Solid End Mill

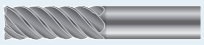
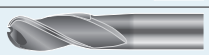
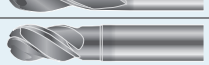
Carbide material

L

L1~L53

High feed End Mill
4MFK
4MFR

Application and selection

Ref. 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			2	35°	ϕ3~ϕ13	
		3FESW				3			
		4FESW				4			
L15	Multi-purpose	3UFSM	3 flutes, Multi-purpose		TiAlN	3	45°	ϕ1~ϕ20	
L16		4PGSS	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 High feed, high efficiency		MEGACOAT NANO	4	Variable Lead 42°, 44°	ϕ3~ϕ16	
		4MFR							
L22		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			
L23		5DEKM			AlTiN	5		ϕ4~ϕ25	
		5DERM (Radius)				5			
		4YFSM	Steel and Difficult-to-cut materials, Finishing		TiAlN	4	45°	ϕ4~ϕ20	
		6YFSM				6			
L24		3RDSM	Roughing, serrated edge		TiAlN	3	20°	ϕ4~ϕ25	
		4RDSM				4			
		5RDSM				5			
		3RDSL				3		ϕ6~ϕ25	
		4RDSL				4			
		5RDSL				5			
L25		4RFSM	Roughing, notched edge			4	45°	ϕ6~ϕ25	
		6RFSM				6			
		3RFRS (Radius)				3		ϕ4~ϕ12	
		4RFRS (Radius)				4			
L26	Ball-nose	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	
L27		4YEBM	Ball-nose End Mill with 4 flutes			4	38°	ϕ5~ϕ20	

Carbide material Substrate of all solid end mills is carbide.

Workpiece Material										Description	Ref. Page
	Steel		Hardened 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	
	◎	◎			◎	◎	◎	○		4YEKM	L22
										4YECM	
										4YERM (Radius)	
	◎	◎			◎	◎	◎	○		5DEKM	L23
										5DERM (Radius)	
	◎	◎			◎	◎	◎	○		4YFSM	
										6YFSM	
	◎	◎			○			◎		3RDSM	L24
										4RDSM	
										5RDSM	
										3RDSL	
										4RDSL	
										5RDSL	
	○	◎	◎	○	○	◎	○	○		4RFSM	L25
										6RFSM	
	○	◎	◎	○	○	◎	○	○		3RFRS (Radius)	
										4RFRS (Radius)	
	◎	◎						◎		2UEBS	L26
	◎	◎			○	○		◎	○	3UEBS	
	◎	○			◎	◎	○	○		4YEBM	L27

◎ : 1st Choice ○ : 2nd Choice

Application and selection

Ref. Page	Applications	Description	Features	Shape	Coating	No. of Flutes	Helix Angle	Outside Dia. ϕDc (mm)
L28	Special corner-R shaped	6PDRS	6 flutes, High feed rate		AlTiN	6	20°	ϕ6~ϕ12
L30	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		
L31		4UGSM			TiAlN	4	50°	ϕ3~ϕ16
		6UGSM				6		
L32	Aluminum & Non-ferrous Metals	3NESM	Varied interval flute design with wiper edge		-	3	38°	ϕ3~ϕ20
L33		2NFSM	Sharpness oriented, Smooth chip evacuation			2	45°	ϕ1~ϕ20
		3NFSM				3		ϕ3~ϕ20
		3NFSL				3		ϕ3~ϕ20
L34		3AESM	Roughing			3	30°	ϕ6~ϕ25
		3AESL				3		ϕ6~ϕ25
L36	Counterboring	2ZDK	NEW 2 flutes, Counterboring		MEGACOAT NANO	2	20°	ϕ3~ϕ12

Solid End Mill Identification System (except 4MFK, 4MFR, 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 : Square B : Ball-nose R : Radius K : Tough corner edge C : with Corner Chamfering	S : Short M : Medium L : Long W : For Automatic Lathe	020 ↓ 2.0mm	060 ↓ 6.0mm	04 ↓ 4.0mm	Corner Radius, C width etc …

Solid End Mill Identification System (4MFK/4MFR) NEW

4 M F K 030 - 045

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

(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Outside Dia.	(6) Length of cut
4	M : High feed, high efficiency	F : 40-49°	K : Tough corner edge R : Radius	030 ↓ 3.0mm	045 ↓ 4.5mm

Solid End Mill Identification System (2ZDK) NEW

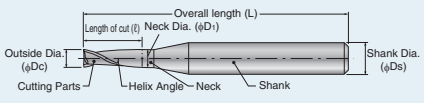
2 Z D K 030

(1) (2) (3) (4) (5)

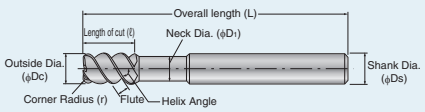
(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Outside Dia.
2	Z : Counterboring	D : 20°	K : Tough corner edge	030 ↓ 3.0mm

Name of parts

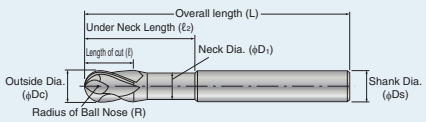
●Square Type



●Radius Type



●Ball-nosed Type



Carbide material

Substrate of all solid end mills is carbide.

Workpiece Material										Description	Ref. Page
Steel		Hardened 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			
◎	◎	◎	◎							6PDRS	L28
◎	◎	◎	◎							4HFSS 5HFSS 6HFSS 7HFSS 4HFSM 5HFSM 6HFSM 7HFSM 8HFSM	L30
		◎	◎							4UGSM 6UGSM	L31
								◎		3NESM 2NFSM 3NFSM 3NFSL 3AESM 3AESL	L32 L33 L34
◎	◎						◎	◎		2ZDK	L36

◎ : 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
- AlCrN — AlCrN 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 to -0.02 mm R — Corner Radius Tolerance is 0/-0.02mm.

Ball-nose radius Tolerance

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

Flutes

3 — 3-edge design

Helix Angle

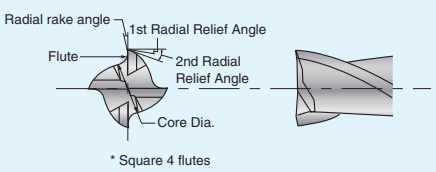
30° — Helix Angle 30°

Cutting edge shape

Roughing

Cutting parts shape

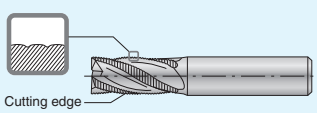
●Edge Shape



* Square 4 flutes

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

●Cutting edge shape



●with Chamfered Edge

● Tough Corner edge (with Corner land)

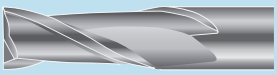
Introduction

Surface finish oriented

L10~L14

F Series

MEGACOAT is applied



(FES)

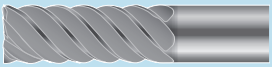
MEGACOAT and sharp cutting edge enable high precision finishing owing to excellent wear and heat resistance.
Total lengths 35mm and 45mm are available for automatic lathes.

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~L25

Z Series

MEGACOAT is applied

(3ZEKS)

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

NEW

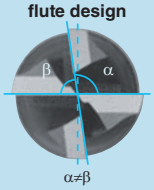
M Series

MEGACOAT NANO is applied

(4MFK / 4MFR)

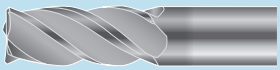
Superior anti vibration performance due to Kyocera's unique varied interval flute design and variable Lead.
Achieves high rigidity and Stable chip evacuation due to New Special Flute Design
Achieves high feed, high efficiency cutting

Varied interval flute design



L20

Y Series

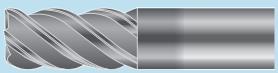


(4YEKM, 4YECM, 4YERM)

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)

L22

D Series

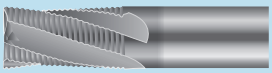


(5DEKM, 5DERM)

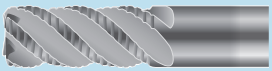
Varied interval flute design with 5 flutes. For high efficiency slotting and shouldering.
Applicable for difficult-to-cut materials like stainless steel and heat resistant steel.

L23

R Series



(RDS)



(RFS)

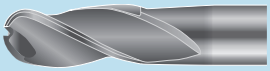
RDS type is for general use with large flat surface edge with a 20 degrees helix angle.
RFS has notched surface edge of 45 degrees helix angle.

L24~L25

Ball-nose End Mill

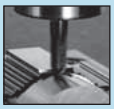
L26~L29

U Series, Y Series (UEB, YEB)



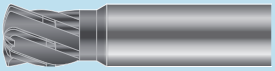
(3UEBS)

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



L26~L27

P Series (PDR)



(6PDRS)

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

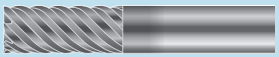
L28

Hard materials

L30~L31

H Series

"MEGACOAT Hard" is applied

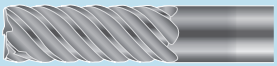


(HFS)

New 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 cutting and long tool life with wide range of 4, 5, 6, 7 and 8 flute types.

L30

U Series (UGS)



(UGS)

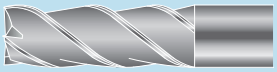
For hard materials with negative rake angle.
Helix angle is 50 degrees.

L31

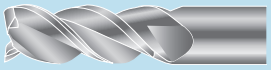
Aluminum & Non-ferrous Metals

L32~L34

N Series (NES, NFS)



(3NESM)

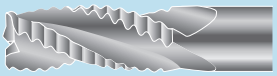


(3NFSM)

NES type realizes good surface finish with wiper cutting edge.
Varied interval flute design prevents chattering and improves cutting 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.

L32~L33

A Series



(3AESM)

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

L34

Counterboring

L35~L36

NEW

2ZDK

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

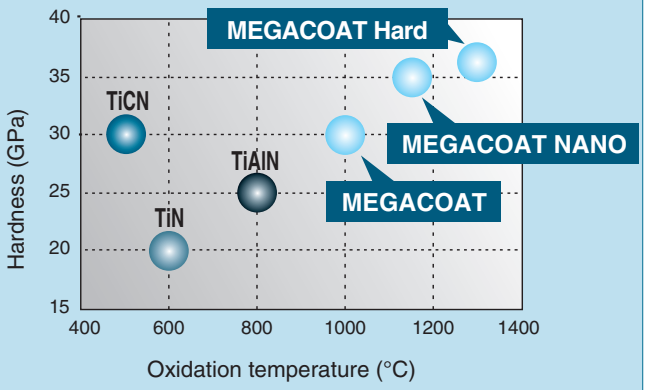
L36

New PVD technology, MEGACOAT

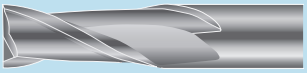
Superior wear and oxidation resistant MEGACOAT

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



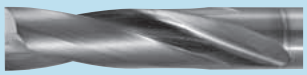
F Series
L10~L14

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

NEW

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

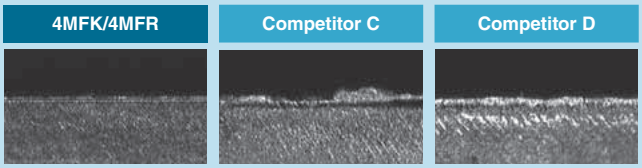
4MFK/4MFR



2ZDK

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

Edge Conditions after 140m Cutting



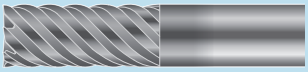
[Cutting Condition : n=6,000min^{-1}, Vf=1,100mm/min, ap×ae=5.0×0.8mm, ϕ8, SCM440, Shouldering]

4MFK/4MFR
L20

2ZDK
L35

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 milling of hard materials



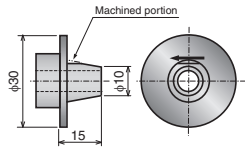
H Series
L30

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

Case Studies

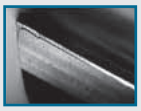
SUM24L

- 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/edge
Competitor Coated Carbide E	100 pcs/edge

- 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.



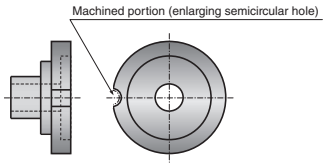
MEGACOAT
(Number of workpiece processed: 230 pcs/edge)

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

(Evaluation by the user)

SCr420

- 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/edge
Competitor Coated Carbide F	350 pcs/edge

- 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.

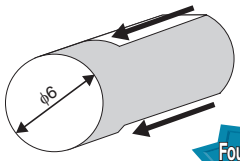
MEGACOAT
(Number of workpiece processed: 700 pcs/edge)

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

(Evaluation by the user)

S45C

- Machine parts
- n=3,980min^{-1}(Vc=100m/min)
- ap =0.45mm
- Vf=800mm/min (fz=0.05mm/t)
- Wet
- Tool life 4000 pcs/edge
- 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

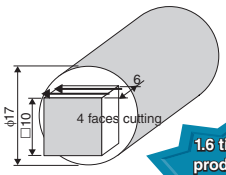
[Competitor Coated Carbide G]
ϕ8·4 flutes
n=2,508min^{-1}(Vc=63m/min)
ap=0.45mm
Tool life 4,000 pcs/edge
Vf=200mm/min (fz=0.02mm/t)

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

(Evaluation by the user)

SUM

- 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

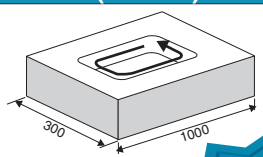
[Competitor Coated Carbide H]
ϕ7·4 flutes
n=2,000min^{-1} (Vc=44m/min)
ap × ae=3.5 × 3.0mm
Vf=400mm/min (fz=0.05mm/t)

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

(Evaluation by the user)

Hardened 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/ edge
Competitor Coated Carbide I	Amount of chip extraction 2.4cc/min Tool life: 5pcs/ edge

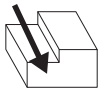
[Competitor Coated Carbide I]
ϕ16·6 flutes
n=597min^{-1} (Vc=30m/min)
ap × ae=40 × 0.3mm
Vf=200mm/min (fz=0.056mm/t)

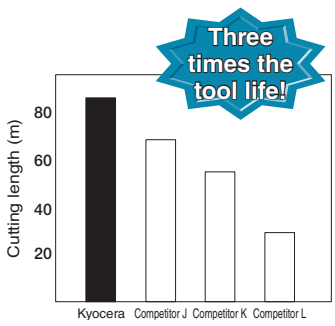
User comments:
The cutting speed and table feed rate is doubled compared to competitor's coated carbide product I. The cutting edge conditions are excellent and the tool life is also doubled.

(Evaluation by the user)

SKD11 (63HRC)

- 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)





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

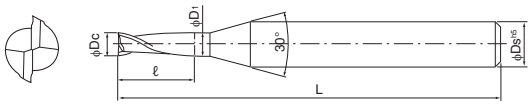
2FESS, 2FESM, 2FESL

2

MEGACOAT is applied

Super Micro-grain carbide

Workpiece Materials ★ 1st Choice



2FESS (Short)

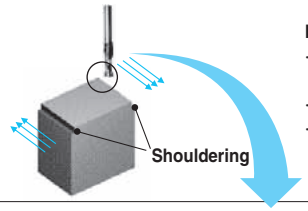
Shouldering Slotting

(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

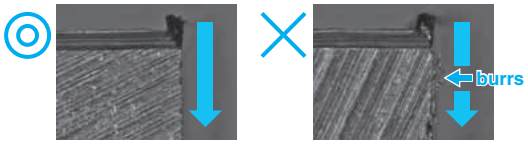
SUS304



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 D**



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 L37

● : Std. Item

2FESM (Medium)

Shouldering Slotting

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ϕDs	L	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.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ϕDs	L	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.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ϕDs	L	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 ➡ L37~L38

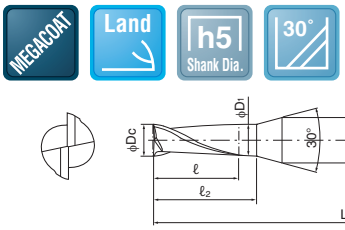
No. of Flutes: 2

2FEKS, 2FEKM

Workpiece Materials ★ 1st Choice

MEGACOAT is applied

Super Micro-grain carbide



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 L38

● : Std. Item

No. of Flutes: 4

4 flutes, Sharp corner edge

4FESM

Workpiece Materials ★ 1st Choice

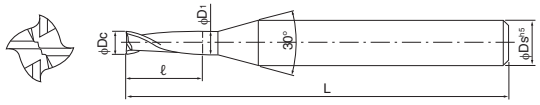
P ~30HRC | P 30~40HRC | H ~55HRC | ★M Stainless steel | K Cast Iron | N Aluminum & Non Ferrous Material

4

MEGACOAT is applied

Super Micro-grain carbide

MEGACOAT | Sharp | h5 Shank Dia. | 30°



4 flutes, Tough corner edge

4FEKM

Workpiece Materials ★ 1st Choice

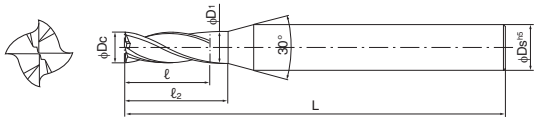
P ~30HRC | P 30~40HRC | H ~55HRC | ★M Stainless steel | K Cast Iron | N Aluminum & Non Ferrous Material

4

MEGACOAT is applied

Super Micro-grain carbide

MEGACOAT | Land | h5 Shank Dia. | 30°



4FESM

Shouldering

(Unit: mm)

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

● : Std. Item

4FEKM

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
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

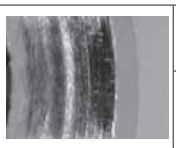
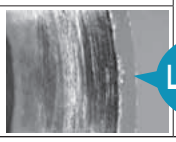
Recommended Cutting Conditions L39

Surface finish oriented, For automatic lathe

No. of Flutes: 2, 3, 4

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

(2FESW)

Workpiece Material: Kovar 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 C (ϕ3·2flutes) ×Large burrs	 Large burrs	

Comparison with competitor's end mill after 600 passes

2 3 4

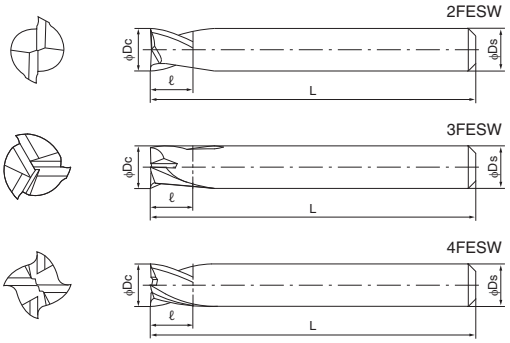
MEGACOAT is applied

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

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 ⓫ L40-L41

● : Std. Item

3 flutes, Multi-purpose

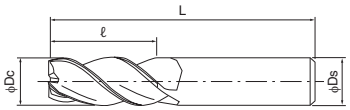
No. of Flutes: 3

3UFSM

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

TiAlN | Sharp (ϕ1~3) | Land (ϕ4~) | h6 Shank Dia. | 45°



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 cutting, three flutes type for general semi finishing. It is available for slotting and shouldering of wide range of workpiece materials.

Recommended Cutting Conditions L41

● : Std. Item

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

No. of Flutes: 4, 5, 6

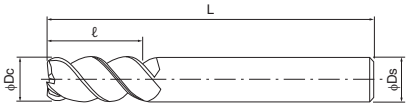
4PGS, 5PGS, 6PGS

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

(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

(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

(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

● Web thickness 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 ⓖ L42-L43

● : Std. Item

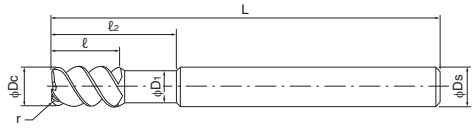
4PGRM

No. of Flutes: 4

Workpiece Materials ★ 1st Choice

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

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



4PGRM

Shouldering | Slotting

(Unit: mm)

Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	Spec of Corners
		ϕDc		ℓ	ϕD1	ℓ2	ϕDs	L	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 L43

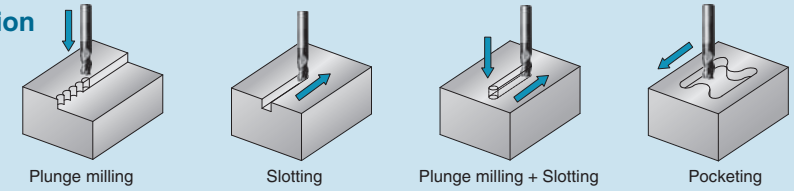
● : Std. Item

3ZFK

Triple functions

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

●Application

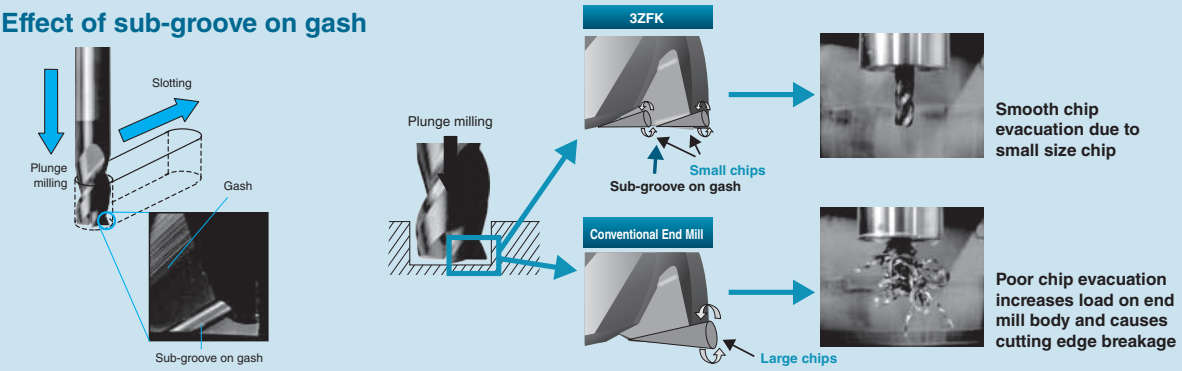


Triple Performances

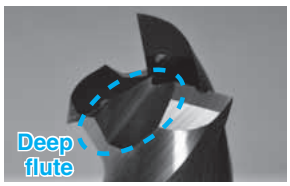
1. High efficiency cutting due to new design

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

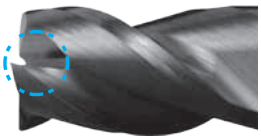
●Effect of sub-groove on gash



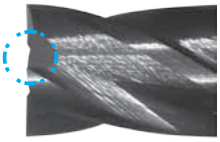
· Prevents **chip clogging** owing to deep flute and gash design.



Bottom surface of 3ZFK cutting edge



3ZFK

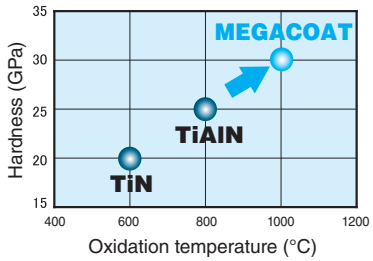


Conventional End Mill

2. Longer tool life owing to MEGACOAT

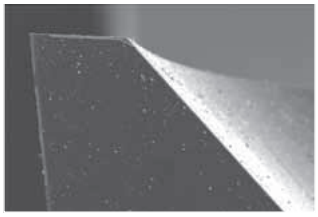
· Excellent wear resistance and heat-resistance

MEGACOAT (New PVD coat)



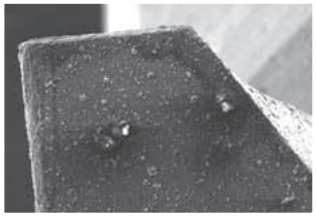
3. Better surface finish owing to sharp cutting edge quality

· 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

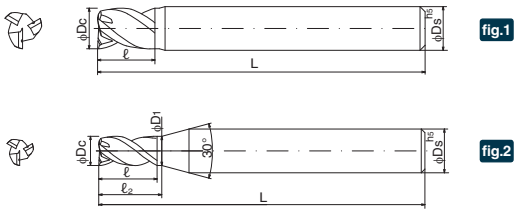
3ZFKS, 3ZFKM

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	-	-	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	-	-	8	60	3
3ZFKS100-150-10 fig.1	●	10.0	-0.005 -0.025	15	-	-	10	70	3
3ZFKS120-180-12 fig.1	●	12.0	-0.01 -0.03	18	-	-	12	75	3

3ZFKM (Medium)

Shouldering | Slotting | Plunge milling

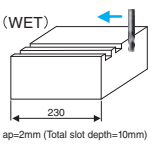
(Unit: mm)

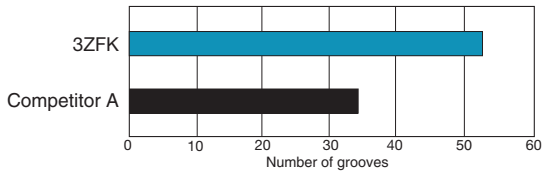
Description	Std.	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		ϕDc		ℓ	ϕD1	ℓ2	ϕDs	L	Z
3ZFKM030-060-06 fig.2	●	3.0	0 -0.015	6.0	3.2	6.5	6	50	3
3ZFKM030-080-06 fig.2	●	3.0	0 -0.015	8.0	3.2	8.6	6	50	3
3ZFKM040-080-06 fig.2	●	4.0	0 -0.015	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

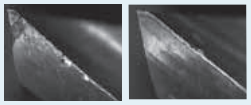
Outside Dia.	ϕ10
Workpiece Material	Ti-6Al-4V
Spindle Revolution	3ZFK: n=1,700min^{-1}
	Competitor A: n=1,300min^{-1}
Feed Rate	Vf =460mm/min
Depth of Cut	ap×ae=2×10mm



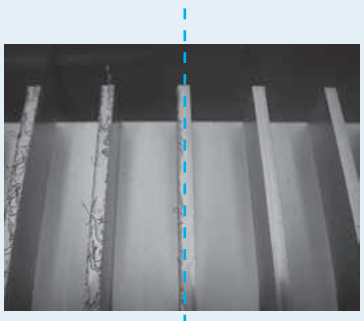


· Better surface finish and longer tool life with 3ZFK.
· Compared to competitor's coated products, the 3ZFK has a 1.4 times longer tool life.
· 3ZFK prevents burr formation due to sharp cutting edge.

◆Cutting edge after 35 passes



Competitor A 3ZFK



Competitor A 3ZFK

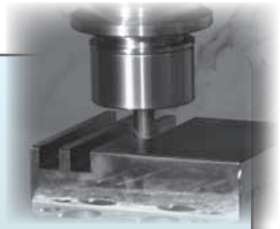
Recommended Cutting Conditions ➔ L44

● : Std. Item

4MFK, 4MFR

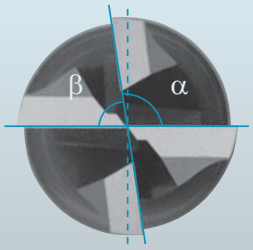
Innovative design for high efficiency stable milling

●Unequal spacing of teeth / Variable Lead



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

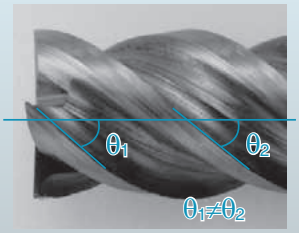
Varied interval flute design



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

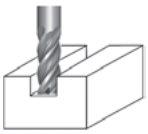
$\alpha \neq \beta$

Variable Lead



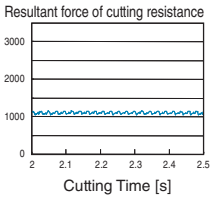
Every flute has its optimum Helix Angle (Lead Angle θ), which enables excellent anti vibration effect.
Prevents chattering, and superior surface finish
Helix Angle: θ_1=42°, θ_2=44°

Variable Lead: Prevents chattering

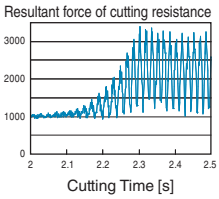


Workpiece Material	SCM440
Outside Dia.	ϕ8
Spindle Revolution	n=2,650min^{-1}
Table feed	Vf=300mm/min
Depth of cut	ap×ae=10×8mm

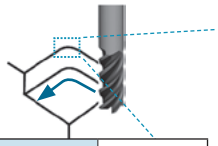
4MFK080-190



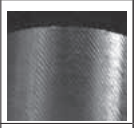
Competitor A (Equal lead angle)



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

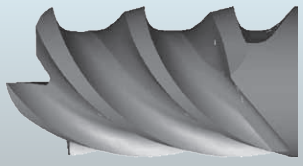
Minimum vibration when shouldering. Excellent surface finish.

●Special Flute Design

Stable Chip Evacuation due to New Special Flute Design

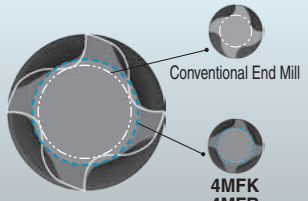
Wide chip pocket

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



High rigidity due to increased core thickness

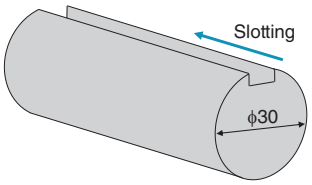
Core thickness improves the rigidity, preventing vibration and inclination of tool during machining.



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/edge
Competitor Coated Carbide E	50 pcs/edge

6.6 times the productivity
5 times the tool life

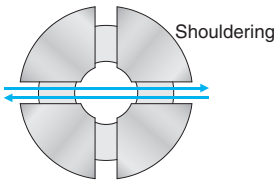
[Competitor Coated Carbide E]
ϕ7·4 flutes
n=2,000min^{-1}(Vc=44m/min)
ap×ae=5×7mm
Vf=150mm/min (fz=0.019mm/t)
Wet

· 4MFK showed 5 times longer tool life than Competitor E.
· Compared to Competitor E, 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	1000 pcs/edge
Competitor Coated Carbide G	500 pcs/edge Chipping

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

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

(Evaluation by the user)

4MFK, 4MFR NEW

No. of Flutes: 4

4

MEGACOAT NANO is applied

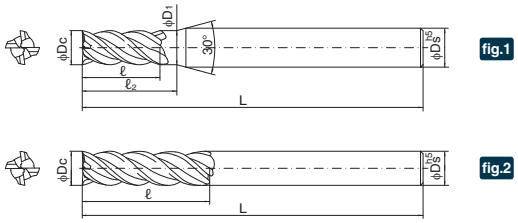
Super Micro-grain carbide

Workpiece Materials ★ 1st Choice

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

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

4MFK 4MFR



4MFK (Square)

(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 R 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						

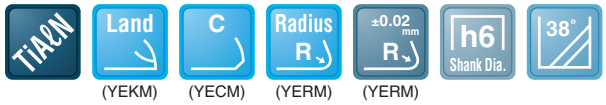
Recommended Cutting Conditions ⓫ L45

● : Std. Item

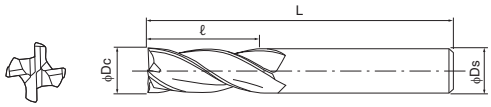
No. of Flutes: 4

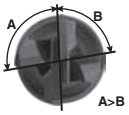
4YEKM, 4YECM, 4YERM

Workpiece Materials ★ 1st Choice



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





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 cutting. 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 ➔ L45

● : Std. Item

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

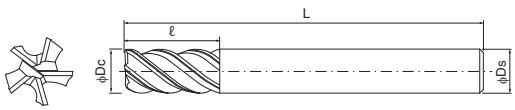
No. of Flutes: 5

5DEKM, 5DERM

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°



5

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 cutting. Varied intervals prevent vibration. 5DERM is suitable for 0.8Dc slotting.

Recommended Cutting Conditions L46

Steel and Difficult-to-cut materials, Finishing

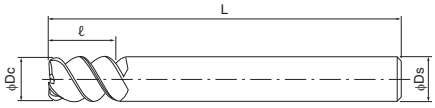
No. of Flutes: 4, 6

4YFSM, 6YFSM

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°



4 6

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

- Multiple flutes type with excellent chip evacuation. (web thickness 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.

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

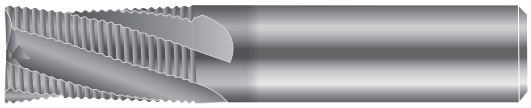
Recommended Cutting Conditions L47

● : Std. Item

High efficiency chip evacuation Roughing, Large flat surface

No. of Flutes: 3, 4, 5

3RDS, 4RDS, 5RDS

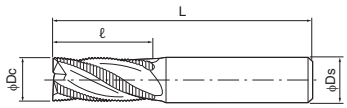


3 4 5

Workpiece Materials ★ 1st Choice

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

TiAlN | Cutting edge shape / Cutting 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 ➡ L47-L48

● : Std. Item

High efficiency chip evacuation Roughing, Notched surface

No. of Flutes: 4, 6

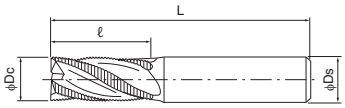
4RFSM, 6RFSM

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 Cutting 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 L48

- 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 surface, Radius

No. of Flutes: 3, 4

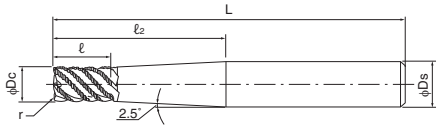
3RFRS, 4RFRS

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 Cutting 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 L49

● : Std. Item

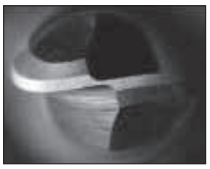
Ball-nose End Mill (Copying)

No. of Flutes: 2, 3

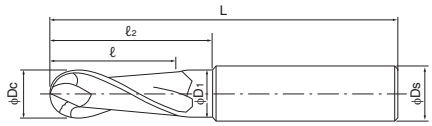
2UEBS (Ball-nose End Mill with 2 Flutes)

Workpiece Materials ★ 1st Choice

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



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

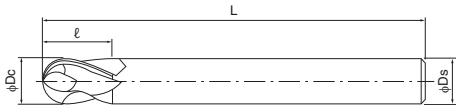


3UEBS (Ball-nose End Mill with 3 Flutes)

Workpiece Materials ★ 1st Choice

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

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	Mill Dia. tolerance	Length of cut ℓ	Neck Dia. ϕD1	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L
2UEBS010-030-04	●	R0.5	1	-0.014 -0.028	3	-	-	4	50
2UEBS020-030-04	●	R1	2	-0.014 -0.028	3	-	-	4	50
2UEBS030-095-06	●	R1.5	3	-0.014 -0.028	9.5	-	-	6	58
2UEBS040-120-06	●	R2	4	-0.020 -0.038	12	-	-	6	76
2UEBS050-140-06	●	R2.5	5	-0.020 -0.038	14	-	-	6	76
2UEBS060-160-06	●	R3	6	-0.020 -0.038	16	5.5	40	6	100
2UEBS080-200-08	●	R4	8	-0.025 -0.047	20	7.5	40	8	100
2UEBS100-220-10	●	R5	10	-0.025 -0.047	22	9.5	35	10	100
2UEBS120-250-12	●	R6	12	-0.032 -0.059	25	11.5	50	12	125
2UEBS160-320-16	●	R8	16	-0.032 -0.059	32	15.5	60	16	150
2UEBS200-380-20	●	R10	20	-0.040 -0.073	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	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L
3UEBS030-070-06	●	R1.5	3	-0.014 -0.028	7	6	57
3UEBS040-080-06	●	R2	4	-0.020 -0.038	8	6	57
3UEBS050-100-06	●	R2.5	5	-0.020 -0.038	10	6	57
3UEBS060-100-06	●	R3	6	-0.020 -0.038	10	6	57
3UEBS080-160-08	●	R4	8	-0.025 -0.047	16	8	63
3UEBS100-190-10	●	R5	10	-0.025 -0.047	19	10	72
3UEBS120-220-12	●	R6	12	-0.032 -0.059	22	12	83

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

Recommended Cutting Conditions ➔ L49

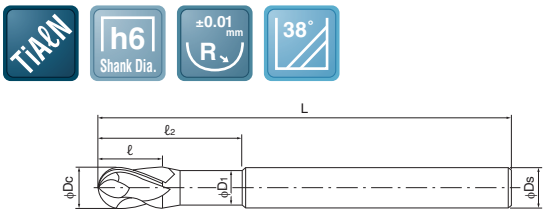
● : Std. Item

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.	Mill Dia. tolerance	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	-0.020 -0.038	9	4.5	15	6	57
4YEBM060-100-06	●	R3	6	-0.020 -0.038	10	5.5	15	6	57
4YEBM080-120-08	●	R4	8	-0.025 -0.047	12	7.4	20	8	63
4YEBM100-140-10	●	R5	10	-0.025 -0.047	14	9.2	25	10	72
4YEBM120-160-12	●	R6	12	-0.032 -0.059	16	11	30	12	83
4YEBM160-220-16	●	R8	16	-0.032 -0.059	22	15	38	16	92
4YEBM200-260-20	●	R10	20	-0.040 -0.073	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 ➔ L50

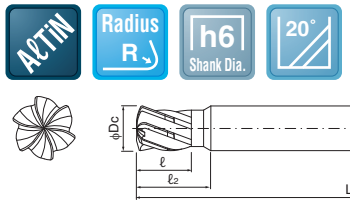
● : Std. Item

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

No. of Flutes: 6

6PDRS

Workpiece Materials ★ 1st Choice

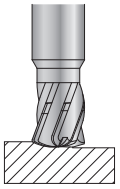


6PDRS

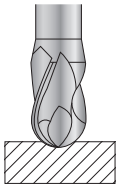
(Unit: mm)

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 cutting.
  Achieves large cutting allowance and high efficiency cutting with special corner-R shaped.
  Ramping and arc cutting are possible.

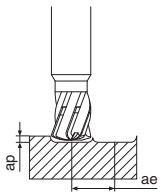


PDR



General Purpose Ball-nose End Mill

Recommended Cutting Conditions



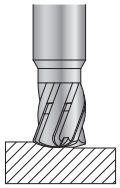
Copying

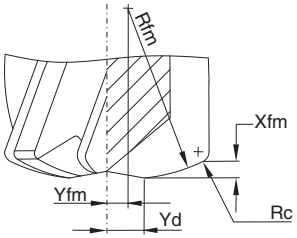
Workpiece Material		Depth of Cut (ap×ae) (mm)	Outside Dia. Dc(mm)	φ6	φ8	φ10	φ12
Pre-hardened steel	52HRC	φ6 : 0.32×3.3mm (0.32×0.55Dc) φ8 : 0.42×4.4mm (0.42×0.55Dc) φ10: 0.53×5.5mm (0.53×0.55Dc) φ12: 0.63×6.6mm (0.63×0.55Dc)	Spindle Revolution (min-1)	6,400	4,800	3,800	3,200
			Feed Rate (mm/min)	7,600	7,200	6,900	7,600
SNCM439 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

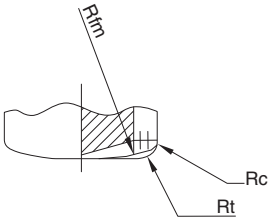
● : Std. Item

6PDRS Ramping / Arc cutting

Details of 6PDRS cutting edge shape







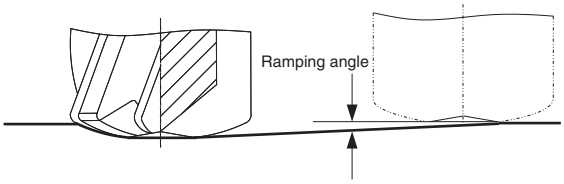
Xfm : Maximum Depth of Cut
Yfm : Distance between the center line of tool and the center of Rfm
Yd : Distance between the center line of tool and the start position of cutting edge
Rfm : Radius of tool tip
Rc : Corner-R
Rt : Virtual radius in program

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.

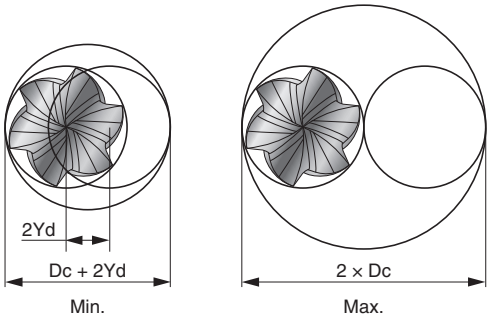


Ramping angle	1°	2°	3°	4°	5°
Ratio of feed rate	100%	70%	50%	30%	10%

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

Circular Interpolation

For arc cutting, hole diameter of each cutting 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

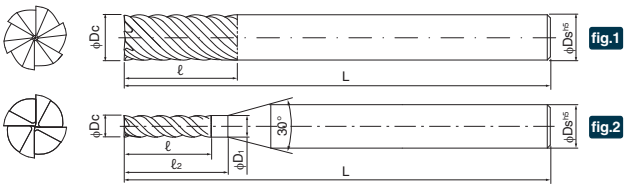
Super Micro-grain carbide

Height efficiency cutting

Workpiece Materials ★ 1st Choice

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

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

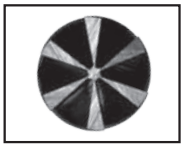


4HFSS, 5HFSS, 6HFSS, 7HFSS (Short)

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
6HFSM070-200-08 fig.2	●	7	-0.005 -0.025	20	7.2	24.0	8	70	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
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

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

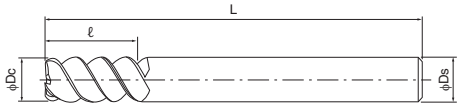
Recommended Cutting Conditions ➔ L50

● : 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 cutting 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 ➔ L51

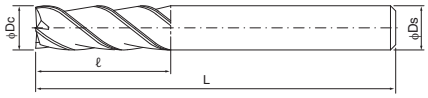
● : Std. Item

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

No. of Flutes: 3

3NESM

Workpiece Materials ★ 1st Choice



3NESM

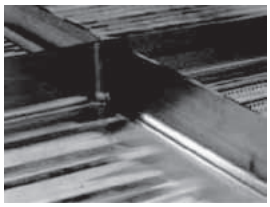
Shouldering Slotting

(Unit: mm)

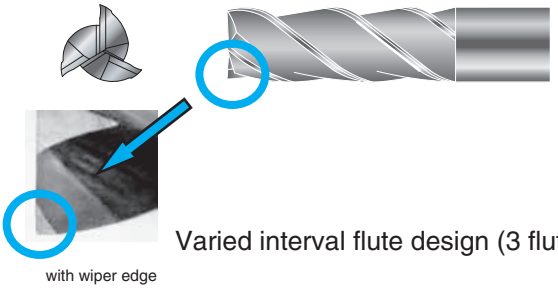
Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Shank Dia. ϕDs	Overall length L	No. of Flutes Z
3NESM030-120-06	●	3	-0.014 -0.028	12	6	50	3
3NESM040-120-06	●	4	-0.020 -0.038	12	6	50	3
3NESM050-140-06	●	5	-0.020 -0.038	14	6	50	3
3NESM060-160-06	●	6	0 -0.008	16	6	50	3
3NESM080-200-08	●	8	0 -0.009	20	8	63	3
3NESM100-220-10	●	10	0 -0.009	22	10	76	3
3NESM120-250-12	●	12	0 -0.011	25	12	76	3
3NESM160-320-16	●	16	0 -0.011	32	16	89	3
3NESM200-380-20	●	20	0 -0.013	38	20	104	3

* 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 cutting.
Reached 0.25μmRa
(Bottom face / side face/corner)



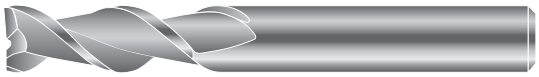
Varied interval flute design (3 flutes)
with wiper edge

Recommended Cutting Conditions ➔ L51

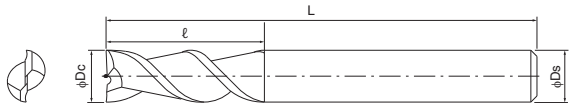
● : Std. Item

No. of Flutes: 2, 3

2NFSM, 3NFSM, 3NFSL



Workpiece Materials ★ 1st Choice



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.

3NFSL (Medium)

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.

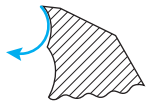
3NFSM (Medium)

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.

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

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

Recommended Cutting Conditions ➡ L51-L52

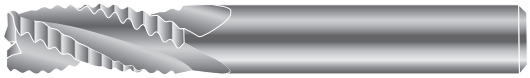
● : Std. Item

No. of Flutes: 3

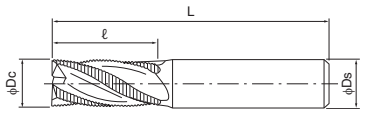
3AESM, 3AESL

Workpiece Materials ★ 1st Choice

N Aluminum & Non Ferrous Material



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



3

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

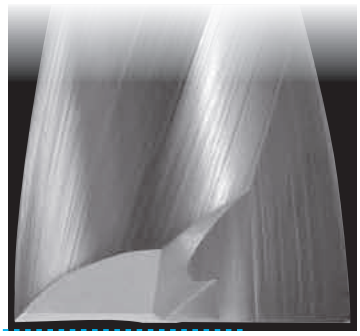
● Three flutes type for roughing of aluminum. With corner chamfering.

Recommended Cutting Conditions ➔ L52

● : Std. Item

2ZDK SUPER FLAT

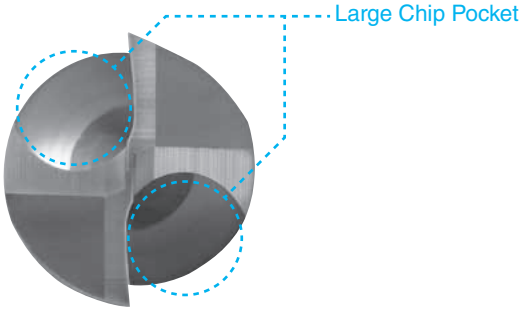
Edge ends have 180° flat and are applicable to various applications.
Available for high-precision counterboring.
Optimum tool for improvement and cost reduction of difficult cutting processes.



Flat Bottom

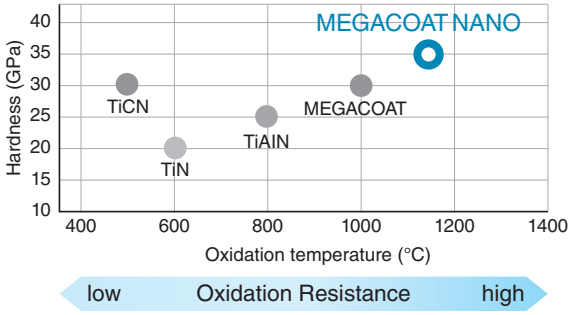
● Smooth Chip Evacuation

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



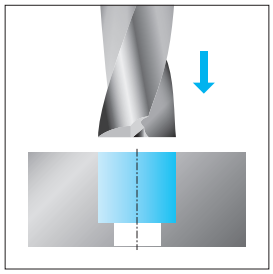
● Long Tool Life with "MEGACOAT NANO"

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

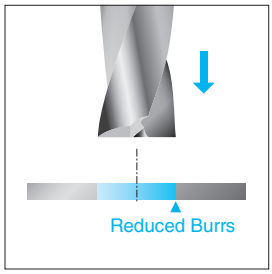


●Applications

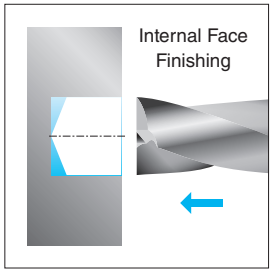
Hole Counterboring



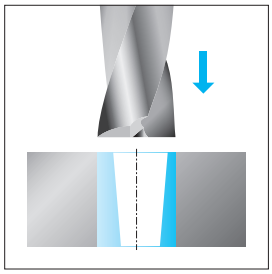
Plunging on Thin Plate



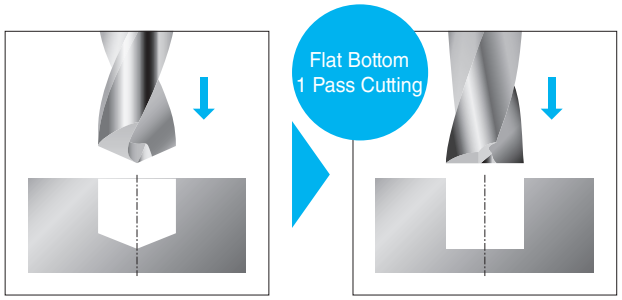
Turning in Automatic Lathes/Turning



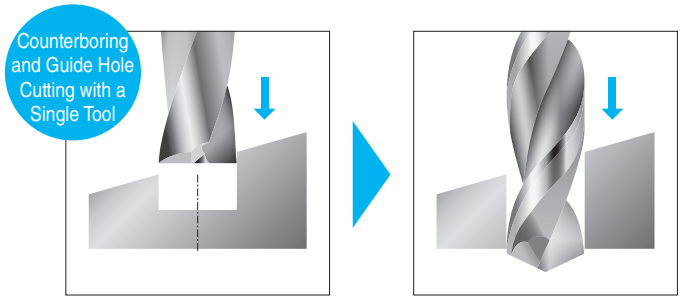
Hole Expanding



Bottom Finishing after Drilling



Counterboring on Slant Surface/Guide Hole Cutting

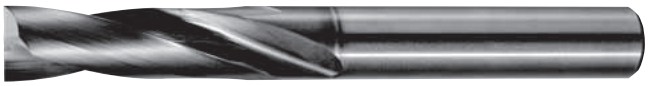


No. of Flutes: 2

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.

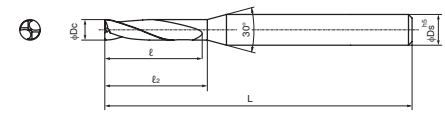


fig.1

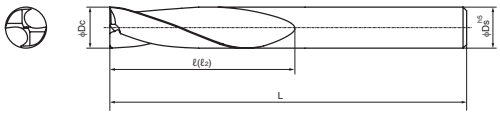


fig.2

2ZDK

Plunge milling

(Unit: mm)

Description	Std.	Outside Dia. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. of Flutes 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. ϕDc	Mill Dia. tolerance	Length of cut ℓ	Under Neck Length ℓ2	Shank Dia. ϕDs	Overall length L	No. of Flutes 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	46			
2ZDK110 fig.1	●	11.0		51	50			
2ZDK115 fig.1	●	11.5		53	52			
2ZDK120 fig.2	●	12.0		54	(54)			

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

· Helix Angle is 20°

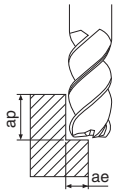
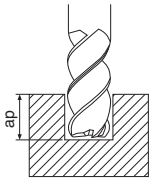
· The cutting depth should be less than 2D(2×Dc) when the workpiece is not pre-drilled.

Recommended Cutting Conditions L53

● : Std. Item

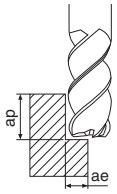
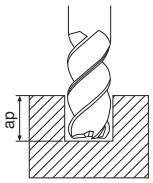
Recommended Cutting Conditions

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

* Cutting with coolant is recommended for stainless steel.

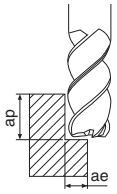
2FESM

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

* Cutting with coolant is recommended for stainless steel.

Recommended Cutting Conditions

2FESL (Shouldering)

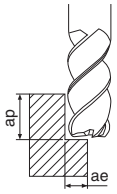
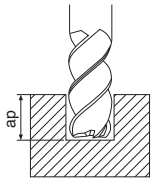
Applications	Workpiece Material	Outside Dia. Dc (mm)	ϕ1	ϕ2	ϕ4	ϕ6	ϕ8	ϕ12	ϕ16
 Shouldering	Carbon steel, Cast iron	Spindle Revolution (min-1)	19,000	9,500	4,800	3,200	2,400	1,600	1,200
		Feed Rate (mm/min)	210	210	210	210	210	210	210
	Alloy steel	Spindle Revolution (min-1)	14,300	7,200	3,600	2,400	2,000	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)

* Cutting 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

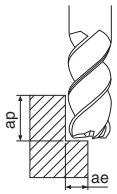
Depth of Cut (ap×ae) (mm)
1.2Dc×0.1Dc

Depth of Cut (ap) (mm)
0.5Dc

* Cutting with coolant is recommended for stainless steel.

Recommended Cutting Conditions

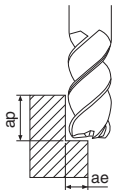
4FESM (Shouldering)

Applications	Workpiece Material	Outside Dia. Dc (mm)	ϕ1	ϕ2	ϕ4	ϕ6	ϕ8	ϕ12	ϕ16
 Shouldering Depth of Cut (ap×ae) (mm) 1.5Dc×0.05Dc (Dc<ϕ3) 1.5Dc×0.1Dc (Dc≥ϕ3)	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

* Cutting with coolant is recommended for stainless steel.

Slotting is not recommended.

4FEKM (Tough corner edge) (Shouldering)

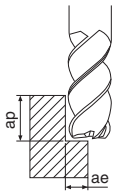
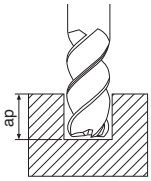
Applications	Workpiece Material	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering Depth of Cut (ap×ae) (mm) 1.5Dc×0.1Dc	Carbon steel, Cast iron	Spindle Revolution (min-1)	10,600	8,000	5,300	4,000	3,200	2,700	2,100
		Feed Rate (mm/min)	680	690	770	770	770	770	770
	Alloy steel	Spindle Revolution (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

* Cutting with coolant is recommended for stainless steel.

Slotting is not recommended.

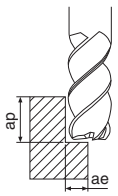
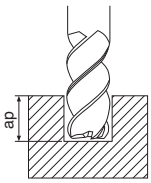
Recommended Cutting Conditions

2FESW

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ13
 Shouldering Depth of Cut (ap×ae) (mm) 1Dc×0.2Dc  Slotting Depth of Cut (ap) (mm) 0.2Dc	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
	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)	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
	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
	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)	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

* Cutting with coolant is recommended for stainless steel.

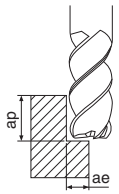
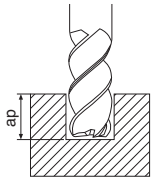
3FESW

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ13
 Shouldering Depth of Cut (ap×ae) (mm) 1Dc×0.2Dc  Slotting Depth of Cut (ap) (mm) 0.2Dc	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
	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)	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
	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
	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)	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

* Cutting with coolant is recommended for stainless steel.

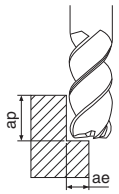
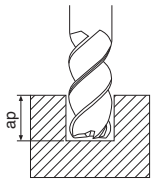
Recommended Cutting Conditions

4FESW

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ13
 Shouldering Depth of Cut (ap×ae) (mm) 1Dc×0.2Dc  Slotting Depth of Cut (ap) (mm) 0.2Dc	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
	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
	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
	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

* Cutting with coolant is recommended for stainless steel.

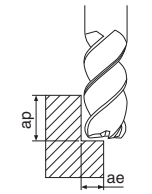
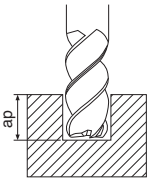
3UFSM

Applications	Workpiece Material	Application	Outside Dia. Dc (mm)	ϕ2	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering Depth of Cut (ap×ae) (mm) 1.5Dc×0.1Dc  Slotting Depth of Cut (ap) (mm) 0.25Dc (Carbon steel/Cast iron 0.5Dc)	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
	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
	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
	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

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

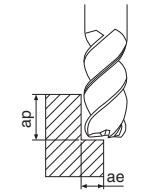
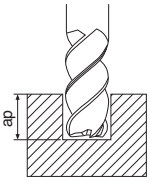
Recommended Cutting Conditions

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

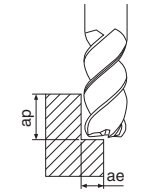
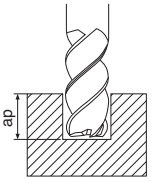
* Cutting with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

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

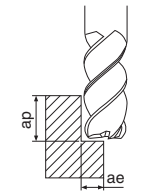
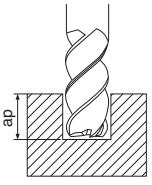
* Cutting with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

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	1.5Dcx0.3Dc	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	1.5Dcx0.3Dc	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	1.5Dcx0.2Dc	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	1.5Dcx0.2Dc	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	1.5Dcx0.2Dc	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

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

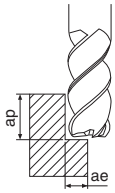
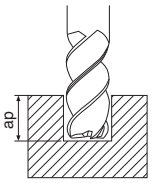
4PGRM

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	1Dcx0.3Dc	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	1Dcx0.3Dc	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	1Dcx0.25Dc	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	1Dcx0.25Dc	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	1Dcx0.2Dc	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

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

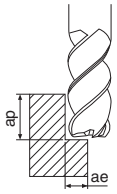
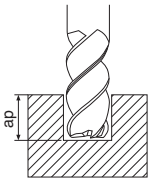
Recommended Cutting Conditions

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
 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
			Feed Rate (mm/min)	Shouldering	850	950	1,100	1,200	1,100	1,000	910	850
				Plunge milling	180	170	170	170	160	150	120	100
				Slotting	570	650	700	730	750	780	800	750
	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
			Feed Rate (mm/min)	Shouldering	700	780	900	980	900	850	750	700
				Plunge milling	120	120	130	140	130	130	120	100
				Slotting	500	540	570	590	610	600	580	500
	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
			Feed Rate (mm/min)	Shouldering	440	440	490	490	490	440	400	370
				Plunge milling	90	110	110	130	110	100	80	70
				Slotting	220	270	270	320	330	330	230	200
 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
			Feed Rate (mm/min)	Shouldering	280	270	330	340	330	330	350	320
				Plunge milling	20	30	40	40	40	30	20	20
				Slotting	110	110	130	140	130	130	120	120
	Titanium Alloys		Spindle Revolution (min-1)		3,300	2,500	2,000	1,700	1,400	1,300	1,100	900
			Feed Rate (mm/min)	Shouldering	280	270	330	340	330	330	350	320
				Plunge milling	20	30	40	40	40	30	20	20
				Slotting	110	110	130	140	130	130	120	120

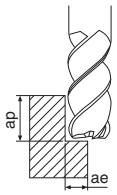
· Compressed air is recommended for cutting steel.
· Water soluble coolant is recommended for machining stainless steel and titanium alloys.
· Adjust depth of cut (ap) to suit machine rigidity

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  Slotting	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
	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

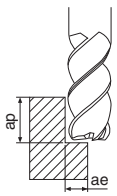
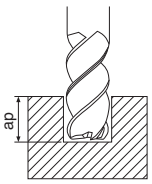
* Cutting with coolant is recommended for stainless steel.

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	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

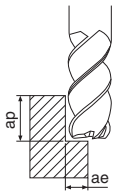
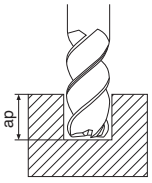
* Cutting with coolant is recommended for stainless steel.

4YEKM, 4YECM, 4YERM

Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering  Slotting	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
	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

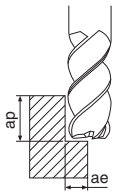
* Cutting with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

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	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
 Slotting Depth of Cut (ap) (mm) 5DEKM: 0.25Dc 5DERM: 0.8Dc	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

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

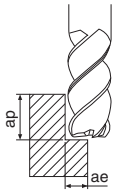
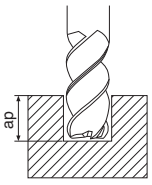
4YFSM, 6YFSM (Shouldering)

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

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

Slotting is not recommended.

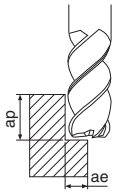
3RDSM, 4RDSM, 5RDSM

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

* Cutting with coolant is recommended for stainless steel.

Recommended Cutting Conditions

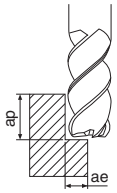
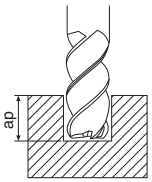
3RDSL, 4RDSL, 5RDSL (Shouldering)

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

* Cutting with coolant is recommended for stainless steel.

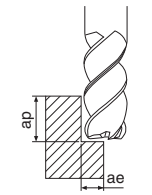
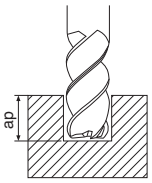
Slotting is not recommended.

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

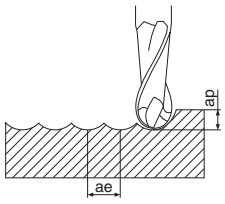
* Cutting with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

3RFRS, 4RFRS

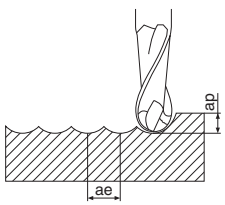
Applications	Workpiece Material		Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12
 Shouldering  Slotting	Steel	< 30HRC	Shouldering	0.8Dc×0.5Dc	Spindle Revolution (min-1)	14,300	11,500	9,600	7,200	5,700	4,800
					Feed Rate (mm/min)	860	860	1,150	1,150	1,150	1,150
			Slotting	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
		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

* Cutting with coolant is recommended for titanium alloys.

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

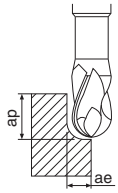
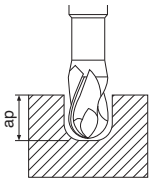
3UEBS

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

* Cutting with coolant is recommended for stainless steel.

Recommended Cutting Conditions

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	1Dcx0.5Dc	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	1Dcx0.5Dc	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	1Dcx0.3Dc	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	1Dcx0.2Dc	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	1Dcx0.4Dc	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

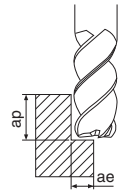
* Cutting with coolant is recommended for stainless steel, titanium alloys and heat-resistant alloys.

L

Solid End Mill

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

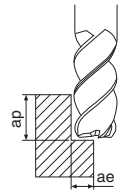
4HFSM, 5HFSM, 6HFSM, 7HFSM, 8HFSM (Shouldering)

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	1.5Dcx0.05Dc (Dc<ϕ3) 1.5Dcx0.1Dc (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
	Hardened Steel (45~55HRC)	1.5Dcx0.05Dc	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
	Hardened Steel (55~60HRC)	1.5Dcx0.02Dc	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
	Hardened Steel (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
	Hardened Steel (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.

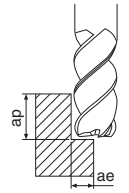
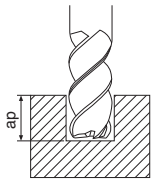
Slotting is not recommended.

4UGSM, 6UGSM (Shouldering)

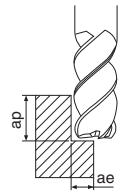
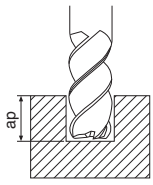
Applications	Workpiece Material		Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ4	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16
 Shouldering	Steel	45~55HRC	1Dc×0.05Dc	Spindle Revolution (min⁻¹)	11,900	8,000	6,000	4,800	4,000	3,000
				Feed Rate (mm/min)	810	1,200	1,200	1,000	980	900
		55~60HRC		Spindle Revolution (min⁻¹)	8,000	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

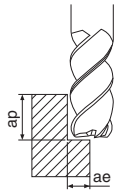
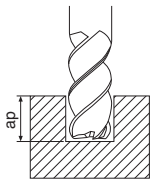
Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Aluminum Alloys	Shouldering	1.5Dc×0.5Dc	Spindle Revolution (min⁻¹)	34,000	17,000	13,000	10,200	8,500	6,400	5,100
				Feed Rate (mm/min)	2,750	2,750	2,750	2,750	2,750	2,750	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

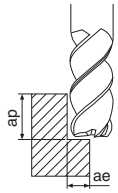
Applications	Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	Aluminum Alloys	Shouldering	1Dc×0.5Dc	Spindle Revolution (min⁻¹)	26,500	13,300	10,000	8,000	6,600	5,000	4,000
				Feed Rate (mm/min)	690	950	950	1,130	1,260	1,000	880
		Slotting	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 Alloys	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

Recommended Cutting Conditions

3NFSM

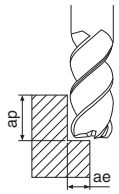
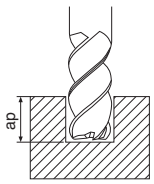
Applications		Workpiece Material	Application	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ3	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20
 Shouldering	 Slotting	Aluminum Alloys	Shouldering	1Dc×0.5Dc	Spindle Revolution (min⁻¹)	26,500	13,300	10,000	8,000	6,600	5,000	4,000
					Feed Rate (mm/min)	1,040	1,400	1,400	1,700	1,890	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 Alloys	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)

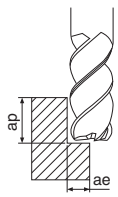
Applications	Workpiece Material	Depth of Cut (ap×ae) (mm)	Outside Dia. Dc (mm)	ϕ6	ϕ8	ϕ10	ϕ12	ϕ16	ϕ20	ϕ25
 Shouldering	Aluminum Alloys	2.5Dc×0.5Dc	Spindle Revolution (min⁻¹)	18,500	9,300	7,000	5,600	4,600	3,500	2,800
			Feed Rate (mm/min)	730	980	980	1,200	1,320	1,040	920
	High-silicon Aluminum Alloys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

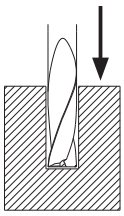
3AESL (Shouldering)

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 Alloys		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)	ϕ3	ϕ4	ϕ5	ϕ6	ϕ8	ϕ10	ϕ12
 Plunge milling	Structural steel Carbon steel	Plunge milling	Spindle Revolution (min-1)	8,300	6,200	5,000	4,200	3,200	2,500	2,100
			Feed Rate (mm/min)	520	520	520	520	520	520	520
	Alloy steel		Spindle Revolution (min-1)	7,200	5,400	4,400	3,600	2,700	2,200	1,800
			Feed Rate (mm/min)	450	450	450	450	450	450	450
	Pre-hardened steel (30~45HRC)		Spindle Revolution (min-1)	3,900	2,900	2,300	1,900	1,500	1,200	1,000
			Feed Rate (mm/min)	210	210	210	210	210	210	210
	Nodular Cast Iron		Spindle Revolution (min-1)	7,200	5,400	4,400	3,600	2,700	2,200	1,800
			Feed Rate (mm/min)	390	390	390	390	390	390	390
	Aluminum Alloys		Spindle Revolution (min-1)	17,800	13,100	10,500	8,900	6,700	5,400	4,500
			Feed Rate (mm/min)	1,270	1,270	1,270	1,270	1,270	1,270	1,270
	Aluminium alloy casting		Spindle Revolution (min-1)	13,100	10,000	8,000	6,700	5,000	4,000	3,400
			Feed Rate (mm/min)	820	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 ap to suit machine rigidity.
· Use chuck and machine with as high rigidity as possible.
· Stainless steel cutting (SUS304/SUS316) is NOT recommended.
· Modifications of cutting conditions can be needed when cutting 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%.

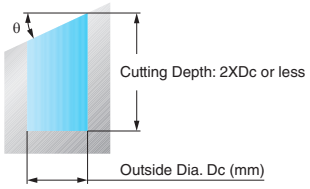


fig.1

Solid End Mill