No interference	No interference	No interference
EPDBEH2040-50-TH3	●			50			100		A	1.11	51.9	53.64	No interference	No interference	No interference
EPDBEH2050-10-TH3	●	2.5	5	10	3.5	4.85	55	6	A	2.97	10.54	10.82	11.12	No interference	No interference
EPDBEH2050-20-TH3	●			20			65		A	1.46	20.87	21.52	No interference	No interference	No interference
EPDBEH2050-25-TH3	●			25			70		A	1.17	26.04	26.86	No interference	No interference	No interference
EPDBEH2050-30-TH3	●			30			75		A	0.97	31.21	No interference	No interference	No interference	No interference
EPDBEH2050-40-TH3	●			40			80		A	0.73	41.55	No interference	No interference	No interference	No interference
EPDBEH2060-12-TH3	●	3	6	12	6	5.85	60	6	A	0	No interference	No interference	No interference	No interference	No interference
EPDBEH2060-20-TH3	●			20			65		A	0	No interference	No interference	No interference	No interference	No interference
EPDBEH2060-30-TH3	●			30			75		A	0	No interference	No interference	No interference	No interference	No interference
EPDBEH2060-50-TH3	●			50			100		A	0	No interference	No interference	No interference	No interference	No interference
EPDBEH2080-24-TH3	●	4	8	24	12	7.6	100	8	A	0	No interference	No interference	No interference	No interference	No interference
EPDBEH2100-30-TH3	●	5	10	30	15	9.5	100	10	A	0	No interference	No interference	No interference	No interference	No interference
EPDBEH2120-36-TH3	●	6	12	36	18	11.5	110	12	A	0	No interference	No interference	No interference	No interference	No interference

● : Inventory maintained in US

Recommended Cutting Conditions (Inch)

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.21 about high accuracy cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35~45HRC)		Hardened steels (45~55HRC)		Hardened steels (55~65HRC)		Hardened steels (65~68HRC)		Hardened steels (68~72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
0.05	0.1	**0.08**	.0002	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
		0.2	.0002	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
		0.3	.0002	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
		0.5	.0001	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
0.075	0.15	**0.12**	.0004	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		0.3	.0004	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		0.5	.0003	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		0.75	.0003	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		1	.0002	46,000	9.1	41,400	7.5	37,800	5.9	33,750	5.1	31,950	3.9
0.1	0.2	**0.15**	.0006	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		0.3	.0006	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		0.5	.0006	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		0.75	.0006	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		1	.0004	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		1.25	.0004	45,900	10.6	40,500	8.7	37,800	6.7	34,020	5.9	32,130	4.7
		1.5	.0002	45,900	10.6	40,500	8.7	37,800	6.7	34,020	5.9	32,130	4.7
		2	.0002	45,900	10.6	40,500	8.7	37,800	6.7	34,020	5.9	32,130	4.7
		2.5	.0002	40,800	8.3	36,000	6.7	33,600	5.1	30,240	4.7	28,560	3.5
		3	.0001	40,800	8.3	36,000	6.7	33,600	5.1	30,240	4.7	28,560	3.5
0.15	0.3	**0.25**	.0009	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		0.5	.0009	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		0.75	.0007	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		1	.0007	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		1.25	.0006	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		1.5	.0005	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		2	.0004	45,900	14.6	40,500	12.2	37,800	10.6	34,020	9.8	32,130	7.5
		2.5	.0003	45,900	14.6	40,500	12.2	37,800	10.6	34,020	9.8	32,130	7.5
		3	.0002	45,900	14.6	40,500	12.2	37,800	10.6	34,020	9.8	32,130	7.5
		3.5	.0002	36,720	10.2	29,400	8.3	26,400	7.1	23,760	6.3	22,440	5.1
		4	.0001	36,720	10.2	29,400	8.3	26,400	7.1	23,760	6.3	22,440	5.1
0.2	0.4	**0.3**	.0013	50,000	30.3	46,800	26.0	43,680	24.0	39,310	21.7	37,130	16.9
		0.5	.0013	50,000	30.3	46,800	26.0	43,680	24.0	39,310	21.7	37,130	16.9
		0.75	.0013	50,000	30.3	46,800	26.0	43,680	24.0	39,310	21.7	37,130	16.9
		1	.0013	50,000	30.3	46,800	26.0	43,680	24.0	39,310	21.7	37,130	16.9
		1.5	.0011	50,000	26.0	46,800	18.5	43,680	17.3	39,310	15.4	37,130	12.2
		2	.0009	50,000	21.7	46,800	18.5	43,680	17.3	39,310	15.4	37,130	12.2
		2.5	.0007	36,720	14.2	32,400	11.4	36,290	10.6	32,660	9.8	30,850	7.5
		3	.0005	36,720	14.2	32,400	11.4	36,290	10.6	32,660	9.8	30,850	7.5
		3.5	.0004	36,720	14.2	32,400	11.4	36,290	10.6	32,660	9.8	30,850	7.5
		4	.0003	36,720	14.2	32,400	11.4	36,290	10.6	32,660	9.8	30,850	7.5
		4.5	.0002	32,640	12.2	28,800	9.8	26,880	9.1	24,190	8.3	22,850	6.3
		5	.0002	32,640	12.2	28,800	9.8	26,880	9.1	24,190	8.3	22,850	6.3
0.25	0.5	**0.35**	.0014	50,000	46.9	47,130	41.3	43,930	29.1	39,820	26.4	37,560	20.5
		0.75	.0014	50,000	46.9	47,130	41.3	43,930	29.1	39,820	26.4	37,560	20.5
		1	.0014	50,000	46.9	47,130	41.3	43,930	29.1	39,820	26.4	37,560	20.5
		1.5	.0013	50,000	46.9	47,130	41.3	43,930	26.8	39,820	24.0	37,560	18.9
		2	.0011	50,000	37.8	47,130	33.1	43,930	26.8	39,820	24.0	37,560	18.9
		2.5	.0010	45,450	25.6	42,840	22.4	39,940	19.7	36,220	17.7	34,180	13.8
		3	.0009	45,450	25.6	42,840	22.4	39,940	15.4	36,220	13.8	34,180	10.6
		4	.0006	34,970	19.7	32,950	20.5	30,730	15.4	28,540	13.8	26,290	10.6
		5	.0006	34,970	19.7	32,950	20.5	30,730	15.4	28,540	13.8	26,290	10.6
		5.5	.0005	31,080	16.5	29,300	14.6	27,310	12.6	24,770	11.4	23,370	9.1
		6	.0004	31,080	16.5	29,300	14.6	27,310	12.6	24,770	11.4	23,370	9.1
		7	.0003	31,080	16.5	29,300	14.6	27,310	12.6	24,770	11.4	23,370	9.1
		8	.0002	31,080	16.5	29,300	14.6	27,310	12.6	24,770	11.4	23,370	9.1
0.3	0.6	**0.4**	.0024	50,000	76.8	48,000	68.1	44,800	52.8	40,320	47.6	38,080	37.0
		0.75	.0024	50,000	76.8	48,000	68.1	44,800	52.8	40,320	47.6	38,080	37.0

【Note】 Upon usage, please refer to comments and notes below table on page 20.

Recommended Cutting Conditions (Inch)

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.21 about high accuracy cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35~45HRC)		Hardened steels (45~55HRC)		Hardened steels (55~65HRC)		Hardened steels (65~68HRC)		Hardened steels (68~72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
0.3	0.6	1	.0024	50,000	76.8	48,000	68.1	44,800	52.8	40,320	47.6	38,080	37.0
		1.5	.0022	50,000	76.8	48,000	68.1	44,800	52.8	40,320	47.6	38,080	37.0
		2	.0020	50,000	76.8	48,000	68.1	44,800	52.8	40,320	47.6	38,080	37.0
		2.5	.0014	50,000	61.4	48,000	54.3	44,800	39.0	40,320	35.0	38,080	27.2
		3	.0013	50,000	61.4	48,000	54.3	44,800	39.0	40,320	35.0	38,080	27.2
		3.5	.0011	48,960	57.1	43,200	46.5	40,320	33.1	36,290	29.9	34,270	23.2
		4	.0008	48,960	57.1	43,200	46.5	40,320	30.3	36,290	27.2	34,270	21.3
		4.5	.0007	45,900	42.1	40,500	34.6	37,800	26.8	34,020	24.0	32,130	18.9
		5	.0006	39,780	36.6	35,100	29.9	32,760	23.2	29,480	20.9	27,850	16.1
		5.5	.0006	39,780	36.6	35,100	29.9	32,760	23.2	29,480	20.9	27,850	16.1
		6	.0005	39,780	36.6	35,100	29.9	32,760	23.2	29,480	20.9	27,850	16.1
		7	.0005	27,200	23.6	24,000	19.3	22,400	16.5	20,160	14.6	19,040	11.4
		8	.0005	27,200	23.6	24,000	19.3	22,400	15.0	20,160	13.4	19,040	10.6
		9	.0004	27,200	23.6	24,000	19.3	22,400	15.0	20,160	13.4	19,040	10.6
		10	.0003	23,800	20.9	21,000	16.9	19,600	13.0	17,640	11.8	16,660	9.1
		12	.0002	20,400	16.5	18,000	13.8	16,800	10.6	15,120	9.4	14,280	7.5
0.35	0.7	0.45	.0029	50,000	85.0	48,000	76.0	44,800	46.9	40,320	42.1	38,080	32.7
		2	.0029	50,000	85.0	48,000	76.0	44,800	46.9	40,320	42.1	38,080	32.7
		4	.0013	48,960	63.0	43,200	52.0	43,870	33.5	39,480	29.9	37,370	23.2
		6	.0009	39,780	40.6	35,100	33.5	35,650	25.2	32,080	22.8	30,370	17.7
		8	.0006	27,200	24.8	24,000	20.5	24,370	16.5	21,940	15.0	20,760	11.8
0.4	0.8	0.5	.0047	50,000	94.5	48,000	102.0	44,800	74.0	40,320	66.5	38,080	52.0
		1	.0047	50,000	94.5	48,000	102.0	44,800	74.0	40,320	66.5	38,080	52.0
		1.5	.0047	50,000	94.5	48,000	102.0	44,800	74.0	40,320	66.5	38,080	52.0
		2	.0038	50,000	94.5	48,000	102.0	44,800	74.0	40,320	66.5	38,080	52.0
		2.5	.0035	50,000	94.5	48,000	102.0	44,800	74.0	40,320	66.5	38,080	52.0
		3	.0031	50,000	94.5	48,000	102.0	44,800	74.0	40,320	66.5	38,080	52.0
		4	.0025	50,000	94.5	48,000	102.0	44,800	74.0	40,320	66.5	38,080	52.0
		5	.0019	48,960	83.1	43,200	83.5	40,320	59.8	36,290	53.9	34,270	42.1
		6	.0013	42,840	68.1	37,800	56.3	35,280	49.2	31,750	44.1	29,990	34.3
		8	.0006	35,360	40.2	31,200	33.1	29,120	28.7	26,210	26.0	24,750	20.1
		10	.0006	27,200	29.1	24,000	24.0	22,400	20.9	20,160	18.9	19,040	14.6
		12	.0004	27,200	29.1	24,000	24.0	22,400	20.9	20,160	18.9	19,040	14.6
0.45	0.9	0.6	.0043	50,000	111.0	45,600	94.9	42,560	84.3	38,300	76.0	36,180	59.1
		2	.0043	50,000	111.0	45,600	94.9	42,560	84.3	38,300	76.0	36,180	59.1
		4	.0026	48,450	93.3	42,750	77.2	39,900	68.5	35,910	61.4	33,920	48.0
		6	.0017	40,700	59.8	35,910	49.2	33,520	43.7	30,160	39.4	28,490	30.7
		8	.0011	31,010	41.3	27,360	34.3	25,540	30.3	22,980	27.2	21,710	21.3
0.5	1	0.8	.0071	45,900	122.0	43,200	107.1	37,800	89.4	34,020	80.3	32,130	62.6
		1.5	.0071	45,900	122.0	43,200	107.1	37,800	89.4	34,020	80.3	32,130	62.6
		2	.0063	45,900	122.0	43,200	107.1	37,800	89.4	34,020	80.3	32,130	62.6
		2.5	.0063	45,900	122.0	43,200	107.1	37,800	89.4	34,020	80.3	32,130	62.6
		3	.0063	45,900	122.0	43,200	107.1	37,800	89.4	34,020	80.3	32,130	62.6
		4	.0044	45,900	122.0	43,200	107.1	37,800	89.4	34,020	80.3	32,130	62.6
		5	.0028	39,780	102.4	43,200	100.0	32,760	72.4	29,480	65.0	27,850	50.4
		6	.0019	38,560	91.3	38,880	92.5	29,480	54.3	26,540	48.8	25,060	38.2
		7	.0019	33,050	52.8	31,590	52.0	27,220	41.7	24,490	37.8	23,130	29.1
		8	.0019	33,050	52.8	31,590	52.0	27,220	38.6	24,490	34.6	23,130	27.2
		9	.0014	33,050	52.8	31,590	52.0	27,220	38.6	24,490	34.6	23,130	27.2
		10	.0012	33,050	52.8	31,590	52.0	27,220	38.6	24,490	34.6	23,130	27.2
		12	.0008	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		13	.0007	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		14	.0006	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		16	.0005	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		18	.0004	21,420	30.3	18,900	25.2	17,640	22.0	15,880	20.1	14,990	15.7
		20	.0003	18,360	26.0	16,200	21.3	15,120	18.9	13,610	17.3	12,850	13.4

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.21 about high accuracy cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35～45HRC)		Hardened steels (45～55HRC)		Hardened steels (55～65HRC)		Hardened steels (65～68HRC)		Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
0.55	1.1	2	.0063	42,840	115.4	37,800	96.5	35,280	85.8	31,750	77.2	29,990	59.8
		4	.0044	42,840	115.4	37,800	96.5	35,280	85.8	31,750	77.2	29,990	59.8
		6	.0019	33,810	67.3	29,840	56.3	27,850	50.0	25,060	44.9	23,670	35.0
		8	.0019	31,210	51.6	27,540	43.3	25,700	38.6	23,130	34.6	21,850	26.8
		10	.0012	31,210	51.6	27,540	43.3	25,700	38.6	23,130	34.6	21,850	26.8
0.6	1.2	2	.0061	39,230	107.1	36,920	100.8	32,310	73.2	29,080	65.7	27,460	51.2
		3	.0061	39,230	107.1	36,920	100.8	32,310	73.2	29,080	65.7	27,460	51.2
		4	.0050	39,230	107.1	36,920	100.8	32,310	73.2	29,080	65.7	27,460	51.2
		6	.0035	39,230	107.1	36,920	100.8	32,310	73.2	29,080	65.7	27,460	51.2
		8	.0019	31,820	81.5	30,240	81.1	26,210	41.3	23,590	37.0	22,280	28.7
		10	.0017	29,380	52.0	27,000	42.1	24,190	34.3	21,770	30.7	20,560	24.0
		12	.0014	29,380	52.0	25,920	40.6	24,190	34.3	21,770	30.7	20,560	24.0
0.7	1.4	3	.0062	33,420	92.5	29,480	78.3	27,520	70.5	24,770	63.4	23,390	49.2
		8	.0035	27,850	71.3	24,570	60.2	22,930	54.3	20,640	48.8	19,490	37.8
		12	.0017	25,700	49.2	22,680	41.7	21,170	37.4	19,050	33.9	17,990	26.4
		16	.0011	19,040	34.3	16,800	29.1	15,680	26.4	14,110	23.6	13,330	18.5
0.75	1.5	2	.0076	35,700	126.4	31,500	100.4	29,400	87.0	26,460	78.3	24,990	60.6
		2.5	.0076	35,700	126.4	31,500	100.4	29,400	87.0	26,460	78.3	24,990	60.6
		3	.0076	35,700	126.4	31,500	100.4	29,400	87.0	26,460	78.3	24,990	60.6
		4	.0063	35,700	126.4	31,500	100.4	29,400	87.0	26,460	78.3	24,990	60.6
		5	.0063	35,700	126.4	31,500	100.4	29,400	87.0	26,460	78.3	24,990	60.6
		6	.0063	35,700	126.4	31,500	100.4	29,400	87.0	26,460	78.3	24,990	60.6
		8	.0028	27,850	71.3	24,570	56.3	22,930	48.8	20,640	44.1	19,490	34.3
		10	.0028	25,700	65.7	22,680	52.0	21,170	44.9	19,050	40.6	17,990	31.5
		12	.0028	25,700	54.7	22,680	43.3	21,170	37.4	19,050	33.9	17,990	26.4
		14	.0024	22,850	46.1	20,160	36.6	18,820	31.5	16,930	28.3	15,990	22.0
		16	.0012	19,040	38.2	16,800	30.3	15,680	26.4	14,110	23.6	13,330	18.5
		18	.0012	19,040	38.2	16,800	30.3	15,680	26.4	14,110	23.6	13,330	18.5
		20	.0012	19,040	38.2	16,800	30.3	15,680	26.4	14,110	23.6	13,330	18.5
0.8	1.6	4	.0091	33,110	131.5	29,210	112.2	25,320	83.9	22,780	75.6	21,520	58.7
		8	.0069	30,940	98.0	27,300	83.9	23,660	62.6	21,290	56.3	20,110	43.7
		12	.0031	27,850	85.8	24,570	73.2	21,290	50.8	19,170	45.7	18,100	35.4
		16	.0019	23,870	52.4	21,060	44.9	19,660	39.0	17,690	35.0	16,710	27.2
		20	.0013	17,680	36.6	15,600	31.5	14,560	27.2	13,100	24.4	12,380	19.3
0.9	1.8	4	.0114	28,730	94.9	25,350	79.1	23,660	66.9	21,290	60.2	20,110	46.9
		8	.0082	28,730	94.9	25,350	79.1	23,660	66.9	21,290	60.2	20,110	46.9
		12	.0033	23,870	59.1	21,060	49.2	19,660	41.7	17,690	37.8	16,710	29.1
		16	.0021	23,870	59.1	21,060	49.2	19,660	41.7	17,690	37.8	16,710	29.1
		20	.0014	17,680	41.3	15,600	34.6	14,560	29.1	13,100	26.4	12,380	20.5
1	2	2.5	.0126	26,780	142.5	23,630	120.1	22,050	104.3	19,850	93.7	18,740	72.8
		3	.0126	26,780	142.5	23,630	120.1	22,050	104.3	19,850	93.7	18,740	72.8
		4	.0126	26,780	142.5	23,630	120.1	22,050	104.3	19,850	93.7	18,740	72.8
		5	.0126	26,780	142.5	23,630	120.1	22,050	104.3	19,850	93.7	18,740	72.8
		6	.0126	26,780	126.4	23,630	105.9	22,050	93.7	19,850	84.3	18,740	65.7
		8	.0088	26,780	126.4	23,630	105.9	22,050	93.7	19,850	84.3	18,740	65.7
		10	.0066	24,990	106.3	22,050	88.6	19,110	57.9	17,200	52.0	16,240	40.6
		12	.0038	22,490	95.7	19,850	80.7	17,200	52.0	15,480	46.9	14,620	36.6
		13	.0038	22,490	95.7	19,850	79.5	15,880	40.2	14,290	36.2	13,500	28.0
		14	.0038	22,490	83.1	18,430	64.2	15,880	40.2	14,290	36.2	13,500	28.0
		16	.0038	20,890	53.1	18,430	57.9	15,880	35.8	14,290	32.3	13,500	25.2
		18	.0028	19,280	49.2	18,430	53.1	15,880	35.8	14,290	32.3	13,500	25.2
		20	.0024	19,280	49.2	18,430	44.5	15,880	35.8	14,290	32.3	13,500	25.2
		22	.0016	15,170	36.6	13,390	30.3	14,990	32.3	13,500	28.7	12,750	22.4
		25	.0016	14,280	34.3	12,600	28.7	14,110	30.3	12,700	27.2	12,000	21.3
		30	.0009	14,280	34.3	12,600	28.7	14,110	30.3	12,700	27.2	12,000	21.3
		35	.0008	12,500	28.3	11,030	23.6	10,290	20.9	9,260	18.5	8,750	14.6
		40	.0007	10,710	24.4	9,450	20.1	8,820	17.7	7,940	16.1	7,500	12.6

【Note】 Upon usage, please refer to comments and notes below table on page 20.

Recommended Cutting Conditions (Inch)

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.21 about high accuracy cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35～45HRC)		Hardened steels (45～55HRC)		Hardened steels (55～65HRC)		Hardened steels (65～68HRC)		Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
1.25	2.5	6	.0157	23,590	149.6	20,810	121.7	19,430	99.6	17,480	89.8	16,610	71.7
		10	.0107	23,590	149.6	20,810	121.7	19,430	99.6	17,480	89.8	16,610	71.7
		15	.0047	18,400	83.9	16,230	79.5	15,150	55.9	13,640	50.4	12,950	40.2
		20	.0038	16,980	64.6	16,230	57.1	13,990	42.9	12,590	38.6	11,960	31.1
		25	.0031	16,980	58.3	14,990	47.2	13,990	38.6	12,590	34.6	11,960	28.0
		30	.0017	12,580	45.3	11,100	36.6	10,360	30.3	9,320	27.2	8,860	21.7
1.5	3	6	.0189	20,400	161.4	18,000	133.9	16,800	118.9	15,120	107.1	14,360	85.8
		8	.0189	20,400	161.4	18,000	133.9	16,800	118.9	15,120	107.1	14,360	85.8
		10	.0132	20,400	161.4	18,000	133.9	16,800	118.9	15,120	107.1	14,360	85.8
		13	.0099	19,040	120.5	16,800	100.0	15,680	89.0	14,110	79.9	13,410	64.2
		16	.0099	19,040	108.7	16,800	90.2	14,560	74.4	13,100	66.9	12,450	53.5
		20	.0057	15,910	75.6	14,040	62.6	12,100	51.6	10,890	46.5	10,340	37.0
		25	.0038	15,910	75.6	14,040	62.6	12,100	51.6	10,890	46.5	10,340	37.0
		30	.0038	14,690	69.7	12,960	57.9	12,100	51.6	10,890	46.5	10,340	37.0
		35	.0025	10,880	48.8	9,600	40.6	10,750	43.3	9,680	39.0	9,190	31.1
1.75	3.5	10	.0129	15,190	108.3	13,410	88.2	12,510	72.0	11,260	65.0	10,700	52.0
		15	.0113	15,190	108.3	13,410	88.2	12,510	72.0	11,260	65.0	10,700	52.0
		25	.0066	12,620	67.3	11,140	54.7	10,400	44.9	9,360	40.6	8,890	32.3
		35	.0028	12,620	67.3	11,140	54.7	10,400	44.9	9,360	40.6	8,890	32.3
		45	.0028	9,350	47.2	8,250	38.6	7,700	31.5	6,930	28.3	6,580	22.8
2	4	8	.0189	14,660	155.9	12,940	129.9	12,080	114.2	10,870	102.8	10,320	82.3
		10	.0189	14,660	155.9	12,940	129.9	12,080	114.2	10,870	102.8	10,320	82.3
		12	.0151	14,660	155.9	12,940	129.9	12,080	114.2	10,870	102.8	10,320	82.3
		13	.0151	14,660	155.9	12,940	129.9	12,080	114.2	10,870	102.8	10,320	82.3
		16	.0132	14,660	155.9	12,940	129.9	12,080	114.2	10,870	102.8	10,320	82.3
		20	.0132	12,710	108.3	11,210	90.2	10,470	79.1	9,420	71.3	8,950	57.1
		25	.0076	11,440	87.4	10,090	85.0	9,420	64.2	8,480	57.5	8,050	46.1
		30	.0050	10,560	67.3	9,320	56.3	8,690	49.2	7,820	44.5	7,430	35.4
		35	.0031	10,560	67.3	9,320	56.3	8,690	49.2	7,820	44.5	7,430	35.4
		40	.0031	10,560	67.3	9,320	56.3	8,690	49.2	7,820	44.5	7,430	35.4
		45	.0031	7,820	47.2	6,900	39.4	6,440	34.6	5,800	31.1	5,510	24.8
		50	.0031	7,820	47.2	6,900	39.4	6,440	34.6	5,800	31.1	5,510	24.8
2.5	5	10	.0230	10,710	126.4	9,450	111.8	8,820	93.7	7,940	84.3	7,540	67.3
		20	.0165	10,710	126.4	9,450	111.8	8,820	93.7	7,940	84.3	7,540	67.3
		25	.0165	9,950	117.3	8,780	103.5	8,190	87.0	7,370	78.3	7,000	62.6
		30	.0094	8,950	105.9	7,900	93.3	7,370	78.3	6,630	70.5	6,300	56.3
		40	.0063	8,260	58.7	7,290	51.6	6,800	43.3	6,120	39.0	5,820	31.1
3	6	12	.0189	11,480	167.3	10,130	136.2	9,450	111.8	8,510	100.4	8,080	80.3
		20	.0157	10,840	146.9	9,560	119.3	8,930	98.0	8,030	88.2	7,630	70.5
		30	.0132	8,840	83.5	7,800	79.9	7,280	61.8	6,550	55.5	6,220	44.5
		50	.0047	7,340	62.6	6,480	55.1	6,050	46.5	5,440	41.7	5,170	33.5
4	8	24	.0197	8,750	134.6	7,550	102.4	7,100	96.5	6,390	72.8	5,750	50.0
5	10	30	.0236	7,000	118.1	6,050	88.6	5,680	83.9	5,110	63.4	4,600	40.6
6	12	36	.0315	5,850	102.4	5,050	78.0	4,720	72.4	4,250	56.7	3,820	34.6

※(1) a_p is shown as the criteria for Group 1 workpieces. For other groups, adjust the cutting depth according to the cutting depth factors in the above table.
※(2) When performing cutting where cutting chips may cause clogging, such as for rib cutting, blind grooves, etc., cutting depth setting should be set by multiplying a cutting depth factor to calculate the cutting depth amount, and this amount should then be reduced to 80% of the calculated value.
※(3) Adjust by setting a_e to (3 to 5)×(a_p)×(cutting depth ratio). When performing finishing processing, calculate the theoretical cusp height and set accordingly.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDBEH2020-10-TH3 tool:
Cutting depth = .0066 (a_p) × .85 (cutting depth factor for Group 2 hardened steel) × .8 (for closed-area cutting) = .0045 inch

【Note】

① Although basically dry (air blow) cutting is recommended, please use appropriate coolant according to the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

High efficiency cutting condition

High accuracy cutting condition

Please refer to P.17 about high efficiency cutting conditions

Work material				1 Pre-hardened steels (35～45HRC)		2 Hardened steels (45～55HRC)		3 Hardened steels (55～65HRC)		4 Hardened steels (65～68HRC)		5 Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
0.05	**0.1**	**0.08**	.0001	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
		0.2	.0001	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
		0.3	.0001	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
		0.5	.0001	50,000	9.1	50,000	7.9	50,000	7.5	45,000	6.7	42,500	5.1
0.075	**0.15**	**0.12**	.0003	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		0.3	.0003	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		0.5	.0002	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		0.75	.0002	50,000	11.0	46,000	9.1	42,000	7.1	37,500	6.3	35,500	4.7
		1	.0001	46,000	9.1	41,400	7.5	37,800	5.9	33,750	5.1	31,950	3.9
0.1	**0.2**	**0.15**	.0005	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		0.3	.0005	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		0.5	.0005	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		0.75	.0004	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		1	.0004	50,000	13.0	45,500	10.6	42,000	8.3	37,800	7.5	35,700	5.9
		1.25	.0002	45,900	10.6	40,500	8.7	37,800	6.7	34,020	5.9	32,130	4.7
		1.5	.0002	45,900	10.6	40,500	8.7	37,800	6.7	34,020	5.9	32,130	4.7
		2	.0002	45,900	10.6	40,500	8.7	37,800	6.7	34,020	5.9	32,130	4.7
		2.5	.0002	40,800	8.3	36,000	6.7	33,600	5.1	30,240	4.7	28,560	3.5
		3	.0001	40,800	8.3	36,000	6.7	33,600	5.1	30,240	4.7	28,560	3.5
0.15	**0.3**	**0.25**	.0006	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		0.5	.0006	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		0.75	.0006	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		1	.0005	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		1.25	.0004	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		1.5	.0004	50,000	17.7	45,000	15.0	42,000	13.4	37,800	11.8	35,700	9.4
		2	.0003	45,900	14.6	40,500	12.2	37,800	10.6	34,020	9.8	32,130	7.5
		2.5	.0002	45,900	14.6	40,500	12.2	37,800	10.6	34,020	9.8	32,130	7.5
		3	.0002	45,900	14.6	40,500	12.2	37,800	10.6	34,020	9.8	32,130	7.5
		3.5	.0001	36,720	10.2	29,400	8.3	26,400	7.1	23,760	6.3	22,440	5.1
		4	.0001	36,720	10.2	29,400	8.3	26,400	7.1	23,760	6.3	22,440	5.1
0.2	**0.4**	**0.3**	.0013	40,800	17.7	36,000	14.2	33,600	13.4	30,240	11.8	28,560	9.4
		0.5	.0013	40,800	17.7	36,000	14.2	33,600	13.4	30,240	11.8	28,560	9.4
		0.75	.0013	40,800	17.7	36,000	14.2	33,600	13.4	30,240	11.8	28,560	9.4
		1	.0013	40,800	17.7	36,000	14.2	33,600	13.4	30,240	11.8	28,560	9.4
		1.5	.0011	40,800	17.7	36,000	14.2	33,600	13.4	30,240	11.8	28,560	9.4
		2	.0009	40,800	17.7	36,000	14.2	33,600	13.4	30,240	11.8	28,560	9.4
		2.5	.0005	36,720	14.2	32,400	11.4	30,240	10.6	27,220	9.8	25,700	7.5
		3	.0004	36,720	14.2	32,400	11.4	30,240	10.6	27,220	9.8	25,700	7.5
		3.5	.0002	36,720	14.2	32,400	11.4	30,240	10.6	27,220	9.8	25,700	7.5
		4	.0002	36,720	14.2	32,400	11.4	30,240	10.6	27,220	9.8	25,700	7.5
		4.5	.0001	32,640	12.2	28,800	9.8	26,880	9.1	24,190	8.3	22,850	6.3
		5	.0001	32,640	12.2	28,800	9.8	26,880	9.1	24,190	8.3	22,850	6.3
0.25	**0.5**	**0.35**	.0014	34,000	24.0	30,000	21.3	28,000	18.9	25,200	16.9	23,800	13.0
		0.75	.0014	34,000	24.0	30,000	21.3	28,000	18.9	25,200	16.9	23,800	13.0
		1	.0014	34,000	24.0	30,000	21.3	28,000	18.9	25,200	16.9	23,800	13.0
		1.5	.0013	34,000	24.0	30,000	21.3	28,000	18.9	25,200	16.9	23,800	13.0
		2	.0011	34,000	24.0	30,000	21.3	28,000	18.9	25,200	16.9	23,800	13.0
		2.5	.0010	30,600	19.7	27,000	17.3	25,200	15.4	22,680	13.8	21,420	10.6
		3	.0009	30,600	19.7	27,000	17.3	25,200	15.4	22,680	13.8	21,420	10.6
		4	.0006	30,600	19.7	27,000	17.3	25,200	15.4	22,680	13.8	21,420	10.6
		5	.0006	30,600	19.7	27,000	17.3	25,200	15.4	22,680	13.8	21,420	10.6
		5.5	.0002	27,200	16.5	24,000	14.6	22,400	12.6	20,160	11.4	19,040	9.1
		6	.0002	27,200	16.5	24,000	14.6	22,400	12.6	20,160	11.4	19,040	9.1
		7	.0002	27,200	16.5	24,000	14.6	22,400	12.6	20,160	11.4	19,040	9.1
		8	.0001	27,200	16.5	24,000	14.6	22,400	12.6	20,160	11.4	19,040	9.1
0.3	**0.6**	**0.4**	.0016	34,000	34.6	30,000	28.3	28,000	22.0	25,200	19.7	23,800	15.4
		0.75	.0016	34,000	34.6	30,000	28.3	28,000	22.0	25,200	19.7	23,800	15.4

【Note】 Upon usage, please refer to comments and notes below table on page 24.

Recommended Cutting Conditions (Inch)

High efficiency cutting condition

High accuracy cutting condition

Please refer to P.17 about high efficiency cutting conditions

Work material				1 Pre-hardened steels (35～45HRC)		2 Hardened steels (45～55HRC)		3 Hardened steels (55～65HRC)		4 Hardened steels (65～68HRC)		5 Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
0.3	0.6	1	.0016	34,000	34.6	30,000	28.3	28,000	22.0	25,200	19.7	23,800	15.4
		1.5	.0015	34,000	34.6	30,000	28.3	28,000	22.0	25,200	19.7	23,800	15.4
		2	.0013	34,000	34.6	30,000	28.3	28,000	22.0	25,200	19.7	23,800	15.4
		2.5	.0012	34,000	34.6	30,000	28.3	28,000	22.0	25,200	19.7	23,800	15.4
		3	.0011	34,000	34.6	30,000	28.3	28,000	22.0	25,200	19.7	23,800	15.4
		3.5	.0009	30,600	29.9	27,000	24.4	25,200	18.9	22,680	16.9	21,420	13.4
		4	.0007	30,600	29.9	27,000	24.4	25,200	18.9	22,680	16.9	21,420	13.4
		4.5	.0007	30,600	28.3	27,000	22.8	25,200	17.7	22,680	16.1	21,420	12.6
		5	.0006	30,600	28.3	27,000	22.8	25,200	17.7	22,680	16.1	21,420	12.6
		5.5	.0006	30,600	28.3	27,000	22.8	25,200	17.7	22,680	16.1	21,420	12.6
		6	.0005	30,600	28.3	27,000	22.8	25,200	17.7	22,680	16.1	21,420	12.6
		7	.0002	27,200	23.6	24,000	19.3	22,400	15.0	20,160	13.4	19,040	10.6
		8	.0002	27,200	23.6	24,000	19.3	22,400	15.0	20,160	13.4	19,040	10.6
		9	.0002	27,200	23.6	24,000	19.3	22,400	15.0	20,160	13.4	19,040	10.6
		10	.0002	23,800	20.9	21,000	16.9	19,600	13.0	17,640	11.8	16,660	9.1
		12	.0001	20,400	16.5	18,000	13.8	16,800	10.6	15,120	9.4	14,280	7.5
0.35	0.7	0.45	.0019	34,000	38.6	30,000	31.9	28,000	26.0	25,200	23.2	23,800	18.1
		2	.0019	34,000	38.6	30,000	31.9	28,000	26.0	25,200	23.2	23,800	18.1
		4	.0011	30,600	33.1	27,000	27.2	25,200	22.0	22,680	20.1	21,420	15.7
		6	.0009	30,600	31.1	27,000	25.6	25,200	21.3	22,680	18.9	21,420	14.6
		8	.0003	27,200	24.8	24,000	20.5	22,400	16.5	20,160	15.0	19,040	11.8
0.4	0.8	0.5	.0031	34,000	42.9	30,000	35.4	28,000	30.7	25,200	28.0	23,800	21.7
		1	.0031	34,000	42.9	30,000	35.4	28,000	30.7	25,200	28.0	23,800	21.7
		1.5	.0031	34,000	42.9	30,000	35.4	28,000	30.7	25,200	28.0	23,800	21.7
		2	.0025	34,000	42.9	30,000	35.4	28,000	30.7	25,200	28.0	23,800	21.7
		2.5	.0024	34,000	42.9	30,000	35.4	28,000	30.7	25,200	28.0	23,800	21.7
		3	.0022	34,000	42.9	30,000	35.4	28,000	30.7	25,200	28.0	23,800	21.7
		4	.0018	34,000	42.9	30,000	35.4	28,000	30.7	25,200	28.0	23,800	21.7
		5	.0014	30,600	34.6	27,000	28.7	25,200	25.2	22,680	22.4	21,420	17.7
		6	.0010	30,600	34.6	27,000	28.7	25,200	25.2	22,680	22.4	21,420	17.7
		8	.0006	27,200	30.7	24,000	25.6	22,400	22.0	20,160	20.1	19,040	15.7
		10	.0003	27,200	29.1	24,000	24.0	22,400	20.9	20,160	18.9	19,040	14.6
		12	.0002	27,200	29.1	24,000	24.0	22,400	20.9	20,160	18.9	19,040	14.6
0.45	0.9	0.6	.0028	32,300	48.0	28,500	39.4	26,600	35.0	23,940	31.5	22,610	24.4
		2	.0028	32,300	48.0	28,500	39.4	26,600	35.0	23,940	31.5	22,610	24.4
		4	.0018	32,300	48.0	28,500	39.4	26,600	35.0	23,940	31.5	22,610	24.4
		6	.0013	29,070	38.6	25,650	31.9	23,940	28.3	21,550	25.6	20,350	20.1
		8	.0009	25,840	34.6	22,800	28.3	21,280	25.2	19,150	22.8	18,090	17.7
0.5	1	0.8	.0035	30,600	54.3	27,000	44.5	25,200	39.8	22,680	35.8	21,420	28.0
		1.5	.0035	30,600	54.3	27,000	44.5	25,200	39.8	22,680	35.8	21,420	28.0
		2	.0031	30,600	54.3	27,000	44.5	25,200	39.8	22,680	35.8	21,420	28.0
		2.5	.0031	30,600	54.3	27,000	44.5	25,200	39.8	22,680	35.8	21,420	28.0
		3	.0031	30,600	54.3	27,000	44.5	25,200	39.8	22,680	35.8	21,420	28.0
		4	.0022	30,600	54.3	27,000	44.5	25,200	39.8	22,680	35.8	21,420	28.0
		5	.0019	30,600	54.3	27,000	44.5	25,200	39.8	22,680	35.8	21,420	28.0
		6	.0013	27,540	44.1	24,300	36.2	22,680	32.3	20,410	28.7	19,280	22.4
		7	.0013	27,540	44.1	24,300	36.2	22,680	32.3	20,410	28.7	19,280	22.4
		8	.0013	27,540	44.1	24,300	36.2	22,680	32.3	20,410	28.7	19,280	22.4
		9	.0009	27,540	44.1	24,300	36.2	22,680	32.3	20,410	28.7	19,280	22.4
		10	.0008	27,540	44.1	24,300	36.2	22,680	32.3	20,410	28.7	19,280	22.4
		12	.0004	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		13	.0004	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		14	.0003	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		16	.0002	24,480	37.0	21,600	30.3	20,160	27.2	18,140	24.4	17,140	18.9
		18	.0002	21,420	30.3	18,900	25.2	17,640	22.0	15,880	20.1	14,990	15.7
		20	.0002	18,360	26.0	16,200	21.3	15,120	18.9	13,610	17.3	12,850	13.4

High efficiency cutting condition

High accuracy cutting condition

Please refer to P.17 about high efficiency cutting conditions

Work material				1 Pre-hardened steels (35～45HRC)		2 Hardened steels (45～55HRC)		3 Hardened steels (55～65HRC)		4 Hardened steels (65～68HRC)		5 Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
0.55	1.1	2	.0031	28,560	51.2	25,200	42.9	23,520	38.2	21,170	34.3	19,990	26.8
		4	.0022	28,560	51.2	25,200	42.9	23,520	38.2	21,170	34.3	19,990	26.8
		6	.0013	26,010	42.9	22,950	36.2	21,420	31.9	19,280	28.7	18,210	22.4
		8	.0013	26,010	42.9	22,950	36.2	21,420	31.9	19,280	28.7	18,210	22.4
		10	.0008	26,010	42.9	22,950	36.2	21,420	31.9	19,280	28.7	18,210	22.4
0.6	1.2	2	.0030	26,150	47.6	23,080	39.4	21,540	35.0	19,380	31.5	18,310	24.4
		3	.0030	26,150	47.6	23,080	39.4	21,540	35.0	19,380	31.5	18,310	24.4
		4	.0025	26,150	47.6	23,080	39.4	21,540	35.0	19,380	31.5	18,310	24.4
		6	.0019	26,150	47.6	23,080	39.4	21,540	35.0	19,380	31.5	18,310	24.4
		8	.0013	24,480	48.0	21,600	37.4	20,160	31.9	18,140	28.7	17,140	22.0
		10	.0011	24,480	43.3	21,600	33.9	20,160	28.7	18,140	25.6	17,140	20.1
		12	.0009	24,480	43.3	21,600	33.9	20,160	28.7	18,140	25.6	17,140	20.1
0.7	1.4	3	.0035	21,420	45.7	18,900	38.6	17,640	34.6	15,880	31.1	14,990	24.4
		8	.0017	21,420	45.7	18,900	38.6	17,640	34.6	15,880	31.1	14,990	24.4
		12	.0011	21,420	40.9	18,900	35.0	17,640	31.1	15,880	28.3	14,990	22.0
		16	.0006	19,040	34.3	16,800	29.1	15,680	26.4	14,110	23.6	13,330	18.5
0.75	1.5	2	.0038	23,800	56.3	21,000	44.5	19,600	38.6	17,640	34.6	16,660	27.2
		2.5	.0038	23,800	56.3	21,000	44.5	19,600	38.6	17,640	34.6	16,660	27.2
		3	.0038	23,800	56.3	21,000	44.5	19,600	38.6	17,640	34.6	16,660	27.2
		4	.0031	23,800	56.3	21,000	44.5	19,600	38.6	17,640	34.6	16,660	27.2
		5	.0031	23,800	56.3	21,000	44.5	19,600	38.6	17,640	34.6	16,660	27.2
		6	.0031	23,800	56.3	21,000	44.5	19,600	38.6	17,640	34.6	16,660	27.2
		8	.0019	21,420	45.7	18,900	36.2	17,640	31.1	15,880	28.3	14,990	22.0
		10	.0019	21,420	45.7	18,900	36.2	17,640	31.1	15,880	28.3	14,990	22.0
		12	.0019	21,420	45.7	18,900	36.2	17,640	31.1	15,880	28.3	14,990	22.0
		14	.0016	19,040	38.2	16,800	30.3	15,680	26.4	14,110	23.6	13,330	18.5
		16	.0006	19,040	38.2	16,800	30.3	15,680	26.4	14,110	23.6	13,330	18.5
		18	.0006	19,040	38.2	16,800	30.3	15,680	26.4	14,110	23.6	13,330	18.5
		20	.0006	19,040	38.2	16,800	30.3	15,680	26.4	14,110	23.6	13,330	18.5
0.8	1.6	4	.0043	22,100	53.9	19,500	46.1	18,200	40.2	16,380	36.2	15,470	28.0
		8	.0035	22,100	53.9	19,500	46.1	18,200	40.2	16,380	36.2	15,470	28.0
		12	.0020	19,890	43.7	17,550	37.4	16,380	32.7	14,740	29.1	13,920	22.8
		16	.0013	19,890	43.7	17,550	37.4	16,380	32.7	14,740	29.1	13,920	22.8
		20	.0006	17,680	36.6	15,600	31.5	14,560	27.2	13,100	24.4	12,380	19.3
0.9	1.8	4	.0058	22,100	61.0	19,500	50.8	18,200	42.9	16,380	38.6	15,470	29.9
		8	.0041	22,100	61.0	19,500	50.8	18,200	42.9	16,380	38.6	15,470	29.9
		12	.0022	19,890	49.2	17,550	40.9	16,380	35.0	14,740	31.5	13,920	24.4
		16	.0014	19,890	49.2	17,550	40.9	16,380	35.0	14,740	31.5	13,920	24.4
		20	.0007	17,680	41.3	15,600	34.6	14,560	29.1	13,100	26.4	12,380	20.5
1	2	2.5	.0063	17,850	63.4	15,750	53.5	14,700	46.5	13,230	41.7	12,500	32.3
		3	.0063	17,850	63.4	15,750	53.5	14,700	46.5	13,230	41.7	12,500	32.3
		4	.0063	17,850	63.4	15,750	53.5	14,700	46.5	13,230	41.7	12,500	32.3
		5	.0063	17,850	63.4	15,750	53.5	14,700	46.5	13,230	41.7	12,500	32.3
		6	.0063	17,850	56.3	15,750	47.2	14,700	41.7	13,230	37.4	12,500	29.1
		8	.0044	17,850	56.3	15,750	47.2	14,700	41.7	13,230	37.4	12,500	29.1
		10	.0044	17,850	50.8	15,750	42.1	14,700	37.0	13,230	33.5	12,500	26.0
		12	.0025	16,070	45.7	14,180	37.8	13,230	33.5	11,910	29.9	11,250	23.2
		13	.0025	16,070	45.7	14,180	37.8	13,230	33.5	11,910	29.9	11,250	23.2
		14	.0025	16,070	45.7	14,180	37.8	13,230	33.5	11,910	29.9	11,250	23.2
		16	.0025	16,070	40.9	14,180	34.3	13,230	29.9	11,910	27.2	11,250	20.9
		18	.0019	16,070	40.9	14,180	34.3	13,230	29.9	11,910	27.2	11,250	20.9
		20	.0016	16,070	40.9	14,180	34.3	13,230	29.9	11,910	27.2	11,250	20.9
		22	.0013	15,170	36.6	13,390	30.3	12,500	26.8	11,250	24.0	10,620	18.9
		25	.0011	14,280	34.3	12,600	28.7	11,760	25.2	10,580	22.8	10,000	17.7
		30	.0005	14,280	34.3	12,600	28.7	11,760	25.2	10,580	22.8	10,000	17.7
		35	.0004	12,500	28.3	11,030	23.6	10,290	20.9	9,260	18.5	8,750	14.6
		40	.0003	10,710	24.4	9,450	20.1	8,820	17.7	7,940	16.1	7,500	12.6

【Note】 Upon usage, please refer to comments and notes below table on page 24.

Recommended Cutting Conditions (Inch)

High efficiency cutting condition | **High accuracy cutting condition**

Please refer to P.17 about high efficiency cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35～45HRC)		Hardened steels (45～55HRC)		Hardened steels (55～65HRC)		Hardened steels (65～68HRC)		Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (inch)	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM	Revolution n min^{-1}	Feed rate v_f IPM
1.25	2.5	6	.0079	15,730	66.5	13,880	53.9	12,950	44.5	11,660	39.8	11,070	31.9
		10	.0054	15,730	66.5	13,880	53.9	12,950	44.5	11,660	39.8	11,070	31.9
		15	.0031	14,150	53.9	12,490	43.7	11,660	35.8	10,490	32.3	9,970	26.0
		20	.0025	14,150	53.9	12,490	43.7	11,660	35.8	10,490	32.3	9,970	26.0
		25	.0020	14,150	48.4	12,490	39.4	11,660	32.3	10,490	29.1	9,970	23.2
		30	.0014	12,580	45.3	11,100	36.6	10,360	30.3	9,320	27.2	8,860	21.7
1.5	3	6	.0094	13,600	71.7	12,000	59.4	11,200	52.8	10,080	47.6	9,580	38.2
		8	.0094	13,600	71.7	12,000	59.4	11,200	52.8	10,080	47.6	9,580	38.2
		10	.0066	13,600	71.7	12,000	59.4	11,200	52.8	10,080	47.6	9,580	38.2
		13	.0066	13,600	71.7	12,000	59.4	11,200	52.8	10,080	47.6	9,580	38.2
		16	.0066	13,600	64.6	12,000	53.5	11,200	47.6	10,080	42.9	9,580	34.3
		20	.0038	12,240	58.3	10,800	48.4	10,080	42.9	9,070	38.6	8,620	30.7
		25	.0025	12,240	58.3	10,800	48.4	10,080	42.9	9,070	38.6	8,620	30.7
		30	.0025	12,240	58.3	10,800	48.4	10,080	42.9	9,070	38.6	8,620	30.7
		35	.0020	10,880	48.8	9,600	40.6	8,960	35.8	8,060	32.3	7,660	26.0
1.75	3.5	10	.0085	11,690	69.3	10,310	56.3	9,630	46.5	8,660	41.7	8,230	33.5
		15	.0076	11,690	69.3	10,310	56.3	9,630	46.5	8,660	41.7	8,230	33.5
		25	.0044	10,520	56.3	9,280	45.7	8,660	37.4	7,800	33.9	7,410	26.8
		35	.0028	10,520	56.3	9,280	45.7	8,660	37.4	7,800	33.9	7,410	26.8
		45	.0023	9,350	47.2	8,250	38.6	7,700	31.5	6,930	28.3	6,580	22.8
2	4	8	.0126	9,780	69.3	8,630	57.9	8,050	50.8	7,250	45.7	6,880	36.6
		10	.0126	9,780	69.3	8,630	57.9	8,050	50.8	7,250	45.7	6,880	36.6
		12	.0101	9,780	69.3	8,630	57.9	8,050	50.8	7,250	45.7	6,880	36.6
		13	.0101	9,780	69.3	8,630	57.9	8,050	50.8	7,250	45.7	6,880	36.6
		16	.0088	9,780	69.3	8,630	57.9	8,050	50.8	7,250	45.7	6,880	36.6
		20	.0088	9,780	69.3	8,630	57.9	8,050	50.8	7,250	45.7	6,880	36.6
		25	.0050	8,800	56.3	7,760	46.9	7,250	40.9	6,520	37.0	6,190	29.5
		30	.0050	8,800	56.3	7,760	46.9	7,250	40.9	6,520	37.0	6,190	29.5
		35	.0031	8,800	56.3	7,760	46.9	7,250	40.9	6,520	37.0	6,190	29.5
		40	.0031	8,800	56.3	7,760	46.9	7,250	40.9	6,520	37.0	6,190	29.5
		45	.0025	7,820	47.2	6,900	39.4	6,440	34.6	5,800	31.1	5,510	24.8
		50	.0022	7,820	47.2	6,900	39.4	6,440	34.6	5,800	31.1	5,510	24.8
2.5	5	10	.0154	7,650	60.2	6,750	53.1	6,300	44.5	5,670	40.2	5,390	32.3
		20	.0110	7,650	60.2	6,750	53.1	6,300	44.5	5,670	40.2	5,390	32.3
		25	.0110	7,650	60.2	6,750	53.1	6,300	44.5	5,670	40.2	5,390	32.3
		30	.0063	6,890	54.3	6,080	48.0	5,670	40.2	5,100	36.2	4,850	29.1
		40	.0063	6,890	48.8	6,080	42.9	5,670	36.2	5,100	32.7	4,850	26.0
3	6	12	.0189	7,650	74.4	6,750	60.6	6,300	49.6	5,670	44.5	5,390	35.8
		20	.0157	7,230	65.4	6,380	53.1	5,950	43.7	5,360	39.0	5,090	31.5
		30	.0132	6,800	53.5	6,000	47.2	5,600	39.8	5,040	35.8	4,790	28.7
		50	.0047	6,120	43.3	5,400	38.2	5,040	32.3	4,540	28.7	4,310	23.2
4	8	24	.0197	6,400	66.5	5,720	52.0	4,180	46.1	3,960	34.3	3,760	27.6
5	10	30	.0236	5,100	57.5	4,510	44.5	3,520	39.4	3,190	30.3	3,030	24.4
6	12	36	.0315	4,200	48.8	3,850	39.4	2,640	34.6	2,640	26.0	2,510	20.9

※(1) a_p is shown as the criteria for Group 1 workpieces. For other groups, adjust the cutting depth according to the cutting depth factors in the above table.
※(2) When performing cutting where cutting chips may cause clogging, such as for rib cutting, blind grooves, etc., cutting depth setting should be set by multiplying a cutting depth factor to calculate the cutting depth amount, and this amount should then be reduced to 80% of the calculated value.
※(3) Adjust by setting a_e to (3 to 5)×(a_p)×(cutting depth ratio). When performing finishing processing, calculate the theoretical cusp height and set accordingly.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDBEH2020-10-TH3 tool:
Cutting depth = .0044 (a_p) × .85 (cutting depth factor for Group 2 hardened steel) × .8 (for closed-area cutting) = .003 inch

【Note】

① Although basically dry (air blow) cutting is recommended, please use appropriate coolant according to the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

Recommended Cutting Conditions (Metric)

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.29 about high accuracy cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35~45HRC)		Hardened steels (45~55HRC)		Hardened steels (55~65HRC)		Hardened steels (65~68HRC)		Hardened steels (68~72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
0.05	0.1	**0.08**	0.006	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
		0.2	0.006	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
		0.3	0.005	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
		0.5	0.003	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
0.075	0.15	**0.12**	0.009	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		0.3	0.009	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		0.5	0.008	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		0.75	0.007	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		1	0.005	46,000	230	41,400	190	37,800	150	33,750	130	31,950	100
0.1	0.2	**0.15**	0.016	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		0.3	0.016	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		0.5	0.016	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		0.75	0.014	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		1	0.011	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		1.25	0.009	45,900	270	40,500	220	37,800	170	34,020	150	32,130	120
		1.5	0.006	45,900	270	40,500	220	37,800	170	34,020	150	32,130	120
		2	0.006	45,900	270	40,500	220	37,800	170	34,020	150	32,130	120
		2.5	0.005	40,800	210	36,000	170	33,600	130	30,240	120	28,560	90
		3	0.003	40,800	210	36,000	170	33,600	130	30,240	120	28,560	90
0.15	0.3	**0.25**	0.022	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		0.5	0.022	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		0.75	0.019	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		1	0.017	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		1.25	0.015	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		1.5	0.013	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		2	0.01	45,900	370	40,500	310	37,800	270	34,020	250	32,130	190
		2.5	0.008	45,900	370	40,500	310	37,800	270	34,020	250	32,130	190
		3	0.006	45,900	370	40,500	310	37,800	270	34,020	250	32,130	190
		3.5	0.004	36,720	260	29,400	210	26,400	180	23,760	160	22,440	130
		4	0.003	36,720	260	29,400	210	26,400	180	23,760	160	22,440	130
0.2	0.4	**0.3**	0.034	50,000	770	46,800	660	43,680	610	39,310	550	37,130	430
		0.5	0.034	50,000	770	46,800	660	43,680	610	39,310	550	37,130	430
		0.75	0.034	50,000	770	46,800	660	43,680	610	39,310	550	37,130	430
		1	0.032	50,000	770	46,800	660	43,680	610	39,310	550	37,130	430
		1.5	0.027	50,000	660	46,800	470	43,680	440	39,310	390	37,130	310
		2	0.022	50,000	550	46,800	470	43,680	440	39,310	390	37,130	310
		2.5	0.018	36,720	360	32,400	290	36,290	270	32,660	250	30,850	190
		3	0.013	36,720	360	32,400	290	36,290	270	32,660	250	30,850	190
		3.5	0.01	36,720	360	32,400	290	36,290	270	32,660	250	30,850	190
		4	0.008	36,720	360	32,400	290	36,290	270	32,660	250	30,850	190
		4.5	0.006	32,640	310	28,800	250	26,880	230	24,190	210	22,850	160
		5	0.004	32,640	310	28,800	250	26,880	230	24,190	210	22,850	160
0.25	0.5	**0.35**	0.036	50,000	1,190	47,130	1,050	43,930	740	39,820	670	37,560	520
		0.75	0.036	50,000	1,190	47,130	1,050	43,930	740	39,820	670	37,560	520
		1	0.036	50,000	1,190	47,130	1,050	43,930	740	39,820	670	37,560	520
		1.5	0.032	50,000	1,190	47,130	1,050	43,930	680	39,820	610	37,560	480
		2	0.028	50,000	960	47,130	840	43,930	680	39,820	610	37,560	480
		2.5	0.026	45,450	650	42,840	570	39,940	500	36,220	450	34,180	350
		3	0.024	45,450	650	42,840	570	39,940	390	36,220	350	34,180	270
		4	0.016	34,970	500	32,950	520	30,730	390	28,540	350	26,290	270
		5	0.014	34,970	500	32,950	520	30,730	390	28,540	350	26,290	270
		5.5	0.012	31,080	420	29,300	370	27,310	320	24,770	290	23,370	230
		6	0.01	31,080	420	29,300	370	27,310	320	24,770	290	23,370	230
		7	0.008	31,080	420	29,300	370	27,310	320	24,770	290	23,370	230
		8	0.006	31,080	420	29,300	370	27,310	320	24,770	290	23,370	230
0.3	0.6	**0.4**	0.06	50,000	1,950	48,000	1,730	44,800	1,340	40,320	1,210	38,080	940
		0.75	0.06	50,000	1,950	48,000	1,730	44,800	1,340	40,320	1,210	38,080	940

【Note】 Upon usage, please refer to comments and notes below table on page 28.

Recommended Cutting Conditions (Metric)

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.29 about high accuracy cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35～45HRC)		Hardened steels (45～55HRC)		Hardened steels (55～65HRC)		Hardened steels (65～68HRC)		Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
0.3	0.6	1	0.06	50,000	1,950	48,000	1,730	44,800	1,340	40,320	1,210	38,080	940
		1.5	0.055	50,000	1,950	48,000	1,730	44,800	1,340	40,320	1,210	38,080	940
		2	0.05	50,000	1,950	48,000	1,730	44,800	1,340	40,320	1,210	38,080	940
		2.5	0.036	50,000	1,560	48,000	1,380	44,800	990	40,320	890	38,080	690
		3	0.033	50,000	1,560	48,000	1,380	44,800	990	40,320	890	38,080	690
		3.5	0.028	48,960	1,450	43,200	1,180	40,320	840	36,290	760	34,270	590
		4	0.021	48,960	1,450	43,200	1,180	40,320	770	36,290	690	34,270	540
		4.5	0.018	45,900	1,070	40,500	880	37,800	680	34,020	610	32,130	480
		5	0.016	39,780	930	35,100	760	32,760	590	29,480	530	27,850	410
		5.5	0.014	39,780	930	35,100	760	32,760	590	29,480	530	27,850	410
		6	0.012	39,780	930	35,100	760	32,760	590	29,480	530	27,850	410
		7	0.012	27,200	600	24,000	490	22,400	420	20,160	370	19,040	290
		8	0.012	27,200	600	24,000	490	22,400	380	20,160	340	19,040	270
		9	0.01	27,200	600	24,000	490	22,400	380	20,160	340	19,040	270
		10	0.007	23,800	530	21,000	430	19,600	330	17,640	300	16,660	230
		12	0.006	20,400	420	18,000	350	16,800	270	15,120	240	14,280	190
0.35	0.7	0.45	0.073	50,000	2,160	48,000	1,930	44,800	1,190	40,320	1,070	38,080	830
		2	0.073	50,000	2,160	48,000	1,930	44,800	1,190	40,320	1,070	38,080	830
		4	0.033	48,960	1,600	43,200	1,320	43,870	850	39,480	760	37,370	590
		6	0.022	39,780	1,030	35,100	850	35,650	640	32,080	580	30,370	450
		8	0.016	27,200	630	24,000	520	24,370	420	21,940	380	20,760	300
0.4	0.8	0.5	0.12	50,000	2,400	48,000	2,590	44,800	1,880	40,320	1,690	38,080	1,320
		1	0.12	50,000	2,400	48,000	2,590	44,800	1,880	40,320	1,690	38,080	1,320
		1.5	0.12	50,000	2,400	48,000	2,590	44,800	1,880	40,320	1,690	38,080	1,320
		2	0.096	50,000	2,400	48,000	2,590	44,800	1,880	40,320	1,690	38,080	1,320
		2.5	0.088	50,000	2,400	48,000	2,590	44,800	1,880	40,320	1,690	38,080	1,320
		3	0.08	50,000	2,400	48,000	2,590	44,800	1,880	40,320	1,690	38,080	1,320
		4	0.063	50,000	2,400	48,000	2,590	44,800	1,880	40,320	1,690	38,080	1,320
		5	0.047	48,960	2,110	43,200	2,120	40,320	1,520	36,290	1,370	34,270	1,070
		6	0.033	42,840	1,730	37,800	1,430	35,280	1,250	31,750	1,120	29,990	870
		8	0.016	35,360	1,020	31,200	840	29,120	730	26,210	660	24,750	510
		10	0.016	27,200	740	24,000	610	22,400	530	20,160	480	19,040	370
		12	0.01	27,200	740	24,000	610	22,400	530	20,160	480	19,040	370
0.45	0.9	0.6	0.108	50,000	2,820	45,600	2,410	42,560	2,140	38,300	1,930	36,180	1,500
		2	0.108	50,000	2,820	45,600	2,410	42,560	2,140	38,300	1,930	36,180	1,500
		4	0.065	48,450	2,370	42,750	1,960	39,900	1,740	35,910	1,560	33,920	1,220
		6	0.044	40,700	1,520	35,910	1,250	33,520	1,110	30,160	1,000	28,490	780
		8	0.029	31,010	1,050	27,360	870	25,540	770	22,980	690	21,710	540
0.5	1	0.8	0.18	45,900	3,100	43,200	2,720	37,800	2,270	34,020	2,040	32,130	1,590
		1.5	0.18	45,900	3,100	43,200	2,720	37,800	2,270	34,020	2,040	32,130	1,590
		2	0.16	45,900	3,100	43,200	2,720	37,800	2,270	34,020	2,040	32,130	1,590
		2.5	0.16	45,900	3,100	43,200	2,720	37,800	2,270	34,020	2,040	32,130	1,590
		3	0.16	45,900	3,100	43,200	2,720	37,800	2,270	34,020	2,040	32,130	1,590
		4	0.112	45,900	3,100	43,200	2,720	37,800	2,270	34,020	2,040	32,130	1,590
		5	0.072	39,780	2,600	43,200	2,540	32,760	1,840	29,480	1,650	27,850	1,280
		6	0.048	38,560	2,320	38,880	2,350	29,480	1,380	26,540	1,240	25,060	970
		7	0.048	33,050	1,340	31,590	1,320	27,220	1,060	24,490	960	23,130	740
		8	0.048	33,050	1,340	31,590	1,320	27,220	980	24,490	880	23,130	690
		9	0.036	33,050	1,340	31,590	1,320	27,220	980	24,490	880	23,130	690
		10	0.03	33,050	1,340	31,590	1,320	27,220	980	24,490	880	23,130	690
		12	0.02	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		13	0.018	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		14	0.016	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		16	0.012	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		18	0.01	21,420	770	18,900	640	17,640	560	15,880	510	14,990	400
		20	0.008	18,360	660	16,200	540	15,120	480	13,610	440	12,850	340

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.29 about high accuracy cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35～45HRC)		Hardened steels (45～55HRC)		Hardened steels (55～65HRC)		Hardened steels (65～68HRC)		Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
0.55	1.1	2	0.16	42,840	2,930	37,800	2,450	35,280	2,180	31,750	1,960	29,990	1,520
		4	0.112	42,840	2,930	37,800	2,450	35,280	2,180	31,750	1,960	29,990	1,520
		6	0.048	33,810	1,710	29,840	1,430	27,850	1,270	25,060	1,140	23,670	890
		8	0.048	31,210	1,310	27,540	1,100	25,700	980	23,130	880	21,850	680
		10	0.03	31,210	1,310	27,540	1,100	25,700	980	23,130	880	21,850	680
0.6	1.2	2	0.154	39,230	2,720	36,920	2,560	32,310	1,860	29,080	1,670	27,460	1,300
		3	0.154	39,230	2,720	36,920	2,560	32,310	1,860	29,080	1,670	27,460	1,300
		4	0.128	39,230	2,720	36,920	2,560	32,310	1,860	29,080	1,670	27,460	1,300
		6	0.088	39,230	2,720	36,920	2,560	32,310	1,860	29,080	1,670	27,460	1,300
		8	0.048	31,820	2,070	30,240	2,060	26,210	1,050	23,590	940	22,280	730
		10	0.042	29,380	1,320	27,000	1,070	24,190	870	21,770	780	20,560	610
		12	0.036	29,380	1,320	25,920	1,030	24,190	870	21,770	780	20,560	610
0.7	1.4	3	0.158	33,420	2,350	29,480	1,990	27,520	1,790	24,770	1,610	23,390	1,250
		8	0.088	27,850	1,810	24,570	1,530	22,930	1,380	20,640	1,240	19,490	960
		12	0.042	25,700	1,250	22,680	1,060	21,170	950	19,050	860	17,990	670
		16	0.028	19,040	870	16,800	740	15,680	670	14,110	600	13,330	470
0.75	1.5	2	0.192	35,700	3,210	31,500	2,550	29,400	2,210	26,460	1,990	24,990	1,540
		2.5	0.192	35,700	3,210	31,500	2,550	29,400	2,210	26,460	1,990	24,990	1,540
		3	0.192	35,700	3,210	31,500	2,550	29,400	2,210	26,460	1,990	24,990	1,540
		4	0.16	35,700	3,210	31,500	2,550	29,400	2,210	26,460	1,990	24,990	1,540
		5	0.16	35,700	3,210	31,500	2,550	29,400	2,210	26,460	1,990	24,990	1,540
		6	0.16	35,700	3,210	31,500	2,550	29,400	2,210	26,460	1,990	24,990	1,540
		8	0.072	27,850	1,810	24,570	1,430	22,930	1,240	20,640	1,120	19,490	870
		10	0.072	25,700	1,670	22,680	1,320	21,170	1,140	19,050	1,030	17,990	800
		12	0.072	25,700	1,390	22,680	1,100	21,170	950	19,050	860	17,990	670
		14	0.06	22,850	1,170	20,160	930	18,820	800	16,930	720	15,990	560
		16	0.03	19,040	970	16,800	770	15,680	670	14,110	600	13,330	470
		18	0.03	19,040	970	16,800	770	15,680	670	14,110	600	13,330	470
		20	0.03	19,040	970	16,800	770	15,680	670	14,110	600	13,330	470
0.8	1.6	4	0.23	33,110	3,340	29,210	2,850	25,320	2,130	22,780	1,920	21,520	1,490
		8	0.176	30,940	2,490	27,300	2,130	23,660	1,590	21,290	1,430	20,110	1,110
		12	0.078	27,850	2,180	24,570	1,860	21,290	1,290	19,170	1,160	18,100	900
		16	0.048	23,870	1,330	21,060	1,140	19,660	990	17,690	890	16,710	690
		20	0.032	17,680	930	15,600	800	14,560	690	13,100	620	12,380	490
0.9	1.8	4	0.29	28,730	2,410	25,350	2,010	23,660	1,700	21,290	1,530	20,110	1,190
		8	0.208	28,730	2,410	25,350	2,010	23,660	1,700	21,290	1,530	20,110	1,190
		12	0.084	23,870	1,500	21,060	1,250	19,660	1,060	17,690	960	16,710	740
		16	0.054	23,870	1,500	21,060	1,250	19,660	1,060	17,690	960	16,710	740
		20	0.036	17,680	1,050	15,600	880	14,560	740	13,100	670	12,380	520
1	2	2.5	0.32	26,780	3,620	23,630	3,050	22,050	2,650	19,850	2,380	18,740	1,850
		3	0.32	26,780	3,620	23,630	3,050	22,050	2,650	19,850	2,380	18,740	1,850
		4	0.32	26,780	3,620	23,630	3,050	22,050	2,650	19,850	2,380	18,740	1,850
		5	0.32	26,780	3,620	23,630	3,050	22,050	2,650	19,850	2,380	18,740	1,850
		6	0.32	26,780	3,210	23,630	2,690	22,050	2,380	19,850	2,140	18,740	1,670
		8	0.224	26,780	3,210	23,630	2,690	22,050	2,380	19,850	2,140	18,740	1,670
		10	0.168	24,990	2,700	22,050	2,250	19,110	1,470	17,200	1,320	16,240	1,030
		12	0.096	22,490	2,430	19,850	2,050	17,200	1,320	15,480	1,190	14,620	930
		13	0.096	22,490	2,430	19,850	2,020	15,880	1,020	14,290	920	13,500	710
		14	0.096	22,490	2,110	18,430	1,630	15,880	1,020	14,290	920	13,500	710
		16	0.096	20,890	1,350	18,430	1,470	15,880	910	14,290	820	13,500	640
		18	0.072	19,280	1,250	18,430	1,350	15,880	910	14,290	820	13,500	640
		20	0.06	19,280	1,250	18,430	1,130	15,880	910	14,290	820	13,500	640
		22	0.04	15,170	930	13,390	770	14,990	820	13,500	730	12,750	570
		25	0.04	14,280	870	12,600	730	14,110	770	12,700	690	12,000	540
		30	0.024	14,280	870	12,600	730	14,110	770	12,700	690	12,000	540
		35	0.02	12,500	720	11,030	600	10,290	530	9,260	470	8,750	370
		40	0.018	10,710	620	9,450	510	8,820	450	7,940	410	7,500	320

【Note】 Upon usage, please refer to comments and notes below table on page 28.

Recommended Cutting Conditions (Metric)

High efficiency cuttiing condition | High accuracy cuttiing condition

Please refer to P.29 about high accuracy cutting conditions

Work material				1 Pre-hardened steels (35～45HRC)		2 Hardened steels (45～55HRC)		3 Hardened steels (55～65HRC)		4 Hardened steels (65～68HRC)		5 Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1.25	2.5	6	0.4	23,590	3,800	20,810	3,090	19,430	2,530	17,480	2,280	16,610	1,820
		10	0.272	23,590	3,800	20,810	3,090	19,430	2,530	17,480	2,280	16,610	1,820
		15	0.12	18,400	2,130	16,230	2,020	15,150	1,420	13,640	1,280	12,950	1,020
		20	0.096	16,980	1,640	16,230	1,450	13,990	1,090	12,590	980	11,960	790
		25	0.078	16,980	1,480	14,990	1,200	13,990	980	12,590	880	11,960	710
		30	0.044	12,580	1,150	11,100	930	10,360	770	9,320	690	8,860	550
1.5	3	6	0.48	20,400	4,100	18,000	3,400	16,800	3,020	15,120	2,720	14,360	2,180
		8	0.48	20,400	4,100	18,000	3,400	16,800	3,020	15,120	2,720	14,360	2,180
		10	0.336	20,400	4,100	18,000	3,400	16,800	3,020	15,120	2,720	14,360	2,180
		13	0.252	19,040	3,060	16,800	2,540	15,680	2,260	14,110	2,030	13,410	1,630
		16	0.252	19,040	2,760	16,800	2,290	14,560	1,890	13,100	1,700	12,450	1,360
		20	0.144	15,910	1,920	14,040	1,590	12,100	1,310	10,890	1,180	10,340	940
		25	0.096	15,910	1,920	14,040	1,590	12,100	1,310	10,890	1,180	10,340	940
		30	0.096	14,690	1,770	12,960	1,470	12,100	1,310	10,890	1,180	10,340	940
		35	0.064	10,880	1,240	9,600	1,030	10,750	1,100	9,680	990	9,190	790
1.75	3.5	10	0.328	15,190	2,750	13,410	2,240	12,510	1,830	11,260	1,650	10,700	1,320
		15	0.288	15,190	2,750	13,410	2,240	12,510	1,830	11,260	1,650	10,700	1,320
		25	0.168	12,620	1,710	11,140	1,390	10,400	1,140	9,360	1,030	8,890	820
		35	0.072	12,620	1,710	11,140	1,390	10,400	1,140	9,360	1,030	8,890	820
		45	0.072	9,350	1,200	8,250	980	7,700	800	6,930	720	6,580	580
2	4	8	0.48	14,660	3,960	12,940	3,300	12,080	2,900	10,870	2,610	10,320	2,090
		10	0.48	14,660	3,960	12,940	3,300	12,080	2,900	10,870	2,610	10,320	2,090
		12	0.384	14,660	3,960	12,940	3,300	12,080	2,900	10,870	2,610	10,320	2,090
		13	0.384	14,660	3,960	12,940	3,300	12,080	2,900	10,870	2,610	10,320	2,090
		16	0.336	14,660	3,960	12,940	3,300	12,080	2,900	10,870	2,610	10,320	2,090
		20	0.336	12,710	2,750	11,210	2,290	10,470	2,010	9,420	1,810	8,950	1,450
		25	0.192	11,440	2,220	10,090	2,160	9,420	1,630	8,480	1,460	8,050	1,170
		30	0.128	10,560	1,710	9,320	1,430	8,690	1,250	7,820	1,130	7,430	900
		35	0.08	10,560	1,710	9,320	1,430	8,690	1,250	7,820	1,130	7,430	900
		40	0.08	10,560	1,710	9,320	1,430	8,690	1,250	7,820	1,130	7,430	900
		45	0.08	7,820	1,200	6,900	1,000	6,440	880	5,800	790	5,510	630
		50	0.08	7,820	1,200	6,900	1,000	6,440	880	5,800	790	5,510	630
2.5	5	10	0.584	10,710	3,210	9,450	2,840	8,820	2,380	7,940	2,140	7,540	1,710
		20	0.42	10,710	3,210	9,450	2,840	8,820	2,380	7,940	2,140	7,540	1,710
		25	0.42	9,950	2,980	8,780	2,630	8,190	2,210	7,370	1,990	7,000	1,590
		30	0.24	8,950	2,690	7,900	2,370	7,370	1,990	6,630	1,790	6,300	1,430
		40	0.16	8,260	1,490	7,290	1,310	6,800	1,100	6,120	990	5,820	790
3	6	12	0.48	11,480	4,250	10,130	3,460	9,450	2,840	8,510	2,550	8,080	2,040
		20	0.4	10,840	3,730	9,560	3,030	8,930	2,490	8,030	2,240	7,630	1,790
		30	0.336	8,840	2,120	7,800	2,030	7,280	1,570	6,550	1,410	6,220	1,130
		50	0.12	7,340	1,590	6,480	1,400	6,050	1,180	5,440	1,060	5,170	850
4	8	24	0.5	8,750	3,420	7,550	2,600	7,100	2,450	6,390	1,850	5,750	1,270
5	10	30	0.6	7,000	3,000	6,050	2,250	5,680	2,130	5,110	1,610	4,600	1,030
6	12	36	0.8	5,850	2,600	5,050	1,980	4,720	1,840	4,250	1,440	3,820	880

※(1) a_p is shown as the criteria for Group 1 workpieces. For other groups, adjust the cutting depth according to the cutting depth factors in the above table.
※(2) When performing cutting where cutting chips may cause clogging, such as for rib cutting, blind grooves, etc., cutting depth setting should be set by multiplying a cutting depth factor to calculate the cutting depth amount, and this amount should then be reduced to 80% of the calculated value.
※(3) Adjust by setting a_e to (3 to 5)×(a_p)×(cutting depth ratio). When performing finishing processing, calculate the theoretical cusp height and set accordingly.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDBEH2020-10-TH3 tool:
Cutting depth = 0.168 (a_p) × 0.85 (cutting depth factor for Group 2 hardened steel) × 0.8 (for closed-area cutting) = 0.11mm

【Note】

① Although basically dry (air blow) cutting is recommended, please use appropriate coolant according to the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

High efficiency cutting condition

High accuracy cutting condition

Please refer to P.25 about high efficiency cutting conditions

Work material				1		2		3		4		5	
				Pre-hardened steels (35～45HRC)		Hardened steels (45～55HRC)		Hardened steels (55～65HRC)		Hardened steels (65～68HRC)		Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
0.05	0.1	0.08	0.003	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
		0.2	0.003	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
		0.3	0.002	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
		0.5	0.002	50,000	230	50,000	200	50,000	190	45,000	170	42,500	130
0.075	0.15	0.12	0.007	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		0.3	0.007	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		0.5	0.006	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		0.75	0.005	50,000	280	46,000	230	42,000	180	37,500	160	35,500	120
		1	0.003	46,000	230	41,400	190	37,800	150	33,750	130	31,950	100
0.1	0.2	0.15	0.012	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		0.3	0.012	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		0.5	0.012	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		0.75	0.01	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		1	0.009	50,000	330	45,500	270	42,000	210	37,800	190	35,700	150
		1.25	0.006	45,900	270	40,500	220	37,800	170	34,020	150	32,130	120
		1.5	0.006	45,900	270	40,500	220	37,800	170	34,020	150	32,130	120
		2	0.005	45,900	270	40,500	220	37,800	170	34,020	150	32,130	120
		2.5	0.004	40,800	210	36,000	170	33,600	130	30,240	120	28,560	90
		3	0.002	40,800	210	36,000	170	33,600	130	30,240	120	28,560	90
0.15	0.3	0.25	0.016	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		0.5	0.016	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		0.75	0.014	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		1	0.013	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		1.25	0.011	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		1.5	0.01	50,000	450	45,000	380	42,000	340	37,800	300	35,700	240
		2	0.007	45,900	370	40,500	310	37,800	270	34,020	250	32,130	190
		2.5	0.006	45,900	370	40,500	310	37,800	270	34,020	250	32,130	190
		3	0.005	45,900	370	40,500	310	37,800	270	34,020	250	32,130	190
		3.5	0.003	36,720	260	29,400	210	26,400	180	23,760	160	22,440	130
		4	0.002	36,720	260	29,400	210	26,400	180	23,760	160	22,440	130
0.2	0.4	0.3	0.034	40,800	450	36,000	360	33,600	340	30,240	300	28,560	240
		0.5	0.034	40,800	450	36,000	360	33,600	340	30,240	300	28,560	240
		0.75	0.034	40,800	450	36,000	360	33,600	340	30,240	300	28,560	240
		1	0.032	40,800	450	36,000	360	33,600	340	30,240	300	28,560	240
		1.5	0.027	40,800	450	36,000	360	33,600	340	30,240	300	28,560	240
		2	0.022	40,800	450	36,000	360	33,600	340	30,240	300	28,560	240
		2.5	0.013	36,720	360	32,400	290	30,240	270	27,220	250	25,700	190
		3	0.009	36,720	360	32,400	290	30,240	270	27,220	250	25,700	190
		3.5	0.006	36,720	360	32,400	290	30,240	270	27,220	250	25,700	190
		4	0.004	36,720	360	32,400	290	30,240	270	27,220	250	25,700	190
		4.5	0.003	32,640	310	28,800	250	26,880	230	24,190	210	22,850	160
		5	0.002	32,640	310	28,800	250	26,880	230	24,190	210	22,850	160
0.25	0.5	0.35	0.036	34,000	610	30,000	540	28,000	480	25,200	430	23,800	330
		0.75	0.036	34,000	610	30,000	540	28,000	480	25,200	430	23,800	330
		1	0.036	34,000	610	30,000	540	28,000	480	25,200	430	23,800	330
		1.5	0.032	34,000	610	30,000	540	28,000	480	25,200	430	23,800	330
		2	0.028	34,000	610	30,000	540	28,000	480	25,200	430	23,800	330
		2.5	0.026	30,600	500	27,000	440	25,200	390	22,680	350	21,420	270
		3	0.024	30,600	500	27,000	440	25,200	390	22,680	350	21,420	270
		4	0.016	30,600	500	27,000	440	25,200	390	22,680	350	21,420	270
		5	0.014	30,600	500	27,000	440	25,200	390	22,680	350	21,420	270
		5.5	0.006	27,200	420	24,000	370	22,400	320	20,160	290	19,040	230
		6	0.005	27,200	420	24,000	370	22,400	320	20,160	290	19,040	230
		7	0.004	27,200	420	24,000	370	22,400	320	20,160	290	19,040	230
		8	0.003	27,200	420	24,000	370	22,400	320	20,160	290	19,040	230
0.3	0.6	0.4	0.04	34,000	880	30,000	720	28,000	560	25,200	500	23,800	390
		0.75	0.04	34,000	880	30,000	720	28,000	560	25,200	500	23,800	390

【Note】 Upon usage, please refer to comments and notes below table on page 32.

Recommended Cutting Conditions (Metric)

High efficiency cutting condition

High accuracy cutting condition

Please refer to P.25 about high efficiency cutting conditions

Work material				1 Pre-hardened steels (35～45HRC)		2 Hardened steels (45～55HRC)		3 Hardened steels (55～65HRC)		4 Hardened steels (65～68HRC)		5 Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
0.3	0.6	1	0.04	34,000	880	30,000	720	28,000	560	25,200	500	23,800	390
		1.5	0.038	34,000	880	30,000	720	28,000	560	25,200	500	23,800	390
		2	0.034	34,000	880	30,000	720	28,000	560	25,200	500	23,800	390
		2.5	0.03	34,000	880	30,000	720	28,000	560	25,200	500	23,800	390
		3	0.027	34,000	880	30,000	720	28,000	560	25,200	500	23,800	390
		3.5	0.023	30,600	760	27,000	620	25,200	480	22,680	430	21,420	340
		4	0.019	30,600	760	27,000	620	25,200	480	22,680	430	21,420	340
		4.5	0.018	30,600	720	27,000	580	25,200	450	22,680	410	21,420	320
		5	0.016	30,600	720	27,000	580	25,200	450	22,680	410	21,420	320
		5.5	0.014	30,600	720	27,000	580	25,200	450	22,680	410	21,420	320
		6	0.012	30,600	720	27,000	580	25,200	450	22,680	410	21,420	320
		7	0.006	27,200	600	24,000	490	22,400	380	20,160	340	19,040	270
		8	0.006	27,200	600	24,000	490	22,400	380	20,160	340	19,040	270
		9	0.005	27,200	600	24,000	490	22,400	380	20,160	340	19,040	270
		10	0.004	23,800	530	21,000	430	19,600	330	17,640	300	16,660	230
		12	0.003	20,400	420	18,000	350	16,800	270	15,120	240	14,280	190
0.35	0.7	0.45	0.049	34,000	980	30,000	810	28,000	660	25,200	590	23,800	460
		2	0.049	34,000	980	30,000	810	28,000	660	25,200	590	23,800	460
		4	0.027	30,600	840	27,000	690	25,200	560	22,680	510	21,420	400
		6	0.022	30,600	790	27,000	650	25,200	540	22,680	480	21,420	370
		8	0.008	27,200	630	24,000	520	22,400	420	20,160	380	19,040	300
0.4	0.8	0.5	0.08	34,000	1,090	30,000	900	28,000	780	25,200	710	23,800	550
		1	0.08	34,000	1,090	30,000	900	28,000	780	25,200	710	23,800	550
		1.5	0.08	34,000	1,090	30,000	900	28,000	780	25,200	710	23,800	550
		2	0.064	34,000	1,090	30,000	900	28,000	780	25,200	710	23,800	550
		2.5	0.06	34,000	1,090	30,000	900	28,000	780	25,200	710	23,800	550
		3	0.055	34,000	1,090	30,000	900	28,000	780	25,200	710	23,800	550
		4	0.045	34,000	1,090	30,000	900	28,000	780	25,200	710	23,800	550
		5	0.036	30,600	880	27,000	730	25,200	640	22,680	570	21,420	450
		6	0.026	30,600	880	27,000	730	25,200	640	22,680	570	21,420	450
		8	0.016	27,200	780	24,000	650	22,400	560	20,160	510	19,040	400
		10	0.008	27,200	740	24,000	610	22,400	530	20,160	480	19,040	370
		12	0.006	27,200	740	24,000	610	22,400	530	20,160	480	19,040	370
0.45	0.9	0.6	0.072	32,300	1,220	28,500	1,000	26,600	890	23,940	800	22,610	620
		2	0.072	32,300	1,220	28,500	1,000	26,600	890	23,940	800	22,610	620
		4	0.046	32,300	1,220	28,500	1,000	26,600	890	23,940	800	22,610	620
		6	0.034	29,070	980	25,650	810	23,940	720	21,550	650	20,350	510
		8	0.024	25,840	880	22,800	720	21,280	640	19,150	580	18,090	450
0.5	1	0.8	0.09	30,600	1,380	27,000	1,130	25,200	1,010	22,680	910	21,420	710
		1.5	0.09	30,600	1,380	27,000	1,130	25,200	1,010	22,680	910	21,420	710
		2	0.08	30,600	1,380	27,000	1,130	25,200	1,010	22,680	910	21,420	710
		2.5	0.08	30,600	1,380	27,000	1,130	25,200	1,010	22,680	910	21,420	710
		3	0.08	30,600	1,380	27,000	1,130	25,200	1,010	22,680	910	21,420	710
		4	0.056	30,600	1,380	27,000	1,130	25,200	1,010	22,680	910	21,420	710
		5	0.048	30,600	1,380	27,000	1,130	25,200	1,010	22,680	910	21,420	710
		6	0.032	27,540	1,120	24,300	920	22,680	820	20,410	730	19,280	570
		7	0.032	27,540	1,120	24,300	920	22,680	820	20,410	730	19,280	570
		8	0.032	27,540	1,120	24,300	920	22,680	820	20,410	730	19,280	570
		9	0.024	27,540	1,120	24,300	920	22,680	820	20,410	730	19,280	570
		10	0.02	27,540	1,120	24,300	920	22,680	820	20,410	730	19,280	570
		12	0.01	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		13	0.009	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		14	0.008	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		16	0.006	24,480	940	21,600	770	20,160	690	18,140	620	17,140	480
		18	0.005	21,420	770	18,900	640	17,640	560	15,880	510	14,990	400
		20	0.004	18,360	660	16,200	540	15,120	480	13,610	440	12,850	340

High efficiency cutting condition

High accuracy cutting condition

Please refer to P.25 about high efficiency cutting conditions

Work material				1 Pre-hardened steels (35～45HRC)		2 Hardened steels (45～55HRC)		3 Hardened steels (55～65HRC)		4 Hardened steels (65～68HRC)		5 Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
0.55	1.1	2	0.08	28,560	1,300	25,200	1,090	23,520	970	21,170	870	19,990	680
		4	0.056	28,560	1,300	25,200	1,090	23,520	970	21,170	870	19,990	680
		6	0.032	26,010	1,090	22,950	920	21,420	810	19,280	730	18,210	570
		8	0.032	26,010	1,090	22,950	920	21,420	810	19,280	730	18,210	570
		10	0.02	26,010	1,090	22,950	920	21,420	810	19,280	730	18,210	570
0.6	1.2	2	0.077	26,150	1,210	23,080	1,000	21,540	890	19,380	800	18,310	620
		3	0.077	26,150	1,210	23,080	1,000	21,540	890	19,380	800	18,310	620
		4	0.064	26,150	1,210	23,080	1,000	21,540	890	19,380	800	18,310	620
		6	0.048	26,150	1,210	23,080	1,000	21,540	890	19,380	800	18,310	620
		8	0.032	24,480	1,220	21,600	950	20,160	810	18,140	730	17,140	560
		10	0.028	24,480	1,100	21,600	860	20,160	730	18,140	650	17,140	510
		12	0.024	24,480	1,100	21,600	860	20,160	730	18,140	650	17,140	510
0.7	1.4	3	0.088	21,420	1,160	18,900	980	17,640	880	15,880	790	14,990	620
		8	0.044	21,420	1,160	18,900	980	17,640	880	15,880	790	14,990	620
		12	0.028	21,420	1,040	18,900	890	17,640	790	15,880	720	14,990	560
		16	0.014	19,040	870	16,800	740	15,680	670	14,110	600	13,330	470
0.75	1.5	2	0.096	23,800	1,430	21,000	1,130	19,600	980	17,640	880	16,660	690
		2.5	0.096	23,800	1,430	21,000	1,130	19,600	980	17,640	880	16,660	690
		3	0.096	23,800	1,430	21,000	1,130	19,600	980	17,640	880	16,660	690
		4	0.08	23,800	1,430	21,000	1,130	19,600	980	17,640	880	16,660	690
		5	0.08	23,800	1,430	21,000	1,130	19,600	980	17,640	880	16,660	690
		6	0.08	23,800	1,430	21,000	1,130	19,600	980	17,640	880	16,660	690
		8	0.048	21,420	1,160	18,900	920	17,640	790	15,880	720	14,990	560
		10	0.048	21,420	1,160	18,900	920	17,640	790	15,880	720	14,990	560
		12	0.048	21,420	1,160	18,900	920	17,640	790	15,880	720	14,990	560
		14	0.04	19,040	970	16,800	770	15,680	670	14,110	600	13,330	470
		16	0.015	19,040	970	16,800	770	15,680	670	14,110	600	13,330	470
		18	0.015	19,040	970	16,800	770	15,680	670	14,110	600	13,330	470
		20	0.015	19,040	970	16,800	770	15,680	670	14,110	600	13,330	470
0.8	1.6	4	0.11	22,100	1,370	19,500	1,170	18,200	1,020	16,380	920	15,470	710
		8	0.088	22,100	1,370	19,500	1,170	18,200	1,020	16,380	920	15,470	710
		12	0.052	19,890	1,110	17,550	950	16,380	830	14,740	740	13,920	580
		16	0.032	19,890	1,110	17,550	950	16,380	830	14,740	740	13,920	580
		20	0.016	17,680	930	15,600	800	14,560	690	13,100	620	12,380	490
0.9	1.8	4	0.147	22,100	1,550	19,500	1,290	18,200	1,090	16,380	980	15,470	760
		8	0.104	22,100	1,550	19,500	1,290	18,200	1,090	16,380	980	15,470	760
		12	0.056	19,890	1,250	17,550	1,040	16,380	890	14,740	800	13,920	620
		16	0.036	19,890	1,250	17,550	1,040	16,380	890	14,740	800	13,920	620
		20	0.018	17,680	1,050	15,600	880	14,560	740	13,100	670	12,380	520
1	2	2.5	0.16	17,850	1,610	15,750	1,360	14,700	1,180	13,230	1,060	12,500	820
		3	0.16	17,850	1,610	15,750	1,360	14,700	1,180	13,230	1,060	12,500	820
		4	0.16	17,850	1,610	15,750	1,360	14,700	1,180	13,230	1,060	12,500	820
		5	0.16	17,850	1,610	15,750	1,360	14,700	1,180	13,230	1,060	12,500	820
		6	0.16	17,850	1,430	15,750	1,200	14,700	1,060	13,230	950	12,500	740
		8	0.112	17,850	1,430	15,750	1,200	14,700	1,060	13,230	950	12,500	740
		10	0.112	17,850	1,290	15,750	1,070	14,700	940	13,230	850	12,500	660
		12	0.064	16,070	1,160	14,180	960	13,230	850	11,910	760	11,250	590
		13	0.064	16,070	1,160	14,180	960	13,230	850	11,910	760	11,250	590
		14	0.064	16,070	1,160	14,180	960	13,230	850	11,910	760	11,250	590
		16	0.064	16,070	1,040	14,180	870	13,230	760	11,910	690	11,250	530
		18	0.048	16,070	1,040	14,180	870	13,230	760	11,910	690	11,250	530
		20	0.04	16,070	1,040	14,180	870	13,230	760	11,910	690	11,250	530
		22	0.034	15,170	930	13,390	770	12,500	680	11,250	610	10,620	480
		25	0.028	14,280	870	12,600	730	11,760	640	10,580	580	10,000	450
		30	0.012	14,280	870	12,600	730	11,760	640	10,580	580	10,000	450
		35	0.01	12,500	720	11,030	600	10,290	530	9,260	470	8,750	370
		40	0.008	10,710	620	9,450	510	8,820	450	7,940	410	7,500	320

【Note】 Upon usage, please refer to comments and notes below table on page 32.

Recommended Cutting Conditions (Metric)

High efficiency cutting condition

High accuracy cutting condition

Please refer to P.25 about high efficiency cutting conditions

Work material				1 Pre-hardened steels (35～45HRC)		2 Hardened steels (45～55HRC)		3 Hardened steels (55～65HRC)		4 Hardened steels (65～68HRC)		5 Hardened steels (68～72HRC)	
Ratio to standard depth of cut				100%		85%		80%		65%		55%	
Ball radius RE (mm)	Tool dia. DC (mm)	Under neck length LU (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1.25	2.5	6	0.2	15,730	1,690	13,880	1,370	12,950	1,130	11,660	1,010	11,070	810
		10	0.136	15,730	1,690	13,880	1,370	12,950	1,130	11,660	1,010	11,070	810
		15	0.08	14,150	1,370	12,490	1,110	11,660	910	10,490	820	9,970	660
		20	0.064	14,150	1,370	12,490	1,110	11,660	910	10,490	820	9,970	660
		25	0.052	14,150	1,230	12,490	1,000	11,660	820	10,490	740	9,970	590
		30	0.035	12,580	1,150	11,100	930	10,360	770	9,320	690	8,860	550
1.5	3	6	0.24	13,600	1,820	12,000	1,510	11,200	1,340	10,080	1,210	9,580	970
		8	0.24	13,600	1,820	12,000	1,510	11,200	1,340	10,080	1,210	9,580	970
		10	0.168	13,600	1,820	12,000	1,510	11,200	1,340	10,080	1,210	9,580	970
		13	0.168	13,600	1,820	12,000	1,510	11,200	1,340	10,080	1,210	9,580	970
		16	0.168	13,600	1,640	12,000	1,360	11,200	1,210	10,080	1,090	9,580	870
		20	0.096	12,240	1,480	10,800	1,230	10,080	1,090	9,070	980	8,620	780
		25	0.064	12,240	1,480	10,800	1,230	10,080	1,090	9,070	980	8,620	780
		30	0.064	12,240	1,480	10,800	1,230	10,080	1,090	9,070	980	8,620	780
		35	0.051	10,880	1,240	9,600	1,030	8,960	910	8,060	820	7,660	660
1.75	3.5	10	0.216	11,690	1,760	10,310	1,430	9,630	1,180	8,660	1,060	8,230	850
		15	0.192	11,690	1,760	10,310	1,430	9,630	1,180	8,660	1,060	8,230	850
		25	0.112	10,520	1,430	9,280	1,160	8,660	950	7,800	860	7,410	680
		35	0.072	10,520	1,430	9,280	1,160	8,660	950	7,800	860	7,410	680
		45	0.058	9,350	1,200	8,250	980	7,700	800	6,930	720	6,580	580
2	4	8	0.32	9,780	1,760	8,630	1,470	8,050	1,290	7,250	1,160	6,880	930
		10	0.32	9,780	1,760	8,630	1,470	8,050	1,290	7,250	1,160	6,880	930
		12	0.256	9,780	1,760	8,630	1,470	8,050	1,290	7,250	1,160	6,880	930
		13	0.256	9,780	1,760	8,630	1,470	8,050	1,290	7,250	1,160	6,880	930
		16	0.224	9,780	1,760	8,630	1,470	8,050	1,290	7,250	1,160	6,880	930
		20	0.224	9,780	1,760	8,630	1,470	8,050	1,290	7,250	1,160	6,880	930
		25	0.128	8,800	1,430	7,760	1,190	7,250	1,040	6,520	940	6,190	750
		30	0.128	8,800	1,430	7,760	1,190	7,250	1,040	6,520	940	6,190	750
		35	0.08	8,800	1,430	7,760	1,190	7,250	1,040	6,520	940	6,190	750
		40	0.08	8,800	1,430	7,760	1,190	7,250	1,040	6,520	940	6,190	750
		45	0.064	7,820	1,200	6,900	1,000	6,440	880	5,800	790	5,510	630
		50	0.056	7,820	1,200	6,900	1,000	6,440	880	5,800	790	5,510	630
2.5	5	10	0.392	7,650	1,530	6,750	1,350	6,300	1,130	5,670	1,020	5,390	820
		20	0.28	7,650	1,530	6,750	1,350	6,300	1,130	5,670	1,020	5,390	820
		25	0.28	7,650	1,530	6,750	1,350	6,300	1,130	5,670	1,020	5,390	820
		30	0.16	6,890	1,380	6,080	1,220	5,670	1,020	5,100	920	4,850	740
		40	0.16	6,890	1,240	6,080	1,090	5,670	920	5,100	830	4,850	660
3	6	12	0.48	7,650	1,890	6,750	1,540	6,300	1,260	5,670	1,130	5,390	910
		20	0.4	7,230	1,660	6,380	1,350	5,950	1,110	5,360	990	5,090	800
		30	0.336	6,800	1,360	6,000	1,200	5,600	1,010	5,040	910	4,790	730
		50	0.12	6,120	1,100	5,400	970	5,040	820	4,540	730	4,310	590
4	8	24	0.5	6,400	1,690	5,720	1,320	4,180	1,170	3,960	870	3,760	700
5	10	30	0.6	5,100	1,460	4,510	1,130	3,520	1,000	3,190	770	3,030	620
6	12	36	0.8	4,200	1,240	3,850	1,000	2,640	880	2,640	660	2,510	530

※(1) a_p is shown as the criteria for Group 1 workpieces. For other groups, adjust the cutting depth according to the cutting depth factors in the above table.
※(2) When performing cutting where cutting chips may cause clogging, such as for rib cutting, blind grooves, etc., cutting depth setting should be set by multiplying a cutting depth factor to calculate the cutting depth amount, and this amount should then be reduced to 80% of the calculated value.
※(3) Adjust by setting a_e to (3 to 5)×(a_p)×(cutting depth ratio). When performing finishing processing, calculate the theoretical cusp height and set accordingly.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDBEH2020-10-TH3 tool:
Cutting depth = 0.112 (a_p) × 0.85 (cutting depth factor for Group 2 hardened steel) × 0.8 (for closed-area cutting) = 0.076mm

【Note】

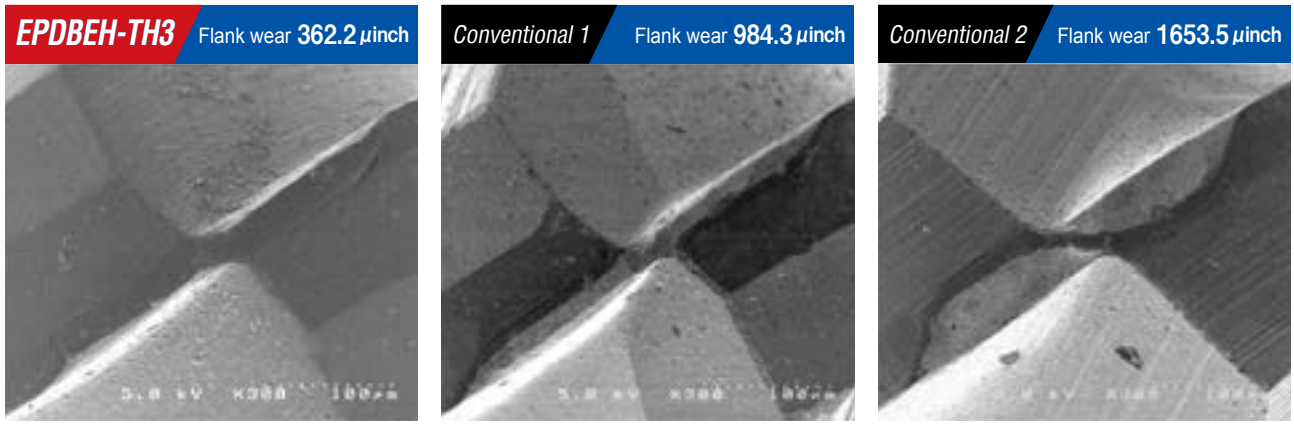
① Although basically dry (air blow) cutting is recommended, please use appropriate coolant according to the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

Field data of High-speed steel cutting

01 Direct cutting of powdered high-speed steel【HAP40 65HRC】

Tool：EPDBEH2010-3-TH3　Work material：HAP40 65HRC　Machine：Vertical MC（HSK-F63）
Cutting method：Contour pocketing
Cutting conditions：n=24,000min^{-1} (v_c=246.0 SFM)　v_f=33.9 IPM (f_z=.001 IPT)　a_p .002 inch　a_e .002 inch　Dry(Air-blow)

Figure　Wear condition after 30 minutes of machining

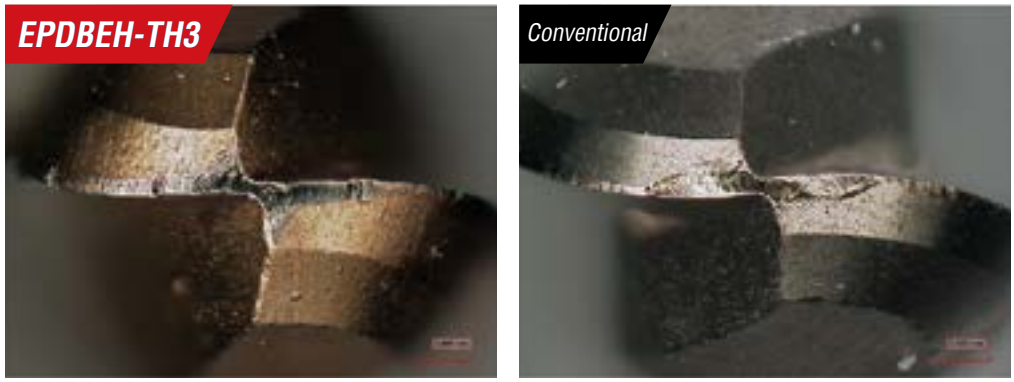


Wear amount is 1/3 that of conventional products!!
Demonstrates excellent wear resistance.

02 Pocketing of matrix high-speed steel【YXR33 58HRC】

Pocket size：.504 x .394 x .197 inch
Tool：EPDBEH2010-6-TH3　Work material：YXR33 58HRC　Machine： Vertical MC (HSK-E32)
Cutting conditions：n=22,600min^{-1} (v_c=233.0 SFM)　v_f=32.3 IPM (f_z=.001 IPT)
a_p .001 inch　a_e .005 inch　OH=.709 inch　Coolant：Mist blow

Figure　Wear condition after 60 minutes of machining

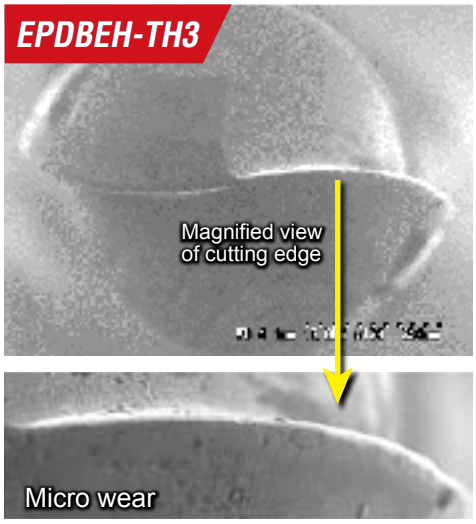


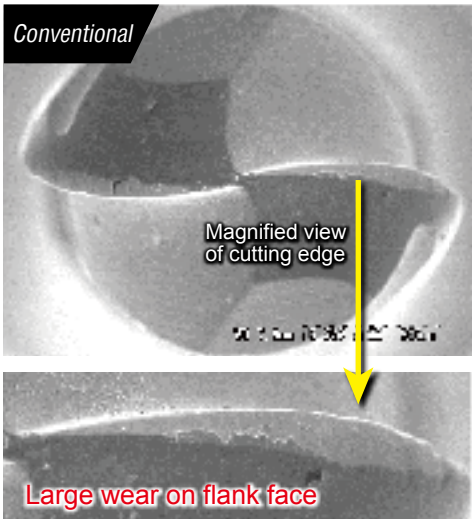
The amount of wear was only 433.1 µinch
even after processing for 1 hour.

Field data of High-speed steel cutting

03 Dissolution high-speed steel 【DURO-V5 62-63HRC】

Tool：EPDBEH2010-2-TH3 Work material：DURO-V5(62-63HRC) Machine：5-axis MC(BT40)
Cutting conditions：n=17,000min^{-1} (v_c=174.0 SFM) v_f=31.5 IPM (f_z=.002 IPT)
a_p .001 inch a_e .002 inch Stock material .0006 inch Coolant：Mist blow
Cutting time：45min





Field data of plastic mold steel cutting

01 Cutting of equivalent to S420 【Relief engraving of "TH3"】

Machine: Vertical MC(HSK-E25) Work material：HPM38 (57HRC) Coolant：Mist-blow

Figure Wear condition after finishing

(R0.75-Under neck length 2mm)

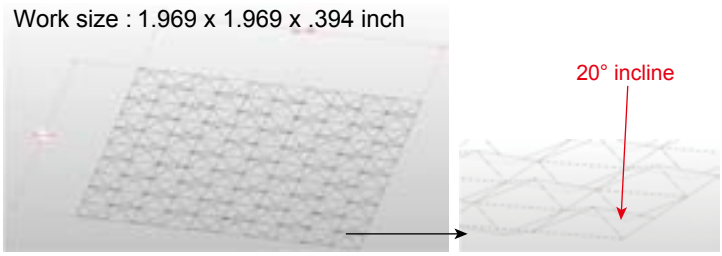
Figure Work

Work size : 50×50×10mm

Process	Item code	Tool dia. (mm)	Under neck length (mm)	Revolution (min^{-1})	Cutting speed (SFM)	Feed rate (IPM)	Feed per tooth (IPT)	a_p (inch)	a_e (inch)	Cutting time
Roughing	EPDBEH2030-8-TH3	ϕ3.0	8	21,221	328	83.5	.002	.008	.016	38 min
Finishing	EPDBEH2015-2-TH3	ϕ1.5	2	40,000	617	94.5	.001	.002	.004	76 min
									Total	**1hr 54 min**

02 High speed cutting of equivalent to S440C

Figure Work shape



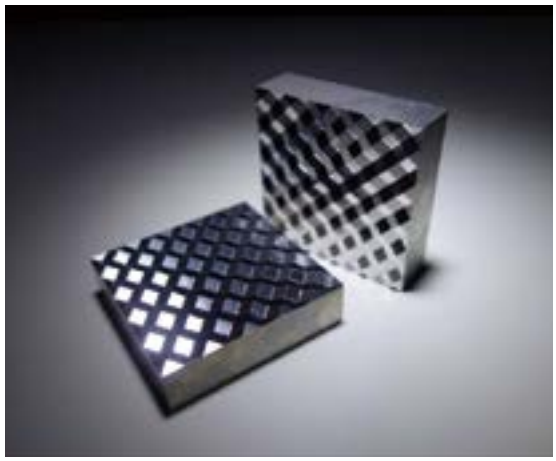
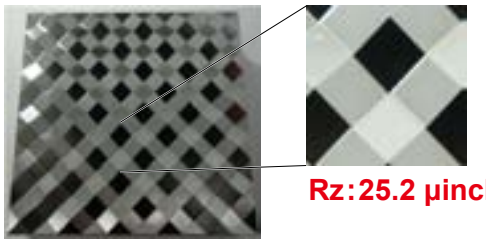


Figure Magnified view

Surface roughness of 20° incline



Rz：25.2 µinch

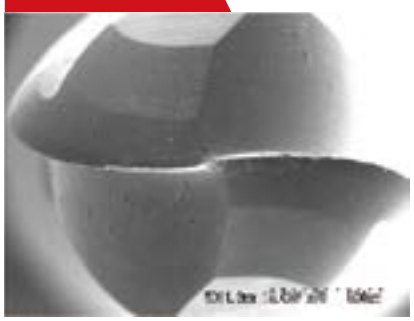
Machine: Vertical MC(HSK-E25)　S440C(60HRC)　Coolant：Mist-blow

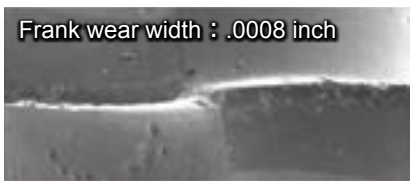
Process	Item code	Tool dia. (mm)	Under neck length (mm)	Revolution (min^{-1})	Cutting speed (SFM)	Feed rate (IPM)	Feed per tooth (IPT)	a_p (inch)	a_e (inch)	Cutting time
Roughing	EPDBEH2030-8-TH3	ϕ3.0	8	10,610	328	41.8	.002	.012	.012	60 min
Semi-finishing	EPDBEH2030-8-TH3	ϕ3.0	8	15,915	492	62.7	.002	.004	.004	28 min
Finishing	EPDBEH2010-2-TH3	ϕ1.0	2	31,831	328	75.2	.001	.0012	.0012	56 min
									Total	**2hr 24 min**

03 Equivalent to S440C M340 【M340 57HRC】

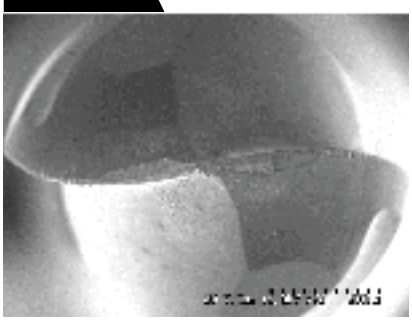
Tool：EPDBEH2020-10-TH3　Work material：M340 (57HRC)　Machine：Vertical MC (HSK-E32)
Cutting conditions：n=15,000min^{-1} (v_c=308.0 SFM)　v_f=23.6 IPM (f_z=.001 IPT)　a_p .005 inch　a_e .006 inch　Coolant：Mist blow
Cutting time：180min

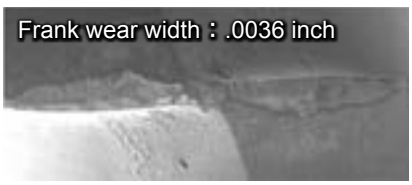
EPDBEH-TH3





Conventional





Multi-cavity model pocketing

Figure Work shape

Pocket size: .315 x .315 x depth .197 inch

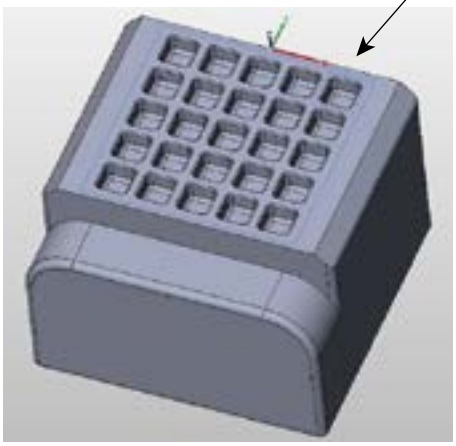


Figure Work after machining

Processed total 100 of pockets

Machine : 5-axsis MC(HSK-A63)　Work material : Equivalent to SUS420J2(52HRC)
Coolant : Dry(air)

Process	Item code	Tool dia. (mm)	Revolution (min^{-1})	Cutting speed (SFM)	Feed rate (IPM)	Feed per tooth (IPT)	a_p (inch)	a_e (inch)	Removal stock (inch)	Cutting time
Contour roughing	EPDBEH2030-8-TH3	ϕ3.0	11,200	344	52.9	.002	.012	.028	.002	47 min
Contour semi finishing	EPDBEH2020-6-TH3	ϕ2.0	14,700	302	41.7	.001	.008	–	.0008	25 min
Contour finishing	EPDBEH2020-6-TH3	ϕ2.0	14,700	302	41.7	.001	.004	.001	0	37 min
Contour bottom finishing	EPDBEH2020-6-TH3	ϕ2.0	14,700	302	41.7	.001	–	.001	0	49 min

※Cutting time per work (25 pockets)

■ Tool wear condition

EPDBEH2020-6-TH3

Flank wear width : .0009 inch

■ Amount of cutting remain

Measures pocket width

Cutting remain per one side :
.0001 inch ~ .0005 inch
(variation in 100 pockets: .0003 inch)

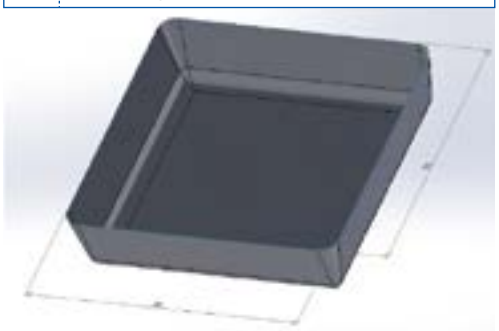
Finalized semi-finishing and finishing by 1 tool.
Machining time is 7 hours and 24 minutes!

Cutting remain is very small, only .0005 inch and achieved very precise machining.

Direct pocketing of powder high-speed steel

Machine : Vertical MC (HSK-E32)
Work material : HAP40 (65HRC)
Coolant : Mist-blow

Figure Work shape

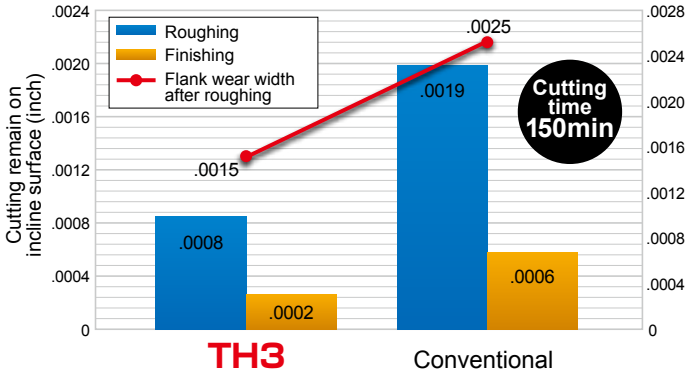


Pocket size : .787×.787×.197 inch (Incline angle 10°)

Process	Item code	Tool dia. (mm)	Revolution (min^{-1})	Cutting speed (SFM)	Feed rate (IPM)	Feed per tooth (IPM)	a_p (inch)	a_e (inch)	Removal stock (inch)	Cutting time
Contour roughing	EPDBEH2030-8-TH3	ϕ3.0	11,200	348.0	52.9	.002	.007	.007	.002	39 min
Contour finishing	EPDBEH2020-6-TH3	ϕ2.0	22,680	469.0	32.1	.001	.001	.001	0	20 min
Parallel finishing	EPDBEH2020-6-TH3	ϕ2.0	22,680	469.0	32.1	.001	.001	.001	0	16 min
									Total	**75 min**

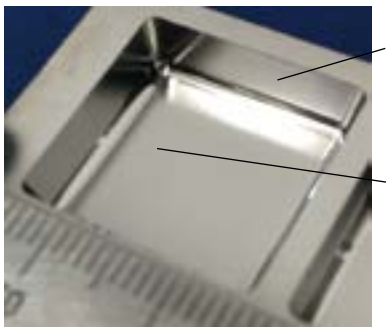
■ Comparison of cutting remain

Figure Correlation chart of cutting remain and tool wear after 2 pockets processing



■ Machined surface roughness

Figure Work after 2 pocketing



○10° incline surface
Ra 3.54 µinch
Rz 22.44 µinch

○Bottom surface
Ra 7.87 µinch
Rz 47.24 µinch

Hi-Pre² The synergy of the superior wear resistance of TH3 Coating and high-rigidity cutting edge geometry reduces the cutting remain on direct cutting of powder high-speed steel and realizes good machined surface roughness

Hi-Pre² = **"High Precision Pre-finishing"**

⚠ Safety notes

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 the local laws and regulations regarding prevention of hazards due to specified chemical substances.

Notes

MOLDINO
The Edge To Innovation

4 Flute High Efficiency Ball End Mill

EHHBE-TH3

Epoch High Hard Ball-TH3

MOLDINO Tool Engineering, Ltd.

New Product News | No. H2005A-1 | 2020-10

EHHBE has evolved by adopting the new TH3 coating for high hardened steel machining. Longer tool life capability when cutting high hardened steels.

Features of EHHBE-TH3

01 Highly efficient cutting with 4 flutes

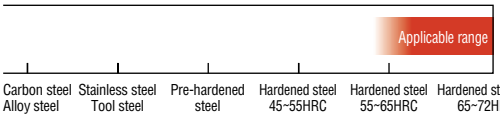
02 Special cutting edge shape on the tool tip that improves cutting performance.

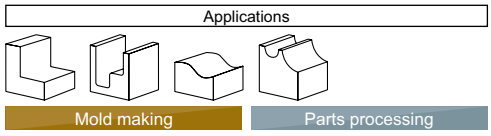
03 TH3 Coating provides long tool life even on hardened steels.

04 Variable Pitch tool geometry reduces cutting vibration.

05 Wide chip pocket improves chip removal.

06 Available for high-efficiency side milling.

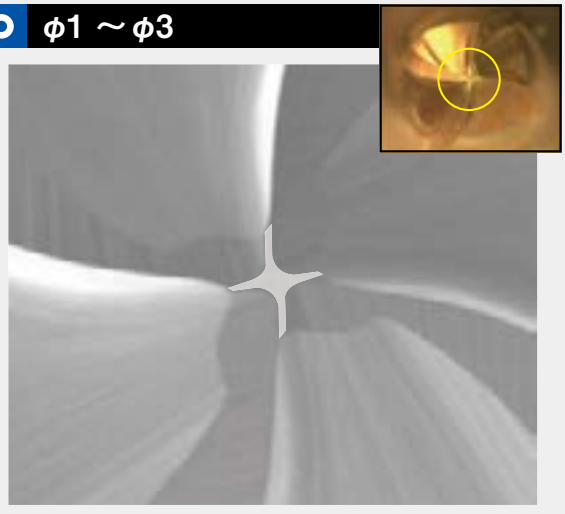




EHHBE-TH3
R0.5～R6 [17 Items]

Features Special tip shape

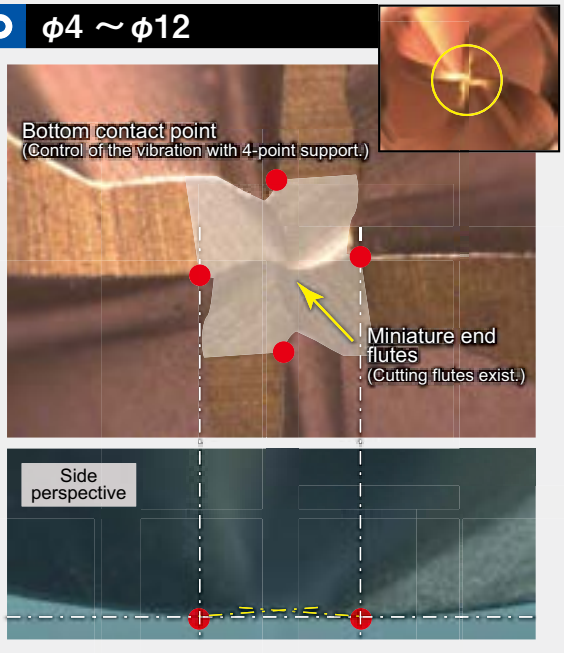
ϕ1 ～ϕ3



<Features and effects>

By creating a special flank face with a tiny relief angle at the very tip section, R accuracy is improved even with 4 flutes.

ϕ4 ～ϕ12

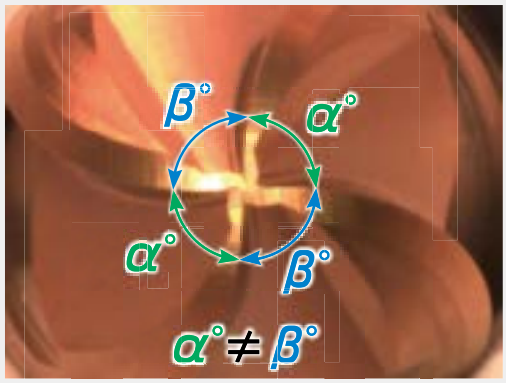


<Features and effects>

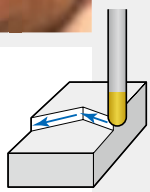
Features: There is no cutting point at the center of the tool tip.

Effects: Flute chipping, due to chip jamming at the center of the tip, is reduced.

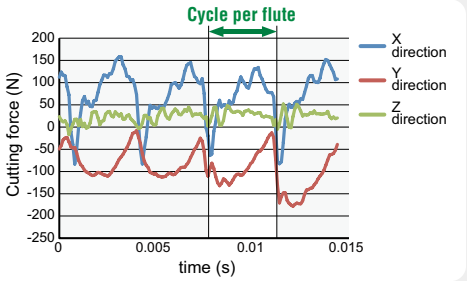
Features Suppressed vibration with Variable Pitch geometry



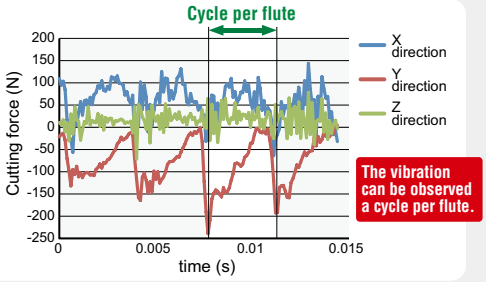
Work material：Matrix HSS(58HRC)
Tool：ϕ8 (R4) ×4 flutes
n =4,000min^{-1} (v_c=100m/min)
v_f =1,920mm/min (f_z=0.12mm/t)
a_p=0.3mm a_e=0.1mm Dry Air-blow
Machine: HSK-A63 Over hang：32mm



EHHBE-TH3
4 flutes
Variable Pitch

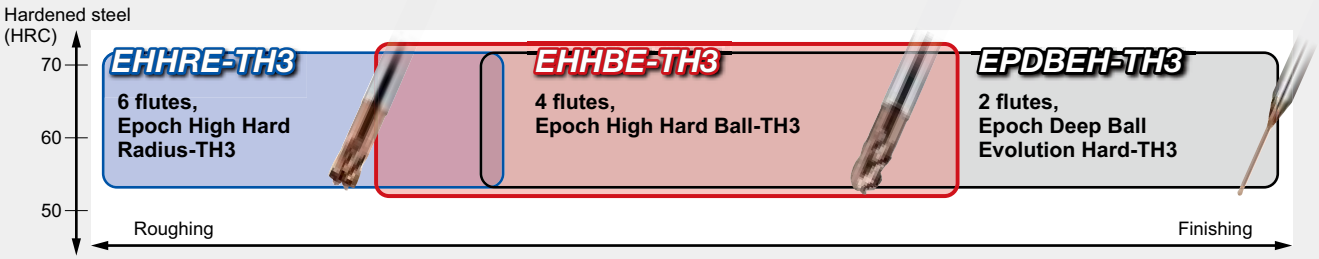


Conventional
4 flutes
Equal pitch



Features Performance and positioning

EHHBE-TH3 exhibits the performance during roughing to semi-finishing of high hardened steel (55HRC～).



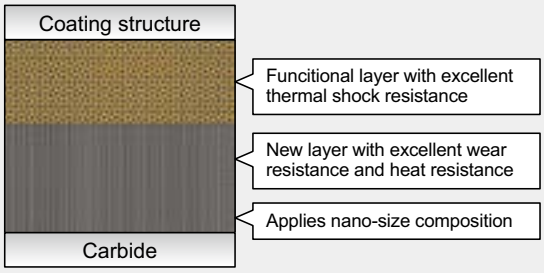
Features Newly developed "TH3" coating for hardened steel machining.

Features and performance

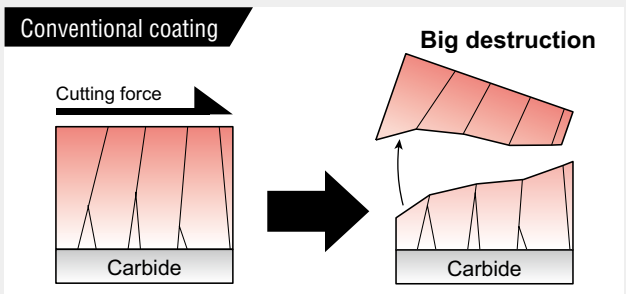
- High hardness coating with excellent wear resistance and heat resistance
- Has excellent thermal shock resistance which reduces the risk of rapid tool chipping.
- Long tool life when cutting high-hardness materials (50HRC or higher) such as hardened steel

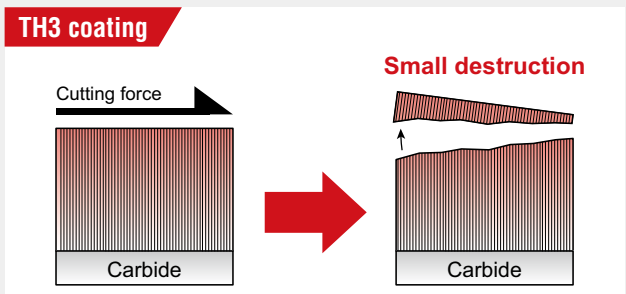
Target steel grade

- Hardened steel (especially 50HRC or higher), high-speed steel

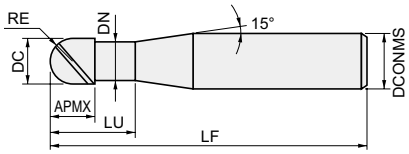


! Point TH3 coating utilizes nano-size composition to reduce large chipping of the coating.

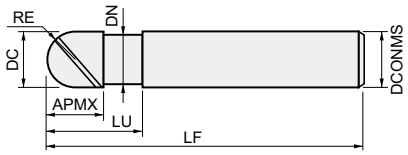




A type



B type



(mm)

Ball Radius RE	Tolerance on RE	Tolerance on dia.
0.5~1.5	±0.005	0~−0.010
2~3	±0.007	0~−0.014
4~6	±0.010	0~−0.020

EHHBE4○○○(-S○)-TH3

Carbide | TH3 | Helix 40° | Variable Pitch | h5

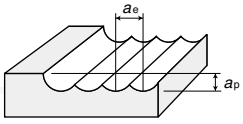
Order Number	Stock	Size (mm) Ball radius RE	Tool dia. DC	Flute length APMX	Under neck length LU	Neck dia. DN	Overall length LF	Shank dia. DCONMS	No. of flutes	Type
EHHBE4010-S4-TH3	●	0.5	1	1.5	3	0.95	50	4	4	A
EHHBE4010-S6-TH3	●			1.5	3	0.95	50	6	4	A
EHHBE4015-S4-TH3	●	0.75	1.5	2.5	4.5	1.43	50	4	4	A
EHHBE4015-S6-TH3	●			2.5	4.5	1.43	50	6	4	A
EHHBE4020-S4-TH3	●	1	2	3	6	1.9	50	4	4	A
EHHBE4020-S6-TH3	●			3	6	1.9	50	6	4	A
EHHBE4025-S4-TH3	●	1.25	2.5	4	7.5	2.38	50	4	4	A
EHHBE4025-S6-TH3	●			4	7.5	2.38	50	6	4	A
EHHBE4030-S4-TH3	●	1.5	3	4.5	9	2.9	70	4	4	A
EHHBE4030-S6-TH3	●			4.5	9	2.9	70	6	4	A
EHHBE4040-S4-TH3	●	2	4	6	12	3.9	70	4	4	B
EHHBE4040-S6-TH3	●			6	12	3.9	70	6	4	A
EHHBE4050-TH3	●	2.5	5	7.5	15	4.7	80	6	4	A
EHHBE4060-TH3	●	3	6	9	18	5.7	90	6	4	B
EHHBE4080-TH3	●	4	8	12	24	7.6	100	8	4	B
EHHBE4100-TH3	●	5	10	15	30	9.5	100	10	4	B
EHHBE4120-TH3	●	6	12	18	36	11.5	110	12	4	B

● : Stoked Items.

Recommended Cutting Conditions

Roughing

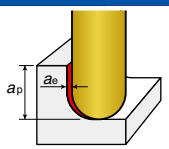
For work materials with hardnesses up to 55HRC, we recommend our company's 2-flute or 3-flute tool series.



Work material		Hardened Steels (55~62HRC) D2, Matrix HSS					Hardened Steels (62~66HRC) Powdered HSS, Matrix HSS, HSS					Hardened Steels (66~72HRC) Powdered HSS				
Ball radius RE (mm)	Tool dia. DC (mm)	Cutting speed v_c=110m/min Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Cutting speed v_c=90m/min Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Cutting speed v_c=70m/min Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm
0.5	1	35,000	1,930	76	0.08	0.23	28,700	1,340	53	0.06	0.18	22,300	860	34	0.05	0.14
0.75	1.5	23,400	1,760	69	0.11	0.34	19,100	1,220	48	0.09	0.27	14,900	780	31	0.07	0.20
1	2	17,500	1,750	69	0.15	0.45	14,300	1,220	48	0.12	0.36	11,100	780	31	0.09	0.27
1.25	2.5	14,000	1,650	65	0.19	0.56	11,500	1,150	45	0.15	0.45	8,900	730	29	0.11	0.34
1.5	3	11,700	1,650	65	0.23	0.68	9,600	1,150	45	0.18	0.54	7,400	730	29	0.14	0.41
2	4	8,800	1,670	66	0.30	0.90	7,200	1,160	46	0.24	0.72	5,600	740	29	0.18	0.54
2.5	5	7,000	1,700	67	0.38	1.13	5,700	1,170	46	0.30	0.90	4,500	760	30	0.23	0.68
3	6	5,800	1,690	67	0.45	1.35	4,800	1,190	47	0.36	1.08	3,700	750	30	0.27	0.81
4	8	4,400	1,760	69	0.60	1.80	3,600	1,220	48	0.48	1.44	2,800	780	31	0.36	1.08
5	10	3,500	1,750	69	0.75	2.25	2,900	1,230	48	0.60	1.80	2,200	770	30	0.45	1.35
6	12	2,900	1,650	65	0.90	2.70	2,400	1,160	46	0.72	2.16	1,900	760	30	0.54	1.62

Side Cutting

For work materials with hardnesses up to 55HRC, we recommend our company's 2-flute or 3-flute tool series.

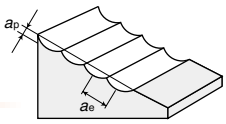


Work material		Hardened Steels (55～62HRC) D2, Matrix HSS					Hardened Steels (62～66HRC) Powdered HSS, Matrix HSS, HSS					Hardened Steels (66～72HRC) Powdered HSS				
Ball radius RE (mm)	Tool dia. DC (mm)	Cutting speed v_c=150m/min					Cutting speed v_c=125m/min					Cutting speed v_c=100m/min				
		Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm
0.5	1	47,800	2,630	104	1.00	0.02	39,800	1,750	69	1.00	0.02	31,800	1,050	41	1.00	0.01
0.75	1.5	31,800	2,390	94	1.50	0.03	26,500	1,590	63	1.50	0.02	21,200	950	37	1.50	0.02
1	2	23,900	2,390	94	2.00	0.04	19,900	1,590	63	2.00	0.03	15,900	950	37	2.00	0.02
1.25	2.5	19,100	2,240	88	2.50	0.05	15,900	1,490	59	2.50	0.04	12,700	900	35	2.50	0.03
1.5	3	15,900	2,240	88	3.00	0.06	13,300	1,500	59	3.00	0.05	10,600	900	35	3.00	0.03
2	4	11,900	2,260	89	4.00	0.08	10,000	1,520	60	4.00	0.06	8,000	910	36	4.00	0.04
2.5	5	9,600	2,330	92	5.00	0.10	8,000	1,550	61	5.00	0.08	6,400	930	37	5.00	0.05
3	6	8,000	2,330	92	6.00	0.12	6,600	1,540	61	6.00	0.09	5,300	930	37	6.00	0.06
4	8	6,000	2,400	94	8.00	0.16	5,000	1,600	63	8.00	0.12	4,000	960	38	8.00	0.08
5	10	4,800	2,400	94	10.00	0.20	4,000	1,600	63	10.00	0.15	3,200	960	38	10.00	0.10
6	12	4,000	2,280	90	12.00	0.24	3,300	1,500	59	12.00	0.18	2,700	920	36	12.00	0.12

	55～62HRC	62～66HRC	66～72HRC
Slant angle for helical boring	1°	0.5°	0.2°
Feed rate for helical boring	70% of side cutting conditions		

※Set the hole diameter for helical boring to between 1.6 and 2.0 times the tool diameter.

※Set the maximum depth for helical boring to the tool diameter or smaller (≤ 1D).



Finishing

Work material		Tool Steels (25～35HRC) P20, 4140					Pre-hardened Steels (35～45HRC) P21					Hardened Steels (45～55HRC) H13, H13 Modified, 420 Stainless Steel				
Ball radius RE (mm)	Tool dia. DC (mm)	Cutting speed v_c=280m/min					Cutting speed v_c=250m/min					Cutting speed v_c=210m/min				
		Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm
0.5	1	60,000	3,240	128	0.02～0.05	0.02	60,000	2,970	117	0.02～0.05	0.02	60,000	2,700	106	0.02～0.05	0.02
0.75	1.5	60,000	4,860	191	0.02～0.07	0.03	53,100	3,940	155	0.02～0.07	0.03	44,600	3,010	119	0.02～0.07	0.03
1	2	44,600	4,820	190	0.02～0.10	0.04	39,800	3,940	155	0.02～0.10	0.04	33,400	3,010	119	0.02～0.10	0.04
1.25	2.5	35,700	5,030	198	0.05～0.12	0.05	31,800	4,110	162	0.05～0.12	0.05	26,800	3,150	124	0.05～0.12	0.05
1.5	3	29,700	5,030	198	0.05～0.15	0.06	26,500	4,110	162	0.05～0.15	0.06	22,300	3,140	124	0.05～0.15	0.06
2	4	22,300	5,080	200	0.05～0.20	0.08	19,900	4,160	164	0.05～0.20	0.08	16,700	3,170	125	0.05～0.20	0.08
2.5	5	17,800	5,180	204	0.05～0.25	0.1	15,900	4,240	167	0.05～0.25	0.1	13,400	3,250	128	0.05～0.25	0.10
3	6	14,900	5,200	205	0.05～0.3	0.12	13,300	4,260	168	0.05～0.3	0.12	11,100	3,230	127	0.05～0.3	0.12
4	8	11,100	5,330	210	0.05～0.4	0.16	10,000	4,400	173	0.05～0.4	0.16	8,400	3,360	132	0.05～0.4	0.16
5	10	8,900	5,340	210	0.05～0.5	0.2	8,000	4,400	173	0.05～0.5	0.2	6,700	3,350	132	0.05～0.5	0.20
6	12	7,400	5,060	199	0.05～0.6	0.24	6,600	4,140	163	0.05～0.6	0.24	5,600	3,190	126	0.05～0.6	0.24

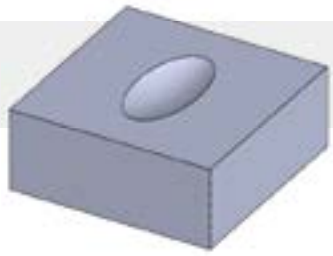
Work material		Hardened Steels (55～62HRC) D2, Matrix HSS					Hardened Steels (62～66HRC) Powdered HSS, Matrix HSS, HSS					Hardened Steels (66～72HRC) Powdered HSS				
Ball radius RE (mm)	Tool dia. DC (mm)	Cutting speed v_c=160m/min					Cutting speed v_c=140m/min					Cutting speed v_c=120m/min				
		Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm	Revolution n min^{-1}	Feed rate V_f mm/min	IPM	a_p mm	a_e mm
0.5	1	51,000	1,840	72	0.02～0.05	0.02	44,600	1,300	51	0.02～0.05	0.02	38,200	950	37	0.02～0.05	0.02
0.75	1.5	34,000	1,840	72	0.02～0.07	0.03	29,700	1,300	51	0.02～0.07	0.03	25,500	950	37	0.02～0.07	0.03
1	2	25,500	1,840	72	0.02～0.10	0.04	22,300	1,300	51	0.02～0.10	0.04	19,100	950	37	0.02～0.10	0.04
1.25	2.5	20,400	1,920	76	0.05～0.12	0.05	17,800	1,360	54	0.05～0.12	0.05	15,300	990	39	0.05～0.12	0.05
1.5	3	17,000	1,920	76	0.05～0.15	0.06	14,900	1,370	54	0.05～0.15	0.06	12,700	980	39	0.05～0.15	0.06
2	4	12,700	1,930	76	0.05～0.20	0.08	11,100	1,370	54	0.05～0.20	0.08	9,600	1,000	39	0.05～0.20	0.08
2.5	5	10,200	1,980	78	0.05～0.25	0.10	8,900	1,400	55	0.05～0.25	0.10	7,600	1,010	40	0.05～0.25	0.10
3	6	8,500	1,980	78	0.05～0.3	0.12	7,400	1,400	55	0.05～0.3	0.12	6,400	1,020	40	0.05～0.3	0.12
4	8	6,400	2,050	81	0.05～0.4	0.16	5,600	1,460	57	0.05～0.4	0.16	4,800	1,060	42	0.05～0.4	0.16
5	10	5,100	2,040	80	0.05～0.5	0.20	4,500	1,460	57	0.05～0.5	0.20	3,800	1,050	41	0.05～0.5	0.20
6	12	4,200	1,920	76	0.05～0.6	0.24	3,700	1,370	54	0.05～0.6	0.24	3,200	1,000	39	0.05～0.6	0.24

【Note】
① Use the appropriate coolant for the work material and machining shape.
② Use as highly rigid and accurate machine as possible.
③ These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
④ If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.

Field Data

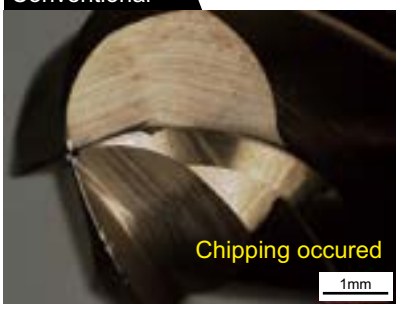
01 Cold tool steel cutting example [D2, 60HRC]

Tool：ϕ6 (R3)　Machine：Vertical MC(BT50)
n=8,000min^{-1}(v_c=150m/min)　v_f=2,100mm/min (f_z=0.066mm/t)　a_e=0.1mm
Scanning　Dry, Air-blow　　Over hang：18mm

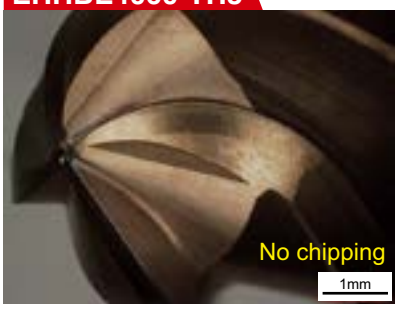


Size :30×60×5mm
Machining time：10min

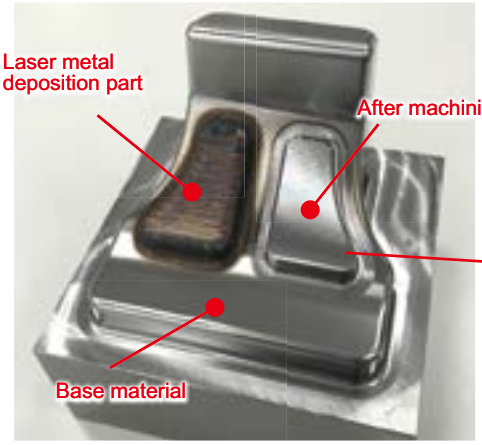
Conventional



EHHBE4060-TH3



02 Cutting application for Laser metal deposition [H13Ⓗ 56HRC]



After machining

■ Condition for tool wear (after machining)

EHHBE4120-TH3

EHHBE4040-S4-TH3

Work size：150×150×150mm

Work material
Base material：H13 43HRC
Laser metal deposition part：H13 56HRC

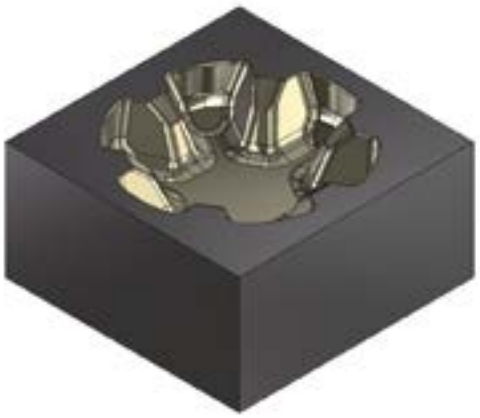
Microwear and possible to use continuously

Machine tool : Okuma Corporation MU-8000V LASER EX
CAM : C&G SYSTEMS INC. CAM-TOOL

Process		Tool	Tool dia. (mm)	Revolution n (min^{-1})	Cutting speed v_c (m/min)	Feed rate v_f (mm/min)	Feed per tooth f_z (mm/t)	a_p (mm)	a_e (mm)	Coolant
Laser metal deposition part	Rouging	EHHBE4120-TH3	12	2,400	90	1,160	0.12	0.5	0.7	Air
		EHHBE4040-S4-TH3	4	7,200	90	1,160	0.04	0.2	0.6	Air
	Finishing	EHHBE4120-TH3	12	3,700	139	1,370	0.09	–	0.2	Air
		EHHBE4040-S4-TH3	4	10,000	126	1,240	0.03	–	0.1	Air

03 Compare with contouring machining and high efficiency side milling.

■ Cutting application for cold forging die (Bevel Gear) [Matrix HSS 60HRC]

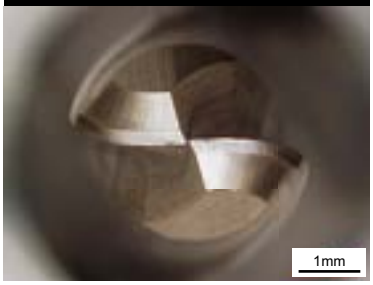


(ϕ25.6×Depth 6mm)

EHHBE4040-S4-TH3
(High-efficiency side milling)

Flank wear：0.015mm

Conventional 2 flutes ball end mill
(Contouring)



Flank wear：0.062mm

High efficiency side milling with EHHBE-TH3 increases tool life when compared to conventional ball end mill (2 flutes).

Cutting conditions

Machine : Vertical MC(HSK-F63) Coolant : Air-blow

Cutting method	Tool	Revolution n (min^{-1})	Cutting speed v_c (m/min)	Feed rate v_f (mm/min)	Feed per tooth f_z (mm/t)	a_p (mm)	a_e (mm)	Max. chip removal volume (cm^3/min)	Actual cutting time
Contouring	Conventional 2 flutes Ball End Mill	14,000	176	750	0.027	0.2	0.6	0.09	28 min.
High efficiency side milling (Helical cutting ⇒ Trochoidal cutting)	EHHBE4040-S4-TH3	11,900	150	1,200	0.025	4	0.25 (Max.)	1.2	10 min.

⚠ Safety notes

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.

Notes

NEW

MOLDINO
The Edge To Innovation

Radius End Mill for Hardened Steel

EPDREH-TH3

Epoch Deep Radius Evolution Hard-TH3

Lineup ranges from ϕ0.2 to ϕ1 for 2-flute version and ϕ1 to ϕ6 for 4-flute version

MOLDINO Tool Engineering, Ltd.

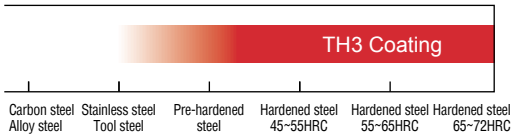
New Product News | No. H2203A-1 | 2022-01

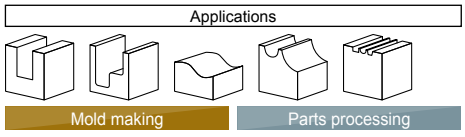
Small-radius deep-milling radius end mill for hardened steel

TH3 Coating benefits and unique cutting edge profile enables long-life/high-accuracy milling of hardened steel.

Features of EPDREH-TH3

- Corner radius precision guaranteed for high-accuracy milling
- Tool design optimized for high-accuracy milling
- TH3 Coating for milling hardened steel





EPDREH-TH3	
2 Flutes	ϕ0.2～ϕ1 [53 Items] (Corner Radius R0.02～R0.2)
4 Flutes	ϕ1～ϕ6 [266 Items] (Corner Radius R0.02～R1.0)

Task

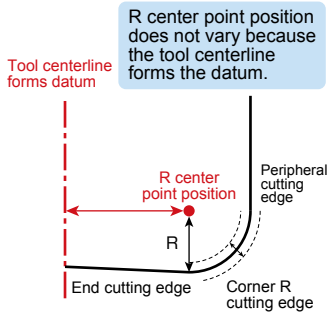
High-precision milling is required, but that requires measuring the actual tool diameter of each tool.

Point

The corner radius of the tool is ground off of the tool centerline, instead of the outside diameter of the tool.

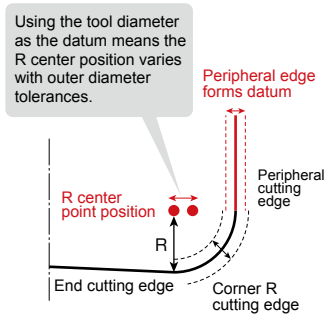
High-precision corner radius

EPDREH-TH3 (tool centerline datum)



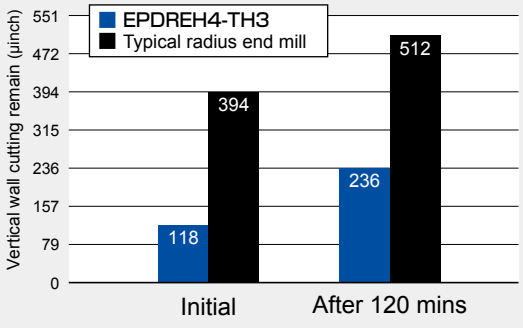
Impact on tool precision
= Radius variations

Typical radius end mill (tool diameter datum)



Impact on tool precision
= Variations in tool diameter + Radius variations

Comparison between cutting remain for vertical wall milling using nominal diameter



【Cutting conditions】

Tool dia : φ1×R0.1 (DC .039 inch x R .004 inch)
No. of flutes : 4flutes
Cutting speed : v_c = 216 SFM Feed per tooth : f_z = .0008 IPT
Depth of cut : a_p × a_e = .0008x.0008 inch
Work material : STAVAX(52HRC) Coolant : Mist blow

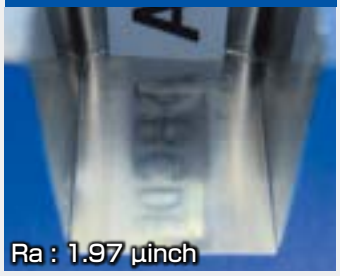
Task

Mill surface is uneven when milling for extended periods of time, which then requires polishing time.

Point

A positive cutting edge profile is adopted for the bottom cutting edge. Thus, improved milled surface quality for hardened steel is achiveved.

EPDREH4-TH3



Conventional 4flutes radius end mill

【Cutting conditions】

Bottom face finishing
Tool dia. : φ3×R0.1 (DC .118 inch × R .004 inch)
No. of flutes : 4flutes
Cutting speed : v_c = 430 SFM
Feed per tooth : f_z = .001 IPT
Depth of cut : a_p × a_e = .001x.002 inch
Work material : STAVAX(52HRC)
Coolant : Mist blow

Good level of shine for bottom face finishing (“ABCDE” text is reflected)

Task

We want to switch to an automated operation.
With direct milling of hardened steel, the tool life is inconsistent.

Point

The tools combine a carbide based material designed fro hardened steel machining along with the TH3 Coating.
This combination improves the wear resistance and allows for longer machining times compared to conventional tools.

TH3 Coating

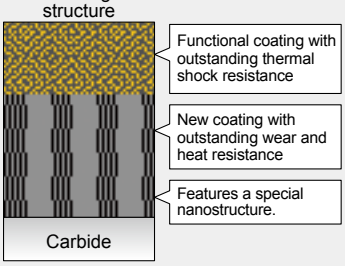
Features and performance

- Hard surface coating for outstanding wear and heat resistance
- Outstanding impact resistance to minimize risk of sudden damage
- Long tool life when machining hardened steels of 50 HRC or harder

Target steel grades

- Hardened steels (especially 50 HRC or higher); high-speed steel

Coating structure



Less damage after 11 hours of finish processing

Tool photo after use

Flank wear : .0002 inch (0.005mm)

【Cutting conditions】

Tool dia : φ2×R0.1
(DC .079 inch × RE .004 inch)
Under neck length : .079 inch (2mm)
No. of flutes : 2 flutes
Work material : STAVAX(52HRC)
Cutting speed : v_c =410 SFM
Feed per tooth : f_z =.0002 IPT
Depth of cut : a_p×a_e=.0002x.0002 inch
Coolant : Air blow

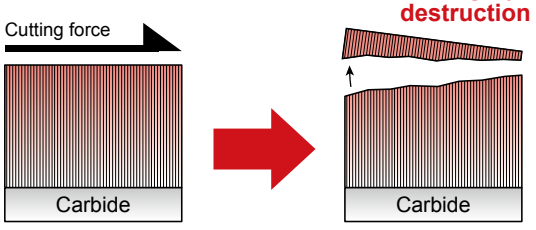
Cutting time : 11Hours

⇒Finished surface is posted on page 90

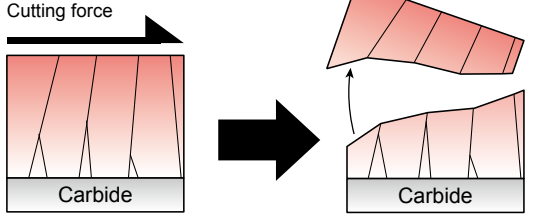
! Point

TH3 features a special nanostructure to minimize degradation of the coating layer!

TH3 Coating



Conventional coating



Lineup by tool diameter/corner radius and tool diameter/under neck length

2 Flutes EPDREH2

■ Tool diameter/corner radius

Corner radius (mm)	Tool dia.(mm)						
	φ0.2	φ0.3	φ0.4	φ0.5	φ0.6	φ0.8	φ1.0
0.02	●	●	●	●	●	●	●
0.05	●	●	●	●	●	●	●
0.1			●	●	●	●	●
0.2							
0.3							

■ Tool diameter/under neck length

Under neck length (mm)	Tool dia.(mm)						
	φ0.2	φ0.3	φ0.4	φ0.5	φ0.6	φ0.8	φ1.0
0.5	●						
1	●	●	●	●			
2		●	●	●	●	●	●
3				●			
4					●	●	●
6							●
8							●

4 Flutes EPDREH4

■ Tool diameter/corner radius

Corner radius (mm)	Tool dia.(mm)						
	φ1.0	φ1.5	φ2	φ3	φ4	φ5	φ6
0.02	●	●	●				
0.05	●	●	●	●			
0.1	●	●	●	●	●	●	●
0.2	●	●	●	●	●	●	●
0.3	●	●	●	●	●	●	●
0.5		●	●	●	●	●	●
1					●	●	●

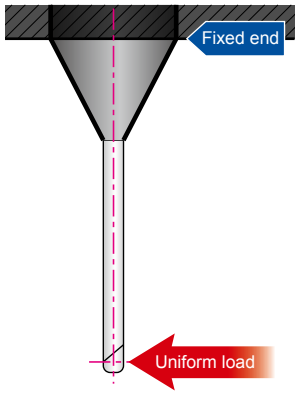
■ Tool diameter/under neck length

Under neck length (mm)	Tool dia.(mm)						
	φ1.0	φ1.5	φ2	φ3	φ4	φ5	φ6
1.5	●						
2	●	●					
2.5	●		●				
3	●	●	●				
4	●	●	●	●			
5	●	●	●				
6	●	●	●	●			
8	●	●	●	●	●		
10		●	●	●	●	●	
12		●	●	●	●		●
14				●	●		
15						●	
16				●	●		
18				●	●		●
20				●	●	●	
22					●		
24					●		●
25						●	
30							●

● : Inventory maintained in US ★ : Inventory maintained in Japan

Individual tool deflection comparison

Please use this information as one criteria for selecting tool



【Note】

- The calculated deflections are based on MOLDINO equations that treat the tool as an elastic body.
- The data here does not account for flute and does not indicate deflection accurately.
  This is not a guarantee of accuracy. Actual deflection will vary during machining.

【Method of calculation】

- Calculated as a cantilever beam
- The start of the taper is set as a fixed end
- A uniform load is applied at the outermost diameter section of the flute tip
- The deflection is calculated at the outermost diameter section of the flute tip (loading point)

Example EPDREH2010-2-002 = 0.36, EPDREH2010-4-002 = 1.61: under neck length .079 inch (2mm) is stiffer (1.61/0.36 = 4.47 times stiffer) than under neck .157 inch (4mm)

2 Flutes EPDREH2

Deflection characteristics (Smaller values indicate greater rigidity.)

Corner radius (mm)	Under neck length (mm)	Tool dia.(mm) 0.2	0.3	0.4	0.5	0.6	0.8	1
0.02	0.5	3.86						
	1	19.84	4.09	1.53	0.77			
	2		23.37	7.51	3.28	1.72	0.66	0.36
	3				9.12			
	4					9.67	3.26	1.61
	6							4.54
	8							9.86

Corner radius (mm)	Under neck length (mm)	Tool dia.(mm) 0.2	0.3	0.4	0.5	0.6	0.8	1
0.05	0.5	3.42						
	1	18.34	3.82	1.45	0.74			
	2		22.45	7.23	3.17	1.67	0.64	0.35
	3				8.88			
	4					9.48	3.20	1.59
	6							4.48
	8							9.76

Corner radius (mm)	Under neck length (mm)	Tool dia.(mm) 0.4	0.5	0.6	0.8	1
0.1	1	1.31	0.67			
	2	6.77	2.98	1.57	0.61	0.34
	3		8.49			
	4			9.16	3.10	1.54
	6					4.38
	8					9.59
0.2	2				0.55	0.31
	4				2.90	1.44
	6					4.19
	8					9.26

4 Flutes EPDREH4

Corner radius (mm)	Under neck length (mm)	Tool dia.(mm) 1	1.5	2	3	4	5	6
0.02	1.5	0.21						
	2	0.34	0.10					
	2.5	0.52		0.06				
	3	0.77	0.21	0.08				
	4	1.50	0.37	0.14				
	5	2.62	0.62	0.22				
	6	4.20	0.97	0.34				
	8	9.11	2.02	0.69				
	10		3.65	1.23				
	12		6.01	2.01				
0.05	1.5	0.20						
	2	0.33	0.10					
	2.5	0.51		0.06				
	3	0.75	0.20	0.08				
	4	1.47	0.37	0.14	0.04			
	5	2.58	0.61	0.22				
	6	4.15	0.96	0.34	0.09			
	8	9.02	2.00	0.69	0.17			
	10		3.62	1.22	0.29			
	12		5.97	2.00	0.46			
	14				0.68			
	16				0.97			
	18				1.34			
	20				1.78			
0.1	1.5	0.19						
	2	0.32	0.10					
	2.5	0.49		0.06				
	3	0.73	0.20	0.08				
	4	1.43	0.36	0.13	0.04			
	5	2.51	0.60	0.22				
	6	4.05	0.94	0.33	0.09			
	8	8.86	1.96	0.68	0.17	0.06		
	10		3.57	1.21	0.29	0.09	0.03	
	12		5.90	1.97	0.46	0.15		0.02
	14				0.68	0.22		
	15						0.10	
	16				0.97	0.31		

Corner radius (mm)	Under neck length (mm)	Tool dia.(mm) 1	1.5	2	3	4	5	6
0.1	18				1.33	0.43		0.06
	20				1.77	0.57	0.22	
	22					0.74		
	24					0.94		0.14
	25						0.40	
	30							0.28
0.2	1.5	0.18						
	2	0.29	0.09					
	2.5	0.45		0.05				
	3	0.67	0.18	0.07				
	4	1.34	0.34	0.13	0.04			
	5	2.38	0.57	0.21				
	6	3.88	0.90	0.32	0.09			
	8	8.56	1.90	0.65	0.16	0.05		
	10		3.48	1.18	0.28	0.09	0.03	
	12		5.76	1.93	0.45	0.15		0.02
	14				0.67	0.22		
	15						0.10	
	16				0.95	0.31		
	18				1.31	0.42		0.06
	20				1.74	0.56	0.21	
	22					0.73		
	24					0.92		0.14
	25						0.40	
	30							0.27
0.3	1.5	0.16						
	2	0.26	0.08					
	2.5	0.41		0.05				
	3	0.62	0.17	0.07				
	4	1.26	0.32	0.12	0.04			
	5	2.26	0.54	0.20				
	6	3.70	0.86	0.31	0.08			
	8	8.27	1.84	0.63	0.16	0.05		
	10		3.38	1.15	0.27	0.09	0.03	
	12		5.63	1.88	0.44	0.14		0.02
	14				0.65	0.21		
	15						0.10	

Corner radius (mm)	Under neck length (mm)	Tool dia.(mm) 1.5	2	3	4	5	6
0.3	16			0.93	0.30		
	18			1.29	0.41		0.06
	20			1.72	0.55	0.21	
	22				0.72		
	24				0.91		0.14
	25					0.39	
	30						0.27
0.5	2	0.07					
	2.5		0.04				
	3	0.15	0.06				
	4	0.29	0.11	0.04			
	5	0.49	0.18				
	6	0.79	0.28	0.08			
	8	1.72	0.59	0.15	0.05		
	10	3.20	1.09	0.26	0.09	0.03	
	12	5.37	1.80	0.42	0.14		0.02
	14			0.63	0.20		
	15					0.09	
	16			0.90	0.29		
	18			1.25	0.40		0.06
	20			1.67	0.54	0.20	
	22				0.70		
	24				0.89		0.14
	25					0.38	
	30						0.27
1	8				0.04		
	10				0.08	0.03	
	12				0.12		0.02
	14				0.19		
	15					0.08	
	16				0.27		
	18				0.37		0.05
	20				0.50	0.19	
	22				0.66		
	24				0.84		0.13
	25					0.36	
	30						0.25

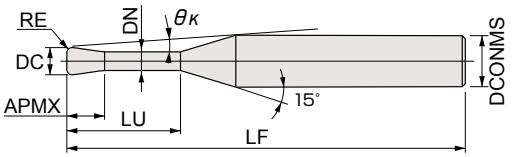
Line Up

2 Flutes

Radius

2 Flutes

Corner radius tolerance : ±0.005 (centerline datum)



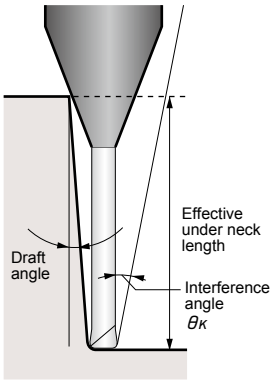
※The 2-flute tool uses a backdraft profile (with strong back taper).

EPDREH2○○○-○.○-○○○-TH3

Carbide TH3 72 HRC Helix 30 h4

Item code	Stock	Size(mm)							Interference angle θK (°)	Effective under neck length with respect to draft angle				
		Tool dia. DC	Corner radius RE	Under neck length LU	Flute length APMX	Neck dia. DN	Overall length LF	Shank dia. DCONMS		0.5°	1°	1.5°	2°	3°
EPDREH2002-0.5-002-TH3	●	0.2 (.008inch)	0.02 (.001inch)	0.5 (.020inch)	0.15	0.17	50	4	13.99	0.57	0.59	0.61	0.63	0.68
EPDREH2002-1-002-TH3	●			1 (.039inch)					13.16	1.09	1.12	1.16	1.21	1.30
EPDREH2002-0.5-005-TH3	●		0.05 (.002inch)	0.5 (.020inch)					14.05	0.57	0.59	0.61	0.63	0.67
EPDREH2002-1-005-TH3	●			1 (.039inch)					13.21	1.08	1.12	1.16	1.20	1.30
EPDREH2003-1-002-TH3	●	0.3 (.012inch)	0.02 (.001inch)	1 (.039inch)	0.25	0.27	50	4	13.12	1.09	1.12	1.16	1.21	1.30
EPDREH2003-2-002-TH3	●			2 (.079inch)					11.70	2.12	2.19	2.27	2.36	2.55
EPDREH2003-1-005-TH3	●		0.05 (.002inch)	1 (.039inch)					13.17	1.08	1,12	1.16	1.20	1.30
EPDREH2003-2-005-TH3	●			2 (.079inch)					11.73	2.12	2.19	2.27	2.35	2.54
EPDREH2004-1-002-TH3	●	0.4 (.016inch)	0.02 (.001inch)	1 (.039inch)	0.3	0.37	50	4	13.07	1.09	1.12	1.16	1.21	1.30
EPDREH2004-2-002-TH3	●			2 (.079inch)					11.62	2.12	2.19	2.27	2.36	2.55
EPDREH2004-1-005-TH3	●		0.05 (.002inch)	1 (.039inch)					13.12	1.08	1.12	1.16	1.20	1.30
EPDREH2004-2-005-TH3	●			2 (.079inch)					11.66	2.12	2.19	2.27	2.35	2.54
EPDREH2004-1-01-TH3	●		0.1 (.004inch)	1 (.039inch)					13.21	1.08	1.12	1.15	1.19	1.28
EPDREH2004-2-01-TH3	●			2 (.079inch)					11.73	2.12	2.19	2.26	2.34	2.53
EPDREH2005-1-002-TH3	●	0.5 (.020inch)	0.02 (.001inch)	1 (.039inch)	0.35	0.47	50	4	13.03	1.09	1.12	1.16	1.21	1.30
EPDREH2005-2-002-TH3	●			2 (.079inch)					11.55	2.12	2.19	2.27	2.36	2.55
EPDREH2005-3-002-TH3	●			3 (.118inch)					10.37	3.15	3.26	3.38	3.51	3.79
EPDREH2005-1-005-TH3	●		0.05 (.002inch)	1 (.039inch)					13.08	1.08	1.12	1.16	1.20	1.30
EPDREH2005-2-005-TH3	●			2 (.079inch)					11.59	2.12	2.19	2.27	2.35	2.54
EPDREH2005-3-005-TH3	●			3 (.118inch)					10.40	3.15	3.26	3.38	3.50	3.78
EPDREH2005-1-01-TH3	●		0.1 (.004inch)	1 (.039inch)					13.16	1.08	1.12	1.15	1.19	1.28
EPDREH2005-2-01-TH3	●			2 (.079inch)					11.66	2.12	2.19	2.26	2.34	2.53
EPDREH2005-3-01-TH3	●			3 (.118inch)					10.46	3.15	3.26	3.37	3.49	3.77
EPDREH2006-2-002-TH3	●	0.6 (.024inch)	0.02 (.001inch)	2 (.079inch)	0.4	0.57	50	4	11.47	2.12	2.19	2.27	2.36	2.55
EPDREH2006-4-002-TH3	●			4 (.157inch)					9.31	4.19	4.33	4.49	4.66	5.03
EPDREH2006-2-005-TH3	●		0.05 (.002inch)	2 (.079inch)					11.51	2.12	2.19	2.27	2.35	2.54
EPDREH2006-4-005-TH3	●			4 (.157inch)					9.33	4.19	4.33	4.48	4.65	5.03
EPDREH2006-2-01-TH3	●		0.1 (.004inch)	2 (.079inch)					11.58	2.12	2.19	2.26	2.34	2.53
EPDREH2006-4-01-TH3	●			4 (.157inch)					9.38	4.18	4.33	4.48	4.64	5.01
EPDREH2008-2-002-TH3	●	0.8 (.031inch)	0.02 (.001inch)	2 (.079inch)	0.5	0.77	50	4	11.30	2.12	2.19	2.27	2.36	2.55
EPDREH2008-4-002-TH3	●			4 (.157inch)					9.09	4.19	4.33	4.49	4.66	5.03
EPDREH2008-2-005-TH3	●		0.05 (.002inch)	2 (.079inch)					11.35	2.12	2.19	2.27	2.35	2.54
EPDREH2008-4-005-TH3	●			4 (.157inch)					9.12	4.19	4.33	4.48	4.65	5.03
EPDREH2008-2-01-TH3	●		0.1 (.004inch)	2 (.079inch)					11.42	2.12	2.19	2.26	2.34	2.53
EPDREH2008-4-01-TH3	●			4 (.157inch)					9.16	4.18	4.33	4.48	4.64	5.01
EPDREH2008-2-02-TH3	●		0.2 (.008inch)	2 (.079inch)					11.56	2.11	2.18	2.25	2.33	2.50
EPDREH2008-4-02-TH3	●			4 (.157inch)					9.25	4.18	4.32	4.47	4.63	4.99

● : Inventory maintained in US ★ : Inventory maintained in Japan



【Note】
The actual effective under neck length with respect to the draft angle differs from the Epoch Deep Radius Evolution EPDRE-ATH.
Please be sure to check this.

EPDREH2○○○-○.○-○○○-TH3

Item code	Stock	Size(mm)							Interference angle θκ (°)	Effective under neck length with respect to draft angle				
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.						
		DC	RE	LU	APMX	DN	LF	DCONMS		0.5°	1°	1.5°	2°	3°
EPDREH2010-2-002-TH3	●	1 (.039inch)	0.02 (.001inch)	2 (.079inch)	0.8	0.94	50	4	11.04	2.18	2.25	2.33	2.42	2.62
EPDREH2010-4-002-TH3	●			4 (.157inch)					8.80	4.24	4.39	4.55	4.72	5.10
EPDREH2010-6-002-TH3	●			6 (.236inch)					7.32	6.31	6.53	6.77	7.02	7.59
EPDREH2010-8-002-TH3	●			8 (.315inch)					6.26	8.38	8.67	8.98	9.32	10.07
EPDREH2010-2-005-TH3	●		0.05 (.002inch)	2 (.079inch)					11.08	2.18	2.25	2.33	2.42	2.61
EPDREH2010-4-005-TH3	●			4 (.157inch)					8.83	4.24	4.39	4.55	4.72	5.09
EPDREH2010-6-005-TH3	●			6 (.236inch)					7.34	6.31	6.53	6.76	7.02	7.58
EPDREH2010-8-005-TH3	●			8 (.315inch)					6.27	8.38	8.67	8.98	9.32	10.07
EPDREH2010-2-01-TH3	●		0.1 (.004inch)	2 (.079inch)					11.16	2.17	2.25	2.33	2.41	2.60
EPDREH2010-4-01-TH3	●			4 (.157inch)					8.88	4.24	4.39	4.54	4.71	5.08
EPDREH2010-6-01-TH3	●			6 (.236inch)					7.37	6.31	6.53	6.76	7.01	7.57
EPDREH2010-8-01-TH3	●			8 (.315inch)					6.29	8.38	8.67	8.97	9.31	10.06
EPDREH2010-2-02-TH3	●		0.2 (.008inch)	2 (.079inch)					11.30	2.17	2.24	2.31	2.39	2.57
EPDREH2010-4-02-TH3	●			4 (.157inch)					8.97	4.24	4.38	4.53	4.69	5.06
EPDREH2010-6-02-TH3	●			6 (.236inch)					7.43	6.31	6.52	6.75	6.99	7.55
EPDREH2010-8-02-TH3	●			8 (.315inch)					6.34	8.37	8.66	8.96	9.29	10.03

For detailed information on the EPDREH2 cutting conditions, refer to pages 61, 62, 63, 64, 75, 76, 77 and 78.

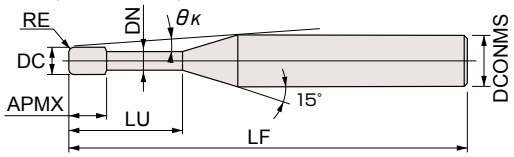
Line Up

4 Flutes

Radius

4 Flutes

Corner radius tolerance : ±0.005 (centerline datum)

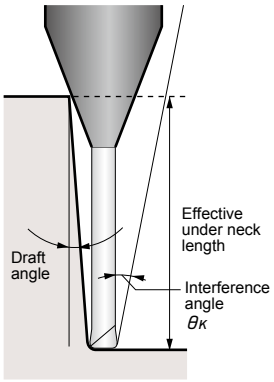


EPDREH4○○○-○.○-○○○-TH3

Carbide TH3 Helix 30° h4 DCONMS=4 h5 DCONMS=6

Item code	Stock	Size(mm)							Interference angle θκ (°)	Effective under neck length with respect to draft angle				
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.						
		DC	RE	LU	APMX	DN	LF	DCONMS		0.5°	1°	1.5°	2°	3°
EPDREH4010-1.5-002-TH3	●	1 (.039inch)	0.02 (.001inch)	1.5 (.059inch)	0.6	0.96	50	4	11.85	1.62	1.68	1.74	1.80	1.95
EPDREH4010-2-002-TH3	●			2 (.079inch)					11.09	2.14	2.21	2.29	2.38	2.57
EPDREH4010-2.5-002-TH3	●			2.5 (.098inch)					10.43	2.66	2.75	2.85	2.95	3.19
EPDREH4010-3-002-TH3	●			3 (.118inch)					9.84	3.17	3.28	3.40	3.53	3.81
EPDREH4010-4-002-TH3	●			4 (.157inch)					8.84	4.21	4.35	4.51	4.68	5.06
EPDREH4010-5-002-TH3	●			5 (.197inch)					8.02	5.24	5.42	5.62	5.83	6.30
EPDREH4010-6-002-TH3	●			6 (.236inch)					7.34	6.27	6.49	6.73	6.98	7.54
EPDREH4010-8-002-TH3	●			8 (.315inch)					6.27	8.34	8.63	8.94	9.28	10.03
EPDREH4010-1.5-005-TH3	●		0.05 (.002inch)	1.5 (.059inch)					11.90	1.62	1.68	1.73	1.80	1.94
EPDREH4010-2-005-TH3	●			2 (.079inch)					11.14	2.14	2.21	2.29	2.37	2.56
EPDREH4010-2.5-005-TH3	●			2.5 (.098inch)					10.47	2.65	2.75	2.84	2.95	3.18
EPDREH4010-3-005-TH3	●			3 (.118inch)					9.87	3.17	3.28	3.40	3.52	3.81
EPDREH4010-4-005-TH3	●			4 (.157inch)					8.87	4.21	4.35	4.51	4.67	5.05
EPDREH4010-5-005-TH3	●			5 (.197inch)					8.04	5.24	5.42	5.61	5.82	6.29
EPDREH4010-6-005-TH3	●			6 (.236inch)					7.36	6.27	6.49	6.72	6.97	7.53
EPDREH4010-8-005-TH3	●			8 (.315inch)					6.29	8.34	8.63	8.94	9.27	10.02
EPDREH4010-1.5-01-TH3	●		0.1 (.004inch)	1.5 (.059inch)					11.98	1.62	1.67	1.73	1.79	1.93
EPDREH4010-2-01-TH3	●			2 (.079inch)					11.21	2.14	2.21	2.28	2.37	2.55
EPDREH4010-2.5-01-TH3	●			2.5 (.098inch)					10.53	2.65	2.74	2.84	2.94	3.17
EPDREH4010-3-01-TH3	●			3 (.118inch)					9.93	3.17	3.28	3.39	3.52	3.79
EPDREH4010-4-01-TH3	●			4 (.157inch)					8.91	4.20	4.35	4.50	4.67	5.04
EPDREH4010-5-01-TH3	●			5 (.197inch)					8.08	5.24	5.42	5.61	5.82	6.28
EPDREH4010-6-01-TH3	●			6 (.236inch)					7.39	6.27	6.49	6.72	6.97	7.52
EPDREH4010-8-01-TH3	●			8 (.315inch)					6.31	8.34	8.63	8.93	9.26	10.01
EPDREH4010-1.5-02-TH3	●		0.2 (.008inch)	1.5 (.059inch)					12.15	1.62	1.67	1.72	1.78	1.91
EPDREH4010-2-02-TH3	●			2 (.079inch)					11.36	2.13	2.20	2.27	2.35	2.53
EPDREH4010-2.5-02-TH3	●			2.5 (.098inch)					10.66	2.65	2.74	2.83	2.93	3.15
EPDREH4010-3-02-TH3	●			3 (.118inch)					10.04	3.17	3.27	3.38	3.50	3.77
EPDREH4010-4-02-TH3	●			4 (.157inch)					9.00	4.20	4.34	4.49	4.65	5.01
EPDREH4010-5-02-TH3	●			5 (.197inch)					8.16	5.23	5.41	5.60	5.80	6.26
EPDREH4010-6-02-TH3	●			6 (.236inch)					7.45	6.27	6.48	6.71	6.95	7.50
EPDREH4010-8-02-TH3	●			8 (.315inch)					6.36	8.33	8.62	8.92	9.25	9.99
EPDREH4010-1.5-03-TH3	●		0.3 (.012inch)	1.5 (.059inch)					12.32	1.61	1.66	1.71	1.76	1.88
EPDREH4010-2-03-TH3	●			2 (.079inch)					11.51	2.13	2.19	2.26	2.34	2.50
EPDREH4010-2.5-03-TH3	●			2.5 (.098inch)					10.79	2.65	2.73	2.82	2.91	3.12
EPDREH4010-3-03-TH3	●			3 (.118inch)					10.16	3.16	3.26	3.37	3.49	3.75
EPDREH4010-4-03-TH3	●			4 (.157inch)					9.10	4.20	4.33	4.48	4.64	4.99
EPDREH4010-5-03-TH3	●			5 (.197inch)					8.23	5.23	5.40	5.59	5.79	6.23
EPDREH4010-6-03-TH3	●			6 (.236inch)					7.52	6.26	6.47	6.70	6.94	7.48
EPDREH4010-8-03-TH3	●			8 (.315inch)					6.41	8.33	8.61	8.91	9.24	9.96

● : Inventory maintained in US ★ : Inventory maintained in Japan



【Note】
The actual effective under neck length with respect to the draft angle differs from the Epoch Deep Radius Evolution EPDRE-ATH.
Please be sure to check this.

EPDREH4○○○-○.○-○○○-TH3

Item code	Stock	Size(mm)							Interference angle θκ (°)	Effective under neck length with respect to draft angle				
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.		0.5°	1°	1.5°	2°	3°
		DC	RE	LU	APMX	DN	LF	DCONMS						
EPDREH4015-2-002-TH3	●	1.5 (.059inch)	0.02 (.001inch)	2 (.079inch)	0.9	1.44	50	4	10.49	2.18	2.25	2.33	2.42	2.62
EPDREH4015-3-002-TH3	●			3 (.118inch)					9.16	3.21	3.32	3.44	3.57	3.86
EPDREH4015-4-002-TH3	●			4 (.157inch)					8.13	4.24	4.39	4.55	4.72	5.10
EPDREH4015-5-002-TH3	●			5 (.197inch)					7.31	5.28	5.46	5.66	5.87	6.35
EPDREH4015-6-002-TH3	●			6 (.236inch)					6.63	6.31	6.53	6.77	7.02	7.59
EPDREH4015-8-002-TH3	●			8 (.315inch)					5.60	8.38	8.67	8.98	9.32	10.07
EPDREH4015-10-002-TH3	●			10 (.394inch)					4.85	10.45	10.81	11.20	11.62	12.56
EPDREH4015-12-002-TH3	●			12 (.472inch)					4.27	12.51	12.95	13.42	13.92	15.05
EPDREH4015-2-005-TH3	●		0.05 (.002inch)	2 (.079inch)					10.53	2.18	2.25	2.33	2.42	2.61
EPDREH4015-3-005-TH3	●			3 (.118inch)					9.19	3.21	3.32	3.44	3.57	3.85
EPDREH4015-4-005-TH3	●			4 (.157inch)					8.16	4.24	4.39	4.55	4.72	5.09
EPDREH4015-5-005-TH3	●			5 (.197inch)					7.33	5.28	5.46	5.66	5.87	6.34
EPDREH4015-6-005-TH3	●			6 (.236inch)					6.65	6.31	6.53	6.76	7.02	7.58
EPDREH4015-8-005-TH3	●			8 (.315inch)					5.61	8.38	8.67	8.98	9.32	10.07
EPDREH4015-10-005-TH3	●			10 (.394inch)					4.86	10.45	10.81	11.20	11.61	12.55
EPDREH4015-12-005-TH3	●			12 (.472inch)					4.28	12.51	12.95	13.41	13.91	15.04
EPDREH4015-2-01-TH3	●		0.1 (.004inch)	2 (.079inch)					10.61	2.17	2.25	2.33	2.41	2.60
EPDREH4015-3-01-TH3	●			3 (.118inch)					9.25	3.21	3.32	3.43	3.56	3.84
EPDREH4015-4-01-TH3	●			4 (.157inch)					8.20	4.24	4.39	4.54	4.71	5.08
EPDREH4015-5-01-TH3	●			5 (.197inch)					7.37	5.28	5.46	5.65	5.86	6.33
EPDREH4015-6-01-TH3	●			6 (.236inch)					6.68	6.31	6.53	6.76	7.01	7.57
EPDREH4015-8-01-TH3	●			8 (.315inch)					5.64	8.38	8.67	8.97	9.31	10.06
EPDREH4015-10-01-TH3	●			10 (.394inch)					4.87	10.44	10.80	11.19	11.61	12.54
EPDREH4015-12-01-TH3	●			12 (.472inch)					4.29	12.51	12.94	13.41	13.91	15.03
EPDREH4015-2-02-TH3	●		0.2 (.008inch)	2 (.079inch)					10.77	2.17	2.24	2.31	2.39	2.57
EPDREH4015-3-02-TH3	●			3 (.118inch)					9.37	3.21	3.31	3.42	3.54	3.82
EPDREH4015-4-02-TH3	●			4 (.157inch)					8.30	4.24	4.38	4.53	4.69	5.06
EPDREH4015-5-02-TH3	●			5 (.197inch)					7.44	5.27	5.45	5.64	5.84	6.30
EPDREH4015-6-02-TH3	●			6 (.236inch)					6.74	6.31	6.52	6.75	6.99	7.55
EPDREH4015-8-02-TH3	●			8 (.315inch)					5.68	8.37	8.66	8.96	9.29	10.03
EPDREH4015-10-02-TH3	●			10 (.394inch)					4.91	10.44	10.80	11.18	11.59	12.52
EPDREH4015-12-02-TH3	●			12 (.472inch)					4.32	12.51	12.94	13.40	13.89	15.00
EPDREH4015-2-03-TH3	●		0.3 (.012inch)	2 (.079inch)					10.93	2.17	2.23	2.30	2.38	2.55
EPDREH4015-3-03-TH3	●			3 (.118inch)					9.50	3.20	3.30	3.41	3.53	3.79
EPDREH4015-4-03-TH3	●			4 (.157inch)					8.39	4.24	4.37	4.52	4.68	5.04
EPDREH4015-5-03-TH3	●			5 (.197inch)					7.52	5.27	5.44	5.63	5.83	6.28
EPDREH4015-6-03-TH3	●			6 (.236inch)					6.81	6.30	6.51	6.74	6.98	7.52
EPDREH4015-8-03-TH3	●			8 (.315inch)					5.73	8.37	8.65	8.95	9.28	10.01
EPDREH4015-10-03-TH3	●			10 (.394inch)					4.94	10.44	10.79	11.17	11.58	12.49
EPDREH4015-12-03-TH3	●			12 (.472inch)					4.34	12.50	12.93	13.39	13.88	14.98

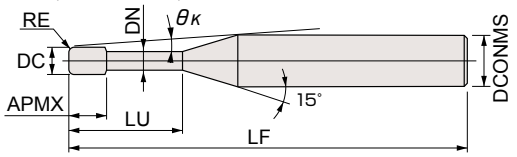
For detailed information on the EPDREH4 ⌀1 to ⌀1.5 cutting conditions, refer to pages 65, 66, 70, 71, 79, 80, 84 and 85.

4 Flutes

Radius

4 Flutes

Corner radius tolerance : ±0.005 (centerline datum)

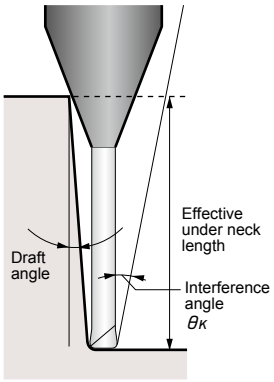


EPDREH4○○○-○.○-○○○-TH3

Carbide TH3 Helix 30° h4 DCONMS=4 h5 DCONMS=6

Item code	Stock	Size(mm)							Interference angle θκ (°)	Effective under neck length with respect to draft angle				
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.						
		DC	RE	LU	APMX	DN	LF	DCONMS		0.5°	1°	1.5°	2°	3°
EPDREH4015-2-05-TH3	●	1.5 (.059inch)	0.5 (.020inch)	2 (.079inch)	0.9	1.44	50	4	11.27	2.16	2.22	2.28	2.35	2.50
EPDREH4015-3-05-TH3	●			3 (.118inch)					9.75	3.19	3.29	3.39	3.50	3.75
EPDREH4015-4-05-TH3	●			4 (.157inch)					8.59	4.23	4.36	4.50	4.65	4.99
EPDREH4015-5-05-TH3	●			5 (.197inch)					7.68	5.26	5.43	5.61	5.80	6.23
EPDREH4015-6-05-TH3	●			6 (.236inch)					6.94	6.30	6.50	6.72	6.95	7.47
EPDREH4015-8-05-TH3	●			8 (.315inch)					5.82	8.36	8.64	8.93	9.25	9.96
EPDREH4015-10-05-TH3	●			10 (.394inch)					5.01	10.43	10.78	11.15	11.55	12.45
EPDREH4015-12-05-TH3	●			12 (.472inch)					4.40	12.50	12.92	13.37	13.85	14.93
EPDREH4020-2.5-002-TH3	●	2 (.079inch)	0.02 (.001inch)	2.5 (.098inch)	1.2	1.92	50	4	8.94	2.73	2.83	2.93	3.04	3.28
EPDREH4020-3-002-TH3	●			3 (.118inch)					8.30	3.25	3.36	3.48	3.61	3.91
EPDREH4020-4-002-TH3	●			4 (.157inch)					7.25	4.28	4.43	4.59	4.76	5.15
EPDREH4020-5-002-TH3	●			5 (.197inch)					6.44	5.32	5.50	5.70	5.91	6.39
EPDREH4020-6-002-TH3	●			6 (.236inch)					5.80	6.35	6.57	6.81	7.06	7.63
EPDREH4020-8-002-TH3	●			8 (.315inch)					4.82	8.42	8.71	9.02	9.36	10.12
EPDREH4020-10-002-TH3	●			10 (.394inch)					4.13	10.49	10.85	11.24	11.66	12.61
EPDREH4020-12-002-TH3	●			12 (.472inch)					3.61	12.55	12.99	13.46	13.96	15.09
EPDREH4020-2.5-005-TH3	●		0.05 (.002inch)	2.5 (.098inch)					8.98	2.73	2.83	2.93	3.03	3.28
EPDREH4020-3-005-TH3	●			3 (.118inch)					8.33	3.25	3.36	3.48	3.61	3.90
EPDREH4020-4-005-TH3	●			4 (.157inch)					7.28	4.28	4.43	4.59	4.76	5.14
EPDREH4020-5-005-TH3	●			5 (.197inch)					6.47	5.32	5.50	5.70	5.91	6.38
EPDREH4020-6-005-TH3	●			6 (.236inch)					5.81	6.35	6.57	6.80	7.06	7.63
EPDREH4020-8-005-TH3	●			8 (.315inch)					4.84	8.42	8.71	9.02	9.36	10.11
EPDREH4020-10-005-TH3	●			10 (.394inch)					4.14	10.48	10.85	11.24	11.66	12.60
EPDREH4020-12-005-TH3	●			12 (.472inch)					3.62	12.55	12.99	13.45	13.96	15.09
EPDREH4020-2.5-01-TH3	●		0.1 (.004inch)	2.5 (.098inch)					9.05	2.73	2.82	2.92	3.03	3.26
EPDREH4020-3-01-TH3	●			3 (.118inch)					8.39	3.25	3.36	3.47	3.60	3.89
EPDREH4020-4-01-TH3	●			4 (.157inch)					7.33	4.28	4.43	4.58	4.75	5.13
EPDREH4020-5-01-TH3	●			5 (.197inch)					6.50	5.31	5.50	5.69	5.90	6.37
EPDREH4020-6-01-TH3	●			6 (.236inch)					5.84	6.35	6.57	6.80	7.05	7.62
EPDREH4020-8-01-TH3	●			8 (.315inch)					4.86	8.42	8.71	9.02	9.35	10.10
EPDREH4020-10-01-TH3	●			10 (.394inch)					4.16	10.48	10.84	11.23	11.65	12.59
EPDREH4020-12-01-TH3	●			12 (.472inch)					3.63	12.55	12.98	13.45	13.95	15.07
EPDREH4020-2.5-02-TH3	●		0.2 (.008inch)	2.5 (.098inch)					9.19	2.73	2.82	2.91	3.01	3.24
EPDREH4020-3-02-TH3	●			3 (.118inch)					8.52	3.24	3.35	3.46	3.59	3.86
EPDREH4020-4-02-TH3	●			4 (.157inch)					7.42	4.28	4.42	4.57	4.74	5.11
EPDREH4020-5-02-TH3	●			5 (.197inch)					6.58	5.31	5.49	5.68	5.89	6.35
EPDREH4020-6-02-TH3	●			6 (.236inch)					5.90	6.34	6.56	6.79	7.04	7.59
EPDREH4020-8-02-TH3	●			8 (.315inch)					4.90	8.41	8.70	9.01	9.34	10.08
EPDREH4020-10-02-TH3	●			10 (.394inch)					4.19	10.48	10.84	11.22	11.64	12.56
EPDREH4020-12-02-TH3	●			12 (.472inch)					3.65	12.55	12.98	13.44	13.94	15.05

● : Inventory maintained in US ★ : Inventory maintained in Japan



【Note】
The actual effective under neck length with respect to the draft angle differs from the Epoch Deep Radius Evolution EPDRE-ATH.
Please be sure to check this.

EPDREH4○○○-○.○-○○○-TH3

Item code	Stock	Size(mm)							Interference angle θκ (°)	Effective under neck length with respect to draft angle				
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.		0.5°	1°	1.5°	2°	3°
		DC	RE	LU	APMX	DN	LF	DCONMS						
EPDREH4020-2.5-03-TH3	●	2 (.079inch)	0.3 (.012inch)	2.5 (.098inch)	1.2	1.92	50	4	9.34	2.72	2.81	2.90	3.00	3.22
EPDREH4020-3-03-TH3	●			3 (.118inch)					8.64	3.24	3.34	3.45	3.57	3.84
EPDREH4020-4-03-TH3	●			4 (.157inch)					7.52	4.27	4.41	4.56	4.72	5.08
EPDREH4020-5-03-TH3	●			5 (.197inch)					6.65	5.31	5.48	5.67	5.87	6.33
EPDREH4020-6-03-TH3	●			6 (.236inch)					5.96	6.34	6.55	6.78	7.02	7.57
EPDREH4020-8-03-TH3	●			8 (.315inch)					4.94	8.41	8.69	8.99	9.32	10.05
EPDREH4020-10-03-TH3	●			10 (.394inch)					4.22	10.48	10.83	11.21	11.62	12.54
EPDREH4020-12-03-TH3	●			12 (.472inch)					3.68	12.54	12.97	13.43	13.92	15.03
EPDREH4020-2.5-05-TH3	●		0.5 (.020inch)	2.5 (.098inch)					9.65	2.72	2.79	2.88	2.97	3.17
EPDREH4020-3-05-TH3	●			3 (.118inch)					8.91	3.23	3.33	3.43	3.54	3.79
EPDREH4020-4-05-TH3	●			4 (.157inch)					7.72	4.27	4.40	4.54	4.69	5.03
EPDREH4020-5-05-TH3	●			5 (.197inch)					6.81	5.30	5.47	5.65	5.84	6.28
EPDREH4020-6-05-TH3	●			6 (.236inch)					6.09	6.33	6.54	6.76	6.99	7.52
EPDREH4020-8-05-TH3	●			8 (.315inch)					5.03	8.40	8.68	8.97	9.29	10.01
EPDREH4020-10-05-TH3	●			10 (.394inch)					4.28	10.47	10.82	11.19	11.59	12.49
EPDREH4020-12-05-TH3	●			12 (.472inch)					3.72	12.54	12.96	13.41	13.89	14.98
EPDREH4030-4-005-TH3	●	3 (.118inch)	0.05 (.002inch)	4 (.157inch)	1.8	2.88	50	6	8.73	4.36	4.51	4.67	4.84	5.23
EPDREH4030-6-005-TH3	●			6 (.236inch)					7.27	6.43	6.65	6.89	7.14	7.72
EPDREH4030-8-005-TH3	●			8 (.315inch)			55		6.22	8.49	8.79	9.10	9.44	10.21
EPDREH4030-10-005-TH3	●			10 (.394inch)					5.44	10.56	10.93	11.32	11.74	12.69
EPDREH4030-12-005-TH3	●			12 (.472inch)			60		4.83	12.63	13.07	13.54	14.04	15.18
EPDREH4030-14-005-TH3	●			14 (.551inch)					4.34	14.70	15.21	15.75	16.34	17.67
EPDREH4030-16-005-TH3	●			16 (.630inch)					3.95	16.76	17.35	17.97	18.64	20.15
EPDREH4030-18-005-TH3	●			18 (.709inch)			65		3.62	18.83	19.49	20.19	20.94	22.64
EPDREH4030-20-005-TH3	●			20 (.787inch)					3.34	20.90	21.62	22.40	23.24	25.12
EPDREH4030-4-01-TH3	●		0.1 (.004inch)	4 (.157inch)			50		8.78	4.36	4.51	4.67	4.84	5.22
EPDREH4030-6-01-TH3	●			6 (.236inch)					7.30	6.43	6.65	6.88	7.14	7.71
EPDREH4030-8-01-TH3	●			8 (.315inch)			55		6.24	8.49	8.79	9.10	9.44	10.19
EPDREH4030-10-01-TH3	●			10 (.394inch)					5.45	10.56	10.92	11.32	11.74	12.68
EPDREH4030-12-01-TH3	●			12 (.472inch)			60		4.84	12.63	13.06	13.53	14.04	15.17
EPDREH4030-14-01-TH3	●			14 (.551inch)					4.35	14.69	15.20	15.75	16.34	17.65
EPDREH4030-16-01-TH3	●			16 (.630inch)					3.96	16.76	17.34	17.97	18.64	20.14
EPDREH4030-18-01-TH3	●			18 (.709inch)			65		3.62	18.83	19.48	20.18	20.94	22.63
EPDREH4030-20-01-TH3	●			20 (.787inch)					3.34	20.90	21.62	22.40	23.23	25.11
EPDREH4030-4-02-TH3	●		0.2 (.008inch)	4 (.157inch)			50		8.87	4.35	4.50	4.66	4.82	5.20
EPDREH4030-6-02-TH3	●			6 (.236inch)					7.36	6.42	6.64	6.87	7.12	7.68
EPDREH4030-8-02-TH3	●			8 (.315inch)			55		6.29	8.49	8.78	9.09	9.42	10.17
EPDREH4030-10-02-TH3	●			10 (.394inch)					5.49	10.56	10.92	11.30	11.72	12.66
EPDREH4030-12-02-TH3	●			12 (.472inch)			60		4.87	12.62	13.06	13.52	14.02	15.14
EPDREH4030-14-02-TH3	●			14 (.551inch)					4.38	14.69	15.20	15.74	16.32	17.63

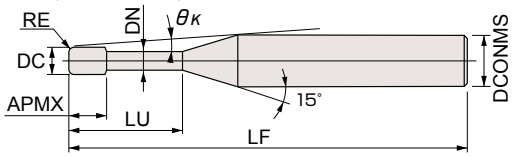
For detailed information on the EPDREH4 ⌀1 to ⌀1.5 cutting conditions, refer to pages 66, 67, 71, 72, 80, 81, 85 and 86.

4 Flutes

Radius

4 Flutes

Corner radius tolerance : ±0.005 (centerline datum)



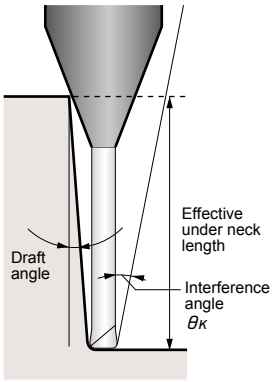
EPDREH4○○○-○.○-○○○-TH3

Carbide TH3 Helix 30° h4 DCONMS=4 h5 DCONMS=6

Item code	Stock	Size(mm)							Interference angle θK (°)	Effective under neck length with respect to draft angle				
		Tool dia. DC	Corner radius RE	Under neck length LU	Flute length APMX	Neck dia. DN	Overall length LF	Shank dia. DCONMS		0.5°	1°	1.5°	2°	3°
EPDREH4030-16-02-TH3	●	3 (.118inch)	0.2 (.008inch)	16 (.630inch)	1.8	2.88	60	6	3.97	16.76	17.34	17.95	18.62	20.12
EPDREH4030-18-02-TH3	●			18 (.709inch)			65		3.64	18.83	19.47	20.17	20.92	22.60
EPDREH4030-20-02-TH3	●			20 (.787inch)					3.36	20.89	21.61	22.39	23.22	25.09
EPDREH4030-4-03-TH3	●		0.3 (.012inch)	4 (.157inch)			50		8.96	4.35	4.49	4.64	4.81	5.17
EPDREH4030-6-03-TH3	●			6 (.236inch)					7.42	6.42	6.63	6.86	7.11	7.66
EPDREH4030-8-03-TH3	●			8 (.315inch)			55		6.33	8.49	8.77	9.08	9.41	10.15
EPDREH4030-10-03-TH3	●			10 (.394inch)					5.52	10.55	10.91	11.29	11.71	12.63
EPDREH4030-12-03-TH3	●			12 (.472inch)			60		4.90	12.62	13.05	13.51	14.01	15.12
EPDREH4030-14-03-TH3	●			14 (.551inch)					4.40	14.69	15.19	15.73	16.31	17.61
EPDREH4030-16-03-TH3	●			16 (.630inch)					3.99	16.76	17.33	17.94	18.61	20.09
EPDREH4030-18-03-TH3	●			18 (.709inch)			65		3.65	18.82	19.47	20.16	20.91	22.58
EPDREH4030-20-03-TH3	●			20 (.787inch)					3.37	20.89	21.61	22.38	23.21	25.07
EPDREH4030-4-05-TH3	●		0.5 (.020inch)	4 (.157inch)			50		9.15	4.34	4.48	4.62	4.78	5.13
EPDREH4030-6-05-TH3	●			6 (.236inch)					7.55	6.41	6.62	6.84	7.08	7.61
EPDREH4030-8-05-TH3	●			8 (.315inch)			55		6.43	8.48	8.76	9.06	9.38	10.10
EPDREH4030-10-05-TH3	●			10 (.394inch)					5.60	10.55	10.90	11.27	11.68	12.59
EPDREH4030-12-05-TH3	●			12 (.472inch)			60		4.95	12.61	13.04	13.49	13.98	15.07
EPDREH4030-14-05-TH3	●			14 (.551inch)					4.44	14.68	15.18	15.71	16.28	17.56
EPDREH4030-16-05-TH3	●			16 (.630inch)					4.03	16.75	17.31	17.92	18.58	20.05
EPDREH4030-18-05-TH3	●			18 (.709inch)			65		3.69	18.82	19.45	20.14	20.88	22.53
EPDREH4030-20-05-TH3	●			20 (.787inch)					3.40	20.88	21.59	22.36	23.18	25.02
EPDREH4040-8-01-TH3	●	4 (.157inch)	0.1 (.004inch)	8 (.315inch)	3.5	3.85	55	6	4.80	8.55	8.84	9.16	9.50	10.26
EPDREH4040-10-01-TH3	●			10 (.394inch)			60		4.12	10.62	10.98	11.38	11.80	12.75
EPDREH4040-12-01-TH3	●			12 (.472inch)					3.60	12.68	13.12	13.59	14.10	15.24
EPDREH4040-14-01-TH3	●			14 (.551inch)					3.20	14.75	15.26	15.81	16.40	17.72
EPDREH4040-16-01-TH3	●			16 (.630inch)					2.88	16.82	17.40	18.03	18.70	No interference
EPDREH4040-18-01-TH3	●			18 (.709inch)					2.62	18.89	19.54	20.24	21.00	No interference
EPDREH4040-20-01-TH3	●			20 (.787inch)			65		2.40	20.95	21.68	22.46	23.30	No interference
EPDREH4040-22-01-TH3	●			22 (.866inch)					2.22	23.02	23.82	24.68	25.60	No interference
EPDREH4040-24-01-TH3	●			24 (.945inch)			70		2.06	25.09	25.96	26.89	27.90	No interference
EPDREH4040-8-02-TH3	●		0.2 (.008inch)	8 (.315inch)			55		4.84	8.55	8.84	9.15	9.49	10.24
EPDREH4040-10-02-TH3	●			10 (.394inch)			60		4.15	10.61	10.98	11.37	11.79	12.73
EPDREH4040-12-02-TH3	●			12 (.472inch)					3.62	12.68	13.12	13.58	14.09	15.21
EPDREH4040-14-02-TH3	●			14 (.551inch)					3.22	14.75	15.26	15.80	16.39	17.70
EPDREH4040-16-02-TH3	●			16 (.630inch)					2.89	16.82	17.40	18.02	18.69	No interference
EPDREH4040-18-02-TH3	●			18 (.709inch)					2.63	18.88	19.53	20.23	20.98	No interference
EPDREH4040-20-02-TH3	●			20 (.787inch)			65		2.41	20.95	21.67	22.45	23.28	No interference
EPDREH4040-22-02-TH3	●			22 (.866inch)					2.22	23.02	23.81	24.67	25.58	No interference
EPDREH4040-24-02-TH3	●			24 (.945inch)			70		2.06	25.09	25.95	26.88	27.88	No interference

● : Inventory maintained in US ★ : Inventory maintained in Japan

EPDREH4○○○-○.○-○○○-TH3



【Note】
The actual effective under neck length with respect to the draft angle differs from the Epoch Deep Radius Evolution EPDRE-ATH.
Please be sure to check this.

Item code	Stock	Size(mm)							Interference angle θK (°)	Effective under neck length with respect to draft angle				
		Tool dia. DC	Corner radius RE	Under neck length LU	Flute length APMX	Neck dia. DN	Overall length LF	Shank dia. DCONMS		0.5°	1°	1.5°	2°	3°
EPDREH4040-8-03-TH3	●	4 (.157inch)	0.3 (.012inch)	8 (.315inch)	3.5	3.85	55	6	4.89	8.54	8.83	9.14	9.47	10.22
EPDREH4040-10-03-TH3	●			10 (.394inch)			60		4.18	10.61	10.97	11.36	11.77	12.70
EPDREH4040-12-03-TH3	●			12 (.472inch)					3.65	12.68	13.11	13.57	14.07	15.19
EPDREH4040-14-03-TH3	●			14 (.551inch)					3.24	14.75	15.25	15.79	16.37	17.68
EPDREH4040-16-03-TH3	●			16 (.630inch)					2.91	16.81	17.39	18.01	18.67	No interference
EPDREH4040-18-03-TH3	●			18 (.709inch)					2.64	18.88	19.53	20.22	20.97	No interference
EPDREH4040-20-03-TH3	●			20 (.787inch)			65		2.42	20.95	21.67	22.44	23.27	No interference
EPDREH4040-22-03-TH3	●			22 (.866inch)					2.23	23.01	23.81	24.66	25.57	No interference
EPDREH4040-24-03-TH3	●			24 (.945inch)			70		2.07	25.08	25.95	26.87	27.87	No interference
EPDREH4040-8-05-TH3	●		0.5 (.020inch)	8 (.315inch)			55		4.97	8.54	8.82	9.12	9.44	10.17
EPDREH4040-10-05-TH3	●			10 (.394inch)			60		4.24	10.60	10.96	11.33	11.74	12.66
EPDREH4040-12-05-TH3	●			12 (.472inch)					3.69	12.67	13.10	13.55	14.04	15.14
EPDREH4040-14-05-TH3	●			14 (.551inch)					3.27	14.74	15.24	15.77	16.34	17.63
EPDREH4040-16-05-TH3	●			16 (.630inch)					2.94	16.81	17.37	17.98	18.64	No interference
EPDREH4040-18-05-TH3	●			18 (.709inch)					2.67	18.87	19.51	20.20	20.94	No interference
EPDREH4040-20-05-TH3	●			20 (.787inch)			65		2.44	20.94	21.65	22.42	23.24	No interference
EPDREH4040-22-05-TH3	●			22 (.866inch)					2.25	23.01	23.79	24.63	25.54	No interference
EPDREH4040-24-05-TH3	●			24 (.945inch)			70		2.09	25.08	25.93	26.85	27.84	No interference
EPDREH4040-8-10-TH3	●		1 (.039inch)	8 (.315inch)			55		5.19	8.52	8.78	9.06	9.37	10.05
EPDREH4040-10-10-TH3	●			10 (.394inch)			60		4.40	10.59	10.92	11.28	11.67	12.54
EPDREH4040-12-10-TH3	●			12 (.472inch)					3.82	12.65	13.06	13.50	13.97	15.02
EPDREH4040-14-10-TH3	●			14 (.551inch)					3.37	14.72	15.20	15.71	16.27	17.51
EPDREH4040-16-10-TH3	●			16 (.630inch)					3.02	16.79	17.34	17.93	18.57	20.00
EPDREH4040-18-10-TH3	●			18 (.709inch)					2.73	18.86	19.48	20.15	20.87	No interference
EPDREH4040-20-10-TH3	●			20 (.787inch)			65		2.49	20.92	21.62	22.36	23.17	No interference
EPDREH4040-22-10-TH3	●			22 (.866inch)					2.29	22.99	23.76	24.58	25.47	No interference
EPDREH4040-24-10-TH3	●			24 (.945inch)			70		2.13	25.06	25.90	26.80	27.77	No interference
EPDREH4050-10-01-TH3	●	5 (.197inch)	0.1 (.004inch)	10 (.394inch)	4	4.85	60	6	2.38	10.62	10.98	11.38	11.80	No interference
EPDREH4050-15-01-TH3	●			15 (.591inch)					1.69	15.79	16.33	16.92	No interference	No interference
EPDREH4050-20-01-TH3	●			20 (.787inch)			65		1.30	20.95	21.68	No interference	No interference	No interference
EPDREH4050-25-01-TH3	●			25 (.984inch)			70		1.06	26.12	27.03	No interference	No interference	No interference
EPDREH4050-10-02-TH3	●		0.2 (.008inch)	10 (.394inch)			60		2.40	10.61	10.98	11.37	11.79	No interference
EPDREH4050-15-02-TH3	●			15 (.591inch)					1.70	15.78	16.33	16.91	No interference	No interference
EPDREH4050-20-02-TH3	●			20 (.787inch)			65		1.31	20.95	21.67	No interference	No interference	No interference
EPDREH4050-25-02-TH3	●			25 (.984inch)			70		1.07	26.12	27.02	No interference	No interference	No interference
EPDREH4050-10-03-TH3	●		0.3 (.012inch)	10 (.394inch)			60		2.42	10.61	10.97	11.36	11.77	No interference
EPDREH4050-15-03-TH3	●			15 (.591inch)					1.71	15.78	16.32	16.90	No interference	No interference
EPDREH4050-20-03-TH3	●			20 (.787inch)			65		1.32	20.95	21.67	No interference	No interference	No interference
EPDREH4050-25-03-TH3	●			25 (.984inch)			70		1.07	26.12	27.02	No interference	No interference	No interference

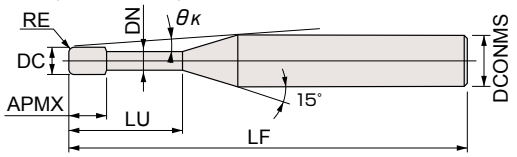
For detailed information on the EPDREH4 ⌀1.5 to ⌀3 cutting conditions, refer to pages 67, 68, 72, 73, 81, 82, 86 and 87.

4 Flutes

Radius

4 Flutes

Corner radius tolerance : ±0.005 (centerline datum)



EPDREH4○○○-○.○-○○○-TH3

Carbide TH3 Helix 30° h4 DCONMS=4 h5 DCONMS=6

Item code	Stock	Size(mm)							Interference angle θK (°)	Effective under neck length with respect to draft angle				
		Tool dia. DC	Corner radius RE	Under neck length LU	Flute length APMX	Neck dia. DN	Overall length LF	Shank dia. DCONMS		0.5°	1°	1.5°	2°	3°
EPDREH4050-10-05-TH3	●	5 (.197inch)	0.5 (.020inch)	10 (.394inch)	4	4.85	60	6	2.46	10.60	10.96	11.33	11.74	No interference
EPDREH4050-15-05-TH3	●			15 (.591inch)					1.73	15.77	16.31	16.88	No interference	No interference
EPDREH4050-20-05-TH3	●			20 (.787inch)			65		1.33	20.94	21.65	No interference	No interference	No interference
EPDREH4050-25-05-TH3	●			25 (.984inch)			70		1.08	26.11	27.00	No interference	No interference	No interference
EPDREH4050-10-10-TH3	●		1 (.039inch)	10 (.394inch)			60		2.57	10.59	10.92	11.28	11.67	No interference
EPDREH4050-15-10-TH3	●			15 (.591inch)					1.78	15.76	16.27	16.82	No interference	No interference
EPDREH4050-20-10-TH3	●			20 (.787inch)			65		1.36	20.92	21.62	No interference	No interference	No interference
EPDREH4050-25-10-TH3	●			25 (.984inch)			70		1.10	26.09	26.97	No interference	No interference	No interference
EPDREH4060-12-01-TH3	●	6 (.236inch)	0.1 (.004inch)	12 (.472inch)	5	5.85	60	6	0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-18-01-TH3	●			18 (.709inch)					0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-24-01-TH3	●			24 (.945inch)			70		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-30-01-TH3	●			30 (1.181inch)			80		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-12-02-TH3	●		0.2 (.008inch)	12 (.472inch)			60		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-18-02-TH3	●			18 (.709inch)					0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-24-02-TH3	●			24 (.945inch)			70		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-30-02-TH3	●			30 (1.181inch)			80		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-12-03-TH3	●		0.3 (.012inch)	12 (.472inch)			60		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-18-03-TH3	●			18 (.709inch)					0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-24-03-TH3	●			24 (.945inch)			70		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-30-03-TH3	●			30 (1.181inch)			80		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-12-05-TH3	●		0.5 (.020inch)	12 (.472inch)			60		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-18-05-TH3	●			18 (.709inch)					0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-24-05-TH3	●			24 (.945inch)			70		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-30-05-TH3	●			30 (1.181inch)			80		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-12-10-TH3	●		1 (.039inch)	12 (.472inch)			60		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-18-10-TH3	●			18 (.709inch)					0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-24-10-TH3	●			24 (.945inch)			70		0.00	No interference	No interference	No interference	No interference	No interference
EPDREH4060-30-10-TH3	●			30 (1.181inch)			80		0.00	No interference	No interference	No interference	No interference	No interference

For detailed information on the EPDREH4 ⌀5 and ⌀6 cutting conditions, refer to pages 68, 69, 73, 74, 82, 83, 87 and 88.

● : Inventory maintained in US ★ : Inventory maintained in Japan

Recommended Cutting Conditions (Inch)

2 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 63.

Work material				1		2		3		4		5	
				Pre-hardened Steel (35～45HRC)		**Hardened Steel (45～55HRC)**		**Hardened Steel (55～65HRC)**		**Hardened Steel (65～68HRC)**		**Hardened Steel (68～72HRC)**	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.008	.001	.02	.0006	42,500	28.0	37,500	21.7	35,000	17.7	31,500	16.1	31,880	12.6
		.039	.0004	42,500	28.0	37,500	21.7	35,000	17.7	31,500	16.1	31,880	12.6
	.002	.02	.0008	42,500	28.0	37,500	21.7	35,000	17.7	31,500	16.1	31,880	12.6
		.039	.0006	42,500	28.0	37,500	21.7	35,000	17.7	31,500	16.1	31,880	12.6
.012	.001	.039	.0006	40,800	28.7	36,000	21.7	33,600	17.3	30,240	15.7	30,600	12.2
		.079	.0004	33,050	23.2	29,160	17.3	27,220	14.2	24,490	12.6	24,790	9.8
	.002	.039	.0008	40,800	28.7	36,000	21.7	33,600	17.3	30,240	15.7	30,600	12.2
		.079	.0005	33,050	23.2	29,160	17.3	27,220	14.2	24,490	12.6	24,790	9.8
.016	.001	.039	.0006	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.079	.0005	32,260	28.0	28,800	22.0	26,730	18.1	24,050	16.1	24,480	12.6
	.002	.039	.001	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.079	.0006	32,260	28.0	28,800	22.0	26,730	18.1	24,050	16.1	24,480	12.6
	.004	.039	.0013	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.079	.0011	32,260	28.0	28,800	22.0	26,730	18.1	24,050	16.1	24,480	12.6
.020	.001	.039	.0006	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.079	.0005	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.118	.0004	26,440	24.8	23,330	18.5	21,770	15.0	19,600	13.4	19,830	10.6
	.002	.039	.0012	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.079	.0009	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.118	.0007	26,440	24.8	23,330	18.5	21,770	15.0	19,600	13.4	19,830	10.6
	.004	.039	.0014	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.079	.0012	32,260	31.1	28,800	24.4	26,730	20.1	24,050	18.1	24,480	14.2
		.118	.0008	26,440	24.8	23,330	18.5	21,770	15.0	19,600	13.4	19,830	10.6
.024	.001	.079	.0006	32,260	39.0	28,800	30.3	26,730	25.2	24,050	22.4	24,480	17.3
		.157	.0005	26,440	31.1	23,330	23.2	21,770	18.9	19,600	16.9	19,830	13.0
	.002	.079	.0011	32,260	39.0	28,800	30.3	26,730	25.2	24,050	22.4	24,480	17.3
		.157	.0007	26,440	31.1	23,330	23.2	21,770	18.9	19,600	16.9	19,830	13.0
	.004	.079	.0014	32,260	39.0	28,800	30.3	26,730	25.2	24,050	22.4	24,480	17.3
		.157	.0009	26,440	31.1	23,330	23.2	21,770	18.9	19,600	16.9	19,830	13.0
.031	.001	.079	.0009	34,000	55.5	30,000	43.7	28,000	35.4	25,200	31.9	25,500	24.8
		.157	.0006	34,000	44.5	30,000	35.0	28,000	28.3	25,200	25.6	25,500	20.1
	.002	.079	.0015	34,000	55.5	30,000	43.7	28,000	35.4	25,200	31.9	25,500	24.8
		.157	.001	34,000	44.5	30,000	35.0	28,000	28.3	25,200	25.6	25,500	20.1
	.004	.079	.0019	34,000	55.5	30,000	43.7	28,000	35.4	25,200	31.9	25,500	24.8
		.157	.0013	34,000	44.5	30,000	35.0	28,000	28.3	25,200	25.6	25,500	20.1
	.008	.079	.0032	34,000	55.5	30,000	43.7	28,000	35.4	25,200	31.9	25,500	24.8
		.157	.0022	34,000	44.5	30,000	35.0	28,000	28.3	25,200	25.6	25,500	20.1

【Note】 Refer to the comments and notes below the table on page 62 regarding usage.

Recommended Cutting Conditions (Inch)

2 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 63.

Work material				1		2		3		4		5	
				Pre-hardened Steel (35～45HRC)		**Hardened Steel (45～55HRC)**		**Hardened Steel (55～65HRC)**		**Hardened Steel (65～68HRC)**		**Hardened Steel (68～72HRC)**	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.039	.001	.079	.0006	33,440	71.3	29,620	55.9	27,710	45.7	24,940	41.3	25,170	31.9
		.157	.0005	30,600	65.0	27,000	50.8	25,200	41.7	22,680	37.4	22,950	29.1
		.236	.0004	24,790	52.8	21,870	41.3	20,410	33.9	18,370	30.3	18,590	23.6
		.315	.0003	22,030	46.9	19,440	36.6	18,140	29.9	16,330	26.8	16,520	20.9
	.002	.079	.0018	33,440	71.3	29,620	55.9	27,710	45.7	24,940	41.3	25,170	31.9
		.157	.0011	30,600	65.0	27,000	50.8	25,200	41.7	22,680	37.4	22,950	29.1
		.236	.0007	24,790	52.8	21,870	41.3	20,410	33.9	18,370	30.3	18,590	23.6
		.315	.0006	22,030	46.9	19,440	36.6	18,140	29.9	16,330	26.8	16,520	20.9
	.004	.079	.0026	33,440	71.3	29,620	55.9	27,710	45.7	24,940	41.3	25,170	31.9
		.157	.0015	30,600	65.0	27,000	50.8	25,200	41.7	22,680	37.4	22,950	29.1
		.236	.0009	24,790	52.8	21,870	41.3	20,410	33.9	18,370	30.3	18,590	23.6
		.315	.0009	22,030	46.9	19,440	36.6	18,140	29.9	16,330	26.8	16,520	20.9
	.008	.079	.0043	33,440	71.3	29,620	55.9	27,710	45.7	24,940	41.3	25,170	31.9
		.157	.0028	30,600	65.0	27,000	50.8	25,200	41.7	22,680	37.4	22,950	29.1
		.236	.0016	24,790	52.8	21,870	41.3	20,410	33.9	18,370	30.3	18,590	23.6
		.315	.0016	22,030	46.9	19,440	36.6	18,140	29.9	16,330	26.8	16,520	20.9

(1) a_p indicates guidelines for Group 1 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH2010-2-02-TH3 tool:
Cutting depth = .004 inch (0.11mm) (a_p) × 0.85 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = .003 inch (0.075mm)

【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

2 Flutes

High efficiency cutting condition

High accuracy cuttiing condition

For detailed information on high-efficiency cutting conditions, refer to page 61.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～65HRC)		4 Hardened Steel (65～68HRC)		5 Hardened Steel (68～72HRC)	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.008	.001	.02	.0006	50,000	8.3	50,000	7.1	50,000	6.3	45,000	5.5	42,500	4.3
		.039	.0004	50,000	8.3	50,000	7.1	50,000	6.3	45,000	5.5	42,500	4.3
	.002	.02	.0008	50,000	8.3	50,000	7.1	50,000	6.3	45,000	5.5	42,500	4.3
		.039	.0006	50,000	8.3	50,000	7.1	50,000	6.3	45,000	5.5	42,500	4.3
.012	.001	.039	.0006	50,000	18.1	50,000	13.4	50,000	12.6	45,000	11.4	42,500	8.7
		.079	.0004	45,000	16.5	45,000	11.8	45,000	11.4	40,500	10.2	38,250	7.9
	.002	.039	.0008	50,000	18.1	50,000	13.4	50,000	12.6	45,000	11.4	42,500	8.7
		.079	.0005	45,000	16.5	45,000	11.8	45,000	11.4	40,500	10.2	38,250	7.9
.016	.001	.039	.0006	50,000	18.1	40,000	12.6	36,000	10.6	32,400	9.4	30,600	7.5
		.079	.0005	45,000	16.1	36,000	11.4	34,000	9.4	30,600	8.7	28,900	6.7
	.002	.039	.001	50,000	18.1	40,000	12.6	36,000	10.6	32,400	9.4	30,600	7.5
		.079	.0006	45,000	16.1	36,000	11.4	34,000	9.4	30,600	8.7	28,900	6.7
	.004	.039	.0013	50,000	18.1	40,000	12.6	36,000	10.6	32,400	9.4	30,600	7.5
		.079	.0011	45,000	16.1	36,000	11.4	34,000	9.4	30,600	8.7	28,900	6.7
.020	.001	.039	.0006	40,000	18.1	30,000	15.0	28,000	12.6	25,200	11.0	23,800	8.7
		.079	.0005	40,000	18.1	30,000	15.0	28,000	12.6	25,200	11.0	23,800	8.7
		.118	.0004	36,000	16.1	27,000	12.6	24,500	10.2	22,050	9.1	20,830	7.1
	.002	.039	.0012	40,000	18.1	30,000	15.0	28,000	12.6	25,200	11.0	23,800	8.7
		.079	.0009	40,000	18.1	30,000	15.0	28,000	12.6	25,200	11.0	23,800	8.7
		.118	.0007	36,000	16.1	27,000	12.6	24,500	10.2	22,050	9.1	20,830	7.1
	.004	.039	.0014	40,000	18.1	30,000	15.0	28,000	12.6	25,200	11.0	23,800	8.7
		.079	.0012	40,000	18.1	30,000	15.0	28,000	12.6	25,200	11.0	23,800	8.7
		.118	.0008	36,000	16.1	27,000	12.6	24,500	10.2	22,050	9.1	20,830	7.1
.024	.001	.079	.0006	37,830	23.6	28,200	15.4	23,000	12.6	20,700	11.4	19,550	8.7
		.157	.0005	27,800	17.3	23,600	11.0	21,000	9.1	18,900	8.3	17,850	6.3
	.002	.079	.0011	37,830	23.6	28,200	15.4	23,000	12.6	20,700	11.4	19,550	8.7
		.157	.0007	27,800	17.3	23,600	11.0	21,000	9.1	18,900	8.3	17,850	6.3
	.004	.079	.0014	37,830	23.6	28,200	15.4	23,000	12.6	20,700	11.4	19,550	8.7
		.157	.0009	27,800	17.3	23,600	11.0	21,000	9.1	18,900	8.3	17,850	6.3
.031	.001	.079	.0009	28,000	25.6	20,000	15.7	20,000	14.2	18,000	12.6	17,000	9.8
		.157	.0006	28,000	20.5	20,000	12.6	20,000	11.4	18,000	10.2	17,000	7.9
	.002	.079	.0015	28,000	25.6	20,000	15.7	20,000	14.2	18,000	12.6	17,000	9.8
		.157	.001	28,000	20.5	20,000	12.6	20,000	11.4	18,000	10.2	17,000	7.9
	.004	.079	.0019	28,000	25.6	20,000	15.7	20,000	14.2	18,000	12.6	17,000	9.8
		.157	.0013	28,000	20.5	20,000	12.6	20,000	11.4	18,000	10.2	17,000	7.9
	.008	.079	.0032	28,000	25.6	20,000	15.7	20,000	14.2	18,000	12.6	17,000	9.8
		.157	.0022	28,000	20.5	20,000	12.6	20,000	11.4	18,000	10.2	17,000	7.9

【Note】 Refer to the comments and notes below the table on page 64 regarding usage.

Recommended Cutting Conditions (Inch)

2 Flutes | High efficiency cutting condition | **High accuracy cutting condition**

For detailed information on high-efficiency cutting conditions, refer to page 61.

Work material				1		2		3		4		5	
				Pre-hardened Steel (35～45HRC)		**Hardened Steel (45～55HRC)**		**Hardened Steel (55～65HRC)**		**Hardened Steel (65～68HRC)**		**Hardened Steel (68～72HRC)**	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.039	.001	**.079**	.0006	30,290	47.6	**26,730**	**37.8**	**24,950**	**31.5**	**22,450**	**28.3**	**21,210**	**22.0**
		.157	.0005	27,540	40.9	**24,300**	**32.3**	**22,680**	**26.4**	**20,410**	**23.6**	**19,280**	**18.5**
		.236	.0004	22,310	33.1	**19,680**	**26.0**	**18,370**	**21.3**	**16,530**	**19.3**	**15,620**	**15.0**
		.315	.0003	19,830	29.5	**17,500**	**23.2**	**16,330**	**18.9**	**14,700**	**16.9**	**13,880**	**13.4**
	.002	**.079**	.0018	30,250	47.6	**26,730**	**37.8**	**24,950**	**31.5**	**22,450**	**28.3**	**21,210**	**22.0**
		.157	.0011	28,920	44.5	**24,300**	**32.3**	**22,680**	**26.4**	**20,410**	**23.6**	**19,280**	**18.5**
		.236	.0007	24,540	36.6	**19,680**	**26.0**	**18,370**	**21.3**	**16,530**	**19.3**	**15,620**	**15.0**
		.315	.0006	19,830	29.5	**17,500**	**23.2**	**16,330**	**18.9**	**14,700**	**16.9**	**13,880**	**13.4**
	.004	**.079**	.0026	30,290	47.6	**26,730**	**37.8**	**24,950**	**31.5**	**22,450**	**28.3**	**21,210**	**22.0**
		.157	.0015	27,540	40.9	**24,300**	**32.3**	**22,680**	**26.4**	**20,410**	**23.6**	**19,280**	**18.5**
		.236	.0009	22,310	33.1	**19,680**	**26.0**	**18,370**	**21.3**	**16,530**	**19.3**	**15,620**	**15.0**
		.315	.0009	19,830	29.5	**17,500**	**23.2**	**16,330**	**18.9**	**14,700**	**16.9**	**13,880**	**13.4**
	.008	**.079**	.0043	30,290	47.6	**26,730**	**37.8**	**24,950**	**31.5**	**22,450**	**28.3**	**21,210**	**22.0**
		.157	.0028	27,540	40.9	**24,300**	**32.3**	**22,680**	**26.4**	**20,410**	**23.6**	**19,280**	**18.5**
		.236	.0016	22,310	33.1	**19,680**	**26.0**	**18,370**	**21.3**	**16,530**	**19.3**	**15,620**	**15.0**
		.315	.0016	19,830	29.5	**17,500**	**23.2**	**16,330**	**18.9**	**14,700**	**16.9**	**13,880**	**13.4**

(1) a_p indicates guidelines for Group 1 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH2010-2-02-TH3 tool:
Cutting depth = .004 inch (0.11mm) (a_p) × 0.85 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = .003 inch (0.075mm)

【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 70.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.039	.001	.059	.0007	38,900	134.6	38,900	122.0	28,300	80.3	23,000	72.4	21,200	56.7
		.079	.0006	35,000	121.3	35,000	110.2	25,500	72.4	20,700	65.4	19,100	51.2
		.098	.0006	31,800	110.2	31,800	100.0	23,100	65.4	18,800	59.1	17,400	46.5
		.118	.0006	29,200	101.2	29,200	92.1	21,200	60.2	17,200	54.3	15,900	42.5
		.157	.0005	25,000	86.6	25,000	78.7	18,200	51.6	14,800	46.5	13,600	36.2
		.197	.0005	21,900	76.0	21,900	68.9	15,900	44.9	12,900	40.6	11,900	31.9
		.236	.0003	19,500	67.7	19,500	61.4	14,100	40.2	11,500	36.2	10,600	28.3
		.315	.0002	15,900	55.1	15,900	50.0	11,600	33.1	9,400	29.5	8,700	23.2
	.002	.059	.0018	38,900	134.6	38,900	122.4	28,300	80.3	23,000	72.4	21,200	56.7
		.079	.0013	35,000	121.3	35,000	110.2	25,500	72.4	20,700	65.4	19,100	51.2
		.098	.0013	31,800	110.2	31,800	100.0	23,100	65.4	18,800	59.1	17,400	46.5
		.118	.0012	29,200	101.2	29,200	92.1	21,200	60.2	17,200	54.3	15,900	42.5
		.157	.0011	25,000	86.6	25,000	78.7	18,200	51.6	14,800	46.5	13,600	36.2
		.197	.0011	21,900	76.0	21,900	68.9	15,900	44.9	12,900	40.6	11,900	31.9
		.236	.0006	19,500	67.7	19,500	61.4	14,100	40.2	11,500	36.2	10,600	28.3
		.315	.0004	15,900	55.1	15,900	50.0	11,600	33.1	9,400	29.5	8,700	23.2
	.004	.059	.0022	38,900	134.6	38,900	122.4	28,300	80.3	23,000	72.4	21,200	56.7
		.079	.0017	35,000	121.3	35,000	110.2	25,500	72.4	20,700	65.4	19,100	51.2
		.098	.0016	31,800	110.2	31,800	100.0	23,100	65.4	18,800	59.1	17,400	46.5
		.118	.0015	29,200	101.2	29,200	92.1	21,200	60.2	17,200	54.3	15,900	42.5
		.157	.0014	25,000	86.6	25,000	78.7	18,200	51.6	14,800	46.5	13,600	36.2
		.197	.0013	21,900	76.0	21,900	68.9	15,900	44.9	12,900	40.6	11,900	31.9
		.236	.0007	19,500	67.7	19,500	61.4	14,100	40.2	11,500	36.2	10,600	28.3
		.315	.0004	15,900	55.1	15,900	50.0	11,600	33.1	9,400	29.5	8,700	23.2
	.008	.059	.0025	38,900	134.6	38,900	122.4	28,300	80.3	23,000	72.4	21,200	56.7
		.079	.0019	35,000	121.3	35,000	110.2	25,500	72.4	20,700	65.4	19,100	51.2
		.098	.0018	31,800	110.2	31,800	100.0	23,100	65.4	18,800	59.1	17,400	46.5
		.118	.0017	29,200	101.2	29,200	92.1	21,200	60.2	17,200	54.3	15,900	42.5
		.157	.0015	25,000	86.6	25,000	78.7	18,200	51.6	14,800	46.5	13,600	36.2
		.197	.0015	21,900	76.0	21,900	68.9	15,900	44.9	12,900	40.6	11,900	31.9
		.236	.0008	19,500	67.7	19,500	61.4	14,100	40.2	11,500	36.2	10,600	28.3
		.315	.0005	15,900	55.1	15,900	50.0	11,600	33.1	9,400	29.5	8,700	23.2
	.012	.059	.0028	38,900	134.6	38,900	122.4	28,300	80.3	23,000	72.4	21,200	56.7
		.079	.0021	35,000	121.3	35,000	110.2	25,500	72.4	20,700	65.4	19,100	51.2
		.098	.0020	31,800	110.2	31,800	100.0	23,100	65.4	18,800	59.1	17,400	46.5
		.118	.0019	29,200	101.2	29,200	92.1	21,200	60.2	17,200	54.3	15,900	42.5
		.157	.0017	25,000	86.6	25,000	78.7	18,200	51.6	14,800	46.5	13,600	36.2
		.197	.0017	21,900	76.0	21,900	68.9	15,900	44.9	12,900	40.6	11,900	31.9
		.236	.0009	19,500	67.7	19,500	61.4	14,100	40.2	11,500	36.2	10,600	28.3
		.315	.0005	15,900	55.1	15,900	50.0	11,600	33.1	9,400	29.5	8,700	23.2
.059	.001	.079	.0007	26,900	130.3	26,900	118.5	19,600	78.0	15,900	70.1	14,700	55.1
		.118	.0006	23,300	113.0	23,300	102.8	17,000	67.3	13,800	61.0	12,700	47.6
		.157	.0006	20,600	100.0	20,600	90.9	15,000	59.4	12,200	53.9	11,200	42.1
		.197	.0005	18,400	89.4	18,400	81.1	13,400	53.1	10,900	48.0	10,100	37.8
		.236	.0005	16,700	81.1	16,700	73.6	12,100	48.0	9,900	43.7	9,100	34.3
		.315	.0004	15,200	73.6	15,200	66.9	11,100	44.1	9,000	39.8	8,300	31.1
		.394	.0004	14,000	67.7	14,000	61.8	10,200	40.6	8,300	36.6	7,600	28.3
		.472	.0003	12,100	58.7	12,100	53.5	8,800	35.0	7,100	31.5	6,600	24.8
	.002	.079	.0019	26,900	130.3	26,900	118.5	19,600	78.0	15,900	70.1	14,700	55.1
		.118	.0017	23,300	113.0	23,300	102.8	17,000	67.3	13,800	61.0	12,700	47.6
		.157	.0015	20,600	100.0	20,600	90.9	15,000	59.4	12,200	53.9	11,200	42.1
		.197	.0014	18,400	89.4	18,400	81.1	13,400	53.1	10,900	48.0	10,100	37.8
		.236	.0013	16,700	81.1	16,700	73.6	12,100	48.0	9,900	43.7	9,100	34.3
		.315	.0012	15,200	73.6	15,200	66.9	11,100	44.1	9,000	39.8	8,300	31.1
		.394	.0011	14,000	67.7	14,000	61.8	10,200	40.6	8,300	36.6	7,600	28.3
		.472	.0009	12,100	58.7	12,100	53.5	8,800	35.0	7,100	31.5	6,600	24.8
	.004	.079	.0031	26,900	130.3	26,900	118.5	19,600	78.0	15,900	70.1	14,700	55.1
		.118	.0028	23,300	113.0	23,300	102.8	17,000	67.3	13,800	61.0	12,700	47.6
		.157	.0025	20,600	100.0	20,600	90.9	15,000	59.4	12,200	53.9	11,200	42.1
		.197	.0022	18,400	89.4	18,400	81.1	13,400	53.1	10,900	48.0	10,100	37.8

【Note】 Refer to the comments and notes below the table on page 69 regarding usage.

Recommended Cutting Conditions (Inch)

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 70.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.059	.004	.236	.0020	16,700	81.1	16,700	73.6	12,100	48.0	9,900	43.7	9,100	34.3
		.315	.0019	15,200	73.6	15,200	66.9	11,100	44.1	9,000	39.8	8,300	31.1
		.394	.0017	14,000	67.7	14,000	61.8	10,200	40.6	8,300	36.6	7,600	28.3
		.472	.0014	12,100	58.7	12,100	53.5	8,800	35.0	7,100	31.5	6,600	24.8
	.008	.079	.0032	26,900	130.3	26,900	118.5	19,600	78.0	15,900	70.1	14,700	55.1
		.118	.0030	23,300	113.0	23,300	102.8	17,000	67.3	13,800	61.0	12,700	47.6
		.157	.0026	20,600	100.0	20,600	90.9	15,000	59.4	12,200	53.9	11,200	42.1
		.197	.0024	18,400	89.4	18,400	81.1	13,400	53.1	10,900	48.0	10,100	37.8
		.236	.0022	16,700	81.1	16,700	73.6	12,100	48.0	9,900	43.7	9,100	34.3
		.315	.0020	15,200	73.6	15,200	66.9	11,100	44.1	9,000	39.8	8,300	31.1
		.394	.0019	14,000	67.7	14,000	61.8	10,200	40.6	8,300	36.6	7,600	28.3
		.472	.0015	12,100	58.7	12,100	53.5	8,800	35.0	7,100	31.5	6,600	24.8
	.012	.079	.0033	26,900	130.3	26,900	118.5	19,600	78.0	15,900	70.1	14,700	55.1
		.118	.0030	23,300	113.0	23,300	102.8	17,000	67.3	13,800	61.0	12,700	47.6
		.157	.0027	20,600	100.0	20,600	90.9	15,000	59.4	12,200	53.9	11,200	42.1
		.197	.0024	18,400	89.4	18,400	81.1	13,400	53.1	10,900	48.0	10,100	37.8
		.236	.0022	16,700	81.1	16,700	73.6	12,100	48.0	9,900	43.7	9,100	34.3
		.315	.0021	15,200	73.6	15,200	66.9	11,100	44.1	9,000	39.8	8,300	31.1
		.394	.0019	14,000	67.7	14,000	61.8	10,200	40.6	8,300	36.6	7,600	28.3
		.472	.0015	12,100	58.7	12,100	53.5	8,800	35.0	7,100	31.5	6,600	24.8
	.020	.079	.0034	26,900	130.3	26,900	118.5	19,600	78.0	15,900	70.1	14,700	55.1
		.118	.0031	23,300	113.0	23,300	102.8	17,000	67.3	13,800	61.0	12,700	47.6
		.157	.0028	20,600	100.0	20,600	90.9	15,000	59.4	12,200	53.9	11,200	42.1
		.197	.0025	18,400	89.4	18,400	81.1	13,400	53.1	10,900	48.0	10,100	37.8
		.236	.0023	16,700	81.1	16,700	73.6	12,100	48.0	9,900	43.7	9,100	34.3
		.315	.0021	15,200	73.6	15,200	66.9	11,100	44.1	9,000	39.8	8,300	31.1
		.394	.0019	14,000	67.7	14,000	61.8	10,200	40.6	8,300	36.6	7,600	28.3
		.472	.0015	12,100	58.7	12,100	53.5	8,800	35.0	7,100	31.5	6,600	24.8
.079	.001	.098	.0007	20,600	142.9	20,600	129.9	15,000	85.0	12,200	76.8	11,200	59.8
		.118	.0006	19,500	135.0	19,500	122.8	14,100	79.9	11,500	72.4	10,600	56.7
		.157	.0006	17,500	121.3	17,500	110.2	12,700	72.0	10,300	65.0	9,500	50.8
		.197	.0006	15,900	110.2	15,900	100.0	11,600	65.7	9,400	59.1	8,700	46.5
		.236	.0005	14,600	101.2	14,600	92.1	10,600	60.2	8,600	54.3	8,000	42.9
		.315	.0005	12,500	86.6	12,500	78.7	9,100	51.6	7,400	46.5	6,800	36.2
		.394	.0005	10,900	75.6	10,900	68.5	8,000	45.3	6,500	40.9	6,000	32.3
		.472	.0004	9,700	67.3	9,700	61.0	7,100	40.2	5,700	35.8	5,300	28.3
	.002	.098	.0019	20,600	142.9	20,600	129.9	15,000	85.0	12,200	76.8	11,200	59.8
		.118	.0017	19,500	135.0	19,500	122.8	14,100	79.9	11,500	72.4	10,600	56.7
		.157	.0015	17,500	121.3	17,500	110.2	12,700	72.0	10,300	65.0	9,500	50.8
		.197	.0014	15,900	110.2	15,900	100.0	11,600	65.7	9,400	59.1	8,700	46.5
		.236	.0014	14,600	101.2	14,600	92.1	10,600	60.2	8,600	54.3	8,000	42.9
		.315	.0013	12,500	86.6	12,500	78.7	9,100	51.6	7,400	46.5	6,800	36.2
		.394	.0013	10,900	75.6	10,900	68.5	8,000	45.3	6,500	40.9	6,000	32.3
		.472	.0009	9,700	67.3	9,700	61.0	7,100	40.2	5,700	35.8	5,300	28.3
	.004	.098	.0032	20,600	142.9	20,600	129.9	15,000	85.0	12,200	76.8	11,200	59.8
		.118	.0029	19,500	135.0	19,500	122.8	14,100	79.9	11,500	72.4	10,600	56.7
		.157	.0025	17,500	121.3	17,500	110.2	12,700	72.0	10,300	65.0	9,500	50.8
		.197	.0024	15,900	110.2	15,900	100.0	11,600	65.7	9,400	59.1	8,700	46.5
		.236	.0023	14,600	101.2	14,600	92.1	10,600	60.2	8,600	54.3	8,000	42.9
		.315	.0023	12,500	86.6	12,500	78.7	9,100	51.6	7,400	46.5	6,800	36.2
		.394	.0021	10,900	75.6	10,900	68.5	8,000	45.3	6,500	40.9	6,000	32.3
		.472	.0016	9,700	67.3	9,700	61.0	7,100	40.2	5,700	35.8	5,300	28.3
	.008	.098	.0036	20,600	142.9	20,600	129.9	15,000	85.0	12,200	76.8	11,200	59.8
		.118	.0032	19,500	135.0	19,500	122.8	14,100	79.9	11,500	72.4	10,600	56.7
		.157	.0028	17,500	121.3	17,500	110.2	12,700	72.0	10,300	65.0	9,500	50.8
		.197	.0027	15,900	110.2	15,900	100.0	11,600	65.7	9,400	59.1	8,700	46.5
		.236	.0026	14,600	101.2	14,600	92.1	10,600	60.2	8,600	54.3	8,000	42.9
		.315	.0026	12,500	86.6	12,500	78.7	9,100	51.6	7,400	46.5	6,800	36.2
		.394	.0024	10,900	75.6	10,900	68.5	8,000	45.3	6,500	40.9	6,000	32.3
		.472	.0018	9,700	67.3	9,700	61.0	7,100	40.2	5,700	35.8	5,300	28.3

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 70.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.079	.012	.098	.0038	20,600	142.9	20,600	129.9	15,000	85.0	12,200	76.8	11,200	59.8
		.118	.0034	19,500	135.0	19,500	122.8	14,100	79.9	11,500	72.4	10,600	56.7
		.157	.0029	17,500	121.3	17,500	110.2	12,700	72.0	10,300	65.0	9,500	50.8
		.197	.0029	15,900	110.2	15,900	100.0	11,600	65.7	9,400	59.1	8,700	46.5
		.236	.0028	14,600	101.2	14,600	92.1	10,600	60.2	8,600	54.3	8,000	42.9
		.315	.0027	12,500	86.6	12,500	78.7	9,100	51.6	7,400	46.5	6,800	36.2
		.394	.0025	10,900	75.6	10,900	68.5	8,000	45.3	6,500	40.9	6,000	32.3
		.472	.0019	9,700	67.3	9,700	61.0	7,100	40.2	5,700	35.8	5,300	28.3
	.020	.098	.0040	20,600	142.9	20,600	129.9	15,000	85.0	12,200	76.8	11,200	59.8
		.118	.0036	19,500	135.0	19,500	122.8	14,100	79.9	11,500	72.4	10,600	56.7
		.157	.0031	17,500	121.3	17,500	110.2	12,700	72.0	10,300	65.0	9,500	50.8
		.197	.0030	15,900	110.2	15,900	100.0	11,600	65.7	9,400	59.1	8,700	46.5
		.236	.0029	14,600	101.2	14,600	92.1	10,600	60.2	8,600	54.3	8,000	42.9
		.315	.0029	12,500	86.6	12,500	78.7	9,100	51.6	7,400	46.5	6,800	36.2
		.394	.0027	10,900	75.6	10,900	68.5	8,000	45.3	6,500	40.9	6,000	32.3
		.472	.0020	9,700	67.3	9,700	61.0	7,100	40.2	5,700	35.8	5,300	28.3
.118	.002	.157	.0018	18,600	116.1	18,600	105.5	13,500	68.9	11,000	62.2	10,200	49.2
		.236	.0017	15,400	96.1	15,400	87.4	11,200	57.1	9,100	51.6	8,400	40.6
		.315	.0017	13,100	81.9	13,100	74.4	9,500	48.4	7,700	43.7	7,100	34.3
		.394	.0016	11,400	71.3	11,400	64.6	8,300	42.5	6,700	37.8	6,200	29.9
		.472	.0015	10,100	63.0	10,100	57.1	7,300	37.4	5,900	33.5	5,500	26.4
		.551	.0014	9,000	56.3	9,000	51.2	6,600	33.9	5,300	29.9	4,900	23.6
		.630	.0013	8,200	51.2	8,200	46.5	5,900	29.9	4,800	27.2	4,500	21.7
		.709	.0012	7,500	46.9	7,500	42.5	5,400	27.6	4,400	24.8	4,100	19.7
		.787	.0009	6,900	42.9	6,900	39.0	5,000	25.6	4,100	23.2	3,800	18.5
	.004	.157	.0035	18,600	116.1	18,600	105.5	13,500	68.9	11,000	62.2	10,200	49.2
		.236	.0034	15,400	96.1	15,400	87.4	11,200	57.1	9,100	51.6	8,400	40.6
		.315	.0033	13,100	81.9	13,100	74.4	9,500	48.4	7,700	43.7	7,100	34.3
		.394	.0032	11,400	71.3	11,400	64.6	8,300	42.5	6,700	37.8	6,200	29.9
		.472	.0030	10,100	63.0	10,100	57.1	7,300	37.4	5,900	33.5	5,500	26.4
		.551	.0027	9,000	56.3	9,000	51.2	6,600	33.9	5,300	29.9	4,900	23.6
		.630	.0026	8,200	51.2	8,200	46.5	5,900	29.9	4,800	27.2	4,500	21.7
		.709	.0024	7,500	46.9	7,500	42.5	5,400	27.6	4,400	24.8	4,100	19.7
		.787	.0017	6,900	42.9	6,900	39.0	5,000	25.6	4,100	23.2	3,800	18.5
	.008	.157	.0040	18,600	116.1	18,600	105.5	13,500	68.9	11,000	62.2	10,200	49.2
		.236	.0039	15,400	96.1	15,400	87.4	11,200	57.1	9,100	51.6	8,400	40.6
		.315	.0037	13,100	81.9	13,100	74.4	9,500	48.4	7,700	43.7	7,100	34.3
		.394	.0036	11,400	71.3	11,400	64.6	8,300	42.5	6,700	37.8	6,200	29.9
		.472	.0033	10,100	63.0	10,100	57.1	7,300	37.4	5,900	33.5	5,500	26.4
		.551	.0031	9,000	56.3	9,000	51.2	6,600	33.9	5,300	29.9	4,900	23.6
		.630	.0030	8,200	51.2	8,200	46.5	5,900	29.9	4,800	27.2	4,500	21.7
		.709	.0027	7,500	46.9	7,500	42.5	5,400	27.6	4,400	24.8	4,100	19.7
		.787	.0020	6,900	42.9	6,900	39.0	5,000	25.6	4,100	23.2	3,800	18.5
	.012	.157	.0042	18,600	116.1	18,600	105.5	13,500	68.9	11,000	62.2	10,200	49.2
		.236	.0041	15,400	96.1	15,400	87.4	11,200	57.1	9,100	51.6	8,400	40.6
		.315	.0040	13,100	81.9	13,100	74.4	9,500	48.4	7,700	43.7	7,100	34.3
		.394	.0038	11,400	71.3	11,400	64.6	8,300	42.5	6,700	37.8	6,200	29.9
		.472	.0035	10,100	63.0	10,100	57.1	7,300	37.4	5,900	33.5	5,500	26.4
		.551	.0032	9,000	56.3	9,000	51.2	6,600	33.9	5,300	29.9	4,900	23.6
		.630	.0031	8,200	51.2	8,200	46.5	5,900	29.9	4,800	27.2	4,500	21.7
		.709	.0028	7,500	46.9	7,500	42.5	5,400	27.6	4,400	24.8	4,100	19.7
		.787	.0021	6,900	42.9	6,900	39.0	5,000	25.6	4,100	23.2	3,800	18.5
	.020	.157	.0044	18,600	116.1	18,600	105.5	13,500	68.9	11,000	62.2	10,200	49.2
		.236	.0043	15,400	96.1	15,400	87.4	11,200	57.1	9,100	51.6	8,400	40.6
		.315	.0042	13,100	81.9	13,100	74.4	9,500	48.4	7,700	43.7	7,100	34.3
		.394	.0040	11,400	71.3	11,400	64.6	8,300	42.5	6,700	37.8	6,200	29.9
		.472	.0037	10,100	63.0	10,100	57.1	7,300	37.4	5,900	33.5	5,500	26.4
		.551	.0034	9,000	56.3	9,000	51.2	6,600	33.9	5,300	29.9	4,900	23.6
		.630	.0033	8,200	51.2	8,200	46.5	5,900	29.9	4,800	27.2	4,500	21.7
		.709	.0030	7,500	46.9	7,500	42.5	5,400	27.6	4,400	24.8	4,100	19.7
		.787	.0022	6,900	42.9	6,900	39.0	5,000	25.6	4,100	23.2	3,800	18.5

【Note】 Refer to the comments and notes below the table on page 69 regarding usage.

Recommended Cutting Conditions (Inch)

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 70.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.157	.004	.315	.0036	10,400	108.3	10,400	98.4	7,600	64.6	6,200	58.7	5,700	45.7
		.394	.0035	9,300	96.9	9,300	87.8	6,800	57.9	5,500	52.0	5,100	40.9
		.472	.0033	8,400	87.4	8,400	79.5	6,100	52.0	5,000	47.2	4,600	37.0
		.551	.0031	7,700	79.9	7,700	72.8	5,600	47.6	4,500	42.5	4,200	33.9
		.630	.0030	7,100	73.6	7,100	66.9	5,100	43.3	4,200	39.8	3,900	31.5
		.709	.0029	6,500	67.7	6,500	61.4	4,800	40.9	3,900	37.0	3,600	28.7
		.787	.0028	6,100	63.4	6,100	57.5	4,400	37.4	3,600	33.9	3,300	26.4
		.866	.0023	5,700	59.1	5,700	53.9	4,100	35.0	3,400	32.3	3,100	24.8
		.945	.0022	5,300	55.1	5,300	50.0	3,900	33.1	3,200	30.3	2,900	23.2
	.008	.315	.0050	10,400	108.3	10,400	98.4	7,600	64.6	6,200	58.7	5,700	45.7
		.394	.0048	9,300	96.9	9,300	87.8	6,800	57.9	5,500	52.0	5,100	40.9
		.472	.0046	8,400	87.4	8,400	79.5	6,100	52.0	5,000	47.2	4,600	37.0
		.551	.0043	7,700	79.9	7,700	72.8	5,600	47.6	4,500	42.5	4,200	33.9
		.630	.0041	7,100	73.6	7,100	66.9	5,100	43.3	4,200	39.8	3,900	31.5
		.709	.0040	6,500	67.7	6,500	61.4	4,800	40.9	3,900	37.0	3,600	28.7
		.787	.0038	6,100	63.4	6,100	57.5	4,400	37.4	3,600	33.9	3,300	26.4
		.866	.0032	5,700	59.1	5,700	53.9	4,100	35.0	3,400	32.3	3,100	24.8
		.945	.0030	5,300	55.1	5,300	50.0	3,900	33.1	3,200	30.3	2,900	23.2
	.012	.315	.0052	10,400	108.3	10,400	98.4	7,600	64.6	6,200	58.7	5,700	45.7
		.394	.0051	9,300	96.9	9,300	87.8	6,800	57.9	5,500	52.0	5,100	40.9
		.472	.0048	8,400	87.4	8,400	79.5	6,100	52.0	5,000	47.2	4,600	37.0
		.551	.0045	7,700	79.9	7,700	72.8	5,600	47.6	4,500	42.5	4,200	33.9
		.630	.0044	7,100	73.6	7,100	66.9	5,100	43.3	4,200	39.8	3,900	31.5
		.709	.0043	6,500	67.7	6,500	61.4	4,800	40.9	3,900	37.0	3,600	28.7
		.787	.0040	6,100	63.4	6,100	57.5	4,400	37.4	3,600	33.9	3,300	26.4
		.866	.0034	5,700	59.1	5,700	53.9	4,100	35.0	3,400	32.3	3,100	24.8
		.945	.0032	5,300	55.1	5,300	50.0	3,900	33.1	3,200	30.3	2,900	23.2
	.020	.315	.0054	10,400	108.3	10,400	98.4	7,600	64.6	6,200	58.7	5,700	45.7
		.394	.0052	9,300	96.9	9,300	87.8	6,800	57.9	5,500	52.0	5,100	40.9
		.472	.0050	8,400	87.4	8,400	79.5	6,100	52.0	5,000	47.2	4,600	37.0
		.551	.0046	7,700	79.9	7,700	72.8	5,600	47.6	4,500	42.5	4,200	33.9
		.630	.0045	7,100	73.6	7,100	66.9	5,100	43.3	4,200	39.8	3,900	31.5
		.709	.0044	6,500	67.7	6,500	61.4	4,800	40.9	3,900	37.0	3,600	28.7
		.787	.0042	6,100	63.4	6,100	57.5	4,400	37.4	3,600	33.9	3,300	26.4
		.866	.0035	5,700	59.1	5,700	53.9	4,100	35.0	3,400	32.3	3,100	24.8
		.945	.0033	5,300	55.1	5,300	50.0	3,900	33.1	3,200	30.3	2,900	23.2
	.039	.315	.0055	10,400	108.3	10,400	98.4	7,600	64.6	6,200	58.7	5,700	45.7
		.394	.0054	9,300	96.9	9,300	87.8	6,800	57.9	5,500	52.0	5,100	40.9
		.472	.0051	8,400	87.4	8,400	79.5	6,100	52.0	5,000	47.2	4,600	37.0
		.551	.0048	7,700	79.9	7,700	72.8	5,600	47.6	4,500	42.5	4,200	33.9
		.630	.0046	7,100	73.6	7,100	66.9	5,100	43.3	4,200	39.8	3,900	31.5
		.709	.0045	6,500	67.7	6,500	61.4	4,800	40.9	3,900	37.0	3,600	28.7
		.787	.0043	6,100	63.4	6,100	57.5	4,400	37.4	3,600	33.9	3,300	26.4
		.866	.0035	5,700	59.1	5,700	53.9	4,100	35.0	3,400	32.3	3,100	24.8
		.945	.0033	5,300	55.1	5,300	50.0	3,900	33.1	3,200	30.3	2,900	23.2
.197	.004	.394	.0038	9,300	128.7	9,300	117.3	6,800	77.2	5,500	69.3	5,100	54.7
		.591	.0032	7,400	102.4	7,400	93.3	5,400	61.4	4,400	55.5	4,000	42.9
		.787	.0030	6,100	84.6	6,100	76.8	4,400	50.0	3,600	45.3	3,300	35.4
		.984	.0030	5,200	72.0	5,200	65.4	3,800	42.9	3,100	39.0	2,800	29.9
	.008	.394	.0048	9,300	128.7	9,300	117.3	6,800	77.2	5,500	69.3	5,100	54.7
		.591	.0041	7,400	102.4	7,400	93.3	5,400	61.4	4,400	55.5	4,000	42.9
		.787	.0039	6,100	84.6	6,100	76.8	4,400	50.0	3,600	45.3	3,300	35.4
		.984	.0037	5,200	72.0	5,200	65.4	3,800	42.9	3,100	39.0	2,800	29.9
	.012	.394	.0065	9,300	128.7	9,300	117.3	6,800	77.2	5,500	69.3	5,100	54.7
		.591	.0055	7,400	102.4	7,400	93.3	5,400	61.4	4,400	55.5	4,000	42.9
		.787	.0052	6,100	84.6	6,100	76.8	4,400	50.0	3,600	45.3	3,300	35.4
		.984	.0051	5,200	72.0	5,200	65.4	3,800	42.9	3,100	39.0	2,800	29.9
	.020	.394	.0068	9,300	128.7	9,300	117.3	6,800	77.2	5,500	69.3	5,100	54.7
		.591	.0057	7,400	102.4	7,400	93.3	5,400	61.4	4,400	55.5	4,000	42.9
		.787	.0054	6,100	84.6	6,100	76.8	4,400	50.0	3,600	45.3	3,300	35.4
		.984	.0052	5,200	72.0	5,200	65.4	3,800	42.9	3,100	39.0	2,800	29.9

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 70.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.197	.039	**.394**	.0069	9,300	366.1	**9,300**	**117.3**	**6,800**	**77.2**	**5,500**	**69.3**	**5,100**	**54.7**
		.591	.0058	7,400	291.3	**7,400**	**93.3**	**5,400**	**61.4**	**4,400**	**55.5**	**4,000**	**42.9**
		.787	.0055	6,100	240.2	**6,100**	**76.8**	**4,400**	**50.0**	**3,600**	**45.3**	**3,300**	**35.4**
		.984	.0053	5,200	204.7	**5,200**	**65.4**	**3,800**	**42.9**	**3,100**	**39.0**	**2,800**	**29.9**
.236	.004	**.472**	.0039	8,300	326.8	**8,300**	**117.7**	**6,100**	**78.0**	**4,900**	**69.3**	**4,500**	**54.3**
		.709	.0035	6,500	255.9	**6,500**	**92.1**	**4,700**	**59.8**	**3,800**	**53.9**	**3,500**	**42.1**
		.945	.0032	5,300	208.7	**5,300**	**75.2**	**3,900**	**49.6**	**3,100**	**44.1**	**2,900**	**35.0**
		1.181	.0031	4,500	177.2	**4,500**	**63.8**	**3,300**	**42.1**	**2,700**	**38.2**	**2,400**	**28.7**
	.008	**.472**	.0070	8,300	326.8	**8,300**	**117.7**	**6,100**	**78.0**	**4,900**	**69.3**	**4,500**	**54.3**
		.709	.0062	6,500	255.9	**6,500**	**92.1**	**4,700**	**59.8**	**3,800**	**53.9**	**3,500**	**42.1**
		.945	.0058	5,300	208.7	**5,300**	**75.2**	**3,900**	**49.6**	**3,100**	**44.1**	**2,900**	**35.0**
		1.181	.0056	4,500	177.2	**4,500**	**63.8**	**3,300**	**42.1**	**2,700**	**38.2**	**2,400**	**28.7**
	.012	**.472**	.0074	8,300	326.8	**8,300**	**117.7**	**6,100**	**78.0**	**4,900**	**69.3**	**4,500**	**54.3**
		.709	.0065	6,500	255.9	**6,500**	**92.1**	**4,700**	**59.8**	**3,800**	**53.9**	**3,500**	**42.1**
		.945	.0061	5,300	208.7	**5,300**	**75.2**	**3,900**	**49.6**	**3,100**	**44.1**	**2,900**	**35.0**
		1.181	.0059	4,500	177.2	**4,500**	**63.8**	**3,300**	**42.1**	**2,700**	**38.2**	**2,400**	**28.7**
	.020	**.472**	.0076	8,300	326.8	**8,300**	**117.7**	**6,100**	**78.0**	**4,900**	**69.3**	**4,500**	**54.3**
		.709	.0068	6,500	255.9	**6,500**	**92.1**	**4,700**	**59.8**	**3,800**	**53.9**	**3,500**	**42.1**
		.945	.0063	5,300	208.7	**5,300**	**75.2**	**3,900**	**49.6**	**3,100**	**44.1**	**2,900**	**35.0**
		1.181	.0061	4,500	177.2	**4,500**	**63.8**	**3,300**	**42.1**	**2,700**	**38.2**	**2,400**	**28.7**
	.039	**.472**	.0078	8,300	326.8	**8,300**	**117.7**	**6,100**	**78.0**	**4,900**	**69.3**	**4,500**	**54.3**
		.709	.0069	6,500	255.9	**6,500**	**92.1**	**4,700**	**59.8**	**3,800**	**53.9**	**3,500**	**42.1**
		.945	.0065	5,300	208.7	**5,300**	**75.2**	**3,900**	**49.6**	**3,100**	**44.1**	**2,900**	**35.0**
		1.181	.0062	4,500	177.2	**4,500**	**63.8**	**3,300**	**42.1**	**2,700**	**38.2**	**2,400**	**28.7**

(1) a_p indicates guidelines for Group 2 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH4010-2-02-TH3 tool:
Cutting depth = .0019 inch (0.047mm) (a_p) × 1 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = .0015 inch (0.0376mm)

【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

Recommended Cutting Conditions (Inch)

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 65.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.039	.001	.059	.0006	32,300	111.8	32,300	101.6	23,500	66.5	19,100	60.2	17,600	47.2
		.079	.0005	29,100	100.8	29,100	91.3	21,200	60.2	17,200	54.3	15,900	42.5
		.098	.0005	26,400	91.3	26,400	83.1	19,200	54.3	15,600	49.2	14,400	38.6
		.118	.0005	24,200	83.9	24,200	76.4	17,600	50.0	14,300	45.3	13,200	35.4
		.157	.0004	20,800	72.0	20,800	65.4	15,100	42.9	12,300	38.6	11,300	29.9
		.197	.0004	18,200	63.0	18,200	57.1	13,200	37.4	10,700	33.5	9,900	26.4
		.236	.0002	16,200	56.3	16,200	50.8	11,700	33.5	9,500	29.9	8,800	23.6
		.315	.0001	13,200	45.7	13,200	41.7	9,600	27.6	7,800	24.4	7,200	19.3
	.002	.059	.0015	32,300	111.8	32,300	101.6	23,500	66.5	19,100	60.2	17,600	47.2
		.079	.0011	29,100	100.8	29,100	91.3	21,200	60.2	17,200	54.3	15,900	42.5
		.098	.0011	26,400	91.3	26,400	83.1	19,200	54.3	15,600	49.2	14,400	38.6
		.118	.0010	24,200	83.9	24,200	76.4	17,600	50.0	14,300	45.3	13,200	35.4
		.157	.0009	20,800	72.0	20,800	65.4	15,100	42.9	12,300	38.6	11,300	29.9
		.197	.0009	18,200	63.0	18,200	57.1	13,200	37.4	10,700	33.5	9,900	26.4
		.236	.0005	16,200	56.3	16,200	50.8	11,700	33.5	9,500	29.9	8,800	23.6
		.315	.0003	13,200	45.7	13,200	41.7	9,600	27.6	7,800	24.4	7,200	19.3
	.004	.059	.0018	32,300	111.8	32,300	101.6	23,500	66.5	19,100	60.2	17,600	47.2
		.079	.0014	29,100	100.8	29,100	91.3	21,200	60.2	17,200	54.3	15,900	42.5
		.098	.0013	26,400	91.3	26,400	83.1	19,200	54.3	15,600	49.2	14,400	38.6
		.118	.0012	24,200	83.9	24,200	76.4	17,600	50.0	14,300	45.3	13,200	35.4
		.157	.0011	20,800	72.0	20,800	65.4	15,100	42.9	12,300	38.6	11,300	29.9
		.197	.0011	18,200	63.0	18,200	57.1	13,200	37.4	10,700	33.5	9,900	26.4
		.236	.0006	16,200	56.3	16,200	50.8	11,700	33.5	9,500	29.9	8,800	23.6
		.315	.0004	13,200	45.7	13,200	41.7	9,600	27.6	7,800	24.4	7,200	19.3
	.008	.059	.0020	32,300	111.8	32,300	101.6	23,500	66.5	19,100	60.2	17,600	47.2
		.079	.0015	29,100	100.8	29,100	91.3	21,200	60.2	17,200	54.3	15,900	42.5
		.098	.0015	26,400	91.3	26,400	83.1	19,200	54.3	15,600	49.2	14,400	38.6
		.118	.0014	24,200	83.9	24,200	76.4	17,600	50.0	14,300	45.3	13,200	35.4
		.157	.0013	20,800	72.0	20,800	65.4	15,100	42.9	12,300	38.6	11,300	29.9
		.197	.0012	18,200	63.0	18,200	57.1	13,200	37.4	10,700	33.5	9,900	26.4
		.236	.0007	16,200	56.3	16,200	50.8	11,700	33.5	9,500	29.9	8,800	23.6
		.315	.0004	13,200	45.7	13,200	41.7	9,600	27.6	7,800	24.4	7,200	19.3
	.012	.059	.0023	32,300	111.8	32,300	101.6	23,500	66.5	19,100	60.2	17,600	47.2
		.079	.0017	29,100	100.8	29,100	91.3	21,200	60.2	17,200	54.3	15,900	42.5
		.098	.0017	26,400	91.3	26,400	83.1	19,200	54.3	15,600	49.2	14,400	38.6
		.118	.0015	24,200	83.9	24,200	76.4	17,600	50.0	14,300	45.3	13,200	35.4
		.157	.0014	20,800	72.0	20,800	65.4	15,100	42.9	12,300	38.6	11,300	29.9
		.197	.0014	18,200	63.0	18,200	57.1	13,200	37.4	10,700	33.5	9,900	26.4
		.236	.0007	16,200	56.3	16,200	50.8	11,700	33.5	9,500	29.9	8,800	23.6
		.315	.0004	13,200	45.7	13,200	41.7	9,600	27.6	7,800	24.4	7,200	19.3
.059	.001	.079	.0006	22,300	108.3	22,300	98.4	16,300	64.6	13,200	58.3	12,200	45.7
		.118	.0005	19,300	93.7	19,300	85.4	14,100	55.9	11,500	50.8	10,500	39.4
		.157	.0005	17,100	83.1	17,100	75.6	12,500	49.2	10,100	44.9	9,300	35.0
		.197	.0004	15,300	74.0	15,300	67.3	11,100	44.1	9,000	39.8	8,400	31.5
		.236	.0004	13,900	67.3	13,900	61.0	10,000	39.8	8,200	36.2	7,600	28.3
		.315	.0003	12,600	61.0	12,600	55.5	9,200	36.6	7,500	33.1	6,900	26.0
		.394	.0003	11,600	56.3	11,600	51.2	8,500	33.5	6,900	30.3	6,300	23.6
		.472	.0002	10,000	48.8	10,000	44.5	7,300	29.1	5,900	26.0	5,500	20.5
	.002	.079	.0016	22,300	108.3	22,300	98.4	16,300	64.6	13,200	58.3	12,200	45.7
		.118	.0014	19,300	93.7	19,300	85.4	14,100	55.9	11,500	50.8	10,500	39.4
		.157	.0013	17,100	83.1	17,100	75.6	12,500	49.2	10,100	44.9	9,300	35.0
		.197	.0011	15,300	74.0	15,300	67.3	11,100	44.1	9,000	39.8	8,400	31.5
		.236	.0010	13,900	67.3	13,900	61.0	10,000	39.8	8,200	36.2	7,600	28.3
		.315	.0009	12,600	61.0	12,600	55.5	9,200	36.6	7,500	33.1	6,900	26.0
		.394	.0007	11,600	56.3	11,600	51.2	8,500	33.5	6,900	30.3	6,300	23.6
		.472	.0005	10,000	48.8	10,000	44.5	7,300	29.1	5,900	26.0	5,500	20.5
	.004	.079	.0026	22,300	108.3	22,300	98.4	16,300	64.6	13,200	58.3	12,200	45.7
		.118	.0023	19,300	93.7	19,300	85.4	14,100	55.9	11,500	50.8	10,500	39.4
		.157	.0021	17,100	83.1	17,100	75.6	12,500	49.2	10,100	44.9	9,300	35.0
		.197	.0019	15,300	74.0	15,300	67.3	11,100	44.1	9,000	39.8	8,400	31.5

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 65.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.059	.004	.236	.0017	13,900	67.3	13,900	61.0	10,000	39.8	8,200	36.2	7,600	28.3
		.315	.0015	12,600	61.0	12,600	55.5	9,200	36.6	7,500	33.1	6,900	26.0
		.394	.0011	11,600	56.3	11,600	51.2	8,500	33.5	6,900	30.3	6,300	23.6
		.472	.0008	10,000	48.8	10,000	44.5	7,300	29.1	5,900	26.0	5,500	20.5
	.008	.079	.0027	22,300	108.3	22,300	98.4	16,300	64.6	13,200	58.3	12,200	45.7
		.118	.0024	19,300	93.7	19,300	85.4	14,100	55.9	11,500	50.8	10,500	39.4
		.157	.0022	17,100	83.1	17,100	75.6	12,500	49.2	10,100	44.9	9,300	35.0
		.197	.0020	15,300	74.0	15,300	67.3	11,100	44.1	9,000	39.8	8,400	31.5
		.236	.0018	13,900	67.3	13,900	61.0	10,000	39.8	8,200	36.2	7,600	28.3
		.315	.0015	12,600	61.0	12,600	55.5	9,200	36.6	7,500	33.1	6,900	26.0
		.394	.0012	11,600	56.3	11,600	51.2	8,500	33.5	6,900	30.3	6,300	23.6
		.472	.0008	10,000	48.8	10,000	44.5	7,300	29.1	5,900	26.0	5,500	20.5
	.012	.079	.0028	22,300	108.3	22,300	98.4	16,300	64.6	13,200	58.3	12,200	45.7
		.118	.0025	19,300	93.7	19,300	85.4	14,100	55.9	11,500	50.8	10,500	39.4
		.157	.0023	17,100	83.1	17,100	75.6	12,500	49.2	10,100	44.9	9,300	35.0
		.197	.0020	15,300	74.0	15,300	67.3	11,100	44.1	9,000	39.8	8,400	31.5
		.236	.0019	13,900	67.3	13,900	61.0	10,000	39.8	8,200	36.2	7,600	28.3
		.315	.0016	12,600	61.0	12,600	55.5	9,200	36.6	7,500	33.1	6,900	26.0
		.394	.0013	11,600	56.3	11,600	51.2	8,500	33.5	6,900	30.3	6,300	23.6
		.472	.0008	10,000	48.8	10,000	44.5	7,300	29.1	5,900	26.0	5,500	20.5
	.020	.079	.0028	22,300	108.3	22,300	98.4	16,300	64.6	13,200	58.3	12,200	45.7
		.118	.0026	19,300	93.7	19,300	85.4	14,100	55.9	11,500	50.8	10,500	39.4
		.157	.0023	17,100	83.1	17,100	75.6	12,500	49.2	10,100	44.9	9,300	35.0
		.197	.0020	15,300	74.0	15,300	67.3	11,100	44.1	9,000	39.8	8,400	31.5
		.236	.0019	13,900	67.3	13,900	61.0	10,000	39.8	8,200	36.2	7,600	28.3
		.315	.0016	12,600	61.0	12,600	55.5	9,200	36.6	7,500	33.1	6,900	26.0
		.394	.0013	11,600	56.3	11,600	51.2	8,500	33.5	6,900	30.3	6,300	23.6
		.472	.0009	10,000	48.8	10,000	44.5	7,300	29.1	5,900	26.0	5,500	20.5
.079	.001	.098	.0006	17,100	118.5	17,100	107.9	12,500	70.5	10,100	63.8	9,300	49.6
		.118	.0006	16,200	112.2	16,200	102.0	11,700	66.1	9,500	60.2	8,800	47.2
		.157	.0005	14,500	100.8	14,500	91.3	10,500	59.8	8,500	53.9	7,900	42.1
		.197	.0004	13,200	91.3	13,200	83.1	9,600	54.7	7,800	49.2	7,200	38.6
		.236	.0004	12,100	83.9	12,100	76.4	8,800	50.0	7,100	45.3	6,600	35.4
		.315	.0004	10,400	72.0	10,400	65.4	7,600	42.9	6,100	38.6	5,600	29.9
		.394	.0004	9,000	62.6	9,000	56.7	6,600	37.4	5,400	33.9	5,000	26.8
		.472	.0003	8,100	55.9	8,100	50.8	5,900	33.5	4,700	29.9	4,400	23.6
	.002	.098	.0016	17,100	118.5	17,100	107.9	12,500	70.5	10,100	63.8	9,300	49.6
		.118	.0014	16,200	112.2	16,200	102.0	11,700	66.1	9,500	60.2	8,800	47.2
		.157	.0012	14,500	100.8	14,500	91.3	10,500	59.8	8,500	53.9	7,900	42.1
		.197	.0012	13,200	91.3	13,200	83.1	9,600	54.7	7,800	49.2	7,200	38.6
		.236	.0011	12,100	83.9	12,100	76.4	8,800	50.0	7,100	45.3	6,600	35.4
		.315	.0011	10,400	72.0	10,400	65.4	7,600	42.9	6,100	38.6	5,600	29.9
		.394	.0010	9,000	62.6	9,000	56.7	6,600	37.4	5,400	33.9	5,000	26.8
		.472	.0008	8,100	55.9	8,100	50.8	5,900	33.5	4,700	29.9	4,400	23.6
	.004	.098	.0027	17,100	118.5	17,100	107.9	12,500	70.5	10,100	63.8	9,300	49.6
		.118	.0024	16,200	112.2	16,200	102.0	11,700	66.1	9,500	60.2	8,800	47.2
		.157	.0020	14,500	100.8	14,500	91.3	10,500	59.8	8,500	53.9	7,900	42.1
		.197	.0020	13,200	91.3	13,200	83.1	9,600	54.7	7,800	49.2	7,200	38.6
		.236	.0019	12,100	83.9	12,100	76.4	8,800	50.0	7,100	45.3	6,600	35.4
		.315	.0019	10,400	72.0	10,400	65.4	7,600	42.9	6,100	38.6	5,600	29.9
		.394	.0018	9,000	62.6	9,000	56.7	6,600	37.4	5,400	33.9	5,000	26.8
		.472	.0013	8,100	55.9	8,100	50.8	5,900	33.5	4,700	29.9	4,400	23.6
	.008	.098	.0030	17,100	118.5	17,100	107.9	12,500	70.5	10,100	63.8	9,300	49.6
		.118	.0027	16,200	112.2	16,200	102.0	11,700	66.1	9,500	60.2	8,800	47.2
		.157	.0023	14,500	100.8	14,500	91.3	10,500	59.8	8,500	53.9	7,900	42.1
		.197	.0022	13,200	91.3	13,200	83.1	9,600	54.7	7,800	49.2	7,200	38.6
		.236	.0022	12,100	83.9	12,100	76.4	8,800	50.0	7,100	45.3	6,600	35.4
		.315	.0021	10,400	72.0	10,400	65.4	7,600	42.9	6,100	38.6	5,600	29.9
		.394	.0020	9,000	62.6	9,000	56.7	6,600	37.4	5,400	33.9	5,000	26.8
		.472	.0015	8,100	55.9	8,100	50.8	5,900	33.5	4,700	29.9	4,400	23.6

【Note】 Refer to the comments and notes below the table on page 74 regarding usage.

Recommended Cutting Conditions (Inch)

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 65.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.079	.012	.098	.0032	17,100	118.5	17,100	107.9	12,500	70.5	10,100	63.8	9,300	49.6
		.118	.0028	16,200	112.2	16,200	102.0	11,700	66.1	9,500	60.2	8,800	47.2
		.157	.0024	14,500	100.8	14,500	91.3	10,500	59.8	8,500	53.9	7,900	42.1
		.197	.0024	13,200	91.3	13,200	83.1	9,600	54.7	7,800	49.2	7,200	38.6
		.236	.0023	12,100	83.9	12,100	76.4	8,800	50.0	7,100	45.3	6,600	35.4
		.315	.0022	10,400	72.0	10,400	65.4	7,600	42.9	6,100	38.6	5,600	29.9
		.394	.0021	9,000	62.6	9,000	56.7	6,600	37.4	5,400	33.9	5,000	26.8
		.472	.0016	8,100	55.9	8,100	50.8	5,900	33.5	4,700	29.9	4,400	23.6
	.020	.098	.0033	17,100	118.5	17,100	107.9	12,500	70.5	10,100	63.8	9,300	49.6
		.118	.0030	16,200	112.2	16,200	102.0	11,700	66.1	9,500	60.2	8,800	47.2
		.157	.0026	14,500	100.8	14,500	91.3	10,500	59.8	8,500	53.9	7,900	42.1
		.197	.0025	13,200	91.3	13,200	83.1	9,600	54.7	7,800	49.2	7,200	38.6
		.236	.0024	12,100	83.9	12,100	76.4	8,800	50.0	7,100	45.3	6,600	35.4
		.315	.0024	10,400	72.0	10,400	65.4	7,600	42.9	6,100	38.6	5,600	29.9
		.394	.0022	9,000	62.6	9,000	56.7	6,600	37.4	5,400	33.9	5,000	26.8
		.472	.0017	8,100	55.9	8,100	50.8	5,900	33.5	4,700	29.9	4,400	23.6
.118	.002	.157	.0015	15,400	96.5	15,400	87.4	11,200	57.1	9,100	51.6	8,500	40.9
		.236	.0014	12,800	79.9	12,800	72.4	9,300	47.2	7,600	42.9	7,000	33.5
		.315	.0014	10,900	68.1	10,900	61.8	7,900	40.2	6,400	36.2	5,900	28.3
		.394	.0013	9,500	59.1	9,500	53.5	6,900	35.4	5,600	31.5	5,100	24.8
		.472	.0012	8,400	52.4	8,400	47.2	6,100	31.1	4,900	28.0	4,600	22.0
		.551	.0011	7,500	46.9	7,500	42.5	5,500	28.0	4,400	24.8	4,100	19.7
		.630	.0011	6,800	42.5	6,800	38.6	4,900	24.8	4,000	22.4	3,700	18.1
		.709	.0010	6,200	39.0	6,200	35.4	4,500	22.8	3,700	20.5	3,400	16.5
		.787	.0007	5,700	35.4	5,700	32.3	4,200	21.3	3,400	19.3	3,200	15.4
	.004	.157	.0030	15,400	96.5	15,400	87.4	11,200	57.1	9,100	51.6	8,500	40.9
		.236	.0028	12,800	79.9	12,800	72.4	9,300	47.2	7,600	42.9	7,000	33.5
		.315	.0028	10,900	68.1	10,900	61.8	7,900	40.2	6,400	36.2	5,900	28.3
		.394	.0027	9,500	59.1	9,500	53.5	6,900	35.4	5,600	31.5	5,100	24.8
		.472	.0025	8,400	52.4	8,400	47.2	6,100	31.1	4,900	28.0	4,600	22.0
		.551	.0023	7,500	46.9	7,500	42.5	5,500	28.0	4,400	24.8	4,100	19.7
		.630	.0022	6,800	42.5	6,800	38.6	4,900	24.8	4,000	22.4	3,700	18.1
		.709	.0020	6,200	39.0	6,200	35.4	4,500	22.8	3,700	20.5	3,400	16.5
		.787	.0015	5,700	35.4	5,700	32.3	4,200	21.3	3,400	19.3	3,200	15.4
	.008	.157	.0033	15,400	96.5	15,400	87.4	11,200	57.1	9,100	51.6	8,500	40.9
		.236	.0032	12,800	79.9	12,800	72.4	9,300	47.2	7,600	42.9	7,000	33.5
		.315	.0031	10,900	68.1	10,900	61.8	7,900	40.2	6,400	36.2	5,900	28.3
		.394	.0030	9,500	59.1	9,500	53.5	6,900	35.4	5,600	31.5	5,100	24.8
		.472	.0028	8,400	52.4	8,400	47.2	6,100	31.1	4,900	28.0	4,600	22.0
		.551	.0026	7,500	46.9	7,500	42.5	5,500	28.0	4,400	24.8	4,100	19.7
		.630	.0025	6,800	42.5	6,800	38.6	4,900	24.8	4,000	22.4	3,700	18.1
		.709	.0022	6,200	39.0	6,200	35.4	4,500	22.8	3,700	20.5	3,400	16.5
		.787	.0016	5,700	35.4	5,700	32.3	4,200	21.3	3,400	19.3	3,200	15.4
	.012	.157	.0035	15,400	96.5	15,400	87.4	11,200	57.1	9,100	51.6	8,500	40.9
		.236	.0034	12,800	79.9	12,800	72.4	9,300	47.2	7,600	42.9	7,000	33.5
		.315	.0033	10,900	68.1	10,900	61.8	7,900	40.2	6,400	36.2	5,900	28.3
		.394	.0031	9,500	59.1	9,500	53.5	6,900	35.4	5,600	31.5	5,100	24.8
		.472	.0029	8,400	52.4	8,400	47.2	6,100	31.1	4,900	28.0	4,600	22.0
		.551	.0027	7,500	46.9	7,500	42.5	5,500	28.0	4,400	24.8	4,100	19.7
		.630	.0026	6,800	42.5	6,800	38.6	4,900	24.8	4,000	22.4	3,700	18.1
		.709	.0024	6,200	39.0	6,200	35.4	4,500	22.8	3,700	20.5	3,400	16.5
		.787	.0017	5,700	35.4	5,700	32.3	4,200	21.3	3,400	19.3	3,200	15.4
	.020	.157	.0037	15,400	96.5	15,400	87.4	11,200	57.1	9,100	51.6	8,500	40.9
		.236	.0035	12,800	79.9	12,800	72.4	9,300	47.2	7,600	42.9	7,000	33.5
		.315	.0035	10,900	68.1	10,900	61.8	7,900	40.2	6,400	36.2	5,900	28.3
		.394	.0033	9,500	59.1	9,500	53.5	6,900	35.4	5,600	31.5	5,100	24.8
		.472	.0031	8,400	52.4	8,400	47.2	6,100	31.1	4,900	28.0	4,600	22.0
		.551	.0028	7,500	46.9	7,500	42.5	5,500	28.0	4,400	24.8	4,100	19.7
		.630	.0028	6,800	42.5	6,800	38.6	4,900	24.8	4,000	22.4	3,700	18.1
		.709	.0025	6,200	39.0	6,200	35.4	4,500	22.8	3,700	20.5	3,400	16.5
		.787	.0018	5,700	35.4	5,700	32.3	4,200	21.3	3,400	19.3	3,200	15.4

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 65.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.157	.004	.315	.0030	8,600	89.8	8,600	338.6	6,300	53.5	5,100	48.8	4,700	37.8
		.394	.0029	7,700	80.3	7,700	303.1	5,600	48.0	4,600	43.3	4,200	33.9
		.472	.0028	7,000	72.4	7,000	275.6	5,100	43.3	4,200	39.4	3,800	30.7
		.551	.0026	6,400	66.1	6,400	252.0	4,600	39.4	3,700	35.4	3,500	28.0
		.630	.0025	5,900	61.0	5,900	232.3	4,200	35.8	3,500	33.1	3,200	26.0
		.709	.0024	5,400	56.3	5,400	212.6	4,000	33.9	3,200	30.7	3,000	24.0
		.787	.0023	5,100	52.8	5,100	200.8	3,700	31.1	3,000	28.0	2,700	22.0
		.866	.0019	4,700	49.2	4,700	185.0	3,400	29.1	2,800	26.8	2,600	20.5
		.945	.0018	4,400	45.7	4,400	173.2	3,200	27.6	2,700	25.2	2,400	19.3
	.008	.315	.0041	8,600	89.8	8,600	338.6	6,300	53.5	5,100	48.8	4,700	37.8
		.394	.0040	7,700	80.3	7,700	303.1	5,600	48.0	4,600	43.3	4,200	33.9
		.472	.0038	7,000	72.4	7,000	275.6	5,100	43.3	4,200	39.4	3,800	30.7
		.551	.0035	6,400	66.1	6,400	252.0	4,600	39.4	3,700	35.4	3,500	28.0
		.630	.0034	5,900	61.0	5,900	232.3	4,200	35.8	3,500	33.1	3,200	26.0
		.709	.0033	5,400	56.3	5,400	212.6	4,000	33.9	3,200	30.7	3,000	24.0
		.787	.0031	5,100	52.8	5,100	200.8	3,700	31.1	3,000	28.0	2,700	22.0
		.866	.0026	4,700	49.2	4,700	185.0	3,400	29.1	2,800	26.8	2,600	20.5
		.945	.0025	4,400	45.7	4,400	173.2	3,200	27.6	2,700	25.2	2,400	19.3
	.012	.315	.0043	8,600	89.8	8,600	338.6	6,300	53.5	5,100	48.8	4,700	37.8
		.394	.0042	7,700	80.3	7,700	303.1	5,600	48.0	4,600	43.3	4,200	33.9
		.472	.0040	7,000	72.4	7,000	275.6	5,100	43.3	4,200	39.4	3,800	30.7
		.551	.0037	6,400	66.1	6,400	252.0	4,600	39.4	3,700	35.4	3,500	28.0
		.630	.0036	5,900	61.0	5,900	232.3	4,200	35.8	3,500	33.1	3,200	26.0
		.709	.0035	5,400	56.3	5,400	212.6	4,000	33.9	3,200	30.7	3,000	24.0
		.787	.0033	5,100	52.8	5,100	200.8	3,700	31.1	3,000	28.0	2,700	22.0
		.866	.0028	4,700	49.2	4,700	185.0	3,400	29.1	2,800	26.8	2,600	20.5
		.945	.0026	4,400	45.7	4,400	173.2	3,200	27.6	2,700	25.2	2,400	19.3
	.020	.315	.0045	8,600	89.8	8,600	338.6	6,300	53.5	5,100	48.8	4,700	37.8
		.394	.0044	7,700	80.3	7,700	303.1	5,600	48.0	4,600	43.3	4,200	33.9
		.472	.0041	7,000	72.4	7,000	275.6	5,100	43.3	4,200	39.4	3,800	30.7
		.551	.0039	6,400	66.1	6,400	252.0	4,600	39.4	3,700	35.4	3,500	28.0
		.630	.0037	5,900	61.0	5,900	232.3	4,200	35.8	3,500	33.1	3,200	26.0
		.709	.0036	5,400	56.3	5,400	212.6	4,000	33.9	3,200	30.7	3,000	24.0
		.787	.0035	5,100	52.8	5,100	200.8	3,700	31.1	3,000	28.0	2,700	22.0
		.866	.0029	4,700	49.2	4,700	185.0	3,400	29.1	2,800	26.8	2,600	20.5
		.945	.0027	4,400	45.7	4,400	173.2	3,200	27.6	2,700	25.2	2,400	19.3
	.039	.315	.0046	8,600	89.8	8,600	338.6	6,300	53.5	5,100	48.8	4,700	37.8
		.394	.0044	7,700	80.3	7,700	303.1	5,600	48.0	4,600	43.3	4,200	33.9
		.472	.0043	7,000	72.4	7,000	275.6	5,100	43.3	4,200	39.4	3,800	30.7
		.551	.0039	6,400	66.1	6,400	252.0	4,600	39.4	3,700	35.4	3,500	28.0
		.630	.0038	5,900	61.0	5,900	232.3	4,200	35.8	3,500	33.1	3,200	26.0
		.709	.0037	5,400	56.3	5,400	212.6	4,000	33.9	3,200	30.7	3,000	24.0
		.787	.0035	5,100	52.8	5,100	200.8	3,700	31.1	3,000	28.0	2,700	22.0
		.866	.0030	4,700	49.2	4,700	185.0	3,400	29.1	2,800	26.8	2,600	20.5
		.945	.0028	4,400	45.7	4,400	173.2	3,200	27.6	2,700	25.2	2,400	19.3
.197	.004	.394	.0031	7,700	106.7	7,700	303.1	5,600	64.2	4,600	57.5	4,200	45.3
		.591	.0026	6,100	85.0	6,100	240.2	4,500	50.8	3,700	46.1	3,300	35.4
		.787	.0025	5,100	70.1	5,100	200.8	3,700	41.3	3,000	37.4	2,700	29.5
		.984	.0024	4,300	59.8	4,300	169.3	3,200	35.4	2,600	32.3	2,300	24.8
	.008	.394	.0040	7,700	106.7	7,700	303.1	5,600	64.2	4,600	57.5	4,200	45.3
		.591	.0034	6,100	85.0	6,100	240.2	4,500	50.8	3,700	46.1	3,300	35.4
		.787	.0032	5,100	70.1	5,100	200.8	3,700	41.3	3,000	37.4	2,700	29.5
		.984	.0031	4,300	59.8	4,300	169.3	3,200	35.4	2,600	32.3	2,300	24.8
	.012	.394	.0054	7,700	106.7	7,700	303.1	5,600	64.2	4,600	57.5	4,200	45.3
		.591	.0046	6,100	85.0	6,100	240.2	4,500	50.8	3,700	46.1	3,300	35.4
		.787	.0043	5,100	70.1	5,100	200.8	3,700	41.3	3,000	37.4	2,700	29.5
		.984	.0042	4,300	59.8	4,300	169.3	3,200	35.4	2,600	32.3	2,300	24.8
	.020	.394	.0056	7,700	106.7	7,700	303.1	5,600	64.2	4,600	57.5	4,200	45.3
		.591	.0047	6,100	85.0	6,100	240.2	4,500	50.8	3,700	46.1	3,300	35.4
		.787	.0045	5,100	70.1	5,100	200.8	3,700	41.3	3,000	37.4	2,700	29.5
		.984	.0043	4,300	59.8	4,300	169.3	3,200	35.4	2,600	32.3	2,300	24.8

【Note】 Refer to the comments and notes below the table on page 74 regarding usage.

Recommended Cutting Conditions (Inch)

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 65.

Work material				1 Pre-hardened Steel (35～45HRC)		2 **Hardened Steel (45～55HRC)**		3 **Hardened Steel (55～60HRC)**		4 **Hardened Steel (60～65HRC)**		5 **Hardened Steel (65～72HRC)**	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (inch)	Corner radius RE (inch)	Under neck length (inch)	a_p (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
.197	**.039**	**.394**	.0057	7,700	106.7	**7,700**	**97.2**	**5,600**	**64.2**	**4,600**	**57.5**	**4,200**	**45.3**
		.591	.0048	6,100	85.0	**6,100**	**77.6**	**4,500**	**50.8**	**3,700**	**46.1**	**3,300**	**35.4**
		.787	.0046	5,100	70.1	**5,100**	**63.8**	**3,700**	**41.3**	**3,000**	**37.4**	**2,700**	**29.5**
		.984	.0044	4,300	59.8	**4,300**	**54.3**	**3,200**	**35.4**	**2,600**	**32.3**	**2,300**	**24.8**
.236	**.004**	**.472**	.0032	6,900	107.5	**6,900**	**97.6**	**5,100**	**64.6**	**4,100**	**57.5**	**3,700**	**45.3**
		.709	.0029	5,400	83.9	**5,400**	**76.4**	**3,900**	**49.6**	**3,200**	**44.9**	**2,900**	**35.0**
		.945	.0027	4,400	68.5	**4,400**	**62.6**	**3,200**	**41.3**	**2,600**	**36.6**	**2,400**	**29.1**
		1.181	.0026	3,700	58.3	**3,700**	**52.8**	**2,700**	**35.0**	**2,200**	**31.9**	**2,000**	**24.0**
	.008	**.472**	.0058	6,900	107.5	**6,900**	**97.6**	**5,100**	**64.6**	**4,100**	**57.5**	**3,700**	**45.3**
		.709	.0052	5,400	83.9	**5,400**	**76.4**	**3,900**	**49.6**	**3,200**	**44.9**	**2,900**	**35.0**
		.945	.0048	4,400	68.5	**4,400**	**62.6**	**3,200**	**41.3**	**2,600**	**36.6**	**2,400**	**29.1**
		1.181	.0046	3,700	58.3	**3,700**	**52.8**	**2,700**	**35.0**	**2,200**	**31.9**	**2,000**	**24.0**
	.012	**.472**	.0061	6,900	107.5	**6,900**	**97.6**	**5,100**	**64.6**	**4,100**	**57.5**	**3,700**	**45.3**
		.709	.0054	5,400	83.9	**5,400**	**76.4**	**3,900**	**49.6**	**3,200**	**44.9**	**2,900**	**35.0**
		.945	.0051	4,400	68.5	**4,400**	**62.6**	**3,200**	**41.3**	**2,600**	**36.6**	**2,400**	**29.1**
		1.181	.0049	3,700	58.3	**3,700**	**52.8**	**2,700**	**35.0**	**2,200**	**31.9**	**2,000**	**24.0**
	.020	**.472**	.0063	6,900	107.5	**6,900**	**97.6**	**5,100**	**64.6**	**4,100**	**57.5**	**3,700**	**45.3**
		.709	.0056	5,400	83.9	**5,400**	**76.4**	**3,900**	**49.6**	**3,200**	**44.9**	**2,900**	**35.0**
		.945	.0052	4,400	68.5	**4,400**	**62.6**	**3,200**	**41.3**	**2,600**	**36.6**	**2,400**	**29.1**
		1.181	.0050	3,700	58.3	**3,700**	**52.8**	**2,700**	**35.0**	**2,200**	**31.9**	**2,000**	**24.0**
	.039	**.472**	.0064	6,900	107.5	**6,900**	**97.6**	**5,100**	**64.6**	**4,100**	**57.5**	**3,700**	**45.3**
		.709	.0057	5,400	83.9	**5,400**	**76.4**	**3,900**	**49.6**	**3,200**	**44.9**	**2,900**	**35.0**
		.945	.0054	4,400	68.5	**4,400**	**62.6**	**3,200**	**41.3**	**2,600**	**36.6**	**2,400**	**29.1**
		1.181	.0052	3,700	58.3	**3,700**	**52.8**	**2,700**	**35.0**	**2,200**	**31.9**	**2,000**	**24.0**

(1) a_p indicates guidelines for Group 2 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH4010-2-02-TH3 tool:
Cutting depth = .0015 inch (0.039mm) (a_p) × 1 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = .0012 inch (0.0312mm)

【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

Recommended Cutting Conditions (Metric)

2 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 77.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～65HRC)		4 Hardened Steel (65～68HRC)		5 Hardened Steel (68～72HRC)	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
0.2	0.02	0.5	0.016	42,500	710	37,500	550	35,000	450	31,500	410	31,880	320
		1	0.011	42,500	710	37,500	550	35,000	450	31,500	410	31,880	320
	0.05	0.5	0.020	42,500	710	37,500	550	35,000	450	31,500	410	31,880	320
		1	0.014	42,500	710	37,500	550	35,000	450	31,500	410	31,880	320
0.3	0.02	1	0.016	40,800	730	36,000	550	33,600	440	30,240	400	30,600	310
		2	0.011	33,050	590	29,160	440	27,220	360	24,490	320	24,790	250
	0.05	1	0.021	40,800	730	36,000	550	33,600	440	30,240	400	30,600	310
		2	0.012	33,050	590	29,160	440	27,220	360	24,490	320	24,790	250
0.4	0.02	1	0.016	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		2	0.013	32,260	710	28,800	560	26,730	460	24,050	410	24,480	320
	0.05	1	0.025	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		2	0.016	32,260	710	28,800	560	26,730	460	24,050	410	24,480	320
	0.1	1	0.033	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		2	0.028	32,260	710	28,800	560	26,730	460	24,050	410	24,480	320
0.5	0.02	1	0.016	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		2	0.013	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		3	0.010	26,440	630	23,330	470	21,770	380	19,600	340	19,830	270
	0.05	1	0.030	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		2	0.023	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		3	0.017	26,440	630	23,330	470	21,770	380	19,600	340	19,830	270
	0.1	1	0.035	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		2	0.030	32,260	790	28,800	620	26,730	510	24,050	460	24,480	360
		3	0.020	26,440	630	23,330	470	21,770	380	19,600	340	19,830	270
0.6	0.02	2	0.016	32,260	990	28,800	770	26,730	640	24,050	570	24,480	440
		4	0.013	26,440	790	23,330	590	21,770	480	19,600	430	19,830	330
	0.05	2	0.028	32,260	990	28,800	770	26,730	640	24,050	570	24,480	440
		4	0.019	26,440	790	23,330	590	21,770	480	19,600	430	19,830	330
	0.1	2	0.035	32,260	990	28,800	770	26,730	640	24,050	570	24,480	440
		4	0.024	26,440	790	23,330	590	21,770	480	19,600	430	19,830	330
0.8	0.02	2	0.023	34,000	1,410	30,000	1,110	28,000	900	25,200	810	25,500	630
		4	0.016	34,000	1,130	30,000	890	28,000	720	25,200	650	25,500	510
	0.05	2	0.038	34,000	1,410	30,000	1,110	28,000	900	25,200	810	25,500	630
		4	0.026	34,000	1,130	30,000	890	28,000	720	25,200	650	25,500	510
	0.1	2	0.047	34,000	1,410	30,000	1,110	28,000	900	25,200	810	25,500	630
		4	0.032	34,000	1,130	30,000	890	28,000	720	25,200	650	25,500	510
	0.2	2	0.081	34,000	1,410	30,000	1,110	28,000	900	25,200	810	25,500	630
		4	0.056	34,000	1,130	30,000	890	28,000	720	25,200	650	25,500	510

【Note】 Refer to the comments and notes below the table on page 76 regarding usage.

Recommended Cutting Conditions (Metric)

2 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 77.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～65HRC)		4 Hardened Steel (65～68HRC)		5 Hardened Steel (68～72HRC)	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1	0.02	2	0.016	33,440	1,810	**29,620**	**1,420**	**27,710**	**1,160**	**24,940**	**1,050**	**25,170**	**810**
		4	0.013	30,600	1,650	**27,000**	**1,290**	**25,200**	**1,060**	**22,680**	**950**	**22,950**	**740**
		6	0.010	24,790	1,340	**21,870**	**1,050**	**20,410**	**860**	**18,370**	**770**	**18,590**	**600**
		8	0.008	22,030	1,190	**19,440**	**930**	**18,140**	**760**	**16,330**	**680**	**16,520**	**530**
	0.05	2	0.046	33,440	1,810	**29,620**	**1,420**	**27,710**	**1,160**	**24,940**	**1,050**	**25,170**	**810**
		4	0.027	30,600	1,650	**27,000**	**1,290**	**25,200**	**1,060**	**22,680**	**950**	**22,950**	**740**
		6	0.017	24,790	1,340	**21,870**	**1,050**	**20,410**	**860**	**18,370**	**770**	**18,590**	**600**
		8	0.016	22,030	1,190	**19,440**	**930**	**18,140**	**760**	**16,330**	**680**	**16,520**	**530**
	0.1	2	0.065	33,440	1,810	**29,620**	**1,420**	**27,710**	**1,160**	**24,940**	**1,050**	**25,170**	**810**
		4	0.038	30,600	1,650	**27,000**	**1,290**	**25,200**	**1,060**	**22,680**	**950**	**22,950**	**740**
		6	0.024	24,790	1,340	**21,870**	**1,050**	**20,410**	**860**	**18,370**	**770**	**18,590**	**600**
		8	0.024	22,030	1,190	**19,440**	**930**	**18,140**	**760**	**16,330**	**680**	**16,520**	**530**
	0.2	2	0.110	33,440	1,810	**29,620**	**1,420**	**27,710**	**1,160**	**24,940**	**1,050**	**25,170**	**810**
		4	0.070	30,600	1,650	**27,000**	**1,290**	**25,200**	**1,060**	**22,680**	**950**	**22,950**	**740**
		6	0.040	24,790	1,340	**21,870**	**1,050**	**20,410**	**860**	**18,370**	**770**	**18,590**	**600**
		8	0.040	22,030	1,190	**19,440**	**930**	**18,140**	**760**	**16,330**	**680**	**16,520**	**530**

(1) a_p indicates guidelines for Group 1 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH2010-2-02-TH3 tool:
Cutting depth = 0.11 (a_p) × 0.85 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = 0.075 mm

【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

2 Flutes

High efficiency cutting condition

High accuracy cutting condition

For detailed information on high-efficiency cutting conditions, refer to page 75.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～65HRC)		4 Hardened Steel (65～68HRC)		5 Hardened Steel (68～72HRC)	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	ap (mm)	Revolution n min-1	Feed rate vf mm/min	Revolution n min-1	Feed rate vf mm/min	Revolution n min-1	Feed rate vf mm/min	Revolution n min-1	Feed rate vf mm/min	Revolution n min-1	Feed rate vf mm/min
0.2	0.02	0.5	0.016	50,000	210	50,000	180	50,000	160	45,000	140	42,500	110
		1	0.011	50,000	210	50,000	180	50,000	160	45,000	140	42,500	110
	0.05	0.5	0.020	50,000	210	50,000	180	50,000	160	45,000	140	42,500	110
		1	0.014	50,000	210	50,000	180	50,000	160	45,000	140	42,500	110
0.3	0.02	1	0.016	50,000	460	50,000	340	50,000	320	45,000	290	42,500	220
		2	0.011	45,000	420	45,000	300	45,000	290	40,500	260	38,250	200
	0.05	1	0.021	50,000	460	50,000	340	50,000	320	45,000	290	42,500	220
		2	0.012	45,000	420	45,000	300	45,000	290	40,500	260	38,250	200
0.4	0.02	1	0.016	50,000	460	40,000	320	36,000	270	32,400	240	30,600	190
		2	0.013	45,000	410	36,000	290	34,000	240	30,600	220	28,900	170
	0.05	1	0.025	50,000	460	40,000	320	36,000	270	32,400	240	30,600	190
		2	0.016	45,000	410	36,000	290	34,000	240	30,600	220	28,900	170
	0.1	1	0.033	50,000	460	40,000	320	36,000	270	32,400	240	30,600	190
		2	0.028	45,000	410	36,000	290	34,000	240	30,600	220	28,900	170
0.5	0.02	1	0.016	40,000	460	30,000	380	28,000	320	25,200	280	23,800	220
		2	0.013	40,000	460	30,000	380	28,000	320	25,200	280	23,800	220
		3	0.010	36,000	410	27,000	320	24,500	260	22,050	230	20,830	180
	0.05	1	0.030	40,000	460	30,000	380	28,000	320	25,200	280	23,800	220
		2	0.023	40,000	460	30,000	380	28,000	320	25,200	280	23,800	220
		3	0.017	36,000	410	27,000	320	24,500	260	22,050	230	20,830	180
	0.1	1	0.035	40,000	460	30,000	380	28,000	320	25,200	280	23,800	220
		2	0.030	40,000	460	30,000	380	28,000	320	25,200	280	23,800	220
		3	0.020	36,000	410	27,000	320	24,500	260	22,050	230	20,830	180
0.6	0.02	2	0.016	37,830	600	28,200	390	23,000	320	20,700	290	19,550	220
		4	0.013	27,800	440	23,600	280	21,000	230	18,900	210	17,850	160
	0.05	2	0.028	37,830	600	28,200	390	23,000	320	20,700	290	19,550	220
		4	0.019	27,800	440	23,600	280	21,000	230	18,900	210	17,850	160
	0.1	2	0.035	37,830	600	28,200	390	23,000	320	20,700	290	19,550	220
		4	0.024	27,800	440	23,600	280	21,000	230	18,900	210	17,850	160
0.8	0.02	2	0.023	28,000	650	20,000	400	20,000	360	18,000	320	17,000	250
		4	0.016	28,000	520	20,000	320	20,000	290	18,000	260	17,000	200
	0.05	2	0.038	28,000	650	20,000	400	20,000	360	18,000	320	17,000	250
		4	0.026	28,000	520	20,000	320	20,000	290	18,000	260	17,000	200
	0.1	2	0.047	28,000	650	20,000	400	20,000	360	18,000	320	17,000	250
		4	0.032	28,000	520	20,000	320	20,000	290	18,000	260	17,000	200
	0.2	2	0.081	28,000	650	20,000	400	20,000	360	18,000	320	17,000	250
		4	0.056	28,000	520	20,000	320	20,000	290	18,000	260	17,000	200

【Note】 Refer to the comments and notes below the table on page 78 regarding usage.

Recommended Cutting Conditions (Metric)

2 Flutes

High efficiency cutting condition

High accuracy cutting condition

For detailed information on high-efficiency cutting conditions, refer to page 75.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～65HRC)		4 Hardened Steel (65～68HRC)		5 Hardened Steel (68～72HRC)	
Cutting depth ratio				100%		85%		80%		65%		55%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1	0.02	2	0.016	30,290	1,210	**26,730**	**960**	**24,950**	**800**	**22,450**	**720**	**21,210**	**560**
		4	0.013	27,540	1,040	**24,300**	**820**	**22,680**	**670**	**20,410**	**600**	**19,280**	**470**
		6	0.010	22,310	840	**19,680**	**660**	**18,370**	**540**	**16,530**	**490**	**15,620**	**380**
		8	0.008	19,830	750	**17,500**	**590**	**16,330**	**480**	**14,700**	**430**	**13,880**	**340**
	0.05	2	0.046	30,250	1,210	**26,730**	**960**	**24,950**	**800**	**22,450**	**720**	**21,210**	**560**
		4	0.027	28,920	1,130	**24,300**	**820**	**22,680**	**670**	**20,410**	**600**	**19,280**	**470**
		6	0.017	24,540	930	**19,680**	**660**	**18,370**	**540**	**16,530**	**490**	**15,620**	**380**
		8	0.016	19,830	750	**17,500**	**590**	**16,330**	**480**	**14,700**	**430**	**13,880**	**340**
	0.1	2	0.065	30,290	1,210	**26,730**	**960**	**24,950**	**800**	**22,450**	**720**	**21,210**	**560**
		4	0.038	27,540	1,040	**24,300**	**820**	**22,680**	**670**	**20,410**	**600**	**19,280**	**470**
		6	0.024	22,310	840	**19,680**	**660**	**18,370**	**540**	**16,530**	**490**	**15,620**	**380**
		8	0.024	19,830	750	**17,500**	**590**	**16,330**	**480**	**14,700**	**430**	**13,880**	**340**
	0.2	2	0.110	30,290	1,210	**26,730**	**960**	**24,950**	**800**	**22,450**	**720**	**21,210**	**560**
		4	0.070	27,540	1,040	**24,300**	**820**	**22,680**	**670**	**20,410**	**600**	**19,280**	**470**
		6	0.040	22,310	840	**19,680**	**660**	**18,370**	**540**	**16,530**	**490**	**15,620**	**380**
		8	0.040	19,830	750	**17,500**	**590**	**16,330**	**480**	**14,700**	**430**	**13,880**	**340**

(1) a_p indicates guidelines for Group 1 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH2010-2-02-TH3 tool:
Cutting depth = 0.11 (a_p) × 0.85 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = 0.075 mm

【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 84.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1	0.02	1.5	0.019	38,900	3,420	38,900	3,110	28,300	2,040	23,000	1,840	21,200	1,440
		2	0.016	35,000	3,080	35,000	2,800	25,500	1,840	20,700	1,660	19,100	1,300
		2.5	0.015	31,800	2,800	31,800	2,540	23,100	1,660	18,800	1,500	17,400	1,180
		3	0.014	29,200	2,570	29,200	2,340	21,200	1,530	17,200	1,380	15,900	1,080
		4	0.013	25,000	2,200	25,000	2,000	18,200	1,310	14,800	1,180	13,600	920
		5	0.013	21,900	1,930	21,900	1,750	15,900	1,140	12,900	1,030	11,900	810
		6	0.007	19,500	1,720	19,500	1,560	14,100	1,020	11,500	920	10,600	720
		8	0.004	15,900	1,400	15,900	1,270	11,600	840	9,400	750	8,700	590
	0.05	1.5	0.046	38,900	3,420	38,900	3,110	28,300	2,040	23,000	1,840	21,200	1,440
		2	0.034	35,000	3,080	35,000	2,800	25,500	1,840	20,700	1,660	19,100	1,300
		2.5	0.033	31,800	2,800	31,800	2,540	23,100	1,660	18,800	1,500	17,400	1,180
		3	0.030	29,200	2,570	29,200	2,340	21,200	1,530	17,200	1,380	15,900	1,080
		4	0.028	25,000	2,200	25,000	2,000	18,200	1,310	14,800	1,180	13,600	920
		5	0.027	21,900	1,930	21,900	1,750	15,900	1,140	12,900	1,030	11,900	810
		6	0.015	19,500	1,720	19,500	1,560	14,100	1,020	11,500	920	10,600	720
		8	0.009	15,900	1,400	15,900	1,270	11,600	840	9,400	750	8,700	590
	0.1	1.5	0.056	38,900	3,420	38,900	3,110	28,300	2,040	23,000	1,840	21,200	1,440
		2	0.042	35,000	3,080	35,000	2,800	25,500	1,840	20,700	1,660	19,100	1,300
		2.5	0.040	31,800	2,800	31,800	2,540	23,100	1,660	18,800	1,500	17,400	1,180
		3	0.037	29,200	2,570	29,200	2,340	21,200	1,530	17,200	1,380	15,900	1,080
		4	0.035	25,000	2,200	25,000	2,000	18,200	1,310	14,800	1,180	13,600	920
		5	0.034	21,900	1,930	21,900	1,750	15,900	1,140	12,900	1,030	11,900	810
		6	0.019	19,500	1,720	19,500	1,560	14,100	1,020	11,500	920	10,600	720
		8	0.011	15,900	1,400	15,900	1,270	11,600	840	9,400	750	8,700	590
	0.2	1.5	0.063	38,900	3,420	38,900	3,110	28,300	2,040	23,000	1,840	21,200	1,440
		2	0.047	35,000	3,080	35,000	2,800	25,500	1,840	20,700	1,660	19,100	1,300
		2.5	0.045	31,800	2,800	31,800	2,540	23,100	1,660	18,800	1,500	17,400	1,180
		3	0.042	29,200	2,570	29,200	2,340	21,200	1,530	17,200	1,380	15,900	1,080
		4	0.039	25,000	2,200	25,000	2,000	18,200	1,310	14,800	1,180	13,600	920
		5	0.038	21,900	1,930	21,900	1,750	15,900	1,140	12,900	1,030	11,900	810
		6	0.021	19,500	1,720	19,500	1,560	14,100	1,020	11,500	920	10,600	720
		8	0.012	15,900	1,400	15,900	1,270	11,600	840	9,400	750	8,700	590
	0.3	1.5	0.070	38,900	3,420	38,900	3,110	28,300	2,040	23,000	1,840	21,200	1,440
		2	0.053	35,000	3,080	35,000	2,800	25,500	1,840	20,700	1,660	19,100	1,300
		2.5	0.050	31,800	2,800	31,800	2,540	23,100	1,660	18,800	1,500	17,400	1,180
		3	0.047	29,200	2,570	29,200	2,340	21,200	1,530	17,200	1,380	15,900	1,080
		4	0.044	25,000	2,200	25,000	2,000	18,200	1,310	14,800	1,180	13,600	920
		5	0.042	21,900	1,930	21,900	1,750	15,900	1,140	12,900	1,030	11,900	810
		6	0.023	19,500	1,720	19,500	1,560	14,100	1,020	11,500	920	10,600	720
		8	0.013	15,900	1,400	15,900	1,270	11,600	840	9,400	750	8,700	590
1.5	0.02	2	0.017	26,900	3,310	26,900	3,010	19,600	1,980	15,900	1,780	14,700	1,400
		3	0.016	23,300	2,870	23,300	2,610	17,000	1,710	13,800	1,550	12,700	1,210
		4	0.014	20,600	2,540	20,600	2,310	15,000	1,510	12,200	1,370	11,200	1,070
		5	0.013	18,400	2,270	18,400	2,060	13,400	1,350	10,900	1,220	10,100	960
		6	0.012	16,700	2,060	16,700	1,870	12,100	1,220	9,900	1,110	9,100	870
		8	0.011	15,200	1,870	15,200	1,700	11,100	1,120	9,000	1,010	8,300	790
		10	0.010	14,000	1,720	14,000	1,570	10,200	1,030	8,300	930	7,600	720
		12	0.008	12,100	1,490	12,100	1,360	8,800	890	7,100	800	6,600	630
	0.05	2	0.048	26,900	3,310	26,900	3,010	19,600	1,980	15,900	1,780	14,700	1,400
		3	0.043	23,300	2,870	23,300	2,610	17,000	1,710	13,800	1,550	12,700	1,210
		4	0.039	20,600	2,540	20,600	2,310	15,000	1,510	12,200	1,370	11,200	1,070
		5	0.035	18,400	2,270	18,400	2,060	13,400	1,350	10,900	1,220	10,100	960
		6	0.032	16,700	2,060	16,700	1,870	12,100	1,220	9,900	1,110	9,100	870
		8	0.030	15,200	1,870	15,200	1,700	11,100	1,120	9,000	1,010	8,300	790
		10	0.027	14,000	1,720	14,000	1,570	10,200	1,030	8,300	930	7,600	720
		12	0.022	12,100	1,490	12,100	1,360	8,800	890	7,100	800	6,600	630
	0.1	2	0.078	26,900	3,310	26,900	3,010	19,600	1,980	15,900	1,780	14,700	1,400
		3	0.071	23,300	2,870	23,300	2,610	17,000	1,710	13,800	1,550	12,700	1,210
		4	0.064	20,600	2,540	20,600	2,310	15,000	1,510	12,200	1,370	11,200	1,070
		5	0.057	18,400	2,270	18,400	2,060	13,400	1,350	10,900	1,220	10,100	960

【Note】 Refer to the comments and notes below the table on page 83 regarding usage.

Recommended Cutting Conditions (Metric)

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 84.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1.5	0.1	6	0.052	16,700	2,060	**16,700**	**1,870**	**12,100**	**1,220**	**9,900**	**1,110**	**9,100**	**870**
		8	0.049	15,200	1,870	**15,200**	**1,700**	**11,100**	**1,120**	**9,000**	**1,010**	**8,300**	**790**
		10	0.044	14,000	1,720	**14,000**	**1,570**	**10,200**	**1,030**	**8,300**	**930**	**7,600**	**720**
		12	0.035	12,100	1,490	**12,100**	**1,360**	**8,800**	**890**	**7,100**	**800**	**6,600**	**630**
	0.2	2	0.082	26,900	3,310	**26,900**	**3,010**	**19,600**	**1,980**	**15,900**	**1,780**	**14,700**	**1,400**
		3	0.075	23,300	2,870	**23,300**	**2,610**	**17,000**	**1,710**	**13,800**	**1,550**	**12,700**	**1,210**
		4	0.067	20,600	2,540	**20,600**	**2,310**	**15,000**	**1,510**	**12,200**	**1,370**	**11,200**	**1,070**
		5	0.060	18,400	2,270	**18,400**	**2,060**	**13,400**	**1,350**	**10,900**	**1,220**	**10,100**	**960**
		6	0.055	16,700	2,060	**16,700**	**1,870**	**12,100**	**1,220**	**9,900**	**1,110**	**9,100**	**870**
		8	0.051	15,200	1,870	**15,200**	**1,700**	**11,100**	**1,120**	**9,000**	**1,010**	**8,300**	**790**
		10	0.047	14,000	1,720	**14,000**	**1,570**	**10,200**	**1,030**	**8,300**	**930**	**7,600**	**720**
		12	0.037	12,100	1,490	**12,100**	**1,360**	**8,800**	**890**	**7,100**	**800**	**6,600**	**630**
	0.3	2	0.085	26,900	3,310	**26,900**	**3,010**	**19,600**	**1,980**	**15,900**	**1,780**	**14,700**	**1,400**
		3	0.077	23,300	2,870	**23,300**	**2,610**	**17,000**	**1,710**	**13,800**	**1,550**	**12,700**	**1,210**
		4	0.069	20,600	2,540	**20,600**	**2,310**	**15,000**	**1,510**	**12,200**	**1,370**	**11,200**	**1,070**
		5	0.062	18,400	2,270	**18,400**	**2,060**	**13,400**	**1,350**	**10,900**	**1,220**	**10,100**	**960**
		6	0.057	16,700	2,060	**16,700**	**1,870**	**12,100**	**1,220**	**9,900**	**1,110**	**9,100**	**870**
		8	0.053	15,200	1,870	**15,200**	**1,700**	**11,100**	**1,120**	**9,000**	**1,010**	**8,300**	**790**
		10	0.048	14,000	1,720	**14,000**	**1,570**	**10,200**	**1,030**	**8,300**	**930**	**7,600**	**720**
		12	0.039	12,100	1,490	**12,100**	**1,360**	**8,800**	**890**	**7,100**	**800**	**6,600**	**630**
	0.5	2	0.087	26,900	3,310	**26,900**	**3,010**	**19,600**	**1,980**	**15,900**	**1,780**	**14,700**	**1,400**
		3	0.079	23,300	2,870	**23,300**	**2,610**	**17,000**	**1,710**	**13,800**	**1,550**	**12,700**	**1,210**
		4	0.071	20,600	2,540	**20,600**	**2,310**	**15,000**	**1,510**	**12,200**	**1,370**	**11,200**	**1,070**
		5	0.063	18,400	2,270	**18,400**	**2,060**	**13,400**	**1,350**	**10,900**	**1,220**	**10,100**	**960**
		6	0.058	16,700	2,060	**16,700**	**1,870**	**12,100**	**1,220**	**9,900**	**1,110**	**9,100**	**870**
		8	0.054	15,200	1,870	**15,200**	**1,700**	**11,100**	**1,120**	**9,000**	**1,010**	**8,300**	**790**
		10	0.049	14,000	1,720	**14,000**	**1,570**	**10,200**	**1,030**	**8,300**	**930**	**7,600**	**720**
		12	0.039	12,100	1,490	**12,100**	**1,360**	**8,800**	**890**	**7,100**	**800**	**6,600**	**630**
2	0.02	2.5	0.018	20,600	3,630	**20,600**	**3,300**	**15,000**	**2,160**	**12,200**	**1,950**	**11,200**	**1,520**
		3	0.016	19,500	3,430	**19,500**	**3,120**	**14,100**	**2,030**	**11,500**	**1,840**	**10,600**	**1,440**
		4	0.014	17,500	3,080	**17,500**	**2,800**	**12,700**	**1,830**	**10,300**	**1,650**	**9,500**	**1,290**
		5	0.014	15,900	2,800	**15,900**	**2,540**	**11,600**	**1,670**	**9,400**	**1,500**	**8,700**	**1,180**
		6	0.013	14,600	2,570	**14,600**	**2,340**	**10,600**	**1,530**	**8,600**	**1,380**	**8,000**	**1,090**
		8	0.013	12,500	2,200	**12,500**	**2,000**	**9,100**	**1,310**	**7,400**	**1,180**	**6,800**	**920**
		10	0.012	10,900	1,920	**10,900**	**1,740**	**8,000**	**1,150**	**6,500**	**1,040**	**6,000**	**820**
		12	0.009	9,700	1,710	**9,700**	**1,550**	**7,100**	**1,020**	**5,700**	**910**	**5,300**	**720**
	0.05	2.5	0.048	20,600	3,630	**20,600**	**3,300**	**15,000**	**2,160**	**12,200**	**1,950**	**11,200**	**1,520**
		3	0.043	19,500	3,430	**19,500**	**3,120**	**14,100**	**2,030**	**11,500**	**1,840**	**10,600**	**1,440**
		4	0.037	17,500	3,080	**17,500**	**2,800**	**12,700**	**1,830**	**10,300**	**1,650**	**9,500**	**1,290**
		5	0.036	15,900	2,800	**15,900**	**2,540**	**11,600**	**1,670**	**9,400**	**1,500**	**8,700**	**1,180**
		6	0.035	14,600	2,570	**14,600**	**2,340**	**10,600**	**1,530**	**8,600**	**1,380**	**8,000**	**1,090**
		8	0.034	12,500	2,200	**12,500**	**2,000**	**9,100**	**1,310**	**7,400**	**1,180**	**6,800**	**920**
		10	0.032	10,900	1,920	**10,900**	**1,740**	**8,000**	**1,150**	**6,500**	**1,040**	**6,000**	**820**
		12	0.024	9,700	1,710	**9,700**	**1,550**	**7,100**	**1,020**	**5,700**	**910**	**5,300**	**720**
	0.1	2.5	0.082	20,600	3,630	**20,600**	**3,300**	**15,000**	**2,160**	**12,200**	**1,950**	**11,200**	**1,520**
		3	0.073	19,500	3,430	**19,500**	**3,120**	**14,100**	**2,030**	**11,500**	**1,840**	**10,600**	**1,440**
		4	0.063	17,500	3,080	**17,500**	**2,800**	**12,700**	**1,830**	**10,300**	**1,650**	**9,500**	**1,290**
		5	0.061	15,900	2,800	**15,900**	**2,540**	**11,600**	**1,670**	**9,400**	**1,500**	**8,700**	**1,180**
		6	0.059	14,600	2,570	**14,600**	**2,340**	**10,600**	**1,530**	**8,600**	**1,380**	**8,000**	**1,090**
		8	0.058	12,500	2,200	**12,500**	**2,000**	**9,100**	**1,310**	**7,400**	**1,180**	**6,800**	**920**
		10	0.054	10,900	1,920	**10,900**	**1,740**	**8,000**	**1,150**	**6,500**	**1,040**	**6,000**	**820**
		12	0.041	9,700	1,710	**9,700**	**1,550**	**7,100**	**1,020**	**5,700**	**910**	**5,300**	**720**
	0.2	2.5	0.092	20,600	3,630	**20,600**	**3,300**	**15,000**	**2,160**	**12,200**	**1,950**	**11,200**	**1,520**
		3	0.082	19,500	3,430	**19,500**	**3,120**	**14,100**	**2,030**	**11,500**	**1,840**	**10,600**	**1,440**
		4	0.071	17,500	3,080	**17,500**	**2,800**	**12,700**	**1,830**	**10,300**	**1,650**	**9,500**	**1,290**
		5	0.069	15,900	2,800	**15,900**	**2,540**	**11,600**	**1,670**	**9,400**	**1,500**	**8,700**	**1,180**
		6	0.066	14,600	2,570	**14,600**	**2,340**	**10,600**	**1,530**	**8,600**	**1,380**	**8,000**	**1,090**
		8	0.066	12,500	2,200	**12,500**	**2,000**	**9,100**	**1,310**	**7,400**	**1,180**	**6,800**	**920**
		10	0.061	10,900	1,920	**10,900**	**1,740**	**8,000**	**1,150**	**6,500**	**1,040**	**6,000**	**820**
		12	0.046	9,700	1,710	**9,700**	**1,550**	**7,100**	**1,020**	**5,700**	**910**	**5,300**	**720**

4 Flutes

High efficiency cuttiing condition

High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 84.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
2	0.3	2.5	0.097	20,600	3,630	20,600	3,300	15,000	2,160	12,200	1,950	11,200	1,520
		3	0.087	19,500	3,430	19,500	3,120	14,100	2,030	11,500	1,840	10,600	1,440
		4	0.074	17,500	3,080	17,500	2,800	12,700	1,830	10,300	1,650	9,500	1,290
		5	0.073	15,900	2,800	15,900	2,540	11,600	1,670	9,400	1,500	8,700	1,180
		6	0.070	14,600	2,570	14,600	2,340	10,600	1,530	8,600	1,380	8,000	1,090
		8	0.069	12,500	2,200	12,500	2,000	9,100	1,310	7,400	1,180	6,800	920
		10	0.064	10,900	1,920	10,900	1,740	8,000	1,150	6,500	1,040	6,000	820
		12	0.049	9,700	1,710	9,700	1,550	7,100	1,020	5,700	910	5,300	720
	0.5	2.5	0.102	20,600	3,630	20,600	3,300	15,000	2,160	12,200	1,950	11,200	1,520
		3	0.091	19,500	3,430	19,500	3,120	14,100	2,030	11,500	1,840	10,600	1,440
		4	0.078	17,500	3,080	17,500	2,800	12,700	1,830	10,300	1,650	9,500	1,290
		5	0.076	15,900	2,800	15,900	2,540	11,600	1,670	9,400	1,500	8,700	1,180
		6	0.074	14,600	2,570	14,600	2,340	10,600	1,530	8,600	1,380	8,000	1,090
		8	0.073	12,500	2,200	12,500	2,000	9,100	1,310	7,400	1,180	6,800	920
		10	0.068	10,900	1,920	10,900	1,740	8,000	1,150	6,500	1,040	6,000	820
		12	0.051	9,700	1,710	9,700	1,550	7,100	1,020	5,700	910	5,300	720
3	0.05	4	0.045	18,600	2,950	18,600	2,680	13,500	1,750	11,000	1,580	10,200	1,250
		6	0.043	15,400	2,440	15,400	2,220	11,200	1,450	9,100	1,310	8,400	1,030
		8	0.042	13,100	2,080	13,100	1,890	9,500	1,230	7,700	1,110	7,100	870
		10	0.041	11,400	1,810	11,400	1,640	8,300	1,080	6,700	960	6,200	760
		12	0.038	10,100	1,600	10,100	1,450	7,300	950	5,900	850	5,500	670
		14	0.035	9,000	1,430	9,000	1,300	6,600	860	5,300	760	4,900	600
		16	0.034	8,200	1,300	8,200	1,180	5,900	760	4,800	690	4,500	550
		18	0.030	7,500	1,190	7,500	1,080	5,400	700	4,400	630	4,100	500
		20	0.022	6,900	1,090	6,900	990	5,000	650	4,100	590	3,800	470
	0.1	4	0.090	18,600	2,950	18,600	2,680	13,500	1,750	11,000	1,580	10,200	1,250
		6	0.087	15,400	2,440	15,400	2,220	11,200	1,450	9,100	1,310	8,400	1,030
		8	0.085	13,100	2,080	13,100	1,890	9,500	1,230	7,700	1,110	7,100	870
		10	0.081	11,400	1,810	11,400	1,640	8,300	1,080	6,700	960	6,200	760
		12	0.075	10,100	1,600	10,100	1,450	7,300	950	5,900	850	5,500	670
		14	0.069	9,000	1,430	9,000	1,300	6,600	860	5,300	760	4,900	600
		16	0.067	8,200	1,300	8,200	1,180	5,900	760	4,800	690	4,500	550
		18	0.061	7,500	1,190	7,500	1,080	5,400	700	4,400	630	4,100	500
		20	0.044	6,900	1,090	6,900	990	5,000	650	4,100	590	3,800	470
	0.2	4	0.102	18,600	2,950	18,600	2,680	13,500	1,750	11,000	1,580	10,200	1,250
		6	0.098	15,400	2,440	15,400	2,220	11,200	1,450	9,100	1,310	8,400	1,030
		8	0.095	13,100	2,080	13,100	1,890	9,500	1,230	7,700	1,110	7,100	870
		10	0.092	11,400	1,810	11,400	1,640	8,300	1,080	6,700	960	6,200	760
		12	0.085	10,100	1,600	10,100	1,450	7,300	950	5,900	850	5,500	670
		14	0.078	9,000	1,430	9,000	1,300	6,600	860	5,300	760	4,900	600
		16	0.076	8,200	1,300	8,200	1,180	5,900	760	4,800	690	4,500	550
		18	0.068	7,500	1,190	7,500	1,080	5,400	700	4,400	630	4,100	500
		20	0.050	6,900	1,090	6,900	990	5,000	650	4,100	590	3,800	470
	0.3	4	0.107	18,600	2,950	18,600	2,680	13,500	1,750	11,000	1,580	10,200	1,250
		6	0.103	15,400	2,440	15,400	2,220	11,200	1,450	9,100	1,310	8,400	1,030
		8	0.101	13,100	2,080	13,100	1,890	9,500	1,230	7,700	1,110	7,100	870
		10	0.097	11,400	1,810	11,400	1,640	8,300	1,080	6,700	960	6,200	760
		12	0.090	10,100	1,600	10,100	1,450	7,300	950	5,900	850	5,500	670
		14	0.082	9,000	1,430	9,000	1,300	6,600	860	5,300	760	4,900	600
		16	0.080	8,200	1,300	8,200	1,180	5,900	760	4,800	690	4,500	550
		18	0.072	7,500	1,190	7,500	1,080	5,400	700	4,400	630	4,100	500
		20	0.053	6,900	1,090	6,900	990	5,000	650	4,100	590	3,800	470
	0.5	4	0.113	18,600	2,950	18,600	2,680	13,500	1,750	11,000	1,580	10,200	1,250
		6	0.109	15,400	2,440	15,400	2,220	11,200	1,450	9,100	1,310	8,400	1,030
		8	0.106	13,100	2,080	13,100	1,890	9,500	1,230	7,700	1,110	7,100	870
		10	0.102	11,400	1,810	11,400	1,640	8,300	1,080	6,700	960	6,200	760
		12	0.094	10,100	1,600	10,100	1,450	7,300	950	5,900	850	5,500	670
		14	0.087	9,000	1,430	9,000	1,300	6,600	860	5,300	760	4,900	600
		16	0.084	8,200	1,300	8,200	1,180	5,900	760	4,800	690	4,500	550
		18	0.076	7,500	1,190	7,500	1,080	5,400	700	4,400	630	4,100	500
		20	0.056	6,900	1,090	6,900	990	5,000	650	4,100	590	3,800	470

【Note】 Refer to the comments and notes below the table on page 83 regarding usage.

Recommended Cutting Conditions (Metric)

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 84.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
4	0.1	8	0.091	10,400	2,750	10,400	2,500	7,600	1,640	6,200	1,490	5,700	1,160
		10	0.089	9,300	2,460	9,300	2,230	6,800	1,470	5,500	1,320	5,100	1,040
		12	0.084	8,400	2,220	8,400	2,020	6,100	1,320	5,000	1,200	4,600	940
		14	0.079	7,700	2,030	7,700	1,850	5,600	1,210	4,500	1,080	4,200	860
		16	0.076	7,100	1,870	7,100	1,700	5,100	1,100	4,200	1,010	3,900	800
		18	0.074	6,500	1,720	6,500	1,560	4,800	1,040	3,900	940	3,600	730
		20	0.070	6,100	1,610	6,100	1,460	4,400	950	3,600	860	3,300	670
		22	0.059	5,700	1,500	5,700	1,370	4,100	890	3,400	820	3,100	630
		24	0.055	5,300	1,400	5,300	1,270	3,900	840	3,200	770	2,900	590
	0.2	8	0.126	10,400	2,750	10,400	2,500	7,600	1,640	6,200	1,490	5,700	1,160
		10	0.123	9,300	2,460	9,300	2,230	6,800	1,470	5,500	1,320	5,100	1,040
		12	0.117	8,400	2,220	8,400	2,020	6,100	1,320	5,000	1,200	4,600	940
		14	0.109	7,700	2,030	7,700	1,850	5,600	1,210	4,500	1,080	4,200	860
		16	0.105	7,100	1,870	7,100	1,700	5,100	1,100	4,200	1,010	3,900	800
		18	0.102	6,500	1,720	6,500	1,560	4,800	1,040	3,900	940	3,600	730
		20	0.097	6,100	1,610	6,100	1,460	4,400	950	3,600	860	3,300	670
		22	0.081	5,700	1,500	5,700	1,370	4,100	890	3,400	820	3,100	630
		24	0.077	5,300	1,400	5,300	1,270	3,900	840	3,200	770	2,900	590
	0.3	8	0.133	10,400	2,750	10,400	2,500	7,600	1,640	6,200	1,490	5,700	1,160
		10	0.129	9,300	2,460	9,300	2,230	6,800	1,470	5,500	1,320	5,100	1,040
		12	0.123	8,400	2,220	8,400	2,020	6,100	1,320	5,000	1,200	4,600	940
		14	0.115	7,700	2,030	7,700	1,850	5,600	1,210	4,500	1,080	4,200	860
		16	0.111	7,100	1,870	7,100	1,700	5,100	1,100	4,200	1,010	3,900	800
		18	0.108	6,500	1,720	6,500	1,560	4,800	1,040	3,900	940	3,600	730
		20	0.102	6,100	1,610	6,100	1,460	4,400	950	3,600	860	3,300	670
		22	0.086	5,700	1,500	5,700	1,370	4,100	890	3,400	820	3,100	630
		24	0.081	5,300	1,400	5,300	1,270	3,900	840	3,200	770	2,900	590
	0.5	8	0.137	10,400	2,750	10,400	2,500	7,600	1,640	6,200	1,490	5,700	1,160
		10	0.133	9,300	2,460	9,300	2,230	6,800	1,470	5,500	1,320	5,100	1,040
		12	0.127	8,400	2,220	8,400	2,020	6,100	1,320	5,000	1,200	4,600	940
		14	0.118	7,700	2,030	7,700	1,850	5,600	1,210	4,500	1,080	4,200	860
		16	0.114	7,100	1,870	7,100	1,700	5,100	1,100	4,200	1,010	3,900	800
		18	0.111	6,500	1,720	6,500	1,560	4,800	1,040	3,900	940	3,600	730
		20	0.106	6,100	1,610	6,100	1,460	4,400	950	3,600	860	3,300	670
		22	0.088	5,700	1,500	5,700	1,370	4,100	890	3,400	820	3,100	630
		24	0.084	5,300	1,400	5,300	1,270	3,900	840	3,200	770	2,900	590
	1	8	0.140	10,400	2,750	10,400	2,500	7,600	1,640	6,200	1,490	5,700	1,160
		10	0.136	9,300	2,460	9,300	2,230	6,800	1,470	5,500	1,320	5,100	1,040
		12	0.130	8,400	2,220	8,400	2,020	6,100	1,320	5,000	1,200	4,600	940
		14	0.121	7,700	2,030	7,700	1,850	5,600	1,210	4,500	1,080	4,200	860
		16	0.117	7,100	1,870	7,100	1,700	5,100	1,100	4,200	1,010	3,900	800
		18	0.114	6,500	1,720	6,500	1,560	4,800	1,040	3,900	940	3,600	730
		20	0.108	6,100	1,610	6,100	1,460	4,400	950	3,600	860	3,300	670
		22	0.090	5,700	1,500	5,700	1,370	4,100	890	3,400	820	3,100	630
		24	0.085	5,300	1,400	5,300	1,270	3,900	840	3,200	770	2,900	590
5	0.1	10	0.096	9,300	3,270	9,300	2,980	6,800	1,960	5,500	1,760	5,100	1,390
		15	0.081	7,400	2,600	7,400	2,370	5,400	1,560	4,400	1,410	4,000	1,090
		20	0.077	6,100	2,150	6,100	1,950	4,400	1,270	3,600	1,150	3,300	900
		25	0.075	5,200	1,830	5,200	1,660	3,800	1,090	3,100	990	2,800	760
	0.2	10	0.123	9,300	3,270	9,300	2,980	6,800	1,960	5,500	1,760	5,100	1,390
		15	0.103	7,400	2,600	7,400	2,370	5,400	1,560	4,400	1,410	4,000	1,090
		20	0.098	6,100	2,150	6,100	1,950	4,400	1,270	3,600	1,150	3,300	900
		25	0.095	5,200	1,830	5,200	1,660	3,800	1,090	3,100	990	2,800	760
	0.3	10	0.166	9,300	3,270	9,300	2,980	6,800	1,960	5,500	1,760	5,100	1,390
		15	0.140	7,400	2,600	7,400	2,370	5,400	1,560	4,400	1,410	4,000	1,090
		20	0.133	6,100	2,150	6,100	1,950	4,400	1,270	3,600	1,150	3,300	900
		25	0.129	5,200	1,830	5,200	1,660	3,800	1,090	3,100	990	2,800	760
	0.5	10	0.172	9,300	3,270	9,300	2,980	6,800	1,960	5,500	1,760	5,100	1,390
		15	0.144	7,400	2,600	7,400	2,370	5,400	1,560	4,400	1,410	4,000	1,090
		20	0.137	6,100	2,150	6,100	1,950	4,400	1,270	3,600	1,150	3,300	900
		25	0.133	5,200	1,830	5,200	1,660	3,800	1,090	3,100	990	2,800	760

4 Flutes | **High efficiency cuttiing condition** | High accuracy cuttiing condition

For detailed information on high-accuracy cutting conditions, refer to page 84.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
5	1	10	0.175	9,300	3,270	**9,300**	**2,980**	**6,800**	**1,960**	**5,500**	**1,760**	**5,100**	**1,390**
		15	0.147	7,400	2,600	**7,400**	**2,370**	**5,400**	**1,560**	**4,400**	**1,410**	**4,000**	**1,090**
		20	0.140	6,100	2,150	**6,100**	**1,950**	**4,400**	**1,270**	**3,600**	**1,150**	**3,300**	**900**
		25	0.135	5,200	1,830	**5,200**	**1,660**	**3,800**	**1,090**	**3,100**	**990**	**2,800**	**760**
6	0.1	12	0.098	8,300	3,290	**8,300**	**2,990**	**6,100**	**1,980**	**4,900**	**1,760**	**4,500**	**1,380**
		18	0.088	6,500	2,570	**6,500**	**2,340**	**4,700**	**1,520**	**3,800**	**1,370**	**3,500**	**1,070**
		24	0.082	5,300	2,100	**5,300**	**1,910**	**3,900**	**1,260**	**3,100**	**1,120**	**2,900**	**890**
		30	0.079	4,500	1,780	**4,500**	**1,620**	**3,300**	**1,070**	**2,700**	**970**	**2,400**	**730**
	0.2	12	0.177	8,300	3,290	**8,300**	**2,990**	**6,100**	**1,980**	**4,900**	**1,760**	**4,500**	**1,380**
		18	0.158	6,500	2,570	**6,500**	**2,340**	**4,700**	**1,520**	**3,800**	**1,370**	**3,500**	**1,070**
		24	0.148	5,300	2,100	**5,300**	**1,910**	**3,900**	**1,260**	**3,100**	**1,120**	**2,900**	**890**
		30	0.142	4,500	1,780	**4,500**	**1,620**	**3,300**	**1,070**	**2,700**	**970**	**2,400**	**730**
	0.3	12	0.187	8,300	3,290	**8,300**	**2,990**	**6,100**	**1,980**	**4,900**	**1,760**	**4,500**	**1,380**
		18	0.166	6,500	2,570	**6,500**	**2,340**	**4,700**	**1,520**	**3,800**	**1,370**	**3,500**	**1,070**
		24	0.156	5,300	2,100	**5,300**	**1,910**	**3,900**	**1,260**	**3,100**	**1,120**	**2,900**	**890**
		30	0.150	4,500	1,780	**4,500**	**1,620**	**3,300**	**1,070**	**2,700**	**970**	**2,400**	**730**
	0.5	12	0.193	8,300	3,290	**8,300**	**2,990**	**6,100**	**1,980**	**4,900**	**1,760**	**4,500**	**1,380**
		18	0.172	6,500	2,570	**6,500**	**2,340**	**4,700**	**1,520**	**3,800**	**1,370**	**3,500**	**1,070**
		24	0.161	5,300	2,100	**5,300**	**1,910**	**3,900**	**1,260**	**3,100**	**1,120**	**2,900**	**890**
		30	0.154	4,500	1,780	**4,500**	**1,620**	**3,300**	**1,070**	**2,700**	**970**	**2,400**	**730**
	1	12	0.197	8,300	3,290	**8,300**	**2,990**	**6,100**	**1,980**	**4,900**	**1,760**	**4,500**	**1,380**
		18	0.175	6,500	2,570	**6,500**	**2,340**	**4,700**	**1,520**	**3,800**	**1,370**	**3,500**	**1,070**
		24	0.164	5,300	2,100	**5,300**	**1,910**	**3,900**	**1,260**	**3,100**	**1,120**	**2,900**	**890**
		30	0.158	4,500	1,780	**4,500**	**1,620**	**3,300**	**1,070**	**2,700**	**970**	**2,400**	**730**

(1) a_p indicates guidelines for Group 2 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH4010-2-02-TH3 tool:
Cutting depth = 0.047 (a_p) × 1 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = 0.0376 mm

【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

Recommended Cutting Conditions (Metric)

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 79.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1	0.02	1.5	0.016	32,300	2,840	32,300	2,580	23,500	1,690	19,100	1,530	17,600	1,200
		2	0.013	29,100	2,560	29,100	2,320	21,200	1,530	17,200	1,380	15,900	1,080
		2.5	0.013	26,400	2,320	26,400	2,110	19,200	1,380	15,600	1,250	14,400	980
		3	0.012	24,200	2,130	24,200	1,940	17,600	1,270	14,300	1,150	13,200	900
		4	0.011	20,800	1,830	20,800	1,660	15,100	1,090	12,300	980	11,300	760
		5	0.010	18,200	1,600	18,200	1,450	13,200	950	10,700	850	9,900	670
		6	0.006	16,200	1,430	16,200	1,290	11,700	850	9,500	760	8,800	600
		8	0.003	13,200	1,160	13,200	1,060	9,600	700	7,800	620	7,200	490
	0.05	1.5	0.038	32,300	2,840	32,300	2,580	23,500	1,690	19,100	1,530	17,600	1,200
		2	0.028	29,100	2,560	29,100	2,320	21,200	1,530	17,200	1,380	15,900	1,080
		2.5	0.027	26,400	2,320	26,400	2,110	19,200	1,380	15,600	1,250	14,400	980
		3	0.025	24,200	2,130	24,200	1,940	17,600	1,270	14,300	1,150	13,200	900
		4	0.024	20,800	1,830	20,800	1,660	15,100	1,090	12,300	980	11,300	760
		5	0.023	18,200	1,600	18,200	1,450	13,200	950	10,700	850	9,900	670
		6	0.013	16,200	1,430	16,200	1,290	11,700	850	9,500	760	8,800	600
		8	0.007	13,200	1,160	13,200	1,060	9,600	700	7,800	620	7,200	490
	0.1	1.5	0.046	32,300	2,840	32,300	2,580	23,500	1,690	19,100	1,530	17,600	1,200
		2	0.035	29,100	2,560	29,100	2,320	21,200	1,530	17,200	1,380	15,900	1,080
		2.5	0.033	26,400	2,320	26,400	2,110	19,200	1,380	15,600	1,250	14,400	980
		3	0.031	24,200	2,130	24,200	1,940	17,600	1,270	14,300	1,150	13,200	900
		4	0.029	20,800	1,830	20,800	1,660	15,100	1,090	12,300	980	11,300	760
		5	0.028	18,200	1,600	18,200	1,450	13,200	950	10,700	850	9,900	670
		6	0.015	16,200	1,430	16,200	1,290	11,700	850	9,500	760	8,800	600
		8	0.009	13,200	1,160	13,200	1,060	9,600	700	7,800	620	7,200	490
	0.2	1.5	0.052	32,300	2,840	32,300	2,580	23,500	1,690	19,100	1,530	17,600	1,200
		2	0.039	29,100	2,560	29,100	2,320	21,200	1,530	17,200	1,380	15,900	1,080
		2.5	0.038	26,400	2,320	26,400	2,110	19,200	1,380	15,600	1,250	14,400	980
		3	0.035	24,200	2,130	24,200	1,940	17,600	1,270	14,300	1,150	13,200	900
		4	0.033	20,800	1,830	20,800	1,660	15,100	1,090	12,300	980	11,300	760
		5	0.031	18,200	1,600	18,200	1,450	13,200	950	10,700	850	9,900	670
		6	0.017	16,200	1,430	16,200	1,290	11,700	850	9,500	760	8,800	600
		8	0.010	13,200	1,160	13,200	1,060	9,600	700	7,800	620	7,200	490
	0.3	1.5	0.058	32,300	2,840	32,300	2,580	23,500	1,690	19,100	1,530	17,600	1,200
		2	0.044	29,100	2,560	29,100	2,320	21,200	1,530	17,200	1,380	15,900	1,080
		2.5	0.042	26,400	2,320	26,400	2,110	19,200	1,380	15,600	1,250	14,400	980
		3	0.039	24,200	2,130	24,200	1,940	17,600	1,270	14,300	1,150	13,200	900
		4	0.036	20,800	1,830	20,800	1,660	15,100	1,090	12,300	980	11,300	760
		5	0.035	18,200	1,600	18,200	1,450	13,200	950	10,700	850	9,900	670
		6	0.019	16,200	1,430	16,200	1,290	11,700	850	9,500	760	8,800	600
		8	0.011	13,200	1,160	13,200	1,060	9,600	700	7,800	620	7,200	490
1.5	0.02	2	0.014	22,300	2,750	22,300	2,500	16,300	1,640	13,200	1,480	12,200	1,160
		3	0.013	19,300	2,380	19,300	2,170	14,100	1,420	11,500	1,290	10,500	1,000
		4	0.012	17,100	2,110	17,100	1,920	12,500	1,250	10,100	1,140	9,300	890
		5	0.010	15,300	1,880	15,300	1,710	11,100	1,120	9,000	1,010	8,400	800
		6	0.010	13,900	1,710	13,900	1,550	10,000	1,010	8,200	920	7,600	720
		8	0.008	12,600	1,550	12,600	1,410	9,200	930	7,500	840	6,900	660
		10	0.007	11,600	1,430	11,600	1,300	8,500	850	6,900	770	6,300	600
		12	0.004	10,000	1,240	10,000	1,130	7,300	740	5,900	660	5,500	520
	0.05	2	0.040	22,300	2,750	22,300	2,500	16,300	1,640	13,200	1,480	12,200	1,160
		3	0.036	19,300	2,380	19,300	2,170	14,100	1,420	11,500	1,290	10,500	1,000
		4	0.032	17,100	2,110	17,100	1,920	12,500	1,250	10,100	1,140	9,300	890
		5	0.029	15,300	1,880	15,300	1,710	11,100	1,120	9,000	1,010	8,400	800
		6	0.026	13,900	1,710	13,900	1,550	10,000	1,010	8,200	920	7,600	720
		8	0.022	12,600	1,550	12,600	1,410	9,200	930	7,500	840	6,900	660
		10	0.018	11,600	1,430	11,600	1,300	8,500	850	6,900	770	6,300	600
		12	0.012	10,000	1,240	10,000	1,130	7,300	740	5,900	660	5,500	520
	0.1	2	0.065	22,300	2,750	22,300	2,500	16,300	1,640	13,200	1,480	12,200	1,160
		3	0.059	19,300	2,380	19,300	2,170	14,100	1,420	11,500	1,290	10,500	1,000
		4	0.053	17,100	2,110	17,100	1,920	12,500	1,250	10,100	1,140	9,300	890
		5	0.047	15,300	1,880	15,300	1,710	11,100	1,120	9,000	1,010	8,400	800

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 79.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
1.5	0.1	6	0.043	13,900	1,710	13,900	1,550	10,000	1,010	8,200	920	7,600	720
		8	0.037	12,600	1,550	12,600	1,410	9,200	930	7,500	840	6,900	660
		10	0.029	11,600	1,430	11,600	1,300	8,500	850	6,900	770	6,300	600
		12	0.020	10,000	1,240	10,000	1,130	7,300	740	5,900	660	5,500	520
	0.2	2	0.068	22,300	2,750	22,300	2,500	16,300	1,640	13,200	1,480	12,200	1,160
		3	0.062	19,300	2,380	19,300	2,170	14,100	1,420	11,500	1,290	10,500	1,000
		4	0.056	17,100	2,110	17,100	1,920	12,500	1,250	10,100	1,140	9,300	890
		5	0.050	15,300	1,880	15,300	1,710	11,100	1,120	9,000	1,010	8,400	800
		6	0.046	13,900	1,710	13,900	1,550	10,000	1,010	8,200	920	7,600	720
		8	0.039	12,600	1,550	12,600	1,410	9,200	930	7,500	840	6,900	660
		10	0.031	11,600	1,430	11,600	1,300	8,500	850	6,900	770	6,300	600
		12	0.021	10,000	1,240	10,000	1,130	7,300	740	5,900	660	5,500	520
	0.3	2	0.070	22,300	2,750	22,300	2,500	16,300	1,640	13,200	1,480	12,200	1,160
		3	0.064	19,300	2,380	19,300	2,170	14,100	1,420	11,500	1,290	10,500	1,000
		4	0.058	17,100	2,110	17,100	1,920	12,500	1,250	10,100	1,140	9,300	890
		5	0.051	15,300	1,880	15,300	1,710	11,100	1,120	9,000	1,010	8,400	800
		6	0.047	13,900	1,710	13,900	1,550	10,000	1,010	8,200	920	7,600	720
		8	0.040	12,600	1,550	12,600	1,410	9,200	930	7,500	840	6,900	660
		10	0.032	11,600	1,430	11,600	1,300	8,500	850	6,900	770	6,300	600
		12	0.021	10,000	1,240	10,000	1,130	7,300	740	5,900	660	5,500	520
	0.5	2	0.072	22,300	2,750	22,300	2,500	16,300	1,640	13,200	1,480	12,200	1,160
		3	0.065	19,300	2,380	19,300	2,170	14,100	1,420	11,500	1,290	10,500	1,000
		4	0.059	17,100	2,110	17,100	1,920	12,500	1,250	10,100	1,140	9,300	890
		5	0.052	15,300	1,880	15,300	1,710	11,100	1,120	9,000	1,010	8,400	800
		6	0.048	13,900	1,710	13,900	1,550	10,000	1,010	8,200	920	7,600	720
		8	0.041	12,600	1,550	12,600	1,410	9,200	930	7,500	840	6,900	660
		10	0.033	11,600	1,430	11,600	1,300	8,500	850	6,900	770	6,300	600
		12	0.022	10,000	1,240	10,000	1,130	7,300	740	5,900	660	5,500	520
2	0.02	2.5	0.015	17,100	3,010	17,100	2,740	12,500	1,790	10,100	1,620	9,300	1,260
		3	0.014	16,200	2,850	16,200	2,590	11,700	1,680	9,500	1,530	8,800	1,200
		4	0.012	14,500	2,560	14,500	2,320	10,500	1,520	8,500	1,370	7,900	1,070
		5	0.011	13,200	2,320	13,200	2,110	9,600	1,390	7,800	1,250	7,200	980
		6	0.011	12,100	2,130	12,100	1,940	8,800	1,270	7,100	1,150	6,600	900
		8	0.011	10,400	1,830	10,400	1,660	7,600	1,090	6,100	980	5,600	760
		10	0.010	9,000	1,590	9,000	1,440	6,600	950	5,400	860	5,000	680
		12	0.008	8,100	1,420	8,100	1,290	5,900	850	4,700	760	4,400	600
	0.05	2.5	0.040	17,100	3,010	17,100	2,740	12,500	1,790	10,100	1,620	9,300	1,260
		3	0.036	16,200	2,850	16,200	2,590	11,700	1,680	9,500	1,530	8,800	1,200
		4	0.031	14,500	2,560	14,500	2,320	10,500	1,520	8,500	1,370	7,900	1,070
		5	0.030	13,200	2,320	13,200	2,110	9,600	1,390	7,800	1,250	7,200	980
		6	0.029	12,100	2,130	12,100	1,940	8,800	1,270	7,100	1,150	6,600	900
		8	0.028	10,400	1,830	10,400	1,660	7,600	1,090	6,100	980	5,600	760
		10	0.026	9,000	1,590	9,000	1,440	6,600	950	5,400	860	5,000	680
		12	0.020	8,100	1,420	8,100	1,290	5,900	850	4,700	760	4,400	600
	0.1	2.5	0.068	17,100	3,010	17,100	2,740	12,500	1,790	10,100	1,620	9,300	1,260
		3	0.061	16,200	2,850	16,200	2,590	11,700	1,680	9,500	1,530	8,800	1,200
		4	0.052	14,500	2,560	14,500	2,320	10,500	1,520	8,500	1,370	7,900	1,070
		5	0.051	13,200	2,320	13,200	2,110	9,600	1,390	7,800	1,250	7,200	980
		6	0.049	12,100	2,130	12,100	1,940	8,800	1,270	7,100	1,150	6,600	900
		8	0.048	10,400	1,830	10,400	1,660	7,600	1,090	6,100	980	5,600	760
		10	0.045	9,000	1,590	9,000	1,440	6,600	950	5,400	860	5,000	680
		12	0.034	8,100	1,420	8,100	1,290	5,900	850	4,700	760	4,400	600
	0.2	2.5	0.077	17,100	3,010	17,100	2,740	12,500	1,790	10,100	1,620	9,300	1,260
		3	0.068	16,200	2,850	16,200	2,590	11,700	1,680	9,500	1,530	8,800	1,200
		4	0.059	14,500	2,560	14,500	2,320	10,500	1,520	8,500	1,370	7,900	1,070
		5	0.057	13,200	2,320	13,200	2,110	9,600	1,390	7,800	1,250	7,200	980
		6	0.055	12,100	2,130	12,100	1,940	8,800	1,270	7,100	1,150	6,600	900
		8	0.054	10,400	1,830	10,400	1,660	7,600	1,090	6,100	980	5,600	760
		10	0.050	9,000	1,590	9,000	1,440	6,600	950	5,400	860	5,000	680
		12	0.038	8,100	1,420	8,100	1,290	5,900	850	4,700	760	4,400	600

【Note】 Refer to the comments and notes below the table on page 88 regarding usage.

Recommended Cutting Conditions (Metric)

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 79.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
2	0.3	2.5	0.081	17,100	3,010	17,100	2,740	12,500	1,790	10,100	1,620	9,300	1,260
		3	0.072	16,200	2,850	16,200	2,590	11,700	1,680	9,500	1,530	8,800	1,200
		4	0.062	14,500	2,560	14,500	2,320	10,500	1,520	8,500	1,370	7,900	1,070
		5	0.060	13,200	2,320	13,200	2,110	9,600	1,390	7,800	1,250	7,200	980
		6	0.058	12,100	2,130	12,100	1,940	8,800	1,270	7,100	1,150	6,600	900
		8	0.057	10,400	1,830	10,400	1,660	7,600	1,090	6,100	980	5,600	760
		10	0.053	9,000	1,590	9,000	1,440	6,600	950	5,400	860	5,000	680
		12	0.041	8,100	1,420	8,100	1,290	5,900	850	4,700	760	4,400	600
	0.5	2.5	0.085	17,100	3,010	17,100	2,740	12,500	1,790	10,100	1,620	9,300	1,260
		3	0.076	16,200	2,850	16,200	2,590	11,700	1,680	9,500	1,530	8,800	1,200
		4	0.065	14,500	2,560	14,500	2,320	10,500	1,520	8,500	1,370	7,900	1,070
		5	0.063	13,200	2,320	13,200	2,110	9,600	1,390	7,800	1,250	7,200	980
		6	0.061	12,100	2,130	12,100	1,940	8,800	1,270	7,100	1,150	6,600	900
		8	0.061	10,400	1,830	10,400	1,660	7,600	1,090	6,100	980	5,600	760
		10	0.056	9,000	1,590	9,000	1,440	6,600	950	5,400	860	5,000	680
		12	0.043	8,100	1,420	8,100	1,290	5,900	850	4,700	760	4,400	600
3	0.05	4	0.037	15,400	2,450	15,400	2,220	11,200	1,450	9,100	1,310	8,500	1,040
		6	0.036	12,800	2,030	12,800	1,840	9,300	1,200	7,600	1,090	7,000	850
		8	0.035	10,900	1,730	10,900	1,570	7,900	1,020	6,400	920	5,900	720
		10	0.034	9,500	1,500	9,500	1,360	6,900	900	5,600	800	5,100	630
		12	0.031	8,400	1,330	8,400	1,200	6,100	790	4,900	710	4,600	560
		14	0.029	7,500	1,190	7,500	1,080	5,500	710	4,400	630	4,100	500
		16	0.028	6,800	1,080	6,800	980	4,900	630	4,000	570	3,700	460
		18	0.025	6,200	990	6,200	900	4,500	580	3,700	520	3,400	420
		20	0.018	5,700	900	5,700	820	4,200	540	3,400	490	3,200	390
	0.1	4	0.075	15,400	2,450	15,400	2,220	11,200	1,450	9,100	1,310	8,500	1,040
		6	0.072	12,800	2,030	12,800	1,840	9,300	1,200	7,600	1,090	7,000	850
		8	0.070	10,900	1,730	10,900	1,570	7,900	1,020	6,400	920	5,900	720
		10	0.068	9,500	1,500	9,500	1,360	6,900	900	5,600	800	5,100	630
		12	0.063	8,400	1,330	8,400	1,200	6,100	790	4,900	710	4,600	560
		14	0.058	7,500	1,190	7,500	1,080	5,500	710	4,400	630	4,100	500
		16	0.056	6,800	1,080	6,800	980	4,900	630	4,000	570	3,700	460
		18	0.051	6,200	990	6,200	900	4,500	580	3,700	520	3,400	420
		20	0.037	5,700	900	5,700	820	4,200	540	3,400	490	3,200	390
	0.2	4	0.084	15,400	2,450	15,400	2,220	11,200	1,450	9,100	1,310	8,500	1,040
		6	0.081	12,800	2,030	12,800	1,840	9,300	1,200	7,600	1,090	7,000	850
		8	0.079	10,900	1,730	10,900	1,570	7,900	1,020	6,400	920	5,900	720
		10	0.076	9,500	1,500	9,500	1,360	6,900	900	5,600	800	5,100	630
		12	0.070	8,400	1,330	8,400	1,200	6,100	790	4,900	710	4,600	560
		14	0.065	7,500	1,190	7,500	1,080	5,500	710	4,400	630	4,100	500
		16	0.063	6,800	1,080	6,800	980	4,900	630	4,000	570	3,700	460
		18	0.057	6,200	990	6,200	900	4,500	580	3,700	520	3,400	420
		20	0.041	5,700	900	5,700	820	4,200	540	3,400	490	3,200	390
	0.3	4	0.089	15,400	2,450	15,400	2,220	11,200	1,450	9,100	1,310	8,500	1,040
		6	0.086	12,800	2,030	12,800	1,840	9,300	1,200	7,600	1,090	7,000	850
		8	0.084	10,900	1,730	10,900	1,570	7,900	1,020	6,400	920	5,900	720
		10	0.080	9,500	1,500	9,500	1,360	6,900	900	5,600	800	5,100	630
		12	0.074	8,400	1,330	8,400	1,200	6,100	790	4,900	710	4,600	560
		14	0.068	7,500	1,190	7,500	1,080	5,500	710	4,400	630	4,100	500
		16	0.066	6,800	1,080	6,800	980	4,900	630	4,000	570	3,700	460
		18	0.060	6,200	990	6,200	900	4,500	580	3,700	520	3,400	420
		20	0.044	5,700	900	5,700	820	4,200	540	3,400	490	3,200	390
	0.5	4	0.094	15,400	2,450	15,400	2,220	11,200	1,450	9,100	1,310	8,500	1,040
		6	0.090	12,800	2,030	12,800	1,840	9,300	1,200	7,600	1,090	7,000	850
		8	0.088	10,900	1,730	10,900	1,570	7,900	1,020	6,400	920	5,900	720
		10	0.084	9,500	1,500	9,500	1,360	6,900	900	5,600	800	5,100	630
		12	0.078	8,400	1,330	8,400	1,200	6,100	790	4,900	710	4,600	560
		14	0.072	7,500	1,190	7,500	1,080	5,500	710	4,400	630	4,100	500
		16	0.070	6,800	1,080	6,800	980	4,900	630	4,000	570	3,700	460
		18	0.063	6,200	990	6,200	900	4,500	580	3,700	520	3,400	420
		20	0.046	5,700	900	5,700	820	4,200	540	3,400	490	3,200	390

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 79.

Work material				1 Pre-hardened Steel (35～45HRC)		2 Hardened Steel (45～55HRC)		3 Hardened Steel (55～60HRC)		4 Hardened Steel (60～65HRC)		5 Hardened Steel (65～72HRC)	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
4	0.1	8	0.076	8,600	2,280	**8,600**	**2,080**	**6,300**	**1,360**	**5,100**	**1,240**	**4,700**	**960**
		10	0.073	7,700	2,040	**7,700**	**1,850**	**5,600**	**1,220**	**4,600**	**1,100**	**4,200**	**860**
		12	0.070	7,000	1,840	**7,000**	**1,680**	**5,100**	**1,100**	**4,200**	**1,000**	**3,800**	**780**
		14	0.065	6,400	1,680	**6,400**	**1,540**	**4,600**	**1,000**	**3,700**	**900**	**3,500**	**710**
		16	0.063	5,900	1,550	**5,900**	**1,410**	**4,200**	**910**	**3,500**	**840**	**3,200**	**660**
		18	0.061	5,400	1,430	**5,400**	**1,290**	**4,000**	**860**	**3,200**	**780**	**3,000**	**610**
		20	0.058	5,100	1,340	**5,100**	**1,210**	**3,700**	**790**	**3,000**	**710**	**2,700**	**560**
		22	0.049	4,700	1,250	**4,700**	**1,140**	**3,400**	**740**	**2,800**	**680**	**2,600**	**520**
		24	0.046	4,400	1,160	**4,400**	**1,050**	**3,200**	**700**	**2,700**	**640**	**2,400**	**490**
	0.2	8	0.105	8,600	2,280	**8,600**	**2,080**	**6,300**	**1,360**	**5,100**	**1,240**	**4,700**	**960**
		10	0.102	7,700	2,040	**7,700**	**1,850**	**5,600**	**1,220**	**4,600**	**1,100**	**4,200**	**860**
		12	0.097	7,000	1,840	**7,000**	**1,680**	**5,100**	**1,100**	**4,200**	**1,000**	**3,800**	**780**
		14	0.090	6,400	1,680	**6,400**	**1,540**	**4,600**	**1,000**	**3,700**	**900**	**3,500**	**710**
		16	0.087	5,900	1,550	**5,900**	**1,410**	**4,200**	**910**	**3,500**	**840**	**3,200**	**660**
		18	0.085	5,400	1,430	**5,400**	**1,290**	**4,000**	**860**	**3,200**	**780**	**3,000**	**610**
		20	0.080	5,100	1,340	**5,100**	**1,210**	**3,700**	**790**	**3,000**	**710**	**2,700**	**560**
		22	0.067	4,700	1,250	**4,700**	**1,140**	**3,400**	**740**	**2,800**	**680**	**2,600**	**520**
		24	0.064	4,400	1,160	**4,400**	**1,050**	**3,200**	**700**	**2,700**	**640**	**2,400**	**490**
	0.3	8	0.110	8,600	2,280	**8,600**	**2,080**	**6,300**	**1,360**	**5,100**	**1,240**	**4,700**	**960**
		10	0.107	7,700	2,040	**7,700**	**1,850**	**5,600**	**1,220**	**4,600**	**1,100**	**4,200**	**860**
		12	0.102	7,000	1,840	**7,000**	**1,680**	**5,100**	**1,100**	**4,200**	**1,000**	**3,800**	**780**
		14	0.095	6,400	1,680	**6,400**	**1,540**	**4,600**	**1,000**	**3,700**	**900**	**3,500**	**710**
		16	0.092	5,900	1,550	**5,900**	**1,410**	**4,200**	**910**	**3,500**	**840**	**3,200**	**660**
		18	0.090	5,400	1,430	**5,400**	**1,290**	**4,000**	**860**	**3,200**	**780**	**3,000**	**610**
		20	0.085	5,100	1,340	**5,100**	**1,210**	**3,700**	**790**	**3,000**	**710**	**2,700**	**560**
		22	0.071	4,700	1,250	**4,700**	**1,140**	**3,400**	**740**	**2,800**	**680**	**2,600**	**520**
		24	0.067	4,400	1,160	**4,400**	**1,050**	**3,200**	**700**	**2,700**	**640**	**2,400**	**490**
	0.5	8	0.114	8,600	2,280	**8,600**	**2,080**	**6,300**	**1,360**	**5,100**	**1,240**	**4,700**	**960**
		10	0.111	7,700	2,040	**7,700**	**1,850**	**5,600**	**1,220**	**4,600**	**1,100**	**4,200**	**860**
		12	0.105	7,000	1,840	**7,000**	**1,680**	**5,100**	**1,100**	**4,200**	**1,000**	**3,800**	**780**
		14	0.098	6,400	1,680	**6,400**	**1,540**	**4,600**	**1,000**	**3,700**	**900**	**3,500**	**710**
		16	0.095	5,900	1,550	**5,900**	**1,410**	**4,200**	**910**	**3,500**	**840**	**3,200**	**660**
		18	0.092	5,400	1,430	**5,400**	**1,290**	**4,000**	**860**	**3,200**	**780**	**3,000**	**610**
		20	0.088	5,100	1,340	**5,100**	**1,210**	**3,700**	**790**	**3,000**	**710**	**2,700**	**560**
		22	0.073	4,700	1,250	**4,700**	**1,140**	**3,400**	**740**	**2,800**	**680**	**2,600**	**520**
		24	0.069	4,400	1,160	**4,400**	**1,050**	**3,200**	**700**	**2,700**	**640**	**2,400**	**490**
	1	8	0.116	8,600	2,280	**8,600**	**2,080**	**6,300**	**1,360**	**5,100**	**1,240**	**4,700**	**960**
		10	0.113	7,700	2,040	**7,700**	**1,850**	**5,600**	**1,220**	**4,600**	**1,100**	**4,200**	**860**
		12	0.108	7,000	1,840	**7,000**	**1,680**	**5,100**	**1,100**	**4,200**	**1,000**	**3,800**	**780**
		14	0.100	6,400	1,680	**6,400**	**1,540**	**4,600**	**1,000**	**3,700**	**900**	**3,500**	**710**
		16	0.097	5,900	1,550	**5,900**	**1,410**	**4,200**	**910**	**3,500**	**840**	**3,200**	**660**
		18	0.094	5,400	1,430	**5,400**	**1,290**	**4,000**	**860**	**3,200**	**780**	**3,000**	**610**
		20	0.089	5,100	1,340	**5,100**	**1,210**	**3,700**	**790**	**3,000**	**710**	**2,700**	**560**
		22	0.075	4,700	1,250	**4,700**	**1,140**	**3,400**	**740**	**2,800**	**680**	**2,600**	**520**
		24	0.071	4,400	1,160	**4,400**	**1,050**	**3,200**	**700**	**2,700**	**640**	**2,400**	**490**
5	0.1	10	0.080	7,700	2,710	**7,700**	**2,470**	**5,600**	**1,630**	**4,600**	**1,460**	**4,200**	**1,150**
		15	0.067	6,100	2,160	**6,100**	**1,970**	**4,500**	**1,290**	**3,700**	**1,170**	**3,300**	**900**
		20	0.064	5,100	1,780	**5,100**	**1,620**	**3,700**	**1,050**	**3,000**	**950**	**2,700**	**750**
		25	0.062	4,300	1,520	**4,300**	**1,380**	**3,200**	**900**	**2,600**	**820**	**2,300**	**630**
	0.2	10	0.102	7,700	2,710	**7,700**	**2,470**	**5,600**	**1,630**	**4,600**	**1,460**	**4,200**	**1,150**
		15	0.086	6,100	2,160	**6,100**	**1,970**	**4,500**	**1,290**	**3,700**	**1,170**	**3,300**	**900**
		20	0.081	5,100	1,780	**5,100**	**1,620**	**3,700**	**1,050**	**3,000**	**950**	**2,700**	**750**
		25	0.079	4,300	1,520	**4,300**	**1,380**	**3,200**	**900**	**2,600**	**820**	**2,300**	**630**
	0.3	10	0.138	7,700	2,710	**7,700**	**2,470**	**5,600**	**1,630**	**4,600**	**1,460**	**4,200**	**1,150**
		15	0.116	6,100	2,160	**6,100**	**1,970**	**4,500**	**1,290**	**3,700**	**1,170**	**3,300**	**900**
		20	0.110	5,100	1,780	**5,100**	**1,620**	**3,700**	**1,050**	**3,000**	**950**	**2,700**	**750**
		25	0.107	4,300	1,520	**4,300**	**1,380**	**3,200**	**900**	**2,600**	**820**	**2,300**	**630**
	0.5	10	0.142	7,700	2,710	**7,700**	**2,470**	**5,600**	**1,630**	**4,600**	**1,460**	**4,200**	**1,150**
		15	0.120	6,100	2,160	**6,100**	**1,970**	**4,500**	**1,290**	**3,700**	**1,170**	**3,300**	**900**
		20	0.114	5,100	1,780	**5,100**	**1,620**	**3,700**	**1,050**	**3,000**	**950**	**2,700**	**750**
		25	0.110	4,300	1,520	**4,300**	**1,380**	**3,200**	**900**	**2,600**	**820**	**2,300**	**630**

【Note】 Refer to the comments and notes below the table on page 88 regarding usage.

Recommended Cutting Conditions (Metric)

4 Flutes | High efficiency cuttiing condition | **High accuracy cuttiing condition**

For detailed information on high-efficiency cutting conditions, refer to page 79.

Work material				1		2		3		4		5	
				Pre-hardened Steel (35～45HRC)		**Hardened Steel (45～55HRC)**		**Hardened Steel (55～60HRC)**		**Hardened Steel (60～65HRC)**		**Hardened Steel (65～72HRC)**	
Cutting depth ratio				120%		100%		70%		50%		25%	
Tool dia. DC (mm)	Corner radius RE (mm)	Under neck length (mm)	a_p (mm)	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min	Revolution n min^{-1}	Feed rate v_f mm/min
5	1	**10**	0.145	7,700	2,710	**7,700**	**2,470**	**5,600**	**1,630**	**4,600**	**1,460**	**4,200**	**1,150**
		15	0.122	6,100	2,160	**6,100**	**1,970**	**4,500**	**1,290**	**3,700**	**1,170**	**3,300**	**900**
		20	0.116	5,100	1,780	**5,100**	**1,620**	**3,700**	**1,050**	**3,000**	**950**	**2,700**	**750**
		25	0.112	4,300	1,520	**4,300**	**1,380**	**3,200**	**900**	**2,600**	**820**	**2,300**	**630**
6	0.1	**12**	0.082	6,900	2,730	**6,900**	**2,480**	**5,100**	**1,640**	**4,100**	**1,460**	**3,700**	**1,150**
		18	0.073	5,400	2,130	**5,400**	**1,940**	**3,900**	**1,260**	**3,200**	**1,140**	**2,900**	**890**
		24	0.068	4,400	1,740	**4,400**	**1,590**	**3,200**	**1,050**	**2,600**	**930**	**2,400**	**740**
		30	0.065	3,700	1,480	**3,700**	**1,340**	**2,700**	**890**	**2,200**	**810**	**2,000**	**610**
	0.2	**12**	0.147	6,900	2,730	**6,900**	**2,480**	**5,100**	**1,640**	**4,100**	**1,460**	**3,700**	**1,150**
		18	0.131	5,400	2,130	**5,400**	**1,940**	**3,900**	**1,260**	**3,200**	**1,140**	**2,900**	**890**
		24	0.123	4,400	1,740	**4,400**	**1,590**	**3,200**	**1,050**	**2,600**	**930**	**2,400**	**740**
		30	0.118	3,700	1,480	**3,700**	**1,340**	**2,700**	**890**	**2,200**	**810**	**2,000**	**610**
	0.3	**12**	0.155	6,900	2,730	**6,900**	**2,480**	**5,100**	**1,640**	**4,100**	**1,460**	**3,700**	**1,150**
		18	0.138	5,400	2,130	**5,400**	**1,940**	**3,900**	**1,260**	**3,200**	**1,140**	**2,900**	**890**
		24	0.129	4,400	1,740	**4,400**	**1,590**	**3,200**	**1,050**	**2,600**	**930**	**2,400**	**740**
		30	0.124	3,700	1,480	**3,700**	**1,340**	**2,700**	**890**	**2,200**	**810**	**2,000**	**610**
	0.5	**12**	0.160	6,900	2,730	**6,900**	**2,480**	**5,100**	**1,640**	**4,100**	**1,460**	**3,700**	**1,150**
		18	0.142	5,400	2,130	**5,400**	**1,940**	**3,900**	**1,260**	**3,200**	**1,140**	**2,900**	**890**
		24	0.133	4,400	1,740	**4,400**	**1,590**	**3,200**	**1,050**	**2,600**	**930**	**2,400**	**740**
		30	0.128	3,700	1,480	**3,700**	**1,340**	**2,700**	**890**	**2,200**	**810**	**2,000**	**610**
	1	**12**	0.163	6,900	2,730	**6,900**	**2,480**	**5,100**	**1,640**	**4,100**	**1,460**	**3,700**	**1,150**
		18	0.145	5,400	2,130	**5,400**	**1,940**	**3,900**	**1,260**	**3,200**	**1,140**	**2,900**	**890**
		24	0.136	4,400	1,740	**4,400**	**1,590**	**3,200**	**1,050**	**2,600**	**930**	**2,400**	**740**
		30	0.131	3,700	1,480	**3,700**	**1,340**	**2,700**	**890**	**2,200**	**810**	**2,000**	**610**

(1) a_p indicates guidelines for Group 2 workpieces. For other groups, adjust cutting depth based on the cutting depth factors in the above table.
(2) In cases in which cutting chips may cause clogging--for example, for rib cutting and blind grooves--set the cutting depth using a cutting depth factor to calculate the cutting depth amount. This amount should then be reduced to 80% of the calculated value.
(3) Adjust by setting a_e to (5 or less) × (a_p) × (cutting depth ratio). For finishing cutting, calculate the theoretical cusp height and set accordingly.
(4) The recommended slope entrance angle when engraving is 1° or less. Adjust the feed rate to 70% or less of values presented in the cutting condition table.
(5) When slotting such engraving letters, adjust the feed rate to 50% or less and a_p to 30% or less of the values shown. We recommend reciprocal cutting.

Cutting depth setting example: When cutting rib groove contours in hardened steel (50HRC) using an EPDREH4010-2-02-TH3 tool:
Cutting depth = 0.039 (a_p) × 1 (cutting depth factor for Group 2 Hardened steels) × 0.8 (for closed-area cutting) = 0.0312mm

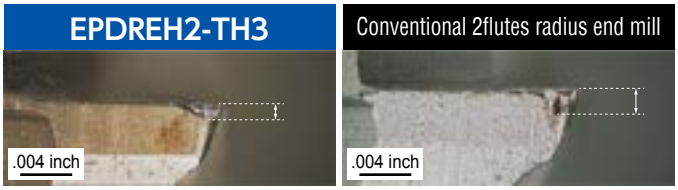
【Note】

① Use the appropriate coolant for the work material and machining shape.
② These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
③ If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

Field data

Tool wear after 66 minutes of machining D2 (58 HRC)

2 Flutes

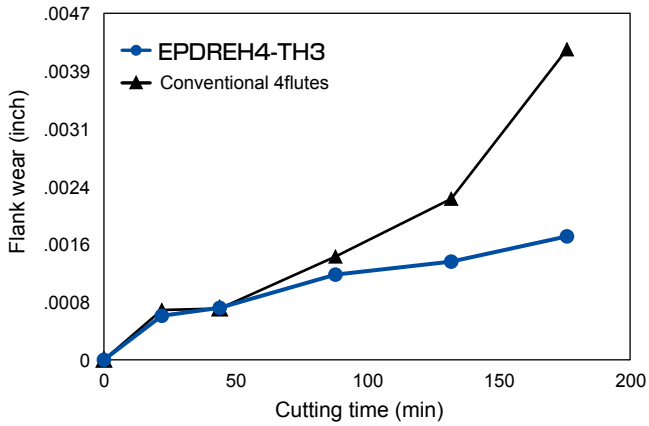


Flank wear .002 inch　　Flank wear .003 inch

Tool size : φ0.8×R0.05 (DC .031 inch × R .002 inch)
Under neck length 2mm (.079 inch)
Work material : PD613(58HRC)
Machine : Vertical MC (HSK-F63)
Cutting method : Contour pocketing
(Pocket size : .394×.394×.020 inch)
Cutting conditions : n=23,000min^{-1} (v_c=190 SFM)
v_f=27.6 IPM (f_z=.001 IPT)
a_p .001 inch a_e .006 inch Mist blow

Tool wear after 176 minutes of machining STAVAX (51 HRC)

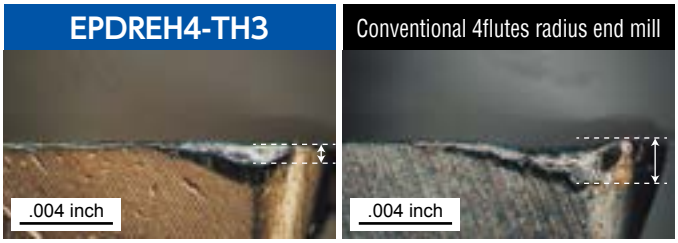
4 Flutes



Tool size : φ3×R0.1 (DC .118 inch × R .004 inch)
Under neck length 12mm (.472 inch)
Work material：STAVAX(51HRC)
Machine：Vertical MC (HSK-A63)
Cutting method：Bottom face cutting
Cutting conditions：n=11,000min^{-1} (v_c=341 SFM)
v_f=63.0 IPM (f_z=.001 IPT)
a_p .003 inch a_e .031 inch Mist blow

Tool wear after 60 minutes of machining VANADIS23 (61 HRC)

4 Flutes



Flank wear .001 inch　　Flank wear .002 inch

Tool size : φ1×R0.1 (DC .039 inch × R .004 inch)
Under neck length 8mm (.315 inch)
Work material：VANADIS23(62HRC)
Machine：Vertical MC (HSK-E32)
Cutting method：Bottom face cutting
Cutting conditions：n=10,000min^{-1} (v_c=102 SFM)
v_f=25.6 IPM (f_z=.001 IPT)
a_p .0002 inch a_e .008 inch Mist blow

Offers wear resistance superior to conventional tools when machining high hardened steel

Field data

Comparison of vertical wall machining accuracy: PD613 (58 HRC)

2 Flutes

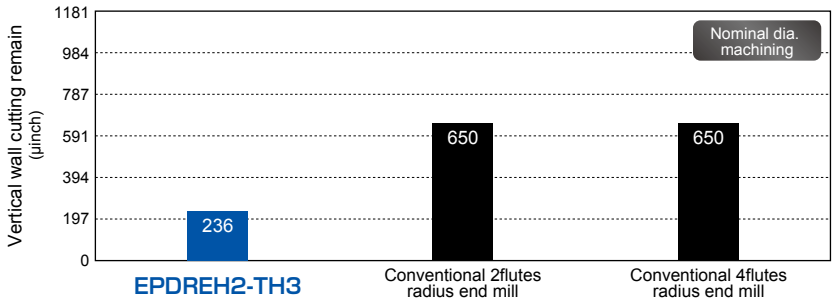
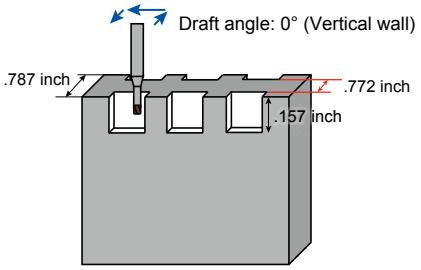


Figure Machining shape



Finishing time: 10 mins

Tool size：φ0.8×R0.2 (DC .031 inch × R .008 inch) Under neck length 4mm (.157 inch)
Work material：PD613(58HRC) Machine：Vertical MC (HSK-E25)
Cutting conditions：n=23,000min^{-1} (v_c=190 SFM)
v_f=23.6 IPM (2flutes f_z=.0005 IPT, 4flutes f_z=.0003 IPT)
a_p .001 inch a_e .002 inch Mist blow

Reduces cutting remain by approx. 60% compared to conventional tools

Bottom face finishing example

2 Flutes

Tool size：φ1×R0.2 (DC .039 inch × R .008 inch)
Under neck length 2mm (.079 inch)
Work material：STAVAX(52HRC)
Machine：Vertical MC (HSK-E32)
Cutting conditions：
n=40,000min^{-1} (v_c=410 SFM)
v_f=15.6 IPM (f_z=.0002 IPT)
a_p .0002 inch a_e .0002 inch
Water base Wet

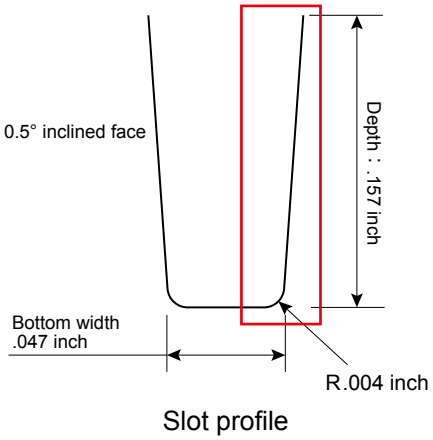
Maintains a smooth high-quality surface even after 11 hours of continuous milling

The machining conditions can be adjusted to achieve an even higher quality machined face

Deep slot machining example

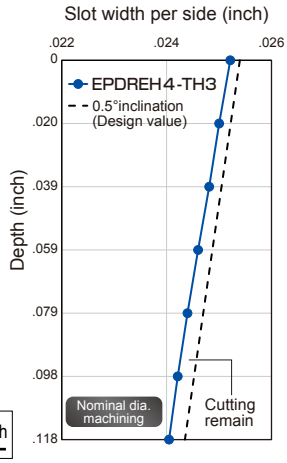
4 Flutes

Contour finishing, deep slot profile, work material: D2 (60 HRC), machining time: 30 mins

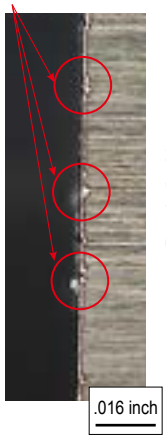


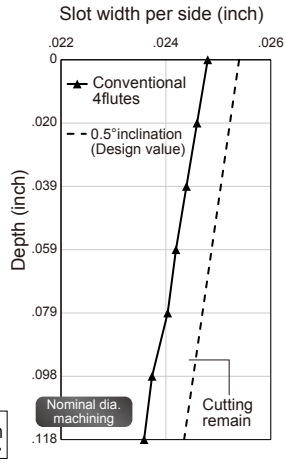
EPDREH4-TH3 | Conventional 4flutes radius end mill

No burrs



Burrs





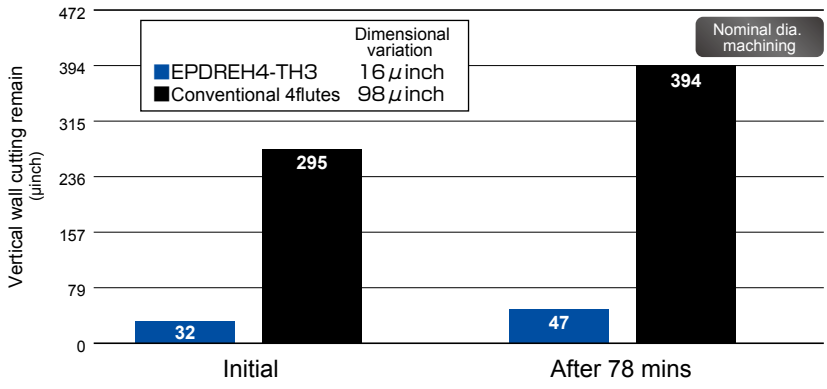
Tool size：φ1×R0.1 (DC .039 inch × R .004 inch) Under neck length 4mm (.157 inch) Work material：D2 (60HRC)
Machine：Vertical MC (HSK-E25) Cutting conditions：n=18,200min^{-1}(v_c=187 SFM) v_f=51.6 IPM (f_z=.0007 IPT) a_p .002 inch a_e .008 inch Air blow

Deep slots can be milled with precision and without burrs

Vertical wall finishing example

4 Flutes

Vertical wall finising, contour milling, work material: STAVAX, total finishing time: 78 mins



Machining shape φ.347 inch × Depth .059 inch

Process	Tools	Tool dia.	Corner radius RE	Revolution n (min^{-1})	Cutting speed v_c (SFM)	Feed rate v_f (IPM)	Feed per tooth f_z (IPT)	a_p (inch)	Finishing allowance (inch)	Coolant
Semi-finishing	EPDREH4010-3-01-TH3	1	0.1	25,000	259	23.6	.0002	.002	.0004	Mist blow
FInishing	EPDREH4010-3-01-TH3	1	0.1	25,000	259	11.8	.0001	.001	0	Mist blow

Offers high-accuracy machining with dimensional variation of just 16 μinch after 1 hour of finishing machining

Notes

⚠ Safety notes

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.

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. H2202A-1 | 2022-01

From now on, deep cutting is ...

Deeper!! From electrodischarge machining to direct machining

Faster!! To higher-efficient direct machining

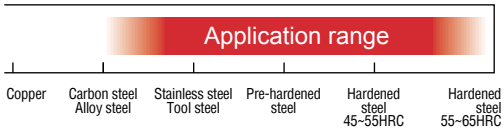
Features of ETR(P)-TH

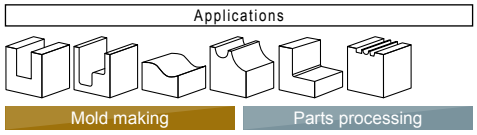
Small-diameter deep-cutting corner radius end mill for high-efficient machining
responds to demands for shortening mold delivery times.

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!

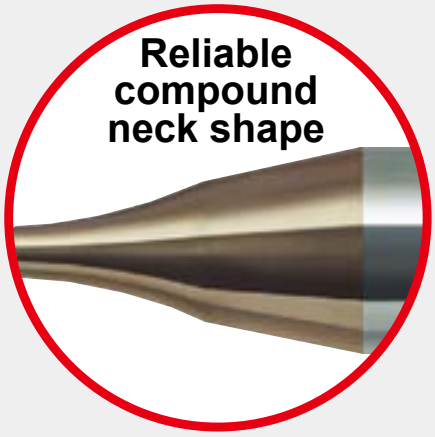




ETR-TH	φ1～φ3	[44 Items]
ETRP-TH	φ1～φ3	[49 Items]
ETM-TH	φ2～φ20	[10 Items]
ETMLN-TH	φ4～φ16	[16 Items]
ETMP-TH	φ2～φ16	[25 Items]

Features 01 Compound neck shape

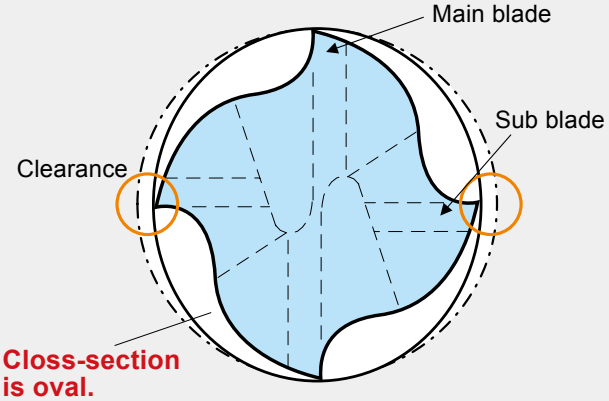
The compound neck shape with results proven by the Epoch Deep Series is used.
Breakage resistance is improved even for end mills with long below-neck lengths, so that stable deep machining can be performed.



Features 02 Oval effect

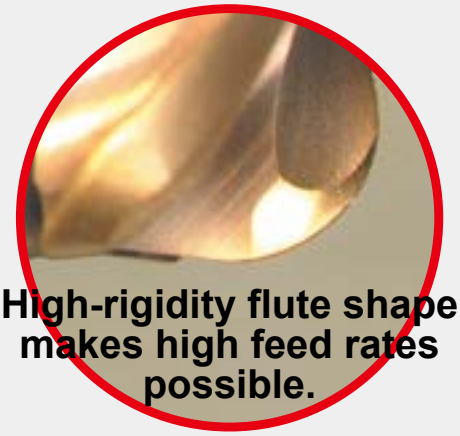
The flute cross-section is the oval shape with results proven by Epoch Turbo Mills.
It suppresses vibrations, particularly when machining corner areas, so that stable high-efficient cutting can be performed.

Reliable oval shape



Features 03 High-rigidity flute shape

The corner R flute shape is the same chipping-resistant, high-rigidity flute type that is used the the Epoch Turbo Mills. Machining with high per-flute feed amounts is possible and increases machining efficiency.



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 is able to withstand high cutting temperatures.
  Through the use of a new structure made up of nanocrystal material, a higher hardness of coating is achieved.
- 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: LU)

(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		

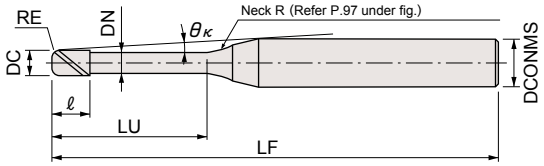
※For items larger than φ4, refer to catalog pages 102 and 103. ● : indicates Turbo Mill lineup. ( ) shows Under neck length.

Line up, Epoch Turbo Rib (Metric)

Straight Neck type

Tolerance on RE : ±0.01

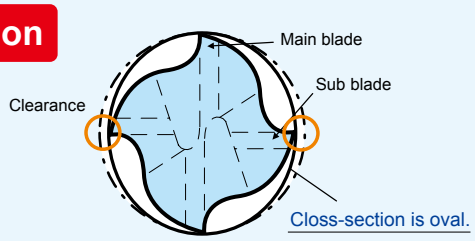
Tolerance on Shank : h5



ETR4○○○○-○○-○○-TH

Item code	Stock	Size (mm)								Interference angle	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						
		DC	RE	LU	ℓ	DN	LF	DCONMS		θκ	0.5°	1°	1.5°	2°	3°
ETR4010-5-02-TH	●	1 (.039inch)	0.2 (.008inch)	5 (.197inch)	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 (.295inch)	1	0.94	50	6	4	7.42	8.39	8.68	8.91	9.11	10.07
ETR4010-10-02-TH	●			10 (.394inch)	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 (.492inch)	1	0.94	60	6	4	5.90	13.57	13.94	14.38	15.08	16.71
ETR4010-15-02-TH	●			15 (.591inch)	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 (.689inch)	1	0.94	60	6	4	4.90	18.72	19.20	20.09	21.07	23.35
ETR4010-20-02-TH	●			20 (.787inch)	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 (.886inch)	1	0.94	70	6	4	4.19	23.85	24.64	25.79	27.05	29.98
ETR4010-25-02-TH	●			25 (.984inch)	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 (1.083inch)	1	0.94	70	6	4	3.65	28.97	30.09	31.49	33.03	36.62
ETR4010-30-02-TH	●			30 (1.181inch)	1	0.94	70	6	4	3.44	31.52	32.82	34.34	36.02	39.94
ETR40125-5-02-TH	●	1.25 (.049inch)	0.2 (.008inch)	5 (.197inch)	1.25	1.18	50	6	4	8.38	5.81	6.03	6.22	6.39	6.79
ETR40125-10-02-TH	●			10 (.394inch)	1.25	1.18	50	6	4	6.42	11.00	11.33	11.59	12.12	13.42
ETR40125-15-02-TH	●			15 (.591inch)	1.25	1.18	60	6	4	5.20	16.16	16.56	17.26	18.10	20.06
ETR40125-20-02-TH	●			20 (.787inch)	1.25	1.18	60	6	4	4.37	21.30	21.95	22.97	24.09	26.69
ETR40125-25-02-TH	●			25 (.984inch)	1.25	1.18	70	6	4	3.77	26.42	27.39	28.67	30.07	33.33
ETR40125-30-02-TH	●			30 (1.181inch)	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 (.059inch)	0.3 (.012inch)	5 (.197inch)	1.5	1.42	50	6	4	8.28	5.83	6.05	6.23	6.40	6.79
ETR4015-10-03-TH	●			10 (.394inch)	1.5	1.42	50	6	4	6.28	11.02	11.34	11.60	12.13	13.42
ETR4015-15-03-TH	●			15 (.591inch)	1.5	1.42	60	6	4	5.05	16.18	16.57	17.28	18.11	20.06
ETR4015-20-03-TH	●			20 (.787inch)	1.5	1.42	60	6	4	4.23	21.31	21.96	22.98	24.09	26.69
ETR4015-25-03-TH	●			25 (.984inch)	1.5	1.42	70	6	4	3.63	26.43	27.41	28.68	30.08	33.33
ETR4015-30-03-TH	●			30 (1.181inch)	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 (.069inch)	0.3 (.012inch)	10 (.394inch)	1.75	1.65	50	6	4	6.09	11.06	11.37	11.63	12.18	13.48
ETR40175-20-03-TH	●			20 (.787inch)	1.75	1.65	60	6	4	4.07	21.34	22.01	23.03	24.15	26.76
ETR40175-30-03-TH	●			30 (1.181inch)	1.75	1.65	70	6	4	3.05	31.57	32.91	34.44	36.12	40.03
ETR40175-40-03-TH	●			40 (1.575inch)	1.75	1.65	80	6	4	2.44	41.94	43.80	45.84	48.08	No interference
ETR4020-10-05-TH	●	2 (.079inch)	0.5 (.020inch)	10 (.394inch)	2	1.92	50	6	4	5.98	11.01	11.33	11.59	12.09	13.36
ETR4020-15-05-TH	●			15 (.591inch)	2	1.92	60	6	4	4.75	16.17	16.56	17.25	18.07	19.99
ETR4020-20-05-TH	●			20 (.787inch)	2	1.92	60	6	4	3.94	21.31	21.95	22.95	24.06	26.63
ETR4020-25-05-TH	●			25 (.984inch)	2	1.92	70	6	4	3.36	26.43	27.39	28.65	30.04	33.27
ETR4020-30-05-TH	●			30 (1.181inch)	2	1.92	70	6	4	2.93	31.54	32.84	34.36	36.02	No interference
ETR4020-35-05-TH	●			35 (1.378inch)	2	1.92	80	6	4	2.60	36.67	38.29	40.06	42.00	No interference
ETR4020-40-05-TH	●			40 (1.575inch)	2	1.92	80	6	4	2.34	41.88	43.73	45.76	47.99	No interference
ETR4025-10-05-TH	●	2.5 (.098inch)	0.5 (.020inch)	10 (.394inch)	2.5	2.4	50	6	4	5.57	11.05	11.36	11.61	12.15	13.42
ETR4025-20-05-TH	●			20 (.787inch)	2.5	2.4	60	6	4	3.59	21.34	22.00	23.00	24.11	26.69
ETR4025-30-05-TH	●			30 (1.181inch)	2.5	2.4	70	6	4	2.64	31.57	32.89	34.41	36.08	No interference
ETR4025-40-05-TH	●			40 (1.575inch)	2.5	2.4	80	6	4	2.09	41.93	43.79	45.81	48.04	No interference
ETR4025-50-05-TH	●			50 (1.969inch)	2.5	2.4	90	6	4	1.73	52.36	54.68	57.22	No interference	No interference
ETR4030-10-08-TH	●	3 (.118inch)	0.8 (.031inch)	10 (.394inch)	3	2.86	50	6	4	5.17	11.12	11.40	11.66	12.20	13.45
ETR4030-20-08-TH	●			20 (.787inch)	3	2.86	60	6	4	3.23	21.39	22.07	23.07	24.17	26.72
ETR4030-30-08-TH	●			30 (1.181inch)	3	2.86	70	6	4	2.35	31.61	32.97	34.47	36.13	No interference
ETR4030-40-08-TH	●			40 (1.575inch)	3	2.86	80	6	4	1.85	42.02	43.86	45.88	No interference	No interference
ETR4030-50-08-TH	●			50 (1.969inch)	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.

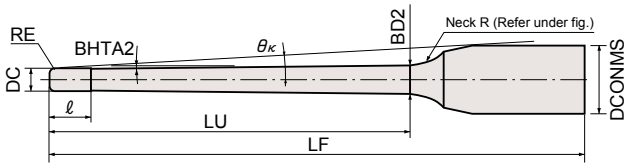
The tool is designed with a smaller outer diameter connected to end sub blades. When measuring tool diameter or run out, measure the main blades.

● : Inventory maintained in US ★ : Inventory maintained in Japan

Pencil Neck type

Tolerance on RE : ±0.01

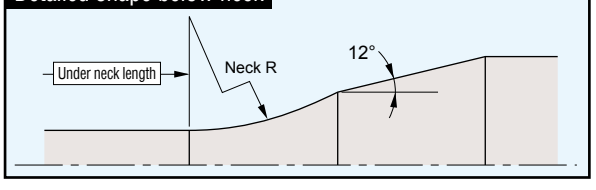
Tolerance on Shank : h5



ETRP4○○○○-○○-○○○○-TH

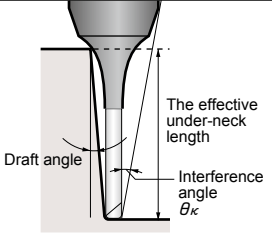
Item code	Stock	Size (mm)									Interference angle	The effective under-neck length for the various draft angles				
		Tool dia.	Corner radius	Under neck length	Neck angle	Flute length	Under neck dia.	Overall length	Shank dia.	Neck R						
		DC	RE	LU	BHTA2	ℓ	BD2	LF	DCONMS		θκ	0°	1°	1.5°	2°	3°
ETRP4010-5-0902-TH	●	1 (.039inch)	0.2 (.008inch)	5 (.197inch)	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 (.295inch)	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 (.394inch)	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 (.591inch)	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 (.787inch)	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 (.984inch)	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 (1.181inch)	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 (1.378inch)	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 (1.575inch)	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 (1.772inch)	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 (1.969inch)	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 (.049inch)	0.2 (.008inch)	10 (.394inch)	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 (.591inch)	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 (.787inch)	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 (1.181inch)	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 (1.575inch)	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 (1.969inch)	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 (.059inch)	0.3 (.012inch)	10 (.394inch)	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 (.591inch)	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 (.787inch)	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 (1.181inch)	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 (1.575inch)	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 (1.969inch)	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 (.069inch)	0.3 (.012inch)	10 (.394inch)	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 (.591inch)	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 (.787inch)	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 (1.181inch)	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 (1.575inch)	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 (1.969inch)	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 (.079inch)	0.5 (.020inch)	15 (.591inch)	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 (.787inch)	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 (.984inch)	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 (1.181inch)	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 (1.378inch)	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 (1.575inch)	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 (1.772inch)	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 (1.969inch)	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 (2.165inch)	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 (2.362inch)	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 (.098inch)	0.5 (.020inch)	20 (.787inch)	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 (1.181inch)	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 (1.575inch)	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 (1.969inch)	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 (2.362inch)	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 (.118inch)	0.8 (.031inch)	20 (.787inch)	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 (1.181inch)	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 (1.575inch)	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 (1.969inch)	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 (2.362inch)	0.9	3	4.651	110	6	10	1.37	7.45	62.20	No interference	No interference	No interference

Detailed shape below neck



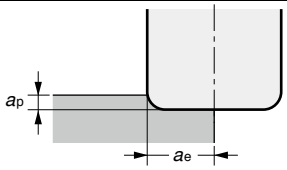
【Note】

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 Conditions, Epoch Turbo Rib (Inch)

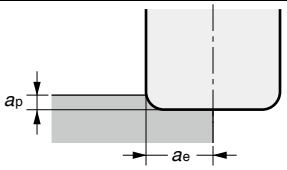
Straight Neck type ETR



Work material		Cast Iron, Carbon Steel, Alloy Steel (150～250HB)				Tool Steel, (25～35HRC)				Pre-hardened Steel (35～45HRC)				Hardened Steel (45～55HRC)				Hardened Steel (55～60HRC)			
DC (inch)	LU (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)
.039	.197	32,000	229.1	.0016	.0197	27,100	177.6	.0016	.0197	22,300	114.2	.0013	.0197	19,100	97.6	.0008	.0197	15,900	33.0	.0005	.0197
	.295	32,000	229.1	.0011	.0197	27,100	177.6	.0011	.0197	22,300	114.2	.0008	.0197	19,100	97.6	.0005	.0197	15,900	33.0	.0003	.0197
	.394	32,000	229.1	.0008	.0197	27,100	177.6	.0008	.0197	22,300	114.2	.0006	.0197	19,100	97.6	.0004	.0197	15,900	33.0	.0002	.0197
	.492	28,800	206.3	.0006	.0197	24,400	159.8	.0006	.0197	20,100	102.8	.0005	.0197	17,200	87.8	.0003	.0197	14,300	30.0	.0002	.0197
	.591	28,800	206.3	.0005	.0197	24,400	159.8	.0005	.0197	20,100	102.8	.0004	.0197	17,200	87.8	.0003	.0197	14,300	30.0	.0002	.0197
	.689	25,600	183.5	.0004	.0197	21,700	142.1	.0004	.0197	17,800	91.3	.0004	.0197	15,300	78.0	.0002	.0197	12,700	26.0	.0001	.0197
	.787	25,600	183.5	.0004	.0197	21,700	142.1	.0004	.0197	17,800	91.3	.0003	.0197	15,300	78.0	.0002	.0197	12,700	26.0	.0001	.0197
	.886	22,400	160.2	.0004	.0197	19,000	124.4	.0004	.0197	15,600	79.9	.0003	.0197	13,400	68.5	.0002	.0197	11,100	23.0	.0001	.0197
	.984	22,400	160.2	.0003	.0197	19,000	124.4	.0003	.0197	15,600	79.9	.0002	.0197	13,400	68.5	.0002	.0197	11,100	23.0	.0001	.0197
	1.083	19,200	137.4	.0003	.0197	16,300	106.7	.0003	.0197	13,400	68.5	.0002	.0197	11,500	58.7	.0002	.0197	9,500	20.0	.0001	.0197
	1.181	19,200	137.4	.0003	.0197	16,300	106.7	.0003	.0197	13,400	68.5	.0002	.0197	11,500	58.7	.0001	.0197	9,500	20.0	.0001	.0197
.049	.197	25,000	241.3	.0025	.0244	21,600	190.6	.0025	.0244	17,800	122.8	.0020	.0244	15,300	105.5	.0012	.0244	12,700	35.0	.0007	.0244
	.394	25,000	241.3	.0012	.0244	21,600	190.6	.0012	.0244	17,800	122.8	.0010	.0244	15,300	105.5	.0006	.0244	12,700	35.0	.0004	.0244
	.591	22,500	217.3	.0008	.0244	19,400	171.7	.0008	.0244	16,000	110.6	.0007	.0244	13,800	94.9	.0004	.0244	11,400	31.5	.0002	.0244
	.787	20,000	192.9	.0006	.0244	17,300	152.4	.0006	.0244	14,200	98.4	.0005	.0244	12,200	84.3	.0003	.0244	10,200	28.0	.0002	.0244
	.984	20,000	192.9	.0005	.0244	17,300	152.4	.0005	.0244	14,200	98.4	.0004	.0244	12,200	84.3	.0002	.0244	10,200	28.0	.0002	.0244
	1.181	17,500	168.9	.0004	.0244	15,100	133.5	.0004	.0244	12,500	85.8	.0003	.0244	10,700	74.0	.0002	.0244	8,900	24.4	.0001	.0244
.059	.197	21,000	260.6	.0035	.0295	18,000	203.9	.0035	.0295	14,900	131.9	.0028	.0295	12,700	112.6	.0018	.0295	10,600	37.4	.0011	.0295
	.394	21,000	260.6	.0018	.0295	18,000	203.9	.0018	.0295	14,900	131.9	.0014	.0295	12,700	112.6	.0009	.0295	10,600	37.4	.0006	.0295
	.591	21,000	260.6	.0012	.0295	18,000	203.9	.0012	.0295	14,900	131.9	.0009	.0295	12,700	112.6	.0006	.0295	10,600	37.4	.0004	.0295
	.787	18,900	234.6	.0009	.0295	16,200	183.5	.0009	.0295	13,400	118.9	.0007	.0295	11,400	101.2	.0004	.0295	9,500	33.9	.0003	.0295
	.984	16,800	208.7	.0007	.0295	14,400	163.0	.0007	.0295	11,900	105.5	.0006	.0295	10,200	90.2	.0004	.0295	8,500	29.9	.0002	.0295
	1.181	16,800	208.7	.0006	.0295	14,400	163.0	.0006	.0295	11,900	105.5	.0005	.0295	10,200	90.2	.0003	.0295	8,500	29.9	.0002	.0295
.069	.394	18,000	278.0	.0024	.0343	15,500	218.9	.0024	.0343	12,700	140.2	.0019	.0343	10,900	120.1	.0012	.0343	9,100	40.2	.0007	.0343
	.787	16,200	250.0	.0012	.0343	14,000	196.9	.0012	.0343	11,400	126.0	.0010	.0343	9,800	108.3	.0006	.0343	8,200	36.2	.0004	.0343
	1.181	14,400	222.4	.0008	.0343	12,400	175.2	.0008	.0343	10,200	112.2	.0006	.0343	8,700	96.1	.0004	.0343	7,300	32.3	.0002	.0343
	1.575	12,600	194.5	.0006	.0343	10,900	153.2	.0006	.0343	8,900	98.0	.0005	.0343	7,600	84.3	.0003	.0343	6,400	28.0	.0002	.0343
.079	.394	16,000	300.0	.0031	.0394	13,500	231.5	.0031	.0394	11,100	148.4	.0025	.0394	9,500	127.2	.0016	.0394	8,000	42.9	.0009	.0394
	.591	16,000	300.0	.0021	.0394	13,500	231.5	.0021	.0394	11,100	148.4	.0017	.0394	9,500	127.2	.0011	.0394	8,000	42.9	.0006	.0394
	.787	16,000	300.0	.0016	.0394	13,500	231.5	.0016	.0394	11,100	148.4	.0013	.0394	9,500	127.2	.0008	.0394	8,000	42.9	.0005	.0394
	.984	14,400	270.1	.0013	.0394	12,200	208.3	.0013	.0394	10,000	133.5	.0010	.0394	8,600	114.6	.0006	.0394	7,200	38.6	.0004	.0394
	1.181	14,400	270.1	.0011	.0394	12,200	208.3	.0011	.0394	10,000	133.5	.0008	.0394	8,600	114.6	.0005	.0394	7,200	38.6	.0003	.0394
	1.378	12,800	240.2	.0009	.0394	10,800	185.0	.0009	.0394	8,900	118.9	.0007	.0394	7,600	101.6	.0004	.0394	6,400	34.3	.0003	.0394
	1.575	12,800	240.2	.0008	.0394	10,800	185.0	.0008	.0394	8,900	118.9	.0006	.0394	7,600	101.6	.0004	.0394	6,400	34.3	.0002	.0394
.098	.394	13,000	322.4	.0049	.0492	10,800	244.9	.0049	.0492	8,900	157.9	.0039	.0492	7,600	134.6	.0025	.0492	6,400	45.3	.0015	.0492
	.787	13,000	322.4	.0025	.0492	10,800	244.9	.0025	.0492	8,900	157.9	.0020	.0492	7,600	134.6	.0012	.0492	6,400	45.3	.0007	.0492
	1.181	11,700	290.2	.0017	.0492	9,700	220.5	.0017	.0492	8,000	142.1	.0013	.0492	6,800	121.3	.0008	.0492	5,800	40.9	.0005	.0492
	1.575	10,400	257.9	.0012	.0492	8,600	196.1	.0012	.0492	7,100	126.4	.0010	.0492	6,100	107.9	.0006	.0492	5,100	36.2	.0004	.0492
	1.969	10,400	257.9	.0010	.0492	8,600	196.1	.0010	.0492	7,100	126.4	.0008	.0492	6,100	107.9	.0005	.0492	5,100	36.2	.0003	.0492
.118	.394	10,600	333.1	.0071	.0551	9,000	258.7	.0071	.0551	7,400	166.1	.0057	.0551	6,400	143.7	.0035	.0551	5,300	47.6	.0021	.0551
	.787	10,600	333.1	.0035	.0551	9,000	258.7	.0035	.0551	7,400	166.1	.0028	.0551	6,400	143.7	.0018	.0551	5,300	47.6	.0011	.0551
	1.181	10,600	333.1	.0024	.0551	9,000	258.7	.0024	.0551	7,400	166.1	.0019	.0551	6,400	143.7	.0012	.0551	5,300	47.6	.0007	.0551
	1.575	9,540	299.6	.0018	.0551	8,100	232.7	.0018	.0551	6,700	149.6	.0014	.0551	5,800	129.5	.0009	.0551	4,800	42.9	.0006	.0551
	1.969	8,480	266.5	.0014	.0551	7,200	207.1	.0014	.0551	5,900	133.1	.0011	.0551	5,100	115.0	.0007	.0551	4,200	38.2	.0004	.0551

【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.

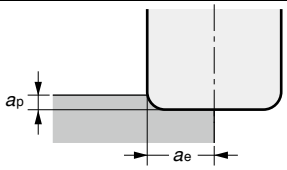
Pencil Neck type ETRP



Work material		Cast Iron, Carbon Steel, Alloy Steel (150～250HB)				Tool Steel, (25～35HRC)				Pre-hardened Steel (35～45HRC)				Hardened Steel (45～55HRC)				Hardened Steel (55～60HRC)			
DC (inch)	LU (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)	RPM (min^{-1})	Feed rate (IPM)	a_p (inch)	a_e (inch)
.039	.197	32,000	229.1	.0024	.0197	27,100	177.6	.0024	.0197	22,300	114.2	.0019	.0197	19,100	97.6	.0012	.0197	15,900	32.7	.0007	.0197
	.295	32,000	229.1	.0018	.0197	27,100	177.6	.0018	.0197	22,300	114.2	.0014	.0197	19,100	97.6	.0009	.0197	15,900	32.7	.0005	.0197
	.394	32,000	229.1	.0012	.0197	27,100	177.6	.0012	.0197	22,300	114.2	.0009	.0197	19,100	97.6	.0006	.0197	15,900	32.7	.0004	.0197
	.591	28,800	206.3	.0008	.0197	24,400	159.8	.0008	.0197	20,100	102.8	.0006	.0197	17,200	87.8	.0004	.0197	14,300	29.5	.0002	.0197
	.787	28,800	206.3	.0006	.0197	24,400	159.8	.0006	.0197	20,100	102.8	.0005	.0197	17,200	87.8	.0003	.0197	14,300	29.5	.0002	.0197
	.984	25,600	183.5	.0005	.0197	21,700	142.1	.0005	.0197	17,800	91.3	.0004	.0197	15,300	78.0	.0002	.0197	12,700	26.0	.0002	.0197
	1.181	24,000	172.0	.0004	.0197	20,300	133.1	.0004	.0197	16,700	85.8	.0003	.0197	14,300	73.2	.0002	.0197	11,900	24.4	.0001	.0197
	1.378	22,400	160.2	.0004	.0197	19,000	124.4	.0004	.0197	15,600	79.9	.0003	.0197	13,400	68.5	.0002	.0197	11,100	22.8	.0001	.0197
	1.575	20,800	148.8	.0003	.0197	17,600	115.4	.0003	.0197	14,500	74.4	.0002	.0197	12,400	63.4	.0002	.0197	10,300	21.3	.0001	.0197
	1.772	19,200	137.4	.0003	.0197	16,300	106.7	.0003	.0197	13,400	68.5	.0002	.0197	11,500	58.7	.0001	.0197	9,500	19.7	.0001	.0197
	1.969	16,000	114.6	.0002	.0197	13,600	89.0	.0002	.0197	11,200	57.1	.0002	.0197	9,600	48.8	.0001	.0197	8,000	16.5	.0001	.0197
.049	.394	25,000	241.3	.0019	.0244	21,600	190.6	.0019	.0244	17,800	122.8	.0015	.0244	15,300	105.5	.0009	.0244	12,700	35.0	.0006	.0244
	.591	23,800	229.5	.0014	.0244	20,500	181.1	.0014	.0244	16,900	116.7	.0011	.0244	14,550	100.2	.0007	.0244	12,050	33.3	.0004	.0244
	.787	22,500	217.3	.0009	.0244	19,400	171.7	.0009	.0244	16,000	110.6	.0007	.0244	13,800	94.9	.0005	.0244	11,400	31.5	.0003	.0244
	1.181	20,000	192.9	.0006	.0244	17,300	152.4	.0006	.0244	14,200	98.4	.0005	.0244	12,200	84.3	.0003	.0244	10,200	28.0	.0002	.0244
	1.575	17,500	168.9	.0005	.0244	15,100	133.5	.0005	.0244	12,500	85.8	.0004	.0244	10,700	74.0	.0002	.0244	8,900	24.4	.0002	.0244
	1.969	16,300	156.7	.0004	.0244	14,000	124.0	.0004	.0244	11,600	79.9	.0003	.0244	9,900	68.5	.0002	.0244	8,300	22.8	.0001	.0244
.059	.394	21,000	260.6	.0027	.0295	18,000	203.9	.0027	.0295	14,900	131.9	.0021	.0295	12,700	112.6	.0013	.0295	10,600	37.4	.0008	.0295
	.591	21,000	260.6	.0020	.0295	18,000	203.9	.0020	.0295	14,900	131.9	.0016	.0295	12,700	112.6	.0010	.0295	10,600	37.4	.0006	.0295
	.787	18,900	234.6	.0013	.0295	16,200	183.5	.0013	.0295	13,400	118.9	.0011	.0295	11,400	101.2	.0007	.0295	9,500	33.9	.0004	.0295
	1.181	18,900	234.6	.0009	.0295	16,200	183.5	.0009	.0295	13,400	118.9	.0007	.0295	11,400	101.2	.0004	.0295	9,500	33.9	.0003	.0295
	1.575	15,800	195.7	.0007	.0295	13,500	153.1	.0007	.0295	11,200	98.8	.0006	.0295	9,500	84.6	.0003	.0295	8,000	28.0	.0002	.0295
	1.969	14,700	182.3	.0006	.0295	12,600	142.9	.0006	.0295	10,400	92.5	.0004	.0295	8,900	78.7	.0003	.0295	7,400	26.4	.0002	.0295
.069	.394	18,000	278.0	.0036	.0343	15,500	218.9	.0036	.0343	12,700	140.2	.0029	.0343	10,900	120.1	.0018	.0343	9,100	40.2	.0011	.0343
	.591	18,000	278.0	.0027	.0343	15,500	218.9	.0027	.0343	12,700	140.2	.0022	.0343	10,900	120.1	.0014	.0343	9,100	40.2	.0008	.0343
	.787	16,200	250.0	.0018	.0343	14,000	196.9	.0018	.0343	11,400	126.0	.0015	.0343	9,800	108.3	.0009	.0343	8,200	36.2	.0006	.0343
	1.181	16,200	250.0	.0012	.0343	14,000	196.9	.0012	.0343	11,400	126.0	.0010	.0343	9,800	108.3	.0006	.0343	8,200	36.2	.0004	.0343
	1.575	14,400	222.4	.0009	.0343	12,400	175.2	.0009	.0343	10,200	112.2	.0007	.0343	8,700	96.1	.0004	.0343	7,300	32.3	.0003	.0343
	1.969	13,500	208.7	.0007	.0343	11,600	164.2	.0007	.0343	9,500	105.1	.0006	.0343	8,200	90.2	.0004	.0343	6,800	30.3	.0002	.0343
.079	.591	16,000	300.0	.0031	.0394	13,500	231.5	.0031	.0394	11,100	148.4	.0025	.0394	9,500	127.2	.0016	.0394	8,000	42.9	.0009	.0394
	.787	16,000	300.0	.0024	.0394	13,500	231.5	.0024	.0394	11,100	148.4	.0019	.0394	9,500	127.2	.0012	.0394	8,000	42.9	.0007	.0394
	.984	14,400	270.1	.0019	.0394	12,200	208.3	.0019	.0394	10,000	133.5	.0015	.0394	8,600	114.6	.0009	.0394	7,200	38.6	.0006	.0394
	1.181	14,400	270.1	.0016	.0394	12,200	208.3	.0016	.0394	10,000	133.5	.0013	.0394	8,600	114.6	.0008	.0394	7,200	38.6	.0005	.0394
	1.378	14,400	270.1	.0013	.0394	12,200	208.3	.0013	.0394	10,000	133.5	.0011	.0394	8,600	114.6	.0007	.0394	7,200	38.6	.0004	.0394
	1.575	14,400	270.1	.0012	.0394	12,200	208.3	.0012	.0394	10,000	133.5	.0009	.0394	8,600	114.6	.0006	.0394	7,200	38.6	.0004	.0394
	1.772	12,800	240.2	.0011	.0394	10,800	185.0	.0011	.0394	8,900	118.9	.0008	.0394	7,600	101.6	.0005	.0394	6,400	34.3	.0003	.0394
	1.969	12,800	240.2	.0009	.0394	10,800	185.0	.0009	.0394	8,900	118.9	.0007	.0394	7,600	101.6	.0005	.0394	6,400	34.3	.0003	.0394
	2.165	12,000	225.2	.0009	.0394	10,100	173.6	.0009	.0394	8,300	111.4	.0007	.0394	7,100	95.3	.0004	.0394	6,000	32.3	.0003	.0394
	2.362	12,000	225.2	.0008	.0394	10,100	173.6	.0008	.0394	8,300	111.4	.0006	.0394	7,100	95.3	.0004	.0394	6,000	32.3	.0002	.0394
.098	.787	13,000	322.4	.0037	.0492	10,800	244.9	.0037	.0492	8,900	157.9	.0030	.0492	7,600	134.6	.0019	.0492	6,400	45.3	.0011	.0492
	1.181	11,700	290.2	.0025	.0492	9,700	220.5	.0025	.0492	8,000	142.1	.0020	.0492	6,800	121.3	.0012	.0492	5,800	40.9	.0007	.0492
	1.575	11,700	290.2	.0019	.0492	9,700	220.5	.0019	.0492	8,000	142.1	.0015	.0492	6,800	121.3	.0009	.0492	5,800	40.9	.0006	.0492
	1.969	11,700	290.2	.0015	.0492	9,700	220.5	.0015	.0492	8,000	142.1	.0012	.0492	6,800	121.3	.0007	.0492	5,800	40.9	.0004	.0492
	2.362	10,400	257.9	.0012	.0492	8,600	196.1	.0012	.0492	7,100	126.4	.0010	.0492	6,100	107.9	.0006	.0492	5,100	36.2	.0004	.0492
.118	.787	10,600	333.1	.0053	.0551	9,000	258.7	.0053	.0551	7,400	166.1	.0043	.0551	6,400	143.7	.0027	.0551	5,300	47.6	.0016	.0551
	1.181	10,600	333.1	.0035	.0551	9,000	258.7	.0035	.0551	7,400	166.1	.0028	.0551	6,400	143.7	.0018	.0551	5,300	47.6	.0011	.0551
	1.575	9,500	299.6	.0027	.0551	8,100	232.7	.0027	.0551	6,700	149.6	.0021	.0551	5,800	129.5	.0013	.0551	4,800	42.9	.0008	.0551
	1.969	9,500	299.6	.0021	.0551	8,100	232.7	.0021	.0551	6,700	149.6	.0017	.0551	5,800	129.5	.0011	.0551	4,800	42.9	.0006	.0551
	2.362	9,500	299.6	.0018	.0551	8,100	232.7	.0018	.0551	6,700	149.6	.0014	.0551	5,800	129.5	.0009	.0551	4,800	42.9	.0006	.0551

Recommended Cutting Conditions, Epoch Turbo Rib (Metric)

Straight Neck type ETR

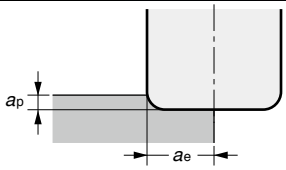


Work material		Cast Iron, Carbon Steel, Alloy Steel (150～250HB)				Tool Steel, (25～35HRC)				Pre-hardened Steel (35～45HRC)				Hardened Steel (45～55HRC)				Hardened Steel (55～60HRC)			
DC (mm)	LU (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (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

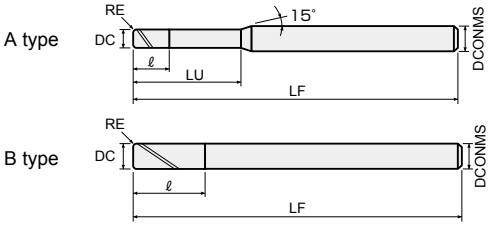


Work material		Cast Iron, Carbon Steel, Alloy Steel (150～250HB)				Tool Steel, (25～35HRC)				Pre-hardened Steel (35～45HRC)				Hardened Steel (45～55HRC)				Hardened Steel (55～60HRC)			
DC (mm)	LU (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (mm)	RPM (min^{-1})	Feed rate (mm/min)	a_p (mm)	a_e (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 (Metric)

Straight Neck type

Tolerance on RE : ±0.015　　Tolerance on shank : h5

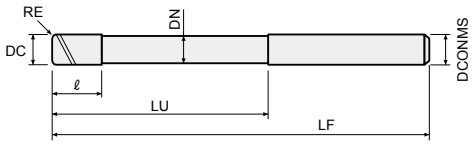


ETM4○○○-○○-TH

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 (.079inch)	0.5	6	4	70	6	A
ETM4030-08-TH	●	3 (.118inch)	0.8	9	6	70	6	
ETM4040-10-TH	●	4 (.157inch)	1.0	12	8	70	6	
ETM4050-12-TH	●	5 (.197inch)	1.2	15	10	70	6	
ETM4060-15-TH	●	6 (.236inch)	1.5	—	12	90	6	B
ETM4080-20-TH	●	8 (.315inch)	2.0	—	16	100	8	
ETM4100-20-TH	●	10 (.394inch)	2.0	—	20	110	10	
ETM4120-20-TH	●	12 (.472inch)	2.0	—	24	120	12	
ETM4160-30-TH	★	16 (.630inch)	3.0	—	32	140	16	
ETM4200-30-TH	★	20 (.787inch)	3.0	—	40	150	20	

Long Neck type

Tolerance on RE : ±0.015　　Tolerance on shank : h5



ETMLN4○○○-○○○-○○-TH

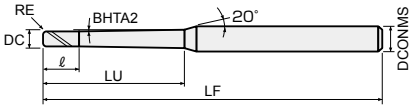
Item code	Stock	Size (mm)						
		Tool dia.	Corner radius	Under neck length	Flute length	Neck dia.	Overall length	Shank dia.
		DC	RE	LU	ℓ	DN	LF	DCONMS
ETMLN4040-20-10-TH	★	4 (.157inch)	1.0	20	6	3.8	70	4
ETMLN4040-28-10-TH	★			28	6	3.8	70	4
ETMLN4060-30-15-TH	★	6 (.236inch)	1.5	30	9	5.7	75	6
ETMLN4060-42-15-TH	★			42	9	5.7	90	6
ETMLN4060-54-15-TH	★			54	9	5.7	100	6
ETMLN4080-40-20-TH	★	8 (.315inch)	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 (.394inch)	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 (.472inch)	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 (.630inch)	3.0	80	24	15.5	140	16
ETMLN4160-120-30-TH	★			120	24	15.5	175	16

● : Inventory maintained in US　★ : Inventory maintained in Japan

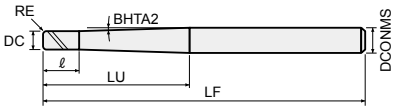
Pencil Neck type

Tolerance on RE：±0.015　　Tolerance on shank：h5

A type



B type

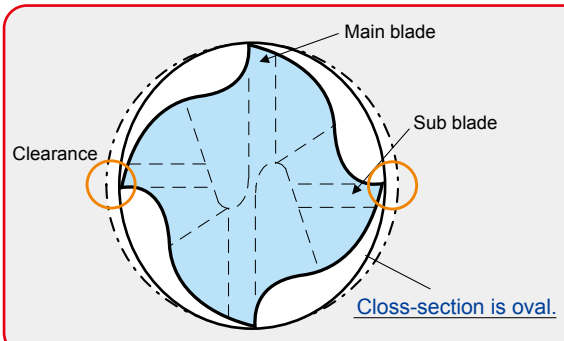


ETMP4○○○-○○○-○○-TH

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 (.079inch)	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 (.118inch)	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 (.157inch)	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 (.197inch)	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 (.236inch)	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 (.315inch)	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 (.394inch)	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 (.472inch)	2.0	80	18	1°	135	16	A
ETMP4120-105-20-TH	★			105	18	1°	160	16	A
ETMP4160-105-30-TH	★	16 (.630inch)	3.0	105	24	1°	160	20	A
ETMP4160-140-30-TH	★			140	24	1°	200	20	B

● : Inventory maintained in US　★ : Inventory maintained in Japan

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 Conditions, Epoch Turbo Mill (Inch)

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 Iron Carbon Steel, Alloy Steel (150～250HB)			Tool Steel (25～35HRC)			Pre-hardened Steel (35～45HRC)			Hardened Steel (45～55HRC)			Hardened Steel (55～60HRC)		
Ratio to standard depth of cut	100%			100%			100%			70%			50%		
Tool dia. (inch)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)
.079	12,000	.004	211.8	11,000	.004	177.6	10,000	.003	126.0	8,000	.003	100.8	8,000	.001	40.2
.118	8,000	.007	238.2	7,400	.007	201.2	6,900	.006	146.9	5,300	.006	112.6	5,300	.002	44.9
.157	6,000	.011	251.2	5,600	.009	214.6	5,200	.007	155.5	4,000	.007	119.7	4,000	.003	48.0
.197	4,800	.013	251.2	4,500	.012	215.4	4,100	.009	153.5	3,200	.009	119.7	3,200	.004	48.0
.236	4,000	.017	264.6	3,700	.015	223.6	3,400	.012	160.6	2,700	.012	127.6	2,700	.005	51.2
.315	3,000	.022	264.6	2,800	.020	225.6	2,600	.016	163.8	2,000	.016	126.0	2,000	.006	50.4
.394	2,400	.028	264.6	2,200	.025	221.7	2,100	.020	165.4	1,600	.020	126.0	1,600	.008	50.4
.472	2,000	.031	251.2	1,900	.029	218.1	1,700	.022	152.8	1,300	.022	116.5	1,300	.009	46.9
.630	1,500	.035	211.8	1,400	.032	180.7	1,300	.025	131.1	1,000	.025	100.8	1,000	.010	40.2
.787	1,200	.036	172.0	1,100	.033	144.1	1,000	.026	102.4	800	.026	81.9	800	.010	32.7

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 Iron Carbon Steel, Alloy Steel (150～250HB)			Tool Steel (25～35HRC)			Pre-hardened Steel (35～45HRC)			Hardened Steel (45～55HRC)			Hardened Steel (55～60HRC)		
Ratio to standard depth of cut	80%			80%			70%			60%			40%		
Tool dia. (inch)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)
.079	20,000	.004	352.8	18,000	.004	290.2	16,000	.003	201.6	12,700	.003	159.8	11,100	.001	55.9
.118	13,300	.007	395.7	11,700	.007	318.5	10,600	.006	225.2	8,500	.006	180.7	7,400	.002	63.0
.157	9,900	.011	414.6	8,800	.009	337.0	8,000	.007	239.4	6,400	.007	191.3	5,600	.003	66.9
.197	8,000	.013	418.9	7,000	.012	335.0	6,400	.009	239.4	5,100	.009	190.9	4,500	.004	67.3
.236	6,600	.017	436.6	5,800	.015	350.8	5,300	.012	250.4	4,200	.012	198.4	3,700	.005	70.1
.315	5,000	.022	440.9	4,400	.020	354.7	4,000	.016	252.0	3,200	.016	201.6	2,800	.006	70.5
.394	4,000	.028	440.9	3,500	.025	352.8	3,200	.020	252.0	2,500	.020	196.9	2,200	.008	69.3
.472	3,300	.031	414.6	2,900	.029	333.1	2,700	.022	242.5	2,100	.022	188.6	1,900	.009	68.1
.630	2,500	.035	352.8	2,200	.032	283.9	2,000	.025	201.6	1,600	.025	161.4	1,400	.010	56.3
.787	2,000	.036	286.6	1,800	.033	235.8	1,600	.026	163.8	1,300	.026	133.1	1,100	.010	44.9

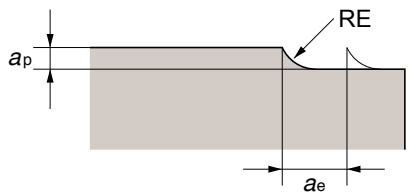
【Note】
① Use a highly rigid and accurate machine as possible.
② These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③ If the rpm available is lower than that recommended please reduce the feed rate 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 Iron Carbon Steel, Alloy Steel (150～250HB)			Tool Steel (25～35HRC)			Pre-hardened Steel (35～45HRC)			Hardened Steel (45～55HRC)			Hardened Steel (55～60HRC)		
Ratio to standard depth of cut	100%			100%			100%			70%			50%		
Tool dia. (inch)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed per tooth f_z (IPT)	Feed rate v_f (IPM)
.079	15,000	.004	203.9	14,000	.003	169.3	14,000	.002	133.9	10,300	.002	90.9	9,500	.001	35.8
.118	10,100	.006	231.9	9,500	.005	193.7	9,000	.004	145.3	6,900	.004	102.8	6,400	.002	40.9
.157	7,600	.008	245.7	7,200	.007	206.7	6,800	.006	154.7	5,200	.005	109.1	4,800	.002	42.9
.197	6,000	.010	242.5	5,700	.009	204.7	5,400	.007	153.5	4,100	.007	107.5	3,800	.003	42.5
.236	5,000	.013	255.1	4,800	.011	217.7	4,500	.009	161.4	3,400	.008	112.6	3,200	.004	45.3
.315	3,800	.017	258.7	3,600	.015	217.7	3,400	.012	162.6	2,600	.011	114.6	2,400	.005	45.3
.394	3,000	.021	255.1	2,900	.019	219.3	2,700	.015	161.4	2,100	.014	115.7	1,900	.006	44.9
.472	2,500	.024	242.5	2,400	.022	206.7	2,300	.017	157.1	1,700	.016	106.7	1,600	.007	42.9
.630	1,900	.027	206.7	1,800	.024	174.0	1,700	.019	130.3	1,300	.018	91.7	1,200	.007	36.2
.787	1,500	.028	165.7	1,400	.024	137.4	1,400	.019	109.1	1,000	.018	71.7	1,000	.008	30.7

Relation between the depth of cut and overhang.



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

a_p : Below table

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

① Feed rates for pencil-neck types are shown for 6D and higher in the above table. For straight type and long-neck type of 6D 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%.

Recommended Cutting Conditions, Epoch Turbo Mill (Metric)

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 Iron Carbon Steel, Alloy Steel (150～250HB)			Tool Steel (25～35HRC)			Pre-hardened Steel (35～45HRC)			Hardened Steel (45～55HRC)			Hardened Steel (55～60HRC)		
Ratio to standard depth of cut	100%			100%			100%			70%			50%		
Tool dia. (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	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 Iron Carbon Steel, Alloy Steel (150～250HB)			Tool Steel (25～35HRC)			Pre-hardened Steel (35～45HRC)			Hardened Steel (45～55HRC)			Hardened Steel (55～60HRC)		
Ratio to standard depth of cut	80%			80%			70%			60%			40%		
Tool dia. (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	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

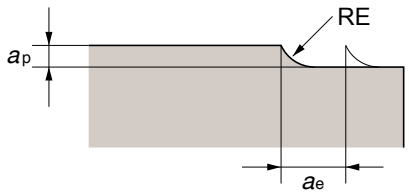
【Note】
① Use a highly rigid and accurate machine as possible.
② These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③ If the rpm available is lower than that recommended please reduce the feed rate 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 Iron Carbon Steel, Alloy Steel (150～250HB)			Tool Steel (25～35HRC)			Pre-hardened Steel (35～45HRC)			Hardened Steel (45～55HRC)			Hardened Steel (55～60HRC)		
Ratio to standard depth of cut	100%			100%			100%			70%			50%		
Tool dia. (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.



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

a_p : Below table

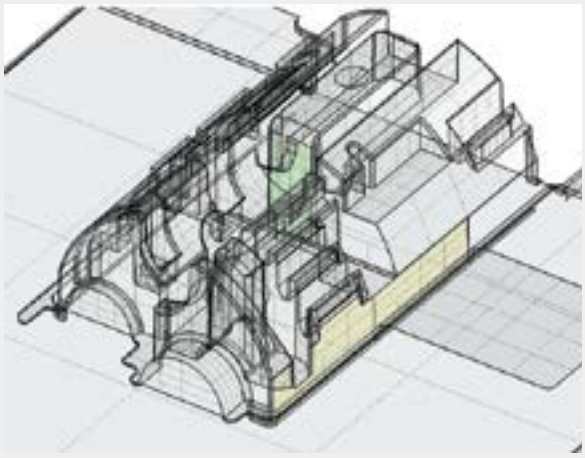
Overhang	a_p : Z pick mm	Overhang	a_p : Z pick mm
5D or less	0.3× RE × cutting depth ratio	**8D**	0.23× RE × cutting depth ratio
6D	0.27× RE × cutting depth ratio	**9D**	0.19× RE × cutting depth ratio
7D	0.25× RE × cutting depth ratio	**10D**	0.15× RE × cutting depth ratio

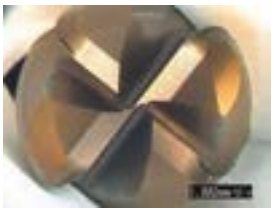
① Feed rates for pencil-neck types are shown for 6D and higher in the above table. For straight type and long-neck type of 6D or higher, cutting depth in the Z direction should be set about 10% lower than the above values.
② Use for cutting contour lines or down cutting. In Z direction, cut at an incline (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%.

Cutting example

Work material : H13(48HRC) 2.362 inch × 2.756 inch × 1.969 inch
Incline angle : 1° Groove width : .106 inch Groove depth : 1.181 inch

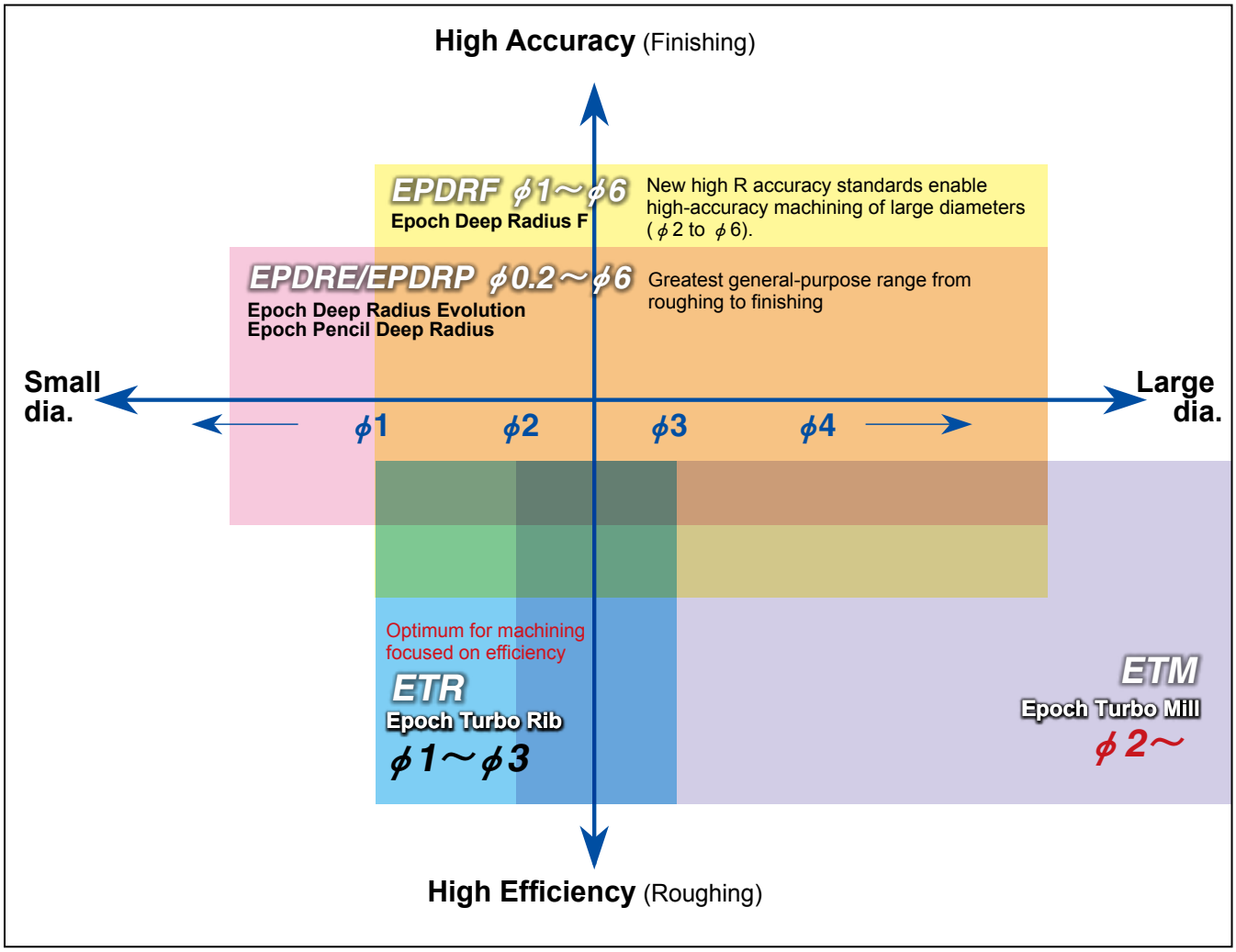
Cutting work shape



	Process 1	Process 2
Use tool	ETM4120-20-TH	ETM4060-15-TH
Revolution	2100min^{-1} (259 SFM)	4200min^{-1} (259 SFM)
Feed rate	188.6 IPM (.022 IPT)	198.4 IPM (.012 IPT)
Depth of cut	a_p×a_e = .014 inch × .236 inch	a_p×a_e = .010 inch × .039 inch
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}(262 SFM)	12700min^{-1} (262 SFM)	12700min^{-1} (262 SFM)
Feed rate	159.8 IPM (.003 IPT)	159.8 IPM (.003 IPT)	159.8 IPM (.003 IPT)
Depth of cut	a_p×a_e = .003 inch × .039 inch	a_p×a_e = .002 inch × .039 inch	a_p×a_e = .001 inch × .039 inch
Cutting time	**55** min.	**75** min.	**45** min.
			

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



Safety notes

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.

Notes

MOLDINO
The Edge To Innovation

High Feed Radius End Mill for Hardened Steel

EHHRE-TH3

Epoch High Hard Radius

MOLDINO Tool Engineering, Ltd.

New Product News | No. H2006A-1 | 2020-10

Utilize the high-feed indexable cutter design on a solid end mill. High feed cutting is also possible in high hardness steels.

Lineup of Φ 1 ~ Φ 12

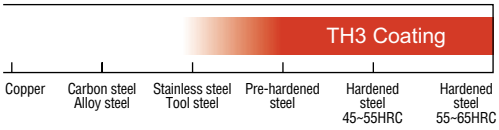
This multi-flute end mill allows for high efficiency machining on small precision molds.

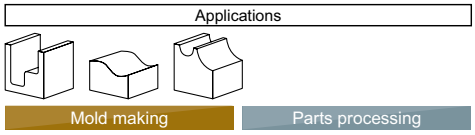
Features of EHHRE-TH3

01 Approximate radius creates a much thinner chip than a standard full radius.

02 Peripheral clearance geometry to reduce vibration

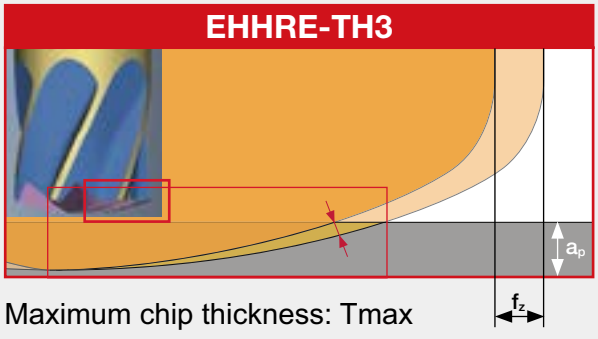
03 Newly developed "TH3" coating for hardened steel machining.



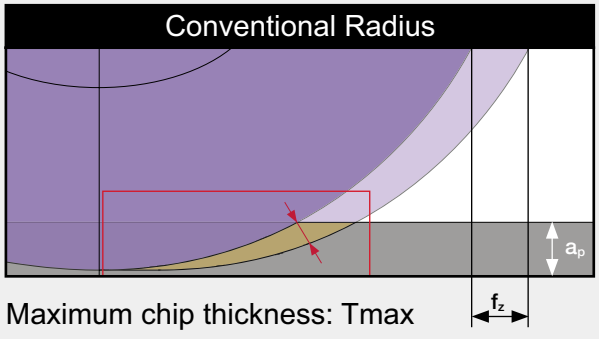


EHHRE-TH3
ϕ1～ϕ12 [13 Items]

Features 01 New Cutting Edge Geometry - Approximate radius creates a much thinner chip than a standard full radius.

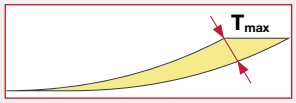


Maximum chip thickness: Tmax



Maximum chip thickness: Tmax

Thinner removed chip

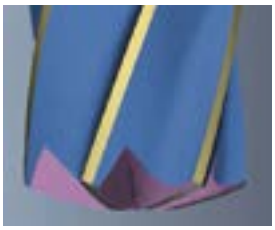


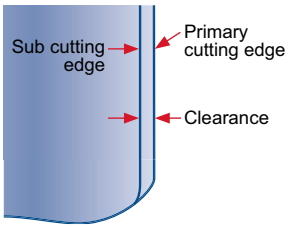
Effect

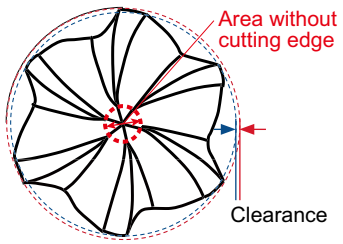
Composite R geometry on the bottom cutting edge creates a thinner chip than a conventional radius, which leads to reduced cutting forces. Furthermore, the bottom edge has a high helix shape, which improves the chip flow and achieves excellent chip removal performance.

Features 02 Peripheral clearance geometry to reduce vibration

Peripheral clearance geometry to reduce vibration



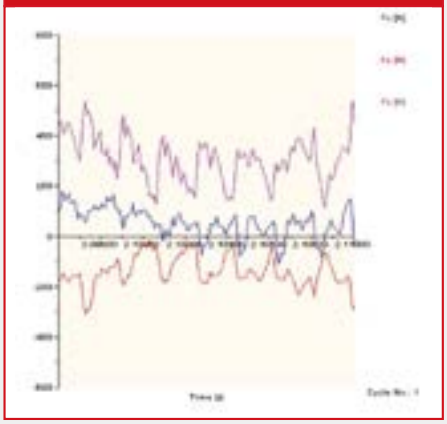




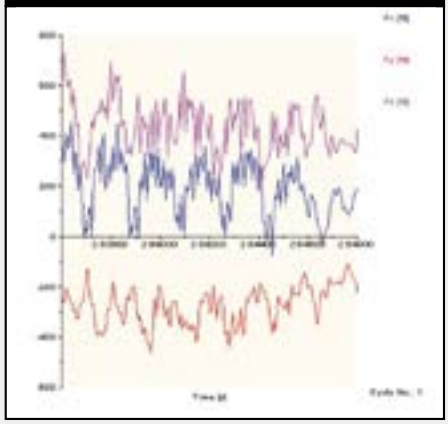
Vibrations are reduced when milling into corners.

Work material：H13Ⓗ 49HRC　Machine：Vertical MC (HSK-A63)　Tool：EHHRE6100-TH3
Cutting conditions：n=6,000min^{-1}(v_c=188m/min)　v_f=1,800mm/min (f_z=0.05mm/t)
Cutting amount：0.3mm,　Dry with air blow

EHHRE-TH3



Conventional



Effect

Chatter and vibrations are reduced when high speed machining internal corners. This prevents unexpected tool chipping and failure when machining the corners.

90 degree corner milling

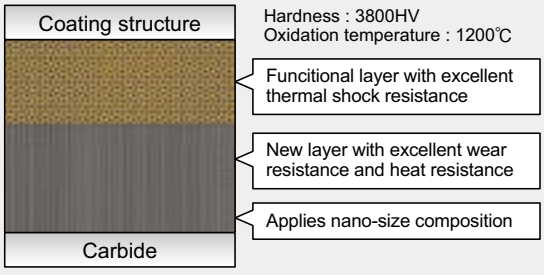
Features 03 Newly developed "TH3" coating for hardened steel machining.

Features and performance

- High hardness coating with excellent wear resistance and heat resistance
- Has excellent thermal shock resistance which reduces the risk of rapid tool chipping.
- Long tool life when cutting high-hardness materials (50HRC or higher) such as hardened steel

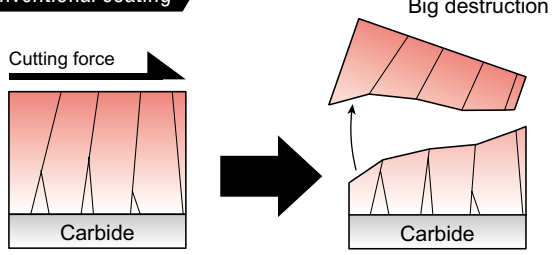
Target steel grade

- TH3 coating utilizes nano-size composition to reduce large chipping of the coating.

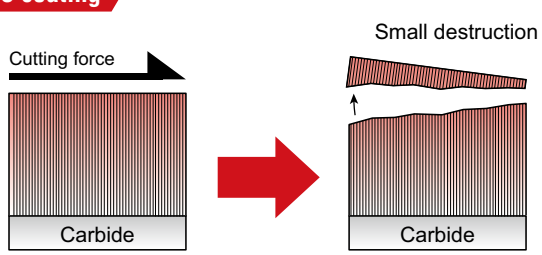


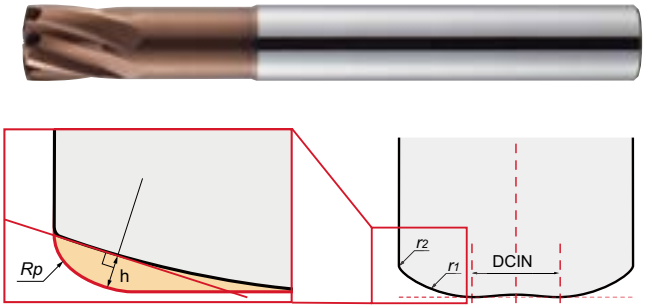
! Point TH3 coating utilizes nano-size composition to reduce large chipping of the coating.

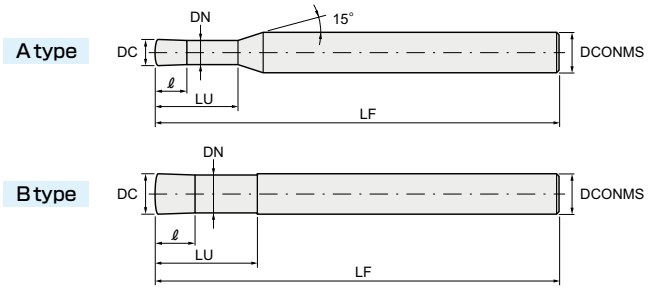
Conventional coating



TH3 coating







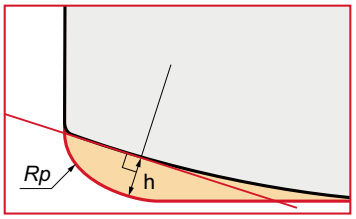
EHHRE○○○○(-S○)-TH3

Rough | Carbide | TH3 | 0 -0.02 | Helix 20° | h5 | 4 Flutes | 6 Flutes

Order Number	Stock	Size (mm)										No. of flutes	Type
		Tool dia.	Approx radius	Lowest point diameter	End R	Corner radius	Under Neck length	Flute length	Neck dia.	Overall Length	Shank dia.		
		DC	*Rp*	DCIN	*r1*	*r2*	LU	ℓ	DN	LF	DCONMS		
EHHRE4010-S4-TH3	●	1	0.134	0.28	1.1	0.1	3	1	0.95	50	4	4	A
EHHRE4010-S6-TH3	●							1	0.95	50	6	4	A
EHHRE4020-S4-TH3	●	2	0.194	0.56	2.2	0.1	6	2	1.9	50	4	4	A
EHHRE4020-S6-TH3	●							2	1.9	50	6	4	A
EHHRE4030-S4-TH3	●	3	0.328	0.84	3.3	0.2	9	3	2.9	60	4	4	A
EHHRE4030-S6-TH3	●							3	2.9	60	6	4	A
EHHRE6040-S4-TH3	●	4	0.387	1.12	4.4	0.2	12	4	3.9	60	4	6	B
EHHRE6040-S6-TH3	●							4	3.9	60	6	6	A
EHHRE6050-TH3	●	5	0.521	1.4	5.5	0.3	15	5	4.7	60	6	6	A
EHHRE6060-TH3	●	6	0.581	1.68	6.6	0.3	18	6	5.7	60	6	6	B
EHHRE6080-TH3	●	8	0.849	2.24	8.8	0.5	24	8	7.6	75	8	6	B
EHHRE6100-TH3	●	10	0.968	2.8	11	0.5	30	10	9.5	80	10	6	B
EHHRE6120-TH3	●	12	1.088	3.36	13.2	0.5	36	12	11.5	100	12	6	B

● : Stocked items.

Precaution for creating machining program



- When entering corner radius into CAM as radius end mill, Please use approximate R for your programing corner radius.
- For precise tool definition for the CAM system please download DXF data from "TOOL SEARCH" program on our website.

【Note】

- Since the shape of this tool is different from that of a conventional radius tool, adjustment may be required in case of using automatic tool measurement equipment. Depending on the model of the measuring equipment, it may not be possible to measure accurately, so please check the tool shape with DXF before use.

Tool dia. DC	Approx radius and maximum remains at CAM input		Ramping angle	Possible helical hole dia.
	Approx radius *Rp*	Max remains h		D
Φ1	0.134	0.026	0.5° or less	1.3～1.9
Φ2	0.194	0.068		2.6～3.8
Φ3	0.328	0.094		3.9～5.7
Φ4	0.387	0.136		5.2～7.6
Φ5	0.521	0.162		6.4～9.5
Φ6	0.581	0.204		7.7～11.4
Φ8	0.849	0.255		10.3～15.2
Φ10	0.968	0.34		12.8～19.0
Φ12	1.088	0.424		15.4～22.8

※For helical machining, Please set feed rate to 70% of recommended cutting condition.

Recommended Cutting Conditions

General cutting conditions (Emphasis on tool life)

Work material		Hardened steel (50～55HRC) ※1					Hardened steel (55～62HRC)				
Tool dia. DC (mm)	No. of flutes	Cutting speed vc=80m/min					Cutting speed vc=60m/min				
		n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)	n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)
1	4	25,500	3,670	145	0.040	0.55	19,100	1,720	68	0.023	0.55
2	4	12,700	3,660	144	0.080	1.1	9,600	1,730	68	0.046	1.1
3	4	8,500	3,840	151	0.120	1.65	6,400	1,800	71	0.069	1.65
4	6	6,400	5,840	230	0.160	2.2	4,800	2,740	108	0.092	2.2
5	6	5,100	5,940	234	0.200	2.75	3,800	2,760	109	0.115	2.75
6	6	4,200	5,870	231	0.240	3.3	3,200	2,790	110	0.138	3.3
8	6	3,200	6,140	242	0.320	4.4	2,400	2,880	113	0.184	4.4
10	6	2,500	6,000	236	0.400	5.5	1,900	2,850	112	0.230	5.5
12	6	2,100	5,750	226	0.480	6.6	1,600	2,740	108	0.276	6.6

Work material		Hardened steel (62～66HRC)					Hardened steel (66～72HRC)				
Tool dia. DC (mm)	No. of flutes	Cutting speed vc=50m/min					Cutting speed vc=40m/min				
		n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)	n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)
1	4	15,900	1,070	42	0.019	0.55	12,700	570	22	0.013	0.5
2	4	8,000	1,080	43	0.038	1.1	6,400	580	23	0.026	1
3	4	5,300	1,120	44	0.057	1.65	4,200	590	23	0.039	1.5
4	6	4,000	1,710	67	0.076	2.2	3,200	910	36	0.052	2
5	6	3,200	1,750	69	0.095	2.75	2,500	910	36	0.065	2.5
6	6	2,700	1,770	70	0.114	3.3	2,100	920	36	0.078	3
8	6	2,000	1,800	71	0.152	4.4	1,600	960	38	0.104	4
10	6	1,600	1,800	71	0.190	5.5	1,300	980	39	0.130	5
12	6	1,300	1,670	66	0.228	6.6	1,100	940	37	0.156	6

Cutting conditions for high-efficiency cutting (Emphasis on efficiency)

Work material		Hardened steel (50～55HRC) ※1					Hardened steel (55～62HRC)				
Tool dia. DC (mm)	No. of flutes	Cutting speed vc=100m/min					Cutting speed vc=70m/min				
		n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)	n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)
1	4	31,880	4,730	186	0.038	0.7	22,280	2,070	82	0.022	0.7
2	4	15,880	4,710	185	0.076	1.4	11,200	2,080	82	0.044	1.4
3	4	10,630	4,940	195	0.114	2.1	7,470	2,170	85	0.066	2.1
4	6	8,000	7,510	296	0.152	2.8	5,600	3,290	130	0.087	2.8
5	6	6,380	7,650	301	0.190	3.5	4,430	3,320	131	0.109	3.5
6	6	5,250	7,550	297	0.228	4.2	3,730	3,350	132	0.131	4.2
8	6	4,000	7,910	311	0.304	5.6	2,800	3,460	136	0.175	5.6
10	6	3,130	7,740	305	0.380	7	2,220	3,430	135	0.219	7
12	6	2,630	7,410	292	0.456	8.4	1,870	3,290	130	0.262	8.4

Work material		Hardened steel (62～66HRC)					Hardened steel (66～72HRC)				
Tool dia. DC (mm)	No. of flutes	Cutting speed vc=60m/min					Cutting speed vc=50m/min				
		n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)	n (min-1)	Vf (mm/min)	IPM	ap (mm)	ae (mm)
1	4	19,080	1,330	52	0.018	0.7	15,880	740	29	0.012	0.6
2	4	9,600	1,330	52	0.036	1.4	8,000	740	29	0.025	1.2
3	4	6,360	1,390	55	0.054	2.1	5,250	760	30	0.037	1.8
4	6	4,800	2,110	83	0.072	2.8	4,000	1,170	46	0.049	2.4
5	6	3,840	2,160	85	0.090	3.5	3,130	1,170	46	0.062	3
6	6	3,240	2,190	86	0.108	4.2	2,630	1,180	47	0.074	3.6
8	6	2,400	2,220	87	0.144	5.6	2,000	1,240	49	0.099	4.8
10	6	1,920	2,220	87	0.181	7	1,630	1,260	50	0.124	6
12	6	1,560	2,060	81	0.217	8.4	1,380	1,220	48	0.148	7.2

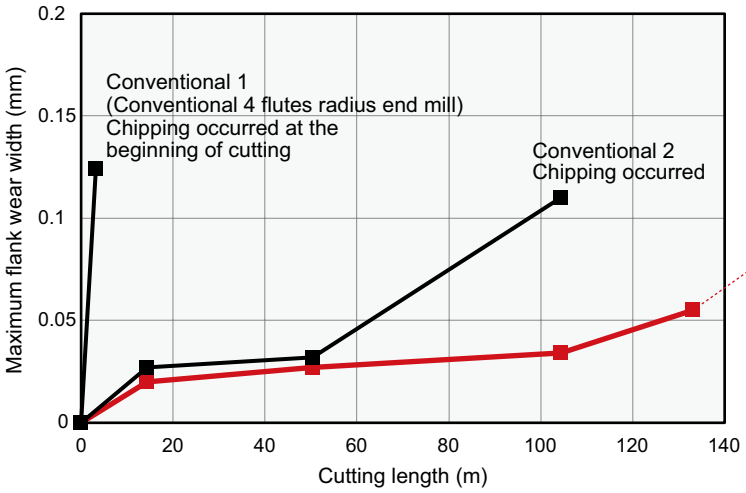
【Note】
① Use the appropriate coolant for the work material and machining shape.
② Use the most accurate and rigid machine as possible.
③ These Recommended Cutting Conditions are standard parameters. When machining, these parameters should be adjusted according to the machining shape and the machine capabilities.
④ If the RPM available is lower than the recommended RPM, please reduce the feed rate by the same ratio.
⑤ **Please use for contouring process.**
⑥ **If you set the pick feed (*ae*) larger than the lowest point diameter of the tool, then a cusp will remain on part.**

※1 **This EHHRE-TH3 utilizes cutting edge geometry for high hardness steel cutting. It is not recommended for sticky hard material such as hot forging die material (H13).**
EMBE-ATH is recommended for those sticky materials.

Field data

Tool life evaluation of cutting D2Ⓗ

Tool size：ϕ10×6 flutes　Work material：D2Ⓗ（60HRC）　Machine：Vertical MC (HSK-F63)
Cutting conditions：n=1,900min^{-1} (v_c=60m/min)　v_f=2,850mm/min (f_z=0.25mm/t)　a_p 0.2mm　a_e 5.5mm
OH＝30mm　Coolant：Air-blow

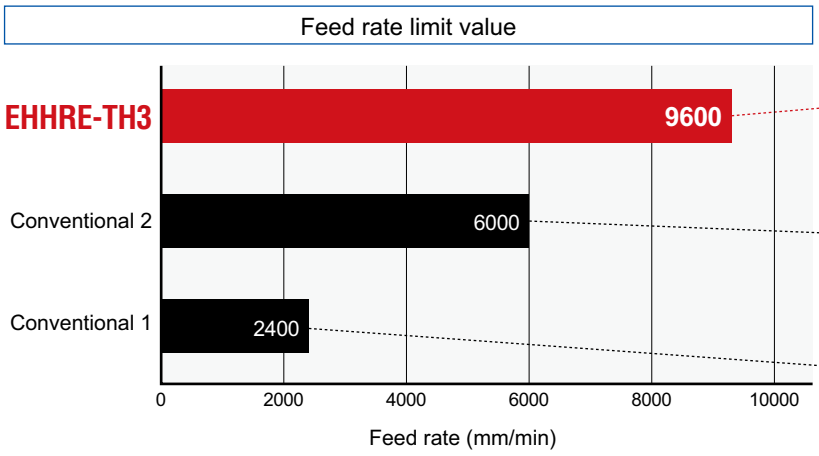


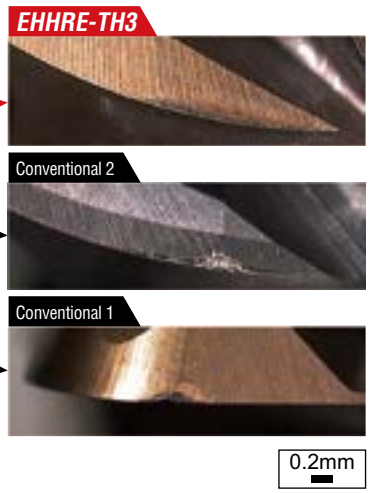
EHHRE-TH3 achieves more than twice the tool life of conventional products

High feed cutting of high hardness steel which was difficult with conventional radius geometry was realized.

Marginal test to evaluate feed limit for cutting powder high-speed steel

Tool size：ϕ10×6 flutes　Work material：Powdered HSS (65HRC)　Machine：Vertical MC (HSK-F63)
Cutting conditions：n=2,000min^{-1}(v_c=63m/min)　v_f=Refer to below table　a_p 0.15mm　a_e 3mm　OH＝30mm　Coolant：Air-blow





High feed cutting of high hardness steel is possible by synergistic effect of low cutting force radius geometry and TH3 coating.

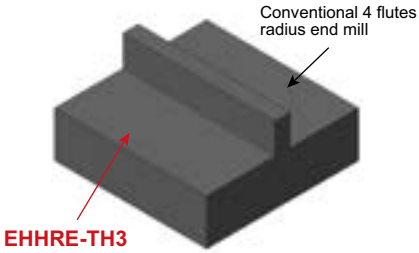
After roughing by EHHRE-TH3, recommended semi-finishing and finishing with the following tool.
Epoch High Hard Ball (EHHB-ATH), Epoch Deep Ball Evolution Hard -TH3 (EPDBEH-TH3)

Example of high-efficiency roughing of matrix high-speed steel

Work size：100×100mm
Work material：Matrix HSS (58HRC)
Machine：Vertical MC(BT40)
Coolant：Air-blow

Tool	Tool Dia. [mm]	R [mm]	Revolution [min^{-1}]	Cutting speed [m/min]	Feed rate [mm/min]	Feed per tooth [mm/t]	a_p [mm]	a_e [mm]	Chip removal volume [cm^3/min]	Machining time
EHHRE6100-TH3	10	0.968	2,200	69	4,000	0.3	0.2	6	4.8	24 min
Conventional (4 flutes radius)	10	2	2,100	66	2,000	0.24	0.15	3	0.9	1hr.25min.

Work shape：100×45×Depth10mm



Wear condition after cutting

Micro wear, possible to use continuously

Chipping occured on R edge

EHHRE achieved 5 times the cutting efficiency than the conventional tool. Tool wear was minimal enough to continue using.

High-efficiency cutting example of powder high-speed steel

Work size：50×50mm　Work material：Powdered HSS (65HRC)　Machine：Vertical MC(HSK-F63)

Process	Tool	Tool Dia. [mm]	R [mm]	Revolution [min^{-1}]	Cutting speed [m/min]	Feed rate [mm/min]	Feed per tooth [mm/t]	a_p [mm]	a_e [mm]	Removal stock [mm]	Coolant	Machining time
Contour roughing ❶	EHHRE4030-S6-TH3	3	0.328	6,360	60	1,390	0.055	0.054	2	0.05	Air-blow	1hr. 3min.
Contour roughing ❷	EHHRE4030-S6-TH3	3	0.328	6,360	60	1,390	0.055	0.054	2	0.05	Air-blow	1hr. 3min.

Figure Work model

Cubic shape size：5×5×6mm, Space 5mm

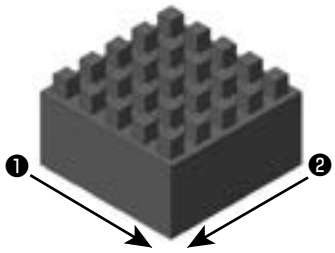


Figure Work after cutting

Figure Wear condition after roughing

Normal wear even after 1 hour cutting

EHHRE can perform high-efficiency machining even for small work-piece of high hardness steel

Safety notes

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.

Notes

NEW

MOLDINO
The Edge To Innovation

8-flute End Mill for Vertical Wall/Bottom Face Finishing

ER8WB-ATH (Radius type)
ES8WB-ATH (Square type)

MOLDINO Tool Engineering, Ltd.

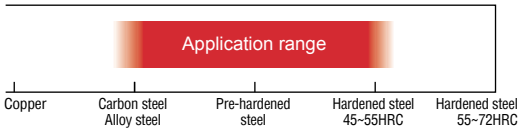
New Product News | No. H2204A-1 | 2022-01

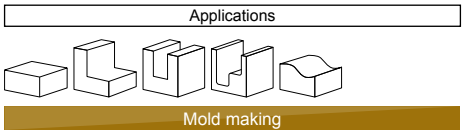
The Pinnacle of Finish Milling Vertical Walls and Bottom Faces. Vertical walls and bottom face finishing all with a single tool!

ER8WB-ATH/ES8WB-ATH features

01 Peripheral cutting edge design tailored for vertical wall milling. Allows milling as intended with minimal deflection, reducing re-machining and re-working steps.

02 Incorporates MOLDINO's own corner radius edges to achieve high-quality bottom face milling.



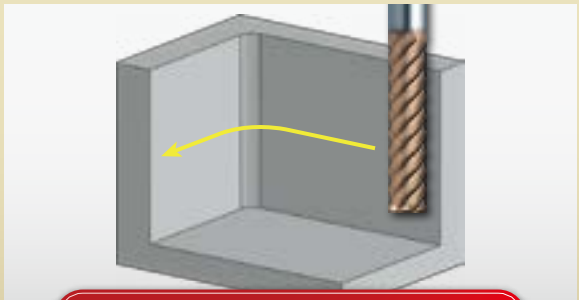


ER8WB-ATH : ϕ6～ϕ12 [19 Items]
(Corner radius R1)

ES8WB-ATH : ϕ6～ϕ12 [19 Items]
(Square)

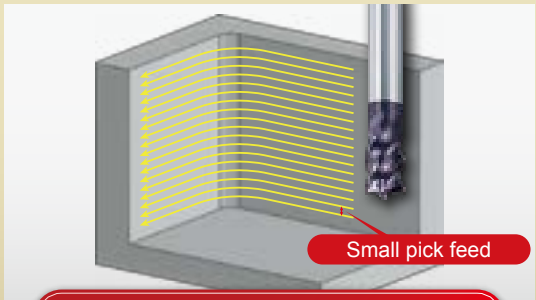
Task

1 Using long-fluted end mill for cutting vertical walls on mold parts reduces accuracy and generates time-consuming re-maching and reworking.



Task : Vertical wall machining accuracy

2 Reducing pick feed when contour milling achieves machining accuracy for vertical walls but increases machining time.

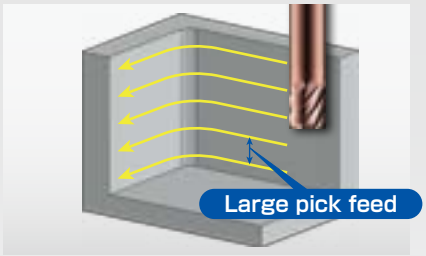


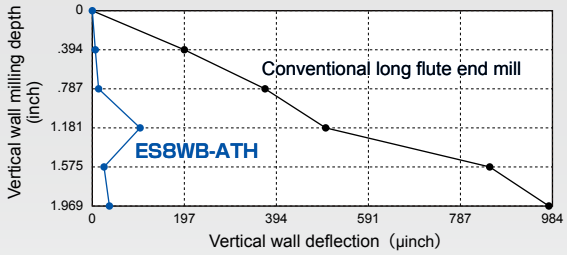
Task : Machining time

Proposal

Using the ER(S)8WB-ATH will reduce the need for re-machining, allowing for unattended machining processes.

The ER(S)8WB-ATH allows contour milling with larger pick feed.





Work material : STAVAX (52HRC)　Machine : Vertical MC　Coolant : Air blow　Projection : 1.181 inch(L/D=5)

【Conventional long-flute end mill】

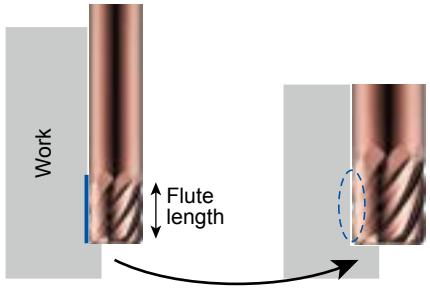
Tool specifications：DC .472 inch・Flute length 2.165 inch・6Flutes
n=530min^{-1}(v_c=66 SFM)　v_f=3.7 IPM(f_z =.001 IPT)
a_p=1.969 inch　a_e=.002 inch

【ES8WB-ATH】

Tool specifications：ES8WB1200LN-60-ATH (DC .472 inch・Flute length .472 inch・8Flutes)
n=1,326min^{-1}(v_c=164 SFM)　v_f=25.0 IPM(f_z=.002 IPT)
a_p=.236 inch　a_e=.002 inch

Features 01 Peripheral cutting edge design tailored for vertical wall milling

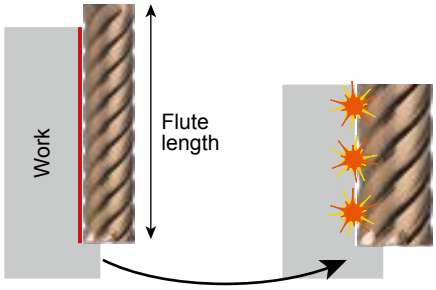
Vertical wall finishing using ER(S)8WB-ATH



Solution

- Short flute gives high rigidity
  => Minimizes deflection
- Tool design with few contact points
  => Minimizes vibration

Vertical wall finishing with conventional long-flute end mill



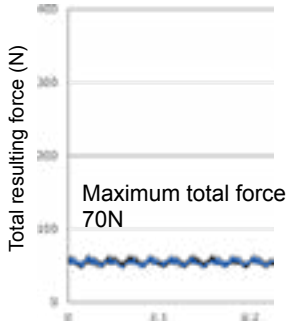
Task

- Extended projection length (flute length)
  => Deflection
- Multiple contact points
  => Increased vibration

Comparison of cutting force

Work material：H13(48HRC)　Machine：Vertical MC(BT40)　Coolant：Air blow　Projection：30mm(L/D=5)

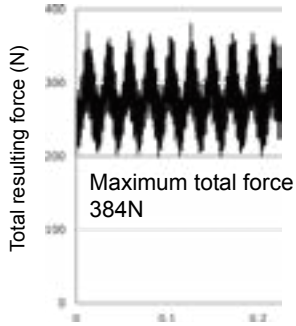
ER(S)8WB-ATH



Tool : ES8WB0600LN-30-AT
(DC .236 inch,
Flute length .236 inch,
Under neck length 1.181 inch)
Cutting conditions : n=2650min^{-1}
(v_c 164 SFM)
v_f=25.0 IPM
(f_z .001 IPT)
a_p .118 inch
a_e .004 inch

Reduced cutting force and vibration

Conventional long flute end mill

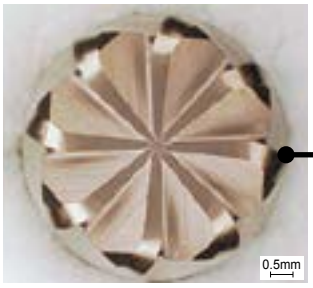


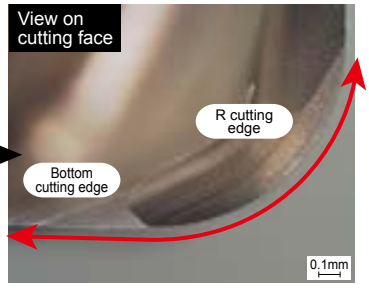
Tool : 6flutes long flute
(DC .236 inch,
Flute length .984 inch)
Cutting conditions : n=2650min^{-1}
(v_c 164 SFM)
v_f=18.8 IPM
(f_z .001 IPT)
a_p .984 inch
a_e .004 inch

Large cutting force, resulting in vibration

This is the Point The unique design reducing cutting force and vibration allows milling as intended with minimal deflection.

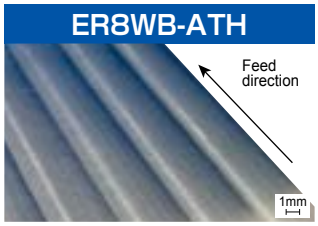
Features 02 MOLDINO's own corner radius cutting edge design * ER8WB-ATH only





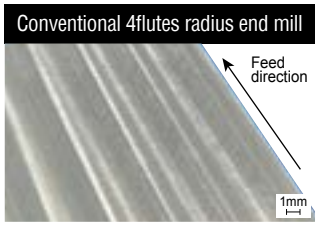
Smooth interface between bottom and radius cutting edges insures high-quality bottom face milling.

ER8WB-ATH



Shiny appearance with uniform cutter marks

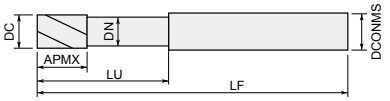
Conventional 4flutes radius end mill



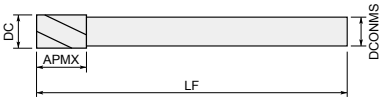
Milled surface appears cloudy. Uneven cutter marks

Work material：Carbon Steel　Machine：Vertical MC(BT40)
Coolant：Air blow　Projection：2.362 inch(L/D=5)
Tool : Conventional 4flutes radius end mill,
ER8WB1200LN-60-R1.0-ATH(DC .472 inch)
Cutting conditions：n=5310min^{-1}(v_c 656 SFM) f_z=.002 IPT
a_p .002 inch, a_e .236 inch

Square



A type



B type

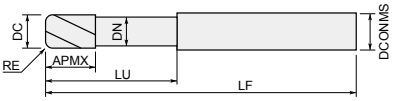
ES8WB○○○○LN(LS)-○○-ATH

Carbide ATH Helix 38 $^{0}_{-0.015}$ $^{0}_{-0.02}$ h5 h6

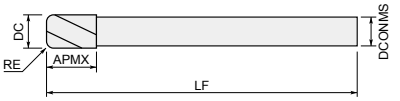
$^{0}_{-0.015}$: φ6 $^{0}_{-0.02}$: φ7~φ12 h5: φ6,8,10,12 h6: φ7,9,11

Item code	Stock	Size(mm)						Shape
		Tool dia.	Flute length	Under neck length	Neck dia.	Overall length	Shank dia.	
		DC	APMX	LU	DN	LF	DCONMS	
ES8WB0600LN-20-ATH	●	6 (.236inch)	6 (.236inch)	20	5.88	70	6	A
ES8WB0600LN-30-ATH	●			30	5.88	80	6	A
ES8WB0600LN-40-ATH	●			40	5.88	90	6	A
ES8WB0600LN-50-ATH	●			50	5.88	100	6	A
ES8WB0700LS-ATH	●	7 (.276inch)	7 (.276inch)	–	–	90	6	B
ES8WB0800LN-30-ATH	●	8 (.315inch)	8 (.315inch)	30	7.84	75	8	A
ES8WB0800LN-40-ATH	●			40	7.84	90	8	A
ES8WB0800LN-50-ATH	●			50	7.84	100	8	A
ES8WB0800LN-60-ATH	●			60	7.84	110	8	A
ES8WB0900LS-ATH	●	9 (.354inch)	9 (.354inch)	–	–	100	8	B
ES8WB1000LN-35-ATH	●	10 (.394inch)	10 (.394inch)	35	9.8	80	10	A
ES8WB1000LN-50-ATH	●			50	9.8	100	10	A
ES8WB1000LN-60-ATH	●			60	9.8	110	10	A
ES8WB1000LN-80-ATH	●			80	9.8	130	10	A
ES8WB1100LS-ATH	●	11 (.433inch)	11 (.433inch)	–	–	110	10	B
ES8WB1200LN-40-ATH	●	12 (.472inch)	12 (.472inch)	40	11.8	90	12	A
ES8WB1200LN-60-ATH	●			60	11.8	110	12	A
ES8WB1200LN-80-ATH	●			80	11.8	130	12	A
ES8WB1200LN-100-ATH	●			100	11.8	150	12	A

Radius



A type



B type

ER8WB○○○○LN(LS)-○○-R○○-ATH

Carbide ATH Helix 38 $^{0}_{-0.015}$ $^{0}_{-0.02}$ h5 h6

$^{0}_{-0.015}$: φ6 $^{0}_{-0.02}$: φ7~φ12 h5: φ6,8,10,12 h6: φ7,9,11

Item code	Stock	Size(mm)							Shape
		Tool dia.	Corner radius	Flute length	Under neck length	Neck dia.	Overall length	Shank dia.	
		DC	RE	APMX	LU	DN	LF	DCONMS	
ER8WB0600LN-20-R1.0-ATH	●	6 (.236inch)	1	7 (.276inch)	20	5.88	70	6	A
ER8WB0600LN-30-R1.0-ATH	●		1		30	5.88	80	6	A
ER8WB0600LN-40-R1.0-ATH	●		1		40	5.88	90	6	A
ER8WB0600LN-50-R1.0-ATH	●		1		50	5.88	100	6	A
ER8WB0700LS-R1.0-ATH	●	7 (.276inch)	1	8 (.315inch)	–	–	90	6	B
ER8WB0800LN-30-R1.0-ATH	●	8 (.315inch)	1	9 (.354inch)	30	7.84	75	8	A
ER8WB0800LN-40-R1.0-ATH	●		1		40	7.84	90	8	A
ER8WB0800LN-50-R1.0-ATH	●		1		50	7.84	100	8	A
ER8WB0800LN-60-R1.0-ATH	●		1		60	7.84	110	8	A
ER8WB0900LS-R1.0-ATH	●	9 (.354inch)	1	10 (.394inch)	–	–	100	8	B
ER8WB1000LN-35-R1.0-ATH	●	10 (.394inch)	1	11 (.433inch)	35	9.8	80	10	A
ER8WB1000LN-50-R1.0-ATH	●		1		50	9.8	100	10	A
ER8WB1000LN-60-R1.0-ATH	●		1		60	9.8	110	10	A
ER8WB1000LN-80-R1.0-ATH	●		1		80	9.8	130	10	A
ER8WB1100LS-R1.0-ATH	●	11 (.433inch)	1	12 (.472inch)	–	–	110	10	B
ER8WB1200LN-40-R1.0-ATH	●	12 (.472inch)	1	13 (.512inch)	40	11.8	90	12	A
ER8WB1200LN-60-R1.0-ATH	●		1		60	11.8	110	12	A
ER8WB1200LN-80-R1.0-ATH	●		1		80	11.8	130	12	A
ER8WB1200LN-100-R1.0-ATH	●		1		100	11.8	150	12	A

● : Inventory maintained in US ★ : Inventory maintained in Japan

Recommended Cutting Conditions (Inch)

Vertical wall finishing

Work material			Carbon steel Alloy steel (180~250HB)		Tool steel (25~35HRC)		Pre-hardened steel (35~45HRC)		Hardened steel (45~55HRC)		Hardened steel (55~62HRC)	
Item code	a_p (inch)	a_e (inch)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)
ER(S)8WB0600LN-20-(R1.0)-ATH	.118	≦.004	7960	75.2	6370	60.2	4770	44.9	3180	29.9	2650	25.2
ER(S)8WB0600LN-30-(R1.0)-ATH	.118	≦.004	6630	62.6	5310	50.0	3980	37.8	2650	25.2	2120	20.1
ER(S)8WB0600LN-40-(R1.0)-ATH	.118	≦.004	4640	30.7	3710	24.4	2790	18.5	1860	12.2	1490	9.8
ER(S)8WB0600LN-50-(R1.0)-ATH	.118	≦.004	3320	15.7	2650	12.6	1990	9.4	1330	6.3	1060	5.1
ER(S)8WB0700LS-(R1.0)-ATH	.138	≦.004	5680	62.6	4550	50.0	3410	37.4	2270	25.2	1820	20.1
ER(S)8WB0800LN-30-(R1.0)-ATH	.157	≦.004	5970	75.2	4770	60.2	3580	45.3	2390	29.9	1990	25.2
ER(S)8WB0800LN-40-(R1.0)-ATH	.157	≦.004	4970	62.6	3980	50.0	2980	37.4	1990	25.2	1590	20.1
ER(S)8WB0800LN-50-(R1.0)-ATH	.157	≦.004	3480	35.0	2790	24.4	2090	21.3	1390	14.2	1110	11.0
ER(S)8WB0800LN-60-(R1.0)-ATH	.157	≦.004	2490	15.7	1990	12.6	1490	9.4	990	6.3	800	5.1
ER(S)8WB0900LS-(R1.0)-ATH	.177	≦.004	4420	62.6	3540	50.0	2650	37.4	1770	25.2	1410	20.1
ER(S)8WB1000LN-35-(R1.0)-ATH	.197	≦.004	4770	75.2	3820	60.2	2860	44.9	1910	29.9	1590	25.2
ER(S)8WB1000LN-50-(R1.0)-ATH	.197	≦.004	3980	62.6	3180	50.0	2390	37.8	1590	25.2	1270	20.1
ER(S)8WB1000LN-60-(R1.0)-ATH	.197	≦.004	2790	35.0	2230	24.4	1670	20.9	1110	14.2	890	11.0
ER(S)8WB1000LN-80-(R1.0)-ATH	.197	≦.004	1990	15.7	1590	12.6	1190	9.4	800	6.3	640	5.1
ER(S)8WB1100LS-(R1.0)-ATH	.217	≦.004	3620	59.4	2890	47.6	2170	35.8	1450	24.0	1160	18.9
ER(S)8WB1200LN-40-(R1.0)-ATH	.236	≦.004	3980	67.7	3180	53.9	2390	40.6	1590	27.2	1330	22.4
ER(S)8WB1200LN-60-(R1.0)-ATH	.236	≦.004	3320	56.3	2650	44.9	1990	33.9	1330	22.4	1060	18.1
ER(S)8WB1200LN-80-(R1.0)-ATH	.236	≦.004	2320	27.6	1860	22.0	1390	16.5	930	11.0	740	8.7
ER(S)8WB1200LN-100-(R1.0)-ATH	.236	≦.004	1660	14.2	1330	11.4	990	8.3	660	5.5	530	4.3

* Cutting conditions for the long-shank type (⌀7/9/11) are for a tool projection of 5D (tool diameter × 5). Modify the conditions using the following correction factors if the projection amount changes:

Cutting condition correction factors for long-shank type (%)

Work material			Carbon steel Alloy steel (180~250HB)		Tool steel (25~35HRC)		Pre-hardened steel (35~45HRC)		Hardened steel (45~55HRC)		Hardened steel (55~62HRC)	
Projection	a_p (inch)	a_e (inch)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)	Revolution n (min^{-1})	Feed rate vf (IPM)
5D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6D	100%	100%	70%	60%	70%	60%	70%	60%	70%	60%	70%	60%
7D	100%	100%	70%	50%	70%	50%	70%	50%	70%	50%	70%	50%

【Note】
① Use the appropriate coolant for the work material and machining shape.
② Use a highly rigid and accurate machine as possible.
③ These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
④ If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.

Recommended Cutting Conditions (Inch)

Bottom face finishing

※ A radius type (ER8WB-ATH) should be used for bottom face finishing.

Work material			Carbon steel Alloy steel (180~250HB)		Tool steel (25~35HRC)		Pre-hardened steel (35~45HRC)		Hardened steel (45~55HRC)		Hardened steel (55~62HRC)	
Item code	a_p (inch)	a_e (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
ER8WB0600LN-20-R1.0-ATH	.002~.004	.118~.236	9550	90.2	7960	75.2	6370	60.2	4770	44.9	3180	29.9
ER8WB0600LN-30-R1.0-ATH	.002~.004	.118~.236	7960	75.2	6630	62.6	5310	50.0	3980	37.8	2650	25.2
ER8WB0600LN-40-R1.0-ATH	.002~.004	.118~.236	5570	37.0	4640	30.7	3710	24.4	2790	18.5	1860	12.2
ER8WB0600LN-50-R1.0-ATH	.002~.004	.118~.236	3980	18.9	3320	15.7	2650	12.6	1990	9.4	1330	6.3
ER8WB0700LS-R1.0-ATH	.002~.004	.138~.276	6820	75.2	5680	62.6	4550	50.0	3410	37.4	2270	25.2
ER8WB0800LN-30-R1.0-ATH	.002~.004	.157~.315	7160	90.2	5970	75.2	4770	60.2	3580	45.3	2390	29.9
ER8WB0800LN-40-R1.0-ATH	.002~.004	.157~.315	5970	75.2	4970	62.6	3980	50.0	2980	37.4	1990	25.2
ER8WB0800LN-50-R1.0-ATH	.002~.004	.157~.315	4180	42.1	3480	35.0	2790	28.0	2090	21.3	1390	14.2
ER8WB0800LN-60-R1.0-ATH	.002~.004	.157~.315	2980	18.9	2490	15.7	1990	12.6	1490	9.4	990	6.3
ER8WB0900LS-R1.0-ATH	.002~.004	.177~.354	5310	75.2	4420	62.6	3540	50.0	2650	37.4	1770	25.2
ER8WB1000LN-35-R1.0-ATH	.002~.004	.197~.394	5730	90.2	4770	75.2	3820	60.2	2860	44.9	1910	29.9
ER8WB1000LN-50-R1.0-ATH	.002~.004	.197~.394	4770	75.2	3980	62.6	3180	50.0	2390	37.8	1590	25.2
ER8WB1000LN-60-R1.0-ATH	.002~.004	.197~.394	3340	42.1	2790	35.0	2230	28.0	1670	20.9	1110	14.2
ER8WB1000LN-80-R1.0-ATH	.002~.004	.197~.394	2390	18.9	1990	15.7	1590	12.6	1190	9.4	800	6.3
ER8WB1100LS-R1.0-ATH	.002~.004	.217~.433	4340	71.3	3620	59.4	2890	47.6	2170	35.8	1450	24.0
ER8WB1200LN-40-R1.0-ATH	.002~.004	.236~.472	4770	81.1	3980	67.7	3180	53.9	2390	40.6	1590	27.2
ER8WB1200LN-60-R1.0-ATH	.002~.004	.236~.472	3980	67.7	3320	56.3	2650	44.9	1990	33.9	1330	22.4
ER8WB1200LN-80-R1.0-ATH	.002~.004	.236~.472	2790	33.1	2320	27.6	1860	22.0	1390	16.5	930	11.0
ER8WB1200LN-100-R1.0-ATH	.002~.004	.236~.472	1990	16.9	1660	14.2	1330	11.4	990	8.3	660	5.5

* Cutting conditions for the long-shank type (⌀ 7/9/11) are for a tool projection of 5D (tool diameter × 5). Modify the conditions using the following correction factors if the projection amount changes:

Cutting condition correction factors for long-shank type (%)

Work material			Carbon steel Alloy steel (180~250HB)		Tool steel (25~35HRC)		Pre-hardened steel (35~45HRC)		Hardened steel (45~55HRC)		Hardened steel (55~62HRC)	
Projection	a_p (inch)	a_e (inch)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)	Revolution n (min^{-1})	Feed rate v_f (IPM)
5D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6D	100%	100%	70%	60%	70%	60%	70%	60%	70%	60%	70%	60%
7D	100%	100%	70%	50%	70%	50%	70%	50%	70%	50%	70%	50%

【Note】
① Use the appropriate coolant for the work material and machining shape.
② Use a highly rigid and accurate machine as possible.
③ These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
④ If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.
⑤ For slotting, adjust the feed rate to 50% as general criteria.
⑥ For ramping, adjust the ramp angle to 0.5° or less and the feed rate to 50% as general criteria.

Recommended Cutting Conditions (Metric)

Vertical wall finishing

Work material			Carbon steel Alloy steel (180~250HB)		Tool steel (25~35HRC)		Pre-hardened steel (35~45HRC)		Hardened steel (45~55HRC)		Hardened steel (55~62HRC)	
Item code	a_p (mm)	a_e (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
ER(S)8WB0600LN-20-(R1.0)-ATH	3	≦0.1	7960	1910	6370	1530	4770	1140	3180	760	2650	640
ER(S)8WB0600LN-30-(R1.0)-ATH	3	≦0.1	6630	1590	5310	1270	3980	960	2650	640	2120	510
ER(S)8WB0600LN-40-(R1.0)-ATH	3	≦0.1	4640	780	3710	620	2790	470	1860	310	1490	250
ER(S)8WB0600LN-50-(R1.0)-ATH	3	≦0.1	3320	400	2650	320	1990	240	1330	160	1060	130
ER(S)8WB0700LS-(R1.0)-ATH	3.5	≦0.1	5680	1590	4550	1270	3410	950	2270	640	1820	510
ER(S)8WB0800LN-30-(R1.0)-ATH	4	≦0.1	5970	1910	4770	1530	3580	1150	2390	760	1990	640
ER(S)8WB0800LN-40-(R1.0)-ATH	4	≦0.1	4970	1590	3980	1270	2980	950	1990	640	1590	510
ER(S)8WB0800LN-50-(R1.0)-ATH	4	≦0.1	3480	890	2790	620	2090	540	1390	360	1110	280
ER(S)8WB0800LN-60-(R1.0)-ATH	4	≦0.1	2490	400	1990	320	1490	240	990	160	800	130
ER(S)8WB0900LS-(R1.0)-ATH	4.5	≦0.1	4420	1590	3540	1270	2650	950	1770	640	1410	510
ER(S)8WB1000LN-35-(R1.0)-ATH	5	≦0.1	4770	1910	3820	1530	2860	1140	1910	760	1590	640
ER(S)8WB1000LN-50-(R1.0)-ATH	5	≦0.1	3980	1590	3180	1270	2390	960	1590	640	1270	510
ER(S)8WB1000LN-60-(R1.0)-ATH	5	≦0.1	2790	890	2230	620	1670	530	1110	360	890	280
ER(S)8WB1000LN-80-(R1.0)-ATH	5	≦0.1	1990	400	1590	320	1190	240	800	160	640	130
ER(S)8WB1100LS-(R1.0)-ATH	5.5	≦0.1	3620	1510	2890	1210	2170	910	1450	610	1160	480
ER(S)8WB1200LN-40-(R1.0)-ATH	6	≦0.1	3980	1720	3180	1370	2390	1030	1590	690	1330	570
ER(S)8WB1200LN-60-(R1.0)-ATH	6	≦0.1	3320	1430	2650	1140	1990	860	1330	570	1060	460
ER(S)8WB1200LN-80-(R1.0)-ATH	6	≦0.1	2320	700	1860	560	1390	420	930	280	740	220
ER(S)8WB1200LN-100-(R1.0)-ATH	6	≦0.1	1660	360	1330	290	990	210	660	140	530	110

* Cutting conditions for the long-shank type (⌀7/9/11) are for a tool projection of 5D (tool diameter × 5). Modify the conditions using the following correction factors if the projection amount changes:

Cutting condition correction factors for long-shank type (%)

Work material			Carbon steel Alloy steel (180~250HB)		Tool steel (25~35HRC)		Pre-hardened steel (35~45HRC)		Hardened steel (45~55HRC)		Hardened steel (55~62HRC)	
Projection	a_p (mm)	a_e (mm)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)	Revolution n (min^{-1})	Feed rate v_f (mm/min)
5D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6D	100%	100%	70%	60%	70%	60%	70%	60%	70%	60%	70%	60%
7D	100%	100%	70%	50%	70%	50%	70%	50%	70%	50%	70%	50%

【Note】
① Use the appropriate coolant for the work material and machining shape.
② Use a highly rigid and accurate machine as possible.
③ These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
④ If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.

Recommended Cutting Conditions (Metric)

Bottom face finishing

※ A radius type (ER8WB-ATH) should be used for bottom face finishing.

Work material			Carbon steel Alloy steel (180～250HB)		Tool steel (25～35HRC)		Pre-hardened steel (35～45HRC)		Hardened steel (45～55HRC)		Hardened steel (55～62HRC)	
Item code	a_p (mm)	a_e (mm)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)
ER8WB0600LN-20-R1.0-ATH	0.05～0.1	3～6	9550	2290	7960	1910	6370	1530	4770	1140	3180	760
ER8WB0600LN-30-R1.0-ATH	0.05～0.1	3～6	7960	1910	6630	1590	5310	1270	3980	960	2650	640
ER8WB0600LN-40-R1.0-ATH	0.05～0.1	3～6	5570	940	4640	780	3710	620	2790	470	1860	310
ER8WB0600LN-50-R1.0-ATH	0.05～0.1	3～6	3980	480	3320	400	2650	320	1990	240	1330	160
ER8WB0700LS-R1.0-ATH	0.05～0.1	3.5～7	6820	1910	5680	1590	4550	1270	3410	950	2270	640
ER8WB0800LN-30-R1.0-ATH	0.05～0.1	4～8	7160	2290	5970	1910	4770	1530	3580	1150	2390	760
ER8WB0800LN-40-R1.0-ATH	0.05～0.1	4～8	5970	1910	4970	1590	3980	1270	2980	950	1990	640
ER8WB0800LN-50-R1.0-ATH	0.05～0.1	4～8	4180	1070	3480	890	2790	710	2090	540	1390	360
ER8WB0800LN-60-R1.0-ATH	0.05～0.1	4～8	2980	480	2490	400	1990	320	1490	240	990	160
ER8WB0900LS-R1.0-ATH	0.05～0.1	4.5～9	5310	1910	4420	1590	3540	1270	2650	950	1770	640
ER8WB1000LN-35-R1.0-ATH	0.05～0.1	5～10	5730	2290	4770	1910	3820	1530	2860	1140	1910	760
ER8WB1000LN-50-R1.0-ATH	0.05～0.1	5～10	4770	1910	3980	1590	3180	1270	2390	960	1590	640
ER8WB1000LN-60-R1.0-ATH	0.05～0.1	5～10	3340	1070	2790	890	2230	710	1670	530	1110	360
ER8WB1000LN-80-R1.0-ATH	0.05～0.1	5～10	2390	480	1990	400	1590	320	1190	240	800	160
ER8WB1100LS-R1.0-ATH	0.05～0.1	5.5～11	4340	1810	3620	1510	2890	1210	2170	910	1450	610
ER8WB1200LN-40-R1.0-ATH	0.05～0.1	6～12	4770	2060	3980	1720	3180	1370	2390	1030	1590	690
ER8WB1200LN-60-R1.0-ATH	0.05～0.1	6～12	3980	1720	3320	1430	2650	1140	1990	860	1330	570
ER8WB1200LN-80-R1.0-ATH	0.05～0.1	6～12	2790	840	2320	700	1860	560	1390	420	930	280
ER8WB1200LN-100-R1.0-ATH	0.05～0.1	6～12	1990	430	1660	360	1330	290	990	210	660	140

* Cutting conditions for the long-shank type (⌀7/9/11) are for a tool projection of 5D (tool diameter × 5). Modify the conditions using the following correction factors if the projection amount changes:

Cutting condition correction factors for long-shank type (%)

Work material			Carbon steel Alloy steel (180～250HB)		Tool steel (25～35HRC)		Pre-hardened steel (35～45HRC)		Hardened steel (45～55HRC)		Hardened steel (55～62HRC)	
Projection	a_p (mm)	a_e (mm)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)	Revolution n (min^{-1})	Feed rate vf (mm/min)
5D	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
6D	100%	100%	70%	60%	70%	60%	70%	60%	70%	60%	70%	60%
7D	100%	100%	70%	50%	70%	50%	70%	50%	70%	50%	70%	50%

【Note】
① Use the appropriate coolant for the work material and machining shape.
② Use a highly rigid and accurate machine as possible.
③ These Recommended Cutting Conditions indicate only the rule of a thumb for the cutting conditions. In actual machining, the condition should be adjusted according to the machining shape, purpose and the machine type.
④ If the rpm available is lower than that recommended please reduce the feed rate to the same ratio.
⑤ For slotting, adjust the feed rate to 50% as general criteria.
⑥ For ramping, adjust the ramp angle to 0.5° or less and the feed rate to 50% as general criteria.

The ER8WB-ATH achieves high-quality bottom face milling.

This is the Point

Use with a small pick feed and high cutting speed milling allows for a high mirror finish

ER8WB-ATH

Work size：3.150×2.756 inch

Work material：STAVAX(52HRC)
Machine：Vertical MC(HSK-E32)
Coolant：Water base coolant
Projection：.787 inch(L/D≒3)
Tool：ER8WB0600LN-20-R1.0-ATH (DC .236 inch)
Cutting conditions：n=40,000min^{-1} (v_c=2,470 SFM)
vf=126.0 IPM (f_z=.0004 IPT)
a_p=.0006 inch a_e=.0008 inch Wet
Reciprocating machining of scanning line 2-hour machining time

Surface roughness in pick direction Ra：.591 µinch, Rz：2.717 µinch

Field data

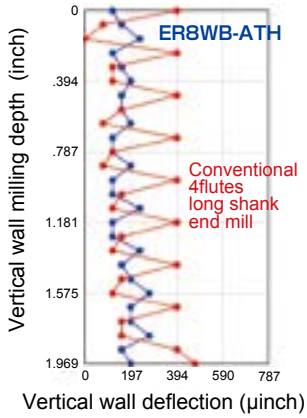
Diecast mold core vertical wall finishing

Work material : H13(45HRC)　Machine : Vertical MC (HSK-A63)　Coolant : Air blow　Projection : 2.559 inch(L/D≒5)
Tool : ER8WB1200LN-60-R1.0-ATH(φ12)　Conventional 4flutes long shank end mill

Cutting conditions :

ER8WB-ATH
n=1,326min^{-1}(v_c=164 SFM)　v_f=25.0 IPM(f_z=.002 IPT)
a_p=.236 inch　a_e=.004 inch

Conventional 4flutes long shank end mill
n=1,326min^{-1}(v_c=164 SFM)　v_f=12.5 IPM(f_z=.002 IPT)
a_p=.236 inch　a_e=.004 inch



ER8WB-ATH

Surface roughness in pick direction
Ra 5.12 µinch
Rz 38.03 µinch

Milled surface with minimal unevenness and shine

Conventional

Surface roughness in pick direction
Ra 18.90 µinch
Rz 139.09 µinch

Cloudy and uneven milled surface with conventional tools

ER8WB-ATH produces good machining accuracy and surface finish that increases efficiency compared to conventional tools.

Example for plastic molds and bushing hole finishing

Work material : STAVAX(52HRC)　Machine : Vertical MC (BT40)　Coolant : Oil base coolant　Projection : 1.969 inch(L/D=5)
Tool : ES8WB1000LN-50-ATH(φ10)　Conventional long flute end mill　Hole dia. : 1.654 inch　Depth : 1.457 inch

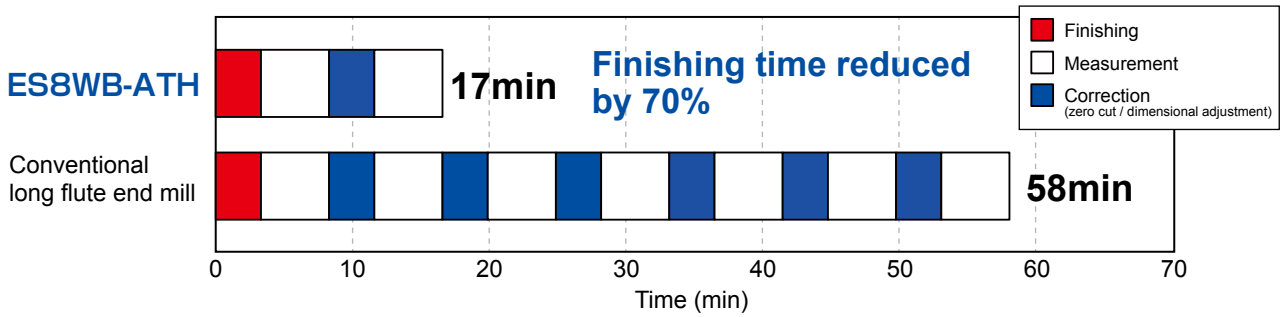
Cutting conditions :

ES8WB-ATH
n=1,592min^{-1}(v_c=164 SFM)　v_f=12.5 IPM(f_z=.001 IPT)
a_p=.197 inch　a_e=.002 inch

Conventional 6flutes long flute end mill
n=600min^{-1}(v_c=62 SFM)　v_f=3.2 IPM(f_z=.001 IPT)
a_p=.787 inch　a_e=.002 inch

* Machined using finishing machining with nominal diameter for both tools

【Comparison of finishing time】



ES8WB-ATH

- Long-flute end mill requires total of 6 zero cuts and corrections for deflection and dimensional adjustment.
- ES8WB-ATH achieves deflection of less than 118.11 µinch, even without zero cutting.
  Completed with just one final dimensional adjustment.

Surface roughness in pick direction Ra : 8.50 µinch, Rz : 36.38 µinch

Notes

⚠ Safety notes

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.

MOLDINO
The Edge To Innovation

Special Shape Tool Series for High Efficiency Finishing.

GALLEA

GALLEA series

Added corner-connected R insert for GP1LB that is easy to use for 3-axis machining.

MOLDINO Tool Engineering, Ltd.

New Product News | No. H2007A-1 | 2020-10

GALLEA Series

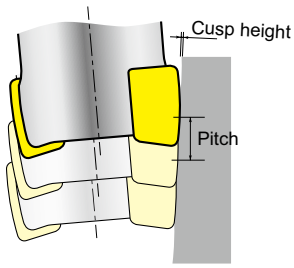
Combination of
lens tool and barrel tool

Concept of GALLEA series

Comparison of barrel tool and ball-radius end mill

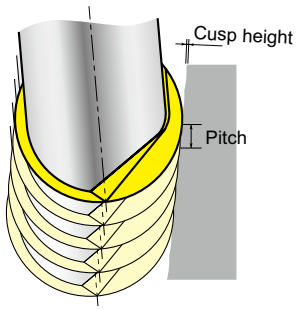
Barrel tool

Tool dia. 20mm Peripheral flute R30



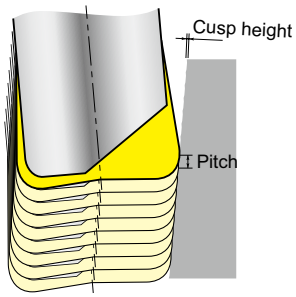
Ball end mill

Tool dia. 20mm R10



Corner radius end mill

Tool dia. 20mm Corner radius R3

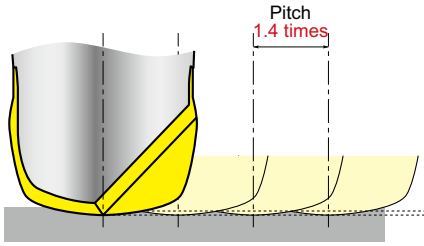


When contour milling with the same theoretical cusp height, the barrel tool can be machined with a pitch of about 1.7 times compared with the ball end mill of the same diameter, and about 3 times compared with the R3 radius end mill.

Comparison of lens tool and ball end mill

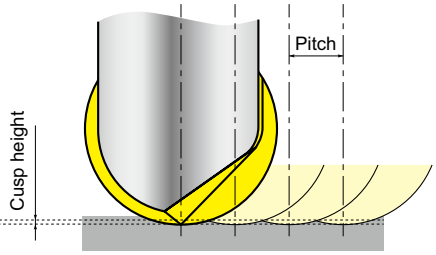
Lens tool

Tool dia. 30mm Lens R 30



Ball end mill

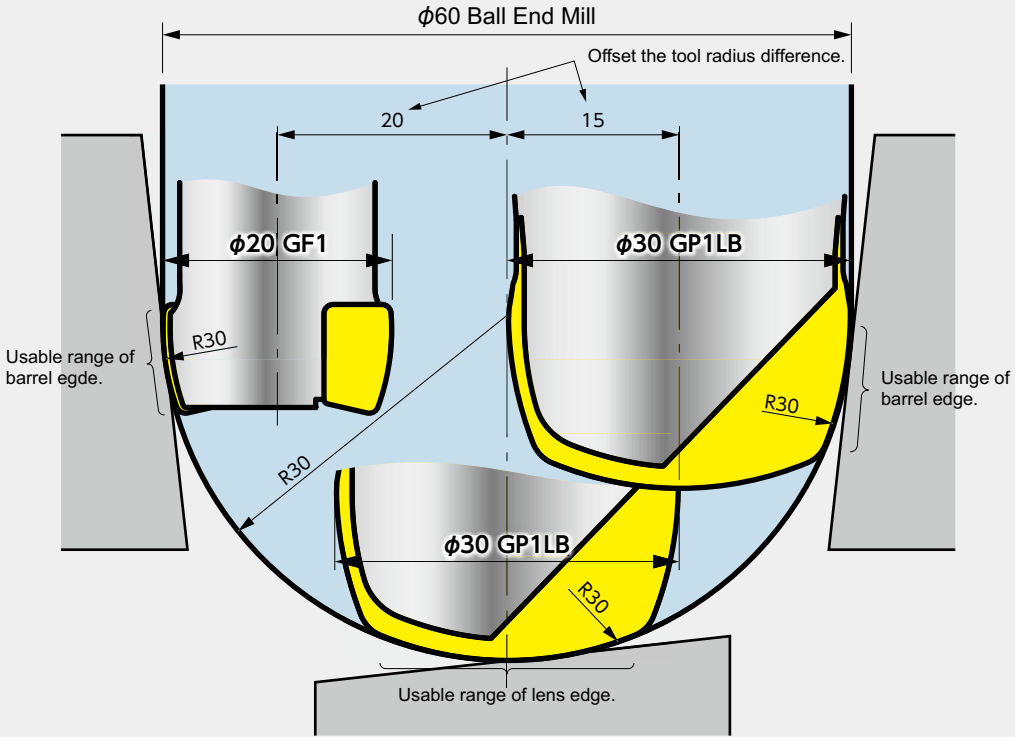
Tool dia. 30mm R15



Can be machined with pitch of about 1.4 times compared with the ball end mill of same diameter.

Because of the ability to increase the pitch, machining time can be reduced without needing to modify speeds and feeds.

The same R size GALLEA series as ϕ60 ball end mill.



How can finishing time be reduced? **Large pitch! Small cusp!**

Conventional pitch and cusp height

Pitch of GALLEA series

Possible to reduce the polishing time in case of same pitch condition

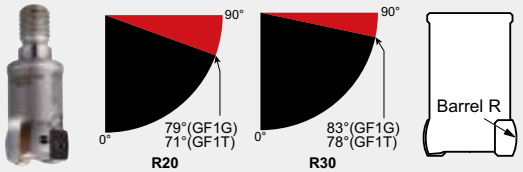
List of GALLEA series

Red In 3-axis machining usable range of Barrel edge

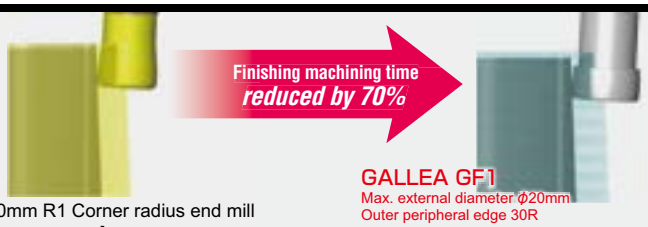
Blue In 3-axis machining usable range of Lens edge / Tip edge

Green In 3-axis machining usable range of corner-connected R

GF1 Barrel P.6



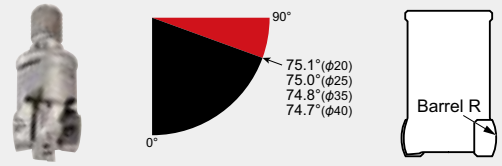
For tilted wall finishing



φ20mm R1 Corner radius end mill
【Cutting conditions】
v_f=2000mm/min n=4500min^{-1} a_p=0.2mm
Machining time simulation = Approx. 150 min.

GALLEA GF1
Max. external diameter φ20mm
Outer peripheral edge 30R
【Cutting conditions】
v_f=2000mm/min n=4500min^{-1} a_p=0.6mm
Cutting time = Approx. 40min.

GF2T Barrel P.8



For tilted wall finishing

High-performance tilted wall finishing!

Enables machining at a larger pitch than ball end mills or radius end mills.

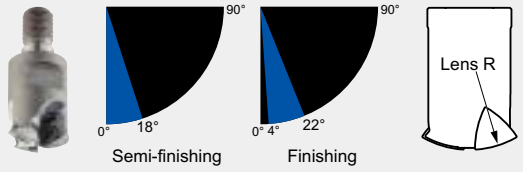
Series expansion toward larger diameters

φ20 φ25 φ35 φ40

Economical 2-corner specification

Unique insert holding surface enables realization of 2-corners specification.

GF3L Lens P.10



For gentle curved surfaces and gentle sloped surfaces

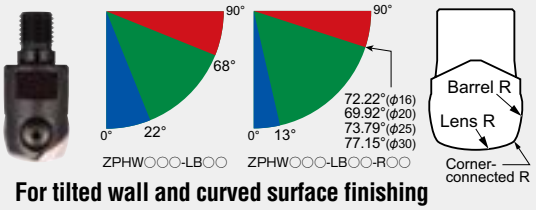
01 Using GALLEA series increases efficiency in both semi-finish and finish process.

02 Good sharp positive design.

03 High efficiency cutting tool with three flutes specification

04 Unique insert retaining surface insures strong insert clamping.

GP1LB Barrel, Lens P.12

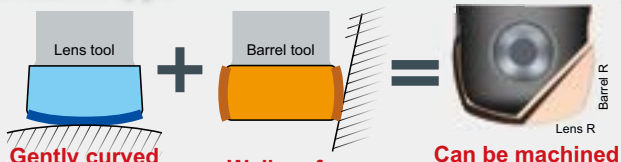


For tilted wall and curved surface finishing

Combination of lens tool and barrel tool.

Precision type

GP1LB type

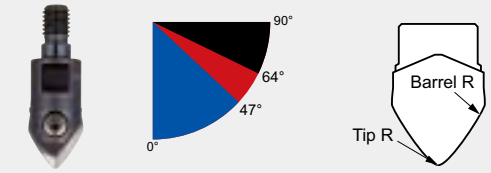


Gently curved surface

Wall surface

Can be machined with a single tool.

GP1T Taper Barrel P.14



For tilted wall, curved surface and corner finishing

Two types of processes are possible with one tool when using a 5-axis machine.

Since it can work for 2 types of machining processes, the machining surface steps can be minimized.

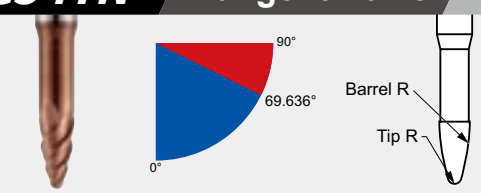
Barrel R

This tool can take a larger pitch with a barrel R which larger than the tool radius.

Tip R

The tip can be used as a ball end mill for corner processing.

GS4TN Tangent Barrel P.18



For tilted wall, curved surface and corner finishing

- Barrel R achieves high-efficiency and high-quality machining for a tilted area on part.
- Tip R can finish curved connecting faces to a high surface quality.
- Employs unique high helix shape that reduces the cutting forces.

Overview of GALLEA series

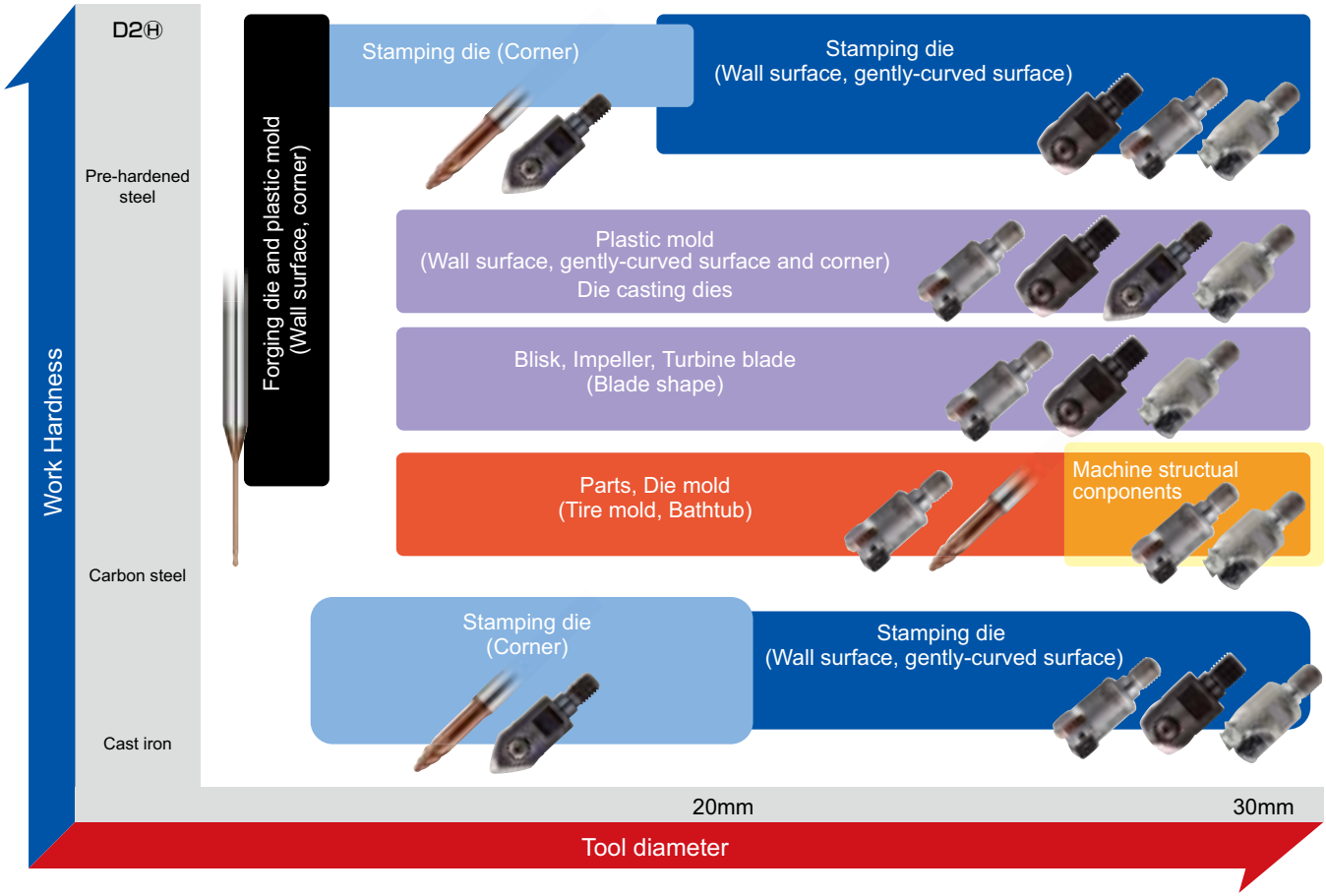


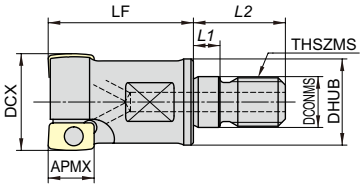
Chart of tool dia. and barrel for GALLEA series

Barrel R (mm) \ Tool dia. (mm)	2.5	3.75	5.0	7.5	10.0	12.0	16.0	20.0	25.0	30.0	35.0	40.0
12.5	GS4TN											
16.0							GP1LB					
18.75		GS4TN										
19.91									GF1T			
19.93									GF1G			
20.0								GF1T/GF1G GP1LB				
20.14							GF1G					
20.18							GF1T					
25.0			GS4TN						GP1LB			
29.78												GF2T
29.81									GF1T			
29.82									GF1G			
29.84											GF2T	
30.0						GP1T		GF1T/GF1G	GF2T	GP1LB		
30.24								GF2T				
30.33							GF1T					
30.38							GF1G					
37.5				GS4TN								
40.0							GP1T					
50.0					GS4TN			GP1T				
62.5									GP1T			
75.0										GP1T		

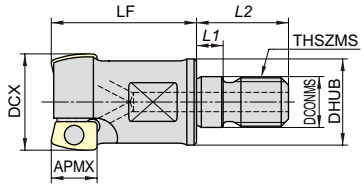
Modular type

GF1□20○○M-○-M○○

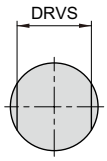
Numeric figure in a circle ○ and Alphabetical character comes in a square □



Basic type



Offset type



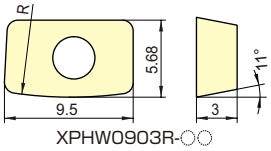
Type	Item code	Stock	No.of flutes	Size (mm)									Insert
				DCX	LF	APMX	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS	
Basic type	**GF1G2016M-2-M8**	●	2	**16**	25	9.5	8.5	M8	14	5.5	17	10	XPHW0903R-20 XPHW0903R-30
	GF1G2020M-3-M10	●	3	**20**	30	9.5	10.5	M10	17.8	5.5	19	15	
	GF1G2025M-4-M10	●	4	**25**	30	9.5	10.5	M10	17.8	5.5	19	15	
	GF1G2025M-4-M12	●	4	**25**	35	9.5	12.5	M12	22.5	5.5	22	17	
Offset type	**GF1T2016M-2-M8**	●	2	**16**	25	9.5	8.5	M8	14	5.5	17	10	YPHW0903R-20 YPHW0903R-30
	GF1T2020M-3-M10	●	3	**20**	30	9.5	10.5	M10	17.8	5.5	19	15	
	GF1T2025M-4-M12	●	4	**25**	35	9.5	12.5	M12	22.5	5.5	22	17	

【Note】 Do not apply lubricants such as grease, etc. to the “contact faces” and “modular screws” of the “modular mill”, “special shanks” and “special arbor”.

※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

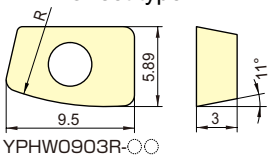
Inserts

Basic type



XPHW0903R-○○

Offset type



YPHW0903R-○○

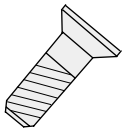
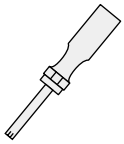
P	Carbon steel, Alloy steel	■	⊔
M	SUS, etc.	■	
K	Cast iron	⊔	■
H	Hardened steel		■

■ : General cutting, First recommended
⊔ : General cutting, Second recommended

Type	Item code	Tolerance class	PN215	TH315	Size (mm) R
Basic type	**XPHW0903R-20**	H	●	●	20
	XPHW0903R-30		●	●	30
Offset type	**YPHW0903R-20**		●	●	20
	YPHW0903R-30		●	●	30

※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

Parts

Shape / Cutter body	Clamp screw	Fastening torque (N·m)	Screw driver	Screw anti-seizure agent
				
GF1□20○○M-○-M○○	**250-141**	**1.1**	**104-T8**	**P-37**

【Note】 The clamp screw is a consumable part. Since replacement life depends on the use environment, it is recommended that it be replaced at an early stage.

● : Inventory maintained in US ★ : Inventory maintained in Japan

Recommended cutting conditions

※Red indicates primary recommended grade.

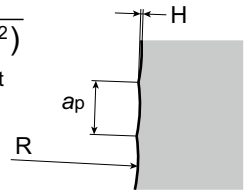
Work material	Recommended grade	Cutting condition	φ16	φ20	φ25
Carbon Steel Alloy Steel (<30HRC)	※ PN215	n (min-1)	11,950	9,560	7,650
		vc (m/min)	600	600	600
		vf (mm/min)	4,780	5,740	6,120
		fz (mm/t)	0.2	0.2	0.2
		ap (mm)	Refer right table		
		ae (mm)	~0.1	~0.1	~0.1
Carbon Steel Alloy Steel (30~45HRC)	PN215 TH315	n (min-1)	7,970	6,370	5,100
		vc (m/min)	400	400	400
		vf (mm/min)	3,190	3,830	4,080
		fz (mm/t)	0.2	0.2	0.2
		ap (mm)	Refer right table		
		ae (mm)	~0.1	~0.1	~0.1
Stainless Steel SUS	PN215	n (min-1)	9,960	7,970	6,370
		vc (m/min)	500	500	500
		vf (mm/min)	3,990	4,790	5,100
		fz (mm/t)	0.2	0.2	0.2
		ap (mm)	Refer right table		
		ae (mm)	~0.1	~0.1	~0.1
Cast Iron Ductile Cast Iron	TH315 PN215	n (min-1)	11,950	9,560	7,650
		vc (m/min)	600	600	600
		vf (mm/min)	5,980	7,170	7,650
		fz (mm/t)	0.25	0.25	0.25
		ap (mm)	Refer right table		
		ae (mm)	~0.1	~0.1	~0.1
Hardened Steel (45~55HRC)	TH315 PN215	n (min-1)	4,980	3,990	3,190
		vc (m/min)	250	250	250
		vf (mm/min)	1,500	1,800	1,920
		fz (mm/t)	0.15	0.15	0.15
		ap (mm)	Refer right table		
		ae (mm)	~0.08	~0.08	~0.08

Determine the a_p value based on the desired cusp height by selecting it from the table below or by calculating it using the equation below.

Insert		Cusp height (mm)					
Item code	R	0.001	0.002	0.003	0.004	0.005	0.01
XPHW0903R-20	20	0.4	0.57	0.69	0.8	0.89	1.26
XPHW0903R-30	30	0.49	0.69	0.85	0.98	1.1	1.55

$$a_p = 2\sqrt{(R^2-(R-H)^2)}$$

R : Tool R H : Cusp height



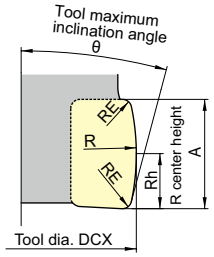
※When overhang length is 3D or greater, adjust the values shown in the table at left according to the table below.

Overhang ratio	vc (m/min)	vf (mm/min)
<3D	100%	100%
3D ~ 5D	70%	70%
5D ~ 6D	60%	60%
6D ~ 7D	50%	50%
7D ~	45%	45%

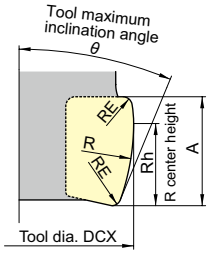
【Note】

①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③To prevent tool breakage due to chips clogging tool flutes, always be sure to use an air blower, etc. to remove chips.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.

Flute tip shape definitions for programing



Basic type



Offset type

Rotation locus shape will be different depending on the combination of insert and tool diameter. Refer to the table below.

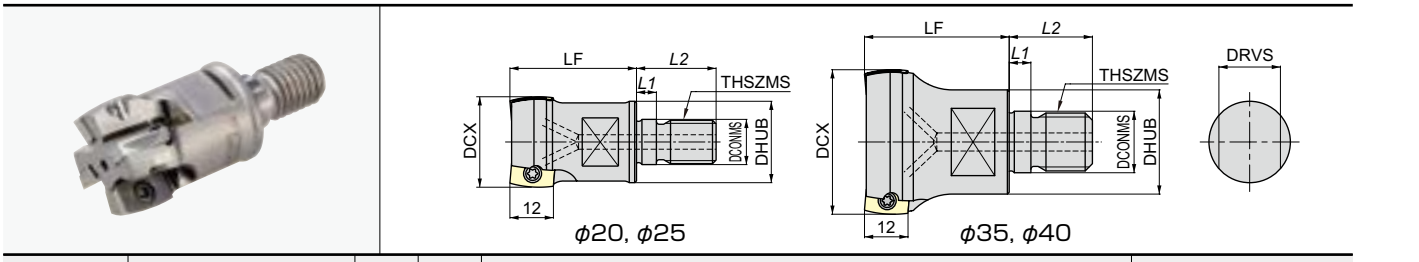
	Basic type						Offset type					
Insert item code	XPHW0903R-20			XPHW0903R-30			YPHW0903R-20			YPHW0903R-30		
Tool dia. DCX	φ16	φ20	φ25	φ16	φ20	φ25	φ16	φ20	φ25	φ16	φ20	φ25
R (mm)	20.14	20	19.93	30.38	30	29.82	20.18	20	19.91	30.33	30	29.81
Rh (mm)	4.75	4.75	4.75	4.75	4.75	4.75	7.25	7.25	7.25	7.25	7.25	7.25
RE (mm)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
A (mm)	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5
θ	11°	11°	11°	7°	7°	7°	19°	19°	19°	12°	12°	12°

【Note】 The numbers after the third decimal point are rounded off. When defining the shape parametrically, check the required dimensions from the DXF data.

Modular type

GF2T30○○M-○

Numeric figure in a circle ○ and Alphabetical character comes in a square □

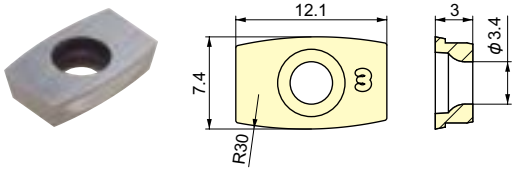


Type	Item code	Stock	No. of flutes	Size (mm)								Insert
				DCX	LF	DCONMS	THSZMS	DHUB	L1	L2	DRVS	
Offset type	GF2T3020M-3	★	3	20	30	10.5	M10	17.8	5.5	19	15	YPHW1203R-30
	GF2T3025M-4	★	4	25	35	12.5	M12	22.5	5.5	22	17	
	GF2T3035M-5	★	5	35	40	17	M16	28.8	6	23	22	
	GF2T3040M-6	★	6	40	40	17	M16	28.8	6	23	22	

【Note】Do not apply lubricants such as grease, etc. to the “contact faces” and “modular screws” of the “modular mill”, “special shanks” and “special arbor”.

※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

Inserts



P	Carbon steel, Alloy steel	■	⊔
M	SUS, etc.	■	
K	Cast iron	⊔	■
H	Hardened steel		■

■ : General cutting, First recommended
⊔ : General cutting, Second recommended

Item code	Tolerance class	Grade		Size (mm)
		PN215	TH315	R
YPHW1203R-30	H	●	●	30

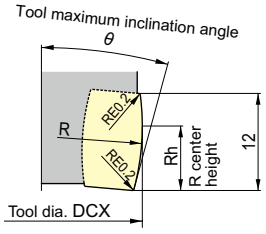
※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

Parts

Shape / Cutter body	Clamp screw	Fastening torque (N·m)	Screw driver	Screw anti-seizure agent
GF2T30○○M-○	265-143	2.0	104-T10	P-37

【Note】The clamp screw is a consumable part. Since replacement life depends on the use environment, it is recommended that it be replaced at an early stage.

Flute tip shape definitions for programing



Offset type

Rotation locus shape will be different depending on the combination of insert and tool diameter. Refer to the table below.

Insert item code	Offset type YPHW1203-R30			
Tool dia. DCX (mm)	ϕ20	ϕ25	ϕ35	ϕ40
R (mm)	30.24	30	29.84	29.78
Rh (mm)	7.92	8	8	8
θ	14.9°	15°	15.2°	15.3°

【Note】The numbers after the third decimal point are rounded off. When defining the shape parametrically, check the required dimensions from the DXF data.

★ : Inventory maintained in Japan

Recommended cutting conditions

※Red indicates primary recommended grade.

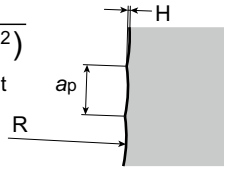
Work material	Recommended grade	Cutting conditions	φ20	φ25	φ35	φ40
Carbon Steel Alloy Steel (<30HRC)	PN215	n (min-1)	9,560	7,650	5,460	4,780
		vc (m/min)	600	600	600	600
		vf (mm/min)	5,740	6,120	5,460	5,740
		fz (mm/t)	0.2	0.2	0.2	0.2
		ap (mm)	Refer to the table at right.			
		ae (mm)	<0.1	<0.1	<0.1	<0.1
Carbon Steel Alloy Steel (30~45HRC)	PN215 TH315	n (min-1)	6,370	5,100	3,640	3,190
		vc (m/min)	400	400	400	400
		vf (mm/min)	3,830	4,080	3,640	3,830
		fz (mm/t)	0.2	0.2	0.2	0.2
		ap (mm)	Refer to the table at right.			
		ae (mm)	<0.1	<0.1	<0.1	<0.1
Stainless Steel	PN215	n (min-1)	7,970	6,370	4,550	3,990
		vc (m/min)	500	500	500	500
		vf (mm/min)	4,790	5,100	4,550	4,790
		fz (mm/t)	0.2	0.2	0.2	0.2
		ap (mm)	Refer to the table at right.			
		ae (mm)	<0.1	<0.1	<0.1	<0.1
Cast Iron Ductile Cast Iron	TH315 PN215	n (min-1)	9,560	7,650	5,460	4,780
		vc (m/min)	600	600	600	600
		vf (mm/min)	7,170	7,650	6,830	7,170
		fz (mm/t)	0.25	0.25	0.25	0.25
		ap (mm)	Refer to the table at right.			
		ae (mm)	<0.1	<0.1	<0.1	<0.1
Hardened Steel (45~55HRC)	TH315 PN215	n (min-1)	3,990	3,190	2,280	2,000
		vc (m/min)	250	250	250	250
		vf (mm/min)	1,800	1,920	1,710	1,800
		fz (mm/t)	0.15	0.15	0.15	0.15
		ap (mm)	Refer to the table at right.			
		ae (mm)	<0.08	<0.08	<0.08	<0.08

Determine the *ap* value based on the desired cusp height by selecting it from the table below or by calculating it using the equation below.

Insert		Cusp height (mm)					
Item code	R	0.001	0.002	0.003	0.004	0.005	0.01
YPHW1203R-30	30	0.49	0.69	0.85	0.98	1.1	1.55

$$ap = 2\sqrt{(R^2-(R-H)^2)}$$

R : Tool R　H : Cusp height



※When overhang length is 3D or more, adjust the values shown in the table at left according to the table below.

Overhang ratio	vc (m/min)	vf (mm/min)
<3D	100%	100%
3D ~ 5D	70%	70%
5D ~ 6D	60%	60%
6D ~ 7D	50%	50%
7D ~	45%	45%

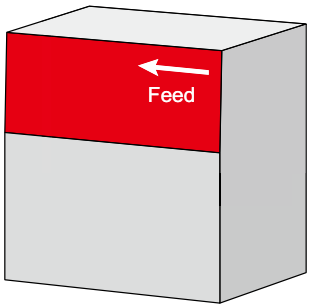
【Note】

①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③To prevent tool breakage due to chips clogging tool flutes, always be sure to use an air blower, etc. to remove chips.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.

GALLEA

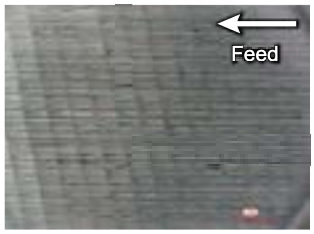
Field Data

Cutting of a 1°incline face

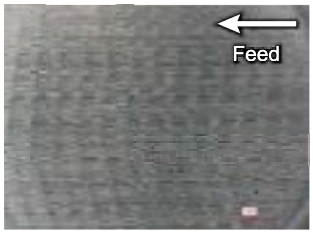


Work material : P21 (40HRC)

Achieves same surface roughness at 3 times the pitch of conventional tools.



Conventional radius mill
Ra0.54μm
ap=0.2mm



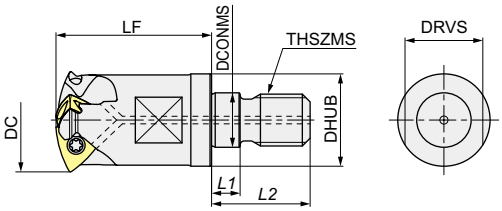
GF2T3040M-6
Ra0.54μm
ap=0.6mm

Tool	Overhang length (mm)	Tool dia. (mm)	Cutting speed (m/min)	Revolution (min-1)	Feed per tooth (mm/t)	Feed rate (mm/min)	ap (mm)	ae (mm)	Coolant
GF2T3040M-6 YPHW1203R-30 PN215	245	40	160	1,273	0.1	765	0.6	0.1	Air blow
Conventional R2 radius mill							0.2		

Modular type

GF3L○○M-3-M○○

Numeric figure in a circle ◌

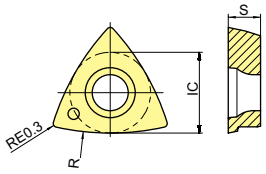


Item code	Stock	No. of Inserts	Size (mm)								Insert
			DC	LF	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS	
GF3L20M-3-M10	★	3	**20**	30	10.5	M10	17.8	5.5	19	15	TPHW0902-20
GF3L25M-3-M12	★	3	**25**	35	12.5	M12	22.5	5.5	22	17	TPHW1303-25
GF3L30M-3-M16	★	3	**30**	40	17	M16	28.8	6	23	22	TPHW1403-30

【Note】 Do not apply lubricants such as grease, etc. to the “contact faces” and “modular screws” of the “modular mill”, “special shanks” and “special arbor”.

※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

Inserts



P	Carbon Steel, Alloy Steel	■	⌴
M	Stainless Steel, etc.	■	
K	Cast Iron・Ductile Cast Iron	⌴	■
H	Hardened Steel		■

■ : General cutting, First recommended
⌴ : General cutting, Second recommended

Order No.	Tolerance class	Grade		Size(mm)		
		PN215	TH315	IC	S	R
TPHW0902-20	H	★	★	6.5	2.6	20
TPHW1303-25		★	★	8.2	3.0	25
TPHW1403-30		★	★	9.8	3.2	30

※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

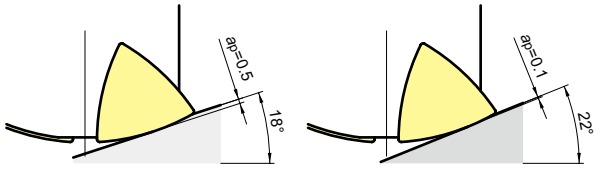
Parts

Parts	Clamp screw		Wrench	Screw anti-seizure agent
Shape / Cutter body		Fastening torque (N·m)		
GF3L20M-3-M10	**251-141**	**1.1**	**104-T8**	
GF3L25M-3-M12	**265-143**	**2.0**	**104-T10**	**P-37**
GF3L30M-3-M16	**412-141**	**2.9**	**104-T15**	

【Note】 The clamp screw is a consumable part. Since replacement life depends on the use environment, it is recommended that it be replaced at an early stage.

Usable range of cutting edge for GF3L type

Semi-finishing | Finishing

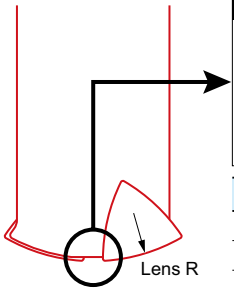


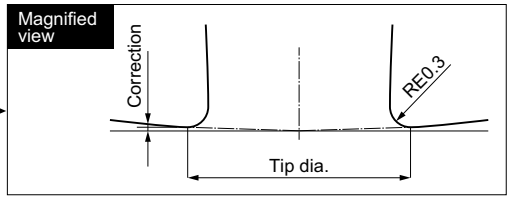
	a_p max finishing allowance	Available cutting range
Semi-finishing	0.5mm	18°
Finishing	0.1mm	22°

Because of GF3L type does not have a peripheral cutting edge, cutting range changes according to cutting depth (a_p).

Correction of tool length measurement value

GF3L type does not have cutting edge in the tool center. When create toolpath with lens tool definition, correct the measurement value of tool length. When using a CAM that can define a tool shape with CAM and DXF data that can define a tool shape, it is unnecessary to correct the tool length measurement value.





	Correction (mm)	Tip dia.(mm)
GF3L20M-3-M10	0.058	3.0
GF3L25M-3-M12	0.056	3.3
GF3L30M-3-M16	0.062	3.9

★ : Inventory maintained in Japan

Recommended cutting conditions

※Red indicates primary recommended grade.

Work material	Recommended grade	Cutting condition	Finishing			Semi-finishing		
			ϕ20	ϕ25	ϕ30	ϕ20	ϕ25	ϕ30
Carbon Steel Alloy Steel (<30HRC)	PN215	*n* (min^{-1})	11,470	9,180	7,650	4,780	3,830	3,190
		vc (m/min)	720	720	720	300	300	300
		vf (mm/min)	6,890	5,510	4,590	7,170	5,750	4,790
		fz (mm/t)	0.2	0.2	0.2	0.5	0.5	0.5
		ap (mm)	0.1	0.1	0.1	0.5	0.5	0.5
		ae (mm)	Refer below table			Refer below table		
Carbon Steel Alloy Steel (30~45HRC)	PN215 TH315	*n* (min^{-1})	8,290	6,630	5,530	3,190	2,550	2,130
		vc (m/min)	520	520	520	200	200	200
		vf (mm/min)	4,980	3,980	3,320	4,790	3,830	3,200
		fz (mm/t)	0.2	0.2	0.2	0.5	0.5	0.5
		ap (mm)	0.1	0.1	0.1	0.5	0.5	0.5
		ae (mm)	Refer below table			Refer below table		
Stainless Steel	PN215	*n* (min^{-1})	7,970	6,370	5,310	4,780	3,830	3,190
		vc (m/min)	500	500	500	300	300	300
		vf (mm/min)	4,790	3,830	3,190	7,170	5,750	4,790
		fz (mm/t)	0.2	0.2	0.2	0.5	0.5	0.5
		ap (mm)	0.1	0.1	0.1	0.5	0.5	0.5
		ae (mm)	Refer below table			Refer below table		
Cast Iron Ductile Cast Iron	TH315 PN215	*n* (min^{-1})	10,360	8,290	6,910	6,370	5,100	4,250
		vc (m/min)	650	650	650	400	400	400
		vf (mm/min)	9,330	7,470	6,220	9,560	7,650	6,380
		fz (mm/t)	0.3	0.3	0.3	0.5	0.5	0.5
		ap (mm)	0.1	0.1	0.1	0.5	0.5	0.5
		ae (mm)	Refer below table			Refer below table		
Hardened Steel (45~55HRC)	TH315	*n* (min^{-1})	3,990	3,190	2,660	1,920	1,530	1,280
		vc (m/min)	250	250	250	120	120	120
		vf (mm/min)	2,400	1,920	1,600	580	460	390
		fz (mm/t)	0.2	0.2	0.2	0.15	0.15	0.15
		ap (mm)	0.08	0.08	0.08	0.2	0.2	0.2
		ae (mm)	Refer below table			Refer below table		

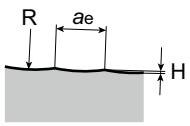
How to calculate "*ae*"

Determine the *ae* value based on the desired cusp height by selecting it from the table below or by calculating it using the equation below.

Insert	R	Cusp height (mm)						
		0.001	0.002	0.003	0.004	0.005	0.01	0.02
TPHW0902-20	20	0.4	0.57	0.69	0.8	0.89	1.26	1.79
TPHW1303-25	25	0.45	0.63	0.77	0.89	1	1.41	2
TPHW1403-30	30	0.49	0.69	0.85	0.98	1.1	1.55	2.19

$$ae = 2\sqrt{(R^2-(R-H)^2)}$$

R : Tool R H : Cusp height



【Note】
①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③To prevent tool breakage due to chips clogging tool flutes, always be sure to use an air blower, etc. to remove chips.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.

Ajustment ratio of cutting conditions by overhang length.

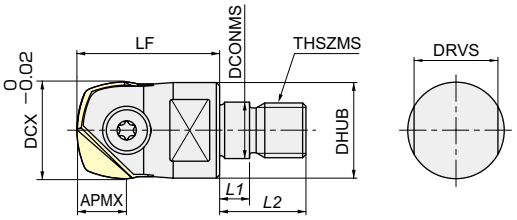
When overhang length is 3D or more, please adjust the values in the above cutting condition table referring to the right table.

Overhang ratio	*Vc* (m/min)	*Vf* (mm/min)
<3D	100%	100%
3D ~ 5D	70%	70%
5D ~ 6D	60%	60%
6D ~ 7D	50%	50%
7D ~	45%	45%

Modular type

GP1LB○○M-M○○

Numeric figure in a circle ○ and Alphabetical character comes in a square □

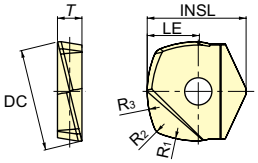


Item code	Stock	No. of Inserts	Size (mm)									Insert
			DCX	LF	APMX	DCONMS	THSZMS	DHUB	L1	L2	DRVS	
GP1LB16M-M8	●	1	16	32	8	8.5	M8	12.8	5.5	17	10	ZPHW160-LB16
GP1LB20M-M10	●	1	20	38	10	10.5	M10	17.8	5.5	19	15	ZPHW200-LB20
GP1LB25M-M12	●	1	25	38	12.5	12.5	M12	20.8	5.5	22	17	ZPHW250-LB25
GP1LB30M-M16	★	1	30	43	15	17	M16	28.8	6	23	22	ZPHW300-LB30

【Note】Do not apply lubricants such as grease, etc. to the “contact faces” and “modular screws” of the “modular mill”, “special shanks” and “special arbor”.

※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

Inserts



P	Carbon Steel, Alloy Steel	■	□
M	Stainless Steel, etc.	■	
K	Cast Iron・Ductile Cast Iron	□	■
H	Hardened Steel		■

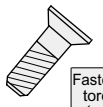
■ : General cutting, First recommended

□ : General cutting, Second recommended

Item code	Tolerance class	Grade		Size (mm)						
		PN215	TH308	R1	R2	R3	LE	INSL	DC	T
ZPHW160-LB16	H	●	●	16	1.5	16	8	16.6	16	4.2
ZPHW160-LB16-R5		●	●	16	5	16	8	16.6	16	4.2
ZPHW200-LB20		●	●	20	1.9	20	10	20.3	20	5.2
ZPHW200-LB20-R6		●	●	20	6	20	10	20.3	20	5.2
ZPHW250-LB25		●	●	25	2.38	25	12.5	24.1	25	6.2
ZPHW250-LB25-R8		●	●	25	8	25	12.5	24.1	25	6.2
ZPHW300-LB30		★	★	30	2.85	30	15	29.1	30	7.2
ZPHW300-LB30-R10		★	★	30	10	30	15	29.1	30	7.2

【Note】The numbers after the third decimal point are rounded off. When defining the shape parametrically, check the required dimensions from the DXF data.

Parts

Parts	Clamp screw		Wrench	Screw anti-seizure agent
Shape / Cutter body		Fastening torque (N·m)		
GP1LB16M-M8	581-144	4.9	105-T20	P-37
GP1LB20M-M10	581-145	6.9	101-T25S	
GP1LB25M-M12	581-146	9.8	105-T30A	
GP1LB30M-M16	581-147	9.8		

※The insert can be attached to Ball Precision F (ABPF type) holders.

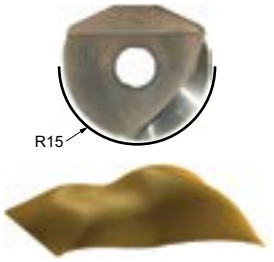
※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database
TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

【Note】The clamp screw is a consumable part. Since replacement life depends on the use environment, it is recommended that it be replaced at an early stage.

How to select GP1LB inserts

Comparison of cutting efficiency of 3-axis machining with φ30 tool. ※Set the cusp-height of each edge of barrel R, lens R and corner-connected R same as ball end mill

Ball end mill (φ30)

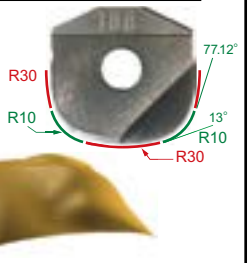


Ball end mill is recommended for shapes with large undulations

GP1LB ZPHW300-LB30-R10

1.4 times cutting efficiency than ball end mill

Cutting efficiency Compared with the ball end mill 0.8 times



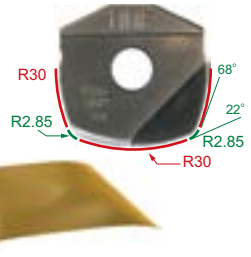
High efficiency machining on undulating curved surface.

If the barrel R and lens R can be used more than 47% of the whole machining, it's more efficient than ball end mill of same diameter.

GP1LB ZPHW300-LB30

1.4 times cutting efficiency than ball end mill

Cutting efficiency Compared with the ball end mill 0.4 times



High efficiency machining with gentle curved surface with less undulation.

If the barrel R and lens R can be used more than 84% of the whole machining, it's more efficient than ball end mill of same diameter.

※Checking the usage rate of barrel R edge and lens R edge in model shape to be processed and choosing an insert, more efficient machining is possible.

● : Inventory maintained in US ★ : Inventory maintained in Japan

Recommended cutting conditions

※Red indicates primary recommended grade.

Work material	Recommended grade	Cutting condition	Lens part				Barrel part			
			φ16	φ20	φ25	φ30	φ16	φ20	φ25	φ30
Carbon Steel Alloy Steel (<30HRC)	PN215	*n* (min^{-1})	14,340	11,470	9,180	7,650	11,950	9,560	7,650	6,370
		vc (m/min)	720	720	720	720	600	600	600	600
		vf (mm/min)	7,170	5,740	4,590	3,830	4780	3,830	3,060	2,550
		fz (mm/t)	0.25	0.25	0.25	0.25	0.2	0.2	0.2	0.2
		ap (mm)	0.1	0.1	0.1	0.1	Refer below table			
		ae (mm)	Refer below table				0.1	0.1	0.1	0.1
Carbon Steel Alloy Steel (30～45HRC)	PN215 TH308	*n* (min^{-1})	10,360	8,290	6,630	5,530	7,970	6,370	5,100	4,250
		vc (m/min)	520	520	520	520	400	400	400	400
		vf (mm/min)	5,180	4,150	3,320	2,770	3,190	2,550	2,040	1,700
		fz (mm/t)	0.25	0.25	0.25	0.25	0.2	0.2	0.2	0.2
		ap (mm)	0.1	0.1	0.1	0.1	Refer below table			
		ae (mm)	Refer below table				0.1	0.1	0.1	0.1
Stainless Steel	PN215	*n* (min^{-1})	12,940	10,360	8,290	6,910	9,960	7,970	6,370	5,310
		vc (m/min)	650	650	650	650	500	500	500	500
		vf (mm/min)	6,470	5,180	4,150	3,460	3,990	3,190	2,550	2,130
		fz (mm/t)	0.25	0.25	0.25	0.25	0.2	0.2	0.2	0.2
		ap (mm)	0.1	0.1	0.1	0.1	Refer below table			
		ae (mm)	Refer below table				0.1	0.1	0.1	0.1
Cast iron Ductile Cast Iron	TH308 PN215	*n* (min^{-1})	14,340	11,470	9,180	7,650	11,950	9,560	7,650	6,370
		vc (m/min)	720	720	720	720	600	600	600	600
		vf (mm/min)	11,480	9,180	7,350	6,120	5,980	4,780	3,830	3,190
		fz (mm/t)	0.4	0.4	0.4	0.4	0.25	0.25	0.25	0.25
		ap (mm)	0.1	0.1	0.1	0.1	Refer below table			
		ae (mm)	Refer below table				0.1	0.1	0.1	0.1
Hardened Steel (45～55HRC)	TH308	*n* (min^{-1})	6,370	5,100	4,080	3,400	4,980	3,990	3,190	2,660
		vc (m/min)	320	320	320	320	250	250	250	250
		vf (mm/min)	2,550	2,040	1,640	1,360	1,500	1,200	960	800
		fz (mm/t)	0.20	0.20	0.20	0.20	0.15	0.15	0.15	0.15
		ap (mm)	0.08	0.08	0.08	0.08	Refer below table			
		ae (mm)	Refer below table				0.08	0.08	0.08	0.08
Hardened steels (55～62HRC)	TH308	*n* (min^{-1})	5,580	4,460	3,570	2,980	4,380	3,510	2,810	2,340
		vc (m/min)	280	280	280	280	220	220	220	220
		vf (mm/min)	2,240	1,790	1,430	1,200	1,320	1,060	850	710
		fz (mm/t)	0.20	0.20	0.20	0.20	0.15	0.15	0.15	0.15
		ap (mm)	0.05	0.05	0.05	0.05	Refer below table			
		ae (mm)	Refer below table				0.05	0.05	0.05	0.05

- For machining shapes that make heavy use of lens R, refer to the "Lens part cutting conditions" in the above table.
- For machining shapes that make heavy use of barrel R, refer to the "Barrel part cutting conditions" in the above table.
- For machining shapes that use both lens R and barrel R, refer to the conditions for the higher usage ratio.

When overhang length is 3D or more, adjust the values shown in the below table according to the above table.

Overhang ratio	*Vc* (m/min)	*Vf* (mm/min)
<3D	100%	100%
3D ～ 5D	70%	70%
5D ～ 6D	60%	60%
6D ～ 7D	50%	50%
7D ～	45%	45%

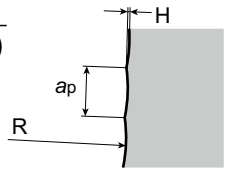
Determine the *ap* or *ae* value based on the desired cusp height by selecting it from the table below or by calculating it using the equation below.

Insert		Cusp height (mm)					
Item code	R	0.001	0.002	0.003	0.004	0.005	0.01
ZPHW160-LB16	16	0.36	0.51	0.62	0.72	0.8	1.13
ZPHW200-LB20	20	0.4	0.57	0.69	0.8	0.89	1.26
ZPHW250-LB25	25	0.45	0.63	0.77	0.89	1	1.41
ZPHW300-LB30	30	0.49	0.69	0.85	0.98	1.1	1.55

$$a_p = 2\sqrt{(R^2-(R-H)^2)}$$

(*ae*)

R : Tool R　H : Cusp height



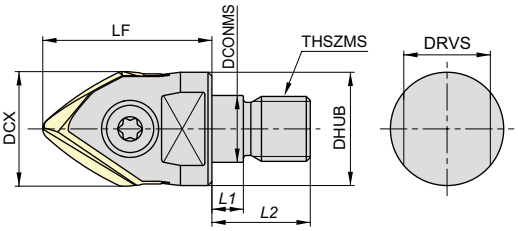
【Note】
①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③To prevent tool breakage due to chips clogging tool flutes, always be sure to use an air blower, etc. to remove chips.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.

Refer page 143 for set-up procedures of inserts.

Modular type

GP1T ○○M-M○○

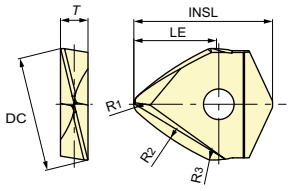
Numeric figure in a circle ○ and Alphabetical character comes in a square □



Item code	Stock	No. of flutes	Size (mm)								Insert
			DCX	LF	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS	
GP1T12M-M6	★	1	12	26	6.5	M6	9.8	5.5	14.5	7	ZDHW120-T43R1.2-30
GP1T16M-M8	★	1	16	32	8.5	M8	12.8	5.5	17	10	ZDHW160-T43R1.6-40
GP1T20M-M10	★	1	20	38	10.5	M10	17.8	5.5	19	15	ZDHW200-T43R2-50
GP1T25M-M12	★	1	25	38	12.5	M12	20.8	5.5	22	17	ZDHW250-T43R2.5-62.5
GP1T30M-M16	★	1	30	43	17	M16	28.8	6	23	22	ZDHW300-T43R3-75

【Note】Do not apply lubricants such as grease, etc. to the “contact faces” and “modular screws” of the “modular mill”, “special shanks” and “special arbor”.
※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

Inserts



P	Carbon Steel, Alloy Steel	■	⊔
M	Stainless Steel, etc.	■	
K	Cast Iron・Ductile Cast Iron	⊔	■
H	Hardened Steel		■

■ : General cutting, First recommended
⊔ : General cutting, Second recommended

Order No.	Tolerance class	Grade		Size(mm)						
		PN215	TH308	R_1	R_2	R_3	LE	INSL	DC	*T*
ZDHW120-T43R1.2-30	H	★	★	1.2	30	0.98	8.6	17.6	12	3.2
ZDHW160-T43R1.6-40		★	★	1.6	40	1.3	11.3	20.6	16	4.2
ZDHW200-T43R2-50		★	★	2.0	50	1.63	14.3	25.4	20	5.2
ZDHW250-T43R2.5-62.5		★	★	2.5	62.5	2.04	17.9	30.1	25	6.2
ZDHW300-T43R3-75		★	★	3.0	75	2.45	21.6	36.3	30	7.2

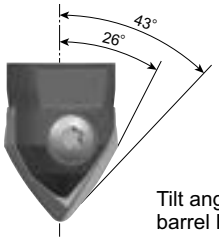
・The insert can be set with "ABPF-type" cutter body ・Use solid barrel end mill, "GS4TN-type" for smaller diameter in size
【Note】The numbers after the third decimal point are rounded off. When defining the shape parametrically, check the required dimensions from the DXF data.
※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

Parts

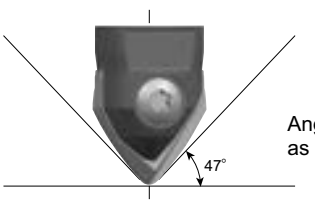
Parts / Shape / Cutter body	Clamp screw	Fastening torque (N·m)	Wrench	Screw anti-seizure agent
				
GP1T12M-M6	**581-143**	**4.9**	**105-T20**	**P-37**
GP1T16M-M8	**581-144**	**4.9**		
GP1T20M-M10	**581-145**	**6.9**	**101-T25S**	
GP1T25M-M12	**581-146**	**9.8**	**105-T30A**	
GP1T30M-M16	**581-147**	**9.8**		

【Note】The clamp screw is a consumable part. Since replacement life depends on the use environment, it is recommended that it be replaced at an early stage.

Angle range of barrel R and tip R



Tilt angle range when barrel R is used



Angle range that can be used as a ball end mill

★ : Inventory maintained in Japan

Recommended cutting conditions

※Red indicates primary recommended grade.

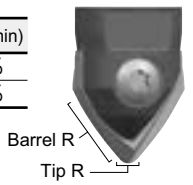
Work material	Recommended grade	Cutting conditions	Tip R					Barrel R				
			φ12(R1.2)	φ16(R1.6)	φ20(R2)	φ25(R2.5)	φ30(R3)	φ12	φ16	φ20	φ25	φ30
Carbon Steel Alloy Steel (<30HRC)	PN215	n (min⁻¹)	19,910	14,930	11,950	9,560	7,970	19,110	14,340	11,470	9,180	7,650
		vc (m/min)	750(150)	750(150)	750(150)	750(150)	750(150)	720	720	720	720	720
		vf (mm/min)	1,600	1,500	1,440	1,340	1,280	5,740	4,310	3,450	2,760	2,300
		fz (mm/t)	0.04	0.05	0.06	0.07	0.08	0.15	0.15	0.15	0.15	0.15
		ap (mm)	0.1	0.1	0.1	0.1	0.1	Refer below table				
		ae (mm)	Refer below table					0.1	0.1	0.1	0.1	0.1
Carbon Steel Alloy Steel (30~45HRC)	PN215 TH308	n (min⁻¹)	18,580	13,940	11,150	8,920	7,440	13,810	10,360	8,290	6,630	5,530
		vc (m/min)	700(140)	700(140)	700(140)	700(140)	700(140)	520	520	520	520	520
		vf (mm/min)	1,490	1,400	1,340	1,250	1,200	4,150	3,110	2,490	1,990	1,660
		fz (mm/t)	0.04	0.05	0.06	0.07	0.08	0.15	0.15	0.15	0.15	0.15
		ap (mm)	0.1	0.1	0.1	0.1	0.1	Refer below table				
		ae (mm)	Refer below table					0.1	0.1	0.1	0.1	0.1
Stainless Steel	PN215	n (min⁻¹)	19,910	14,930	11,950	9,560	7,970	17,260	12,940	10,360	8,290	6,910
		vc (m/min)	750(150)	750(150)	750(150)	750(150)	750(150)	650	650	650	650	650
		vf (mm/min)	1,600	1,500	1,440	1,340	1,280	5,180	3,890	3,110	2,490	2,080
		fz (mm/t)	0.04	0.05	0.06	0.07	0.08	0.15	0.15	0.15	0.15	0.15
		ap (mm)	0.1	0.1	0.1	0.1	0.1	Refer below table				
		ae (mm)	Refer below table					0.1	0.1	0.1	0.1	0.1
Cast Iron Ductile Cast Iron	TH308 PN215	n (min⁻¹)	19,910	14,930	11,950	9,560	7,970	19,110	14,340	11,470	9,180	7,650
		vc (m/min)	750(150)	750(150)	750(150)	750(150)	750(150)	720	720	720	720	720
		vf (mm/min)	1,600	1,500	1,440	1,340	1,280	7,650	5,740	4,590	3,680	3,060
		fz (mm/t)	0.04	0.05	0.06	0.07	0.08	0.2	0.2	0.2	0.2	0.2
		ap (mm)	0.1	0.1	0.1	0.1	0.1	Refer below table				
		ae (mm)	Refer below table					0.1	0.1	0.1	0.1	0.1
Hardened Steel (45~55HRC)	TH308	n (min⁻¹)	13,270	9,960	7,970	6,370	5,310	8,500	6,370	5,100	4,080	3,400
		vc (m/min)	500(100)	500(100)	500(100)	500(100)	500(100)	320	320	320	320	320
		vf (mm/min)	1,070	1,000	960	900	850	1,700	1,280	1,020	820	680
		fz (mm/t)	0.04	0.05	0.06	0.07	0.08	0.1	0.1	0.1	0.1	0.1
		ap (mm)	0.08	0.08	0.08	0.08	0.08	Refer below table				
		ae (mm)	Refer below table					0.08	0.08	0.08	0.08	0.08
Hardened Steel (55~62HRC)	TH308	n (min⁻¹)	11,950	8,960	7,170	5,740	4,780	7,440	5,580	4,460	3,570	2,980
		vc (m/min)	450(90)	450(90)	450(90)	450(90)	450(90)	280	280	280	280	280
		vf (mm/min)	960	900	870	810	770	1,490	1,120	900	720	600
		fz (mm/t)	0.04	0.05	0.06	0.07	0.08	0.1	0.1	0.1	0.1	0.1
		ap (mm)	0.05	0.05	0.05	0.05	0.05	Refer below table				
		ae (mm)	Refer below table					0.05	0.05	0.05	0.05	0.05

※The ( ) values of vc indicate the cutting speed of the tip R part.

When overhang length is 3D or more, adjust the values shown in the table at right according to the above table.

Overhang ratio	Vc (m/min)	Vf (mm/min)
<3D	100%	100%
3D ~ 5D	70%	70%
5D ~ 6D	60%	60%

Overhang ratio	Vc (m/min)	Vf (mm/min)
6D ~ 7D	50%	50%
7D ~	45%	45%

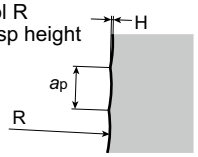


Determine the ap or ae value based on the desired cusp height by selecting it from the table below or by calculating it using the equation below.

Insert Item code	Barrel R	Cutting depth using barrel R ap(mm) Cusp height (mm) 0.0005	0.001	0.002	0.003	0.004	0.005	0.01	Tip R	Cutting depth using tip R ae(mm) Cusp height (mm) 0.0005	0.001	0.002	0.003	0.004	0.005	0.01
ZDHW120-T43R1.2-30	30	0.35	0.49	0.69	0.85	0.98	1.1	1.55	1.2	0.07	0.1	0.14	0.17	0.2	0.22	0.31
ZDHW160-T43R1.6-40	40	0.4	0.57	0.8	0.98	1.13	1.26	1.79	1.6	0.08	0.11	0.16	0.2	0.23	0.25	0.36
ZDHW200-T43R2-50	50	0.45	0.63	0.89	1.1	1.26	1.41	2	2	0.09	0.13	0.18	0.22	0.25	0.28	0.4
ZDHW250-T43R2.5-62.5	62.5	0.5	0.71	1	1.22	1.41	1.58	2.24	2.5	0.1	0.14	0.2	0.24	0.28	0.32	0.45
ZDHW300-T43R3-75	75	0.55	0.77	1.1	1.34	1.55	1.73	2.45	3	0.11	0.15	0.22	0.27	0.31	0.35	0.49

$$ap = 2\sqrt{(R^2-(R-H)^2)}\ (ae)$$

R: Tool R
H: Cusp height



【Note】
①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③To prevent tool breakage due to chips clogging tool flutes, always be sure to use an air blower, etc. to remove chips.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.

Set-up Procedures of Inserts

1 Clean the insert seat:
Using air-blow or alike, clean the seat.

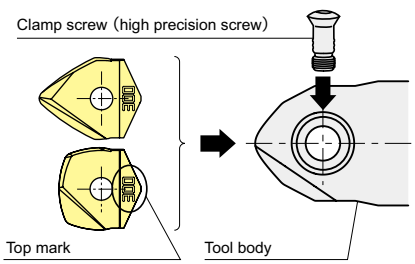
2 Put in the insert with its top positioned to the screw-tightening side of the tool body.

3 Tighten the clamp screw with the special wrench. Please do not press down the insert during this tightening process.

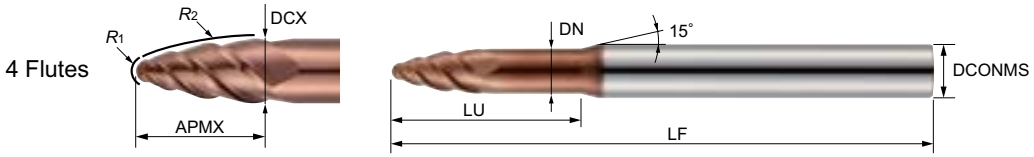
4 This is the end of insert set-up.

Attention Never tighten the clamp screw without putting the insert. The tool body may be deformed, resulting in improper insert mounting or deterioration of mounting accuracy.

Do not tighten the screw without putting insert



Solid type



GS4TN○○.○○-○○.○○R-TH3

Carbide TH3 72 HRC Helix 45 h5

Form tolerance：±0.01

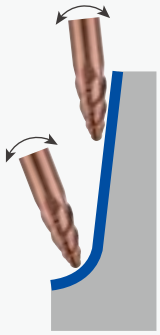
Item code	Stock	Size (mm)							
		Tip R	Barrel R	Tool dia.	Flute length	Under neck length	Neck dia.	Overall length	Shank dia.
		R_1	R_2	DCX	APMX	LU	DN	LF	DCONMS
GS4TN2.5-12.5R-TH3	●	0.5	12.5	2.5	4.68	10	2.4	50	4
GS4TN3.75-18.75R-TH3	●	0.75	18.75	3.75	7.01	15	3.65	50	4
GS4TN5-25R-TH3	●	1	25	5	9.35	20	4.8	60	6
GS4TN7.5-37.5R-TH3	●	1.5	37.5	7.5	14.03	30	7.3	75	8
GS4TN10-50R-TH3	●	2	50	10	18.70	40	9.5	100	12

・There is no regrinding compatibility for this tool. ・For the large diameter in size, use the indexable end mill "GP1T".

※For information on the detailed tool shape, download the DXF data from the MOLDINO Tool Engineering home page.
(MOLDINO Tool Engineering tool selection database TOOL SEARCH: http://data.moldino.com/toolsearch/?lang=en)

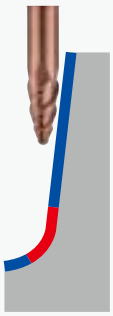
Machining method of GS4TN

When using with 5-axis machine



By using the barrel R with tilted tool axis, tilted section can be cut with large pitch.
Furthermore, it is possible to cut with less machining steps by using the tip R.

When using with 3-axis machine



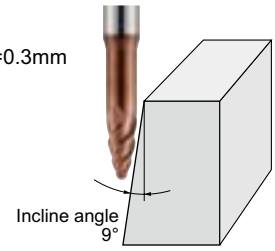
Barrel R enables to cut steep face with large pitch.
However, it is necessary to process the bottom corner section with a separate tool.

Processable with GS4TN　Needs separate tool

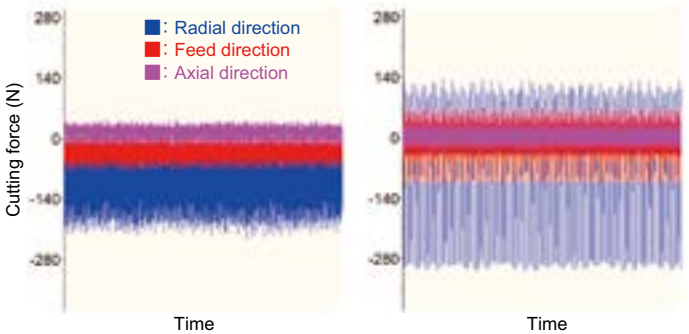
High helix shape realized low cutting force

Cutting conditions

Work material：Matrix HSS (58HRC)
Tool：GS4TN10-50R-TH3
　　2 flutes Ball End Mill
Shape：See the figure right
Conditions：　n=4780min^{-1}
　　v_f=956mm/min
　　(Ball：v_f=478)
　　a_p=0.5mm　a_e=0.3mm
　　Contouring
　　Down cut



GS4TN　2 flutes Ball End mill



High helix shape reduces cutting force,
4 flutes improve efficiency

●：Inventory maintained in US

Recommended cutting conditions

●Barrel R　cutting conditions

Work material		Carbon Steel, Alloy Steel (<35HRC)				Pre-hardened Steel (35～45HRC)				Hardened Steel (45～55HRC)				Hardened Steel (55～65HRC)				Hardened Steel (65～72HRC)			
Tip R R_1 (mm)	Barrel R R_2 (mm)	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm
0.5	12.5	23,550	3,060	0.22	0.05～0.1	19,100	2,480	0.22	0.05～0.1	17,830	1,960	0.22	0.05～0.1	16,550	1,820	0.22	0.01～0.05	12,730	1,400	0.22	0.01～0.05
0.75	18.75	15,700	2,670	0.27	0.05～0.1	13,840	2,460	0.27	0.05～0.1	11,880	1,780	0.27	0.05～0.1	11,370	1,640	0.27	0.01～0.05	8,570	1,230	0.27	0.01～0.05
1	25	11,780	2,540	0.32	0.05～0.1	10,500	2,260	0.32	0.05～0.1	9,130	1,670	0.32	0.05～0.1	7,040	1,440	0.32	0.01～0.05	6,490	1,100	0.32	0.01～0.05
1.5	37.5	7,850	1,990	0.39	0.05～0.1	6,930	1,780	0.39	0.05～0.1	6,190	1,390	0.39	0.05～0.1	4,460	1,230	0.39	0.01～0.05	4,290	920	0.39	0.01～0.05
2	50	5,890	1,680	0.45	0.05～0.1	5,100	1,460	0.45	0.05～0.1	4,510	1,130	0.45	0.05～0.1	3,520	1,000	0.45	0.01～0.05	3,190	770	0.45	0.01～0.05

●Tip R　cutting conditions

Work material		Carbon Steel, Alloy Steel (<35HRC)				Pre-hardened Steel (35～45HRC)				Hardened Steel (45～55HRC)				Hardened Steel (55～65HRC)				Hardened Steel (65～72HRC)			
Tip R R_1 (mm)	Barrel R R_2 (mm)	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm	Revolution n min^{-1}	Feed rate vf mm/min	ap mm	ae mm
0.5	12.5	34,320	2,580	0.09	0.29	28,600	2,060	0.08	0.24	26,000	1,870	0.06	0.18	24,700	1,600	0.06	0.18	20,800	1,120	0.05	0.15
0.75	18.75	25,680	2,890	0.10	0.31	21,400	2,310	0.09	0.26	19,500	2,110	0.07	0.21	18,500	1,800	0.07	0.21	15,600	1,260	0.06	0.18
1	25	22,080	3,310	0.19	0.58	18,400	2,650	0.16	0.48	16,700	2,400	0.13	0.39	15,900	2,060	0.12	0.36	13,400	1,450	0.10	0.30
1.5	37.5	20,400	3,280	0.28	0.86	17,000	2,620	0.24	0.72	15,400	1,850	0.20	0.60	14,300	1,720	0.19	0.57	11,000	1,320	0.15	0.45
2	50	15,600	3,040	0.38	1.15	13,000	2,430	0.32	0.96	11,000	1,760	0.27	0.81	10,560	1,580	0.25	0.75	7,920	1,190	0.20	0.60

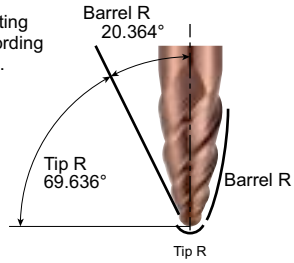
●Cutting conditions for using both barrel R and tip R

Work material		Carbon Steel, Alloy Steel (<35HRC)		Pre-hardened Steel (35～45HRC)		Hardened Steel (45～55HRC)		Hardened Steel (55～65HRC)		Hardened Steel (65～72HRC)	
Tip R R_1 (mm)	Barrel R R_2 (mm)	Revolution n min^{-1}	Feed rate vf mm/min	Revolution n min^{-1}	Feed rate vf mm/min	Revolution n min^{-1}	Feed rate vf mm/min	Revolution n min^{-1}	Feed rate vf mm/min	Revolution n min^{-1}	Feed rate vf mm/min
0.5	12.5	28,940	2,820	23,850	2,270	21,920	1,920	20,630	1,710	16,770	1,260
0.75	18.75	20,690	2,780	17,620	2,390	15,690	1,950	14,940	1,720	12,090	1,250
1	25	16,930	2,930	14,450	2,460	12,920	2,040	11,470	1,750	9,950	1,280
1.5	37.5	14,130	2,640	11,970	2,200	10,800	1,620	9,380	1,480	7,650	1,120
2	50	10,750	2,360	9,050	1,950	7,760	1,450	7,040	1,290	5,560	980

※For cutting depth (ap, ae), refer to the above conditions for each section.

■Angle range of barrel R and tip R

Depending on the cutting shape, the contact section is divided into barrel R and tip R. Check the contact section and select the appropriate cutting conditions according to each section.

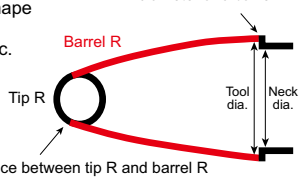


Determine the *ap* value based on the desired cusp height by selecting it from the table below.

Tool		Cusp height (mm)					
Order No.	Barrel R	0.0001	0.0003	0.0005	0.001	0.003	0.005
GS4TN2.5-12.5R-TH3	12.5	0.10	0.17	0.22	0.32	0.55	0.71
GS4TN3.75-18.75R-TH3	18.75	0.12	0.21	0.27	0.39	0.67	0.87
GS4TN5-25R-TH3	25	0.14	0.24	0.32	0.45	0.77	1.00
GS4TN7.5-37.5R-TH3	37.5	0.17	0.30	0.39	0.55	0.95	1.22
GS4TN10-50R-TH3	50	0.20	0.35	0.45	0.63	1.10	1.41

■ About tool shape

"Barrel R" of GS4TN has a shape that connects "tip R" and "tool diameter" with double arc. See the figure on the right.



【Note】

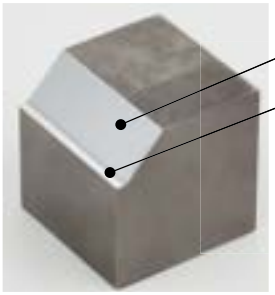
①Use the appropriate coolant for the work material and machining shape.
②Use a machine having as high rigidity and high accuracy as possible.
③These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
④If the rpm of the machine is low, lower the feed rate also to put the rpm and feed rate in the same ratio.

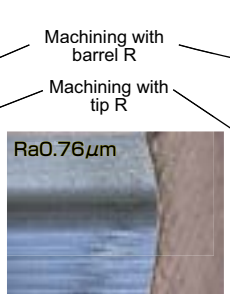
Field data

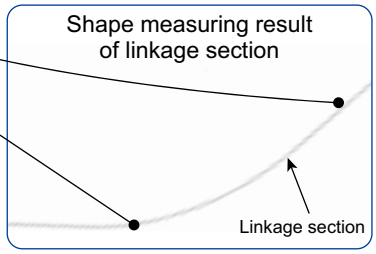
In 3-axis machining evaluation test of machining surface step between barrel R and tip R — GP1T

Cutting conditions

Work material：H13 (52HRC)
GP1Tϕ20-TH308
OH=88mm
n=7,970min^{-1}
v_f=960mm/min
Cusp height setting value：0.001mm
Air-blow, Down cut







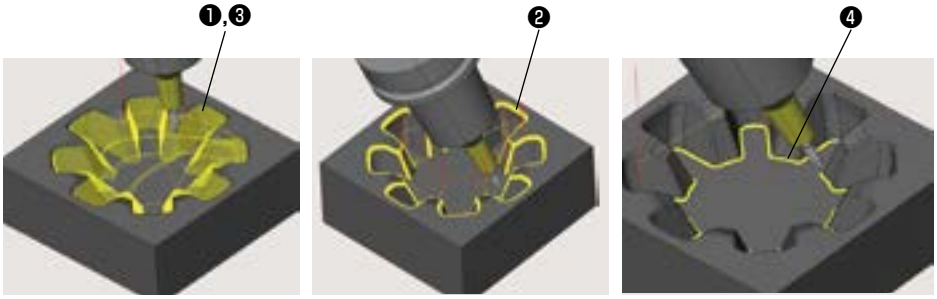
Good machined surface without machining step.

Model machining of Matrix HSS with 5-axis machine Hi-Pre² — GS4TN

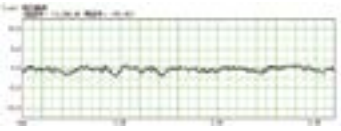
Tool：GS4TN10-50R-TH3　Machine：5-axis machine,　Air blow　Work material：Matrix HSS (58HRC)　Machining depth：30mm
Work size：About 90mm　Finishing time：**About 2 hours.**　CAD/CAM：hyperMILL

Process	Tool	Working area	Flute shape	Revolution n (min^{-1})	Cutting speed v_c (m/min)	Feed rate v_f (mm/min)	Feed per tooth f_z (mm/t)	Depth of cut a_p (mm)	Depth of cut a_e (mm)	Cutting time (min)
Roughing	HGOF4100-20-TH		Radius	2,200	69.1	1,760	0.2	0.4	3	92
Finishing	ETM4060-15-H		Radius	3,700	69.7	1,780	0.12	0.24	3	13
Semi-finishing	GS4TN5-25R-TH3 (O/H:30mm)	❶	Barrel edge	10,560	165.8	1,440	0.034	0.6	0	46
								0.2	0	
		❷	Tip edge	15,900	249.6	2,060	0.032	0	0.15	
Finishing	GS4TN3.75-18.75R-TH3 (O/H:25mm)	❸	Barrel edge	11,370	127.5	1,640	0.036	0.5	0	92
								0.5	0	
		❹	Tip edge	18,500	207.4	1,800	0.024	0	0.7	

Possible to finish tilted section and fillet section (connection surface) with one tool.
Good machined surface without machining steps which caused by tool change.



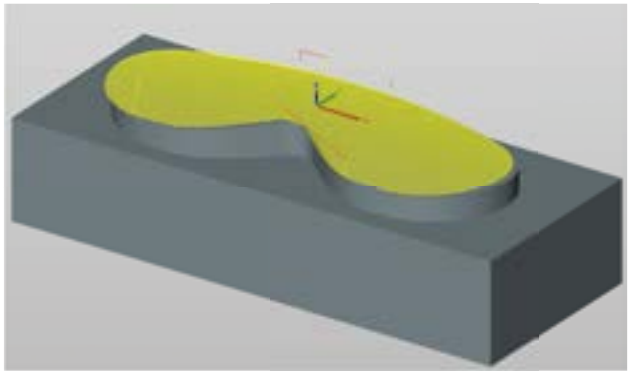
The same tool could finish even fillet section.



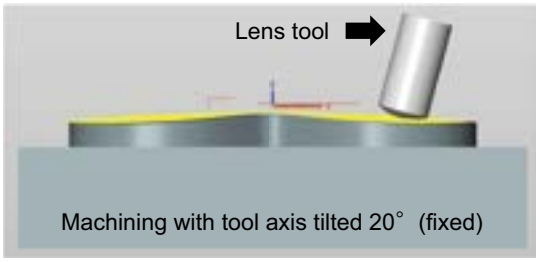
Surface roughness is good even when cutting with large pitch

Ra:0.515μm Rz:2.574μm

Curved surface finishing of eyeglass shape GF3L



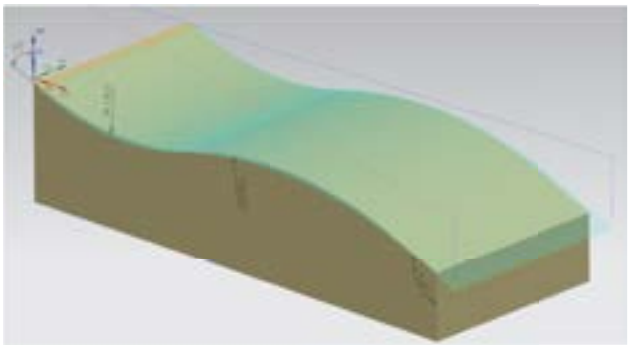
Work material : STAVAX (420 Stainless Steel)
Machine : 5 axis M/C (HSK-A63)



v_c=392m/min、f_z=0.17mm/t、a_p=0.1mm、
Cusp height =0.003mm、wet、DC=25mm, 3NT

Cutting efficiency about doubled with the similar surface roughness as ball end mill.

Semi-finishing of gentle sloped surface. (3 axis M/C) GF3L



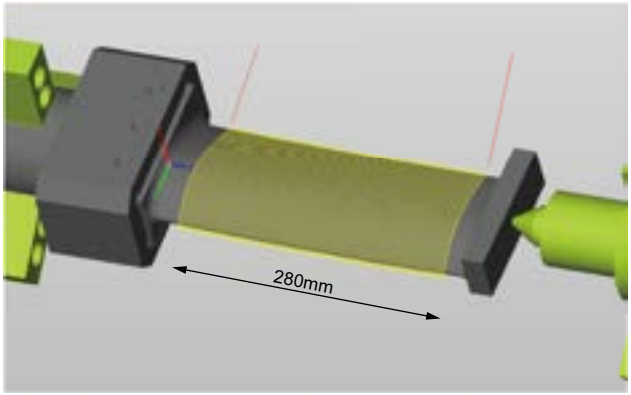
By utilizing GF3L type for semi-finishing process after contour roughing, it is possible to double the efficiency of a standard ball mill.

Using the GALLEA series (GF3L, GP1LB) it is possible to process from semi-finishing to finishing with high efficiency

Work material : P20　Machine : 3 axis vertical M/C (HSK-A63)

Process	Tool	Grade	Cutting conditions									Cutting time
			v_c (m/min)	n (mm^{-1})	v_f (mm/min)	f_z (mm/t)	a_p (mm)	a_e (mm)	Cusp height (mm)	Removal stock (mm)	Method	
Roughing	RD16B4032S32	GX2160	200	2000	2400	0.4	0.8	10	–	0.6	Contouring	27' 28"
Semi-roughing	GF3L25M-3-M12	PN215	200	2546	3820	0.5	0.5	(2)	0.02	0.1	Surface machining	3' 57"
Finishing	GP1LB25M-M12	PN215	720	9180	4590	0.25	0.1	–	0.003	0	Surface machining	6' 30"

Turbine blade finishing GF3L



Work material : 420 Stainless Steel
Machine : Multi-function machine (HSK-A63)

Surface roughness

Ra=0.71μm
Rz=3.52μm

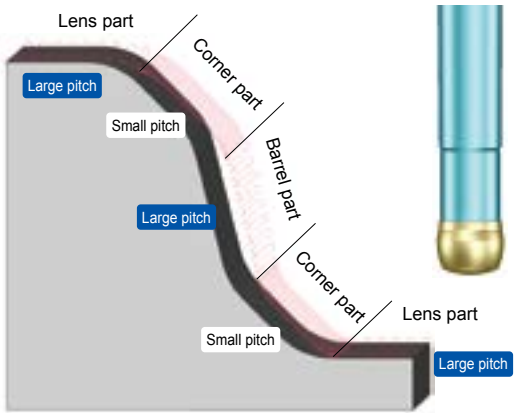
Ra=9.74μm
Rz=34.6μm

v_c=500m/min、f_z=0.4mm/t、v_f=7,640mm/min、
a_p=0.5mm、Cusp height=0.02mm、wet、
DC=25mm、Simultaneous 5-axis machining
Heal angle：10° Fixed
GF3L25M-3-M12／TPHW1303-25 PN215

High efficiency finishing possible by using GF3L type.

Field data

Three-axis machining of auto mobile C pillar outer plate model GP1LB



Combining high efficiency and high quality machining

Work material : H13 (43HRC) Machine : BT50 class
CAD/CAM : tebis

Roughing①: About 4 hours.

- ϕ42mm High feed tool TD4N type

Roughing②: About 50 min.

- ϕ20mm Ball end mill BCF type

Semi-finishing・finishing : About 8 hours.

- ϕ20mm Ball end mill ABPF type
- ϕ20mm GALLEA GP1LB type ZPHW200-LB PN215
- ϕ16mm Ball end mill ABPF type
- ϕ10mm Ball end mill EMBE
- ϕ6mm Ball end mill EMBE

Total cutting time : About 13 hours

After roughing

Unequal part after roughing process can be machined at 1.4 times the rate of a conventional ball end mill.

Surface roughness improved by 40% with the same processing time as conventional ball end mill.

After finishing

Three-axis machining of automobile door panel model GP1LB

By separately using the GALLEA series and conventional tool, you can process the rest of fillets speedy and with high quality.
For high hardened steel, GP1LB can process the part at 1.4 times the rate of a conventional ball end mill of the same diameter.

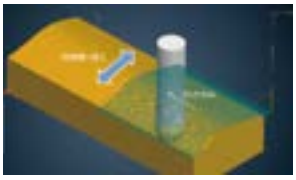
Work material : D2 Modified (60HRC) Machine : BT40 class
CAD/CAM : WorkNC

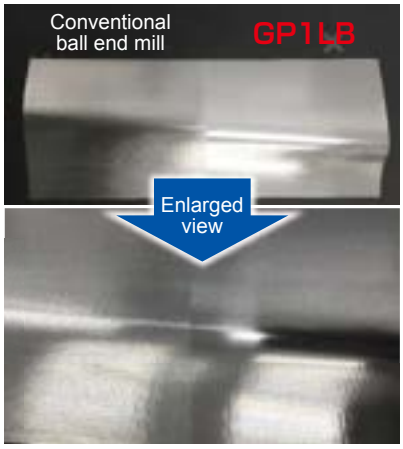
Process		Tool	Cutting speed *vc* (m/min)	Revolution *n* (min^{-1})	Feed per tooth *fz* (mm/t)	Feed rate *vf* (mm/min)	Depth of cut *ap* (mm)	Depth of cut *ae* (mm)	Cusp height (μm)	Removal stock (mm)	Coolant
Roughing		RH2P1016S-4 EPHW0402TN-2 JP4105	65	1,290	0.3	1,540	0.1	6.5	–	0.2	Air-blow
Semi-finishing	All	GP1LB20M-M10 ZPHW200-LB20 TH308	200	3,183	0.2	1,273	0.05	1.0	6	0.1	Air-blow
	Corner etc.	EHHB4080-ATH	136	5,400	0.09	1,905	0.3	0.6	11	0.1	Air-blow
	Corner etc.	EHHB4050-ATH	135	8,600	0.05	1,840	0.2	0.4	8	0.1	Air-blow
Finishing	All	GP1LB20M-M10 ZPHW200-LB20 TH308	200	3,183	0.2	1,273	0.05	0.57	2	0	Air-blow
	Corner etc.	EHHB4080-ATH	161	6,400	0.08	2,050	0.05	0.25	2	0	Air-blow
	Corner etc.	EHHB4050-ATH	160	10,200	0.05	1,980	0.05	0.20	2	0	Air-blow

Total cutting time : About 4 hours

Comparison of machined surface with the same pick. GP1LB

Work material：Ductile Cast Iron
Tool：GP1LB30M-M16　ZPHW300-LB TH308
Conventional ball end mill φ30mm
n=6,000min^{-1} v_c=565m/min
v_f=6,000mm/min
Pitch =0.6mm　Removal stock =0.1mm





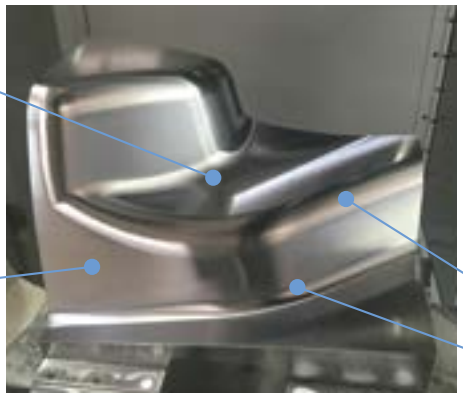
Conventional ball end mill	GP1LB
Ra:0.8μm　Rz:4.66μm	Ra:0.36μm　Rz:2.42μm

Surface roughness is about 1/2 of the ball end mill.

Part of door-inner model for automobile (3-Axis) GP1LB

Gentle sloped surface
Using lens R
Ra0.234μm

Steep sloped surface
Using barrel R
Ra0.279μm



POINT
Combination of lens tool and barrel tool steep-slope and gentle-slope can be finished with single tool

About 1.3 times as compared with conventional ball end mill

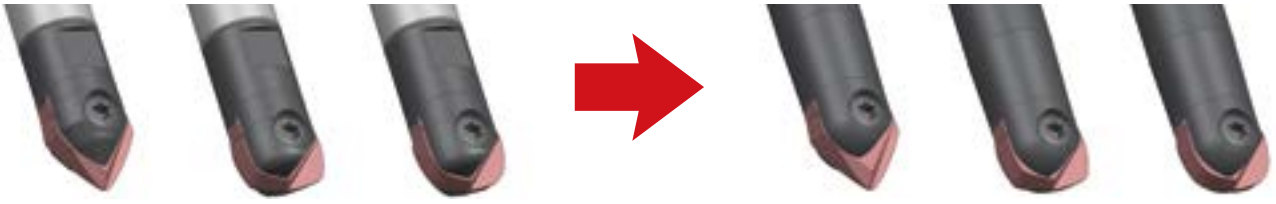
Work material：P21 (42HRC)
Machine：BT40 class　CAD/CAM：FF CAM

For fillet processing, use connection-R edge.

Corner R was processed using ball end mill.
Processing is completed. there is no connecting step on the surface.

Process		Tool	Tool dia.	Cutting conditions						
				v_c (m/min)	n (mm^{-1})	v_f (mm/min)	f_z (mm/t)	Pitch (mm)	Cutting amount (mm/t)	Coolant
Semi-finishing	Gentle sloped surface	GP1LB16M-M8 ZPHW160-LB16 PN215 (Lens R:16, Barrel R:16)	16	231	4,600	1,840	0.2	1.6	0.15	Mist
	Steep sloped surface		16	181	3,600	1,440	0.2	1.6	0.15	Mist
Finishing	Gentle sloped surface		16	231	4,600	1,840	0.2	0.25	0.05	Mist
	Steep sloped surface		16	181	3,600	1,440	0.2	0.25	0.05	Mist

GP1LB and GP1T inserts can be set in corresponding metric ABPF cutter body.



Set to original cutter body　　**Can be set in ABPF cutter body**

The insert of GP1LB and GP1T are able to set in ABPF cutter body.

Notes

Safety Considerations

1. Handling

(1) When removing tool from packaging, be careful not to drop the tool on your foot or fingers.
(2) When actually setting the inserts, be careful not to touch the cutting flute directly with your bare hands.

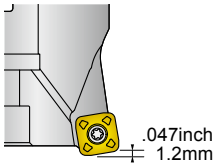
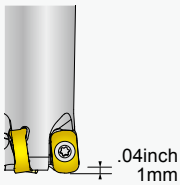
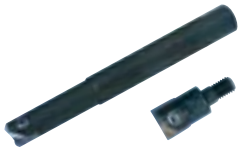
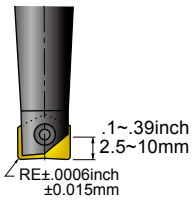
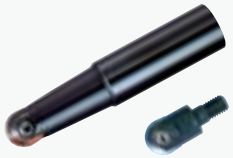
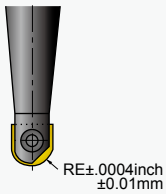
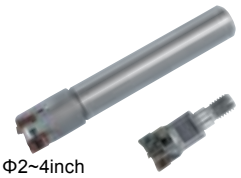
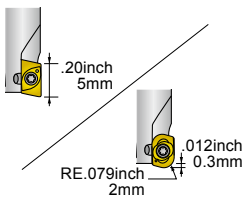
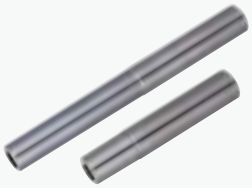
2. Mounting

(1) When preparing to use, be sure that the insert is firmly screwed in the pocket and cutter is properly mounted on the tool holder.
(2) If abnormal chattering occurs during use, stop the machine immediately, identify the cause of the chatter and take corrective action.

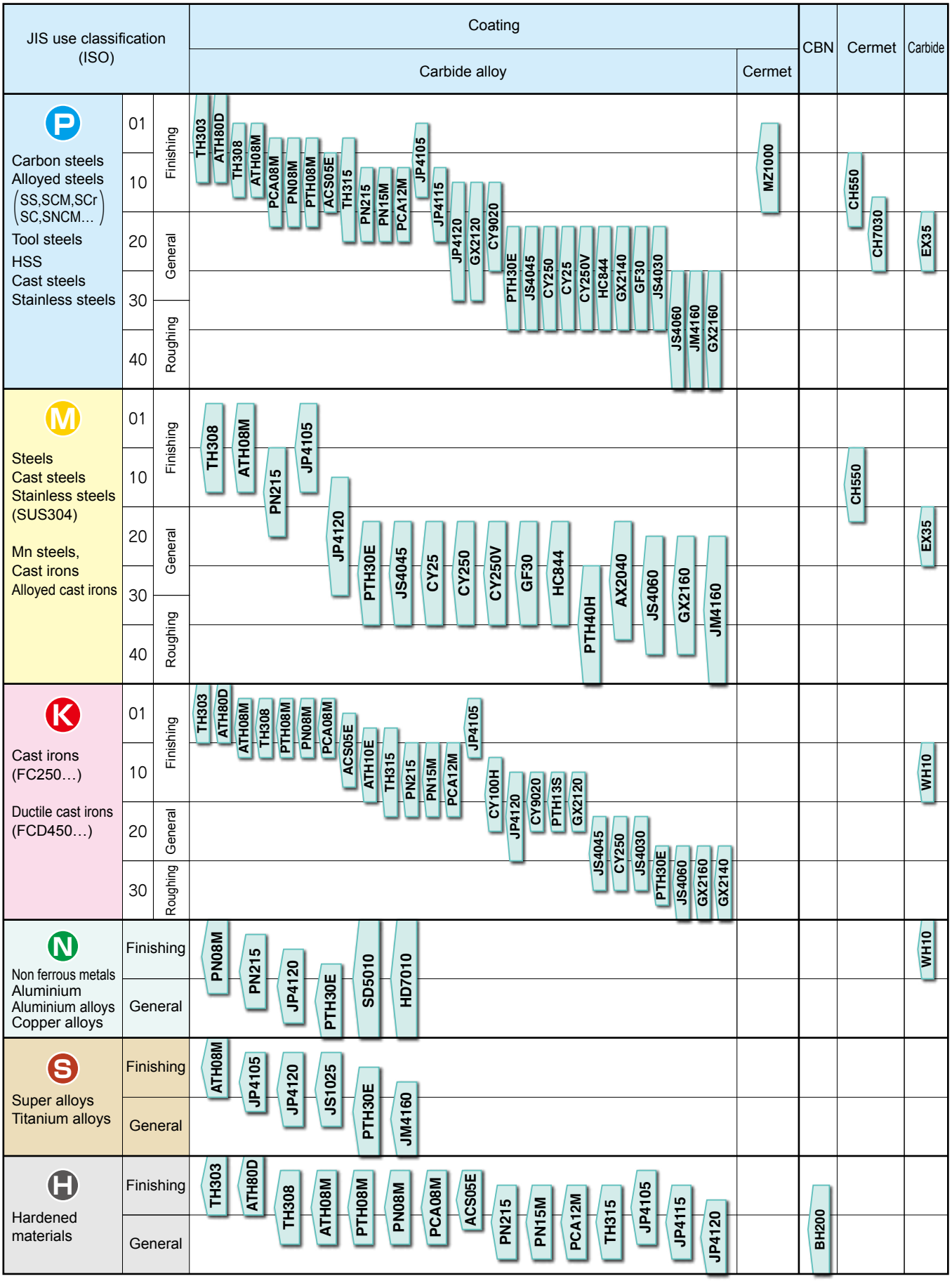
3. Usage

(1) Before use confirm all dimensions, verify work material and programmed tool rotation.
(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) Inserts are made of hard material and may break and be expelled from cutter at high speeds. Since there is a danger of injury to workers from chip evacuation, insert breakage or fire safety precautions must be observed at all times. Including, but not limited to: safety glasses, machine enclosures or other means to create a safe environment for work. If you have questions on safety, contact your supervisor.
    • Do not use where there is a risk of fire or explosion.
    • Do not use non-water-soluble cutting oils. Such oils may result in fire.
(4) Do not use the tool for any purpose other than that for which it is intended, and do not modify it.

Criteria table of Indexable Tools

Type	Name/Item Code	Shape, Tool dia.	Cutting edge angle Max. Depth of cut	Finishing Group	Cutting Application	Page
Radius End Mills	**TR4D** Radius Mill TR4D	 Φ2~4inch Φ50~100mm	 .047inch 1.2mm	Rough	Planing, Profiling, Vertical, Die-sinking, Slotting, Helical	155
	TD4N Radius Mill TD4N Cutter body -0.06 ~ -0.11, Insert M	 Φ.625~1.5inch Φ16~42mm	 .04inch 1mm	Rough	Planing, Die-sinking, Slotting, Profiling, Helical	167
	ARPF Radius Precision ARPF Cutter body 0 ~ -0.02, Insert F	 Φ3/8~1inch Φ6~32mm	 .1~.39inch 2.5~10mm RE±.0006inch ±0.015mm	Finish	Planing, Side Milling, Die-sinking, Profiling, Helical	177
Ball End Mill	**ABPF** Ball Precision F ABPF Cutter body ±0.01, Insert F	 Φ5/16~1inch Φ6~32mm	 RE±.0004inch ±0.01mm	Finish	Planing, Side Milling, Die-sinking, Profiling, R, Helical	197
Square End Mill	**ASM** Super Excellent Mini ASM Cutter body -0.1 ~ -0.2, Insert M	 Φ2~4inch Φ50~100mm	 .20inch 5mm .012inch 0.3mm RE.079inch 2mm	Rough, Semi Finish	Planing, Side Milling, Slotting, Die-sinking, Profiling, Helical, Spot Facing	217
Shank	**ASC** Carbide Shank for Modular Mill					235

Guide to grades for milling inserts



Coating materials for milling inserts

Grade name	Coating name Coating type	Base material's Hardness (HRA) Bending strength (GPa)	Application	Features
JP4105	AJ Coating PVD	93.3 4.0	For hardened steel 50HRC or more	Uses ultra micro grain substrate and AJ Coating. Suitable for 50HRC or more high hardness material cutting.
JP4120	AJ Coating PVD	91.0 4.0	For hardened steel and alloy steel (35-50HRC)	Uses micro grain substrate and AJ Coating. Suitable for cutting of common steels through hardened steels.
PTH30E	TH Coating PVD	90.5 3.8	For wet general purpose of steel	Uses micro grain substrate and nanocomposite coating. Suitable for wet cutting.
JS4045	JS Coating PVD	90.6 2.7	General purpose for steel	Uses coarse grain substrate and JS coating. Suitable for cutting of the common steels.
GX2140	GX Coating CVD	89.0 3.0	Dry high speed cutting for Steel 35HRC or less	Uses coarse grain substrate and GX Coating. Suitable for dry high speed mild steel cutting.
JS4060	JS Coating PVD	89.0 3.0	For wet unstable cutting	Uses coarse grain substrate and JS Coating. Suitable for unstable mild steel cutting and wet cuttting
JM4160	AJ Coating PVD	89.0 3.8	General purpose for wet stainless steel cutting	Uses coarse grain substrate and AJ Coating. Suitable for univerasal stainless cutting.
ATH80D	ATH Coating PVD	93.6 4.0	Finishing for hardened steels (45-65HRC)	Uses ultra micro grain substrate and ATH Coating. High wear resistance, Suitable for high hard material finishing.
TH303	ATH Coating PVD	93.6 4.0	Finishing for hardened steels (45-65HRC)	Uses ultra micro grain substrate and TH3 Coating. High wear resistance, Suitable for high hard material finishing.
TH308	TH3 Coating PVD	93.3 4.0	Finishing for hardened steels	Uses ultra micro grain substrate and TH3 Coating. Suitable for hardened steel general finishing.
ATH08M	ATH Coating PVD	93.3 4.0	Finishing for hardened steels	Uses ultra micro grain substrate and ATH Coating. High wear resistance, Suitable for high hard material finishing.
PN08M	PN Coating PVD	93.3 4.0	Finishing for hardened steels	Uses ultra micro grain substrate and PN Coating. Suitable for high speed steel finishing.
PTH08M	TH Coating PVD	93.3 4.0	Finishing for hardened steels	Uses ultra micro grain substrate and nanocomposite coating. Suitable for high speed steel finishing.
PCA08M	C Coating PVD	93.3 4.0	Finishing for general steels	Uses ultra micro grain substrate and TiAlN coating. Suitable for general cutting.
ACS05E	ACS Coating PVD	93.1 3.6	Finishing for hardened steels	Uses ultra micro grain substrate and ACS Coating. Suitable for high speed steel finishing.
PN215	PN2 Coating PVD	92.4 4.2	Finishing for general steels	Uses ultra micro grain substrate and PN2 Coating. High adhesion resistance, Suitable for general steel finishing.
PN15M	PN Coating PVD	92.4 4.2	Finishing for general steels	Uses ultra micro grain substrate and PN Coating. Suitable for general steel finishing.
PCA12M	C Coating PVD	92.4 4.2	Finishing for general steels	Uses ultra micro grain substrate and TiAlN coating. Suitable for general cutting.
SD5010	SD Coating PVD	92.0 2.6	For aluminium alloys and non ferrousmetals	Uses high hardness DLC Coating. Suitable for aluminium alloys etc. and non ferrous metals.
HD7010	HD Coating CVD	91.3 2.8	For graphites and fiber-reinforced plastics (FRP)	Uses high hardness diamond coating. Suitable for wear resistance and graphite cutting etc.
ATH10E	ATH Coating PVD	93.0 3.8	Finishing for cast iron	Uses micro grain substrate and ATH Coating. Suitable for cast iron finishing.
TH315	TH3 Coating PVD	92.4 4.2	Finishing for hardened steels	Uses ultra micro grain substrate and TH3 Coating. Excellent in finishing of high hardened materials up to 55HRC.

Each characteristic value represents a typical value.
Please refer to Fuide to grades for milling inserts

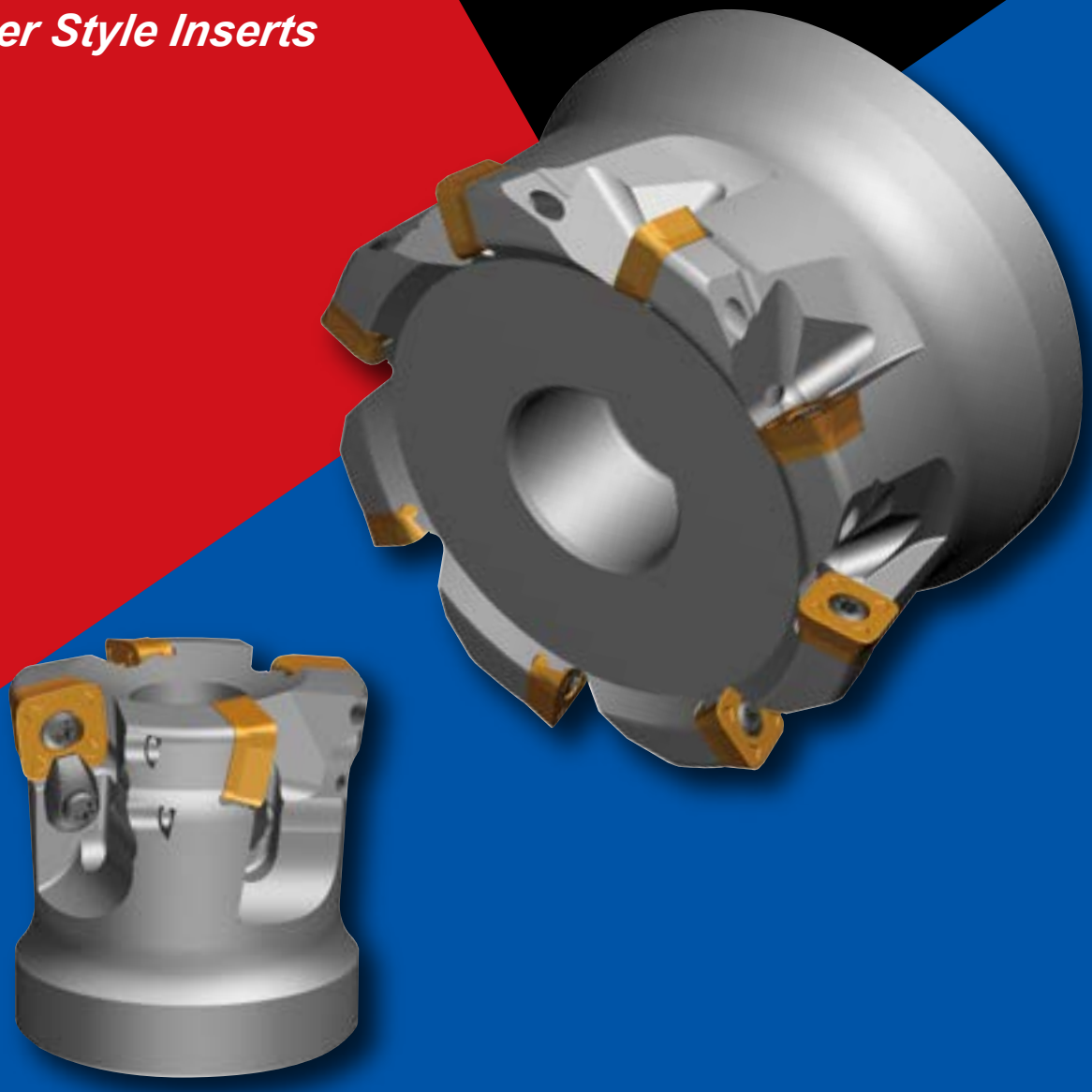
Notes

MOLDINO
The Edge To Innovation

TR4D

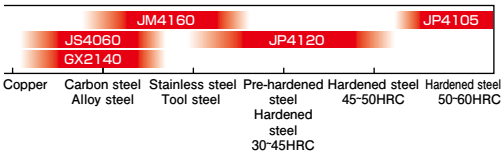
High Feed Radius Mill

Chip Breaker Style Inserts added

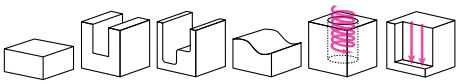


MOLDINO Tool Engineering, Ltd.

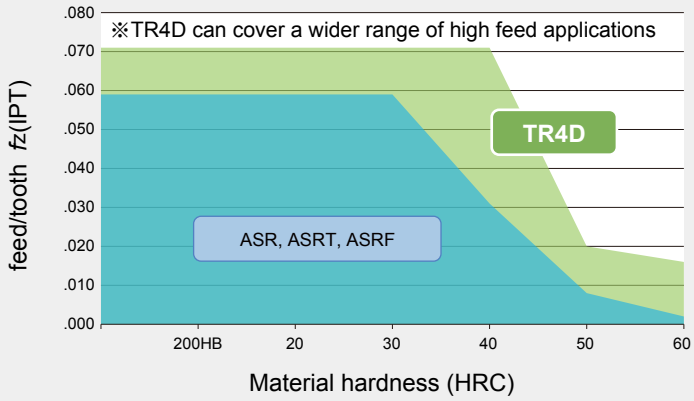
New Product News | No. H1903A-3 | 2021-5



Applications



Features 01 Pocket Stability



	Conventional	TR4D type
Cross-sectional area	 100%	 110%
Constraint area	 100%	 135%

●Increased cross-sectional and constraint areas have added insert strength for high-load cutting applications.

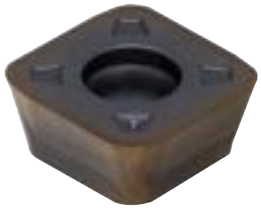
Features 02 Insert Options

Insert Options - 3 geometries & 5 insert grades cover various applications.

SDNW120520TR

The recommended default insert offers superior cutting edge strength. Ideal for general high-feed cutting.

SDNW120520TR-P



Recommended for relatively continuous (uninterrupted) cutting with short overhangs. Ideal for pre-hardened steel (P20 and P21 materials).

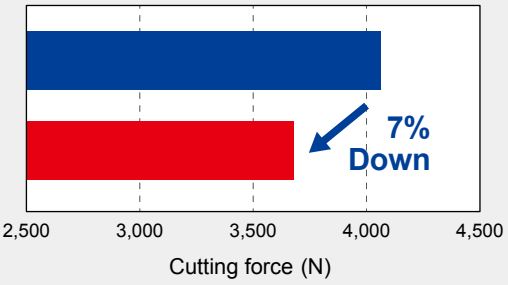
SDMT120520TR NEW

Breaker type insert.
Ideal for rough machining with low-rigidity work materials and low-horsepower M/C.

Comparison of cutting force

SDNW120520TR

SDMT120520TR
(with breaker)



(Resultant force ; summation of the each component's maximum value)

Cutting Conditions

Work Material	Pre-hardened steel (32HRC)
Tool	DCX = 2.480 inch (63mm)
Insert Model	SDNW120520TR : JP4120 SDMT120520TR : JP4120
Cutting Speed	*Vc* = 492 SFM (150m/min)
Feed per tooth	*fz* = .059 IPT (1.5mm/t)
Cutting depth	*ap*×*ae* = .039 x 1.654 inch (1.0x42mm)
Overhang	7.874 inch (200mm)
Air-blow	Single edge cutting

Features 03 Cutter body assortment

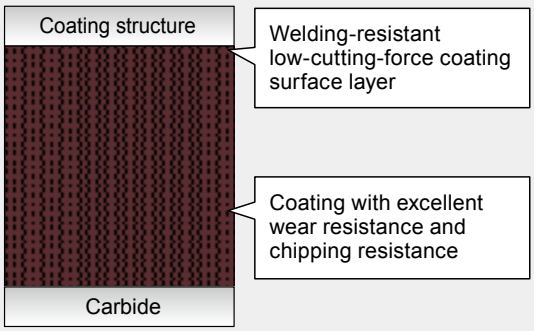
Line up includes:
- Inch and metric shell mill coupling
- Additional insert clamps are available for corse pitch cutters when extreme rigidity is needed.
- Multiple pitch options including a variable pitch design to reduce vibration.

Features 04 Application

❶ Max feed per tooth: f_z = .079 IPT (2.0mm/tooth)
It is necessary to adjust the feed rate according to machining situation
❷ For best milling performance, recommend max cutting depth *a*p=.047 inch (1.2mm)
❸ Number of corners: 4 corners (single-side)
Economical multi-corner
❹ Advantages of single sided inserts compared to double sided inserts.
1) Large chip pocket for chip evacuation 2) Optimized rake angle reduces chip jamming 3) Higher clamping security than a 2 sided insert.
4) All corners can be fully used up 5) Large ramping angle

AJ Coating Series

New AJ coating is now applied to all 4100 series inserts. AJ coating features High Al(Aluminum) content AlTiN PVD coating technology that delivers both improved heat resistance and coating adhesion. To further increase performance, 4100 series inserts have a special surface treatment that reduces friction and minimizes welding.



PVD Technology Grade for machining high-hardness materials **JP4105**

- Employs an ultra-fine cemented carbide substrate along with the new "AJ Coating" to improve wear resistance.
- Excellent wear resistance when machining high hardness materials of 50HRC or higher.

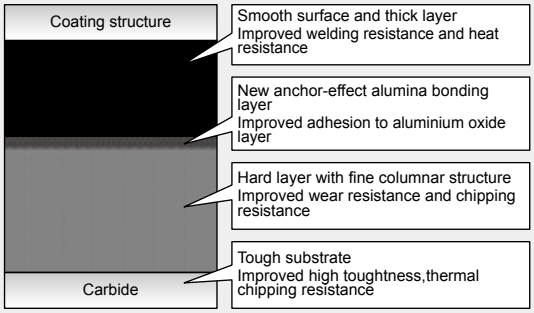
PVD Technology Grade for machining pre-hardened or hardened materials **JP4120**

Highly versatile with excellent cutting performance on pre-hardened steel or hardened steel. (30-50 HRC).

PVD Technology Grade for machining stainless-steel materials **JM4160**

JM4160 features a tough substrate to handle demanding stainless materials topped with AJ coating engineered specially for stainless materials.

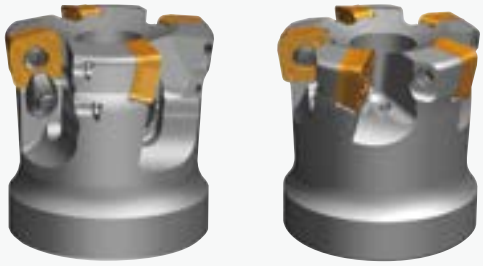
GX Coating Series



CVD Technology General purpose for steel **GX2140**

- Smooth surfaced α-Al_2O_3 layer with improved chipping / welding resistance reduces sudden chipping of cutting edge.
- Machining efficiency is improved for high speed, and high feed rate roughing by using the hard layer with fine columnar structure.
- Dry cutting of materials less than 35 HRC.
- For continuous and light interrupted cutting.

Shell Mill type (I)TR4D4○○○B(M)-○



With air hole

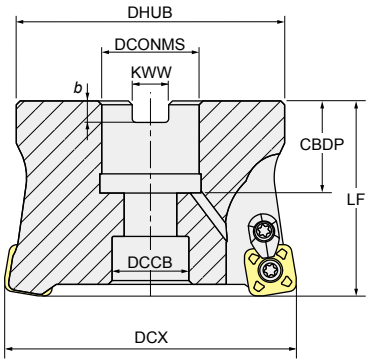


Fig.1 with clamp piece set

With air hole

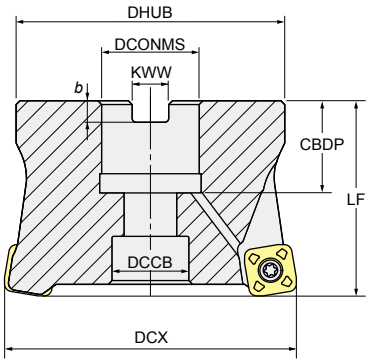


Fig.2 Multi-flutes (no clamp piece set)

Inch

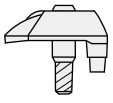
Item code	Stock	# of Flutes	Dimensions (inch)								Insert	Fig.
			DCX	DHUB	LF	CBDP	KWW	*b*	DCONMS	DCCB		
ITR4D4032B-4	●	4	2.000	1.875	2.000	.748	.313	.187	.750	.630	SDNW120520TR SDNW120520TR-P SDMT120520TR	Fig.1
ITR4D4032B-5	●	5	2.000	1.875	2.000	.748	.313	.187	.750	.630		Fig.2
ITR4D4040B-4	●	4	2.500	2.375	2.000	.945	.375	.219	1.000	.787		Fig.1
ITR4D4040B-6	●	6	2.500	2.375	2.000	.945	.375	.219	1.000	.787		Fig.2
ITR4D4048B-5	●	5	3.000	2.750	2.000	.945	.375	.219	1.000	.787		Fig.1
ITR4D4048B-7	●	7	3.000	2.750	2.000	.945	.375	.219	1.000	.787		Fig.2
ITR4D4048B-7-1.25	●	7	3.000	2.875	2.500	1.260	.500	.281	1.250	1.024		Fig.2
ITR4D4064B-6	●	6	4.000	3.813	2.500	1.181	.625	.375	1.500	1.181		Fig.1
ITR4D4064B-8	●	8	4.000	3.813	2.500	1.181	.625	.375	1.500	1.181		Fig.2

Metric

Item code	Stock	# of Flutes	Dimensions (mm)								Insert	Fig.
			DCX	DHUB	LF	CBDP	KWW	*b*	DCONMS	DCCB		
TR4D4050BM-3	●	3	50	47	50	20	10.4	6.3	22	17	SDNW120520TR SDNW120520TR-P SDMT120520TR	Fig.1
TR4D4050BM-4	●	4	50	47	50	20	10.4	6.3	22	17		Fig.1
TR4D4063BM-4	●	4	63	60	50	20	10.4	6.3	22	17		Fig.1
TR4D4063BM-5	●	5	63	60	50	20	10.4	6.3	22	17		Fig.1
TR4D4080BM-5	●	5	80	76	70	22	12.4	7	27	20		Fig.1
TR4D4100BM-6	●	6	100	96	70	25.5	14.4	8	32	26		Fig.1

Parts

The clamp screw is a consumable part. Clamp screw replacement is dependent on use.
We recommend replacing screw at signs of wear on screw seat chamfer.

Parts	Insert Screw		Clamp Piece Set	Wrench	Screw Anti-Seizure Agent
Shape		Fastening torque (N•m)			
Order No.	262-141	2.9	CM3.5-141	105-T15	P37

● : Inventory maintained in US

Insert

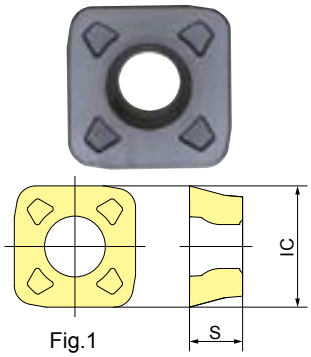


Fig.1

SDNW120520TR

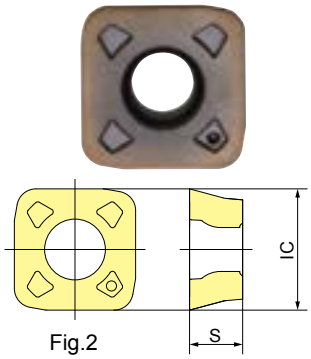


Fig.2

SDNW120520TR-P

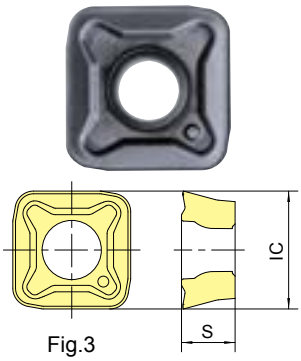


Fig.3

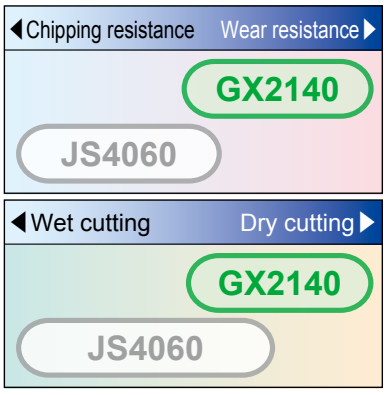
SDMT120520TR

								■ : General cutting, First recommendation □ : General cutting, Second recommendation
P	Carbon steel		■		■	■	■	
M	Stainless Steel			■				
K	Cast Iron/Ductile Cast Iron		■		■	■	■	
H	Hardened steel	■	□					

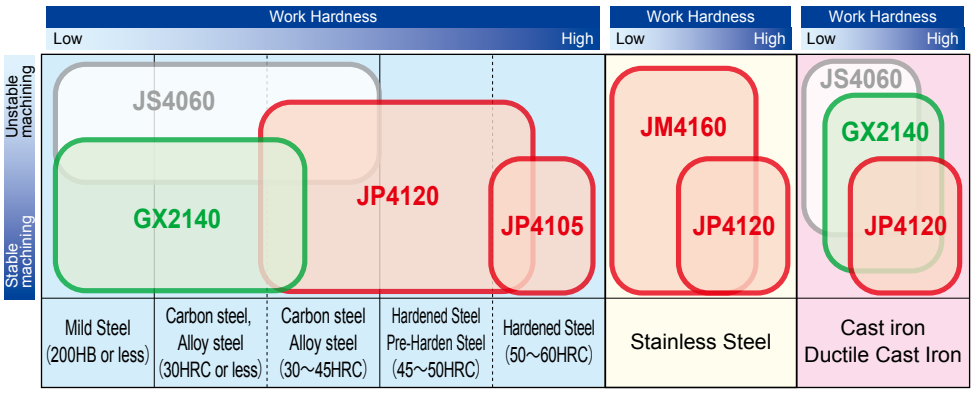
Item Code	Tolerance Class	AJ Coating			JS Coating		GX Coating	Dimensions (mm)		Dimensions (inch)		Shape
		JP4105	JP4120	JM4160	JS4045	JS4060	GX2140	IC	S	IC	S	
SDNW120520TR	N	●	●	●	△	●	●	12.7	5.56	.500	.219	Fig.1
SDNW120520TR-P	N		●	●				12.7	5.56	.500	.219	Fig.2
SDMT120520TR	M		●※1	●※1		●	●	12.7	5.76	.500	.227	Fig.3

※ 1 : Can be used to process the precipitation hardend stainless steel.
[Note] Please note that the GX coating and JS coating do not cause a reaction in conductive touch sensors.

Grade map for less than 35HRC



Grade map for work material



● : Inventory maintained in US △ : Discontinued after stock runs out

Inch

Face Milling, Side Milling

Red indicates primary recommended insert grade.

Work Material	Insert Grade	Cutter Dia.	ϕ2.000(4NT)					ϕ2.000(5NT)					ϕ2.500(4NT)					ϕ2.500(6NT)				
		Overhang Ratio	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC
			General	High Speed				General	High Speed				General	High Speed				General	High Speed			
General Structural Steel (200HB or less)	GX2140 JS4060	n (min⁻¹)	940	1,250	940	810	690	940	1,250	940	810	690	750	1,000	750	650	550	750	1,000	750	650	550
		Vc (SFM)	492	654	492	424	361	492	654	492	424	361	491	654	491	425	360	491	654	491	425	360
		Vf (IPM)	270	400	270	230	200	330	490	330	290	240	210	320	210	180	160	320	470	320	280	230
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
		Q (inch³/min)	16.8	25.0	16.8	11.4	9.9	20.6	30.6	20.6	14.4	11.9	16.4	25.0	16.4	11.2	9.9	25.0	36.7	25.0	17.4	14.3
Carbon Steel Alloy Steel (<35HRC)	GX2140 JS4060	n (min⁻¹)	940	1,250	940	810	690	940	1,250	940	810	690	750	1,000	750	650	550	750	1,000	750	650	550
		Vc (SFM)	492	654	492	424	361	492	654	492	424	361	491	654	491	425	360	491	654	491	425	360
		Vf (IPM)	270	400	270	230	200	330	490	330	290	240	210	320	210	180	160	320	470	320	280	230
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
		Q (inch³/min)	16.8	25.0	16.8	11.4	9.9	20.6	30.6	20.6	14.4	11.9	16.4	25.0	16.4	11.2	9.9	25.0	36.7	25.0	17.4	14.3
Carbon Steel Alloy Steel (35～45HRC)	JP4120 JS4060	n (min⁻¹)	810	940	810	690	560	810	940	810	690	560	650	750	650	550	450	650	750	650	550	450
		Vc (SFM)	424	492	424	361	293	424	492	424	361	293	425	491	425	360	295	425	491	425	360	295
		Vf (IPM)	230	300	230	170	140	290	370	290	220	180	180	240	180	140	110	280	360	280	210	170
		fz (IPT)	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
		Q (inch³/min)	14.4	18.7	14.4	8.4	6.9	18.1	23.1	18.1	10.9	8.9	14.0	18.7	14.0	8.7	6.8	21.8	28.1	21.8	13.0	10.5
300 series Stainless Steel (WET)	JM4160	n (min⁻¹)	630	-	630	530	440	630	-	630	530	440	500	-	500	430	350	500	-	500	430	350
		Vc (SFM)	330	-	330	278	230	330	-	330	278	230	327	-	327	281	229	327	-	327	281	229
		Vf (IPM)	100	-	100	80	70	120	-	120	100	90	80	-	80	70	50	120	-	120	100	80
		fz (IPT)	.039	-	.039	.039	.039	.039	-	.039	.039	.039	.039	-	.039	.039	.039	.039	-	.039	.039	.039
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	1.600	-	1.600	1.600	1.600	1.600	-	1.600	1.600	1.600	2.000	-	2.000	2.000	2.000	2.000	-	2.000	2.000	2.000
		Q (inch³/min)	6.2	-	6.2	4.0	3.5	7.5	-	7.5	5.0	4.5	6.2	-	6.2	4.3	3.1	9.4	-	9.4	6.2	5.0
Precipitation Hardening Stainless Steel (WET)	JM4160 JP4120	n (min⁻¹)	560	-	560	500	440	560	-	560	500	440	450	-	450	400	350	450	-	450	400	350
		Vc (SFM)	293	-	293	262	230	293	-	293	262	230	295	-	295	262	229	295	-	295	262	229
		Vf (IPM)	70	-	70	60	50	90	-	90	80	70	60	-	60	50	40	80	-	80	70	70
		fz (IPT)	.031	-	.031	.031	.031	.031	-	.031	.031	.031	.031	-	.031	.031	.031	.031	-	.031	.031	.031
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	1.600	-	1.600	1.600	1.600	1.600	-	1.600	1.600	1.600	2.000	-	2.000	2.000	2.000	2.000	-	2.000	2.000	2.000
		Q (inch³/min)	4.4	-	4.4	3.0	2.5	5.6	-	5.6	4.0	3.5	4.7	-	4.7	3.1	2.5	6.2	-	6.2	4.3	4.3
Cast Iron Ductile Cast Iron	GX2140 JS4060 JP4120	n (min⁻¹)	940	1,250	940	810	690	940	1,250	940	810	690	750	1,000	750	650	550	750	1,000	750	650	550
		Vc (SFM)	492	654	492	424	361	492	654	492	424	361	491	654	491	425	360	491	654	491	425	360
		Vf (IPM)	300	400	300	260	220	370	490	370	320	270	240	320	240	210	170	360	470	360	310	260
		fz (IPT)	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
		Q (inch³/min)	18.7	25.0	18.7	12.9	10.9	23.1	30.6	23.1	15.9	13.4	18.7	25.0	18.7	13.0	10.5	28.1	36.7	28.1	19.2	16.1
Hardened Steel (45～50HRC)	JP4120 JP4105	n (min⁻¹)	500	560	500	440	380	500	560	500	440	380	400	450	400	350	300	400	450	400	350	300
		Vc (SFM)	262	293	262	230	199	262	293	262	230	199	262	295	262	229	196	262	295	262	229	196
		Vf (IPM)	40	70	40	40	30	50	90	50	40	40	30	60	30	30	20	50	80	50	40	40
		fz (IPT)	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
		Q (inch³/min)	2.0	3.5	2.0	1.5	1.2	2.5	4.5	2.5	1.5	1.5	1.9	3.7	1.9	1.4	1.0	3.1	5.0	3.1	1.9	1.9
Hardened Steel (50～60HRC)	JP4105 JP4120	n (min⁻¹)	500	560	500	440	380	500	560	500	440	380	400	450	400	350	300	400	450	400	350	300
		Vc (SFM)	262	293	262	230	199	262	293	262	230	199	262	295	262	229	196	262	295	262	229	196
		Vf (IPM)	30	50	30	30	20	40	70	40	40	30	30	40	30	20	20	40	60	40	30	30
		fz (IPT)	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	1.600	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000	2.000
		Q (inch³/min)	1.5	2.5	1.5	1.2	.8	2.0	3.5	2.0	1.5	1.2	1.9	2.5	1.9	1.0	1.0	2.5	3.7	2.5	1.4	1.4

Standard Cutting Conditions for plunging

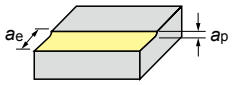
Red indicates primary recommended insert grade.

Work Material	Insert Grade	Cutter Dia.	ϕ2.000(4NT)				ϕ2.000(5NT)				ϕ2.500(4NT)				ϕ2.500(6NT)			
		Overhang Ratio	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC
Cast Iron Ductile Cast Iron	JP4120 GX2140 JS4060	n (min⁻¹)	1,250	1,250	1,070	940	1,250	1,250	1,070	940	1,000	1,000	850	750	1,000	1,000	850	750
		Vc (SFM)	654	654	560	492	654	654	560	492	654	654	556	491	654	654	556	491
		Vf (IPM)	40	40	30	20	50	50	30	30	30	30	20	20	50	50	30	30
		fz (IPT)	.008	.008	.006	.006	.008	.008	.006	.006	.008	.008	.006	.006	.008	.008	.006	.006
		pf (inch)	≦0.5DC				≦0.5DC				≦0.5DC				≦0.5DC			
		ae (inch)	≦.354				≦.354				≦.354				≦.354			

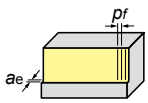
【Note】①This table provides general guidelines for cutting conditions; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
In particular, when performing shoulder milling in combination with slotting or machining of cutting widths close to slots, etc., chattering vibrations may occur, which can lead to trouble.
Therefore, please consider the following when adjusting the conditions;

- Reduce rotation speed and table feed rate by 50 to 70%
- Reduce cutting depth ap by 50 to 70%
- Reduce cutting width ae by 50 to 70%

②Please note that the GX coating and JS coating do not cause a reaction in conductive touch sensors.
③JP4105 is for the high-hardness steels. It is not suitable for Non-heat-treated steel material.



Work Material	Insert Grade	Cutter Dia. / Overhang Ratio	φ3.000(5NT)					φ3.000(7NT)					φ4.000(6NT)					φ4.000(8NT)				
			<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC
			General	High Speed				General	High Speed				General	High Speed				General	High Speed			
General Structural Steel (200HB or less)	GX2140 JS4060	n (min⁻¹)	630	840	630	540	460	630	840	630	540	460	470	630	470	410	340	470	630	470	410	340
		vc (SFM)	495	660	495	424	361	495	660	495	424	361	492	660	492	429	356	492	660	492	429	356
		vf (IPM)	220	330	220	190	160	310	460	310	270	230	200	300	200	170	140	270	400	270	230	190
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
		Q (inch³/min)	20.6	30.9	20.6	14.1	11.9	29.0	43.1	29.0	20.1	17.1	25.0	37.4	25.0	16.9	13.9	33.7	49.9	33.7	22.8	18.8
Carbon Steel Alloy Steel (<35HRC)	GX2140 JS4060	n (min⁻¹)	630	840	630	540	460	630	840	630	540	460	470	630	470	410	340	470	630	470	410	340
		vc (SFM)	495	660	495	424	361	495	660	495	424	361	492	660	492	429	356	492	660	492	429	356
		vf (IPM)	220	330	220	190	160	310	460	310	270	230	200	300	200	170	140	270	400	270	230	190
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
		Q (inch³/min)	20.6	30.9	20.6	14.1	11.9	29.0	43.1	29.0	20.1	17.1	25.0	37.4	25.0	16.9	13.9	33.7	49.9	33.7	22.8	18.8
Carbon Steel Alloy Steel (35～45HRC)	JP4120 JS4060	n (min⁻¹)	540	630	540	460	380	540	630	540	460	380	410	470	410	340	280	410	470	410	340	280
		vc (SFM)	424	495	424	361	298	424	495	424	361	298	429	492	429	356	293	429	492	429	356	293
		vf (IPM)	190	250	190	140	120	270	350	270	200	170	170	220	170	130	110	230	300	230	170	140
		fz (IPT)	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
		Q (inch³/min)	17.8	23.4	17.8	10.4	8.9	25.3	32.8	25.3	14.9	12.6	21.2	27.5	21.2	12.9	10.9	28.7	37.4	28.7	16.9	13.9
300 series Stainless Steel (WET)	JM4160	n (min⁻¹)	420	-	420	360	290	420	-	420	360	290	310	-	310	270	220	310	-	310	270	220
		vc (SFM)	330	-	330	283	228	330	-	330	283	228	325	-	325	283	230	325	-	325	283	230
		vf (IPM)	80	-	80	70	60	110	-	110	100	80	70	-	70	60	50	100	-	100	80	70
		fz (IPT)	.039	-	.039	.039	.039	.039	-	.039	.039	.039	.039	-	.039	.039	.039	.039	-	.039	.039	.039
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	2.400	-	2.400	2.400	2.400	2.400	-	2.400	2.400	2.400	3.200	-	3.200	3.200	3.200	3.200	-	3.200	3.200	3.200
		Q (inch³/min)	7.5	-	7.5	5.2	4.5	10.3	-	10.3	7.4	6.0	8.7	-	8.7	6.0	5.0	12.5	-	12.5	7.9	6.9
Precipitation Hardening Stainless Steel (WET)	JM4160 JP4120	n (min⁻¹)	380	-	380	330	290	380	-	380	330	290	280	-	280	250	220	280	-	280	250	220
		vc (SFM)	298	-	298	259	228	298	-	298	259	228	293	-	293	262	230	293	-	293	262	230
		vf (IPM)	60	-	60	50	40	80	-	80	70	60	50	-	50	50	40	70	-	70	60	50
		fz (IPT)	.031	-	.031	.031	.031	.031	-	.031	.031	.031	.031	-	.031	.031	.031	.031	-	.031	.031	.031
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	2.400	-	2.400	2.400	2.400	2.400	-	2.400	2.400	2.400	3.200	-	3.200	3.200	3.200	3.200	-	3.200	3.200	3.200
		Q (inch³/min)	5.6	-	5.6	3.7	3.0	7.5	-	7.5	5.2	4.5	6.2	-	6.2	5.0	4.0	8.7	-	8.7	6.0	5.0
Cast Iron Ductile Cast Iron	GX2140 JS4060 JP4120	n (min⁻¹)	630	840	630	540	460	630	840	630	540	460	470	630	470	410	340	470	630	470	410	340
		vc (SFM)	495	660	495	424	361	495	660	495	424	361	492	660	492	429	356	492	660	492	429	356
		vf (IPM)	250	330	250	210	180	350	460	350	300	250	220	300	220	190	160	300	400	300	260	210
		fz (IPT)	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
		Q (inch³/min)	23.4	30.9	23.4	15.6	13.4	32.8	43.1	32.8	22.3	18.6	27.5	37.4	27.5	18.8	15.9	37.4	49.9	37.4	25.8	20.8
Hardened Steel (45～50HRC)	JP4120 JP4105	n (min⁻¹)	330	380	330	290	250	330	380	330	290	250	250	280	250	220	190	250	280	250	220	190
		vc (SFM)	259	298	259	228	196	259	298	259	228	196	262	293	262	230	199	262	293	262	230	199
		vf (IPM)	30	60	30	30	30	50	80	50	40	40	30	50	30	30	20	40	70	40	40	30
		fz (IPT)	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
		Q (inch³/min)	2.2	4.5	2.2	1.7	1.7	3.7	6.0	3.7	2.3	2.3	3.0	5.0	3.0	2.3	1.5	4.0	6.9	4.0	3.1	2.3
Hardened Steel (50～60HRC)	JP4105 JP4120	n (min⁻¹)	330	380	330	290	250	330	380	330	290	250	250	280	250	220	190	250	280	250	220	190
		vc (SFM)	259	298	259	228	196	259	298	259	228	196	262	293	262	230	199	262	293	262	230	199
		vf (IPM)	30	50	30	20	20	40	60	40	30	30	20	40	20	20	20	30	50	30	30	20
		fz (IPT)	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	2.400	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200	3.200
		Q (inch³/min)	2.2	3.7	2.2	1.2	1.2	3.0	4.5	3.0	1.7	1.7	2.0	4.0	2.0	1.5	1.5	3.0	5.0	3.0	2.3	1.5



Work Material	Insert Grade	Cutter Dia. / Overhang Ratio	φ3.000(5NT)				φ3.000(7NT)				φ4.000(6NT)				φ4.000(8NT)			
			<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC
Cast Iron Ductile Cast Iron	JP4120 GX2140 JS4060	n (min⁻¹)	840	840	710	630	840	840	710	630	630	630	530	470	630	630	530	470
		vc (SFM)	660	660	558	495	660	660	558	495	660	660	555	492	660	660	555	492
		vf (IPM)	30	30	20	20	50	50	30	30	30	30	20	20	40	40	30	20
		fz (IPT)	.008	.008	.006	.006	.008	.008	.006	.006	.008	.008	.006	.006	.008	.008	.006	.006
		pf (inch)	≦0.5DC				≦0.5DC				≦0.5DC				≦0.5DC			
		ae (inch)	≦.354				≦.354				≦.354				≦.354			

【Note】 ④For strongly interrupted cutting, when unsupported length is long, or for wet cutting, JM4160 is recommended.
⑤To prevent tool damage due to chip clogging, always use a chip removal method such as an air blower, etc.
⑥Since there is a danger of the removed chips flying out and causing injury to workers, fire, or damage to eyes, during use be sure to cover the work area with a safety cover and have workers wear protective equipment such as glasses, etc. to make the work area safe.
⑦Perform insert replacement at an early stage to prevent chipping due to excessive use.
⑧The following equation can be used to determine the metal removal rate per unit time Q;
$Q(\text{inch}^3/\text{min}) = a_p(\text{inch}) \times a_e(\text{inch}) \times v_f(\text{IPM})$

Metric

Face Milling, Side Milling

Red indicates primary recommended insert grade.

Work Material	Insert Grade	Cutter Dia.	ϕ1.969 inch (50mm) (3NT)					ϕ1.969 inch (50mm) (4NT)					ϕ2.480 inch (63mm) (4NT)				
		Overhang Ratio	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC
			General	High Speed				General	High Speed				General	High Speed			
General Structural Steel (200HB or less)	GX2140 JS4060	*n* (min⁻¹)	950	1,270	950	830	700	950	1,270	950	830	700	760	1,010	760	660	560
		Vc (SFM)	492	656	492	426	361	492	656	492	426	361	492	656	492	426	361
		Vf (IPM)	202	300	202	176	149	269	400	269	235	198	215	318	215	187	159
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.969	1.969	1.969	1.969	1.969
		Q (inch³/min)	8.1	12.0	8.1	5.6	4.8	10.8	16.0	10.8	7.5	6.3	10.8	15.9	10.8	7.5	6.3
Carbon Steel Alloy Steel (<35HRC)	GX2140 JS4060	*n* (min⁻¹)	950	1,270	950	830	700	950	1,270	950	830	700	760	1,010	760	660	560
		Vc (SFM)	492	656	492	426	361	492	656	492	426	361	492	656	492	426	361
		Vf (IPM)	202	300	202	176	149	269	400	269	235	198	215	318	215	187	159
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.969	1.969	1.969	1.969	1.969
		Q (inch³/min)	8.1	12.0	8.1	5.6	4.8	10.8	16.0	10.8	7.5	6.3	10.8	15.9	10.8	7.5	6.3
Carbon Steel Alloy Steel (35～45HRC)	JP4120 JS4060	*n* (min⁻¹)	830	950	830	700	570	830	950	830	700	570	660	760	660	560	450
		Vc (SFM)	426	492	426	361	295	426	492	426	361	295	426	492	426	361	295
		Vf (IPM)	176	224	176	132	108	235	299	235	176	144	187	239	187	141	113
		fz (IPT)	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.969	1.969	1.969	1.969	1.969
		Q (inch³/min)	7.0	9.0	7.0	4.3	3.5	9.4	12.0	9.4	5.6	4.6	9.4	12.0	9.4	5.6	4.5
300 series Stainless Steel (WET)	JM4160	*n* (min⁻¹)	640	-	640	540	450	640	-	640	540	450	510	-	510	430	350
		Vc (SFM)	328	-	328	279	230	328	-	328	279	230	328	-	328	279	230
		Vf (IPM)	76	-	76	64	53	101	-	101	85	71	80	-	80	68	55
		fz (IPT)	.039	-	.039	.039	.039	.039	-	.039	.039	.039	.039	-	.039	.039	.039
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	1.575	-	1.575	1.575	1.575	1.575	-	1.575	1.575	1.575	1.969	-	1.969	1.969	1.969
		Q (inch³/min)	3.0	-	3.0	2.0	1.7	4.0	-	4.0	2.7	2.3	4.0	-	4.0	2.7	2.2
Precipitation Hardening Stainless Steel (WET)	JM4160 JP4120	*n* (min⁻¹)	570	-	570	510	450	570	-	570	510	450	450	-	450	400	350
		Vc (SFM)	295	-	295	262	230	295	-	295	262	230	295	-	295	262	230
		Vf (IPM)	54	-	54	48	43	72	-	72	64	57	57	-	57	50	44
		fz (IPT)	.031	-	.031	.031	.031	.031	-	.031	.031	.031	.031	-	.031	.031	.031
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	1.575	-	1.575	1.575	1.575	1.575	-	1.575	1.575	1.575	1.969	-	1.969	1.969	1.969
		Q (inch³/min)	2.2	-	2.2	1.5	1.4	2.9	-	2.9	2.0	1.8	2.8	-	2.8	2.0	1.8
Cast Iron Ductile Cast Iron	GX2140 JS4060 JP4120	*n* (min⁻¹)	950	1,270	950	830	700	950	1,270	950	830	700	760	1,010	760	660	560
		Vc (SFM)	492	656	492	426	361	492	656	492	426	361	492	656	492	426	361
		Vf (IPM)	224	300	224	196	165	299	400	299	261	220	239	318	239	208	176
		fz (IPT)	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.969	1.969	1.969	1.969	1.969
		Q (inch³/min)	9.0	12.0	9.0	6.3	5.3	12.0	16.0	12.0	8.3	7.0	12.0	15.9	12.0	8.3	7.0
Hardened Steel (45～50HRC)	JP4120 JP4105	*n* (min⁻¹)	510	570	510	450	380	510	570	510	450	380	400	450	400	350	300
		Vc (SFM)	262	295	262	230	197	262	295	262	230	197	262	295	262	230	197
		Vf (IPM)	30	54	30	27	22	40	72	40	35	30	31	57	31	28	24
		fz (IPT)	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.969	1.969	1.969	1.969	1.969
		Q (inch³/min)	1.0	1.7	1.0	.6	.6	1.3	2.3	1.3	.9	.7	1.3	2.3	1.3	.8	.7
Hardened Steel (50～60HRC)	JP4105 JP4120	*n* (min⁻¹)	510	570	510	450	380	510	570	510	450	380	400	450	400	350	300
		Vc (SFM)	262	295	262	230	197	262	295	262	230	197	262	295	262	230	197
		Vf (IPM)	24	41	24	21	18	32	54	32	28	24	25	43	25	22	19
		fz (IPT)	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.575	1.969	1.969	1.969	1.969	1.969
		Q (inch³/min)	.8	1.3	.8	.5	.4	1.0	1.7	1.0	.7	.6	1.0	1.7	1.0	.7	.6

Standard Cutting Conditions for plunging

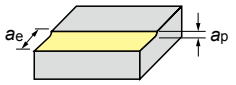
Red indicates primary recommended insert grade.

Work Material	Insert Grade	Cutter Dia.	ϕ1.969 inch (50 ㎜) (3NT)				ϕ1.969 inch (50mm) (4NT)				ϕ2.480 inch (63mm) (4NT)			
		Overhang Ratio	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC
Cast Iron Ductile Cast Iron	JP4120 GX2140 JS4060	*n* (min⁻¹)	1,270	1,270	1,080	950	1,270	1,270	1,080	950	1,010	1,010	860	760
		Vc (SFM)	656	656	558	492	656	656	558	492	656	656	558	492
		Vf (IPM)	30	30	19	17	40	40	26	22	32	32	20	18
		fz (IPT)	.008	.008	.006	.006	.008	.008	.006	.006	.008	.008	.006	.006
		pf (inch)	≦0.5DC				≦0.5DC				≦0.5DC			
		ae (inch)	≦.354				≦.354				≦.354			

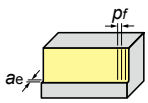
【Note】①This table provides general guidelines for cutting conditions; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
In particular, when performing shoulder milling in combination with slotting or machining of cutting widths close to slots, etc., chattering vibrations may occur, which can lead to trouble.
Therefore, please consider the following when adjusting the conditions;

- Reduce rotation speed and table feed rate by 50 to 70%
- Reduce cutting depth ap by 50 to 70%
- Reduce cutting width ae by 50 to 70%

②Please note that the GX coating and JS coating do not cause a reaction in conductive touch sensors.
③JP4105 is for the high-hardness steels. It is not suitable for Non-heat-treated steel material.



Work Material	Insert Grade	Cutter Dia. / Overhang Ratio	ϕ2.480 inch (63mm) (5NT)					ϕ3.150 inch (80mm) (5NT)					ϕ3.937 inch (100mm) (6NT)				
			<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC	<3DC		3~5DC	5~7DC	>7DC
			General	High Speed				General	High Speed				General	High Speed			
General Structural Steel (200HB or less)	GX2140 JS4060	n (min-1)	760	1,010	760	660	560	600	800	600	520	440	480	640	480	410	350
		Vc (SFM)	492	656	492	426	361	492	656	492	426	361	492	656	492	426	361
		Vf (IPM)	269	398	269	234	198	213	315	213	184	156	204	302	204	174	149
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.969	1.969	1.969	1.969	1.969	2.520	2.520	2.520	2.520	2.520	3.150	3.150	3.150	3.150	3.150
		Q (inch3/min)	13.5	19.9	13.5	9.4	8.0	13.6	20.2	13.6	9.4	8.0	16.3	24.2	16.3	11.2	9.5
Carbon Steel Alloy Steel (<35HRC)	GX2140 JS4060	n (min-1)	760	1,010	760	660	560	600	800	600	520	440	480	640	480	410	350
		Vc (SFM)	492	656	492	426	361	492	656	492	426	361	492	656	492	426	361
		Vf (IPM)	269	398	269	234	198	213	315	213	184	156	204	302	204	174	149
		fz (IPT)	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071	.071	.079	.071	.071	.071
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.969	1.969	1.969	1.969	1.969	2.520	2.520	2.520	2.520	2.520	3.150	3.150	3.150	3.150	3.150
		Q (inch3/min)	13.5	19.9	13.5	9.4	8.0	13.6	20.2	13.6	9.4	8.0	16.3	24.2	16.3	11.2	9.5
Carbon Steel Alloy Steel (35~45HRC)	JP4120 JS4060	n (min-1)	660	760	660	560	450	520	600	520	440	360	410	480	410	350	290
		Vc (SFM)	426	492	426	361	295	426	492	426	361	295	426	492	426	361	295
		Vf (IPM)	234	299	234	176	142	184	236	184	139	113	174	227	174	132	109
		fz (IPT)	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063	.071	.079	.071	.063	.063
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.969	1.969	1.969	1.969	1.969	2.520	2.520	2.520	2.520	2.520	3.150	3.150	3.150	3.150	3.150
		Q (inch3/min)	11.7	15.0	11.7	7.0	5.7	11.8	15.1	11.8	7.1	5.8	13.9	18.2	13.9	8.5	7.0
300 series Stainless Steel (WET)	JM4160	n (min-1)	510	-	510	430	350	400	-	400	340	280	320	-	320	270	220
		Vc (SFM)	328	-	328	279	230	328	-	328	279	230	328	-	328	279	230
		Vf (IPM)	100	-	100	85	69	79	-	79	67	55	76	-	76	64	52
		fz (IPT)	.039	-	.039	.039	.039	.039	-	.039	.039	.039	.039	-	.039	.039	.039
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	1.969	-	1.969	1.969	1.969	2.520	-	2.520	2.520	2.520	3.150	-	3.150	3.150	3.150
		Q (inch3/min)	5.0	-	5.0	3.4	2.8	5.0	-	5.0	3.4	2.8	6.1	-	6.1	4.1	3.3
Precipitation Hardening Stainless Steel (WET)	JM4160 JP4120	n (min-1)	450	-	450	400	350	360	-	360	320	280	290	-	290	250	220
		Vc (SFM)	295	-	295	262	230	295	-	295	262	230	295	-	295	262	230
		Vf (IPM)	71	-	71	63	55	57	-	57	50	44	55	-	55	47	42
		fz (IPT)	.031	-	.031	.031	.031	.031	-	.031	.031	.031	.031	-	.031	.031	.031
		ap (inch)	.039	-	.039	.031	.031	.039	-	.039	.031	.031	.039	-	.039	.031	.031
		ae (inch)	1.969	-	1.969	1.969	1.969	2.520	-	2.520	2.520	2.520	3.150	-	3.150	3.150	3.150
		Q (inch3/min)	3.5	-	3.5	2.5	2.2	3.6	-	3.6	2.6	2.2	4.4	-	4.4	3.0	2.7
Cast Iron Ductile Cast Iron	GX2140 JS4060 JP4120	n (min-1)	760	1,010	760	660	560	600	800	600	520	440	480	640	480	410	350
		Vc (SFM)	492	656	492	426	361	492	656	492	426	361	492	656	492	426	361
		Vf (IPM)	299	398	299	260	220	236	315	236	205	173	227	302	227	194	165
		fz (IPT)	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079	.079
		ap (inch)	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031	.039	.039	.039	.031	.031
		ae (inch)	1.969	1.969	1.969	1.969	1.969	2.520	2.520	2.520	2.520	2.520	3.150	3.150	3.150	3.150	3.150
		Q (inch3/min)	15.0	19.9	15.0	10.4	8.8	15.1	20.2	15.1	10.5	8.9	18.2	24.2	18.2	12.4	10.6
Hardened Steel (45~50HRC)	JP4120 JP4105	n (min-1)	400	450	400	350	300	320	360	320	280	240	250	290	250	220	190
		Vc (SFM)	262	295	262	230	197	262	295	262	230	197	262	295	262	230	197
		Vf (IPM)	39	71	39	35	30	31	57	31	28	24	30	55	30	26	22
		fz (IPT)	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020	.020	.031	.020	.020	.020
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	1.969	1.969	1.969	1.969	1.969	2.520	2.520	2.520	2.520	2.520	3.150	3.150	3.150	3.150	3.150
		Q (inch3/min)	1.6	2.8	1.6	1.0	.9	1.6	2.9	1.6	1.1	.9	1.9	3.5	1.9	1.3	1.1
Hardened Steel (50~60HRC)	JP4105 JP4120	n (min-1)	400	450	400	350	300	320	360	320	280	240	250	290	250	220	190
		Vc (SFM)	262	295	262	230	197	262	295	262	230	197	262	295	262	230	197
		Vf (IPM)	31	53	31	28	24	25	43	25	22	19	24	41	24	21	18
		fz (IPT)	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016	.016	.024	.016	.016	.016
		ap (inch)	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024	.031	.031	.031	.024	.024
		ae (inch)	1.969	1.969	1.969	1.969	1.969	2.520	2.520	2.520	2.520	2.520	3.150	3.150	3.150	3.150	3.150
		Q (inch3/min)	1.3	2.1	1.3	.8	.7	1.3	2.2	1.3	.9	.7	1.5	2.6	1.5	1.0	.9



Work Material	Insert Grade	Cutter Dia. / Overhang Ratio	ϕ2.480 inch (63mm) (5NT)				ϕ3.150 inch (80mm) (5NT)				ϕ3.937 inch (100mm) (6NT)			
			<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC	<3DC	3~5DC	5~7DC	>7DC
Cast Iron Ductile Cast Iron	JP4120 GX2140 JS4060	n (min-1)	1,010	1,010	860	760	800	800	680	600	640	640	540	480
		Vc (SFM)	656	656	558	492	656	656	558	492	656	656	558	492
		Vf (IPM)	40	40	26	22	31	31	20	18	30	30	19	17
		fz (IPT)	.008	.008	.006	.006	.008	.008	.006	.006	.008	.008	.006	.006
		pf (inch)	≦0.5DC				≦0.5DC				≦0.5DC			
		ae (inch)	≦.354				≦.354				≦.354			

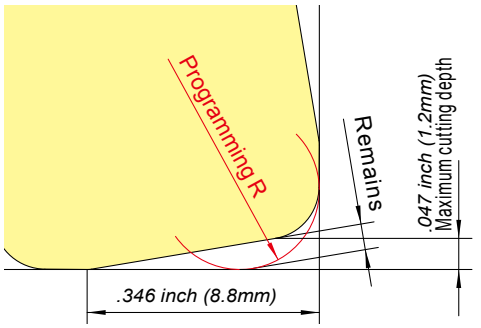
【Note】 ④For strongly interrupted cutting, when unsupported length is long, or for wet cutting, JM4160 is recommended.
⑤To prevent tool damage due to chip clogging, always use a chip removal method such as an air blower, etc.
⑥Since there is a danger of the removed chips flying out and causing injury to workers, fire, or damage to eyes, during use be sure to cover the work area with a safety cover and have workers wear protective equipment such as glasses, etc. to make the work area safe.
⑦Perform insert replacement at an early stage to prevent chipping due to excessive use.
⑧The following equation can be used to determine the metal removal rate per unit time Q;
$Q(\text{inch}^3/\text{min}) = a_p(\text{inch}) \times a_e(\text{inch}) \times V_f(\text{IPM}) \div 1000$

Precautions for use

Programming guidance

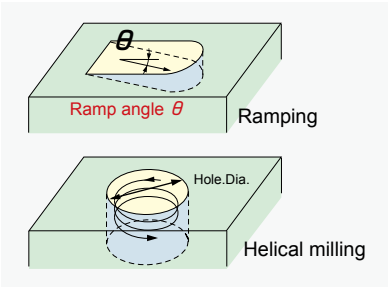
・In CAM, define the tool shape as .118 inch (R3.0mm) radius shape.

Corner R Definition in CAM inch (mm)	Remains inch (mm)	Maximum cutting depth inch (mm)
.118 (R3.0)	.039 (1.0)	.047 (1.2)



Maximum ramp angle and helical hole diameter

・Since the cutting flute does not extend to the center of the cutter, there are limitations on the maximum ramp angle. However, it is possible to helical mill without a pilot hole as shown in below table.



Tool Diameter	2.000 inch or 50mm	2.500 inch or 63mm	3.000 inch or 80mm	4.000 inch or 100mm
Max ramp angle θ	3°	2°	1.7°	1°
Hole Dia. (inch)	3.228~3.780	4.252~4.803	5.591~6.142	7.165~7.717
Hole Dia. (mm)	82~96	108~122	142~156	182~196

【Note】 ①Please set the ramp angle within the above range on table. we recommend to use less than 1 °. Pilot hole is necessary if the hole diameter is larger than that range.
②For hole diameters outside the ranges listed above, a pilot hole should be drilled before milling.
③For helical cutting, please set the "ap" to around 50% of recommended cutting condition.
④It is recommended that the tool be used while performing sufficient chip removal and checking that there are no abnormal vibrations.

Attention for the corner change

・Turn the insert counterclockwise upon corner change.

High Feed Tools Lineup

Application Matrix: Rough Machining

Type	Feature: Economical (No. of corners)	Feature: High accuracy (Less uncut remnants)	Feature: Supports for high-hardened steel	Feature: Efficiency (No. of Flutes)	Holder: Tool dia. Upper (inch) Lower (mm)	Insert: No. of corners	Insert: Shape	Insert: Inscribed circle code	Programing R inch (mm)	Max cutting depth inch (mm)
TD4N	◎	◎	~50HRC	◎ High efficiency multiflutes	.625 ~1.500 16~42	4		06	.079 (2.0)	.039 (1.0)
ASR MULTI		○	○ ~62HRC	◎ High efficiency multiflutes	.625~2.500 16~66	2		06 12	.079 (2.0)	.059 (1.5)
ASRF-mini	◎		○ ~62HRC	○ General	.750~2.500 20~63	4		07	.079 (2.0)	.047 (1.2)
ASR		○	○ ~60HRC	○ General	.750~4.000 20~100	2		08 ~ 15	.118 (3.0)	.079 (2.0)
IASRT	○	○	○ ~62HRC	○ General	2.000~5.000	3		09 ~ 15	.118 (3.0)	.079 (2.0)
IASRF	◎		○ ~60HRC	○ General	1.250~4.000	4		12	.177 (4.5)	.079 (2.0)
TR4D	◎		○ ~60HRC	◎ High efficiency multiflutes	2.000~4.000 50~100	4		12	.118 (3.0)	.047 (1.2)

※ For details of tool specifications, please check on catalog or website (www.moldino.com/en-US/)

Field Data

No.	User name	Work (mold type / parts)	Competitor	Tools & cutting conditions	Evaluation
1	Company A	Plastic mold (for automotive bumper) Pre-hardened steel (42HRC)	—	【Tools】 TR4D4100B-6 (φ3.937 inch -6 flutes) SDNW120520TR-P: JP4120 【Cutting conditions】 v_c:351 SFM (107m/min) , f_z:.071 IPT (1.8mm/t) OH:16.063 inch (408mm) (4D) $a_p \times a_e$ = .039 x 2.559 inch (1.0 x 65mm) 【Tools】 TR4D4080B-5 (φ3.150 inch -5 flutes) SDNW120520TR-P: JP4120 【Cutting conditions】 v_c:328 SFM (100m/min), f_z:.067 IPT (1.7mm/t) OH:16.063 inch (408mm) $a_p \times a_e$ = .039 x 2.047 inch (1.0 x 52 mm)	Achieved high efficiency stable cutting with long projection
2	Company B	Shear blade SCM440 (47 ～ 48HRC)	Competitor G 3 corner High-feed tools	【Tools】 TR4D4063BM-5 (φ2.480 inch -5 flutes) SDNW120520TR: JP4120 v_c:390 SFM (119m/min) f_z:.031 IPT (0.8mm/t) $a_p \times a_e$ = .039 x 1.732 (1.0 x 44mm)	1.5 times longer tool life against competitors
3	Company C	Forging dies (for crank shaft) H13 (46 ～ 48HRC)	Competitor Y 4 corner High-feed tools	【Tools】 TR4D4100B-6 (φ3.937 inch -6 flutes) SDNW120520TR :JP4120 【Cutting conditions】 v_c:331 SFM (101m/min) f_z:.017 IPT (0.42mm/t) $a_p \times a_e$ = .059 x 2.756 inch (1.5 x 70mm)	Achieved stable cutting with 1.2 times efficiency It was well received since small and curlled cutting chips were generated
4	Company D	Lens mold 4140(A)	Competitor J 3 corner High-feed tools	【Tools】 TR4D4063BM-5 (φ2.480 inch -5 flutes) SDNW120520TR: JP4120 【Cutting conditions】 v_c:430 SFM (131m/min) f_z:.047 IPT (1.2mm/t) $a_p \times a_e$ = .043 ~.071 x 1.968 Inch (1.1 ~ 1.8 x 50mm)	Achieved stable cutting with 1.6 times efficiency It was well received since machining noise and cutting chipps are small

The diagrams and table data are examples of test results, and are not guaranteed values.

Safety Considerations

1. Handling

(1) When removing tool from packaging, be careful not to drop the tool on your foot or fingers.
(2) When actually setting the inserts, be careful not to touch the cutting flute directly with your bare hands.

2. Mounting

(1) When preparing to use, be sure that the insert is firmly screwed in the pocket and cutter is properly mounted on the tool holder.
(2) If abnormal chattering occurs during use, stop the machine immediately, identify the cause of the chatter and take corrective action.

3. Usage

(1) Before use confirm all dimensions, verify work material and programmed tool rotation.
(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) Inserts are made of hard material and may break and be expelled from cutter at high speeds. Since there is a danger of injury to workers from chip evacuation, insert breakage or fire safety precautions must be observed at all times. Including, but not limited to: safety glasses, machine enclosures or other means to create a safe environment for work. If you have questions on safety, contact your supervisor.
- Do not use where there is a risk of fire or explosion.
- Do not use non-water-soluble cutting oils. Such oils may result in fire.

(4) Do not use the tool for any purpose other than that for which it is intended, and do not modify it.

Notes

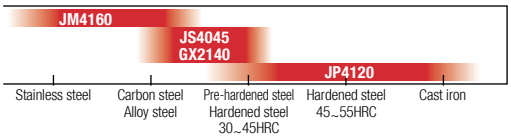
MOLDINO
The Edge To Innovation

TD4N

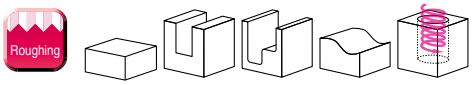
High Feed Radius Mill TD4N type

MOLDINO Tool Engineering, Ltd.

New Product News | No. H1801A-2 | 2020-4



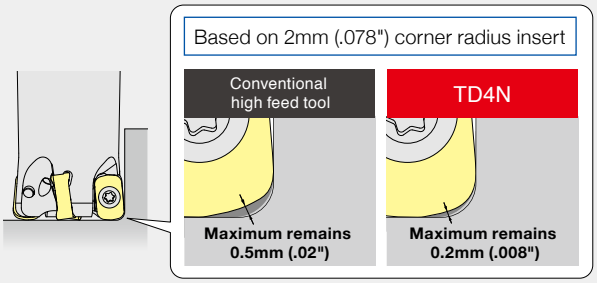
Applications



Features 01 Reduces uncut portion on work pieces

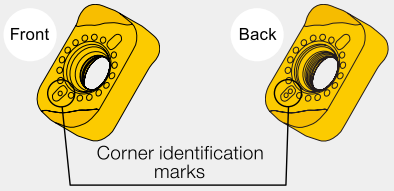
The cutting edge geometry of the TD4N is designed to minimize remaining stock in the uncut portion of the insert to reduce process variability and cycle time.

New insert design doubles usable corners from 2 to 4 without impacting edge security or performance.



Features 02 Economical 4-corner inserts with chip breakers for various applications

The TD4N is engineered to utilize both sides of the insert doubling cutting edges from 2 to 4 while maintaining performance and edge security of a single sided insert. As an added plus, the chip breaker rake angle was increased to reduce cutting forces and improve chip discharge.



Features of insert breaker

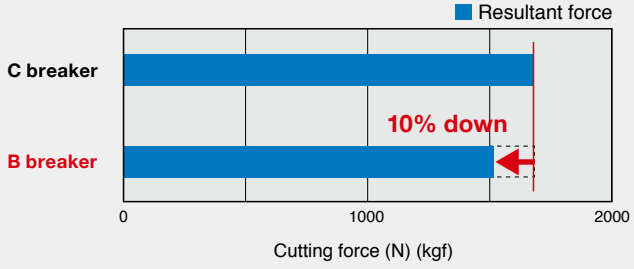
C breaker

First choice breaker for machine steel 30 to 50 HRC. Breaker is designed to be resistant to chip jamming, vibrations and crater wear.

B breaker

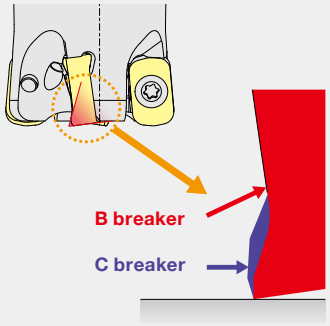
Designed for application that require low cutting resistance. The B breaker has a positive rake making it ideal for both stainless and low carbon steels.

Cutting force comparison



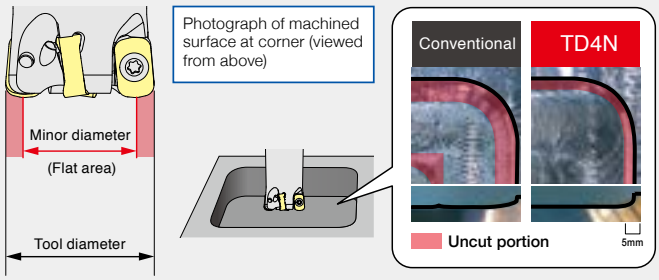
Magnified view of cutting edge cross section

Positive rake angle



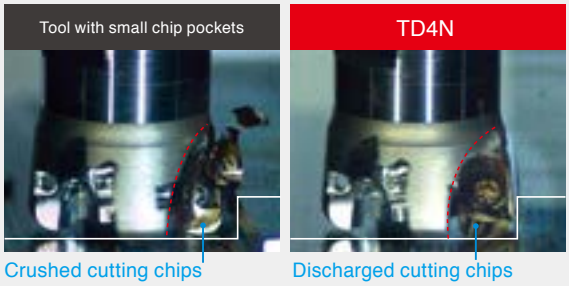
Features 03 Large minor cutting diameter minimized stock variation

Compared to conventional high feed tools, TD4N high feed cutters have a large minor diameter. The large minor diameter minimizes the uncut material in shoulders and enables an increased width of cut -ae- for improved cutter paths and floor blends without sacrificing performance.



Features 04 Excellent chip discharge characteristics

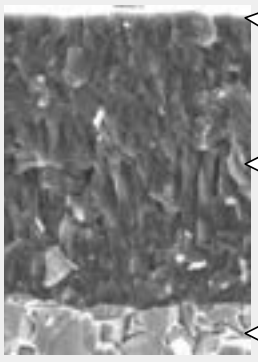
The next generation TD4N high feed cutter excels in chip control without sacrificing performance.



The TD4N insert is designed to curl the chip up and into the new chip pocket design before discharge. The breakthrough concept in high feed milling chip control minimizes the possibility of chip jamming especially when machining shoulders.

AJ Coating Series

New AJ coating is now applied to all 4100 series inserts. AJ coating features High AlTiN PVD coating technology that delivers both improved heat resistance and coating adhesion. To further increase performance, 4100 series inserts have a special surface treatment that reduces friction and minimizes welding.



Coating structure

PVD Technology Grade for machining pre-hardened or hardened materials **JP4120**

Highly versatile with excellent cutting performance on pre-hardened steel or hardened steel. (30-50 HRC).

PVD Technology Grade for machining stainless-steel materials **JM4160**

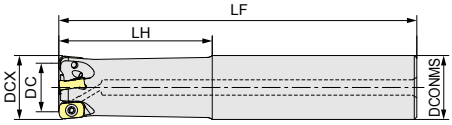
JM4160 features a tough substrate to handle demanding stainless materials topped with AJ coating engineered specially for stainless materials.

PVD Technology General purpose for steel **JS4045**

JS4045 is an existing PVD coated steel grade selected for the TD4N cutter due to its exceptional toughness in interrupted or unstable applications. JS4045 should be used when JP4120 encounters chipping.

Shank type ITD4N20○○□-○ Inch

Fig.1
(Standard type)



Style		Item code	# of Flutes	Dimensions (Inch)					Type	Insert
				DCX	DC	LF	LH	DCONMS		
Shank Style	Regular	ITD4N2010S-2	2	0.625	0.389	4.000	1.250	0.625	Fig.1	ENMU0603ER-B/C
		ITD4N2012S-3	3	0.750	0.514	5.000	2.000	0.750		
		ITD4N2016S-4	4	1.000	0.764	5.500	2.500	1.000		
		ITD4N2020S-5	5	1.250	1.014	6.000	2.750	1.250		
		ITD4N2024S-6	6	1.500	1.264	6.000	1.750	1.500		
	Long	ITD4N2010L-2	2	0.625	0.389	6.000	2.000	0.625		
		ITD4N2012L-3	3	0.750	0.514	6.250	3.250	0.750		
		ITD4N2016L-4	4	1.000	0.764	7.000	4.000	1.000		
		ITD4N2020L-5	5	1.250	1.014	8.000	5.000	1.250		
		ITD4N2024L-6	6	1.500	1.264	9.000	1.750	1.500		

Shank type TD4N20○○□(32)-○ Metric

Fig.1
(Standard type)

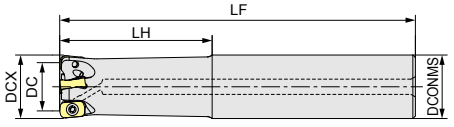
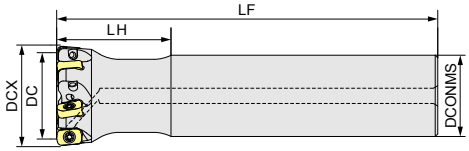
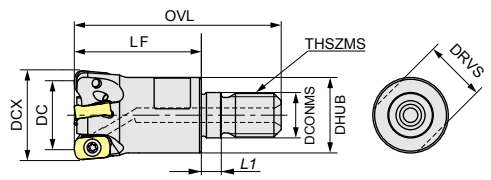


Fig.2
(Undercut type)



Style		Item code	# of Flutes	Dimensions (mm)					Type	Insert
				DCX	DC	LF	LH	DCONMS		
Shank Style	Regular	TD4N2016S-2	2	16	10	100	30	16	Fig.1	ENMU0603ER-B/C
		TD4N2020S-3	3	20	14	130	50	20		
		TD4N2025S-4	4	25	19	140	60	25		
		TD4N2032S-5	5	32	26	150	70	32		
		TD4N2040S32-6	6	40	34	150	45	32	Fig.2	
	Long	TD4N2016L-2	2	16	10	150	50	16	Fig.1	
		TD4N2018L-2	2	18	12	150	25	16	Fig.2	
		TD4N2020L-3	3	20	14	160	80	20	Fig.1	
		TD4N2022L-3	3	22	16	160	30	20	Fig.2	
		TD4N2025L-4	4	25	19	180	100	25	Fig.1	
		TD4N2028L-4	4	28	22	180	35	25	Fig.2	
		TD4N2032L-5	5	32	26	200	120	32	Fig.1	
		TD4N2035L-5	5	35	29	200	40	32	Fig.2	
		TD4N2040L32-6	6	40	34	220	45	32	Fig.2	

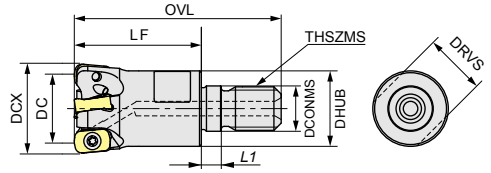
Modular type ITD4N20○○M-○ Inch



Item code	# of Flutes	Dimensions (Inch)									Insert
		DCX	DC	LF	OVL	*L1*	DCON	DHUB	THSZMS	DRVS	
ITD4N2010M-2	2	0.625	0.389	0.984	1.653	0.217	0.335	0.504	M8	0.394	ENMU0603ER-B/C
ITD4N2012M-3	3	0.750	0.514	1.181	1.929	0.217	0.413	0.701	M10	0.591	
ITD4N2016M-4	4	1.000	0.764	1.378	2.244	0.217	0.492	0.819	M12	0.669	
ITD4N2020M-5	5	1.250	1.014	1.575	2.481	0.236	0.669	1.134	M16	0.866	
ITD4N2024M-6	6	1.500	1.264	1.575	2.481	0.236	0.669	1.134	M16	0.866	

Note Do not apply lubricants such as grease, etc. to the contact faces and modular screws of the modular mill, special shanks and special arbor.

Modular type TD4N20○○M-○ Metric



Item code	# of Flutes	Dimensions (mm)									Insert
		DCX	DC	LF	OVL	*L1*	DCON	DHUB	THSZMS	DRVS	
TD4N2016M-2	2	16	10	25	42	5.5	8.5	12.8	M8	10	ENMU0603ER-B/C
TD4N2018M-2	2	18	12	25	42	5.5	8.5	12.8	M8	10	
TD4N2020M-3	3	20	14	30	49	5.5	10.5	17.8	M10	15	
TD4N2022M-3	3	22	16	30	49	5.5	10.5	17.8	M10	15	
TD4N2025M-4	4	25	19	35	57	5.5	12.5	20.8	M12	17	
TD4N2028M-4	4	28	22	35	57	5.5	12.5	20.8	M12	17	
TD4N2032M-5	5	32	26	40	63	6	17	28.8	M16	22	
TD4N2035M-5	5	35	29	40	63	6	17	28.8	M16	22	
TD4N2040M-6	6	40	34	40	63	6	17	28.8	M16	22	
TD4N2042M-6	6	42	36	40	63	6	17	28.8	M16	22	

Note Do not apply lubricants such as grease, etc. to the contact faces and modular screws of the modular mill, special shanks and special arbor.

Insert Super Radius Mill TD4N type

Fig.1
Tougher edge
C breaker
ENMU0603ER-C

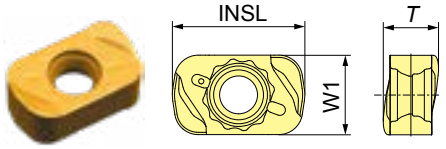
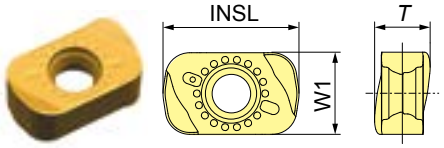


Fig.2
Reduce cutting force
B breaker
ENMU0603ER-B



P	Carbon Steel		■		■	■
M	Stainless Steel			■		
K	Cast Iron		■		▭	▭
H	Hardened Steel		■			

■ : General cutting, First recommendation
▭ : General cutting, Second recommendation

Item code	Tolerance Class	AJ-Coated		JS-Coated	GX-Coated	Size (mm)			Shape
		JP4120	JM4160	JS4045	GX2140	INSL	W1	*T*	
ENMU0603ER-C	M	●	●	●	●	10	6	4.2	Fig.1
ENMU0603ER-B		●	●	●	●				Fig.2

● Inventory maintained in US Note the GX2140 can not be used with conductive touch sensors.

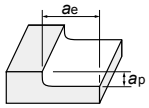
Material Name ISO Classification	Coating Name Coating Type	Application	Features
JP4120 **P10-M10-K10**	AJ Coating PVD	For pre-hardened steel (35-50HRC) and alloy steel.	Uses fine grain substrate and AJ coating. Suitable for cutting of common steels through pre-hardened steels.
JM4160 **M40**	AJ Coating PVD	General purpose for stainless steel.	Uses high toughness substrate and AJ coating. Suitable for cutting of stainless steels.
JS4045 **P30-K30**	JS Coating PVD	General purpose for steel.	Uses tough substrate and JS coating. Suitable for general steel cutting.
GX2140 **P40-K40**	GX Coating CVD	Dry high speed cutting for steel 35HRC or less.	Uses tough substrate and GX coating. Suitable for dry high speed mild steel cutting.

Parts

Parts	Clamp Screw		Screw Driver	Screw Anti-Seizure Agent
Shape		Fastening torque (N•m)		
Item code	250-141	1.1	104-T8	P-37

The clamp screw is a consumable part. Clamp screw replacement is dependent on use, we recommend replacing screw at signs of wear on screw seat chamfer.

INCH

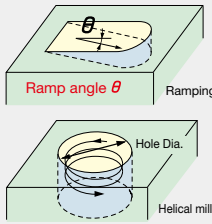


Red indicates primary recommended insert grade.

Work Material	Recommended Insert Grade	Tool Diameter	Ø5/8" (2 flutes)		Ø3/4" (3 flutes)		Ø1" (4 flutes)		Ø1.25" (5 flutes)		Ø1.5" (6 flutes)	
		Overhang ratio	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC
Carbon Steel Alloy Steel <30HRC	GX2140 JS4045	n (min-1)	3380	2990	2710	2390	2170	1910	1690	1490	1350	1190
		Vc (sfm)	558	492	558	492	558	492	558	492	558	492
		Vf (inch/min)	319	282	384	339	410	361	399	352	383	337
		fz (inch/t)	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
		ap (inch)	0.031	0.024	0.031	0.024	0.031	0.024	0.031	0.024	0.031	0.024
		ae (inch)	0.394	0.394	0.551	0.551	0.748	0.748	0.866	0.866	1.102	1.102
		Q (In3/min)	3.9	2.7	6.6	4.5	9.5	6.5	10.7	7.3	13.1	8.9
Alloy Steel Tool Steel 30 ~ 40HRC	JP4120 JS4045	n (min-1)	2990	2590	2390	2070	1910	1660	1490	1290	1190	1040
		Vc (sfm)	492	426	492	426	492	426	492	426	492	426
		Vf (inch/min)	235	204	282	244	301	261	293	254	281	246
		fz (inch/t)	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
		ap (inch)	0.031	0.024	0.031	0.024	0.031	0.024	0.031	0.024	0.031	0.024
		ae (inch)	0.394	0.394	0.551	0.551	0.748	0.748	0.866	0.866	1.102	1.102
		Q (In3/min)	2.9	1.9	4.8	3.2	7	4.7	7.9	5.3	9.6	6.5
Pre-Hardened Steel Alloy Steel 40 ~ 50HRC	JP4120 JS4045	n (min-1)	1990	1790	1590	1430	1270	1150	1000	900	800	720
		Vc (sfm)	328	295	328	295	328	295	328	295	328	295
		Vf (inch/min)	157	113	188	135	200	145	197	142	189	136
		fz (inch/t)	0.039	0.031	0.039	0.031	0.039	0.031	0.039	0.031	0.039	0.031
		ap (inch)	0.024	0.02	0.024	0.02	0.024	0.02	0.024	0.02	0.024	0.02
		ae (inch)	0.394	0.394	0.551	0.551	0.748	0.748	0.866	0.866	1.102	1.102
		Q (In3/min)	1.5	0.9	2.5	1.5	3.6	2.2	4.1	2.5	5	3
Stainless Steel	JM4160	n (min-1)	1990	1790	1590	1430	1270	1150	1000	900	800	720
		Vc (sfm)	328	295	328	295	328	295	328	295	328	295
		Vf (inch/min)	157	113	188	135	200	145	197	142	189	136
		fz (inch/t)	0.039	0.031	0.039	0.031	0.039	0.031	0.039	0.031	0.039	0.031
		ap (inch)	0.024	0.02	0.024	0.02	0.024	0.02	0.024	0.02	0.024	0.02
		ae (inch)	0.394	0.394	0.551	0.551	0.748	0.748	0.866	0.866	1.102	1.102
		Q (In3/min)	1.5	0.9	2.5	1.5	3.6	2.2	4.1	2.5	5	3
Cast Iron	JP4120 GX2140	n (min-1)	3980	3580	3180	2870	2550	2290	1990	1790	1590	1430
		Vc (sfm)	656	590	656	590	656	590	656	590	656	590
		Vf (inch/min)	470	338	563	407	602	433	587	423	563	405
		fz (inch/t)	0.059	0.047	0.059	0.047	0.059	0.047	0.059	0.047	0.059	0.047
		ap (inch)	0.031	0.024	0.031	0.024	0.031	0.024	0.031	0.024	0.031	0.024
		ae (inch)	0.394	0.394	0.551	0.551	0.748	0.748	0.866	0.866	1.102	1.102
		Q (In3/min)	5.7	3.2	9.6	5.4	14	7.8	15.8	8.8	19.2	10.7
Maximum ap (Inch)			ap ≤ 0.04									

1. Use the appropriate coolant for the work material and machining shape.
2. These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
3. Grade GX2140 can not be used with conductive touch sensors.
4. To prevent tool damage due to chip clogging, always use a chip removal method such as an air blower, etc.
5. Ensure to exchange the insert at the correct time to ensure safety of the tool-body.
6. The following equation can be used to determine the metal removal rate per unit time Q:
   Q (in 3/min) = ap (in) × ae (in) × Vf (in/min)
   Do not set values higher than the maximum value.

Regarding ramping and helical milling diameter

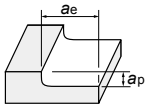


Tool Diameter	0.625" or 16mm	18mm	0.75" or 20mm	22mm	1" or 25mm	28mm	1.25" or 32mm	35mm	1.5" or 40mm
Max ramp angle Ø	0.8°	0.8°	0.8°	0.8°	0.8°	0.6°	0.5°	0.5°	0.3°
Hole Dia. (inch)	0.945"~ 1.181"	1.102"~ 1.339"	1.260"~ 1.496"	1.417"~ 1.654"	1.654"~ 1.890"	1.890"~ 2.126"	2.205"~ 2.441"	2.441"~ 2.677"	2.835"~ 3.071"
Hole Dia. (mm)	24~30mm	28~34mm	32~38mm	36~42mm	42~48mm	48~54mm	56~62mm	62~68mm	72~78mm

Cutting depth per rotation should be set to ap = 0.04" (1mm) or less
It is recommended that the tool be used while performing sufficient chip removal and checking that there are no abnormal vibrations.

Recommended Cutting Conditions

METRIC



Red indicates primary recommended insert grade.

Work Material	Recommended Insert Grade	Tool Diameter	Ø16 (2 flutes)		Ø20 (3 flutes)		Ø25 (4 flutes)		Ø32 (5 flutes)		Ø40 (6 flutes)	
		Overhang ratio	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC	~ 3DC	4DC ~ 7DC
Carbon Steel Alloy Steel <30HRC	GX2140 JS4045	n (min-1)	3380	2990	2710	2390	2170	1910	1690	1490	1350	1190
		Vc (m/min)	170	150	170	150	170	150	170	150	170	150
		Vf (mm/min)	8110	7170	9750	8600	10410	9160	10140	8940	9720	8560
		fz (mm/t)	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
		ap (mm)	0.8	0.6	0.8	0.6	0.8	0.6	0.8	0.6	0.8	0.6
		ae (mm)	10	10	14	14	19	19	22	22	28	28
		Q (cm3/min)	65	43	109	72	158	104	178	118	218	144
Alloy Steel Tool Steel 30 ~ 40HRC	JP4120 JS4045	n (min-1)	2990	2590	2390	2070	1910	1660	1490	1290	1190	1040
		Vc (m/min)	150	130	150	130	150	130	150	130	150	130
		Vf (mm/min)	5980	5180	7170	6210	7640	6640	7450	6450	7140	6240
		fz (mm/t)	1	1	1	1	1	1	1	1	1	1
		ap (mm)	0.8	0.6	0.8	0.6	0.8	0.6	0.8	0.6	0.8	0.6
		ae (mm)	10	10	14	14	19	19	22	22	28	28
		Q (cm3/min)	48	31	80	52	116	76	131	85	160	105
Pre-Hardened Steel Alloy Steel 40 ~ 50HRC	JP4120 JS4045	n (min-1)	1990	1790	1590	1430	1270	1150	1000	900	800	720
		Vc (m/min)	100	90	100	90	100	90	100	90	100	90
		Vf (mm/min)	3980	2860	4770	3430	5080	3680	5000	3600	4800	3450
		fz (mm/t)	1	0.8	1	0.8	1	0.8	1	0.8	1	0.8
		ap (mm)	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.5
		ae (mm)	10	10	14	14	19	19	22	22	28	28
		Q (cm3/min)	24	14	40	24	58	35	66	40	81	48
Stainless Steel	JM4160	n (min-1)	1990	1790	1590	1430	1270	1150	1000	900	800	720
		Vc (m/min)	100	90	100	90	100	90	100	90	100	90
		Vf (mm/min)	3980	2860	4770	3430	5080	3680	5000	3600	4800	3450
		fz (mm/t)	1	0.8	1	0.8	1	0.8	1	0.8	1	0.8
		ap (mm)	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.5	0.6	0.5
		ae (mm)	10	10	14	14	19	19	22	22	28	28
		Q (cm3/min)	24	14	40	24	58	35	66	40	81	48
Cast Iron	JP4120 GX2140	n (min-1)	3980	3580	3180	2870	2550	2290	1990	1790	1590	1430
		Vc (m/min)	200	180	200	180	200	180	200	180	200	180
		Vf (mm/min)	11940	8590	14310	10330	15300	10990	14920	10740	14310	10290
		fz (mm/t)	1.5	1.2	1.5	1.2	1.5	1.2	1.5	1.2	1.5	1.2
		ap (mm)	0.8	0.6	0.8	0.6	0.8	0.6	0.8	0.6	0.8	0.6
		ae (mm)	10	10	14	14	19	19	22	22	28	28
		Q (cm3/min)	96	52	160	87	233	125	263	142	321	173
Maximum ap (mm)			ap ≤ 1.0									

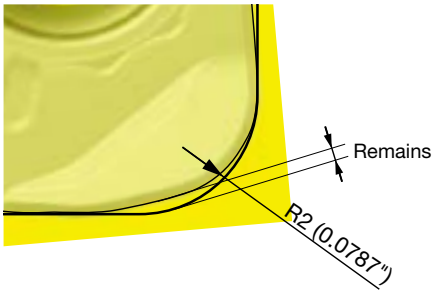
1. Use the appropriate coolant for the work material and machining shape.
2. These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
3. Grade GX2140 can not be used with conductive touch sensors.
4. To prevent tool damage due to chip clogging, always use a chip removal method such as an air blower, etc.
5. Ensure to exchange the insert at the correct time to ensure safety of the tool-body.
6. The following equation can be used to determine the metal removal rate per unit time Q:
   Q (cm3/min) = ap (mm) × ae (mm) × Vf (mm/min) / 1000
   Do not set values higher than the maximum value.

Points requiring care when creating the machining program

- In CAM, define the tool shape as an R2.0 (0.0787") radius shape.
- Use with axial-direction cutting depths ap of 1.0mm (0.04") or less.

Corner R Definition in CAM	Remains (inch/mm)	Over Cut (inch/mm)
0.0591" / R1.5mm	0.0118" / 0.3mm	0
Recommended 0.0787" / R2.0mm	0.0079" / 0.2mm	0
0.1181" / R3.0mm	0	0.0157" / 0.4mm

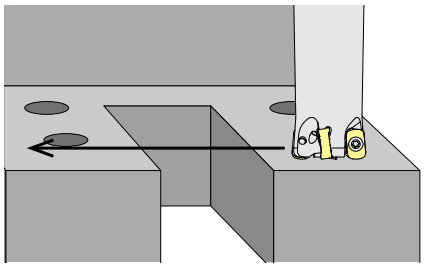
apmax = 1.0mm (0.04")



Field Data

01 Shortened machining time

Interrupted machining



Cutting edge condition after 30 minutes of cutting

[Work material] Pre-hardened steel (40HRC)

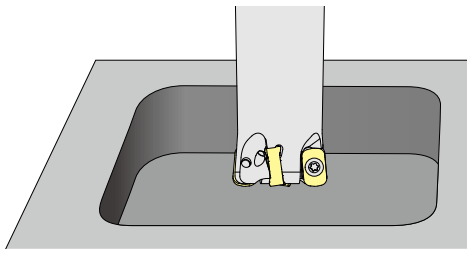
[Tool] TD4N2032S-5 (Ø1.5"-5 flutes)
ENMU0603EN-B (JP4120)

[Cutting conditions]
Vc = 100 m/min (328 sfm)
Vf = 9000 mm/min (354 ipm)
fz = 1.8 mm/t (0.071 in/tooth)
ap × *ae* = 0.6 × 20 mm (0.024" x 0.79")
Air-blow

● 90-minute machining time shortened to approximately 30 minutes.

02 Improved tool life

Pocketing



Cutting edge condition after 100 minutes of cutting

[Work material] Carbon steel

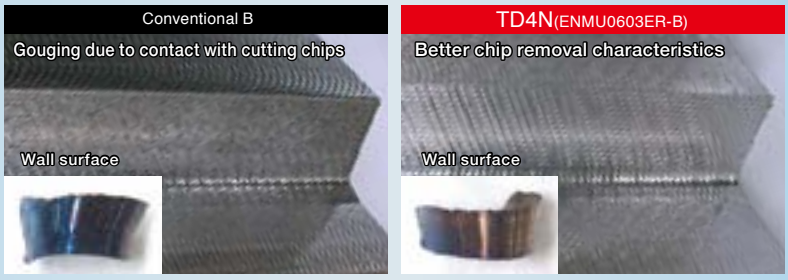
[Tool] TD4N2020S-3 (Ø 0.75"-3 flutes)
ENMU0603EN-B (JP4120)

[Cutting conditions]
Vc = 140 m/min (459 sfm)
Vf = 5000 mm/min (197 ipm)
fz = 0.75 mm/t (0.03 in/tooth)
ap × *ae* = 0.8 × 10 mm (0.031" x 0.394")
Emulsion oil

● There is no major chipping and damage is reduced.

03 Machining condition comparison for walls

Condition of machined wall and cutting chips



[Work material] Carbon steel

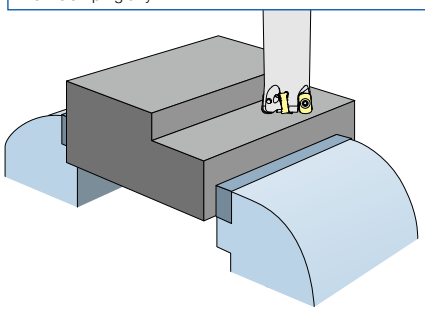
[Tool] TD4N2025S-4 (Ø1"-4 flutes)
ENMU0603EN-B (JM4160)

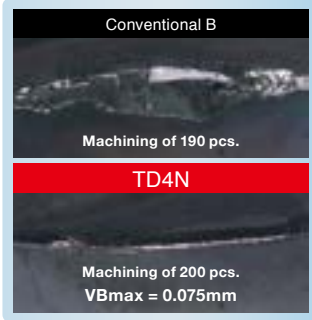
[Cutting conditions]
Vc = 180 m/min (590 sfm)
Vf = 7300 mm/min (287 ipm)
fz = 0.8 mm/t (0.031 in/tooth)
ap × *ae* = 0.5 × 18 mm (0.02" x 0.71")
Air-blow

● New free cutting design curls chip up and into the pocket minimizing chip discharge contact with walls.

04 High-performance machining when clamp rigidity is weak

Low clamp rigidity





[Work material] Mild steel

[Tool] TD4N2032S-5 (Ø1.5"-5 flutes)
ENMU0603EN-C (JS4045)

[Cutting conditions]
Vc = 200 m/min (656 sfm)
Vf = 8000 mm/min (315 ipm)
fz = 0.8 mm/t (0.031 in/tooth)
ap × *ae* = 0.5 × 20 mm (0.02" x 0.79")
Emulsion oil

● Even after machining 200 pieces, wear is minimal.

High Feed Tools Lineup

Application Matrix: Rough Machining

Type	Feature				Holder	Insert			Programing R inch (mm)	Max cutting depth inch (mm)
	Economical (No. of corners)	High accuracy (Less uncut remnants)	Supports for high-hardened steel	Efficiency (No. of Flutes)	Tool dia. Upper (inch) Lower (mm)	No. of corners	Shape	Inscribed circle code		
TD4N 	◎	◎	~50HRC	◎ High efficiency multiflutes	.625 ~1.500 16~42	4		06	.079 (2.0)	.039 (1.0)
ASR MULTI 		○	○ ~62HRC	◎ High efficiency multiflutes	.625~2.500 16~66	2		06 12	.079 (2.0)	.059 (1.5)
ASRF-mini 	◎		○ ~62HRC	○ General	.750~2.500 20~63	4		07	.079 (2.0)	.047 (1.2)
ASR 		○	○ ~60HRC	○ General	.750~4.000 20~100	2		08 ~ 15	.118 (3.0)	.079 (2.0)
IASRT 	○	○	○ ~62HRC	○ General	2.000~5.000	3		09 ~ 15	.118 (3.0)	.079 (2.0)
IASRF 	◎		○ ~60HRC	○ General	1.250~4.000	4		12	.177 (4.5)	.079 (2.0)
TR4D 	◎		○ ~60HRC	◎ High efficiency multiflutes	2.000~4.000 50~100	4		12	.118 (3.0)	.047 (1.2)

※ For details of tool specifications, please check on catalog or website (www.moldino.com/en-US/)

The diagrams and table data are examples of test results, and are not guaranteed values.

Safety Considerations

1. Handling

(1) When removing tool from packaging, be careful not to drop the tool on your foot or fingers.
(2) When actually setting the inserts, be careful not to touch the cutting flute directly with your bare hands.

2. Mounting

(1) When preparing to use, be sure that the insert is firmly screwed in the pocket and cutter is properly mounted on the tool holder.
(2) If abnormal chattering occurs during use, stop the machine immediately, identify the cause of the chatter and take corrective action.

3. Usage

(1) Before use confirm all dimensions, verify work material and programmed tool rotation.
(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) Inserts are made of hard material and may break and be expelled from cutter at high speeds. Since there is a danger of injury to workers from chip evacuation, insert breakage or fire safety precautions must be observed at all times. Including, but not limited to: safety glasses, machine enclosures or other means to create a safe environment for work. If you have questions on safety, contact your supervisor.
- Do not use where there is a risk of fire or explosion.
- Do not use non-water-soluble cutting oils. Such oils may result in fire.

(4) Do not use the tool for any purpose other than that for which it is intended, and do not modify it.

MOLDINO
The Edge To Innovation

ARPF

Radius Precision ARPF

Additional lineup of helical cutting edge inserts

MOLDINO Tool Engineering, Ltd.

New Product News | No. H2003A-1 | 2020-4

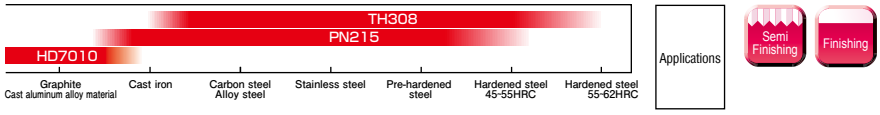
Radius End Mill for High-Precision Finishing.

Additional lineup of helical cutting edge inserts which offer both cutting edge strength and cutting performance

SG type
Excellent for semi-finishing and finishing of flat surfaces, angled surfaces, or 3-dimensional shapes

SW type
Excellent for high-accuracy finishing of vertical walls.

SQ type
Excellent for removing corner radius from previous operation.



Applications

Semi Finishing

Finishing

Features 01 Mounting runout accuracy of 0.02mm (.0008”) or less

・Unique clamp mechanism complete with a high-accuracy body and mounting screw allows inserts to be attached firmly with high accuracy.

Features 02 R accuracy of insert is ±0.01mm (.0004”) or less

・SG and SW types with a helical cutting edge use the tool axis center as a reference for the radius accuracy.

Features 03 Blade diameter tolerance for inserts is 0 to -0.02mm (.0008")

Features 04 Sharp cutting edge allows for smooth surface finishes.

・SG and SW types with helical cutting edges reduce vibrations and enable smooth cutting performance.

Features 05 New coating material for longer tool life.

・Multi-layer coating provides long life.
  ・TH308: Excellent for high-speed, high-performance machining of hardened steel or pre-hardened steel.
  ・PN215: Reduces material sticking to coating to achieve good machining surfaces when machining carbon, alloy, and stainless steels.

※For details regarding cutting performance, see p.193 and 194.

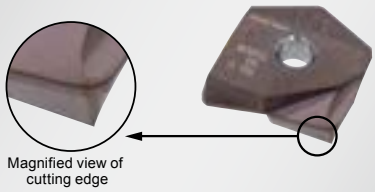
Proper use of helical cutting edge inserts

How to select helical cutting edge inserts

SG type

High-efficiency machining.

Application : semi-finishing to finishing



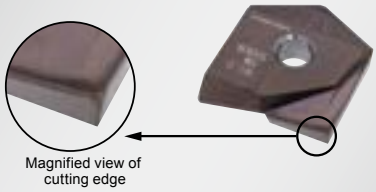
Magnified view of cutting edge

Suitable for machining of 3-dimensional shapes including flat surfaces and angled surfaces.

SW type

High-accuracy machining of vertical walls

Application : Finishing

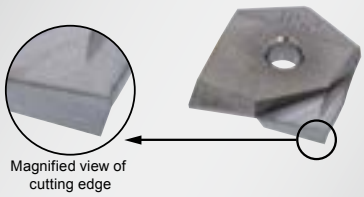


Magnified view of cutting edge

Suitable for high-accuracy finishing of vertical side surfaces (Vertical walls) which will be used as reference surfaces.

SQ type

Application : Corner R removal



Magnified view of cutting edge

Suitable for removing remaining corner material after rough machining.

An effect by helix edge shape

Typical conventional problem

When machining with a long tool overhang, the increased chances of chattering occurs. The tool would vibrate due to the increased cutting resistance. As a result, chatter marks would be prevalent on the machined surface.

Reduce cutting force

Helix edge shape reduces rapid increase in cutting force.
This reduces chattering when cutting and improves surface finish.

- **Improved cutting surface finish.**
- **Chattering is unlikely even when machining with long overhang.**

Merit

Improved machining performance and accuracy which reduces the workload for future processes.

Improved quality | **Cost reduction** | **Time savings**

Improved tool life

Lower cutting force reduces wear and chipping which leads to improved tool life.

PVD Technology TH3 Coating TH308

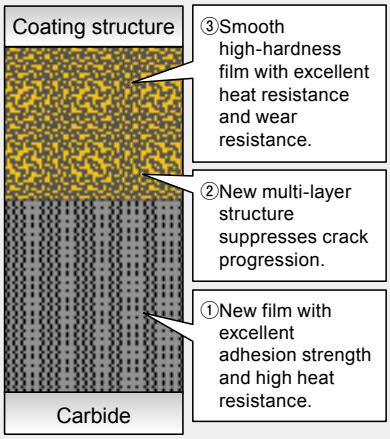
Features

- TH coating has further evolved to the new 3rd-generation TH coating.
- New film composition and structure that improves heat and wear resistance.
- New multi-layer structure increases durability and reduces cracks in the coating.

Strong fields

- High-speed finishing of hardened steel (45 to 65 HRC) such as D2, H13, 420 Stainless Steel types, etc.
- High-speed finishing of pre-hardened steel such as P20, P21, etc.
- TH308 uses ultra-fine carbide alloy with excellent wear resistance along with the new TH3 coating to increase performance, especially in high-hardness materials.

Characteristics



PVD Technology PN2 Coating PN215

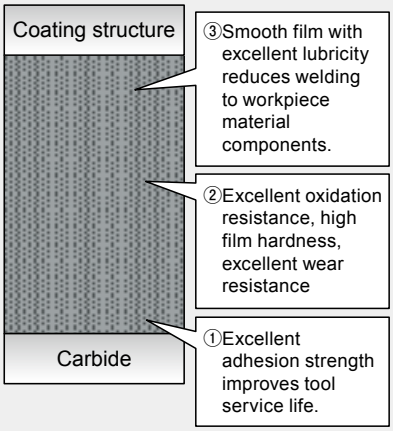
Features

- PN coating with excellent oxidation resistance, high film hardness, and excellent wear resistance.
- Low-friction, smooth film surface has excellent lubricity which reduces material sticking to the coating during machining.

Strong fields

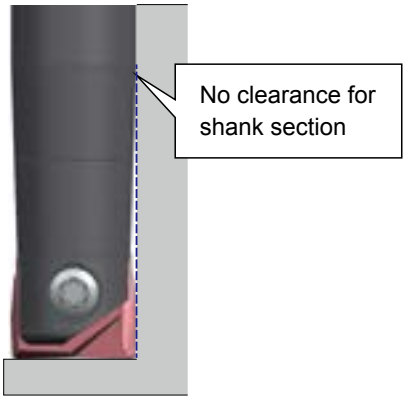
- Carbon steel, general steel: High-speed finishing of 1049, A36, etc.
- Alloy steel: High-speed finishing of D2, H13, etc.
- Pre-hardened steel: High-speed finishing of P20, P21, etc.
- PN215 uses ultra-fine carbide alloy with excellent chipping resistance along with the PN2 coating to increase performance when finishing carbon or alloy steel.

Characteristics

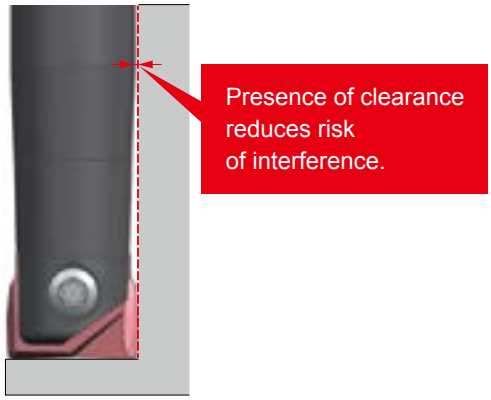


01 Mounting inserts with diameter of shank diameter +1mm

- A ϕ13 mm insert can be mounted on a ϕ12 mm body, a ϕ17 mm insert can be mounted on a ϕ16 mm body, a ϕ21 mm insert can be mounted on a ϕ20 mm body, or a ϕ26 mm insert can be mounted on a ϕ25 mm body.



When insert with same diameter as shank is mounted



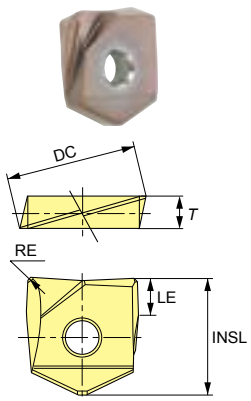
When insert with diameter +1mm larger than shank diameter is mounted.

Inch

SG・SW type (helical cutting edge inserts)

P	Carbon steel	⌐	■
K	Cast Iron・Ductile Cast Iron	■	⌐
	Graphite	⌐	
N	Aluminum Alloy		⌐
H	Hardened steel	■	⌐

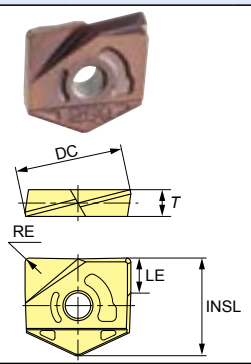
■ : General cutting, First recommendation
⌐ : General cutting, Second recommendation

Shape		Item Code	Tolerance Class	TH3 Coated	PN2 Coated	Size (Inch)				
				TH308	PN215	DC	RE	LE	INSL	*T*
	SG type	IZCFG060SG-R0.8	F	●	●	.375	.031	.118	.492	.106
		IZCFG060SG-R1.6		●	●		.063			
		IZCFG060SG-R3.2		●	●		.126	.177		
		IZCFG080SG-R0.8		●	●	.5	.031	.157	.594	.126
		IZCFG080SG-R1.6		●	●		.063			
		IZCFG080SG-R3.2		●	●		.126	.177		
		IZCFG120SG-R0.8		●	●	.75	.031	.276	.823	.205
		IZCFG120SG-R1.6		●	●		.063			
		IZCFG120SG-R3.2		●	●		.126			
		IZCFG160SG-R0.8		●	●	1.0	.031	.315	.961	.244
		IZCFG160SG-R1.6		●	●		.063			
		IZCFG160SG-R3.2		●	●		.126			
	SW type	IZCFG080SW-R0.8	F	●	●	.5	.031	.157	.594	.126
		IZCFG120SW-R0.8		●	●	.75	.031	.276	.823	.205

General cutting edge shape inserts

P	Carbon steel	⌐	■
K	Cast Iron・Ductile Cast Iron	⌐	■
H	Hardened steel	⌐	■

■ : General cutting, First recommendation
⌐ : General cutting, Second recommendation

Shape	Item Code	Tolerance Class	C Coated	ATH Coated	Size (Inch)				
			PCA12M	ATH08M	DC	RE	LE	INSL	*T*
	IZCFW060-R0.8	F	●	●	.375	.031	.118	.474	.106
	IZCFW060-R1.6		●	●		.063			
	IZCFW060-R3.2		●	●		.126	.157		
	IZCFW080-R0.8		●	●	.5	.031	.157	.574	.126
	IZCFW080-R1.6		●	●		.063			
	IZCFW080-R3.2		●	●		.126			
	IZCFW120-R0.8		●	●	.75	.031	.236	.784	.205
	IZCFW120-R1.6		●	●		.063			
	IZCFW120-R3.2		●	●		.126			
	IZCFW160-R0.8		●	●	1.0	.031	.315	.889	.244
	IZCFW160-R1.6		●	●		.063			
	IZCFW160-R3.2		●	●		.126			

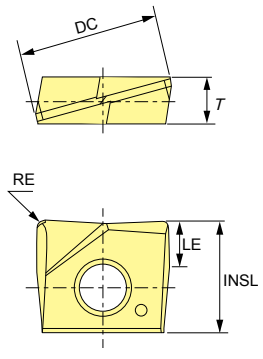
●:Inventory maintained in US

Metric

SG • SW • SQ type (helical cutting edge inserts)

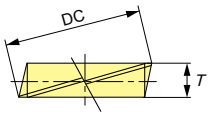
		TH3 Coated	PN2 Coated
P	Carbon steel	▱	■
K	FC • FCD	■	▱
	Graphite	▱	
N	Aluminum Alloy		▱
H	Hardened steel	■	▱

■ : General cutting, First recommendation
▱ : General cutting, Second recommendation

Shape	Item Code	Tolerance Class	TH3 Coated TH308	PN2 Coated PN215	Size (mm) DC	RE	LE	INSL	T	Shape
	ZCFG06NSG-R0.3	F	★	★	6	0.3	2	5	2	Fig1
	ZCFG06NSG-R0.5		★	★		0.5				
	ZCFG06NSG-R1.0		★	★		1.0				
	ZCFG080SG-R0.3		●	●	8	0.3	2.5	9.9	2.1	Fig2
	ZCFG080SG-R0.5		●	●		0.5				
	ZCFG080SG-R1.0		●	●		1.0				
	ZCFG080SG-R1.5		●	●		1.5				
	ZCFG080SG-R2.0		●	●		2.0	3			
	ZCFG100SG-R0.3		●	●	10	0.3	3	12.5	2.7	
	ZCFG100SG-R0.5		●	●		0.5				
	ZCFG100SG-R1.0		●	●		1.0				
	ZCFG100SG-R1.5		●	●		1.5				
	ZCFG100SG-R2.0		●	●		2.0				
	ZCFG100SG-R3.0		●	●		3.0	4			
	ZCFG120SG-R0.3		●	●	12	0.3	4	15.1	3.2	
	ZCFG120SG-R0.5		●	●		0.5				
	ZCFG120SG-R1.0		●	●		1.0				
	ZCFG120SG-R1.5		●	●		1.5				
	ZCFG120SG-R2.0		●	●		2.0				
	ZCFG120SG-R3.0		●	●		3.0				
	ZCFG130SG-R0.3		★	★	13	0.3	4	15.1	3.2	
	ZCFG130SG-R0.5		★	★		0.5				
	ZCFG130SG-R1.0		★	★		1.0				
	ZCFG130SG-R1.5		★	★		1.5				
	ZCFG130SG-R2.0		★	★		2.0				
	ZCFG130SG-R3.0		★	★		3.0				
	ZCFG160SG-R0.3		●	●	16	0.3	5	17.2	4.2	
	ZCFG160SG-R0.5		●	●		0.5				
	ZCFG160SG-R1.0		●	●		1.0				
	ZCFG160SG-R1.5		●	●		1.5				
	ZCFG160SG-R2.0		●	●		2.0				
	ZCFG160SG-R3.0		●	●		3.0				
	ZCFG170SG-R0.3		★	★	17	0.3	5	17.2	4.2	
	ZCFG170SG-R0.5		★	★		0.5				
	ZCFG170SG-R1.0		★	★		1.0				
	ZCFG170SG-R1.5		★	★		1.5				
	ZCFG170SG-R2.0		★	★		2.0				
	ZCFG170SG-R3.0		★	★		3.0				
	ZCFG200SG-R0.3		●	●	20	0.3	7	20.9	5.2	
	ZCFG200SG-R0.5		●	●		0.5				
	ZCFG200SG-R1.0		●	●		1.0				
	ZCFG200SG-R1.5		●	●		1.5				
	ZCFG200SG-R2.0		●	●		2.0				
	ZCFG200SG-R3.0		●	●		3.0				
	ZCFG210SG-R0.3		★	★	21	0.3	7	20.9	5.2	
	ZCFG210SG-R0.5		★	★		0.5				
	ZCFG210SG-R1.0		★	★		1.0				
	ZCFG210SG-R1.5		★	★		1.5				
	ZCFG210SG-R2.0		★	★		2.0				
	ZCFG210SG-R3.0		★	★		3.0				
	ZCFG250SG-R0.3		●	●	25	0.3	8	24.4	6.2	
	ZCFG250SG-R0.5		●	●		0.5				
	ZCFG250SG-R1.0		●	●		1.0				
	ZCFG250SG-R1.5		●	●		1.5				
	ZCFG250SG-R2.0		●	●		2.0				
	ZCFG250SG-R3.0		●	●		3.0				

SG type

Fig.1



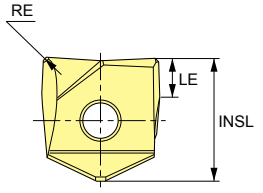


Fig.2

P	Carbon steel	⌐	■
K	FC・FCD	■	⌐
	Graphite	⌐	
N	Aluminum Alloy		⌐
H	Hardened steel	■	⌐

■ : General cutting, First recommendation
⌐ : General cutting, Second recommendation

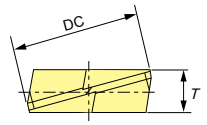
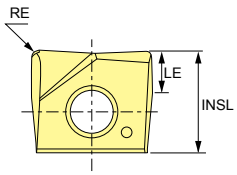
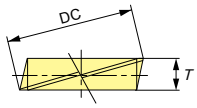
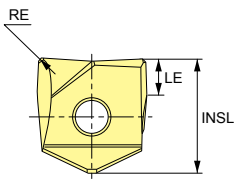
Shape		Item Code	Tolerance Class	TH3 Coated	PN2 Coated	Size (mm)					Shape
				TH308	PN215	DC	RE	LE	INSL	*T*	
	SG type	ZCFG260SG-R0.3	F	★	★	26	0.3	8	24.4	6.2	Fig2
		ZCFG260SG-R0.5		★	★		0.5				
		ZCFG260SG-R1.0		★	★		1.0				
		ZCFG260SG-R1.5		★	★		1.5				
		ZCFG260SG-R2.0		★	★		2.0				
		ZCFG260SG-R3.0		★	★		3.0				
		ZCFG300SG-R0.3		★	★	30	0.3	10	29.4	7.2	
		ZCFG300SG-R0.5		★	★		0.5				
		ZCFG300SG-R1.0		★	★		1.0				
		ZCFG300SG-R1.5		★	★		1.5				
		ZCFG300SG-R2.0		★	★		2.0				
		ZCFG300SG-R3.0		★	★		3.0				
		ZCFG320SG-R0.3		★	★	32	0.3	10	30.4	7.2	
		ZCFG320SG-R0.5		★	★		0.5				
		ZCFG320SG-R1.0		★	★		1.0				
		ZCFG320SG-R1.5		★	★		1.5				
		ZCFG320SG-R2.0		★	★		2.0				
		ZCFG320SG-R3.0		★	★		3.0				
Fig.1	SW type	ZCFG06NSW-R0.3	F	★	★	6	0.3	2	5	2	Fig1
		ZCFG06NSW-R0.5		★	★		0.5				
		ZCFG080SW-R0.3		★	★	8	0.3	2.5	9.9	2.1	Fig2
		ZCFG080SW-R0.5		★	★		0.5				
		ZCFG080SW-R1.0		★	★		1.0				
		ZCFG100SW-R0.3		★	★	10	0.3	3	12.5	2.7	
		ZCFG100SW-R0.5		★	★		0.5				
		ZCFG100SW-R1.0		★	★		1.0				
		ZCFG120SW-R0.3		★	★	12	0.3	4	15.1	3.2	
		ZCFG120SW-R0.5		●	●		0.5				
		ZCFG120SW-R1.0		●	●		1.0				
		ZCFG130SW-R0.3		★	★	13	0.3	4	15.1	3.2	
		ZCFG130SW-R0.5		★	★		0.5				
		ZCFG130SW-R1.0		★	★		1.0				
		ZCFG160SW-R0.3		★	★	16	0.3	5	17.2	4.2	
		ZCFG160SW-R0.5		●	●		0.5				
		ZCFG160SW-R1.0		●	●		1.0				
		ZCFG170SW-R0.3		★	★	17	0.3	5	17.2	4.2	
		ZCFG170SW-R0.5		★	★		0.5				
		ZCFG170SW-R1.0		★	★		1.0				
		ZCFG200SW-R0.3		★	★	20	0.3	7	20.9	5.2	
		ZCFG200SW-R0.5		●	●		0.5				
		ZCFG200SW-R1.0		●	●		1.0				
		ZCFG210SW-R0.3		★	★	21	0.3	7	20.9	5.2	
		ZCFG210SW-R0.5		★	★		0.5				
		ZCFG210SW-R1.0		★	★		1.0				
		ZCFG250SW-R0.3		★	★	25	0.3	8	24.4	6.2	
		ZCFG250SW-R0.5		●	●		0.5				
		ZCFG250SW-R1.0		●	●		1.0				
		ZCFG260SW-R0.3		★	★	26	0.3	8	24.4	6.2	
		ZCFG260SW-R0.5		★	★		0.5				
		ZCFG260SW-R1.0		★	★		1.0				
		ZCFG300SW-R0.3		★	★	30	0.3	10	29.4	7.2	
		ZCFG300SW-R0.5		★	★		0.5				
		ZCFG300SW-R1.0		★	★		1.0				
		ZCFG320SW-R0.3		★	★	32	0.3	10	30.4	7.2	
		ZCFG320SW-R0.5		★	★		0.5				
		ZCFG320SW-R1.0		★	★		1.0				

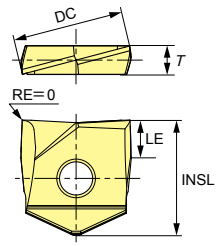
Fig.2

●: Inventory maintained in US ★: Inventory maintained in Japan

Line up

P	Carbon steel	■
K	FC・FCD	□
	Graphite	□
N	Aluminum Alloy	□
H	Hardened steel	□

■ : General cutting, First recommendation
□ : General cutting, Second recommendation

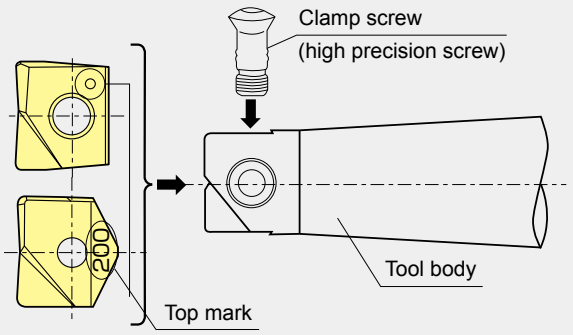
Shape		Item Code	Tolerance Class	PN2 Coated	Size (mm)				Shape
				PN215	DC	LE	INSL	*T*	
 Fig.3	SQ type	ZCFG080SQ	F	★	8	2.5	9.9	2.1	Fig3
		ZCFG100SQ		★	10	3	12.5	2.7	
		ZCFG120SQ		★	12	4	15.1	3.2	
		ZCFG130SQ		★	13	4	15.1	3.2	
		ZCFG160SQ		★	16	5	17.2	4.2	
		ZCFG170SQ		★	17	5	17.2	4.2	
		ZCFG200SQ		★	20	7	20.9	5.2	
		ZCFG210SQ		★	21	7	20.9	5.2	
		ZCFG250SQ		★	25	8	24.4	6.2	
		ZCFG260SQ		★	26	8	24.4	6.2	

【Note】Inserts of SG, SW, SQ type can be installed on Ball Precision F "ABPF type" bodies.
Inserts(ϕ 8 ～ϕ 32) of SG, SW, SQ type have a design with a longer A dimension than conventional products. Be careful of the dimension when installed on body.

Set-up Procedures of Inserts

1. Clean the insert seat: Using air-blow or alike, clean the seat.
2. Put in the insert with its top positioned to the screw-tightening side of the tool body.
3. Tighten the clamp screw with the special wrench.
   Please do not press down the insert during this tightening process.
4. This is the end of insert set-up.

In order to satisfy runout of 0.02mm (.0008") or less, follow the procedure at above.



●: Inventory maintained in US ★: Inventory maintained in Japan

General cutting edge shape inserts

Fig.1

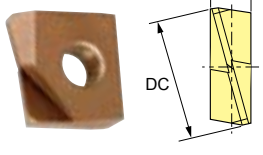
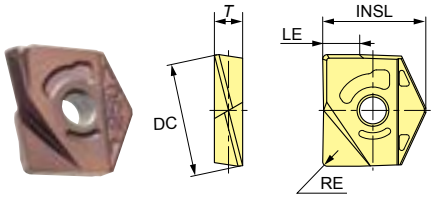


Fig.2



P	Carbon steel	⌐	■		
K	FC・FCD	⌐	■		
	Graphite			■	
N	Aluminum Alloy			■	
H	Hardened steel	⌐	■		

■ : General cutting, First recommendation

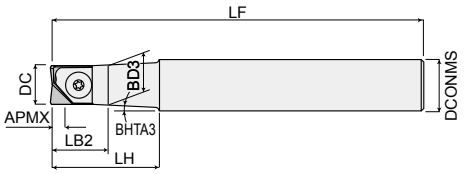
⌐ : General cutting, Second recommendation

Item Code	Tolerance Class	C Coated	TH Coated	HD Coated	CBN	Size (mm)					Shape
		PCA12M	PTH08M	HD7010	BH250	DC	RE	LE	INSL	*T*	
ZCFW060-R0.3	F		★	★	—	6	0.3	2	5.0	2.0	Fig.1
ZCFW060-R0.5			★		—		0.5				
ZCFW060-R1.0			★		—		1.0				
ZCFW080-R0.3		●	●	★	—	8	0.3	2.5	9.7	2.1	Fig.2
ZCFW080-R0.5		●	●		—		0.5				
ZCFW080-R1.0		●	●		—		1.0				
ZCFW100-R0.3		●	●	★	—	10	0.3	3	12.0	2.7	
ZCFW100-R0.5		●	●		—		0.5				
ZCFW100-R1.0		●	●		—		1.0				
ZCFW100-R1.5		●	●		—		1.5				
ZCFW100-R2.0		●	●		—		2.0				
ZCFW100-R3.0		●	●		—		3.0	4			
ZCFW120-R0.3		●	●	★	—	12	0.3	4	14.6	3.2	
ZCFW120-R0.5		●	●		—		0.5				
ZCFW120-R1.0		●	●		—		1.0				
ZCFW120-R1.5		●	●		—		1.5				
ZCFW120-R2.0		●	●		—		2.0				
ZCFW120-R3.0		●	●		—		3.0				
ZCFW160-R0.3		●	●	★		16	0.3	5	16.6	4.2	
ZCFW160-R0.5		●	●				0.5				
ZCFW160-R1.0		●	●		★		1.0				
ZCFW160-R1.5		●	●				1.5				
ZCFW160-R2.0		●	●		★		2.0				
ZCFW160-R3.0		●	●				3.0				
ZCFW200-R0.3		●	●	★		20	0.3	6	19.9	5.2	
ZCFW200-R0.5		●	●				0.5				
ZCFW200-R1.0		●	●		★		1.0				
ZCFW200-R1.5		●	●				1.5				
ZCFW200-R2.0		●	●		★		2.0				
ZCFW200-R3.0		●	●				3.0				
ZCFW250-R0.3		●	●			25	0.3	8	22.6	6.2	
ZCFW250-R0.5		●	●				0.5				
ZCFW250-R1.0		●	●		★		1.0				
ZCFW250-R2.0		●	●		★		2.0				
ZCFW250-R3.0		●	●				3.0				
ZCFW300-R0.3		★	★			30	0.3	10	27.2	7.2	
ZCFW300-R0.5		★	★				0.5				
ZCFW300-R1.0		★	★		★		1.0				
ZCFW300-R2.0		★	★		★		2.0				
ZCFW300-R3.0		★	★				3.0				
ZCFW320-R0.3		★	★			32	0.3	10	28.2	7.2	
ZCFW320-R0.5		★	★				0.5				
ZCFW320-R1.0		★	★				1.0				
ZCFW320-R2.0		★	★				2.0				
ZCFW320-R3.0		★	★				3.0				

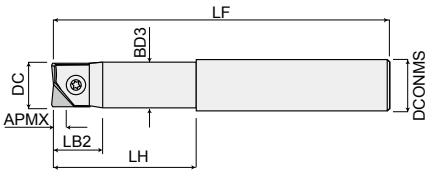
Inch

Numeric figure in a circle ◌ and alphabetical character comes in a square □.

Steel shank・Carbide shank IARPF◌◌S◌◌(□/□□)



Type A (Taper Neck)



Type B (Straight Neck)

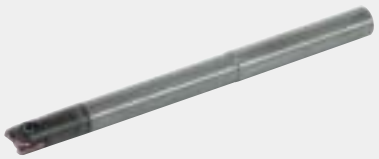
Type		Item Code	Stock	# of Inserts	Size (Inch)								Type	Inserts
					DC	LF	DCONMS	APMX	LB2	LH	BHTA3	BD3		
Steel Shank	Regular	IARPF06S08	●	1	.375	3.937(3.955)	.5	.118	.512(.53)	.984 (1.002)	3°	.354	A	IZCFG060SG-R◌.◌ IZCFW060-R◌.◌
		IARPF08S08	●	1	.5	4.331(4.351)	.5	.157	.591(.611)	1.181(1.201)	–	.48	B	IZCFG080S□-R◌.◌ IZCFW080-R◌.◌
		IARPF12S12	●	1	.75	5.512(5.551)	.75	.236	.827(.866)	2.362(2.401)	–	.728	B	IZCFG120S□-R◌.◌ IZCFW120-R◌.◌
		IARPF16S16	●	1	1.0	5.906(5.978)	1.0	.315	.945(1.017)	2.756(2.828)	–	.98	B	IZCFG160SG-R◌.◌ IZCFW160-R◌.◌
	Long Length	IARPF06S08L	●	1	.375	5.906(5.924)	.5	.118	.512(.53)	1.969(1.987)	4.5°	.354	A	IZCFG060SG-R◌.◌ IZCFW060-R◌.◌
		IARPF08S10L	●	1	.5	6.299(6.319)	.625	.157	.591(.611)	2.362(2.382)	2°	.48	A	IZCFG080S□-R◌.◌ IZCFW080-R◌.◌
		IARPF12S16L	●	1	.75	7.087(7.126)	1.0	.236	.827(.866)	3.15(3.189)	–	.728	B	IZCFG120S□-R◌.◌ IZCFW120-R◌.◌
		IARPF16S20L	●	1	1.0	7.874(7.946)	1.25	.315	.945(1.017)	3.543(3.615)	–	.98	B	IZCFG160SG-R◌.◌ IZCFW160-R◌.◌
Carbide Shank	Regular	IARPF06S06W	●	1	.375	3.937(3.955)	.375	.118	.906(.924)	1.378(1.396)	–	.366	B	IZCFG060SG-R◌.◌ IZCFW060-R◌.◌
		IARPF08S08W	●	1	.5	4.331(4.351)	.5	.157	1.024(1.044)	1.772(1.792)	–	.492	B	IZCFG080S□-R◌.◌ IZCFW080-R◌.◌
		IARPF12S12W	●	1	.75	6.299(6.338)	.75	.236	.866(.905)	2.165(2.204)	–	.728	B	IZCFG120S□-R◌.◌ IZCFW120-R◌.◌
		IARPF16S16W	●	1	1.0	7.087(7.159)	1.0	.315	.984(1.056)	2.5(2.572)	–	.98	B	IZCFG160SG-R◌.◌ IZCFW160-R◌.◌
	Medium	IARPF06S06WR	●	1	.375	5.512(5.530)	.375	.118	.906(.924)	2.935(2.953)	–	.366	B	IZCFG060SG-R◌.◌ IZCFW060-R◌.◌
		IARPF08S08WR	●	1	.5	5.906(5.926)	.5	.157	1.024(1.044)	3.346(3.366)	–	.492	B	IZCFG080S□-R◌.◌ IZCFW080-R◌.◌
	Long Length	IARPF06S06WL	●	1	.375	7.087(7.105)	.375	.118	.512(.53)	1.378(1.396)	–	.366	B	IZCFG060SG-R◌.◌ IZCFW060-R◌.◌
		IARPF08S08WL	●	1	.5	7.087(7.107)	.5	.157	.591(.611)	1.772(1.792)	–	.492	B	IZCFG080S□-R◌.◌ IZCFW080-R◌.◌
		IARPF12S12WL	●	1	.75	9.843(9.522)	.75	.236	.827(.866)	3.15(3.189)	–	.728	B	IZCFG120S□-R◌.◌ IZCFW120-R◌.◌
		IARPF16S16WL	●	1	1.0	9.843(9.915)	1.0	.315	.945(1.017)	3.15(3.222)	–	.98	B	IZCFG160SG-R◌.◌ IZCFW160-R◌.◌
		IARPF16S20WL	●	1	1.0	11.811(11.883)	1.0	.315	.945(1.017)	7.48(7.552)	–	.98	B	

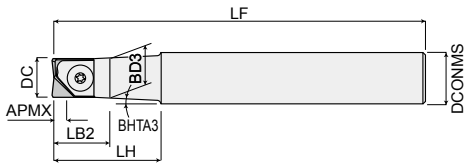
●:Inventory maintained in US 【Note】( )dimension indicates when IZCFG type insert is installed.

Metric

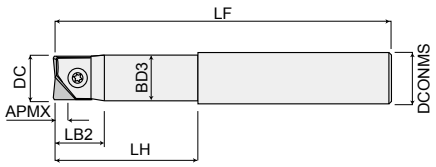
Numeric figure in a circle ◯ and alphabetical character comes in a square □.

Steel shank ARPF□□S□□(□□□/□□□)





Type A (Taper Neck)



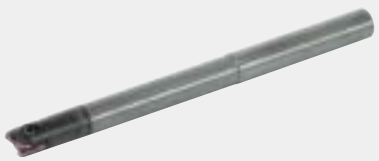
Type B (Straight Neck)

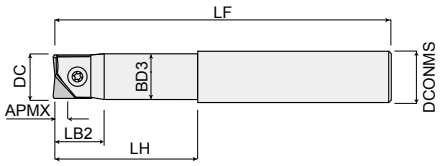
Type	Item Code	Stock	# of Inserts	Size (mm)								Type	Inserts
				DC	LF	DCONMS	APMX	LB2	LH	BHTA3	BD3		
Regular	ARPF06S10	★	1	6	80	10	2	15	30	8.25°	5.4	A	ZCFG06NS□-R□.□ ZCFW060-R□.□
	ARPF08S12	●	1	8	100(100.2)	12	2.5	10(10.2)	22(22.2)	9.5°	7.5	A	ZCFG080S□-R□.□ ZCFW080-R□.□
	ARPF10S12	●	1	10	100(100.5)	12	3	13(13.5)	25(25.5)	3°	9.5	A	ZCFG100S□-R□.□ ZCFW100-R□.□
	ARPF12S12	●	1	12	110(110.5)	12	4	21(21.5)	30(30.5)	–	11.5	B	ZCFG120S□-R□.□ ZCFW120-R□.□ ZCFG130S□-R□.□
	ARPF16S16	●	1	16	130(130.6)	16	5	27(27.6)	50(50.6)	–	15.5	B	ZCFG160S□-R□.□ ZCFW160-R□.□ ZCFG170S□-R□.□
	ARPF20S20	●	1	20	140(141)	20	6	35(36)	60(61)	–	19.5	B	ZCFG200S□-R□.□ ZCFW200-R□.□ ZCFG210S□-R□.□
	ARPF25S25	●	1	25	150(151.8)	25	8	43(44.8)	70(71.8)	–	24.5	B	ZCFG250S□-R□.□ ZCFW250-R□.□ ZCFG260S□-R□.□
	ARPF30S32	★	1	30	160(162.2)	32	10	55(57.2)	80(82.2)	–	29.5	B	ZCFG300S□-R□.□ ZCFW300-R□.□
	ARPF32S32	★	1	32	160(162.2)	32	10	58(60.2)	80(82.2)	–	31.5	B	ZCFG320S□-R□.□ ZCFW320-R□.□
Long Length	ARPF08S12L	●	1	8	130(130.2)	12	2.5	10(10.2)	50(50.2)	3°	7.5	A	ZCFG080S□-R□.□ ZCFW080-R□.□
	ARPF10S16L	●	1	10	150(150.5)	16	3	13(13.5)	50(50.5)	4.5°	9.5	A	ZCFG100S□-R□.□ ZCFW100-R□.□
	ARPF12S16L	●	1	12	160(160.5)	16	4	21(21.5)	60(60.5)	2°	11.5	A	ZCFG120S□-R□.□ ZCFW120-R□.□ ZCFG130S□-R□.□
	ARPF16S16L	●	1	16	165(165.6)	16	5	27(27.6)	65(65.6)	–	15.5	B	ZCFG160S□-R□.□ ZCFW160-R□.□ ZCFG170S□-R□.□
	ARPF20S20L	●	1	20	180(181)	20	6	35(36)	80(81)	–	19.5	B	ZCFG200S□-R□.□ ZCFW200-R□.□
	ARPF20S20L120	★	1	20	220(221)	20	6	35(36)	120(121)	–	19.5	B	ZCFG210S□-R□.□
	ARPF20S20L150	★	1	20	250(251)	20	6	35(36)	150(151)	–	19.5	B	
	ARPF25S25L	●	1	25	200(201.8)	25	8	43(44.8)	90(91.8)	–	24.5	B	ZCFG250S□-R□.□ ZCFW250-R□.□
	ARPF25S32L150	★	1	25	250(251.8)	32	8	43(44.8)	150(151.8)	–	24.5	B	ZCFG260S□-R□.□
	ARPF30S32L	★	1	30	220(222.2)	32	10	55(57.2)	100(102.2)	–	29.5	B	
	ARPF30S32L150	★	1	30	250(252.2)	32	10	55(57.2)	150(152.2)	–	29.5	B	ZCFG300S□-R□.□ ZCFW300-R□.□
	ARPF30S32L200	★	1	30	300(302.2)	32	10	55(57.2)	200(202.2)	–	29.5	B	
	ARPF32S32L	★	1	32	220(222.2)	32	10	58(60.2)	100(102.2)	–	31.5	B	ZCFG320S□-R□.□ ZCFW320-R□.□
Long Shank	ARPF16S16E	★	1	16	200(200.6)	16	5	27(27.6)	65(65.6)	–	15.5	B	ZCFG160S□-R□.□ ZCFW160-R□.□ ZCFG170S□-R□.□
	ARPF20S20E	★	1	20	250(251)	20	6	35(36)	80(81)	–	19.5	B	ZCFG200S□-R□.□ ZCFW200-R□.□ ZCFG210S□-R□.□
	ARPF25S25E	★	1	25	300(301.8)	25	8	43(44.8)	90(91.8)	–	24.5	B	ZCFG250S□-R□.□ ZCFW250-R□.□
	ARPF25S32E	★	1	25	300(301.8)	32	8	43(44.8)	100(101.8)	3.5°	24.5	A	ZCFG260S□-R□.□
	ARPF30S32E	★	1	30	350(352.2)	32	10	55(57.2)	100(102.2)	–	29.5	B	ZCFG300S□-R□.□ ZCFW300-R□.□
	ARPF30S42E	★	1	30	350(352.2)	42	10	55(57.2)	120(122.2)	5.3°	29.5	A	
	ARPF32S32E	★	1	32	350(352.2)	32	10	58(60.2)	100(102.2)	–	31.5	B	ZCFG320S□-R□.□ ZCFW320-R□.□

【Note】( )dimension indicates when ZCFG type insert is installed.

Numeric figure in a circle ◌ and alphabetical character comes in a square □.

Carbide shank ARPF○○S○○ (□○○○/□□○○)

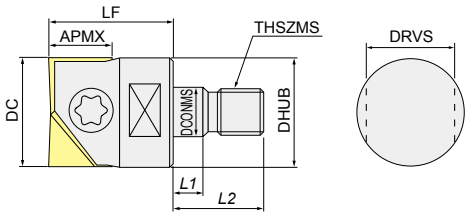




Type		Item Code	Stock	# of Inserts	Size (mm) DC	LF	DCONMS	APMX	LB2	LH	BD3	Inserts
Carbide Shank	Regular	**ARPF06S06W**	★	1	6	90	6	2	10.3	25	5.8	ZCFG06NS□-R○.○ ZCFW060-R○.○
	Long Length	**ARPF06S06WL65**	★	1	6	120	6	2	10.3	65	5.8	ZCFG06NS□-R○.○ ZCFW060-R○.○
		ARPF08S08WL	●	1	8	130(130.2)	8	2.5	65(65.2)	65(65.2)	7.8	ZCFG080S□-R○.○ ZCFW080-R○.○
		ARPF10S10WL	●	1	10	140(140.5)	10	3	18(18.5)	75(75.5)	9.8	ZCFG100S□-R○.○ ZCFW100-R○.○
		ARPF12S12WL	●	1	12	150(150.5)	12	4	21(21.5)	85(85.5)	11.8	ZCFG120S□-R○.○ ZCFW120-R○.○ ZCFG130S□-R○.○ ZCFW160-R○.○
	Long Shank	**ARPF16S16WE**	●	1	16	200(200.6)	16	5	27(27.6)	120(120.6)	15.5	ZCFG160S□-R○.○ ZCFW200-R○.○ ZCFG170S□-R○.○ ZCFW250-R○.○
		ARPF20S20WE	●	1	20	250(251)	20	6	35(36)	150(151)	19.5	ZCFG200S□-R○.○ ZCFW300-R○.○ ZCFG210S□-R○.○ ZCFW320-R○.○
		ARPF25S25WE	●	1	25	300(301.8)	25	8	43(44.8)	190(191.8)	24.5	ZCFG250S□-R○.○ ZCFG260S□-R○.○
		ARPF30S32WE	★	1	30	350(352.2)	32	10	55(57.2)	230(232.2)	29.5	ZCFG300S□-R○.○
		ARPF32S32WE	★	1	32	350(352.2)	32	10	58(60.2)	230(232.2)	31.5	ZCFG320S□-R○.○

Modular Mill Type ARPFM○○

Numeric figure in a circle ◌ and alphabetical character comes in a square □.

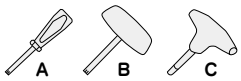


Item Code	Stock	# of Inserts	Size (mm) DC	LF	APMX	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS	Inserts
ARPFM10	★	1	10	26(26.5)	3	6.5	M6	9.8	5.5	14.5	7	ZCFG100S□-R○.○ ZCFW100-R○.○
ARPFM12	★	1	12	26(26.5)	4	6.5	M6	9.8	5.5	14.5	7	ZCFG120S□-R○.○ ZCFW120-R○.○ ZCFG130S□-R○.○
ARPFM16	★	1	16	32(32.6)	5	8.5	M8	12.8	5.5	17	10	ZCFG160S□-R○.○ ZCFW160-R○.○ ZCFG170S□-R○.○
ARPFM20	●	1	20	38(39)	6	10.5	M10	17.8	5.5	19	15	ZCFG200S□-R○.○ ZCFW200-R○.○ ZCFG210S□-R○.○
ARPFM25	●	1	25	38(39.8)	8	12.5	M12	20.8	5.5	22	17	ZCFG250S□-R○.○ ZCFW250-R○.○ ZCFG260S□-R○.○
ARPFM30	★	1	30	43(45.2)	10	17	M16	28.8	6	23	22	ZCFG300S□-R○.○ ZCFW300-R○.○
ARPFM32	★	1	32	43(45.2)	10	17	M16	28.8	6	23	22	ZCFG320S□-R○.○ ZCFW320-R○.○

【Note】Do not apply lubricants such as grease, etc. to the "contact faces" and "modular screws" of the "modular mill", "special shanks" and "special arbor".

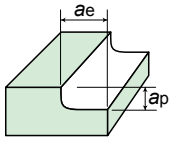
●:Inventory maintained in US ★:Inventory maintained in Japan 【Note】( )dimension indicates when ZCFG type insert is installed.

Parts

Parts	Clamp screw		Screw Driver / Wrench		Screw anti-seizure agent
Shape / Cutter body		Fastening torque (N·m)	 A B C	Type	
ARPF06S□□(W/WL□□)	581-140	0.5	104-T6	A	P-37
ARPF08S□□(L/WL)	581-141	1.1	104-T8	A	
ARPF10S□□(L/WL) ARPFM10 IARPF06S□□(L/WL)	581-142	2.2	104-T10	A	
ARPF12S□□(L/WL) ARPFM12 IARPF08S□□(L/WL)	581-143	4.9	105-T20	B	
ARPF16S□□(L/E/WE) ARPFM16	581-144	4.9			
ARPF20S□□(L□□□/E/WE) ARPFM20 IARPF12S□□(L□□□/E/WE)	581-145	6.9	101-T25S	B	
ARPF25S□□(L□□□/E/WE) ARPFM25 IARPF16S□□(L□□□/E/WE)	581-146	9.8	105-T30A	C	
ARPF30S□□(L□□□/E/WE) ARPFM30	581-147	9.8			
ARPF32S□□(L/E/WE) ARPFM32					

【Note】①One clamp screw is attached to the body. Spare screws are not included (sold separately).
②The clamp screw is a consumable part. Since replacement life depends on the use environment, it is recommended that it be replaced at an early stage.

Recommended Cutting Conditions (Inch)



※Red indicates primary recommended insert grade.

Work material	Insert Grade		Cutting Conditions	ϕ.375			ϕ.5			ϕ.75			ϕ1		
	SG・SW (helical cutting edge inserts)	General Edge Shape		Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing
				General purpose	High-speed		General purpose	High-speed		General purpose	High-speed		General purpose	High-speed	
Carbon steel Alloy steel (30HRC or less)	※ PN215 TH308	ATH08M (PCA12M)	*n* (min^{-1})	5,348	10,028	10,028	4,011	7,521	7,521	2,550	5,014	5,014	2,006	3,820	3,820
			SFM	525	984	984	525	984	984	525	984	984	525	984	984
			IPM	84.2	118.4	118.4	63.2	88.8	88.8	52.6	79.0	79.0	39.5	59.2	59.2
			IPT	.0079	.0059	.0059	.0079	.0059	.0059	.0098	.0079	.0079	.0098	.0079	.0079
			*a*p (inch)	.0098	.0098	.0039	.0118	.0118	.0039	.0394	.0394	.0079	.0492	.0492	.0079
			*a*e (inch)	.0394	.0197	.0079	.0472	.0236	.0079	.0787	.0787	.0079	.0984	.0492	.0079
Carbon steel Alloy steel (30～45HRC)	TH308 PN215	ATH08M (PCA12M)	*n* (min^{-1})	3,820	9,359	9,359	3,008	7,020	7,020	2,006	4,680	4,680	1,530	3,510	3,510
			SFM	397	918	918	397	918	918	397	918	918	397	918	918
			IPM	63.2	110.5	110.5	47.4	82.9	82.9	39.5	73.7	73.7	29.6	55.3	55.3
			IPT	.0079	.0059	.0059	.0079	.0059	.0059	.0098	.0079	.0079	.0098	.0079	.0079
			*a*p (inch)	.0098	.0098	.0039	.0118	.0118	.0039	.0394	.0394	.0079	.0492	.0492	.0079
			*a*e (inch)	.0394	.0197	.0079	.0472	.0236	.0079	.0787	.0787	.0079	.0984	.0492	.0079
Cast Iron	TH308 PN215	ATH08M (PCA12M)	*n* (min^{-1})	5,090	12,100	12,100	4,011	10,080	10,080	2,674	6,351	6,351	2,006	4,763	4,763
			SFM	525	1,246	1,246	525	1,246	1,246	525	1,246	1,246	525	1,246	1,246
			IPM	126.3	200.0	200.0	94.8	150.0	150.0	73.7	150.0	150.0	55.3	112.5	112.5
			IPT	.0118	.0079	.0079	.0118	.0079	.0079	.0138	.0118	.0118	.0138	.0118	.0118
			*a*p (inch)	.0098	.0079	.0039	.0098	.0079	.0039	.0394	.0394	.0079	.0492	.049	.0079
			*a*e (inch)	.0394	.0154	.0079	.0472	.0236	.0079	.0787	.787	.0079	.0984	.0984	.0079
Graphite	TH308		*n* (min^{-1})	10,028	13,371	13,371	7,521	10,028	10,028	5,014	6,685	6,685	3,760	5,012	5,012
			SFM	984	1,312	1,312	984	1,312	1,312	984	1,312	1,312	984	1,312	1,312
			IPM	157.9	315.8	210.6	118.4	236.9	157.9	98.7	157.9	131.6	73.7	118.3	98.2
			IPT	.0079	.0118	.0079	.0079	.0118	.0079	.0098	.0118	.0098	.0098	.0118	.0098
			*a*p (inch)	.0197	.0118	.0079	.0236	.0157	.0079	.0394	.0276	.0079	.0492	.0492	.0079
			*a*e (inch)	.0394	.0315	.0098	.0472	.0354	.0118	.0787	.0591	.0157	.0984	.0984	.0157
Cast aluminum alloy AC4A, ADC12 etc	PN215		*n* (min^{-1})	10,028	15,920	15,920	7,521	13,270	13,270	5,014	7,960	7,960	3,760	6,265	6,265
			SFM	984	1,640	1,640	984	1,640	1,640	984	1,640	1,640	984	1,640	1,640
			IPM	157.9	526.4	263.2	118.4	394.8	197.4	98.7	263.2	131.6	73.7	147.8	122.8
			IPT	.0079	.0157	.0079	.0079	.0157	.0079	.0098	.0157	.0098	.0098	.0157	.0098
			*a*p (inch)	.0197	.0118	.0079	.0236	.0157	.0079	.0394	.0276	.0079	.0492	.0492	.0079
			*a*e (inch)	.0394	.0315	.0098	.0472	.0354	.0118	.0787	.0591	.0157	.0984	.0984	.0157
Hardened Steel 45～55HRC	TH308 PN215	ATH08M (PCA12M)	*n* (min^{-1})	3,343	9,359	9,359	2,507	7,020	7,020	1,590	4,680	4,680	1,254	3,510	3,510
			SFM	328	918	918	328	918	918	328	918	918	328	918	918
			IPM	26.3	36.8	36.8	19.7	27.6	27.6	15.8	22.1	22.1	11.8	16.6	16.6
			IPT	.0039	.002	.002	.0039	.002	.002	.0047	.0024	.0024	.0047	.0024	.0024
			*a*p (inch)	.0098	.0098	.0039	.0118	.0118	.0039	.0394	.0394	.0787	.0492	.0492	.0079
			*a*e (inch)	.0394	.0098	.0078	.0472	.0118	.0078	.0787	.0394	.0079	.0984	.0492	.0079
Hardened Steel 55～62HRC	TH308	ATH08M	*n* (min^{-1})	2,674	7,354	7,354	2,006	5,515	5,515	1,337	3,677	3,677	1,003	2,758	2,758
			SFM	262	721	721	262	721	721	262	721	721	262	721	721
			IPM	21.1	29.0	29.0	15.8	21.7	21.7	12.6	17.4	17.4	9.5	13.0	13.0
			IPT	.0039	.002	.002	.0039	.002	.002	.0047	.0024	.0024	.0047	.0024	.0024
			*a*p (inch)	.0098	.0098	.0039	.0118	.0118	.0039	.0394	.0394	.0787	.0492	.0492	.0079
			*a*e (inch)	.0394	.0098	.0078	.0472	.0118	.0078	.0787	.0394	.0079	.0984	.0492	.0079
Maximum *fz* (inch/t)				<0.0197			<0.0197			<0.0236			<0.0236		
Maximum *a*p (inch)				<0.118			<0.1575			<0.236			<0.236		

【Note】
1. Use the appropriate coolant for the work material and machining shape.
2. These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
3. Be sure to practice safety instructions and precautions such as wearing glasses and safety shoes, and placing safety covers when you use this tool. Because this tool can be broken during machining so failure to follow these instructions may cause personal injury.
4. Never attempt to modify the carbide shank holder. Use the value for the depth of cut (*a*p) when the carbide shank holder is used.
   Tool diameters D≦.5" :*a*p≦.008". Tool diameters D≧.75 ":*a*p≦0.012".

※with overhang of more than 3D, please modify parameter using the chart below

Overhang ratio	SFM	IPM
<3D	100%	100%
3D～5D	70%	70%
5D～8D	60%	60%
8D～10D	50%	50%

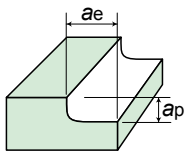
Recommended Cutting Conditions (Metric)

※Red indicates primary recommended insert grade.

Work material	Insert Grade		Cutting Conditions	φ6			φ8			φ10			φ12		
	SG・SW (helical cutting edge inserts)	General edge shape		Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing
				General purpose	High-speed		General purpose	High-speed		General purpose	High-speed		General purpose	High-speed	
Carbon steel Alloy steel (30HRC or less)	※ PN215 TH308	PTH08M (PCA12M)	*n* (min^{-1})	8,490	16,450	16,450	6,370	11,940	11,940	5,090	9,550	9,550	4,240	7,960	7,960
			Vc (m/min)	160	310	310	160	300	300	160	300	300	160	300	300
			Vf (mm/min)	1,700	2,300	2,300	2,550	3,580	3,580	2,040	2,870	2,870	1,700	2,390	2,390
			fz (mm/t)	0.1	0.07	0.07	0.2	0.15	0.15	0.2	0.15	0.15	0.2	0.15	0.15
			*a*p (mm)	0.1	0.1	0.05	0.2	0.2	0.1	0.25	0.25	0.1	0.3	0.3	0.1
			*a*e (mm)	0.6	0.3	0.2	0.8	0.4	0.2	1	0.5	0.2	1.2	0.6	0.2
Carbon steel Alloy steel (30～45HRC)	TH308 PN215	PTH08M (PCA12M)	*n* (min^{-1})	6,370	14,850	14,850	4,770	11,150	11,150	3,820	8,920	8,920	3,180	7,430	7,430
			Vc (m/min)	120	280	280	120	280	280	120	280	280	120	280	280
			Vf (mm/min)	1,270	2,080	2,080	1,910	3,350	3,350	1,530	2,680	2,680	1,270	2,230	2,230
			fz (mm/t)	0.1	0.07	0.07	0.2	0.15	0.15	0.2	0.15	0.15	0.2	0.15	0.15
			*a*p (mm)	0.1	0.1	0.05	0.2	0.2	0.1	0.25	0.25	0.1	0.3	0.3	0.1
			*a*e (mm)	0.6	0.3	0.2	0.8	0.4	0.2	1	0.5	0.2	1.2	0.6	0.2
Cast Iron	TH308 PN215	PTH08M (PCA12M)	*n* (min^{-1})	8,490	20,160	20,160	6,370	15,120	15,120	5,090	12,100	12,100	4,240	10,080	10,080
			Vc (m/min)	160	380	380	160	380	380	160	380	380	160	380	380
			Vf (mm/min)	2,550	4,030	4,030	3,820	6,050	6,050	3,050	4,840	4,840	2,550	4,030	4,030
			fz (mm/t)	0.15	0.1	0.1	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.2	0.2
			*a*p (mm)	0.1	0.1	0.05	0.2	0.2	0.1	0.25	0.2	0.1	0.3	0.3	0.1
			*a*e (mm)	0.6	0.3	0.2	0.8	0.4	0.2	1	0.4	0.2	1.2	0.6	0.2
Graphite	TH308	HD7010	*n* (min^{-1})	15,920	21,220	21,220	11,940	15,920	15,920	9,550	12,740	12,740	7,960	10,620	10,620
			Vc (m/min)	300	400	400	300	400	400	300	400	400	300	400	400
			Vf (mm/min)	3,180	6,370	4,240	4,780	9,550	6,370	3,820	7,640	5,100	3,190	6,370	4,240
			fz (mm/t)	0.1	0.15	0.1	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.2
			*a*p (mm)	0.3	0.15	0.15	0.4	0.2	0.2	0.5	0.3	0.2	0.6	0.4	0.2
			*a*e (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1.0	0.8	0.25	1.2	0.9	0.3
Cast aluminum alloy AC4A, ADC12 etc	PN215	HD7010	*n* (min^{-1})	15,920	26,530	26,530	11,940	19,900	19,900	9,550	15,920	15,920	7,960	13,270	13,270
			Vc (m/min)	300	500	500	300	500	500	300	500	500	300	500	500
			Vf (mm/min)	3,180	10,610	5,310	4,780	15,920	7,960	3,820	12,740	6,370	3,190	10,620	5,310
			fz (mm/t)	0.1	0.2	0.1	0.2	0.4	0.2	0.2	0.4	0.2	0.2	0.4	0.2
			*a*p (mm)	0.3	0.15	0.15	0.4	0.2	0.2	0.5	0.3	0.2	0.6	0.4	0.2
			*a*e (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1.0	0.8	0.25	1.2	0.9	0.3
Hardened Steel 45～55HRC	TH308 PN215	PTH08M (PCA12M)	*n* (min^{-1})	5,310	14,850	14,850	3,980	11,150	11,150	3,180	8,920	8,920	2,650	7,430	7,430
			Vc (m/min)	100	280	280	100	280	280	100	280	280	100	280	280
			Vf (mm/min)	850	1,190	1,190	800	1,120	1,120	640	890	890	530	740	740
			fz (mm/t)	0.08	0.04	0.04	0.1	0.05	0.05	0.1	0.05	0.05	0.1	0.05	0.05
			*a*p (mm)	0.1	0.1	0.05	0.2	0.2	0.1	0.25	0.25	0.1	0.3	0.3	0.1
			*a*e (mm)	0.6	0.2	0.2	0.8	0.2	0.2	1	0.25	0.2	1.2	0.3	0.2
Hardened Steel 55～62HRC	TH308	PTH08M	*n* (min^{-1})	4,240	11,670	11,670	3,180	8,760	8,760	2,550	7,000	7,000	2,120	5,840	5,840
			Vc (m/min)	80	220	220	80	220	220	80	220	220	80	220	220
			Vf (mm/min)	680	930	930	640	880	880	510	700	700	420	580	580
			fz (mm/t)	0.08	0.04	0.04	0.1	0.05	0.05	0.1	0.05	0.05	0.1	0.05	0.05
			*a*p (mm)	0.1	0.1	0.05	0.2	0.2	0.1	0.25	0.25	0.1	0.3	0.3	0.1
			*a*e (mm)	0.6	0.2	0.2	0.8	0.2	0.2	1	0.25	0.2	1.2	0.3	0.2
Maximum *fz* (mm/t)				<0.2			<0.5			<0.5			<0.5		
Maximum *a*p (mm)				<0.6			<2.5			<3.0			<4.0		

【Note】

1. Use the appropriate coolant for the work material and machining shape.
2. These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
3. Be sure to practice safety instructions and precautions such as wearing glasses and safety shoes, and placing safety covers when you use this tool. Because this tool can be broken during machining so failure to follow these instructions may cause personal injury.
4. Never attempt to modify the carbide shank holder. Use the value for the depth of cut (*a*p) when the carbide shank holder is used.
   Tool diameters D≦12mm:*a*p≦0.2mm. Tool diameters D≧16mm:*a*p≦0.3mm.



Recommended Cutting Conditions (Metric)

※Red indicates primary recommended insert grade.

Work material	Insert Grade		Cutting Conditions	ϕ16			ϕ20			ϕ25			ϕ30			ϕ32		
	SG・SW (helical cutting edge inserts)	General edge shape		Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing
				General purpose	High-speed		General purpose	High-speed		General purpose	High-speed		General purpose	High-speed		General purpose	High-speed	
Carbon steel Alloy steel (30HRC or less)	※ PN215 TH308	PTH08M (PCA12M)	*n* (min⁻¹)	3,190	5,970	5,970	2,550	4,780	4,780	2,040	3,820	3,820	1,700	3,180	3,180	1,590	2,990	2,990
			Vc (m/min)	160	300	300	160	300	300	160	300	300	160	300	300	160	300	300
			Vf (mm/min)	1,600	2,390	2,390	1,280	1,910	1,910	1,020	1,530	1,530	850	1,270	1,270	800	1,200	1,200
			fz (mm/t)	0.25	0.2	0.2	0.25	0.2	0.2	0.25	0.2	0.2	0.25	0.2	0.2	0.25	0.2	0.2
			*a*p (mm)	0.8	0.8	0.2	1	1	0.2	1.25	1.25	0.2	1.6	1.6	0.2	1.6	1.6	0.2
			*a*e (mm)	1.6	1.6	0.2	2	2	0.2	2.5	1.25	0.2	3.2	3.2	0.2	3.2	3.2	0.2
Carbon steel Alloy steel (30～45HRC)	TH308 PN215	PTH08M (PCA12M)	*n* (min⁻¹)	2,390	5,570	5,570	1,910	4,460	4,460	1,530	3,570	3,570	1,270	2,970	2,970	1,190	2,790	2,790
			Vc (m/min)	120	280	280	120	280	280	120	280	280	120	280	280	120	280	280
			Vf (mm/min)	1,200	2,230	2,230	960	1,780	1,780	760	1,430	1,430	640	1,190	1,190	600	1,120	1,120
			fz (mm/t)	0.25	0.2	0.2	0.25	0.2	0.2	0.25	0.2	0.2	0.25	0.2	0.2	0.25	0.2	0.2
			*a*p (mm)	0.8	0.8	0.2	1	1	0.2	1.25	1.25	0.2	1.6	1.6	0.2	1.6	1.6	0.2
			*a*e (mm)	1.6	1.6	0.2	2	2	0.2	2.5	2.5	0.2	3.2	3.2	0.2	3.2	3.2	0.2
Cast Iron	TH308 PN215	PTH08M (PCA12M)	*n* (min⁻¹)	3,190	7,560	7,560	2,550	6,050	6,050	2,040	4,840	4,840	1,700	4,030	4,030	1,590	3,780	3,780
			Vc (m/min)	160	380	380	160	380	380	160	380	380	160	380	380	160	380	380
			Vf (mm/min)	2,240	4,540	4,540	1,790	3,630	3,630	1,430	2,900	2,900	1,190	2,420	2,420	1,110	2,270	2,270
			fz (mm/t)	0.35	0.3	0.3	0.35	0.3	0.3	0.35	0.3	0.3	0.35	0.3	0.3	0.35	0.3	0.3
			*a*p (mm)	0.8	0.8	0.2	1	1	0.2	1.25	1.25	0.2	1.6	1.6	0.2	1.6	1.6	0.2
			*a*e (mm)	1.6	1.6	0.2	2	2	0.2	2.5	2.5	0.2	3.2	3.2	0.2	3.2	3.2	0.2
Graphite	TH308	HD7010	*n* (min⁻¹)	5,970	7,960	7,960	4,780	6,370	6,370	3,830	5,100	5,100	3,190	4,250	4,250	3,190	4,250	4,250
			Vc (m/min)	300	400	400	300	400	400	300	400	400	300	400	400	300	400	400
			Vf (mm/min)	2,990	4,780	3,980	2,390	3,820	3,190	1,920	3,060	2,550	1,600	2,550	2,130	1,600	2,550	2,130
			fz (mm/t)	0.25	0.3	0.25	0.25	0.3	0.25	0.25	0.3	0.25	0.25	0.3	0.25	0.25	0.3	0.25
			*a*p (mm)	0.8	0.6	0.2	1	0.7	0.2	1.25	1.25	0.2	1.6	1.6	0.2	1.6	1.6	0.2
			*a*e (mm)	1.6	1.1	0.3	2	1.5	0.4	2.5	2.5	0.4	3.2	3.2	0.4	3.2	3.2	0.4
Cast aluminum alloy AC4A, ADC12 etc	PN215	HD7010	*n* (min⁻¹)	5,970	9,950	9,950	4,780	7,960	7,960	3,830	6,370	6,370	3,190	5,310	5,310	3,190	5,310	5,310
			Vc (m/min)	300	500	500	300	500	500	300	500	500	300	500	500	300	500	500
			Vf (mm/min)	2,990	7,960	4,980	2,390	6,370	3,980	1,920	5,100	3,190	1,600	4,250	2,660	1,600	4,250	2,660
			fz (mm/t)	0.25	0.4	0.25	0.25	0.4	0.25	0.25	0.4	0.25	0.25	0.4	0.25	0.25	0.4	0.25
			*a*p (mm)	0.8	0.6	0.2	1	0.7	0.2	1.25	1.25	0.2	1.6	1.6	0.2	1.6	1.6	0.2
			*a*e (mm)	1.6	1.1	0.3	2	1.5	0.4	2.5	2.5	0.4	3.2	3.2	0.4	3.2	3.2	0.4
Hardened Steel 45～55HRC	TH308 PN215	PTH08M (PCA12M)	*n* (min⁻¹)	1,990	5,570	5,570	1,590	4,460	4,460	1,270	3,570	3,570	1,060	2,970	2,970	1,000	2,790	2,790
			Vc (m/min)	100	280	280	100	280	280	100	280	280	100	280	280	100	280	280
			Vf (mm/min)	480	670	670	380	530	530	310	430	430	250	360	360	240	330	330
			fz (mm/t)	0.12	0.06	0.06	0.12	0.06	0.06	0.12	0.06	0.06	0.12	0.06	0.06	0.12	0.06	0.06
			*a*p (mm)	0.8	0.8	0.2	1	1	0.2	1.25	1.25	0.2	1.6	1.6	0.2	1.6	1.6	0.2
			*a*e (mm)	1.6	0.8	0.2	2	1	0.2	2.5	1.25	0.2	3.2	1.6	0.2	3.2	1.6	0.2
Hardened Steel 55～62HRC	TH308	PTH08M	*n* (min⁻¹)	1,590	4,380	4,380	1,270	3,500	3,500	1,020	2,800	2,800	850	2,330	2,330	800	2,190	2,190
			Vc (m/min)	80	220	220	80	220	220	80	220	220	80	220	220	80	220	220
			Vf (mm/min)	380	530	530	300	420	420	240	340	340	200	280	280	190	260	260
			fz (mm/t)	0.12	0.06	0.06	0.12	0.06	0.06	0.12	0.06	0.06	0.12	0.06	0.06	0.12	0.06	0.06
			*a*p (mm)	0.8	0.8	0.2	1	1	0.2	1.25	1.25	0.2	1.6	1.6	0.2	1.6	1.6	0.2
			*a*e (mm)	1.6	0.8	0.2	2	1	0.2	2.5	1.25	0.2	3.2	1.6	0.2	3.2	1.6	0.2
Maximum *fz* (mm/t)				<0.6			<0.6			<0.6			<0.6			<0.6		
Maximum *a*p (mm)				<5.0			<6.0			<8.0			<10.0			<10.0		

※with overhang of more than 3D, please modify parameter using the chart below

Overhang ratio	*v*c (m/min)	*v*f (mm/min)
<3D	100%	100%
3D～5D	70%	70%
5D～8D	60%	60%
8D～10D	50%	50%

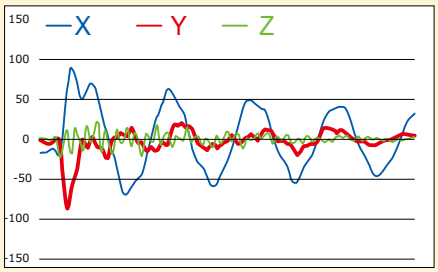
Cutting performance

SG type

01 Cutting force comparison between conventional edge shape and high helix one.

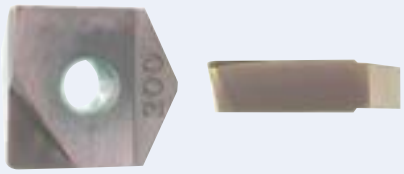
ZCFG-SG(helical cutting edge inserts)

Insert : ZCFG200SG-R1.0

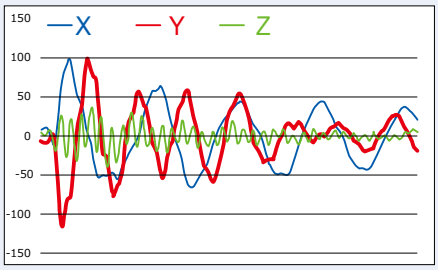


Compared to conventional tools, the cutting resistance (Y part force) received from the wall surface is low and the variation is also small so machining stability is good.

Conventional



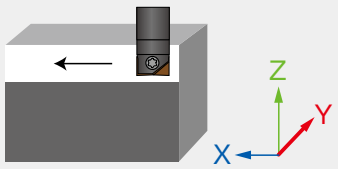
Insert : ZCFW200



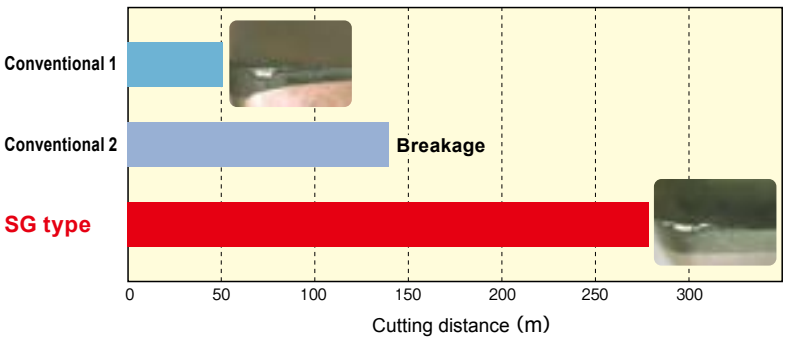
Cutting resistance variation is large.

Cutting conditions

Work material : 1050 (220HB)
Cutter : ARPFM20(Tool dia. ϕ20-R1.0)
Shank : ASC20-10.5-170-90Z
(Overhang : 140mm)
Machine : Vertical type(BT50)
Cutting speed : Vc=200m/min
Feed rate : fz=0.15mm/t
Cutting depth(ap)=1.0mm
Radial depth of cut(ae)=0.1mm
Cutting shape : Vertical wall
Coolant : Air



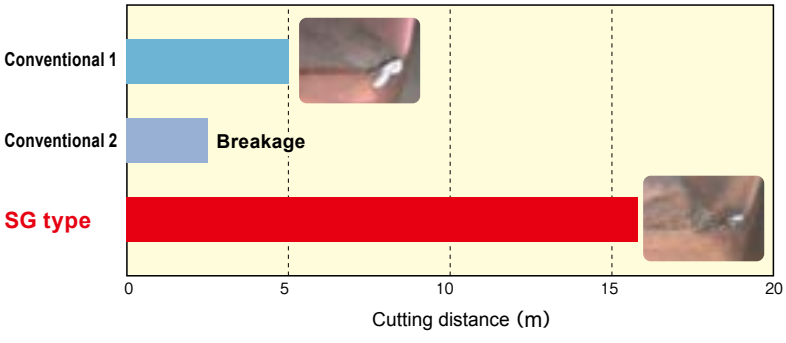
02 Tool life when performing semi-finishing of vertical walls.



Cutting conditions

Work material : stainless materials (52HRC)
Cutter : ARPFM20 (Tool dia. ϕ20)
Shank : ASC20-10.5-120-50Z
(Overhang : 60mm)
Machine : Vertical type (BT50)
Cutting speed : Vc=120m/min
Feed rate : fz=0.25mm/t
Cutting depth (ap) =1.0mm
Radial depth of cut (ae) =0.5mm
Cutting shape : Vertical wall
Coolant : Air

03 Tool life when performing semi-finishing of flat surfaces.



Cutting conditions

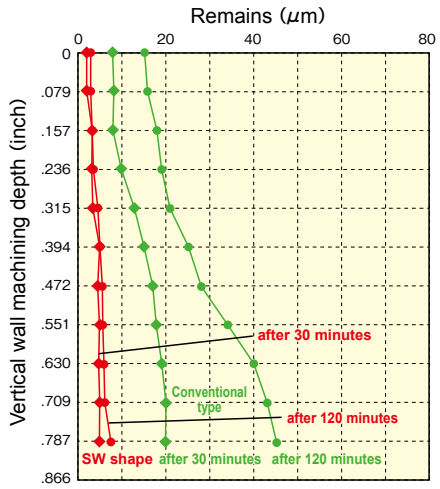
Work material : stainless materials (52HRC)
Cutter : ARPFM20 (Tool dia. ϕ20)
Shank : ASC20-10.5-120-50Z
(Overhang : 60mm)
Machine : Vertical type (BT50)
Cutting speed : Vc=120m/min
Feed rate : fz=0.25mm/t
Cutting depth (ap) =0.5mm
Radial depth of cut (ae) =10mm
Cutting shape : Planing
Coolant : Air

Cutting performance

SW type

Remaining stock when cutting vertical walls

※Comparison of remaining stock with conventional products when the vertical wall was machined for 120 minutes.

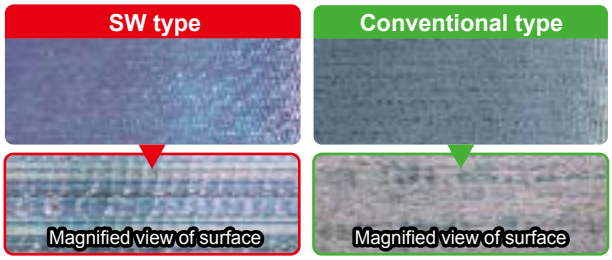


With SW type, even after machining for 120 minutes, the remaining stock was 10μm or less and cut surface quality is good.

Cutting conditions

Work material : Carbon steel (220HB)
Cutter : ARPFM20 (Tool dia. φ20)
Shank : ASC20-10.5-170-90Z (Overhang : 140mm)
Machine : Vertical type (BT50)
Cutting speed : *Vc*=200m/min
Feed rate : *fz*=0.15mm/t
Cutting depth (*ap*) =1.0mm
Radial depth of cut (*ae*) =0.1mm
Cutting shape : Vertical wall
Coolant : Air

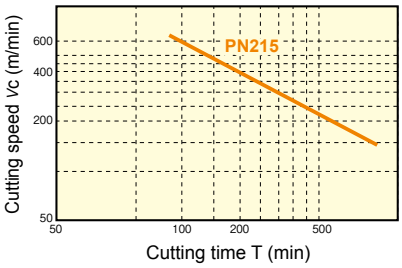
Magnified view of surface after 120 minutes of machining



Shiny surface　　Cloudy surface

Field data

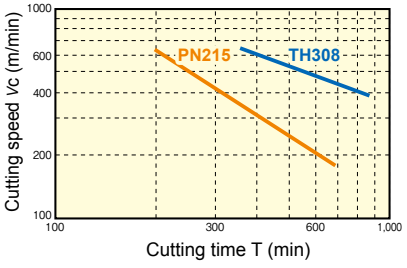
01 *Vc*-T chart for Carbon Steel【220HB】



Cutting conditions

Work material : Carbon steel (220HB)
Tool Cutter : ARPFM20(φ20)
Shank : ASC20-10.5-120-50Z
Insert : ZCFG200SG-R1.0(PN215)
Overhang : 80mm, Feed rate : *fz*=0.15mm/t
Radial depth of cut : *ap*×*ae*=1×0.1mm
Machine : Vertical type(BT50)
Cutting shape : vertical wall, Coolant : Air

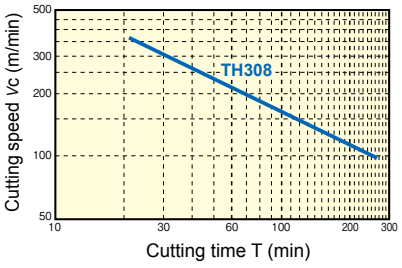
02 *Vc*-T chart for H13【45HRC】



Cutting conditions

Work material : H13 (45HRC)
Tool Cutter : ARPFM20(φ20)
Shank : ASC20-10.5-120-50Z
Insert : ZCFG200SG-R1.0(PN215), ZCFG200SG-R1.0(TH308)
Overhang : 80mm, Feed rate : *fz*=0.15mm/t
Radial depth of cut : *ap*×*ae*=1×0.1mm
Machine : Vertical type(BT50)
Cutting shape : vertical wall, Coolant : Air

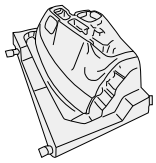
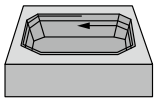
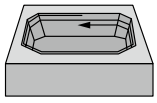
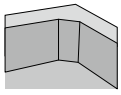
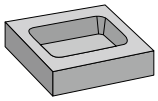
03 *Vc*-T chart for D2【60HRC】



Cutting conditions

Work material : D2 (60HRC)
Tool Cutter : ARPFM20(φ20)
Shank : ASC20-10.5-120-50Z
Insert : ZCFG200SG-R1.0(TH308)
Overhang : 80mm, Feed rate : *fz*=0.15mm/t
Radial depth of cut : *ap*×*ae*=1×0.1mm
Machine : Vertical type(BT50)
Cutting shape : vertical wall, Coolant : Air

Field data

Cutting examples	Cutting conditions		Result
Plastic mold 	Tool : ARPF20S20WE (OH=150mm) Work material : Carbon steel Insert: ZCFG200SG-R1.0 (PN215) Machine:Vertical type M/C(BT50) Cutting speed: *Vc*=220m/min Revolution: *n*=3500min^{-1}	Feed speed: *Vf*=1750mm/min Feed rate:*fz*=0.25mm/t Cutting depth: *a*p=0.2mm Radial depth of cut: *a*e=0.1mm Coolant: Dry(Air)	After 6 hours, the cutting edge is good with normal wear. The finished surface is also good compared with conventional products.
	Tool : ARPFM20 + ASC20-10.5-120-50Z(OH=90mm) Work material : Carbon steel Insert : ZCFG200SG-R1.0 (PN215) Machine : Vertical type M/C(BT50) Cutting speed : *Vc*=188m/min Revolution : *n*=3000min^{-1}	Feed speed : *Vf*=1500mm/min Feed rate : *fz*=0.25mm/t Cutting depth : *a*p=0.3mm Radial depth of cut : *a*e=0.4mm Coolant : Dry(Air)	Even after performing semi-finishing with non-uniform cutting for 7 hours, the cutting edge is good with no chipping.
Plastic mold (Carbon Steel) 	Tool : ARPFM20 + ASC20-10.5-220-120Z(OH=150mm) Work material : Carbon steel Insert : ZCFG200SG-R1.0 (PN215) Machine : Vertical type M/C(BT50) Cutting speed : *Vc*=176m/min Revolution : *n*=2800min^{-1}	Feed speed : *Vf*=1700mm/min Feed rate : *fz*=0.3mm/t Cutting depth : *a*p=0.3mm Radial depth of cut : *a*e=0.05mm Coolant : Water base	Even after 7 hours of machining, surface accuracy is good. (Surface is glossy.) With conventional products, surface accuracy became bad after approximately 3 hours of machining, which was judged as the tool life end.
Machining of die-casting mold (pocket area) 	Tool : ARPFM20+ASC20-10.5-220-120Z (OH=160mm) Work material : Equivalent to H13 (40 ～ 43HRC) Insert : ZCFG200SW-R1.0 (TH308) Machine : Vertical type M/C(BT50) ■side wall Cutting speed : *Vc*=182m/min Revolution : *n*=2900min^{-1} Feed speed : *Vf*=600mm/min Feed rate : *fz*=0.1mm/t Cutting depth : *a*p=0.1mm Radial depth of cut : *a*e=0.1mm	■planar section Cutting speed : *Vc*=70m/min Revolution : *n*=1100min^{-1} Feed speed : *Vf*=180mm/min Feed rate : *fz*=0.08mm/t Cutting depth : *a*p=0.1mm Radial depth of cut : *a*e=8mm Coolant : Dry(Air)	Machining accuracy for both side surface areas and flat surface areas is good. With conventional indexable tools, machining accuracy had been a problem.
Machining of die-casting mold 	Tool : ARPFM20+ASC20-10.5-170-90Z(OH=130mm) Work material : H13 Equivalent (45HRC) Insert : ZCFG200SG-R1.0 (PN215) Machine : Vertical type M/C(BT50) Cutting speed : *Vc*=88m/min Revolution : *n*=1400min^{-1}	Feed speed : *Vf*=280mm/min Feed rate : *fz*=0.1mm/t Cutting depth : *a*p=0.5mm Radial depth of cut : *a*e=1mm Coolant : Dry(Air)	Even when machining corner areas where cutting amount is non-uniform, the cutting edge is good with no chipping.
Machining of die-casting mold (structural area) 	Tool : ARPFM20+ASC20-10.5-170-90Z(OH=130mm) Work material : H13 (45HRC) Insert : ZCFG200SG-R1.0 (TH308) Machine : Vertical type M/C(BT50) Cutting speed : *Vc*=200m/min Revolution : *n*=3200min^{-1}	Feed speed : *Vf*=1600mm/min Feed rate : *fz*=0.25mm/t Cutting depth : *a*p=0.2mm Radial depth of cut : *a*e=0.1mm Coolant : Dry(Air)	Performing finishing once resulted in finishing that was within the specified dimensional tolerance. With conventional products, chattering often occurred and there were uncut areas so re-machining was necessary.

Safety Considerations

1. Handling

(1) When removing tool from packaging, be careful not to drop the tool on your foot or fingers.
(2) When actually setting the inserts, be careful not to touch the cutting flute directly with your bare hands.

2. Mounting

(1) When preparing to use, be sure that the insert is firmly screwed in the pocket and cutter is properly mounted on the tool holder.
(2) If abnormal chattering occurs during use, stop the machine immediately, identify the cause of the chatter and take corrective action.

3. Usage

(1) Before use confirm all dimensions, verify work material and programmed tool rotation.
(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) Inserts are made of hard material and may break and be expelled from cutter at high speeds. Since there is a danger of injury to workers from chip evacuation, insert breakage or fire safety precautions must be observed at all times. Including, but not limited to: safety glasses, machine enclosures or other means to create a safe environment for work. If you have questions on safety, contact your supervisor.
- Do not use where there is a risk of fire or explosion.
- Do not use non-water-soluble cutting oils. Such oils may result in fire.

(4) Do not use the tool for any purpose other than that for which it is intended, and do not modify it.

Notes

NEW

MOLDINO
The Edge To Innovation

Indexable ball end mill for finishing

ABPF type

Ball Precision F ABPF

Inch and Metric sizes are available!

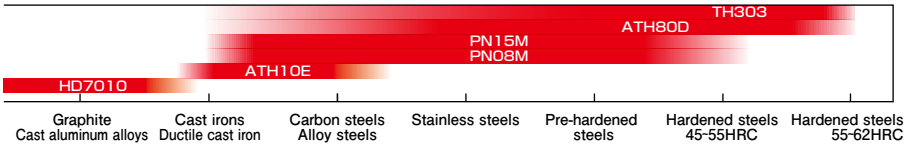
MOLDINO Tool Engineering, Ltd.

New Product News | No. H2201A-1 | 2022-01

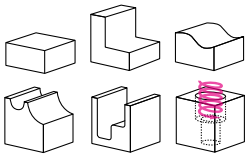
Increased cutting performance due to S-shaped cutting edge!
High helix shape provides an improved surface finish.
Insert for high-accuracy machining reduces chatter on corners.

Tougher and Stronger

Introducing 6 Modular Mill Type with Air hole items!



Applications

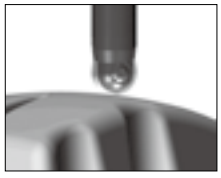


Mold making | Parts processing

ABPF

Features 01 Set up R accuracy : ±0.01mm ±.0004 inch

・High accuracy is exhibited from the ball tip to the outer circumference.



Features 02 Excellent cutting performance and beautiful cutting surface finish.

・High helix edge shape reduces the increase in cutting forces.

Features 03 New insert grade for longer life.

・Multi-layer coating provides long life.

※For details regarding cutting performance, see p.214.

An effect by high helix edge shape

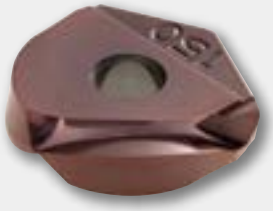
Typical conventional problem

Frequent chattering happens when cutting R-shapes.
With the increase in cutting forces in these areas, the chattering causes poor surface finishes.

Reduce cutting force

With the high helix edge, it reduces the cutting forces.
The reduced cutting forces limits the chattering and leaves an improved surface finish.

- Improved cutting surface finish.
- Less chattering on corner.



Merit

Improved machining performance and machining accuracy can be expected, reducing work for downstream processes.

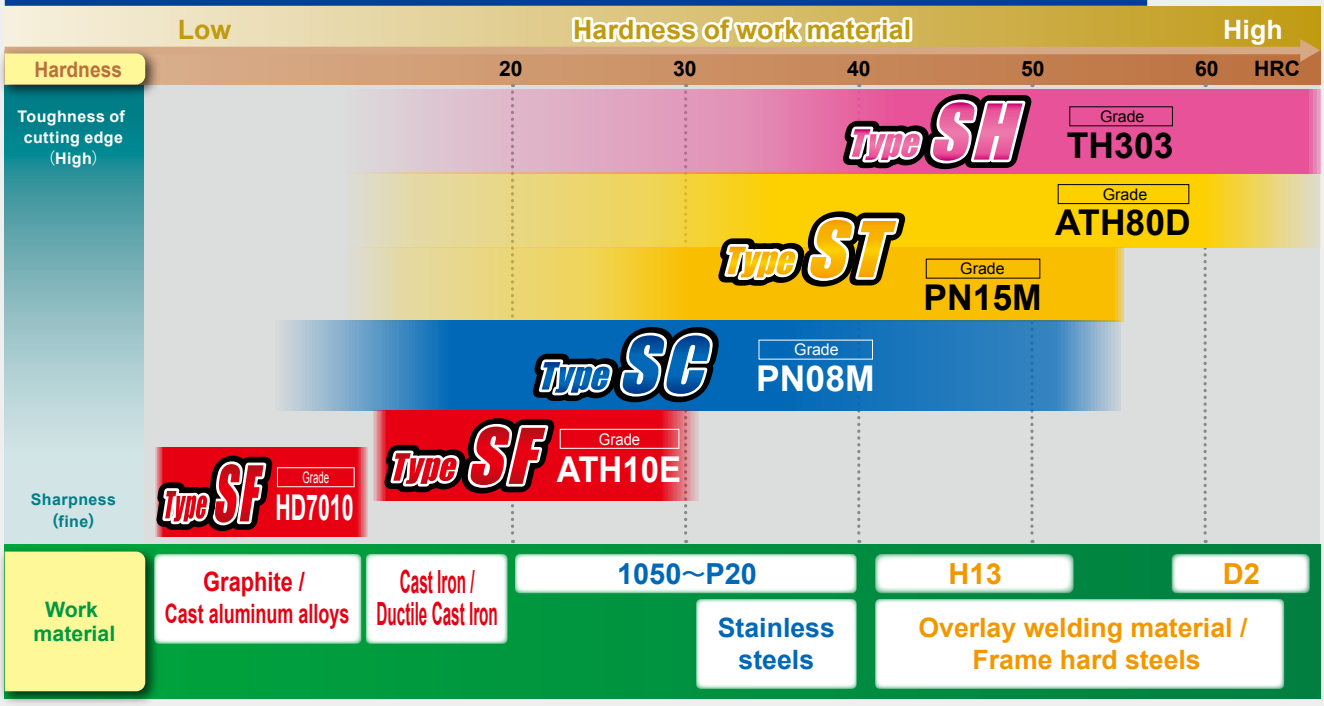
Improved quality | Cost reduction | Time savings

Improved tool life

Lower cutting forces reduces chipping due to wear and impact, therefore tool life is improved.

Recommended grades map

Recommendation of based on hardness of work materials



Technology

PVD Technology TH3 Coating **TH303**

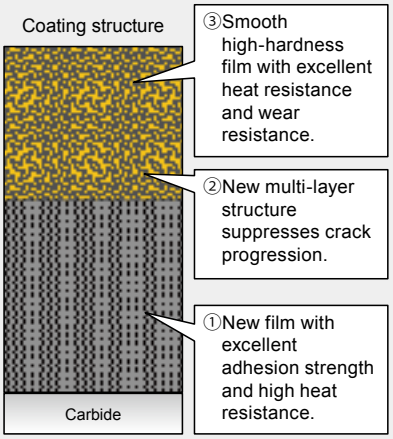
Features

- TH coating has further evolved to the new 3rd-generation TH coating.
- New film composition and film structure improves heat resistance and wear resistance.
- New multi-layer structure provides excellent durability and suppresses crack progression.

Strong fields

- High-speed finishing of hardened steels (45 to 65 HRC) such as D2, H13, M2, S420 types, etc.
- High-speed finishing of pre-hardened steels such as P20, P21, etc.
- TH308 uses ultra-fine carbide alloy with excellent wear resistance and TH3 coating to demonstrate good performance especially for finishing of high-hardness materials.

Characteristics



PVD Nano Technology Super Coating “Panacea Technology” **PN**

Features

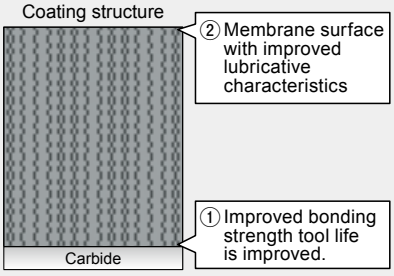
- Multi-layer structure provides improved adhesion and membrane hardness as well as improving the oxidation-resistance temperature.
- PN coating improves the friction coefficient which reduces heat generation when cutting.

Strong fields

- Exhibits stable tool life in cutting materials like plastic injection molds where tool seizure often occurs. Longer tool life is possible in cutting prehardened like carbon steel, alloy steel, stainless steel, and hot and cold tool steels.
- PN08M adopts micro-grain substrate and PN Coating. Improves the cutting performance for plastic injection mold finishing.
- PN15M adopts micro-grain substrate and PN Coating. Improves the cutting performance for overhang cutting.

Characteristics

Cross-sectional structure and characteristics of PN coating membrane

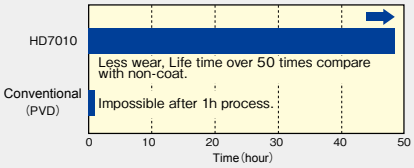


High adhesion Diamond coating Diamond Coating **HD**

Characteristics

- Uses diamond with good crystallization. Ideal for cutting of graphite, high-silicon aluminum alloys and fiber-reinforced plastics (FRP).
- Our exclusive pre-treatment technology is used to provide higher adhesion due to anchor effect.
- Special material for Diamond Coating is adopted for base metal.

Machining example of Graphite (HD7010)



Cutting conditions
Cutter Body : ABPF10S10WL140(ϕ10mm)
v_c=200 SFM n=6,370min^{-1}
v_f=98.43 IPM (f_z=.008 IPT)
a_p×a_e=.020×.012 inch Dry

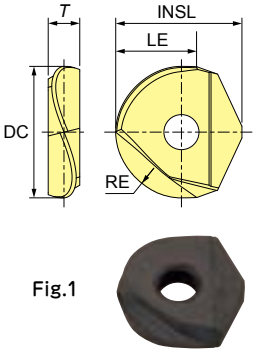
ABPF

Line Up (Inch)

High helix edge shape inserts

P	Carbon steels	⌐	■	⌐
K	Cast Iron, Ductile Cast Iron	⌐	⌐	⌐
H	Hardened steels	■	⌐	⌐

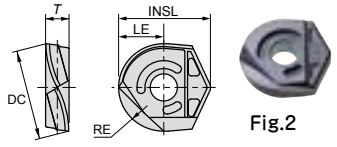
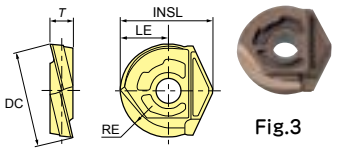
■ : General cutting, First recommendation
⌐ : General cutting, Second recommendation

Shape	Item code	Tolerance class	TH3 Coating	PN Coating		Size (inch)					Shape
			TH303	PN08M	PN15M	RE	LE	INSL	DC	T	
 Fig.1	IZPFG050-SH	F	●			.156	.217	.383	.312	.083	Fig.1
	IZPFG060-SH		●			.188	.256	.478	.375	.106	
	IZPFG080-SH		●			.250	.295	.574	.500	.126	
	IZPFG100-SH		●			.313	.315	.648	.625	.165	
	IZPFG120-SH		●			.375	.394	.795	.750	.205	
	IZPFG160-SH		●			.500	.492	.943	1.000	.244	
	IZDFG050-ST	F	●		●	.156	.217	.383	.312	.083	Fig.1
	IZDFG060-ST		●		●	.188	.256	.478	.375	.106	
	IZDFG080-ST		●		●	.250	.295	.574	.500	.126	
	IZDFG100-ST		●		●	.313	.315	.648	.625	.165	
	IZDFG120-ST		●		●	.375	.394	.795	.750	.205	
	IZDFG160-ST		●		●	.500	.492	.943	1.000	.244	
	IZDFG050-SC	F		●		.156	.217	.383	.312	.083	Fig.1
	IZDFG060-SC			●		.188	.256	.478	.375	.106	
	IZDFG080-SC			●		.250	.295	.574	.500	.126	
	IZDFG100-SC			●		.313	.315	.648	.625	.165	
	IZDFG120-SC			●		.375	.394	.795	.750	.205	
	IZDFG160-SC			●		.500	.492	.943	1.000	.244	

Standard insert

P	Carbon steels	⌐		■
K	Cast Iron, Ductile Cast Iron	⌐	⌐	■
H	Hardened steels	⌐	■	⌐

■ : General cutting, First recommendation
⌐ : General cutting, Second recommendation

Shape	Item code	Tolerance class	C Coating	TH Coating	ACS Coating	Size (inch)					Shape
			PCA12M	ATH80D	ACS05E	RE	LE	INSL	DC	T	
 Fig.2	IZPFG050	F	△			.156	.217	.381	.312	.083	Fig.2
	IZPFG060		△			.188	.256	.478	.375	.106	
	IZPFG080		△			.250	.295	.574	.500	.126	
	IZPFG100		△			.313	.315	.654	.625	.165	
	IZPFG120		△			.375	.394	.800	.750	.205	
	IZPFG160		△			.500	.492	.948	1.000	.244	
 Fig.3	IZDFG050-WF	F			△	.156	.217	.381	.312	.083	Fig.3
	IZDFG050-WH			△		.156	.217	.381	.312	.083	
	IZDFG060-WF				△	.188	.256	.478	.375	.106	
	IZDFG060-WH			△		.188	.256	.478	.375	.106	
	IZDFG080-WF				△	.250	.295	.574	.500	.126	
	IZDFG080-WH			△		.250	.295	.574	.500	.126	
	IZDFG100-WF				△	.313	.315	.654	.625	.165	
	IZDFG100-WH			△		.313	.315	.654	.625	.165	
	IZDFG120-WF				△	.375	.394	.800	.750	.205	
	IZDFG120-WH			△		.375	.394	.800	.750	.205	
	IZDFG160-WF				△	.500	.492	.948	1.000	.244	
	IZDFG160-WH			△		.500	.492	.948	1.000	.244	

W type:WF/WH
For vertical wall machining;
Regrinding is not possible.

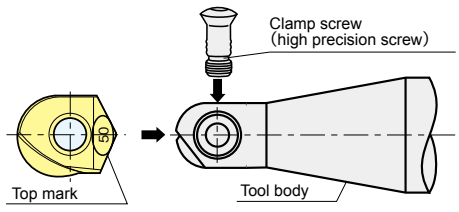
●: Inventory maintained in US △: Discontined after stock run out No Mark: Manufactured upon request only

Set-up Procedures of Inserts

1. Clean the insert seat:
Using air-blow or alike, clean the seat.
2. Put in the insert with its top positioned to the screw-tightening side of the tool body.
3. Tighten the clamp screw with the special wrench. Please do not press down the insert during this tightening process.
4. This is the end of insert set-up.

Attention Never tighten the clamp screw without assembling the insert into the tool.

Do not tighten the screw without putting insert

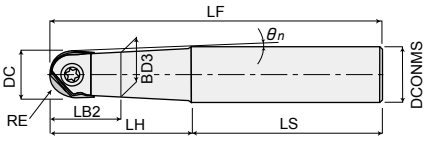


To meet the specification for precision of ±.0004 inch, please follow this procedure.

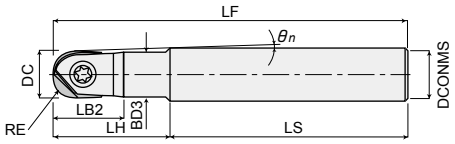
Line Up (Inch)

Steel Shank IABPF○○S○○(L)

Numeric figure in a circle ○ and Alphabetical character comes in a square □



Type A (Taper neck)

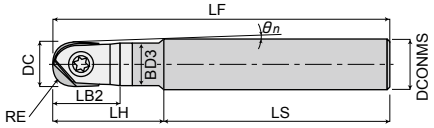


Type B (Straight neck)

	Item code	Stock	No.of inserts	Size (inch) DC	RE	LF	DCONMS	LB2	LH	BD3	LS	θn	Type	Inserts
Regular	IABPF05S08	●	1	.313	.156	3.937	.500	.394	.984	.291	2.953	6.5°	A	IZ□FG050
	IABPF06S08	●	1	.375	.188	3.937	.500	.512	.984	.335	2.953	4.5°	A	IZ□FG060
	IABPF08S08	●	1	.500	.250	4.331	.500	.591	1.181	.480	3.150	-	B	IZ□FG080
	IABPF10S10	●	1	.625	.313	5.118	.625	.748	1.969	.602	3.150	-	B	IZ□FG100
	IABPF12S12	●	1	.750	.375	5.512	.750	.866	2.362	.728	3.150	-	B	IZ□FG120
	IABPF16S16	●	1	1.000	.500	5.906	1.000	.984	2.756	.980	3.150	-	B	IZ□FG160
Long neck	IABPF05S08L	●	1	.313	.156	5.906	.500	.394	1.969	.291	3.937	-	A	IZ□FG050
	IABPF06S08L	●	1	.375	.188	5.906	.500	.512	1.969	.335	3.937	-	A	IZ□FG060
	IABPF08S10L	●	1	.500	.250	6.299	.625	.591	2.362	.480	3.937	-	A	IZ□FG080
	IABPF10S12L	●	1	.625	.313	6.496	.750	.748	2.559	.602	3.937	-	A	IZ□FG100
	IABPF12S16L	●	1	.750	.375	7.087	1.000	.866	3.150	.728	3.937	-	A	IZ□FG120
	IABPF16S20L	●	1	1.000	.500	7.874	1.250	.984	3.543	.980	4.331	-	A	IZ□FG160

Carbide Shank IABPF○○S○○W(R/L)

Numeric figure in a circle ○ and Alphabetical character comes in a square □



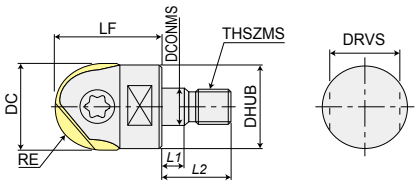
Item code	Stock	No.of inserts	Size (inch) DC	RE	LF	DCONMS	LB2	L/D*	LH	BD3	LS	Inserts
IABPF05S05W	●	1	.313	.156	3.937	.313	.709	3.773	1.181	.303	2.756	IZ□FG050
IABPF06S06W	●	1	.375	.188	3.937	.375	.906	3.675	1.378	.366	2.559	IZ□FG060
IABPF08S08W	●	1	.500	.250	4.331	.500	1.024	3.544	1.772	.472	2.559	IZ□FG080
IABPF10S10W	●	1	.625	.313	5.512	.625	.748	2.520	1.575	.602	3.937	IZ□FG100
IABPF12S12W	●	1	.750	.375	4.724	.750	.866	2.887	2.165	.728	2.559	IZ□FG120
IABPF16S16W	●	1	1.000	.500	5.315	1.000	.984	2.559	2.559	.980	2.756	IZ□FG160
IABPF05S05WR	●	1	.313	.156	5.118	.310	.394	8.176	2.559	.303	2.559	IZ□FG050
IABPF06S06WR	●	1	.375	.188	5.512	.375	.512	7.875	2.953	.366	2.559	IZ□FG060
IABPF08S08WR	●	1	.500	.250	5.906	.500	.591	6.692	3.346	.472	2.559	IZ□FG080
IABPF12S12WR	●	1	.750	.375	6.299	.750	.709	2.887	2.165	.728	4.134	IZ□FG120
IABPF16S16WR	●	1	1.000	.500	7.087	1.000	.709	1.651	1.651	.980	4.528	IZ□FG160
IABPF05S05WL	●	1	.313	.156	7.087	.303	.394	4.403	1.378	.303	5.709	IZ□FG050
IABPF06S06WL	●	1	.375	.188	7.087	.366	.512	3.675	1.378	.366	5.709	IZ□FG060
IABPF08S08WL	●	1	.500	.250	7.087	.472	.591	3.544	1.772	.472	5.315	IZ□FG080
IABPF10S10WL	●	1	.625	.313	7.874	.602	.787	4.094	2.559	.602	5.315	IZ□FG100
IABPF12S12WL	●	1	.750	.375	9.843	.728	.866	4.200	3.150	.728	6.693	IZ□FG120
IABPF16S16WL	●	1	1.000	.500	9.843	.980	.984	3.150	3.150	.980	6.693	IZ□FG160

*L/D is LH/DC

● : Inventory maintained in US

Modular Mill Type IABPFM○○

Numeric figure in a circle ○ and Alphabetical character comes in a square □.

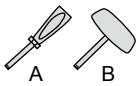


Item code	Stock	No.of inserts	Size (inch)									Inserts
			DC	RE	LF	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS	
IABPFM08	●	1	**.500**	.250	1.024	.256	M6	.386	.217	.571	.276	IZ□FG080
IABPFM12	●	1	**.750**	.375	1.496	.413	M10	.701	.217	.748	.591	IZ□FG120
IABPFM16	●	1	**1.000**	.500	1.496	.492	M12	.819	.217	.866	.669	IZ□FG160

【Note】Do not apply lubricants such as grease, etc. to the "contact faces" and "modular screws" of the "modular mill", "special shanks" and "special arbor".

Parts

Numeric figure in a circle ○.

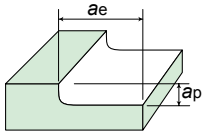
Parts	Clamp screw		Screw driver / Wrench		Screw anti-seizure agent
Shape / Cutter Body		Fastening torque (N・m)	 A B	Shape	
IABPF05S○○(L/W/WR/WL)	**581-141**	**1.1**	**104-T8**	**A**	**P-37**
IABPF06S○○(L/W/WR/WL)	**581-142**	**2.2**	**104-T10**	**A**	
IABPF08S○○(L/W/WR/WL), IABPFM08	**581-143**	**4.9**	**105-T20**	**B**	
IABPF10S○○(L/W/WR/WL)	**581-144**	**4.9**			
IABPF12S○○(L/W/WR/WL), IABPFM12	**581-145**	**6.9**	**101-T25S**	**B**	
IABPF16S○○(L/W/WR/WL), IABPFM16	**581-146**	**9.8**	**105-T30A**	**B**	

Recommended Cutting Conditions (Inch)

※ Red indicates primary recommended insert grades.

Work material	Recommended inserts grade		Cutting conditions	φ6mm			5/16" (φ8mm)			3/8" (φ10mm)			1/2" (φ12mm)		
				Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing
	High helix edge shape	Standard		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing	
Carbon Steel Alloy Steel (<30HRC)	※ PN08M PN15M TH303 ATH80D ATH10E	ACS05E (PCA12M PCA08M)	*n* (min^{-1})	8,490	16,450	16,450	6,370	12,340	12,340	5,100	9,240	11,150	4,250	7,170	10,080
			vc (SFM)	525	1,017	1,017	525	1,018	1,018	526	952	1,149	526	887	1,247
			vf (IPM)	68	197	132	102	395	197	82	296	178	68	229	161
			fz (IPT)	.004	.006	.004	.008	.016	.008	.008	.016	.008	.008	.016	.008
			ap (inch)	.004	.002	.002	.008	.004	.004	.010	.006	.004	.012	.008	.004
			ae (inch)	.024	.024	.008	.031	.031	.010	.039	.031	.010	.047	.035	.012
Carbon Steel Alloy Steel (30-45HRC)	PN08M PN15M TH303 ATH80D	ACS05E (PCA12M PCA08M)	*n* (min^{-1})	6,370	14,320	14,320	4,780	10,750	10,750	3,820	7,640	9,550	3,180	6,100	8,760
			vc (SFM)	394	886	886	394	886	886	394	787	984	393	754	1,083
			vf (IPM)	51	172	115	76	344	172	61	244	153	51	195	140
			fz (IPT)	.004	.006	.004	.008	.016	.008	.008	.016	.008	.008	.016	.008
			ap (inch)	.004	.002	.002	.008	.004	.004	.010	.006	.004	.012	.008	.004
			ae (inch)	.024	.024	.008	.031	.031	.010	.039	.031	.010	.047	.035	.012
Cast Iron	ATH10E TH303 ATH80D PN08M PN15M	ACS05E (ATH80D PTH08M PCA12M PCA08M)	*n* (min^{-1})	8,490	16,450	16,450	6,370	12,340	12,340	5,090	9,240	11,150	4,240	7,170	10,080
			vc (SFM)	525	1,017	1,017	525	1,018	1,018	525	952	1,149	524	887	1,247
			vf (IPM)	68	263	132	153	592	197	122	444	268	102	344	242
			fz (IPT)	.004	.008	.004	.012	.024	.008	.012	.024	.012	.012	.024	.012
			ap (inch)	.004	.002	.002	.008	.004	.004	.010	.006	.004	.012	.008	.004
			ae (inch)	.024	.024	.008	.031	.031	.010	.039	.031	.010	.047	.035	.012
Graphite	HD7010 ATH10E	HD7010	*n* (min^{-1})	15,920	21,220	21,220	11,940	15,920	15,920	9,550	12,740	12,740	7,960	10,620	10,620
			vc (SFM)	985	1,312	1,312	985	1,313	1,313	984	1,313	1,313	985	1,314	1,314
			vf (IPM)	127	255	170	191	382	255	153	306	204	127	255	170
			fz (IPT)	.004	.006	.004	.008	.012	.008	.008	.012	.008	.008	.012	.008
			ap (inch)	.012	.006	.006	.016	.008	.008	.020	.012	.008	.024	.016	.008
			ae (inch)	.024	.024	.008	.031	.031	.010	.039	.031	.010	.047	.035	.012
Cast Aluminum alloys AC4A, ADC12, etc.	HD7010 PN08M	HD7010	*n* (min^{-1})	15,920	26,530	26,530	11,940	19,900	19,900	9,550	15,920	15,920	7,960	13,270	13,270
			vc (SFM)	985	1,641	1,641	985	1,641	1,641	984	1,641	1,641	985	1,641	1,641
			vf (IPM)	127	424	212	191	637	318	153	509	255	127	425	212
			fz (IPT)	.004	.008	.004	.008	.016	.008	.008	.016	.008	.008	.016	.008
			ap (inch)	.012	.006	.006	.016	.008	.008	.020	.012	.008	.024	.016	.008
			ae (inch)	.024	.024	.008	.031	.031	.010	.039	.031	.010	.047	.035	.012
Hardened Steels 45-55HRC	TH303 ATH80D PN15M PN08M	ATH80D (PTH08M PCA12M PCA08M ACS05E)	*n* (min^{-1})	5,310	12,200	12,200	3,980	9,160	9,160	3,180	6,690	8,280	2,650	5,310	7,700
			vc (SFM)	328	754	754	328	755	755	328	690	853	328	657	952
			vf (IPM)	31.86	98	98	31.84	147	147	25.44	107	132	21.2	85	123
			fz (IPT)	.003	.004	.004	.004	.008	.008	.004	.008	.008	.004	.008	.008
			ap (inch)	.004	.002	.002	.008	.004	.004	.010	.006	.004	.012	.008	.004
			ae (inch)	.024	.024	.008	.031	.031	.010	.039	.031	.010	.047	.035	.012
Hardened Steels 55-62HRC	TH303 ATH80D	ATH80D (PTH08M)	*n* (min^{-1})	4,240	9,550	9,550	3,180	7,170	7,170	2,550	5,410	6,370	2,120	4,250	6,100
			vc (SFM)	262	591	591	262	591	591	263	558	657	262	526	754
			vf (IPM)	25.44	76	76	25.44	115	115	20.4	87	102	16.96	68	98
			fz (IPT)	.003	.004	.004	.004	.008	.008	.004	.008	.008	.004	.008	.008
			ap (inch)	.004	.002	.002	.008	.004	.004	.010	.006	.004	.012	.008	.004
			ae (inch)	.024	.024	.008	.031	.031	.010	.039	.031	.010	.047	.035	.012
Maximum *fz* (IPT)				< .008			< .031			< .031			< .031		
Maximum *ap* (inch)				< .118			< .157			< .197			< .236		

【Note】 ①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③Be sure to practice safety instructions and precautions such as wearing glasses and safety shoes, and placing safety covers when you use this tool. Because this tool can be broken during machining so failure to follow these instructions may cause personal injury.
④Never attempt to modify the carbide shank holder. Use the value for the depth of cut (*ap*) when finishing with 3D or more overhang.



5/8" (ϕ 16mm)			3/4" (ϕ 20mm)			1" (ϕ 25mm)			ϕ 30mm			ϕ 32mm			Work material
Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	
General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		
3,180	4,180	9,950	2,550	3,340	9,080	2,040	2,680	8,030	1,700	2,230	7,640	1,590	2,090	7,170	Carbon Steel Alloy Steel (<30HRC)
524	689	1,641	526	689	1,872	526	691	2,069	526	690	2,362	524	689	2,365	
64	167	239	51	134	291	41	107	321	34	89	367	31.8	84	344	
.010	.020	.012	.010	.020	.016	.010	.020	.020	.010	.020	.024	.010	.020	.024	
.031	.024	.004	.039	.028	.004	.049	.035	.004	.063	.043	.004	.063	.043	.004	
.063	.043	.014	.079	.059	.016	.098	.071	.020	.126	.094	.020	.126	.094	.020	
2,390	2,990	7,560	1,910	2,550	6,690	1,530	2,040	5,990	1,270	1,700	5,730	1,190	1,590	5,370	Carbon Steel Alloy Steel (30-45HRC)
394	493	1,247	394	526	1,379	394	526	1,543	393	526	1,772	392	524	1,771	
48	120	181	38.2	102	214	30.6	82	240	25.4	68	275	23.8	64	258	
.010	.020	.012	.010	.020	.016	.010	.020	.020	.010	.020	.024	.010	.020	.024	
.031	.024	.004	.039	.028	.004	.049	.035	.004	.063	.043	.004	.063	.043	.004	
.063	.043	.012	.079	.059	.016	.098	.071	.020	.126	.094	.024	.126	.094	.024	
3,180	4,180	9,950	2,550	3,340	9,080	2,040	2,680	8,030	1,700	2,230	7,640	1,590	2,090	7,170	Cast Iron
524	689	1,641	526	689	1,872	526	691	2,069	526	690	2,362	524	689	2,365	
89	234	239	71	187	291	57	150	321	48	125	367	45	117	344	
.014	.028	.012	.014	.028	.016	.014	.028	.020	.014	.028	.024	.014	.028	.024	
.031	.024	.004	.039	.028	.004	.049	.035	.004	.063	.043	.004	.063	.043	.004	
.063	.043	.012	.079	.059	.016	.098	.071	.020	.126	.094	.024	.126	.094	.024	
5,970	7,960	7,960	4,780	6,370	6,370	3,820	5,090	5,090	3,180	4,240	4,240				Graphite
985	1,313	1,313	985	1,313	1,313	984	1,312	1,312	983	1,311	1,311				
119	191	159	96	153	127	76	204	204	64	170	204				
.010	.012	.010	.010	.012	.010	.010	.020	.020	.010	.020	.024				
.031	.024	.004	.039	.028	.004	.049	.035	.004	.063	.043	.004				
.063	.043	.012	.079	.059	.016	.098	.071	.020	.126	.094	.024				
5,970	9,950	9,950	4,780	7,960	7,960	3,820	6,370	6,370	3,180	5,310	5,310				Cast Aluminum alloys AC4A, ADC12, etc.
985	1,641	1,641	985	1,641	1,641	984	1,641	1,641	983	1,642	1,642				
119	318	199	96	255	159	76	255	255	64	212	255				
.010	.016	.010	.010	.016	.010	.010	.020	.020	.010	.020	.024				
.031	.024	.004	.039	.028	.004	.049	.035	.004	.063	.043	.004				
.063	.043	.012	.079	.059	.016	.098	.071	.020	.126	.094	.024				
1,990	2,990	6,970	1,590	2,390	6,370	1,270	1,910	5,730	1,060	1,590	5,310	1,000	1,490	4,980	Hardened Steels 45-55HRC
328	493	1,149	328	493	1,313	327	492	1,476	328	492	1,642	330	491	1,643	
19.9	54	167	15.9	43	204	12.7	34.38	229	10.6	28.62	255	10	26.82	239	
.005	.009	.012	.005	.009	.016	.005	.009	.020	.005	.009	.024	.005	.009	.024	
.031	.024	.004	.039	.028	.004	.049	.035	.004	.063	.043	.004	.063	.043	.004	
.063	.043	.012	.079	.059	.016	.098	.071	.020	.126	.094	.024	.126	.094	.024	
1,590	2,390	5,570	1,270	1,910	5,100	1,020	1,530	4,590	850	1,270	4,240	800	1,190	3,980	Hardened Steels 55-62HRC
262	394	919	262	394	1,051	263	394	1,183	263	393	1,311	264	392	1,313	
15.9	43	134	12.7	34.38	163	10.2	27.54	184	8.5	22.86	204	8	21.42	191	
.005	.009	.012	.005	.009	.016	.005	.009	.020	.005	.009	.024	.005	.009	.024	
.031	.024	.004	.039	.028	.004	.049	.035	.004	.063	.043	.004	.063	.043	.004	
.063	.043	.012	.079	.059	.016	.098	.071	.020	.126	.094	.024	.126	.094	.024	
< .039			< .039			< .039			< .039			< .039			Maximum f_z (mm/t)
< .315			< .394			< .492			< .591			< .630			Maximum a_p (mm)

※If overhang length is 3D or more, make adjustments to the table above according to the table at right.

Overhang	v_c (SFM)	v_f (IPM)
<3D	100%	100%
3D～5D	70%	70%
5D～8D	60%	60%
8D～10D	50%	50%

Line Up (Metric)

High helix edge shape inserts

		TH303	ATH80D	ATH10E	PN08M	PN15M	HD7010
P	Carbon steels	□	□	□	■	□	
K	Cast Iron, Ductile Cast Iron	□	□	■	□	□	
	Graphite						■
N	Aluminum alloys						■
H	Hardened steels	■	■		□	□	

■ : General cutting, First recommendation

□ : General cutting, Second recommendation

Shape	Item code	Tolerance class	TH303	ATH80D	ATH10E	PN08M	PN15M	HD7010	RE	LE	INSL	DC	T	Shape
Type SH	ZPFG06N-SH	F	★						3	3	5	6	2	Fig.1
	ZPFG080-SH		★						4	4.4	9.7	8	2.1	
	ZPFG100-SH		★						5	5.6	12.1	10	2.7	
	ZPFG120-SH		★						6	6.6	14.6	12	3.2	
	ZPFG160-SH		★						8	9	16.6	16	4.2	Fig.2
	ZPFG200-SH		★						10	11.5	20.3	20	5.2	
	ZPFG250-SH		★						12.5	14.5	24.1	25	6.2	
	ZPFG300-SH		★						15	18.5	29.2	30	7.2	
Type ST	ZDFG06N-ST	F		★			★		3	3	5	6	2	Fig.1
	ZDFG080-ST			●			●		4	4.4	9.7	8	2.1	
	ZDFG100-ST			●			●		5	5.6	12.1	10	2.7	
	ZDFG120-ST			●			●		6	6.6	14.6	12	3.2	
	ZDFG160-ST			●			●		8	9	16.6	16	4.2	Fig.2
	ZDFG200-ST			●			●		10	11.5	20.3	20	5.2	
	ZDFG250-ST			●			●		12.5	14.5	24.1	25	6.2	
	ZDFG300-ST			★			★		15	18.5	29.2	30	7.2	
Type SC	ZDFG06N-SC	F				★			3	3	5	6	2	Fig.1
	ZDFG080-SC					●			4	4.4	9.7	8	2.1	
	ZDFG100-SC					●			5	5.6	12.1	10	2.7	
	ZDFG120-SC					●			6	6.6	14.6	12	3.2	
	ZDFG160-SC					●			8	9	16.6	16	4.2	Fig.2
	ZDFG200-SC					●			10	11.5	20.3	20	5.2	
	ZDFG250-SC					●			12.5	14.5	24.1	25	6.2	
	ZDFG300-SC					★			15	18.5	29.2	30	7.2	
Type SF	ZDFG06N-SF	F						★	3	3	5	6	2	Fig.1
	ZDFG080-SF							★	4	4.4	9.7	8	2.1	
	ZDFG100-SF							★	5	5.6	12.1	10	2.7	
	ZDFG120-SF							★	6	6.6	14.6	12	3.2	
	ZDFG160-SF				★			★	8	9	16.6	16	4.2	Fig.2
	ZDFG200-SF				★			★	10	11.5	20.3	20	5.2	
	ZDFG250-SF				★				12.5	14.5	24.1	25	6.2	
	ZDFG300-SF				★				15	18.5	29.2	30	7.2	

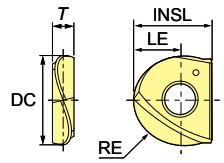


Fig.1

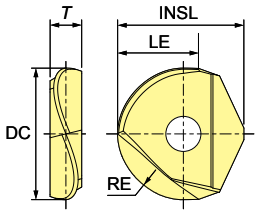
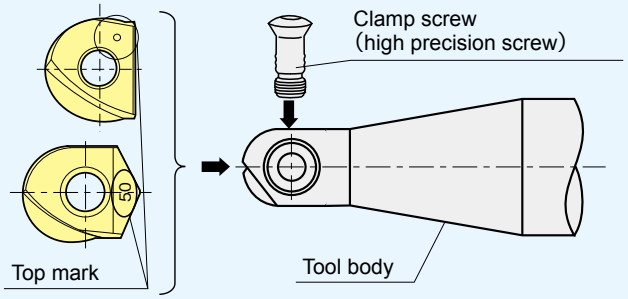


Fig.2

Set-up Procedures of Inserts

1. Clean the insert seat:
   Using air-blow or alike, clean the seat.
2. Put in the insert with its top positioned
   to the screw-tightening side of the tool body.
3. Tighten the clamp screw with the special wrench.
   Please do not press down the insert during this tightening process.
4. This is the end of insert set-up.



To meet the specification for precision of ±0.01mm, please follow this procedure.

Attention Never tighten the clamp screw without assembling the insert into the tool.

Do not tighten the screw without putting insert

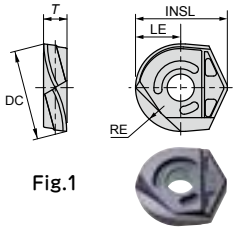
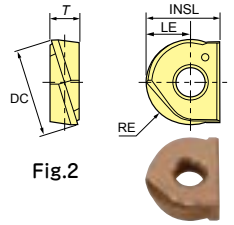
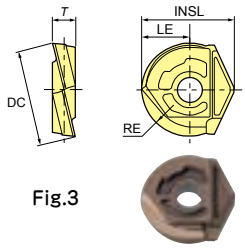
●: Inventory maintained in US ★: Inventory maintained in Japan △: Discontined after stock run out No Mark: Manufactured upon request only

Inserts

P	Carbon steels	⊔	⊔			■	
K	Cast Iron, Ductile Cast Iron	⊔	⊔	⊔	⊔	■	
	Graphite						
N	Aluminum alloys						
H	Hardened steels	⊔	⊔	⊔	■	⊔	

■ : General cutting, First recommendation

⊔ : General cutting, Second recommendation

Shape	Item code	Tolerance class	C Coating		TH Coating		ACS Coating	CBN	Size (mm)					
			PCA12M	PCA08M	PTH08M	ATH80D	ACS05E	BH200	RE	LE	INSL	DC	*T*	Shape
 Fig.1	ZPFG080	F						-	4	4.4	9.7	8	2.1	Fig.1
	ZPFG100							-	5	5.5	12.1	10	2.7	
	ZPFG120							-	6	6.6	14.6	12	3.2	
	ZPFG160							★	8	8.8	16.6	16	4.2	
	ZPFG200							★	10	11	20.3	20	5.2	
	ZPFG250							★	12.5	13.7	24.1	25	6.2	
	ZPFG300							★	15	16.5	29.2	30	7.2	
	ZPFG320		△	△	△			-	16	17.6	30.2	32	7.2	
 Fig.2	ZDFG060-WF	F						-	3	3	5	6	2	Fig.2
	ZDFG060-WH							-	3	3	5	6	2	
	ZDFG080-WF							-	4	4	9.7	8	2.1	Fig.3
	ZDFG080-WH							-	4	4	9.7	8	2.1	
	ZDFG100-WF							-	5	5	12.1	10	2.7	
	ZDFG100-WH							-	5	5	12.1	10	2.7	
	ZDFG120-WF							-	6	6	14.6	12	3.2	
	ZDFG120-WH							-	6	6	14.6	12	3.2	
 Fig.3	ZDFG160-WF							-	8	8	16.6	16	4.2	
	ZDFG160-WH							-	8	8	16.6	16	4.2	
	ZDFG200-WF							-	10	10	20.3	20	5.2	
	ZDFG200-WH							-	10	10	20.3	20	5.2	
	ZDFG250-WF							-	12.5	12.5	24.1	25	6.2	
	ZDFG250-WH							-	12.5	12.5	24.1	25	6.2	
	ZDFG300-WF							-	15	15	29.2	30	7.2	
	ZDFG300-WH							-	15	15	29.2	30	7.2	
	ZDFG320-WF						△	-	16	16	30.2	32	7.2	
W type:WF/WH For vertical wall machining; Regrinding is not possible.	ZDFG320-WH					△		-	16	16	30.2	32	7.2	

Comparative table of the conventional and new items.

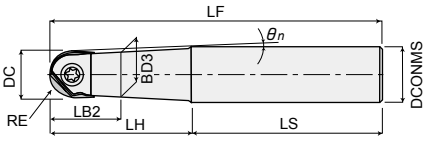
Numeric figure comes in a circle ◌.

Conventional		Diameter		High helix edge shape inserts	
Item Code	Grade			Item Code	Grade
ZPFG◌◌◌	PTH08M	ϕ8 ~ 30 (mm)	➡	ZDFG◌◌◌-ST	ATH80D
	PCA08M		➡	ZDFG◌◌◌-SC	PN08M
	PCA12M		➡	ZDFG◌◌◌-ST	PN15M
IZPFG◌◌◌		.312 ~ 1.000 (inch)	➡	IZDFG◌◌◌-ST	
IZDFG◌◌◌-WH	ATH80D	.312 ~ 1.000 (inch)	➡	IZDFG◌◌◌-ST	TH303
ZDFG◌◌◌-WH	ATH80D	ϕ6 ~ 30 (mm)	➡	ZDFG◌◌◌-ST	ATH80D
(I)ZDFG◌◌◌-WF	ACS05E	ϕ6 ~ 12 (mm), .312 ~ 1.000 (inch)	➡	(I)ZDFG◌◌◌-SC	PN08M
		ϕ16 ~ 30 (mm)	➡	ZDFG◌◌◌-SF	ATH10E

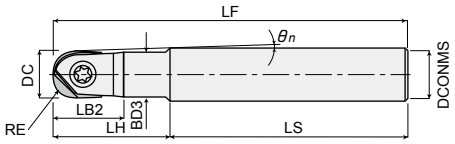
－: Not Manufactured

Steel Shank ABPF○○S○○(L/L○○○)

Numeric figure in a circle ○ and Alphabetical character comes in a square □



Type A (Taper neck)



Type B (Straight neck)

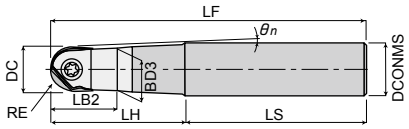
	Item code	Stock	No.of inserts	Size (mm)									Type	Inserts	
				DC	RE	LF	DCONMS	LB2	LH	BD3	LS	θn			
Regular	ABPF06S10	★	1	6	3	80	10	15	30	5.4	50	4.3°	A	ZPFG06N-SH	ZDFG06N-S□
	ABPF08S12	●	1	8	4	100	12	10	22	7.5	78	6.4°	A	ZPFG080-SH	ZDFG080-S□
	ABPF10S12	●	1	10	5	100	12	13	25	9.5	75	2.9°	A	ZPFG100-SH	ZDFG100-S□
	ABPF12S12	●	1	12	6	110	12	15	30	11.5	80	—	B	ZPFG120-SH	ZDFG120-S□
	ABPF16S20	●	1	16	8	130	20	27	50	15	80	2.8°	A	ZPFG160-SH	ZDFG160-S□
	ABPF20S25	●	1	20	10	140	25	35	60	19	80	2.9°	A	ZPFG200-SH	ZDFG200-S□
	ABPF25S32	●	1	25	12.5	150	32	43	70	24	80	3.5°	A	ZPFG250-SH	ZDFG250-S□
	ABPF30S32	★	1	30	15	160	32	55	80	29	80	1.2°	A	ZPFG300-SH	ZDFG300-S□
	ABPF32S32	★	1	32	16	160	32	58	80	31	80	—	B	ZPFG320(-G□)	ZDFG320-W□
Under neck long	ABPF08S12L	●	1	8	4	130	12	10	50	7.5	80	2.5°	A	ZPFG080-SH	ZDFG080-S□
	ABPF10S16L	●	1	10	5	150	16	13	50	9.5	100	3.9°	A	ZPFG100-SH	ZDFG100-S□
	ABPF12S16L	●	1	12	6	160	16	15	60	10.8	100	2.2°	A	ZPFG120-SH	ZDFG120-S□
	ABPF16S20L	●	1	16	8	160	20	27	65	15	95	2.1°	A	ZPFG160-SH	ZDFG160-S□
	ABPF20S25L	●	1	20	10	180	25	35	80	19	100	2.1°	A	ZPFG200-SH	ZDFG200-S□
	ABPF20S20L120	★	1	20	10	220	20	35	120	19	100	—	B		
	ABPF20S20L150	★	1	20	10	250	20	35	150	19	100	—	B		
	ABPF25S32L	●	1	25	12.5	200	32	43	90	24	110	2.6°	A	ZPFG250-SH	ZDFG250-S□
	ABPF25S32L150	●	1	25	12.5	250	32	43	150	24	100	1.5°	B		
	ABPF30S32L	★	1	30	15	220	32	55	100	29	120	0.7°	A	ZPFG300-SH	ZDFG300-S□
	ABPF30S32L150	★	1	30	15	250	32	55	150	29	100	0.5°	B		
	ABPF30S32L200	★	1	30	15	300	32	55	200	29	100	0.3°	B		
	ABPF32S32L	★	1	32	16	220	32	58	100	31	120	—	B	ZPFG320(-G□)	ZDFG320-W□

●: Inventory maintained in US ★: Inventory maintained in Japan No Mark: Manufactured upon request only

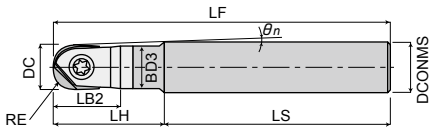
Carbide shank

ABPF○○S○○W(□/□○○○)

Numeric figure in a circle ○ and
Alphabetical character comes in a square □.



Type A (Taper neck)



Type B (Straight neck)

Item code	Stock	No.of inserts	Size (mm)									Type	Inserts
			DC	RE	LF	DCONMS	LB2	LH	BD3	LS	θn		
ABPF06S06W	★	1	6	3	90	6	10.3	25	5.5	65	—	B	ZPFG06N-SH ZDFG06N-S□
ABPF06S06WL65	★	1	6	3	120	6	10.3	65	5.5	55	—	B	
ABPF08S08W-90-25	★	1	8	4	90	8	25	25	7.5	65	—	B	ZPFG080-SH ZDFG080-S□
ABPF08S08W	●	1	8	4	100	8	30	30	7.5	70	—	B	
ABPF08S08W-115-50	★	1	8	4	115	8	50	50	7.5	65	—	B	
ABPF08S08WL	●	1	8	4	130	8	65	65	7.5	65	—	B	
ABPF08S08W-140-75	●	1	8	4	140	8	75	75	7.5	65	—	B	
ABPF08S08WL95	★	1	8	4	160	8	95	95	7.5	65	—	B	
ABPF08S08W-175-110	★	1	8	4	175	8	110	110	7.5	65	—	B	
ABPF08S12WLT75		1	8	4	140	12	14	75	7.5	65	1.62°	A	
ABPF10S10W-90-25	★	1	10	5	90	10	18	25	9.5	65	—	B	ZPFG100-SH ZDFG100-S□
ABPF10S10W	●	1	10	5	100	10	18	35	9.5	65	—	B	
ABPF10S10W-115-50	★	1	10	5	115	10	18	50	9.5	65	—	B	
ABPF10S10WL	●	1	10	5	140	10	18	75	9.5	65	—	B	
ABPF10S10WL95	★	1	10	5	160	10	18	95	9.5	65	—	B	
ABPF10S10W-185-120	●	1	10	5	185	10	18	120	9.5	65	—	B	
ABPF10S10WL140	★	1	10	5	220	10	18	140	9.5	80	—	B	
ABPF10S12WLT75		1	10	5	140	12	18	75	9.5	65	0.82°	A	
ABPF12S12W-95-30	★	1	12	6	95	12	21	30	11.5	65	—	B	ZPFG120-SH ZDFG120-S□
ABPF12S12W	●	1	12	6	110	12	21	45	11.5	65	—	B	
ABPF12S12W-125-60	★	1	12	6	125	12	21	60	11.5	65	—	B	
ABPF12S12WL	●	1	12	6	150	12	21	85	11.5	65	—	B	
ABPF12S12WL100	★	1	12	6	200	12	21	100	11.5	100	—	B	
ABPF12S12WL120	★	1	12	6	200	12	21	120	11.5	80	—	B	
ABPF12S12WL150	★	1	12	6	220	12	21	150	11.5	70	—	B	
ABPF12S16WLT85		1	12	6	150	16	21	85	11.5	65	1.45°	A	
ABPF16S16W-105-35	★	1	16	8	105	16	27	35	15	70	—	B	ZPFG160-SH ZDFG160-S□
ABPF16S16W-120-50	★	1	16	8	120	16	27	50	15	70	—	B	
ABPF16S16W60	★	1	16	8	130	16	27	60	15	70	—	B	
ABPF16S16WL80	★	1	16	8	160	16	27	80	15	80	—	B	
ABPF16S16WL100	★	1	16	8	200	16	27	100	15	100	—	B	
ABPF16S16WE	●	1	16	8	200	16	27	120	15	80	—	B	
ABPF16S16WE150	★	1	16	8	220	16	27	150	15	70	—	B	
ABPF16S16W-250-180	★	1	16	8	250	16	27	180	15	70	—	B	
ABPF16S20WLT100		1	16	8	165	20	27	100	15	65	1.25°	A	
ABPF20S20W-120-40	★	1	20	10	120	20	35	40	19	80	—	B	ZPFG200-SH ZDFG200-S□
ABPF20S20W-140-60	★	1	20	10	140	20	35	60	19	80	—	B	
ABPF20S20W80	★	1	20	10	160	20	35	80	19	80	—	B	
ABPF20S20WL100	★	1	20	10	220	20	35	100	19	120	—	B	
ABPF20S20WL120	★	1	20	10	220	20	35	120	19	100	—	B	
ABPF20S20WE	●	1	20	10	250	20	35	150	19	100	—	B	
ABPF20S20W-270-190	●	1	20	10	270	20	35	190	19	80	—	B	
ABPF20S20WE220	★	1	20	10	300	20	35	220	19	80	—	B	
ABPF20S25WLT115		1	20	10	195	25	35	115	19	80	1.37°	A	
ABPF25S25W-130-50	★	1	25	12.5	130	25	43	50	24	80	—	B	ZPFG250-SH ZDFG250-S□
ABPF25S25W-160-80	★	1	25	12.5	160	25	43	80	24	80	—	B	
ABPF25S25W100	★	1	25	12.5	220	25	43	100	24	120	—	B	
ABPF25S25WL120	★	1	25	12.5	220	25	43	120	24	100	—	B	
ABPF25S25WL150	★	1	25	12.5	250	25	43	150	24	100	—	B	
ABPF25S25WE	●	1	25	12.5	300	25	43	190	24	110	—	B	
ABPF25S25W-300-220	●	1	25	12.5	300	25	43	220	24	80	—	B	
ABPF25S32WLT135		1	25	12.5	215	32	43	135	24	80	1.64°	A	
ABPF30S32W-160-80	●	1	30	15	160	32	55	80	29	80	—	B	ZPFG300-SH ZDFG300-S□
ABPF30S32W100	★	1	30	15	180	32	55	100	29	80	0.7°	B	
ABPF30S32W120	★	1	30	15	220	32	55	120	29	100	0.6°	B	
ABPF30S32WL150	★	1	30	15	250	32	55	150	29	100	0.4°	B	
ABPF30S32W-260-180	★	1	30	15	260	32	55	180	29	80	—	B	
ABPF30S32W-290-210	●	1	30	15	290	32	55	210	29	80	—	B	
ABPF30S32WE	★	1	30	15	350	32	55	230	29	120	0.3°	B	
ABPF30S32WLT160		1	30	15	240	32	55	160	29	80	0.4°	A	
ABPF32S32W120	★	1	32	16	200	32	58	120	31	80	—	B	ZPFG320(-G□) ZDFG320-W□
ABPF32S32WL150	★	1	32	16	250	32	58	150	31	100	—	B	
ABPF32S32WE220	●	1	32	16	300	32	58	220	31	80	—	B	

Modular Mill Type ABPFM○○

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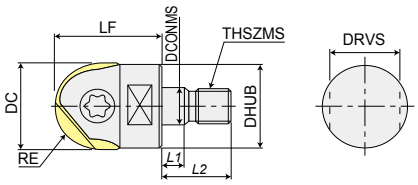
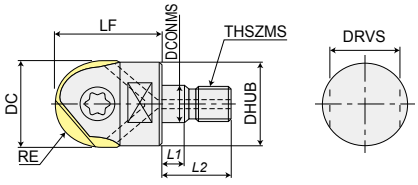


Item code	Stock	No.of inserts	Size (mm)									Inserts	
			DC	RE	LF	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS		
ABPFM10	★	1	**10**	5	26	6.5	M6	9.8	5.5	14.5	7	ZPFG100-SH	ZDFG100-S□
ABPFM12	★	1	**12**	6	26	6.5	M6	9.8	5.5	14.5	7	ZPFG120-SH	ZDFG120-S□
ABPFM16	★	1	**16**	8	32	8.5	M8	12.8	5.5	17	10	ZPFG160-SH	ZDFG160-S□
ABPFM20	●	1	**20**	10	38	10.5	M10	17.8	5.5	19	15	ZPFG200-SH	ZDFG200-S□
ABPFM25	●	1	**25**	12.5	38	12.5	M12	20.8	5.5	22	17	ZPFG250-SH	ZDFG250-S□
ABPFM30	★	1	**30**	15	43	17	M16	28.8	6	23	22	ZPFG300-SH	ZDFG300-S□
ABPFM32	★	1	**32**	16	43	17	M16	28.8	6	23	22	ZPFG320(-G□)	ZDFG320-W□



With air hole

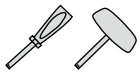
Item code	Stock	No.of inserts	Size (mm)									Inserts	
			DC	RE	LF	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS		
ABPFM10-M6H	★	1	**10**	5	26	6.5	M6	9.8	5.5	14.5	7	ZPFG100-SH	ZDFG100-S□
ABPFM12-M6H	★	1	**12**	6	26	6.5	M6	9.8	5.5	14.5	7	ZPFG120-SH	ZDFG120-S□
ABPFM16-M8H	★	1	**16**	8	32	8.5	M8	12.8	5.5	17	10	ZPFG160-SH	ZDFG160-S□
ABPFM20-M10H	★	1	**20**	10	38	10.5	M10	17.8	5.5	19	15	ZPFG200-SH	ZDFG200-S□
ABPFM25-M12H	★	1	**25**	12.5	38	12.5	M12	20.8	5.5	22	17	ZPFG250-SH	ZDFG250-S□
ABPFM30-M16H	★	1	**30**	15	43	17	M16	28.8	6	23	22	ZPFG300-SH	ZDFG300-S□

[Note] Do not apply lubricants such as grease, etc. to the “contact faces” and “modular screws” of the “modular mill”, “dedicated shanks” and “dedicated arbor”.

● : Inventory maintained in US ★ : Inventory maintained in Japan

Parts

Numeric figure in a circle ◌.

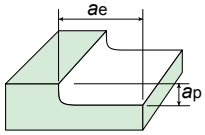
Parts	Clamp screw		Screw driver / Wrench		Screw anti-seizure agent
Shape / Cutter Body		Fastening torque (N・m)	 A B	Shape	
ABPF06S◌◌(W/WL◌◌)	581-140	0.5	104-T6	A	P-37
ABPF08S◌◌(L/W/WL/WL◌◌◌/WLT◌◌)	581-141	1.1	104-T8	A	
ABPF10S◌◌(L/W/WL/WL◌◌◌/WLT◌◌) ABPFM10(−M6H)	581-142	2.2	104-T10	A	
ABPF12S◌◌(L/W/WL/WL◌◌◌/WLT◌◌) ABPFM12(−M6H)	581-143	4.9	105-T20	B	
ABPF16S◌◌(L/W◌◌/WL◌◌◌/WE/WE◌◌◌/WLT◌◌◌)	581-144	4.9			
ABPFU16W220 ABPFM16(−M8H)					
ABPF20S◌◌(L/W◌◌/WL◌◌◌/WE/WE◌◌◌/WLT◌◌◌)	581-145	6.9	101-T25S	B	
ABPF20MT2 ABPFU20W270 ABPFM20(−M10H)					
ABPF25S◌◌(L/W◌◌/WL◌◌◌/WE/WE◌◌◌/WLT◌◌◌)	581-146	9.8	105-T30A	B	
ABPF25MT3 ABPFU25W300 ABPFM25(−M12H)					
ABPF30S◌◌(L/W◌◌/WL◌◌◌/WE/WE◌◌◌/WLT◌◌◌)	581-147	9.8			
ABPF30MT4 ABPFU30W300 ABPFM30(−M16H)					
ABPF32S◌◌(L/W◌◌◌/WL◌◌◌/WE◌◌◌)	581-147	9.8			
ABPF32MT4 ABPFM32					

Recommended Cutting Conditions (Metric)

※ Red indicates primary recommended insert grades.

Work material	Recommended inserts grade		Cutting conditions	φ6			φ8			φ10			φ12		
				Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing
	High helix edge shape	Standard		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing	
Carbon Steel Alloy Steel (<30HRC)	※ PN08M PN15M TH303 ATH80D ATH10E	ACS05E (PCA12M PCA08M)	*n* (min^{-1})	8,490	16,450	16,450	6,370	12,340	12,340	5,100	9,240	11,150	4,250	7,170	10,080
			vc (m/min)	160	310	310	160	310	310	160	290	350	160	270	380
			vf (mm/min)	1,700	4,930	3,290	2,550	9,870	4,940	2,040	7,390	4,460	1,700	5,740	4,030
			fz (mm/t)	0.1	0.15	0.1	0.2	0.4	0.2	0.2	0.4	0.2	0.2	0.4	0.2
			ap (mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
			ae (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Carbon Steel Alloy Steel (30-45HRC)	PN08M PN15M TH303 ATH80D	ACS05E (PCA12M PCA08M)	*n* (min^{-1})	6,370	14,320	14,320	4,780	10,750	10,750	3,820	7,640	9,550	3,180	6,100	8,760
			vc (m/min)	120	270	270	120	270	270	120	240	300	120	230	330
			vf (mm/min)	1,270	4,300	2,860	1,910	8,600	4,300	1,530	6,110	3,820	1,270	4,880	3,500
			fz (mm/t)	0.1	0.15	0.1	0.2	0.4	0.2	0.2	0.4	0.2	0.2	0.4	0.2
			ap (mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
			ae (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Cast Iron	ATH10E TH303 ATH80D PN08M PN15M	ACS05E (ATH80D PTH08M PCA12M PCA08M)	*n* (min^{-1})	8,490	16,450	16,450	6,370	12,340	12,340	5,090	9,240	11,150	4,240	7,170	10,080
			vc (m/min)	160	310	310	160	310	310	160	290	350	160	270	380
			vf (mm/min)	1,700	6,580	3,290	3,820	14,810	4,940	3,050	11,090	6,690	2,550	8,600	6,050
			fz (mm/t)	0.1	0.2	0.1	0.3	0.6	0.2	0.3	0.6	0.3	0.3	0.6	0.3
			ap (mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
			ae (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Graphite	HD7010 ATH10E	HD7010	*n* (min^{-1})	15,920	21,220	21,220	11,940	15,920	15,920	9,550	12,740	12,740	7,960	10,620	10,620
			vc (m/min)	300	400	400	300	400	400	300	400	400	300	400	400
			vf (mm/min)	3,180	6,370	4,240	4,780	9,550	6,370	3,820	7,640	5,100	3,190	6,370	4,240
			fz (mm/t)	0.1	0.15	0.1	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.2
			ap (mm)	0.3	0.15	0.15	0.4	0.2	0.2	0.5	0.3	0.2	0.6	0.4	0.2
			ae (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1.0	0.8	0.25	1.2	0.9	0.3
Cast Aluminum alloys AC4A, ADC12, etc.	HD7010 PN08M	HD7010	*n* (min^{-1})	15,920	26,530	26,530	11,940	19,900	19,900	9,550	15,920	15,920	7,960	13,270	13,270
			vc (m/min)	300	500	500	300	500	500	300	500	500	300	500	500
			vf (mm/min)	3,180	10,610	5,310	4,780	15,920	7,960	3,820	12,740	6,370	3,190	10,620	5,310
			fz (mm/t)	0.1	0.2	0.1	0.2	0.4	0.2	0.2	0.4	0.2	0.2	0.4	0.2
			ap (mm)	0.3	0.15	0.15	0.4	0.2	0.2	0.5	0.3	0.2	0.6	0.4	0.2
			ae (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1.0	0.8	0.25	1.2	0.9	0.3
Hardened Steels 45-55HRC	TH303 ATH80D PN15M PN08M	ATH80D (PTH08M PCA12M PCA08M ACS05E)	*n* (min^{-1})	5,310	12,200	12,200	3,980	9,160	9,160	3,180	6,690	8,280	2,650	5,310	7,700
			vc (m/min)	100	230	230	100	230	230	100	210	260	100	200	290
			vf (mm/min)	850	2,440	2,440	800	3,660	3,660	640	2,680	3,310	530	2,120	3,080
			fz (mm/t)	0.08	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2
			ap (mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
			ae (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Hardened Steels 55-62HRC	TH303 ATH80D	ATH80D (PTH08M)	*n* (min^{-1})	4,240	9,550	9,550	3,180	7,170	7,170	2,550	5,410	6,370	2,120	4,250	6,100
			vc (m/min)	80	180	180	80	180	180	80	170	200	80	160	230
			vf (mm/min)	680	1,910	1,910	640	2,870	2,870	510	2,160	2,550	420	1,700	2,440
			fz (mm/t)	0.08	0.1	0.1	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2	0.2
			ap (mm)	0.1	0.05	0.05	0.2	0.1	0.1	0.25	0.15	0.1	0.3	0.2	0.1
			ae (mm)	0.6	0.6	0.2	0.8	0.8	0.25	1	0.8	0.25	1.2	0.9	0.3
Maximum *fz* (mm/t)				< 0.2			< 0.8			< 0.8			< 0.8		
Maximum *ap* (mm)				< 3.0			< 4.0			< 5.0			< 6.0		

【Note】
①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③Be sure to practice safety instructions and precautions such as wearing glasses and safety shoes, and placing safety covers when you use this tool. Because this tool can be broken during machining so failure to follow these instructions may cause personal injury.
④Never attempt to modify the carbide shank holder. Use the value for the depth of cut (*ap*) when finishing with 3D or more overhang.



ABPF

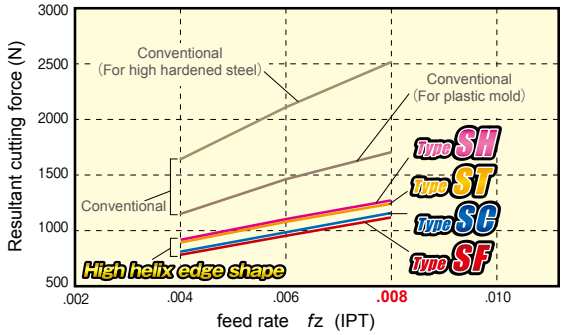
φ16			φ20			φ25			φ30			φ32			Work material
Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	Semi Finishing		Finishing	
General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		General purpose	High-speed processing		
3,180	4,180	9,950	2,550	3,340	9,080	2,040	2,680	8,030	1,700	2,230	7,640	1,590	2,090	7,170	Carbon Steel Alloy Steel (<30HRC)
160	210	500	160	210	570	160	210	630	160	210	720	160	210	720	
1,590	4,180	5,970	1,280	3,340	7,260	1,020	2,680	8,030	850	2,230	9,170	800	2,090	8,600	
0.25	0.5	0.3	0.25	0.5	0.4	0.25	0.5	0.5	0.25	0.5	0.6	0.25	0.5	0.6	
0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1	1.6	1.1	0.1	1.6	1.1	0.1	
1.6	1.1	0.35	2	1.5	0.4	2.5	1.8	0.5	3.2	2.4	0.5	3.2	2.4	0.5	
2,390	2,990	7,560	1,910	2,550	6,690	1,530	2,040	5,990	1,270	1,700	5,730	1,190	1,590	5,370	Carbon Steel Alloy Steel (30-45HRC)
120	150	380	120	160	420	120	160	470	120	160	540	120	160	540	
1,200	2,990	4,540	960	2,550	5,350	770	2,040	5,990	640	1,700	6,880	600	1,590	6,440	
0.25	0.5	0.3	0.25	0.5	0.4	0.25	0.5	0.5	0.25	0.5	0.6	0.25	0.5	0.6	
0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1	1.6	1.1	0.1	1.6	1.1	0.1	
1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5	3.2	2.4	0.6	3.2	2.4	0.6	
3,180	4,180	9,950	2,550	3,340	9,080	2,040	2,680	8,030	1,700	2,230	7,640	1,590	2,090	7,170	Cast Iron
160	210	500	160	210	570	160	210	630	160	210	720	160	210	720	
2,230	5,850	5,970	1,790	4,680	7,260	1,430	3,750	8,030	1,190	3,120	9,170	1,110	2,930	8,600	
0.35	0.7	0.3	0.35	0.7	0.4	0.35	0.7	0.5	0.35	0.7	0.6	0.35	0.7	0.6	
0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1	1.6	1.1	0.1	1.6	1.1	0.1	
1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5	3.2	2.4	0.6	3.2	2.4	0.6	
5,970	7,960	7,960	4,780	6,370	6,370	3,820	5,090	5,090	3,180	4,240	4,240				Graphite
300	400	400	300	400	400	300	400	400	300	400	400				
2,990	4,780	3,980	2,390	3,820	3,190	1,910	5,090	5,090	1,590	4,240	5,090				
0.25	0.3	0.25	0.25	0.3	0.25	0.25	0.5	0.5	0.25	0.5	0.6				
0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1	1.6	1.1	0.1				
1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5	3.2	2.4	0.6				
5,970	9,950	9,950	4,780	7,960	7,960	3,820	6,370	6,370	3,180	5,310	5,310				Cast Aluminum alloys AC4A, ADC12, etc.
300	500	500	300	500	500	300	500	500	300	500	500				
2,990	7,960	4,980	2,390	6,370	3,980	1,910	6,370	6,370	1,590	5,310	6,370				
0.25	0.4	0.25	0.25	0.4	0.25	0.25	0.5	0.5	0.25	0.5	0.6				
0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1	1.6	1.1	0.1				
1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5	3.2	2.4	0.6				
1,990	2,990	6,970	1,590	2,390	6,370	1,270	1,910	5,730	1,060	1,590	5,310	1,000	1,490	4,980	Hardened Steels 45-55HRC
100	150	350	100	150	400	100	150	450	100	150	500	100	150	500	
480	1,440	4,180	380	1,150	5,100	310	920	5,730	250	760	6,370	240	720	5,980	
0.12	0.24	0.3	0.12	0.24	0.4	0.12	0.24	0.5	0.12	0.24	0.6	0.12	0.24	0.6	
0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1	1.6	1.1	0.1	1.6	1.1	0.1	
1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5	3.2	2.4	0.6	3.2	2.4	0.6	
1,590	2,390	5,570	1,270	1,910	5,100	1,020	1,530	4,590	850	1,270	4,240	800	1,190	3,980	Hardened Steels 55-62HRC
80	120	280	80	120	320	80	120	360	80	120	400	80	120	400	
380	1,150	3,340	300	920	4,080	240	730	4,590	200	610	5,090	190	570	4,780	
0.12	0.24	0.3	0.12	0.24	0.4	0.12	0.24	0.5	0.12	0.24	0.6	0.12	0.24	0.6	
0.8	0.6	0.1	1	0.7	0.1	1.25	0.9	0.1	1.6	1.1	0.1	1.6	1.1	0.1	
1.6	1.1	0.3	2	1.5	0.4	2.5	1.8	0.5	3.2	2.4	0.6	3.2	2.4	0.6	
< 1.0			< 1.0			< 1.0			< 1.0			< 1.0			Maximum f_z (mm/t)
< 8.0			< 10.0			< 12.5			< 15.0			< 16.0			Maximum a_p (mm)

※If overhang length is 3D or more, make adjustments to the table above according to the table at right.

Overhang	v_c (m/min)	v_f (mm/min)
<3D	100%	100%
3D～5D	70%	70%
5D～8D	60%	60%
8D～10D	50%	50%

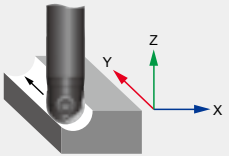
Cutting performance

01 Cutting force comparison between conventional edge shape and high helix one.



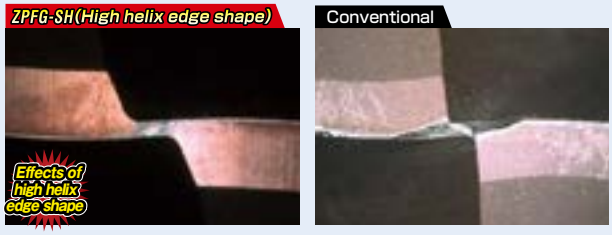
Cutting conditions

Work material : 1050 (220HB)
Tool : Diameter 30mm (DC 1.181 inch)
v_c = 656 SFM f_z=.004, .006, .008 IPT
Axial depth of cut (a_p) = .591 inch
Radial depth of cut (a_e) = .020 inch



Type SH

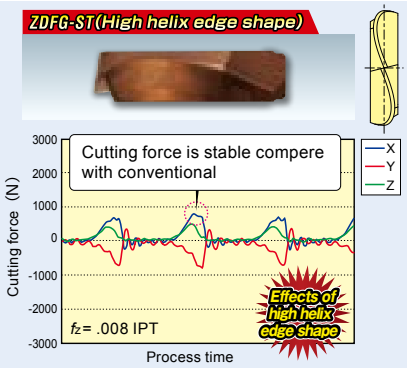
02 Strength comparison of tip chisel by heavy interrupted cutting test

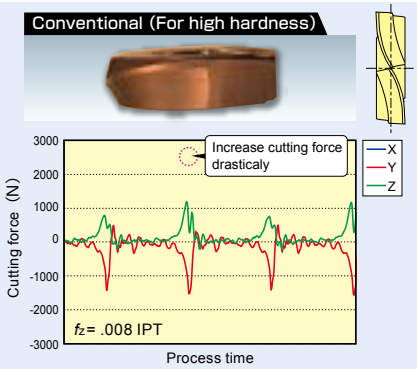


Cutting conditions

Work material : D2 (60HRC)
Tool : ABPFM25 Diameter 25mm (DC .984 inch)
Shank : ASC25-12.5-265-145 (Overhang : 7.205 inch)
v_c = 1,030 SFM (n=4,000min^{-1})
f_z= .028 IPT (v_f= 220.5 IPM)
Axial depth of cut (a_p)= .020 inch
Radial depth of cut (a_e)= .039 inch
Air

Type ST





Type SC

03 Comparison of performance with solid end mill and type SC

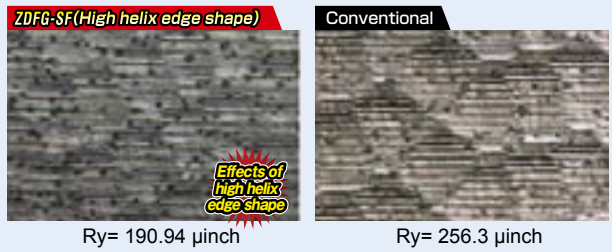
Improves chip discharge performance by high helix edge shape.
Good cutting surface on semi-finishing process.

Cutting conditions

Work material : 1050 (220HB)
Tool : Diameter 10mm (DC .394 inch)
v_c = 656 SFM (n= 6,366min^{-1})
f_z= .004 IPT (v_f= 50.1 IPM)
Axial depth of cut (a_p)= .020 inch
Radial depth of cut (a_e)= .079 inch
Air

Type SF

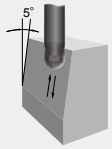
04 Comparison of cutting surface with type SF and conventional



Ry= 190.94 µinch Ry= 256.3 µinch

Cutting conditions

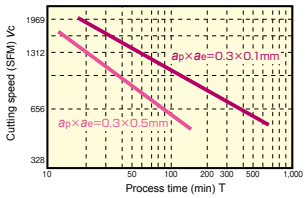
Work material : Cast Iron
Tool : ABPFM30 Diameter 30mm (DC 1.181 inch)
Shank : ASC32-17-260-140 (Overhang : 7.874 inch)
Machine : Vertical type (BT50)
v_c= 2,625 SFM f_z= .019 IPT
Radial depth of cut (a_e)= .012 inch
Pick feed (pf)= .020 inch
Cutting shape : 5° sloped surface



Field data

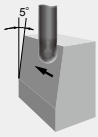
01 Vc-T chart for D2 (60HRC)

TypeSH



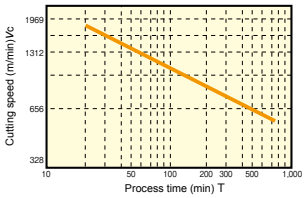
Cutting conditions

Work material : D2 (60HRC)
Tool : ABPF25S25W100
Insert : ZPFG250-SH(TH303)
Overhang : 4.724 inch
Feed rate : f_z= .016 IPT
Radial depth of cut : a_p×a_e= .012 × .004 inch,
a_p×a_e= .012 × .020 inch
Machine : Vertical type(BT50)
Cutting shape : contouring cutting on the sloped face 5°
Air



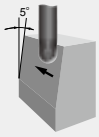
02 Vc-T chart for D2 (60HRC)

TypeST



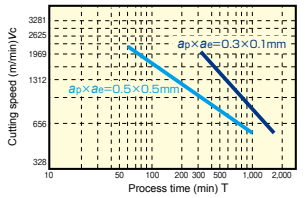
Cutting conditions

Work material : D2 (60HRC)
Tool : ABPF30S32WL150
Insert : ZDFG300-ST (ATH80D)
Overhang : 5.906 inch
Feed rate : f_z= .012 IPT
Radial depth of cut : a_p×a_e= .012 × .004 inch
Machine : Vertical type(BT50)
Cutting shape : contouring cutting on the sloped face 5°
Air



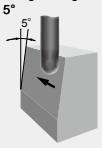
03 Vc-T chart for Pre-hardened steel (P21 40HRC)

TypeSC



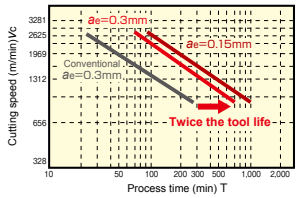
Cutting conditions

Work material : P21 (40HRC)
Tool : ABPFM20
Shank : ASC20-10.5-120-50Z
Insert : ZDFG200-SC (PN08M)
Overhang : 3.937 inch
Feed rate : f_z= .012 IPT
Radial depth of cut : a_p×a_e= .012 × .004 inch,
a_p×a_e= .020 × .020 inch
Machine : Vertical type(BT50)
Cutting shape : contouring cutting on the sloped face 5°
Air



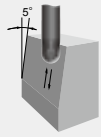
04 Vc-T chart for Cast Iron

TypeSF

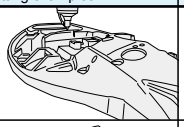
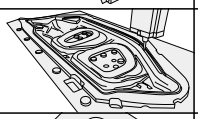
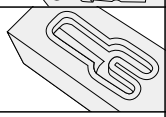
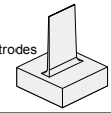
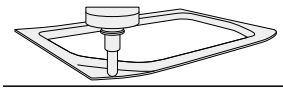


Cutting conditions

Work material : Cast Iron
Vc=Variable
Feed rate : f_z= .019 IPT
Machine : Vertical type(BT50)
Tool : ABPFM30 Diameter φ30 (DC 1.181 inch)
Shank : ASC32-17-260-140 (Overhang : 7.874 inch)
Insert : ZDFG300-SF (ATH10E)
Radial depth of cut (a_e)= .006, .012 inch
Pick feed (pf)= .020 inch
Cutting shape : 5° sloped surface
Air



Field Data

Cutting examples	Cutting Conditions	Result
Frame hard steels (surface 55~60HRC) 	Tool : ABPF25S25W100 Work material : Frame hard steels (surface 55~60HRC) Insert : ZDFG250-ST(ATH80D) Machine : Gate type M/C(BT50) Cutting speed : V_c = 1,289 SFM Revolution : n = 5,000min^{-1} Feed rate : V_f = 204.7 IPM Feed rate : f_z= .020 IPT Depth of cut : a_p = .004 inch Pick feed : a_e = .020 inch Coolant : Dry	Still nomal wear even after 11 hours process. Improves the surface roughness than conventional.
Plastic mold (S50C) 	Tool : ABPF20S20WL100 Work material : 1050 Insert : ZDFG200-SC(PN08M) Machine : Horizontal type M/C(BT50) Cutting speed : V_c = 823 SFM Revolution : n = 4,000min^{-1} Feed rate : V_f = 78.7 IPM Feed rate : f_z= .010 IPT Depth of cut : a_p = .004 inch Pick feed : a_e = .016 inch Coolant : Dry	Still nomal wear even after 15 hours process. Improves the surface roughness than conventional.
Press die (as FCD700) 	Tool : ABPF30S32W120 Work material : Material equivalent to Cast Iron Insert : ZDFG300-SF(ATH10E) Machine : Gate type M/C(BT50) Cutting speed : V_c = 1,673 SFM Revolution : n = 5,400min^{-1} Feed rate : V_f = 177.2 IPM Feed rate : f_z= .017 IPT Depth of cut : a_p = .008 inch Pick feed : a_e = .020 inch Coolant : Dry	Finished surface is fine. Re-grinding is possible by nomal wear after process.
Forging die 	Tool : ABPF12S12W Work material : H13 (45HRC) Insert : ZDFG120-ST (PN15M) Machine : Vertical type M/C(BT50) Cutting speed : V_c = 308 SFM Revolution : n = 2,500min^{-1} Feed rate : V_f = 31.5 IPM Feed rate : f_z= .006 IPT Depth of cut : a_p = .012~ .020 inch Pick feed : a_e = .020 inch Coolant : Dry	Nomal wear after overhang cutting (2.362 inch L/D:5)
Machining of graphite electrodes 	Tool : ABPF10S10WL Work material : Graphite Insert : ZDFG100-SF(HD7010) Machine : Vertical type M/C(BT40) Cutting speed : V_c = 823 SFM Revolution : n = 8,000min^{-1} Feed rate : V_f = 23.6 IPM Feed rate : f_z= .001 IPT Depth of cut(Rough): a_p = .118 inch (Finishing): a_p = .012 inch Pick feed(Rough) : a_e = .157 inch (Finishing): a_e = .004 inch Coolant : Dry	Even for tool projection of 75mm (L/D: 7.5), roughing was stable resulting in good finished surface accuracy.
Ductile cast iron and frame hard steels 	Tool : ABPF30S32WL150 Work material : Ductile cast iron and frame hard steels(55HRC) Insert : ZPFG300-SH (TH303) Machine : Gate type M/C(BT50) Cutting speed : V_c = 1,545 SFM Revolution : n = 5,000min^{-1} Feed rate : V_f = 196.9 IPM Feed rate : f_z= .020 IPT Depth of cut : a_p = .008 inch Pick feed : a_e = .079 inch Coolant : Air	SH (TH 303) performed well with steady wear even in semi-finishing which conventional tool life was unstable. Finishing accuracy of next process was also stabilized.
SKD11 (60HRC) 	Tool : ABPF30S32W120 Work material : D2 (60HRC) Insert : ZPFG300-SH (TH303) Machine : Vertical type M/C(BT50) Cutting speed : V_c = 1,237 SFM Revolution : n = 4,000min^{-1} Feed rate : V_f = 118.1 IPM Feed rate : f_z= .015 IPT Depth of cut : a_p = .008 inch Pick feed : a_e = .024 inch Coolant : Dry	SH (TH303) stabilized tool life and could increase efficiency even in semi-finishing which conventional tool had to reduce cutting conditions. Finishing surface roughness is also good.

Safety Considerations

1. Handling
(1) When removing tool from packaging, be careful not to drop the tool on your foot or fingers.
(2) When actually setting the inserts, be careful not to touch the cutting flute directly with your bare hands.

2. Mounting
(1) When preparing to use, be sure that the insert is firmly screwed in the pocket and cutter is properly mounted on the tool holder.
(2) If abnormal chattering occurs during use, stop the machine immediately, identify the cause of the chatter and take corrective action.

3. U s a g e
(1) Before use confirm all dimensions, verify work material and programmed tool rotation.
(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) Inserts are made of hard material and may break and be expelled from cutter at high speeds. Since there is a danger of injury to workers from chip evacuation, insert breakage or fire safety precautions must be observed at all times. Including, but not limited to: safety glasses, machine enclosures or other means to create a safe environment for work. If you have questions on safety, contact your supervisor.
- Do not use where there is a risk of fire or explosion.
- Do not use non-water-soluble cutting oils. Such oils may result in fire.
(4) Do not use the tool for any purpose other than that for which it is intended, and do not modify it.

Notes

MOLDINO
The Edge To Innovation

Indexable Square End Mill

ASM

Super Excellent Mini ASM

All sizes are now coolant-through.

MOLDINO Tool Engineering, Ltd.

New Product News | No. H2002A-2 | 2022-05

Indexable mill using advanced small-diameter inserts. Pocket design and 3D-shaped cutting edge allows for high-efficient machining with small diameter sizes.

Small dia.

Lineup of small diameter sizes from φ8mm to φ32mm and φ3/8" to φ1.25"
▶ **Can be used instead of solid carbide end mills.**

Multi-function

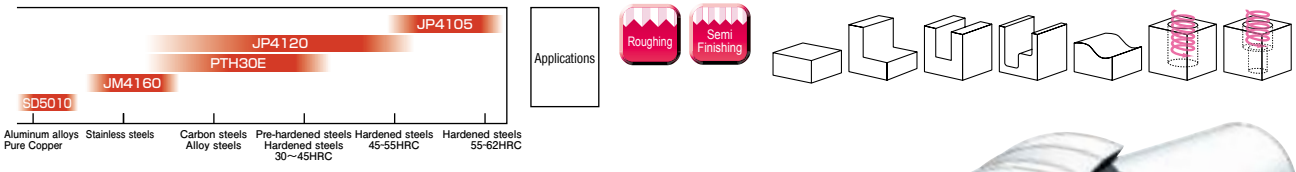
JDMT-type inserts for shoulder cutting and EDMT-type inserts for low-depth, high-feed-rate machining can be used in the same holder.
▶ **Wide selection of roughing tools available.**
Variety of modular options, including carbide shanks and special arbors, for specific cutting depths and shapes, that are required.
▶ **Wide cutting range**

Easy cutting

Utilizes a low-resistance, free-cutting shaped insert.
▶ **Compatible with low-powered, small-sized machines equivalent to a BT-30 spindle.**

Environment

▶ **Economical insert with 2 cutting edges**
▶ **Special environmentally-friendly, high-hardness, corrosion-resistant surface treatment applied on the holder.**



Features 01 2 types of applications by changing inserts

・High-efficient tooling system to match cutting depth or cutting shape

1 Steel Shank type
2 Carbide Shank
3 Modular Arbor

EDMT-type insert for machining efficiency

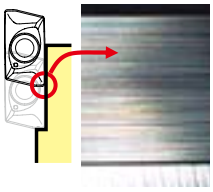
Utilizes R2.0mm(.079") cutting edge shape.
▶No uncut remnants peculiar to high feed tools
▶Low cutting resistance

Work material：S50C
Tools：ASMM0710R-2(φ10-2NT)
+ASC10-6.5-114-49
Cutting Conditions：v_c=160m/min
v_f=6,115mm/min
$a_p \times a_e$=0.25×5mm
Tool overhang 80mm

JDMT-type insert for high-grade machined surfaces

Utilizes Fine Wall (FW) shape.
▶Decrease unevenness of machined surfaces
▶Decrease burring

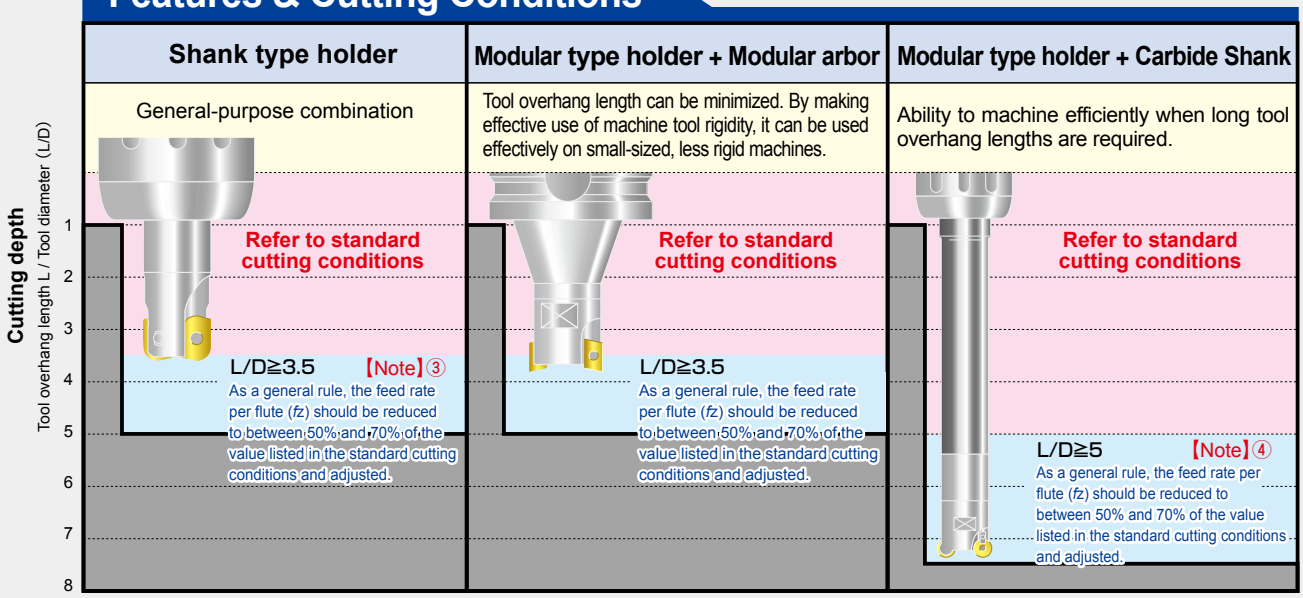
Work material：S50C
Tools：ASM0712S12R-2(φ12-3NT)
+ASC10-6.5-114-49
Cutting Conditions：v_c=200m/min
v_f=800mm/min
$a_p \times a_e$=5×0.5mm×2
Tool overhang 25mm



High-efficient tooling system and selecting of cutting conditions

・ASM allows for high-efficient machining, with various tool setups, to achieve desired cutting shape.

Features & Cutting Conditions



【Note】 ①This table shows general conditions for shoulder cutting. Adjustments should be made according to machine rigidity or tooling and the shape of the subject for cutting.
②When using ASM Ø20mm to Ø32mm inserts in a BT30 or BT40 arbor, the use of a combination of modular type holder and modular arbor is recommended. Furthermore, this is not suitable for cutting where L/D ≥ 2.
③When using an ASM0710S08R-2 or ASM0712S10R-2 undercut type shank, the feed rate per flute (*fz*) should be reduced to 50~70% of the value listed in the standard cutting conditions.
④When L/D>5 when using the carbide shank: ASC10-6.5-114-49/24, use a feed rate (*fz*) of 0.3mm/t with a depth (*ap*) that is less than 0.2mm.

2 kinds of insert geometry

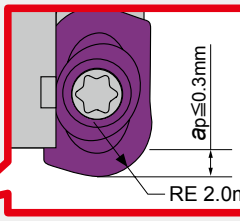
・2 kinds of inserts are available: Standard type inserts (T-type) and low-cutting force-type inserts.
・Low-resistance cutting force-type inserts reduce cutting force at the corners when pocketting by approximately 10%.

Standard type Insert
(EDMT070220R-T)

Low-resistance type Insert
(EDMT070220R)

Cutting programs

・Regular R shape is used for corner R. There is no need for an approximate R definition.



•Tool corner is R2.0mm (.079")
(Different from common high-feed tools in that it leaves no uncut areas.)
•Axial direction cutting depth ap should be set to 0.3 mm (.012") or less. (*ap* ≦ 0.3 mm)

【Note】
①Cutting dia. =DCX - 4(mm)
②When performing pocket cutting, be careful of the cutting width (a_e) and generated variations due to remaining work to cut. (Recommended Cutting width a_e=Cutting dia.×0.5~0.8(mm))
③When cutting the corner area of a vertical wall, setting the tool path corner area to R will achieve more stable cutting.

Technology

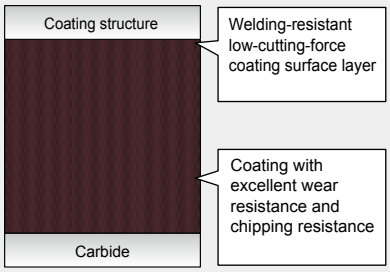
Features of AJ Coating series

- Employs an AlTiN layer with a new composition created by increasing the Al content of conventional layers.
- Excellent wear resistance, chipping resistance, and heat resistance!

New technology!!

- The new layer with high Al content employs a new composition and optimizes the crystal structure to improve wear resistance and chipping resistance!
- Employs a low-friction-effect coating with excellent welding resistance as the top-most surface layer. This reduces welding to the work and decreases cutting force!

Layer structure **AJ Coating**



PVD Technology Grade for machining pre-hardened or hardened materials **JP4120**

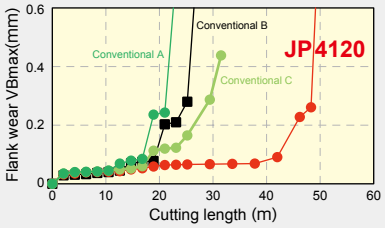
Features

- Employs a fine carbide substrate with an excellent balance between wear resistance and toughness along with the new "AJ Coating" to provide improved wear resistance and chipping resistance.
- Highly versatile with excellent wear resistance and chipping resistance when machining steel materials with hardnesses of 30 to 50 HRC.

Strong fields

- Exhibits excellent cutting performance when machining pre-hardened or hardened steel with hardnesses of 30 to 50 HRC.
- Exhibits excellent wear resistance even on difficult-to-cut diecast tool steel or precipitation-hardened stainless steel, or for finishing.

Cutting performance



Work material : H13(40HRC)
Tool : ASRT5063R-4 Insert : WDNW140520
Cutting conditions :
v_c=90m/min f_z=0.8mm/t $a_p \times a_e$=1×44mm
Dry ※Single-flute cutting

PVD Technology Grade for machining stainless-steel materials **JM4160**

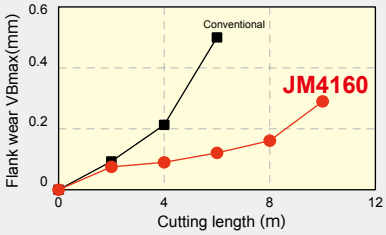
Features

- Employs a carbide substrate with high toughness along with the new "AJ Coating" to improve wear resistance and chipping resistance when machining stainless-steel materials.
- Employs AJ Coating with excellent welding resistance to reduce the welding to work material that occurs when machining stainless steel materials.

Strong fields

- Provides long tool life for general processing of stainless-steel materials

Cutting performance



Work material : 304 Stainless Steel
Tool : ASRS2032R-5 Insert : EPMT0603EN-8LF
Cutting conditions :
v_c=180m/min f_z=0.5mm/t $a_p \times a_e$=0.8×21mm
Wet ※Single-flute cutting

PVD Technology Grade for machining high-hardness materials **JP4105**

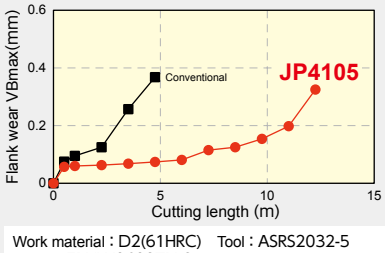
Features

- Employs an ultra-fine cemented carbide substrate along with the new "AJ Coating" to improve wear resistance.
- Excellent wear resistance when machining high hardness materials of 50HRC or higher.

Strong fields

- Ability to machine hardened steels (50 to 60 HRC): H13, D2, 420 Stainlesss Steel.

Cutting performance

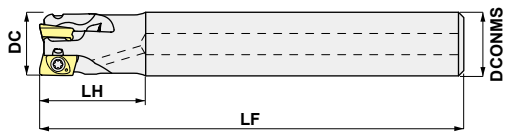


Work material : D2(61HRC) Tool : ASRS2032-5
Insert : EPNW0603TN-8
Cutting conditions :
v_c=80m/min f_z=0.2mm/t $a_p \times a_e$=0.5×21mm
Dry ※Single-flute cutting

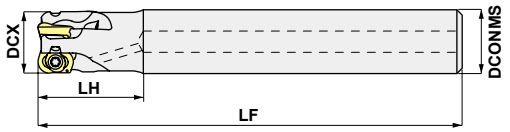
Inch

Shank type IASM□07○○S○○R-○

Numeric figure in a circle ○ and alphabetical character comes in a square □.



Standard type JDMT insert



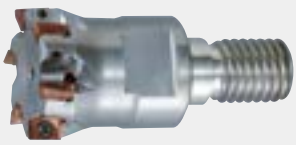
Standard type EDMT insert

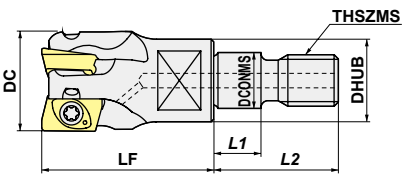
Maximum tightening torque **0.5Nm**
Spare screw included

Item code	Stock	# of Flutes	Size (Inch) DC DCX	LF	LH	DCONMS	Fig	Insert
IASM0706S06R-2	●	2	.375	3.0	.75	.375	Standard type	JDMT0702○○R EDMT070220R(-T)
IASM0708S08R-3	●	3	.5	3.0	.75	.5	Standard type	
IASM0710S10R-4	●	4	.625	3.5	1.0	.625	Standard type	
IASM0712S12R-5	●	5	.75	4.0	1.0	.75	Standard type	
IASML0710S10R-4	●	4	.625	4.5	2.0	.625	Standard type	
IASML0712S12R-5	●	5	.75	5.5	2.5	.750	Standard type	

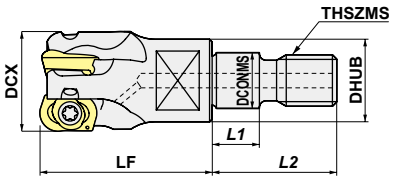
Modular type IASMM07○○R-○

Numeric figure in a circle ○.





JDMT insert



EDMT insert

Maximum tightening torque **0.5Nm**
Spare screw included

Item code	Stock	# of Flutes	Size (Inch) DC DCX	LF	DCONMS	THSZMS	DHUB	*L1*	*L2*	DRVS	Insert
IASMM0706R-2	●	2	.375	.787	.256	M6	.37	.217	.571	.276	JDMT0702○○R EDMT070220R-(T)
IASMM0708R-3	●	3	.5	.787	.256	M6	.386	.217	.571	.276	
IASMM0710R-4	●	4	.625	.984	.335	M8	.504	.217	.669	.394	
IASMM0712R-5	●	5	.75	1.181	.413	M10	.701	.217	.748	.591	
IASMM0716R-6	●	6	1.0	1.181	.492	M12	.819	.217	.866	.669	
IASMM0720R-8	●	8	1.25	1.181	.669	M16	1.134	.236	.906	.866	

【Note】 Do not apply lubricants such as grease, etc. to the "contact faces" and "modular screws" of the "modular mill", "special shanks" and "special arbor".

●:Inventory maintained in US

Metric

Shank type ASM□07○○S○○R-○

Numeric figure in a circle ○ and alphabetical character comes in a square □.

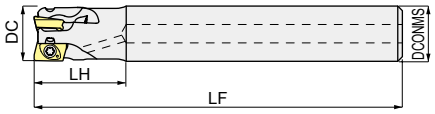


Fig-1 Standard type JDMT insert

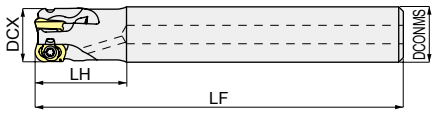


Fig-2 Standard type EDMT insert

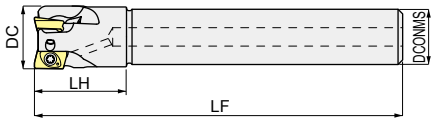


Fig-3 Undercut type JDMT insert

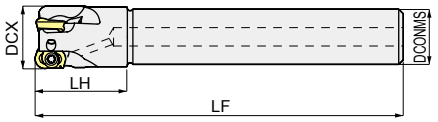


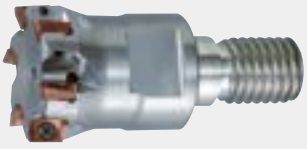
Fig-4 Undercut type EDMT insert

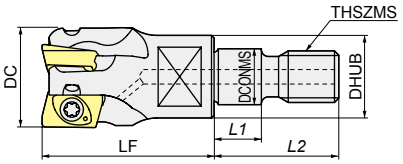
Maximum tightening torque **0.5Nm** Spare screw included

Item code	Stock	# of Flutes	Size (mm) DC DCX	LF	LH	DCONMS	Fig	Insert
ASM0708S10R-1	★	1	8	75	16	10	Standard type (Fig-1,2)	JDMT0702○○R EDMT070220R(-T)
ASM0710S10R-2	●	2	10	80	20	10	Standard type (Fig-1,2)	
ASM0710S08R-2	★	2	10	80	20	8	Undercut type (Fig-3,4)	
ASM0711S10R-2	★	2	11	80	20	10	Undercut type (Fig-3,4)	
ASM0712S12R-3	●	3	12	80	20	12	Standard type (Fig-1,2)	
ASM0712S10R-3	★	3	12	80	20	10	Undercut type (Fig-3,4)	
ASM0714S12R-3	★	3	14	80	20	12	Undercut type (Fig-3,4)	
ASM0716S16R-4	●	4	16	90	25	16	Standard type (Fig-1,2)	
ASML0716S16R-4	●	4	16	115	50	16	Standard type (Fig-1,2)	
ASM0717S16R-4	★	4	17	115	20	16	Undercut type (Fig-3,4)	
ASM0720S20R-5	●	5	20	105	25	20	Standard type (Fig-1,2)	
ASML0720S20R-5	●	5	20	140	60	20	Standard type (Fig-1,2)	
ASM0721S20R-5	★	5	21	140	20	20	Undercut type (Fig-3,4)	

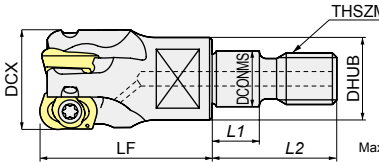
Modular type ASMM07○○R-○

Numeric figure in a circle ○.





JDMT insert



EDMT insert

Maximum tightening torque **0.5Nm** Spare screw included

Item code	Stock	# of Flutes	Size (mm) DC DCX	LF	DCONMS	THSZMS	DHUB	L1	L2	DRVS	Insert
ASMM0708R-1	★	1	8	20	6.5	M6	9.8	5.5	14.5	7	JDMT0702○○R EDMT070220R-(T)
ASMM0710R-2	●	2	10	20	6.5	M6	9.4	5.5	14.5	7	
ASMM0711R-2	★	2	11	20	6.5	M6	9.8	5.5	14.5	7	
ASMM0712R-3	●	3	12	20	6.5	M6	9.8	5.5	14.5	7	
ASMM0716R-4	●	4	16	25	8.5	M8	12.8	5.5	17	10	
ASMM0720R-5	●	5	20	30	10.5	M10	17.8	5.5	19	15	
ASMM0725R-6	★	6	25	30	12.5	M12	20.8	5.5	22	17	
ASMM0732R-8	★	8	32	30	17	M16	28.8	6	23	22	

【Note】 Do not apply lubricants such as grease, etc. to the "contact faces" and "modular screws" of the "modular mill", "special shanks" and "special arbor".

●:Inventory maintained in US ★:Inventory maintained in Japan

Inserts

Fig-3 JDMT07020◌R
Insert with 5mm(.197") cutting edge for shoulder cutting
a_{pmax}=5.0mm(.197")

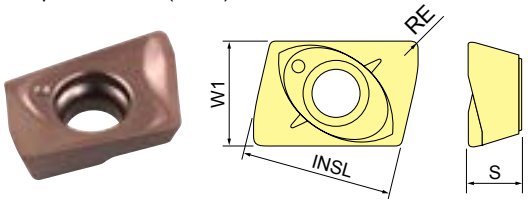
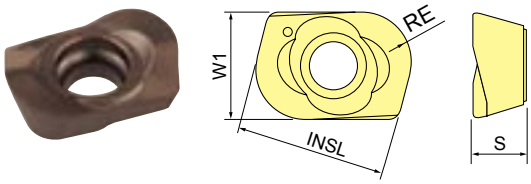


Fig-4 EDMT070220R(-T)
Insert with 2.0mm(.079") corner RE for small-depth, high-feed-rate cutting
a_{pmax}=0.3mm(.012")



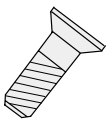
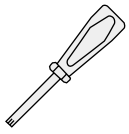
P	Carbon steel		■		■		⊏	
M	Stainless Steel		⊏	■	⊏	■	■	
K	Cast Iron・Ductile Cast Iron						⊏	
N	Aiuminum Alloy		⊏		⊏		⊏	■
H	Hardened steel	■	⊏		⊏			

■ : General cutting, First recommended

⊏ : General cutting, Second recommended

Item code	Tolerance Class	AJ Coated NEW			JP Coated	JM Coated	TH Coated	DLC Coated	Size (mm)				Shape
		JP4105	JP4120	JM4160	JP4020	JM4060	PTH30E	SD5010	INSL	W1	RE	S	
JDMT070202R	M	●	●	●	●	●	●	●	6.4	4.3	0.2	2.45	Fig-3
JDMT070204R		●	●	●	●	●	●	●	6.4	4.3	0.4	2.45	
JDMT070208R		●	●	●	●	●	●	●	6.4	4.3	0.8	2.45	
EDMT070220R-T		●	●	●	●	●			6.4	4.3	2	2.5	Fig-4 Standard type
EDMT070220R		●	●	●	●	●			6.4	4.3	2	2.5	Fig-4 Low-resistance type

Parts

Parts	Clamp screw		Screw Driver	Screw anti-seizure agent
Shape / Cutter body		Fastening torque (N・m)		
All ASM Cutter	**240-140**	0.5	**104-T6**	**P-37**

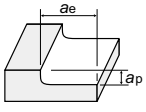
Recommended Cutting Conditions (Inch)

Side Milling standard cutting conditions for EDMT-type inserts：Low cutting depth, high feed rate

※Red indicates primary recommended grade.

Work material	Recommended grade	Tool dia.	ϕ.375 / 2 Flutes	ϕ.5 / 3 Flutes	ϕ.625 / 4 Flutes	ϕ.75 / 5 Flutes	ϕ1 / 6 Flutes	ϕ1.25 / 8 Flutes
Carbon Steel Alloy Steel <30HRC	※ JP4120 (SFM=328～590)	n(min-1)	4,000	3,000	2,408	2,007	1,505	1,204
		SFM	394	394	394	394	394	394
		IPM	～189	～212	～303	～316	～284	～303
		IPT	～.024	～.024	～.032	～.032	～.032	～.032
		ap(inch)	.012	.012	.012	.012	.012	.012
		ae(inch)	～.1875	～.291	～.39	～.412	～.68	～.859
		Q(inch3/min)	.427	.732	1.403	1.525	2.258	3.051
Carbon Steel Alloy Steel 30～40HRC	JP4120 (SFM=328～524)	n(min-1)	3,667	2,750	2,200	1,833	1,375	1,100
		SFM	360	360	360	360	360	360
		IPM	～173	～194.7	～277	～288.7	～260	～277.2
		IPT	～.024	～.024	～.032	～.032	～.032	～.032
		ap(inch)	.012	.012	.012	.012	.012	.012
		ae(inch)	～.1875	～.291	～.39	～.412	～.68	～.859
		Q(inch3/min)	.366	.671	1.281	1.403	2.075	2.807
Hardened Steel 40～50HRC	JP4120 (SFM=262～393)	n(min-1)	3,005	2,254	1,803	1,502	1,127	900
		SFM	295	295	295	295	295	295
		IPM	～94.4	～106.2	～170.2	～177.2	～159.6	～170
		IPT	～.016	～.016	～.024	～.024	～.024	～.024
		ap(inch)	.012	.012	.012	.012	.012	.012
		ae(inch)	～.1875	～.291	～.39	～.412	～.68	～.859
		Q(inch3/min)	.183	.366	.793	.854	1.281	1.709
Stainless Steel	JM4160 JP4120 (SFM=262～393)	n(min-1)	3,005	2,254	1,803	1,502	1,127	900
		SFM	295	295	295	295	295	295
		IPM	～94.4	～106.2	～170.2	～177.2	～159.6	～170
		IPT	～.016	～.016	～.024	～.024	～.024	～.024
		ap(inch)	.012	.012	.012	.012	.012	.012
		ae(inch)	～.1875	～.291	～.39	～.412	～.68	～.859
		Q(inch3/min)	.183	.366	.793	.854	1.281	1.709
Cast Iron/ Ductile Cast Iron	JP4120 (SFM=363～720)	n(min-1)	5,011	3,759	3,007	2,506	1,879	1,503
		SFM	492	492	492	492	492	492
		IPM	～236.5	～266.1	～378.9	～394.7	～355.1	～378.8
		IPT	～.024	～.024	～.032	～.032	～.032	～.032
		ap(inch)	.012	.012	.012	.012	.012	.012
		ae(inch)	～.1875	～.291	～.39	～.412	～.68	～.859
		Q(inch3/min)	.549	.915	1.77	1.953	2.868	3.845
Hardened Steel 50～60HRC	JP4105 JP4120 (SFM=197～328)	n(min-1)	2,007	1,505	1,204	1,003	752	600
		SFM	197	197	197	197	197	197
		IPM	～47.4	～53.3	～75.6	～78.7	～70.8	～75.3
		IPT	～.012	～.012	～.016	～.016	～.016	～.016
		ap(inch)	.008	.008	.008	.008	.008	.008
		ae(inch)	～.1875	～.291	～.39	～.412	～.68	～.859
		Q(inch3/min)	.061	.122	.183	.183	.366	.488

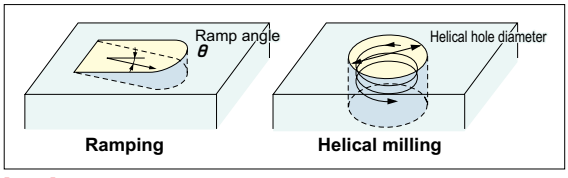
【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For slotting or ramping, feed rate should be set to 70% as general criteria.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.
⑤The evacuation of swarf can cause burns, cuts or damage to the eyes please ensue the correct safety cover is fitted around the machine, and necessary personal protection equipment is worn by the machine operator.
⑥Due to fire risks do not use neat cutting oil as a coolant.



Ramping with EDMT-type inserts

Since the cutting flute does not extend to the center, there are limitations on the ramp angle and hole diameter, but as shown below, cutting by direct milling without a pilot hole is possible for ramping and helical milling.

(inch)



Inserts	EDMT0702○○					
Tool dia.	ϕ.375	ϕ.5	ϕ.625	ϕ.75	ϕ1	ϕ1.25
Recommended θ	Less than 0.5 °					
Hole Dia	.512"～.748"	.670"～.905"	.985"～1.22"	1.30"～1.535"	1.693"～1.929"	2.245"～2.49"

【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For hole diameters outside the ranges listed above, a pilot hole should be drilled before milling.

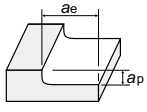
Recommended Cutting Conditions (Metric)

Side Milling standard cutting conditions for EDMT-type inserts：Low cutting depth, high feed rate

※Red indicates primary recommended grade.

Work material	Recommended grade	Tool dia.	φ8 / 1 Flute	φ10 / 2 Flutes	φ12 / 3 Flutes	φ14 / 3 Flutes	φ16 / 4 Flutes	φ20 / 5 Flutes	φ25 / 6 Flutes	φ32 / 8 Flutes
Carbon Steel Alloy Steel <30HRC	※ JP4120 (vc=100~180)	n(min-1)	4,780	3,820	3,180	2,730	2,390	1,910	1,530	1,190
		vc(m/min)	120	120	120	120	120	120	120	120
		vf(mm/min)	~2,870	~4,590	~5,730	~6,550	~7,640	~7,640	~7,340	~7,640
		fz(mm/t)	~0.6	~0.6	~0.6	~0.8	~0.8	~0.8	~0.8	~0.8
		ap(mm)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
		ae(mm)	~3	~5	~7	~8	~10	~11	~17	~22
		Q(cm3/min)	3	7	12	16	23	25	37	50
Carbon Steel Alloy Steel 30~40HRC	JP4120 (vc=100~160)	n(min-1)	4,380	3,500	2,920	2,500	2,190	1,750	1,400	1,090
		vc(m/min)	110	110	110	110	110	110	110	110
		vf(mm/min)	~2,630	~4,200	~5,260	~6,010	~7,010	~7,010	~6,730	~7,010
		fz(mm/t)	~0.6	~0.6	~0.6	~0.8	~0.8	~0.8	~0.8	~0.8
		ap(mm)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
		ae(mm)	~3	~5	~7	~8	~10	~11	~17	~22
		Q(cm3/min)	2	6	11	14	21	23	34	46
Hardened Steel 40~50HRC	JP4120 (vc=80~120)	n(min-1)	3,580	2,870	2,390	2,050	1,790	1,430	1,150	900
		vc(m/min)	90	90	90	90	90	90	90	90
		vf(mm/min)	~1,430	~2,290	~2,870	~3,690	~4,300	~4,300	~4,130	~4,300
		fz(mm/t)	~0.4	~0.4	~0.4	~0.6	~0.6	~0.6	~0.6	~0.6
		ap(mm)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
		ae(mm)	~3	~5	~7	~8	~10	~11	~17	~22
		Q(cm3/min)	1	3	6	9	13	14	21	28
Stainless Steel	JM4160 JP4120 (vc=80~120)	n(min-1)	3,580	2,870	2,390	2,050	1,790	1,430	1,150	900
		vc(m/min)	90	90	90	90	90	90	90	90
		vf(mm/min)	~1,430	~2,290	~2,870	~3,690	~4,300	~4,300	~4,130	~4,300
		fz(mm/t)	~0.4	~0.4	~0.4	~0.6	~0.6	~0.6	~0.6	~0.6
		ap(mm)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
		ae(mm)	~3	~5	~7	~8	~10	~11	~17	~22
		Q(cm3/min)	1	3	6	9	13	14	21	28
Cast Iron/ Ductile Cast Iron	JP4120 (vc=120~220)	n(min-1)	5,970	4,780	3,980	3,410	2,990	2,390	1,910	1,490
		vc(m/min)	150	150	150	150	150	150	150	150
		vf(mm/min)	~3,580	~5,730	~7,170	~8,190	~9,550	~9,550	~9,170	~9,550
		fz(mm/t)	~0.6	~0.6	~0.6	~0.8	~0.8	~0.8	~0.8	~0.8
		ap(mm)	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
		ae(mm)	~3	~5	~7	~8	~10	~11	~17	~22
		Q(cm3/min)	3	9	15	20	29	32	47	63
Hardened Steel 50~60HRC	JP4105 JP4120 (vc=60~100)	n(min-1)	2,390	1,910	1,590	1,360	1,190	950	760	600
		vc(m/min)	60	60	60	60	60	60	60	60
		vf(mm/min)	~720	~1,150	~1,430	~1,630	~1,900	~1,900	~1,820	~1,900
		fz(mm/t)	~0.3	~0.3	~0.3	~0.4	~0.4	~0.4	~0.4	~0.4
		ap(mm)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
		ae(mm)	~3	~5	~7	~8	~10	~11	~17	~22
		Q(cm3/min)	0.4	1	2	2	3	3	6	8

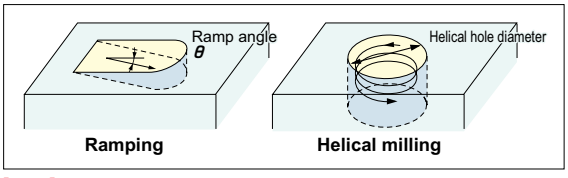
【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For slotting or ramping, feed rate should be set to 70% as general criteria.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.
⑤The evacuation of swarf can cause burns, cuts or damage to the eyes please ensue the correct safety cover is fitted around the machine, and necessary personal protection equipment is worn by the machine operator.
⑥Due to fire risks do not use neat cutting oil as a coolant.
⑦When using an ASM0710S08R-2 or ASM0712S10R-2 undercut type shank, as a general rule the feed rate per flute (f_z) should be reduced to 50~70% of the value listed in the standard cutting conditions.



Ramping with EDMT-type inserts

Since the cutting flute does not extend to the center, there are limitations on the ramp angle and hole diameter, but as shown below, cutting by direct milling without a pilot hole is possible for ramping and helical milling.

(mm)



Inserts	EDMT0702○○									
Tool dia.	φ8	φ10	φ12	φ14	φ16	φ17	φ20	φ21	φ25	φ32
Recommended θ	Less than 0.5 °									
Hole Dia	10~15	13~19	17~23	21~27	25~31	27~33	33~39	35~41	43~49	57~63

【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For hole diameters outside the ranges listed above, a pilot hole should be drilled before milling.

Recommended Cutting Conditions (Inch)

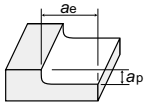
Side Milling standard cutting conditions for JDMT-type inserts

It is make standard that the depth cut *ap* and the cutting width *ae* be as shown in Tool Overhang (OH) and Cutting Region on the Page 227.
Work Hardness > Please use the conditions in the table as a guideline for the cut depth *ap* and width *ae* of 40HRC.

※Red indicates primary recommended grade.

Work material	Recommended grade	Cutting speed (SFM) / Feed rate per tooth (IPT)	Tool dia.	ϕ.375 / 2 Flutes	ϕ.5 / 3 Flutes	ϕ.625 / 4 Flutes	ϕ.75 / 5 Flutes	ϕ1 / 6 Flutes	ϕ1.25 / 8 Flutes
Carbon Steel Alloy Steel <30HRC	※ JP4120 PTH30E	SFM=492～656	*n*(min⁻¹)	5,730	4,780	3,580	2,870	2,290	1,790
			SFM	590	590	590	590	590	590
		IPT=.002～.004	IPM	31.5	39.4	39.4	39.4	37.8	39.4
			IPT	.00275	.00275	.00275	.00275	.00275	.00275
Die Tool Steel <30HRC	JP4120 PTH30E	SFM=426～590	*n*(min⁻¹)	4,780	3,980	2,990	2,390	1,910	1,490
			SFM	492	492	492	492	492	492
		IPT=.002～.003	IPM	22.4	28.3	28.3	28.3	27.2	28.3
			IPT	.00236	.00236	.00236	.00236	.00236	.00236
Pre-Hardened Steel Alloy Steel Die Tool Steel 30～40HRC	JP4120 PTH30E	SFM=328～492	*n*(min⁻¹)	3,820	3,180	2,390	1,910	1,530	1,190
			SFM	394	394	394	394	394	394
		IPT=.002～.003	IPM	18.1	22.4	22.4	22.4	21.7	22.4
			IPT	.00236	.00236	.00236	.00236	.00236	.00236
Pre-Hardened Steel Alloy Steel Die Tool Steel 40～50HRC	JP4120	SFM=262～394	*n*(min⁻¹)	2,860	2,390	1,790	1,430	1,150	900
			SFM	295	295	295	295	295	295
		IPT=.002～.003	IPM	13.4	16.9	16.9	16.9	16.1	16.9
			IPT	.00236	.00236	.00236	.00236	.00236	.00236
			ap(inch)	.079	.079	.079	.079	.079	.079
			ae(inch)	.05DC	.05DC	.05DC	.05DC	.05DC	.05DC
Stainless Steel	JM4160 PTH30E JP4120	SFM=328～492	*n*(min⁻¹)	3,820	3,180	2,390	1,910	1,530	1,190
			SFM	394	394	394	394	394	394
		IPT=.002～.004	IPM	18.1	22.4	22.4	22.4	21.7	22.4
			IPT	.00236	.00236	.00236	.00236	.00236	.00236
Cast Iron/ Ductile Cast Iron	JP4120 PTH30E	SFM=426～590	*n*(min⁻¹)	4,780	3,980	2,990	2,390	1,910	1,490
			SFM	492	492	492	492	492	492
		IPT=.002～.004	IPM	26.4	33.1	33.1	33.1	31.5	33.1
			IPT	.00275	.00275	.00275	.00275	.00275	.00275
Alminum Alloy (Wet Condition)	SD5010 PTH30E JP4120	SFM=656～1,640	*n*(min⁻¹)	9,550	7,960	5,970	4,780	3,820	2,990
			SFM	984	984	984	984	984	984
		IPT=.002～.005	IPM	60.2	75.2	75.2	75.2	72	75.2
			IPT	.00315	.00315	.00315	.00315	.00315	.00315
Hardened Steel 50～60HRC	JP4105 JP4120	SFM=197～328	*n*(min⁻¹)	1,910	1,590	1,190	950	760	600
			SFM	197	197	197	197	197	197
		IPT=.002～.003	IPM	9.0	11.4	11.4	11.4	10.6	11.4
			IPT	.00236	.00236	.00236	.00236	.00236	.00236
			ap(inch)	.079	.079	.079	.079	.079	.079
			ae(inch)	.05DC	.05DC	.05DC	.05DC	.05DC	.05DC

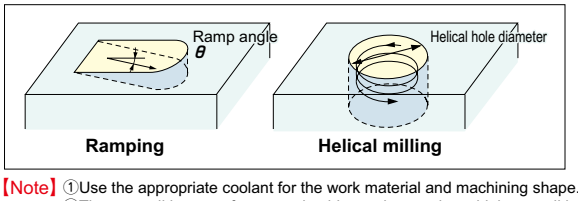
【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For slotting or ramping, feed rate should be set to 70% as general criteria.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.
⑤The evacuation of swarf can cause burns, cuts or damage to the eyes please ensue the correct safety cover is fitted around the machine, and necessary personal protection equipment is worn by the machine operator.
⑥Due to fire risks do not use neat cutting oil as a coolant.



Ramping with JDMT-type inserts

Since the cutting flute does not extend to the center, there are limitations on the ramp angle and hole diameter, but as shown below, cutting by direct milling without a pilot hole is possible for ramping and helical milling.

(inch)



Inserts	JDMT0702○○					
Tool dia.	ϕ.375	ϕ.5	ϕ.625	ϕ.75	ϕ1	ϕ1.25
Recommended θ	Less than 1 °					
Hole Dia	.512"～.748"	.670"～.905"	.985"～1.22"	1.30"～1.535"	1.693"～1.929"	2.245"～2.49"

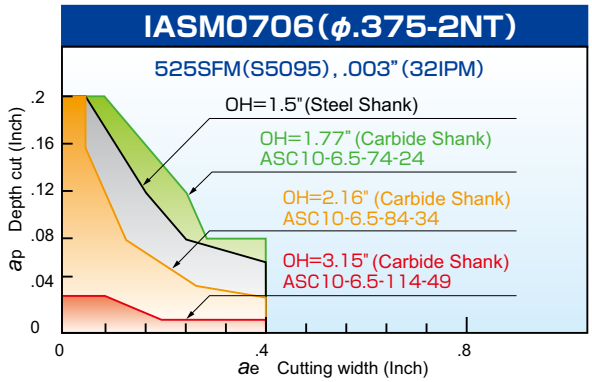
【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For hole diameters outside the ranges listed above, a pilot hole should be drilled before milling.

Relation between Tool Overhang（OH）and Limits of the cutting region

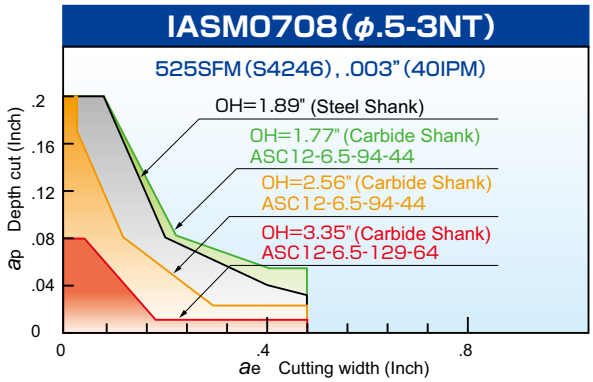
The cutting region curves shown below indicate criteria for selecting cutting conditions at each overhang (OH).
If chattering occurs near the limits of the cutting region, make adjustments by reducing the per-flute feed rate (*f*z).

Milling Conditions | Machine：BT30 5.5/3.7kw
Work material：Carbon Steel　Cutting Conditions：525SFM, .003"

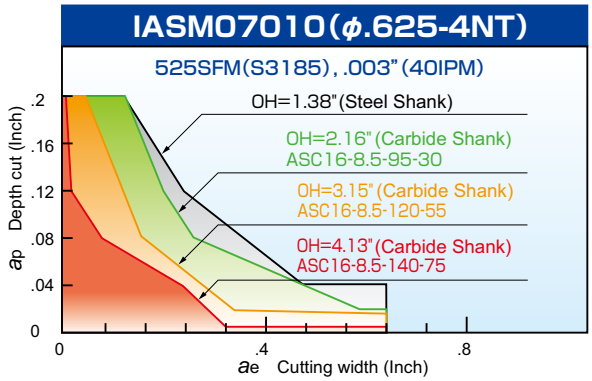
IASM0706(ϕ.375-2NT)



IASM0708(ϕ.5-3NT)

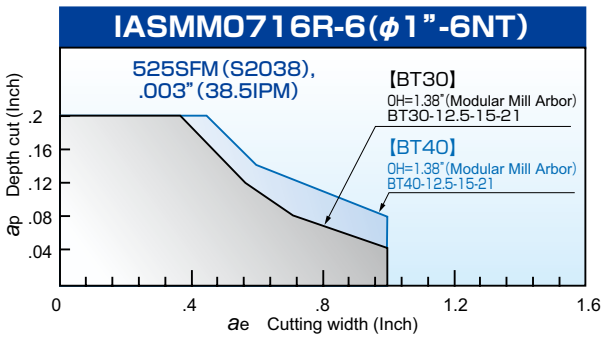


IASM07010(ϕ.625-4NT)

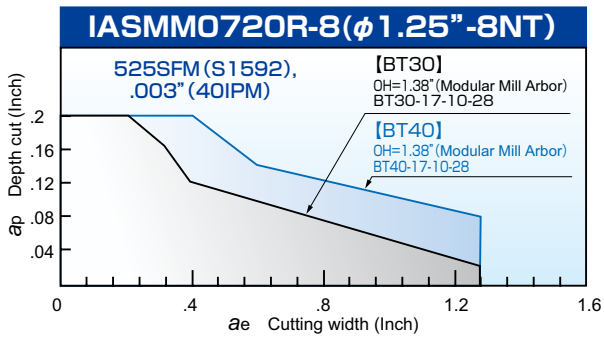


Milling Conditions | Machine：BT40 11kw
Work material：Carbon Steel　Cutting Conditions：525SFM, .003"

IASMM0716R-6(ϕ1"-6NT)



IASMM0720R-8(ϕ1.25"-8NT)



Recommended Cutting Conditions (Metric)

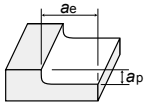
Side Milling standard cutting conditions for JDMT-type inserts

It is make standard that the depth cut *ap* and the cutting width *ae* be as shown in Tool Overhang (OH) and Cutting Region on the Page 229.
Work Hardness > Please use the conditions in the table as a guideline for the cut depth *ap* and width *ae* of 40HRC.

※Red indicates primary recommended grade.

Work material	Recommended grade	Cutting speed v_c (m/min) / Feed rate per tooth f_z (mm/t)	Tool dia.	ϕ8 / 1 Flute	ϕ10 / 2 flutes	ϕ12 / 3 Flutes	ϕ14 / 3 Flutes	ϕ16 / 4 Flutes	ϕ20 / 5 Flutes	ϕ25 / 6 Flutes	ϕ32 / 8 Flutes
Carbon Steel Alloy Steel <30HRC	※ JP4120 PTH30E	v_c=150～200	n(min^{-1})	7,170	5,730	4,780	4,090	3,580	2,870	2,290	1,790
			v_c(m/min)	180	180	180	180	180	180	180	180
		f_z=0.04～0.09	v_f(mm/min)	500	800	1,000	860	1,000	1,000	960	1,000
			f_z(mm/t)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Die Tool Steel <30HRC	JP4120 PTH30E	v_c=130～180	n(min^{-1})	5,970	4,780	3,980	3,410	2,990	2,390	1,910	1,490
			v_c(m/min)	150	150	150	150	150	150	150	150
		f_z=0.04～0.07	v_f(mm/min)	360	570	720	610	720	720	690	720
			f_z(mm/t)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Pre-Hardened Steel Alloy Steel Die Tool Steel 30～40HRC	JP4120 PTH30E	v_c=100～150	n(min^{-1})	4,780	3,820	3,180	2,730	2,390	1,910	1,530	1,190
			v_c(m/min)	120	120	120	120	120	120	120	120
		f_z=0.04～0.07	v_f(mm/min)	290	460	570	490	570	570	550	570
			f_z(mm/t)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Pre-Hardened Steel Alloy Steel Die Tool Steel 40～50HRC	JP4120	v_c=80～120	n(min^{-1})	3,580	2,860	2,390	2,050	1,790	1,430	1,150	900
			v_c(m/min)	90	90	90	90	90	90	90	90
		f_z=0.04～0.07	v_f(mm/min)	220	340	430	370	430	430	410	430
			f_z(mm/t)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
			a_p(mm)	2	2	2	2	2	2	2	2
			a_e(mm)	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC
Stainless Steel	JM4160 PTH30E JP4120	v_c=100～150	n(min^{-1})	4,780	3,820	3,180	2,730	2,390	1,910	1,530	1,190
			v_c(m/min)	120	120	120	120	120	120	120	120
		f_z=0.04～0.09	v_f(mm/min)	290	460	570	490	570	570	550	570
			f_z(mm/t)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Cast Iron/ Ductile Cast Iron	JP4120 PTH30E	v_c=130～180	n(min^{-1})	5,970	4,780	3,980	3,410	2,990	2,390	1,910	1,490
			v_c(m/min)	150	150	150	150	150	150	150	150
		f_z=0.04～0.10	v_f(mm/min)	420	670	840	720	840	840	800	840
			f_z(mm/t)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Alminum Alloy (Wet Condition)	SD5010 PTH30E JP4120	v_c=200～500	n(min^{-1})	11,940	9,550	7,960	6,820	5,970	4,780	3,820	2,990
			v_c(m/min)	300	300	300	300	300	300	300	300
		f_z=0.04～0.12	v_f(mm/min)	960	1,530	1,910	1,640	1,910	1,910	1,830	1,910
			f_z(mm/t)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Hardened Steel 50～60HRC	JP4105 JP4120	v_c=60～100	n(min^{-1})	2,390	1,910	1,590	1,360	1,190	950	760	600
			v_c(m/min)	60	60	60	60	60	60	60	60
		f_z=0.04～0.07	v_f(mm/min)	140	230	290	240	290	290	270	290
			f_z(mm/t)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
			a_p(mm)	2	2	2	2	2	2	2	2
			a_e(mm)	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC	0.05DC

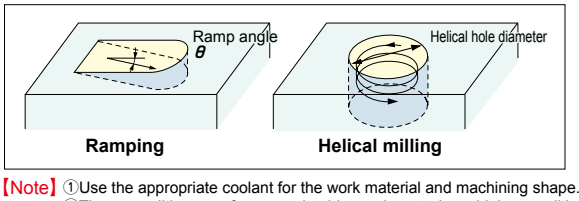
【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For slotting or ramping, feed rate should be set to 70% as general criteria.
④Ensure to index the insert at the correct time to ensure safety of the tool-body.
⑤The evacuation of swarf can cause burns, cuts or damage to the eyes please ensue the correct safety cover is fitted around the machine, and necessary personal protection equipment is worn by the machine operator.
⑥Due to fire risks do not use neat cutting oil as a coolant.



Ramping with JDMT-type inserts

Since the cutting flute does not extend to the center, there are limitations on the ramp angle and hole diameter, but as shown below, cutting by direct milling without a pilot hole is possible for ramping and helical milling.

(mm)



Inserts	JDMT0702○○									
Tool dia.	ϕ8	ϕ10	ϕ12	ϕ14	ϕ16	ϕ17	ϕ20	ϕ21	ϕ25	ϕ32
Recommended θ	Less than 1 °									
Hole Dia	10～15	13～19	17～23	21～27	25～31	27～33	33～39	35～41	43～49	57～63

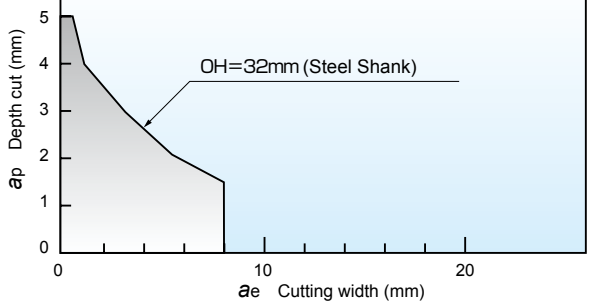
【Note】①Use the appropriate coolant for the work material and machining shape.
②These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine and work-piece conditions.
③For hole diameters outside the ranges listed above, a pilot hole should be drilled before milling.

Relation between Tool Overhang（OH）and Limits of the cutting region

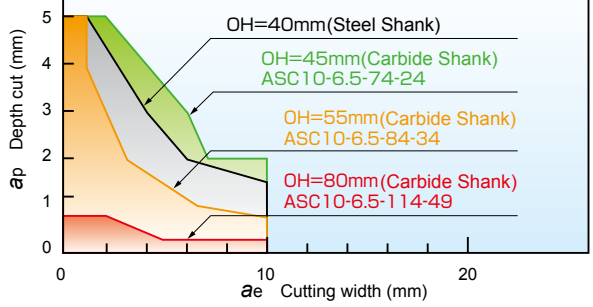
The cutting region curves shown below indicate criteria for selecting cutting conditions at each overhang (OH).
If chattering occurs near the limits of the cutting region, make adjustments by reducing the per-flute feed rate (*f*z).

Milling Conditions | Machine：BT30 5.5/3.7kw
Work material：Carbon Steel　Cutting Conditions：v_c=160m/min,　f_z=0.08mm/t

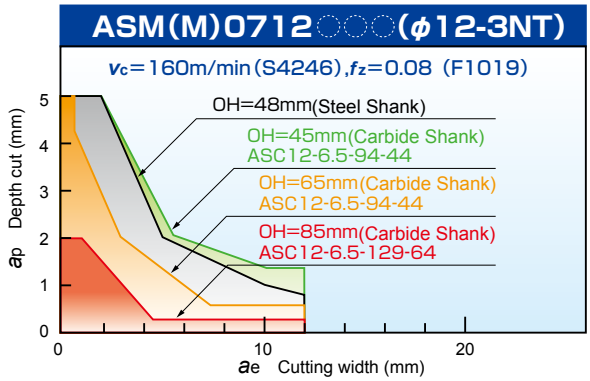
ASM0708S10R-1(φ8-1NT)



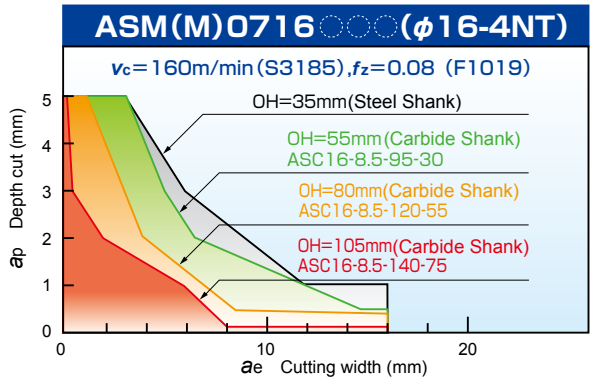
ASM(M)0710○○○(φ10-2NT)



ASM(M)0712○○○(φ12-3NT)



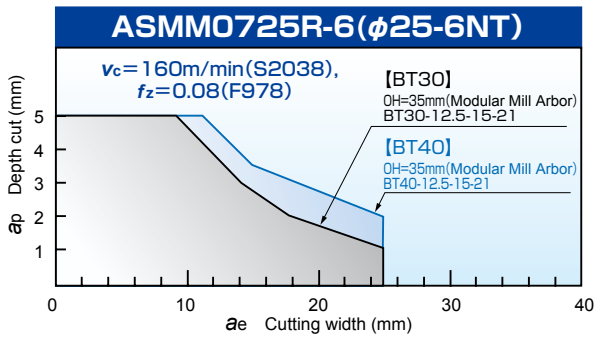
ASM(M)0716○○○(φ16-4NT)



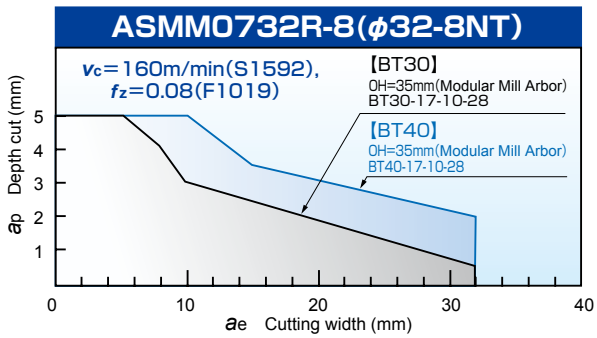
※As a general rule, the cutting amount for ASM0710S08R-2 undercut type shank should be set within 50% of the cutting region for ASM0710S10R-2, and the cutting amount for ASM0712S10R-2 should be set within the cutting region for ASM0710S10R-2.

Milling Conditions | Machine：BT40 11kw
Work material：Carbon Steel　Cutting Conditions：v_c=160m/min,　f_z=0.08mm/t

ASMM0725R-6(φ25-6NT)



ASMM0732R-8(φ32-8NT)



Field data

No.	Tool dia. DC(mm)	Cutter	Insert	Work material	Test conditions	Result Note
1	12	ASM0712S12R-3	JDMT070204R (Material equivalent to P30)	304 Stainless Steel	v_c=120m/min, v_f=670mm/min a_pxa_e=1×8mm, Dry	1.5times tool life of insert tools from conventional.
2	20	ASMM0720R-5	EDMT070220R (Material equivalent to P10)	40HRC Pre-hardened Steel	v_c=90m/min, v_f=4,300mm/min a_pxa_e=0.3×10mm, Dry	Good cutting performance and good tool life with O.H.80mm.
3	10	ASMM0710R-2	JDMT070208R (SD5010)	Graphite	v_c=1,000m/min, v_f=10,000mm/min a_pxa_e=0.6×4.0mm, Dry	Good cutting performance with O.H.90mm. 2×the tool life of conventional products.

Cutting conditions for aluminum alloy and copper

<Shoulder cutting> : *a*e=0.5D <Recommended grade> :SD5010

Inch

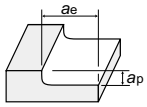
Work material		ϕ.375	ϕ.5	ϕ.625	ϕ.75	ϕ1	ϕ1.25
Expanded aluminum alloy material 5052,7075, etc. (Wet : Water-soluble agent)	*n* (min^{-1})	12,700	10,600	9,900	9,500	7,600	6,000
	IPM	80.1	100.2	124.7	149.6	143.6	151.2
	IPT	.00315	.00315	.00315	.00315	.00315	.00315
	SFM	1,312	1,312	1,640	1,968	1,968	1,968
	*a*p (inch)	.079	.079	.079	.079	.079	.079
Cast aluminum alloy material 383.0, etc. (Wet : Water-soluble agent)	*n* (min^{-1})	11,100	9,300	8,000	8,000	6,400	5,000
	IPM	69.9	87.9	100.8	126.0	121.0	126.0
	IPT	.00315	.00315	.00315	.00315	.00315	.00315
	SFM	1,148	1,148	1,312	1,640	1,640	1,640
	*a*p (inch)	.079	.079	.079	.079	.079	.079
Pure copper C11000,C10200, etc. (Wet : Water-soluble agent)	*n* (min^{-1})	9,500	8,000	6,000	4,800	3,820	3,000
	IPM	59.9	75.6	75.6	75.6	72.2	75.6
	IPT	.00315	.00315	.00315	.00315	.00315	.00315
	SFM	984	984	984	984	984	984
	*a*p (inch)	.079	.079	.079	.079	.079	.079

Metric

Work material		ϕ8	ϕ10	ϕ12	ϕ14	ϕ16	ϕ17	ϕ20	ϕ21	ϕ25	ϕ32
Expanded aluminum alloy material 5052,7075, etc. (Wet : Water-soluble agent)	*n* (min^{-1})	11,900	12,700	10,600	11,400	9,900	9,400	9,500	9,100	7,600	6,000
	*v*f (mm/min)	950	2,040	2,550	2,730	3,180	3,000	3,820	3,640	3,670	3,820
	*f*z (mm/t)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	*v*c (m/min)	300	400	400	500	500	500	600	600	600	600
	*a*p (mm)	2	2	2	2	2	2	2	2	2	2
Cast aluminum alloy material 383.0, etc. (Wet : Water-soluble agent)	*n* (min^{-1})	9,900	11,100	9,300	9,100	8,000	7,500	8,000	7,600	6,400	5,000
	*v*f (mm/min)	800	1,780	2,230	2,180	2,550	2,400	3,180	3,030	3,060	3,180
	*f*z (mm/t)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	*v*c (m/min)	250	350	350	400	400	400	500	500	500	500
	*a*p (mm)	2	2	2	2	2	2	2	2	2	2
Pure copper C11000,C10200, etc. (Wet : Water-soluble agent)	*n* (min^{-1})	9,900	9,500	8,000	6,800	6,000	5,600	4,800	4,500	3,820	3,000
	*v*f (mm/min)	800	1,530	1,910	1,640	1,910	1,800	1,910	1,820	1,830	1,910
	*f*z (mm/t)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	*v*c (m/min)	250	300	300	300	300	300	300	300	300	300
	*a*p (mm)	2	2	2	2	2	2	2	2	2	2

【Note】

❶Use the appropriate coolant for the work material and machining shape.
❷The cutting conditions shown in the above table are for reference and should be adjusted according to the actual machining circumstances.
❸When cutting grooves, reduce the feed rate by 30% (set it to 0.7 times the value shown above).
❹When L/D=4 or higher, reduce rotation speed and feed rate by 50% (set to 0.5× stated values) as general criteria. In addition, when machining copper, set cutting depth in axial direction to 1mm or less.
❺Use on a machine equipped with splashguards. During use, be sure to wear protective equipment such as safety glasses, and always perform work in a safe environment.
❻When using a machine that cannot provide the rotation speed shown above, set the highest rotation speed possible and calculate the feed rate using the *f*z value.
❼Be sure to use this tool at rotation speeds within the acceptable range for the milling chuck being used. If the acceptable rotation speed range is below the rotation speed shown above, set the highest acceptable rotation speed and calculate the feed rate using the *f*z value.



Safety Considerations

1. Handling

(1) When removing tool from packaging, be careful not to drop the tool on your foot or fingers.
(2) When actually setting the inserts, be careful not to touch the cutting flute directly with your bare hands.

2. Mounting

(1) When preparing to use, be sure that the insert is firmly screwed in the pocket and cutter is properly mounted on the tool holder.
(2) If abnormal chattering occurs during use, stop the machine immediately, identify the cause of the chatter and take corrective action.

3. Usage

(1) Before use confirm all dimensions, verify work material and programmed tool rotation.
(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) Inserts are made of hard material and may break and be expelled from cutter at high speeds. Since there is a danger of injury to workers from chip evacuation, insert breakage or fire safety precautions must be observed at all times. Including, but not limited to: safety glasses, machine enclosures or other means to create a safe environment for work. If you have questions on safety, contact your supervisor.
- Do not use where there is a risk of fire or explosion.
- Do not use non-water-soluble cutting oils. Such oils may result in fire.

(4) Do not use the tool for any purpose other than that for which it is intended, and do not modify it.

Notes

Designation of milling inserts

① Insert shape	
Symbol	Insert shape
T	Triangle 60°
S	Square 90°
R	Round
E	Diamond 75°
C	Diamond 80°
O	Octagonal 135°
A	Parallelogram 85°
L	Rectangular 90°
Z	For Ball & Precisions
X	For Ball End Mills
Y	For Ball End Mills

② Normal clearance	
Symbol	Clearance
C	7°
D	15°
E	20°
F	25°
N	0°
O	Negative, Positive
P	11°

③ Tolerance class			
Symbol	Tolerances (mm)		
	Inscribed circle (d)	Thickness (s)	Nose height (m)
A	±0.025	±0.025	±0.005
F	±0.013	±0.025	±0.005
C	±0.025	±0.025	±0.013
H	±0.013	±0.025	±0.013
E	±0.025	±0.025	±0.025
G(P)	±0.025	±0.13	±0.025
K	±0.05~0.13	±0.025	±0.013
M	±0.05~0.13	±0.13	±0.08~0.18
N	±0.05~0.13	±0.025	±0.08~0.18

	①	②	③				
Inch Series	S	E	E	○	4	2	○
Metric Series	S	E	E	N	12	03	AF
				④	⑤	⑥	⑦

④ Fixing and/or chip breaker		
Symbol	Fixing	Chip breaker
F	Nil	Both face
A	With hole	Nil
W※	With hole	Nil
G	With hole	Both face
T※	With hole	One face
M	With hole	One face
X	—	—
N	Nil	Nil
R	Nil	Both face

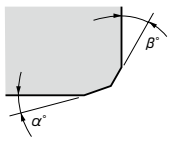
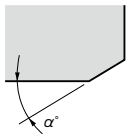
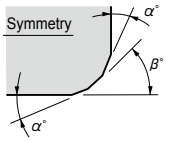
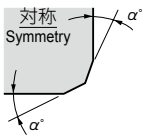
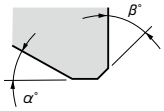
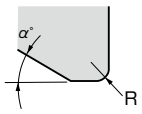
※ With tapered hole on one side

⑤ Edge length & diameter of inscribed circle (Matric series)									
R		S		C E・A・L		T		Inscribed circle (mm)	Inscribed circle symbol (Inch)
Symbol	Size (mm)	Symbol	Size (mm)	Symbol	Size (mm)	Symbol	Size (mm)		
		06	6.35	06	6.5	11	11.0	6.35	2
		07	7.94	08	8.1	13	13.8	7.94	
09	9.525	09	9.525	09	9.7	16	16.5	9.525	3
10	10.0							10.0	
12	12.0							12.0	
12	12.70	12	12.7	12	12.9	22	22.0	12.70	4
15	15.875	15	15.875	16	16.1	27	27.5	15.875	5
16	16.0							16.0	
19	19.05	19	19.05	19	19.3	33	33.0	19.05	6

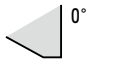
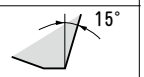
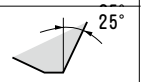
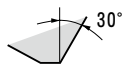
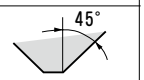
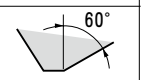
⑥ Thickness			
Symbol (Metric)	Thickness (mm)	Symbol (Inch)	
		Nomal Series	Small Size Series
01	1.59	—	2
02	2.38	—	3
T2	2.78	—	—
03	3.18	2	4
T3	3.97	—	5
04	4.76	3	6
06	6.35	4	—
07	7.94	5	—
09	9.52	6	—

Thickness might be shown approximately.

⑩ Wiper edge

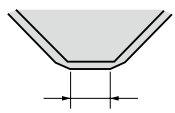
Symbol	A	B	C
Shape			
	Two steped chamfered	Chamferd	Three steped chamfered
Symbol	D	E	G
Shape			
	Two steped chamfered	Two steped chamfered	One steped chamfered and round

⑪ Cutting edge angle

Symbol	Shape
0	
3	
5	
6	
9	
12	

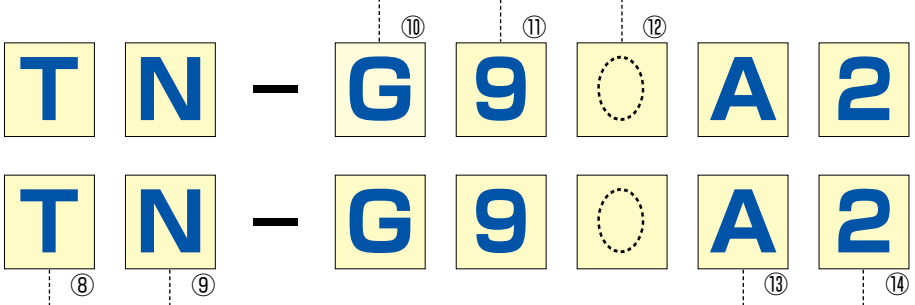
⑭ Width wiper edge

Symbol	W : Size(mm)
1	1.0
2	1.2
3	1.4
4	1.6
5	1.8
6	2.0
7	2.2
8	2.5
9	2.8
0	3.2

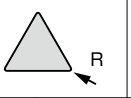


W : Size

(If the width of wiper edge is special, fill in.)



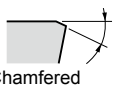
⑦ Corner coniguration (Metric series)



Symbol	Corner radius R (mm)	Symbol	Corner angle	Depth angle	Symbol	Clearance
02	0.2	A	45°	45°	A	3°
04	0.4	D	30°	60°	B	5°
08	0.8	E	15°	75°	C	7°
12	1.2	F	5°	85°	D	15°
16	1.6	P	0°	90°	E	20°
20	2.0	Z	Others		F	25°
24	2.4				G	30°
					N	0°
					P	11°
					Z	Others

Round top : 00 for inch-based diameter dimensions; M0 for metric dimensions. (Inch system uses 0.)

⑧ Cutting edge condition

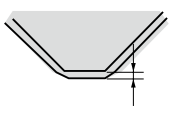
Symbol	Shape
T	 Chamfered cutting edges
E	 Rounded cutting edges
F	 Sharp cutting edges
S	 Chamfered and rounded cutting edges

⑨ Feed direction

Symbol	Feed direction
R	Right hand
L	Left hand
N	Neutral

⑬ Honing on wiper edge

Symbol	h: Size (mm)
A	0.06
B	0.10
C	0.15
D	0.20



h: Size (mm)

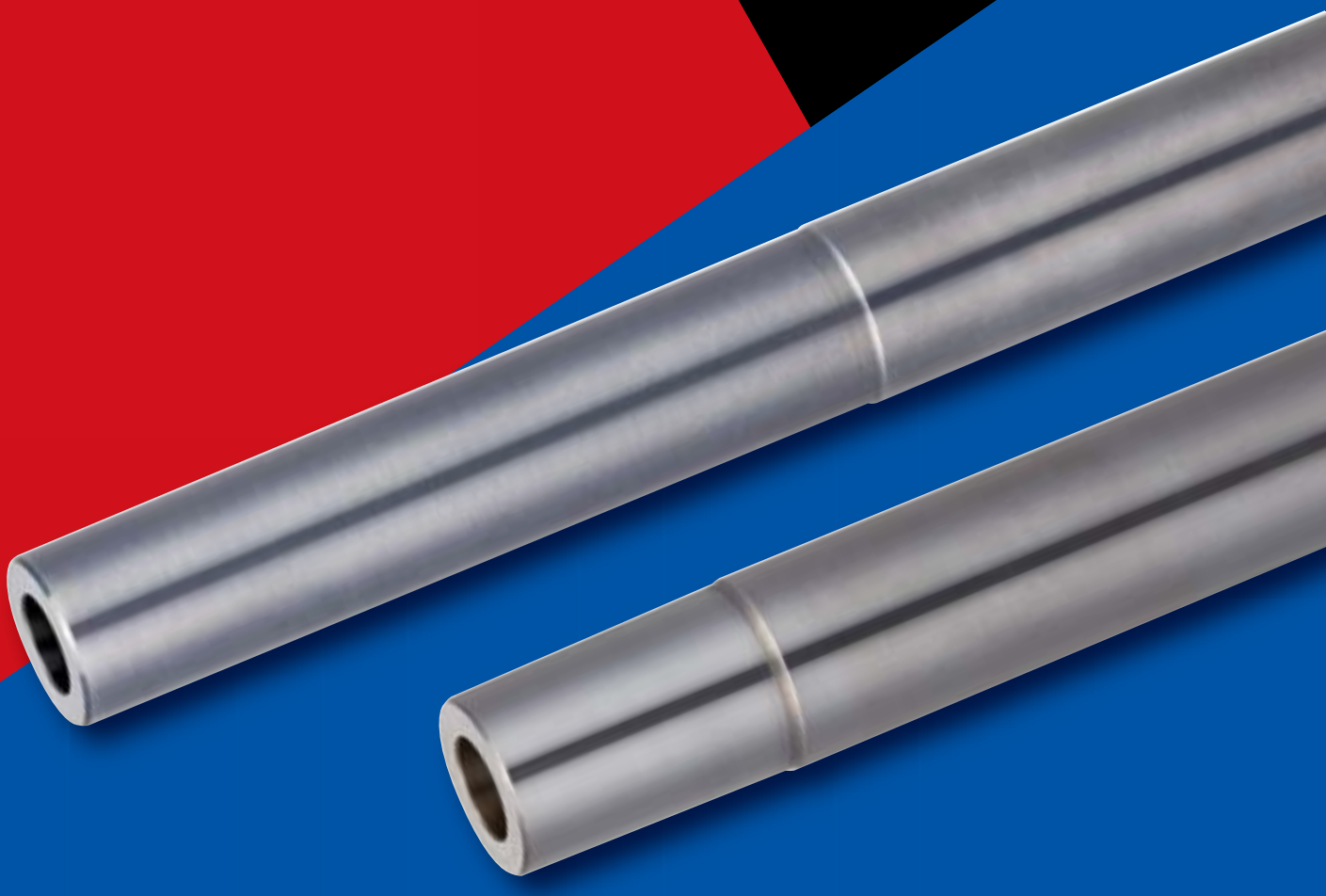
Exact size of insert might not be same as shown by its designation due to each specification.

Notes

MOLDINO
The Edge To Innovation

Carbide Shank for Modular Mill

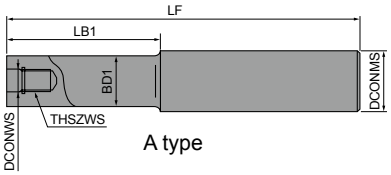
Center Through products are added.



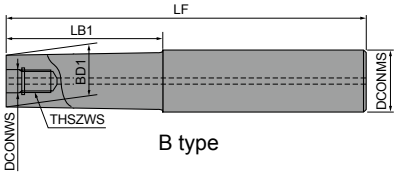
MOLDINO Tool Engineering, Ltd.

New Product News | No. H2208A-3 | 2022-08

Inch



A type



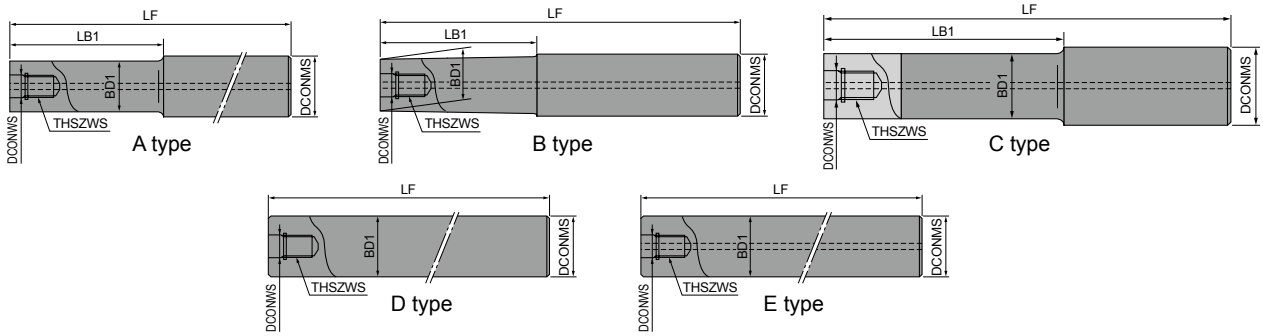
B type

Item code	Stock	Size (inch)						Type	Cutter body	Coolant hole
		DCONWS	THSZWS	LF	LB1	BD1	DCONMS			
IASC0.375-M6-3-1	●	6.5mm	M6	3	1	.366	.375	A	ϕ3/8″※1 ϕ1/2″	–
IASC0.5-M6-4-2	●		M6	4	2	.453	.500	A	ϕ8mm※1 ϕ10mm※1	–
IASC0.5-M6-6-3	●		M6	6	3	.453	.500	A	ϕ11mm※1 ϕ12mm※1	–
IASC0.625-M8-4-2	●	8.5mm	M8	4	2	.571	.625	B	ϕ5/8″※1 ϕ16mm ϕ18mm	○
IASC0.625-M8-6-3	●		M8	6	3	.571	.625	B		○
IASC0.75-M10-5-2.5Z	●	10.5mm	M10	5	2.5	.689	.750	B	ϕ3/4″※1 ϕ20mm ϕ22mm	○
IASC0.75-M10-8-4Z	●		M10	8	4	.689	.750	B		○
IASC1-M12-6-3Z	●	12.5mm	M12	6	3	.906	1.000	B	ϕ1″※1 ϕ25mm※1 ϕ28mm	○
IASC1-M12-8-4Z	●		M12	8	4	.906	1.000	B		○

○= Tool with coolant hole

※1 Cutter Dia. is same or smaller than the shank dia.. Interference may occures.

Metric



Item code	Stock	Size (mm)						Type	Cutter body	Coolant hole
		DCONWS	THSZWS	LF	LB1	BD1	DCONMS			
ASC10-6.5-74-24Z	●	6.5	M6	74	24	9.3	10	A	ϕ8mm※1 ϕ10mm※1 ϕ11mm ϕ12mm ϕ3/8″※1 ϕ1/2″	○
ASC10-6.5-84-34Z	●			84	34			A		○
ASC10-6.5-114-49Z	★			114	49			A		○
ASC10-6.5-114-24Z	★				24			A		○
ASC12-6.5-74-24Z	●	6.5	M6	74	24	11	12	B	ϕ8mm※1 ϕ10mm※1 ϕ11mm※1 ϕ12mm※1 ϕ3/8″※1 ϕ1/2″	○
ASC12-6.5-94-44Z	●			94	44			B		○
ASC12-M6-100-0	●			100	-	12		D		–
ASC12-6.5-129-64Z	★			129	64	11		B		○
ASC12-6.5-129-24Z	★				24			B		○
ASC16-8.5-95-30Z	●	8.5	M8	95	30	14.5	16	B	ϕ16mm※1 ϕ17mm ϕ18mm ϕ5/8″※1	○
ASC16-8.5-120-55Z	●			120	55					
ASC16-8.5-140-75Z	●			140	75					
ASC16-8.5-160-95Z	★			160	95					
ASC16-8.5-160-30Z	★			160	30					
ASC18-M10-125-0Z	●	10.5	M10	125	-	18	18	E	ϕ20mm※1 ϕ22mm ϕ3/4″※1	○
ASC20-10.5-120-50Z	★			120	50	18.5	20	B		○
ASC20-10.5-170-90Z	●			170	90					
ASC20-10.5-220-120Z	●			220	120					
ASC20-10.5-270-150Z	★			270	150					
ASC20-10.5-220-50Z	★	10.5	M10	220	50	18.5	20	B		○
ASC20-10.5-270-50Z	★			270						
ASC25-12.5-145-65	★	12.5	M12	145	65	23	25	C	ϕ25mm※1 ϕ28mm ϕ1″	○
ASC25-M12-150-0Z	●			150	-	25		E		
ASC25-12.5-215-115	●			215	115	23		C		
ASC25-12.5-265-145	●			265	145					
ASC25-12.5-315-195	★			315	195					
ASC25-12.5-265-65	★	12.5	M12	265	65	23	25	C		○
ASC25-12.5-315-65	★			315						
ASC32-17-160-80	★	17	M16	160	80	28	32	C	ϕ30mm※1 ϕ32mm※1 ϕ35mm <ϕ40mm> <ϕ42mm> ϕ1.25″※1 <ϕ1.5″>	○
ASC32-17-210-110	●			210	110					
ASC32-17-260-140	●			260	140					
ASC32-17-310-190	★			310	190					
ASC32-17-360-240	★			360	240					
ASC32-17-260-80	★	17	M16	260	80	28	32	C		○
ASC32-17-310-80	★			310						
ASC32-17-360-80	★			360						

※1 Cutter Dia. is same or smaller than the shank dia.. Interference may occurs.

○= Tool with coolant hole

<ϕ40mm><ϕ42mm><ϕ1.5″> When using oversized screw on heads -40mm and 1.5″ diameter- maximum tool projection from holder is 200mm or 8″

Notes

MOLDINO
The Edge To Innovation

Carbide Threading tool

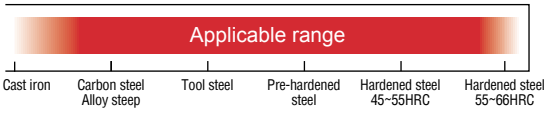
ET-PN
EDT-TH
EDT-(N)PT-ATH

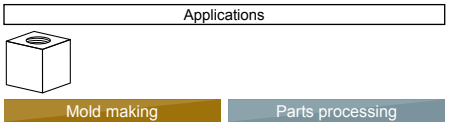
Carbide Thread Mill series

MOLDINO Tool Engineering, Ltd.

New Product News | No. H1803A-3 | 2021-5

Features





ET-PN
EDT-TH, EDT-(N)PT-ATH

ϕ1.4mm～ϕ15.8mm,
ϕ.055 inch～.622 inch [140 Sizes]

Features of Epoch Thread Mill

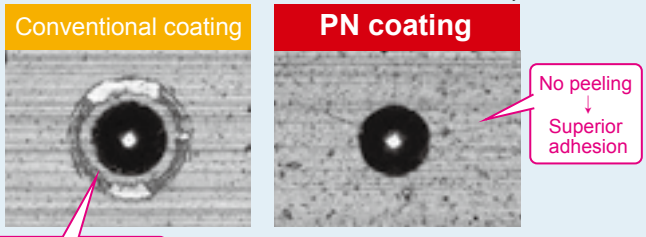
- Tough and strong edge design provides threading in hardened steels.
- Tip shape reduces cutting resistance suppresses tool bending.
- Drastically reduces tool breakage.
- PN Coating provides excellent adhesion and wear resistance.

Reduces risk of breaking off inside!

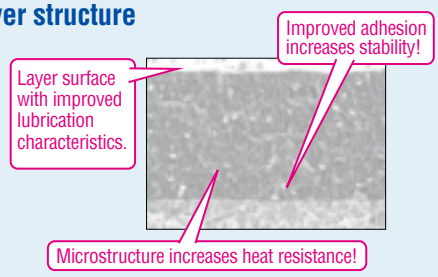
New coating with excellent adhesion and wear resistance

Adhesion of PN coating

Substrate: Carbide alloy



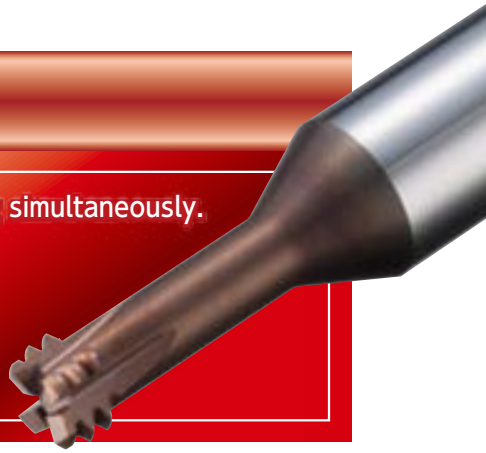
Cross-section photograph of PN coating layer structure



Features of Epoch D Thread Mill

- No pilot hole needed. This single tool can perform both drilling and threading simultaneously.
- High-strength edge shape design suppresses edge tip breakage in severe machining environments including hardened steels.
- ATH Coating delivers improved hardness and oxidation resistance.

No pilot hole needed



ATH coating further improves the hardness and oxidation resistance of the previous TH coating.

New PVD Nano Technology

Epoch Super Coating ATH

- Hardness and oxidation resistance of TH coatings is further improved. Enables longer life and higher efficiency when cutting high-hardness materials.
  Hardness: 3800HV; Oxidation temperature: 1200℃
  (Si nano composite coating with finer crystal particles)
- Exhibits performance in ultra high-efficient cutting.

Reduces the risk of breaking off inside

By using a tool with a diameter smaller than the inside diameter of the thread, cutting chips are smaller and chip evacuation is improved.
The risk of the tool breaking off inside the hole is reduced as a result.

One tool - various types of thread milling

Right hand, left-hand and fine thread milling can be performed by just changing the NC program.
The thread diameters of the coarse threads and fine threads that can be processed with the same tool are different.
(Example: For ET-1.25-16-PN, coarse thread is M8 × 1.25 and fine thread is M10 × 1.25)

Cutting conditions can be freely set

Unlike when using taps, synchronizing the rotation and feed rates is not necessary, so these tools can be used in the same manner as end mills and cutting conditions can be set according to the processing environment.

Usable on a variety of machines

Since the load is smaller than when using taps, these tools can be used even on machines having low-powered spindle.
In addition, special tooling such as tapping holders are not necessary.

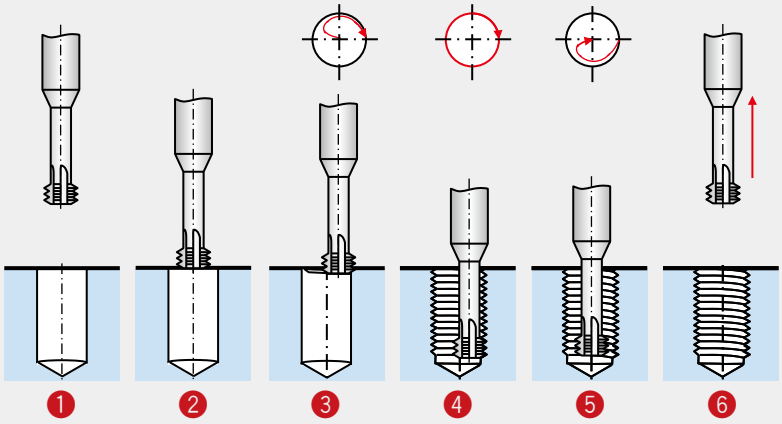
Provides good finished surfaces

Interrupted cutting suppresses gouging to provide good finished surfaces.

Thread milling can be performed to the bottom of the hole.

Epoch Thread Mills are designed with no incomplete threads and Epoch D Thread Mills have only one incomplete thread, making them ideal for when you want to perform thread milling to the bottom of shallow holes.

Machining process with Epoch Thread Mill



1. Startup
2. Positioning for starting point of machining
3. Entry (gradually cutting in)
4. Threading
5. Release (gradually detaching from cutting)
6. Ending

※Epoch D Thread Mill can perform boring simultaneously.

Easily Create NC Programs Online

You can create NC programs on our website!
http://www.moldino.com/en-US/

Left-hand cutting tool - Reverse spindle rotation should be used.

Epoch Thread Mill

4 flutes

No incomplete thread

ET-(U)○○.○○-○○.○-PN

Unit: Metric Screw : mm, UN Screw Thread : inch

Carbide PN

Order Number		Stock	Thread Dia. D_1		Thread Pitch TP	Cutting Dia. DC	Neck Length LU	Overall Length OAL	Connection Dia. DCONMS	Oil Hole
UN Screw Thread DC × 2	ET-U64-3.7-PN	★	No.1-64UNC	.073	64	.055	.146	1.969	.236	-
	ET-U56-4.4-PN	★	No.2-56UNC	.086	56	.065	.173	1.969	.236	-
	ET-U48-5-PN	★	No.3-48UNC	.099	48	.075	.197	1.969	.236	-
	ET-U40-5.7-PN	★	No.4-40UNC	.112	40	.083	.224	1.969	.236	-
	ET-U32-7-PN	★	No.6-32UNC	.138	32	.100	.276	1.969	.236	-
	ET-U36-8.3-PN	★	No.8-36UNF	.164	36	.130	.327	1.969	.236	-
	ET-U24-9.7-PN	★	No.10-24UNC	.190	24	.138	.382	2.756	.236	-
	ET-U20-12.7-PN	●	1/4-20UNC	1/4	20	.187	.500	2.756	.236	-
	ET-U28-12.7-PN	●	1/4-28UNF	1/4	28	.197	.500	2.756	.236	-
	ET-U18-15.9-PN	●	5/16-18UNC	5/16	18	.236	.626	3.150	.394	-
	ET-U16-19.1-PN	●	3/8-16UNC	3/8	16	.264	.752	3.150	.394	-
	ET-U14-22.2-PN	★	7/16-14UNC	7/16	14	.303	.874	3.150	.394	-
	ET-U13-25.4-PN	●	1/2-13UNC	1/2	13	.362	1.000	3.150	.394	-
	ET-U12-28.6-PN	★	9/16-12UNC	9/16	12	.413	1.126	3.937	.472	-
	ET-U11-31.8-PN	●	5/8-11UNC	5/8	11	.449	1.252	3.937	.472	-
UN Screw Thread DC × 2.5	ET-U64-4.6-PN	★	No.1-64UNC	.073	64	.055	.181	1.969	.236	-
	ET-U56-5.5-PN	★	No.2-56UNC	.086	56	.065	.217	1.969	.236	-
	ET-U48-6.3-PN	★	No.3-48UNC	.099	48	.075	.248	1.969	.236	-
	ET-U40-7.1-PN	★	No.4-40UNC	.112	40	.083	.280	1.969	.236	-
	ET-U32-8.8-PN	★	No.6-32UNC	.138	32	.100	.346	1.969	.236	-
	ET-U36-10.4-PN	★	No.8-36UNF	.164	36	.130	.409	1.969	.236	-
	ET-U24-12.1-PN	★	No.10-24UNC	.190	24	.138	.476	2.756	.236	-
	ET-U20-15.9-PN	●	1/4-20UNC	1/4	20	.187	.626	2.756	.236	-
	ET-U28-15.9-PN	●	1/4-28UNF	1/4	28	.197	.626	2.756	.236	-
	ET-U18-19.8-PN	●	5/16-18UNC	5/16	18	.236	.780	3.150	.394	-
	ET-U16-23.8-PN	●	3/8-16UNC	3/8	16	.264	.937	3.150	.394	-
	ET-U14-27.8-PN	★	7/16-14UNC	7/16	14	.303	1.094	3.150	.394	-
	ET-U13-31.8-PN	●	1/2-13UNC	1/2	13	.362	1.252	3.150	.394	-
	ET-U12-35.7-PN	★	9/16-12UNC	9/16	12	.413	1.406	3.937	.472	-
	ET-U11-39.7-PN	●	5/8-11UNC	5/8	11	.449	1.563	3.937	.472	-
Metric Screw DC × 2	ET-0.4-4-PN	★	M2		0.4	1.4	4	50	6	-
	ET-0.45-4.4-PN	★	M2.2		0.45	1.6	4.4	50	6	-
	ET-0.45-5-PN	★	M2.5		0.45	1.8	5	50	6	-
	ET-0.5-6-PN	●	M3		0.5	2.4	6	50	6	-
	ET-0.7-8-PN	●	M4		0.7	3.1	8	50	6	-
	ET-0.8-10-PN	●	M5		0.8	3.8	10	50	6	-
	ET-1.0-12-PN	●	M6		1	4.6	12	50	6	-
	ET-1.25-16-PN	●	M8		1.25	6.2	16	70	10	-
	ET-1.5-20-PN	●	M10		1.5	7.5	20	70	10	-
	ET-1.75-24-PN	●	M12		1.75	9	24	80	10	-
	ET-2-32-PN	★	M16		2	11.5	32	100	12	-
	ET-2.5-36-PN	★	M18		2.5	14	36	135	16	○
	ET-2.5-40-PN	★	M20		2.5	15	40	135	16	○
Metric Screw DC × 2.5	ET-0.4-5-PN	★	M2		0.4	1.4	5	50	6	-
	ET-0.45-5.5-PN	★	M2.2		0.45	1.6	5.5	50	6	-
	ET-0.45-6.25-PN	★	M2.5		0.45	1.8	6.25	50	6	-
	ET-0.5-7.5-PN	●	M3		0.5	2.4	7.5	50	6	-
	ET-0.7-10-PN	●	M4		0.7	3.1	10	50	6	-
	ET-0.8-12.5-PN	●	M5		0.8	3.8	12.5	50	6	-
	ET-1.0-15-PN	●	M6		1	4.6	15	50	6	-
	ET-1.25-20-PN	●	M8		1.25	6.2	20	70	10	-
	ET-1.5-25-PN	●	M10		1.5	7.5	25	70	10	-
	ET-1.75-30-PN	●	M12		1.75	9	30	80	10	-
	ET-2-40-PN	★	M16		2	11.5	40	100	12	-
	ET-2.5-45-PN	★	M18		2.5	14	45	135	16	○
	ET-2.5-50-PN	★	M20		2.5	15	50	135	16	○

● : Inventory maintained in US ★ : Inventory maintained in Japan

※For information about tool diameter correction, refer to the item in "Cautions on use" on p. 257.

Epoch Thread Mill

UN Screw Thread

Work Material		Cast Iron, Carbon Steels 150～200HB, Stainless Steels 300 series		Tool Steels 25 ～ 35HRC		Pre-hardened Steels 35 ～ 45HRC	
Vc (SFM)		262 ～ **279** ～ 295		230 ～ **246** ～ 262		197 ～ **213** ～ 230	
Thread Dia. *D1*	DC (inch)	RPM (min^{-1})	Feed Rate *Vf* (IPM)	RPM (min^{-1})	Feed Rate *Vf* (IPM)	RPM (min^{-1})	Feed Rate *Vf* (IPM)
No.1-64UNC	.055	19,300	6.690	17,100	5.280	14,800	4.570
No.2-56UNC	.065	16,400	6.930	14,500	6.140	12,500	4.800
No.3-48UNC	.075	14,200	7.130	12,600	5.830	10,900	4.610
No.4-40UNC	.083	12,900	7.990	11,400	6.570	9,900	5.310
No.6-32UNC	.100	10,600	8.190	9,400	6.850	8,100	5.550
No.8-36UNF	.130	8,200	6.690	7,200	5.670	6,300	4.530
No.10-24UNC	.138	7,700	8.980	6,800	7.360	5,900	5.870
1/4-20UNC	.187	5,700	8.580	5,000	7.130	4,400	5.750
1/4-28UNF	.197	5,400	7.240	4,800	6.100	4,100	4.800
5/16-18UNC	.236	4,500	8.310	4,000	6.930	3,400	5.470
3/8-16UNC	.264	4,000	10.080	3,600	8.430	3,100	6.810
7/16-14UNC	.303	3,500	10.510	3,100	8.700	2,700	7.050
1/2-13UNC	.362	2,900	9.330	2,600	7.800	2,200	6.100
9/16-12UNC	.413	2,600	8.700	2,300	7.200	2,000	5.830
5/8-11UNC	.449	2,400	9.250	2,100	7.560	1,800	6.060

Work Material		Hardened Steels 45 ～ 55HRC		Hardened Steels 55 ～ 62HRC		Hardened Steels 62 ～ 66HRC	
Vc (SFM)		164 ～ **180** ～ 197		131 ～ **148** ～ 164		98 ～ **115** ～ 131	
Thread Dia. *D1*	DC (inch)	RPM (min^{-1})	Feed Rate *Vf* (IPM)	RPM (min^{-1})	Feed Rate *Vf* (IPM)	RPM (min^{-1})	Feed Rate *Vf* (IPM)
No.1-64UNC	.055	12,500	3.390	10,200	2.360	8,000	1.850
No.2-56UNC	.065	10,600	3.660	8,700	2.360	6,800	1.850
No.3-48UNC	.075	9,200	3.540	7,500	2.320	5,900	1.810
No.4-40UNC	.083	8,300	4.090	6,800	2.520	5,300	1.970
No.6-32UNC	.100	6,900	4.450	5,600	2.640	4,400	2.090
No.8-36UNF	.130	5,300	3.460	4,300	2.240	3,400	1.770
No.10-24UNC	.138	5,000	4.760	4,100	3.030	3,200	2.360
1/4-20UNC	.187	3,700	4.570	3,000	2.870	2,300	2.200
1/4-28UNF	.197	3,500	3.860	2,900	2.440	2,200	1.850
5/16-18UNC	.236	2,900	4.330	2,400	2.760	1,900	2.200
3/8-16UNC	.264	2,600	5.350	2,100	3.350	1,700	2.720
7/16-14UNC	.303	2,300	5.550	1,900	3.580	1,400	2.640
1/2-13UNC	.362	1,900	4.960	1,600	3.190	1,200	2.400
9/16-12UNC	.413	1,700	4.610	1,400	2.910	1,100	2.280
5/8-11UNC	.449	1,500	4.650	1,300	3.110	1,000	2.400

【Note】

①ET thread mills are only for threading the inside of holes.
②The above cutting conditions are for the thread diameters stated in the table. Cutting conditions for other thread diameters should be calculated taking into consideration the Cutting Considerations (page 257).
③The machinery should be a machining center equipped with NC (numerical control) equipment having a helical interpolation function.
④The feed rate stated in the above conditions table is the feed rate at the tool center during tapping. In addition, the per-tooth feed rate is the numerical value at the cutting point.
⑤Since there is a risk of cutting chips getting inside the machine, when using tools equipped with oil holes, be sure to use the oil holes.
⑥Use the appropriate coolant for the work material and machining shape.
⑦These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine conditions.

Epoch Thread Mill

Metric Screw

Work Material			Cast Iron, Carbon Steels 150～200HB		Stainless Steels 300 series	Tool Steels 25 ～ 35HRC			Pre-hardened Steels 35 ～ 45HRC		
v_c (SFM)			262 ～ **279** ～ 295			230 ～ **246** ～ 262			197 ～ **213** ～ 230		
Thread Dia. D_1	DC (inch)	DC (mm)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)
M2	.055	1.4	19,300	8.189	208	17,100	6.457	164	14,800	5.591	142
M2.2	.063	1.6	16,900	7.992	203	14,900	6.417	163	12,900	5.551	141
M2.5	.071	1.8	15,000	7.953	202	13,300	6.457	164	11,500	5.591	142
M3	.094	2.4	11,300	6.063	154	9,900	5.000	127	8,600	4.055	103
M4	.122	3.1	8,700	7.402	188	7,700	5.984	152	6,700	5.000	127
M5	.150	3.8	7,100	7.795	198	6,300	6.417	163	5,400	5.118	130
M6	.181	4.6	5,900	8.031	204	5,200	6.693	170	4,500	5.276	134
M8	.244	6.2	4,400	7.795	198	3,900	6.496	165	3,300	5.039	128
M10	.295	7.5	3,600	8.504	216	3,200	7.047	179	2,800	5.827	148
M12	.354	9	3,000	8.504	216	2,700	7.244	184	2,300	5.709	145
M16	.453	11.5	2,400	9.252	235	2,100	7.638	194	1,800	6.063	154
M18	.551	14	1,900	6.732	171	1,700	5.669	144	1,500	4.606	117
M20	.591	15	1,800	7.244	184	1,600	6.063	154	1,400	4.921	125

Work Material			Hardened Steels 45 ～ 55HRC			Hardened Steels 55 ～ 62HRC			Hardened Steels 62 ～ 66HRC		
v_c (m/min)			164 ～ **180** ～ 197			131 ～ **148** ～ 164			98 ～ **115** ～ 131		
Thread Dia. D_1	DC (inch)	DC (mm)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)
M2	.055	1.4	12,500	4.134	105	10,200	2.874	73	8,000	2.283	58
M2.2	.063	1.6	10,900	4.213	107	9,000	2.717	69	7,000	2.087	53
M2.5	.071	1.8	9,700	4.291	109	8,000	2.835	72	6,200	2.205	56
M3	.094	2.4	7,300	3.228	82	6,000	2.087	53	4,600	1.575	40
M4	.122	3.1	5,600	3.780	96	4,600	2.441	62	3,600	1.929	49
M5	.150	3.8	4,600	4.016	102	3,800	2.598	66	2,900	1.969	50
M6	.181	4.6	3,800	4.173	106	3,100	2.638	67	2,400	2.047	52
M8	.244	6.2	2,800	3.976	101	2,300	2.520	64	1,800	1.969	50
M10	.295	7.5	2,300	4.449	113	1,900	2.835	72	1,500	2.244	57
M12	.354	9	1,900	4.409	112	1,600	2.835	72	1,200	2.126	54
M16	.453	11.5	1,500	4.724	120	1,200	2.913	74	1,000	2.441	62
M18	.551	14	1,300	3.740	95	1,000	2.205	56	800	1.772	45
M20	.591	15	1,200	3.937	100	1,000	2.520	64	700	1.772	45

【Note】

①ET thread mills are only for threading the inside of holes.
②The above cutting conditions are for the thread diameters stated in the table. Cutting conditions for other thread diameters should be calculated taking into consideration the Cutting Considerations (page 257).
③The machinery should be a machining center equipped with NC (numerical control) equipment having a helical interpolation function.
④The feed rate stated in the above conditions table is the feed rate at the tool center during tapping. In addition, the per-tooth feed rate is the numerical value at the cutting point.
⑤Since there is a risk of cutting chips getting inside the machine, when using tools equipped with oil holes, be sure to use the oil holes.
⑥Use the appropriate coolant for the work material and machining shape.
⑦These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine conditions.

Epoch D Thread Mill

4 flutes

1 incomplete thread and
2 complete threads

EDT-U○○-○○.○-TH

Unit inch

Carbide ATH

Order Number		Stock	Thread Dia. D_1		Thread Pitch TP	Cutting Dia. DC	Neck Length LU	Overall Length OAL	Connection Dia. DCONMS	Oil Hole
UN Screw Thread DC × 2	EDT-U64-3.7-TH	★	No.1-64UNC	.073	64	.055	.146	1.969	.236	-
	NEW EDT-U56-4.4-TH	●	No.2-56UNC	.086	56	.065	.173	1.969	.236	-
	EDT-U48-5-TH	★	No.3-48UNC	.099	48	.075	.197	1.969	.236	-
	NEW EDT-U40-5.7-TH	●	No.4-40UNC	.112	40	.083	.224	1.969	.236	-
	NEW EDT-U32-7-TH	●	No.6-32UNC	.138	32	.100	.276	1.969	.236	-
	EDT-U32-8.3-TH	●	No.8-32UNC	.164	32	.130	.327	2.362	.236	-
	EDT-U36-8.3-TH	★	No.8-36UNF	.164	36	.130	.327	1.969	.236	-
	EDT-U24-9.7-TH	★	No.10-24UNC	.190	24	.138	.382	2.362	.236	-
	EDT-U32-9.7-TH	●	NO.10-32UNF	.190	32	.138	.382	2.756	.236	-
	EDT-U20-12.7-TH	●	1/4-20UNC	1/4	20	.187	.500	2.756	.236	-
	EDT-U28-12.7-TH	●	1/4-28UNF	1/4	28	.197	.500	2.756	.236	-
	EDT-U18-15.9-TH	●	5/16-18UNC	5/16	18	.236	.626	3.150	.394	-
	EDT-U24-15.9-TH	●	5/16-24UNF	5/16	24	.236	.626	3.150	.394	-
	EDT-U16-19.1-TH	●	3/8-16UNC	3/8	16	.264	.752	3.150	.394	-
	EDT-U14-22.2-TH	★	7/16-14UNC	7/16	14	.303	.874	3.150	.394	○
	EDT-U13-25.4-TH	●	1/2-13UNC	1/2	13	.362	1.000	3.150	.394	○
	EDT-U20-25.4-TH	●	1/2-20UNF	1/2	20	.362	1.000	3.150	.394	○
	EDT-U12-28.6-TH	★	9/16-12UNC	9/16	12	.413	1.126	3.937	.472	○
	EDT-U11-31.8-TH	●	5/8-11UNC	5/8	11	.449	1.252	3.937	.472	○
	EDT-U18-31.8-TH	●	5/8-18UNF	5/8	18	.449	1.252	3.937	.472	○
	EDT-U10-3/4-38.1-TH	●	3/4-10UNC	3/4	10	.571	1.500	5.315	.630	○
	EDT-U9-7/8-44.5-TH	●	7/8-9UNC	7/8	9	.591	1.752	5.315	.630	○
	EDT-U8-1-50.8-TH	●	1-8UNC	1	8	.622	2.000	5.315	.630	○
UN Screw Thread DC × 2.5	EDT-U64-4.6-TH	★	No.1-64UNC	.073	64	.055	.181	1.969	.236	-
	NEW EDT-U56-5.5-TH	●	No.2-56UNC	.086	56	.065	.217	1.969	.236	-
	EDT-U48-6.3-TH	★	No.3-48UNC	.099	48	.075	.248	1.969	.236	-
	NEW EDT-U40-7.1-TH	●	No.4-40UNC	.112	40	.083	.280	1.969	.236	-
	NEW EDT-U32-8.8-TH	●	No.6-32UNC	.138	32	.100	.346	1.969	.236	-
	EDT-U32-10.4-TH	●	No.8-32UNC	.164	32	.130	.409	2.362	.236	-
	EDT-U36-10.4-TH	★	No.8-36UNF	.164	36	.130	.409	1.969	.236	-
	EDT-U24-12.1-TH	★	No.10-24UNC	.190	24	.138	.476	2.756	.236	-
	EDT-U32-12.1-TH	●	No.10-32UNF	.190	32	.138	.476	2.362	.236	-
	EDT-U20-15.9-TH	●	1/4-20UNC	1/4	20	.187	.626	2.756	.236	-
	EDT-U28-15.9-TH	●	1/4-28UNF	1/4	28	.197	.626	2.756	.236	-
	EDT-U18-19.8-TH	●	5/16-18UNC	5/16	18	.236	.780	3.150	.394	-
	EDT-U24-19.8-TH	●	5/16-24UNF	5/16	24	.236	.780	3.150	.394	-
	EDT-U16-23.8-TH	●	3/8-16UNC	3/8	16	.264	.937	3.150	.394	-
	EDT-U14-27.8-TH	★	7/16-14UNC	7/16	14	.303	1.094	3.150	.394	○
	EDT-U13-31.8-TH	●	1/2-13UNC	1/2	13	.362	1.252	3.150	.394	○
	EDT-U20-31.8-TH	●	1/2-20UNF	1/2	20	.362	1.252	3.150	.394	○
	EDT-U12-35.7-TH	★	9/16-12UNC	9/16	12	.413	1.406	3.937	.472	○
	EDT-U11-39.7-TH	●	5/8-11UNC	5/8	11	.449	1.563	3.937	.472	○
	EDT-U18-39.7-TH	●	5/8-18UNF	5/8	18	.449	1.563	3.937	.472	○
	EDT-U10-3/4-47.6-TH	●	3/4-10UNC	3/4	10	.571	1.874	5.315	.630	○
	EDT-U9-7/8-55.6-TH	●	7/8-9UNC	7/8	9	.591	2.189	5.315	.630	○
	EDT-U8-1-63.5-TH	●	1-8UNC	1	8	.622	2.500	5.315	.630	○

● : Inventory maintained in US ★ : Inventory maintained in Japan

※For information about tool diameter correction, refer to the item in "Cautions on use" on p. 257.

Epoch D Thread Mill

4 flutes

1 incomplete thread and
2 complete threads

EDT○.○○-○○.○-TH

Unit mm

Order Number		Stock	Thread Dia. D_1	Thread Pitch TP	Cutting Dia. DC	Neck Length LU	Overall Length OAL	Connection Dia. DCONMS	Oil Hole
Metric Screw DC × 2	NEW EDT-0.4-4-TH	●	M2	0.4	1.4	4	50	6	-
	EDT-0.45-4.4-TH	★	M2.2	0.45	1.6	4.4	50	6	-
	NEW EDT-0.45-5-TH	●	M2.5	0.45	1.8	5	50	6	-
	EDT-0.5-6-TH	●	M3	0.5	2.4	6	50	6	-
	EDT-0.7-8-TH	●	M4	0.7	3.1	8	50	6	-
	EDT-0.8-10-TH	●	M5	0.8	3.8	10	50	6	-
	EDT-1.0-12-TH	●	M6	1	4.6	12	50	6	-
	EDT-1.25-16-TH	●	M8	1.25	6.2	16	70	10	-
	EDT-1.5-20-TH	●	M10	1.5	7.5	20	70	10	○
	EDT-1.75-24-TH	●	M12	1.75	9	24	80	10	○
	NEW EDT-2-32-TH	●	M16	2	11.5	32	100	12	○
	EDT-2.5-36-TH	★	M18	2.5	14	36	135	16	○
	EDT-2.5-40-TH	★	M20	2.5	15	40	135	16	○
Metric Screw DC × 2.5	NEW EDT-0.4-5-TH	●	M2	0.4	1.4	5	50	6	-
	EDT-0.45-5.5-TH	★	M2.2	0.45	1.6	5.5	50	6	-
	NEW EDT-0.45-6.25-TH	●	M2.5	0.45	1.8	6.25	50	6	-
	EDT-0.5-7.5-TH	●	M3	0.5	2.4	7.5	50	6	-
	EDT-0.7-10-TH	●	M4	0.7	3.1	10	50	6	-
	EDT-0.8-12.5-TH	●	M5	0.8	3.8	12.5	50	6	-
	EDT-1.0-15-TH	●	M6	1	4.6	15	50	6	-
	EDT-1.25-20-TH	●	M8	1.25	6.2	20	70	10	-
	EDT-1.5-25-TH	●	M10	1.5	7.5	25	70	10	○
	EDT-1.75-30-TH	●	M12	1.75	9	30	80	10	○
	NEW EDT-2-40-TH	●	M16	2	11.5	40	100	12	○
	EDT-2.5-45-TH	★	M18	2.5	14	45	135	16	○
	EDT-2.5-50-TH	★	M20	2.5	15	50	135	16	○

● : Inventory maintained in US ★ : Inventory maintained in Japan

※For information about tool diameter correction, refer to the item in "Cautions on use" on p. 257.

Epoch D Thread Mill

UN Screw Thread

Work Material		Cast Iron, Carbon Steels 150～200HB		Tool Steels 25 ～ 35HRC		Pre-hardened Steels 35 ～ 45HRC	
v_c (SFM)		262 ～ **279** ～ 295		230 ～ **246** ～ 262		197 ～ **219** ～ 230	
Thread Dia. D_1	DC (inch)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)
No.1-64UNC	.055	19,300	4.450	17,100	3.940	14,800	3.430
No.2-56UNC	.065	16,400	4.410	14,500	3.900	12,500	3.390
No.3-48UNC	.075	14,200	4.370	12,600	3.900	10,900	3.350
No.4-40UNC	.083	12,900	4.800	11,400	4.210	9,900	3.660
No.6-32UNC	.100	10,600	5.000	9,400	4.450	8,100	3.820
No.8-32UNC	.130	8,200	4.290	7,200	3.780	6,300	3.310
No.8-36UNF	.130	8,200	4.290	7,200	3.780	6,300	3.310
No.10-24UNC	.138	7,700	5.670	6,800	5.000	5,900	4.330
No.10-32UNF	.138	7,700	5.670	6,800	5.000	5,900	4.330
¼-20UNC	.187	5,700	5.430	5,000	4.760	4,400	4.170
¼-28UNF	.197	5,400	4.530	4,800	4.020	4,100	3.430
5/16-18UNC	.236	4,500	5.200	4,000	4.610	3,400	3.940
5/16-24UNF	.236	4,500	5.200	4,000	4.610	3,400	3.940
⅜-16UNC	.264	4,000	6.340	3,600	5.710	3,100	4.920
7/16-14UNC	.303	3,500	6.610	3,100	5.830	2,700	5.080
½-13UNC	.362	2,900	5.790	2,600	5.200	2,200	4.410
½-20UNF	.362	2,900	5.790	2,600	5.200	2,200	4.410
9/16-12UNC	.413	2,600	5.430	2,300	4.800	2,000	4.170
⅝-11UNC	.449	2,400	5.750	2,100	5.040	1,800	4.330
⅝-18UNF	.449	2,400	5.750	2,100	5.040	1,800	4.330
¾-10UNC	.571	1,900	4.450	1,600	3.740	1,400	3.270
⅞-9UNC	.591	1,800	5.910	1,600	5.240	1,400	4.610
1-8UNC	.622	1,700	6.770	1,500	5.980	1,300	5.200

Work Material		Hardened Steels 45 ～ 55HRC		Hardened Steels 55 ～ 62HRC		Hardened Steels 62 ～ 66HRC	Stainless Steels 300 series
v_c (SFM)		164 ～ **180** ～ 197		131 ～ **148** ～ 164		98 ～ **115** ～ 131	
Thread Dia. D_1	DC (inch)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)
No.1-64UNC	.055	12,500	2.870	10,200	2.360	8,000	1.850
No.2-56UNC	.065	10,600	2.870	8,700	2.360	6,800	1.850
No.3-48UNC	.075	9,200	2.830	7,500	2.320	5,900	1.810
No.4-40UNC	.083	8,300	3.070	6,800	2.520	5,300	1.970
No.6-32UNC	.100	6,900	3.270	5,600	2.640	4,400	2.090
No.8-32UNC	.130	5,300	2.800	4,300	2.240	3,400	1.770
No.8-36UNF	.130	5,300	2.800	4,300	2.240	3,400	1.770
No.10-24UNC	.138	5,000	3.660	4,100	3.030	3,200	2.360
No.10-32UNF	.138	5,000	3.660	4,100	3.030	3,200	2.360
¼-20UNC	.187	3,700	3.500	3,000	2.870	2,300	2.200
¼-28UNF	.197	3,500	2.910	2,900	2.440	2,200	1.850
5/16-18UNC	.236	2,900	3.350	2,400	2.760	1,900	2.200
5/16-24UNF	.236	2,900	3.350	2,400	2.760	1,900	2.200
⅜-16UNC	.264	2,600	4.130	2,100	3.350	1,700	2.720
7/16-14UNC	.303	2,300	4.330	1,900	3.580	1,400	2.640
½-13UNC	.362	1,900	3.780	1,600	3.190	1,200	2.400
½-20UNF	.362	1,900	3.780	1,600	3.190	1,200	2.400
9/16-12UNC	.413	1,700	3.540	1,400	2.910	1,100	2.280
⅝-11UNC	.449	1,500	3.580	1,300	3.110	1,000	2.400
⅝-18UNF	.449	1,500	3.580	1,300	3.110	1,000	2.400
¾-10UNC	.571	1,200	2.800	1,000	2.320	800	1.850
⅞-9UNC	.591	1,200	3.940	1,000	3.270	700	2.280
1-8UNC	.622	1,100	4.370	900	3.580	700	2.800

【Note】
①EDT thread mills are capable of simultaneous boring and threading.
②The above cutting conditions are for the thread diameters stated in the table. Cutting conditions for other thread diameters should be calculated taking into consideration the Cutting Considerations (page 257).
③The machinery should be a machining center equipped with NC (numerical control) equipment having a helical interpolation function.
④The feed rate stated in the above conditions table is the feed rate at the tool center during tapping. In addition, the per-tooth feed rate is the numerical value at the cutting point.
⑤Since there is a risk of cutting chips getting inside the machine, when using tools equipped with oil holes, be sure to use the oil holes.
⑥Use the appropriate coolant for the work material and machining shape.
⑦These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine conditions.

Epoch D Thread Mill

Metric Screw

Work Material			Cast Iron, Carbon Steels 150～200HB			Tool Steels 25 ～ 35HRC			Pre-hardened Steels 35 ～ 45HRC		
v_c (SFM)			262 ～ **279** ～ 295			230 ～ **246** ～ 262			197 ～ **213** ～ 230		
Thread Dia. D_1	DC (inch)	DC (mm)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)
M2	.055	1.4	19,300	5.472	139	17,100	4.843	123	14,800	4.213	107
M2.2	.063	1.6	16,900	5.079	129	14,900	4.488	114	12,900	3.898	99
M2.5	.071	1.8	15,000	5.276	134	13,300	4.685	119	11,500	4.055	103
M3	.094	2.4	11,300	3.898	99	9,900	3.425	87	8,600	2.992	76
M4	.122	3.1	8,700	4.606	117	7,700	4.094	104	6,700	3.543	90
M5	.150	3.8	7,100	4.843	123	6,300	4.291	109	5,400	3.661	93
M6	.181	4.6	5,900	5.000	127	5,200	4.409	112	4,500	3.819	97
M8	.244	6.2	4,400	4.843	123	3,900	4.291	109	3,300	3.622	92
M10	.295	7.5	3,600	5.394	137	3,200	4.803	122	2,800	4.173	106
M12	.354	9	3,000	5.315	135	2,700	4.803	122	2,300	4.094	104
M16	.453	11.5	2,400	5.866	149	2,100	5.118	130	1,800	4.370	111
M18	.551	14	1,900	4.173	106	1,700	3.740	95	1,500	3.307	84
M20	.591	15	1,800	4.528	115	1,600	4.016	102	1,400	3.543	90

Work Material			Hardened Steels 45 ～ 55HRC			Hardened Steels 55 ～ 62HRC			Hardened Steels 62 ～ 66HRC / Stainless Steels 300 series		
v_c (SFM)			164 ～ **180** ～ 197			131 ～ **148** ～ 164			98 ～ **115** ～ 131		
Thread Dia. D_1	DC (inch)	DC (mm)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)	RPM (min^{-1})	Feed Rate v_f (IPM)	Feed Rate v_f (mm/min)
M2	.055	1.4	12,500	3.543	90	10,200	2.874	73	8,000	2.283	58
M2.2	.063	1.6	10,900	3.268	83	9,000	2.717	69	7,000	2.087	53
M2.5	.071	1.8	9,700	3.425	87	8,000	2.835	72	6,200	2.205	56
M3	.094	2.4	7,300	2.520	64	6,000	2.087	53	4,600	1.575	40
M4	.122	3.1	5,600	2.992	76	4,600	2.441	62	3,600	1.929	49
M5	.150	3.8	4,600	3.110	79	3,800	2.598	66	2,900	1.969	50
M6	.181	4.6	3,800	3.228	82	3,100	2.638	67	2,400	2.047	52
M8	.244	6.2	2,800	3.071	78	2,300	2.520	64	1,800	1.969	50
M10	.295	7.5	2,300	3.425	87	1,900	2.835	72	1,500	2.244	57
M12	.354	9	1,900	3.386	86	1,600	2.835	72	1,200	2.126	54
M16	.453	11.5	1,500	3.661	93	1,200	2.913	74	1,000	2.441	62
M18	.551	14	1,300	2.874	73	1,000	2.205	56	800	1.772	45
M20	.591	15	1,200	3.031	77	1,000	2.520	64	700	1.772	45

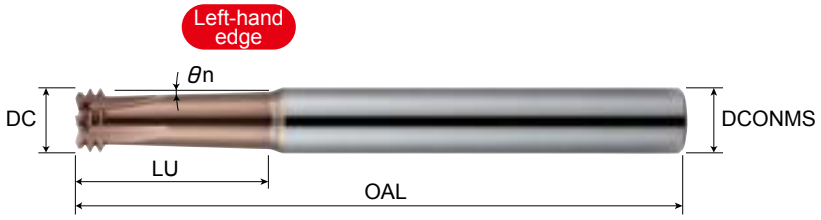
【Note】

①EDT thread mills are capable of simultaneous boring and threading.
②The above cutting conditions are for the thread diameters stated in the table. Cutting conditions for other thread diameters should be calculated taking into consideration the Cutting Considerations (page 257).
③The machinery should be a machining center equipped with NC (numerical control) equipment having a helical interpolation function.
④The feed rate stated in the above conditions table is the feed rate at the tool center during tapping. In addition, the per-tooth feed rate is the numerical value at the cutting point.
⑤Since there is a risk of cutting chips getting inside the machine, when using tools equipped with oil holes, be sure to use the oil holes.
⑥Use the appropriate coolant for the work material and machining shape.
⑦These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine conditions.

Epoch D Thread Mill for PT,NPT Threads

4 flutes

1 incomplete thread and 2 complete threads



θn : 1.7°
※The neck angle (θn) of EDT-PT1(NPT1)-45-ATH is 0° (straight neck).

EDT-NPT○○-○○-ATH

Unit : inch

NPT Thread / Order Number	Stock	Thread dia. Pilot hole not required D_1	Thread dia. Pilot hole required (pilot hole diameter) D_1	Thread Pitch TP	Reference Dia. DC	Neck Length LU	Overall Length OAL	Connection Dia. DCONMS	Oil Hole	Compensation Value D_2
EDT-NPT1/16-18-ATH	●	NPT1/16-27 .311	NPT1/8-27(ϕ.1578 or larger) .403	27	.189	.709	2.756	.236	–	.0012
EDT-NPT1/8-19-ATH	●	NPT1/8-27 .403	–	27	.224	.748	2.756	.236	–	.0012
EDT-NPT1/4-28-ATH	●	NPT1/4-18 .536	NPT3/8-18(ϕ.2362 or larger) .672	18	.311	1.102	3.150	.394	–	.0018
EDT-NPT3/8-28-ATH	●	NPT3/8-18 .672	–	18	.378	1.102	3.150	.394	–	.0018
EDT-NPT1/2-35-ATH	●	NPT1/2-14 .836	NPT3/4-14(ϕ.3150 or larger) 1.046	14	.453	1.378	4.331	.472	–	.0023
EDT-NPT1-45-ATH	●	–	NPT1-11.5(ϕ.3937 or larger) 1.308	11.5	.606	1.772	5.315	.630	–	.0028

EDT-PT○○-○○-ATH

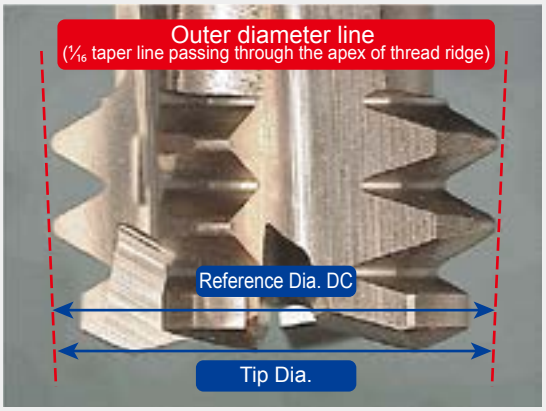
Unit : mm

PT (Rc) Thread / Order Number	Stock	Thread dia. Pilot hole not required D_1	Thread dia. Pilot hole required (pilot hole diameter) D_1	Thread Pitch TP	Reference Dia. DC	Neck Length LU	Overall Length OAL	Connection Dia. DCONMS	Oil Hole	Compensation Value D_2
EDT-PT1/16-18-ATH	●	PT1/16-28 7.723	PT1/8-28(ϕ4 or large) 9.728	0.9071	4.8	18.0	70.0	6.0	–	0.029
EDT-PT1/8-19-ATH	●	PT1/8-28 9.728	–	0.9071	5.7	19.0	70.0	6.0	–	0.029
EDT-PT1/4-28-ATH	●	PT1/4-19 13.157	PT3/8-19(ϕ6 or large) 16.662	1.3368	7.9	28.0	80.0	10.0	–	0.043
EDT-PT3/8-28-ATH	●	PT3/8-19 16.662	–	1.3368	9.6	28.0	80.0	10.0	–	0.043
EDT-PT1/2-35-ATH	●	PT1/2-14 20.955	PT3/4-14(ϕ8 or large) 26.441	1.8143	11.5	35.0	110.0	12.0	–	0.058
EDT-PT1-45-ATH	●	–	PT1-11(ϕ10 or large) 33.249	2.3091	15.4	45.0	135.0	16.0	–	0.074

● : Inventory maintained in US

Thread diameter which requires pilot hole can not be used without larger pilot hole than the values shown in the table.

Cautions when using Epoch D Thread Mill for PT, NPT threads



Reference Dia. DC:
diameter at the virtual crest position of the first thread
Tip Dia. : diameter at the tool tip position

Since the reference diameter DC and the tool tip diameter are different, it is necessary to correct the thread diameter D_1 and program.
The thread diameter D_1 corresponds to the reference diameter of the groove of the internal thread (reference diameter of the tap).

Example

PT1/4 thread milling with EDT-PT1/4-28-ATH

Thread diameter D_1 + compensation value D_2
= setup thread diameter .5180 inch+ .0017 inch= .5197 inch

*The NC program provided by MOLDINO already incorporates the D_2 thread diameter compensation value.

Recommended Cutting Conditions

Epoch D Thread Mill for PT,NPT Threads

NPT Thread

Work Material		Cast Iron, Carbon Steels 150～200HB		Tool Steels 25 ～ 35HRC		Pre-hardened Steels 35 ～ 45HRC	
v_c (SFM)		262～**279**～295		230～**246**～262		197～**219**～230	
Thread Dia. D_1	DC (inch)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)
NPT1/16-27	.189	5,600	6.140	5,000	5.510	4,300	4.720
NPT1/8-27	.224	4,700	7.950	4,200	7.090	3,600	6.100
NPT1/4-18	.311	3,400	7.170	3,000	6.300	2,600	5.470
NPT3/8-18	.378	2,800	7.870	2,500	7.050	2,200	6.180
NPT1/2-14	.453	2,400	8.230	2,100	7.200	1,800	6.180
NPT3/4-14	.453	2,400	10.980	2,100	9.610	1,800	8.230
NPT1-11.5	.606	1,800	9.090	1,600	8.070	1,300	6.570

Work Material		Hardened Steels 45 ～ 55HRC		Hardened Steels 55 ～ 62HRC		Hardened Steels 62 ～ 66HRC	Stainless Steels 300 series
v_c (SFM)		164～**180**～197		131～**148**～164		98～**115**～131	
Thread Dia. D_1	DC (inch)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)	RPM (min^{-1})	Feed Rate v_f (IPM)
NPT1/16-27	.189	3,600	3.980	3,000	3.310	2,300	2.520
NPT1/8-27	.224	3,100	5.240	2,500	4.210	2,000	3.390
NPT1/4-18	.311	2,200	4.650	1,800	3.780	1,400	2.950
NPT3/8-18	.378	1,800	5.080	1,500	4.210	1,200	3.390
NPT1/2-14	.453	1,500	5.160	1,200	4.130	1,000	3.430
NPT3/4-14	.453	1,500	6.850	1,200	5.470	1,000	4.570
NPT1-11.5	.606	1,100	5.550	900	4.570	700	3.540

【Note】

①Epoch D Thread Mill is capable of simultaneous boring and threading.
②The above cutting conditions are for the thread diameters stated in the table. Cutting conditions for other thread diameters should be calculated taking into consideration the cautions on use (p.257).
③The machinery should be a machining center equipped with NC (numerical control) equipment having a helical interpolation function.
④The feed rate stated in the above conditions table is the feed rate at the tool center during tapping. In addition, the per-tooth feed rate is the numerical value at the cutting point.
⑤Since there is a risk of cutting chips getting inside the machine, when using tools equipped with oil holes, be sure to perform processing using the oil holes.
⑥Use the appropriate coolant for the work material and machining shape.
⑦These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine conditions.

PT (Rc) Thread

Work Material			Cast Iron, Carbon Steels 150～200HB			Tool Steels 25 ～ 35HRC			Pre-hardened Steels 35 ～ 45HRC		
vc (SFM)			262 ～ **279** ～ 295			230 ～ **246** ～ 262			197 ～ **213** ～ 230		
Thread Dia. *D1*	DC (inch)	DC (mm)	RPM (min^{-1})	Feed Rate *vf* (IPM)	Feed Rate *vf* (mm/min)	RPM (min^{-1})	Feed Rate *vf* (IPM)	Feed Rate *vf* (mm/min)	RPM (min^{-1})	Feed Rate *vf* (IPM)	Feed Rate *vf* (mm/min)
PT1/16-28	.189	4.8	5,600	5.748	146	5,000	5.157	131	4,300	4.409	112
PT1/8-28	.224	5.7	4,700	7.126	181	4,200	6.378	162	3,600	5.472	139
PT1/4-19	.311	7.9	3,400	6.575	167	3,000	5.827	148	2,600	5.039	128
PT3/8-19	.378	9.6	2,800	7.559	192	2,500	6.732	171	2,200	5.906	150
PT1/2-14	.453	11.5	2,400	8.031	204	2,100	7.047	179	1,800	6.024	153
PT3/4-14	.453	11.5	2,400	10.945	278	2,100	9.567	243	1,800	8.189	208
PT1-11	.606	15.4	1,800	9.094	231	1,600	8.110	206	1,300	6.575	167

Work Material			Hardened Steels 45 ～ 55HRC			Hardened Steels 55 ～ 62HRC			Hardened Steels 62 ～ 66HRC		Stainless Steels 300 series
vc (SFM)			164 ～ **180** ～ 197			131 ～ **148** ～ 164			98 ～ **115** ～ 131		
Thread Dia. *D1*	DC (inch)	DC (mm)	RPM (min^{-1})	Feed Rate *vf* (IPM)	Feed Rate *vf* (mm/min)	RPM (min^{-1})	Feed Rate *vf* (IPM)	Feed Rate *vf* (mm/min)	RPM (min^{-1})	Feed Rate *vf* (IPM)	Feed Rate *vf* (mm/min)
PT1/16-28	.189	4.8	3,600	3.701	94	3,000	3.071	78	2,300	2.362	60
PT1/8-28	.224	5.7	3,100	4.724	120	2,500	3.780	96	2,000	3.031	77
PT1/4-19	.311	7.9	2,200	4.252	108	1,800	3.504	89	1,400	2.717	69
PT3/8-19	.378	9.6	1,800	4.843	123	1,500	4.055	103	1,200	3.228	82
PT1/2-14	.453	11.5	1,500	5.039	128	1,200	4.016	102	1,000	3.346	85
PT3/4-14	.453	11.5	1,500	6.850	174	1,200	5.472	139	1,000	4.567	116
PT1-11	.606	15.4	1,100	5.551	141	900	4.567	116	700	3.543	90

【Note】

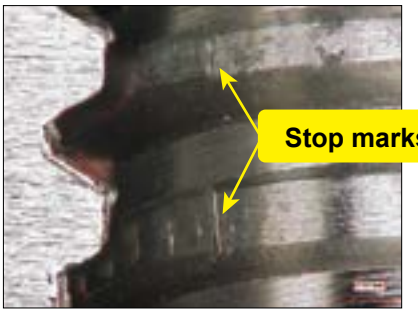
①Epoch D Thread Mill is capable of simultaneous boring and threading.
②The above cutting conditions are for the thread diameters stated in the table. Cutting conditions for other thread diameters should be calculated taking into consideration the cautions on use (p.257).
③The machinery should be a machining center equipped with NC (numerical control) equipment having a helical interpolation function.
④The feed rate stated in the above conditions table is the feed rate at the tool center during tapping. In addition, the per-tooth feed rate is the numerical value at the cutting point.
⑤Since there is a risk of cutting chips getting inside the machine, when using tools equipped with oil holes, be sure to perform processing using the oil holes.
⑥Use the appropriate coolant for the work material and machining shape.
⑦These conditions are for general guidance; in actual machining conditions adjust the parameters according to your actual machine conditions.

Advantages of using Epoch D Thread Mill in pipe threading

Epoch D Thread Mill

Good finished surface without tear

General tap



Tears easily and stop marks occurred

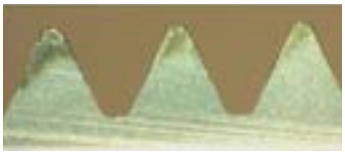
Effective for countermeasures against liquid leakage that is often caused by tapping.

Field data of Epoch Thread Mill

01 Threading of hardened steels (M4×0.7)

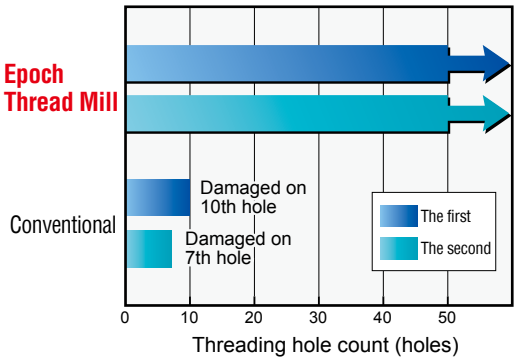
Cutting conditions

Work material：D2(60HRC) Tool：ET-0.7-8-PN
n=4,620min^{-1}(v_c=148 SFM) v_f=2.441 IPM
Threading depth：.315 inch Blind hole
Pilot hole dia.×Pilot hole depth：ϕ.134 x .472 inch Coolant：Air-blow



Epoch Thread Mill after threading 50 holes

Conventional after threading 10 holes.



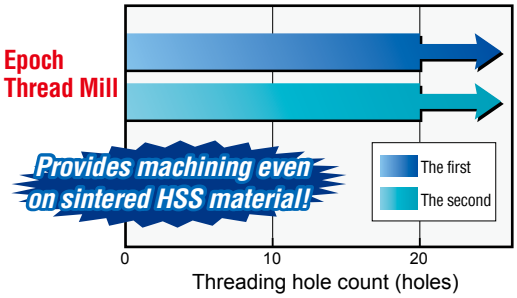
In the above example after 50 holes, the tool shows minimum wear.

02 Threading of sintered HSS material (M4×0.7)

Cutting conditions

Work material：High Speed Steel (64HRC) Tool：ET-0.7-8-PN
n=4,620min^{-1}(v_c=148 SFM) v_f=1.850 IPM
Threading depth：.276 inch Through hole
Pilot hole dia.×Pilot hole depth：ϕ134 x .276 inch Coolant：Water-base

In the above example after 20 holes, the tool shows minimum wear.



03 Threading of pre-hardened steel (M12×1.75)

Cutting conditions

Work material：P21 Modified(40HRC) Tool：ET-1.75-24-PN
n=3,537min^{-1}(v_c=328 SFM) v_f= 12.244 IPM
Threading depth：.866 inch Blind hole
Pilot hole dia.×Pilot hole depth：ϕ.413 x 1.102 inch Coolant：Water-base

In the above example after 300 holes, the tool shows minimum wear.

Epoch Thread Mill after threading 300 holes.

04 Threading of stainless steel (M8×1.25)

Cutting conditions

Work material：304 Stainless Steel Tool：ET-1.25-20-PN
n=5,130min^{-1}(v_c=328 SFM) v_f=10.906 IPM
Threading depth：.787 inch Blind hole
Pilot hole dia.×Pilot hole depth：ϕ.272 x .866 inch Coolant：Water-base

In the above example after 300 holes, the tool shows minimum wear.

Epoch Thread Mill after threading 300 holes.

05 Threading of superalloy (M6×1)

Cutting conditions

Work material：Inconel 718(40HRC) Tool：ET-1.0-12-PN
n=2,420min^{-1}(v_c=115 SFM)　v_f=2.205 IPM
Threading depth：.472 inch Blind hole
Pilot hole dia.×Pilot hole depth：ϕ.201 x .591 inch
Coolant：Water-base

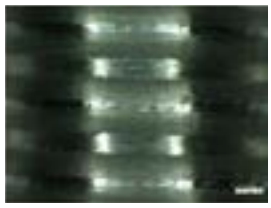
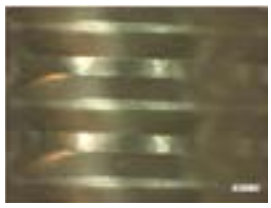
Epoch Thread Mill after threading 25 holes.

It is possible to thread superalloy which is difficult to tap.

06 Threading of non-ferrous (Aluminium alloy A7075, Acrylic resin) (M6×1)

Cutting conditions

Work material：Aluminium alloy A7075, Acrylic resin
Tool：ET-1.0-12-PN　n=14,500min^{-1}(v_c=689 SFM)　v_f=21.260 IPM
Threading depth：.472 inch Blind hole　Pilot hole dia.×Pilot hole depth：ϕ.197 x .591 inch

Work material	Aluminium alloy A7075		Acrylic resin	
Coolant	Water-base	Air-blow	Water-base	Air-blow
Surface				

High efficiency threading is possible even in dry condition.

※By using water-soluble cutting fluid, it is possible to obtain a glossy high-quality machined surface.
※By using water-soluble cutting fluid, Epoch D Thread Mill can be used with same cutting parameters.

Recommended pilot hole dia.

Metric threads

Order Number	Thread Dia. D_1	Pitch TPI (inch)	Pitch TPI (mm)	Recommended pilot hole dia. (inch)
ET-0.4-4-PN	M2	.016	0.4	.063
ET-0.45-4.4-PN	M2.2	.018	0.45	.069
ET-0.45-5-PN	M2.5	.018	0.45	.081
ET-0.5-6-PN	M3	.020	0.5	.098
ET-0.7-8-PN	M4	.028	0.7	.130
ET-0.8-10-PN	M5	.031	0.8	.165
ET-1.0-12-PN	M6	.039	1	.197
ET-1.25-16-PN	M8	.049	1.25	.266
ET-1.5-20-PN	M10	.059	1.5	.335
ET-1.75-24-PN	M12	.069	1.75	.404
ET-2-32-PN	M16	.079	2	.551
ET-2.5-36-PN	M18	.098	2.5	.610
ET-2.5-40-PN	M20	.098	2.5	.689

Order Number	Thread Dia. D_1	Pitch TPI (inch)	Pitch TPI (mm)	Recommended pilot hole dia. (inch)
ET-0.4-5-PN	M2	.016	0.4	.063
ET-0.45-5.5-PN	M2.2	.018	0.45	.069
ET-0.45-6.25-PN	M2.5	.018	0.45	.081
ET-0.5-7.5-PN	M3	.020	0.5	.098
ET-0.7-10-PN	M4	.028	0.7	.130
ET-0.8-12.5-PN	M5	.031	0.8	.165
ET-1.0-15-PN	M6	.039	1	.197
ET-1.25-20-PN	M8	.049	1.25	.266
ET-1.5-25-PN	M10	.059	1.5	.335
ET-1.75-30-PN	M12	.069	1.75	.404
ET-2-40-PN	M16	.079	2	.551
ET-2.5-45-PN	M18	.098	2.5	.610
ET-2.5-50-PN	M20	.098	2.5	.689

※Recommended pilot hole diameters are for internal threads regulated by former JIS class 2 and Unified class 2B.

Unified threads

Order Number	Thread Dia. D_1		Pitch TPI (inch)	Recommended pilot hole dia. (inch)
ET-U64-3.7-PN	No.1-64UNC	.073	64	.059
ET-U56-4.4-PN	No.2-56UNC	.086	56	.071
ET-U48-5-PN	No.3-48UNC	.099	48	.081
ET-U40-5.7-PN	No.4-40UNC	.112	40	.089
ET-U32-7-PN	No.6-32UNC	.138	32	.109
ET-U36-8.3-PN	No.8-36UNF	.164	36	.138
ET-U24-9.7-PN	No.10-24UNC	.190	24	.151
ET-U20-12.7-PN	¼-20UNC	1/4	20	.202
ET-U28-12.7-PN	¼-28UNF	1/4	28	.215
ET-U18-15.9-PN	5/16-18UNC	5/16	18	.259
ET-U16-19.1-PN	3/8-16UNC	3/8	16	.314
ET-U14-22.2-PN	7/16-14UNC	7/16	14	.368
ET-U13-25.4-PN	½-13UNC	1/2	13	.426
ET-U12-28.6-PN	9/16-12UNC	9/16	12	.480
ET-U11-31.8-PN	5/8-11UNC	5/8	11	.535

Order Number	Thread Dia. D_1		Pitch TPI (inch)	Recommended pilot hole dia. (inch)
ET-U64-4.6-PN	No.1-64UNC	.073	64	.059
ET-U56-5.5-PN	No.2-56UNC	.086	56	.071
ET-U48-6.3-PN	No.3-48UNC	.099	48	.081
ET-U40-7.1-PN	No.4-40UNC	.112	40	.089
ET-U32-8.8-PN	No.6-32UNC	.138	32	.109
ET-U36-10.4-PN	No.8-36UNF	.164	36	.138
ET-U24-12.1-PN	No.10-24UNC	.190	24	.151
ET-U20-15.9-PN	¼-20UNC	1/4	20	.202
ET-U28-15.9-PN	¼-28UNF	1/4	28	.215
ET-U18-19.8-PN	5/16-18UNC	5/16	18	.259
ET-U16-23.8-PN	3/8-16UNC	3/8	16	.314
ET-U14-27.8-PN	7/16-14UNC	7/16	14	.368
ET-U13-31.8-PN	½-13UNC	1/2	13	.426
ET-U12-35.7-PN	9/16-12UNC	9/16	12	.480
ET-U11-39.7-PN	5/8-11UNC	5/8	11	.535

Field data of Epoch D Thread Mill

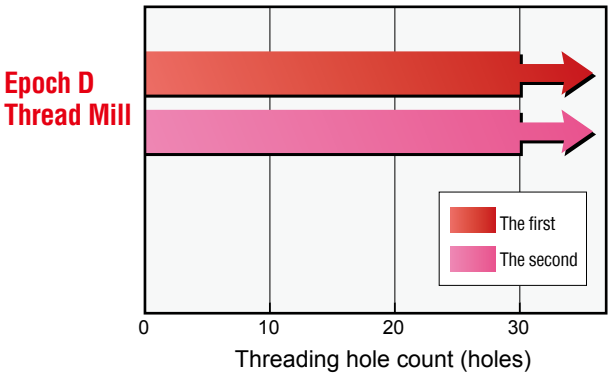
01 Simultaneous threading and drilling on hardened steels (M8×1.25)

Cutting conditions

Work material：D2(Improved)(62HRC)
Tool：EDT-1.25-16-TH
n=2,060min^{-1}(v_C=131 SFM)　v_f=1.850 IPM
Threading depth：.591 inch Blind hole
Coolant：Air-blow

Tool condition of Epoch D Thread Mill after machining 30 holes

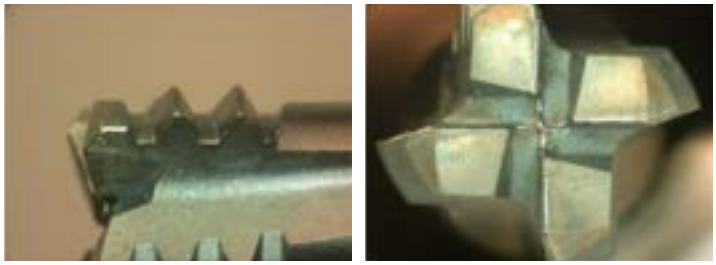
Wear condition is good with no chipping or damage!



02 Simultaneous threading and drilling on hardened steels (M8×1.25)

Cutting conditions

Work material：H13(45HRC)
Tool：EDT-1.25-16-TH
n=2,820min^{-1}(v_C=180 SFM)
v_f=2.953 IPM
Threading depth：.623 inch Blind hole
Coolant：Air-blow



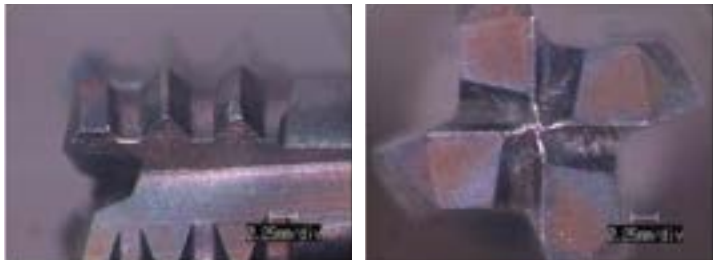
Epoch D Thread Mill after threading 150 holes.

In the above example after 150 holes, the tool shows minimum wear.

03 Simultaneous threading and drilling on pre-hardened steels (M4×0.7)

Cutting conditions

Work material：Pre-hardened steel(40HRC)
Tool：EDT-0.7-10-TH
n=5,650min^{-1}(v_C=180 SFM)
v_f=2.953 IPM
Threading depth：.394 inch Blind hole
Coolant：Air-blow



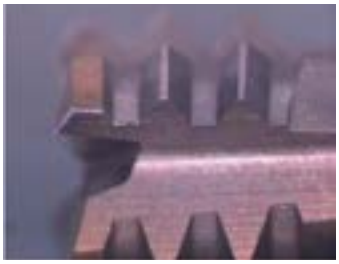
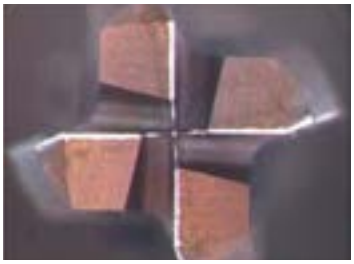
Epoch D Thread Mill after threading 400 holes.

In the above example after 400 holes, the tool shows minimum wear.

04 Simultaneous threading and drilling on stainless steels (M4×0.7)

Cutting conditions

Work material：304 Stainless Steel
Tool：EDT-0.7-10-TH
n=3,600min^{-1}(v_c=115 SFM)
v_f=1.929 IPM
Threading depth：.394 inch Blind hole
Coolant：Water-base

Epoch D Thread Mill after threading 600 holes.

In the above example after 600 holes, the tool shows minimum wear.

05 Simultaneous threading and drilling on titanium alloys (M4×0.7)

Cutting conditions

Work material：Ti-6Al-4V
Tool：EDT-0.7-10-TH
n=3,600min^{-1}(v_c=115 SFM)
v_f=1.929 IPM
Threading depth：.394 inch Blind hole
Coolant：Water-base


Epoch D Thread Mill after threading 64 holes.

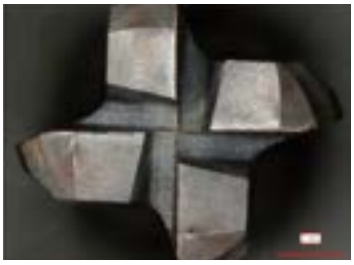
Threading titanium alloy which is difficult to tap, is possible without a pilot hole.

06 Simultaneous threading and drilling on hardened steel (PT$^1/_{16}$-28)

for PT,NPT Threads

Cutting conditions

Work material：STAVAX(52HRC)
Tool：EDT-PT1/16-18-ATH
n=3,600min^{-1}(v_c=180 SFM)
v_f=3.701 IPM
Threading depth：.630 inch
Coolant：Air-blow

Epoch D Thread Mill after threading 50 holes.

In the above example after 50 holes, the tool shows minimum wear.

Regarding thread diameter expansion/contraction

Suitable tool diameter correction should be performed according to the work material and tool wear condition. Also, please be careful not to forget to input the tool diameter compensation value into the machine.

Dimensional accuracy worsens when moving toward the bottom of the hole (deflection)

A characteristic of the thread milling method is that tool deflection increases as the tool progresses toward the bottom of the hole.
It may be necessary to perform zero cutting in order to perform high-accuracy thread milling with low deflection.

Regarding tool breakage

As a countermeasure against tool breakage, performing processing with a reduced feed rate is effective. In addition, when processing with tool extended or when large rough cutting chips are produced, breakage due to chip clogging should be considered. In such cases, if processing is performed with a higher cutting speed, the cutting chips will be broken into smaller bits which may improve conditions.

Changes in cutting chip conditions due to different cutting speeds;
Simultaneous boring and thread milling (M8 × 1.25) of carbon steel

If the NC program using MOLDINO's NC program creation software doesn't work properly.

There are differences in the programming code for the machine being used. Please contact the machine manufacturer for details.

Regarding upper limit on Machinable Thread Diameters

Please note that since the Epoch D Thread Mill performs boring simultaneously, it cannot perform thread milling for diameters of more than 1.68 times the tool diameter DC.
There are no particular similar limitations on using the Epoch Thread Mill.
Also, please be aware that if screws of a size smaller than the thread diameter described in the line-up table are processed, there is a possibility of malfunctioning the screw shape.
Example) Threading M14×2 with ET-2-40-PN (designed for M16×2)

Cautions on use

About tool feed rate

When performing thread milling by helical interpolation, the cutting point feed rate should be multiplied by a coefficient to determine the tool center feed rate.
The equation for calculating the tool center feed rate is shown at right.
The standard cutting conditions for PT and NPT threads are calculated based on the thread diameter D_1 at the machinable maximum depth (neck length).
Example) Thread milling PT⅛ with EDT-PT1/8-19-ATH
.383 inch (9.728mm) (D_1) - .748 inch (19mm) (under neck length)
x 1/16 (thread taper angle) = .336 inch (8.5405mm)

$$v_f = f_z \times z \times n \times \frac{D_1\text{-DC}}{D_1}$$

v_f	: Feed rate	(IPM) or (mm/min)
f_z	: Feed per tooth	(IPT) or (mm/t)
z	: No. of flutes	
n	: Rotation	(min^{-1})
D_1	: Thread Dia.	(inch) or (mm)
DC	: Tool Dia.	(inch) or (mm)

* Above formula applies to both inch and metric.

About tool diameter correction

When performing thread milling by helical interpolation, it may be necessary to compensate for increased cutting resistance due to differences in work materials or tool wear condition.
In the NC programs created using MOLDINO's NC program creation software, tool diameter correction is in radius designation format.

Correction example **Threading of hardened material (60HRC) (M8×1.25)**

Work material：D2(60HRC) Tool：ET-1.25-20-PN(Tool dia. ϕ.244) Pilot hole dia.×Pilot hole depth：ϕ.268 x .984 inch
n=2,060min^{-1}（v_c=131 SFM） v_f=2.205 IPM Threading depth：.787 inch Blind hole

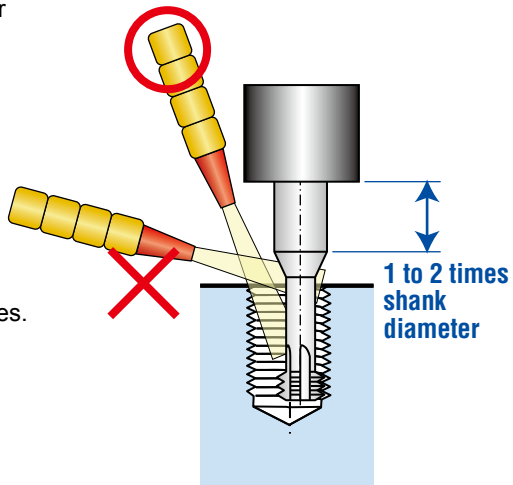
Threading hole count (holes)	10	20	30	40
Tool dia. correction value (mm)	.1217	.1213	.1205	.1197

Tool life has NOT been reached.

About coolant

- The first recommended coolant shown in the table tends to have the superior tool life. When priority is given to finished surface quality, water-soluble cutting fluids are effective. Oil-based cutting fluids are not suitable because they degrade chip removal characteristics.
- The holder should grip the tool shank so that the holder does not block the hole and the shank projection amount is 1 to 2 times the shank diameter. The coolant nozzle should then be positioned so that the coolant will reach the bottom of the hole. In addition, coolant pressure should be adjusted so that it removes cutting chips. If the setting is bad, cutting chip clogging may lead to flute tip damage or tool breakage.
- Since there is a risk of cutting chips getting inside the machine, when using tools equipped with oil holes, be sure to perform processing using the oil holes.

Work material	ET		EDT	
	Air-blow	Water-base	Air-blow	Water-base
Hardened steel, Pre-hardened steel Tool steel, Cast iron, Carbon steel	◎	○	◎	△
Stainless steel	×	◎	×	◎
Super heat resistant alloy, Titanium alloy	×	◎	×	◎
Aluminium alloy, Copper alloy, Resin	○	◎	×	◎



◎: First recommended
○: Second recommended
△: Tendency to decrease tool life
×: Not recommended

About safety when using cutting tool products

1. When using cutting tool products

In accordance with the Product Liability Law (PL law) enforced on July 1, 1995, our company has attached warning labels and caution labels to the packaging of our applicable products.
However, there are no specific caution notes, etc. displayed on the tools themselves. Before handling or using any cutting tool or cutting tool material, please read the sections "About safety when using cutting tool products" and "Cautions regarding the use of cutting tools" in this catalog. In addition, please teach the information stated in these sections to all workers as part of the safety education at your company.

2. Basic characteristics of cutting tool materials

Meanings of words used in this catalog

Cutting tool materials: General terms such as carbide alloy, cermet, ceramics, sintered CBN, sintered diamond, HSS, alloy steel, etc.

Physical characteristics

Appearance: Varies depending on material properties and material type. Example: Gray, black, gold, etc.
Odor : Odorless
Hardness : Carbide alloy, cermet: 5 to 30GPaHV; Ceramic: 10 to 40GPaHV; Sintered CBN: 20 to 50GPaHV; Sintered diamond: 80 to 120GPaHV; HSS: 2 to 12GPaHV; Alloy steel: 2 to 12GPaHV
Specific gravity: Carbide alloy: 9 to 16; Cermet: 5 to 9; Ceramic: 2 to 7; Sintered CBN: 3 to 5; Sintered diamond: 3 to 5; HSS: 7 to 9; Alloy steel: 7 to 9

Composition

Including carbides, nitrides, and sulfides of W, Ti, Al, Si, Ta, Nb, B, V, etc. as well as metal components of Fe, Co, Ni, Cr, Mo, etc.

3. Cautions regarding the handling of cutting tool materials

◇ Cutting tool materials have the characteristics of being extremely hard yet brittle. Therefore, they may be broken by impact or by overtightening.
◇ Since carbide tool materials have high specific gravities, be careful to handle large products or large quantities as heavy materials.
◇ The thermal expansion of carbide tool materials is different from that of metal materials. Because of this, for shrink-fit or cooling-fit products, if the usage temperature is slightly higher (lower) than the specified temperature, cracking may occur.
◇ If cutting tool materials become corroded due to cutting fluid, lubricating agents, or other moisture, their strength will be reduced. Care should be taken regarding storage conditions.

4. Cautions regarding machining of cutting tool products (materials)

◇ For carbide tool materials, the strength may be slightly reduced due to the surface conditions. For finishing, always use a diamond grinder.
◇ When cutting tool materials are ground or heated, dust or mist (smoke) occurs. If a lot of it is inhaled, swallowed, or comes in contact with the eyes or skin, it could result in injury to the body. When machining, be careful to avoid exposing your body to the dust or mist; it is recommended that localized ventilation equipment be used and that a protective mask, protective goggles, and protective gloves be worn. In addition, if the dust, etc. comes in contact with your hands, wash them thoroughly with soap and water.
Do not drink or eat in the work area, and wash your hands before drinking or eating.
Dust on clothes should not be shaken out; use a vacuum, etc. to remove the dust or wash the clothes in a washing machine.
If the cobalt contained in the cutting tool material is touched repeatedly or over a long period of time, it has been reported that it may affect the skin, respiratory organs, or heart, etc.
◇ When performing wet machining of carbide tool materials or brazed tool, the cutting fluid may contain heavy metals and must be disposed of properly.
◇ When a cutting tool product has been reground, check that there are no cracks after regrinding.
◇ If a laser or electric pen, etc. is used to mark carbide tool material or products, cracks may form.
Do not mark sections which may be subject to stress.

Precaution for using cutting tools

ITEM	Caution	Counter plan
General Cutting Tools	Direct touch to the sharp cutting edge may cause injury.	When you set up them to the machine or take them out of the case, please wear protective gloves.
	Misuse or mismatch of working conditions may cause tool breakage or dispersion of broken pieces.	1. Please equip safety items, such as safety glasses and protective gloves. 2. Please use them in the area of our recommended cutting condition. (See our catalog or instruction.)
	Excess impact or heavy wear will increase cutting resistance and may cause tool breakage and dispersion of broken pieces.	1. Please equip safety items, such as safety glasses and protective gloves. 2. Please change tools a bit early for its tool life.
	Dispersion of hearted or prolonged chips may cause injury or burn.	1. Please equip safety items, such as safety glasses and protective gloves. 2. When you get rid of chips, please stop machining at first, and equip protective items before doing it.
	During cutting operation, cutting tools get very hot. Direct touch to tools immediately after operation may cause burn.	Please equip safety items, such as safety glasses and protective gloves.
	Sparks, generation of heat or chips in high temperature during operation may cause fire.	1. Please don't operate around "Danger Zone", in which area there is some fear of fire or explosion. 2. When oil-coolant is used, please be sure to be enough system for fire-prevention around there.
	Lack of dynamic balance in high-speed revolution cause vibration and tool-broken.	1. Please equip safety items, such as safety glasses and protective gloves. 2. Please operate test-run before cutting, and confirm that there is no vibration or unusual sound.
	Direct contact to the rough surface on the work may cause injury.	Please don't touch work materials with bear hand.
	The cutting conditions in this catalog shown in the table above are reference cutting conditions, and should be adjusted according to the actual shape to be machined, the machine used, and purpose for machining.	
Indexable Cutting Tools	When inserts or parts are not clamped well, falling off or dispersion may occur and cause injury.	1. Please clean up the insert pocket or fastening parts before setting insert. 2. Please set up the inserts with supplied wrench only, and confirm that the inserts or parts are clamped completely.
	When clamped too tight by supplementary tools like pipe etc, inserts or body may be broken.	Please set up them with supplied wrench only.
	When indexable tools are used in high-speed revolution or parts may burst out of the body due to centrifugal force.	Please use them in the area of our recommended cutting condition. (See our catalog or instruction.)
Milling Cutters and Other Milling Tools	Since milling cutters have sharp edges, direct contact with bare hands may cause injury.	Please equip safety items, such as safety glasses and protective gloves.
	If cutter lacks dynamic balance, tool breakage or dispersion of broken pieces may occur by vibration.	1. Please use them in the area of our recommended cutting condition. (See our catalog or instruction.) 2. Rotating portion and dynamic balancing should be periodically checked to prevent from eccentric rotation or run out due to wear of bearing portion.
Drills	When drilling through hole with turning work, a kind of disk(reminder parts) sometimes flies out from the end of frilling very fast. It's very dangerous since the disc has sharp edge.	Please equip safety items, such as safety glasses, protective gloves and covers at the chucking.
	Some micro drills have sharp edge with the top. Direct touch to tools may cause injury.	Please equip safety items, such as safety glasses and protective gloves.
Brazed Tools	Dispersion of broken inserts by tools breakage or falling off body may cause injury.	1. Please confirm if they are firmly brazed. 2. Please don't use brazed tools in the condition that requires high cutting temperature.
Others	When brazing is carried out again and again, the strength of carbide insert is deteriorated and becomes easy to be broken during cutting.	Carbide tools which is brazed several times should not be used because its strength has deteriorated.
	It is dangerous to use tools except for the fixed application. It may cause damage of tool and machine.	Please use them in the area of our recommended cutting condition. (See our catalog or instruction.)

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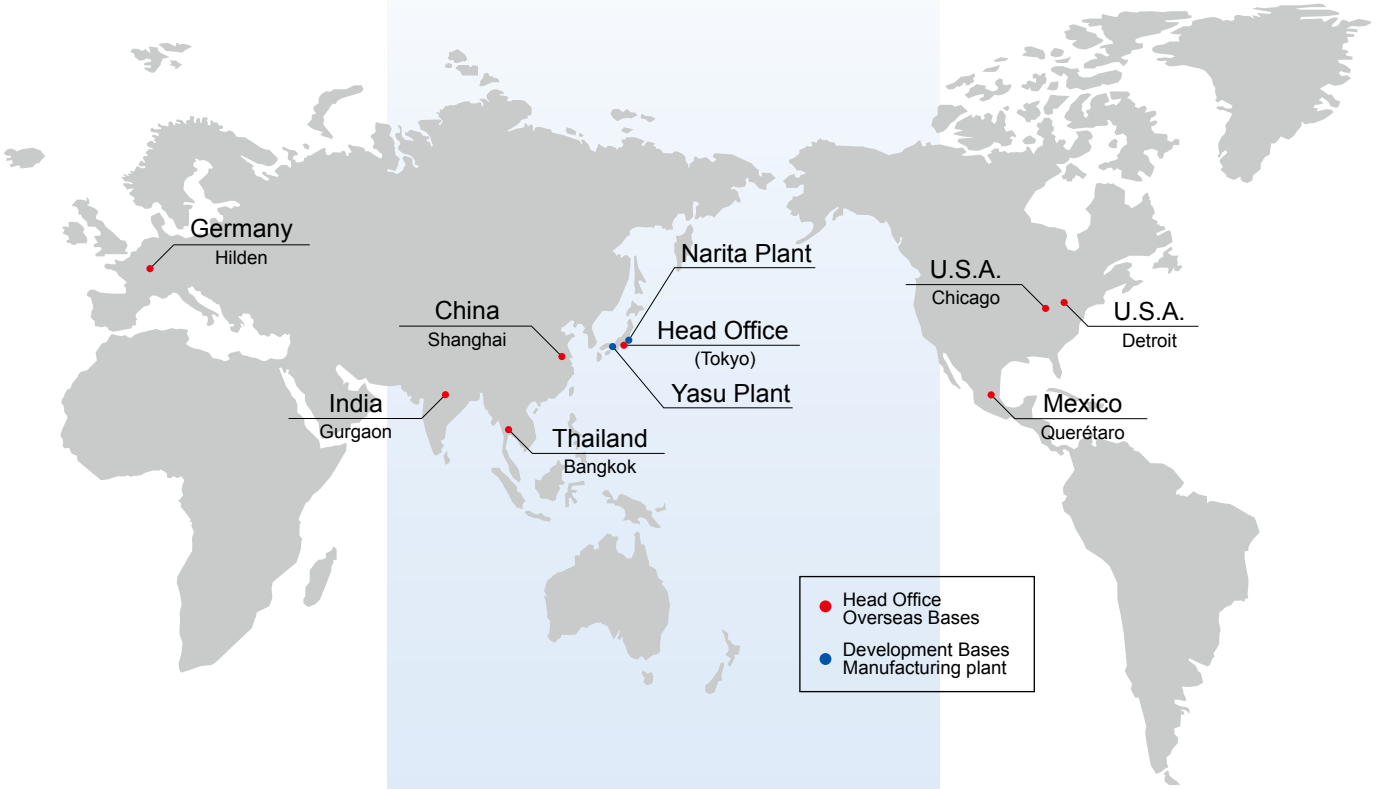

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