Solid End Mill

Carbide Substrate

L

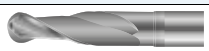
L1~L64

Difficult-to-cut Materials , high efficiency

4TFK

4TFR

Application and selection

Ref. to Page	Applications	Description	Features	Shape	Coating	No. of Flutes	Helix Angle	Outside Dia. ϕDc (mm)	
L10	Surface finish oriented	2FESS	2 flutes, sharp corner edge		MEGACOAT	2	30°	ϕ1~ϕ16	
		2FESM				2		ϕ0.2~ϕ16	
L11		2FESL				2		ϕ1~ϕ16	
L12		2FEKS	2 flutes, tough corner edge			2		ϕ3~ϕ16	
		2FEKM				2			
L13		4FESM	4 flutes, sharp corner edge			4		ϕ1~ϕ16	
		4FEKM	4 flutes, tough corner edge			4		ϕ3~ϕ16	
L14		2FESW	For Automatic Lathe (Over all length 35mm / 45mm)			2	35°	ϕ3~ϕ13	
		3FESW				3			
		4FESW				4			
L15	Multi-purpose	3UFSM	3 flutes, Multi-purpose		TiAlN	3	45°	ϕ1~ϕ20	
L16		4PGSS	Multi-edge type Slotting, Shouldering Multi-purpose High feed rate finishing			4	50°	ϕ3~ϕ25	
		5PGSS				5			
		4PGSM				4		ϕ6~ϕ25	
		5PGSM				5			
		6PGSM				6			
		4PGSL				4		ϕ6~ϕ25	
		5PGSL				5			
		6PGSL				6			
L17		4PGRM (Radius)				4		ϕ3~ϕ20	
L19	High efficiency chip evacuation	3ZFKS	Multi-functional, high efficiency		MEGACOAT	3	40°	ϕ6~ϕ12	
		3ZFKM				3		ϕ3~ϕ16	
L21		4MFK	NEW 4 flutes, High feed, high efficiency		MEGACOAT NANO	4	Variable Lead 42°, 44°	ϕ3~ϕ16	
		4MFR (Radius)				4			
L23		4TFK	NEW 4 flutes, Difficult-to-cut Materials, High efficiency		MEGACOAT NANO	4	Variable Lead 42°, 44°	ϕ3~ϕ20	
		4TFR (Radius)				4			
L24		4YEKM	4/5 flutes, High efficiency Steel and Difficult-to-cut Materials Varied interval flute design		TiAlN	4	38°	ϕ4~ϕ25	
		4YECM				4			
		4YERM (Radius)				4			
L25		5DEKM			AlTiN	5		ϕ4~ϕ25	
		5DERM (Radius)				5			
		4YFSM	Steel and Difficult-to-cut materials, Finishing		TiAlN	4	45°	ϕ4~ϕ20	
		6YFSM				6			
L26		3RDSM	Roughing, serrated edge		TiAlN	3	20°	ϕ4~ϕ25	
		4RDSM				4			
		5RDSM				5			
		3RDSL				3		ϕ6~ϕ25	
		4RDSL				4			
		5RDSL				5			
L27		4RFSM	Roughing, notched edge			4	45°	ϕ6~ϕ25	
		6RFSM				6			
		3RFRS (Radius)				3		ϕ4~ϕ12	
		4RFRS (Radius)				4			
L29	High efficiency High feed rate Finishing	6PFK	NEW 6/8 flutes, Shouldering, High feed rate, Finishing		MEGACOAT NANO	6	Variable Lead 42°, 44°	ϕ6~ϕ25	
		8PFK				8			
L31	Ball-nose	2SEB	NEW High efficiency Ball-nose End Mill with 2 flutes		MEGACOAT NANO	2	30°	ϕ2~ϕ16	
L32		2UEBS	Ball-nose End Mill with 2 flutes		TiAlN	2	30°	ϕ1~ϕ20	
		3UEBS	Ball-nose End Mill with 3 flutes			3	30°	ϕ3~ϕ12	
L33		4YEBM	Ball-nose End Mill with 4 flutes			4	38°	ϕ5~ϕ20	
L34	Special corner-R shaped	6PDRS	6 flutes, High feed rate		AlTiN	6	20°	ϕ6~ϕ12	

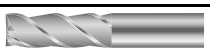
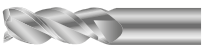
Carbide Substrate

Substrate of all solid end mills is carbide.

Workpiece Material										Description	Ref. to Page
	Steel		Heat Treated Steel		Stainless Steel	Titanium Alloys	Heat-resistant Alloys	Cast Iron	Aluminum & Non-ferrous Metals		
	~30HRC	~40HRC	~55HRC	~68HRC							
	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		
	◎	○	○		◎			○	○	2FESS	L10
										2FESM	
										2FESL	L11
										2FEKS	L12
										2FEKM	
										4FESM	L13
										4FEKM	
										2FESW	L14
										3FESW	
										4FESW	
	◎	◎	○		◎	○		◎	○	3UFSM	L15
	◎	◎	○					○		4PGSS	L16
										5PGSS	
										4PGSM	
										5PGSM	
										6PGSM	
										4PGSL	
										5PGSL	
										6PGSL	
	◎	◎	○					○		4PGRM (Radius)	L17
	◎	○			◎	○		○	○	3ZFKS	L19
										3ZFKM	
	◎	○	○		◎	○		○	○	4MFK	L21
										4MFR (Radius)	
	◎	◎			◎	◎	◎	○		4TFK	L23
										4TFR (Radius)	
	◎	○			◎	◎	◎	○		4YEKM	L24
										4YECM	
										4YERM (Radius)	
	◎	◎			◎	◎	◎	○		5DEKM	L25
										5DERM (Radius)	
	◎	◎			◎	◎	◎	○		4YFSM	
										6YFSM	
	◎	◎			○			◎		3RDSM	L26
										4RDSM	
										5RDSM	
										3RDSL	
										4RDSL	
										5RDSL	
	○	◎	◎	○	○	◎	○	○		4RFSM	L27
										6RFSM	
	○	◎	◎	○	○	◎	○	○		3RFRS (Radius)	
										4RFRS (Radius)	
	◎	○	○		◎	◎		○	○	6PFK	L29
										8PFK	
	◎	◎	◎	○	○			○		2SEB	L31
	◎	◎						◎		2UEBS	L32
	◎	◎			○	○		◎	○	3UEBS	
	◎	○			◎	◎	○	○		4YEBM	L33
	◎	◎	◎	◎						6PDRS	L34

◎ : 1st Choice ○ : 2nd Choice

Application and selection

Ref. to Page	Applications	Description	Features	Shape	Coating	No. of Flutes	Helix Angle	Outside Dia. ϕDc (mm)	
L36	Hard materials	4HFSS	Multi-edge type Negative rake angle Hard Materials Finishing		MEGACOAT Hard	4	45°	ϕ1~ϕ12	
		5HFSS				5			
		6HFSS				6			
		7HFSS				7			
		4HFSM				4		ϕ1~ϕ25	
		5HFSM				5			
		6HFSM				6			
		7HFSM				7			
		8HFSM				8			
L37		4UGSM			TiAlN	4	50°	ϕ3~ϕ16	
		6UGSM				6			
L38	Aluminum & Non-ferrous Metals	3NESM	Varied interval flute design with wiper edge		-	3	38°	ϕ3~ϕ20	
L39		2NFSM	Sharpness oriented, Smooth chip evacuation			2	45°	ϕ1~ϕ20	
		3NFSM				3		ϕ3~ϕ20	
		3NFSL				3		ϕ3~ϕ20	
L40		3AESM	Roughing			3	30°	ϕ6~ϕ25	
		3AESL				3		ϕ6~ϕ25	
L43	Counterboring	2ZDK	NEW 2 flutes, Counterboring		MEGACOAT NANO	2	20°	ϕ3~ϕ12	

Solid End Mill Identification System (except 4MFK/R, 4TFK/R, 6/8PFK, 2SEB and 2ZDK)

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

(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Length of cut	(6) Outside Dia.	(7) Length of cut	(8) Shank Dia.	(9) Others
2 3 4 5 6 7 8	F : Surface finish oriented $U_{(UF)}/P_{(PG)}$: Multi-purpose Z : Multi-functional, high efficiency Y/D : High efficiency (Difficult-to-cut Material) R : Roughing $H/U_{(UG)}$: Hard materials N/A : Aluminum & Non-ferrous Metals	D : 20-29° E : 30-39° F : 40-49° G : 50-59°	S : Sharp corner edge B : Ball-nose R : Radius K : Tough corner edge C : With Corner Chamfering	S : Short M : Medium L : Long W : For Automatic Lathes	020 ↓ 2.0mm	060 ↓ 6.0mm	04 ↓ 4.0mm	Corner Radius, C width etc …

Solid End Mill Identification System (4MFK/R, 4TFK/R, 6/8PFK) NEW

4 T F R 030 - 080 - R02
(1) (2) (3) (4) (5) (6) (7)

(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Outside Dia.	(6) Length of cut	(7) Corner Radius
4	M : High feed, high efficiency P : Shouldering, High feed rate, Finishing T : High efficiency (Difficult-to-cut Materials)	F : 40-49°	K : Tough corner edge R : Radius	030 ↓ 3.0mm	080 ↓ 8.0mm	R02 ↓ 0.2mm

Solid End Mill Identification System (2ZDK) NEW

2 Z D K 030 S
(1) (2) (3) (4) (5) (6)

(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Outside Dia.	(6) Others
2	Z : Counterboring	D : 20°	K : Tough corner edge	030 ↓ 3.0mm	S : Short type

Solid End Mill Identification System (2SEB) NEW

2 S E B 020 - 050 - R10
(1) (2) (3) (4) (5) (6) (7)

(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Outside Dia.	(6) Length of cut	(7) Radius of Ball Nose
2	S : High efficiency	E:30-39°	B: Ball-nose	020 ↓ 2.0mm	050 ↓ 5.0mm	R10 ↓ R1.0mm

Carbide Substrate

Substrate of all solid end mills is carbide.

Workpiece Material										Description	Ref. to Page
	Steel		Heat Treated Steel		Stainless Steel	Titanium Alloys	Heat-resistant Alloys	Cast Iron	Aluminum & Non-ferrous Metals		
	~30HRC	~40HRC	~55HRC	~68HRC							
	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		
	◎	◎	◎	◎						4HFSS 5HFSS 6HFSS 7HFSS 4HFSM 5HFSM 6HFSM 7HFSM 8HFSM	L36
			◎	◎						4UGSM 6UGSM	L37
										3NESM	L38
									◎	2NFSM 3NFSM 3NFSL	L39
										3AESM 3AESL	L40
	◎	◎						◎	◎	2ZDK	L43

◎ : 1st Choice ○ : 2nd Choice

Icon Glossary

Super Micro-grain carbide — The products made from super micro-grain cemented carbide

Coating

- MEGACOAT NANO — MEGACOAT NANO
- MEGACOAT Hard — MEGACOAT Hard
- MEGACOAT — MEGACOAT
- TiAℓN — TiAℓN coating
- AℓTiN — AℓTiN coating
- Uncoated — Non-coating

Shank Diameter Tolerance

- h5 Shank Dia. — Shank Diameter Tolerance is h5.
- h6 Shank Dia. — Shank Diameter Tolerance is h6.

Corner Form

- Radius R — Radius
- Sharp — Sharp corner edge
- Land — With corner land
- C — With corner chamfering

Corner Radius Tolerance

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

Ball-nose radius Tolerance

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

Flutes

3 — 3 flutes design

Helix Angle

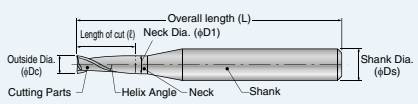
30° — Helix Angle 30°

Cutting edge shape

Cutting edge shape — Roughing

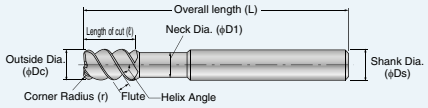
Name of parts

● Square Type

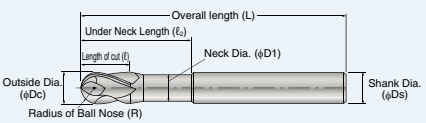


For 2ZDK, length of cut (ℓ) is same as flute length

● Radius Type

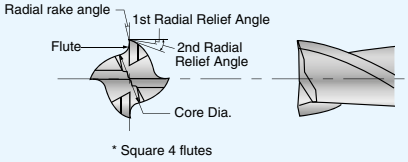


● Ball-nosed Type



Edge Shape

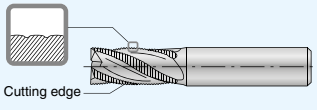
● Cutting edge Shape



* Square 4 flutes

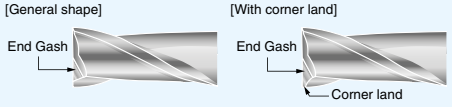
● Core Dia. Ratio (%)=(Core Dia. / Outside Dia.) ×100

● Cutting edge shape



● With Chamfered Edge

● Tough corner edge (with Corner land)



L

Solid End Mill

Tool Selection Guide

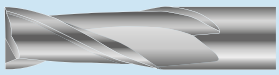
Introduction

Surface finish oriented

L10~L14

F Series

MEGACOAT is applied



(FES)

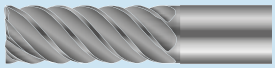
MEGACOAT and sharp cutting edge enable high precision finishing owing to excellent wear and heat resistance.
Total lengths 35mm and 45mm are available for automatic lathes.

L10~L14

Multi-purpose

L15~L17

P Series (PGS)



(PGS)

Multi-purpose end mill for slotting and shouldering.
Core diameter ratio is 60% for 1D distance from the bottom edge, and 80% for the longer distance. Smooth chip evacuation and high rigidity.

L16

High efficiency chip evacuation

L18~L27

Z Series

MEGACOAT is applied

(3ZFKS)

Multi-functional, high efficiency End Mill
Applicable for plunge milling, slotting and finishing with one end mill.
Smooth chip evacuation because sub-groove on gash breaks chips during plunge milling

L18

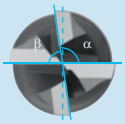
M Series

MEGACOAT NANO is applied

(4MFK)

Superior anti vibration performance due to Kyocera's unique varied interval flute design and variable Lead.
Achieves high rigidity and Stable chip evacuation due to New Special Flute Design
Achieves high feed, high efficiency machining

Varied interval flute design



L20

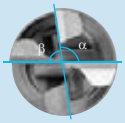
NEW

T Series

MEGACOAT NANO is applied

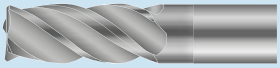
High efficiency end mill for difficult-to-cut materials (stainless steel, titanium alloys and heat-resistant alloys)
Varied interval flute design / Variable Lead

Varied interval flute design



L22

Y Series

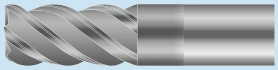


(4YEKM, 4YECM, 4YERM)

Varied interval flute design reduces vibration and improve efficiency at slotting and shouldering.
Applicable for stainless steel and heat resistant steel with 3 types of cutting edge. (corner land, chamfered, radius)

L24

D Series

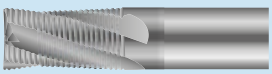


(5DEKM, 5DERM)

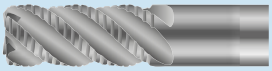
Varied interval flute design with 5 flutes. For high efficiency slotting and shouldering.
Applicable for difficult-to-cut materials like stainless steel and heat resistant steel.

L25

R Series



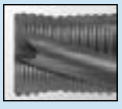
(RDS)

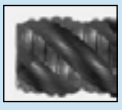


(RFS)

RDS type is for general use with large flat surface edge with a 20 degrees helix angle.

RFS has notched surface edge of 45 degrees helix angle. It is applicable for hard materials and titanium alloys due to strong cutting edge.





L26~L27

High efficiency , High feed rate , Finishing

L28~L29

NEW **PFK**

MEGACOAT NANO is applied

(6PFK)

High feed rate and high efficiency shouldering with Multi-edge design (6 flutes /8 flutes)
Varied interval flute design and variable lead to minimize chattering

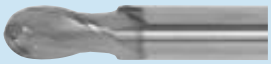
L28

Ball-nose End Mill

L30~L35

NEW **S** Series

MEGACOAT NANO is applied

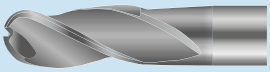


(2SEB)

High efficiency Ball-nose End Mill with 2 flutes
Sharp cutting due to special nose geometry
Close tolerance edge diameter (R±0.005mm, ϕ16 excluded)
Stable chip evacuation by a large chip pocket design

L30~L31

U Series **Y** Series (UEB,YEB)

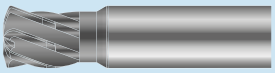


(3UEBS)

Boll-nose end mill with 2/3/4 flutes

L32~L33

P Series (PDR)



(6PDRS)

High efficiency radius. Enables large cutting volume and high efficiency machining with special corner-radius shaped.
Ramping and arc cutting are possible

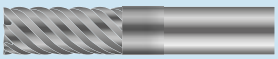
L34

Hard materials

L36~L37

H Series

MEGACOAT Hard is applied

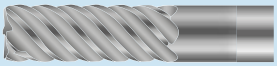


(HFS)

PVD coating MEGACOAT Hard for hard materials is applied.
Large core diameter and negative rake angle improves edge strength.
Helix angle is 45 degrees.
High efficiency machining and long tool life with wide range of 4, 5, 6, 7 and 8 flute types.

L36

U Series (UGS)



(UGS)

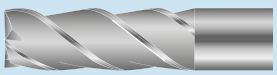
For hard materials with negative rake angle.
Helix angle is 50 degrees.

L37

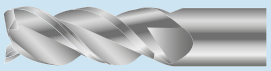
Aluminum & Non-ferrous Metals

L38~L40

N Series (NES, NFS)



(3NESM)

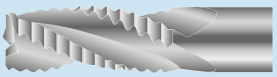


(3NFSM)

NES type realizes good surface finish with wiper cutting edge.
Varied interval flute design prevents chattering and improves machining efficiency and surface finish quality of side wall of workpiece.
NFS type improves chip evacuation owing to special rake face design and 45 degrees helix angle.

L38~L39

A Series



(3AESM)

Roughing end mill for high efficiency machining of aluminum and non-ferrous metals.

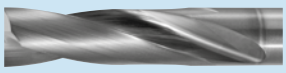
L40

Counterboring

L41~L45

NEW **2ZDK**

MEGACOAT NANO is applied



Edge ends have 180 ° flat and are applicable to various applications including counterboring on slant surface.
Smooth chip control and high rigidity due to the special flute shape

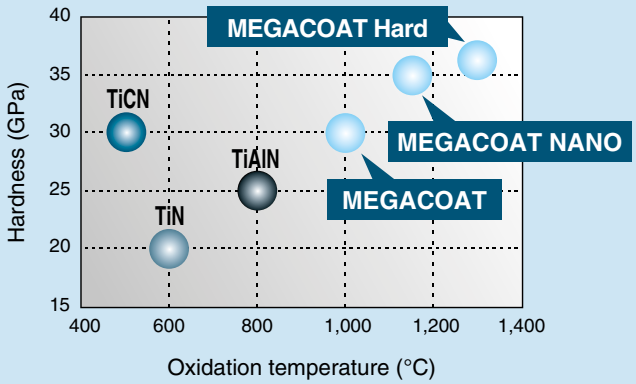
L41

New PVD technology, MEGACOAT

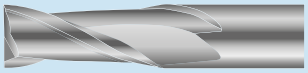
Superior wear and oxidation resistant MEGACOAT

MEGACOAT for Solid End Mill

1. For General Milling ..... MEGACOAT
2. For High Efficiency Milling... MEGACOAT NANO
3. For Hard materials ..... MEGACOAT Hard

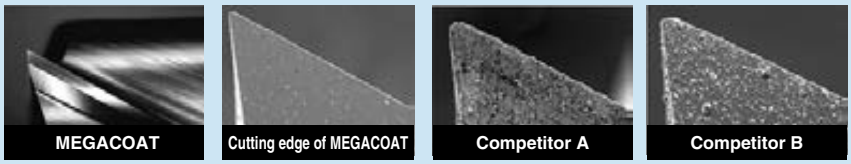


1. MEGACOAT for general milling



F Series
L10~L14

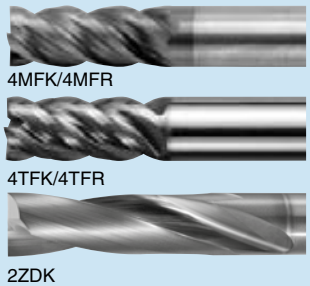
MEGACOAT extend tool life for roughing to finishing of various kinds of material, due to superior wear resistance and high oxidation resistance.



(Internal evaluation)

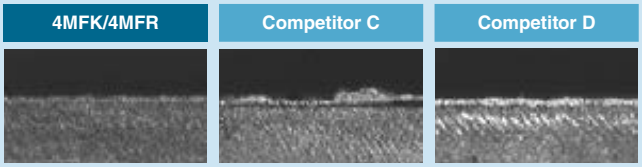
NEW

2. MEGACOAT NANO with special multilayer nano coating for high efficiency machining



Long Tool Life with "MEGACOAT NANO" Doubled Wear Resistance compared to the Competitor's!

Edge Conditions after 140m Machining



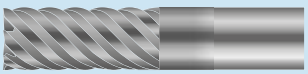
[Cutting Condition : n=6,000min^{-1}, Vf=1,100mm/min, ap×ae=5.0×0.8mm, ϕ8, SCM440, Shouldering]

4MFK / 4MFR
L20
4TFK / 4TFR
L22
2ZDK
L41

(Internal evaluation)

The special Multilayer Nano Coating realizes superior wear resistance due to high hardness and anti-chipping performance.
Suitable for high-feed milling

3. MEGACOAT Hard for machining of hard materials



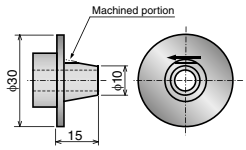
H Series
L36

The special Multilayer Coating provides high hardness and excellent oxidation resistance.
Longer tool life and stability at milling of hard materials

Case Studies

9SMnPb28

· OA parts
· n=3,500min^{-1} (Vc=88m/min)
· ap=0.5mm
· Vf=3,200 mm/min (fz=0.23mm/t)
· Wet
· 4FESM080-190-08 (ϕ8·4 flutes)



4FESM080-190-08	230 pcs
Competitor Coated Carbide E	100 pcs

· Kyocera showed 2.3 times longer tool life than Competitor E.
· Kyocera's new coating technology resolved edge fracturing and provided stability compared with Competitor E.
· Kyocera showed superior finished surface compared with Competitor E.

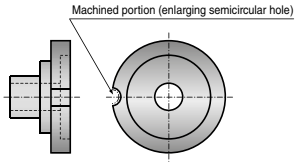
MEGACOAT
(Number of workpiece processed: 230 pcs)

Competitor Coated Carbide E
(Number of workpiece processed: 100 pcs)

(Evaluation by the user)

17Cr3

· Automotive parts
· n=3,200min^{-1} (Vc=40m/min)
· ap=0.1mm
· Vf=70mm/min (fz=0.01mm/t)
· Wet
· 2FESM040-110-06 (ϕ4·2 flutes)



2FESM040-110-06	700 pcs
Competitor Coated Carbide F	350 pcs

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

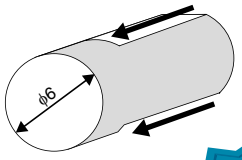
MEGACOAT
(Number of workpiece processed: 700 pcs)

Competitor Coated Carbide F
(Number of workpiece processed: 350 pcs)

(Evaluation by the user)

C45

· Machine parts
· n=3,980min^{-1}(Vc=100m/min)
· ap =0.45mm
· Vf=800mm/min (fz=0.05mm/t)
· Wet
· Tool life 4,000 pcs
· 4FESW080-080-08 (ϕ8·4 flutes)



Four times the productivity!

4FESW080-080-08	Table feed Vf=800mm/min
Competitor Coated Carbide G	Table feed Vf=200mm/min

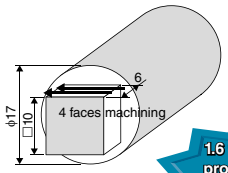
[Competitor Coated Carbide G]
ϕ8·4 flutes
n=2,508min^{-1}(Vc=63m/min)
ap=0.45mm
Tool life 4,000 pcs
Vf=200mm/min (fz=0.02mm/t)

User comments:
· Was able to increase both cutting speed and table feed rate.
· Despite the increase in cutting conditions, burr formation decreased.

(Evaluation by the user)

9SMn28

· Machine parts
· n=3,200min^{-1} (Vc=100m/min)
· ap × ae=3.5 × 3.0mm
· Vf=640mm/min (fz=0.05mm/t)
· Wet
· 4FESW100-080-10 (ϕ10·4 flutes)



1.6 times the productivity! Five times the tool life!

4FESW100-080-10	Table feed Vf=640mm/min
Competitor Coated Carbide H	Table feed Vf=400mm/min

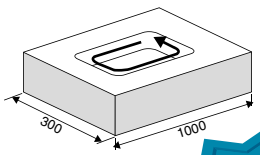
[Competitor Coated Carbide H]
ϕ7·4 flutes
n=2,000min^{-1} (Vc=44m/min)
ap × ae=3.5 × 3.0mm
Vf=400mm/min (fz=0.05mm/t)

User comments:
· General purpose end mills for Automatic Lathes have a shorter edge length with improved rigidity, which enabled an increase from conventional ϕ7 to ϕ10, thus improving cutting conditions.
· Compared to conventional tools, tool life improved five times.

(Evaluation by the user)

Heat Treated Steel (60HRC)

· Mold
· n=1,194min^{-1} (Vc=60m/min)
· ap × ae=40 × 0.3mm
· Vf=400mm/min(fz=0.056mm/t)
· 6HFSM160-420-16 (ϕ16·6 flutes)



Double the amount of chip extraction!

6HFSM160-420-16	Amount of chip extraction 4.8cc/min Tool life: 10pcs
Competitor Coated Carbide I	Amount of chip extraction 2.4cc/min Tool life: 5pcs

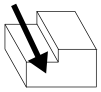
[Competitor Coated Carbide I]
ϕ16·6 flutes
n=597min^{-1} (Vc=30m/min)
ap × ae=40 × 0.3mm
Vf=200mm/min (fz=0.056mm/t)

User comments:
The cutting speed and table feed rate is doubled compared to competitor's coated carbide product I. The cutting edge conditions are excellent and the tool life is also doubled.

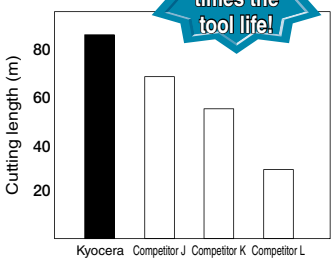
(Evaluation by the user)

X1153CrMoV12

· Block
· n=3,700min^{-1} (Vc=70m/min)
· ap × ae=3 × 0.12mm
· Vf=800mm/min (fz=0.04mm/t)
· Dry
· 6HFSM060-170-06
(ϕ6 · 6 flutes)



Three times the tool life!



6HFSM060-170-06	
Competitor Coated Carbide J,K,L	

[Competitor Coated Carbide J,K,L]
ϕ6·6 flutes
n=3,700min^{-1} (Vc=70m/min)
ap × ae=3 × 0.12mm
Vf=800mm/min (fz=0.04mm/t)

Shouldering:
Compared to competitor's coated carbide products, the 6HFSM has three times longer tool life.

(Internal evaluation)

No. of Flutes: 2

2FESS, 2FESM, 2FESL

2

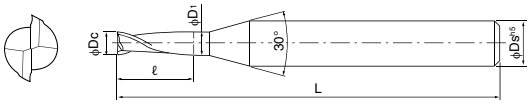
MEGACOAT is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice

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

MEGACOAT | Sharp | h5 Shank Dia. | 30°



2FESS (Short)

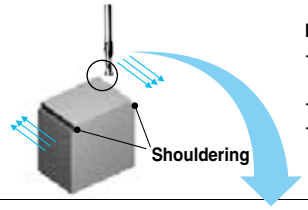
Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Shank Dia. ϕDs	Overall length L	No. 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
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
2FESS070-105-08	●	7.0	0 -0.020	10.5	7.2	8	60	2
2FESS080-120-08	●	8.0	-0.005 -0.025	12.0	-	8	60	2
2FESS090-135-10	●	9.0	-0.005 -0.025	13.5	9.2	10	70	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

Sharp Cutting Edge Reduced Burrs

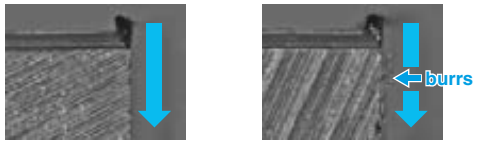
SUS304



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 Coated Carbide A**



(Internal evaluation)

2FESM (Medium)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Shank Dia. ϕDs	Overall length L	No. 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

Recommended Cutting Conditions L46

● : Std. Item

2FESM (Medium)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Shank Dia. ϕDs	Overall length L	No. 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
2FESM060-150-06	●	6.0	0 -0.020	15.0	-	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
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

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
2FESM080-190-08	●	8.0	-0.005 -0.025	19.0	-	8	60	2
2FESM080-200-08	●	8.0	-0.005 -0.025	20.0	-	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
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
2FESM100-250-10	●	10.0	-0.005 -0.025	25.0	-	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

2FESL (Long)

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Shank Dia. ϕDs	Overall length L	No. 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
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

● : Std. Item

Recommended Cutting Conditions ➡ L46~L47

No. of Flutes: 2

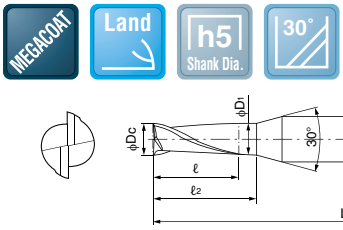
2FEKS, 2FEKM

2

MEGACOAT is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice



2FEKS (Short)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. 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
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

2FEKM (Medium)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. 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
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

● MEGACOAT and sharp cutting edge enable high precision finishing owing to excellent wear and heat resistance.

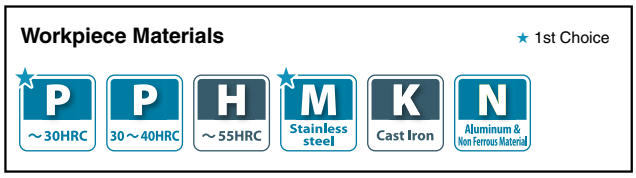
Recommended Cutting Conditions L47

● : Std. Item

No. of Flutes: 4

4 flutes, Sharp corner edge

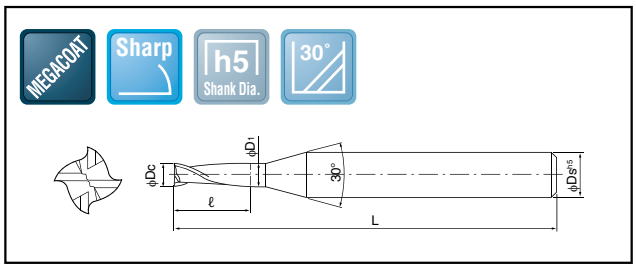
4FESM



4

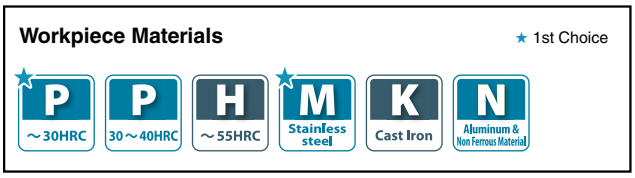
MEGACOAT is applied

Super Micro-grain carbide



4 flutes, Tough corner edge

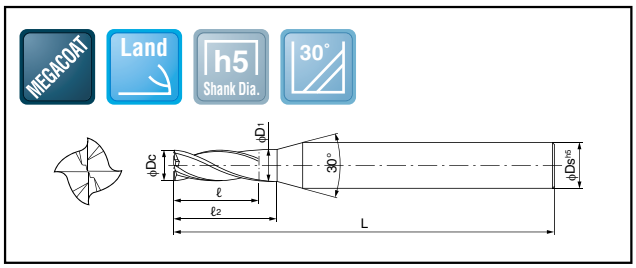
4FEKM



4

MEGACOAT is applied

Super Micro-grain carbide



4FESM

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Shank Dia. ϕDs	Overall length L	No. 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
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
4FESM060-150-06	●	6.0	0 -0.020	15.0	-	6	50	4
4FESM070-160-08	●	7.0	0 -0.020	16.0	7.2	8	60	4
4FESM080-190-08	●	8.0	-0.005 -0.025	19.0	-	8	60	4
4FESM080-200-08	●	8.0	-0.005 -0.025	20.0	-	8	60	4
4FESM090-190-10	●	9.0	-0.005 -0.025	19.0	9.2	10	70	4
4FESM100-220-10	●	10.0	-0.005 -0.025	22.0	-	10	70	4
4FESM100-250-10	●	10.0	-0.005 -0.025	25.0	-	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

4FEKM

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. 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
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

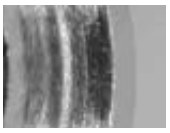
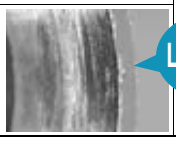
Recommended Cutting Conditions ➔ L48

● : Std. Item

No. of Flutes: 2, 3, 4

2FESW, 3FESW, 4FESW
(Over all length 35mm / 45mm)

(2FESW)

Workpiece Material: Ni-Co alloy		
2FES (ϕ3·2flutes) Smooth surface		Facing of machine component · Vc=20m/min (n=2,150min^{-1}) · fz=0.023mm/t (Vf=100mm/min)
Competitor A (ϕ3·2flutes) Large burrs	 Large burrs	(Internal evaluation)

Comparison with competitor's end mill after 600 passes

2 3 4

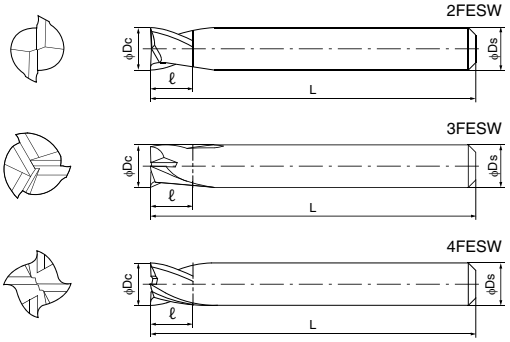
MEGACOAT is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice

★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

2FESW

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
2FESW050-050-05A	●	5	0 -0.020	5	5	35	2
2FESW060-060-05A	●	6	0 -0.020	6	5	35	2
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
2FESW050-050-06	●	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

3FESW

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

4FESW

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
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

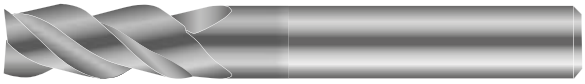
Recommended Cutting Conditions ➔ L49~L50

● : Std. Item

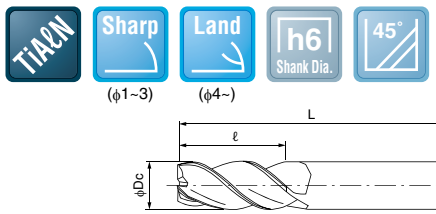
3 flutes, Multi-purpose

No. of Flutes: 3

3UFSM



Workpiece Materials ★ 1st Choice



3UFSM

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕDs	L	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 workpiece materials.

Recommended Cutting Conditions **L50**

● : Std. Item

Multi-edge for Slotting / Shouldering, Multi-purpose (High feed finishing)

No. of Flutes: 4, 5, 6

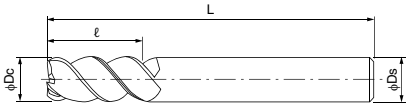
4PGS, 5PGS, 6PGS

4 5 6

Workpiece Materials ★ 1st Choice

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

TiAlN | Land | h6 Shank Dia. | 50°



4PGSS, 5PGSS
(Short)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

4PGSM, 5PGSM, 6PGSM
(Medium)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

4PGSL, 5PGSL, 6PGSL
(Long)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

● Core Diameter Ratio is 60% between the cutting edge and 1Dc and 80% for the rest. Good chip evacuation and high rigidity with Corner land.

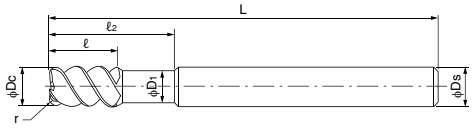
Recommended Cutting Conditions ➔ L51~L52

● : Std. Item

No. of Flutes: 4

4PGRM

Workpiece Materials ★ 1st Choice



4PGRM

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	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
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

No. of Flutes Z=4

● Radius type with 4 flutes. The diameter of the neck portion is thinner than the cutting diameter and 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 L52

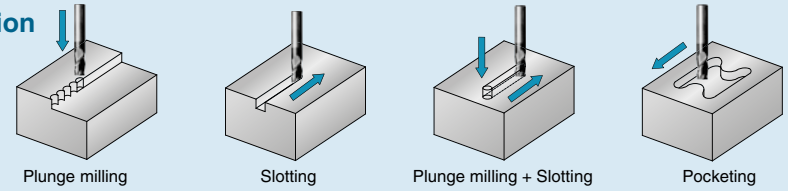
● : Std. Item

3ZFK

Triple functions

Applicable for plunge milling, slotting and finishing with one end mill

● Application

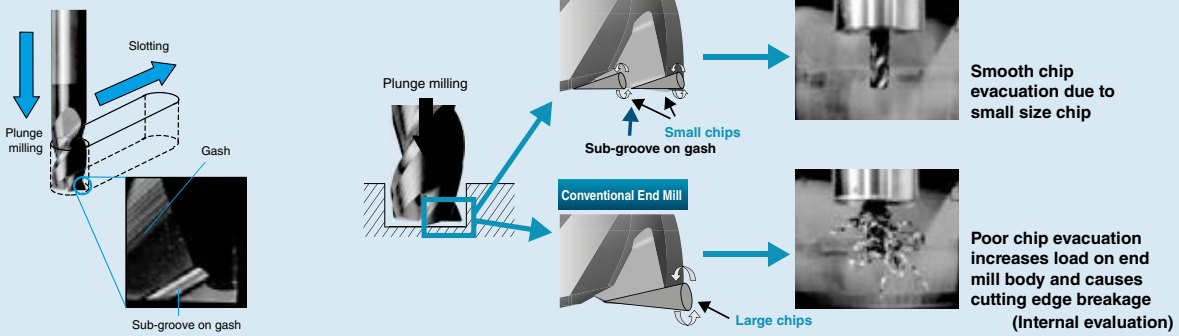


Triple Performances

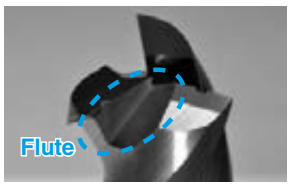
1. High efficiency machining due to new design

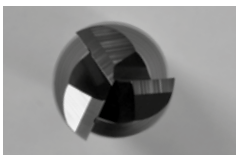
· Smooth chip evacuation because sub-groove on gash breaks chips during plunge milling

● Effect of sub-groove on gash



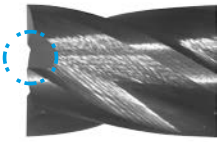
· Prevents **chip clogging** owing to deep flute and gash design.





Bottom surface of 3ZFK cutting edge

3ZFK

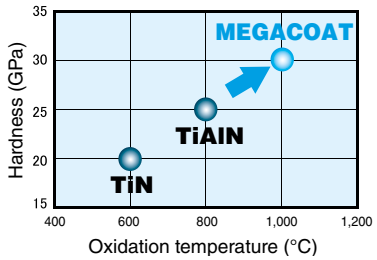


Conventional End Mill

2. Longer tool life owing to MEGACOAT

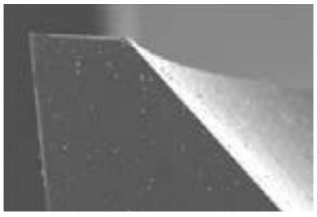
· Excellent wear resistance and heat-resistance

MEGACOAT is applied



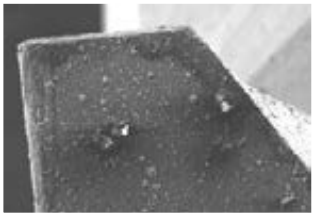
3. Better surface finish owing to sharp cutting edge quality

· Smooth and sharp to the tip of the cutting edge
· Controls burr formation. Better surface roughness



MEGACOAT

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



Competitor Coating A

Rough coating surface and round blunt cutting edge

(Internal evaluation)

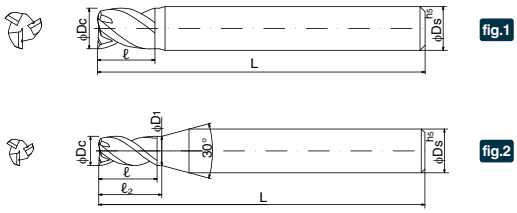
3ZFKS, 3ZFKM

3

MEGACOAT is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice



3ZFKS (Short)

Shouldering Slotting Plunge milling

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ℓ2	ϕDs	L	Z
3ZFKS060-090-06 fig.1	●	6.0	0 -0.02	9.0	-	-	6	50	3
3ZFKS070-105-08 fig.2	●	7.0	0 -0.02	10.5	7.2	11.3	8	60	3
3ZFKS080-120-08 fig.1	●	8.0	-0.005 -0.025	12.0	-	-	8	60	3
3ZFKS100-150-10 fig.1	●	10.0	-0.005 -0.025	15.0	-	-	10	70	3
3ZFKS120-180-12 fig.1	●	12.0	-0.01 -0.03	18.0	-	-	12	75	3

3ZFKM (Medium)

Shouldering Slotting Plunge milling

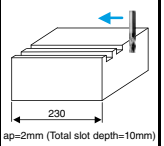
(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ℓ2	ϕDs	L	Z
3ZFKM030-060-06 fig.2	●	3.0	0 -0.015	6.0	3.2	6.5	6	50	3
3ZFKM030-080-06 fig.2	●	3.0	0 -0.015	8.0	3.2	8.6	6	50	3
3ZFKM040-080-06 fig.2	●	4.0	0 -0.015	8.0	4.2	8.6	6	50	3
3ZFKM040-120-06 fig.2	●	4.0	0 -0.015	12.0	4.2	13.0	6	50	3
3ZFKM050-100-06 fig.2	●	5.0	0 -0.015	10.0	5.2	10.8	6	50	3
3ZFKM050-130-06 fig.2	●	5.0	0 -0.015	13.0	5.2	14.0	6	50	3
3ZFKM060-130-06 fig.1	●	6.0	0 -0.02	13.0	-	-	6	50	3
3ZFKM070-160-08 fig.2	●	7.0	0 -0.02	16.0	7.2	17.3	8	60	3
3ZFKM080-190-08 fig.1	●	8.0	-0.005 -0.025	19.0	-	-	8	60	3
3ZFKM100-220-10 fig.1	●	10.0	-0.005 -0.025	22.0	-	-	10	70	3
3ZFKM120-260-12 fig.1	●	12.0	-0.01 -0.03	26.0	-	-	12	75	3
3ZFKM160-350-16 fig.1	●	16.0	-0.010 -0.030	35.0	-	-	16	90	3

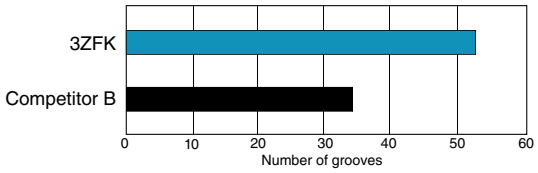
Case Studies

● Slotting of Titanium Alloy

Outside Dia.	ϕ10
Workpiece Material	Ti-6Al-4V
Spindle Revolution	3ZFK: n=1,700min^{-1}
	Competitor B: n=1,300min^{-1}
Feed Rate	Vf =460mm/min
Depth of Cut	ap×ae=2×10mm



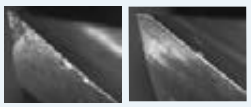
(Wet)



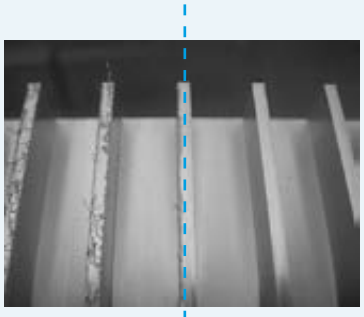
(Internal evaluation)

· Better surface finish and longer tool life with 3ZFK.
· Compared to competitor's coated products, the 3ZFK has a 1.4 times longer tool life.
· 3ZFK prevents burr formation due to sharp cutting edge.

◆ Cutting edge after 35 passes



Competitor B 3ZFK



Competitor B 3ZFK

(Internal evaluation)

Recommended Cutting Conditions L53

● : Std. Item

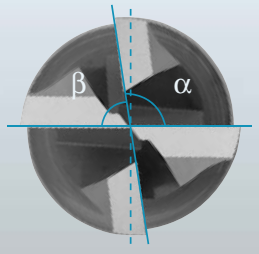
4MFK, 4MFR

Innovative design for high efficiency stable milling

● Varied interval flute design / Variable Lead

Superior anti vibration performance due to Kyocera's unique varied interval flute design / Variable Lead

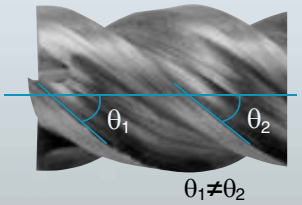
Varied interval flute design



Cutting force varies due to varied flute width, which prevents periodical vibration during milling.

$\alpha \neq \beta$

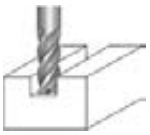
Variable Lead



$\theta_1 \neq \theta_2$

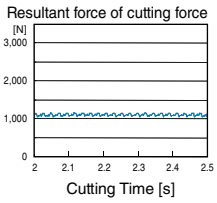
Every flute has its optimum Helix Angle (Lead Angle θ), which enables excellent anti vibration effect.
Prevents chattering, and superior surface finish.
Helix Angle: θ_1=42°, θ_2=44°

Variable Lead: Prevents chattering

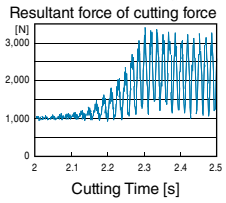


Workpiece Material	SCM440
Outside Dia.	ϕ8
Spindle Revolution	n=2,650min^{-1}
Table feed	Vf=300mm/min
Depth of cut	ap×ae=10×8mm

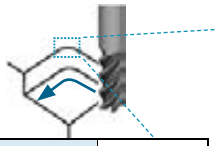
4MFK080-190



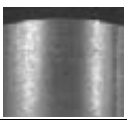
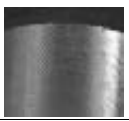
Competitor A (Equal lead angle)



Superior surface finish, compared to Competitor B (variable lead angle)



Workpiece Material	S45C
Outside Dia.	ϕ8
Spindle Revolution	n=6,000min^{-1}
Table feed	Vf=1,500mm/min
Depth of cut	ap×ae=8×2mm

4MFK080-190	Competitor B Variable Lead End Mill
	
Prevents chattering	Chattering occurs

Minimum vibration when shouldering. Excellent surface finish.

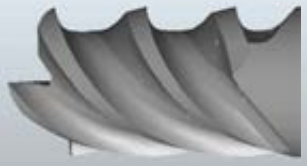
(Internal evaluatin)

● Special Flute Design

Stable Chip Evacuation due to New Special Flute Design

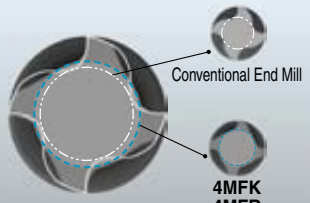
Wide chip pocket

Wide Chip Pocket Effects: Excellent chip evacuation in high feed grooving.



High rigidity due to increased core thickness

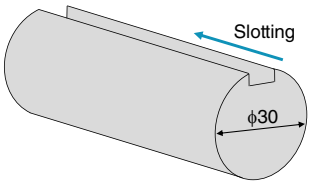
Core thickness improves the rigidity, preventing vibration and inclination of tool during machining.



Case Studies

S45C

- Automotive parts
- n=3,500min^{-1} (Vc=77m/min)
- ap×ae=5×7mm
- Vf=1,000mm/min (fz=0.071mm/t)
- Wet



4MFK070-160	**255 pcs**	6.6 times the productivity 5 times the tool life
Competitor Coated Carbide C	**50 pcs**	

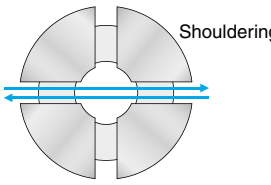
[Competitor Coated Carbide C]
ϕ7·4 flutes
n=2,000min^{-1}(Vc=44m/min)
ap×ae=5×7mm
Vf=150mm/min (fz=0.019mm/t)
Wet

- 4MFK showed 5 times longer tool life than Competitor C.
- Compared to Competitor C, 4MFK increased the feed rate by 6.6 times.
- No vibration occurred. Stable milling.

(Evaluation by the user)

SCM415H

- Automotive parts
- n=5,300min^{-1} (Vc=100m/min)
- ap×ae=3.5×0.9mm
- Vf=500mm/min (0.09mm/t)
- Wet



4MFR060-130-R10	**1,000 pcs**	
Competitor Coated Carbide D	**500 pcs**	**Chipping**

[Competitor Coated Carbide D]
Cutting conditions are same as above.

·The 4MFR End Mill machined 1,000 pieces and was available for further machining, while Competitor D could not continue machining because of chipping after processing 500 pieces.

(Evaluation by the user)

4MFK, 4MFR NEW

4

MEGACOAT NANO is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice

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

MEGACOAT NANO | h5 Shank Dia. | 42° 44° | Land 4MFK | Radius R 4MFR

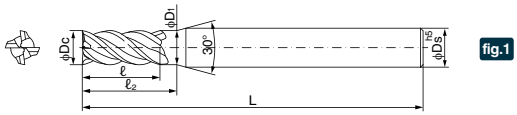


fig.1

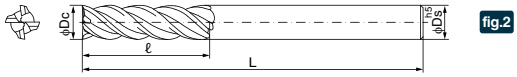


fig.2

4MFK (With corner land)

(Unit: mm)

Description	Std.	Outside Dia. φDc	Mill Dia. tolerance	Length of cut ℓ	* Cutting edge length	Neck Dia. φD1	Under Neck Length ℓ2	Shank Dia. φDs	Overall length L	No. of Flutes Z
4MFK030-045 fig.1	●	3.0	0 -0.015	4.5	S	3.15	5.4	6	60	4
4MFK030-080 fig.1	●			8	M		9.6			
4MFK030-120 fig.1	●			12	L		14.4			
4MFK040-060 fig.1	●	4.0	0 -0.015	6	S	4.2	7.2	6	60	4
4MFK040-110 fig.1	●			11	M		13.2			
4MFK040-120 fig.1	●			12	M(3D)		14.4			
4MFK040-160 fig.1	●			16	L		19.2			
4MFK050-075 fig.1	●	5.0	0 -0.015	7.5	S	5.2	9.0	6	60	4
4MFK050-130 fig.1	●			13	M		15.6			
4MFK050-200 fig.1	●			20	L		24.0			
4MFK060-090 fig.2	●	6.0	0 -0.020	9	S	-	-	6	60	4
4MFK060-130 fig.2	●			13	M					
4MFK060-150 fig.2	●			15	M(2.5D)					
4MFK060-220 fig.2	●			22	L					
4MFK070-105 fig.1	●	7.0	0 -0.020	10.5	S	7.2	12.6	8	70	4
4MFK070-160 fig.1	●			16	M		19.2			
4MFK070-250 fig.1	●			25	L		30.0			
4MFK080-120 fig.2	●	8.0	-0.005 -0.025	12	S	-	-	8	70	4
4MFK080-190 fig.2	●			19	M					
4MFK080-200 fig.2	●			20	M(2.5D)					
4MFK080-280 fig.2	●			28	L					
4MFK090-135 fig.1	●	9.0	-0.005 -0.025	13.5	S	9.2	16.2	10	80	4
4MFK090-205 fig.1	●			20.5	M		24.6			
4MFK100-150 fig.2	●	10.0	-0.005 -0.025	15	S	-	-	10	80	4
4MFK100-220 fig.2	●			22	M					
4MFK100-250 fig.2	●			25	M(2.5D)					
4MFK100-330 fig.2	●			33	L					
4MFK120-180 fig.2	●	12.0	-0.010 -0.030	18	S	-	-	12	100	4
4MFK120-260 fig.2	●			26	M					
4MFK120-360 fig.2	●			36	L					
4MFK160-240 fig.2	●	16.0	-0.010 -0.030	24	S	-	-	16	110	4
4MFK160-350 fig.2	●			35	M					
4MFK160-480 fig.2	●			48	L					

* Applications for each cutting edge length

S : Short
M: Medium ··· Shouldering Slotting
L : Long ····· Shouldering

4MFR (Radius)

(Unit: mm)

Description	Std.	Outside Dia. φDc	Mill Dia. tolerance	Corner Radius r	Length of cut ℓ	Neck Dia. φD1	Under Neck Length ℓ2	Shank Dia. φDs	Overall length L	No. of Flutes Z
4MFR030-080-R02 fig.1	●	3.0	0 -0.015	0.2	8	3.15	9.6	6	60	4
4MFR030-080-R03 fig.1	●			0.3						
4MFR030-080-R05 fig.1	●			0.5						
4MFR040-110-R02 fig.1	●	4.0	0 -0.015	0.2	11	4.2	13.2	6	60	4
4MFR040-110-R03 fig.1	●			0.3						
4MFR040-110-R05 fig.1	●			0.5						
4MFR040-110-R10 fig.1	●			1.0						
4MFR050-130-R02 fig.1	●	5.0	0 -0.015	0.2	13	5.2	15.6	6	60	4
4MFR050-130-R03 fig.1	●			0.3						
4MFR050-130-R05 fig.1	●			0.5						
4MFR050-130-R10 fig.1	●			1.0						
4MFR060-130-R03 fig.2	●	6.0	0 -0.020	0.3	13	-	-	6	60	4
4MFR060-130-R05 fig.2	●			0.5						
4MFR060-130-R10 fig.2	●			1.0						
4MFR060-130-R15 fig.2	●			1.5						
4MFR080-190-R03 fig.2	●	8.0	-0.005 -0.025	0.3	19	-	-	8	70	4
4MFR080-190-R05 fig.2	●			0.5						
4MFR080-190-R10 fig.2	●			1.0						
4MFR080-190-R15 fig.2	●			1.5						
4MFR080-190-R20 fig.2	●			2.0						
4MFR080-190-R30 fig.2	●			3.0						
4MFR100-220-R03 fig.2	●	10.0	-0.005 -0.025	0.3	22	-	-	10	80	4
4MFR100-220-R05 fig.2	●			0.5						
4MFR100-220-R10 fig.2	●			1.0						
4MFR100-220-R15 fig.2	●			1.5						
4MFR100-220-R20 fig.2	●			2.0						
4MFR100-220-R30 fig.2	●			3.0						
4MFR120-260-R05 fig.2	●	12.0	-0.010 -0.030	0.5	26	-	-	12	100	4
4MFR120-260-R10 fig.2	●			1.0						
4MFR120-260-R15 fig.2	●			1.5						
4MFR120-260-R20 fig.2	●			2.0						
4MFR120-260-R30 fig.2	●			3.0						
4MFR160-350-R10 fig.2	●	16.0	-0.010 -0.030	1.0	35	-	-	16	110	4
4MFR160-350-R15 fig.2	●			1.5						
4MFR160-350-R20 fig.2	●			2.0						
4MFR160-350-R30 fig.2	●			3.0						

Recommended Cutting Conditions L54

● : Std. Item

4TFK, 4TFR

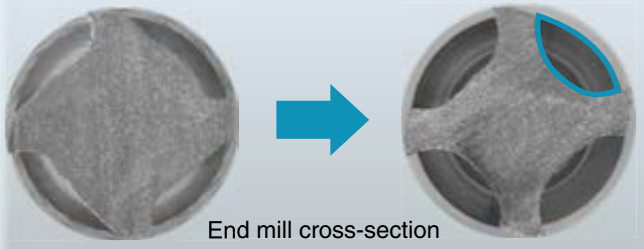
■ High efficiency end mill for high efficiency machining of difficult-to-cut materials (stainless steel, titanium alloys and heat-resistant alloys)

● Optimum edge shape for high efficiency machining

Better chip evacuation at high feed machining
Low cutting force and burr prevention by large rake angle and helix angle

Conventional End Mill

4TFK/4TFR



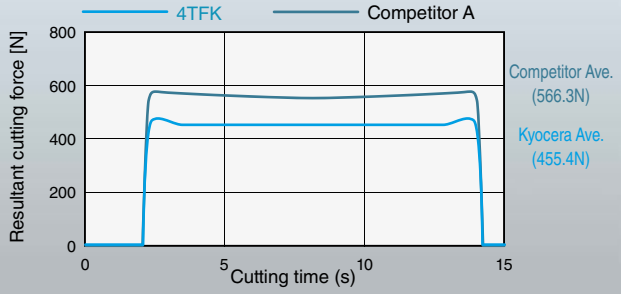
End mill cross-section

Optimum edge shape for high efficiency machining

Excellent chip evacuation at high feed by wide chip pocket and large rake angle

■ 20% reduction of cutting force at slotting

● Cutting force at machining 100mm

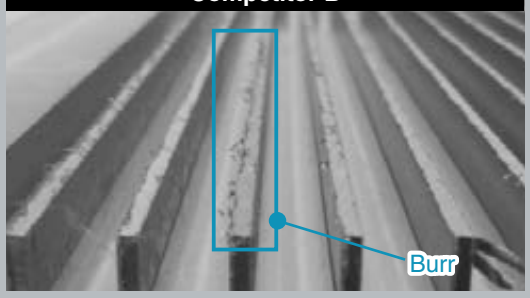


Cutting Condition Workpiece Material : SCM440 End Mill Dia. ϕ6 Dry n=4,800min^{-1} Vf=500m/min ap=6mm

Deep slotting (1xD) by low cutting force design and good chip evacuation

4TFK

Competitor B



Cutting Condition Workpiece Material : SUS304 End Mill Dia. ϕ6 Slotting WET n=3,200min^{-1} Vf=150mm/min ap=6mm

● Varied interval flute design / Variable Lead

Superior anti vibration performance due to Kyocera's unique varied interval flute design / Variable Lead

Varied interval flute design

α≠β

Cutting force varies due to varied interval flute, which prevents periodical vibration during machining

Variable Lead

$\theta_1 \neq \theta_2$

Every flute has its optimum helix angle (lead angle θ), which enables excellent and anti vibration effect and good surface finish

4TFK, 4TFR NEW

4

MEGACOAT NANO is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice

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

MEGACOAT NANO | h5 Shank Dia. | 42° 44° | Land 4TFK | Radius R 4TFR

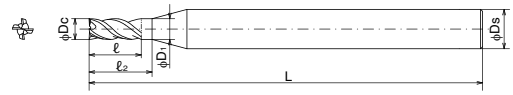


fig.1

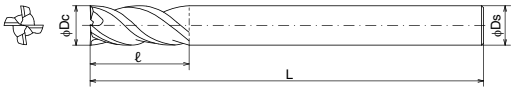


fig.2

4TFK (With corner land)

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	* Cutting edge length	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
4TFK030-045 fig.1	●	3.0	0 -0.015	4.5	S	3.15	5.4	6	60	4
4TFK030-080 fig.1	●			8	M		9.6			
4TFK030-120 fig.1	●			12	L		14.4			
4TFK040-060 fig.1	●	4.0	0 -0.015	6	S	4.2	7.2	6	60	4
4TFK040-120 fig.1	●			12	M		14.4			
4TFK040-160 fig.1	●			16	L		19.2			
4TFK050-075 fig.1	●	5.0	0 -0.015	7.5	S	5.2	9	6	60	4
4TFK050-130 fig.1	●			13	M		15.6			
4TFK050-200 fig.1	●			20	L		24			
4TFK060-090 fig.2	●	6.0	0 -0.020	9	S	-	-	6	60	4
4TFK060-150 fig.2	●			15	M					
4TFK060-220 fig.2	●			22	L					
4TFK070-105 fig.1	●	7.0	0 -0.020	10.5	S	7.2	12.6	8	70	4
4TFK070-160 fig.1	●			16	M		19.2			
4TFK070-250 fig.1	●			25	L		30			
4TFK080-120 fig.2	●	8.0	-0.005 -0.025	12	S	-	-	8	70	4
4TFK080-200 fig.2	●			20	M					
4TFK080-280 fig.2	●			28	L					
4TFK090-135 fig.1	●	9.0	-0.005 -0.025	13.5	S	9.2	16.2	10	80	4
4TFK090-205 fig.1	●			20.5	M		24.6			
4TFK100-150 fig.2	●	10.0	-0.005 -0.025	15	S	-	-	10	80	4
4TFK100-250 fig.2	●			25	M					
4TFK100-330 fig.2	●			33	L					
4TFK120-180 fig.2	●	12.0	-0.010 -0.030	18	S	-	-	12	100	4
4TFK120-260 fig.2	●			26	M					
4TFK120-360 fig.2	●			36	L					
4TFK160-240 fig.2	●	16.0	-0.010 -0.030	24	S	-	-	16	110	4
4TFK160-350 fig.2	●			35	M					
4TFK160-480 fig.2	●			48	L					
4TFK200-300 fig.2	●	20.0	-0.010 -0.030	30	S	-	-	20	125	4
4TFK200-450 fig.2	●			45	M					

4TFR (Radius)

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Corner Radius r	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
4TFR030-080-R02 fig.1	●	3.0	0 -0.015	0.2	8	3.15	9.6	6	60	4
4TFR030-080-R05 fig.1	●			0.5						
4TFR040-120-R02 fig.1	●	4.0	0 -0.015	0.2	12	4.2	14.4	6	60	4
4TFR040-120-R05 fig.1	●			0.5						
4TFR050-130-R02 fig.1	●	5.0	0 -0.015	0.2	13	5.2	15.6	6	60	4
4TFR050-130-R05 fig.1	●			0.5						
4TFR050-130-R10 fig.1	●			1.0						
4TFR060-150-R03 fig.2	●	6.0	0 -0.020	0.3	15	-	-	6	60	4
4TFR060-150-R05 fig.2	●			0.5						
4TFR060-150-R10 fig.2	●			1.0						
4TFR080-200-R03 fig.2	●	8.0	-0.005 -0.025	0.3	20	-	-	8	70	4
4TFR080-200-R05 fig.2	●			0.5						
4TFR080-200-R10 fig.2	●			1.0						
4TFR080-200-R20 fig.2	●			2.0						
4TFR100-250-R03 fig.2	●	10.0	-0.005 -0.025	0.3	25	-	-	10	80	4
4TFR100-250-R05 fig.2	●			0.5						
4TFR100-250-R10 fig.2	●			1.0						
4TFR100-250-R15 fig.2	●			1.5						
4TFR100-250-R20 fig.2	●			2.0						
4TFR100-250-R30 fig.2	●			3.0						
4TFR120-260-R05 fig.2	●	12.0	-0.010 -0.030	0.5	26	-	-	12	100	4
4TFR120-260-R10 fig.2	●			1.0						
4TFR120-260-R15 fig.2	●			1.5						
4TFR120-260-R20 fig.2	●			2.0						
4TFR120-260-R30 fig.2	●			3.0						
4TFR160-350-R10 fig.2	●	16.0	-0.010 -0.030	1.0	35	-	-	16	110	4
4TFR160-350-R20 fig.2	●			2.0						
4TFR160-350-R30 fig.2	●			3.0						
4TFR200-450-R10 fig.2	●	20.0	-0.010 -0.030	1.0	45	-	-	20	125	4
4TFR200-450-R20 fig.2	●			2.0						
4TFR200-450-R30 fig.2	●			3.0						

Recommended Cutting Conditions L55

* Applications for each cutting edge length

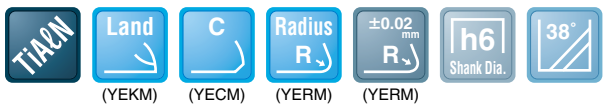
S : Short
M: Medium } ··· Shouldering Slotting
L : Long ····· Shouldering

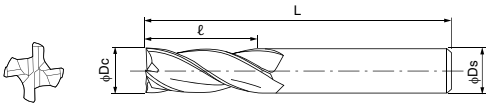
● : Std. Item

No. of Flutes: 4

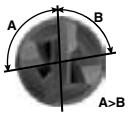
4YEKM, 4YECM, 4YERM

Workpiece Materials ★ 1st Choice





4



4YECM's Varied interval flute design

4YEKM (With corner land)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners	No. of Flutes Z
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

4YECM (With corner chamfering)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners	No. 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

4YERM (Radius)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners	No. of Flutes Z
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
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

- Varied interval flute design prevents vibration and reduces cutting force at slotting.
  This has led to the high speed and high feed rate machining.
  We provide three types of edge shape for different application; Radius, Corner Land and Corner Chamfered type.
  There is Maximum 0.01mm back taper.

Recommended Cutting Conditions ➔ L55

● : Std. Item

High efficiency chip evacuation, for Steel and Difficult-to-cut materials, Varied interval flute design

No. of Flutes: 5

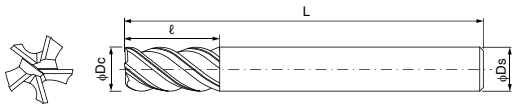
5DEKM, 5DERM

5

Workpiece Materials ★ 1st Choice

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

ACTiN | Land (DEKM) | Radius R (DERM) | ±0.05 mm R (DERM) | h6 Shank Dia. | 38°



5DEKM (With corner land)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

5DERM (Radius)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners	No. of Flutes Z
5DERM040-120-06-R025	●	4	-0.020 -0.038	12	6	55	R0.25	5
5DERM050-130-06-R025	●	5	-0.020 -0.038	13	6	57	R0.25	5
5DERM060-130-06-R040	●	6	-0.020 -0.038	13	6	57	R0.4	5
5DERM080-160-08-R050	●	8	-0.025 -0.047	16	8	63	R0.5	5
5DERM090-190-10-R050	●	9	-0.025 -0.047	19	10	72	R0.5	5
5DERM100-220-10-R050	●	10	-0.025 -0.047	22	10	72	R0.5	5
5DERM120-260-12-R075	●	12	-0.032 -0.059	26	12	83	R0.75	5
5DERM160-320-16-R075	●	16	-0.032 -0.059	32	16	92	R0.75	5
5DERM200-380-20-R075	●	20	-0.040 -0.073	38	20	104	R0.75	5
5DERM250-450-25-R075	●	25	-0.040 -0.073	45	25	121	R0.75	5

- 5 edge design enables high feed rate machining. Varied intervals prevent vibration. 5DERM is suitable for 0.8Dc slotting.

Recommended Cutting Conditions ➔ L56

Steel and Difficult-to-cut materials, Finishing

No. of Flutes: 4, 6

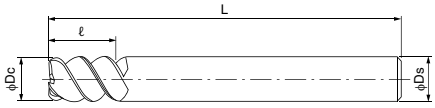
4YFSM, 6YFSM

4 6

Workpiece Materials ★ 1st Choice

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

TiAlN | Sharp | h6 Shank Dia. | 45°



4YFSM

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

6YFSM

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
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

- Multiple flutes type with excellent chip evacuation. (Core Diameter Ratio: 60%) It has positive type rake angle and suitable for semi-finishing of difficult-to-cut materials such as stainless steel and nickel high-heat resistance alloy.

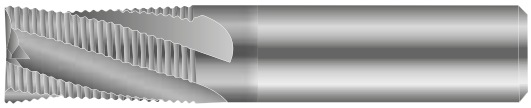
Recommended Cutting Conditions ➔ L57

● : Std. Item

High efficiency chip evacuation, Roughing, serrated edge

No. of Flutes: 3, 4, 5

3RDS, 4RDS, 5RDS

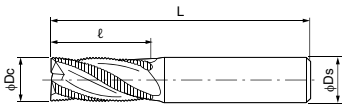


3 4 5

Workpiece Materials ★ 1st Choice

★ P ~30HRC ★ P 30~40HRC M Stainless steel ★ K Cast Iron

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



3RDSM, 4RDSM, 5RDSM (Medium)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners C	No. of Flutes Z
3RDSM040-110-06	●	4	-0.030 -0.105	11	6	55	0.3	3
3RDSM050-130-06	●	5	-0.030 -0.105	13	6	57	0.3	3
3RDSM060-130-06	●	6	-0.030 -0.105	13	6	57	0.3	3
3RDSM080-160-08	●	8	-0.040 -0.130	16	8	63	0.3	3
4RDSM100-220-10	●	10	-0.040 -0.130	22	10	72	0.5	4
4RDSM120-260-12	●	12	-0.050 -0.160	26	12	83	0.5	4
4RDSM160-320-16	●	16	-0.050 -0.160	32	16	92	0.5	4
4RDSM200-380-20	●	20	-0.065 -0.195	38	20	104	0.5	4
5RDSM250-450-25	●	25	-0.065 -0.195	45	25	121	0.5	5

3RDSL, 4RDSL, 5RDSL (Long)

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners C	No. of Flutes Z
3RDSL060-240-06	●	6	-0.030 -0.105	24	6	76	0.3	3
3RDSL080-280-08	●	8	-0.040 -0.130	28	8	76	0.3	3
4RDSL100-340-10	●	10	-0.040 -0.130	34	10	89	0.5	4
4RDSL120-450-12	●	12	-0.050 -0.160	45	12	100	0.5	4
4RDSL160-560-16	●	16	-0.050 -0.160	56	16	125	0.5	4
4RDSL200-600-20	●	20	-0.065 -0.195	60	20	125	0.5	4
5RDSL250-800-25	●	25	-0.065 -0.195	80	25	150	0.5	5

- Three, four and five flutes types are available for roughing. They reduce cutting force due to the edge design with sine-curve pattern.

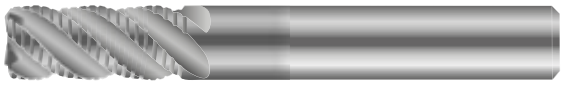
Recommended Cutting Conditions ➔ **L57~L58**

● : Std. Item

High efficiency chip evacuation Roughing, Notched edge

No. of Flutes: 4, 6

4RFSM, 6RFSM

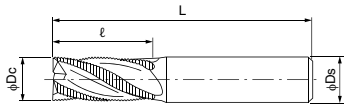


4 6

Workpiece Materials ★ 1st Choice

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

TiAlN | Cutting edge shape: C | h6 Shank Dia. | 45°



4RFSM

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners C	No. of Flutes Z
4RFSM060-130-06	●	6	-0.030 -0.105	13	6	57	0.3	4
4RFSM080-160-08	●	8	-0.040 -0.130	16	8	63	0.4	4
4RFSM100-220-10	●	10	-0.040 -0.130	22	10	72	0.5	4
4RFSM120-260-12	●	12	-0.050 -0.160	26	12	83	0.6	4
4RFSM160-320-16	●	16	-0.050 -0.160	32	16	92	0.6	4
4RFSM200-380-20	●	20	-0.065 -0.195	38	20	104	1.0	4

6RFSM

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners C	No. of Flutes Z
6RFSM160-320-16	●	16	-0.050 -0.160	32	16	92	0.6	6
6RFSM200-380-20	●	20	-0.065 -0.195	38	20	104	1.0	6
6RFSM250-450-25	●	25	-0.065 -0.195	45	25	121	1.1	6

Recommended Cutting Conditions L58

- RFS type is applicable for hard materials and titanium alloys due to strong cutting edge with notched surface and 45 degrees helix angle.

High efficiency chip evacuation Roughing, Notched edge, Radius

No. of Flutes: 3, 4

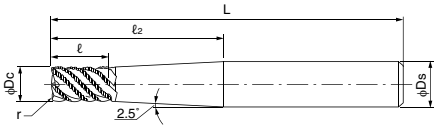
3RFRS, 4RFRS

3 4

Workpiece Materials ★ 1st Choice

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

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



3RFRS (Radius)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners r	Under Neck Length ℓ2	No. 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

4RFRS (Radius)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners r	Under Neck Length ℓ2	No. of Flutes Z
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

- Due to the strong cutting edge with large flat surface, it is suitable for hard materials and titanium alloys. It can provide good surface roughness of 2.5 to 4.9 μmRa.

Recommended Cutting Conditions L59

● : Std. Item

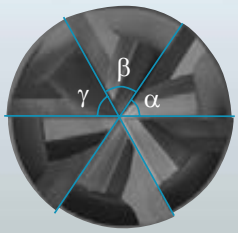
6PFK, 8PFK

High efficiency machining and superior surface finish due to new special flute design

● Varied interval flute design / Variable Lead

Superior anti vibration performance due to Kyocera's unique varied interval flute design / Variable Lead

Varied interval flute design



$\alpha \neq \beta \neq \gamma$

Cutting force varies due to varied interval flute, which prevents periodical vibration during machining

Variable Lead

$\theta_1 \neq \theta_2 \neq \theta_3$

Every flute has its optimum helix angle (lead angle θ), which enables excellent and anti vibration effect and good surface finish

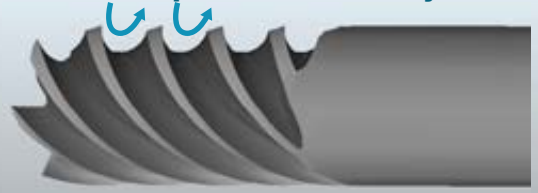
Surface finish comparison (side surface) End Mill Dia. ϕ12

Workpiece Material	SCM440	SUS304	Ti6Al-4V
Cutting Conditions	n=3,300min^{-1} (Vc=124m/rev) Vf=2,000mm/min (fz=0.1mm/t) ap×ae=30×1.5mm	n=2,500min^{-1} (Vc=94m/rev) Vf=1,130mm/min (fz=0.08mm/t) ap×ae=30×0.6mm	n=2,500min^{-1} (Vc=94m/rev) Vf=1,130mm/min (fz=0.08mm/t) ap×ae=30×0.6mm
Results	6PFK ✓	6PFK ✓	6PFK ✓
	Competitor A Chattering occurred	Competitor A Chattering occurred	Competitor A Dull surface due to poor approach

High feed and high efficiency shouldering with Multi-edge design (6 flutes/8 flutes)
Good surface finish

● Special flute design

Stable chip evacuation by new special flute design



Good chip evacuation with wide chip pocket
Good performance at high feed machining

6PFK, 8PFK NEW

6 8

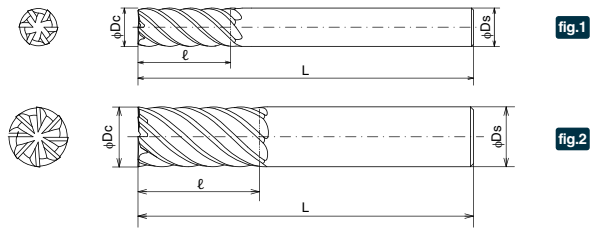
MEGACOAT NANO is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice

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

MEGACOAT NANO | h5 Shank Dia. | 42° 44° | Land



6PFK, 8PFK (Medium)

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
6PFK060-150 fig.1	●	6.0	0 -0.020	15	6	60	6
6PFK080-200 fig.1	●	8.0	-0.005 -0.025	20	8	70	6
6PFK100-250 fig.1	●	10.0	-0.005 -0.025	25	10	80	6
6PFK120-300 fig.1	●	12.0	-0.010 -0.030	30	12	100	6
6PFK160-400 fig.1	●	16.0	-0.010 -0.030	40	16	110	6
6PFK200-450 fig.1	●	20.0	-0.010 -0.030	45	20	125	6
8PFK250-500 fig.2	●	25.0	-0.010 -0.030	50	25	140	8

6PFK, 8PFK (Long)

(Unit: mm)

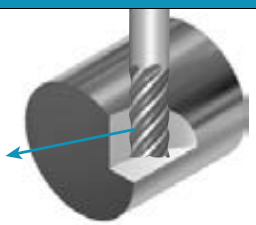
Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
6PFK060-250 fig.1	●	6.0	0 -0.020	25	6	70	6
6PFK080-350 fig.1	●	8.0	-0.005 -0.025	35	8	90	6
6PFK100-450 fig.1	●	10.0	-0.005 -0.025	45	10	100	6
6PFK120-550 fig.1	●	12.0	-0.010 -0.030	55	12	120	6
6PFK160-650 fig.1	●	16.0	-0.010 -0.030	65	16	135	6
6PFK200-750 fig.1	●	20.0	-0.010 -0.030	75	20	155	6
6PFK200-1000 fig.1	●	20.0	-0.010 -0.030	100	20	180	6
8PFK250-1000 fig.2	●	25.0	-0.010 -0.030	100	25	180	8

Recommended Cutting Conditions L59

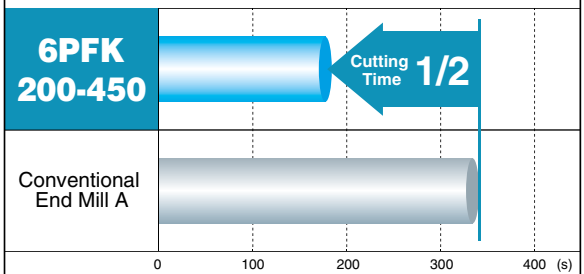
Case Studies

SCM440

- Machine parts
- Vc=150m/min (n=2,400min^{-1})
- fz=0.12mm/t (Vf=1,710mm/min)
- ap=18mm, ae=1.0mm
- Shouldering



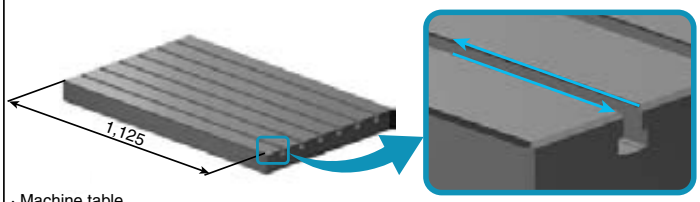
Cycle time for a set of workpiece (setup time included)



- Cycle time greatly reduced compared with the conventional tool A
- No heavy wear after machining 100 workpieces and still possible to continue machining

(Evaluation by the user)

FC250



· Machine table

6PFK200-450

● **Finishing** (1 pass)
- n=2,500min^{-1} (Vc=157m/min)
- apxae=35x1.2mm
- Vf=3,500mm/min (fz=0.23mm/t)

Cutting Time 1/8

Cutting Time 10 min. (1,125mm x 24 slots)

Competitor Coated Carbide B

● **Semi finishing**
- n=2,500min^{-1} (Vc=157m/min)
- apxae=35x1.0mm
- Vf=1,500mm/min (fz=0.1mm/t)

● **Finishing**
- n=2,000min^{-1} (Vc=125m/min)
- apxae=35x0.2mm
- Vf=1,000mm/min (fz=0.1mm/t)

Cutting Time 80 min. (1,125mm x 24 slots) 2 passes

- Competitor B machined the workpiece with 2 passes due to chattering.
- 6PFK machined the workpiece with 1 pass without chattering. Productivity has greatly improved by increasing cutting conditions.

(Evaluation by the user)

● : Std. Item

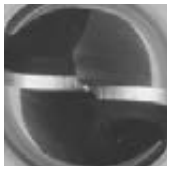
2SEB

Special cutting edge concept and nano layer coating realized high precision and long tool life machining

Point 1 Sharp cutting due to special nose geometry

Arc-like cutting edge distributes the cutting force and controls wear progress

2SEB

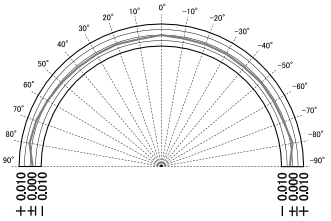


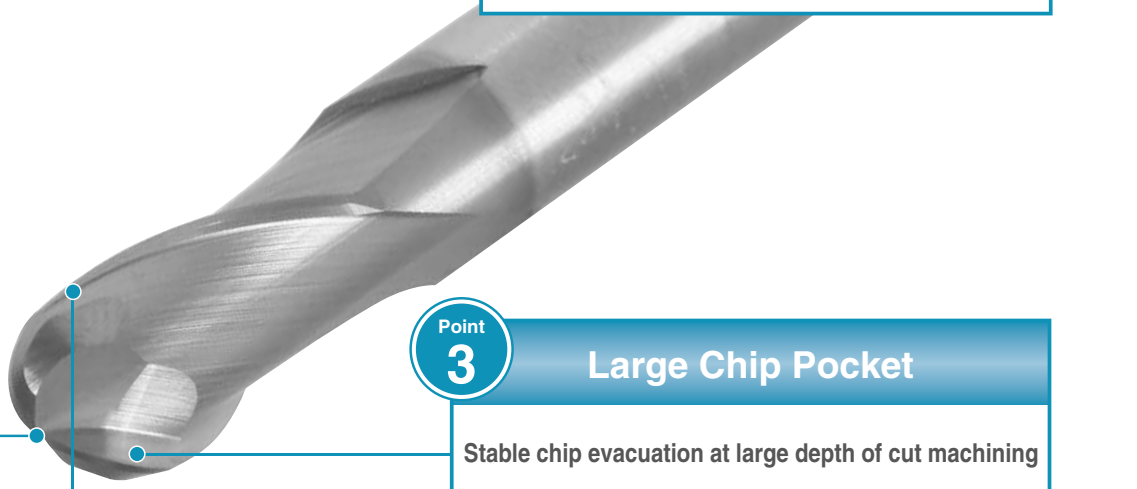
Conventional End Mill

(Internal evaluation)

Point 2 R0.005mm close tolerance edge diameter (ϕ16 excluded)

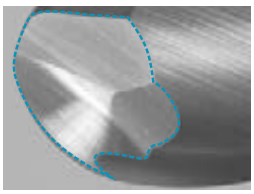
Excellent surface finish quality when using entire cutting edge in machining of the mold's draft angle or profiling



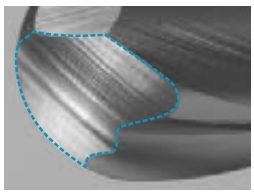


Point 3 Large Chip Pocket

Stable chip evacuation at large depth of cut machining



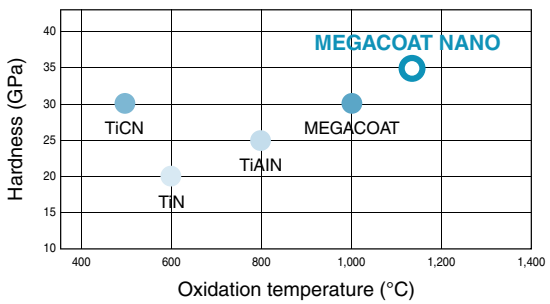
2SEB



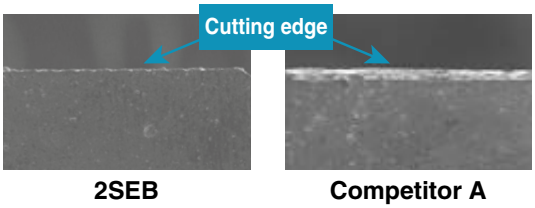
Conventional End Mill

(Internal evaluation)

Point 4 High quality cutting edge by MEGACOAT NANO



Smooth and sharp cutting edge with superior wear resistance and adhesion resistance



2SEB

Competitor A

(Internal evaluation)

Ball-nose End Mill (Copying)

No. of Flutes: 2

2SEB NEW

MEGACOAT NANO is applied

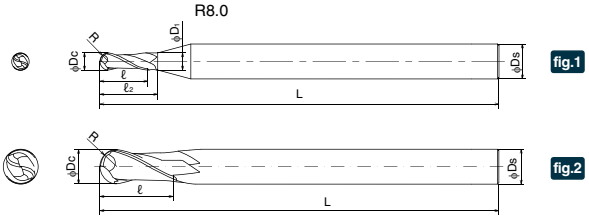
Super Micro-grain carbide

Workpiece Materials ★ 1st Choice

P ~30HRC	P 30~40HRC	H ~55HRC	H ~68HRC	M Stainless steel	K Cast Iron
★	★	★			

MEGACOAT NANO | ±0.005 mm R↘ | ±0.010 mm R↘ | h5 Shank Dia. | 30°

R8.0



2SEB (Ball-nose End Mill with 2 Flutes)

Copying

(Unit: mm)

Description	Std.	Radius of Ball-nose R	Radius of Ball Nose Tolerance	Outside Dia. ϕDc	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
2SEB020-050-R10 fig.1	●	1.0	±0.005	2.0	5	2.10	6.6	6	50	2
2SEB030-080-R15 fig.1	●	1.5	±0.005	3.0	8	3.15	9.8	6	70	2
2SEB040-080-R20 fig.1	●	2.0	±0.005	4.0	8	4.2	10.0	6	70	2
2SEB050-100-R25 fig.1	●	2.5	±0.005	5.0	10	5.2	12.4	6	80	2
2SEB060-120-R30 fig.2	●	3.0	±0.005	6.0	12	-	-	6	90	2
2SEB080-140-R40 fig.2	●	4.0	±0.005	8.0	14	-	-	8	100	2
2SEB100-180-R50 fig.2	●	5.0	±0.005	10.0	18	-	-	10	100	2
2SEB120-220-R60 fig.2	●	6.0	±0.005	12.0	22	-	-	12	110	2
2SEB160-300-R80 fig.2	●	8.0	±0.010	16.0	30	-	-	16	140	2

Solid End Mill Identification System (2SEB)

2 S E B 020 - 050 - R10

(1) (2) (3) (4) (5) (6) (7)

(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Outside Dia.	(6) Length of cut	(7) Radius of Ball-nose
2	S: High efficiency	E: 30-39°	B: Ball-nose End Mill	020 ↓ 2.0mm	050 ↓ 5.0mm	R10 ↓ R1.0mm

Recommended Cutting Conditions L60

● : Std. Item

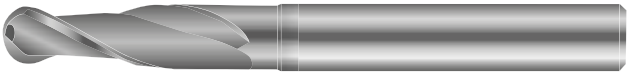
Ball-nose End Mill (Copying)

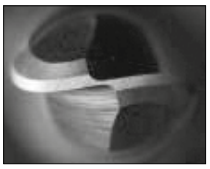
No. of Flutes: 2, 3

2UEBS (Ball-nose End Mill with 2 Flutes)

Workpiece Materials ★ 1st Choice

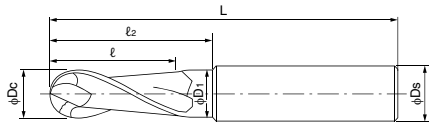
P ~30HRC ★ | P 30~40HRC ★ | K Cast Iron ★





2

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



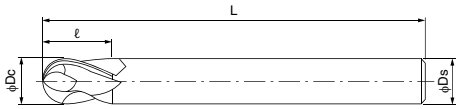
3UEBS (Ball-nose End Mill with 3 Flutes)

Workpiece Materials ★ 1st Choice

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

3

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



2UEBS (Ball-nose End Mill with 2 Flutes) Copying

(Unit: mm)

Description	Std.	*Radius of Ball-nose R	Outside Dia. ϕDc	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L
2UEBS010-030-04	●	R0.5	1	3	-	-	4	50
2UEBS020-030-04	●	R1	2	3	-	-	4	50
2UEBS030-095-06	●	R1.5	3	9.5	-	-	6	58
2UEBS040-120-06	●	R2	4	12	-	-	6	76
2UEBS050-140-06	●	R2.5	5	14	-	-	6	76
2UEBS060-160-06	●	R3	6	16	5.5	40	6	100
2UEBS080-200-08	●	R4	8	20	7.5	40	8	100
2UEBS100-220-10	●	R5	10	22	9.5	35	10	100
2UEBS120-250-12	●	R6	12	25	11.5	50	12	125
2UEBS160-320-16	●	R8	16	32	15.5	60	16	150
2UEBS200-380-20	●	R10	20	38	19.5	60	20	150

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

3UEBS (Ball-nose End Mill with 3 Flutes) Copying

(Unit: mm)

Description	Std.	*Radius of Ball-nose R	Outside Dia. ϕDc	Length of cut ℓ	Shank Dia. ϕDs	Overall length L
3UEBS030-070-06	●	R1.5	3	7	6	57
3UEBS040-080-06	●	R2	4	8	6	57
3UEBS050-100-06	●	R2.5	5	10	6	57
3UEBS060-100-06	●	R3	6	10	6	57
3UEBS080-160-08	●	R4	8	16	8	63
3UEBS100-190-10	●	R5	10	19	10	72
3UEBS120-220-12	●	R6	12	22	12	83

● Ball-nose end mill with three flutes for machining of difficult-to-cut materials.

Recommended Cutting Conditions L60

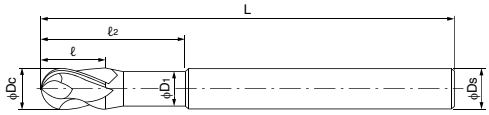
● : Std. Item

Ball-nose End Mill with 4 flutes

No. of Flutes: 4

4YEBM

Workpiece Materials ★ 1st Choice



4YEBM (Ball-nose End Mill with 4 Flutes)

Shouldering Slotting

(Unit: mm)

Description	Std.	*Radius of Ball-nose	Outside Dia.	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length
		R	ϕDc	ℓ	ϕD1	ℓ2	ϕDs	L
4YEBM050-090-06	●	R2.5	5	9	4.5	15	6	57
4YEBM060-100-06	●	R3	6	10	5.5	15	6	57
4YEBM080-120-08	●	R4	8	12	7.4	20	8	63
4YEBM100-140-10	●	R5	10	14	9.2	25	10	72
4YEBM120-160-12	●	R6	12	16	11	30	12	83
4YEBM160-220-16	●	R8	16	22	15	38	16	92
4YEBM200-260-20	●	R10	20	26	19	50	20	104

No. of Flutes Z=4

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

● Ball-nose end mill for semi-finishing of difficult-to-cut materials.

Recommended Cutting Conditions L61

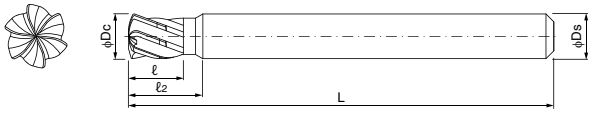
● : Std. Item

Special corner-R shaped, 6 flutes, High feed rate

No. of Flutes: 6

6PDRS

Workpiece Materials ★ 1st Choice

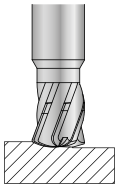


6PDRS

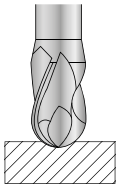
(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ℓ2	ϕDs	L	Z
6PDRS060-045-06	●	6	-0.020 -0.038	4.5	9	6	57	6
6PDRS080-060-08	●	8	-0.025 -0.047	6	12	8	63	6
6PDRS100-075-10	●	10	-0.025 -0.047	7.5	15	10	72	6
6PDRS120-090-12	●	12	-0.032 -0.059	9	18	12	83	6

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

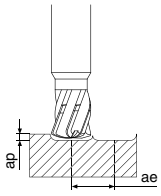


PDR



General Purpose Ball-nose End Mill

Recommended Cutting Conditions



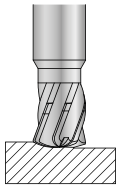
Copying

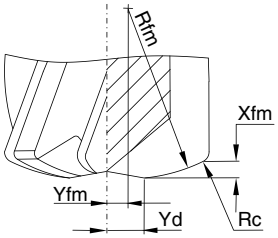
Workpiece Material		Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12
Pre-hardened steel	52HRC	ϕ6 : 0.32×3.3mm (0.32×0.55Dc) ϕ8 : 0.42×4.4mm (0.42×0.55Dc) ϕ10: 0.53×5.5mm (0.53×0.55Dc) ϕ12: 0.63×6.6mm (0.63×0.55Dc)	Spindle Revolution(min^{-1})	6,400	4,800	3,800	3,200
			Feed Rate(mm/min)	7,600	7,200	6,900	7,600
Carbon Steel / Alloy Steel	< 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

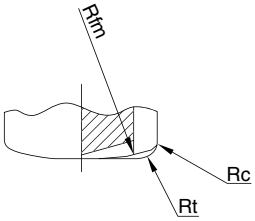
● : Std. Item

6PDRS Ramping / Arc cutting

Details of 6PDRS cutting edge shape







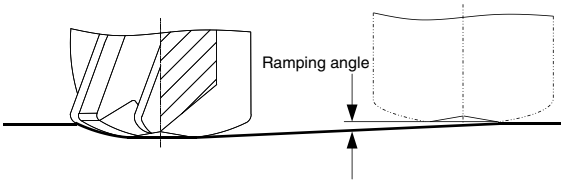
Xfm : Maximum Depth of Cut
Yfm : Distance between the center line of tool and the center of Rfm
Yd : Distance between the center line of tool and the start position of cutting edge
Rfm : Radius of tool tip
Rc : Corner-R
Rt : Virtual radius in program

Description	Outside Dia.	Maximum Depth of Cut	Radius of tool tip	Corner-R	Distance between the center line of tool and the center of Rfm	Distance between the center line of tool and the start position of cutting edge	Virtual radius in program
	ϕDc	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

- Cutting with cut amount exceeding the Xfm value is not recommended.

Ramping

During ramping, lower the feed rate to the ratio in the chart on the right.

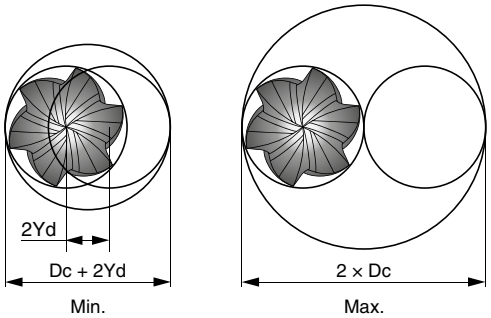


Ramping angle	1°	2°	3°	4°	5°
Ratio of feed rate	100%	70%	50%	30%	10%

- During pocket machining, set the ramping angle at 0.5°.
- Vertical milling is not recommended.

Circular Interpolation

For arc cutting, hole diameter of each machining should be within the range in the chart on the right.



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

No. of Flutes: 4, 5, 6, 7, 8

4HFS, 5HFS, 6HFS, 7HFS, 8HFS

4 5 6 7 8 HFSM

MEGACOAT Hard is applied

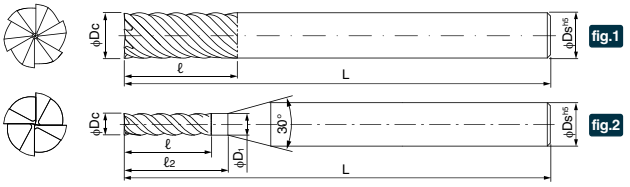
Super Micro-grain carbide

High Efficiency Machining

Workpiece Materials ★ 1st Choice

★ P ~30HRC ★ P 30~40HRC ★ H ~55HRC ★ H ~68HRC

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

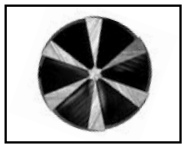


4HFSS, 5HFSS, 6HFSS, 7HFSS (Short)

Shouldering

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ℓ2	ϕDs	L	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
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
7HFSS060-140-06 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



Bottom surface of 6HFSS cutting edge

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

Shouldering

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ℓ2	ϕDs	L	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
6HFSM070-200-08 fig.2	●	7	-0.005 -0.025	20	7.2	24.0	8	70	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
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
7HFSM160-420-16 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

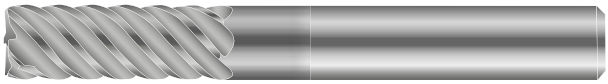
- PVD coating "MEGACOAT Hard" for hard materials.
  Achieves high rigidity by ensuring a large core diameter, longer tool life and stable machining.
  Also increases cutting edge strength and chip evacuation with a negative rake angle.

Recommended Cutting Conditions ➔ L61

● : Std. Item

No. of Flutes: 4, 6

4UGSM, 6UGSM



Workpiece Materials ★ 1st Choice

4UGSM

Shouldering

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕDs	L	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

6UGSM

Shouldering

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕDs	L	Z
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. larger than 6mm.

Recommended Cutting Conditions L62

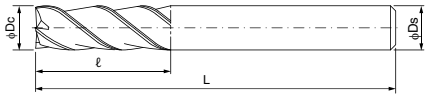
● : Std. Item

Aluminum & Non-ferrous Metals, Varied interval flute design, With wiper edge

No. of Flutes: 3

3NESM

Workpiece Materials ★ 1st Choice



3NESM

Shouldering Slotting

(Unit: mm)

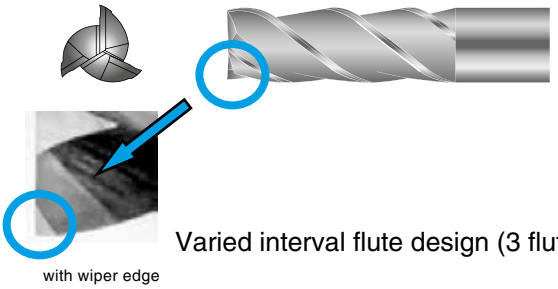
Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕDs	L	Z
3NESM030-120-06	●	3	-0.014 -0.028	12	6	50	3
3NESM040-120-06	●	4	-0.020 -0.038	12	6	50	3
3NESM050-140-06	●	5	-0.020 -0.038	14	6	50	3
3NESM060-160-06	●	6	0 -0.008	16	6	50	3
3NESM080-200-08	●	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

* Cutting edge of over 6mm ϕDc has margin.

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

Finished surface of aluminum alloy at high speed machining.

Reached 0.25μmRa
(Bottom face /
side face/corner)



Varied interval flute design (3 flutes)

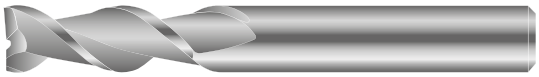
with wiper edge

Recommended Cutting Conditions ➔ L62

● : Std. Item

No. of Flutes: 2, 3

2NFSM, 3NFSM, 3NFSL

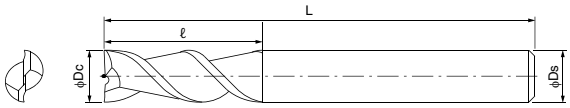


2 3

Workpiece Materials ★ 1st Choice

N Aluminum & Non Ferrous Material

Uncoated | Sharp | h6 Shank Dia. | 45°



2NFSM (Medium)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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
2NFSM160-320-16	●	16	0 -0.011	32	16	89	2
2NFSM200-380-20	●	20	0 -0.013	38	20	104	2

* Cutting edge of over 6mm ϕDc has margin.

3NFSM (Medium)

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
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

* Cutting edge of over 6mm ϕDc has margin.

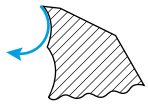
3NFSL (Long)

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. Tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. 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

* Cutting edge of over 6mm ϕDc has margin.

NFSM type NFSL type rake angle	A convex shape in the slot improves chip evacuation. 

- Sharpness oriented for aluminum machining.
  Good chip evacuation from the 45 degrees helix angle.

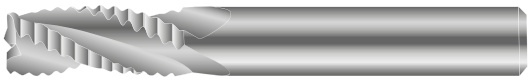
Recommended Cutting Conditions ➔ L62~L63

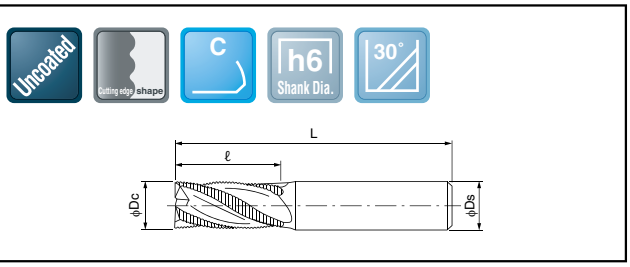
● : Std. Item

No. of Flutes: 3

3AESM, 3AESL

Workpiece Materials ★ 1st Choice





3AESM (Medium)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners C	No. 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

3AESL (Long)

Shouldering

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	Spec of Corners C	No. 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

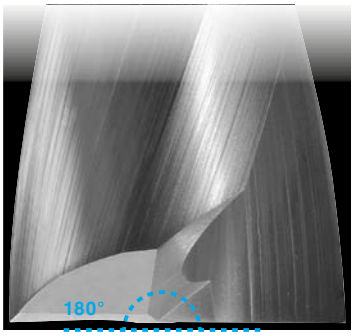
● Three flutes type for roughing of aluminum.With corner chamfering.

Recommended Cutting Conditions ➔ L63

● : Std. Item

2ZDK

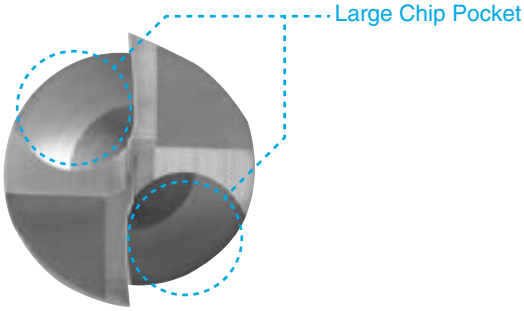
**Edge ends have 180° flat and are applicable to various applications.
Available for high-precision counterboring.
Optimum tool for improvement and cost reduction of difficult machining processes.**



Flat Bottom

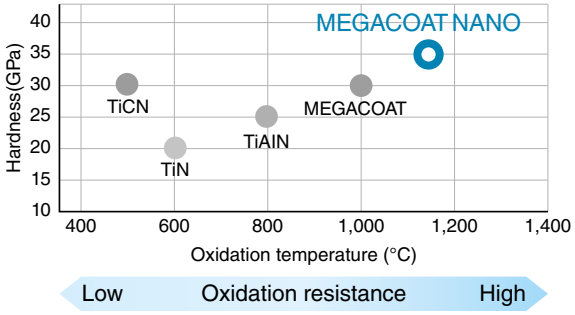
● Smooth Chip Evacuation

· Combination of smooth chip control and high rigidity due to the special flute shape



● Long Tool Life with "MEGACOAT NANO"

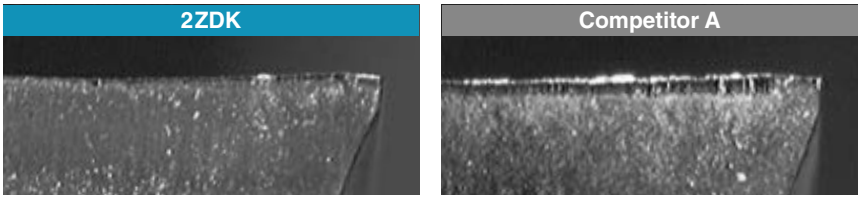
· The special Multilayer Nano Coating prevents wear and chipping with high hardness (35GPa) and superior oxidation resistance (oxidation temperature: 1,150 °C)



■ Tool Life Comparison (S45C, 200 holes) (Internal evaluation)

Stable Cutting with Minimum Wear

● Wear Comparison of Bottom Edge

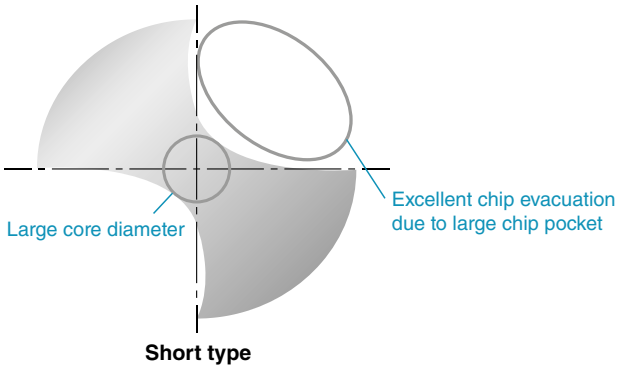


Cutting Conditions:
n=3,000min^{-1}
Vf=420mm/min
Drilling Depth=12mm (1.5D)
Wet

NEW Short type is now available

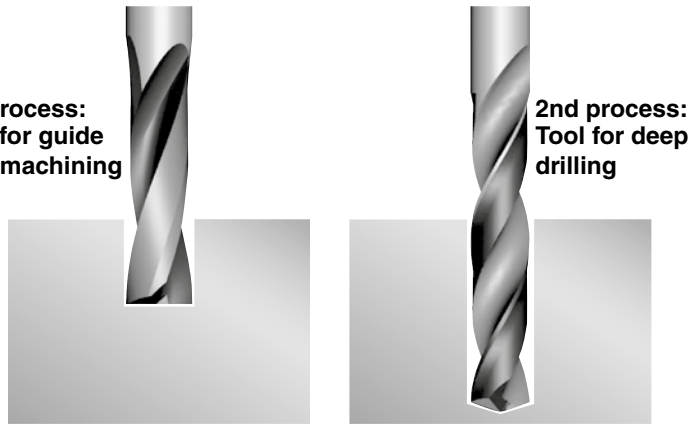
Short type is highly rigid due to large core diameter

Suitable for shallow drilling under 1.5D



Short type

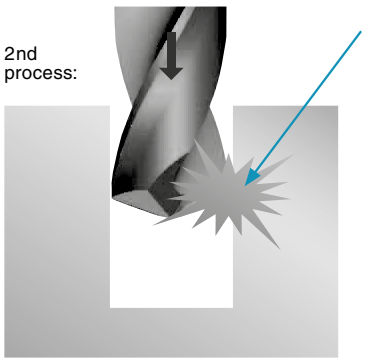
Convenient plus tolerance is available for ϕ6 type (2ZDK060S-P)



◎ Usage example of plus tolerance for ϕ6 type

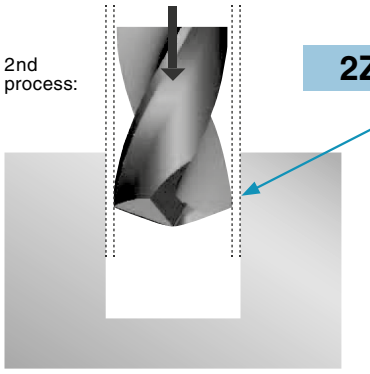
Suitable situation

⊘ 1st process: Tool for guide hole machining: Minus tolerance
2nd process: Tool for deep drilling: Minus tolerance



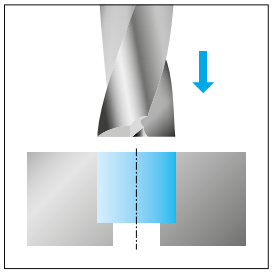
- Hole distortion, bending
- Effects on finished surface
- Effects on dimension of diameter

✓ 1st process: Tool for guide hole machining: Plus tolerance
2nd process: Tool for deep drilling: Minus tolerance

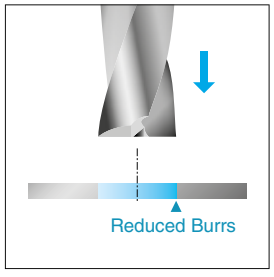


● Applications

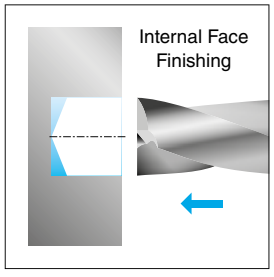
Hole Counterboring



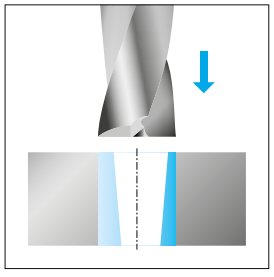
Plunging on Thin Plate



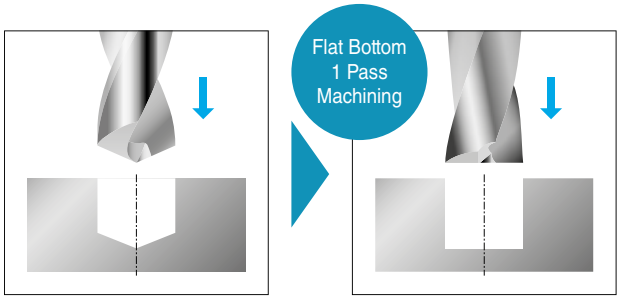
Turning in Automatic Lathes / Turning



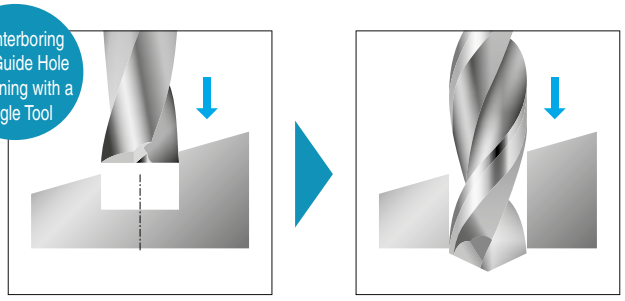
Hole Expanding



Bottom Finishing after Drilling



Counterboring on Slant Surface / Guide Hole Machining



No. of Flutes: 2

2ZDK

Workpiece Materials ★ 1st Choice

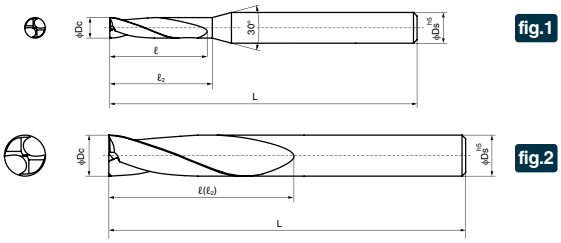
P ~30HRC ★ | P 30~40HRC ★ | K Cast Iron | N Aluminum & Non Ferrous Material

2

MEGACOAT NANO is applied

Super Micro-grain carbide

MEGACOAT NANO | h5 Shank Dia.



2ZDK

Plunge milling

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Flute Length	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ℓ2	ϕDs	L	Z
2ZDK030 fig.1	●	3.0	0 -0.010	14	15	6	60	2
2ZDK033 fig.1	●	3.3	0 -0.012	15	16			
2ZDK035 fig.1	●	3.5		17	18			
2ZDK040 fig.1	●	4.0		19	20			
2ZDK042 fig.1	●	4.2		20	21			
2ZDK045 fig.1	●	4.5		21	22			
2ZDK050 fig.1	●	5.0		23	24			
2ZDK053 fig.1	●	5.3		24	25			
2ZDK055 fig.1	●	5.5		25	26			
2ZDK056 fig.1	●	5.6		26	27			
2ZDK060 fig.2	●	6.0		28	(28)			
2ZDK065 fig.1	●	6.5	0 -0.015	30	31	8	70	
2ZDK068 fig.1	●	6.8		31	32			

Description	Std.	Outside Dia.	Mill Dia. tolerance	Flute Length	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ℓ2	ϕDs	L	Z
2ZDK070 fig.1	●	7.0	0 -0.015	32	33	8	70	2
2ZDK075 fig.1	●	7.5		34	35			
2ZDK080 fig.2	●	8.0		36	(36)			
2ZDK085 fig.1	●	8.5	0 -0.015	38	39	10	80	
2ZDK088 fig.1	●	8.8		39	40			
2ZDK090 fig.1	●	9.0		40	41			
2ZDK095 fig.1	●	9.5		42	43			
2ZDK100 fig.2	●	10.0		45	(45)			
2ZDK103 fig.1	●	10.3	0 -0.018	46	47	12	100	
2ZDK105 fig.1	●	10.5		47	48			
2ZDK110 fig.1	●	11.0		51	52			
2ZDK115 fig.1	●	11.5		53	54			
2ZDK120 fig.2	●	12.0		54	(54)			

*** This tool is specially designed for plunging and NOT recommended for slotting.**

· Helix Angle is 20°

· The drilling depth should be less than 2D(2×Dc) when the workpiece is not pre-drilled.

Recommended Cutting Conditions L64

● : Std. Item

No. of Flutes: 2

2ZDK (Short type)

Workpiece Materials ★ 1st Choice

P ~30HRC ★ | P 30~40HRC ★ | K Cast Iron | N Aluminum & Non Ferrous Material

2

MEGACOAT NANO is applied

Super Micro-grain carbide

MEGACOAT NANO | h5 Shank Dia. ~ϕ12 | h6 Shank Dia. ϕ12.5~

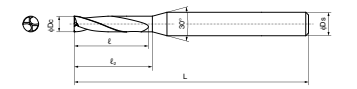


fig.1

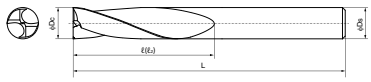


fig.2

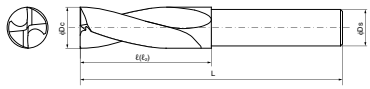


fig.3

2ZDK (Short type)

Plunge milling

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Flute Length	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ℓ2	ϕDs	L	Z
2ZDK010S fig.1	●	1.0	0 -0.010	3	4	4	50	2
2ZDK011S fig.1	MTO	1.1		3.5	4.5			
2ZDK012S fig.1	MTO	1.2						
2ZDK013S fig.1	MTO	1.3		4	5			
2ZDK014S fig.1	MTO	1.4		4.5	5.5			
2ZDK015S fig.1	●	1.5		5	6			
2ZDK016S fig.1	●	1.6						
2ZDK017S fig.1	MTO	1.7		5.5	6.5			
2ZDK018S fig.1	MTO	1.8		6	7			
2ZDK019S fig.1	MTO	1.9						
2ZDK020S fig.1	●	2.0						
2ZDK021S fig.1	MTO	2.1		7	8			
2ZDK022S fig.1	MTO	2.2						
2ZDK023S fig.1	MTO	2.3						
2ZDK024S fig.1	●	2.4		8	9			
2ZDK025S fig.1	●	2.5						
2ZDK026S fig.1	●	2.6						
2ZDK027S fig.1	●	2.7		9	10			
2ZDK028S fig.1	MTO	2.8						
2ZDK029S fig.1	●	2.9						
2ZDK030S fig.1	●	3.0				6	60	
2ZDK031S fig.1	●	3.1	0 -0.012	10	11			
2ZDK032S fig.1	MTO	3.2						
2ZDK033S fig.1	●	3.3						
2ZDK034S fig.1	●	3.4		11	12			
2ZDK035S fig.1	●	3.5						
2ZDK036S fig.1	MTO	3.6						
2ZDK037S fig.1	●	3.7		12	13			
2ZDK038S fig.1	MTO	3.8						
2ZDK039S fig.1	MTO	3.9						
2ZDK040S fig.1	●	4.0						

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Flute Length	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ℓ2	ϕDs	L	Z
2ZDK041S fig.1	●	4.1	0 -0.012	13	14	6	60	2
2ZDK042S fig.1	●	4.2						
2ZDK043S fig.1	●	4.3						
2ZDK044S fig.1	MTO	4.4		14	15			
2ZDK045S fig.1	●	4.5						
2ZDK046S fig.1	MTO	4.6						
2ZDK047S fig.1	MTO	4.7		15	16			
2ZDK048S fig.1	●	4.8						
2ZDK049S fig.1	●	4.9						
2ZDK050S fig.1	●	5.0		16	17			
2ZDK051S fig.1	●	5.1						
2ZDK052S fig.1	●	5.2						
2ZDK053S fig.1	●	5.3						
2ZDK054S fig.1	MTO	5.4		17	18			
2ZDK055S fig.1	●	5.5						
2ZDK056S fig.1	●	5.6						
2ZDK057S fig.1	MTO	5.7		18	19			
2ZDK058S fig.1	●	5.8						
2ZDK059S fig.1	MTO	5.9						
2ZDK060S fig.2	●	6.0		19	(21)			
2ZDK060S-P fig.1	●	6.0	*+0.012 0	19	21	8	70	
2ZDK061S fig.1	●	6.1	0 -0.015	19	21	8	70	
2ZDK062S fig.1	●	6.2						
2ZDK063S fig.1	●	6.3		20	22			
2ZDK064S fig.1	●	6.4						
2ZDK065S fig.1	●	6.5						
2ZDK066S fig.1	●	6.6						
2ZDK067S fig.1	MTO	6.7		21	23			
2ZDK068S fig.1	●	6.8						
2ZDK069S fig.1	MTO	6.9						
2ZDK070S fig.1	●	7.0		22	24			

* Mill Dia. Tolerance of 2ZDK60S-P is plus tolerance

*** This tool is specially designed for plunging and NOT recommended for slotting.**

· Helix Angle is 20°

· The drilling depth should be less than 1.5D(1.5×Dc) when the workpiece is not pre-drilled.

Recommended Cutting Conditions ➔ L64

● : Std. Item

MTO : Made to order

2ZDK (Short type)

Plunge milling

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Flute Length	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ℓ2	ϕDs	L	Z
2ZDK071S fig.1	MTO	7.1	0 -0.015	22	24	8	70	2
2ZDK072S fig.1	MTO	7.2						
2ZDK073S fig.1	●	7.3		23	25			
2ZDK074S fig.1	MTO	7.4						
2ZDK075S fig.1	●	7.5						
2ZDK076S fig.1	MTO	7.6		24				
2ZDK077S fig.1	●	7.7						
2ZDK078S fig.1	●	7.8						
2ZDK079S fig.1	MTO	7.9						
2ZDK080S fig.2	●	8.0		25	(27)			
2ZDK081S fig.1	MTO	8.1			27	10	80	
2ZDK082S fig.1	●	8.2						
2ZDK083S fig.1	MTO	8.3		26	28			
2ZDK084S fig.1	MTO	8.4						
2ZDK085S fig.1	●	8.5						
2ZDK086S fig.1	MTO	8.6		27	29			
2ZDK087S fig.1	●	8.7						
2ZDK088S fig.1	●	8.8						
2ZDK089S fig.1	MTO	8.9		28	30			
2ZDK090S fig.1	●	9.0						
2ZDK091S fig.1	MTO	9.1						
2ZDK092S fig.1	MTO	9.2		29	31			
2ZDK093S fig.1	MTO	9.3						
2ZDK094S fig.1	MTO	9.4						
2ZDK095S fig.1	●	9.5						
2ZDK096S fig.1	MTO	9.6		30	32			
2ZDK097S fig.1	MTO	9.7						
2ZDK098S fig.1	●	9.8						
2ZDK099S fig.1	MTO	9.9		31	33			
2ZDK100S fig.2	●	10.0			(33)			

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Flute Length	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ℓ2	ϕDs	L	Z
2ZDK101S fig.1	MTO	10.1	0 -0.018	31	33	12	100	2
2ZDK102S fig.1	MTO	10.2		32	34			
2ZDK103S fig.1	●	10.3						
2ZDK104S fig.1	MTO	10.4						
2ZDK105S fig.1	●	10.5		33	35			
2ZDK106S fig.1	MTO	10.6						
2ZDK107S fig.1	MTO	10.7						
2ZDK108S fig.1	MTO	10.8						
2ZDK109S fig.1	MTO	10.9		34	36			
2ZDK110S fig.1	●	11.0						
2ZDK111S fig.1	MTO	11.1						
2ZDK112S fig.1	MTO	11.2		35	37			
2ZDK113S fig.1	MTO	11.3						
2ZDK114S fig.1	MTO	11.4						
2ZDK115S fig.1	●	11.5		36	38			
2ZDK116S fig.1	MTO	11.6						
2ZDK117S fig.1	MTO	11.7						
2ZDK118S fig.1	MTO	11.8						
2ZDK119S fig.1	MTO	11.9						
2ZDK120S fig.2	●	12.0		37	(39)			
2ZDK125S fig.3	●	12.5		41	41			
2ZDK130S fig.3	●	13.0		43	43			
2ZDK135S fig.3	●	13.5		44	44			
2ZDK140S fig.3	●	14.0		45	45			
2ZDK160S fig.2	●	16.0		52	(52)	16	115	
2ZDK170S fig.3	●	17.0		54	54			
2ZDK175S fig.3	●	17.5		56	56			
2ZDK180S fig.3	●	18.0		57	57			
2ZDK200S fig.2	●	20.0	0 -0.021	63	(63)	20	125	

*** This tool is specially designed for plunging and NOT recommended for slotting.**

· Helix Angle is 20°

· The drilling depth should be less than 1.5D(1.5×Dc) when the workpiece is not pre-drilled.

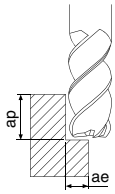
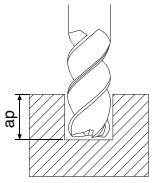
Recommended Cutting Conditions L64

● : Std. Item

MTO : Made to order

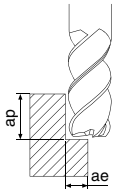
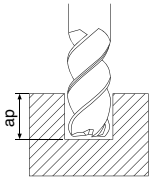
Recommended Cutting Conditions

2FESS

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ1	ϕ2	ϕ4	ϕ6	ϕ8	ϕ12	ϕ16
 Shouldering Depth of Cut (ap×ae) (mm) 1.2Dc×0.05Dc (Dc<ϕ3) 1.2Dc×0.1Dc (Dc≥ϕ3)  Slotting Depth of Cut (ap) (mm) 0.1Dc (Dc<ϕ1) 0.3Dc (ϕ1≤Dc<ϕ3) 0.5Dc (Dc≥ϕ3)	Carbon steel, Cast iron	Shouldering	Spindle Revolution (min-1)	25,500	13,200	6,600	4,400	3,300	2,200	1,700
			Feed Rate (mm/min)	225	230	375	415	420	310	240
		Slotting	Spindle Revolution (min-1)	19,000	11,000	6,000	4,000	3,000	2,000	1,500
			Feed Rate (mm/min)	135	140	225	250	250	245	245
	Alloy Steel	Shouldering	Spindle Revolution (min-1)	22,000	11,000	5,600	3,700	2,800	1,900	1,400
			Feed Rate (mm/min)	195	220	285	315	310	230	200
		Slotting	Spindle Revolution (min-1)	18,000	9,500	4,800	3,200	2,400	1,600	1,200
			Feed Rate (mm/min)	115	130	170	190	185	185	185
	Pre-hardened steel (30~45HRC)	Shouldering	Spindle Revolution (min-1)	17,000	8,800	4,400	3,000	2,200	1,500	1,100
			Feed Rate (mm/min)	55	80	100	105	105	110	110
		Slotting	Spindle Revolution (min-1)	16,000	8,000	4,000	2,700	2,000	1,300	990
			Feed Rate (mm/min)	35	50	60	63	63	65	65
	Stainless Steel	Shouldering	Spindle Revolution (min-1)	22,000	11,000	5,600	3,700	2,800	1,900	1,400
			Feed Rate (mm/min)	95	95	110	115	115	115	115
		Slotting	Spindle Revolution (min-1)	16,000	8,000	4,000	2,700	2,000	1,300	990
			Feed Rate (mm/min)	60	60	65	70	70	70	70

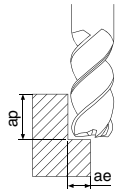
* Machining with coolant is recommended for stainless steel.

2FESM

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ0.5	ϕ1	ϕ2	ϕ4	ϕ6	ϕ8	ϕ12	ϕ16
 Shouldering Depth of Cut (ap×ae) (mm) 1.5Dc×0.05Dc (Dc<ϕ3) 1.5Dc×0.1Dc (Dc≥ϕ3)  Slotting Depth of Cut (ap) (mm) 0.1Dc (Dc<ϕ1) 0.3Dc (ϕ1≤Dc<ϕ3) 0.5Dc (Dc≥ϕ3)	Carbon steel, Cast iron	Shouldering	Spindle Revolution (min-1)	32,000	25,500	13,200	6,600	4,400	3,300	2,200	1,700
			Feed Rate (mm/min)	210	225	230	375	415	420	310	240
		Slotting	Spindle Revolution (min-1)	29,000	19,000	11,000	6,000	4,000	3,000	2,000	1,500
			Feed Rate (mm/min)	130	135	140	225	250	250	245	245
	Alloy Steel	Shouldering	Spindle Revolution (min-1)	27,000	22,000	11,000	5,600	3,700	2,800	1,900	1,400
			Feed Rate (mm/min)	180	195	220	285	315	310	230	200
		Slotting	Spindle Revolution (min-1)	27,000	18,000	9,500	4,800	3,200	2,400	1,600	1,200
			Feed Rate (mm/min)	105	115	130	170	190	185	185	185
	Pre-hardened steel (30~45HRC)	Shouldering	Spindle Revolution (min-1)	25,000	17,000	8,800	4,400	3,000	2,200	1,500	1,100
			Feed Rate (mm/min)	50	55	80	100	105	105	110	110
		Slotting	Spindle Revolution (min-1)	25,000	16,000	8,000	4,000	2,700	2,000	1,300	990
			Feed Rate (mm/min)	30	35	50	60	63	63	65	65
	Stainless Steel	Shouldering	Spindle Revolution (min-1)	27,000	22,000	11,000	5,600	3,700	2,800	1,900	1,400
			Feed Rate (mm/min)	60	95	95	110	115	115	115	115
		Slotting	Spindle Revolution (min-1)	25,000	16,000	8,000	4,000	2,700	2,000	1,300	990
			Feed Rate (mm/min)	35	60	60	65	70	70	70	70

* Machining with coolant is recommended for stainless steel.

2FESL (Shouldering)

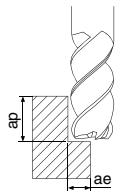
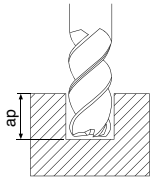
Applications	Workpiece Material	Outside Dia. Dc (mm)	ϕ1	ϕ2	ϕ4	ϕ6	ϕ8	ϕ12	ϕ16
 Shouldering	Carbon steel, Cast iron	Spindle Revolution (min-1)	19,000	9,500	4,800	3,200	2,400	1,600	1,200
		Feed Rate (mm/min)	210	210	210	210	210	210	210
	Alloy Steel	Spindle Revolution (min-1)	14,300	7,200	3,600	2,400	2,000	1,300	1,000
		Feed Rate (mm/min)	155	160	160	160	170	170	150
	Pre-hardened steel (30~45HRC)	Spindle Revolution (min-1)	11,200	5,600	2,800	1,900	1,600	1,000	800
		Feed Rate (mm/min)	85	85	90	90	100	95	80
	Stainless Steel	Spindle Revolution (min-1)	14,300	7,200	3,600	2,400	2,000	1,300	1,000
		Feed Rate (mm/min)	95	95	95	95	105	105	80

Depth of Cut (ap×ae) (mm)
2.5Dc×0.05Dc (Dc<ϕ3) 2.5Dc×0.1Dc (Dc≥ϕ3)

* Machining with coolant is recommended for stainless steel.

Slotting is not recommended.

2FEKS, 2FEKM

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering	Carbon steel, Cast iron	Shouldering	Spindle Revolution (min-1)	9,300	7,000	4,600	3,600	2,900	2,400	2,000
			Feed Rate (mm/min)	450	450	470	430	400	360	320
		Slotting	Spindle Revolution (min-1)	7,500	6,000	4,400	3,300	2,700	2,300	1,900
			Feed Rate (mm/min)	240	260	340	340	340	340	320
	Alloy Steel	Shouldering	Spindle Revolution (min-1)	8,800	6,600	4,400	3,300	2,600	2,200	1,800
			Feed Rate (mm/min)	370	370	440	400	360	330	290
		Slotting	Spindle Revolution (min-1)	7,200	5,400	3,600	2,700	2,200	1,800	1,500
			Feed Rate (mm/min)	270	270	270	270	270	270	270
 Slotting	Pre-hardened steel (30~45HRC)	Shouldering	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
		Slotting	Spindle Revolution (min-1)	5,300	4,000	2,600	2,000	1,600	1,300	1,000
			Feed Rate (mm/min)	120	120	120	120	120	120	120
	Stainless Steel	Shouldering	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
		Slotting	Spindle Revolution (min-1)	5,300	4,000	2,600	2,000	1,600	1,300	1,000
			Feed Rate (mm/min)	80	90	100	100	100	90	90

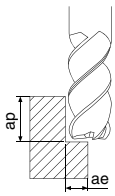
Depth of Cut (ap×ae) (mm)
1.2Dc×0.1Dc

Depth of Cut (ap) (mm)
0.5Dc

* Machining with coolant is recommended for stainless steel.

Recommended Cutting Conditions

4FESM (Shouldering)

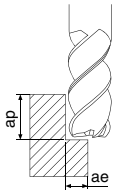
Applications	Workpiece Material	Outside Dia. Dc (mm)	ϕ1	ϕ2	ϕ4	ϕ6	ϕ8	ϕ12	ϕ16
 Shouldering	Carbon steel, Cast iron	Spindle Revolution (min-1)	25,500	13,000	6,600	4,400	3,300	2,200	1,700
		Feed Rate (mm/min)	335	345	580	620	625	630	600
	Alloy Steel	Spindle Revolution (min-1)	22,000	11,000	5,600	3,700	2,800	1,900	1,400
		Feed Rate (mm/min)	290	290	395	455	455	470	460
	Pre-hardened steel (30~45HRC)	Spindle Revolution (min-1)	12,000	7,200	4,200	3,000	2,200	1,500	1,100
		Feed Rate (mm/min)	105	125	150	160	160	165	140
	Stainless Steel	Spindle Revolution (min-1)	22,000	11,000	5,600	3,700	2,800	1,900	1,400
		Feed Rate (mm/min)	130	145	165	165	170	175	155

Depth of Cut (ap×ae) (mm)
1.5Dc×0.05Dc (Dc<ϕ3) 1.5Dc×0.1Dc (Dc≥ϕ3)

* Machining with coolant is recommended for stainless steel.

Slotting is not recommended.

4FEKM (Tough corner edge, Shouldering)

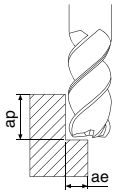
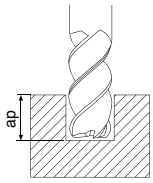
Applications	Workpiece Material	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering	Carbon steel, Cast iron	Spindle Revolution (min-1)	10,600	8,000	5,300	4,000	3,200	2,700	2,100
		Feed Rate (mm/min)	680	690	770	770	770	770	770
	Alloy Steel	Spindle Revolution (min-1)	8,800	6,600	4,400	3,300	2,600	2,200	1,800
		Feed Rate (mm/min)	500	550	620	630	630	630	610
	Pre-hardened steel (30~45HRC)	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	Spindle Revolution (min-1)	8,000	4,800	4,000	2,400	2,300	2,000	1,500
		Feed Rate (mm/min)	190	200	200	200	210	210	210

Depth of Cut (ap×ae) (mm)
1.5Dc×0.1Dc

* Machining with coolant is recommended for stainless steel.

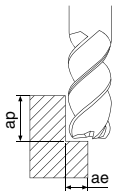
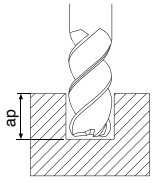
Slotting is not recommended.

2FESW

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ13
 Shouldering	Carbon steel, Cast iron	Shouldering	Spindle Revolution (min-1)	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,500
			Feed Rate (mm/min)	660	640	640	640	520	450	410	400
		Slotting	Spindle Revolution (min-1)	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,500
			Feed Rate (mm/min)	550	480	510	530	480	440	410	400
Depth of Cut (ap×ae) (mm)	Alloy Steel	Shouldering	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
1Dc×0.2Dc			Feed Rate (mm/min)	420	430	430	430	350	300	270	260
		Slotting	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	300	340	360	370	340	310	270	260
 Slotting	Pre-hardened steel (30~45HRC)	Shouldering	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	160	160	160	160	140	140	140	140
		Slotting	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	110	110	120	120	120	120	120	120
Depth of Cut (ap) (mm)	Stainless Steel	Shouldering	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
0.2Dc			Feed Rate (mm/min)	180	240	240	240	200	170	160	160
		Slotting	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	120	120	130	130	130	130	130	130

* Machining with coolant is recommended for stainless steel.

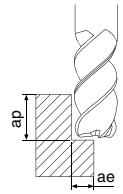
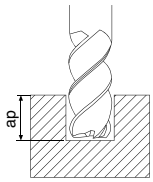
3FESW

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ13
 Shouldering	Carbon steel, Cast iron	Shouldering	Spindle Revolution (min-1)	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,500
			Feed Rate (mm/min)	810	800	800	800	650	560	510	450
		Slotting	Spindle Revolution (min-1)	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,500
			Feed Rate (mm/min)	810	800	800	800	650	560	510	450
Depth of Cut (ap×ae) (mm)	Alloy Steel	Shouldering	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
1Dc×0.2Dc			Feed Rate (mm/min)	530	530	530	530	430	370	340	300
		Slotting	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	530	530	530	530	430	370	340	300
 Slotting	Pre-hardened steel (30~45HRC)	Shouldering	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	200	200	200	200	180	180	180	180
		Slotting	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	140	140	150	150	150	150	150	150
Depth of Cut (ap) (mm)	Stainless Steel	Shouldering	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
0.2Dc			Feed Rate (mm/min)	300	300	300	300	240	210	200	200
		Slotting	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	150	150	160	160	160	160	160	160

* Machining with coolant is recommended for stainless steel.

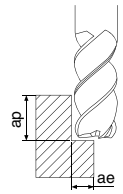
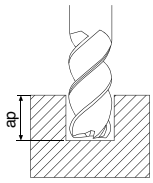
Recommended Cutting Conditions

4FESW

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ13
 Shouldering	Carbon steel, Cast iron	Shouldering	Spindle Revolution (min⁻¹)	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,500
			Feed Rate (mm/min)	960	960	960	960	780	680	620	570
		Slotting	Spindle Revolution (min⁻¹)	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,500
			Feed Rate (mm/min)	960	960	960	960	780	680	620	570
Depth of Cut (ap×ae) (mm) 1Dc×0.2Dc	Alloy Steel	Shouldering	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	640	640	640	640	520	450	410	370
		Slotting	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	640	640	640	640	520	450	410	370
 Slotting	Pre-hardened steel (30~45HRC)	Shouldering	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	240	240	240	240	210	210	210	210
		Slotting	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	160	160	180	180	180	180	180	180
Depth of Cut (ap) (mm) 0.2Dc	Stainless Steel	Shouldering	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	360	360	360	360	300	260	240	240
		Slotting	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,800
			Feed Rate (mm/min)	180	180	200	200	200	200	200	200

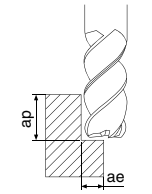
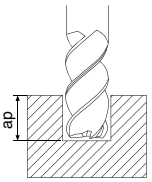
* Machining with coolant is recommended for stainless steel.

3UFSM

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ2	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Carbon steel, Cast iron	Shouldering	Spindle Revolution (min⁻¹)	18,000	12,000	9,200	7,300	6,100	4,600	3,700	3,100	2,300	1,800
			Feed Rate (mm/min)	380	430	440	500	510	500	560	560	590	590
		Slotting	Spindle Revolution (min⁻¹)	16,000	11,000	8,000	6,400	5,300	4,000	3,200	2,700	2,000	1,600
			Feed Rate (mm/min)	190	230	240	290	300	290	280	290	310	350
Depth of Cut (ap×ae) (mm) 1.5Dc×0.1Dc	Alloy Steel	Shouldering	Spindle Revolution (min⁻¹)	14,000	9,000	6,800	5,400	4,500	3,400	2,700	2,300	1,700	1,400
			Feed Rate (mm/min)	250	270	270	320	350	340	360	350	390	420
		Slotting	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)	130	130	150	180	190	180	170	180	190	210
 Slotting	Stainless Steel	Shouldering	Spindle Revolution (min⁻¹)	10,000	6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,200	1,000
			Feed Rate (mm/min)	180	170	170	210	230	220	230	220	220	230
		Slotting	Spindle Revolution (min⁻¹)	10,000	6,400	4,800	3,800	3,200	2,400	1,900	1,600	1,200	1,000
			Feed Rate (mm/min)	120	120	120	140	150	140	140	140	150	180
Depth of Cut (ap) (mm) 0.25Dc (Carbon steel, Cast iron 0.5Dc)	Titanium Alloys Heat-resistant Alloys (40~50HRC)	Shouldering	Spindle Revolution (min⁻¹)	6,000	4,200	3,200	2,500	2,100	1,600	1,300	1,100	800	600
			Feed Rate (mm/min)	60	90	100	120	110	110	120	110	120	130
		Slotting	Spindle Revolution (min⁻¹)	6,000	4,200	3,200	2,500	2,100	1,600	1,300	1,100	800	600
			Feed Rate (mm/min)	50	60	70	80	90	90	90	80	90	100
	Aluminum Alloys	Shouldering	Spindle Revolution (min⁻¹)	32,000	21,000	16,000	13,000	11,000	8,000	6,400	5,300	4,000	3,200
			Feed Rate (mm/min)	670	760	770	900	920	860	1,000	1,100	1,100	1,200
		Slotting	Spindle Revolution (min⁻¹)	32,000	21,000	16,000	13,000	11,000	8,000	6,400	5,300	4,000	3,200
			Feed Rate (mm/min)	480	440	480	590	630	580	670	730	860	960

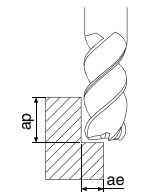
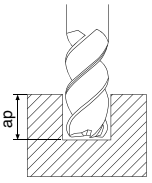
* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

4PGSS, 5PGSS

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Carbon Steel	Shouldering	1Dc×0.3Dc	Spindle Revolution (min-1)	13,300	10,000	8,000	6,600	5,000	4,000	3,300	2,500	2,000	1,600
				Feed Rate (mm/min)	1,860	1,600	1,440	1,320	1,200	1,360	1,320	1,200	1,200	1,360
		Slotting	1Dc	Spindle Revolution (min-1)				6,600	5,000	4,000	3,300	2,500	2,000	1,600
				Feed Rate (mm/min)				660	600	680	660	600	600	680
	Alloy Steel	Shouldering	1Dc×0.3Dc	Spindle Revolution (min-1)	10,600	8,000	6,400	5,300	4,000	3,200	2,700	2,000	1,600	1,300
				Feed Rate (mm/min)	1,180	1,020	920	840	880	890	860	880	830	1,040
		Slotting	0.75Dc	Spindle Revolution (min-1)				5,300	4,000	3,200	2,700	2,000	1,600	1,300
				Feed Rate (mm/min)				420	440	440	430	440	410	520
	Pre-hardened steel (30~45HRC)	Shouldering	1Dc×0.25Dc	Spindle Revolution (min-1)	8,500	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	710	610	550	500	570	550	580	570	570	700
		Slotting	0.5Dc	Spindle Revolution (min-1)				4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)				250	290	280	290	280	280	350
 Slotting	Stainless Steel	Shouldering	1Dc×0.25Dc	Spindle Revolution (min-1)	5,300	4,000	3,200	2,700	2,000	1,600	1,300	1,000	800	600
				Feed Rate (mm/min)	290	250	230	210	240	250	230	240	240	270
		Slotting	0.4Dc	Spindle Revolution (min-1)				2,700	2,000	1,600	1,300	1,000	800	600
				Feed Rate (mm/min)				100	120	120	120	120	120	130
	Titanium Alloys Heat-resistant Alloys (40~50HRC)	Shouldering	1Dc×0.2Dc	Spindle Revolution (min-1)	3,700	2,800	2,200	1,900	1,400	1,100	900	700	550	450
				Feed Rate (mm/min)	160	130	110	110	110	130	120	140	130	150
		Slotting	0.3Dc	Spindle Revolution (min-1)				1,900	1,400	1,100	900	700	550	450
				Feed Rate (mm/min)				60	60	60	60	70	70	80

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

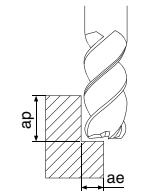
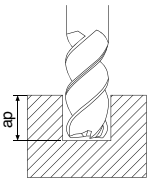
4PGSM, 5PGSM, 6PGSM

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Carbon Steel	Shouldering	1.5Dc×0.3Dc	Spindle Revolution (min-1)	6,600	5,000	4,000	3,300	2,500	2,000	1,600
				Feed Rate (mm/min)	1,030	980	1,260	1,520	1,570	1,510	1,340
		Slotting	0.5Dc	Spindle Revolution (min-1)	6,600	5,000	4,000	3,300	2,500	2,000	1,600
				Feed Rate (mm/min)	520	500	640	770	790	750	670
	Alloy Steel	Shouldering	1.5Dc×0.3Dc	Spindle Revolution (min-1)	5,300	4,000	3,200	2,700	2,000	1,600	1,300
				Feed Rate (mm/min)	740	670	940	1,130	1,170	1,140	1,030
		Slotting	0.5Dc	Spindle Revolution (min-1)	5,300	4,000	3,200	2,700	2,000	1,600	1,300
				Feed Rate (mm/min)	380	330	480	560	580	570	520
	Pre-hardened steel (30~45HRC)	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min-1)	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	470	490	610	700	730	710	710
		Slotting	0.4Dc	Spindle Revolution (min-1)	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	230	250	310	350	370	350	360
 Slotting	Stainless Steel	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min-1)	2,700	2,000	1,600	1,300	1,000	800	600
				Feed Rate (mm/min)	170	190	250	280	280	280	250
		Slotting	0.4Dc	Spindle Revolution (min-1)	2,700	2,000	1,600	1,300	1,000	800	600
				Feed Rate (mm/min)	80	90	120	140	140	140	130
	Titanium Alloys Heat-resistant Alloys (40~50HRC)	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min-1)	1,900	1,400	1,100	900	700	550	450
				Feed Rate (mm/min)	90	90	130	150	160	150	150
		Slotting	0.3Dc	Spindle Revolution (min-1)	1,900	1,400	1,100	900	700	550	450
				Feed Rate (mm/min)	40	40	60	70	80	70	70

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

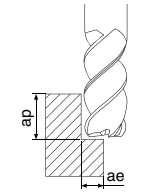
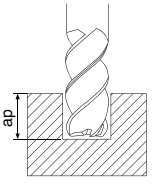
Recommended Cutting Conditions

4PGSL, 5PGSL, 6PGSL

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering  Slotting	Carbon Steel	Shouldering	1.5Dc×0.3Dc	Spindle Revolution (min-1)	6,600	5,000	4,000	3,300	2,500	2,000	1,600
				Feed Rate (mm/min)	1,030	980	1,260	1,520	1,570	1,510	1,340
		Slotting	0.5Dc	Spindle Revolution (min-1)	6,600	5,000	4,000	3,300	2,500	2,000	1,600
				Feed Rate (mm/min)	520	500	640	770	790	750	670
	Alloy Steel	Shouldering	1.5Dc×0.3Dc	Spindle Revolution (min-1)	5,300	4,000	3,200	2,700	2,000	1,600	1,300
				Feed Rate (mm/min)	740	670	940	1,130	1,170	1,140	1,030
		Slotting	0.5Dc	Spindle Revolution (min-1)	5,300	4,000	3,200	2,700	2,000	1,600	1,300
				Feed Rate (mm/min)	380	330	480	560	580	570	520
	Pre-hardened steel (30~45HRC)	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min-1)	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	470	490	610	700	730	710	710
		Slotting	0.4Dc	Spindle Revolution (min-1)	4,200	3,200	2,500	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	230	250	310	350	370	350	360
	Stainless Steel	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min-1)	2,700	2,000	1,600	1,300	1,000	800	600
				Feed Rate (mm/min)	170	190	250	280	280	280	250
		Slotting	0.4Dc	Spindle Revolution (min-1)	2,700	2,000	1,600	1,300	1,000	800	600
				Feed Rate (mm/min)	80	90	120	140	140	140	130
	Titanium Alloys Heat-resistant Alloys (40~50HRC)	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min-1)	1,900	1,400	1,100	900	700	550	450
				Feed Rate (mm/min)	90	90	130	150	160	150	150
		Slotting	0.3Dc	Spindle Revolution (min-1)	1,900	1,400	1,100	900	700	550	450
				Feed Rate (mm/min)	40	40	60	70	80	70	70

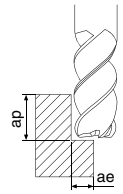
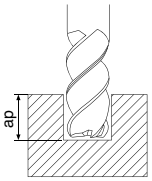
* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

4PGRM

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering  Slotting	Carbon Steel	Shouldering	1Dc×0.3Dc	Spindle Revolution (min-1)	13,300	10,000	8,000	6,600	5,000	4,000	3,300	2,500	2,000
				Feed Rate (mm/min)	1,860	1,600	1,440	1,320	1,200	1,360	1,320	1,200	1,200
		Slotting	1Dc	Spindle Revolution (min-1)				6,600	5,000	4,000	3,300	2,500	2,000
				Feed Rate (mm/min)				660	600	680	660	600	600
	Alloy Steel	Shouldering	1Dc×0.3Dc	Spindle Revolution (min-1)	10,600	8,000	6,400	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	1,180	1,020	920	840	880	890	860	880	830
		Slotting	0.75Dc	Spindle Revolution (min-1)				5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)				420	440	440	430	440	410
	Pre-hardened steel (30~45HRC)	Shouldering	1Dc×0.25Dc	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)	710	610	550	500	570	550	580	570	570
		Slotting	0.5Dc	Spindle Revolution (min-1)				4,200	3,200	2,500	2,100	1,600	1,300
				Feed Rate (mm/min)				250	290	280	290	280	280
	Stainless Steel	Shouldering	1Dc×0.25Dc	Spindle Revolution (min-1)	5,300	4,000	3,200	2,700	2,000	1,600	1,300	1,000	800
				Feed Rate (mm/min)	290	250	230	210	240	250	230	240	240
		Slotting	0.4Dc	Spindle Revolution (min-1)				2,700	2,000	1,600	1,300	1,000	800
				Feed Rate (mm/min)				100	120	120	120	120	120
	Titanium Alloys Heat-resistant Alloys (40~50HRC)	Shouldering	1Dc×0.2Dc	Spindle Revolution (min-1)	3,700	2,800	2,200	1,900	1,400	1,100	900	700	550
				Feed Rate (mm/min)	160	130	110	110	110	130	120	140	130
		Slotting	0.3Dc	Spindle Revolution (min-1)				1,900	1,400	1,100	900	700	550
				Feed Rate (mm/min)				60	60	60	60	70	70

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

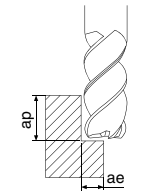
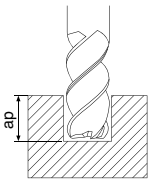
3ZFKS (Short), 3ZFKM (Medium)

Applications	Workpiece Material	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)		ϕ3	ϕ4	ϕ5	ϕ6	ϕ7	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering	Carbon Steel	Shouldering Short 1.2Dc×0.3Dc Medium 1.5Dc×0.3Dc Plunge milling Slotting 1Dc	Spindle Revolution (min-1)		13,800	10,700	8,800	7,500	6,600	6,000	4,800	4,000	3,000
			Feed Rate (mm/min)	Shouldering	850	950	1,100	1,200	1,100	1,000	910	850	800
				Plunge milling	180	170	170	170	160	150	120	100	70
				Slotting	570	650	700	730	750	780	800	750	650
	Alloy Steel	Shouldering Short 1.2Dc×0.3Dc Medium 1.5Dc×0.3Dc Plunge milling Slotting 0.5Dc	Spindle Revolution (min-1)		10,600	9,300	8,300	7,400	6,500	6,000	4,700	3,500	1,900
			Feed Rate (mm/min)	Shouldering	700	780	900	980	900	850	750	700	560
				Plunge milling	120	120	130	140	130	130	120	100	70
				Slotting	500	540	570	590	610	600	580	500	340
	Pre-hardened steel (30~45HRC)		Spindle Revolution (min-1)		5,200	4,000	3,200	2,600	2,300	2,000	1,600	1,400	1,000
			Feed Rate (mm/min)	Shouldering	440	440	490	490	490	440	400	370	300
				Plunge milling	90	110	110	130	110	100	80	70	50
				Slotting	220	270	270	320	330	330	230	200	140
 Plunge milling Slotting	Stainless Steel	Shouldering Short 1.2Dc×0.2Dc Medium 1.5Dc×0.2Dc Plunge milling Slotting 0.5Dc	Spindle Revolution (min-1)		3,300	2,500	2,000	1,700	1,400	1,300	1,100	900	750
			Feed Rate (mm/min)	Shouldering	280	270	330	340	330	330	350	320	300
				Plunge milling	20	30	40	40	40	30	20	20	20
				Slotting	110	110	130	140	130	130	120	120	120
	Titanium Alloys		Spindle Revolution (min-1)		3,300	2,500	2,000	1,700	1,400	1,300	1,100	900	750
			Feed Rate (mm/min)	Shouldering	280	270	330	340	330	330	350	320	300
				Plunge milling	20	30	40	40	40	30	20	20	20
				Slotting	110	110	130	140	130	130	120	120	120

· Compressed air is recommended for machining steel.
· Water soluble coolant is recommended for machining stainless steel and titanium alloys.
· Adjust depth of cut (ap) to suit machine rigidity

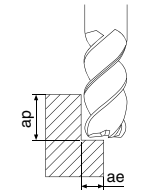
Recommended Cutting Conditions

4MFK (Short, Medium), 4MFR (Medium)

Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering	Carbon steel, Cast iron	Shouldering	Short:1.2Dc×0.15Dc Medium:1.5Dc×0.15Dc	Spindle Revolution (min-1)	13,800	10,700	8,800	7,500	6,000	4,800	4,000	3,300
				Feed Rate (mm/min)	1,400	1,400	1,400	1,500	1,500	1,400	1,400	1,300
		Slotting	ap≤1Dc	Spindle Revolution (min-1)	13,800	10,700	8,800	7,500	6,000	4,800	4,000	3,300
				Feed Rate (mm/min)	620	700	750	780	830	850	800	750
	Alloy Steel	Shouldering	Short:1.2Dc×0.1Dc Medium:1.5Dc×0.1Dc	Spindle Revolution (min-1)	10,600	9,300	8,300	7,400	6,000	4,700	3,800	2,800
				Feed Rate (mm/min)	1,000	1,000	1,000	1,100	1,100	1,000	1,000	900
		Slotting	ap≤1Dc	Spindle Revolution (min-1)	10,600	9,300	8,300	7,400	6,000	4,700	3,800	2,800
				Feed Rate (mm/min)	500	510	520	530	550	570	530	450
 Slotting	Pre-hardened steel (30~45HRC)	Shouldering	Short:1.2Dc×0.07Dc Medium:1.5Dc×0.07Dc	Spindle Revolution (min-1)	8,700	6,800	5,500	4,600	3,500	2,800	2,300	1,700
				Feed Rate (mm/min)	670	730	790	840	900	810	770	630
		Slotting	ap≤1Dc	Spindle Revolution (min-1)	6,700	5,800	4,800	4,000	3,000	2,300	1,900	1,400
				Feed Rate (mm/min)	320	330	360	370	400	420	380	300
	Stainless Steel Titanium Alloys	Shouldering	Short:1.2Dc×0.1Dc Medium:1.5Dc×0.1Dc	Spindle Revolution (min-1)	8,700	7,000	6,000	5,200	4,000	3,000	2,500	1,700
				Feed Rate (mm/min)	670	720	780	830	840	760	710	520
		Slotting	ap≤0.5Dc	Spindle Revolution (min-1)	6,800	6,000	5,100	4,300	3,400	2,600	2,000	1,400
				Feed Rate (mm/min)	390	440	480	500	510	480	460	380

* Machining with coolant is recommended for stainless steel and titanium alloys.

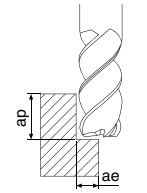
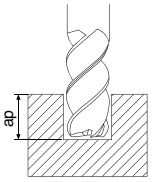
4MFK (Long)

Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering	Carbon steel, Cast iron	Shouldering	3Dc×0.02Dc	Spindle Revolution (min-1)	11,000	8,500	7,000	6,000	4,800	3,800	3,200	2,600
				Feed Rate (mm/min)	910	910	910	970	970	910	910	840
	Alloy Steel	Shouldering		Spindle Revolution (min-1)	6,500	5,700	5,100	4,500	3,700	2,900	2,300	1,700
				Feed Rate (mm/min)	540	540	540	600	600	540	540	490
	Pre-hardened steel (30~45HRC)	Shouldering		Spindle Revolution (min-1)	4,900	3,900	3,100	2,600	2,000	1,600	1,300	1,000
				Feed Rate (mm/min)	330	360	400	420	450	400	380	310
	Stainless Steel	Shouldering		Spindle Revolution (min-1)	4,300	3,500	3,000	2,600	2,000	1,500	1,300	900
				Feed Rate (mm/min)	330	360	390	410	420	380	350	260

* Machining with coolant is recommended for stainless steel.

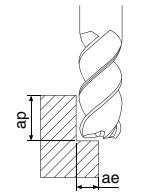
Slotting is not recommended.

4TFK (Short, Medium), 4TFR (Medium)

Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Carbon steel, Cast iron	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min⁻¹)	13,800	10,300	8,300	6,900	5,200	4,100	3,400	2,600	2,100
				Feed Rate (mm/min)	1,490	1,570	1,590	1,660	1,630	1,490	1,410	1,240	1,080
		Slotting	Dc≤ϕ12 : ap≤1.0Dc Dc>ϕ12 : ap≤12	Spindle Revolution (min⁻¹)	11,100	8,400	6,700	5,600	4,200	3,300	2,800	2,100	1,700
				Feed Rate (mm/min)	770	790	790	800	750	690	600	540	410
	Alloy Steel	Shouldering	1.5Dc×0.2Dc	Spindle Revolution (min⁻¹)	10,600	8,000	6,400	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	900	1,020	1,020	1,020	920	870	800	720	640
		Slotting	Dc≤ϕ12 : ap≤1.0Dc Dc>ϕ12 : ap≤12	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)	540	530	550	590	570	530	500	450	410
	Pre-hardened steel (30~45HRC)	Shouldering	1.5Dc×0.05Dc	Spindle Revolution (min⁻¹)	9,500	7,200	5,700	4,800	3,600	2,900	2,400	1,800	1,400
				Feed Rate (mm/min)	690	760	810	850	830	800	770	640	590
		Slotting	ap≤0.5×Dc	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	480	540	570	600	550	490	460	380	340
 Slotting	Stainless Steel	Shouldering	1.5Dc×0.05Dc	Spindle Revolution (min⁻¹)	9,500	7,200	5,700	4,800	3,600	2,900	2,400	1,800	1,400
				Feed Rate (mm/min)	690	760	810	850	830	800	770	640	590
		Slotting	ap≤0.5×Dc	Spindle Revolution (min⁻¹)	5,500	4,200	3,800	3,500	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	120	130	180	300	280	250	230	190	170
	Titanium Alloys	Shouldering	1.5Dc×0.1Dc	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)	500	520	520	540	700	730	670	560	450
		Slotting	Dc≤ϕ12 : ap≤1.0Dc Dc>ϕ12 : ap≤12	Spindle Revolution (min⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	290	330	330	350	370	410	380	290	230
	Heat-resistant Alloys	Shouldering	1.5Dc×0.05Dc	Spindle Revolution (min⁻¹)	4,200	3,200	2,500	2,100	1,600	1,300	1,100	800	640
				Feed Rate (mm/min)	250	250	250	250	240	230	220	210	200
		Slotting	ap≤0.3×Dc	Spindle Revolution (min⁻¹)	3,000	2,200	1,800	1,500	1,100	900	700	600	400
				Feed Rate (mm/min)	90	100	100	100	110	130	120	90	70

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

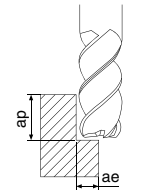
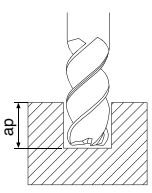
4TFK (Long)

Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Carbon steel, Cast iron	Shouldering	2.5Dc×0.1Dc	Spindle Revolution (min⁻¹)	11,000	8,200	6,600	5,500	4,200	3,300	2,700	2,100	1,700
				Feed Rate (mm/min)	970	1,020	1,030	1,080	1,060	970	920	810	700
	Alloy Steel	Shouldering	2.5Dc×0.1Dc	Spindle Revolution (min⁻¹)	5,000	4,600	3,600	3,000	2,300	1,800	1,500	1,100	910
				Feed Rate (mm/min)	490	550	550	550	500	470	430	390	350
	Pre-hardened steel (30~45HRC)	Shouldering	2.5Dc×0.05Dc	Spindle Revolution (min⁻¹)	4,800	3,600	2,900	2,400	1,800	1,500	1,200	900	700
				Feed Rate (mm/min)	350	380	410	430	420	400	390	320	300
	Stainless Steel Titanium Alloys	Shouldering	2.5Dc×0.05Dc	Spindle Revolution (min⁻¹)	4,300	3,200	2,600	2,100	1,600	1,300	1,100	800	700
				Feed Rate (mm/min)	250	260	260	320	350	370	340	280	230
	Heat-resistant Alloys	Shouldering	2.5Dc×0.02Dc	Spindle Revolution (min⁻¹)	2,100	1,600	1,300	1,100	800	650	550	400	320
				Feed Rate (mm/min)	125	125	125	125	120	115	110	105	100

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

Slotting is not recommended.

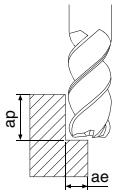
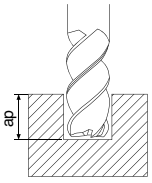
4YEKM, 4YECM, 4YERM

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Carbon Steel Alloy Steel (~30HRC)	Shouldering	1Dc×0.5Dc	Spindle Revolution (min⁻¹)	8,400	6,700	5,600	4,200	3,300	2,800	2,100	1,700	1,300
				Feed Rate (mm/min)	840	800	890	840	790	720	580	510	390
		Slotting	1Dc	Spindle Revolution (min⁻¹)	8,400	6,700	5,600	4,200	3,300	2,800	2,100	1,700	1,300
				Feed Rate (mm/min)	840	800	890	840	790	720	580	510	390
	Carbon Steel Alloy Steel (30~40HRC)	Shouldering	1Dc×0.3Dc	Spindle Revolution (min⁻¹)	6,800	5,400	4,500	3,400	2,700	2,300	1,700	1,400	1,100
				Feed Rate (mm/min)	540	540	630	610	540	500	400	360	300
		Slotting	1Dc	Spindle Revolution (min⁻¹)	6,800	5,400	4,500	3,400	2,700	2,300	1,700	1,400	1,100
				Feed Rate (mm/min)	540	540	630	610	540	500	400	360	300
	Stainless Steel	Shouldering	1Dc×0.25Dc	Spindle Revolution (min⁻¹)	6,400	5,100	4,200	3,200	2,600	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	510	510	580	570	520	460	380	330	280
		Slotting	0.5Dc	Spindle Revolution (min⁻¹)	6,400	5,100	4,200	3,200	2,600	2,100	1,600	1,300	1,000
				Feed Rate (mm/min)	510	510	580	570	520	460	380	330	280
 Slotting	Titanium Alloys	Shouldering	1Dc×0.25Dc	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	190	200	180	190	160
		Slotting	0.5Dc	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	190	200	180	190	160
	Heat-resistant Alloys	Shouldering	1Dc×0.25Dc	Spindle Revolution (min⁻¹)	2,400	1,900	1,600	1,200	1,000	800	600	500	400
				Feed Rate (mm/min)	100	80	100	130	100	120	110	110	80
		Slotting	0.3Dc	Spindle Revolution (min⁻¹)	2,400	1,900	1,600	1,200	1,000	800	600	500	400
				Feed Rate (mm/min)	100	80	100	130	100	120	110	110	80

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

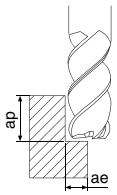
Recommended Cutting Conditions

5DEKM, 5DERM

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering Depth of Cut (ap×ae) (mm) 5DEKM: 1.5Dc×0.25Dc 5DERM: 1.5Dc×0.5Dc  Slotting Depth of Cut (ap) (mm) 5DEKM: 0.25Dc 5DERM: 0.8Dc	Medium Carbon Steel High Carbon Steel (> 0.3%C)	Shouldering	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
		Slotting	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)	Shouldering	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
		Slotting	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)	Shouldering	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
		Slotting	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 SUS302 SUS303 SUS304	Shouldering	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
		Slotting	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 SUS316 SUS316L	Shouldering	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
		Slotting	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
	Titanium Alloys	Shouldering	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
		Slotting	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
	Heat-resistant Alloys	Shouldering	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
		Slotting	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
	Gray Cast Iron	Shouldering	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
		Slotting	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 Malleable Cast Iron	Shouldering	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
		Slotting	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

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

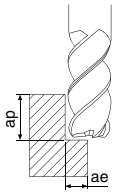
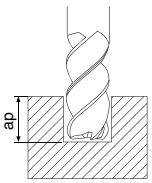
4YFSM, 6YFSM (Shouldering)

Applications	Workpiece Material	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	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)		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)		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		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
	Titanium Alloys	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
	Heat-resistant Alloys		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, titanium alloys and heat-resistant alloys.

Slotting is not recommended.

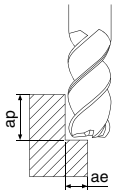
3RDSM, 4RDSM, 5RDSM

Applications	Workpiece Material		Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Steel	< 22HRC	Shouldering	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	1,320	1,340	1,340	1,340	1,380
			Slotting	1Dc	Spindle Revolution (min-1)	9,300	6,900	5,600	4,600	3,500	2,800	2,200
					Feed Rate (mm/min)	800	800	1,000	1,030	1,040	1,050	1,110
		22~32HRC	Shouldering	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
			Slotting	0.75Dc	Spindle Revolution (min-1)	7,900	5,900	4,800	4,000	3,000	2,400	1,900
					Feed Rate (mm/min)	550	550	740	740	740	760	860
		32~40HRC	Shouldering	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
			Slotting	0.6Dc	Spindle Revolution (min-1)	5,300	4,000	3,200	2,600	2,000	1,600	1,300
					Feed Rate (mm/min)	260	260	340	340	330	330	330
		40~45HRC	Shouldering	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
			Slotting	0.5Dc	Spindle Revolution (min-1)	4,300	3,200	2,600	2,200	1,600	1,300	1,000
					Feed Rate (mm/min)	180	180	240	230	230	220	220
 Slotting		45~50HRC	Shouldering	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
			Slotting	0.4Dc	Spindle Revolution (min-1)	3,800	2,900	2,300	1,900	1,400	1,100	900
					Feed Rate (mm/min)	140	140	170	160	160	150	150
	Stainless Steel		Shouldering	1.5Dc×0.4Dc	Spindle Revolution (min-1)	3,700	2,800	2,200	1,900	1,400	1,100	900
					Feed Rate (mm/min)	190	230	310	300	340	310	360
			Slotting	0.5Dc	Spindle Revolution (min-1)	2,700	2,000	1,600	1,300	1,000	800	600
					Feed Rate (mm/min)	110	130	180	170	190	180	190
	Cast Iron		Shouldering	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
			Slotting	1Dc	Spindle Revolution (min-1)	7,900	5,900	4,800	4,000	3,000	2,400	1,900
					Feed Rate (mm/min)	700	700	900	900	900	910	1,140

* Machining with coolant is recommended for stainless steel.

Recommended Cutting Conditions

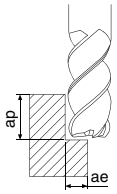
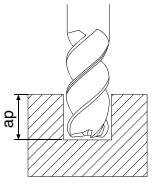
3RDSL, 4RDSL, 5RDSL (Shouldering)

Applications	Workpiece Material		Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	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		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		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
	Stainless Steel		1.5Dc×0.1Dc	Spindle Revolution (min-1)	3,700	2,800	2,200	1,900	1,400	1,100	900
				Feed Rate (mm/min)	120	150	200	200	220	200	230
	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

* Machining with coolant is recommended for stainless steel.

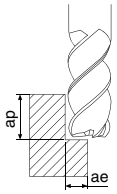
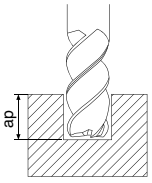
Slotting is not recommended.

4RFSM, 6RFSM

Applications	Workpiece Material		Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16		ϕ20		ϕ25
										4 flutes	6 flutes	4 flutes	6 flutes	
 Shouldering	Steel	35~45HRC	Shouldering	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
			Slotting	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	Shouldering	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
			Slotting	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	Shouldering	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
			Slotting	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
	Stainless Steel		Shouldering	1.5Dc×0.4Dc	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)	300	280	260	300	280	420	290	430	380
			Slotting	0.5Dc	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)	200	190	180	200	190	290	210	310	270
 Slotting	Titanium Alloys	< 40HRC	Shouldering	2Dc×0.4Dc	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
			Slotting	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	Shouldering	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
			Slotting	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
	Heat-resistant Alloys		Shouldering	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
			Slotting	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

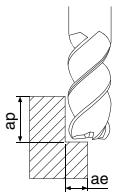
* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

3RFRS, 4RFRS

Applications	Workpiece Material		Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12
 Shouldering	Steel	< 30HRC	Shouldering	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
			Slotting	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	Shouldering	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
			Slotting	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
		40~50HRC	Shouldering	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
			Slotting	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
 Slotting		50~60HRC	Shouldering	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
			Slotting	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	Shouldering	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
			Slotting	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
	Titanium Alloys		Shouldering	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	340	320	350	380
			Slotting	0.5Dc	Spindle Revolution (min-1)	4,000	3,200	2,700	2,000	1,600	1,300
					Feed Rate (mm/min)	80	100	150	140	160	170

* Machining with coolant is recommended for titanium alloys.

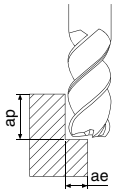
6PFK, 8PFK (Medium)

Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Carbon steel, Cast iron	Shouldering	Dc<ϕ20 : 1.5Dc×0.2Dc Dc≥ϕ20 : 1.5Dc×0.1Dc	Spindle Revolution (min-1)	7,400	5,600	4,500	3,700	2,800	2,200	1,800
				Feed Rate (mm/min)	2,650	2,640	2,410	2,250	2,010	1,700	1,500
	Alloy Steel	Shouldering	Dc<ϕ20 : 1.5Dc×0.2Dc Dc≥ϕ20 : 1.5Dc×0.1Dc	Spindle Revolution (min-1)	6,400	4,800	3,800	3,200	2,400	1,900	1,500
				Feed Rate (mm/min)	2,250	2,090	1,950	1,910	1,720	1,450	1,220
	Pre-hardened steel (30~38HRC)	Shouldering	1.5Dc×0.1Dc	Spindle Revolution (min-1)	5,600	4,200	3,300	2,800	2,100	1,700	1,300
				Feed Rate (mm/min)	1,780	1,710	1,520	1,400	1,220	1,120	980
	Stainless Steel Titanium Alloys	Shouldering	1.5Dc×0.05Dc	Spindle Revolution (min-1)	5,000	3,800	3,000	2,500	1,900	1,500	1,200
				Feed Rate (mm/min)	1,350	1,320	1,200	1,130	970	850	720

* Machining with coolant is recommended for stainless steel and titanium alloys .

Slotting is not recommended.

6PFK, 8PFK (Long)

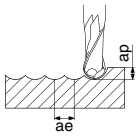
Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Carbon steel, Cast iron	Shouldering	3.0Dc×0.01Dc	Spindle Revolution (min-1)	4,600	3,500	2,800	2,300	1,700	1,400	1,100
				Feed Rate (mm/min)	1,830	1,730	1,530	1,380	1,120	880	660
	Alloy Steel	Shouldering	3.0Dc×0.01Dc	Spindle Revolution (min-1)	3,700	2,800	2,200	1,800	1,400	1,100	900
				Feed Rate (mm/min)	1,490	1,340	1,220	1,120	940	720	540
	Pre-hardened steel (30~38HRC)	Shouldering	3.0Dc×0.01Dc	Spindle Revolution (min-1)	2,800	2,100	1,700	1,400	1,100	850	650
				Feed Rate (mm/min)	920	680	750	670	550	480	390
	Stainless Steel Titanium Alloys	Shouldering	3.0Dc×0.01Dc	Spindle Revolution (min-1)	2,500	1,900	1,500	1,300	950	750	600
				Feed Rate (mm/min)	700	670	590	540	440	370	290

* Machining with coolant is recommended for stainless steel and titanium alloys .

Slotting is not recommended.

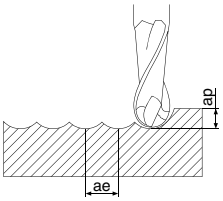
Recommended Cutting Conditions

2SEB

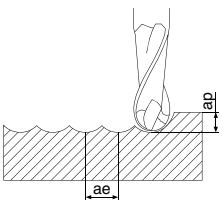
Applications	Workpiece Material		Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ2	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Copying	Carbon steel, Cast iron		0.05Dc×0.05Dc	Spindle Revolution (min-1)	25,900	22,800	21,300	19,700	16,000	14,000	12,800	11,800	9,500
				Feed Rate (mm/min)	3,910	3,570	3,290	3,070	2,890	2,660	2,540	2,500	2,470
	Tool Steel, Alloy steel		0.04Dc×0.04Dc	Spindle Revolution (min-1)	23,300	20,500	19,100	17,700	15,200	12,600	11,500	10,600	8,500
				Feed Rate (mm/min)	3,100	2,880	2,670	2,490	2,330	2,110	2,010	1,980	1,970
	Stainless Steel		0.05Dc×0.05Dc	Spindle Revolution (min-1)	23,300	20,500	19,100	17,700	15,200	12,600	11,500	10,600	8,500
				Feed Rate (mm/min)	3,150	2,880	2,660	2,500	2,370	2,190	2,060	1,970	1,920
	Pre-hardened steel	30~38HRC	0.05Dc×0.05Dc	Spindle Revolution (min-1)	23,300	20,500	19,100	17,700	15,200	12,600	11,500	10,600	8,500
				Feed Rate (mm/min)	3,150	2,880	2,660	2,500	2,370	2,190	2,060	1,970	1,920
		38~45HRC	0.03Dc×0.03Dc	Spindle Revolution (min-1)	20,900	18,500	17,200	15,900	13,700	11,300	10,400	9,500	7,700
				Feed Rate (mm/min)	2,550	2,330	2,170	2,040	1,940	1,800	1,680	1,590	1,550
		45~55HRC	0.03Dc×0.03Dc	Spindle Revolution (min-1)	18,600	16,400	15,300	14,200	12,200	10,000	9,200	8,500	6,800
				Feed Rate (mm/min)	2,060	1,850	1,700	1,600	1,520	1,410	1,320	1,230	1,190
	Heat Treated Steel	45~55HRC	0.03Dc×0.03Dc	Spindle Revolution (min-1)	18,600	16,400	15,300	14,200	12,200	10,000	9,200	8,500	6,800
				Feed Rate (mm/min)	2,060	1,850	1,700	1,600	1,520	1,410	1,320	1,230	1,190
		55~60HRC	0.03Dc×0.03Dc	Spindle Revolution (min-1)	14,300	12,600	11,800	10,900	9,400	7,700	7,100	6,500	5,200
				Feed Rate (mm/min)	1,230	1,130	1,030	980	930	850	800	780	760

* Machining with coolant is recommended for stainless steel.

2UEBS

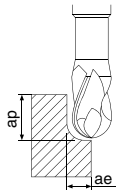
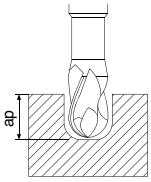
Applications	Workpiece Material		Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Copying	Steel	< 42HRC	0.3Dc×0.7Dc	Spindle Revolution (min-1)	9,600	6,400	4,800	3,800	3,200	2,400	1,900
				Feed Rate (mm/min)	380	420	380	380	340	300	310
		42~48HRC		Spindle Revolution (min-1)	8,000	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		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		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		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

3UEBS

Applications	Workpiece Material	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12
 Copying	Carbon steel, Cast iron (< 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	0.05Dc×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

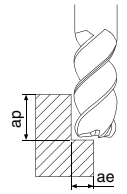
* Machining with coolant is recommended for stainless steel.

4YEBM

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Low Carbon Steel	Shouldering	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
		Slotting	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
	Stainless Steel	Shouldering	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
		Slotting	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
	Titanium Alloys	Shouldering	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
		Slotting	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
 Slotting	Heat-resistant Alloys	Shouldering	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
		Slotting	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
	Gray Cast Iron	Shouldering	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
		Slotting	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

* Machining with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

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

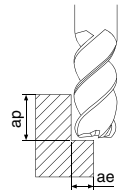
Applications	Workpiece Material		Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ1	ϕ2	ϕ4	ϕ6	ϕ8	ϕ12
 Shouldering	Tool Steel (< 40HRC) Pre-hardened steel		1.5Dc×0.05Dc (Dc<ϕ3) 1.5Dc×0.1Dc (ϕ3≤Dc)	Spindle Revolution (min-1)	20,700	20,000	11,100	7,400	5,600	3,700
				Feed Rate (mm/min)	910	1,750	2,000	2,900	2,930	2,930
	Tool Steel, Hardened Steel (40~45HRC) Pre-hardened steel			Spindle Revolution (min-1)	20,700	20,000	9,900	6,600	5,000	3,300
				Feed Rate (mm/min)	910	1,750	1,800	2,630	2,650	2,650
	Heat Treated Steel	45~55HRC	1.5Dc×0.05Dc	Spindle Revolution (min-1)	20,700	16,000	8,000	5,300	4,000	2,700
				Feed Rate (mm/min)	910	1,400	1,400	2,100	2,100	2,100
		55~60HRC	1.5Dc×0.02Dc	Spindle Revolution (min-1)	20,700	12,000	6,000	4,000	3,000	2,000
				Feed Rate (mm/min)	640	730	740	1,100	1,100	1,100
		60~65HRC		Spindle Revolution (min-1)	20,700	11,100	5,600	3,700	2,800	1,900
				Feed Rate (mm/min)	550	600	600	880	880	880
		65~70HRC		Spindle Revolution (min-1)	15,900	8,000	4,000	2,700	2,000	1,330
				Feed Rate (mm/min)	370	370	370	560	560	550

* Above is even number flute condition. In case of Odd number flute, please take standard with increasing feed rate 15-20% condition.

Slotting is not recommended.

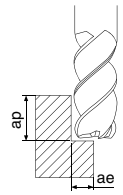
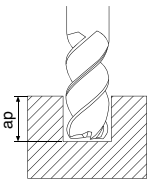
Recommended Cutting Conditions

4UGSM, 6UGSM (Shouldering)

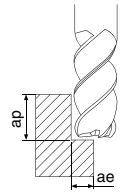
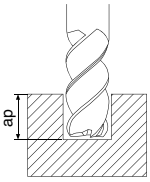
Applications	Workpiece Material		Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering	Steel	45~55HRC	1Dc×0.05Dc	Spindle Revolution (min-1)	11,900	8,000	6,000	4,800	4,000	3,000
				Feed Rate (mm/min)	810	1,200	1,200	1,000	980	900
		55~60HRC		Spindle Revolution (min-1)	8,000	5,300	4,000	3,200	2,700	2,000
				Feed Rate (mm/min)	510	760	740	610	610	540
		60~65HRC	1Dc×0.2mm	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		Spindle Revolution (min-1)	2,800	1,900	1,400	1,100	900	700
				Feed Rate (mm/min)	150	250	230	200	200	170

Slotting is not recommended.

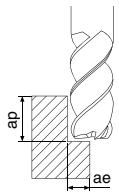
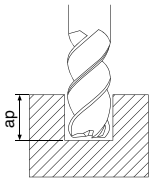
3NESM

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Aluminum Alloys	Shouldering	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
 Slotting		Slotting	1Dc	Spindle Revolution (min-1)	26,500	13,000	9,800	8,000	6,600	5,000	4,000
				Feed Rate (mm/min)	1,100	1,100	1,100	1,100	1,100	1,100	1,100

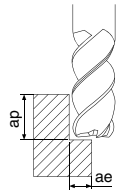
2NFSM

Applications	Workpiece Material	Application	Depth of Cut (apxae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Aluminum Alloys	Shouldering	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
		Slotting	1Dc	Spindle Revolution (min-1)	21,200	10,600	8,000	6,400	5,300	4,000	3,200
				Feed Rate (mm/min)	550	750	750	900	1,010	800	700
 Slotting	High-silicon aluminum	Shouldering	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
		Slotting	1Dc	Spindle Revolution (min-1)	15,900	7,900	5,900	4,800	4,000	3,000	2,400
				Feed Rate (mm/min)	350	420	420	500	560	640	480

3NFSM

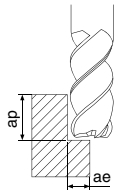
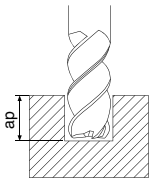
Applications		Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	 Slotting	Aluminum Alloys	Shouldering	1Dc×0.5Dc	Spindle Revolution (min-1)	26,500	13,300	10,000	8,000	6,600	5,000	4,000
					Feed Rate (mm/min)	1,040	1,400	1,400	1,700	1,890	1,490	1,310
			Slotting	1Dc	Spindle Revolution (min-1)	21,200	10,600	8,000	6,400	5,300	4,000	3,200
					Feed Rate (mm/min)	830	1,100	1,100	1,360	1,510	1,290	1,050
		High-silicon aluminum	Shouldering	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
			Slotting	1Dc	Spindle Revolution (min-1)	15,900	7,900	5,900	4,800	4,000	3,000	2,400
					Feed Rate (mm/min)	520	630	630	740	830	960	710

3NFSL (Shouldering)

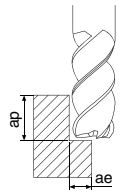
Applications	Workpiece Material	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Aluminum Alloys	2.5Dc×0.5Dc	Spindle Revolution (min-1)	18,500	9,300	7,000	5,600	4,600	3,500	2,800
			Feed Rate (mm/min)	730	980	980	1,200	1,320	1,040	920
	High-silicon aluminum	1.5Dc×0.5Dc	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

Slotting is not recommended.

3AESM

Applications		Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	 Slotting	Aluminum Alloys	Shouldering	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
			Slotting	1Dc	Spindle Revolution (min-1)	19,900	14,900	11,900	10,000	7,500	6,000	4,800
					Feed Rate (mm/min)	3,230	3,090	3,050	2,990	2,930	2,900	2,870
		High-silicon aluminum	Shouldering	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
			Slotting	1Dc	Spindle Revolution (min-1)	6,400	4,800	3,800	3,200	2,400	1,900	1,500
					Feed Rate (mm/min)	860	830	810	790	780	770	770

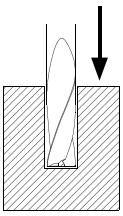
3AESL (Shouldering)

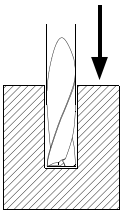
Applications	Workpiece Material	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Aluminum Alloys	2.5Dc×0.5Dc	Spindle Revolution (min-1)	23,000	17,500	14,000	11,600	8,700	7,000	5,600
			Feed Rate (mm/min)	3,760	3,600	3,560	3,490	3,420	3,390	3,350
	High-silicon aluminum		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

Slotting is not recommended.

Recommended Cutting Conditions (Plunge milling)

2ZDK

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ1	ϕ2	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8
 Plunge milling	Structural steel Carbon steel	Plunge milling	Spindle Revolution (min-1)	19,500	11,200	8,300	6,200	5,000	4,200	3,200
			Feed Rate (mm/min)	300	380	520	520	520	520	520
	Alloy Steel		Spindle Revolution (min-1)	19,000	10,000	7,200	5,400	4,400	3,600	2,700
			Feed Rate (mm/min)	300	320	450	450	450	450	450
	Pre-hardened steel (30~45HRC)		Spindle Revolution (min-1)	16,000	8,000	3,900	2,900	2,300	1,900	1,500
			Feed Rate (mm/min)	210	210	210	210	210	210	210
	Nodular Cast Iron		Spindle Revolution (min-1)	16,000	10,000	7,200	5,400	4,400	3,600	2,700
			Feed Rate (mm/min)	200	300	390	390	390	390	390
	Aluminum Alloys		Spindle Revolution (min-1)	20,000	20,000	17,800	13,100	10,500	8,900	6,700
			Feed Rate (mm/min)	500	850	1,270	1,270	1,270	1,270	1,270
	Aluminum Alloy Casting		Spindle Revolution (min-1)	20,000	20,000	13,100	10,000	8,000	6,700	5,000
			Feed Rate (mm/min)	450	750	820	820	820	820	820

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ10	ϕ12	ϕ14	ϕ16	ϕ18	ϕ20
 Plunge milling	Structural steel Carbon steel	Plunge milling	Spindle Revolution (min-1)	2,500	2,100	1,800	1,600	1,400	1,300
			Feed Rate (mm/min)	450	450	450	450	450	450
	Alloy Steel		Spindle Revolution (min-1)	2,200	1,800	1,500	1,350	1,200	1,100
			Feed Rate (mm/min)	400	400	400	400	400	400
	Pre-hardened steel (30~45HRC)		Spindle Revolution (min-1)	1,200	1,000	850	750	650	600
			Feed Rate (mm/min)	190	190	190	190	190	190
	Nodular Cast Iron		Spindle Revolution (min-1)	2,200	1,800	1,550	1,350	1,200	1,100
			Feed Rate (mm/min)	340	340	340	340	340	340
	Aluminum Alloys		Spindle Revolution (min-1)	5,400	4,500	3,800	3,400	3,000	2,700
			Feed Rate (mm/min)	1,270	1,270	1,270	1,270	1,270	1,270
	Aluminum Alloy Casting		Spindle Revolution (min-1)	4,000	3,400	2,900	2,500	2,200	2,000
			Feed Rate (mm/min)	820	820	820	820	820	820

NOT recommended for slotting

***This tool is specially designed for plunging and NOT recommended for slotting.**

· Coolant is recommended.
· Adjust cutting condition to suit machine rigidity.
· Use chuck and machine with as high rigidity as possible.
· Stainless steel machining is NOT recommended.
· Modifications of machining conditions can be needed when machining a slant surface, depending on the slant angle. (fig.1)
When workpiece slant degree is 30° or less, reduce the feed rate by 50%.
When workpiece slant degree is more than 30°, reduce the revolution by 70% and the feed rate by 30%.

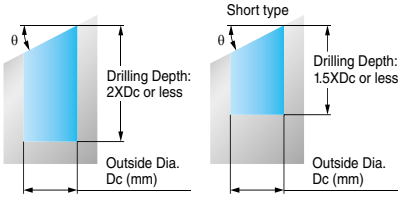


Fig.1