L

Solid End Mill

Carbide substrate

L1~L48

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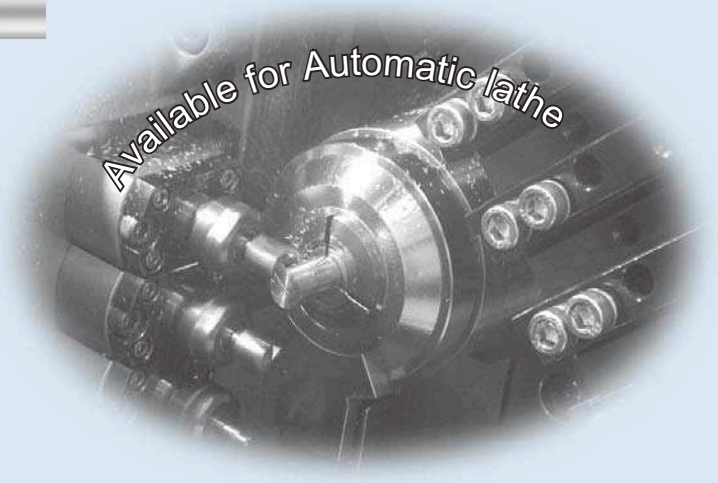
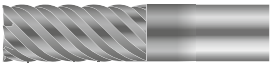


- Kyocera's solid end mill series has wide product lineup from roughing to finishing as well as items for difficult-to-cut Materials and hard materials.

New PVD technology, MEGACOAT

MEGACOAT Hard-A new coating for hard materials.

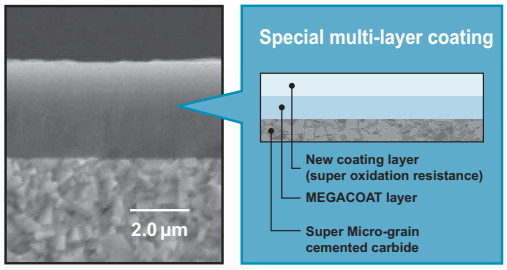


Achieves longer tool life and stable machining of hard materials with a special multi-layer coating.

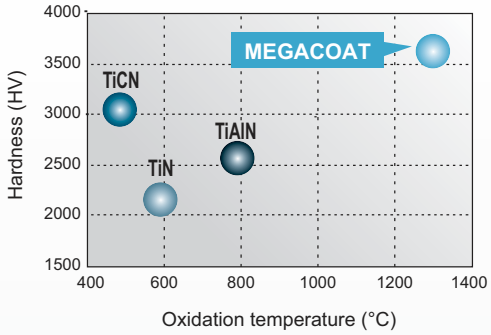
MEGACOAT

Excellent wear resistance and heat resistance

- MEGACOAT Hard structure

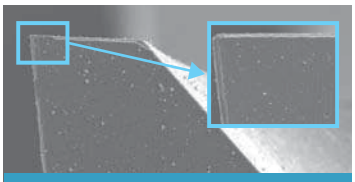


Achieves super hardness to control abrasion of the edge coating



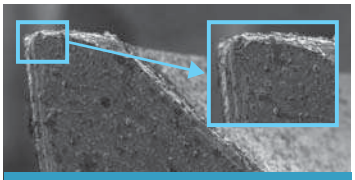
Smooth cutting edge quality with a unique coating technology

- Smooth surface quality



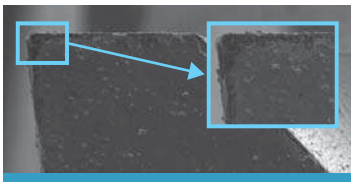
Kyocera MEGACOAT Hard

Smooth and sharp to the tip of the cutting edge.
Longer tool life and improved surface finish.



Competitor A

Coating surface is rough and there is much cutter abrasion.
The cutter edge is rounded.



Competitor B

Major abrasion of cutter and exposed material is noticeable.

- Smooth endmill surface reduces welding and allows stable machining

For high precision finishing, MEGACOAT

MEGACOAT achieves high precision finishing and a sharp cutting edge.

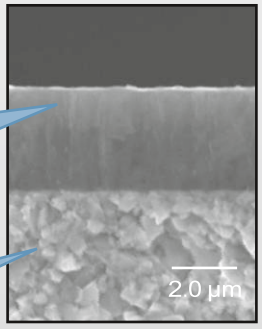
MEGACOAT

- Wear resistance / Heat resistance

MEGACOAT
Nitride solid solution of high melting point metal
High hardness and oxidation resistant
Smooth surface

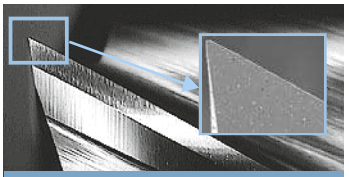
- Fracture resistance / Stable machining

Super Micro-grain cemented carbide



High-quality and sharp edge

- Smooth surface quality



F（FES）series edge

New product introduction

HFS type

End mill for finishing of hard materials

(4,5,6,7HFSS) (4,5,6,7,8HFSM)

MEGACOAT is applied

with Corner land

HFS cross section

FES cross section

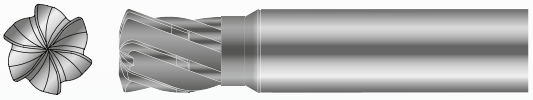
For finishing of hard materials

- End mill for hard materials that achieves longer tool life and stable machining.
- Applicable for hard materials up to 67HRC.
- Achieves high feed rate machining for cutting of hard materials.
- Compared to the FES type, the core diameter was increased by 30%, for higher rigidity.
  Negative rake angle and stronger cutting edge design with corner land.

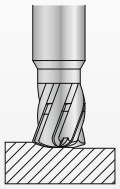
➔ L25, L26

PDR type

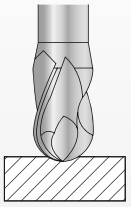
High efficiency radius end mill for hard materials



(6PDRS)



PDR type



General Purpose Ball-Nosed End Mill

For high efficiency machining of hard materials

- Improved productivity with 6 edge design and high feed rate.
- Special corner-R shape with the large contact area on the bottom surface achieves large machining allowance and high efficiency machining.
- Applicable for hard materials up to 67HRC.

➔ L32

DEK type, DER type

End mill for high feed rate machining of difficult-to-cut materials

(5DEKM, 5DERM)

For high efficiency machining of difficult-to-cut materials

- Achieves high feed rate machining with 5 edge design
- Achieves high efficiency machining for difficult-to-cut materials, such as stainless steel and heat-resistant alloys.
- Applicable for slotting with a cutting depth up to 0.8D.
- Unequally partitioned flute design prevents vibration and reduces cutting force.
- Able to accommodate work from roughing to finishing with a single tool.

➔ L37

NES type

End mill for finishing of aluminum & non-ferrous materials

with wiper edge (3NESM)

For finishing of aluminum

- A wiper is attached at the lower edge for improving bottom surface finish.
- Chattering is controlled with cutting edge slots at varied intervals, and finishing of lateral surfaces is improved.
- A special core shape facilitates improved chip evacuation, while assuring rigidity.
- Able to accommodate work from roughing to finishing with a single tool.

➔ L39

General Use End Mill

End mill for difficult-to-cut materials, cast iron, and steel machining

➡ L10~L24

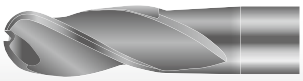
Finishing — F Series

MEGACOAT is applied

(FES)

For finishing. Beautiful surface finish is achieved by high quality cutting edges and MEGACOAT that has excellent wear resistance and heat resistance.

Semi-Finishing — U Series



(3UEBS)

For semi-finishing. High efficiency machining products such as the 3-edge square type and ball-nose end mill have been added to the lineup.

Roughing — R Series

(RDS)

Applicable for machining of wide variety of steel such as stainless steel, cast iron, and etc. The sine curve shaped cutting edge reduces cutting resistance and controls chatter.

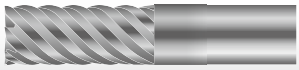
End mill applicable for hard materials

End mill developed primarily for machining of hard materials. Also suitable for steel machining.

➡ L25~L34

Finishing — H Series

MEGACOAT is applied



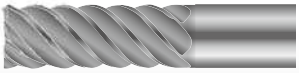
(HFS)

Applicable for finishing of hard materials. MEGACOAT Hard is adopted. Achieves stable machining of hardened materials.

Semi-Finishing — P, U Series

(UGS)

For stable and high efficiency machining of hard materials.



(PGS)

Good chip evacuation and high rigidity. Short, Medium and Long are available.

(6PDRS)

High efficiency radius. Achieves large machining allowance and high efficiency machining with special corner radius shape.

Roughing — R Series

(3 / 4RFRS)

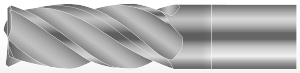
For rough copying / profiling. Strong cutting edge suitable for machining of hard materials and titanium alloys.

End mill for difficult-to-cut materials

End mill designed for difficult-to-cut materials, such as stainless steel, inconel and titanium.

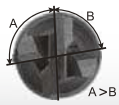
➡ L35~L38

Semi-Finishing — Y Series



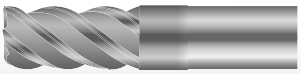
(4YECM, 4YERM, 4YEKM)

Wide enough unequally partitioned flute design reduces vibration and achives high efficiency machining. 5 kinds of edges such as sharp edge, chamfered, land, radius and ball-nose are available.



4YECM varied interval flute

High Feed Rate — D Series



(5DEKM, 5DERM)

5 edge unequally partitioned design. Achieves machining of difficult-to-cut materials, such as stainless steel and heat-resistant alloy at high feed rates.

End mill for aluminum & non-ferrous materials

End mills available for finishing, semi finishing and roughing of aluminum & non-ferrous materials.

➡ L39~L43

Finishing — N Series

(3NESM)

A wiper is attached at the lower edge for improving bottom surface finish. Chattering is controlled with cutting edge slots at varied intervals, and finishing of lateral surfaces is improved.

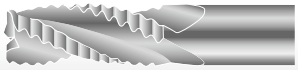
Semi-Finishing — N Series

(2 NFSM)

(3 NFSM)

Achieves good chip evacuation with special rake face shape and 45° helix angle.

Roughing — A Series



(3AESM)

For roughing of Aluminum / Non-ferrous Metal. Achieves high efficiency machining with a large chip evacuation space.

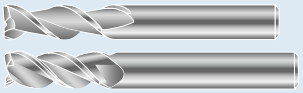
Guide for tool selection

Application and selection

Workpiece Materials	Process	Application		Recommendation	Shape	Ref. Page
General Use (Carbon Steel Alloy Steel)	Finishing	Surface roughness-oriented	Sharp Cutting Oriented	2FESS 2FESM 2FESL	2FESS	L12
					2FESM	L13~L14
					2FESL	L15
			Tough corner edge	2FEKS 2FEKM 4FEKM	2FEKS	L17
					2FEKM	L18
					4FEKM	L19
			Productivity-oriented	4FESM	4FESM	L16
		Automatic lathe		2 / 3 / 4FESW	2 / 3 / 4FESW	L10~L11
	Semi-Finishing			3UFSM	3UFSM	L20
		Copying	Deep milling	2UEBS	2UEBS	L21
			Productivity-oriented	3UEBS	3UEBS	L22
	Roughing			3 / 4 / 5RDSM 3 / 4 / 5RDSL	3 / 4 / 5RDSM	L23
					3 / 4 / 5RDSL	L24
Hard Materials	Finishing			4 / 5 / 6 / 7HFSS 4 / 5 / 6 / 7 / 8HFSM	4 / 5 / 6 / 7HFSS	L25
					4 / 5 / 6 / 7 / 8HFSM	L26
			Deep milling	4PGRM	4PGRM	L27
	Semi-Finishing	High Rigidity		4 / 6UGSM	4 / 6UGSM	L31
			High feed	6PDRS	6PDRS	L32
		Deep milling		4 / 5PGSS 4 / 5 / 6PGSM 4 / 5 / 6PGSL	4 / 5PGSS	L28
					4 / 5 / 6PGSM	L29
					4 / 5 / 6PGSL	L30
	Roughing			4 / 6RFSM	4 / 6RFSM	L33
		Copying		3 / 4RFRS	3 / 4RFRS	L34
Hard-to-machine Materials	Semi-Finishing	Productivity-oriented		4YECM 4YEKM 4YERM 4 / 6YFSM	4YECM	L35
					4YEKM	L35
					4YERM	L35
					4 / 6YFSM	L36
			High feed	5DEKM 5DERM	5DEKM	L37
					5DERM	L37
		Copying		4YEBM	4YEBM	L38
Aluminum Non-ferrous Metals	Finishing			3NESM	3NESM	L39
	Semi-Finishing	Surface roughness-oriented		2NFSM	2NFSM	L40
		Productivity-oriented		3NFSM 3NFSL	3NFSM	L40
					3NFSL	L41
	Roughing			3AESM 3AESL	3AESM	L42
					3AESL	L43

Guide for tool selection

Application and selection of type distinctions

Type	Number of Flutes	Applications	Shape	Description	Outside Dia. øDc (mm)	Page
Square	2 / 3 / 4	For automatic lathe / General use / Finishing		2FESW 3FESW 4FESW	ø3~ø12	L10~11
	2	General use / Finishing (Short)		2FESS	ø1~ø16	L12
	2	General use / Finishing (Medium)		2FESM	ø0.2~ø16	L13~14
	2	General use / Finishing (Long)		2FESL	ø1~ø16	L15
	4	General use / Finishing		4FESM	ø1~ø16	L16
	2	General use / Finishing / Tough corner edge (Short)		2FEKS	ø3~ø16	L17
	2	General use / Finishing / Tough corner edge (Medium)		2FEKM	ø3~ø16	L18
	4	General use / Finishing / Tough corner edge		4FEKM	ø3~ø16	L19
	3	Semi Finishing		3UFSM	ø1~ø20	L20
	3 / 4 / 5	General use / Roughing / Medium		3RDSM 4RDSM 5RDSM	ø4~ø25	L23
	3 / 4 / 5	General use / Roughing / Long		3RDSL 4RDSL 5RDSL	ø6~ø25	L24
	4 / 5 / 6 / 7	Finishing of Hard Material / Short		4HFSS 5HFSS 6HFSS 7HFSS	ø1~ø12	L25
	4 / 5 / 6 / 7 / 8	Finishing of Hard Material / Medium		4HFSM 5HFSM 6HFSM 7HFSM 8HFSM	ø1~ø25	L26
	4 / 5	Deep Slotting and Semi-Finishing of Hard Materials		4PGSS 5PGSS	ø3~ø25	L28
	4 / 5 / 6	Semi-Finishing of Hard Material / Medium		4PGSM 5PGSM 6PGSM	ø6~ø25	L29
	4 / 5 / 6	Semi-Finishing of Hard Materials / Long		4PGSL 5PGSL 6PGSL	ø6~ø25	L30
	4 / 6	Semi-Finishing and high efficiency machining of Hard Material		4UGSM 6UGSM	ø3~ø16	L31
	4 / 6	Roughing of Hard Materials		4RFSM 6RFSM	ø6~ø25	L33
	4	Semi-Finishing of Difficult-to-Cut Materials		4YECM	ø4~ø25	L35
	4	Semi-Finishing of Difficult-to-Cut Materials		4YEKM	ø4~ø25	L35
	4 / 6	Semi-Finishing of Difficult-to-Cut Materials		4YFSM 6YFSM	ø4~ø20	L36
	5	Semi-Finishing of Difficult-to-Cut Materials		5DEKM	ø4~ø25	L37
	3	Finishing of Aluminum		3NESM	ø3~ø20	L39
	2 / 3	Semi-Finishing of Aluminum		2NFSM 3NFSM	ø1~ø20 ø3~ø20	L40
	3	Semi-Finishing of Aluminum / Long		3NFSL	ø3~ø20	L41
	3	Roughing of Aluminum / Medium		3AESM	ø6~ø25	L42
	3	Roughing of Aluminum / Long		3AESL	ø6~ø25	L43

Workpiece materials										Page
	Steel		Hardened							
Steel for General Structure Carbon Steel	Less than 30HRC	Less than 40HRC	Less than 55HRC	Less than 68HRC	Stainless Steel	Titanium Alloy	Heat-resistant alloy	Cast Iron	Aluminum / Non-ferrous Metals	
P ~750N/mm²	P ~30HRC	P 30～40HRC	H ~55HRC	H ~68HRC	M Stainless steel	S Titanium Alloy	S Heat-resistant Alloy	K Cast Iron	N Aluminum & Non Ferrous Material	
○	○	○	○		◎			○	○	L10~11
◎	◎	○	○		◎			○	○	L12
○	○	○	○		◎			○	○	L13~14
◎	◎	○	○		◎			○	○	L15
○	○	○	○		◎			○	○	L16
◎	◎	○	○		◎			○	○	L17
○	○	○	○		◎			○	○	L18
◎	◎	○	○		◎			○	○	L19
	○	○	○		○	○		◎	○	L20
◎	◎	◎			○			◎		L23
○	○	○			○			◎		L24
◎	◎	◎	◎	◎						L25
○	○	○	○	○						L26
		○	◎	○				○		L28
		○	◎	○				○		L29
		○	◎	○				○		L30
			◎	◎						L31
		◎	◎	○	○	◎	○	◎		L33
	○	○			○	○	○	◎		L35
	◎	◎			◎	○	○	◎		L35
○	○	○			○	◎	◎	◎		L36
◎	◎	◎			◎	◎	◎	◎		L37
									◎	L39
									◎	L40
									◎	L41
									◎	L42
									◎	L43

◎: 1st Recommendation ○: 2nd Recommendation

Guide for tool selection

Application and selection of type distinctions

Type	Number of Flutes	Applications	Shape	Description	Outside Dia. øDc (mm)	Page
Radius	4	Deep Slotting and Finishing of Hard Materials		4PGRM	ø3~ø20	L27
	6	Semi-Finishing of Hard Materials		6PDRS	ø6~ø12	L32
	3 / 4	Rough Copying of Hard Material (Radius / Short)		3RFRS 4RFRS	ø4~ø12	L34
	4	Semi-Finishing of Difficult-to-Cut Materials		4YERM	ø4~ø25	L35
	5	Semi-Finishing and high feed machining of Difficult-to-Cut Material		5DERM	ø4~ø25	L37
Ball	2	Copying (Ball-nose End Mill with 2 Flutes)		2UEBS	ø1~ø20	L21
	3	Copying (Ball-nose End Mill with 3 Flutes)		3UEBS	ø3~ø12	L22
	4	Semi-Finishing for Difficult-to-Cut Material (Ball-nose end mill with 4 flutes)		4YEBM	ø5~ø20	L38

Solid End Mill Series

Solid End Mill Identification System

2	F	E	S	M	020	- 060	- 04	XXXXXXXX
①	②	③	④	⑤	⑥	⑦	⑧	⑨

① Number of Flutes	② Name	③ Helix Angle	④ Application	⑤ Length of edge	⑥ Outside Dia.	⑦ Length of edge	⑧ Shank Dia.	⑨ Others
2 3 4 5 6 7 8	F : Finishing U : Semi-Finishing Y : Difficult-to-Cut Material D : Difficult-to-Cut Material H : Finishing of Hardened Material P : Hardened Material R : Roughing A : Roughing for Aluminum N : Aluminum	D : 20-29° E : 30-39° F : 40-49° G : 50-59°	S : Square B : Ball R : Radius K : Tough corner edge (Corner land) C : with Corner Chamfering	S : Short M : Medium L : Long W: Automatic lathe	020 ↓ 2.0mm	060 ↓ 6.0mm	04 ↓ 4.0mm	Corner R, Corner Chamfering width, etc.

How to read icon

Coated Carbide

- MEGACOAT Hard — MEGACOAT Hard
- MEGACOAT — MEGACOAT
- TiAlN — TiAlN Coated Carbide
- AlCrTiN — AlCrTiN Coated Carbide
- Uncoated — Non-coating

Shank Diameter Tolerance

- h5 Shank Dia. — Shank Diameter Tolerance is h5.

Corner Radius Tolerance

- 0~-0.02 mm R — Corner Radius Tolerance is 0 to -0.02mm.

Corner Form

- Radius R — Radius
- Sharp — Corner Sharp Edge
- Land — With Corner land
- C — With Corner Chamfering

Ball-nose Radius Tolerance

- 0~-0.02 mm R — The R tolerance of ball end mill is 0 to -0.02mm.

Helix Angle

- 30° — Helix Angle 30°

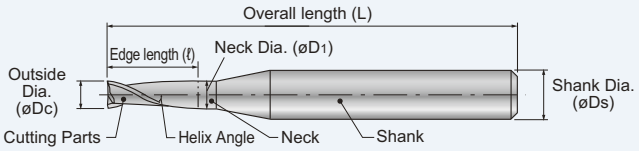
Workpiece materials										Page
Steel for General Structure Carbon Steel SS400, S45C, etc. P ~750N/mm²	Steel: Less than 30HRC SCM, SKS, etc. P ~30HRC	Steel: Less than 40HRC NAK, SKD, etc. P 30~40HRC	Hardened: Less than 55HRC SKD, SKT, etc. H ~55HRC	Hardened: Less than 68HRC SKD, SKH, etc. H ~68HRC	Stainless Steel M Stainless steel	Titanium Alloy S Titanium Alloy	Heat-resistant alloy S Heat-resistant Alloy	Cast Iron K Cast Iron	Aluminum / Non-ferrous Metal N Aluminum & Non Ferrous Material	
		○	◎	◎				○		L27
◎	◎	◎	◎	◎						L32
		○	◎	◎	○	◎		○		L34
	◎	◎			◎	○	○	◎		L35
◎	◎	◎			◎	◎	◎	◎		L37
◎	◎	◎						◎		L21
◎	◎				○				○	L22
	◎	○			◎	◎	○	○		L38

◎: 1st Recommendation ○: 2nd Recommendation

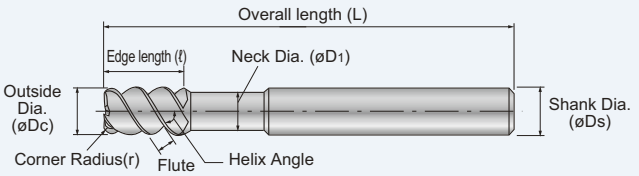
Name of parts and shapes for Solid End Mill

Name of parts

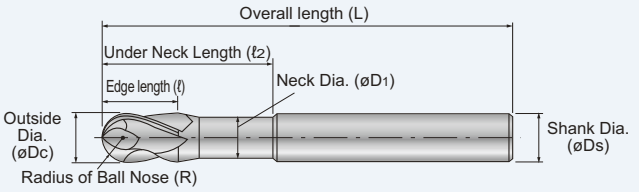
● Square Type



● Radius Type

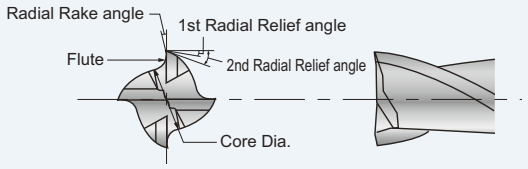


● Ball-nosed Type



Cutting parts shape

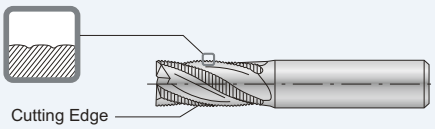
● Edge Shape



* Square 4 flutes

- Core Diameter Ratio (%)=(Core Diameter / Outside Diameter)×100

● Cutting Edge Shape



● With Corner land

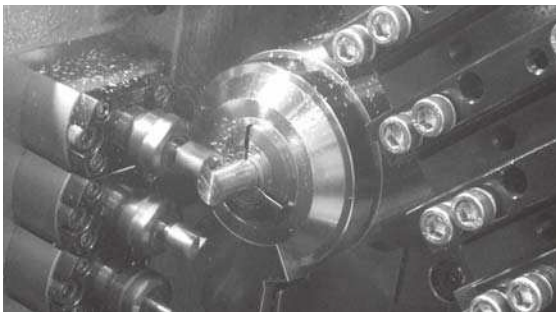
- Tough Corner edge (with Corner land)

2FESW, 3FESW, 4FESW

Number of Flutes: 2, 3, 4

For automatic lathe Finishing / General use

(2FESW)



2 3 4

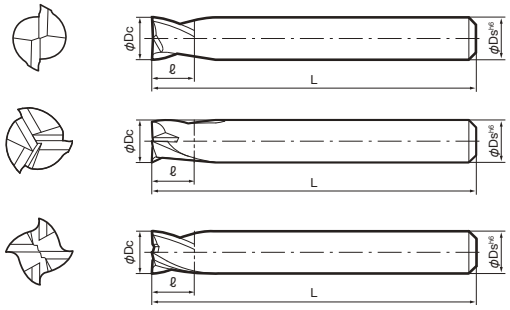
MEGACOAT is applied

Super Micro-grain carbide

Recommended Material ★ 1st Recommendation

★P ~750N/mm² | ★P ~30HRC | P 30~40HRC | H ~55HRC | ★M Stainless steel | K Cast Iron | N Aluminum & Non Ferrous Material

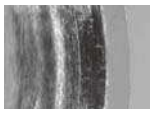
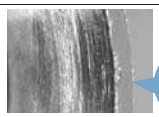
MEGACOAT | Sharp | h6 Shank Dia. | 35°



Sharp Cutting Edge Reduced Burrs

- Applicable to the Swiss-type automatic lathe.
- Achieves high precision machining by reducing burr formation with new PVD Coated Carbide "MEGACOAT" and sharp edge.
- Easy to use total length of 35mm and 45mm are available.

Workpiece Material: Kovar

2FES (ø3•2 flutes) ◎Smooth surface of shoulder wall		Machine Components Facing •Vc=20m/min (n=2150min⁻¹) •fz=0.023mm/t (Vf=100mm/min)
Competitor C (ø3•2 flutes) ×Large burrs	 Large burrs	

Comparison with competitor's endmill after 600 passes

Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESW030-030-04	●	3	0 -0.020	3	4	45	2
2FESW035-035-04	●	3.5	0 -0.020	3.5	4	45	2
2FESW040-040-04	●	4	0 -0.020	4	4	45	2
2FESW050-050-05A	●	5	0 -0.020	5	5	35	2
2FESW060-060-05A	●	6	0 -0.020	6	5	35	2
2FESW050-050-06	●	5	0 -0.020	5	6	45	2
2FESW060-060-06	●	6	0 -0.020	6	6	45	2
2FESW070-070-07	●	7	0 -0.025	7	7	45	2
2FESW080-080-07	●	8	0 -0.025	8	7	45	2
2FESW080-080-08	●	8	0 -0.025	8	8	45	2
2FESW100-080-07	●	10	0 -0.025	8	7	45	2
2FESW100-080-10	●	10	0 -0.025	8	10	45	2
2FESW120-080-10	●	12	0 -0.025	8	10	45	2
2FESW120-080-12	●	12	0 -0.030	8	12	45	2
2FESW130-080-13	●	13	0 -0.030	8	13	45	2

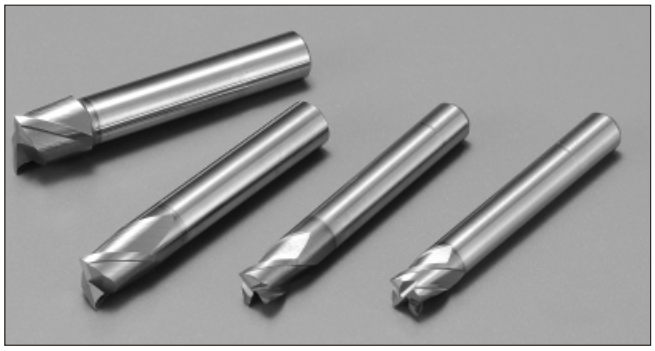
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Number of Flutes Z
3FESW050-050-05A	●	5	0 -0.020	5	5	35	3
3FESW060-060-05A	●	6	0 -0.020	6	5	35	3
3FESW030-030-04	●	3	0 -0.020	3	4	45	3
3FESW035-035-04	●	3.5	0 -0.020	3.5	4	45	3
3FESW040-040-04	●	4	0 -0.020	4	4	45	3
3FESW050-050-06	●	5	0 -0.020	5	6	45	3
3FESW060-060-06	●	6	0 -0.020	6	6	45	3
3FESW070-070-07	●	7	0 -0.025	7	7	45	3
3FESW080-080-07	●	8	0 -0.025	8	7	45	3
3FESW080-080-08	●	8	0 -0.025	8	8	45	3
3FESW100-080-07	●	10	0 -0.025	8	7	45	3
3FESW100-080-10	●	10	0 -0.025	8	10	45	3
3FESW120-080-10	●	12	0 -0.025	8	10	45	3
3FESW120-080-12	●	12	0 -0.030	8	12	45	3
3FESW130-080-13	●	13	0 -0.030	8	13	45	3

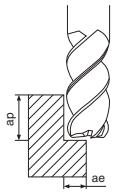
● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

(Unit: mm)

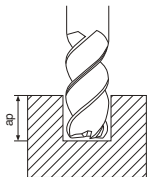
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Number of Flutes Z
4FESW030-030-04	●	3	0 -0.020	3	4	45	4
4FESW035-035-04	●	3.5	0 -0.020	3.5	4	45	4
4FESW040-040-04	●	4	0 -0.020	4	4	45	4
4FESW050-050-06	●	5	0 -0.020	5	6	45	4
4FESW060-060-06	●	6	0 -0.020	6	6	45	4
4FESW070-070-07	●	7	0 -0.025	7	7	45	4
4FESW080-080-07	●	8	0 -0.025	8	7	45	4
4FESW080-080-08	●	8	0 -0.025	8	8	45	4
4FESW100-080-07	●	10	0 -0.025	8	7	45	4
4FESW100-080-10	●	10	0 -0.025	8	10	45	4
4FESW120-080-10	●	12	0 -0.025	8	10	45	4
4FESW120-080-12	●	12	0 -0.030	8	12	45	4
4FESW130-080-13	●	13	0 -0.030	8	13	45	4



Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø14
2FESW										
Carbon Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,300
		Feed Rate (mm/min)	660	640	640	640	520	450	410	350
Alloy Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600
		Feed Rate (mm/min)	420	430	430	430	350	300	270	230
Pre-hardened Steel 30~45HRC	1Dc×0.2Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600
		Feed Rate (mm/min)	420	430	430	430	350	300	270	230
Stainless Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,400
		Feed Rate (mm/min)	320	320	320	320	260	230	210	180
3FESW										
Carbon Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,300
		Feed Rate (mm/min)	810	800	800	800	650	560	510	450
Alloy Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600
		Feed Rate (mm/min)	530	530	530	530	430	370	340	290
Pre-hardened Steel 30~45HRC	1Dc×0.2Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600
		Feed Rate (mm/min)	530	530	530	530	430	370	340	290
Stainless Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,400
		Feed Rate (mm/min)	400	400	400	400	320	280	260	230
4FESW										
Carbon Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,300
		Feed Rate (mm/min)	960	960	960	960	780	680	620	550
Alloy Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600
		Feed Rate (mm/min)	640	640	640	640	520	450	410	350
Pre-hardened Steel 30~45HRC	1Dc×0.2Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600
		Feed Rate (mm/min)	640	640	640	640	520	450	410	350
Stainless Steel	1Dc×0.2Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,400
		Feed Rate (mm/min)	480	480	480	480	390	340	310	280

* Machining with coolant is recommended for stainless steel.

Please refer to page L44 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2FESS

Number of Flutes: 2

General use / Finishing (Short)

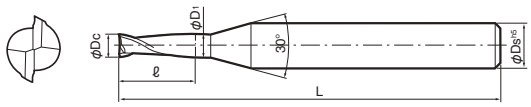
MEGACOAT is applied

Super Micro-grain carbide

Recommended Material ★ 1st Recommendation

★P ~750N/mm² | ★P ~30HRC | P 30~40HRC | H ~55HRC | ★M Stainless steel | K Cast Iron | N Aluminum & Non Ferrous Material

MEGACOAT | Sharp | h5 Shank Dia. | 30°



Lineup

(Unit: mm)

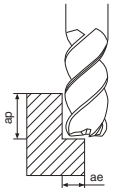
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESS010-015-04	●	1.0	0 -0.015	1.5	1.1	4	45	2
2FESS015-023-04	●	1.5	0 -0.015	2.3	1.6	4	45	2
2FESS020-030-04	●	2.0	0 -0.015	3.0	2.1	4	45	2
2FESS025-037-04	●	2.5	0 -0.015	3.7	2.6	4	45	2
2FESS030-045-06	●	3.0	0 -0.015	4.5	3.2	6	50	2
2FESS035-052-06	●	3.5	0 -0.015	5.2	3.7	6	50	2
2FESS040-060-06	●	4.0	0 -0.015	6.0	4.2	6	50	2
2FESS045-067-06	●	4.5	0 -0.015	6.7	4.7	6	50	2
2FESS050-075-06	●	5.0	0 -0.015	7.5	5.2	6	50	2

(Unit: mm)

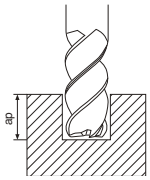
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESS055-082-06	●	5.5	0 -0.015	8.2	5.7	6	50	2
2FESS060-090-06	●	6.0	0 -0.020	9.0	-	6	50	2
2FESS080-120-08	●	8.0	-0.005 -0.025	12.0	-	8	60	2
2FESS100-150-10	●	10.0	-0.005 -0.025	15.0	-	10	70	2
2FESS120-180-12	●	12.0	-0.010 -0.030	18.0	-	12	75	2
2FESS140-210-16	●	14.0	-0.010 -0.030	21.0	14.2	16	75	2
2FESS150-230-16	●	15.0	-0.010 -0.030	23.0	15.2	16	90	2
2FESS160-240-16	●	16.0	-0.010 -0.030	24.0	-	16	90	2

- This product has attained excellent wear resistance by utilizing the new PVD Coated Carbide technology, “MEGACOAT”. It has also achieved fracture resistance and stability of machining with its super micro grain carbide. Smooth endmill surface reduces welding and allows stable machining. Achieves high precision machining with coating and sharp cutting edge.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø0.5	ø1	ø2	ø4	ø6	ø8	ø12	ø16
Carbon Steel	1.2Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	32,000	25,500	13,200	6,600	4,500	3,300	2,200	1,700
	1.2Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	210	225	230	375	415	420	410	410
Alloy Steel	1.2Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	27,000	22,000	11,000	5,600	3,700	2,800	1,900	1,400
	1.2Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	180	195	220	285	315	310	310	310
Pre-hardened Steel 30~45HRC	1.2Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	22,500	12,700	7,200	4,200	3,000	2,200	1,500	1,100
	1.2Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	50	55	80	100	105	105	110	110
Stainless Steel	1.2Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	27,000	22,000	11,000	5,600	3,700	2,800	1,900	1,400
	1.2Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	60	95	95	110	115	115	115	115

* Machining with coolant is recommended for stainless steel.

Please refer to page L44 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2FESM

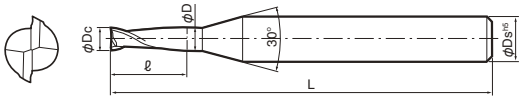
Number of Flutes: 2

General use / Finishing (Medium)

Recommended Material ★ 1st Recommendation

★P ~750N/mm² | ★P ~30HRC | P 30~40HRC | H ~55HRC | ★M Stainless steel | K Cast Iron | N Aluminum & Non Ferrous Material

MEGACOAT | Sharp | h5 Shank Dia. | 30°



2

MEGACOAT is applied

Super Micro-grain carbide

Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESM002-004-04	●	0.2	0 -0.015	0.4	0.22	4	45	2
2FESM003-006-04	●	0.3	0 -0.015	0.6	0.32	4	45	2
2FESM004-008-04	●	0.4	0 -0.015	0.8	0.42	4	45	2
2FESM005-010-04	●	0.5	0 -0.015	1.0	0.53	4	45	2
2FESM006-012-04	●	0.6	0 -0.015	1.2	0.63	4	45	2
2FESM007-014-04	●	0.7	0 -0.015	1.4	0.74	4	45	2
2FESM008-016-04	●	0.8	0 -0.015	1.6	0.84	4	45	2
2FESM009-020-04	●	0.9	0 -0.015	2.0	0.95	4	45	2
2FESM010-025-04	●	1.0	0 -0.015	2.5	1.1	4	45	2
2FESM011-025-04	●	1.1	0 -0.015	2.5	1.2	4	45	2
2FESM012-040-04	●	1.2	0 -0.015	4.0	1.3	4	45	2
2FESM013-040-04	●	1.3	0 -0.015	4.0	1.4	4	45	2
2FESM014-040-04	●	1.4	0 -0.015	4.0	1.5	4	45	2
2FESM015-040-04	●	1.5	0 -0.015	4.0	1.6	4	45	2
2FESM016-050-04	●	1.6	0 -0.015	5.0	1.7	4	45	2
2FESM017-050-04	●	1.7	0 -0.015	5.0	1.8	4	45	2
2FESM018-050-04	●	1.8	0 -0.015	5.0	1.9	4	45	2
2FESM019-050-04	●	1.9	0 -0.015	5.0	2.0	4	45	2
2FESM020-060-04	●	2.0	0 -0.015	6.0	2.1	4	45	2
2FESM021-060-04	●	2.1	0 -0.015	6.0	2.2	4	45	2
2FESM022-060-04	●	2.2	0 -0.015	6.0	2.3	4	45	2
2FESM023-060-04	●	2.3	0 -0.015	6.0	2.4	4	45	2
2FESM024-080-04	●	2.4	0 -0.015	8.0	2.5	4	45	2
2FESM025-080-04	●	2.5	0 -0.015	8.0	2.6	4	45	2
2FESM026-080-04	●	2.6	0 -0.015	8.0	2.7	4	45	2
2FESM027-080-04	●	2.7	0 -0.015	8.0	2.8	4	45	2
2FESM028-080-04	●	2.8	0 -0.015	8.0	2.9	4	45	2
2FESM029-080-04	●	2.9	0 -0.015	8.0	3.1	4	45	2
2FESM030-100-06	●	3.0	0 -0.015	10.0	3.2	6	50	2
2FESM031-100-06	●	3.1	0 -0.015	10.0	3.3	6	50	2
2FESM032-100-06	●	3.2	0 -0.015	10.0	3.4	6	50	2
2FESM033-100-06	●	3.3	0 -0.015	10.0	3.5	6	50	2

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESM034-100-06	●	3.4	0 -0.015	10.0	3.6	6	50	2
2FESM035-100-06	●	3.5	0 -0.015	10.0	3.7	6	50	2
2FESM036-100-06	●	3.6	0 -0.015	10.0	3.8	6	50	2
2FESM037-100-06	●	3.7	0 -0.015	10.0	3.9	6	50	2
2FESM038-110-06	●	3.8	0 -0.015	11.0	4.0	6	50	2
2FESM039-110-06	●	3.9	0 -0.015	11.0	4.1	6	50	2
2FESM040-110-06	●	4.0	0 -0.015	11.0	4.2	6	50	2
2FESM041-110-06	●	4.1	0 -0.015	11.0	4.3	6	50	2
2FESM042-110-06	●	4.2	0 -0.015	11.0	4.4	6	50	2
2FESM043-110-06	●	4.3	0 -0.015	11.0	4.5	6	50	2
2FESM044-110-06	●	4.4	0 -0.015	11.0	4.6	6	50	2
2FESM045-110-06	●	4.5	0 -0.015	11.0	4.7	6	50	2
2FESM046-110-06	●	4.6	0 -0.015	11.0	4.8	6	50	2
2FESM047-110-06	●	4.7	0 -0.015	11.0	4.9	6	50	2
2FESM048-130-06	●	4.8	0 -0.015	13.0	5.0	6	50	2
2FESM049-130-06	●	4.9	0 -0.015	13.0	5.1	6	50	2
2FESM050-130-06	●	5.0	0 -0.015	13.0	5.2	6	50	2
2FESM051-130-06	●	5.1	0 -0.015	13.0	5.3	6	50	2
2FESM052-130-06	●	5.2	0 -0.015	13.0	5.4	6	50	2
2FESM053-130-06	●	5.3	0 -0.015	13.0	5.5	6	50	2
2FESM054-130-06	●	5.4	0 -0.015	13.0	5.6	6	50	2
2FESM055-130-06	●	5.5	0 -0.015	13.0	5.7	6	50	2
2FESM056-130-06	●	5.6	0 -0.015	13.0	5.8	6	50	2
2FESM057-130-06	●	5.7	0 -0.015	13.0	-	6	50	2
2FESM058-130-06	●	5.8	0 -0.015	13.0	-	6	50	2
2FESM059-130-06	●	5.9	0 -0.015	13.0	-	6	50	2
2FESM060-130-06	●	6.0	0 -0.020	13.0	-	6	50	2
2FESM061-160-08	●	6.1	0 -0.020	16.0	6.3	8	60	2
2FESM062-160-08	●	6.2	0 -0.020	16.0	6.4	8	60	2
2FESM063-160-08	●	6.3	0 -0.020	16.0	6.5	8	60	2
2FESM064-160-08	●	6.4	0 -0.020	16.0	6.6	8	60	2
2FESM065-160-08	●	6.5	0 -0.020	16.0	6.7	8	60	2

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2FESM

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. toler-ance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESM066-160-08	●	6.6	0 -0.020	16.0	6.8	8	60	2
2FESM067-160-08	●	6.7	0 -0.020	16.0	6.9	8	60	2
2FESM068-160-08	●	6.8	0 -0.020	16.0	7.0	8	60	2
2FESM069-160-08	●	6.9	0 -0.020	16.0	7.1	8	60	2
2FESM070-160-08	●	7.0	0 -0.020	16.0	7.2	8	60	2
2FESM071-160-08	●	7.1	0 -0.020	16.0	7.3	8	60	2
2FESM072-160-08	●	7.2	0 -0.020	16.0	7.4	8	60	2
2FESM073-160-08	●	7.3	0 -0.020	16.0	7.5	8	60	2
2FESM074-160-08	●	7.4	0 -0.020	16.0	7.6	8	60	2
2FESM075-190-08	●	7.5	0 -0.020	19.0	7.7	8	60	2
2FESM076-190-08	●	7.6	0 -0.020	19.0	-	8	60	2
2FESM077-190-08	●	7.7	0 -0.020	19.0	-	8	60	2
2FESM078-190-08	●	7.8	0 -0.020	19.0	-	8	60	2
2FESM079-190-08	●	7.9	0 -0.020	19.0	-	8	60	2
2FESM080-190-08	●	8.0	-0.005 -0.025	19.0	-	8	60	2
2FESM081-190-10	●	8.1	-0.005 -0.025	19.0	8.3	10	70	2
2FESM082-190-10	●	8.2	-0.005 -0.025	19.0	8.4	10	70	2
2FESM083-190-10	●	8.3	-0.005 -0.025	19.0	8.5	10	70	2
2FESM084-190-10	●	8.4	-0.005 -0.025	19.0	8.6	10	70	2
2FESM085-190-10	●	8.5	-0.005 -0.025	19.0	8.7	10	70	2
2FESM086-190-10	●	8.6	-0.005 -0.025	19.0	8.8	10	70	2
2FESM087-190-10	●	8.7	-0.005 -0.025	19.0	8.9	10	70	2

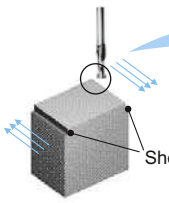
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. toler-ance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESM088-190-10	●	8.8	-0.005 -0.025	19.0	9.0	10	70	2
2FESM089-190-10	●	8.9	-0.005 -0.025	19.0	9.1	10	70	2
2FESM090-190-10	●	9.0	-0.005 -0.025	19.0	9.2	10	70	2
2FESM091-190-10	●	9.1	-0.005 -0.025	19.0	9.3	10	70	2
2FESM092-190-10	●	9.2	-0.005 -0.025	19.0	9.4	10	70	2
2FESM093-190-10	●	9.3	-0.005 -0.025	19.0	9.5	10	70	2
2FESM094-190-10	●	9.4	-0.005 -0.025	19.0	9.6	10	70	2
2FESM095-190-10	●	9.5	-0.005 -0.025	19.0	9.7	10	70	2
2FESM096-220-10	●	9.6	-0.005 -0.025	22.0	-	10	70	2
2FESM097-220-10	●	9.7	-0.005 -0.025	22.0	-	10	70	2
2FESM098-220-10	●	9.8	-0.005 -0.025	22.0	-	10	70	2
2FESM099-220-10	●	9.9	-0.005 -0.025	22.0	-	10	70	2
2FESM100-220-10	●	10.0	-0.005 -0.025	22.0	-	10	70	2
2FESM105-220-12	●	10.5	-0.005 -0.025	22.0	10.7	12	75	2
2FESM110-220-12	●	11.0	-0.005 -0.025	22.0	11.2	12	75	2
2FESM115-220-12	●	11.5	-0.005 -0.025	22.0	11.7	12	75	2
2FESM120-260-12	●	12.0	-0.010 -0.030	26.0	-	12	75	2
2FESM130-260-16	●	13.0	-0.010 -0.030	26.0	13.2	16	75	2
2FESM140-260-16	●	14.0	-0.010 -0.030	26.0	14.2	16	75	2
2FESM150-300-16	●	15.0	-0.010 -0.030	30.0	15.2	16	90	2
2FESM160-320-16	●	16.0	-0.010 -0.030	32.0	-	16	90	2

Sharp Cutting Edge Reduced Burrs

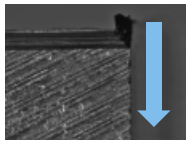
X10CrNiS18 9 (SUS304)

Block
- Vc=70m/min (n=2,230min^{-1})
- ap×ae=5.0mm×1.0mm
- fz=0.03mm/t (Vf=134mm/min)

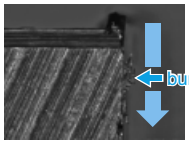


Upper workpiece area

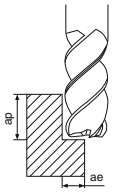
2FESM100-220-10 ◎



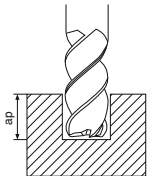
Competitor Coating D ×



Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø0.5	ø1	ø2	ø4	ø6	ø8	ø12	ø16
Carbon Steel	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min^{-1})	32,000	25,500	13,200	6,600	4,500	3,300	2,200	1,700
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	210	225	230	375	415	420	410	410
Alloy Steel	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min^{-1})	27,000	22,000	11,000	5,600	3,700	2,800	1,900	1,400
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	180	195	220	285	315	310	310	310
Pre-hardened Steel 30~45HRC	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min^{-1})	22,500	12,700	7,200	4,200	3,000	2,200	1,500	1,100
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	50	55	80	100	105	105	110	110
Stainless Steel	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min^{-1})	27,000	22,000	11,000	5,600	3,700	2,800	1,900	1,400
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	60	95	95	110	115	115	115	115

* Machining with coolant is recommended for stainless steel.

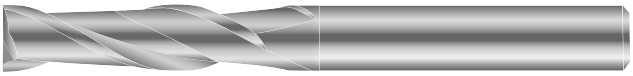
Please refer to page L44 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2FESL

Number of Flutes: 2

General use / Finishing (Long)



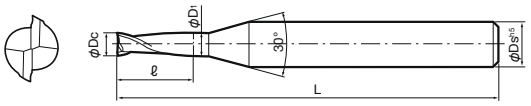
MEGACOAT is applied

Super Micro-grain carbide

Recommended Material ★ 1st Recommendation

P ~750N/mm² ★ | P ~30HRC ★ | P 30~40HRC | H ~55HRC | M Stainless steel ★ | K Cast Iron | N Aluminum & Non Ferrous Material

MEGACOAT | Sharp | h5 Shank Dia. | 30°



Lineup

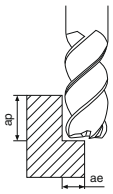
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESL010-040-04	●	1.0	0 -0.015	4.0	1.1	4	45	2
2FESL015-060-04	●	1.5	0 -0.015	6.0	1.6	4	45	2
2FESL020-090-04	●	2.0	0 -0.015	9.0	2.1	4	45	2
2FESL025-120-04	●	2.5	0 -0.015	12.0	2.6	4	45	2
2FESL030-140-06	●	3.0	0 -0.015	14.0	3.2	6	50	2
2FESL040-170-06	●	4.0	0 -0.015	17.0	4.2	6	50	2

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FESL050-200-06	●	5.0	0 -0.015	20.0	5.2	6	60	2
2FESL060-240-06	●	6.0	-0.005 -0.025	24.0	-	6	60	2
2FESL080-280-08	●	8.0	-0.005 -0.025	28.0	-	8	70	2
2FESL100-340-10	●	10.0	-0.005 -0.025	34.0	-	10	90	2
2FESL120-400-12	●	12.0	-0.010 -0.030	40.0	-	12	90	2
2FESL160-480-16	●	16.0	-0.010 -0.030	48.0	-	16	115	2

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø1	ø2	ø4	ø6	ø8	ø12	ø16
Carbon Steel	2.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	19,000	9,500	4,800	3,200	2,400	1,600	1,200
	2.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	210	210	210	210	210	210	210
Alloy Steel	2.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	14,300	7,200	3,600	2,400	2,000	1,300	1,000
	2.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	155	160	160	160	170	170	150
Pre-hardened Steel 30~45HRC	2.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	11,200	5,600	2,800	1,900	1,600	1,000	800
	2.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	85	85	90	90	100	95	80
Stainless Steel	2.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	14,300	7,200	3,600	2,400	2,000	1,300	1,000
	2.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	95	95	95	95	105	105	80

* Machining with coolant is recommended for stainless steel.

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4FESM

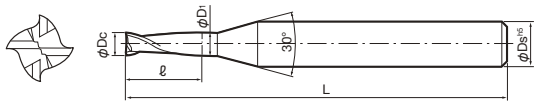
Number of Flutes: 4

General use / Finishing (Medium)

Recommended Material ★ 1st Recommendation

★P ~750N/mm² | ★P ~30HRC | P 30~40HRC | H ~55HRC | ★M Stainless steel | K Cast Iron | N Aluminum & Non Ferrous Material

MEGACOAT | Sharp | h5 Shank Dia. | 30°



4

MEGACOAT is applied

Super Micro-grain carbide

Lineup

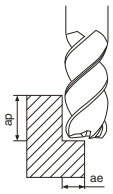
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
4FESM010-025-04	●	1.0	0 -0.015	2.5	1.1	4	45	4
4FESM015-040-04	●	1.5	0 -0.015	4.0	1.6	4	45	4
4FESM020-060-04	●	2.0	0 -0.015	6.0	2.1	4	45	4
4FESM025-080-04	●	2.5	0 -0.015	8.0	2.6	4	45	4
4FESM030-100-06	●	3.0	0 -0.015	10.0	3.2	6	50	4
4FESM035-100-06	●	3.5	0 -0.015	10.0	3.7	6	50	4
4FESM040-110-06	●	4.0	0 -0.015	11.0	4.2	6	50	4
4FESM045-110-06	●	4.5	0 -0.015	11.0	4.7	6	50	4
4FESM050-130-06	●	5.0	0 -0.015	13.0	5.2	6	50	4

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Shank Dia. øDs	Overall length L	Number of Flutes Z
4FESM055-130-06	●	5.5	0 -0.015	13.0	5.7	6	50	4
4FESM060-130-06	●	6.0	0 -0.020	13.0	-	6	50	4
4FESM080-190-08	●	8.0	-0.005 -0.025	19.0	-	8	60	4
4FESM100-220-10	●	10.0	-0.005 -0.025	22.0	-	10	70	4
4FESM120-260-12	●	12.0	-0.010 -0.030	26.0	-	12	75	4
4FESM140-260-16	●	14.0	-0.010 -0.030	26.0	14.2	16	75	4
4FESM150-300-16	●	15.0	-0.010 -0.030	30.0	15.2	16	90	4
4FESM160-320-16	●	16.0	-0.010 -0.030	32.0	-	16	90	4

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø1	ø2	ø4	ø6	ø8	ø12	ø16
Carbon Steel	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	25,500	13,000	6,600	4,400	3,300	2,200	1,700
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	335	345	580	620	625	630	600
Alloy Steel	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	22,000	11,000	5,600	3,700	2,800	1,900	1,400
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	290	290	395	455	455	470	460
Pre-hardened Steel 30~45HRC	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	12,000	7,200	4,200	3,000	2,200	1,500	1,100
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	105	125	150	160	160	165	140
Stainless Steel	1.5Dc×0.05Dc (Dc<ø3)	Spindle Revolution (min⁻¹)	22,000	11,000	5,600	3,700	2,800	1,900	1,400
	1.5Dc×0.1Dc (Dc≧ø3)	Feed Rate (mm/min)	130	145	165	165	170	175	155

* Machining with coolant is recommended for stainless steel.

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2FEKS

Number of Flutes: 2

General use / Finishing
Tough corner edge (Short)

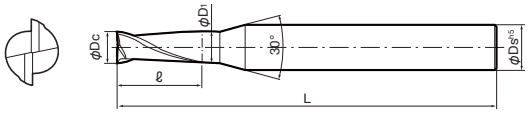
MEGACOAT is applied

Super Micro-grain carbide

Recommended Material ★ 1st Recommendation

★ P	★ P	P	H	★ M	K	N
~750N/mm²	~30HRC	30~40HRC	~55HRC	Stainless steel	Cast Iron	Aluminum & Non Ferrous Material

MEGACOAT | Land | h5 Shank Dia. | 30°



Lineup

(Unit: mm)

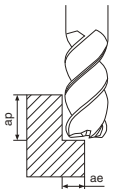
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FEKS030-045-06	●	3.0	0 -0.015	4.5	3.15	6.5	6	50	2
2FEKS035-052-06	●	3.5	0 -0.015	5.2	3.68	7.2	6	50	2
2FEKS040-060-06	●	4.0	0 -0.015	6.0	4.2	8.2	6	50	2
2FEKS045-067-06	●	4.5	0 -0.015	6.7	4.7	8.9	6	50	2
2FEKS050-075-06	●	5.0	0 -0.015	7.5	5.2	10.1	6	50	2
2FEKS055-082-06	●	5.5	0 -0.015	8.2	5.7	10.8	6	50	2
2FEKS060-090-06	●	6.0	0 -0.020	9.0	-	-	6	50	2

(Unit: mm)

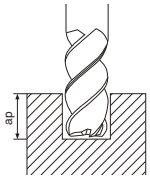
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FEKS080-120-08	●	8.0	-0.005 -0.025	12.0	-	-	8	60	2
2FEKS100-150-10	●	10.0	-0.005 -0.025	15.0	-	-	10	70	2
2FEKS120-180-12	●	12.0	-0.010 -0.030	18.0	-	-	12	75	2
2FEKS140-210-16	●	14.0	-0.010 -0.030	21.0	14.2	31.4	16	75	2
2FEKS150-230-16	●	15.0	-0.010 -0.030	23.0	15.2	35	16	90	2
2FEKS160-240-16	●	16.0	-0.010 -0.030	24.0	-	-	16	90	2

● Corner lands improve the cutting edge strength.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø4	ø6	ø8	ø10	ø12	ø16
Carbon Steel	1.2Dc×0.1Dc	Spindle Revolution (min⁻¹)	9,300	7,000	4,600	3,500	3,000	2,700	2,200
		Feed Rate (mm/min)	450	450	470	470	470	470	440
Alloy Steel	1.2Dc×0.1Dc	Spindle Revolution (min⁻¹)	8,800	6,600	4,400	3,300	2,600	2,200	1,800
		Feed Rate (mm/min)	370	370	380	380	380	380	360
Pre-hardened Steel 30~45HRC	1.2Dc×0.1Dc	Spindle Revolution (min⁻¹)	6,400	4,800	3,200	2,400	1,900	1,600	1,200
		Feed Rate (mm/min)	130	130	130	140	140	140	140
Stainless Steel	1.2Dc×0.1Dc	Spindle Revolution (min⁻¹)	8,000	6,000	4,000	3,000	2,400	2,000	1,500
		Feed Rate (mm/min)	140	140	140	140	140	140	140

* Machining with coolant is recommended for stainless steel.

For Slotting, see page L44.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2FEKM

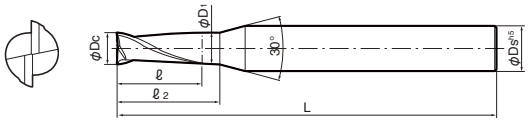
Number of Flutes: 2

General use / Finishing
Tough corner edge (Medium)

Recommended Material ★ 1st Recommendation

★ P	★ P	P	H	★ M	K	N
~750N/mm²	~30HRC	30~40HRC	~55HRC	Stainless steel	Cast Iron	Aluminum & Non Ferrous Material

MEGACOAT | Land | h5 Shank Dia. | 30°



2

MEGACOAT is applied

Super Micro-grain carbide

Lineup

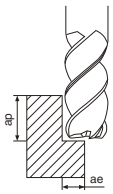
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FEKM030-100-06	●	3.0	0 -0.015	10.0	3.15	12.0	6	50	2
2FEKM035-100-06	●	3.5	0 -0.015	10.0	3.68	12.0	6	50	2
2FEKM040-110-06	●	4.0	0 -0.015	11.0	4.2	13.2	6	50	2
2FEKM045-110-06	●	4.5	0 -0.015	11.0	4.7	13.2	6	50	2
2FEKM050-130-06	●	5.0	0 -0.015	13.0	5.2	15.6	6	50	2
2FEKM055-130-06	●	5.5	0 -0.015	13.0	5.7	15.6	6	50	2
2FEKM060-130-06	●	6.0	0 -0.020	13.0	-	-	6	50	2
2FEKM065-160-08	●	6.5	0 -0.020	16.0	6.7	22.4	8	60	2
2FEKM070-160-08	●	7.0	0 -0.020	16.0	7.2	22.4	8	60	2
2FEKM075-190-08	●	7.5	0 -0.020	19.0	7.7	26.6	8	60	2
2FEKM080-190-08	●	8.0	-0.005 -0.025	19.0	-	-	8	60	2

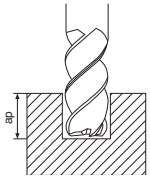
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
2FEKM085-190-10	●	8.5	-0.005 -0.025	19.0	8.7	26.6	10	70	2
2FEKM090-190-10	●	9.0	-0.005 -0.025	19.0	9.2	26.6	10	70	2
2FEKM095-190-10	●	9.5	-0.005 -0.025	19.0	9.7	26.6	10	70	2
2FEKM100-220-10	●	10.0	-0.005 -0.025	22.0	-	-	10	70	2
2FEKM110-220-12	●	11.0	-0.005 -0.025	22.0	11.2	30.8	12	75	2
2FEKM120-260-12	●	12.0	-0.010 -0.030	26.0	-	-	12	75	2
2FEKM130-260-16	●	13.0	-0.010 -0.030	26.0	13.2	36.4	16	75	2
2FEKM140-260-16	●	14.0	-0.010 -0.030	26.0	14.2	36.4	16	75	2
2FEKM150-300-16	●	15.0	-0.010 -0.030	30.0	15.2	42.0	16	90	2
2FEKM160-320-16	●	16.0	-0.010 -0.030	32.0	-	-	16	90	2

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø4	ø6	ø8	ø10	ø12	ø16
Carbon Steel	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	9,300	7,000	4,600	3,500	3,000	2,700	2,200
		Feed Rate (mm/min)	450	450	470	470	470	470	440
Alloy Steel	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,800	6,600	4,400	3,300	2,600	2,200	1,800
		Feed Rate (mm/min)	370	370	380	380	380	380	360
Pre-hardened Steel 30~45HRC	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,200	2,400	1,900	1,600	1,200
		Feed Rate (mm/min)	130	130	130	140	140	140	140
Stainless Steel	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,000	6,000	4,000	3,000	2,400	2,000	1,500
		Feed Rate (mm/min)	140	140	140	140	140	140	140

* Machining with coolant is recommended for stainless steel.

Please refer to page L44 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4FEKM

Number of Flutes: 4

General use / Finishing
Tough corner edge (Medium)

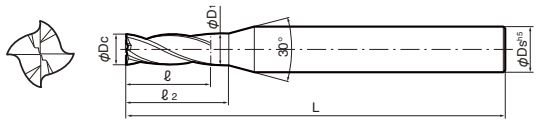
MEGACOAT is applied

Super Micro-grain carbide

Recommended Material ★ 1st Recommendation

★ P ~750N/mm² | ★ P ~30HRC | P 30~40HRC | H ~55HRC | ★ M Stainless steel | K Cast Iron | N Aluminum & Non Ferrous Material

MEGACOAT | Land | h5 Shank Dia. | 30°



Lineup

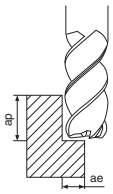
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
4FEKM030-100-06	●	3.0	0 -0.015	10.0	3.15	12	6	50	4
4FEKM035-100-06	●	3.5	0 -0.015	10.0	3.68	12	6	50	4
4FEKM040-110-06	●	4.0	0 -0.015	11.0	4.2	13.2	6	50	4
4FEKM045-110-06	●	4.5	0 -0.015	11.0	4.7	13.2	6	50	4
4FEKM050-130-06	●	5.0	0 -0.015	13.0	5.2	15.6	6	50	4
4FEKM055-130-06	●	5.5	0 -0.015	13.0	5.7	15.6	6	50	4
4FEKM060-130-06	●	6.0	0 -0.020	13.0	-	-	6	50	4

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
4FEKM080-190-08	●	8.0	-0.005 -0.025	19.0	-	-	8	60	4
4FEKM100-220-10	●	10.0	-0.005 -0.025	22.0	-	-	10	70	4
4FEKM120-260-12	●	12.0	-0.010 -0.030	26.0	-	-	12	75	4
4FEKM140-260-16	●	14.0	-0.010 -0.030	26.0	14.2	36.4	16	75	4
4FEKM150-300-16	●	15.0	-0.010 -0.030	30.0	15.2	42	16	90	4
4FEKM160-320-16	●	16.0	-0.010 -0.030	32.0	-	-	16	90	4

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø4	ø6	ø8	ø10	ø12	ø16
Carbon Steel	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	10,600	8,000	5,300	4,000	3,200	2,700	2,100
		Feed Rate (mm/min)	680	690	770	770	770	770	770
Alloy Steel	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,800	6,600	4,400	3,300	2,600	2,200	2,000
		Feed Rate (mm/min)	500	550	620	630	630	630	610
Pre-hardened Steel 30~45HRC	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,200	2,400	1,900	1,600	1,200
		Feed Rate (mm/min)	180	180	180	190	190	190	190
Stainless Steel	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,000	6,000	4,000	3,000	2,300	2,000	1,500
		Feed Rate (mm/min)	190	200	200	200	210	210	210

* Machining with coolant is recommended for stainless steel.

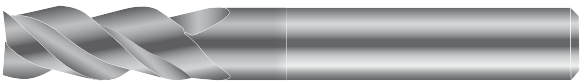
Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3UFSM

Number of Flutes: 3

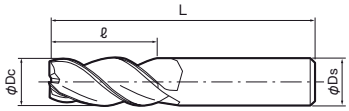
General use / Semi-Finishing



Recommended Material ★ 1st Recommendation

P ~30HRC ★ | P 30~40HRC ★ | H ~55HRC | M Stainless steel ★ | S Titanium Alloy | K Cast Iron ★ | N Aluminum & Non Ferrous Material

TiAlN | h6 Shank Dia. | 45°



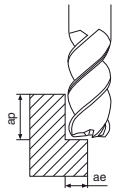
Lineup

(Unit: mm)

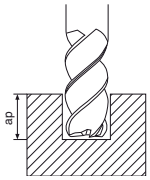
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
3UFSM010-030-04	●	1	-0.014 -0.028	3	4	50	3
3UFSM015-030-04	●	1.5	-0.014 -0.028	3	4	50	3
3UFSM020-030-04	●	2	-0.014 -0.028	3	4	50	3
3UFSM025-040-04	●	2.5	-0.014 -0.028	4	4	50	3
3UFSM030-080-06	●	3	-0.014 -0.028	8	6	50	3
3UFSM040-120-06	●	4	-0.020 -0.038	12	6	50	3
3UFSM050-140-06	●	5	-0.020 -0.038	14	6	50	3
3UFSM060-160-06	●	6	-0.020 -0.038	16	6	50	3
3UFSM080-200-08	●	8	-0.025 -0.047	20	8	63	3
3UFSM100-220-10	●	10	-0.025 -0.047	22	10	76	3
3UFSM120-250-12	●	12	-0.032 -0.059	25	12	76	3
3UFSM160-320-16	●	16	-0.032 -0.059	32	16	89	3
3UFSM200-380-20	●	20	-0.040 -0.073	38	20	104	3

● Products emphasizing high efficiency machining, three flutes type for general semi finishing. It is available for slotting and shouldering of wide range of work materials.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20
Carbon Steel Cast Iron	1.0Dc×0.1Dc	Spindle Revolution (min⁻¹)	16,000	10,600	8,000	6,400	5,300	4,000	3,200	2,700	2,000	1,600
		Feed Rate (mm/min)	330	330	390	420	430	450	480	480	510	530
Alloy Steel (~30HRC)	1.0Dc×0.1Dc	Spindle Revolution (min⁻¹)	11,000	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,400	1,100
		Feed Rate (mm/min)	240	290	290	310	330	330	340	340	340	340
Pre-hardened Steel Stainless Steel (30~40HRC)	1.0Dc×0.1Dc	Spindle Revolution (min⁻¹)	8,000	5,300	4,000	3,200	2,700	2,000	1,600	1,300	1,000	800
		Feed Rate (mm/min)	140	140	140	170	180	180	190	190	190	190
Titanium Alloy Heat-resistant Alloy (40~50HRC)	1.0Dc×0.1Dc	Spindle Revolution (min⁻¹)	4,000	2,700	2,000	1,600	1,300	1,000	800	700	500	400
		Feed Rate (mm/min)	40	50	60	60	70	70	70	70	80	80
Aluminum Alloy	1.0Dc×0.1Dc	Spindle Revolution (min⁻¹)	32,000	21,000	16,000	12,800	10,600	8,000	6,400	5,300	4,000	3,200
		Feed Rate (mm/min)	670	700	760	820	860	880	1,000	1,100	1,100	1,250

* Machining with coolant is recommended for stainless steel.

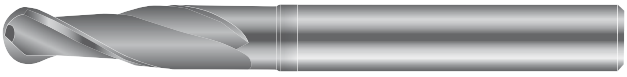
For Slotting, see page L44

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2UEBS

Number of Flutes: 2

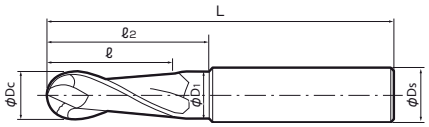
Copying (Ball-nose end mill with 2 flutes)



Recommended Material ★ 1st Recommendation

P ~750N/mm² ★ | P ~30HRC ★ | P 30~40HRC ★ | K Cast Iron ★

TiAlN | h6 Shank Dia. | ±0.01 mm R | 30°



Lineup

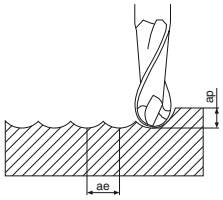
(Unit: mm)

Description	Std.	Radius of Ball Nose	Outside Dia.	Outside Dia. tolerance	Edge Length	Neck Dia.	Under Neck Length	Shank Dia.	Total length	Number of Flutes
		R	øDc		ℓ	øD1	ℓ2	øDs	L	Z
2UEBS010-030-04	●	R0.5	1	-0.014 -0.028	3	-	-	4	50	2
2UEBS020-030-04	●	R1	2	-0.014 -0.028	3	-	-	4	50	2
2UEBS030-095-06	●	R1.5	3	-0.014 -0.028	9.5	-	-	6	58	2
2UEBS040-120-06	●	R2	4	-0.020 -0.038	12	-	-	6	76	2
2UEBS050-140-06	●	R2.5	5	-0.020 -0.038	14	-	-	6	76	2
2UEBS060-160-06	●	R3	6	-0.020 -0.038	16	5.5	40	6	100	2
2UEBS080-200-08	●	R4	8	-0.025 -0.047	20	7.5	40	8	100	2
2UEBS100-220-10	●	R5	10	-0.025 -0.047	22	9.5	35	10	100	2
2UEBS120-250-12	●	R6	12	-0.032 -0.059	25	11.5	50	12	125	2
2UEBS160-320-16	●	R8	16	-0.032 -0.059	32	15.5	60	16	150	2
2UEBS200-380-20	●	R10	20	-0.040 -0.073	38	19.5	60	20	150	2

* Actual ball-nose radius will be half of actual measurement of outer diameter.

● Ball-nose end mill with two flutes.

Recommended Cutting Conditions



Copying

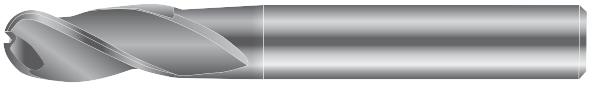
Workpiece Materials		Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø4	ø6	ø8	ø10	ø12	ø16	ø20
Steel	< 42HRC	0.3Dc×0.7Dc	Spindle Revolution (min^{-1})	9,600	6,400	4,800	3,800	3,200	2,400	1,900
			Feed Rate (mm/min)	380	420	380	380	340	300	310
	42~48HRC	0.3Dc×0.7Dc	Spindle Revolution (min^{-1})	8,000	5,300	4,000	3,200	2,700	2,000	1,600
			Feed Rate (mm/min)	300	330	300	290	270	240	240
	48~52HRC	0.3Dc×0.7Dc	Spindle Revolution (min^{-1})	6,400	4,200	3,200	2,500	2,100	1,600	1,300
			Feed Rate (mm/min)	190	210	190	190	170	150	150
Cast Iron	< 180HB	0.3Dc×0.7Dc	Spindle Revolution (min^{-1})	12,700	8,500	6,400	5,100	4,200	3,200	2,500
			Feed Rate (mm/min)	760	850	760	750	690	610	610
	> 180HB	0.3Dc×0.7Dc	Spindle Revolution (min^{-1})	11,100	7,400	5,600	4,500	3,700	2,800	2,200
			Feed Rate (mm/min)	540	590	540	530	480	420	430

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3UEBS

Number of Flutes: 3

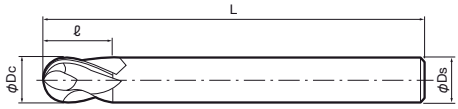
Copying (Ball-nose end mill with 3 flutes)



Recommended Material ★ 1st Recommendation

P ~750N/mm² ★ | P ~30HRC ★ | M Stainless steel | N Aluminum & Non Ferrous Material

TiAlN | h6 Shank Dia. | ±0.01 mm R | 30°



Lineup

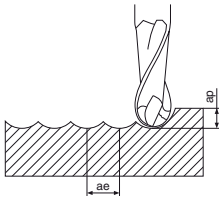
(Unit: mm)

Description	Std.	Radius of Ball Nose	External	Mill Dia. tolerance	Edge Length	Shank Dia.	Total length	Number of Flutes
		R	øDc		ℓ	øDs	L	Z
3UEBS030-070-06	●	R1.5	3	-0.014 -0.028	7	6	57	3
3UEBS040-080-06	●	R2	4	-0.020 -0.038	8	6	57	3
3UEBS050-100-06	●	R2.5	5	-0.020 -0.038	10	6	57	3
3UEBS060-100-06	●	R3	6	-0.020 -0.038	10	6	57	3
3UEBS080-160-08	●	R4	8	-0.025 -0.047	16	8	63	3
3UEBS100-190-10	●	R5	10	-0.025 -0.047	19	10	72	3
3UEBS120-220-12	●	R6	12	-0.032 -0.059	22	12	83	3

* Actual ball-nose radius will be half of actual measurement of outer diameter.

● Ball-nose end mill with well-balanced three flutes. Also applicable for difficult-to-cut materials.

Recommended Cutting Conditions



Copying

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12
Carbon Steel < 20HRC	0.2Dc×0.3Dc	Spindle Revolution (min^{-1})	13,300	10,000	8,000	6,600	5,000	4,000	3,300
		Feed Rate (mm/min)	600	870	840	850	1,400	1,200	990
Alloy Steel < 35HRC	0.2Dc×0.3Dc	Spindle Revolution (min^{-1})	10,600	8,000	6,400	5,300	4,000	3,200	2,700
		Feed Rate (mm/min)	410	500	610	640	940	830	730
Pre-hardened Steel 30~45HRC	0.1Dc×0.2Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,900
		Feed Rate (mm/min)	220	250	257	280	250	240	230
Stainless Steel	0.05.0Dc×0.1Dc	Spindle Revolution (min^{-1})	5,800	4,400	3,500	2,900	2,200	1,800	1,500
		Feed Rate (mm/min)	160	180	190	180	190	190	170

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3RDSM, 4RDSM, 5RDSM

Number of Flutes: 3, 4, 5

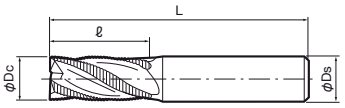
General use / Roughing (Medium)

3 4 5

Recommended Material ★ 1st Recommendation

P ~750N/mm² ★ | P ~30HRC ★ | P 30~40HRC ★ | M Stainless steel | K Cast Iron ★

TiAlN | h6 Shank Dia. | 20° | Cutting shape



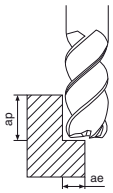
Lineup

(Unit: mm)

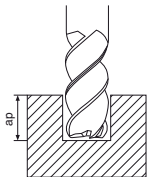
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
3RDSM040-110-06	●	4	-0.030 -0.105	11	6	55	3
3RDSM050-130-06	●	5	-0.030 -0.105	13	6	57	3
3RDSM060-130-06	●	6	-0.030 -0.105	13	6	57	3
3RDSM080-160-08	●	8	-0.040 -0.130	16	8	63	3
4RDSM100-220-10	●	10	-0.040 -0.130	22	10	72	4
4RDSM120-260-12	●	12	-0.050 -0.160	26	12	83	4
4RDSM160-320-16	●	16	-0.050 -0.160	32	16	92	4
4RDSM200-380-20	●	20	-0.065 -0.195	38	20	104	4
5RDSM250-450-25	●	25	-0.065 -0.195	45	25	121	5

● Three, four and five flutes types are available for roughing. The sine curve shaped cutting edge reduces cutting resistance.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Steel	< 22HRC	1.5Dc×0.5Dc	Spindle Revolution (min⁻¹)	11,100	8,400	6,700	5,600	4,200	3,300	2,700
			Feed Rate (mm/min)	1,000	1,000	1,100	1,120	1,200	1,200	1,340
	22~32HRC	1.5Dc×0.4Dc	Spindle Revolution (min⁻¹)	9,600	7,200	5,700	4,800	3,600	2,900	2,300
			Feed Rate (mm/min)	720	720	860	860	860	920	1,030
	32~40HRC	1.5Dc×0.4Dc	Spindle Revolution (min⁻¹)	6,400	4,800	3,800	3,200	2,400	1,900	1,500
			Feed Rate (mm/min)	320	320	410	410	400	400	400
	40~45HRC	1Dc×0.4Dc	Spindle Revolution (min⁻¹)	4,800	3,600	2,900	2,400	1,800	1,400	1,100
			Feed Rate (mm/min)	220	220	260	260	250	250	250
	45~50HRC	1Dc×0.3Dc	Spindle Revolution (min⁻¹)	4,200	3,200	2,500	2,100	1,600	1,300	1,000
			Feed Rate (mm/min)	150	150	180	180	170	170	170
Cast Iron		1.5Dc×0.5Dc	Spindle Revolution (min⁻¹)	9,600	7,200	5,700	4,800	3,600	2,900	2,300
			Feed Rate (mm/min)	850	850	1,030	1,030	1,030	1,100	1,380

For Slotting, see page L45

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3RDSL, 4RDSL, 5RDSL

Number of Flutes: 3, 4, 5

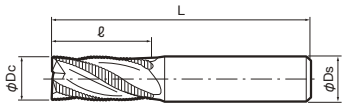
General use / Roughing (Long)

3 4 5

Recommended Material ★ 1st Recommendation

P ~750N/mm² ★ | P ~30HRC ★ | P 30~40HRC ★ | M Stainless steel | K Cast Iron ★

TiAlN | h6 Shank Dia. | 20° | Cutting shape

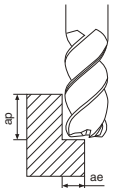


Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
3RDSL060-240-06	●	6	-0.030 -0.105	24	6	76	3
3RDSL080-280-08	●	8	-0.040 -0.130	28	8	76	3
4RDSL100-340-10	●	10	-0.040 -0.130	34	10	89	4
4RDSL120-450-12	●	12	-0.050 -0.160	45	12	100	4
4RDSL160-560-16	●	16	-0.050 -0.160	56	16	125	4
4RDSL200-600-20	●	20	-0.065 -0.195	60	20	125	4
5RDSL250-800-25	●	25	-0.065 -0.195	80	25	150	5

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Steel	< 22HRC	2.5Dc×0.5Dc	Spindle Revolution (min^{-1})	7,800	5,900	4,700	3,900	2,900	2,300	1,900
			Feed Rate (mm/min)	700	700	770	780	840	840	940
	22~32HRC	2.5Dc×0.4Dc	Spindle Revolution (min^{-1})	6,700	5,000	4,000	3,400	2,500	2,000	1,600
			Feed Rate (mm/min)	500	500	600	600	600	640	720
	32~40HRC	2.5Dc×0.4Dc	Spindle Revolution (min^{-1})	4,500	3,400	2,700	2,200	1,700	1,300	1,100
			Feed Rate (mm/min)	220	220	290	290	280	280	280
	40~45HRC	2.5Dc×0.4Dc	Spindle Revolution (min^{-1})	3,400	2,500	2,000	1,700	1,300	1,000	800
			Feed Rate (mm/min)	150	150	180	180	180	180	180
	45~50HRC	2.5Dc×0.3Dc	Spindle Revolution (min^{-1})	2,900	2,200	1,800	1,500	1,100	900	700
			Feed Rate (mm/min)	110	110	130	130	120	120	120
Cast Iron		2.5Dc×0.5Dc	Spindle Revolution (min^{-1})	6,700	5,000	4,000	3,400	2,500	2,000	1,600
			Feed Rate (mm/min)	600	600	720	720	720	770	970

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4HFSS, 5HFSS, 6HFSS, 7HFSS

Number of Flutes: 4, 5, 6, 7

Finishing of Hard Materials

4 5 6 7

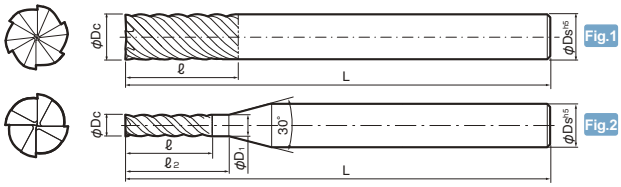
MEGACOAT is applied

Super Micro-grain carbide

Recommended Material ★ 1st Recommendation

★ P ~750N/mm² ★ P ~30HRC ★ P 30~40HRC ★ H ~55HRC ★ H ~68HRC

MEGACOAT Hard | Land | h5 Shank Dia. | 45°



Lineup

(Unit: mm)

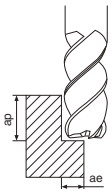
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
4HFSS010-040-06 Fig.2	●	1	0 -0.015	4	1.05	4.8	6	60	4
4HFSS020-060-06 Fig.2	●	2	0 -0.015	6	2.10	7.2	6	60	4
4HFSS030-080-06 Fig.2	●	3	0 -0.015	8	3.15	9.6	6	60	4
4HFSS040-100-06 Fig.2	●	4	0 -0.015	10	4.2	12.0	6	60	4
4HFSS050-120-06 Fig.2	●	5	0 -0.015	12	5.2	14.4	6	60	4
5HFSS040-100-06 Fig.2	●	4	0 -0.015	10	4.2	12.0	6	60	5
6HFSS060-140-06 Fig.1	●	6	0 -0.020	14	–	–	6	60	6

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
6HFSS080-180-08 Fig.1	●	8	-0.005 -0.025	18	-	-	8	70	6
6HFSS100-220-10 Fig.1	●	10	-0.005 -0.025	22	-	-	10	80	6
6HFSS120-260-12 Fig.1	●	12	-0.010 -0.030	26	-	-	12	90	6
6HFSS060-140-06 Fig.1	●	6	0 -0.020	14	-	-	6	60	7
7HFSS080-180-08 Fig.1	●	8	-0.005 -0.025	18	-	-	8	70	7
7HFSS100-220-10 Fig.1	●	10	-0.005 -0.025	22	-	-	10	80	7
7HFSS120-260-12 Fig.1	●	12	-0.010 -0.030	26	-	-	12	90	7

● "MEGACOAT Hard", new PVD Coated Carbide for hardened materials is adopted. Achieves high rigidity by ensuring a large core diameter. End mill for hardened materials that achieves longer tool life and stable machining. Also cutting edge strength and chip evacuation are improved with a negative rake angle.

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø1	ø2	ø4	ø6	ø8	ø12	ø16
Tool Steel (< 40HRC) Pre-hardened steel	1.5Dc×0.05D (D<ø3) 1.5Dc×0.1Dc (ø3≦D)	Spindle Revolution (min⁻¹)	20,700	20,000	11,100	7,400	5,600	3,700	2,800
		Feed Rate (mm/min)	910	1,750	2,000	2,900	2,930	2,930	2,720
Tool Steel Heat Treated Steel (40~45HRC) Pre-hardened steel	1.5Dc×0.05D (D<ø3) 1.5Dc×0.1Dc (ø3≦D)	Spindle Revolution (min⁻¹)	20,700	20,000	9,900	6,600	5,000	3,300	2,500
		Feed Rate (mm/min)	910	1,750	1,800	2,630	2,650	2,650	2,400
Hardened 45~55HRC	1.5Dc×0.05D	Spindle Revolution (min⁻¹)	20,700	16,000	8,000	5,300	4,000	2,700	2,000
		Feed Rate (mm/min)	910	1,400	1,400	2,100	2,100	2,100	1,900
Hardened 55~60HRC	1.5Dc×0.02Dc	Spindle Revolution (min⁻¹)	20,700	12,000	6,000	4,000	3,000	2,000	1,500
		Feed Rate (mm/min)	640	730	740	1,100	1,100	1,100	1,050
Hardened 60~65HRC	1.5Dc×0.02Dc	Spindle Revolution (min⁻¹)	20,700	11,100	5,600	3,700	2,800	1,900	1,400
		Feed Rate (mm/min)	550	600	600	880	880	880	910
Hardened 65~70HRC	1.5Dc×0.02Dc	Spindle Revolution (min⁻¹)	15,900	8,000	4,000	2,700	2,000	1,330	1,000
		Feed Rate (mm/min)	370	370	370	560	560	550	550

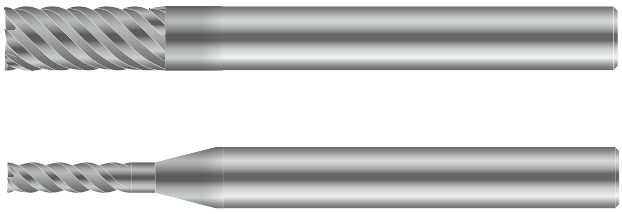
Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4HFSM, 5HFSM, 6HFSM, 7HFSM, 8HFSM

Number of Flutes: 4, 5, 6, 7, 8

Finishing of Hard Materials



4 5 6 7 8

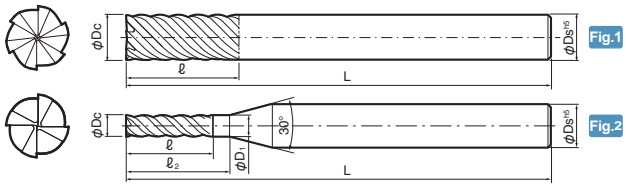
MEGACOAT is applied

Super Micro-grain carbide

Recommended Material ★ 1st Recommendation

★ P ~750N/mm² ★ P ~30HRC ★ P 30~40HRC ★ H ~55HRC ★ H ~68HRC

MEGACOAT Hard | Land | h5 Shank Dia. | 45°



Lineup

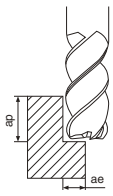
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
4HFSM010-050-06 Fig.2	●	1	0 -0.015	5	1.05	6	6	60	4
4HFSM020-090-06 Fig.2	●	2	0 -0.015	9	2.10	10.8	6	60	4
4HFSM030-120-06 Fig.2	●	3	0 -0.015	12	3.15	14.4	6	60	4
4HFSM040-140-06 Fig.2	●	4	0 -0.015	14	4.2	16.8	6	60	4
4HFSM050-170-06 Fig.2	●	5	0 -0.015	17	5.2	20.4	6	60	4
5HFSM040-140-06 Fig.2	●	4	0 -0.015	14	4.2	16.8	6	60	5
6HFSM060-170-06 Fig.1	●	6	0 -0.020	17	-	-	6	60	6
6HFSM080-230-08 Fig.1	●	8	-0.005 -0.025	23	-	-	8	70	6
6HFSM100-280-10 Fig.1	●	10	-0.005 -0.025	28	-	-	10	80	6
6HFSM120-330-12 Fig.1	●	12	-0.010 -0.030	33	-	-	12	90	6

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Number of Flutes Z
6HFSM140-370-16 Fig.2	●	14	-0.010 -0.030	37	14.2	44.4	16	105	6
6HFSM150-420-16 Fig.2	●	15	-0.010 -0.030	42	15.2	50.4	16	105	6
6HFSM160-420-16 Fig.1	●	16	-0.010 -0.030	42	-	-	16	105	6
6HFSM200-480-20 Fig.1	●	20	-0.010 -0.030	48	-	-	20	110	6
7HFSM060-170-06 Fig.1	●	6	0 -0.020	17	-	-	6	60	7
7HFSM080-230-08 Fig.1	●	8	-0.005 -0.025	23	-	-	8	70	7
7HFSM100-280-10 Fig.1	●	10	-0.005 -0.025	28	-	-	10	80	7
7HFSM120-330-12 Fig.1	●	12	-0.010 -0.030	33	-	-	12	90	7
6HFSM160-420-16 Fig.1	●	16	-0.010 -0.030	42	-	-	16	105	7
8HFSM250-530-25 Fig.1	●	25	-0.010 -0.030	53	-	-	25	125	8

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø1	ø2	ø4	ø6	ø8	ø12	ø16
Tool Steel (< 40HRC) Pre-hardened steel	1.5Dc×0.05D (D<ø3) 1.5Dc×0.1Dc (ø3≦D)	Spindle Revolution (min⁻¹)	20,700	20,000	11,100	7,400	5,600	3,700	2,800
		Feed Rate (mm/min)	910	1,750	2,000	2,900	2,930	2,930	2,720
Tool Steel Heat Treated Steel (40~45HRC) Pre-hardened steel	1.5Dc×0.05D (D<ø3) 1.5Dc×0.1Dc (ø3≦D)	Spindle Revolution (min⁻¹)	20,700	20,000	9,900	6,600	5,000	3,300	2,500
		Feed Rate (mm/min)	910	1,750	1,800	2,630	2,650	2,650	2,400
Hardened 45~55HRC	1.5Dc×0.05D	Spindle Revolution (min⁻¹)	20,700	16,000	8,000	5,300	4,000	2,700	2,000
		Feed Rate (mm/min)	910	1,400	1,400	2,100	2,100	2,100	1,900
Hardened 55~60HRC	1.5Dc×0.02Dc	Spindle Revolution (min⁻¹)	20,700	12,000	6,000	4,000	3,000	2,000	1,500
		Feed Rate (mm/min)	640	730	740	1,100	1,100	1,100	1,050
Hardened 60~65HRC	1.5Dc×0.02Dc	Spindle Revolution (min⁻¹)	20,700	11,100	5,600	3,700	2,800	1,900	1,400
		Feed Rate (mm/min)	550	600	600	880	880	880	910
Hardened 65~70HRC	1.5Dc×0.02Dc	Spindle Revolution (min⁻¹)	15,900	8,000	4,000	2,700	2,000	1,330	1,000
		Feed Rate (mm/min)	370	370	370	560	560	550	550

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

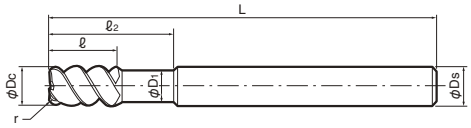
Number of Flutes: 4

Deep Slotting and Finishing of Hard Materials (Radius)

Recommended Material ★ 1st Recommendation

P 30～40HRC | H ★ ～55HRC | H ★ ～68HRC | K Cast Iron

TiAlN | Radius R | h6 Shank Dia. | ±0.02 mm R | 50°



Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Spec of Corners r
4PGRM030-045-06-R025	●	3	-0.014 -0.028	4.5	2.7	9	6	57	R 0.25
4PGRM030-045-06-R050	●	3	-0.014 -0.028	4.5	2.7	9	6	57	R 0.5
4PGRM040-060-06-R025	●	4	-0.020 -0.038	6	3.7	12	6	57	R 0.25
4PGRM040-060-06-R050	●	4	-0.020 -0.038	6	3.7	12	6	57	R 0.5
4PGRM050-075-06-R025	●	5	-0.020 -0.038	7.5	4.6	15	6	76	R 0.25
4PGRM050-075-06-R050	●	5	-0.020 -0.038	7.5	4.6	15	6	76	R 0.5
4PGRM060-090-06-R025	●	6	-0.020 -0.038	9	5.5	18	6	76	R 0.25
4PGRM060-090-06-R050	●	6	-0.020 -0.038	9	5.5	18	6	76	R 0.5
4PGRM060-090-06-R075	●	6	-0.020 -0.038	9	5.5	18	6	76	R 0.75
4PGRM060-090-06-R100	●	6	-0.020 -0.038	9	5.5	18	6	76	R 1.0
4PGRM080-120-08-R050	●	8	-0.025 -0.047	12	7.4	24	8	100	R 0.5
4PGRM080-120-08-R100	●	8	-0.025 -0.047	12	7.4	24	8	100	R 1.0
4PGRM080-120-08-R150	●	8	-0.025 -0.047	12	7.4	24	8	100	R 1.5

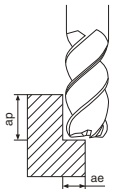
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Neck Dia. øD1	Under Neck Length ℓ2	Shank Dia. øDs	Overall length L	Spec of Corners r
4PGRM080-120-08-R200	●	8	-0.025 -0.047	12	7.4	24	8	100	R 2.0
4PGRM100-150-10-R050	●	10	-0.025 -0.047	15	9.2	30	10	100	R 0.5
4PGRM100-150-10-R100	●	10	-0.025 -0.047	15	9.2	30	10	100	R 1.0
4PGRM100-150-10-R150	●	10	-0.025 -0.047	15	9.2	30	10	100	R 1.5
4PGRM100-150-10-R200	●	10	-0.025 -0.047	15	9.2	30	10	100	R 2.0
4PGRM120-180-12-R050	●	12	-0.032 -0.059	18	11	36	12	125	R 0.5
4PGRM120-180-12-R100	●	12	-0.032 -0.059	18	11	36	12	125	R 1.0
4PGRM120-180-12-R150	●	12	-0.032 -0.059	18	11	36	12	125	R 1.5
4PGRM120-180-12-R200	●	12	-0.032 -0.059	18	11	36	12	125	R 2.0
4PGRM160-240-16-R050	●	16	-0.032 -0.059	24	15	48	16	125	R 0.5
4PGRM160-240-16-R150	●	16	-0.032 -0.059	24	15	48	16	125	R 1.5
4PGRM200-300-20-R050	●	20	-0.040 -0.073	30	19	60	20	150	R 0.5
4PGRM200-300-20-R200	●	20	-0.040 -0.073	30	19	60	20	150	R 2.0

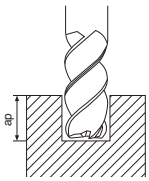
Number of Flutes Z=4

- Radius type with 4 flutes. The diameter of the neck portion (øD1) is thinner than the cutting diameter (øDc), it is suitable for deep slotting. Due to the corner R on the cutting edge, it is applicable for finishing of sloped workpiece.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm) Roughing	Finishing	Outside Dia. (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20
Steel	< 30HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	21,200	10,600	8,000	6,400	5,300	4,000	3,200
				Feed Rate (mm/min)	2,400	2,400	2,400	2,400	2,400	2,400	2,400
	30~ 40HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	19,100	9,600	7,200	5,700	4,800	3,600	2,900
				Feed Rate (mm/min)	1,900	1,900	1,900	1,950	1,950	2,010	1,950
	40~ 45HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	17,000	8,500	6,400	5,100	4,200	3,200	2,500
				Feed Rate (mm/min)	1,400	1,400	1,400	1,430	1,400	1,400	1,330
	45~ 50HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	12,700	6,400	4,800	3,800	3,200	2,400	1,900
				Feed Rate (mm/min)	820	820	860	860	890	860	840
	50~ 55HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,500	4,200	3,200	2,500	2,100	1,600	1,300
				Feed Rate (mm/min)	350	350	380	410	380	380	380
	> 55HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	7,400	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	250	250	250	270	270	280	270

Please refer to page L46 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4PGSS, 5PGSS

Number of Flutes: 4, 5

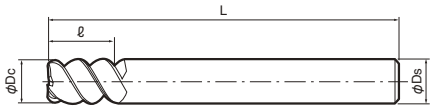
Deep Slotting and Semi-Finishing of Hard Materials

4 5

Recommended Material ★ 1st Recommendation

P 30～40HRC | ★H ～55HRC | H ～68HRC | K Cast Iron

TiAlN | h6 Shank Dia. | 50°



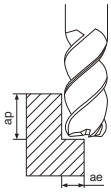
Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
4PGSS030-045-06	●	3	-0.014 -0.028	4.5	6	57	4
4PGSS040-060-06	●	4	-0.020 -0.038	6	6	57	4
4PGSS050-075-06	●	5	-0.020 -0.038	7.5	6	76	4
4PGSS060-090-06	●	6	-0.020 -0.038	9	6	76	4
4PGSS080-120-08	●	8	-0.025 -0.047	12	8	100	4
4PGSS100-150-10	●	10	-0.025 -0.047	15	10	100	4
4PGSS120-180-12	●	12	-0.032 -0.059	18	12	125	4
4PGSS160-240-16	●	16	-0.032 -0.059	24	16	125	4
4PGSS200-300-20	●	20	-0.040 -0.073	30	20	150	4
5PGSS250-380-25	●	25	-0.040 -0.073	38	25	150	5

● Web thickness ratio is 60% between the cutting edge and 1Dc and 80% for the rest. Good chip evacuation and high rigidity.

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm) Roughing	Finishing	Outside Dia. (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Steel	< 30HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	21,200	10,600	8,000	6,400	5,300	4,000	3,200	2,500
				Feed Rate (mm/min)	2,400	2,400	2,400	2,400	2,400	2,400	2,400	2,500
	30~ 40HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	19,100	9,600	7,200	5,700	4,800	3,600	2,900	2,300
				Feed Rate (mm/min)	1,900	1,900	1,900	1,900	1,900	2,000	2,000	2,100
	40~ 45HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	17,000	8,500	6,400	5,100	4,200	3,200	2,500	2,000
				Feed Rate (mm/min)	1,400	1,400	1,400	1,400	1,400	1,400	1,400	1,700
	45~ 50HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	12,700	6,400	4,800	3,800	3,200	2,400	1,900	1,500
				Feed Rate (mm/min)	850	850	860	860	870	870	870	1,000
	50~ 55HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,500	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	400	400	400	410	410	410	410	450
	> 55HRC	1Dc×0.2Dc	1.5Dc×0.1Dc	Spindle Revolution (min^{-1})	7,400	3,700	2,800	2,200	1,900	1,400	1,100	900
				Feed Rate (mm/min)	250	250	250	260	260	280	280	310

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4PGSM, 5PGSM, 6PGSM

Number of Flutes: 4, 5, 6

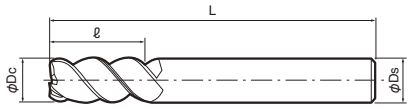
Semi-Finishing of Hard Materials (Medium)

4 5 6

Recommended Material ★ 1st Recommendation

P (30～40HRC) ★ H (～55HRC) H (～68HRC) K (Cast Iron)

TiAlN h6 Shank Dia. 50°



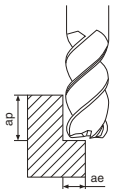
Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
4PGSM060-150-06	●	6	-0.020 -0.038	15	6	76	4
4PGSM080-200-08	●	8	-0.025 -0.047	20	8	100	4
5PGSM100-250-10	●	10	-0.025 -0.047	25	10	100	5
6PGSM120-300-12	●	12	-0.032 -0.059	30	12	125	6
6PGSM160-400-16	●	16	-0.032 -0.059	40	16	125	6
6PGSM200-500-20	●	20	-0.040 -0.073	50	20	150	6
6PGSM250-630-25	●	25	-0.040 -0.073	63	25	150	6

● Four, five and six flutes types are available for semi-finishing of hardened materials. Web thickness ratio is 60% between the cutting edge and 1Dc and 80% for the rest. Good chip evacuation and high rigidity.

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm) Roughing	Depth of Cut (ap×ae) (mm) Finishing	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Steel	< 30HRC	1Dc×0.2Dc	2.5Dc×0.1Dc	Spindle Revolution (min^{-1})	10,700	8,000	6,400	5,300	4,000	3,200	2,500
				Feed Rate (mm/min)	2,240	2,240	2,870	3,500	3,580	3,440	3,060
	30~ 40HRC	1Dc×0.2Dc	2.5Dc×0.1Dc	Spindle Revolution (min^{-1})	9,600	7,200	5,700	4,800	3,600	2,900	2,300
				Feed Rate (mm/min)	1,710	1,720	2,440	2,870	3,010	2,920	2,610
	40~ 45HRC	1Dc×0.2Dc	2.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,500	6,400	5,100	4,200	3,200	2,500	2,000
				Feed Rate (mm/min)	1,360	1,400	1,780	2,040	2,000	2,000	2,080
	45~ 50HRC	1Dc×0.2Dc	2.5Dc×0.1Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,800	3,200	2,400	1,900	1,500
				Feed Rate (mm/min)	760	860	1,050	1,340	1,290	1,260	1,260
	50~ 55HRC	1Dc×0.2Dc	2.5Dc×0.1Dc	Spindle Revolution (min^{-1})	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	340	380	510	570	570	570	550
	> 55HRC	1Dc×0.2Dc	2.5Dc×0.1Dc	Spindle Revolution (min^{-1})	3,700	2,800	2,200	1,900	1,400	1,100	900
				Feed Rate (mm/min)	220	220	330	390	420	400	380

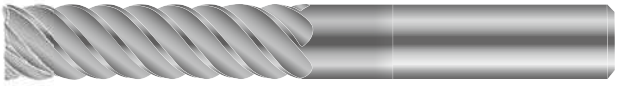
Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4PGSL, 5PGSL, 6PGSL

Number of Flutes: 4, 5, 6

Semi-Finishing of Hard Materials (Long)

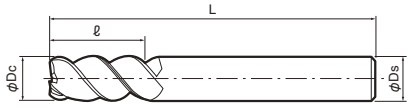


4 5 6

Recommended Material ★ 1st Recommendation

P (30～40HRC) ★ H (～55HRC) H (～68HRC) K (Cast Iron)

TiAlN h6 Shank Dia. 50°



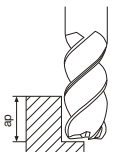
Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
4PGSL060-210-06	●	6	-0.020 -0.038	21	6	76	4
4PGSL080-280-08	●	8	-0.025 -0.047	28	8	100	4
5PGSL100-350-10	●	10	-0.025 -0.047	35	10	100	5
6PGSL120-420-12	●	12	-0.032 -0.059	42	12	125	6
6PGSL160-560-16	●	16	-0.032 -0.059	56	16	125	6
6PGSL200-700-20	●	20	-0.040 -0.073	70	20	150	6
6PGSL250-880-25	●	25	-0.040 -0.073	88	25	150	6

● Web thickness ratio is 60% between the cutting edge and 1Dc and 80% for the rest. Good chip evacuation and high rigidity. Best suitable for high-speed shouldering.

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm) Roughing	Finishing	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Steel	< 30HRC	1Dc×0.2Dc	3.5Dc×0.1Dc	Spindle Revolution (min^{-1})	10,700	8,000	6,400	5,300	4,000	3,200	2,500
				Feed Rate (mm/min)	2,230	2,230	2,870	3,500	3,580	3,440	3,060
	30~40HRC	1Dc×0.2Dc	3.5Dc×0.1Dc	Spindle Revolution (min^{-1})	9,600	7,200	5,700	4,800	3,600	2,900	2,300
				Feed Rate (mm/min)	1,810	1,820	2,440	2,870	3,010	2,920	2,610
	40~45HRC	1Dc×0.2Dc	3.5Dc×0.1Dc	Spindle Revolution (min^{-1})	8,500	6,400	5,100	4,200	3,200	2,500	2,000
				Feed Rate (mm/min)	1,360	1,400	1,780	2,040	2,080	2,080	2,080
	45~50HRC	1Dc×0.2Dc	3.5Dc×0.1Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,800	3,200	2,400	1,900	1,500
				Feed Rate (mm/min)	760	860	1,050	1,340	1,290	1,280	1,280
	50~55HRC	1Dc×0.2Dc	3.5Dc×0.1Dc	Spindle Revolution (min^{-1})	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	340	380	510	570	570	570	550
	> 55HRC	1Dc×0.2Dc	3.5Dc×0.1Dc	Spindle Revolution (min^{-1})	3,700	2,800	2,200	1,900	1,400	1,100	900
				Feed Rate (mm/min)	220	220	330	390	420	400	380

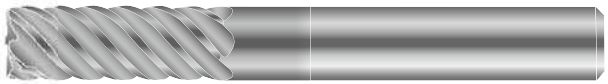
Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4UGSM, 6UGSM

Number of Flutes: 4, 6

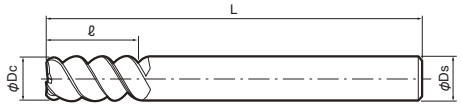
Semi-Finishing of Hard Materials



Recommended Material ★ 1st Recommendation

H ~55HRC ★ H ~68HRC

TiAlN | h6 Shank Dia. | 50°



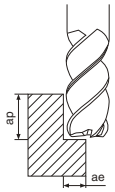
Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
4UGSM030-080-06	●	3	-0.014 -0.028	8	6	50	4
4UGSM040-120-06	●	4	-0.020 -0.038	12	6	57	4
4UGSM050-130-06	●	5	-0.020 -0.038	13	6	57	4
6UGSM060-150-06	●	6	-0.020 -0.038	15	6	60	6
6UGSM080-200-08	●	8	-0.025 -0.047	20	8	75	6
6UGSM100-250-10	●	10	-0.025 -0.047	25	10	80	6
6UGSM120-300-12	●	12	-0.032 -0.059	30	12	100	6
6UGSM160-400-16	●	16	-0.032 -0.059	40	16	110	6

● In order to achieve stable machining of hard materials, negative type rake angle is adopted. Also, for attaining high efficiency, we provide six flutes type for dia. over 6mm.

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø4	ø6	ø8	ø10	ø12	ø16
Steel	45~55HRC	1Dc×0.05Dc	Spindle Revolution (min^{-1})	11,900	8,000	6,000	4,800	4,000	3,000
			Feed Rate (mm/min)	810	1,200	1,200	1,000	980	900
	55~60HRC	1Dc×0.05Dc	Spindle Revolution (min^{-1})	8,000	5,300	4,000	3,200	2,700	2,000
			Feed Rate (mm/min)	510	760	740	610	610	540
	60~65HRC	1Dc×0.2Dc	Spindle Revolution (min^{-1})	5,200	3,500	2,600	2,100	1,700	1,300
			Feed Rate (mm/min)	290	480	450	390	370	330
	65~70HRC	1Dc×0.2Dc	Spindle Revolution (min^{-1})	2,800	1,900	1,400	1,100	900	700
			Feed Rate (mm/min)	150	250	230	200	200	170

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

6PDRS

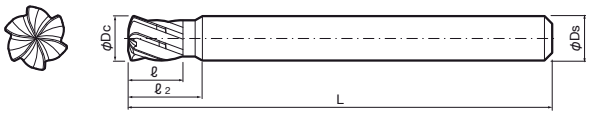
Number of Flutes: 6

Semi-Finishing of Hard Materials

Recommended Material ★ 1st Recommendation

★ P ~750N/mm² | ★ P ~30HRC | ★ P 30~40HRC | ★ H ~55HRC | ★ H ~68HRC

AlCrTiN | Radius R | h6 Shank Dia. | 20°

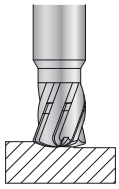


Lineup

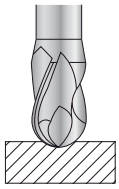
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Under Neck Length ℓ2	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
6PDRS060-045-06	●	6	-0.020 -0.038	9	4.5	6	57	6
6PDRS080-060-08	●	8	-0.025 -0.047	12	6	8	63	6
6PDRS100-075-10	●	10	-0.025 -0.047	15	7.5	10	72	6
6PDRS120-090-12	●	12	-0.032 -0.059	18	9	12	83	6

- Increased rigidity with large core diameter. 6 edge design enables high feed rate cutting. Achieves large machining allowance and high efficiency machining with special corner-R shape. Ramping and arc machining are possible.

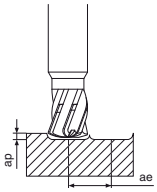


PDR type



General Purpose Ball-Nosed End Mill

Recommended Cutting Conditions



Copying

Workpiece		Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12
Pre-hardened Steel (AISI P20, C)	52HRC	ø6 :0.32mm×0.55Dc ø8 :0.42mm×0.55Dc ø10:0.53mm×0.55Dc ø12:0.63mm×0.55Dc	Spindle Revolution (min-1)	6,400	4,800	3,800	3,200
			Feed Rate (mm/min)	7,600	7,200	6,900	7,600
SNCM439 (AISI 4340, C)	45HRC		Spindle Revolution (min-1)	8,500	6,400	5,100	4,200
			Feed Rate (mm/min)	15,300	15,300	15,300	12,700

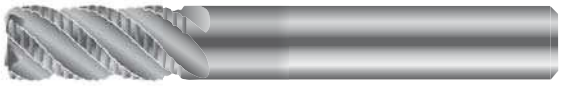
For ramping and arc machining, please refer to page L47.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4RFSM, 6RFSM

Number of Flutes: 4, 6

Roughing of Hard Materials

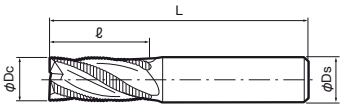


4 6

Recommended Material ★ 1st Recommendation

★P 30～40HRC ★H ～55HRC H ～68HRC M Stainless steel ★S Titanium Alloy S Heat-resistant Alloy ★K Cast Iron

TiAlN h6 Shank Dia. 45° Cutting shape



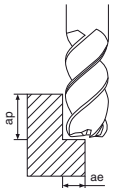
Lineup

(Unit: mm)

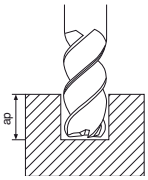
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
4RFSM060-130-06	●	6	-0.030 -0.105	13	6	57	4
4RFSM080-160-08	●	8	-0.040 -0.130	16	8	63	4
4RFSM100-220-10	●	10	-0.040 -0.130	22	10	72	4
4RFSM120-260-12	●	12	-0.050 -0.160	26	12	83	4
4RFSM160-320-16	●	16	-0.050 -0.160	32	16	92	4
4RFSM200-380-20	●	20	-0.065 -0.195	38	20	104	4
6RFSM160-320-16	●	16	-0.050 -0.160	32	16	92	6
6RFSM200-380-20	●	20	-0.065 -0.195	38	20	104	6
6RFSM250-450-25	●	25	-0.065 -0.195	45	25	121	6

- Due to the strong cutting edge with large flat surface, it is suitable for machining of hardened materials and titanium alloy. Four flute type and 6 flute type are available.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16 4 Flute	ø16 6 Flute	ø20 4 Flute	ø20 6 Flute	ø25
Steel	35~45HRC	1.5Dc×0.4Dc	Spindle Revolution (min^{-1})	8,000	6,000	4,800	4,000	3,000	3,000	2,400	2,400	1,900
			Feed Rate (mm/min)	630	630	630	640	640	900	640	930	800
	45~55HRC	1.5Dc×0.33Dc	Spindle Revolution (min^{-1})	5,800	4,400	3,500	2,900	2,200	2,200	1,800	1,800	1,400
			Feed Rate (mm/min)	350	350	350	350	350	530	350	530	460
	55~60HRC	1.5Dc×0.25Dc	Spindle Revolution (min^{-1})	4,800	3,600	2,900	2,400	1,800	1,800	1,400	1,400	1,100
			Feed Rate (mm/min)	190	220	230	240	220	320	230	340	310
Titanium Alloy	< 40HRC	1.5Dc×0.33Dc	Spindle Revolution (min^{-1})	3,700	2,800	2,200	1,900	1,400	1,400	1,100	1,100	900
			Feed Rate (mm/min)	390	390	390	390	390	590	390	540	450
	> 40HRC	1.5Dc×0.25Dc	Spindle Revolution (min^{-1})	3,200	2,400	1,900	1,600	1,200	1,200	1,000	1,000	800
			Feed Rate (mm/min)	300	300	300	300	300	430	300	430	370
Inconel		1Dc×0.2Dc	Spindle Revolution (min^{-1})	1,600	1,200	1,000	800	600	600	500	500	400
			Feed Rate (mm/min)	100	100	100	100	100	140	100	140	130

Please refer to page L46 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3RFRS, 4RFRS

Number of Flutes: 3, 4

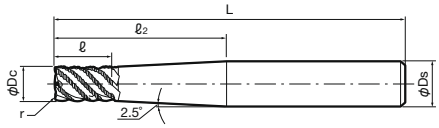
Rough Copying (Radius / Short)

Recommended Material ★ 1st Recommendation

P 30～40HRC | ★H ～55HRC | ★H ～68HRC | M Stainless steel | ★S Titanium Alloy | K Cast Iron

3 4

TiAlN | Radius R | h6 Shank Dia. | ±0.05 mm R | 45° | Cutting shape



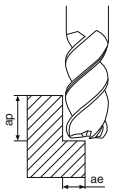
Lineup

(Unit:mm)

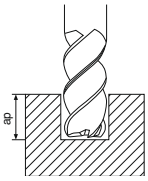
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Spec of Corners r	Under Neck Length ℓ2	Number of Flutes Z
3RFRS040-040-06-R075	●	4	-0.030 -0.105	4	6	75	R 0.75	27.5	3
3RFRS050-050-06-R075	●	5	-0.030 -0.105	5	6	75	R 0.75	17	3
4RFRS060-060-10-R075	●	6	-0.030 -0.105	6	10	100	R 0.75	52.5	4
4RFRS080-080-10-R075	●	8	-0.040 -0.130	8	10	100	R 0.75	31.5	4
4RFRS100-100-12-R075	●	10	-0.040 -0.130	10	12	125	R 0.75	33.5	4
4RFRS120-120-16-R100	●	12	-0.050 -0.160	12	16	125	R 1.0	58.5	4

● For rough copying. It is available for roughing and semi finishing, but especially suitable for rough copying of mold. Shank diameter is larger than the cutting diameter and it is highly rigid. Due to the strong cutting edge with large flat surface, it is suitable for hardened materials and titanium alloy. It can provide the good surface roughness of 2.5 to 4.9Ra (μm).

Recommended Cutting Conditions



Shouldering



Grooving

Shouldering

Workpiece Materials		Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø4	ø5	ø6	ø8	ø10	ø12
Steel	< 30HRC	0.8Dc×0.5Dc	Spindle Revolution (min^{-1})	14,300	11,500	9,600	7,200	5,700	4,800
			Feed Rate (mm/min)	860	860	1,150	1,150	1,150	1,150
	30~40HRC	0.8Dc×0.4Dc	Spindle Revolution (min^{-1})	9,600	7,600	6,400	4,800	3,800	3,200
			Feed Rate (mm/min)	430	460	640	610	610	570
	40~50HRC	0.8Dc×0.4Dc	Spindle Revolution (min^{-1})	6,400	5,100	4,200	3,200	2,500	2,100
			Feed Rate (mm/min)	190	230	320	320	320	340
	50~60HRC	0.8Dc×0.25Dc	Spindle Revolution (min^{-1})	4,800	3,800	3,200	2,400	1,900	1,600
			Feed Rate (mm/min)	100	100	130	140	150	160
	60~70HRC	0.8Dc×0.2Dc	Spindle Revolution (min^{-1})	3,200	2,500	2,100	1,600	1,300	1,100
			Feed Rate (mm/min)	60	60	70	70	80	90

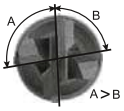
Please refer to page L46 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4YECM, 4YERM, 4YEKM

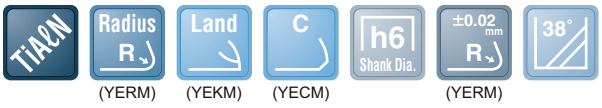
Number of Flutes: 4

Semi-Finishing of Difficult-to-Cut Material (Medium)

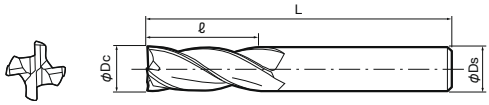


4YECM varied interval flute

Recommended Material ★ 1st Recommendation



(YERM) (YEKM) (YECM) (YERM)



Lineup

(Unit:mm)

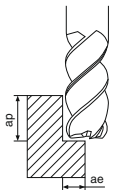
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Spec of Corners	Number of Flutes Z
4YECM040-120-06-C04	●	4	-0.020 -0.038	12	6	55	C 0.4	4
4YECM050-130-06-C04	●	5	-0.020 -0.038	13	6	57	C 0.4	4
4YECM060-130-06-C04	●	6	-0.020 -0.038	13	6	57	C 0.4	4
4YECM080-160-08-C04	●	8	-0.025 -0.047	16	8	63	C 0.4	4
4YECM090-190-10-C05	●	9	-0.025 -0.047	19	10	72	C 0.5	4
4YECM100-220-10-C05	●	10	-0.025 -0.047	22	10	72	C 0.5	4
4YECM120-260-12-C05	●	12	-0.032 -0.059	26	12	83	C 0.5	4
4YECM160-320-16-C05	●	16	-0.032 -0.059	32	16	92	C 0.5	4
4YECM200-380-20-C05	●	20	-0.040 -0.073	38	20	104	C 0.5	4
4YECM250-450-25-C05	●	25	-0.040 -0.073	45	25	121	C 0.5	4
4YERM040-120-06-R020	●	4	-0.020 -0.038	12	6	55	R 0.2	4
4YERM050-130-06-R020	●	5	-0.020 -0.038	13	6	57	R 0.2	4
4YERM060-130-06-R020	●	6	-0.020 -0.038	13	6	57	R 0.2	4
4YERM080-160-08-R020	●	8	-0.025 -0.047	16	8	63	R 0.2	4
4YERM090-190-10-R020	●	9	-0.025 -0.047	19	10	72	R 0.2	4

(Unit:mm)

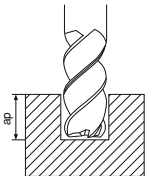
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Spec of Corners	Number of Flutes Z
4YERM100-220-10-R030	●	10	-0.025 -0.047	22	10	72	R 0.3	4
4YERM120-260-12-R030	●	12	-0.032 -0.059	26	12	83	R 0.3	4
4YERM160-320-16-R030	●	16	-0.032 -0.059	32	16	92	R 0.3	4
4YERM200-380-20-R030	●	20	-0.040 -0.073	38	20	104	R 0.3	4
4YERM250-450-25-R030	●	25	-0.040 -0.073	45	25	121	R 0.3	4
4YEKM040-120-06	●	4	-0.020 -0.038	12	6	55	-	4
4YEKM050-130-06	●	5	-0.020 -0.038	13	6	57	-	4
4YEKM060-130-06	●	6	-0.020 -0.038	13	6	57	-	4
4YEKM080-160-08	●	8	-0.025 -0.047	16	8	63	-	4
4YEKM090-190-10	●	9	-0.025 -0.047	19	10	72	-	4
4YEKM100-220-10	●	10	-0.025 -0.047	22	10	72	-	4
4YEKM120-260-12	●	12	-0.032 -0.059	26	12	83	-	4
4YEKM160-320-16	●	16	-0.032 -0.059	32	16	92	-	4
4YEKM200-380-20	●	20	-0.040 -0.073	38	20	104	-	4
4YEKM250-450-25	●	25	-0.040 -0.073	45	25	121	-	4

● Unequally partitioned flute design prevents vibration and reduces cutting force at slotting. This has led to the high speed and high feed machining. We provide three types of edge shape for different application; Radius, Corner Land and Corner Chamfered type.

Recommended Cutting Conditions



Shouldering



Grooving

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Stainless Steel	1Dc×0.5Dc	Spindle Revolution (min^{-1})	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	1,000
		Feed Rate (mm/min)	640	610	670	640	600	550	450	390	300
Heat-resistant Alloy	1Dc×0.2Dc	Spindle Revolution (min^{-1})	2,400	1,900	1,600	1,200	1,000	800	600	500	400
		Feed Rate (mm/min)	100	100	110	130	120	120	120	110	80
Soft Steel	1Dc×0.5Dc	Spindle Revolution (min^{-1})	13,100	10,500	8,800	6,600	5,300	4,400	3,300	2,600	2,100
		Feed Rate (mm/min)	1,310	1,260	1,400	1,580	1,260	1,230	990	950	840
Titanium Alloy	1Dc×0.5Dc	Spindle Revolution (min^{-1})	4,400	3,500	2,900	2,200	1,800	1,500	1,100	900	700
		Feed Rate (mm/min)	210	210	230	260	220	220	200	210	200
Gray Cast Iron	1Dc×0.5Dc	Spindle Revolution (min^{-1})	10,700	8,600	7,200	5,400	4,300	3,600	2,700	2,200	1,700
		Feed Rate (mm/min)	1,070	1,070	1,150	1,290	1,030	1,000	810	770	690

* Machining with coolant is recommended for stainless steel.

4YEKM is not recommended for Slotting.
Please refer to page L45 for Slotting with 4YECM / 4YERM.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4YFSM, 6YFSM

Number of Flutes: 4, 6

Semi-Finishing of Difficult-to-Cut Material

4 6

Recommended Material ★ 1st Recommendation

★P ~750N/mm² ★P ~30HRC ★P 30~40HRC ★M Stainless steel ★S Titanium Alloy ★S Heat-resistant Alloy ★K Cast Iron

TiAlN Sharp h6 Shank Dia. 45°

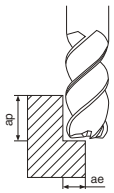
Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
4YFSM040-130-06	●	4	-0.020 -0.038	13	6	50	4
4YFSM050-130-06	●	5	-0.020 -0.038	13	6	50	4
6YFSM060-130-06	●	6	-0.020 -0.038	13	6	50	6
6YFSM080-190-08	●	8	-0.025 -0.047	19	8	63	6
6YFSM100-220-10	●	10	-0.025 -0.047	22	10	76	6
6YFSM120-260-12	●	12	-0.032 -0.059	26	12	76	6
6YFSM160-320-16	●	16	-0.032 -0.059	32	16	89	6
6YFSM200-380-20	●	20	-0.040 -0.073	38	20	104	6

- Multi-Edge Type with web thickness ratio of 60% having superior chip evacuation. It has positive type rake angle and suitable for semi-finishing of difficult-to-cut materials such as stainless steel and inconel.

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20
Carbon Steel < 20HRC	1.5Dc×0.1Dc	Spindle Revolution (min⁻¹)	10,000	8,000	6,600	5,000	4,000	3,300	2,500	2,000
		Feed Rate (mm/min)	800	800	1,340	1,340	1,340	1,350	1,490	1,610
Alloy Steel < 30HRC	1.5Dc×0.1Dc	Spindle Revolution (min⁻¹)	8,000	6,400	5,300	4,000	3,200	2,700	2,000	1,600
		Feed Rate (mm/min)	570	570	960	960	960	960	1,080	1,150
Pre-hardened Steel 30~45HRC	1.5Dc×0.1Dc	Spindle Revolution (min⁻¹)	6,000	4,800	4,000	3,000	2,400	2,000	1,500	1,200
		Feed Rate (mm/min)	360	360	620	660	660	660	740	790
Stainless Steel	1.5Dc×0.1Dc	Spindle Revolution (min⁻¹)	5,200	4,100	3,500	2,600	2,100	1,700	1,300	1,000
		Feed Rate (mm/min)	270	280	520	540	550	550	620	650
Heat-resistant Alloy	1Dc×0.05Dc	Spindle Revolution (min⁻¹)	3,600	2,900	2,400	1,800	1,400	1,200	900	700
		Feed Rate (mm/min)	160	170	340	360	360	360	410	410
Titanium Alloy	1Dc×0.05Dc	Spindle Revolution (min⁻¹)	3,600	2,900	2,400	1,800	1,400	1,200	900	700
		Feed Rate (mm/min)	160	170	340	360	360	360	410	410

* Machining with coolant is recommended for stainless steel.

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

5DERM, 5DEKM

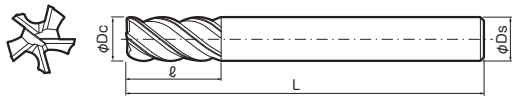
Number of Flutes: 5

Semi-Finishing of Difficult-to-Cut Material (High Feed Rate)

Recommended Material ★ 1st Recommendation

P ~750N/mm² ★ | P ~30HRC ★ | P 30~40HRC ★ | M Stainless steel ★ | S Titanium Alloy ★ | S Heat-resistant Alloy ★ | K Cast Iron

ACTiN | Radius R | Land | h6 Shank Dia. | 38°



Lineup

(Unit: mm)

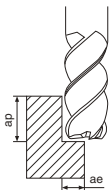
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Spec of Corners	Number of Flutes Z
5DERM040-120-06-R025	●	4	-0.020 -0.038	12	6	55	0.25	5
5DERM050-130-06-R025	●	5	-0.020 -0.038	13	6	57	0.25	5
5DERM060-130-06-R040	●	6	-0.020 -0.038	13	6	57	0.4	5
5DERM080-160-08-R050	●	8	-0.025 -0.047	16	8	63	0.5	5
5DERM090-190-10-R050	●	9	-0.025 -0.047	19	10	72	0.5	5
5DERM100-220-10-R050	●	10	-0.025 -0.047	22	10	72	0.5	5
5DERM120-260-12-R075	●	12	-0.032 -0.059	26	12	83	0.75	5
5DERM160-320-16-R075	●	16	-0.032 -0.059	32	16	92	0.75	5
5DERM200-380-20-R075	●	20	-0.040 -0.073	38	20	104	0.75	5
5DERM250-450-25-R075	●	25	-0.040 -0.073	45	25	121	0.75	5

(Unit: mm)

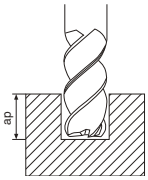
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Number of Flutes Z
5DEKM040-120-06	●	4	-0.020 -0.038	12	6	55	5
5DEKM050-130-06	●	5	-0.020 -0.038	13	6	57	5
5DEKM060-130-06	●	6	-0.020 -0.038	13	6	57	5
5DEKM080-160-08	●	8	-0.025 -0.047	16	8	63	5
5DEKM090-190-10	●	9	-0.025 -0.047	19	10	72	5
5DEKM100-220-10	●	10	-0.025 -0.047	22	10	72	5
5DEKM120-260-12	●	12	-0.032 -0.059	26	12	83	5
5DEKM160-320-16	●	16	-0.032 -0.059	32	16	92	5
5DEKM200-380-20	●	20	-0.040 -0.073	38	20	104	5
5DEKM250-450-25	●	25	-0.040 -0.073	45	25	121	5

- High feed rate machining is possible with 5 edge design. Unequally partitioned flute design prevents vibration. 5DERM type is applicable for slotting with a cutting depth up to 0.8D.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Medium and high carbon steel > 0.3%C	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	16,000	12,700	10,600	8,000	6,400	5,300	4,000	3,200	2,500
		Feed Rate (mm/min)	2,400	2,500	2,700	2,400	2,200	1,900	1,600	1,600	1,400
Alloy Steel Alloy tool Steel < 330HB, < 35HRC	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	14,300	11,500	9,600	7,200	5,700	4,800	3,600	2,900	2,300
		Feed Rate (mm/min)	2,100	1,700	1,900	1,800	1,700	1,700	1,400	1,300	1,100
Alloy Steel Alloy tool Steel 340~450HB, 36~48HRC	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	13,000	10,000	8,500	6,400	5,100	4,200	3,200	2,500	2,000
		Feed Rate (mm/min)	1,300	1,500	1,700	1,300	1,300	1,300	1,100	1,000	1,000
Austenitic Stainless Steel	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	9,200	7,300	6,100	4,600	3,700	3,100	2,300	1,800	1,500
		Feed Rate (mm/min)	1,400	1,100	1,200	1,100	1,100	1,100	920	820	730
Austenitic Stainless Steel	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	1,000
		Feed Rate (mm/min)	640	760	640	640	640	640	560	510	410
Gray Cast Iron	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	14,000	11,000	9,000	6,800	5,400	4,500	3,400	2,700	2,200
		Feed Rate (mm/min)	2,000	2,200	2,300	2,000	2,200	1,800	1,700	1,600	1,400
Nodular Cast Iron, CGI and Malleable Cast Iron	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	10,000	8,300	6,900	5,200	4,100	3,500	2,600	2,100	1,700
		Feed Rate (mm/min)	1,000	1,200	1,000	1,300	1,000	1,000	910	830	830
Heat-resistant Alloy	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	3,200	2,500	2,100	1,600	1,300	1,100	800	640	510
		Feed Rate (mm/min)	160	130	210	240	190	210	200	190	180
Titanium Alloy	5DERM: 1.5Dc×0.5Dc 5DEKM: 1.5Dc×0.25Dc	Spindle Revolution (min⁻¹)	4,800	3,800	3,200	2,400	1,900	1,600	1,200	960	760
		Feed Rate (mm/min)	480	380	480	480	380	400	360	380	340

Please refer to page L45 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

4YEBM

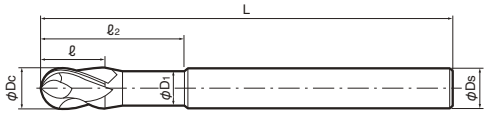
Number of Flutes: 4

Semi-Finishing of Difficult-to-Cut Material (Ball-nose end mill with 4 flutes)

Recommended Material ★ 1st Recommendation

★ P ~30HRC | P 30~40HRC | ★ M Stainless steel | ★ S Titanium Alloy | S Heat-resistant Alloy | K Cast Iron

TiAlN | h6 Shank Dia. | ±0.01 mm R | 38°



Lineup

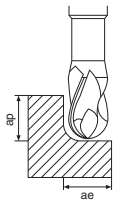
(Unit: mm)

Description	Std.	*Radius of Ball Nose	Outside Dia.	Outside Dia. tolerance	Edge Length	Neck Dia.	Under Neck Length	Shank Dia.	Total length	Number of Flutes
		R	øDc		ℓ	øD1	ℓ2	øDs	L	Z
4YEBM050-090-06	●	R2.5	5	-0.020 -0.038	9	4.5	15	6	57	4
4YEBM060-100-06	●	R3	6	-0.020 -0.038	10	5.5	15	6	57	4
4YEBM080-120-08	●	R4	8	-0.025 -0.047	12	7.4	20	8	63	4
4YEBM100-140-10	●	R5	10	-0.025 -0.047	14	9.2	25	10	72	4
4YEBM120-160-12	●	R6	12	-0.032 -0.059	16	11	30	12	83	4
4YEBM160-220-16	●	R8	16	-0.032 -0.059	22	15	38	16	92	4
4YEBM200-260-20	●	R10	20	-0.040 -0.073	26	19	50	20	104	4

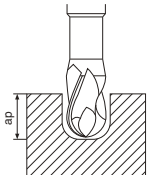
* Actual ball-nose radius will be half of actual measurement of outer diameter.

- Ball-nose end mill for semi-finishing of Difficult-to-Cut materials.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø5	ø6	ø8	ø10	ø12	ø16	ø20
Stainless Steel	1Dc×0.5Dc	Spindle Revolution (min^{-1})	5,700	4,800	3,600	2,900	2,400	1,800	1,400
		Feed Rate (mm/min)	620	630	630	640	560	450	390
Heat-resistant Alloy	1Dc×0.2Dc	Spindle Revolution (min^{-1})	1,700	1,400	1,000	800	700	500	400
		Feed Rate (mm/min)	70	80	100	80	90	90	80
Soft Steels	1Dc×0.5Dc	Spindle Revolution (min^{-1})	9,400	7,900	5,900	4,700	3,900	2,900	2,400
		Feed Rate (mm/min)	1,020	1,130	1,270	1,020	990	800	760
Titanium Alloy	1Dc×0.3Dc	Spindle Revolution (min^{-1})	3,200	2,700	2,000	1,600	1,300	1,000	800
		Feed Rate (mm/min)	180	190	220	170	170	160	160
Gray Cast Iron	1Dc×0.4Dc	Spindle Revolution (min^{-1})	7,800	6,500	4,900	3,900	3,200	2,400	1,900
		Feed Rate (mm/min)	840	930	1,050	840	820	660	630

* Machining with coolant is recommended for stainless steel.

Please refer to page L45 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3NESM

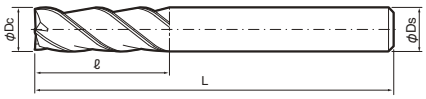
Number of Flutes: 3

Finishing of Aluminum

Recommended Material ★ 1st Recommendation

N Aluminum & Non Ferrous Material

Uncoated | Sharp | h6 Shank Dia. | 38°



Lineup

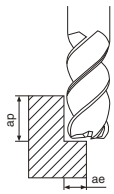
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
3NESM030-120-06	●	3	-0.014 -0.028	12	6	50	3
3NESM040-120-06	●	4	-0.020 -0.038	12	6	50	3
3NESM050-140-06	●	5	-0.020 -0.038	14	6	50	3
3NESM060-160-06	●	6	0 -0.008	16	6	50	3
3NESM080-200-08	●	8	0 -0.009	20	8	63	3
3NESM100-220-10	●	10	0 -0.009	22	10	76	3
3NESM120-250-12	●	12	0 -0.011	25	12	76	3
3NESM160-320-16	●	16	0 -0.011	32	16	89	3
3NESM200-380-20	●	20	0 -0.013	38	20	104	3

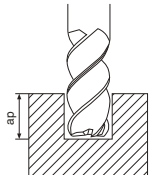
* Outside dia. of over 6mm (øDc) has margin.

- A wiper is attached at the lower edge for improving bottom surface finish.
  Chattering is controlled with cutting edge slots at varied intervals, and finishing of lateral surfaces is improved.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20
Aluminum Alloy	1.5Dc×0.5Dc	Spindle Revolution (min^{-1})	34,000	17,000	13,000	10,200	8,500	6,400	5,100
		Feed Rate (mm/min)	2,750	2,750	2,750	2,750	2,750	2,750	2,750

Please refer to page L46 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

2NFSM, 3NFSM

Number of Flutes: 2, 3

Semi-Finishing of Aluminum (Medium)

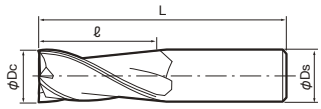
2 3

Recommended Material

★ 1st Recommendation

N Aluminum & Non Ferrous Material

Uncoated | Sharp | h6 Shank Dia. | 45°



Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Number of Flutes Z
2NFSM010-040-04	●	1	-0.014 -0.028	4	4	38	2
2NFSM015-060-04	●	1.5	-0.014 -0.028	6	4	38	2
2NFSM020-080-04	●	2	-0.014 -0.028	8	4	38	2
2NFSM025-080-04	●	2.5	-0.014 -0.028	8	4	38	2
2NFSM030-080-06	●	3	-0.014 -0.028	8	6	50	2
2NFSM040-080-06	●	4	-0.020 -0.038	8	6	50	2
2NFSM050-140-06	●	5	-0.020 -0.038	14	6	50	2
2NFSM060-160-06	●	6	0 -0.008	16	6	50	2
2NFSM080-200-08	●	8	0 -0.009	20	8	63	2
2NFSM100-220-10	●	10	0 -0.009	22	10	76	2
2NFSM120-250-12	●	12	0 -0.011	25	12	76	2

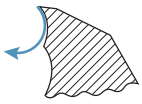
(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Length of edge ℓ	Shank Dia. øDs	Overall length L	Number of Flutes Z
2NFSM160-320-16	●	16	0 -0.011	32	16	89	2
2NFSM200-380-20	●	20	0 -0.013	38	20	104	2
3NFSM030-120-06	●	3	-0.014 -0.028	12	6	50	3
3NFSM040-120-06	●	4	-0.020 -0.038	12	6	50	3
3NFSM050-140-06	●	5	-0.020 -0.038	14	6	50	3
3NFSM060-160-06	●	6	0 -0.008	16	6	50	3
3NFSM080-200-08	●	8	0 -0.009	20	8	63	3
3NFSM100-220-10	●	10	0 -0.009	22	10	76	3
3NFSM120-250-12	●	12	0 -0.011	25	12	76	3
3NFSM160-320-16	●	16	0 -0.011	32	16	89	3
3NFSM200-380-20	●	20	0 -0.013	38	20	104	3

* Outside dia. of over 6mm (øDc) has margin.

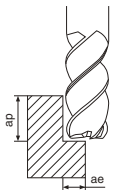
- Sharp cutting oriented for Aluminum machining. 45° helix angle achieves good chip evacuation.

A convex shape in the slot improves chip evacuation.

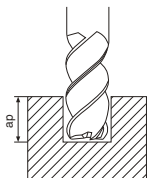


NFSM type rake angle

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

2 Flute

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20
Aluminum Alloy	1Dc×0.5Dc	Spindle Revolution (min^{-1})	26,500	13,300	10,000	8,000	6,600	5,000	4,000
		Feed Rate (mm/min)	690	950	950	1,130	1,260	1,000	880
High-silicon Aluminum	1Dc×0.5Dc	Spindle Revolution (min^{-1})	19,100	9,600	7,200	5,700	4,800	3,600	2,900
		Feed Rate (mm/min)	420	500	500	600	670	770	570

3 Flute

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20
Aluminum Alloy	1Dc×0.5Dc	Spindle Revolution (min^{-1})	26,500	13,300	10,000	8,000	6,600	5,000	4,000
		Feed Rate (mm/min)	1,040	1,400	1,400	1,700	1,890	1,490	1,310
High-silicon Aluminum	1Dc×0.5Dc	Spindle Revolution (min^{-1})	19,100	9,600	7,200	5,700	4,800	3,600	2,900
		Feed Rate (mm/min)	630	750	750	890	1,000	1,160	860

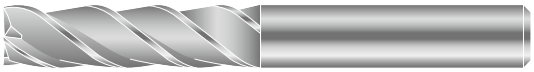
Please refer to page L46 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3NFSL

Number of Flutes: 3

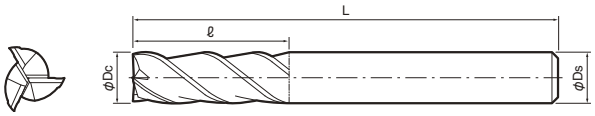
Semi-Finishing of Aluminum (Long)



Recommended Material ★ 1st Recommendation

N Aluminum & Non Ferrous Material

Uncoated | Sharp | h6 Shank Dia. | 45°



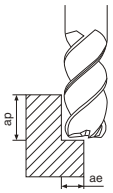
Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Number of Flutes Z
3NFSL030-190-06	●	3	-0.014 -0.028	19	6	63	3
3NFSL040-190-06	●	4	-0.020 -0.038	19	6	63	3
3NFSL050-200-06	●	5	-0.020 -0.038	20	6	63	3
3NFSL060-280-06	●	6	0 -0.008	28	6	76	3
3NFSL080-300-08	●	8	0 -0.009	30	8	76	3
3NFSL100-340-10	●	10	0 -0.009	34	10	89	3
3NFSL120-450-12	●	12	0 -0.011	45	12	100	3
3NFSL160-560-16	●	16	0 -0.011	56	16	125	3
3NFSL200-600-20	●	20	0 -0.013	60	20	125	3

* Outside dia. of over 6mm (øDc) has margin.

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Aluminum Alloy	2.5Dc×0.5Dc	Spindle Revolution (min^{-1})	18,500	9,300	7,000	5,600	4,600	3,500	2,800
		Feed Rate (mm/min)	730	980	980	1,200	1,320	1,040	920
High-silicon Aluminum	1.5Dc×0.5Dc	Spindle Revolution (min^{-1})	13,400	6,700	5,000	4,000	3,400	2,500	2,000
		Feed Rate (mm/min)	440	530	530	620	700	810	600

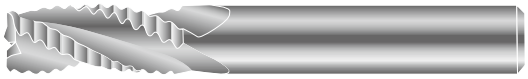
Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3AESM

Number of Flutes: 3

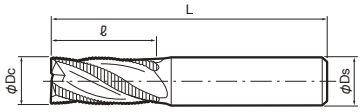
Roughing of Aluminum



Recommended Material ★ 1st Recommendation

N Aluminum & Non Ferrous Material

Uncoated | C | h6 Shank Dia. | 30° | Cutting shape



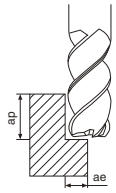
Lineup

(Unit: mm)

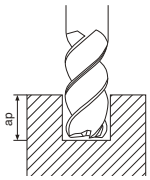
Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Spec of Corners C	Number of Flutes Z
3AESM060-130-06	●	6	-0.030 -0.105	13	6	57	0.6	3
3AESM080-160-08	●	8	-0.040 -0.130	16	8	63	0.6	3
3AESM100-220-10	●	10	-0.040 -0.130	22	10	72	0.6	3
3AESM120-260-12	●	12	-0.050 -0.160	26	12	83	1	3
3AESM160-320-16	●	16	-0.050 -0.160	32	16	92	1	3
3AESM200-380-20	●	20	-0.065 -0.195	38	20	104	1	3
3AESM250-450-25	●	25	-0.065 -0.195	45	25	121	1	3

● Three flutes type for roughing of Aluminum / Non-ferrous Metal. With Corner Chamfering.

Recommended Cutting Conditions



Shouldering



Slotting

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Aluminum Alloy	1.5Dc×0.5Dc	Spindle Revolution (min^{-1})	33,200	24,900	19,900	16,600	12,400	10,000	8,000
		Feed Rate (mm/min)	5,370	5,150	5,080	4,980	4,890	4,840	4,780
High-silicon Aluminum	1.5Dc×0.5Dc	Spindle Revolution (min^{-1})	10,600	8,000	6,400	5,300	4,000	3,200	2,500
		Feed Rate (mm/min)	1,430	1,390	1,360	1,320	1,300	1,290	1,280

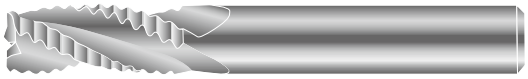
Please refer to page L46 about Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

3AESL

Number of Flutes: 3

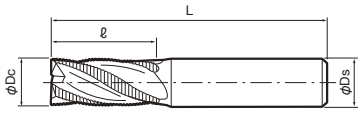
Roughing of Aluminum (Long)



Recommended Material ★ 1st Recommendation

N Aluminum & Non Ferrous Material

Uncoated | C | h6 Shank Dia. | 30° | Cutting shape

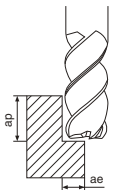


Lineup

(Unit: mm)

Description	Std.	Outside Dia. øDc	Outside Dia. tolerance	Edge Length ℓ	Shank Dia. øDs	Total length L	Spec of Corners C	Number of Flutes Z
3AESL060-240-06	●	6	-0.030 -0.105	24	6	76	0.6	3
3AESL080-280-08	●	8	-0.040 -0.130	28	8	76	0.6	3
3AESL100-340-10	●	10	-0.040 -0.130	34	10	89	0.6	3
3AESL120-450-12	●	12	-0.050 -0.160	45	12	100	1	3
3AESL160-560-16	●	16	-0.050 -0.160	56	16	125	1	3
3AESL200-600-20	●	20	-0.065 -0.195	60	20	125	1	3
3AESL250-800-25	●	25	-0.065 -0.195	80	25	150	1	3

Recommended Cutting Conditions



Shouldering

Shouldering

Workpiece Materials	Depth of Cut (ap×ae) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
Aluminum Alloy	2.5Dc×0.5Dc	Spindle Revolution (min^{-1})	23,000	17,500	14,000	11,600	8,700	7,000	5,600
		Feed Rate (mm/min)	3,760	3,600	3,560	3,490	3,420	3,390	3,350
High-silicon Aluminum	2.5Dc×0.5Dc	Spindle Revolution (min^{-1})	7,400	5,600	4,500	3,700	2,800	2,200	1,800
		Feed Rate (mm/min)	1,000	970	950	920	910	900	900

Not Recommended for Slotting.

● : Std. Item ○ : Check Availability R : Std. Item (R-hand Only) L : Std. Item (L-hand Only)

Recommended Cutting Conditions for Slotting (1)

Workpiece Materials	Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø0.5	ø1	ø2	ø4	ø6	ø8	ø12	ø16
2FESS 2FESM (L12~L14)										
Carbon Steel	0.1Dc (Dc＜ø1) 0.3Dc (ø1≦Dc＜ø3) 0.5Dc (Dc≧ø3)	Spindle Revolution (min^{-1})	19,000	15,300	8,000	4,000	2,700	2,000	1,300	1,000
		Feed Rate (mm/min)	130	135	140	225	250	250	245	245
Alloy Steel	0.1Dc (Dc＜ø1) 0.3Dc (ø1≦Dc＜ø3) 0.5Dc (Dc≧ø3)	Spindle Revolution (min^{-1})	16,000	13,000	6,600	3,400	2,200	1,700	1,200	900
		Feed Rate (mm/min)	105	115	130	170	190	185	185	185
Pre-hardened Steel 30~45HRC	0.1Dc (Dc＜ø1) 0.3Dc (ø1≦Dc＜ø3) 0.5Dc (Dc≧ø3)	Spindle Revolution (min^{-1})	13,500	7,600	4,300	2,500	1,800	1,300	900	700
		Feed Rate (mm/min)	30	35	50	60	63	63	65	65
Stainless Steel	0.1Dc (Dc＜ø1) 0.3Dc (ø1≦Dc＜ø3) 0.5Dc (Dc≧ø3)	Spindle Revolution (min^{-1})	16,000	13,000	6,600	3,400	2,200	1,700	1,200	900
		Feed Rate (mm/min)	35	60	60	65	70	70	70	70

Workpiece Materials	Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø14	ø16	ø20	ø25
2FEKS 2FEKM (L17~L18)														
Carbon Steel	0.5Dc	Spindle Revolution (min^{-1})	-	7,500	6,000	5,000	4,400	3,300	2,700	2,300	2,100	1,900	-	-
		Feed Rate (mm/min)		240	260	310	340	340	340	340	330	320		
Alloy Steel	0.5Dc	Spindle Revolution (min^{-1})		7,200	5,400	4,300	3,600	2,700	2,200	1,800	1,600	1,500		
		Feed Rate (mm/min)		270	270	270	270	270	270	270	270	270		
Pre-hardened Steel 30~45HRC	0.5Dc	Spindle Revolution (min^{-1})		5,300	4,000	3,200	2,600	2,000	1,600	1,300	1,100	1,000		
		Feed Rate (mm/min)		120	120	120	120	120	120	120	120	120		
Stainless Steel	0.5Dc	Spindle Revolution (min^{-1})		5,300	4,000	3,200	2,600	2,000	1,600	1,300	1,100	1,000		
		Feed Rate (mm/min)		80	90	90	100	100	100	90	90	90		
2FESW (L10~L11)														
Carbon Steel	0.2Dc	Spindle Revolution (min^{-1})	-	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,300	-	-	-
		Feed Rate (mm/min)		660	640	640	640	520	450	410	350			
Alloy Steel	0.2Dc	Spindle Revolution (min^{-1})		7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600			
		Feed Rate (mm/min)		420	430	430	430	350	300	270	230			
Pre-hardened Steel 30~45HRC	0.2Dc	Spindle Revolution (min^{-1})		7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600			
		Feed Rate (mm/min)		420	430	430	430	350	300	270	230			
Stainless Steel	0.2Dc	Spindle Revolution (min^{-1})		6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,400			
		Feed Rate (mm/min)		320	320	320	320	260	230	210	180			
3FESW (L10～L11)														
Carbon Steel	0.2Dc	Spindle Revolution (min^{-1})	-	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,300	-	-	-
		Feed Rate (mm/min)		810	800	800	800	650	560	510	450			
Alloy Steel	0.2Dc	Spindle Revolution (min^{-1})		7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600			
		Feed Rate (mm/min)		530	530	530	530	430	370	340	290			
Pre-hardened Steel 30~45HRC	0.2Dc	Spindle Revolution (min^{-1})		7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600			
		Feed Rate (mm/min)		530	530	530	530	430	370	340	290			
Stainless Steel	0.2Dc	Spindle Revolution (min^{-1})		6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,400			
		Feed Rate (mm/min)		400	400	400	400	320	280	260	230			
4FESW (L10～L11)														
Carbon Steel	0.2Dc	Spindle Revolution (min^{-1})	-	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,300	-	-	-
		Feed Rate (mm/min)		960	960	960	960	780	680	620	550			
Alloy Steel	0.2Dc	Spindle Revolution (min^{-1})		7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600			
		Feed Rate (mm/min)		640	640	640	640	520	450	410	350			
Pre-hardened Steel 30~45HRC	0.2Dc	Spindle Revolution (min^{-1})		7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,600			
		Feed Rate (mm/min)		640	640	640	640	520	450	410	350			
Stainless Steel	0.2Dc	Spindle Revolution (min^{-1})		6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,400			
		Feed Rate (mm/min)		480	480	480	480	390	340	310	280			

Workpiece Materials		Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø14	ø16	ø20	ø25
3UFSM (L20)															
Steel	< 42HRC	0.25Dc	Spindle Revolution (min^{-1})	19,000	12,700	9,500	7,600	6,400	4,800	3,800	3,200	-	2,400	1,900	-
			Feed Rate (mm/min)	570	495	513	456	480	461	456	432		360	285	
	42~48HRC	0.25Dc	Spindle Revolution (min^{-1})	16,000	10,600	8,000	6,400	5,300	4,000	3,200	2,700		2,000	1,600	
			Feed Rate (mm/min)	384	331	346	307	318	307	307	292		240	240	
	48~52HRC	0.25Dc	Spindle Revolution (min^{-1})	12,700	8,500	6,400	5,100	4,300	3,200	2,500	2,100		1,600	1,300	
			Feed Rate (mm/min)	274	239	249	220	232	221	216	204		173	176	
Cast Iron	< 180HB	0.5Dc	Spindle Revolution (min^{-1})	25,500	17,000	13,000	10,200	8,500	6,400	5,100	4,200		3,200	2,500	
			Feed Rate (mm/min)	765	663	702	612	638	614	612	567		480	375	
	> 180HB	0.5Dc	Spindle Revolution (min^{-1})	22,300	15,000	11,000	8,900	7,400	5,600	4,500	3,700		2,800	2,200	
			Feed Rate (mm/min)	669	585	594	534	555	538	540	500		420	330	
Stainless Steel		0.25Dc	Spindle Revolution (min^{-1})	16,000	10,600	8,000	6,400	5,300	4,000	3,200	2,700		2,000	1,600	
			Feed Rate (mm/min)	389	389	389	432	464	464	443	400		300	250	
Titanium Alloy		0.25Dc	Spindle Revolution (min^{-1})	16,000	10,600	8,000	6,400	5,300	4,000	3,200	2,700		2,000	1,600	
			Feed Rate (mm/min)	382	382	382	424	456	456	435	392		300	250	

Recommended Cutting Conditions for Slotting (2)

Workpiece Materials		Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20	ø25
3RDSM 4RDSM 5RDSM (L23)														
Steel	< 22HRC	0.75Dc	Spindle Revolution (min^{-1})	-	-	13,900	11,100	9,300	6,900	5,600	4,600	3,500	2,800	2,200
			Feed Rate (mm/min)			750	770	800	800	1,000	1,030	1,040	1,050	1,110
	22~32HRC	0.75Dc	Spindle Revolution (min^{-1})			11,900	9,500	7,900	5,900	4,800	4,000	3,000	2,400	1,900
			Feed Rate (mm/min)			540	540	550	550	740	740	740	760	860
	32~40HRC	0.6Dc	Spindle Revolution (min^{-1})			8,000	6,400	5,300	4,000	3,200	2,600	2,000	1,600	1,300
			Feed Rate (mm/min)			240	250	260	260	340	340	330	330	330
	40~45HRC	0.5Dc	Spindle Revolution (min^{-1})			6,400	5,100	4,300	3,200	2,600	2,200	1,600	1,300	1,000
			Feed Rate (mm/min)			150	170	180	180	240	230	230	220	220
	45~50HRC	0.4Dc	Spindle Revolution (min^{-1})			5,700	4,500	3,800	2,900	2,300	1,900	1,400	1,100	900
			Feed Rate (mm/min)			140	140	140	140	170	160	160	150	150
Cast Iron		1Dc	Spindle Revolution (min^{-1})			11,900	9,500	7,900	5,900	4,800	4,000	3,000	2,400	1,900
			Feed Rate (mm/min)			640	660	700	700	900	900	900	910	1,140
4YECM 4YERM (L35)														
Stainless Steel		1Dc	Spindle Revolution (min^{-1})	-	-	7,200	5,700	4,800	3,600	2,900	2,400	1,800	1,400	1,100
			Feed Rate (mm/min)			700	700	760	720	690	620	500	430	340
Heat-resistant Alloy		0.3Dc	Spindle Revolution (min^{-1})			2,000	1,600	1,300	1,000	800	700	500	400	300
			Feed Rate (mm/min)			80	80	90	110	100	100	100	90	70
Soft Steel		1Dc	Spindle Revolution (min^{-1})			11,900	9,600	8,000	6,000	4,800	4,000	3,000	2,400	1,900
			Feed Rate (mm/min)			1,150	1,150	1,300	1,400	1,100	1,100	900	900	800
Titanium Alloy		1Dc	Spindle Revolution (min^{-1})			4,000	3,200	2,700	2,000	1,600	1,300	1,000	800	600
			Feed Rate (mm/min)			190	190	210	240	200	200	180	180	180
Gray Cast Iron		1Dc	Spindle Revolution (min^{-1})			9,600	7,600	6,400	4,800	3,800	3,200	2,400	1,900	1,500
			Feed Rate (mm/min)			950	950	1,020	1,150	920	900	720	690	610

Workpiece Materials	Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø14	ø16	ø20	ø25
4YEBM (L38)														
Stainless Steel SUS304	1Dc	Spindle Revolution (min^{-1})	-	-	-	5,100	4,200	3,200	2,500	2,100	-	1,600	1,300	-
		Feed Rate (mm/min)				550	610	570	550	500		400	350	
Heat-resistant Alloy	0.5Dc	Spindle Revolution (min^{-1})				1,400	1,200	900	700	600		400	400	
		Feed Rate (mm/min)				60	70	80	80	80		80	70	
Soft Steel	1Dc	Spindle Revolution (min^{-1})				8,600	7,200	5,400	4,300	3,600		2,700	2,200	
		Feed Rate (mm/min)				930	1,030	1,160	930	900		730	700	
Titanium Alloy	0.5Dc	Spindle Revolution (min^{-1})				2,900	2,400	1,800	1,400	1,200		900	700	
		Feed Rate (mm/min)				160	170	190	170	170		160	160	
Gray Cast Iron	1Dc	Spindle Revolution (min^{-1})				7,000	5,800	4,400	3,500	2,900		2,200	1,800	
		Feed Rate (mm/min)				760	840	950	760	740		600	570	

Workpiece Materials	Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20	ø25
5DERM 5DEKM (L37)											
Medium and high carbon steel > 0.3%C	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	16,000	12,700	10,600	8,000	6,400	5,300	4,000	3,200	2,500
		Feed Rate (mm/min)	2,400	2,500	2,700	2,400	2,200	1,900	1,600	1,600	1,400
Alloy steel and alloy tool steel < 330HB, < 35HRC	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	14,300	11,500	9,600	7,200	5,700	4,800	3,600	2,900	2,300
		Feed Rate (mm/min)	2,100	1,700	1,900	1,800	1,700	1,700	1,400	1,300	1,100
Alloy steel and alloy tool steel 340~450HB, 36~48HRC	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	13,000	10,000	8,500	6,400	5,100	4,200	3,200	2,500	2,000
		Feed Rate (mm/min)	1,300	1,500	1,700	1,300	1,300	1,300	1,100	1,000	1,000
Austenitic Stainless Steel	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	9,200	7,300	6,100	4,600	3,700	3,100	2,300	1,800	1,500
		Feed Rate (mm/min)	1,400	1,100	1,200	1,100	1,100	1,100	920	820	730
Austenitic Stainless Steel	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	1,000
		Feed Rate (mm/min)	640	760	640	640	640	640	560	510	410
Gray Cast Iron	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	14,000	11,000	9,000	6,800	5,400	4,500	3,400	2,700	2,200
		Feed Rate (mm/min)	2,000	2,200	2,300	2,000	2,200	1,800	1,700	1,600	1,400
Nodular Cast Iron CGI and malleable cast iron	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	10,000	8,300	6,900	5,200	4,100	3,500	2,600	2,100	1,700
		Feed Rate (mm/min)	1,000	1,200	1,000	1,300	1,000	1,000	910	830	830
Heat-resistant Alloy	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	3,200	2,500	2,100	1,600	1,300	1,100	800	640	510
		Feed Rate (mm/min)	160	130	210	240	190	210	200	190	180
Titanium Alloy	5DERM: 0.8Dc 5DEKM: 0.25Dc	Spindle Revolution (min^{-1})	4,800	3,800	3,200	2,400	1,900	1,600	1,200	960	760
		Feed Rate (mm/min)	480	380	480	480	380	400	360	380	340

Recommended Cutting Conditions for Slotting (3)

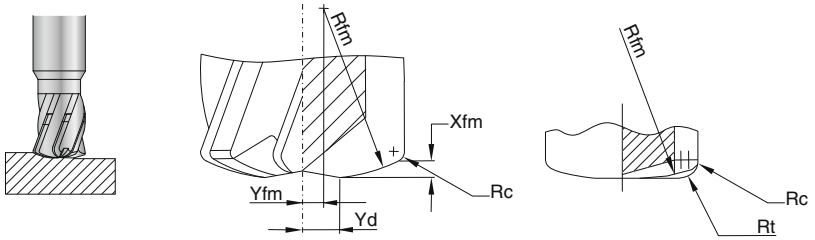
Workpiece Materials		Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20	ø25
4PGRM (L27)														
Steel	< 30HRC	0.5Dc	Spindle Revolution (min^{-1})	-	8,500	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	-
			Feed Rate (mm/min)		900	900	900	900	900	920	930	960	920	
	30~40HRC	0.5Dc	Spindle Revolution (min^{-1})		7,600	5,700	4,500	3,800	2,900	2,300	1,900	1,400	1,100	
			Feed Rate (mm/min)		770	770	770	770	770	780	780	800	780	
	40~45HRC	0.5Dc	Spindle Revolution (min^{-1})		6,800	5,100	4,100	3,400	2,500	2,000	1,700	1,300	1,000	
			Feed Rate (mm/min)		570	570	570	570	570	570	560	560	530	
	45~50HRC	0.5Dc	Spindle Revolution (min^{-1})		5,100	3,800	3,100	2,500	1,900	1,500	1,300	1,000	800	
			Feed Rate (mm/min)		320	320	320	320	340	340	360	340	340	
	50~55HRC	0.5Dc	Spindle Revolution (min^{-1})		3,400	2,500	2,000	1,700	1,300	1,000	800	600	500	
			Feed Rate (mm/min)		150	150	150	150	150	160	150	150	150	
	> 55HRC	0.25Dc	Spindle Revolution (min^{-1})		3,000	2,200	1,800	1,500	1,100	900	700	600	400	
			Feed Rate (mm/min)		100	100	100	100	100	110	110	110	110	
3RFRS 4RFRS (L34)														
Steel	< 30HRC	0.8Dc	Spindle Revolution (min^{-1})	-	-	11,500	9,200	7,600	5,700	4,600	3,800	-	-	-
			Feed Rate (mm/min)			690	690	920	920	920	920			
	30~40HRC	0.8Dc	Spindle Revolution (min^{-1})			7,600	6,100	5,100	3,800	3,100	2,500			
			Feed Rate (mm/min)			340	370	490	490	490	460			
	40~50 HRC	0.5Dc	Spindle Revolution (min^{-1})			5,100	4,100	3,400	2,500	2,000	1,700			
			Feed Rate (mm/min)			150	180	260	260	260	270			
	50~60HRC	0.3Dc	Spindle Revolution (min^{-1})			3,800	3,100	2,500	1,900	1,500	1,300			
			Feed Rate (mm/min)			80	80	100	120	120	130			
	60~70HRC	0.25Dc	Spindle Revolution (min^{-1})			2,500	2,000	1,700	1,300	1,000	800			
			Feed Rate (mm/min)			50	50	60	60	60	70			

Workpiece Materials		Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø6	ø8	ø10	ø12	ø16		ø20		ø25
								4 Flute	6 Flute	4 Flute	6 Flute	
4RFSM 6RFSM (L33)												
Steel	35~45HRC	0.5Dc	Spindle Revolution (min^{-1})	6,400	4,800	3,800	3,200	2,400	2,400	1,900	1,900	1,500
			Feed Rate (mm/min)	480	480	490	500	500	720	500	750	640
	45~55HRC	0.5Dc	Spindle Revolution (min^{-1})	4,700	3,500	2,800	2,300	1,800	1,800	1,400	1,400	1,100
			Feed Rate (mm/min)	280	280	280	280	280	420	280	420	370
	55~60HRC	0.3Dc	Spindle Revolution (min^{-1})	3,800	2,900	2,300	1,900	1,400	1,400	1,100	1,100	900
			Feed Rate (mm/min)	150	170	180	180	180	260	180	280	250
Titanium Alloy	< 40HRC	0.5Dc	Spindle Revolution (min^{-1})	3,000	2,200	1,800	1,500	1,100	1,100	900	900	700
			Feed Rate (mm/min)	310	310	310	310	310	470	310	430	360
	> 40HRC	0.3Dc	Spindle Revolution (min^{-1})	2,500	1,900	1,500	1,300	1,000	1,000	800	800	600
			Feed Rate (mm/min)	230	230	230	230	230	340	230	340	290
Inconel		0.25Dc	Spindle Revolution (min^{-1})	1,300	1,000	800	600	500	500	400	400	300
			Feed Rate (mm/min)	80	80	80	80	80	120	80	120	100

Workpiece Materials	Depth of Cut (ap) (mm)	Outside Dia. (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20	ø25
3NESM (L39)										
Aluminum Alloy	1Dc	Spindle Revolution (min^{-1})	26,500	13,000	9,800	8,000	6,600	5,000	4,000	-
		Feed Rate (mm/min)	1,900	1,900	1,900	1,900	1,900	1,900	1,900	
2NFSM (L40)										
Aluminum Alloy	1Dc	Spindle Revolution (min^{-1})	21,200	10,600	8,000	6,400	5,300	4,000	3,200	2,500
		Feed Rate (mm/min)	550	750	750	900	1,010	800	700	660
High-silicon Aluminum	1Dc	Spindle Revolution (min^{-1})	15,900	7,900	5,900	4,800	4,000	3,000	2,400	1,900
		Feed Rate (mm/min)	350	420	420	500	560	640	480	420
3NFSM (L40)										
Aluminum Alloy	1Dc	Spindle Revolution (min^{-1})	21,200	10,600	8,000	6,400	5,300	4,000	3,200	2,500
		Feed Rate (mm/min)	830	1,100	1,100	1,360	1,510	1,290	1,050	920
High-silicon Aluminum	1Dc	Spindle Revolution (min^{-1})	15,900	7,900	5,900	4,800	4,000	3,000	2,400	1,900
		Feed Rate (mm/min)	520	630	630	740	830	960	710	630
3AESM (L42)										
Aluminum Alloy	1Dc	Spindle Revolution (min^{-1})	39,800	19,900	14,900	11,900	10,000	7,500	6,000	4,800
		Feed Rate (mm/min)	3,700	3,230	3,090	3,050	2,990	2,930	2,900	2,870
High-silicon Aluminum	1Dc	Spindle Revolution (min^{-1})	12,700	6,400	4,800	3,800	3,200	2,400	1,900	1,500
		Feed Rate (mm/min)	920	860	830	810	790	780	770	770

Ramping / Arc Machining

Details of 6PDRS cutting edge shape



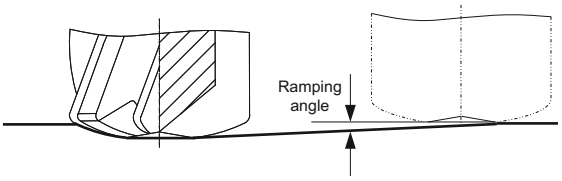
Xfm : Max. Depth of Cut
Yfm : Distance between center line of tool and center line of Rfm
Yd : Distance between center line of tool and start position of cutting edge
Rfm : Radius of tool tip
Rc : Corner R
Rt : Virtual radius in program

Description	Outside Dia.	Max. Depth of Cut (mm)	Radius of tool tip	Corner R	Distance between center line of tool and center line of Rfm	Distance between center line of tool and start position of cutting edge	Virtual radius in program
	øDc	Xfm	Rfm	Rc	Yfm	Yd	Rt
6PDRS060-045-06	6	0.32	6	0.62	0.75	1.32	0.62
6PDRS080-060-08	8	0.42	8	0.83	1.00	1.76	0.83
6PDRS100-075-10	10	0.53	10	1.04	1.25	2.20	1.04
6PDRS120-090-12	12	0.63	12	1.24	1.50	2.64	1.24

- We do not recommend machining with a cut amount exceeding the Xfm value.

About Ramping

During ramping, please reduce the table feed rate with the ratio of the chart on the right.



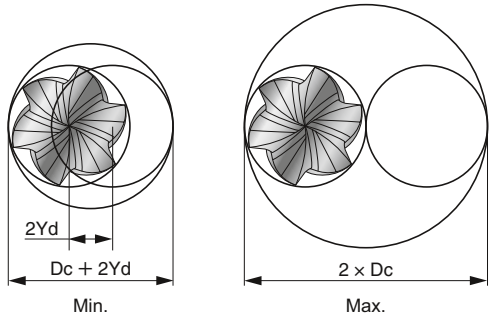
Ramping angle	1°	2°	3°	4°	5°
Feed rate when ramping	100%	70%	50%	30%	10%

*** Please refer to page L32 for standard cutting conditions.**

- During pocket machining, set the recess angle at 0.5 degrees.
- We do not recommend vertical milling.

About Arc Machining

Please use the range of the chart on the right, for one pass of machining hole diameter.



Description	Min.	Max.
6PDRS060-045-06	8.64	12.00
6PDRS080-060-08	11.52	16.00
6PDRS100-075-10	14.40	20.00
6PDRS120-090-12	17.28	24.00

Troubleshooting

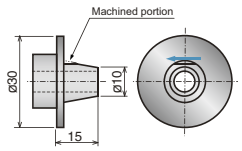
Trouble \ Countermeasures		Cutting Conditions								Tool geometry									Installation		
		Vc	fz	ap	reduce ae (cutting width)	change tool path	Down cut	Coolant		Relief Angle	Rake Angle	Helix Angle	Number of Flutes	Change to short type (edge length)	Change to roughing end mill *2	Change to radius type	Change to sharp edge type	Change to tool with corner land	Work material installation method	Adjustment for overhang length of tools	Insert Runout Check
								Wet	Dry												
		Higher (Larger) ↑ Lower (Smaller) ↓								Larger ↑ Smaller ↓	Larger ↑ Smaller ↓	Larger ↑ Smaller ↓	More ↑ Less ↓								
Tools	Wear Increase	●↓	●↑ *1		●		●	●		●↑	●↑		●↑								
Tools	Chipping		●↓	●↓	●	●			●	●↓	●↓					●		●	●		●
Tools	Burning	●↓	●↓	●↓	●		●	●		●↑											
Tools	Breakage		●↓	●↓	●									●						●	
Machining	Chattering	●↓	●↑ *1	●↓	●	●						●↓	●↓	●	●				●	●	
Machining	Poor surface finish	●↑	●↓		●		●	●				●↑							●	●	●
Machining	Burr generation		●↓			●	●	●			●↑										
Machining	Inclination of slot		●↓	●↓								●↓	●↑							●	●
Machining	Poor flatness / parallelism		●↓	●↓	●			●											●	●	●
Machining	Poor dimensional precision		●↓	●↓	●	●								●			●		●	●	●
Machining	Poor cutting quality	●↑			●						●↑	●↑	●↓		●		●				
Machining	Chip biting / clogging		●↓	●↓	●	●		●					●↓								

*1) The lower feed rate may be suitable.
*2) When roughing was done with an insert without wave profile peripheral cutting edge.

Case Studies

9SMnPb28 (SUM24L)

- **OA Parts**
- **Vc = 88m/min (n=3,500min^{-1})**
- **ap=0.5mm**
- **fz=0.23mm/t (Vf=3200 mm/min)**
- **Wet**
- **4FESM080-190-08**



MEGACOAT	230pcs/edge
Competitor Coating E	100pcs/edge

- In addition to that Kyocera processed 2.3 times more workpices than Competitor E, there was no edge fracturing and the cutting surface was finished finely.

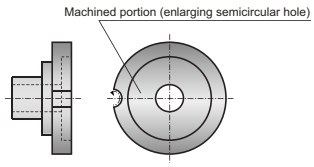
MEGACOAT
(Tool life: 230 pcs/edge)

Competitor Coating E
(Tool life: 100 pcs/edge)

(Evaluation by the user)

20Cr4 (SCr420)

- **Automotive Parts**
- **Vc = 40m/min (n=3,200min^{-1})**
- **ap=0.1mm**
- **fz=0.01mm/t (Vf=70 mm/min)**
- **Wet**
- **2FESM040-110-06**



MEGACOAT	700pcs /edge
Competitor Coating F	350pcs/edge

- Kyocera processed twice as many workpieces compared to Competitor F.
- Competitor F is limited to 350 workpieces due to excessive wear. Kyocera prevented chipping thereby enabling long-life and stabilized machining.

MEGACOAT
(Tool life: 700 pcs/edge)

Competitor Coating F
(Tool life: 350 pcs/edge)

(Evaluation by the user)