

Solid Tools

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Tool Selection Guide

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66M Series

L16

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L18~L30

High feed rate, High efficiency

4MFK/4MFR

L18

Difficult-to-cut Materials, High efficiency

4TFK/4TFR

L20

High vibration resistance, High efficiency

Z Series

L22

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3ZFK

L28

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L31

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Hard materials

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High efficiency, High precision

3AFK

L50

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N Series

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Tool Selection Guide

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Solid Drills

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IC140

L66

3D type (2/3 flutes)

GP108M, GP103

L68

High Efficiency Drill for Aluminum

HP131N

L70

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2ZDK

L72

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L77~L108


















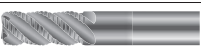











L



Tool Selection Guide

Application and selection

See Page	Applications	Description	Identification System	Features	Shape	Coating	No. of Flutes	Helix Angle	Outside Dia. DC (mm)		
L10-L11	Surface finish oriented	2FES S/M/L	1	2 flutes, Sharp corner edge		MEGACOAT	2	30°	ø0.2~ø16		
L12		2FEK S/M		2 flutes, Tough corner edge					ø3~ø16		
L13		4FESM		4 flutes, Sharp corner edge			4		ø1~ø16		
		4FEKM		4 flutes, Tough corner edge					ø3~ø16		
L14-L15		2/3/4 FESW			For Automatic Lathes (Overall length 35mm / 45mm)				2/3/4	35°	ø3~ø13
L16-L17	66M	5	NEW 7/9/11 flutes, High efficiency Multi-edge type, High efficiency		Multi-element	7/9/11 7/9	35°	ø6~ø25			
L16-L17	66MCR	4						ø6~ø16			
L18-L19	High efficiency chip evacuation	4MFK	2	4 flutes High feed rate, High efficiency		MEGACOAT NANO	4	Variable Lead 42°, 44°	ø3~ø16		
L18-L19		4MFR									
L20-L21		4TFK	2	4 flutes Difficult-to-cut Materials, High efficiency		MEGACOAT NANO	4	Variable Lead 42°, 44°	ø3~ø20		
L20-L21		4TFR									
L24		Z1M	5	NEW 4 flutes, High vibration resistance, High efficiency		AITiN	4	Variable Lead 35°, 38°	ø3~ø25		
L25		Z1MPCR	4						Multi-element	4	ø1~ø20
		Z1MPLC							ø6~ø20		
L26-L27		Z5MCR	4	NEW 5 flutes, Roughing, Difficult-to-cut Materials, High efficiency		Multi-element	5	37°	ø6~ø25		
L28-L29		3ZFK S/M	1	Multi-functional, High efficiency		MEGACOAT	3	40°	ø3~ø16		
L30		5DEKM	1	5 flutes, Steel and Difficult-to-cut Materials Varied interval flute design		AITiN	5	38°	ø4~ø25		
	5DERM										
L31	Multi-purpose	3UFMS	1	3 flutes, Multi-purpose		TiAlN	3	45°	ø1~ø20		
L32-L33	High efficiency, High feed rate with Multi-edge	6PFK	2	6/8 flutes, High efficiency, High feed rate, Finishing (Shouldering)		MEGACOAT NANO	6 8	Variable Lead 42°, 44°	ø6~ø25		
L32-L33		8PFK									
L34-L35		51M	5	NEW 6 flutes High efficiency, High feed rate, Finishing (Trochoid Machining)		AITiN	6	41°	ø6~ø20		
		51ML									
		51MCR									
L34-L35	51MLC	4									
L36	Superalloy	4JER	2	4 flutes High efficiency, Stable Machining		MEGACOAT HARD	4	Variable Lead 32°, 35°	ø6~ø20		
L37		ZH1MCR	4	NEW 4 flutes Variable Lead		AITiN	4	Variable Lead 38°, 41°	ø6~ø20		
L38-L39	Roughing	4RFH	2	NEW Special serrated edge, Difficult-to-cut materials with Coolant hole		MEGACOAT HARD	4 5 6	40°	ø6~ø20		
L38-L39		5RFH									
L38-L39		6RFH									
L40		3/4/5 RDSM	1	Serrated edge			3/4/5	20°	ø4~ø25		
L40	3/4/5 RDSL										
L41	4/6 RFSM	1	Notched edge		TiAlN	4/6	45°	ø6~ø25			
	L41							3/4 RFRS	3/4	ø4~ø12	
L42-L43	Ball-nose	2SEB	3	High efficiency Ball-nose End Mill with 2 flutes		MEGACOAT NANO	2	30°	ø2~ø16		
L44		2UEBS	1	Ball-nose End Mill with 2 flutes		TiAlN	2	30°	ø1~ø20		
		L44	3UEBS	1	Ball-nose End Mill with 3 flutes					3	30°
L45		Z1MB	5	NEW High efficiency Ball-nose End Mill with 4 flutes		Multi-element	4	Variable Lead 35°, 38°	ø3~ø25		
L45		4YEBM	1	Ball-nose End Mill with 4 flutes		TiAlN	4	38°	ø5~ø20		
L46-L47	Special corner-R shaped	6PDRS	1	6 flutes, High feed rate		AITiN	6	20°	ø6~ø12		
L48	Hard materials	4/5/6/7 HFSS	1	Multi-edge type Negative rake angle Hard Materials Finishing		MEGACOAT HARD	4/5/6/7 4/5/6/7/8	45°	ø1~ø12		
		L48							4/5/6/7/8 HFSM	ø1~ø25	
L49		4/6 UGSM				TiAlN	4/6	50°	ø3~ø16		
L49		56MB	5	NEW High efficiency Ball-nose End Mill with 2 flutes		Multi-element	2	30°	ø1~ø20		

L
Solid Tools

Carbide Substrate

Substrate of all solid end mills is carbide.

Workpiece Material										Description	See Page
Steel		Heat Treated Steel		Stainless Steel	Titanium Alloys	Heat-resistant Alloys	Cast Iron	Aluminum & Non-ferrous Metals			
~30HRC	~40HRC	~55HRC	~68HRC								
P ~30HRC	P 30~40HRC	H ~55HRC	H ~68HRC	M Stainless steel	S Titanium Alloy	S Heat-resistant Alloy	K Cast Iron	N Aluminum & Non Ferrous Material			
										2FES S/M/L	L10-L11
										2FEK S/M	L12
										4FESM	L13
										4FEKM	L13
										2/3/4 FESW	L14-L15
										66M	L16-L17
										66MCR	L16-L17
										4MFK	L18-L19
										4MFR	L18-L19
										4TFK	L20-L21
										4TFR	L20-L21
										Z1M	L24
										Z1MPCR	L25
										Z1MPLC	L25
										Z5MCR	L26-L27
										3ZFK S/M	L28-L29
										5DEKM	L30
										5DERM	L30
										3UFSM	L31
										6PFK	L32-L33
										8PFK	L32-L33
										51M	L34-L35
										51ML	L34-L35
										51MCR	L34-L35
										51MLC	L34-L35
										4JER	L36
										ZH1MCR	L37
										4RFH	L38-L39
										5RFH	L38-L39
										6RFH	L38-L39
										3/4/5 RDSM	L40
										3/4/5 RDSL	L40
										4/6 RFSM	L41
										3/4 RFRS	L41
										2SEB	L42-L43
										2UEBS	L44
										3UEBS	L44
										Z1MB	L45
										4YEBM	L45
										6PDRS	L46-L47
										4/5/6/7 HFSS	L48
										4/5/6/7/8 HFSM	L48
										4/6 UGSM	L49
										56MB	L49









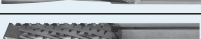
● : 1st Choice ○ : 2nd Choice

Insert Grades
Turning
Indexable Inserts
CNC & PCO Tools
External
Small Parts
Machining
Boring
Grooving
Cut-off
Threading
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Tool Selection Guide

Application and selection

See Page	Applications	Description	Identification System	Features	Shape	Coating	No. of Flutes	Helix Angle	Outside Dia. DC (mm)		
L50-L53	Aluminum & Non-ferrous Metals	3AFK	2	NEW High efficiency, High precision		-	3	45°	ø3~ø16		
L54		47ML	5	NEW 2 flutes, Large diameter type Coated (Square)		TiB ₂	2	35°	ø12~ø20		
		47MB	5	NEW 2 flutes, Large diameter type Coated (Ball-nose)					ø12~ø25		
L55			3NESM	1	Varied interval flute design with wiper edge		-	3	38°	ø3~ø20	
L56			2NFMS	1	Sharpness oriented, Smooth chip evacuation			2	45°	ø1~ø20	
			3NFMS					3		ø3~ø20	
			3NFSL					3		ø3~ø20	
L57			3AESM	1	Roughing			3	30°	ø6~ø25	
	3AESL	3	ø6~ø25								
L60	CFRP	4FCX-KCD	2	NEW For CFRP Diamond Coating		Diamond	4	10°	ø8~ø12		
L62-L63	Routers	29M	-	NEW For Plastics (End Mill / Drill / No End Cut)		Diamond	8/10/12	-	ø3~ø10		
		25M	-	NEW For CFRP Compression						Diamond	4/6/8

Solid End Mill Identification System

1

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	F : Surface finish oriented	D : 20-29°	B : Ball-nose	S : Short	020 ↓ 2.0mm	060 ↓ 6.0mm	04 ↓ 4.0mm	Corner-R, C width etc. ...
3	U(UF)/P(PG) : Multi-purpose	E : 30-39°	R : Radius	M : Medium				
4	Z : Multi-functional, High efficiency	F : 40-49°	S,K : Square	L : Long				
5	Y/D : High efficiency (Difficult-to-cut Materials)	G : 50-59°	C : With corner chamfering	W : For Automatic Lathes				
6	R : Roughing							
7	H/U(UG) : Hard materials							
8	N/A : Aluminum & Non-ferrous Metals							

2

4 T F R 030 - 080 - R02

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

(1) No. of Flutes	(2) Applications	(3) Helix Angle	(4) Series	(5) Outside Dia.	(6) Length of cut	(7) Others
3	M : High feed rate, High efficiency	C : 10-19° E : 30-39° F : 40-49°	K : Tough corner edge	030 ↓ 3.0mm	080 ↓ 8.0mm	R02 : Corner-R 0.2mm
4	P : Shouldering, High feed rate, Finishing		R : Radius			090 : Under Neck Length 9mm
5	T : High efficiency (Difficult-to-cut Materials)		H : Radius (Coolant hole)			KCD : Diamond Coating
8	R : Roughing		X : Special			
6	A : Aluminum & Non-ferrous Metals					
8	F : For CFRP					

3

2 S E B 020 - 050 - R10

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

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

Carbide Substrate

Substrate of all solid end mills is carbide.

Workpiece Material										Description	See Page
Steel		Heat Treated Steel		Stainless Steel	Titanium Alloys	Heat-resistant Alloys	Cast Iron	Aluminum & Non-ferrous Metals			
~30HRC	~40HRC	~55HRC	~68HRC								
P ~30HRC	P 30~40HRC	H ~55HRC	H ~68HRC	M Stainless steel	S Titanium Alloy	S Heat-resistant Alloy	K Cast Iron	N Aluminum & Non Ferrous Material			
								●	3AFK	L50-L53	
								●	47ML	L54	
								●	47MB		
								●	3NESM	L55	
								●	2NFSM	L56	
								●	3NFSM		
								●	3NFSL		
								●	3AESM	L57	
								●	3AESL		
								●	4FCX-KCD	L60	
								●	29M	L62-L63	
								●	25M		

● : 1st Choice ○ : 2nd Choice

4

Z1MPLC 120 - 150 - R15

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

(1) Series	(2) Outside Dia.	(3) Length of cut	(4) Corner-R
Z1MPCR / Z5MCR / ZH1MCR / 51MCR / 66MCR → Radius	120 ↓ 12.0mm	150 ↓ 15.0mm	R15 ↓ 1.5mm
Z1MPLC / 51MLC → Radius (Long)			

5

Z1MB 080 - 190

(1) (2) (3)

(1) Series	(2) Outside Dia.	(3) Length of cut
Z1M / 51M / 66M → Square	080 ↓ 8.0mm	190 ↓ 19.0mm
51ML / 47ML → Square (Long)		
Z1MB / 56MB / 47MB → Ball-nose		

Icon Glossary

Coating

- MEGACOAT NANO
- MEGACOAT HARD
- MEGACOAT
- TiAlN Coating
- AlTiN Coating
- Multi-element Coating
- TiB₂ Coating
- CVD Diamond Coating
- Uncoated

Corner Form

- Radius
- Sharp corner edge
- Land With corner land
- C With corner chamfering
- Honing Honed

Shank Dia. Tolerance

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

Corner Radius Tolerance

0~-0.02mm
R

Corner Radius Tolerance is 0~-0.02mm.

Ball-nose radius Tolerance

0~-0.02mm
R

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

No. of Flutes

3 flutes design

Helix Angle

30°
Helix Angle 30°

Cutting edge shape

Roughing

Insert Grades
 Turnable
 Indexable Inserts
 CN & PCD Tools
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Tool Selection Guide

Introduction

Surface finish oriented

L10-L17

F Series **MEGACOAT is applied** **(FES)**

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

L10-L15

NEW 66M Series **(66M)**

High speed finishing with Multi-edge type, 7/9/11 flutes
High rigidity with large core diameter, Excellent surface finish at shouldering

L16

High efficiency, Excellent chip evacuation

L18-L30

M Series **MEGACOAT NANO is applied** **(4MFK)**

Superior chattering resistance with Kyocera's unique varied interval flute design and variable lead
Achieves high rigidity and stable chip evacuation with new special flute design
Achieves high feed rate, high efficiency machining

Varied interval flute design

L18

T Series **MEGACOAT NANO is applied** **(4TFK)**

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

Varied interval flute design

L20

NEW Z Series (Z1M/Z5M) **(Z1M)**

Superior chattering resistance with Varied interval flute design and variable lead
Radius type (Z1MPCR/Z1MPLC) applies variable rake angle
Lineup of High efficiency roughing type (Z5MCR) with 5 flutes

L24-L27

3ZFK **MEGACOAT is applied** **(3ZFKS)**

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

L28

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

L30

High efficiency, High feed rate

L32-L35

PFK **MEGACOAT NANO is applied** **(6PFK)**

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

L32

NEW 51M Series **(51M)**

High speed trochoid machining with 6 flutes
Chattering is suppressed with cutting edge slots at varied intervals
Applicable to machining for Steel / Stainless Steel / Titanium Alloy

L34-L35

Superalloy

L36-L37

J Series **MEGACOAT HARD is applied** **(4JER)**

High efficiency and stable machining for Heat Resistant Alloys such as Inconel®
Long tool life machining with MEGACOAT HARD for excellent heat resistance

L36

NEW Z Series (ZH1MCR) **(ZH1MCR)**

High efficiency and stable machining for Heat Resistant Alloys such as Inconel®
Superior chattering resistance performance with varied interval flute design and variable lead

L37

Roughing

NEW **R Series** MEGACOAT HARD is applied High efficiency machining of Difficult-to-cut Material with Multi-edge design and Coolant hole
 Deep slotting ($a_p = 2 \times DC$) for Stainless Steel and Titanium Alloy
 Lineup of RDS with serrated edge and RFS with notched edge

(RFH)

L38~L41

L38~L41

Insert Grades
 Turnable
 Indexable Inserts
 CNX & PCO Tools

A
 B
 C

Ball-nose End Mill

S Series MEGACOAT NANO is applied High efficiency Ball-nose End Mill with 2 flutes
 Sharp cutting with special nose geometry
 Close tolerance edge diameter ($R \pm 0.005\text{mm}$, $\sigma 16$ excluded)
 Stable chip evacuation by a large chip pocket design

(2SEB)

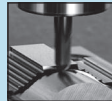
L42~L47

L42

U Series **Y Series** (UEB, YEB) Boll-nose End Mill with 2/3/4 flutes

(3UEBS)

L44~L45



External
 Small Parts
 Machining
 Boring

D
 E
 F

NEW **Z Series** (Z1MB) Z Series Ball-nose End Mill type with 4 flutes
 Superior chattering resistance performance with Varied interval flute design and variable lead
 Extended Tool Life by Multi-element Coating

(Z1MB)

L45

P Series (PDR) High efficiency radius. Enables large cutting volume and high efficiency machining with special corner-R shaped
 Ramping and arc cutting are possible

(6PDRS)

L46

Grooving
 Cut-off
 Threading

G
 H
 J

Hard materials

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

(HFS)

L48~L49

L48

U Series (UGS) For hard materials with negative rake angle
 50° Helix angle

(UGS)

L49

NEW **56MB** Special gash shape enables low cutting force
 Short length of cut, Long shank type
 New multi-element coating with high hardness and excellent heat resistance

(56MB)

L49

Drilling
 Solid Tools

K
 L

Aluminum & Non-ferrous Metals

NEW **A Series** High-efficiency and High-precision 3 flutes End Mill
 Sharp cutting edge and excellent anti-chattering performance
 Delivers high stability in diverse machining situations

(3AFK)

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

(3AESM)

L50~L57

L50

L57

NEW **47M Series** 2 flutes design
 High hardness TiB_2 coating realizes excellent wear and adhesion resistance
 Lineup of square long type and ball-nose large diameter type

(47ML)

(47MB)

L54

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

(3NESM)

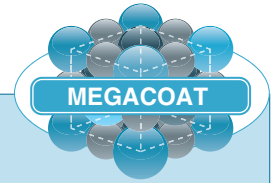
L55~L56

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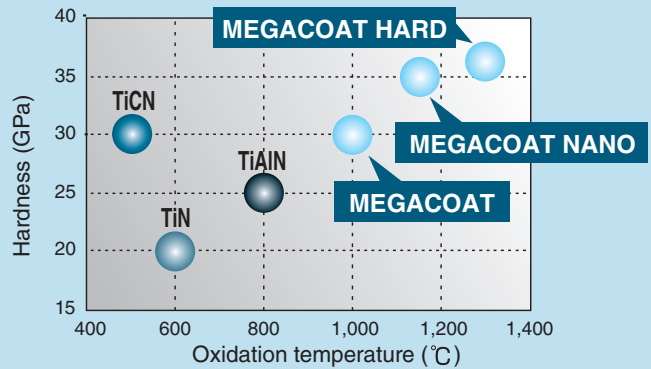
New PVD technology, MEGACOAT



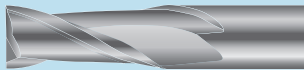
Superior wear and oxidation resistant MEGACOAT

MEGACOAT for Solid End Mill

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

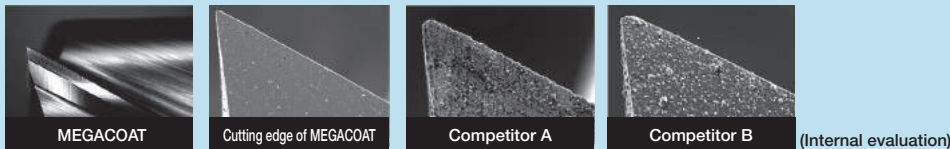


1. MEGACOAT for general milling



F Series
L10-L15

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

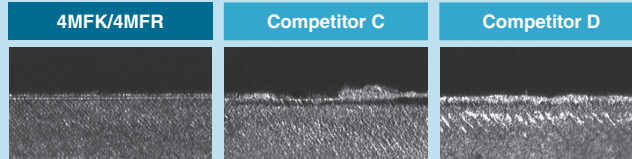


2. MEGACOAT NANO with special multilayer nano coating for high efficiency machining

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



Edge Conditions after 140m Machining



4MFK / 4MFR
L18



4TFK / 4TFR
L20

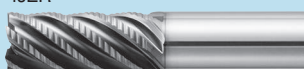
[Cutting Conditions: n=6,000min⁻¹, Vf=1,100mm/min, ap x ae=5.0x0.8mm, ø8, SCM440, Shouldering]

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

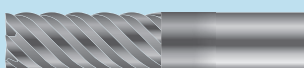
3. MEGACOAT HARD for machining of superalloy and hard materials



4JER
L36



4/5/6RFH
L38



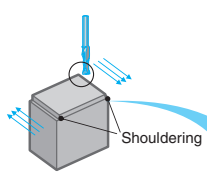
H Series
L48

The special multilayer coating provides high hardness and excellent oxidation resistance
Longer tool life and stability at machining of superalloys and hard materials

Case Studies

Block SUS304

Sharp Cutting Edge Reduced Burrs



Upper workpiece area

2FESM100-220-10

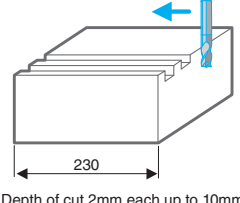
Competitor Coated Carbide E
(Internal evaluation)

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

Burr

Slotting of Titanium Alloy

Outside Dia. $\phi 10 \text{ mm}$
 Workpiece Material Ti-6Al-4V
 Spindle Revolution 3ZFK : $n = 1,700 \text{ min}^{-1}$
 (Vc = 54 m/min)
 Spindle Revolution Competitor B : $n = 1,300 \text{ min}^{-1}$
 (Vc = 40 m/min)
 Feed Rate Vf = 460 mm/min
 (fz = 0.09 mm/t)
 $ap \times ae = 2 \times 10 \text{ mm}$
 Wet



Depth of cut 2mm each up to 10mm

Number of slots

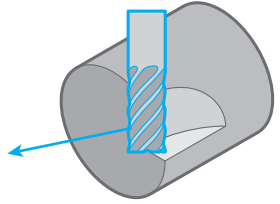
3ZFK **52 slots** **1.4 times** Tool life

Competitor F **35 slots**

Better surface finish and longer tool life with 3ZFK
 Compared to competitor's coated product, the 3ZFK has a 1.4 times longer tool life
 3ZFK prevents burr formation due to sharp cutting edge (Internal evaluation)

Machine parts SCM440

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



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

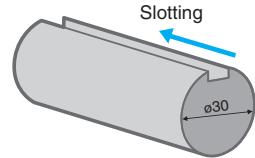
6PFK **159 sec** **52%** Cutting Time

Conventional G **336 sec**

Cycle time greatly reduced compared with conventional End Mill G
 No heavy wear after machining 100 workpieces and still possible to continue machining
 (Evaluation by the user)

Automotive parts S45C

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



Number of workpiece

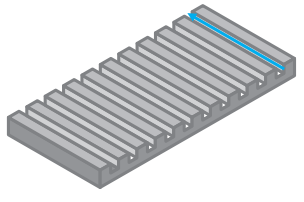
4MFK070-160 **255 pcs** **5 times** Tool life **6.6 times** Productivity

Competitor H **50 pcs**

(Competitor H, Cutting Conditions)
 $\phi 7, 4 \text{ flutes } n = 2,000 \text{ min}^{-1}$ (Vc = 44 m/min)
 $Vf = 150 \text{ mm/min}$ (fz = 0.019 mm/t), $ap \times ae = 5 \times 7 \text{ mm}$, Wet
 Kyocera showed 5 times longer tool life than Competitor H
 Kyocera showed 6.6 times productivity than Competitor H
 No vibration occurred. Stable machining
 (Evaluation by the user)

Plate SUS304

$n = 1,590 \text{ min}^{-1}$
 $(Vc = 50 \text{ m/min})$
 $Vf = 220 \text{ mm/min}$
 $(fz = 0.035 \text{ mm/t})$
 $ap \times ae = 4 \sim 10 \times 10 \text{ mm}$, Wet



Number of workpiece

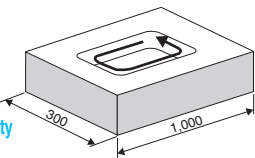
4TFK100-250 **2 pcs** **1.3 times longer** Tool life

Competitor I (4 flutes) **1.5 pcs**

4TFK showed 1.3 times longer tool life than Competitor I
 (Evaluation by the user)

Mold Heat Treated Steel (60HRC)

$n = 1,194 \text{ min}^{-1}$
 $(Vc = 60 \text{ m/min})$
 $Vf = 400 \text{ mm/min}$
 $(fz = 0.056 \text{ mm/t})$
 $ap \times ae = 40 \times 0.3 \text{ mm}$
 6HFSM160-420-16
 $(\phi 16, 6 \text{ flutes})$



Double Tool life **Double** Productivity
 Amount of chip evacuation **4.8cc/min** Tool life : 10pcs

Competitor Coated Carbide J
 Amount of chip evacuation 2.4cc/min Tool life : 5pcs

[Competitor Coated Carbide J]
 $\phi 16, 6 \text{ flutes}$
 $n = 597 \text{ min}^{-1}$
 $(Vc = 30 \text{ m/min})$
 $Vf = 200 \text{ mm/min}$
 $(fz = 0.056 \text{ mm/t})$
 $ap \times ae = 40 \times 0.3 \text{ mm}$

The cutting speed and table feed rate is doubled compared to competitor's coated carbide J. The cutting edge conditions was good and the tool life was also doubled.
 (Evaluation by the user)

Surface finish oriented, 2 flutes, Sharp corner edge

No. of Flutes : 2

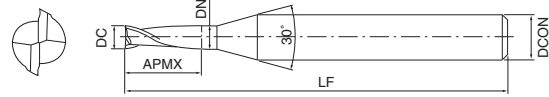
2FESS, 2FESM, 2FESL



MEGACOAT is applied

Recommended Workpiece Materials

★ 1st Choice



2FESS (Short)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		DC	APMX	DN	DCON	LF		
2FESS010-015-04	●	1.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	1.5	1.1	4	45	2
2FESS015-023-04	●	1.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	2.3	1.6	4	45	2
2FESS020-030-04	●	2.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	3.0	2.1	4	45	2
2FESS025-037-04	●	2.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	3.7	2.6	4	45	2
2FESS030-045-06	●	3.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.5	3.2	6	50	2
2FESS035-052-06	●	3.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	5.2	3.7	6	50	2
2FESS040-060-06	●	4.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.0	4.2	6	50	2
2FESS045-067-06	●	4.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.7	4.7	6	50	2
2FESS050-075-06	●	5.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	7.5	5.2	6	50	2
2FESS055-082-06	●	5.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.2	5.7	6	50	2
2FESS060-090-06	●	6.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	9.0	-	6	50	2
2FESS070-105-08	●	7.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	10.5	7.2	8	60	2
2FESS080-120-08	●	8.0	$\begin{matrix} 0 \\ -0.005 \\ -0.025 \end{matrix}$	12.0	-	8	60	2
2FESS090-135-10	●	9.0	$\begin{matrix} 0 \\ -0.005 \\ -0.025 \end{matrix}$	13.5	9.2	10	70	2
2FESS100-150-10	●	10.0	$\begin{matrix} 0 \\ -0.005 \\ -0.025 \end{matrix}$	15.0	-	10	70	2
2FESS120-180-12	●	12.0	$\begin{matrix} 0 \\ -0.010 \\ -0.030 \end{matrix}$	18.0	-	12	75	2
2FESS140-210-16	●	14.0	$\begin{matrix} 0 \\ -0.010 \\ -0.030 \end{matrix}$	21.0	14.2	16	75	2
2FESS150-230-16	●	15.0	$\begin{matrix} 0 \\ -0.010 \\ -0.030 \end{matrix}$	23.0	15.2	16	90	2
2FESS160-240-16	●	16.0	$\begin{matrix} 0 \\ -0.010 \\ -0.030 \end{matrix}$	24.0	-	16	90	2

2FESM (Medium)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		DC	APMX	DN	DCON	LF		
2FESM002-004-04	●	0.2	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	0.4	0.22	4	45	2
2FESM003-006-04	●	0.3	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	0.6	0.32	4	45	2
2FESM004-008-04	●	0.4	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	0.8	0.42	4	45	2
2FESM005-010-04	●	0.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	1.0	0.53	4	45	2
2FESM006-012-04	●	0.6	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	1.2	0.63	4	45	2
2FESM007-014-04	●	0.7	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	1.4	0.74	4	45	2
2FESM008-016-04	●	0.8	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	1.6	0.84	4	45	2
2FESM009-020-04	●	0.9	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	2.0	0.95	4	45	2
2FESM010-025-04	●	1.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	2.5	1.1	4	45	2
2FESM011-025-04	●	1.1	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	2.5	1.2	4	45	2
2FESM012-040-04	●	1.2	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.0	1.3	4	45	2
2FESM013-040-04	●	1.3	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.0	1.4	4	45	2
2FESM014-040-04	●	1.4	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.0	1.5	4	45	2
2FESM015-040-04	●	1.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.0	1.6	4	45	2
2FESM016-050-04	●	1.6	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	5.0	1.7	4	45	2
2FESM017-050-04	●	1.7	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	5.0	1.8	4	45	2
2FESM018-050-04	●	1.8	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	5.0	1.9	4	45	2
2FESM019-050-04	●	1.9	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	5.0	2.0	4	45	2
2FESM020-060-04	●	2.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.0	2.1	4	45	2
2FESM021-060-04	●	2.1	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.0	2.2	4	45	2
2FESM022-060-04	●	2.2	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.0	2.3	4	45	2
2FESM023-060-04	●	2.3	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.0	2.4	4	45	2
2FESM024-080-04	●	2.4	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.0	2.5	4	45	2
2FESM025-080-04	●	2.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.0	2.6	4	45	2
2FESM026-080-04	●	2.6	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.0	2.7	4	45	2
2FESM027-080-04	●	2.7	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.0	2.8	4	45	2
2FESM028-080-04	●	2.8	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.0	2.9	4	45	2
2FESM029-080-04	●	2.9	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.0	3.1	4	45	2
2FESM030-100-06	●	3.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.2	6	50	2
2FESM031-100-06	●	3.1	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.3	6	50	2
2FESM032-100-06	●	3.2	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.4	6	50	2
2FESM033-100-06	●	3.3	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.5	6	50	2

Recommended Cutting Conditions L77

● : Std. Item

L
Solid Tools

End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions

2FESM (Medium)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		DC	APMX	DN	DCON	LF	ZEFP	
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

● : Std. Item

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		DC	APMX	DN	DCON	LF	ZEFP	
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	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		DC	APMX	DN	DCON	LF	ZEFP	
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

Recommended Cutting Conditions ● L77~L78

Insert Grades
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
T

Turning
Indexable Inserts
CNC & CDD Tools
External
Small Parts
Machining
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Turning Mill
Spare Parts
Technical Information
Index

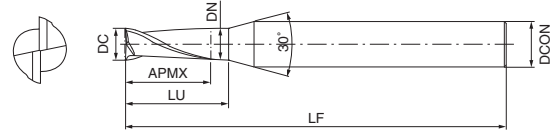
2FEKS, 2FEKM



MEGACOAT is applied

Recommended Workpiece Materials

★ 1st Choice



2FEKS (Short)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN	LU	DCON	LF	ZEFP	
2FEKS030-045-06	●	3.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.5	3.15	6.5	6	50	2	
2FEKS035-052-06	●	3.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	5.2	3.68	7.2	6	50	2	
2FEKS040-060-06	●	4.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.0	4.2	8.2	6	50	2	
2FEKS045-067-06	●	4.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.7	4.7	8.9	6	50	2	
2FEKS050-075-06	●	5.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	7.5	5.2	10.1	6	50	2	
2FEKS055-082-06	●	5.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.2	5.7	10.8	6	50	2	
2FEKS060-090-06	●	6.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	9.0	-	-	6	50	2	
2FEKS080-120-08	●	8.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	12.0	-	-	8	60	2	
2FEKS100-150-10	●	10.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	15.0	-	-	10	70	2	
2FEKS120-180-12	●	12.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	18.0	-	-	12	75	2	
2FEKS140-210-16	●	14.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	21.0	14.2	31.4	16	75	2	
2FEKS150-230-16	●	15.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	23.0	15.2	35	16	90	2	
2FEKS160-240-16	●	16.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	24.0	-	-	16	90	2	

2FEKM (Medium)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN	LU	DCON	LF	ZEFP	
2FEKM030-100-06	●	3.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.15	12.0	6	50	2	
2FEKM035-100-06	●	3.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.68	12.0	6	50	2	
2FEKM040-110-06	●	4.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	11.0	4.2	13.2	6	50	2	
2FEKM045-110-06	●	4.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	11.0	4.7	13.2	6	50	2	
2FEKM050-130-06	●	5.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	13.0	5.2	15.6	6	50	2	
2FEKM055-130-06	●	5.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	13.0	5.7	15.6	6	50	2	
2FEKM060-130-06	●	6.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	13.0	-	-	6	50	2	
2FEKM065-160-08	●	6.5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	16.0	6.7	22.4	8	60	2	
2FEKM070-160-08	●	7.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	16.0	7.2	22.4	8	60	2	
2FEKM075-190-08	●	7.5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	19.0	7.7	26.6	8	60	2	
2FEKM080-190-08	●	8.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	19.0	-	-	8	60	2	
2FEKM085-190-10	●	8.5	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	19.0	8.7	26.6	10	70	2	
2FEKM090-190-10	●	9.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	19.0	9.2	26.6	10	70	2	
2FEKM095-190-10	●	9.5	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	19.0	9.7	26.6	10	70	2	
2FEKM100-220-10	●	10.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	22.0	-	-	10	70	2	
2FEKM110-220-12	●	11.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	22.0	11.2	30.8	12	75	2	
2FEKM120-260-12	●	12.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	26.0	-	-	12	75	2	
2FEKM130-260-16	●	13.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	26.0	13.2	36.4	16	75	2	
2FEKM140-260-16	●	14.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	26.0	14.2	36.4	16	75	2	
2FEKM150-300-16	●	15.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	30.0	15.2	42.0	16	90	2	
2FEKM160-320-16	●	16.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	32.0	-	-	16	90	2	

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

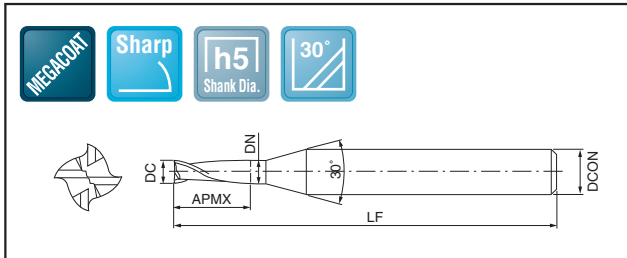
Sharp corner edge

4FESM

Recommended Workpiece Materials ★ 1st Choice



MEGACOAT is applied



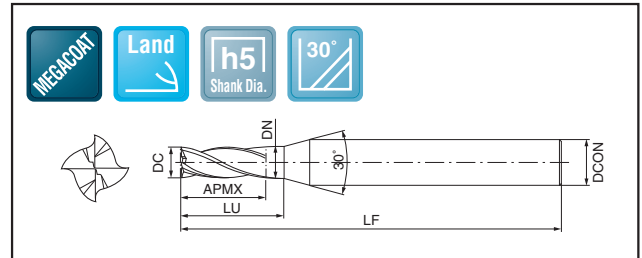
Tough corner edge

4FEKM

Recommended Workpiece Materials ★ 1st Choice



MEGACOAT is applied



4FESM

Shouldering

(Unit : mm)

Description	Stock	Outside Dia.		Length of cut	Neck Dia.	Shank Dia.	Overall length	No. of Flutes
		DC	Mill Dia. tolerance					
4FESM010-025-04	●	1.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	2.5	1.1	4	45	4
4FESM015-040-04	●	1.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.0	1.6	4	45	4
4FESM020-060-04	●	2.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6.0	2.1	4	45	4
4FESM025-080-04	●	2.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	8.0	2.6	4	45	4
4FESM030-100-06	●	3.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.2	6	50	4
4FESM035-100-06	●	3.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.7	6	50	4
4FESM040-110-06	●	4.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	11.0	4.2	6	50	4
4FESM045-110-06	●	4.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	11.0	4.7	6	50	4
4FESM050-130-06	●	5.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	13.0	5.2	6	50	4
4FESM055-130-06	●	5.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	13.0	5.7	6	50	4
4FESM060-130-06	●	6.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	13.0	-	6	50	4
4FESM060-150-06	●	6.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	15.0	-	6	50	4
4FESM070-160-08	●	7.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	16.0	7.2	8	60	4
4FESM080-190-08	●	8.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	19.0	-	8	60	4
4FESM080-200-08	●	8.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	20.0	-	8	60	4
4FESM090-190-10	●	9.0	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	19.0	9.2	10	70	4
4FESM100-220-10	●	10.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	22.0	-	10	70	4
4FESM100-250-10	●	10.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	25.0	-	10	70	4
4FESM120-260-12	●	12.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	26.0	-	12	75	4
4FESM140-260-16	●	14.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	26.0	14.2	16	75	4
4FESM150-300-16	●	15.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	30.0	15.2	16	90	4
4FESM160-320-16	●	16.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	32.0	-	16	90	4

● : Std. Item

4FEKM

Shouldering

(Unit : mm)

Description	Stock	Outside Dia.		Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC	Mill Dia. tolerance						
4FEKM030-100-06	●	3.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.15	12	6	50	4
4FEKM035-100-06	●	3.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.0	3.68	12	6	50	4
4FEKM040-110-06	●	4.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	11.0	4.2	13.2	6	50	4
4FEKM045-110-06	●	4.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	11.0	4.7	13.2	6	50	4
4FEKM050-130-06	●	5.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	13.0	5.2	15.6	6	50	4
4FEKM055-130-06	●	5.5	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	13.0	5.7	15.6	6	50	4
4FEKM060-130-06	●	6.0	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	13.0	-	-	6	50	4
4FEKM080-190-08	●	8.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	19.0	-	-	8	60	4
4FEKM100-220-10	●	10.0	$\begin{matrix} -0.005 \\ -0.025 \end{matrix}$	22.0	-	-	10	70	4
4FEKM120-260-12	●	12.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	26.0	-	-	12	75	4
4FEKM140-260-16	●	14.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	26.0	14.2	36.4	16	75	4
4FEKM150-300-16	●	15.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	30.0	15.2	42	16	90	4
4FEKM160-320-16	●	16.0	$\begin{matrix} -0.010 \\ -0.030 \end{matrix}$	32.0	-	-	16	90	4

Recommended Cutting Conditions ● L79

Insert Grades
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
T

Turning
Indexable Inserts
CNV & PCD Tools
External
Small Parts
Machining
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Tools for
Turning Mill
Spare Parts
Technical
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Surface finish oriented, for Automatic Lathes

No. of Flutes : 2,3,4

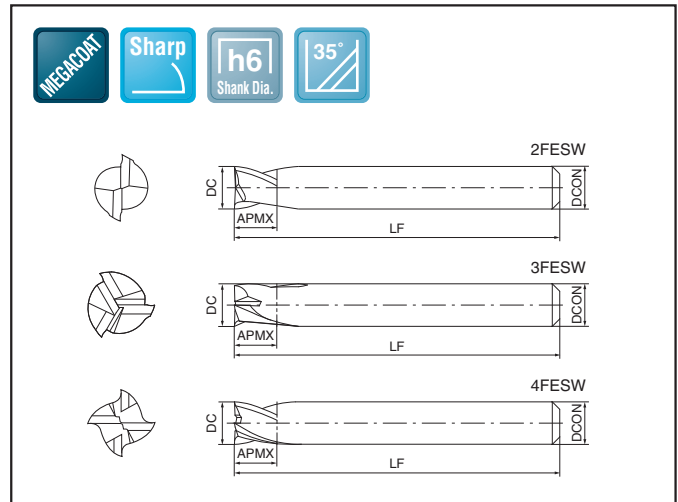
2FESW, 3FESW, 4FESW (Overall length 35mm / 45mm)



(2FESW)

Recommended Workpiece Materials

★ 1st Choice



MEGACOAT is applied

Sharp Cutting Edge Reduced Burrs

2FESW

Shouldering Slotting
(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DCON			
2FESW050-050-05A	●	5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	5	5	5	35	2
2FESW060-060-05A	●	6	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	6	5	5	35	2
2FESW030-030-04	●	3	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	3	4	4	45	2
2FESW035-035-04	●	3.5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	3.5	4	4	45	2
2FESW040-040-04	●	4	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	4	4	4	45	2
2FESW050-050-06	●	5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	5	6	6	45	2
2FESW060-060-06	●	6	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	6	6	6	45	2
2FESW070-070-07	●	7	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	7	7	7	45	2
2FESW080-080-07	●	8	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	7	7	45	2
2FESW080-080-08	●	8	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	8	8	45	2
2FESW100-080-07	●	10	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	7	7	45	2
2FESW100-080-10	●	10	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	10	10	45	2
2FESW120-080-10	●	12	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	10	10	45	2
2FESW120-080-12	●	12	$\begin{matrix} 0 \\ -0.030 \end{matrix}$	8	12	12	45	2
2FESW130-080-13	●	13	$\begin{matrix} 0 \\ -0.030 \end{matrix}$	8	13	13	45	2

3FESW

Shouldering Slotting
(Unit : mm)

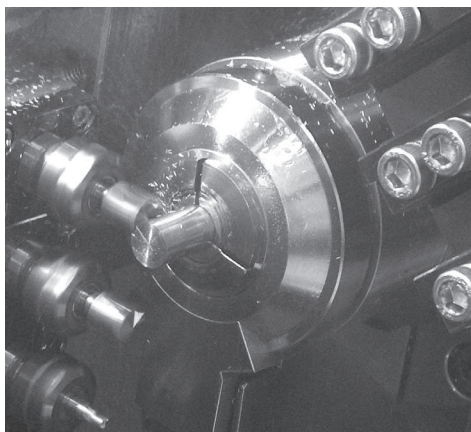
Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DCON			
3FESW050-050-05A	●	5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	5	5	5	35	3
3FESW060-060-05A	●	6	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	6	5	5	35	3
3FESW030-030-04	●	3	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	3	4	4	45	3
3FESW035-035-04	●	3.5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	3.5	4	4	45	3
3FESW040-040-04	●	4	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	4	4	4	45	3
3FESW050-050-06	●	5	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	5	6	6	45	3
3FESW060-060-06	●	6	$\begin{matrix} 0 \\ -0.020 \end{matrix}$	6	6	6	45	3
3FESW070-070-07	●	7	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	7	7	7	45	3
3FESW080-080-07	●	8	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	7	7	45	3
3FESW080-080-08	●	8	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	8	8	45	3
3FESW100-080-07	●	10	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	7	7	45	3
3FESW100-080-10	●	10	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	10	10	45	3
3FESW120-080-10	●	12	$\begin{matrix} 0 \\ -0.025 \end{matrix}$	8	10	10	45	3
3FESW120-080-12	●	12	$\begin{matrix} 0 \\ -0.030 \end{matrix}$	8	12	12	45	3
3FESW130-080-13	●	13	$\begin{matrix} 0 \\ -0.030 \end{matrix}$	8	13	13	45	3

Recommended Cutting Conditions ● L80

● : Std. Item

L
Solid Tools

End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions



Workpiece (Material : Ni-Co alloy)		
2FES (ø3, 2flutes) Excellent surface finish		Facing of machine parts · n=2,150min ⁻¹ (Vc=20m/min) · Vf=100mm/min (fz=0.023mm/t)
	Competitor A (ø3, 2flutes) Large burrs	

Comparison with competitor's end mill after 600 passes

Large burrs

(Internal evaluation)

4FESW

Shouldering Slotting
(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia.	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC	tolerance	APMX	DCON	LF	ZEFP	
4FESW030-030-04	●	3	⁰ _{-0.020}	3	4	45	4	
4FESW035-035-04	●	3.5	⁰ _{-0.020}	3.5	4	45	4	
4FESW040-040-04	●	4	⁰ _{-0.020}	4	4	45	4	
4FESW050-050-06	●	5	⁰ _{-0.020}	5	6	45	4	
4FESW060-060-06	●	6	⁰ _{-0.020}	6	6	45	4	
4FESW070-070-07	●	7	⁰ _{-0.025}	7	7	45	4	
4FESW080-080-07	●	8	⁰ _{-0.025}	8	7	45	4	

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia.	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC	tolerance	APMX	DCON	LF	ZEFP	
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	

Case Studies

Machine parts S45C
 n = 3,980min⁻¹
 (Vc = 100m/min)
 Vf = 800mm/min
 (fz = 0.05mm/t)
 ap = 0.45mm, Wet
 4FESW080-080-08 (ø8, 4 flutes)

Four times the productivity!

4FESW080-080-08 Vf=800mm/min

Competitor Coated Carbide B Vf=200mm/min

[Competitor Coated Carbide B]
 ø8, 4 flutes
 n=2,508min⁻¹
 (Vc=63m/min)
 Vf=200mm/min
 (fz=0.02mm/t)
 ap=0.45mm

Both cutting speed and table feed rate were improved. Despite the increase in cutting conditions, burr formation decreased.

(Evaluation by the user)

Machine parts SUM
 n = 3,200min⁻¹
 (Vc = 100m/min)
 Vf = 640mm/min
 (fz = 0.05mm/t)
 ap x ae = 3.5 x 3.0mm, Wet
 4FESW100-080-10 (ø10, 4 flutes)

1.6 times the productivity!
 Five times the tool life!

4FESW100-080-10 Vf=640mm/min

Competitor Coated Carbide C Vf=400mm/min

[Competitor Coated Carbide C]
 ø7, 4 flutes
 n=2,000min⁻¹
 (Vc=44m/min)
 Vf=400mm/min
 (fz=0.05mm/t)
 apxae=3.5x3.0mm

4FESW has a shorter edge length with improved rigidity, which enabled an increase from conventional ø7 to ø10, thus improving cutting conditions. Compared to conventional tools, tool life improved five times.

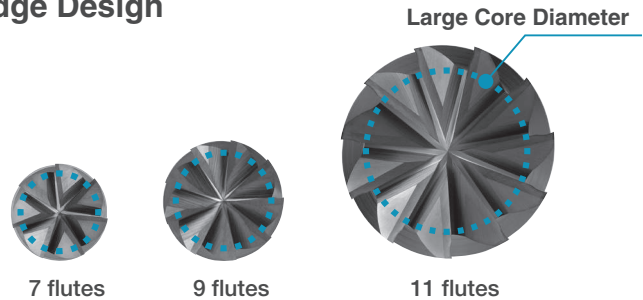
(Evaluation by the user)

66M / 66MCR

Multi-edge Type, 7/9/11 Flutes with Large Core Diameter. High Efficiency and Excellent Surface Finish at Shouldering
High Rigidity and High Quality Surface Finish for Stainless Steel and Titanium Alloys

1 High Efficiency Machining with Multi-edge Design

Applicable for High Feed Machining, 7/9/11 Flutes
High Efficiency Finishing (Machining with $ae = 0.05DC$ or Less)



2 High Quality Surface Finish

Optimal web thickness with high rigidity
Provides high quality surface finish

Cutting Performance Comparison (Internal evaluation)

Cutting Conditions : $n = 3,100 \text{ min}^{-1}$, $f_z = 0.065 \text{ mm/t}$, $ap \times ae = 12 \times 0.6 \text{ mm}$
End Mill Dia. $\phi 12$, Shouldering, Wet, Workpiece Material : SUS304

66MCR (9 flutes / Radius)

$V_f = 1,815 \text{ mm/min}$

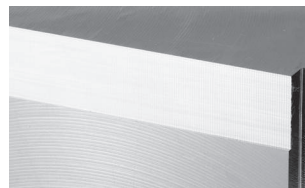
x1.5
Machining efficiency

Competitor A (Multi-edge Design : 6 flutes, Radius)

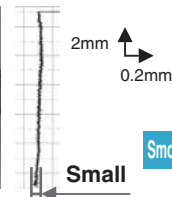
$V_f = 1,210 \text{ mm/min}$

Achieved 1.5 times Machining Efficiency
(Same Surface Roughness)

66MCR



Surface Roughness : $0.36 \mu\text{mRa}$



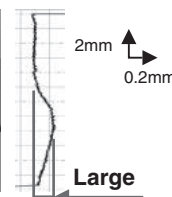
Smoother shoulder wall finish

Small

Competitor A



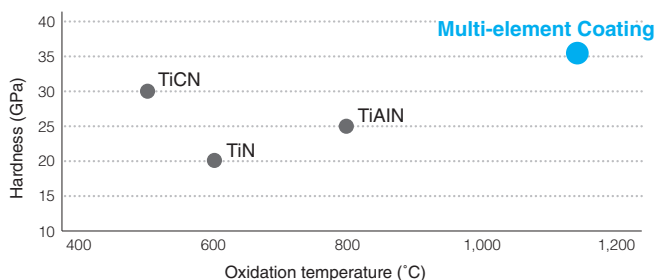
Surface Roughness : $0.37 \mu\text{mRa}$



Large

3 Applicable for a Wide Variety of Workpiece Materials

Properties of Coating (Internal evaluation)



New Multi-element Coating with Excellent Heat Resistance

Long Tool Life in Stainless Steel and Titanium Alloy Machining

Low Oxidation resistance High

No. of Flutes : 7,9,11

66M, 66MCR **NEW**



Recommended Workpiece Materials ★ 1st Choice

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

MULTI
Sharp (66M)
Radius R (66MCR)
0 -0.05mm R (66MCR)
h6 Shank Dia.
35°

66M (Square)

Shouldering
(Unit : mm)

Description	*Code	Stock	Outside Dia.		Length of cut	Shank Dia.		Overall length	No. of Flutes
			DC	Mill Dia. tolerance		APMX	DCON		
66M060-190	46620	●	6	0 -0.050	19	6	63	7	
66M080-200	46621	●	8	0 -0.050	20	8	63	7	
66M100-220	46622	●	10	0 -0.050	22	10	75	7	
66M120-260	46623	●	12	0 -0.050	26	12	83	9	
66M160-320	46624	●	16	0 -0.050	32	16	92	9	
66M200-380	46625	●	20	0 -0.050	38	20	104	11	
66M250-380	46626	●	25	0 -0.050	38	25	104	11	

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

66MCR (Radius)

Shouldering
(Unit : mm)

Description	*Code	Stock	Outside Dia.		Corner-R	Length of cut	Shank Dia.		Overall length	No. of Flutes
			DC	Mill Dia. tolerance			RE	APMX		
66MCR060-190-R05	46627	●	6	0 -0.050	0.5	19	6	63	7	
66MCR080-200-R05	46629	●	8	0 -0.050	0.5	20	8	63	7	
66MCR100-220-R05	46632	●	10	0 -0.050	0.5	22	10	75	7	
66MCR120-260-R10	46636	●	12	0 -0.050	1.0	26	12	83	9	
66MCR120-260-R20	46638	●	12	0 -0.050	2.0	26	12	83	9	
66MCR120-260-R30	46640	●	12	0 -0.050	3.0	26	12	83	9	
66MCR160-320-R10	46641	●	16	0 -0.050	1.0	32	16	92	9	
66MCR160-320-R20	46643	●	16	0 -0.050	2.0	32	16	92	9	
66MCR160-320-R30	46645	●	16	0 -0.050	3.0	32	16	92	9	

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

● : Std. Item

Recommended Cutting Conditions **L81**

Insert Grades
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Indexable Inserts
CN & PCD Tools
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4MFK / 4MFR

MEGACOAT NANO is applied

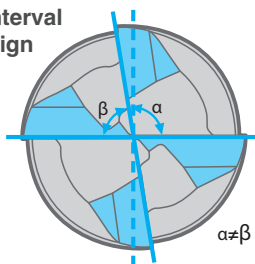
New standard of steel machining

Applicable for high feed machining by anti-chattering structure

1 Chattering control by varied interval flute and variable lead design

Minimizing vibration drastically and stable machining

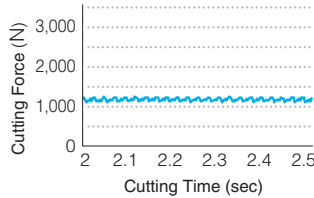
Varied interval flute design



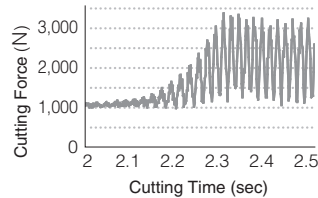
Prevents periodical vibration during machining

Vibration Comparison (Internal evaluation)

4MFK / 4MFR



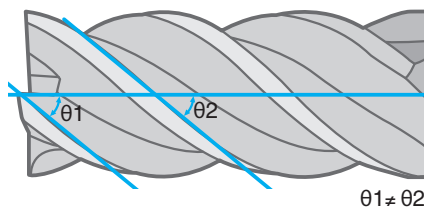
Competitor A (Equal lead)



Cutting Conditions : $n = 2,650 \text{ min}^{-1}$, $V_f = 300 \text{ mm/min}$, $a_p \times a_e = 10 \times 8 \text{ mm}$
Workpiece Material : SCM440, End Mill Dia. $\phi 8 \text{ mm}$

Smooth machining at shouldering and cutting of corner part

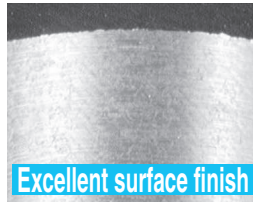
Variable lead



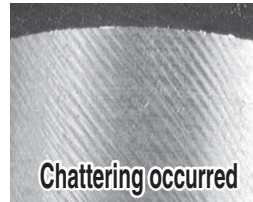
Excellent anti vibration effect
Chattering control, good surface finish

Surface finish comparison (Internal evaluation)

4MFK / 4MFR



Competitor A (Equal lead)

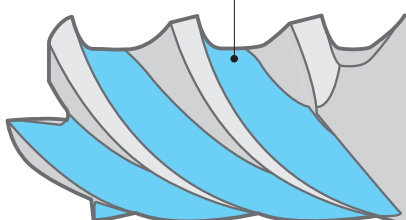


Cutting Conditions : $n = 6,000 \text{ min}^{-1}$, $V_f = 1,500 \text{ mm/min}$, $a_p \times a_e = 8 \times 2 \text{ mm}$
Workpiece Material : S45C, End Mill Dia. $\phi 8 \text{ mm}$

2 Good chip evacuation. High rigidity with large core diameter

High performance at high feed slotting

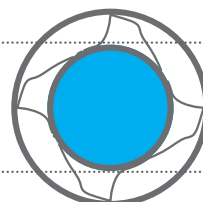
Large Chip Pocket



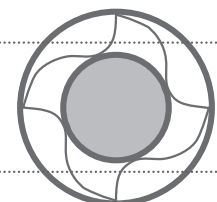
Prevents vibration and tool inclination

Core diameter comparison (Internal evaluation)

UP
11%



4MFK / 4MFR



Competitor B

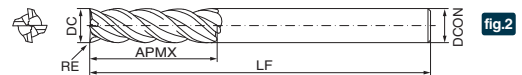
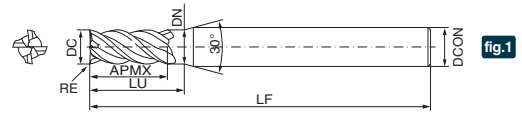
4MFK, 4MFR



MEGACOAT NANO is applied

Recommended Workpiece Materials

★ 1st Choice



4MFK (With corner land)

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Length of cut		Neck Dia.		Under Neck Length LU	Shank Dia. DCON	Overall length LF	No. of Flutes ZEFP
				APMX	Cutting edge length	DN	LU				
4MFK030-045 fig.1	●	3.0	0 -0.015	4.5	S	3.15	5.4	9.6	6	60	4
4MFK030-080 fig.1	●			8	M						
4MFK030-120 fig.1	●			12	L						
4MFK035-050 fig.1	●	3.5	0 -0.015	5.0	S	3.7	11.4	16.8	6	60	4
4MFK035-095 fig.1	●			9.5	M						
4MFK035-140 fig.1	●			14	L						
4MFK040-060 fig.1	●	4.0	0 -0.015	6	S	4.2	13.2	19.2	6	60	4
4MFK040-110 fig.1	●			11	M						
4MFK040-120 fig.1	●			12	M(3D)						
4MFK040-160 fig.1	●			16	L						
4MFK045-065 fig.1	●	4.5	0 -0.015	6.5	S	4.7	7.8	21.6	6	60	4
4MFK045-120 fig.1	●			12	M						
4MFK045-180 fig.1	●			18	L						
4MFK050-075 fig.1	●	5.0	0 -0.015	7.5	S	5.2	9.0	24.0	6	60	4
4MFK050-130 fig.1	●			13	M						
4MFK050-200 fig.1	●			20	L						
4MFK055-080 fig.1	●	5.5	0 -0.015	8.0	S	5.7	9.6	25.2	6	60	4
4MFK055-130 fig.1	●			13	M						
4MFK055-210 fig.1	●			21	L						
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	30.0	8	70	4
4MFK070-160 fig.1	●			16	M						
4MFK070-250 fig.1	●			25	L						
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	24.6	10	80	4
4MFK090-205 fig.1	●			20.5	M						
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 } ... Shouldering **Slotting**
- M : Medium } ...
- L : Long Shouldering

● : Std. Item

4MFR (Radius)

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Corner-R RE	Length of cut		Neck Dia.		Under Neck Length LU	Shank Dia. DCON	Overall length LF	No. of Flutes ZEFP
					APMX	Cutting edge length	DN	LU				
4MFR030-080-R02 fig.1	●	3.0	0 -0.015	0.2	8	3.15	9.6	6	60	4	4	
4MFR030-080-R03 fig.1	●			0.3								
4MFR030-080-R05 fig.1	●			0.5								
4MFR035-095-R02 fig.1	●	3.5	0 -0.015	0.2	9.5	3.7	11.4	6	60	4	4	
4MFR035-095-R03 fig.1	●			0.3								
4MFR035-095-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	4	
4MFR040-110-R03 fig.1	●			0.3								
4MFR040-110-R05 fig.1	●			0.5								
4MFR040-110-R10 fig.1	●			1.0								
4MFR045-120-R02 fig.1	●	4.5	0 -0.015	0.2	12.0	4.7	14.4	6	60	4	4	
4MFR045-120-R03 fig.1	●			0.3								
4MFR045-120-R05 fig.1	●			0.5								
4MFR045-120-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	4	
4MFR050-130-R03 fig.1	●			0.3								
4MFR050-130-R05 fig.1	●			0.5								
4MFR050-130-R10 fig.1	●			1.0								
4MFR055-130-R03 fig.1	●	5.5	0 -0.015	0.3	13.0	5.7	15.6	6	60	4	4	
4MFR055-130-R05 fig.1	●			0.5								
4MFR055-130-R10 fig.1	●			1.0								
4MFR060-130-R03 fig.2	●			0.3								
4MFR060-130-R05 fig.2	●	6.0	0 -0.020	0.5	13	-	-	6	60	4	4	
4MFR060-130-R10 fig.2	●			1.0								
4MFR060-130-R15 fig.2	●			1.5								
4MFR080-190-R03 fig.2	●			0.3								
4MFR080-190-R05 fig.2	●	8.0	-0.005 -0.025	0.5	19	-	-	8	70	4	4	
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	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	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	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 L82

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4TFK / 4TFR

MEGACOAT NANO is applied

High feed and high efficiency machining of difficult-to-cut materials
Resistant to chattering and suppresses burr formation

1 Better chip evacuation at high feed machining

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

4TFK / 4TFR

Optimum edge shape for high efficiency machining

End mill cross-section

No chip clogging

Cutting conditions : $n = 2,800 \text{ min}^{-1}$, $V_f = 550 \text{ mm/min}$, $a_p = 4 \text{ mm}$
End Mill Dia. $\phi 8 \text{ mm}$, Slotting, Wet Workpiece Material : SUS304

Conventional

End mill cross-section

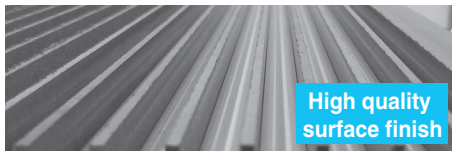
Chip clogging

Cutting Conditions : $n = 2,800 \text{ min}^{-1}$, $V_f = 270 \text{ mm/min}$, $a_p = 4 \text{ mm}$
End Mill Dia. $\phi 8 \text{ mm}$, Slotting, Wet Workpiece Material : SUS304

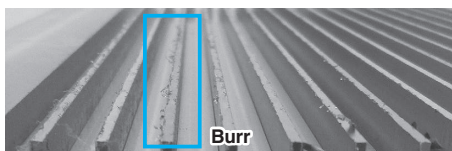
2 Burr prevention

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

4TFK

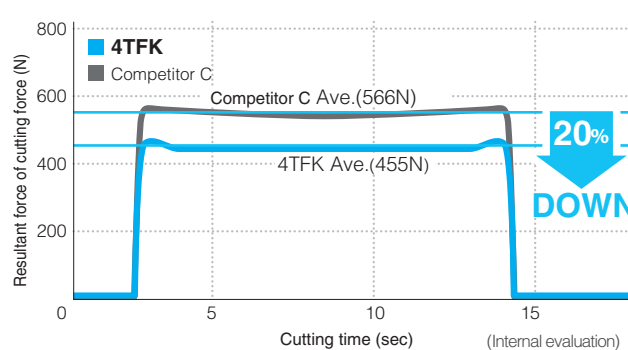


Competitor C



Cutting Conditions : $n = 3,200 \text{ min}^{-1}$, $V_f = 150 \text{ mm/min}$, $a_p = 6 \text{ mm}$ End Mill Dia. $\phi 6 \text{ mm}$, Slotting, Wet Workpiece Material : SUS304

Cutting Force Comparison (Cutting force at machining 100mm)



Cutting Conditions : $n = 4,800 \text{ min}^{-1}$, $V_f = 500 \text{ mm/min}$, $a_p = 6 \text{ mm}$
End Mill Dia. $\phi 6 \text{ mm}$, Dry Workpiece Material : SCM440

3 Chattering control by varied interval flute and variable lead design

L
Solid Tools

End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions

4TFK, 4TFR

MEGACOAT NANO is applied



Recommended Workpiece Materials

★ 1st Choice



Insert Grades
Turning
Indexable Inserts
CNC & PCO Tools
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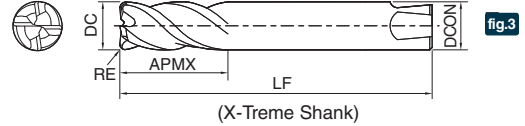
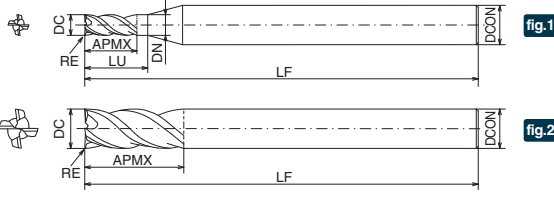
P

R

T



(4TFK) (4TFR)



(X-Treme Shank)



4TFK (With corner land)

(Unit : mm)

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

* Applications for each cutting edge length

S : Short } ... Shouldering **Slotting**
 M : Medium }
 L : Long Shouldering

*4TFR...XT Shank (X-Treme Shank) is for NIKKEN X-Treme chuck

4TFR (Radius)

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Corner-R RE	Length of cut APMX	Neck Dia.		Shank Dia. DCON	Overall length LF	No. of Flutes ZEFP
						DN	LU			
4TFR030-080-R02 fig.1	●	3.0	0 -0.015	0.2	8	3.15	9.6	6	60	4
4TFR030-080-R05 fig.1	●			0.5						
4TFR040-120-R02 fig.1	●			4.0						
4TFR040-120-R05 fig.1	●	0.5								
4TFR050-130-R02 fig.1	●	5.0	0 -0.015		0.2					
4TFR050-130-R05 fig.1	●			0.5						
4TFR050-130-R10 fig.1	●			1.0						
4TFR060-150-R03 fig.2	●	6.0	0 -0.020	0.3	15	-	-	6	60	4
4TFR060-150-R05 fig.2	●			0.5						
4TFR060-150-R10 fig.2	●			1.0						
4TFR080-200-R03 fig.2	●	8.0	-0.005 -0.025	0.3	20	-	-	8	70	4
4TFR080-200-R05 fig.2	●			0.5						
4TFR080-200-R10 fig.2	●			1.0						
4TFR100-250-R03 fig.2	●	10.0	-0.005 -0.025	0.3	25	-	-	10	80	4
4TFR100-250-R05 fig.2	●			0.5						
4TFR100-250-R10 fig.2	●			1.0						
4TFR100-250-R15 fig.2	●	12.0	-0.010 -0.030	1.5	26	-	-	12	100	4
4TFR100-250-R20 fig.2	●			2.0						
4TFR100-250-R30 fig.2	●			3.0						
4TFR120-260-R05 fig.2	●	16.0	-0.010 -0.030	0.5	35	-	-	16	110	4
4TFR120-260-R10 fig.2	●			1.0						
4TFR120-260-R15 fig.2	●			1.5						
4TFR120-260-R20 fig.2	●	20.0	-0.010 -0.030	2.0	45	-	-	20	125	4
4TFR120-260-R30 fig.2	●			3.0						
4TFR160-350-R10 fig.2	●			16.0						
4TFR160-350-R20 fig.2	●	2.0								
4TFR160-350-R30 fig.2	●	3.0								
4TFR200-450-R10 fig.2	●	20.0	-0.010 -0.030	1.0	45	-	-	20	125	4
4TFR200-450-R20 fig.2	●			2.0						
4TFR200-450-R30 fig.2	●			3.0						
4TFR120-260-R10-XT fig.3	●	12.0	-0.010 -0.030	1.0	26	-	-	12	94	4
4TFR120-260-R20-XT fig.3	●			2.0						
4TFR120-260-R30-XT fig.3	●			3.0						
4TFR160-350-R10-XT fig.3	●	16.0	-0.010 -0.030	1.0	35	-	-	16	116	4
4TFR160-350-R20-XT fig.3	●			2.0						
4TFR160-350-R30-XT fig.3	●			3.0						
4TFR200-450-R10-XT fig.3	●	20.0	-0.010 -0.030	1.0	45	-	-	20	130	4
4TFR200-450-R20-XT fig.3	●			2.0						
4TFR200-450-R30-XT fig.3	●			3.0						

Applicable chuck for 4TFR...XT **M74**

Recommended Cutting Conditions **L83**

● : Std. Item

Suppressing Vibration / Variable Design End Mill

Z Series

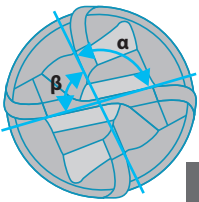
High Chatter Resistance with Variable Lead

4 Different Types of Design for Various Machining Applications from Steel to Super Alloy

Varied Interval Flute Design and Variable Lead

Superior Chattering Resistance

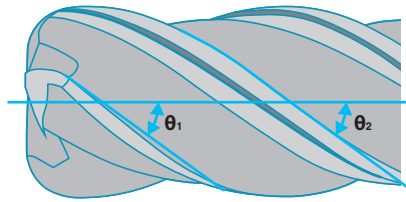
Varied interval flute design



$\alpha \neq \beta$

Prevents periodical vibration during machining

Variable Lead



Lead angle varies from one flute to another flute

Variable Lead : $\theta_1 \neq \theta_2$

Superior vibration control
Reduces chattering and excellent surface finish

Lineup for Various Machining Applications

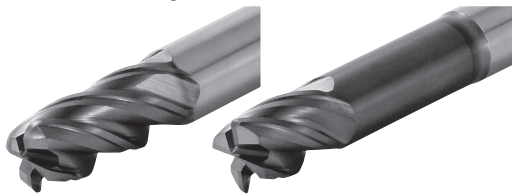
Radius Z1MPCR / Z1MPLC

Superior Chattering Resistance with Variable Rake Angle

Varied interval flute design

Variable Lead

Variable rake angle



End Mill Dia. $\phi 1 \sim \phi 20$
Multi-element Coating

➡ L25

Roughing Z5MCR

Radius type with 5 flutes
High Efficiency Ramping

Varied interval flute design



End Mill Dia. $\phi 6 \sim \phi 25$
Multi-element Coating

➡ L27

Square / Ball-nose Z1M / Z1MB

Z Series Standard
Lineup of Ball-nose Type

Varied interval flute design

Variable Lead



End Mill Dia. $\phi 3 \sim \phi 25$
New AlTiN Coating (Z1M)
Multi-element Coating (Z1MB)

➡ L24 / L45

Superalloy Machining ZH1MCR

For Super Alloy Machining such as Inconel®
High rigidity, Low Cutting Force

Varied interval flute design

Variable Lead



End Mill Dia. $\phi 6 \sim \phi 20$
New AlTiN Coating

➡ L37

L

Solid Tools

End Mills

Solid Tools for CFRP

Routers

Drills

Cutting Conditions

Z1MPCR / Z1MPLC

Variable Lead and Rake Angle

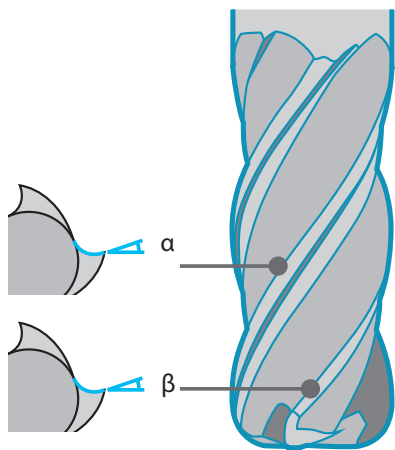
Excellent Chatter Resistance and High Efficiency Machining for Steel, Stainless and Titanium Alloy

Insert Grades	A
Turning	B
Indexable Inserts	C
CBN & PCBN Tools	D
External	E
Small Parts Machining	F
Boring	G
Grooving	H
Cut-off	J
Threading	K
Drilling	L
Solid Tools	M
Milling	N
Tools for Turning Mill	P
Spare Parts	R
Technical Information	T

1 High Chatter Resistance Performance with Variable Rake Angle

Suppresses chattering by changing the timing of periodical vibration

Variable rake angle



Rake angle varies from one flute to another flute

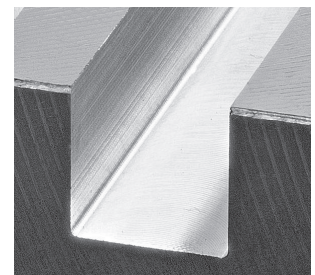
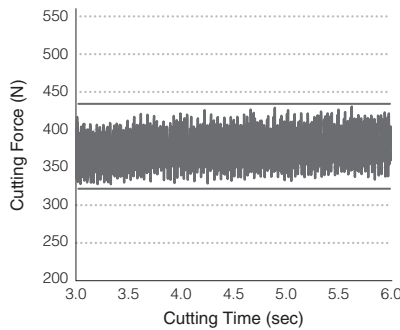
$$\alpha \neq \beta$$

Stable machining for low rigid material with superior chattering resistance performance

Thrust Cutting Force / Surface Finish Comparison (Internal evaluation)

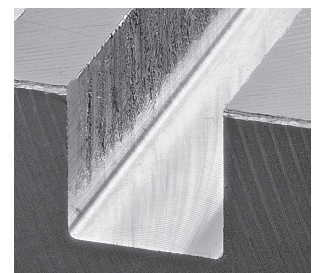
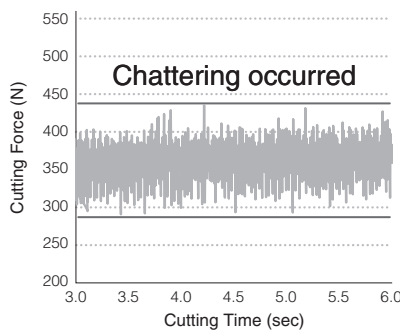
Z1MPCR

Cutting Conditions : $n = 4,780 \text{ min}^{-1}$, $V_f = 840 \text{ mm/min}$, $a_p = 4 \text{ mm}$
End Mill Dia. $\phi 8$, Slotting, Wet, Workpiece Material : S50C (36HS)



Surface Finish of Side Wall : $0.32 \mu\text{mRa}$

Competitor A (Varied Interval Flute Design / Variable Lead)

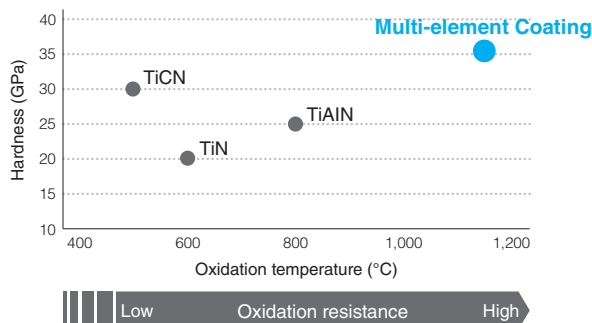


Surface Finish of Side Wall : $1.76 \mu\text{mRa}$

2 Long Tool Life

Long Tool Life with Multi-element Coating

Properties of Coating (Internal evaluation)



Cutting Edge Condition (Internal evaluation)

Z1MPCR



After machining 50 min

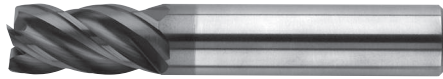
Competitor B



After machining 10 min

Cutting Conditions : $n = 3,300 \text{ min}^{-1}$, $V_f = 400 \text{ mm/min}$, $a_p \times a_e = 15 \times 1 \text{ mm}$,
End Mill Dia. $\phi 10$, Shouldering, Wet, Workpiece Material : SUS316L

Z1M NEW



Recommended Workpiece Materials ★ 1st Choice

★
P
~30HRC

★
P
30~40HRC

★
M
Stainless steel

★
S
Titanium Alloy

★
S
Heat-resistant Alloy

★
K
Cast Iron

ACTiN

Sharp

h6
Shank Dia.

35°
38°

Z1M (Square)

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Shank Dia.	Overall length	No. of Flutes
			DC		APMX	DCON	LF	ZEFP
Z1M030-080	46357	●	3	0 -0.030	8	6	57	4
Z1M040-110	46358	●	4	0 -0.030	11	6	57	4
Z1M050-130	46359	●	5	0 -0.030	13	6	57	4
Z1M060-130	46360	●	6	0 -0.030	13	6	57	4
Z1M080-190	46362	●	8	0 -0.040	19	8	63	4
Z1M100-220	46364	●	10	0 -0.040	22	10	72	4
Z1M120-260	46366	●	12	0 -0.050	26	12	83	4
Z1M140-260	46368	●	14	0 -0.050	26	14	83	4
Z1M160-320	46370	●	16	0 -0.050	32	16	92	4
Z1M180-320	46372	●	18	0 -0.050	32	18	92	4
Z1M200-380	46374	●	20	0 -0.050	38	20	104	4
Z1M250-380	46376	●	25	0 -0.050	38	25	104	4

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

L

Solid Tools

- End Mills
- Solid Tools for CFRP
- Routers
- Drills
- Cutting Conditions

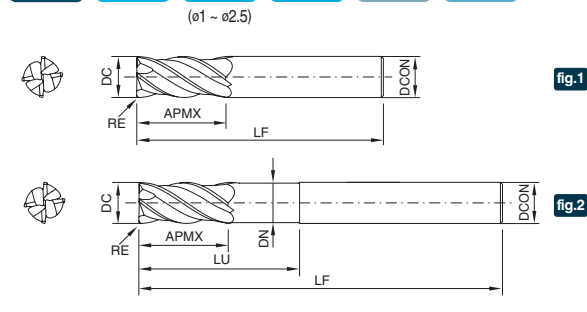
No. of Flutes : 4

Z1MPCR, Z1MPLC **NEW**



Recommended Workpiece Materials

★ 1st Choice



Z1MPCR (Radius)

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Outside Dia.		Corner-R	Length of cut		Shank Dia.		Overall length	No. of Flutes
			DC	Mill Dia. tolerance		RE	APMX	DCON	LF		
Z1MPCR010-030-R01 fig.1	46873	●	1	+0.012 -0.012	0.1	3	6	57	4		
Z1MPCR015-045-R01 fig.1	46849	●	1.5	+0.012 -0.012	0.1	4.5	6	57	4		
Z1MPCR020-060-R02 fig.1	46850	●	2	+0.012 -0.012	0.2	6	6	57	4		
Z1MPCR025-070-R02 fig.1	46874	●	2.5	+0.012 -0.012	0.2	7	6	57	4		
Z1MPCR030-080-R03 fig.1	46851	●	3	0 -0.030	0.3	8	6	57	4		
Z1MPCR030-080-R05 fig.1	46880	●			0.5						
Z1MPCR040-110-R03 fig.1	46852	●	4	0 -0.030	0.3	11	6	57	4		
Z1MPCR040-110-R05 fig.1	46881	●			0.5						
Z1MPCR060-130-R05 fig.1	46854	●	6	0 -0.030	0.5	13	6	57	4		
Z1MPCR060-130-R10 fig.1	46855	●			1.0						
Z1MPCR060-130-R15 fig.1	46884	●			1.5						
Z1MPCR080-190-R05 fig.1	46856	●	8	0 -0.040	0.5	19	8	63	4		
Z1MPCR080-190-R10 fig.1	46857	●			1.0						
Z1MPCR080-190-R15 fig.1	46886	●			1.5						
Z1MPCR080-190-R20 fig.1	46887	●			2.0						
Z1MPCR100-220-R05 fig.1	46858	●	10	0 -0.040	0.5	22	10	72	4		
Z1MPCR100-220-R10 fig.1	46859	●			1.0						
Z1MPCR100-220-R15 fig.1	46889	●			1.5						
Z1MPCR100-220-R20 fig.1	46890	●			2.0						
Z1MPCR120-260-R05 fig.1	46860	●	12	0 -0.050	0.5	26	12	83	4		
Z1MPCR120-260-R10 fig.1	46893	●			1.0						
Z1MPCR120-260-R15 fig.1	46894	●			1.5						
Z1MPCR120-260-R20 fig.1	46895	●			2.0						
Z1MPCR120-260-R30 fig.1	42718	●			3.0						
Z1MPCR160-320-R10 fig.1	46863	●	16	0 -0.050	1.0	32	16	92	4		
Z1MPCR160-320-R15 fig.1	46898	●			1.5						
Z1MPCR160-320-R20 fig.1	46899	●			2.0						
Z1MPCR160-320-R30 fig.1	46864	●			3.0						
Z1MPCR200-380-R10 fig.1	46865	●	20	0 -0.050	1.0	38	20	104	4		
Z1MPCR200-380-R20 fig.1	46904	●			2.0						
Z1MPCR200-380-R30 fig.1	42722	●			3.0						

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

● : Std. Item

Z1MPLC (Radius / Long)

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Outside Dia.		Corner-R	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes	
			DC	Mill Dia. tolerance		RE	APMX						DN
Z1MPLC060-080-R05 fig.2	46821	●	6	0 -0.030	0.5	8	5.5	24	6	75	4		
Z1MPLC080-100-R10 fig.2	46822	●	8	0 -0.040	1.0	10	7.5	32	8	75	4		
Z1MPLC080-100-R20 fig.2	46823	●			2.0								
Z1MPLC100-120-R10 fig.2	46824	●	10	0 -0.040	1.0	12	9.5	40	10	100	4		
Z1MPLC100-120-R20 fig.2	46825	●			2.0								
Z1MPLC120-150-R10 fig.2	46826	●	12	0 -0.050	1.0	15	11.5	48	12	100	4		
Z1MPLC120-150-R15 fig.2	46827	●			1.5								
Z1MPLC120-150-R20 fig.2	46828	●			2.0								
Z1MPLC120-150-R30 fig.2	46829	●			3.0								
Z1MPLC160-200-R10 fig.2	46830	●	16	0 -0.050	1.0	20	15.5	65	16	115	4		
Z1MPLC160-200-R15 fig.2	46831	●			1.5								
Z1MPLC160-200-R20 fig.2	46832	●			2.0								
Z1MPLC160-200-R30 fig.2	46833	●			3.0								
Z1MPLC200-240-R10 fig.2	46836	●	20	0 -0.050	1.0	24	19.5	80	20	140	4		
Z1MPLC200-240-R15 fig.2	46837	●			1.5								
Z1MPLC200-240-R20 fig.2	46838	●			2.0								
Z1MPLC200-240-R30 fig.2	46839	●			3.0								

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

Recommended Cutting Conditions **L85**

Insert Grades
Turning
Indexable Inserts
CNX & PCD Tools
External
Small Parts
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Tools for
Spare Parts
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Z5MCR

5 flutes design, Roughing, High efficiency radius end mill

High efficiency machining for variety of workpieces like steel, difficult-to-cut material



1 Anti-chattering performance

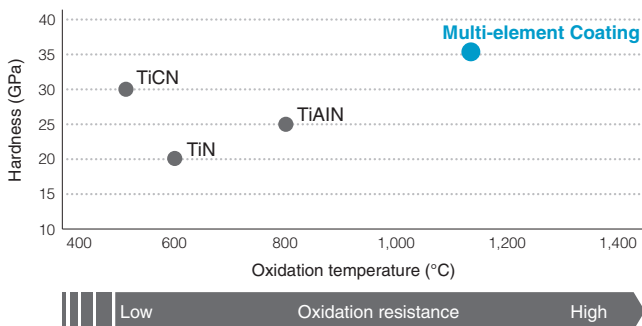
Controlling vibration by odd-number of flutes, and varied interval flute design
Anti-chattering performance

2 Applicable to wide variety machining

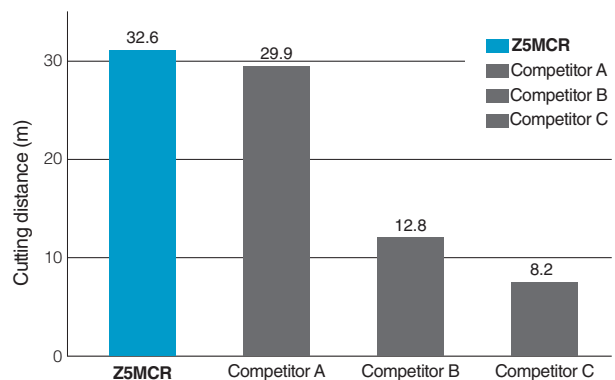
- High efficiency machining of steel, stainless steel and titanium alloy
- Applicable to ramping up to 5° without reducing feed rate
- 1D slotting

3 Longer tool life with multi-element coating with excellent heat resistance

● Properties of Coating (Internal evaluation)



● Tool Life Comparison (Internal evaluation)



Cutting Conditions : $n = 1,643 \text{ min}^{-1}$, $V_f = 416 \text{ mm/min}$, $a_p \times a_e = 19 \times 6.3 \text{ mm}$
End Mill Dia. $\phi 12.7$ Workpiece Material : Ti-6Al-4V

No. of Flutes : 5

Z5MCR NEW



Recommended Workpiece Materials ★ 1st Choice

★
P
~30HRC

★
P
30~40HRC

★
M
Stainless steel

★
S
Titanium Alloy

★
S
Heat-resistant Alloy

K
Cast Iron

MULTI

Radius
R

0
-0.050mm
R

h6
Shank Dia.

37°



Z5MCR (Radius)

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Corner-R	Length of cut	Shank Dia.	Overall length	No. of Flutes
			DC		RE	APMX	DCON	LF	ZEFP
Z5MCR060-130-R03	47001	●	6	0 -0.030	0.3	13	6	57	5
Z5MCR060-130-R05	47002	●			0.5				
Z5MCR060-130-R10	47003	●			1.0				
Z5MCR060-130-R15	47004	●			1.5				
Z5MCR080-180-R05	47006	●	8	0 -0.040	0.5	18	8	63	5
Z5MCR080-180-R10	47007	●			1.0				
Z5MCR080-180-R15	47008	●			1.5				
Z5MCR080-180-R20	47009	●			2.0				
Z5MCR100-220-R05	47011	●	10	0 -0.040	0.5	22	10	72	5
Z5MCR100-220-R10	47012	●			1.0				
Z5MCR100-220-R15	47013	●			1.5				
Z5MCR100-220-R20	47014	●			2.0				
Z5MCR120-260-R05	47017	●	12	0 -0.050	0.5	26	12	83	5
Z5MCR120-260-R10	47019	●			1.0				
Z5MCR120-260-R15	47020	●			1.5				
Z5MCR120-260-R20	47021	●			2.0				
Z5MCR120-260-R30	47023	●			3.0				
Z5MCR160-350-R10	47033	●	16	0 -0.050	1.0	35	16	92	5
Z5MCR160-350-R15	47034	●			1.5				
Z5MCR160-350-R20	47035	●			2.0				
Z5MCR160-350-R30	47037	●			3.0				
Z5MCR200-430-R10	47054	●	20	0 -0.050	1.0	43	20	104	5
Z5MCR200-430-R20	47056	●			2.0				
Z5MCR200-430-R30	47058	●			3.0				
Z5MCR250-530-R10	47078	●	25	0 -0.050	1.0	53	25	121	5
Z5MCR250-530-R20	47079	●			2.0				
Z5MCR250-530-R30	47081	●			3.0				

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

● : Std. Item

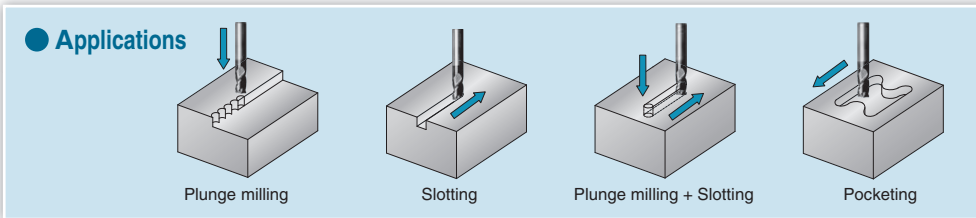
Recommended Cutting Conditions ● L86

Insert Grades
 Turning
 Indexable Inserts
 CNX & PCD Tools
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3ZFK

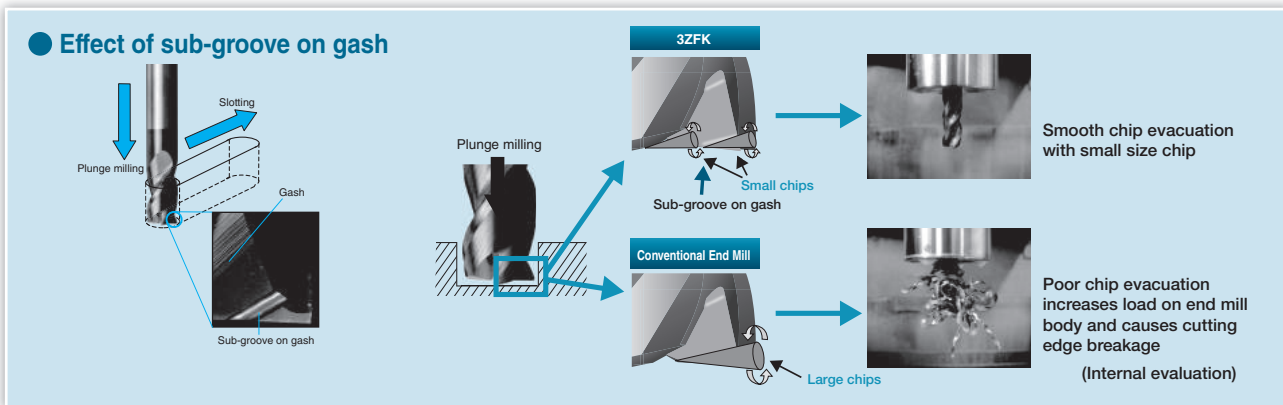
Triple functions Applicable for plunge milling, slotting and finishing with one end mill



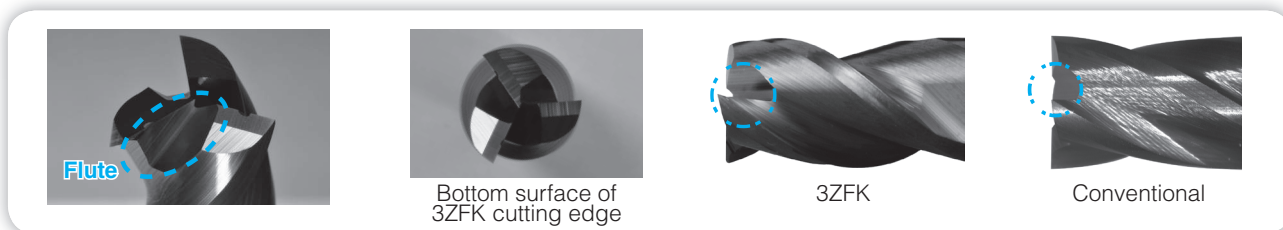
Triple Performances

1. High efficiency machining with new design

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



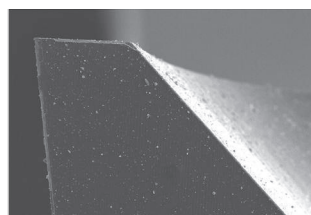
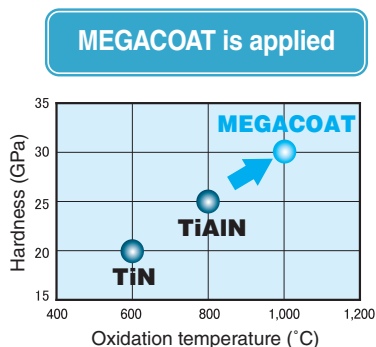
- Prevents chip clogging owing to deep flute and gash design



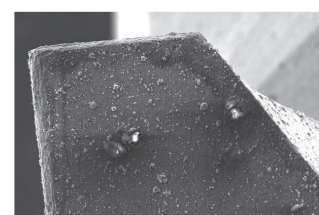
2. Longer tool life with MEGACOAT 3. Better surface finish owing to sharp cutting edge quality

- Excellent wear resistance and heat resistance

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



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



Competitor Coating A
Rough coating surface and round blunt cutting edge
(Internal evaluation)

L
Solid Tools
End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions

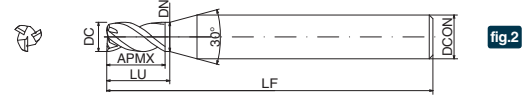
3ZFKS, 3ZFKM



MEGACOAT is applied

Recommended Workpiece Materials

★ 1st Choice



3ZFKS (Short)

Shouldering Slotting Plunge milling

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN	LU	DCON	LF	ZEFP	
3ZFKS060-090-06 fig.1	●	6.0	0 -0.02	9.0	-	-	6	50	3	
3ZFKS070-105-08 fig.2	●	7.0	0 -0.02	10.5	7.2	11.3	8	60	3	
3ZFKS080-120-08 fig.1	●	8.0	-0.005 -0.025	12.0	-	-	8	60	3	
3ZFKS100-150-10 fig.1	●	10.0	-0.005 -0.025	15.0	-	-	10	70	3	
3ZFKS120-180-12 fig.1	●	12.0	-0.01 -0.03	18.0	-	-	12	75	3	

3ZFKM (Medium)

Shouldering Slotting Plunge milling

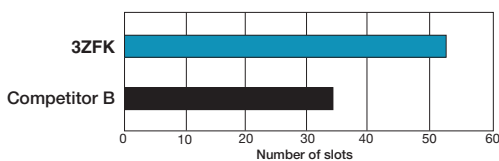
(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN	LU	DCON	LF	ZEFP	
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.	ø10	
Workpiece Material	Ti-6Al-4V	
Spindle Revolution	3ZFK : n=1,700min ⁻¹ Competitor B : n=1,300min ⁻¹	
Feed Rate	Vf =460mm/min	
Depth of Cut	ap x ae=2 x 10mm	



(Internal evaluation)

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

◆ Cutting edge after 35 passes

Competitor B

3ZFK

Competitor B

3ZFK

(Internal evaluation)

5DEKM, 5DERM



Recommended Workpiece Materials ★ 1st Choice

P ~30HRC	P 30~40HRC	M Stainless steel	S Titanium Alloy	S Heat-resistant Alloy	K Cast Iron
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APTIN	Land (DEKM)	Radius R (DERM)	± 0.05 mm R (DERM)	h6 Shank Dia.	38°
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5DEKM (With corner land)

Shouldering Slotting
(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DCON			
5DEKM040-120-06	<input type="checkbox"/>	4	-0.020 -0.038	12	6	55	5	
5DEKM050-130-06	<input type="checkbox"/>	5	-0.020 -0.038	13	6	57	5	
5DEKM060-130-06	<input type="checkbox"/>	6	-0.020 -0.038	13	6	57	5	
5DEKM080-160-08	<input type="checkbox"/>	8	-0.025 -0.047	16	8	63	5	
5DEKM090-190-10	<input type="checkbox"/>	9	-0.025 -0.047	19	10	72	5	
5DEKM100-220-10	<input type="checkbox"/>	10	-0.025 -0.047	22	10	72	5	
5DEKM120-260-12	<input type="checkbox"/>	12	-0.032 -0.059	26	12	83	5	
5DEKM160-320-16	<input type="checkbox"/>	16	-0.032 -0.059	32	16	92	5	
5DEKM200-380-20	<input type="checkbox"/>	20	-0.040 -0.073	38	20	104	5	
5DEKM250-450-25	<input type="checkbox"/>	25	-0.040 -0.073	45	25	121	5	

5DERM (Radius)

Shouldering Slotting
(Unit : mm)

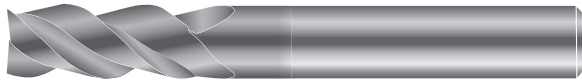
Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	Spec of Corners	No. of Flutes
		DC		APMX	DCON				
5DERM040-120-06-R025	<input checked="" type="checkbox"/>	4	-0.020 -0.038	12	6	55	R0.25	5	
5DERM050-130-06-R025	<input checked="" type="checkbox"/>	5	-0.020 -0.038	13	6	57	R0.25	5	
5DERM060-130-06-R040	<input checked="" type="checkbox"/>	6	-0.020 -0.038	13	6	57	R0.4	5	
5DERM080-160-08-R050	<input checked="" type="checkbox"/>	8	-0.025 -0.047	16	8	63	R0.5	5	
5DERM090-190-10-R050	<input checked="" type="checkbox"/>	9	-0.025 -0.047	19	10	72	R0.5	5	
5DERM100-220-10-R050	<input checked="" type="checkbox"/>	10	-0.025 -0.047	22	10	72	R0.5	5	
5DERM120-260-12-R075	<input checked="" type="checkbox"/>	12	-0.032 -0.059	26	12	83	R0.75	5	
5DERM160-320-16-R075	<input checked="" type="checkbox"/>	16	-0.032 -0.059	32	16	92	R0.75	5	
5DERM200-380-20-R075	<input checked="" type="checkbox"/>	20	-0.040 -0.073	38	20	104	R0.75	5	
5DERM250-450-25-R075	<input checked="" type="checkbox"/>	25	-0.040 -0.073	45	25	121	R0.75	5	

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

3 flutes, Multi-purpose

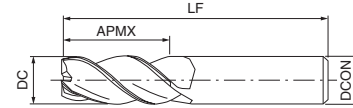
No. of Flutes : 3

3UF5M



Recommended Workpiece Materials

★ 1st Choice



3UF5M

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.		Overall length	No. of Flutes
		DC		APMX	DCON	LF	ZEFP		
3UF5M010-030-04	●	1	-0.014 -0.028	3	4	50	3		
3UF5M015-030-04	●	1.5	-0.014 -0.028	3	4	50	3		
3UF5M020-030-04	●	2	-0.014 -0.028	3	4	50	3		
3UF5M025-040-04	●	2.5	-0.014 -0.028	4	4	50	3		
3UF5M030-080-06	●	3	-0.014 -0.028	8	6	50	3		
3UF5M040-120-06	●	4	-0.020 -0.038	12	6	50	3		
3UF5M050-140-06	●	5	-0.020 -0.038	14	6	50	3		
3UF5M060-160-06	●	6	-0.020 -0.038	16	6	50	3		
3UF5M080-200-08	●	8	-0.025 -0.047	20	8	63	3		
3UF5M100-220-10	●	10	-0.025 -0.047	22	10	76	3		
3UF5M120-250-12	●	12	-0.032 -0.059	25	12	76	3		
3UF5M160-320-16	●	16	-0.032 -0.059	32	16	89	3		
3UF5M200-380-20	●	20	-0.040 -0.073	38	20	104	3		

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

Recommended Cutting Conditions ● L89

● : Std. Item

Insert Grades
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
T

Turning
B
C
D
E
F
G
H
J
K
L
M
N
P
R
T

Indexable Inserts
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
T

External
D
E
F
G
H
J
K
L
M
N
P
R
T

Small Parts
Machining
E
F
G
H
J
K
L
M
N
P
R
T

Boring
F
G
H
J
K
L
M
N
P
R
T

Grooving
G
H
J
K
L
M
N
P
R
T

Cut-off
H
J
K
L
M
N
P
R
T

Threading
J
K
L
M
N
P
R
T

Drilling
K
L
M
N
P
R
T

Solid Tools
L
M
N
P
R
T

Milling
M
N
P
R
T

Tools for
Turning Mill
N
P
R
T

Spare Parts
P
R
T

Technical
Information
R
T

Index
T

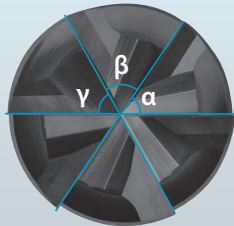
6PFK/8PFK

High efficiency machining and superior surface finish with new special flute design

● Varied interval flute design / Variable lead

Superior chattering resistance performance with Kyocera's unique varied interval flute design / variable lead

Varied interval flute design



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

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

Variable Lead



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

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

Surface finish comparison (side surface) End Mill Dia. $\phi 12$

Workpiece Material	SCM440	SUS304	Ti-6Al-4V
Cutting Conditions	n=3,300min ⁻¹ (Vc=124m/min) Vf=2,000mm/min (fz=0.1mm/t) apxae=30x1.5mm	n=2,500min ⁻¹ (Vc=94m/min) Vf=1,130mm/min (fz=0.08mm/t) apxae=30x0.6mm	n=2,500min ⁻¹ (Vc=94m/min) Vf=1,130mm/min (fz=0.08mm/t) apxae=30x0.6mm
Results	6PFK	6PFK	6PFK
	Competitor A	Competitor A	Competitor A
	Chattering occurred	Chattering occurred	Dull surface due to poor approach

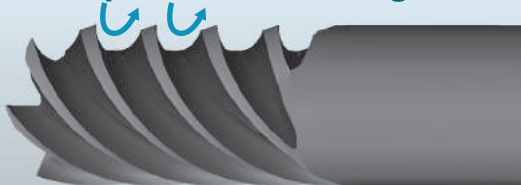
High feed rate and high efficiency shouldering with Multi-edge design (6 flutes /8 flutes)

Varied interval flute design and variable lead to minimize chattering

Good surface finish

● Special Flute Design

New Special Flute Design Enables Stable Chip Evacuation



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

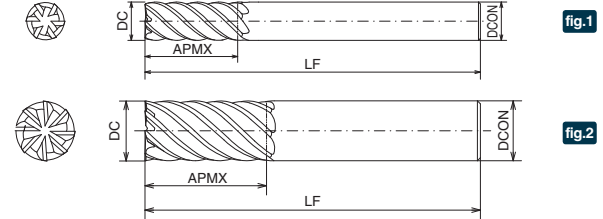
6PFK, 8PFK



MEGACOAT NANO is applied

Recommended Workpiece Materials

★ 1st Choice



6PFK, 8PFK (Medium)

Shouldering

(Unit : mm)

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

6PFK, 8PFK (Long)

Shouldering

(Unit : mm)

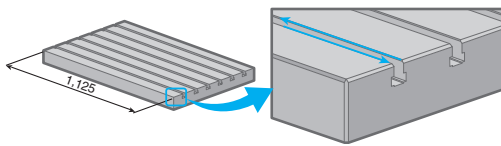
Description	Stock	Outside Dia.		Length of cut	Shank Dia.		Overall length	No. of Flutes
		DC	Mill Dia. tolerance		APMX	DCON		
6PFK060-250 fig.1	●	6.0	0 -0.020	25	6	70	6	
6PFK080-350 fig.1	●	8.0	-0.005 -0.025	35	8	90	6	
6PFK100-450 fig.1	●	10.0	-0.005 -0.025	45	10	100	6	
6PFK120-550 fig.1	●	12.0	-0.010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

Recommended Cutting Conditions L90

Case Studies

Machine table FC250

6PFK200-450
Finishing (1 pass)
n = 2,500 min⁻¹
(Vc = 157 m/min)
ap x ae = 35 x 1.2 mm
Vf = 3,500 mm/min
(fz = 0.23 mm/t)



Competitor Coated Carbide B (2 passes)
Semi finishing n = 2,500 min⁻¹ (Vc = 157 m/min)
ap x ae = 35 x 1.0 mm
Vf = 1,500 mm/min (fz = 0.1 mm/t)
Finishing n = 2,000 min⁻¹ (Vc = 125 m/min)
ap x ae = 35 x 0.2 mm
Vf = 1,000 mm/min (fz = 0.1 mm/t)

Cutting Time (1,125mm x 24 slots)

6PFK 200-450

10 min

1/8
Cutting Time

Competitor Coated Carbide B

80 min.

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

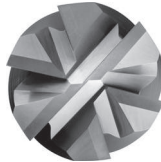
(Evaluation by the user)

51M, 51ML, 51MCR, 51MLC **NEW**



AlTiN coating with high hardness and excellent heat resistance
 Hardness : 36.3GPa
 Oxidation temperature : 1,100°C

6 flutes
 Varied interval flute design



Recommended Workpiece Materials ★ 1st Choice

P ~30HRC	P 30~40HRC	H ~55HRC	M Stainless steel	S Titanium Alloy	S Heat-resistant Alloy	K Cast Iron
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AlTiN	Honing R (51M) (51ML)	Radius R (51MCR) (51MLC)	-0.050_{mm} R (51MCR) (51MLC)	h6 Shank Dia.	41°
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51M (Square)

Shouldering

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Shank Dia.	Overall length	No. of Flutes
			DC		APMX	DCON	LF	ZEFP
51M060-190 fig.1	45100	●	6	0 -0.050	19	6	63	6
51M080-200 fig.1	45101	●	8	0 -0.050	20	8	63	6
51M100-220 fig.1	45102	●	10	0 -0.050	22	10	75	6
51M120-260 fig.1	45103	●	12	0 -0.050	26	12	83	6
51M160-320 fig.1	45104	●	16	0 -0.050	32	16	92	6
51M200-380 fig.1	45105	●	20	0 -0.050	38	20	104	6

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

51ML (Square / Long)

Shouldering

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
			DC		APMX	DN	LU	DCON	LF	ZEFP
51ML060-080 fig.2	45106	●	6	0 -0.050	8	5.7	32	6	75	6
51ML080-100 fig.2	45107	●	8	0 -0.050	10	7.6	32	8	75	6
51ML100-120 fig.2	45108	●	10	0 -0.050	12	9.5	40	10	100	6
51ML120-150 fig.2	45109	●	12	0 -0.050	15	11.3	48	12	100	6
51ML160-200 fig.2	45110	●	16	0 -0.050	20	15.2	65	16	115	6
51ML200-240 fig.2	45111	●	20	0 -0.050	24	19.0	80	20	150	6

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

Recommended Cutting Conditions **L91**

● : Std. Item

L
Solid Tools
End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions

51MCR (Radius)

Shouldering

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Corner-R	Length of cut	Shank Dia.	Overall length	No. of Flutes
			DC		RE	APMX	DCON	LF	ZEFP
51MCR060-190-R05 fig.3	45112	●	6	0 -0.050	0.5	19	6	63	6
51MCR080-200-R05 fig.3	45113	●	8		0.5	20	8	63	6
51MCR080-200-R10 fig.3	45114	●			1.0				
51MCR100-220-R10 fig.3	45115	●	10	0 -0.050	1.0	22	10	75	6
51MCR100-220-R15 fig.3	45116	●			1.5				
51MCR100-220-R20 fig.3	45117	●			2.0				
51MCR120-260-R10 fig.3	45118	●	12	0 -0.050	1.0	26	12	83	6
51MCR120-260-R15 fig.3	45119	●			1.5				
51MCR120-260-R20 fig.3	45120	●			2.0				
51MCR160-320-R10 fig.3	45121	●	16	0 -0.050	1.0	32	16	92	6
51MCR160-320-R15 fig.3	45122	●			1.5				
51MCR160-320-R20 fig.3	45123	●			2.0				
51MCR200-380-R10 fig.3	45124	●	20	0 -0.050	1.0	38	20	104	6
51MCR200-380-R15 fig.3	45125	●			1.5				
51MCR200-380-R20 fig.3	45126	●			2.0				

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

51MLC (Radius / Long)

Shouldering

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Corner-R	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
			DC		RE	APMX	DN	LU	DCON	LF	ZEFP
51MLC060-080-R05 fig.4	45127	●	6	0 -0.050	0.5	8	5.7	32	6	75	6
51MLC080-100-R05 fig.4	45128	●	8		0.5	10	7.6	32	8	75	6
51MLC080-100-R10 fig.4	45129	●		1.0							
51MLC100-120-R10 fig.4	45130	●	10	0 -0.050	1.0	12	9.5	40	10	100	6
51MLC100-120-R15 fig.4	45131	●			1.5						
51MLC100-120-R20 fig.4	45132	●			2.0						
51MLC120-150-R10 fig.4	45133	●	12	0 -0.050	1.0	15	11.3	48	12	100	6
51MLC120-150-R15 fig.4	45134	●			1.5						
51MLC120-150-R20 fig.4	45135	●			2.0						
51MLC160-200-R10 fig.4	45136	●	16	0 -0.050	1.0	20	15.2	65	16	115	6
51MLC160-200-R15 fig.4	45137	●			1.5						
51MLC160-200-R20 fig.4	45138	●			2.0						
51MLC200-240-R10 fig.4	45139	●	20	0 -0.050	1.0	24	19.0	80	20	150	6
51MLC200-240-R15 fig.4	45140	●			1.5						
51MLC200-240-R20 fig.4	45141	●			2.0						

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

- Specialized high speed trochoid machining
- 6 flutes, Superior chattering resistance performance with varied interval flute design
- 41° helix angle achieved side face machining
- Strong cutting edge by eccentric grind
- AlTiN coating with high hardness and excellent heat resistance
- Lineup of Square / Radius / Long type



Recommended Cutting Conditions [L91](#)

● : Std. Item

Insert Grades
A
B
C
D
E
F
G
H
J
K
L
M
N
P
R
T

Turning
Indexable Inserts
CNX & PCD Tools
External
Small Parts
Machining
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Tools for
Turning Mill
Spare Parts
Technical
Information
Index

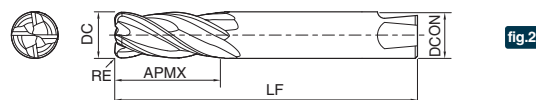
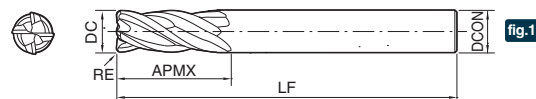
4JER



MEGACOAT HARD is applied

Recommended Workpiece Materials

★ 1st Choice



(X-Treme Shank)

4JER (Short)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.		Corner-R	Length of cut	Shank Dia.		Overall length	No. of Flutes
		DC	Mill Dia. tolerance			RE	APMX		
4JER060-090-R03 fig.1	●	6.0	0 -0.020	0.3	9	6	60	4	
4JER060-090-R05 fig.1	●			0.5					
4JER060-090-R10 fig.1	●			1.0					
4JER080-120-R03 fig.1	●	8.0	-0.005 -0.025	0.3	12	8	70	4	
4JER080-120-R05 fig.1	●			0.5					
4JER080-120-R10 fig.1	●			1.0					
4JER080-120-R15 fig.1	●			1.5					
4JER100-150-R03 fig.1	●	10.0	-0.005 -0.025	0.3	15	10	80	4	
4JER100-150-R05 fig.1	●			0.5					
4JER100-150-R10 fig.1	●			1.0					
4JER100-150-R15 fig.1	●			1.5					
4JER100-150-R20 fig.1	●			2.0					
4JER100-150-R30 fig.1	●	3.0							
4JER120-180-R05 fig.1	●	12.0	-0.010 -0.030	0.5	18	12	100	4	
4JER120-180-R10 fig.1	●			1.0					
4JER120-180-R15 fig.1	●			1.5					
4JER120-180-R20 fig.1	●			2.0					
4JER120-180-R30 fig.1	●			3.0					
4JER160-240-R10 fig.1	●	16.0	-0.010 -0.030	1.0	24	16	110	4	
4JER160-240-R20 fig.1	●			2.0					
4JER160-240-R30 fig.1	●			3.0					
4JER200-300-R10 fig.1	●	20.0	-0.010 -0.030	1.0	30	20	125	4	
4JER200-300-R20 fig.1	●			2.0					
4JER200-300-R30 fig.1	●			3.0					

4JER (Medium)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.		Corner-R	Length of cut	Shank Dia.		Overall length	No. of Flutes
		DC	Mill Dia. tolerance			RE	APMX		
4JER060-150-R03 fig.1	●	6.0	0 -0.020	0.3	15	6	60	4	
4JER060-150-R05 fig.1	●			0.5					
4JER060-150-R10 fig.1	●			1.0					
4JER080-200-R03 fig.1	●	8.0	-0.005 -0.025	0.3	20	8	70	4	
4JER080-200-R05 fig.1	●			0.5					
4JER080-200-R10 fig.1	●			1.0					
4JER080-200-R15 fig.1	●			1.5					
4JER100-250-R03 fig.1	●	10.0	-0.005 -0.025	0.3	25	10	80	4	
4JER100-250-R05 fig.1	●			0.5					
4JER100-250-R10 fig.1	●			1.0					
4JER100-250-R15 fig.1	●			1.5					
4JER100-250-R20 fig.1	●			2.0					
4JER100-250-R30 fig.1	●	3.0							
4JER120-260-R05 fig.1	●	12.0	-0.010 -0.030	0.5	26	12	100	4	
4JER120-260-R10 fig.1	●			1.0					
4JER120-260-R15 fig.1	●			1.5					
4JER120-260-R20 fig.1	●			2.0					
4JER120-260-R30 fig.1	●			3.0					
4JER160-350-R10 fig.1	●	16.0	-0.010 -0.030	1.0	35	16	110	4	
4JER160-350-R20 fig.1	●			2.0					
4JER160-350-R30 fig.1	●			3.0					
4JER200-450-R10 fig.1	●	20.0	-0.010 -0.030	1.0	45	20	125	4	
4JER200-450-R20 fig.1	●			2.0					
4JER200-450-R30 fig.1	●			3.0					
4JER120-260-R10-XT fig.2	●	12.0	-0.010 -0.030	1.0	26	12	94	4	
4JER120-260-R20-XT fig.2	●			2.0					
4JER120-260-R30-XT fig.2	●			3.0					
4JER160-350-R10-XT fig.2	●	16.0	-0.010 -0.030	1.0	35	16	116	4	
4JER160-350-R20-XT fig.2	●			2.0					
4JER160-350-R30-XT fig.2	●			3.0					
4JER200-450-R10-XT fig.2	●	20.0	-0.010 -0.030	1.0	45	20	130	4	
4JER200-450-R20-XT fig.2	●			2.0					
4JER200-450-R30-XT fig.2	●			3.0					

*4JER...XT Shank (X-Treme Shank) is for NIKKEN X-Treme chuck

Applicable chuck for 4JER...XT M74

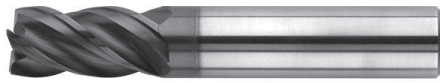
Recommended Cutting Conditions L92

● : Std. Item

No. of Flutes : 4

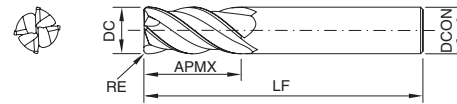
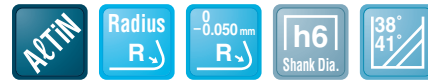
ZH1MCR

NEW



Recommended Workpiece Materials

★ 1st Choice



ZH1MCR (Radius)

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Corner-R	Length of cut	Shank Dia.	Overall length	No. of Flutes
			DC		RE	APMX	DCON	LF	ZEFP
ZH1MCR060-130-R05	46450	●	6	0 -0.030	0.5	13	6	57	4
ZH1MCR060-130-R10	46451	●			1.0				
ZH1MCR060-130-R15	46452	●			1.5				
ZH1MCR080-190-R05	46453	●	8	0 -0.040	0.5	19	8	63	4
ZH1MCR080-190-R10	46454	●			1.0				
ZH1MCR080-190-R15	46455	●			1.5				
ZH1MCR100-220-R05	46456	●	10	0 -0.040	0.5	22	10	72	4
ZH1MCR100-220-R10	46457	●			1.0				
ZH1MCR100-220-R15	46458	●			1.5				
ZH1MCR100-220-R20	46459	●			2.0				
ZH1MCR120-260-R05	46460	●	12	0 -0.050	0.5	26	12	83	4
ZH1MCR120-260-R10	46461	●			1.0				
ZH1MCR120-260-R15	46462	●			1.5				
ZH1MCR120-260-R20	46463	●			2.0				
ZH1MCR120-260-R30	46464	●			3.0				
ZH1MCR160-320-R15	46465	●	16	0 -0.050	1.5	32	16	92	4
ZH1MCR160-320-R20	46466	●			2.0				
ZH1MCR160-320-R30	46467	●			3.0				
ZH1MCR200-380-R30	46468	●	20	0 -0.050	3.0	38	20	104	4

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

- Varied interval flute design, variable lead
- AlTiN coating for excellent heat resistance
Hardness : 36.3GPa
Oxidation temperature : 1,100°C
- Change specification of Z1M for superalloy machining
Core Diameter : 20% UP
Helix Angle : 38°/41°(Z1M : 35°/38°)



Recommended Cutting Conditions ● L92

● : Std. Item

Insert Grades
Turnable
Indexable Inserts
CNV & PCD Tools
External
Small Parts
Machining
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Tools for
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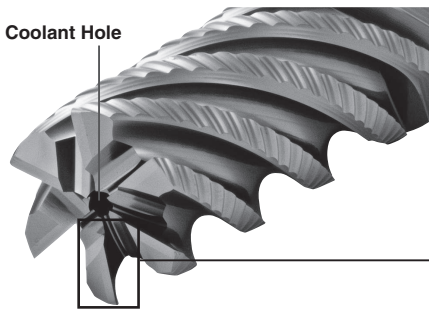
4 / 5 / 6RFH

High Efficiency and Stable Machining with Multi-edge Design and Coolant Hole Deep Slotting for Stainless Steel and Titanium Alloy

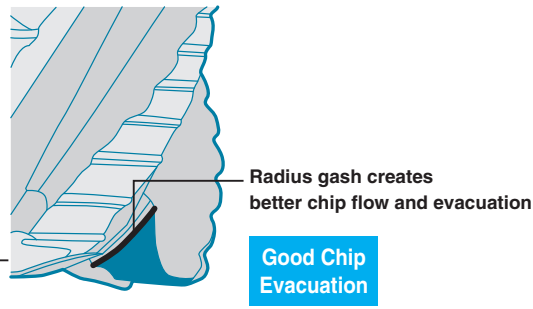
1 High Efficiency Machining with Multi-edge Design

Multi-edge Design with Coolant Hole. Good Chip Evacuation with Original Gash Shape

● Multi-edge Design (ø16 - 6 flutes)



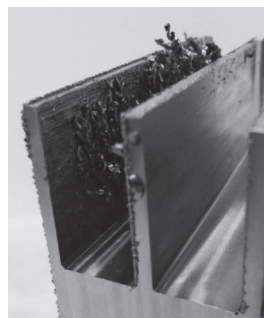
● Original Gash Shape



Deep Slotting ($a_p = 2 \times DC$) for Stainless Steel and Titanium Alloy

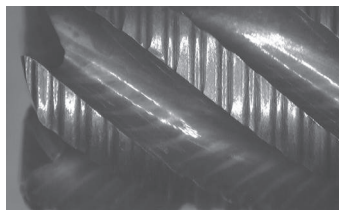
● Slotting Performance Comparison (Internal Evaluation)

After Machining 1 Pass



5RFH

5RFH (Internal and External Coolant)



Cutting Conditions : $n = 2,550 \text{ min}^{-1}$, $V_f = 336 \text{ mm/min}$, $a_p = 20 \text{ mm}$
End Mill Dia. ø10, Wet, Slotting Workpiece Material : SUS304

No Defects when Deep Slotting

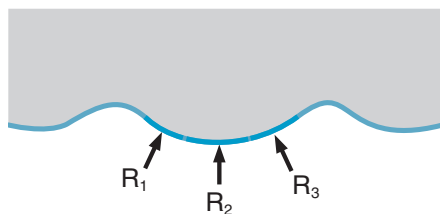
Competitor A (External Coolant)



2 Defect Resistant

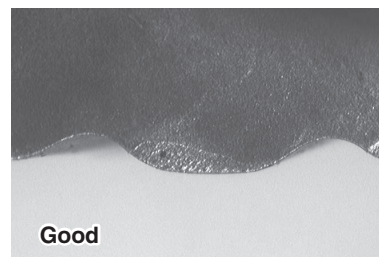
Reduces Cutting Pressure and Defect with Special Curved Radius Serrated Edge. Enables Stable Machining

● Special Curved Radius Serrated Edge



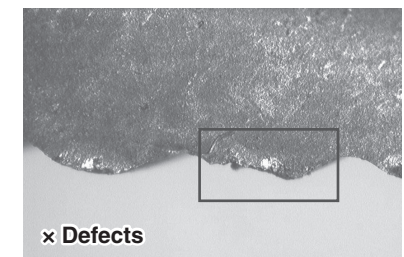
Serrated Curved Edge with Different Radii (Compound Radius Shape)
Distributes cutting pressure and increase defect resistance

● Blade Edge after Machining 12m (Internal Evaluation)



5RFH

Cutting Conditions : $n = 2,900 \text{ min}^{-1}$, $V_f = 712 \text{ mm/min}$,
 $a_p \times a_e = 5 \times 3 \text{ mm}$ End Mill Dia. ø10, Wet, Shouldering
Workpiece Material : Ti-6Al-4V



Competitor B

3 Achieves Long Tool Life and Stable Machining

The MEGACOAT HARD coating technology delivers the highest hardness and heat resistance in Kyocera's PVD coating

No. of Flutes : 4, 5, 6

4 / 5 / 6RFH **NEW**



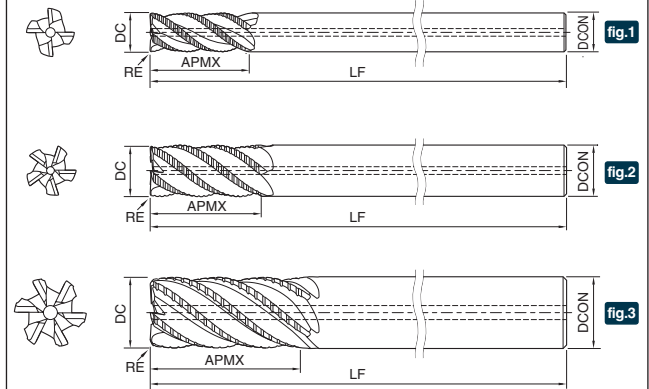
MEGACOAT HARD is applied

with Coolant hole



Recommended Workpiece Materials

★ 1st Choice



4 / 5 / 6RFH (Medium)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	* Corner-R	Length of cut	Shank Dia.	Overall length	No. of Flutes
		DC		RE	APMX	DCON	LF	ZEFP
4RFH060-150 fig.1	●	6.0	0 -0.050	0.3	15	6	60	4
4RFH080-200 fig.1	●	8.0	0 -0.050	0.3	20	8	70	4
5RFH100-250 fig.2	●	10.0	0 -0.050	0.5	25	10	80	5
5RFH120-260 fig.2	●	12.0	0 -0.050	0.5	26	12	100	5
6RFH160-350 fig.3	●	16.0	0 -0.060	0.5	35	16	110	6
6RFH200-450 fig.3	●	20.0	0 -0.060	0.5	45	20	125	6

* Corner-R dimension is reference only

4 / 5 / 6RFH (Long)

Shouldering

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	* Corner-R	Length of cut	Shank Dia.	Overall length	No. of Flutes
		DC		RE	APMX	DCON	LF	ZEFP
4RFH060-300 fig.1	●	6.0	0 -0.050	0.3	30	6	80	4
4RFH080-400 fig.1	●	8.0	0 -0.050	0.3	40	8	100	4
5RFH100-500 fig.2	●	10.0	0 -0.050	0.5	50	10	110	5
5RFH120-600 fig.2	●	12.0	0 -0.050	0.5	60	12	130	5
6RFH160-800 fig.3	●	16.0	0 -0.060	0.5	80	16	160	6
6RFH200-1000 fig.3	●	20.0	0 -0.060	0.5	100	20	180	6

* Corner-R dimension is reference only

● : Std. Item

Recommended Cutting Conditions **L93**

Insert Grades
Turning
Indexable Inserts
CNC & PCD Tools
External
Small Parts
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Turning Mill
Tools for Spare Parts
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Roughing Serrated edge

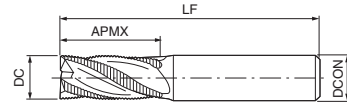
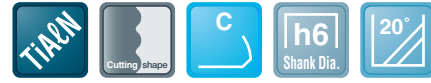
No. of Flutes : 3,4,5

3RDS, 4RDS, 5RDS



Recommended Workpiece Materials

★ 1st Choice



3RDSM, 4RDSM, 5RDSM (Medium)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	Spec. of Cones	No. of Flutes
		DC		APMX	DCON				
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	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	Spec. of Cones	No. of Flutes
		DC		APMX	DCON				
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. Their edge design with sine-curve pattern reduces cutting force.

Roughing Notched edge

No. of Flutes : 4,6

4RFSM, 6RFSM



Recommended 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 shape
C
h6 Shank Dia.
45°

4RFSM

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length LF	Spec of Corners CHW	No. of Flutes ZEFP
				APMX	DCON				
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	Stock	Outside Dia. DC	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length LF	Spec of Corners CHW	No. of Flutes ZEFP
				APMX	DCON				
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 ⚙️ L95

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

Roughing Notched edge, Radius

No. of Flutes : 3,4

3RFRS, 4RFRS



Recommended 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 shape
Radius R
±0.05 mm R
h6 Shank Dia.
45°

3RFRS (Radius)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length LF	Corner-R RE	Under Neck Length LU	No. of Flutes ZEFP
				APMX	DCON					
3RFRS040-040-06-R075	□	4	-0.030 -0.105	4	6	75	0.75	27.5	3	
3RFRS050-050-06-R075	□	5	-0.030 -0.105	5	6	75	0.75	17	3	

* Corner-R dimension is reference only

4RFRS (Radius)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length LF	Corner-R RE	Under Neck Length LU	No. of Flutes ZEFP
				APMX	DCON					
4RFRS060-060-10-R075	□	6	-0.030 -0.105	6	10	100	0.75	52.5	4	
4RFRS080-080-10-R075	□	8	-0.040 -0.130	8	10	100	0.75	31.5	4	
4RFRS100-100-12-R075	□	10	-0.040 -0.130	10	12	125	0.75	33.5	4	
4RFRS120-120-16-R100	□	12	-0.050 -0.160	12	16	125	1.0	58.5	4	

* Corner-R dimension is reference only

- Owing to the strong cutting edge with large flat surface, they are suitable for hard materials and titanium alloys.

Provide good surface roughness of 2.5 ~ 4.9 μmRa.

Recommended Cutting Conditions ⚙️ L94

● : Std. Item

□ : Deleted from the next catalog

Insert Grades
Turnable
Indexable Inserts
CN & PCD Tools
External
Machining
Small Parts
Boring
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Cut-off
Threading
Drilling
Solid Tools
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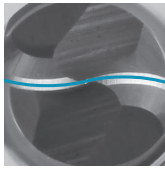
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2SEB

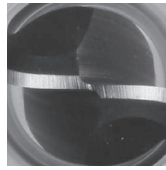
Special cutting edge concept and nano layer coating realized high precision and long tool life machining

Point 1 Sharp cutting with special nose geometry

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



2SEB

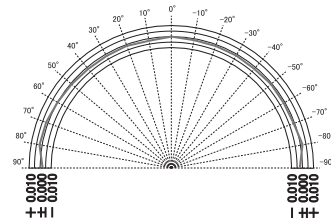


Conventional

(Internal evaluation)

Point 2 $R \pm 0.005\text{mm}$ close tolerance edge diameter (R8.0 excluded)

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

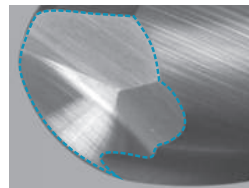


- L
- Solid Tools
- End Mills
- Solid Tools for CFRP
- Routers
- Drills
- Cutting Conditions

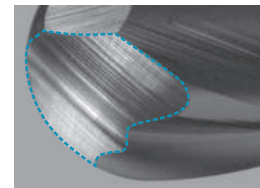


Point 3 Large Chip Pocket

Stable chip evacuation at large depth of cut machining



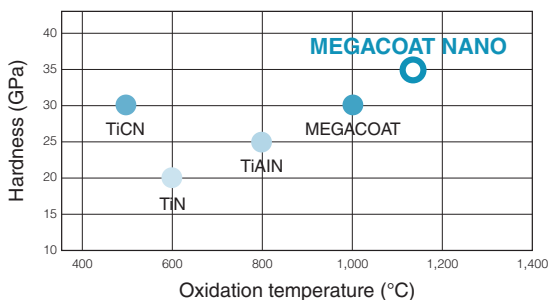
2SEB



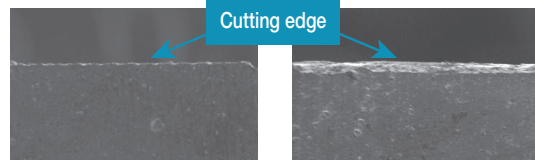
Conventional

(Internal evaluation)

Point 4 High quality cutting edge by MEGACOAT NANO



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

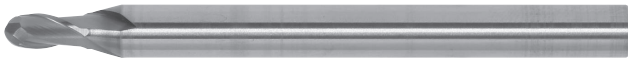


2SEB

Competitor A

(Internal evaluation)

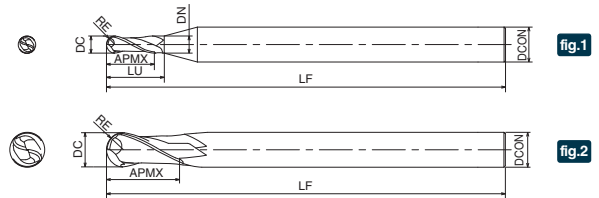
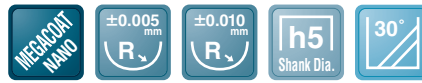
2SEB



MEGACOAT NANO is applied

Recommended Workpiece Materials

★ 1st Choice



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

Copying

(Unit : mm)

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

Solid End Mill Identification System

2 S E B 020 - 050 - R10

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

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

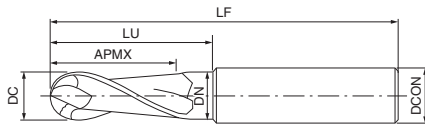
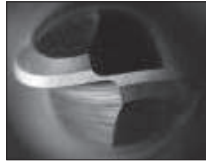
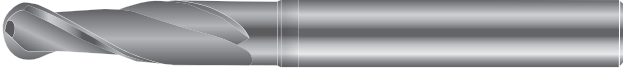
2.3 flutes Ball-nose End Mill

No. of Flutes : 2,3

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

Recommended Workpiece Materials

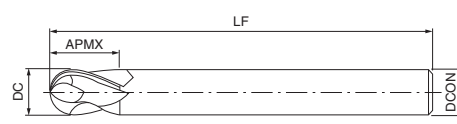
★ 1st Choice



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

Recommended Workpiece Materials

★ 1st Choice



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

Copying

(Unit : mm)

Description	Stock	Radius of Ball-nose		Length of cut		Shank Dia.		Overall length
		RE	DC	APMX	DN	LU	DCON	
2UEBS010-030-04	<input type="checkbox"/>	R0.5	1	3	-	-	4	50
2UEBS020-030-04	<input type="checkbox"/>	R1	2	3	-	-	4	50
2UEBS030-095-06	<input type="checkbox"/>	R1.5	3	9.5	-	-	6	58
2UEBS040-120-06	<input type="checkbox"/>	R2	4	12	-	-	6	76
2UEBS050-140-06	<input type="checkbox"/>	R2.5	5	14	-	-	6	76
2UEBS060-160-06	<input type="checkbox"/>	R3	6	16	5.5	40	6	100
2UEBS080-200-08	<input type="checkbox"/>	R4	8	20	7.5	40	8	100
2UEBS100-220-10	<input type="checkbox"/>	R5	10	22	9.5	35	10	100
2UEBS120-250-12	<input type="checkbox"/>	R6	12	25	11.5	50	12	125
2UEBS160-320-16	<input type="checkbox"/>	R8	16	32	15.5	60	16	150
2UEBS200-380-20	<input type="checkbox"/>	R10	20	38	19.5	60	20	150

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

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

Copying

(Unit : mm)

Description	Stock	Radius of Ball-nose		Length of cut		Shank Dia.		Overall length
		RE	DC	APMX	DN	DCON	LF	
3UEBS030-070-06	<input checked="" type="checkbox"/>	R1.5	3	7	6	6	57	
3UEBS040-080-06	<input checked="" type="checkbox"/>	R2	4	8	6	6	57	
3UEBS050-100-06	<input checked="" type="checkbox"/>	R2.5	5	10	6	6	57	
3UEBS060-100-06	<input checked="" type="checkbox"/>	R3	6	10	6	6	57	
3UEBS080-160-08	<input checked="" type="checkbox"/>	R4	8	16	8	8	63	
3UEBS100-190-10	<input checked="" type="checkbox"/>	R5	10	19	10	10	72	
3UEBS120-220-12	<input checked="" type="checkbox"/>	R6	12	22	12	12	83	

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

Recommended Cutting Conditions ● L96

● : Std. Item
 : Deleted from the next catalog

L

Solid Tools

End Mills

Solid Tools for CFRP

Routers

Drills

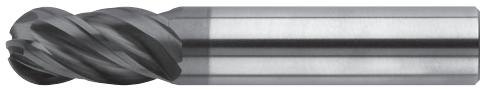
Cutting Conditions

4 Flutes Ball-nose End Mill, High efficiency and High vibration resistance

Z Series

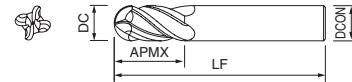
No. of Flutes : 4

Z1MB **NEW**



Recommended Workpiece Materials

★ 1st Choice



Z1MB (Ball-nose End Mill with 4 Flutes)

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Radius of Ball-nose	Radius of Ball-nose Tolerance	Outside Dia.	Length of cut	Shank Dia.	Overall length	No. of Flutes
			RE		DC	APMX	DCON	LF	ZEFP
Z1MB030-080	46354	●	1.5	±0.013	3.0	8	6	57	4
Z1MB040-110	46355	●	2	±0.013	4.0	11	6	57	4
Z1MB050-130	46356	●	2.5	±0.013	5.0	13	6	57	4
Z1MB060-130	46343	●	3	±0.013	6.0	13	6	57	4
Z1MB080-190	46344	●	4	±0.013	8.0	19	8	63	4
Z1MB100-220	46345	●	5	±0.013	10.0	22	10	72	4
Z1MB120-260	46346	●	6	±0.013	12.0	26	12	83	4
Z1MB140-260	46347	●	7	±0.013	14.0	26	14	83	4
Z1MB160-320	46348	●	8	±0.013	16.0	32	16	92	4
Z1MB180-320	46349	●	9	±0.013	18.0	32	18	92	4
Z1MB200-380	46350	●	10	±0.013	20.0	38	20	104	4
Z1MB250-380	46351	●	12.5	±0.013	25.0	38	25	104	4

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

Recommended Cutting Conditions Ⓢ L84

- Z Series Ball-nose End Mill type with 4 flutes
- Superior chattering resistance performance with varied interval flute design, variable lead

4 Flutes Ball-nose End Mill

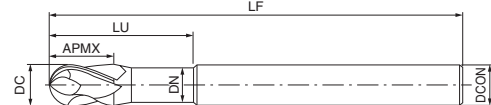
No. of Flutes : 4

4YEBM



Recommended Workpiece Materials

★ 1st Choice



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

Shouldering Slotting

(Unit : mm)

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

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

Recommended Cutting Conditions Ⓢ L97

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

● : Std. Item

Insert Grades
Turning
Indexable Inserts
CNC & PCO Tools
External
Small Parts
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Tools for Turning Mill
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T

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

No. of Flutes : 6

6PDRS



Recommended Workpiece Materials ★ 1st Choice

★
P
~30HRC

★
P
30~40HRC

★
H
~55HRC

★
H
~68HRC

ACTiN

Radius
R

h6
Shank Dia.

20°

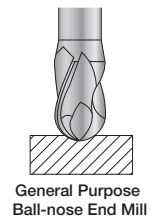
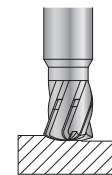
6PDRS

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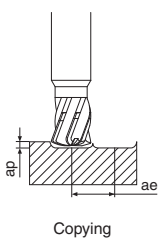
(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC		APMX	LU	DCON		
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 flutes design enables high feed rate machining. Achieves large cutting allowance and high efficiency machining with special corner-R shaped. Ramping and arc cutting are possible.



Recommended Cutting Conditions



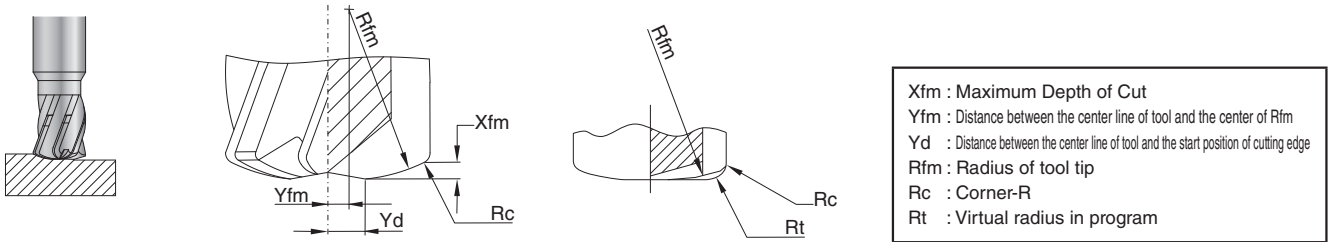
Workpiece Material		Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12
Prehardened steel	52HRC	ø6 : 0.32 x 3.3mm (0.32 x 0.55DC) ø8 : 0.42 x 4.4mm (0.42 x 0.55DC)	Spindle Revolution (min ⁻¹)	6,400	4,800	3,800	3,200
			Feed Rate (mm/min)	7,600	7,200	6,900	7,600
Carbon Steel / Alloy Steel	< 45HRC	ø10: 0.53 x 5.5mm (0.53 x 0.55DC) ø12: 0.63 x 6.6mm (0.63 x 0.55DC)	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

L
Solid Tools
End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions

6PDRS Ramping / Arc cutting

Details of 6PDRS cutting edge shape



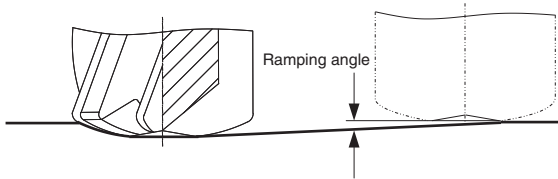
(Unit : mm)

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
	DC	Xfm	Rfm	Rc	Yfm	Yd	Rt
6PDRS060-045-06	6	0.32	6	0.62	0.75	1.32	0.62
6PDRS080-060-08	8	0.42	8	0.83	1.00	1.76	0.83
6PDRS100-075-10	10	0.53	10	1.04	1.25	2.20	1.04
6PDRS120-090-12	12	0.63	12	1.24	1.50	2.64	1.24

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

Ramping

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

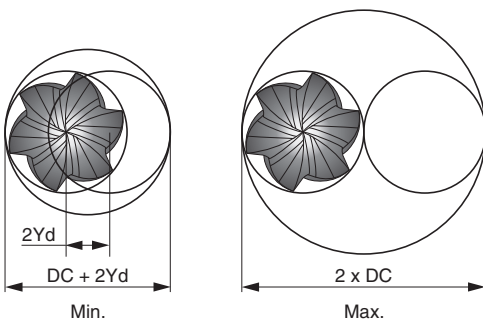


Ramping angle	1°	2°	3°	4°	5°
Ratio of feed rate	100%	70%	50%	30%	10%

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

Arc cutting

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



(Unit : mm)

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

Insert Grades **A**
 Turning Indexable Inserts **B**
 CNV & PCD Tools **C**
 External **D**
 Small Parts Machining **E**
 Boring **F**
 Grooving **G**
 Cut-off **H**
 Threading **J**
 Drilling **K**
 Solid Tools **L**
 Milling **M**
 Tools for Turning Mill **N**
 Spare Parts **P**
 Technical Information **R**
 Index **T**

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

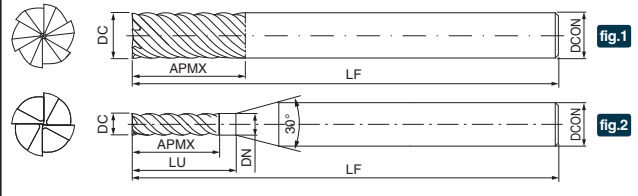


MEGACOAT HARD is applied

High Efficiency Machining

Recommended Workpiece Materials

★ 1st Choice

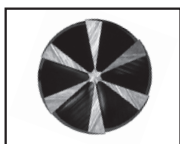


4HFSS, 5HFSS, 6HFSS, 7HFSS (Short)

Shouldering

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN	LU	DCON	LF	ZEFP	
4HFSS010-040-06 fig.2	●	1	0 -0.015	4	1.05	4.8	6	60	4	
4HFSS020-060-06 fig.2	●	2	0 -0.015	6	2.10	7.2	6	60	4	
4HFSS030-080-06 fig.2	●	3	0 -0.015	8	3.15	9.6	6	60	4	
4HFSS040-100-06 fig.2	●	4	0 -0.015	10	4.2	12.0	6	60	4	
4HFSS050-120-06 fig.2	●	5	0 -0.015	12	5.2	14.4	6	60	4	
5HFSS040-100-06 fig.2	●	4	0 -0.015	10	4.2	12.0	6	60	5	
6HFSS060-140-06 fig.1	●	6	0 -0.020	14	-	-	6	60	6	
6HFSS080-180-08 fig.1	●	8	-0.005 -0.025	18	-	-	8	70	6	
6HFSS100-220-10 fig.1	●	10	-0.005 -0.025	22	-	-	10	80	6	
6HFSS120-260-12 fig.1	●	12	-0.010 -0.030	26	-	-	12	90	6	
7HFSS060-140-06 fig.1	●	6	0 -0.020	14	-	-	6	60	7	
7HFSS080-180-08 fig.1	●	8	-0.005 -0.025	18	-	-	8	70	7	
7HFSS100-220-10 fig.1	●	10	-0.005 -0.025	22	-	-	10	80	7	
7HFSS120-260-12 fig.1	●	12	-0.010 -0.030	26	-	-	12	90	7	



Bottom surface of 6HFSS cutting edge

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

Shouldering

(Unit : mm)

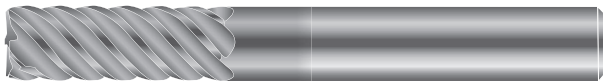
Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN	LU	DCON	LF	ZEFP	
4HFSM010-050-06 fig.2	●	1	0 -0.015	5	1.05	6	6	60	4	
4HFSM020-090-06 fig.2	●	2	0 -0.015	9	2.10	10.8	6	60	4	
4HFSM030-120-06 fig.2	●	3	0 -0.015	12	3.15	14.4	6	60	4	
4HFSM040-140-06 fig.2	●	4	0 -0.015	14	4.2	16.8	6	60	4	
4HFSM050-170-06 fig.2	●	5	0 -0.015	17	5.2	20.4	6	60	4	
5HFSM040-140-06 fig.2	●	4	0 -0.015	14	4.2	16.8	6	60	5	
6HFSM060-170-06 fig.1	●	6	0 -0.020	17	-	-	6	60	6	
6HFSM070-200-08 fig.2	●	7	-0.005 -0.025	20	7.2	24.0	8	70	6	
6HFSM080-230-08 fig.1	●	8	-0.005 -0.025	23	-	-	8	70	6	
6HFSM100-280-10 fig.1	●	10	-0.005 -0.025	28	-	-	10	80	6	
6HFSM120-330-12 fig.1	●	12	-0.010 -0.030	33	-	-	12	90	6	
6HFSM140-370-16 fig.2	●	14	-0.010 -0.030	37	14.2	44.4	16	105	6	
6HFSM150-420-16 fig.2	●	15	-0.010 -0.030	42	15.2	50.4	16	105	6	
6HFSM160-420-16 fig.1	●	16	-0.010 -0.030	42	-	-	16	105	6	
6HFSM200-480-20 fig.1	●	20	-0.010 -0.030	48	-	-	20	110	6	
7HFSM060-170-06 fig.1	●	6	0 -0.020	17	-	-	6	60	7	
7HFSM080-230-08 fig.1	●	8	-0.005 -0.025	23	-	-	8	70	7	
7HFSM100-280-10 fig.1	●	10	-0.005 -0.025	28	-	-	10	80	7	
7HFSM120-330-12 fig.1	●	12	-0.010 -0.030	33	-	-	12	90	7	
7HFSM160-420-16 fig.1	●	16	-0.010 -0.030	42	-	-	16	105	7	
8HFSM250-530-25 fig.1	●	25	-0.010 -0.030	53	-	-	25	125	8	

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

Hard materials, Multi-edge, Negative rake angle, Finishing

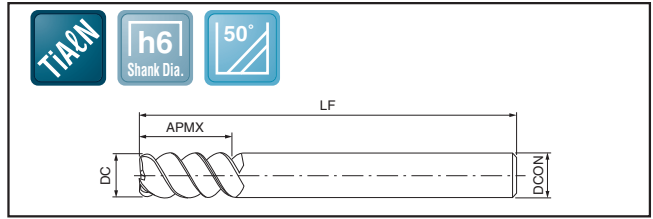
No. of Flutes : 4,6

4UGSM, 6UGSM



Recommended Workpiece Materials ★ 1st Choice

★ **H** ~55HRC ★ **H** ~68HRC



4UGSM

Shouldering

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.		Overall length	No. of Flutes
		DC		APMX	DCON	LF	ZEFP		
4UGSM030-080-06	<input type="checkbox"/>	3	-0.014 -0.028	8	6	50	4		
4UGSM040-120-06	<input type="checkbox"/>	4	-0.020 -0.038	12	6	57	4		
4UGSM050-130-06	<input type="checkbox"/>	5	-0.020 -0.038	13	6	57	4		

- Negative rake angle is adopted for stable machining of hard materials. 6 flutes type for larger than Dia. $\phi 6$ allows high efficiency machining.

6UGSM

Shouldering

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.		Overall length	No. of Flutes
		DC		APMX	DCON	LF	ZEFP		
6UGSM060-150-06	<input type="checkbox"/>	6	-0.020 -0.038	15	6	60	6		
6UGSM080-200-08	<input type="checkbox"/>	8	-0.025 -0.047	20	8	75	6		
6UGSM100-250-10	<input type="checkbox"/>	10	-0.025 -0.047	25	10	80	6		
6UGSM120-300-12	<input type="checkbox"/>	12	-0.032 -0.059	30	12	100	6		
6UGSM160-400-16	<input type="checkbox"/>	16	-0.032 -0.059	40	16	110	6		

Recommended Cutting Conditions ● L98

Hard materials Ball-nose End Mill

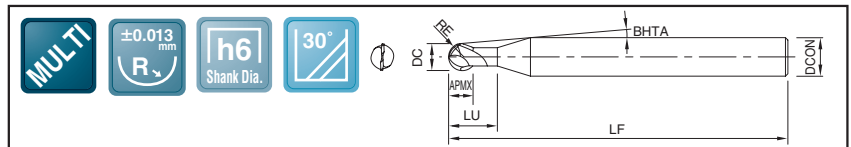
56MB **NEW**



No. of Flutes : 2

Recommended Workpiece Materials ★ 1st Choice

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



56MB (Ball-nose End Mill with 2 Flutes / Short length of cut, Long shank type)

Copying

(Unit : mm)

Description	*Code	Stock	Radius of Ball-nose	Radius of Ball-nose	Outside Dia.		Length of cut		Under Neck Length	Shank Dia.	Inclination angle	Overall length		No. of Flutes
			RE	Tolerance	DC	APMX	LU	DCON				BHTA	LF	
56MB010-010	91349	●	0.5	±0.013	1.0	1	2	6	8° 10'	76	2			
56MB015-015	91350	●	0.75	±0.013	1.5	1.5	3	6	7° 45'	76	2			
56MB020-020	91351	●	1	±0.013	2.0	2	4	6	7° 10'	76	2			
56MB025-025	91352	●	1.25	±0.013	2.5	2.5	5	6	6° 35'	76	2			
56MB030-030	91353	●	1.5	±0.013	3.0	3	6	6	6°	76	2			
56MB040-040	91354	●	2	±0.013	4.0	4	8	6	4° 30'	76	2			
56MB050-050	91355	●	2.5	±0.013	5.0	5	10	6	2° 30'	89	2			
56MB060-060	91356	●	3	±0.013	6.0	6	12	6	-	89	2			
56MB080-080	91357	●	4	±0.013	8.0	8	16	8	-	102	2			
56MB100-100	91358	●	5	±0.013	10.0	10	20	10	-	102	2			
56MB120-120	91359	●	6	±0.013	12.0	12	24	12	-	114	2			
56MB160-160	91360	●	8	±0.013	16.0	16	32	16	-	140	2			
56MB200-200	91361	●	10	±0.013	20.0	20	40	20	-	165	2			

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

- 2 flutes, Low cutting force with the S curve geometry
- Short length of cut, Long shank type
- Longer tool life with new multi-element coating, which is high hardness and excellent heat resistance

● : Std. Item
□ : Deleted from the next catalog

Recommended Cutting Conditions ● L98

Insert Grades
Turning
Indexable Inserts
CNC & CDD Tools
External
Small Parts
Machining
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
Milling
Tools for Turning Mill
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3AFK

High Efficiency and Excellent Precision Machining with 3 Flutes

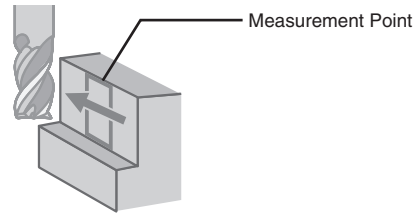
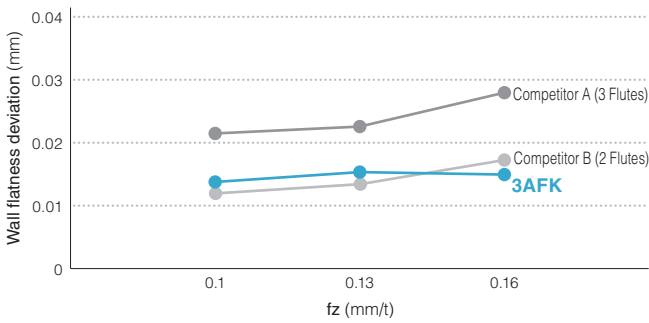
Stable Machining with Sharp Edge for Anti-chattering Performance

Wide Range of Applications including Slotting, Shouldering, Ramping, and Plunge milling

1 High-efficiency and High-precision Machining

High Efficiency with 3 Flutes. Excellent Machining Precision

Comparison of wall flatness (Internal evaluation)

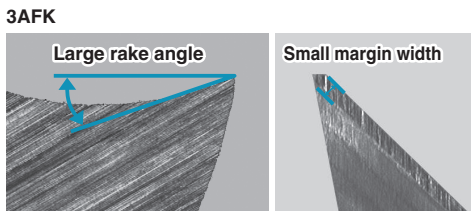


Cutting Conditions : $n = 11,700 \text{ min}^{-1}$, $V_f = 3,500 - 5,600 \text{ mm/min}$, $a_p \times a_e = 15 \times 1 \text{ mm}$
End Mill Dia. $\phi 10$, Shouldering, Down-cut, Wet, HSK A63 Workpiece Material : A5052

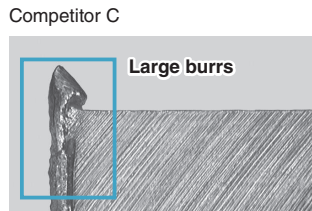
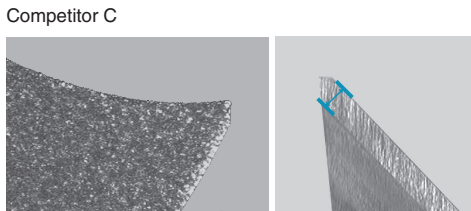
2 Decreased burr

Excellent Sharpness with Large Rake Angle and Small Margin Width

Comparison of the Rake Angle and Margin Width (Internal evaluation)

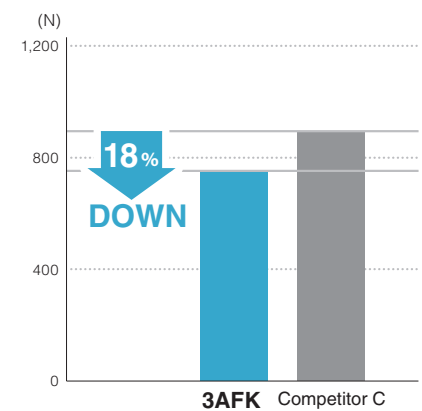


Burr Comparison after Machining (Internal evaluation)



Burr Comparison after Machining Cutting Conditions : $n = 11,700 \text{ min}^{-1}$, $V_f = 4,600 \text{ mm/min}$, $a_p \times a_e = 10 \times 1 \text{ mm}$ End Mill Dia. $\phi 10$, Shouldering, Down-cut, Wet, HSK A63 Workpiece Material : A7075

Cutting Force Comparison (Internal evaluation)



Cutting Conditions : $n = 11,700 \text{ min}^{-1}$, $V_f = 3,400 \text{ mm/min}$, $a_p \times a_e = 10 \times 10 \text{ mm}$ End Mill Dia. $\phi 10$, Slotting, Wet, BT50 Workpiece Material : A5052

L

Solid Tools

End Mills

Solid Tools for CFRP

Routers

Drills

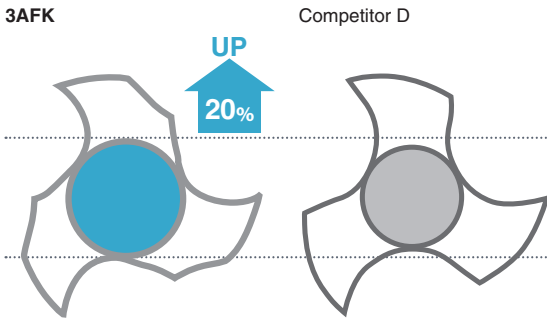
Cutting Conditions

3

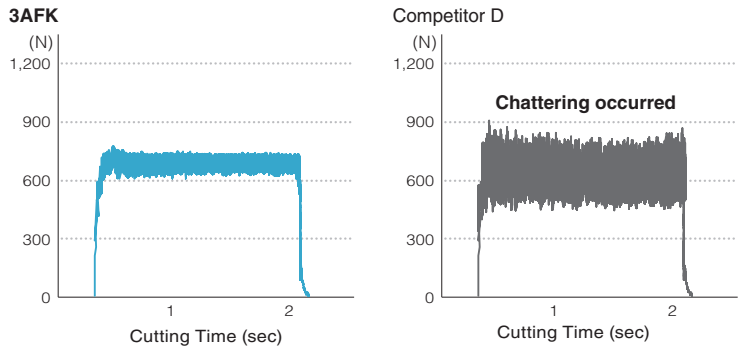
Resistance to chattering

Larger Core Thickness to Reduce Chattering

Core Thickness Comparison (Internal evaluation)

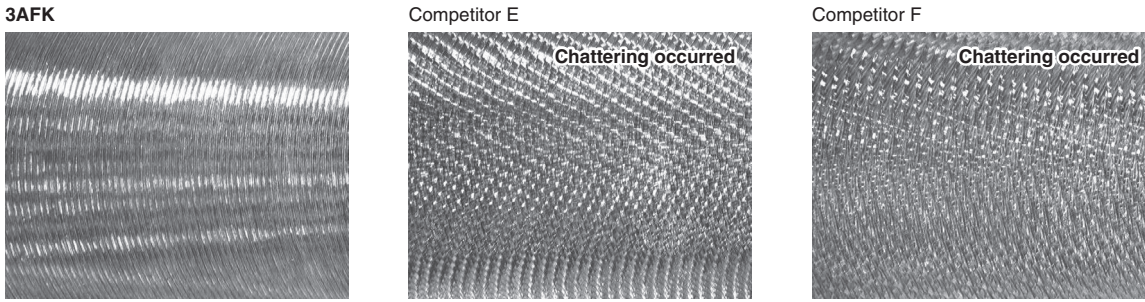


Cutting Force Comparison (Internal evaluation)



Cutting Conditions : $n = 11,700 \text{ min}^{-1}$, $V_f = 3,400 \text{ mm/min}$, $a_p \times a_e = 10 \times 10 \text{ mm}$, End Mill Dia. $\phi 10$, Slotting, Wet, BT50 Workpiece Material : A5052

Comparison of Bottom Surface at Slotting (Internal evaluation)

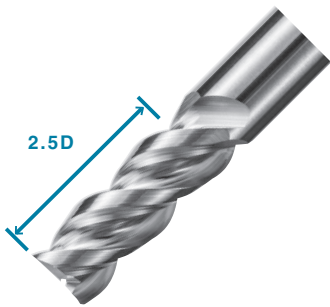


Cutting Conditions : $n = 11,100 \text{ min}^{-1}$, $V_f = 2,600 \text{ mm/min}$, $a_p = 10 \text{ mm}$, Wet Workpiece Material : A5052

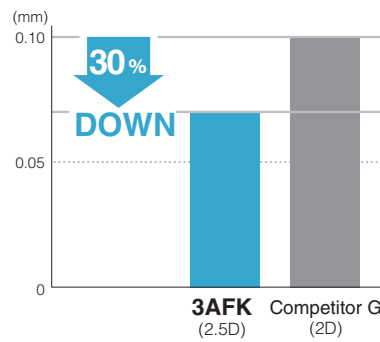
4

Flute Length 2.5 D (medium type) Added to the Lineup

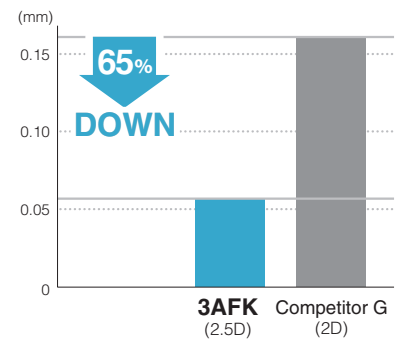
Stable Machining even while Deep Slotting



Comparison of wall flatness (Internal evaluation)



Burr Height Comparison (Internal evaluation)



Cutting Conditions : $n = 11,100 \text{ min}^{-1}$, $V_f = 3,800 \text{ mm/min}$, $a_p \times a_e = 20 \times 1 \text{ mm}$
End Mill Dia. $\phi 10$, Shouldering, Down-cut, Wet, HSK A63 Workpiece Material : A7075

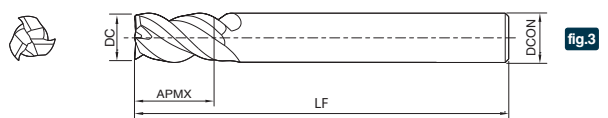
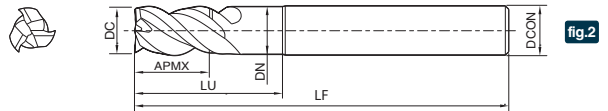
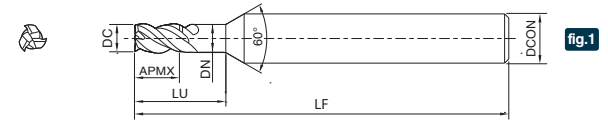
Insert Grades	A
Turning Indexable Inserts	B
CBN & PCBN Tools	C
External	D
Small Parts Machining	E
Boring	F
Grooving	G
Cut-off	H
Threading	J
Drilling	K
Solid Tools	L
Milling	M
Tools for Turning Mill	N
Spare Parts	P
Technical Information	R
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3AFK NEW



Recommended Workpiece Materials

★ 1st Choice



3AFK (Short : 1.5D)

Shouldering Slotting Plunge milling

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN					
3AFK030-045-090 fig.1	●	3.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	4.5	2.7	9	6	70	3	
3AFK040-060-120 fig.1	●	4.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	6	3.7	12	6	70	3	
3AFK050-075-150 fig.1	●	5.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	7.5	4.7	15	6	70	3	
3AFK060-090 fig.3	●	6.0	$\begin{matrix} 0 \\ -0.005 \end{matrix}$	9	-	-	6	70	3	
3AFK060-090-180 fig.2	●	6.0	$\begin{matrix} 0 \\ -0.005 \end{matrix}$	9	5.7	18	6	70	3	
3AFK070-105-210 fig.1	●	7.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	10.5	6.7	21	8	80	3	
3AFK080-120 fig.3	●	8.0	$\begin{matrix} 0 \\ -0.006 \end{matrix}$	12	-	-	8	80	3	
3AFK080-120-240 fig.2	●	8.0	$\begin{matrix} 0 \\ -0.006 \end{matrix}$	12	7.7	24	8	80	3	
3AFK090-135-270 fig.1	●	9.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	13.5	8.7	27	10	90	3	
3AFK100-150 fig.3	●	10.0	$\begin{matrix} 0 \\ -0.006 \end{matrix}$	15	-	-	10	90	3	
3AFK100-150-300 fig.2	●	10.0	$\begin{matrix} 0 \\ -0.006 \end{matrix}$	15	9.7	30	10	90	3	
3AFK110-165-330 fig.1	●	11.0	$\begin{matrix} 0 \\ -0.015 \end{matrix}$	16.5	10.7	33	12	110	3	
3AFK120-180 fig.3	●	12.0	$\begin{matrix} 0 \\ -0.008 \end{matrix}$	18	-	-	12	110	3	
3AFK120-180-360 fig.2	●	12.0	$\begin{matrix} 0 \\ -0.008 \end{matrix}$	18	11.7	36	12	110	3	
3AFK160-240 fig.3	●	16.0	$\begin{matrix} 0 \\ -0.008 \end{matrix}$	24	-	-	16	120	3	
3AFK160-240-480 fig.2	●	16.0	$\begin{matrix} 0 \\ -0.008 \end{matrix}$	24	15.7	48	16	120	3	

Recommended Cutting Conditions L99

● : Std. Item

Solid Tools

End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions



Insert Grades
A
Turning
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Indexable Inserts
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CNC & PCO Tools
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3AFK (Medium : 2.5D)

Shouldering Slotting Plunge milling

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Under Neck Length	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DN				
3AFK030-075-150 fig.1	●	3.0	0 -0.015	7.5	2.7	15	6	70	3
3AFK040-100-200 fig.1	●	4.0	0 -0.015	10	3.7	20	6	70	3
3AFK050-125-250 fig.1	●	5.0	0 -0.015	12.5	4.7	25	6	70	3
3AFK060-150 fig.3	●	6.0	0 -0.005	15	-	-	6	70	3
3AFK060-150-300 fig.2	●	6.0	0 -0.005	15	5.7	30	6	70	3
3AFK070-175-350 fig.1	●	7.0	0 -0.015	17.5	6.7	35	8	80	3
3AFK080-200 fig.3	●	8.0	0 -0.006	20	-	-	8	80	3
3AFK080-200-400 fig.2	●	8.0	0 -0.006	20	7.7	40	8	80	3
3AFK090-225-450 fig.1	●	9.0	0 -0.015	22.5	8.7	45	10	90	3
3AFK100-250 fig.3	●	10.0	0 -0.006	25	-	-	10	90	3
3AFK100-250-500 fig.2	●	10.0	0 -0.006	25	9.7	50	10	90	3
3AFK110-275-550 fig.1	●	11.0	0 -0.015	27.5	10.7	55	12	110	3
3AFK120-300 fig.3	●	12.0	0 -0.008	30	-	-	12	110	3
3AFK120-300-600 fig.2	●	12.0	0 -0.008	30	11.7	60	12	110	3
3AFK160-400 fig.3	●	16.0	0 -0.008	40	-	-	16	120	3
3AFK160-400-800 fig.2	●	16.0	0 -0.008	40	15.7	80	16	120	3

Recommended Cutting Conditions L99

● : Std. Item

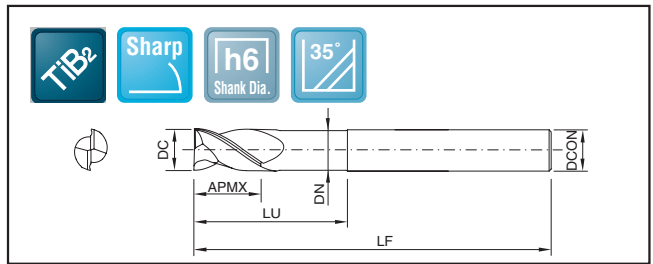
Aluminum & Non-ferrous Metals, 2 flutes, Coated (Square / Ball-nose)

No. of Flutes : 2

47ML NEW



Recommended Workpiece Materials ★ 1st Choice



47ML (Square / Long)

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Neck Dia.	Under Neck Length	Shank Dia.	Overall length	No. of Flutes
			DC	$\begin{matrix} 0 \\ -0.011 \end{matrix}$	APMX	DN	LU	DCON	LF	ZEFP
47ML120-160	44612	●	12	$\begin{matrix} 0 \\ -0.011 \end{matrix}$	16	11.6	80	12	150	2
47ML160-200	44613	●	16	$\begin{matrix} 0 \\ -0.011 \end{matrix}$	20	15.6	80	16	150	2
47ML200-250	44614	●	20	$\begin{matrix} 0 \\ -0.013 \end{matrix}$	25	19.6	80	20	150	2

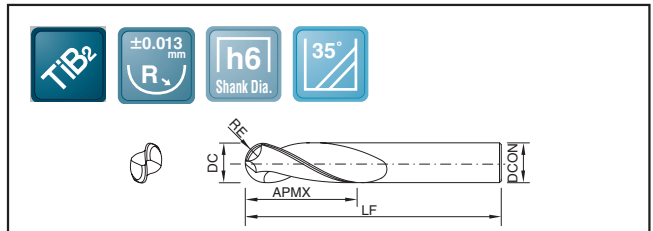
*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

No. of Flutes : 2

47MB NEW



Recommended Workpiece Materials ★ 1st Choice



47MB (Ball-nose End Mill with 2 Flutes)

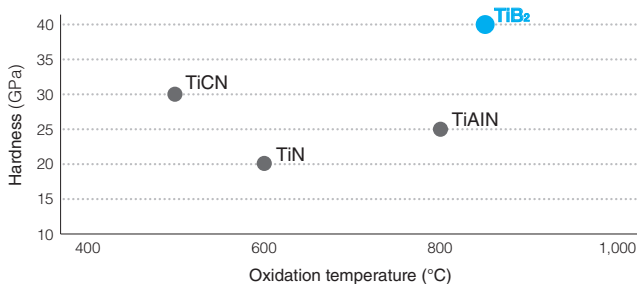
Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Radius of Ball-nose	Radius of Ball-nose Tolerance	Outside Dia.	Length of cut	Shank Dia.	Overall length	No. of Flutes
			RE	± 0.013	DC	APMX	DCON	LF	ZEFP
47MB120-260	44604	●	6	± 0.013	12.0	26	12	83	2
47MB160-320	44606	●	8	± 0.013	16.0	32	16	92	2
47MB200-373	44607	●	10	± 0.013	20.0	37.3	20	104	2
47MB250-380	44608	●	12.5	± 0.013	25.0	38	25	104	2

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

● Properties of Coating



TiB₂ : Coating for Non-ferrous Metals

- Superior wear resistance with high toughness and high hardness
Hardness : 39.2GPa
Oxidation temperature : 850°C
- Smooth surface finish by suppressing welding and edge build-up in machining of aluminum alloys and copper alloys.

Recommended Cutting Conditions L99

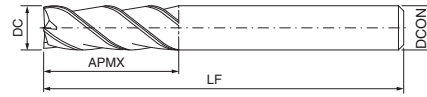
● : Std. Item

3NESM



Recommended Workpiece Materials

★ 1st Choice



3NESM

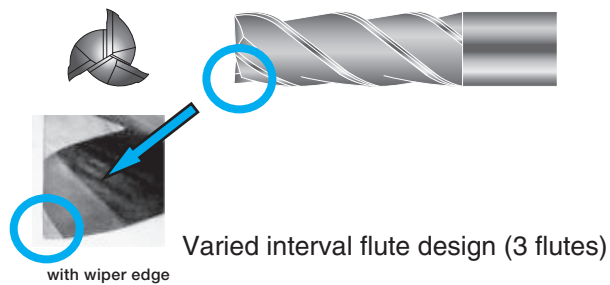
Shouldering Slotting

(Unit : mm)

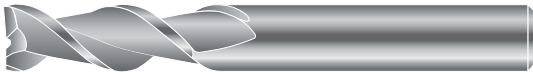
Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut	Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DCON	LF	ZEFP
3NESM030-120-06	●	3	-0.014 -0.028	12	6	50	3
3NESM040-120-06	●	4	-0.020 -0.038	12	6	50	3
3NESM050-140-06	●	5	-0.020 -0.038	14	6	50	3
3NESM060-160-06	●	6	0 -0.008	16	6	50	3
3NESM080-200-08	●	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 øDC 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.

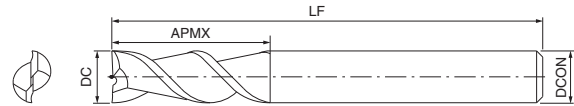


2NFSM, 3NFSM, 3NFSL



Recommended Workpiece Materials

★ 1st Choice



2NFSM (Medium)

Shouldering

Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DCON			
2NFSM010-040-04	<input type="checkbox"/>	1	-0.014 -0.028	4	4	38	2	
2NFSM015-060-04	<input type="checkbox"/>	1.5	-0.014 -0.028	6	4	38	2	
2NFSM020-080-04	<input type="checkbox"/>	2	-0.014 -0.028	8	4	38	2	
2NFSM025-080-04	<input type="checkbox"/>	2.5	-0.014 -0.028	8	4	38	2	
2NFSM030-080-06	<input type="checkbox"/>	3	-0.014 -0.028	8	6	50	2	
2NFSM040-080-06	<input type="checkbox"/>	4	-0.020 -0.038	8	6	50	2	
2NFSM050-140-06	<input type="checkbox"/>	5	-0.020 -0.038	14	6	50	2	
2NFSM060-160-06	<input type="checkbox"/>	6	0 -0.008	16	6	50	2	
2NFSM080-200-08	<input type="checkbox"/>	8	0 -0.009	20	8	63	2	
2NFSM100-220-10	<input type="checkbox"/>	10	0 -0.009	22	10	76	2	
2NFSM120-250-12	<input type="checkbox"/>	12	0 -0.011	25	12	76	2	
2NFSM160-320-16	<input type="checkbox"/>	16	0 -0.011	32	16	89	2	
2NFSM200-380-20	<input type="checkbox"/>	20	0 -0.013	38	20	104	2	

* Cutting edge of over 6mm øDC has margin.

3NFSM (Medium)

Shouldering

Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DCON			
3NFSM030-120-06	<input type="checkbox"/>	3	-0.014 -0.028	12	6	50	3	
3NFSM040-120-06	<input type="checkbox"/>	4	-0.020 -0.038	12	6	50	3	
3NFSM050-140-06	<input type="checkbox"/>	5	-0.020 -0.038	14	6	50	3	
3NFSM060-160-06	<input type="checkbox"/>	6	0 -0.008	16	6	50	3	
3NFSM080-200-08	<input type="checkbox"/>	8	0 -0.009	20	8	63	3	
3NFSM100-220-10	<input type="checkbox"/>	10	0 -0.009	22	10	76	3	
3NFSM120-250-12	<input type="checkbox"/>	12	0 -0.011	25	12	76	3	
3NFSM160-320-16	<input type="checkbox"/>	16	0 -0.011	32	16	89	3	
3NFSM200-380-20	<input type="checkbox"/>	20	0 -0.013	38	20	104	3	

* Cutting edge of over 6mm øDC has margin.

3NFSL (Long)

Shouldering

(Unit : mm)

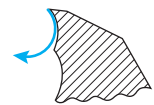
Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Shank Dia.	Overall length	No. of Flutes
		DC		APMX	DCON			
3NFSL030-190-06	<input type="checkbox"/>	3	-0.014 -0.028	19	6	63	3	
3NFSL040-190-06	<input type="checkbox"/>	4	-0.020 -0.038	19	6	63	3	
3NFSL050-200-06	<input type="checkbox"/>	5	-0.020 -0.038	20	6	63	3	
3NFSL060-280-06	<input type="checkbox"/>	6	0 -0.008	28	6	76	3	
3NFSL080-300-08	<input type="checkbox"/>	8	0 -0.009	30	8	76	3	
3NFSL100-340-10	<input type="checkbox"/>	10	0 -0.009	34	10	89	3	
3NFSL120-450-12	<input type="checkbox"/>	12	0 -0.011	45	12	100	3	
3NFSL160-560-16	<input type="checkbox"/>	16	0 -0.011	56	16	125	3	
3NFSL200-600-20	<input type="checkbox"/>	20	0 -0.013	60	20	125	3	

* Cutting edge of over 6mm øDC has margin.

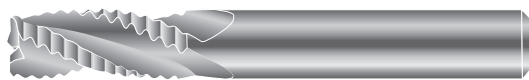
- Sharpness oriented for aluminum machining.
Good chip evacuation with the 45° helix angle.

NFSM type
NFSL type
rake angle

A convex shape in the slot improves chip evacuation.

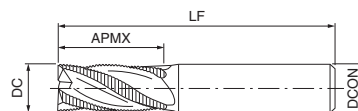


3AESM, 3AESL



Recommended Workpiece Materials

★ 1st Choice



- Insert Grades **A**
- Turning Indexable Inserts **B**
- CNC & PC D Tools **C**
- External **D**
- Small Parts Machining **E**
- Boring **F**
- Grooving **G**
- Cut-off **H**
- Threading **J**
- Drilling **K**
- Solid Tools **L**
- Milling **M**
- Tools for Turning Mill **N**
- Spare Parts **P**
- Technical Information **R**
- Index **T**

3AESM (Medium)

Shouldering Slotting

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Overall length	Spec. of Corners	No. of Flutes
		DC		APMX	DCON			
3AESM060-130-06	<input type="checkbox"/>	6	-0.030 -0.105	13	6	57	0.6	3
3AESM080-160-08	<input type="checkbox"/>	8	-0.040 -0.130	16	8	63	0.6	3
3AESM100-220-10	<input type="checkbox"/>	10	-0.040 -0.130	22	10	72	0.6	3
3AESM120-260-12	<input type="checkbox"/>	12	-0.050 -0.160	26	12	83	1	3
3AESM160-320-16	<input type="checkbox"/>	16	-0.050 -0.160	32	16	92	1	3
3AESM200-380-20	<input type="checkbox"/>	20	-0.065 -0.195	38	20	104	1	3
3AESM250-450-25	<input type="checkbox"/>	25	-0.065 -0.195	45	25	121	1	3

3AESL (Long)

Shouldering

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Overall length	Spec. of Corners	No. of Flutes
		DC		APMX	DCON			
3AESL060-240-06	<input type="checkbox"/>	6	-0.030 -0.105	24	6	76	0.6	3
3AESL080-280-08	<input type="checkbox"/>	8	-0.040 -0.130	28	8	76	0.6	3
3AESL100-340-10	<input type="checkbox"/>	10	-0.040 -0.130	34	10	89	0.6	3
3AESL120-450-12	<input type="checkbox"/>	12	-0.050 -0.160	45	12	100	1	3
3AESL160-560-16	<input type="checkbox"/>	16	-0.050 -0.160	56	16	125	1	3
3AESL200-600-20	<input type="checkbox"/>	20	-0.065 -0.195	60	20	125	1	3
3AESL250-800-25	<input type="checkbox"/>	25	-0.065 -0.195	80	25	150	1	3

- 3 flutes type for roughing of aluminum. With corner chamfering.

: Deleted from the next catalog

End Mill 4FCX-KCD · Drill 2ZDF-KCD

NEW

Diamond Coated Solid Tools

Newly Developed High Performance Diamond Coating
Long Tool Life and High Precision Machining of CFRP

End Mill

4FCX-KCD

Drill

2ZDF-KCD

Special Order Items

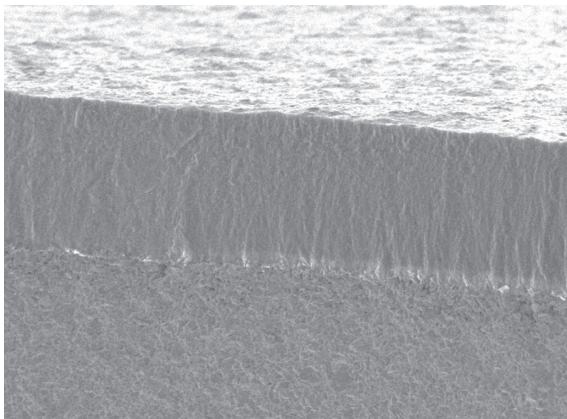
* Special order items such as routers are also available

1

Diamond Coating with Superior Wear Resistance and Fracture Resistance
High Degree of Crystallinity, Adhesion and Toughness Improve Tool Durability

Unique Preprocessing Technology and Special Carbide Material
Superior Adhesion Ensures Stable Machining

Smooth and Even
Coating Surface



Cross-section of Diamond Coating



L

Solid Tools

End Mills

Solid Tools
for CFRP

Routers

Drills

Cutting
Conditions

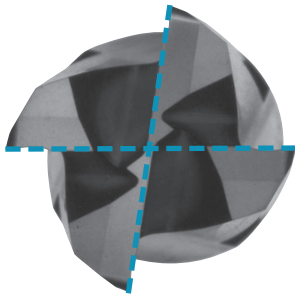
2

Special Tool Geometry Coated with a Smooth Diamond Coating Reduces Cutting Force Long Tool Life, High Precision and High Quality Machining of CFRP

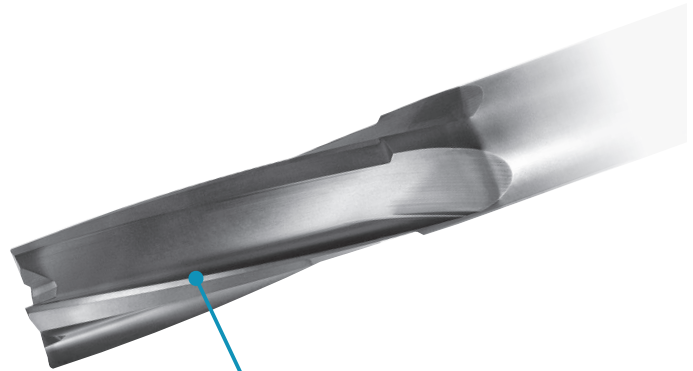
End Mill

Variable Flute Design Prevents Chattering and Stable Machining Provides High-quality Surface finishes Sharp Cutting Edges Cut Off Strong Carbon Fibers. Reduces Delamination and Burr Build Up

New Geometry (Variable Flute Design)



Variable flute design prevents chattering

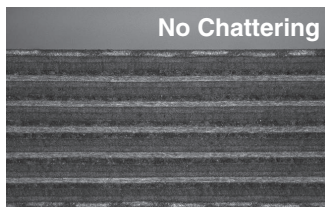


Cutting edge with excellent sharpness

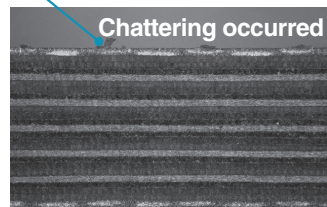
Surface Finish Comparison (Internal evaluation)

Excellent surface finish (Side wall)

Burr (Uncut fiber)



Kyocera

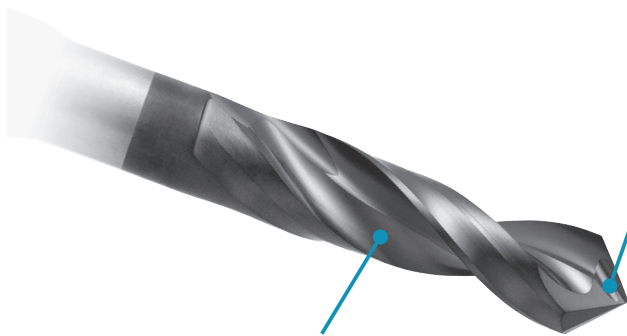


Conventional A

Cutting Conditions : $V_c = 280$ m/min, $f = 0.1$ mm/rev
Outside Dia. $\phi 10$ mm, $a_e = 10$ mm (Slotting), Dry
Workpiece Material : CFRP 4.6 mm (Thickness)

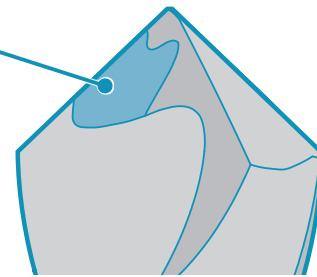
Drill

Unique Rake Face Delivers Sharpness at the top of Drill Low Cutting Force Provides Long Tool Life

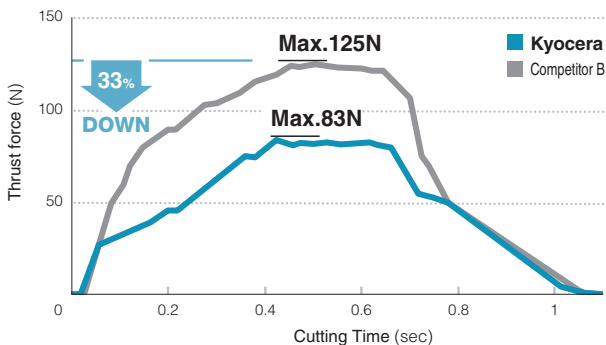


Wide flute width maintains excellent chip evacuation

Unique Rake Face



Cutting Force Comparison (Internal evaluation)

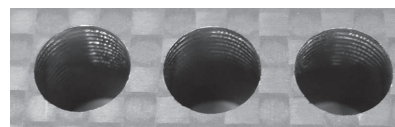


Cutting Conditions : $V_c = 100$ m/min, $f = 0.08$ mm/rev
Outside Dia. $\phi 6$ mm (Special order item), Dry
Workpiece Material : CFRP 4.6 mm (Thickness)

No. of Cutting Holes Comparison (Internal evaluation)



Surface finish



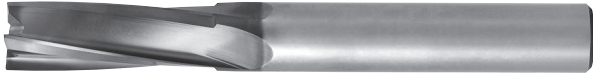
Provides high quality surface finish and long tool life

Cutting Conditions : $V_c = 100$ m/min, $f = 0.08$ mm/rev
Outside Dia. $\phi 7$ mm (Special order item), Dry
Workpiece Material : CFRP 4.6 mm (Thickness)

- Insert Grades A
- Turning Indexable Inserts B
- CNC & PC Tools C
- External D
- Small Parts Machining E
- Boring F
- Grooving G
- Cut-off H
- Threading J
- Drilling K
- Solid Tools L
- Milling M
- Tools for Turning Mill N
- Spare Parts P
- Technical Information R
- Index T

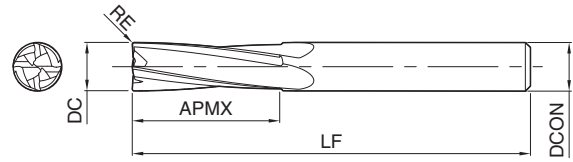
No. of Flutes : 4

4FCX-KCD **NEW**



Recommended Workpiece Materials

★ 1st Choice



Shouldering

(Unit : mm)

Description	Stock	Outside Dia.	Corner-R	Length of cut	Shank Dia.	Overall length	No. of Flutes
		DC	RE	APMX	DCON	LF	ZEFP
4FCX080-250-KCD	●	8	0.4	25	8	80	4
4FCX100-300-KCD	●	10	0.4	30	10	80	4
4FCX120-300-KCD	●	12	0.4	30	12	100	4

* Special order items such as routers are also available

- L
- Solid Tools
- End Mills
- Solid Tools for CFRP
- Routers
- Drills
- Cutting Conditions

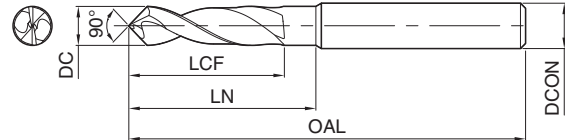
Recommended Cutting Conditions [L102](#)

● : Std. Item

2ZDF-KCD NEW



Recommended Workpiece Materials ★ 1st Choice



(Unit : mm)

Description	Stock	Outside Dia.		Flute length	Under Neck Length	Overall length	Shank Dia.
		DC (mm)	DC (inch)	LCF	LN	OAL	DCON
2ZDF04763-KCD	●	4.763	3/16	35	40	70	6
2ZDF06350-KCD	●	6.350	1/4	40	45	90	8
2ZDF07938-KCD	●	7.938	5/16	50	55	90	8

* Special ordering is available

Solid Drill Identification System

2ZDF - 04763 - KCD

(1) (2) (3)

(1) Series	(2) Outside Dia.	(3) Others
2ZDF : Drill for CFRP	04763 ↓ 4.763mm	KCD : Diamond Coating

● : Std. Item

Recommended Cutting Conditions ➔ L102

- Insert Grades **A**
- Turning Indexable Inserts **B**
- CBN & PCBN Tools **C**
- External Milling **D**
- Small Parts Machining **E**
- Boring **F**
- Grooving **G**
- Cut-off **H**
- Threading **J**
- Drilling **K**
- Solid Tools **L**
- Milling **M**
- Tools for Turning Mill **N**
- Spare Parts **P**
- Technical Information **R**
- Index **T**

29M / 25M

- Lineup 2 types of router for plastics and for CFRPs
- Longer tool life with CVD diamond coating

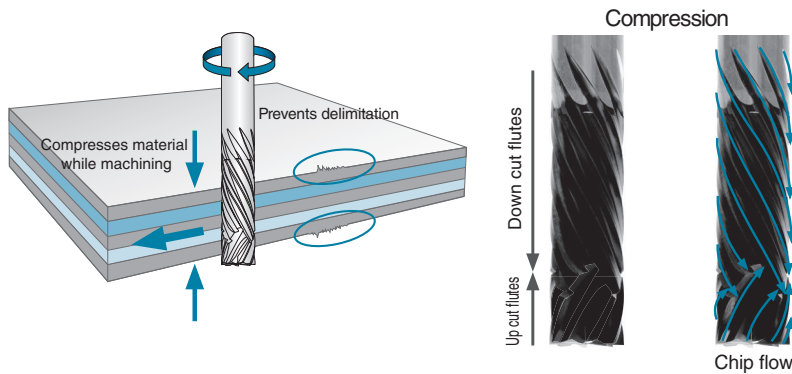


29M

For Plastics
End Mill, Drill and No-End-Cut type are available
Provides various applications

25M

For Fiber-Reinforced Plastics like CFRP
The compression end mill is designed preventing delimitation.



Solid End Mill Identification System

29M

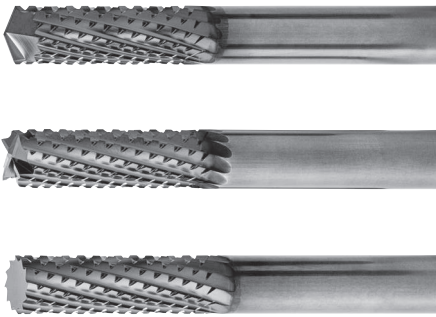
29M - E 080 - 250			
(1)	(2)	(3)	(4)
(1) Series	(2) Applications	(3) Outside Dia.	(4) Length of cut
29M	E : End Mill D : Drill N : No End Cut	080 ↓ 8.0mm	250 ↓ 25.0mm

25M

25M - 080 - 250		
(1)	(2)	(3)
(1) Series	(2) Cutting Diameter	(3) Length of cut
25M	080 ↓ 8.0mm	250 ↓ 25.0mm

No. of Flutes : 8,10,12

29M



Recommended Workpiece Materials

★ 1st Choice



Right helix angle

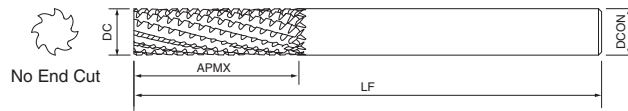


fig.1

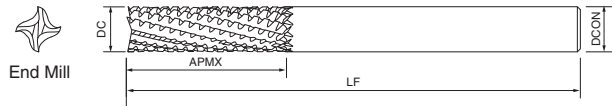


fig.2

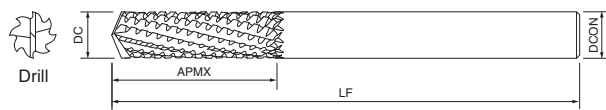


fig.3

Shouldering Slotting

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Overall length	Shank Dia.	No. of Flutes	Applications
			DC		APMX	LF				
29M-N030-120 fig.1	85080	●	3	0 -0.130	12	38	3	8	No End Cut	
29M-E030-120 fig.2	85081	●							End Mill	
29M-D030-120 fig.3	85082	●							Drill	
29M-N060-250 fig.1	85083	●	6	0 -0.130	25	63	6	10	No End Cut	
29M-E060-250 fig.2	85084	●							End Mill	
29M-D060-250 fig.3	85085	●							Drill	
29M-N080-250 fig.1	85086	●	8	0 -0.130	25	63	8	12	No End Cut	
29M-E080-250 fig.2	85087	●							End Mill	
29M-D080-250 fig.3	85088	●							Drill	
29M-N100-250 fig.1	85089	●	10	0 -0.130	25	63	10	12	No End Cut	
29M-E100-250 fig.2	85090	●							End Mill	
29M-D100-250 fig.3	85091	●							Drill	

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

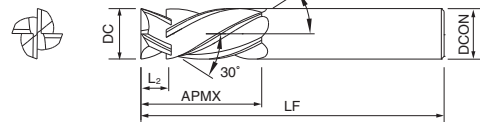
25M (Compression)

No. of Flutes : 4,6,8



Recommended Workpiece Materials

★ 1st Choice



Shouldering

(Unit : mm)

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Length of cut		Overall length	Shank Dia.	Intersect Length	No. of Flutes
			DC		APMX	LF				
25M-060-250	82991	●	6	0 -0.080	25	63	6	4.10	4	
25M-080-250	82993	●	8	0 -0.080	25	63	8	5.58	4	
25M-100-280	82995	●	10	0 -0.080	28	63	10	7.05	6	
25M-120-380	82997	●	12	0 -0.080	38	89	12	8.60	8	

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

Recommended Cutting Conditions [L103](#)

















● : Std. Item

Insert Grades
Turning
Indexable Inserts
CNC & CDD Tools
External
Small Parts
Machining
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
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Solid Drill Tool Selection Guide

Application and selection

Series	High efficiency	2 flutes 3D type	3 flutes 3D type
		IC140 	GP108M 
Shape	 	 	 
Applications	Steel / Stainless Steel / Titanium Alloy / Cast Iron / Hard Material / Non-ferrous Metals        		
No. of Flutes	2 Flutes	2 Flutes	3 Flutes
End Mill Dia.	ø3 ~ ø10	ø0.5 ~ ø12	ø3 ~ ø12
Drilling Depth	5D / 8D	3D	3D
Point angle	140°	145°	150°
Helix Angle	30°	27°	30°
Coating	AlTiN	AlTiN	AlTiN
Internal coolant	✓	-	-

Features

Large Lineup for Milling Various Applications

IC140

With Coolant hole
 High efficiency drilling for variety of workpieces
 AlTiN coating for excellent heat resistance
 Hardness : 36.2GPa
 Oxidation temperature : 1,100°C

HP131N

For Non-ferrous Metals
 Stable machining with
 3 flute design
 High hardness TiB₂ coating

2ZDK

180° flat edge ends
 Applicable to various
 applications including
 counterboring on slant surface



L

Solid Tools

End Mills

Solid Tools for CFRP

Routers

Drills

Cutting Conditions

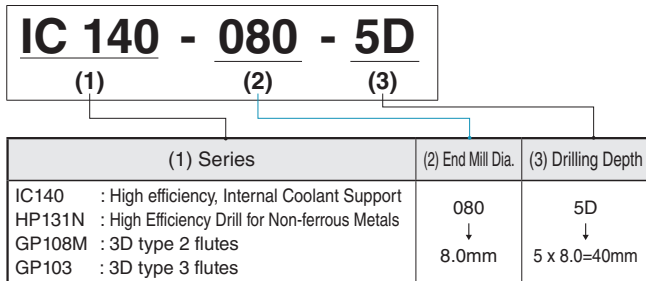
Carbide Substrate

Substrate of all solid drills is carbide.

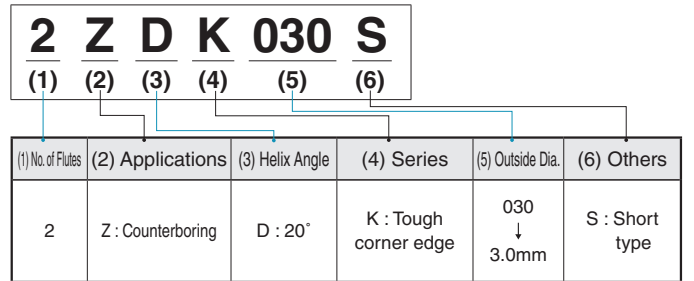
High Efficiency Drill for Non-ferrous Metals	Flat Drill (Counterboring)	CFRP
HP131N	2ZDK	2ZDF-KCD
Non-ferrous Metals 	Steel / Cast Iron / Aluminum Alloy, etc. 	CFRP, etc.
3 Flutes	2 Flutes	2 Flutes
ø3 ~ ø12	ø1 ~ ø20	4.763 ~ 7.938mm (3/16 ~ 5/16 inch)
5D	2D or less	-
124°	180° flat	90°
30°	20°	30°
TiB ₂	MEGACOAT NANO	Diamond
-	-	-

Solid Drill Identification System

IC140, GP108M, GP103, HP131N



2ZDK



Icon Glossary

Coating MEGACOAT NANO AL-TiN Coating TiB ₂ Coating Diamond Coating	Shank Dia. Tolerance h6 Shank Dia. Tolerance is h6		
Point angle Point angle 140°	Helix Angle Helix Angle 30°	Internal coolant with Coolant hole Internal Coolant Support	No. of Flutes 3 flutes design

Insert Grades
Turnable Inserts
CNC & PCO Tools
External
Small Parts
Boring
Grooving
Cut-off
Threading
Drilling
Solid Tools
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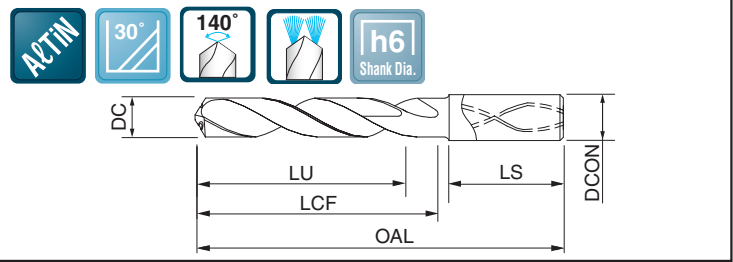
Solid Drill High efficiency

IC140 **NEW**



5D

Recommended Workpiece Materials



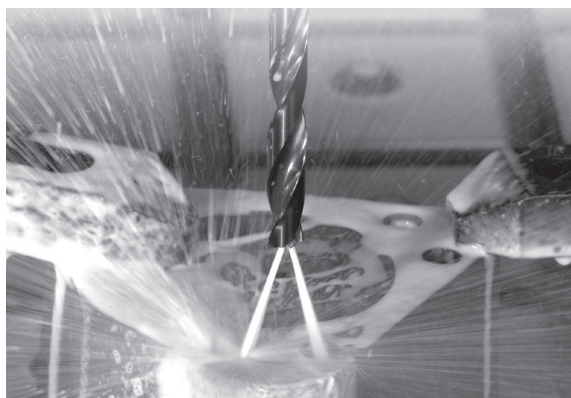
Description	*Code	Stock	Outside Dia. DC	Mill Dia. tolerance	Body Clearance Length LU	Flute length LCF	Shank length LS	Overall length OAL	Shank Dia. DCON
IC140- 030-5D	63901	●	3.0	+0.002 +0.012	23	28	36	66	6
IC140- 031-5D	63902	●	3.1	+0.004 +0.016	23	28	36	66	6
032-5D	63903	●	3.2						
033-5D	63904	●	3.3						
034-5D	63905	●	3.4						
035-5D	63906	●	3.5						
036-5D	63907	●	3.6						
037-5D	63908	●	3.7						
IC140- 038-5D	51904	●	3.8	+0.004 +0.016	29	36	36	74	6
039-5D	63909	●	3.9						
040-5D	63910	●	4.0						
041-5D	63911	●	4.1						
042-5D	63912	●	4.2						
043-5D	63913	●	4.3						
044-5D	63914	●	4.4						
045-5D	63915	●	4.5						
046-5D	63916	●	4.6						
047-5D	63917	●	4.7						
IC140- 048-5D	63918	●	4.8	+0.004 +0.016	35	44	36	82	6
049-5D	63919	●	4.9						
050-5D	63920	●	5.0						
051-5D	63900	●	5.1						
052-5D	63921	●	5.2						
053-5D	63922	●	5.3						
054-5D	63998	●	5.4						
055-5D	63923	●	5.5						
056-5D	63924	●	5.6						
057-5D	63925	●	5.7						
058-5D	63926	●	5.8						
059-5D	63927	●	5.9						
060-5D	63928	●	6.0						
IC140- 061-5D	63929	●	6.1	+0.006 +0.021	43	53	36	91	8
062-5D	63930	●	6.2						
063-5D	63931	●	6.3						
064-5D	63932	●	6.4						
065-5D	63933	●	6.5						

Description	*Code	Stock	Outside Dia. DC	Mill Dia. tolerance	Body Clearance Length LU	Flute length LCF	Shank length LS	Overall length OAL	Shank Dia. DCON
IC140- 066-5D	63934	●	6.6	+0.006 +0.021	43	53	36	91	8
067-5D	63935	●	6.7						
068-5D	63936	●	6.8						
069-5D	63999	●	6.9						
070-5D	63937	●	7.0						
071-5D	63938	●	7.1						
072-5D	63939	●	7.2						
073-5D	63940	●	7.3						
074-5D	63941	●	7.4						
075-5D	63942	●	7.5						
076-5D	63943	●	7.6						
077-5D	63944	●	7.7						
078-5D	63945	●	7.8						
079-5D	63946	●	7.9						
080-5D	63947	●	8.0						
IC140- 081-5D	63948	●	8.1	+0.006 +0.021	49	61	40	103	10
082-5D	63949	●	8.2						
083-5D	63950	●	8.3						
084-5D	63951	●	8.4						
085-5D	63952	●	8.5						
086-5D	63953	●	8.6						
087-5D	63954	●	8.7						
088-5D	63955	●	8.8						
089-5D	63956	●	8.9						
090-5D	63957	●	9.0						
091-5D	63958	●	9.1						
092-5D	63959	●	9.2						
093-5D	63960	●	9.3						
094-5D	63961	●	9.4						
095-5D	63962	●	9.5						
096-5D	63963	●	9.6						
097-5D	63964	●	9.7						
098-5D	63965	●	9.8						
099-5D	63966	●	9.9						
100-5D	63967	●	10.0						

Recommended Cutting Conditions **L104**

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

● : Std. Item



8D

Description	*Code	Stock	Outside Dia. DC	Mill Dia. tolerance	Body Clearance Length LU	Flute length LCF	Shank length LS	Overall length OAL	Shank Dia. DCON
IC140-030-8D	63575	●	3.0	+0.002 +0.012	29	34	36	72	6
IC140-031-8D	63576	●	3.1	+0.004 +0.016	29	34	36	72	6
032-8D	63577	●	3.2						
033-8D	63578	●	3.3						
034-8D	63579	●	3.4						
035-8D	63580	●	3.5						
036-8D	63581	●	3.6						
037-8D	63582	●	3.7						
IC140-038-8D	63583	●	3.8	+0.004 +0.016	36	43	36	81	6
039-8D	63584	●	3.9						
040-8D	63585	●	4.0						
041-8D	63586	●	4.1						
042-8D	63587	●	4.2						
043-8D	63588	●	4.3						
044-8D	63589	●	4.4						
045-8D	63590	●	4.5						
046-8D	63591	●	4.6						
047-8D	63592	●	4.7						
IC140-048-8D	63593	●	4.8	+0.004 +0.016	48	57	36	95	6
049-8D	63594	●	4.9						
050-8D	63595	●	5.0						
051-8D	63596	●	5.1						
052-8D	63597	●	5.2						
053-8D	63598	●	5.3						
054-8D	63599	●	5.4						
055-8D	63600	●	5.5						
056-8D	63601	●	5.6						
057-8D	63602	●	5.7						
058-8D	63603	●	5.8						
059-8D	63604	●	5.9						
060-8D	63605	●	6.0						
IC140-061-8D	63606	●	6.1	+0.006 +0.021	64	76	36	114	8
062-8D	63607	●	6.2						
063-8D	63608	●	6.3						
064-8D	63609	●	6.4						
065-8D	63610	●	6.5						

- **Coolant Hole**
Cooled cutting edge provides better tool life
- **Flute**
Optimized open fluting realized effective chip evacuation
- **AlTiN Coating**
Excellent wear resistance with AlTiN coating for excellent heat resistance
Polished edge reduces the cutting force and minimizes heat rise during machining
- **Special point geometry**
Smooth drilling with 140° point angle
High rigidity with conical relief
- **Cutting Edge**
Curved cutting edge allows efficient chip creation and control
Negative corner position strengthens and protects cutting edge

Description	*Code	Stock	Outside Dia. DC	Mill Dia. tolerance	Body Clearance Length LU	Flute length LCF	Shank length LS	Overall length OAL	Shank Dia. DCON
IC140-066-8D	63611	●	6.6	+0.006 +0.021	64	76	36	114	8
067-8D	63612	●	6.7						
068-8D	63613	●	6.8						
069-8D	63614	●	6.9						
070-8D	63615	●	7.0						
071-8D	63616	●	7.1						
072-8D	63617	●	7.2						
073-8D	63618	●	7.3						
074-8D	63619	●	7.4						
075-8D	63620	●	7.5						
076-8D	63621	●	7.6						
077-8D	63622	●	7.7						
078-8D	63623	●	7.8						
079-8D	63624	●	7.9						
080-8D	63625	●	8.0						
IC140-081-8D	63626	●	8.1						
082-8D	63627	●	8.2						
083-8D	63628	●	8.3						
084-8D	63629	●	8.4						
085-8D	63630	●	8.5						
086-8D	63631	●	8.6						
087-8D	63632	●	8.7						
088-8D	63633	●	8.8						
089-8D	63634	●	8.9						
090-8D	63635	●	9.0						
091-8D	63636	●	9.1						
092-8D	63637	●	9.2						
093-8D	63638	●	9.3						
094-8D	63639	●	9.4						
095-8D	63640	●	9.5						
096-8D	63641	●	9.6						
097-8D	63642	●	9.7						
098-8D	63643	●	9.8						
099-8D	63644	●	9.9						
100-8D	63645	●	10.0						

Recommended Cutting Conditions **L105**

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

● : Std. Item

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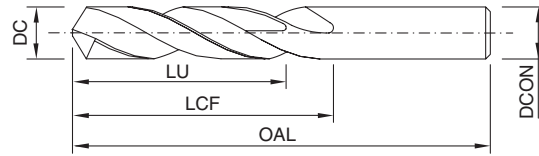
Solid Drill 2 Flutes

GP108M **NEW**



3D

Recommended Workpiece Materials



Description	*Code	Stock	Outside Dia. (Shank Dia.)	Mill Dia. tolerance	Body Clearance Length		Overall length				
			DC=DCON		LU	LCF		OAL			
GP108M-005-3D	68643	●	0.5	$0_{-0.010}$	2.1	3	20				
GP108M-006-3D	68645	●	0.6	$0_{-0.010}$	2.5	3.5	21				
GP108M-007-3D	68647	●	0.7	$0_{-0.010}$	3.2	4.5	23				
GP108M-008-3D	68649	●	0.8	$0_{-0.010}$	3.6	5	24				
GP108M-009-3D	68651	●	0.9	$0_{-0.010}$	4	5.5	25				
GP108M-010-3D	68653	●	1.0	$0_{-0.010}$	4.7	6	26				
GP108M-011-3D	68655	●	1.1	$0_{-0.010}$	5.4	7	28				
GP108M-012-3D	68657	●	1.2	$0_{-0.010}$	6	8	30				
013-3D	68659	●	1.3								
GP108M-014-3D	68661	●	1.4	$0_{-0.010}$	7	9	32				
015-3D	68663	●	1.5								
GP108M-016-3D	68664	●	1.6	$0_{-0.010}$	7	10	34				
017-3D	68665	●	1.7								
GP108M-018-3D	68666	●	1.8	$0_{-0.010}$	8	11	36				
019-3D	68667	●	1.9								
GP108M-020-3D	68668	●	2.0	$0_{-0.010}$	9	12	38				
021-3D	68669	●	2.1								
GP108M-022-3D	68670	●	2.2	$0_{-0.010}$	10	13	40				
023-3D	68671	●	2.3								
GP108M-024-3D	68672	●	2.4	$0_{-0.010}$	11	14	43				
025-3D	68673	●	2.5								
026-3D	68674	●	2.6								
GP108M-027-3D	68675	●	2.7	$0_{-0.010}$	12	16	46				
028-3D	68676	●	2.8								
029-3D	68677	●	2.9								
030-3D	68678	●	3.0								
GP108M-031-3D	68679	●	3.1	$0_{-0.012}$	14	18	49				
032-3D	68680	●	3.2								
033-3D	68681	●	3.3								
GP108M-034-3D	68682	●	3.4					$0_{-0.012}$	15	20	52
035-3D	68683	●	3.5								
036-3D	68684	●	3.6								
037-3D	68685	●	3.7								
GP108M-038-3D	68686	●	3.8	$0_{-0.012}$	17	22	55				
039-3D	68687	●	3.9								
040-3D	68688	●	4.0								

Description	*Code	Stock	Outside Dia. (Shank Dia.)	Mill Dia. tolerance	Body Clearance Length		Overall length
			DC=DCON		LU	LCF	
GP108M-041-3D	68689	●	4.1	$0_{-0.012}$	17	22	55
042-3D	68690	●	4.2				
GP108M-043-3D	68691	●	4.3	$0_{-0.012}$	18	24	58
044-3D	68692	●	4.4				
045-3D	68693	●	4.5				
046-3D	68694	●	4.6				
047-3D	68695	●	4.7				
GP108M-048-3D	68696	●	4.8	$0_{-0.012}$	20	26	62
049-3D	68697	●	4.9				
050-3D	68698	●	5.0				
051-3D	68699	●	5.1				
052-3D	68700	●	5.2				
053-3D	68701	●	5.3				
GP108M-054-3D	68702	●	5.4	$0_{-0.012}$	21	28	66
055-3D	68703	●	5.5				
056-3D	68704	●	5.6				
057-3D	68705	●	5.7				
058-3D	68706	●	5.8				
059-3D	68707	●	5.9				
060-3D	68708	●	6.0				
GP108M-061-3D	68709	●	6.1	$0_{-0.015}$	23	31	70
062-3D	68710	●	6.2				
063-3D	68711	●	6.3				
064-3D	68712	●	6.4				
065-3D	68713	●	6.5				
GP108M-070-3D	68718	●	7.0	$0_{-0.015}$	25	34	74
075-3D	68723	●	7.5				
GP108M-080-3D	68728	●	8.0	$0_{-0.015}$	27	37	79
085-3D	68733	●	8.5				
GP108M-090-3D	68738	●	9.0	$0_{-0.015}$	29	40	84
095-3D	68743	●	9.5				
GP108M-100-3D	68748	●	10.0	$0_{-0.018}$	31	43	89
GP108M-105-3D	68753	●	10.5				
GP108M-110-3D	68758	●	11.0	$0_{-0.018}$	33	47	95
115-3D	68763	●	11.5				
GP108M-120-3D	68768	●	12.0	$0_{-0.018}$	35	51	102

*The code is a management number that is listed on the product.
When ordering, please refer to "Description" in the table.

Recommended Cutting Conditions **L106**

● : Std. Item

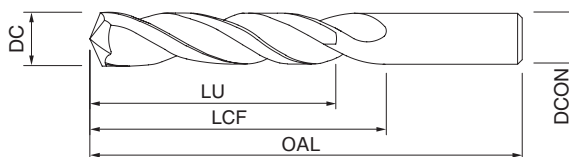
Solid Drill 3 Flutes

GP103 **NEW**



3D

Recommended Workpiece Materials



Description	*Code	Stock	Outside Dia. (Shank Dia.)	Mill Dia. tolerance	Body (Cutting) Length		Overall length
			DC=DCON		LU	LCF	
GP103-030-3D	68965	●	3.0	0 -0.013	12	16	46
GP103-031-3D	68966	●	3.1	0 -0.013	14	18	49
032-3D	68967	●	3.2				
033-3D	68968	●	3.3				
GP103-034-3D	68969	●	3.4	0 -0.013	15	20	52
035-3D	68970	●	3.5				
036-3D	68971	●	3.6				
037-3D	68972	●	3.7				
GP103-038-3D	68973	●	3.8	0 -0.013	17	22	55
039-3D	68974	●	3.9				
040-3D	68975	●	4.0				
041-3D	68976	●	4.1				
042-3D	68977	●	4.2				
GP103-043-3D	68978	●	4.3	0 -0.013	18	24	58
044-3D	68979	●	4.4				
045-3D	68980	●	4.5				
046-3D	68981	●	4.6				
047-3D	68982	●	4.7				
GP103-048-3D	68983	●	4.8	0 -0.013	20	26	62
049-3D	68984	●	4.9				
050-3D	68985	●	5.0				
051-3D	68986	●	5.1				
052-3D	68987	●	5.2				
053-3D	68988	●	5.3				
GP103-054-3D	68989	●	5.4	0 -0.013	21	28	66
055-3D	68990	●	5.5				
056-3D	68991	●	5.6				
057-3D	68992	●	5.7				
058-3D	68993	●	5.8				
059-3D	68994	●	5.9				
060-3D	68995	●	6.0				
GP103-061-3D	68996	●	6.1	0 -0.013	23	31	70
062-3D	68997	●	6.2				
063-3D	68998	●	6.3				
064-3D	68999	●	6.4				
065-3D	69000	●	6.5				
066-3D	69001	●	6.6				
067-3D	69002	●	6.7				

Description	*Code	Stock	Outside Dia. (Shank Dia.)	Mill Dia. tolerance	Body (Cutting) Length		Overall length
			DC=DCON		LU	LCF	
GP103-068-3D	69003	●	6.8	0 -0.013	25	34	74
069-3D	69004	●	6.9				
070-3D	69005	●	7.0				
071-3D	69006	●	7.1				
072-3D	69007	●	7.2				
073-3D	69008	●	7.3				
074-3D	69009	●	7.4				
075-3D	69010	●	7.5				
GP103-076-3D	69011	●	7.6				
077-3D	69012	●	7.7				
078-3D	69013	●	7.8	0 -0.013	27	37	79
079-3D	69014	●	7.9				
080-3D	69015	●	8.0				
081-3D	69016	●	8.1				
082-3D	69017	●	8.2				
083-3D	69018	●	8.3				
084-3D	69019	●	8.4				
085-3D	69020	●	8.5				
GP103-086-3D	69021	●	8.6				
087-3D	69022	●	8.7				
088-3D	69023	●	8.8	0 -0.013	29	40	84
089-3D	69024	●	8.9				
090-3D	69025	●	9.0				
091-3D	69026	●	9.1				
092-3D	69027	●	9.2				
093-3D	69028	●	9.3				
094-3D	69029	●	9.4				
095-3D	69030	●	9.5				
GP103-096-3D	69031	●	9.6				
097-3D	69032	●	9.7				
098-3D	69033	●	9.8	0 -0.013	31	43	89
099-3D	69034	●	9.9				
100-3D	69035	●	10.0				
105-3D	69039	●	10.5				
GP103-110-3D	69042	●	11.0				
115-3D	69043	●	11.5	0 -0.013	33	47	95
GP103-120-3D	69044	●	12.0				

Recommended Cutting Conditions **L107**

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

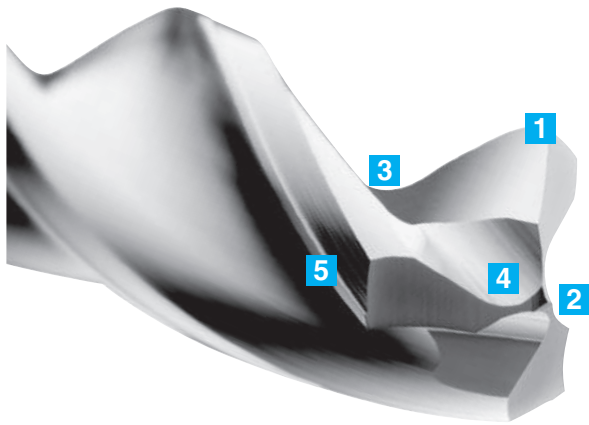
- High efficiency with 3 flutes, AlTiN coating
- Suitable for guide hole drilling with 150° point angle

● : Std. Item

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HP131N



1 3 flutes design

Improved machining stability compared to 2 flute designs
Superior surface finish, roundness, hole cylindricity and unsurpassed hole size control
Superior hole straightness when machining cast punching hole

2 Sharp Chisel Edge

Reduces thrust force. Stabilizes the drill upon contact with the workpiece
High self-centering performance with excellent centripetal property

3 Open flute structure

Efficiently evacuates chips at high feed rates

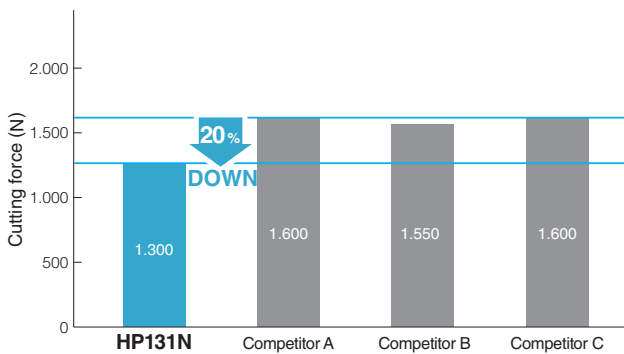
4 Deep Web Thinning

Smooth chip evacuation and low cutting force

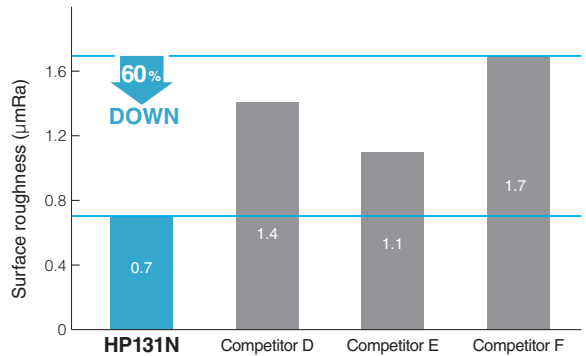
5 Small margin width

Reduces frictional heat and suppresses wear

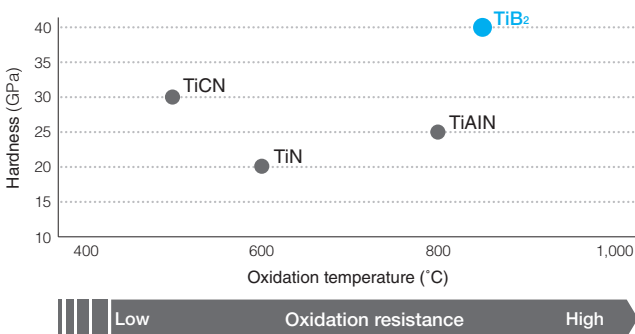
● Cutting Force Comparison (Internal evaluation)



● Surface Finish Comparison (Internal evaluation)



● Properties of Coating



TiB₂ : Coating for Non-ferrous Metals

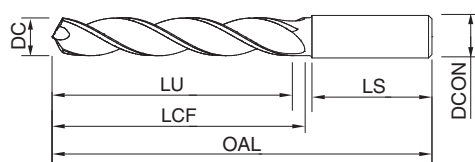
- Superior wear resistance with high toughness and high hardness
Hardness : 39.2GPa
Oxidation temperature : 850°C
- Smooth surface finish by suppressing welding and edge build-up in machining of aluminum alloys and copper alloys.

HP131N NEW



5D

Recommended Workpiece Materials



Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Flute Length	Flute Length	Shank length	Overall length	Shank Dia.
			DC		LU				
HP131N-030-5D	64800	●	3.0	0.002 0.012	23	28	36	66	6
HP131N-031-5D	64801	●	3.1	+0.004 +0.016	23	28	36	66	6
032-5D	64802	●	3.2						
033-5D	64803	●	3.3						
034-5D	64804	●	3.4						
035-5D	64805	●	3.5						
036-5D	64806	●	3.6						
037-5D	64807	●	3.7						
HP131N-038-5D	64808	●	3.8	+0.004 +0.016	29	36	36	74	6
039-5D	64809	●	3.9						
040-5D	64810	●	4.0						
041-5D	64811	●	4.1						
042-5D	64812	●	4.2						
043-5D	64813	●	4.3						
044-5D	64814	●	4.4						
045-5D	64815	●	4.5						
046-5D	64816	●	4.6						
047-5D	64817	●	4.7						
HP131N-048-5D	64818	●	4.8	+0.004 +0.016	35	44	36	82	6
049-5D	64819	●	4.9						
050-5D	64820	●	5.0						
051-5D	64821	●	5.1						
052-5D	64822	●	5.2						
053-5D	64823	●	5.3						
054-5D	64824	●	5.4						
055-5D	64825	●	5.5						
056-5D	64826	●	5.6						
057-5D	64827	●	5.7						
058-5D	64828	●	5.8						
059-5D	64829	●	5.9						
060-5D	64830	●	6.0						
HP131N-061-5D	64831	●	6.1	+0.006 +0.021	43	53	36	91	8
062-5D	64832	●	6.2						
063-5D	64833	●	6.3						
064-5D	64834	●	6.4						
065-5D	64835	●	6.5						
066-5D	64836	●	6.6						
067-5D	64837	●	6.7						

Description	*Code	Stock	Outside Dia.	Mill Dia. tolerance	Flute Length	Flute Length	Shank length	Overall length	Shank Dia.
			DC		LU				
HP131N-068-5D	64838	●	6.8	+0.006 +0.021	43	53	36	91	8
069-5D	64839	●	6.9						
070-5D	64840	●	7.0						
071-5D	64841	●	7.1						
072-5D	64842	●	7.2						
073-5D	64843	●	7.3						
074-5D	64844	●	7.4						
075-5D	64845	●	7.5						
076-5D	64846	●	7.6						
077-5D	64847	●	7.7						
078-5D	64848	●	7.8						
079-5D	64849	●	7.9						
080-5D	64850	●	8.0						
HP131N-081-5D	64851	●	8.1	+0.006 +0.021	49	61	40	103	10
082-5D	64852	●	8.2						
083-5D	64853	●	8.3						
084-5D	64854	●	8.4						
085-5D	64855	●	8.5						
086-5D	64856	●	8.6						
087-5D	64857	●	8.7						
088-5D	64858	●	8.8						
089-5D	64859	●	8.9						
090-5D	64860	●	9.0						
091-5D	64861	●	9.1						
092-5D	64862	●	9.2						
093-5D	64863	●	9.3						
094-5D	64864	●	9.4						
095-5D	64865	●	9.5						
096-5D	64866	●	9.6						
097-5D	64867	●	9.7						
098-5D	64868	●	9.8						
099-5D	64869	●	9.9						
100-5D	64870	●	10.0						
HP131N-105-5D	64875	●	10.5	+0.007 +0.025	56	71	45	118	12
110-5D	64880	●	11.0						
115-5D	64885	●	11.5						
120-5D	64890	●	12.0						

Recommended Cutting Conditions ● L107

*The code is a management number that is listed on the product. When ordering, please refer to "Description" in the table.

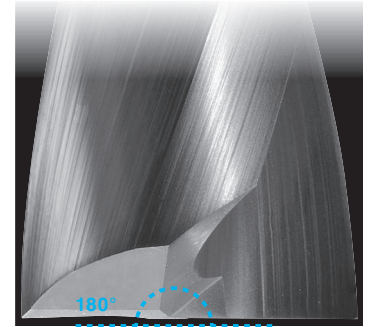
● : Std. Item

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2ZDK

Edge ends have 180° flat and are applicable to various applications.

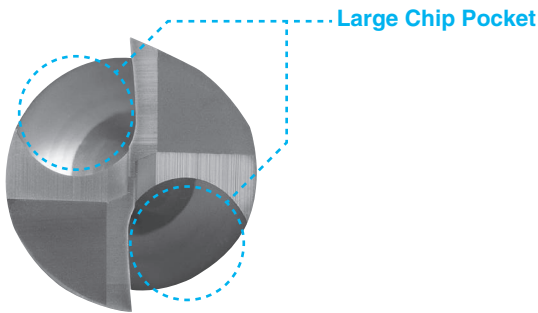
Available for high-precision counterboring. Optimum tool for improvement and cost reduction of difficult machining processes.



Flat Bottom

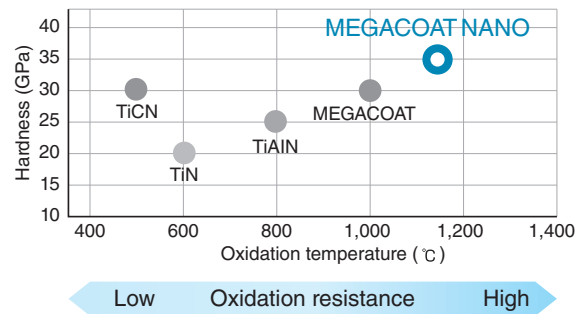
● Smooth Chip Evacuation

- Combination of smooth chip control and high rigidity with the special flute design



● Long Tool Life with "MEGACOAT NANO"

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

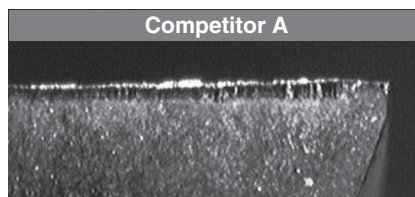
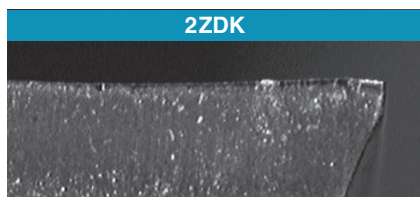


■ Tool Life Comparison (S45C, 200 holes)

(Internal evaluation)

Stable Machining with Minimum Wear

● Wear Comparison of Bottom Edge

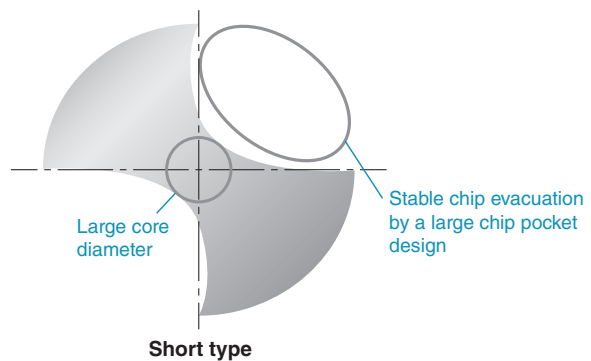


Cutting Conditions :
 n=3,000min⁻¹
 Vf=420mm/min
 Drilling Depth =12mm (1.5D)
 Wet

Short type is available

Short type is highly rigid with large core diameter

Suitable for shallow drilling 1.5D or under



Convenient plus tolerance is available for $\phi 6$ type (2ZDK060S-P)

● Usage example of plus tolerance for $\phi 6$ type

Suitable situation



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

2nd process :

Tool for 2nd process (Deep drilling) interferes machining surface of 1st process (Guide hole machining)

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

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

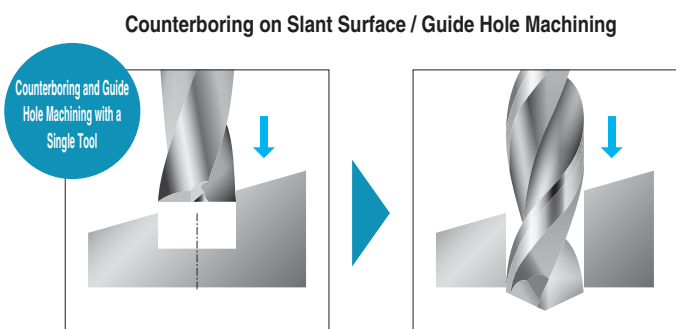
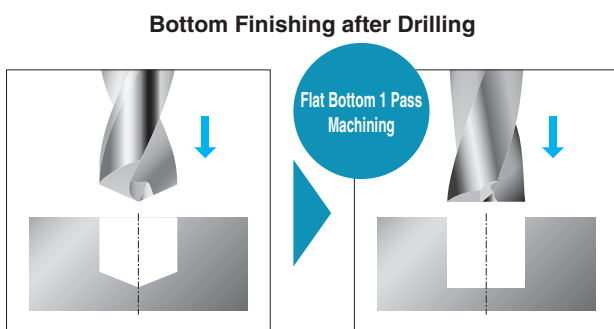
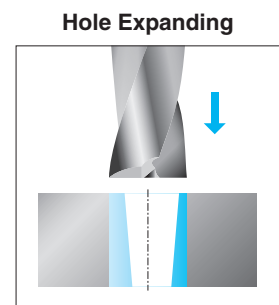
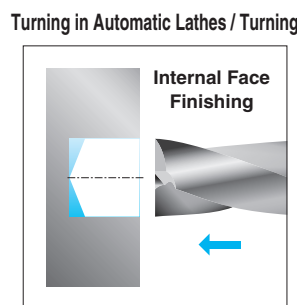
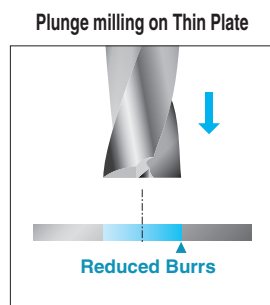
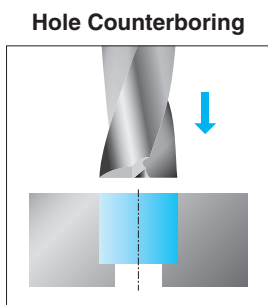
2nd process :

2ZDK060S-P

Finished surface of guide hole

No effect on next process

● Applications



Insert Grades	A
Turning	B
Indexable Inserts	C
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Flat Drill (Counterboring)

No. of Flutes : 2

2ZDK (Short type)



MEGACOAT NANO is applied

Recommended Workpiece Materials

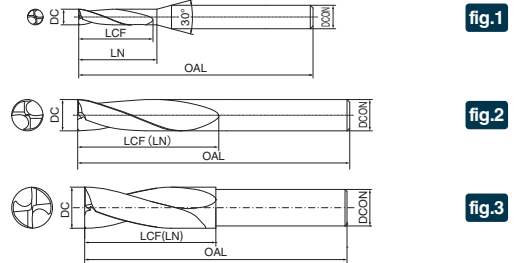
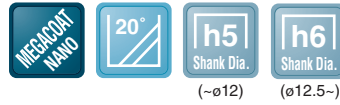


fig.1

fig.2

fig.3

Plunge milling

2ZDK (Short type)

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Flute length		Under Neck Length LN	Shank Dia. DCON	Overall length OAL
				LCF	LN			
2ZDK010S fig.1	●	1.0	0 -0.010	3	4	4	50	
2ZDK011S fig.1	MTO	1.1						
2ZDK012S fig.1	MTO	1.2						
2ZDK013S fig.1	MTO	1.3						
2ZDK014S fig.1	MTO	1.4						
2ZDK015S fig.1	●	1.5						
2ZDK016S fig.1	●	1.6						
2ZDK017S fig.1	MTO	1.7						
2ZDK018S fig.1	MTO	1.8						
2ZDK019S fig.1	MTO	1.9						
2ZDK020S fig.1	●	2.0						
2ZDK021S fig.1	MTO	2.1						
2ZDK022S fig.1	MTO	2.2						
2ZDK023S fig.1	MTO	2.3						
2ZDK024S fig.1	●	2.4						
2ZDK025S fig.1	●	2.5						
2ZDK026S fig.1	●	2.6						
2ZDK027S fig.1	●	2.7						
2ZDK028S fig.1	MTO	2.8						
2ZDK029S fig.1	●	2.9						
2ZDK030S fig.1	●	3.0						
2ZDK031S fig.1	●	3.1						
2ZDK032S fig.1	MTO	3.2						
2ZDK033S fig.1	●	3.3						
2ZDK034S fig.1	●	3.4						
2ZDK035S fig.1	●	3.5						
2ZDK036S fig.1	MTO	3.6						
2ZDK037S fig.1	●	3.7						
2ZDK038S fig.1	MTO	3.8						
2ZDK039S fig.1	MTO	3.9						
2ZDK040S fig.1	●	4.0						
2ZDK041S fig.1	●	4.1						

(Unit : mm)

Description	Stock	Outside Dia. DC	Mill Dia. tolerance	Flute length		Under Neck Length LN	Shank Dia. DCON	Overall length OAL
				LCF	LN			
2ZDK042S fig.1	●	4.2	0 -0.012	13	14	6	60	
2ZDK043S fig.1	●	4.3						
2ZDK044S fig.1	MTO	4.4						
2ZDK045S fig.1	●	4.5						
2ZDK046S fig.1	MTO	4.6						
2ZDK047S fig.1	MTO	4.7						
2ZDK048S fig.1	●	4.8						
2ZDK049S fig.1	●	4.9						
2ZDK050S fig.1	●	5.0						
2ZDK051S fig.1	●	5.1						
2ZDK052S fig.1	●	5.2						
2ZDK053S fig.1	●	5.3						
2ZDK054S fig.1	MTO	5.4						
2ZDK055S fig.1	●	5.5						
2ZDK056S fig.1	●	5.6						
2ZDK057S fig.1	MTO	5.7						
2ZDK058S fig.1	●	5.8						
2ZDK059S fig.1	MTO	5.9						
2ZDK060S fig.2	●	6.0						
2ZDK060S-P fig.1	●	6.0		+0.012 0	19			
2ZDK061S fig.1	●	6.1	0 -0.015	19	21	8	70	
2ZDK062S fig.1	●	6.2						
2ZDK063S fig.1	●	6.3						
2ZDK064S fig.1	●	6.4						
2ZDK065S fig.1	●	6.5						
2ZDK066S fig.1	●	6.6						
2ZDK067S fig.1	MTO	6.7						
2ZDK068S fig.1	●	6.8						
2ZDK069S fig.1	MTO	6.9						
2ZDK070S fig.1	●	7.0						
2ZDK071S fig.1	MTO	7.1						
2ZDK072S fig.1	MTO	7.2						

* This tool is specially designed for plunge milling and NOT recommended for slotting.
 · The drilling depth should be less than 1.5D(1.5 x DC).

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

Recommended Cutting Conditions L108

● : Std. Item
 MTO : Made to order



Plunge milling

2ZDK (Short type)

(Unit : mm)

(Unit : mm)

Description	Stock	Outside Dia.		Mill Dia. tolerance	Flute length		Under Neck Length		Shank Dia.	Overall length
		DC			LCF	LN	DCON	OAL		
2ZDK073S fig.1	●	7.3		0 -0.015	23	24	25	8	70	
2ZDK074S fig.1	MTO	7.4								
2ZDK075S fig.1	●	7.5								
2ZDK076S fig.1	MTO	7.6								
2ZDK077S fig.1	●	7.7								
2ZDK078S fig.1	●	7.8								
2ZDK079S fig.1	MTO	7.9								
2ZDK080S fig.2	●	8.0								
2ZDK081S fig.1	MTO	8.1								
2ZDK082S fig.1	●	8.2								
2ZDK083S fig.1	MTO	8.3								
2ZDK084S fig.1	MTO	8.4								
2ZDK085S fig.1	●	8.5								
2ZDK086S fig.1	MTO	8.6								
2ZDK087S fig.1	●	8.7								
2ZDK088S fig.1	●	8.8								
2ZDK089S fig.1	MTO	8.9								
2ZDK090S fig.1	●	9.0								
2ZDK091S fig.1	MTO	9.1								
2ZDK092S fig.1	MTO	9.2								
2ZDK093S fig.1	MTO	9.3								
2ZDK094S fig.1	MTO	9.4								
2ZDK095S fig.1	●	9.5								
2ZDK096S fig.1	MTO	9.6								
2ZDK097S fig.1	MTO	9.7								
2ZDK098S fig.1	●	9.8								
2ZDK099S fig.1	MTO	9.9								
2ZDK100S fig.2	●	10.0								
2ZDK101S fig.1	MTO	10.1								
2ZDK102S fig.1	MTO	10.2								
2ZDK103S fig.1	●	10.3								
2ZDK104S fig.1	MTO	10.4								

Description	Stock	Outside Dia.		Mill Dia. tolerance	Flute length		Under Neck Length		Shank Dia.	Overall length
		DC			LCF	LN	DCON	OAL		
2ZDK105S fig.1	●	10.5		0 -0.018	33	34	35	12	100	
2ZDK106S fig.1	MTO	10.6								
2ZDK107S fig.1	MTO	10.7								
2ZDK108S fig.1	MTO	10.8								
2ZDK109S fig.1	MTO	10.9								
2ZDK110S fig.1	●	11.0								
2ZDK111S fig.1	MTO	11.1								
2ZDK112S fig.1	MTO	11.2								
2ZDK113S fig.1	MTO	11.3								
2ZDK114S fig.1	MTO	11.4								
2ZDK115S fig.1	●	11.5								
2ZDK116S fig.1	MTO	11.6								
2ZDK117S fig.1	MTO	11.7								
2ZDK118S fig.1	MTO	11.8								
2ZDK119S fig.1	MTO	11.9								
2ZDK120S fig.2	●	12.0								
2ZDK125S fig.3	●	12.5								
2ZDK130S fig.3	●	13.0								
2ZDK135S fig.3	●	13.5								
2ZDK140S fig.3	●	14.0								
2ZDK145S fig.3	●	14.5								
2ZDK150S fig.3	●	15.0								
2ZDK155S fig.3	●	15.5								
2ZDK160S fig.2	●	16.0								
2ZDK165S fig.3	●	16.5								
2ZDK170S fig.3	●	17.0								
2ZDK175S fig.3	●	17.5								
2ZDK180S fig.3	●	18.0								
2ZDK185S fig.3	●	18.5								
2ZDK190S fig.3	●	19.0								
2ZDK195S fig.3	●	19.5								
2ZDK200S fig.2	●	20.0								

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

· The drilling depth should be less than 1.5D(1.5 x DC).

Recommended Cutting Conditions **L108**

● : Std. Item
MTO : Made to order

Flat Drill (Counterboring)

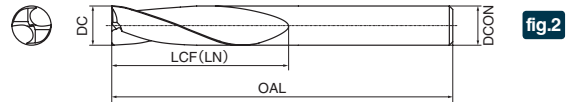
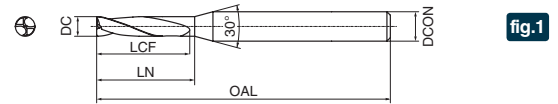
No. of Flutes : 2

2ZDK



MEGACOAT NANO is applied

Recommended Workpiece Materials



2ZDK

Plunge milling

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Flute length		Under Neck Length		Shank Dia.	Overall length
		DC		LCF	LN	DCON	OAL		
2ZDK030 fig.1	●	3.0	0 -0.010	14	15	6	60	8	70
2ZDK033 fig.1	●	3.3		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	0 -0.012	28	(28)	8	70	8	70
2ZDK065 fig.1	●	6.5		30	31				
2ZDK068 fig.1	●	6.8		31	32				

(Unit : mm)

Description	Stock	Outside Dia.	Mill Dia. tolerance	Flute length		Under Neck Length		Shank Dia.	Overall length
		DC		LCF	LN	DCON	OAL		
2ZDK070 fig.1	●	7.0	0 -0.015	32	33	8	70	8	70
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	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	0 -0.015	45	(45)	12	100	12	100
2ZDK103 fig.1	●	10.3		46	47				
2ZDK105 fig.1	●	10.5		47	48				
2ZDK110 fig.1	●	11.0		51	52				
2ZDK115 fig.1	●	11.5		53	54				
2ZDK120 fig.2	●	12.0	54	(54)					

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

· The drilling depth should be less than 2D(2 x DC).

Solid Tools

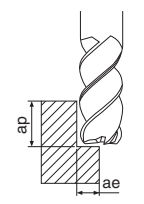
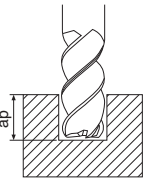
- End Mills
- Solid Tools for CFRP
- Routers
- Drills
- Cutting Conditions

Recommended Cutting Conditions L108

● : Std. Item

Recommended Cutting Conditions

2FESS

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø1	ø2	ø4	ø6	ø8	ø12	ø16
 <p>Shouldering</p> <p>Depth of Cut (ap x ae) (mm)</p> <p>1.2DC x 0.05DC (DC < ø3)</p> <p>1.2DC x 0.1DC (DC ≥ ø3)</p>  <p>Slotting</p> <p>Depth of Cut (ap) (mm)</p> <p>0.1DC (DC < ø1)</p> <p>0.3DC (ø1 ≤ DC < ø3)</p> <p>0.5DC (DC ≥ ø3)</p>	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
	Prehardened steel (30 ~ 45HRC)	Shouldering	Spindle Revolution (min ⁻¹)	17,000	8,800	4,400	3,000	2,200	1,500	1,100
			Feed Rate (mm/min)	55	80	100	105	105	110	110
		Slotting	Spindle Revolution (min ⁻¹)	16,000	8,000	4,000	2,700	2,000	1,300	990
			Feed Rate (mm/min)	35	50	60	63	63	65	65
Stainless Steel	Shouldering	Spindle Revolution (min ⁻¹)	22,000	11,000	5,600	3,700	2,800	1,900	1,400	
		Feed Rate (mm/min)	95	95	110	115	115	115	115	
	Slotting	Spindle Revolution (min ⁻¹)	16,000	8,000	4,000	2,700	2,000	1,300	990	
		Feed Rate (mm/min)	60	60	65	70	70	70	70	

* Machining with water soluble coolant is recommended for stainless steel.

2FESM

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø0.5	ø1	ø2	ø4	ø6	ø8	ø12	ø16
 <p>Shouldering</p> <p>Depth of Cut (ap x ae) (mm)</p> <p>1.5DC x 0.05DC (DC < ø3)</p> <p>1.5DC x 0.1DC (DC ≥ ø3)</p>  <p>Slotting</p> <p>Depth of Cut (ap) (mm)</p> <p>0.1DC (DC < ø1)</p> <p>0.3DC (ø1 ≤ DC < ø3)</p> <p>0.5DC (DC ≥ ø3)</p>	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
	Prehardened steel (30 ~ 45HRC)	Shouldering	Spindle Revolution (min ⁻¹)	25,000	17,000	8,800	4,400	3,000	2,200	1,500	1,100
			Feed Rate (mm/min)	50	55	80	100	105	105	110	110
		Slotting	Spindle Revolution (min ⁻¹)	25,000	16,000	8,000	4,000	2,700	2,000	1,300	990
			Feed Rate (mm/min)	30	35	50	60	63	63	65	65
Stainless Steel	Shouldering	Spindle Revolution (min ⁻¹)	27,000	22,000	11,000	5,600	3,700	2,800	1,900	1,400	
		Feed Rate (mm/min)	60	95	95	110	115	115	115	115	
	Slotting	Spindle Revolution (min ⁻¹)	25,000	16,000	8,000	4,000	2,700	2,000	1,300	990	
		Feed Rate (mm/min)	35	60	60	65	70	70	70	70	

* Machining with water soluble coolant is recommended for stainless steel.

Insert Grades
Turnings
Indexable Inserts
CNC & PCD Tools
External
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Recommended Cutting Conditions

2FESL (Shouldering)

Applications	Workpiece Material	Outside Dia. DC (mm)	ø1	ø2	ø4	ø6	ø8	ø12	ø16
<p>Shouldering</p> <p>Depth of Cut (ap x ae) (mm)</p> <p>2.5DC x 0.05DC (DC < ø3)</p> <p>2.5DC x 0.1DC (DC ≥ ø3)</p>	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
	Prehardened 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

* Machining with water soluble coolant is recommended for stainless steel.

Slotting is not recommended.

2FEKS, 2FEKM

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø3	ø4	ø6	ø8	ø10	ø12	ø16
<p>Shouldering</p> <p>Depth of Cut (ap x ae) (mm)</p> <p>1.2DC x 0.1DC</p> <p>Slotting</p> <p>Depth of Cut (ap) (mm)</p> <p>0.5DC</p>	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
	Prehardened 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	

* Machining with water soluble coolant is recommended for stainless steel.

L

Solid Tools

End Mills

Solid Tools for CFRP

Routers

Drills

Cutting Conditions

4FESM (Shouldering)

Applications	Workpiece Material	Outside Dia. DC (mm)	ø1	ø2	ø4	ø6	ø8	ø12	ø16			
<p>Shouldering</p> <table border="1"> <tr> <td>Depth of Cut (ap x ae) (mm)</td> </tr> <tr> <td>1.5DC x 0.05DC (DC < ø3)</td> </tr> <tr> <td>1.5DC x 0.1DC (DC ≥ ø3)</td> </tr> </table>	Depth of Cut (ap x ae) (mm)	1.5DC x 0.05DC (DC < ø3)	1.5DC x 0.1DC (DC ≥ ø3)	Carbon Steel, Cast Iron	Spindle Revolution (min ⁻¹)	25,500	13,000	6,600	4,400	3,300	2,200	1,700
	Depth of Cut (ap x ae) (mm)											
	1.5DC x 0.05DC (DC < ø3)											
	1.5DC x 0.1DC (DC ≥ ø3)											
	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			
	Prehardened 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			

* Machining with water soluble coolant is recommended for stainless steel.

Slotting is not recommended.

4FEKM (Tough corner edge, Shouldering)

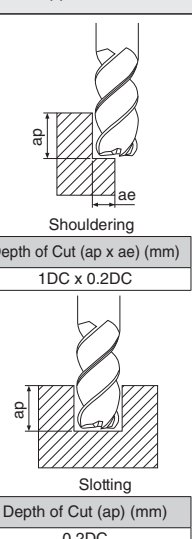
Applications	Workpiece Material	Outside Dia. DC (mm)	ø3	ø4	ø6	ø8	ø10	ø12	ø16		
<p>Shouldering</p> <table border="1"> <tr> <td>Depth of Cut (ap x ae) (mm)</td> </tr> <tr> <td>1.5DC x 0.1DC</td> </tr> </table>	Depth of Cut (ap x ae) (mm)	1.5DC x 0.1DC	Carbon Steel, Cast Iron	Spindle Revolution (min ⁻¹)	10,600	8,000	5,300	4,000	3,200	2,700	2,100
	Depth of Cut (ap x ae) (mm)										
	1.5DC x 0.1DC										
	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		
	Prehardened 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		

* Machining with water soluble coolant is recommended for stainless steel.

Slotting is not recommended.

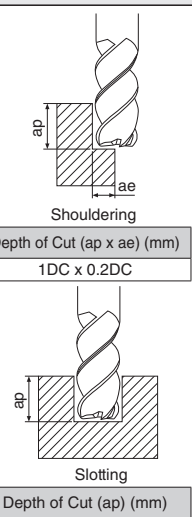
Recommended Cutting Conditions

2FESW

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø13
 <p>Shouldering Depth of Cut (ap x ae) (mm) 1DC x 0.2DC</p> <p>Slotting Depth of Cut (ap) (mm) 0.2DC</p>	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
	Prehardened 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	

* Machining with water soluble coolant is recommended for stainless steel.

3FESW

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø13
 <p>Shouldering Depth of Cut (ap x ae) (mm) 1DC x 0.2DC</p> <p>Slotting Depth of Cut (ap) (mm) 0.2DC</p>	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
	Prehardened 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	

* Machining with water soluble coolant is recommended for stainless steel.

4FESW

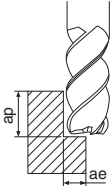
Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø13
 <p>Shouldering Depth of Cut (ap x ae) (mm) 1DC x 0.2DC</p> <p>Slotting Depth of Cut (ap) (mm) 0.2DC</p>	Carbon Steel, Cast Iron	Shouldering	Spindle Revolution (min ⁻¹)	11,000	8,000	6,400	5,300	4,000	3,200	2,700	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
	Prehardened 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	

* Machining with water soluble coolant is recommended for stainless steel.

Solid Tools

End Mills
Solid Tools for CFRP
Routers
Drills
Cutting Conditions

66M, 66MCR

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p>	Carbon Steel	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	10,300	7,700	6,200	5,100	3,800	3,100	2,500
				Feed Rate (mm/min)	2,070	2,530	2,530	3,320	3,280	3,430	2,840
		2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	12,300	9,200	7,400	6,200	4,600	3,700	3,000	
			Feed Rate (mm/min)	1,990	2,430	2,430	3,190	3,150	3,290	2,730	
	Alloy Steel	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	5,800	4,400	3,500	2,900	2,200	1,700	1,400
				Feed Rate (mm/min)	880	1,110	1,110	1,450	1,460	1,540	1,230
		2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	7,000	5,200	4,200	3,500	2,600	2,100	1,700	
			Feed Rate (mm/min)	840	1,060	1,060	1,390	1,400	1,470	1,180	
	Prehardened steel ≤ 40HRC	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	4,700	3,500	2,800	2,300	1,800	1,400	1,100
				Feed Rate (mm/min)	470	630	630	810	810	870	680
		2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	5,600	4,200	3,400	2,800	2,100	1,700	1,300	
			Feed Rate (mm/min)	450	610	610	780	780	830	650	
	Stainless Steel SUS303 SUS416	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	9,000	6,800	5,400	4,500	3,400	2,700	2,200
				Feed Rate (mm/min)	1,370	1,720	1,720	2,250	2,270	2,390	1,910
		2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	7,200	5,400	4,300	3,600	2,700	2,200	1,700	
			Feed Rate (mm/min)	880	1,100	1,100	1,440	1,450	1,530	1,220	
	Stainless Steel SUS304 SUS316	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	6,200	4,700	3,700	3,100	2,300	1,900	1,500
				Feed Rate (mm/min)	730	980	980	1,210	1,240	1,310	1,070
		2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	7,500	5,600	4,500	3,700	2,800	2,200	1,800	
			Feed Rate (mm/min)	700	940	940	1,160	1,190	1,260	1,030	
	Stainless Steel 13-8PH, 15-5PH	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	5,700	4,300	3,400	2,900	2,200	1,700	1,400
				Feed Rate (mm/min)	670	900	900	1,120	1,140	1,210	980
		2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	6,900	5,200	4,100	3,400	2,600	2,100	1,700	
			Feed Rate (mm/min)	650	860	860	1,070	1,090	1,160	950	
Titanium Alloys Ti-6Al-4V	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	6,300	4,700	3,800	3,200	2,400	1,900	1,500	
			Feed Rate (mm/min)	850	1,060	1,060	1,430	1,420	1,500	1,210	
	2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	7,600	5,700	4,500	3,800	2,800	2,300	1,800		
		Feed Rate (mm/min)	810	1,020	1,020	1,370	1,360	1,440	1,160		
Titanium Alloys Ti-10Al-Fe-3Al	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	2,300	1,700	1,400	1,100	800	700	500	
			Feed Rate (mm/min)	300	380	380	510	510	540	430	
	2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	2,700	2,000	1,600	1,400	1,000	800	700		
		Feed Rate (mm/min)	290	370	370	490	490	520	420		
Superalloy Inconel® 625	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	1,700	1,300	1,000	800	600	500	400	
			Feed Rate (mm/min)	200	270	210	330	340	360	290	
	2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	2,000	1,500	1,200	1,000	800	600	500		
		Feed Rate (mm/min)	190	260	260	320	320	340	280		
Superalloy Inconel® 718	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	1,400	1,000	800	700	500	400	300	
			Feed Rate (mm/min)	120	140	140	160	170	180	150	
	2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	1,600	1,200	1,000	800	600	500	400		
		Feed Rate (mm/min)	110	130	130	160	160	170	140		
Cast Iron ≤19HRC	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	11,400	8,500	6,800	5,700	4,300	3,400	2,700	
			Feed Rate (mm/min)	2,300	2,810	2,810	3,690	3,640	3,810	3,160	
	2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	13,700	10,300	8,200	6,800	5,100	4,100	3,300		
		Feed Rate (mm/min)	2,200	2,700	2,690	3,540	3,500	3,660	3,030		
Cast Iron ≤ 26HRC	Shouldering	1DC x 0.05DC	Spindle Revolution (min ⁻¹)	8,700	6,500	5,200	4,400	3,300	2,600	2,100	
			Feed Rate (mm/min)	1,320	1,660	1,660	2,170	2,190	2,300	1,840	
	2DC x 0.02DC (Finishing)	Spindle Revolution (min ⁻¹)	10,500	7,900	6,300	5,200	3,900	3,100	2,500		
		Feed Rate (mm/min)	1,270	1,600	1,600	2,080	2,100	2,210	1,770		

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* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

Slotting is not recommended.

Recommended Cutting Conditions

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

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16
<p>Shouldering</p>	Carbon Steel	Shouldering	Short 1.2DC x 0.15DC Medium 1.5DC x 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
	Alloy Steel	Shouldering	Short 1.2DC x 0.1DC Medium 1.5DC x 0.1DC	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
	Prehardened steel (30 ~ 45HRC)	Shouldering	Short 1.2DC x 0.07DC Medium 1.5DC x 0.07DC	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
Stainless Steel Titanium Alloys	Shouldering	Short 1.2DC x 0.1DC Medium 1.5DC x 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)	8,700	6,800	5,500	4,600	3,500	2,800	2,300	1,700	
<p>Slotting</p>	Carbon Steel	Slotting	ap ≤ 1DC	Spindle Revolution (min ⁻¹)	670	730	790	840	900	810	770	630
				Feed Rate (mm/min)	6,700	5,800	4,800	4,000	3,000	2,300	1,900	1,400
	Alloy Steel	Slotting	ap ≤ 1DC	Spindle Revolution (min ⁻¹)	320	330	360	370	400	420	380	300
				Feed Rate (mm/min)	8,700	7,000	6,000	5,200	4,000	3,000	2,500	1,700
	Prehardened steel (30 ~ 45HRC)	Slotting	ap ≤ 1DC	Spindle Revolution (min ⁻¹)	6,800	6,000	5,100	4,300	3,400	2,600	2,000	1,400
				Feed Rate (mm/min)	190	220	240	250	250	240	230	190
Stainless Steel Titanium Alloys	Slotting	ap ≤ 0.3DC	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	

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

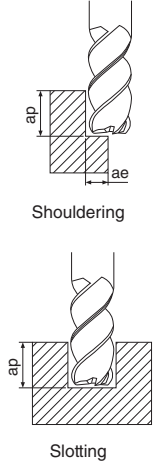
4MFK (Long)

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16
<p>Shouldering</p>	Carbon Steel	Shouldering	3DC x 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	3DC x 0.02DC	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
	Prehardened steel (30 ~ 45HRC)	Shouldering	3DC x 0.02DC	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 Titanium Alloys	Shouldering	3DC x 0.02DC	Spindle Revolution (min ⁻¹)	4,300	3,500	3,000	2,600	2,000	1,500	1,300	900
				Feed Rate (mm/min)	330	360	390	410	420	380	350	260

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

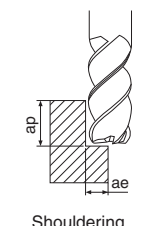
Slotting is not recommended.

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

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p> <p>Slotting</p>	Carbon Steel, Cast Iron	Shouldering	1.5DC x 0.2DC	Spindle Revolution (min ⁻¹)	13,800	10,300	8,300	6,900	5,200	4,100	3,400	2,600	2,100
				Feed Rate (mm/min)	1,490	1,570	1,590	1,660	1,630	1,490	1,410	1,240	1,080
		Slotting	DC ≤ ø12 : ap ≤ 1.0DC DC > ø12 : ap ≤ 12	Spindle Revolution (min ⁻¹)	11,100	8,400	6,700	5,600	4,200	3,300	2,800	2,100	1,700
				Feed Rate (mm/min)	770	790	790	800	750	690	600	540	410
	Alloy Steel	Shouldering	1.5DC x 0.2DC	Spindle Revolution (min ⁻¹)	10,600	8,000	6,400	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	900	1,020	1,020	1,020	920	870	800	720	640
		Slotting	DC ≤ ø12 : ap ≤ 1.0DC DC > ø12 : ap ≤ 12	Spindle Revolution (min ⁻¹)	8,500	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300
				Feed Rate (mm/min)	540	530	550	590	570	530	500	450	410
	Prehardened steel (30 ~ 45HRC)	Shouldering	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	9,500	7,200	5,700	4,800	3,600	2,900	2,400	1,800	1,400
				Feed Rate (mm/min)	690	760	810	850	830	800	770	640	590
		Slotting	ap ≤ 0.5 x DC	Spindle Revolution (min ⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	480	540	570	600	550	490	460	380	340
Stainless Steel	Shouldering	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	9,500	7,200	5,700	4,800	3,600	2,900	2,400	1,800	1,400	
			Feed Rate (mm/min)	690	760	810	850	830	800	770	640	590	
	Slotting	ap ≤ 0.5 x DC	Spindle Revolution (min ⁻¹)	5,500	4,200	3,800	3,500	2,800	2,200	1,900	1,400	1,100	
			Feed Rate (mm/min)	120	130	180	360	420	370	340	280	250	
Titanium Alloys	Shouldering	1.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	8,500	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	
			Feed Rate (mm/min)	500	520	520	640	700	730	670	560	450	
	Slotting	DC ≤ ø12 : ap ≤ 1.0DC DC > ø12 : ap ≤ 12	Spindle Revolution (min ⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,900	1,400	1,100	
			Feed Rate (mm/min)	290	330	330	350	370	410	380	290	230	
Superalloy	Shouldering	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	4,200	3,200	2,500	2,100	1,600	1,300	1,100	800	640	
			Feed Rate (mm/min)	250	250	250	250	240	230	220	210	200	
	Slotting	ap ≤ 0.3 x DC	Spindle Revolution (min ⁻¹)	3,000	2,200	1,800	1,500	1,100	900	700	600	400	
			Feed Rate (mm/min)	90	100	100	100	110	130	120	90	70	

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

4TFK (Long)

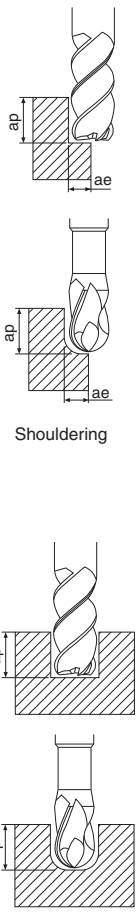
Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p>	Carbon Steel, Cast Iron	Shouldering	2.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	11,000	8,200	6,600	5,500	4,200	3,300	2,700	2,100	1,700
				Feed Rate (mm/min)	970	1,020	1,030	1,080	1,060	970	920	810	700
	Alloy Steel	Shouldering	2.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	6,000	4,600	3,600	3,000	2,300	1,800	1,500	1,100	910
				Feed Rate (mm/min)	490	550	550	550	500	470	430	390	350
	Prehardened steel (30 ~ 45HRC)	Shouldering	2.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	6,000	4,600	3,600	3,000	2,300	1,800	1,500	1,100	910
				Feed Rate (mm/min)	490	550	550	550	500	470	430	390	350
	Stainless Steel	Shouldering	2.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	4,800	3,600	2,900	2,400	1,800	1,500	1,200	900	700
				Feed Rate (mm/min)	350	380	410	430	420	400	390	320	300
	Titanium Alloys	Shouldering	2.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	4,300	3,200	2,600	2,100	1,600	1,300	1,100	800	700
				Feed Rate (mm/min)	250	260	260	320	350	370	340	280	230
	Superalloy	Shouldering	2.5DC x 0.02DC	Spindle Revolution (min ⁻¹)	2,100	1,600	1,300	1,100	800	650	550	400	320
				Feed Rate (mm/min)	125	125	125	125	120	115	110	105	100

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

Slotting is not recommended.

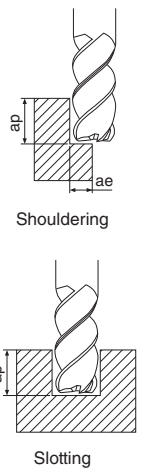
Recommended Cutting Conditions

Z1M, Z1MB

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia.DC (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p> <p>Slotting</p>	Carbon Steel	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	17,900	9,000	6,700	5,400	4,500	3,400	2,700	2,200
				Feed Rate (mm/min)	650	860	1,090	1,090	1,080	1,070	930	750
		Slotting	1DC	Spindle Revolution (min ⁻¹)	14,200	7,100	5,300	4,300	3,600	2,700	2,100	1,700
				Feed Rate (mm/min)	520	680	870	860	850	850	740	600
	Alloy Steel	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	10,200	5,100	3,800	3,100	2,500	1,900	1,500	1,200
				Feed Rate (mm/min)	270	390	460	460	460	470	410	330
		Slotting	1DC	Spindle Revolution (min ⁻¹)	8,100	4,000	3,000	2,400	2,000	1,500	1,200	1,000
				Feed Rate (mm/min)	220	310	360	360	370	370	320	260
	Prehardened steel ≤ 40HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	6,000	3,000	2,200	1,800	1,500	1,100	900	700
				Feed Rate (mm/min)	120	140	190	190	190	180	160	130
		Slotting	1DC	Spindle Revolution (min ⁻¹)	4,700	2,300	1,800	1,400	1,200	900	700	600
				Feed Rate (mm/min)	90	110	150	150	150	140	130	100
	Stainless Steel SUS303 SUS416	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	15,800	7,900	5,900	4,800	4,000	3,000	2,400	1,900
				Feed Rate (mm/min)	460	530	710	710	680	700	610	480
		Slotting	1DC	Spindle Revolution (min ⁻¹)	12,600	6,300	4,700	3,800	3,200	2,400	1,900	1,500
				Feed Rate (mm/min)	360	420	570	570	540	560	480	380
	Stainless Steel SUS304 SUS316	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	11,000	5,500	4,100	3,300	2,700	2,100	1,600	1,300
				Feed Rate (mm/min)	210	320	390	390	370	380	330	260
		Slotting	1DC	Spindle Revolution (min ⁻¹)	8,700	4,400	3,300	2,600	2,200	1,600	1,300	1,000
				Feed Rate (mm/min)	170	250	310	310	290	300	270	210
	Stainless Steel 13-8PH, 15-5PH	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	10,000	5,000	3,800	3,000	2,500	1,900	1,500	1,200
				Feed Rate (mm/min)	190	290	350	350	340	350	310	240
		Slotting	1DC	Spindle Revolution (min ⁻¹)	8,100	4,000	3,000	2,400	2,000	1,500	1,200	1,000
				Feed Rate (mm/min)	160	230	280	280	270	280	250	190
Titanium Alloys Ti-6Al-4V	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	6,900	3,500	2,600	2,100	1,700	1,300	1,000	800	
			Feed Rate (mm/min)	130	170	220	220	220	210	190	150	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	5,500	2,700	2,100	1,600	1,400	1,000	800	700	
			Feed Rate (mm/min)	110	130	180	180	170	170	150	120	
Titanium Alloys Ti-10Alz-Fe-3Al	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	2,400	1,200	900	700	600	500	400	300	
			Feed Rate (mm/min)	50	60	80	80	80	70	70	50	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	1,900	1,000	700	600	500	400	300	200	
			Feed Rate (mm/min)	40	50	60	60	60	60	50	40	
Superalloy Inconel® 625	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	2,600	1,300	1,000	800	600	500	400	300	
			Feed Rate (mm/min)	60	50	70	50	60	70	60	50	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	2,100	1,100	800	600	500	400	300	300	
			Feed Rate (mm/min)	40	40	50	50	50	50	50	40	
Superalloy Inconel® 718	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	2,000	1,000	800	600	500	400	300	200	
			Feed Rate (mm/min)	20	30	30	30	30	30	30	20	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	1,600	800	600	500	400	300	200	200	
			Feed Rate (mm/min)	20	20	30	30	30	20	20	20	
Cast Iron ≤ 19HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	14,400	7,200	5,400	4,300	3,600	2,700	2,200	1,700	
			Feed Rate (mm/min)	480	690	830	830	830	830	710	590	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	11,500	5,700	4,300	3,400	2,900	2,200	1,700	1,400	
			Feed Rate (mm/min)	390	550	660	660	660	660	570	470	
Cast Iron ≤ 26HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	11,000	5,500	4,100	3,300	2,700	2,100	1,600	1,300	
			Feed Rate (mm/min)	320	370	490	490	480	490	420	330	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	8,700	4,400	3,300	2,600	2,200	1,600	1,300	1,000	
			Feed Rate (mm/min)	250	290	390	390	380	390	340	260	

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

Z1MPCR, Z1MPLC

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia.DC (mm)	ø1	ø3	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p> <p>Slotting</p>	Carbon Steel	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	53,800	17,900	9,000	6,700	5,400	4,500	3,400	2,700
				Feed Rate (mm/min)	650	780	1,040	1,320	1,310	1,330	1,170	1,070
	Alloy Steel	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	30,500	10,200	5,100	3,800	3,100	2,500	1,900	1,500
				Feed Rate (mm/min)	280	330	450	550	550	560	510	460
	Prehardened steel ≤ 40HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	17,900	6,000	3,000	2,200	1,800	1,500	1,100	900
				Feed Rate (mm/min)	130	160	200	270	270	260	230	210
	Stainless Steel SUS303 SUS416	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	47,500	15,800	7,900	5,900	4,800	4,000	3,000	2,400
				Feed Rate (mm/min)	440	510	700	860	860	870	800	710
	Stainless Steel SUS304 SUS316	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	33,000	11,000	5,500	4,100	3,300	2,700	2,100	1,600
				Feed Rate (mm/min)	240	280	370	490	490	470	420	390
	Stainless Steel 13-8PH, 15-5PH	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	30,100	10,000	5,000	3,800	3,000	2,500	1,900	1,500
				Feed Rate (mm/min)	220	260	340	450	450	430	380	360
	Titanium Alloys Ti-6Al-4V	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	20,800	6,900	3,500	2,600	2,100	1,700	1,300	1,000
				Feed Rate (mm/min)	170	200	260	330	330	330	290	270
	Titanium Alloys Ti-10Al ₂ -Fe-3Al	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	7,300	2,400	1,200	900	700	600	500	400
				Feed Rate (mm/min)	60	70	90	120	120	120	100	90
	Superalloy Inconel® 625	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	7,800	2,600	1,300	1,000	800	600	500	400
				Feed Rate (mm/min)	60	60	80	110	110	110	90	80
	Superalloy Inconel® 718	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	6,000	2,000	1,000	800	600	500	400	300
				Feed Rate (mm/min)	30	30	40	60	60	60	50	40
	Cast Iron ≤ 19HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	43,100	14,400	7,200	5,400	4,300	3,600	2,700	2,200
				Feed Rate (mm/min)	480	570	750	970	970	960	850	790
	Cast Iron ≤ 26HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	33,000	11,000	5,500	4,100	3,300	2,700	2,100	1,600
				Feed Rate (mm/min)	260	330	440	560	570	550	490	440
	Slotting	1DC	Spindle Revolution (min ⁻¹)	42,700	14,200	7,100	5,300	4,300	3,600	2,700	2,100	
			Feed Rate (mm/min)	510	620	830	1,050	1,040	1,050	930	850	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	24,200	8,100	4,000	3,000	2,400	2,000	1,500	1,200	
			Feed Rate (mm/min)	220	260	360	440	440	440	410	360	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	14,100	4,700	2,300	1,800	1,400	1,200	900	700	
			Feed Rate (mm/min)	100	120	160	210	210	200	180	170	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	37,800	12,600	6,300	4,700	3,800	3,200	2,400	1,900	
			Feed Rate (mm/min)	350	410	560	680	680	690	630	570	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	26,200	8,700	4,400	3,300	2,600	2,200	1,600	1,300	
			Feed Rate (mm/min)	190	220	300	390	390	380	330	310	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	24,200	8,100	4,000	3,000	2,400	2,000	1,500	1,200	
			Feed Rate (mm/min)	170	210	280	360	360	350	310	290	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	16,500	5,500	2,700	2,100	1,600	1,400	1,000	800	
			Feed Rate (mm/min)	130	160	210	260	260	260	230	210	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	5,800	1,900	1,000	700	600	500	400	300	
			Feed Rate (mm/min)	50	60	70	90	90	90	80	70	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	6,300	2,100	1,100	800	600	500	400	300	
			Feed Rate (mm/min)	50	50	70	90	90	90	80	70	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	4,800	1,600	800	600	500	400	300	200	
			Feed Rate (mm/min)	30	30	40	50	50	50	40	40	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	34,400	11,500	5,700	4,300	3,400	2,900	2,200	1,700	
			Feed Rate (mm/min)	390	450	600	770	770	770	680	630	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	26,200	8,700	4,400	3,300	2,600	2,200	1,600	1,300	
			Feed Rate (mm/min)	210	260	350	450	450	440	390	350	

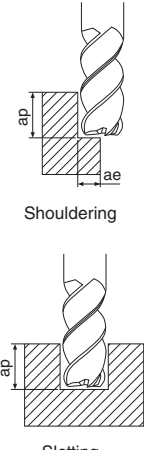
* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

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Recommended Cutting Conditions

Z5MCR

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p> <p>Slotting</p>	Carbon Steel	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	9,000	6,700	5,400	4,500	3,400	2,700	2,200
				Feed Rate (mm/min)	1,290	1,650	1,650	1,670	1,460	1,330	1,160
		Slotting	1DC	Spindle Revolution (min ⁻¹)	7,100	5,300	4,300	3,600	2,700	2,100	1,700
				Feed Rate (mm/min)	1,020	1,310	1,310	1,320	1,160	1,050	920
	Alloy Steel	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	5,100	3,800	3,100	2,500	1,900	1,500	1,200
				Feed Rate (mm/min)	550	690	690	700	640	570	490
		Slotting	1DC	Spindle Revolution (min ⁻¹)	4,000	3,000	2,400	2,000	1,500	1,200	1,000
				Feed Rate (mm/min)	440	550	550	560	500	450	390
	Prehardened steel ≤ 40HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	3,000	2,200	1,800	1,500	1,100	900	700
				Feed Rate (mm/min)	250	340	340	320	290	260	230
		Slotting	1DC	Spindle Revolution (min ⁻¹)	2,300	1,800	1,400	1,200	900	700	600
				Feed Rate (mm/min)	200	260	260	250	230	210	180
	Stainless Steel SUS303 SUS416	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	7,900	5,900	4,800	4,000	3,000	2,400	1,900
				Feed Rate (mm/min)	860	1,080	1,080	1,090	990	890	760
		Slotting	1DC	Spindle Revolution (min ⁻¹)	6,300	4,700	3,800	3,200	2,400	1,900	1,500
				Feed Rate (mm/min)	680	860	860	870	790	710	610
	Stainless Steel SUS304 SUS316	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	5,500	4,100	3,300	2,700	2,100	1,600	1,300
				Feed Rate (mm/min)	460	620	620	590	530	480	410
		Slotting	1DC	Spindle Revolution (min ⁻¹)	4,400	3,300	2,600	2,200	1,600	1,300	1,000
				Feed Rate (mm/min)	370	490	490	470	420	380	330
	Stainless Steel 13-8PH, 15-5PH	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	5,000	3,800	3,000	2,500	1,900	1,500	1,200
				Feed Rate (mm/min)	420	560	560	540	480	440	380
		Slotting	1DC	Spindle Revolution (min ⁻¹)	4,000	3,000	2,400	2,000	1,500	1,200	1,000
				Feed Rate (mm/min)	340	450	450	440	390	360	300
Titanium Alloys Ti-6Al-4V	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	3,500	2,600	2,100	1,700	1,300	1,000	800	
			Feed Rate (mm/min)	330	420	420	420	370	330	290	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	2,700	2,100	1,600	1,400	1,000	800	700	
			Feed Rate (mm/min)	260	330	330	330	290	260	230	
Titanium Alloys Ti-10Al ₂ -Fe-3Al	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	1,200	900	700	600	500	400	300	
			Feed Rate (mm/min)	120	150	150	150	130	120	100	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	1,000	700	600	500	400	300	200	
			Feed Rate (mm/min)	90	120	120	120	100	90	80	
Superalloy Inconel® 625	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	1,300	1,000	800	600	500	400	300	
			Feed Rate (mm/min)	100	130	130	130	120	100	90	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	1,100	800	600	500	400	300	300	
			Feed Rate (mm/min)	80	110	110	110	90	80	80	
Superalloy Inconel® 718	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	1,000	800	600	500	400	300	200	
			Feed Rate (mm/min)	60	70	70	70	60	60	50	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	800	600	500	400	300	200	200	
			Feed Rate (mm/min)	50	60	60	60	50	50	40	
Cast Iron ≤ 19HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	7,200	5,400	4,300	3,600	2,700	2,200	1,700	
			Feed Rate (mm/min)	950	1,210	1,210	1,210	1,070	980	840	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	5,700	4,300	3,400	2,900	2,200	1,700	1,400	
			Feed Rate (mm/min)	760	960	960	960	850	780	670	
Cast Iron ≤ 26HRC	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	5,500	4,100	3,300	2,700	2,100	1,600	1,300	
			Feed Rate (mm/min)	550	700	700	690	610	550	480	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	4,400	3,300	2,600	2,200	1,600	1,300	1,000	
			Feed Rate (mm/min)	440	560	560	550	480	440	380	

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

* Reduce feed when ramping angle is 5° or more

L

Solid Tools

End Mills


Solid Tools for CFRP

Routers

Drills

Cutting Conditions

3ZFKS (Short), 3ZFKM (Medium)

Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø7	ø8	ø10	ø12	ø16	
	Carbon Steel	Shouldering Short 1.2DC x 0.3DC Medium 1.5DC x 0.3DC Plunge milling Slotting 1DC	Spindle Revolution (min ⁻¹)	13,800	10,700	8,800	7,500	6,600	6,000	4,800	4,000	3,000	
			Feed Rate (mm/min)	Shouldering	850	950	1,100	1,200	1,100	1,000	910	850	800
				Plunge milling	180	170	170	170	160	150	120	100	70
	Slotting	570		650	700	730	750	780	800	750	650		
	Alloy Steel	Shouldering Short 1.2DC x 0.3DC Medium 1.5DC x 0.3DC Plunge milling Slotting 0.5DC	Spindle Revolution (min ⁻¹)	10,600	9,300	8,300	7,400	6,500	6,000	4,700	3,500	1,900	
			Feed Rate (mm/min)	Shouldering	700	780	900	980	900	850	750	700	560
				Plunge milling	120	120	130	140	130	130	120	100	70
	Slotting	500		540	570	590	610	600	580	500	340		
	Prehardened steel (30 ~ 45HRC)	Plunge milling Slotting 0.5DC	Spindle Revolution (min ⁻¹)	5,200	4,000	3,200	2,600	2,300	2,000	1,600	1,400	1,000	
			Feed Rate (mm/min)	Shouldering	440	440	490	490	490	440	400	370	300
				Plunge milling	90	110	110	130	110	100	80	70	50
	Slotting	220		270	270	320	330	330	230	200	140		
Stainless Steel	Shouldering Short 1.2DC x 0.2DC Medium 1.5DC x 0.2DC Plunge milling Slotting 0.5DC	Spindle Revolution (min ⁻¹)	3,300	2,500	2,000	1,700	1,400	1,300	1,100	900	750		
		Feed Rate (mm/min)	Shouldering	280	270	330	340	330	330	350	320	300	
			Plunge milling	20	30	40	40	40	30	20	20	20	
Slotting	110		110	130	140	130	130	120	120	120			
Titanium Alloys	Plunge milling Slotting 0.5DC	Spindle Revolution (min ⁻¹)	3,300	2,500	2,000	1,700	1,400	1,300	1,100	900	750		
		Feed Rate (mm/min)	Shouldering	280	270	330	340	330	330	350	320	300	
			Plunge milling	20	30	40	40	40	30	20	20	20	
Slotting	110		110	130	140	130	130	120	120	120			

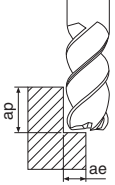
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Recommended Cutting Conditions

5DEKM, 5DERM

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p> <p>Depth of Cut (ap x ae) (mm)</p> <p>5DEKM: 1.5DC x 0.25DC 5DERM: 1.5DC x 0.5DC</p>	Medium Carbon Steel High Carbon Steel (> 0.3% C)	Shouldering	Spindle Revolution (min ⁻¹)	16,000	12,700	10,600	8,000	6,400	5,300	4,000	3,200	2,500
			Feed Rate (mm/min)	2,400	2,500	2,700	2,400	2,200	1,900	1,600	1,600	1,400
		Slotting	Spindle Revolution (min ⁻¹)	16,000	12,700	10,600	8,000	6,400	5,300	4,000	3,200	2,500
			Feed Rate (mm/min)	2,400	2,500	2,700	2,400	2,200	1,900	1,600	1,600	1,400
	Alloy Steel Alloy Tool Steel (< 330HB < 35HRC)	Shouldering	Spindle Revolution (min ⁻¹)	14,300	11,500	9,600	7,200	5,700	4,800	3,600	2,900	2,300
			Feed Rate (mm/min)	2,100	1,700	1,900	1,800	1,700	1,700	1,400	1,300	1,100
		Slotting	Spindle Revolution (min ⁻¹)	14,300	11,500	9,600	7,200	5,700	4,800	3,600	2,900	2,300
			Feed Rate (mm/min)	2,100	1,700	1,900	1,800	1,700	1,700	1,400	1,300	1,100
	Alloy Steel Alloy Tool Steel (340~450HB (36~48HRC)	Shouldering	Spindle Revolution (min ⁻¹)	13,000	10,000	8,500	6,400	5,100	4,200	3,200	2,500	2,000
			Feed Rate (mm/min)	1,300	1,500	1,700	1,300	1,300	1,300	1,100	1,000	1,000
		Slotting	Spindle Revolution (min ⁻¹)	13,000	10,000	8,500	6,400	5,100	4,200	3,200	2,500	2,000
			Feed Rate (mm/min)	1,300	1,500	1,700	1,300	1,300	1,300	1,100	1,000	1,000
Austenitic Stainless Steel SUS302 SUS303 SUS304	Shouldering	Spindle Revolution (min ⁻¹)	9,200	7,300	6,100	4,600	3,700	3,100	2,300	1,800	1,500	
		Feed Rate (mm/min)	1,400	1,100	1,200	1,100	1,100	1,100	920	820	730	
	Slotting	Spindle Revolution (min ⁻¹)	9,200	7,300	6,100	4,600	3,700	3,100	2,300	1,800	1,500	
		Feed Rate (mm/min)	1,400	1,100	1,200	1,100	1,100	1,100	920	820	730	
Austenitic Stainless Steel SUS316 SUS316L	Shouldering	Spindle Revolution (min ⁻¹)	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	1,000	
		Feed Rate (mm/min)	640	760	640	640	640	640	560	510	410	
	Slotting	Spindle Revolution (min ⁻¹)	6,400	5,100	4,200	3,200	2,500	2,100	1,600	1,300	1,000	
		Feed Rate (mm/min)	640	760	640	640	640	640	560	510	410	
Titanium Alloys	Shouldering	Spindle Revolution (min ⁻¹)	4,800	3,800	3,200	2,400	1,900	1,600	1,200	960	760	
		Feed Rate (mm/min)	480	380	480	480	380	400	360	380	340	
	Slotting	Spindle Revolution (min ⁻¹)	4,800	3,800	3,200	2,400	1,900	1,600	1,200	960	760	
		Feed Rate (mm/min)	480	380	480	480	380	400	360	380	340	
Superalloy	Shouldering	Spindle Revolution (min ⁻¹)	3,200	2,500	2,100	1,600	1,300	1,100	800	640	510	
		Feed Rate (mm/min)	160	130	210	240	190	210	200	190	180	
	Slotting	Spindle Revolution (min ⁻¹)	3,200	2,500	2,100	1,600	1,300	1,100	800	640	510	
		Feed Rate (mm/min)	160	130	210	240	190	210	200	190	180	
Gray Cast Iron	Shouldering	Spindle Revolution (min ⁻¹)	14,000	11,000	9,000	6,800	5,400	4,500	3,400	2,700	2,200	
		Feed Rate (mm/min)	2,000	2,200	2,300	2,000	2,200	1,800	1,700	1,600	1,400	
	Slotting	Spindle Revolution (min ⁻¹)	14,000	11,000	9,000	6,800	5,400	4,500	3,400	2,700	2,200	
		Feed Rate (mm/min)	2,000	2,200	2,300	2,000	2,200	1,800	1,700	1,600	1,400	
Nodular Cast Iron CGI Malleable Cast Iron	Shouldering	Spindle Revolution (min ⁻¹)	10,000	8,300	6,900	5,200	4,100	3,500	2,600	2,100	1,700	
		Feed Rate (mm/min)	1,000	1,200	1,000	1,300	1,000	1,000	910	830	830	
	Slotting	Spindle Revolution (min ⁻¹)	10,000	8,300	6,900	5,200	4,100	3,500	2,600	2,100	1,700	
		Feed Rate (mm/min)	1,000	1,200	1,000	1,300	1,000	1,000	910	830	830	

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

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Solid Tools

- End Mills
- Solid Tools for CFRP
- Routers
- Drills
- Cutting Conditions

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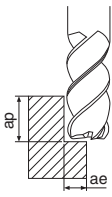
Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16	ø20
	Carbon Steel, Cast Iron	Shouldering	Spindle Revolution (min ⁻¹)	18,000	12,000	9,200	7,300	6,100	4,600	3,700	3,100	2,300	1,800
			Feed Rate (mm/min)	380	430	440	500	510	500	560	560	590	590
		Slotting	Spindle 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	

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

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Recommended Cutting Conditions

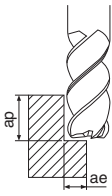
6PFK, 8PFK (Medium)

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p>	Carbon Steel, Cast Iron	Shouldering	DC < ø20 : 1.5DC x 0.2DC DC ≥ ø20 : 1.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,800
				Feed Rate (mm/min)	2,650	2,640	2,410	2,250	2,010	1,700	1,500
	Alloy Steel	Shouldering	DC < ø20 : 1.5DC x 0.2DC DC ≥ ø20 : 1.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	6,400	4,800	3,800	3,200	2,400	1,900	1,500
				Feed Rate (mm/min)	2,250	2,090	1,950	1,910	1,720	1,450	1,220
	Prehardened steel (30 ~ 38HRC)	Shouldering	1.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	5,600	4,200	3,300	2,800	2,100	1,700	1,300
				Feed Rate (mm/min)	1,780	1,710	1,520	1,400	1,220	1,120	980
	Stainless Steel Titanium Alloys	Shouldering	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	5,000	3,800	3,000	2,500	1,900	1,500	1,200
				Feed Rate (mm/min)	1,350	1,320	1,200	1,130	970	850	720

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

Slotting is not recommended.

6PFK, 8PFK (Long)

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p>	Carbon Steel, Cast Iron	Shouldering	3.0DC x 0.01DC	Spindle Revolution (min ⁻¹)	4,600	3,500	2,800	2,300	1,700	1,400	1,100
				Feed Rate (mm/min)	1,830	1,730	1,530	1,380	1,120	880	660
	Alloy Steel	Shouldering	3.0DC x 0.01DC	Spindle Revolution (min ⁻¹)	3,700	2,800	2,200	1,800	1,400	1,100	900
				Feed Rate (mm/min)	1,490	1,340	1,220	1,120	940	720	540
	Prehardened steel (30 ~ 38HRC)	Shouldering	3.0DC x 0.01DC	Spindle Revolution (min ⁻¹)	2,800	2,100	1,700	1,400	1,100	850	650
				Feed Rate (mm/min)	920	680	750	670	550	480	390
	Stainless Steel Titanium Alloys	Shouldering	3.0DC x 0.01DC	Spindle Revolution (min ⁻¹)	2,500	1,900	1,500	1,300	950	750	600
				Feed Rate (mm/min)	700	670	590	540	440	370	290

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

Slotting is not recommended.

L

Solid Tools

End Mills

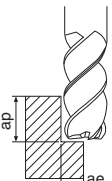
Solid Tools
for CFRP

Routers

Drills

Cutting
Conditions

51M, 51ML, 51MCR, 51MLC

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p>	Carbon Steel	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	11,600	8,700	7,000	5,800	4,400	3,500
				Feed Rate (mm/min)	3,350	4,240	4,230	4,220	3,720	3,310
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	14,800	11,100	8,900	7,400	5,500	4,400
				Feed Rate (mm/min)	5,850	7,520	7,500	7,500	6,550	5,850
	Alloy Steel	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	7,900	5,900	4,800	4,000	3,000	2,400
				Feed Rate (mm/min)	1,710	2,170	2,200	2,190	1,910	1,700
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	10,000	7,500	6,000	5,000	3,800	3,000
				Feed Rate (mm/min)	2,950	3,740	3,750	3,760	3,290	2,940
	Prehardened steel ≤ 40HRC	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	3,900	2,900	2,300	1,900	1,500	1,200
				Feed Rate (mm/min)	680	860	850	850	750	670
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	4,900	3,700	3,000	2,500	1,800	1,500
				Feed Rate (mm/min)	1,180	1,530	1,530	1,520	1,330	1,190
	Stainless Steel SUS303 SUS416	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	8,200	6,200	4,900	4,100	3,100	2,500
				Feed Rate (mm/min)	1,730	2,230	2,230	2,230	1,950	1,740
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	10,500	7,900	6,300	5,300	3,900	3,200
				Feed Rate (mm/min)	3,030	3,880	3,860	3,840	3,380	3,010
	Stainless Steel SUS304 SUS316	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	5,700	4,200	3,400	2,800	2,100	1,700
				Feed Rate (mm/min)	980	1,250	1,240	1,240	1,090	980
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	7,300	5,500	4,400	3,600	2,700	2,200
				Feed Rate (mm/min)	1,750	2,260	2,250	2,250	1,960	1,750
	Stainless Steel 13-8PH,15-5PH	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	5,300	3,900	3,200	2,600	2,000	1,600
				Feed Rate (mm/min)	910	1,160	1,150	1,150	1,020	910
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	6,600	5,000	4,000	3,300	2,500	2,000
				Feed Rate (mm/min)	1,590	2,060	2,050	2,050	1,790	1,600
Titanium Alloys Ti-6Al-4V	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	4,500	3,400	2,700	2,300	1,700	1,400	
			Feed Rate (mm/min)	620	790	800	800	690	630	
		2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	5,700	4,300	3,400	2,900	2,200	1,700	
			Feed Rate (mm/min)	1,100	1,390	1,400	1,390	1,230	1,140	
Titanium Alloys Ti-10Al-2-Fe-3Al	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	2,500	1,900	1,500	1,300	900	800	
			Feed Rate (mm/min)	350	440	440	440	380	350	
		2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	3,200	2,400	1,900	1,600	1,200	1,000	
			Feed Rate (mm/min)	620	790	790	790	690	640	
Superalloy Inconel® 625	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	1,700	1,300	1,000	800	600	500	
			Feed Rate (mm/min)	350	440	430	430	380	340	
		2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	2,100	1,600	1,300	1,100	800	600	
			Feed Rate (mm/min)	580	730	730	760	660	570	
Superalloy Inconel® 718	Shouldering	1DC x 0.1DC	Spindle Revolution (min ⁻¹)	1,300	1,000	800	600	500	400	
			Feed Rate (mm/min)	180	230	230	230	200	180	
		2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	1,600	1,200	1,000	800	600	500	
			Feed Rate (mm/min)	310	390	400	390	350	320	

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

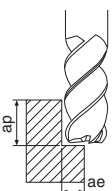
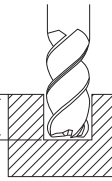
Slotting is not recommended.

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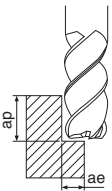
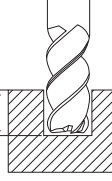
Recommended Cutting Conditions

4JER (Short, Medium)

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p>  <p>Slotting</p>	Carbon Steel, Cast Iron	Shouldering	1.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	6,900	5,200	4,100	3,400	2,600	2,100
				Feed Rate (mm/min)	1,500	1,500	1,400	1,400	1,300	1,100
		Slotting	DC ≤ ø12 : ap ≤ 1.0DC DC > ø12 : ap ≤ 12	Spindle Revolution (min ⁻¹)	5,600	4,200	3,300	2,800	2,100	1,700
				Feed Rate (mm/min)	720	670	620	540	480	360
	Alloy Steel	Shouldering	1.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	1,020	920	870	800	720	640
		Slotting	DC ≤ ø12 : ap ≤ 1.0DC DC > ø12 : ap ≤ 12	Spindle Revolution (min ⁻¹)	4,200	3,200	2,500	2,100	1,600	1,300
				Feed Rate (mm/min)	530	510	470	450	400	360
	Prehardened steel (30 ~ 45HRC)	Shouldering	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	4,600	3,500	2,800	2,300	1,700	1,300
				Feed Rate (mm/min)	850	830	800	770	640	590
		Slotting	ap ≤ 0.5 x DC	Spindle Revolution (min ⁻¹)	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	480	450	440	410	340	300
Stainless Steel	Shouldering	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	4,800	3,600	2,900	2,400	1,800	1,400	
			Feed Rate (mm/min)	850	830	800	770	640	590	
	Slotting	ap ≤ 0.5 x DC	Spindle Revolution (min ⁻¹)	3,500	2,800	2,200	1,900	1,400	1,100	
			Feed Rate (mm/min)	300	280	250	230	190	170	
Titanium Alloys	Shouldering	1.5DC x 0.1DC	Spindle Revolution (min ⁻¹)	4,200	3,200	2,500	2,100	1,600	1,300	
			Feed Rate (mm/min)	580	630	660	600	500	400	
	Slotting	DC ≤ ø12 : ap ≤ 1.0DC DC > ø12 : ap ≤ 12	Spindle Revolution (min ⁻¹)	3,700	2,800	2,200	1,900	1,400	1,100	
			Feed Rate (mm/min)	320	340	370	340	260	210	
Superalloy (Inconel® 718, etc.)	Shouldering	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	2,400	1,800	1,400	1,200	900	720	
			Feed Rate (mm/min)	330	320	320	320	320	290	
	Slotting	ap ≤ 0.5 x DC	Spindle Revolution (min ⁻¹)	1,600	1,200	950	800	600	480	
			Feed Rate (mm/min)	180	140	110	100	80	60	

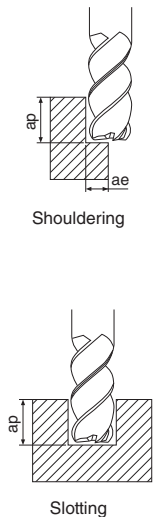
* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

ZH1MCR

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø10	ø12	ø20
 <p>Shouldering</p>  <p>Slotting</p>	Titanium Alloys Ti-6Al-4V	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	3,500	2,100	1,700	1,000
				Feed Rate (mm/min)	260	340	340	240
		Slotting	1DC	Spindle Revolution (min ⁻¹)	2,700	1,600	1,400	800
				Feed Rate (mm/min)	210	270	270	190
	Titanium Alloys Ti-10Alz-Fe-3Al	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	1,200	700	600	400
				Feed Rate (mm/min)	90	120	120	80
		Slotting	1DC	Spindle Revolution (min ⁻¹)	1,000	600	500	300
				Feed Rate (mm/min)	70	100	100	70
	Superalloy Inconel® 625	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	1,400	800	700	400
				Feed Rate (mm/min)	90	110	110	90
		Slotting	1DC	Spindle Revolution (min ⁻¹)	1,100	700	600	300
				Feed Rate (mm/min)	80	90	90	70
Superalloy Inconel® 718	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	1,100	700	600	300	
			Feed Rate (mm/min)	50	70	70	50	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	900	500	400	300	
			Feed Rate (mm/min)	40	50	50	40	

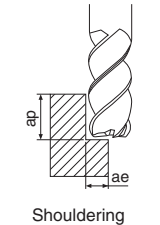
* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

4 / 5 / 6RFH (Medium)

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p> <p>Slotting</p>	Carbon Steel / Alloy Steel / Cast Iron	Shouldering	1.5DC x 0.3DC	Spindle Revolution (min ⁻¹)	6,400	4,800	3,800	3,200	2,400	1,900
				Feed Rate (mm/min)	1,040	1,050	1,100	1,000	980	920
		Slotting	1DC	Spindle Revolution (min ⁻¹)	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	790	790	830	740	700	640
			2DC	Spindle Revolution (min ⁻¹)	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	550	550	580	510	490	450
	Prehardened steel (30 ~ 45HRC)	Shouldering	1.5DC x 0.3DC	Spindle Revolution (min ⁻¹)	4,200	3,200	2,500	2,100	1,600	1,300
				Feed Rate (mm/min)	490	620	580	540	490	460
		Slotting	1DC	Spindle Revolution (min ⁻¹)	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	410	410	430	400	370	360
			2DC	Spindle Revolution (min ⁻¹)	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	290	290	300	280	260	250
	Stainless Steel	Shouldering	1.5DC x 0.3DC	Spindle Revolution (min ⁻¹)	6,400	4,800	3,800	3,200	2,400	1,900
				Feed Rate (mm/min)	410	410	410	400	380	380
		Slotting	1DC	Spindle Revolution (min ⁻¹)	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	280	260	310	240	250	250
			2DC	Spindle Revolution (min ⁻¹)	5,300	4,000	3,200	2,700	2,000	1,600
				Feed Rate (mm/min)	220	210	250	190	200	200
	Titanium Alloys	Shouldering	1.5DC x 0.3DC	Spindle Revolution (min ⁻¹)	4,200	3,200	2,500	2,100	1,600	1,300
				Feed Rate (mm/min)	330	420	410	390	380	370
		Slotting	1DC	Spindle Revolution (min ⁻¹)	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	220	240	240	240	250	250
			2DC	Spindle Revolution (min ⁻¹)	3,700	2,800	2,200	1,900	1,400	1,100
				Feed Rate (mm/min)	180	190	190	190	200	200
Superalloy	Shouldering	1.5DC x 0.2DC	Spindle Revolution (min ⁻¹)	800	600	480	400	300	240	
			Feed Rate (mm/min)	60	60	60	60	60	60	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	530	400	320	270	200	160	
			Feed Rate (mm/min)	28	28	28	28	28	28	
		2DC	Spindle Revolution (min ⁻¹)	530	400	320	270	200	160	
			Feed Rate (mm/min)	20	20	20	20	20	20	

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

4 / 5 / 6RFH (Long)

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p>	Carbon Steel / Alloy Steel / Cast Iron	Shouldering	ap : 4.0DC ae : 0.1DC (DC ≤ ø12) ae : 1.2mm (DC > ø12)	Spindle Revolution (min ⁻¹)	5,100	3,800	3,100	2,500	1,900	1,500
				Feed Rate (mm/min)	620	630	660	600	590	550
	Prehardened steel (30 ~ 45HRC)	Shouldering	ap : 4.0DC ae : 0.1DC (DC ≤ ø12) ae : 1.2mm (DC > ø12)	Spindle Revolution (min ⁻¹)	3,400	2,500	2,000	1,700	1,300	1,000
				Feed Rate (mm/min)	340	430	410	380	340	320
	Stainless Steel	Shouldering	ap : 4.0DC ae : 0.1DC (DC ≤ ø12) ae : 1.2mm (DC > ø12)	Spindle Revolution (min ⁻¹)	5,100	3,800	3,100	2,500	1,900	1,500
				Feed Rate (mm/min)	290	290	290	280	270	270
	Titanium Alloys	Shouldering	ap : 4.0DC ae : 0.1DC (DC ≤ ø12) ae : 1.2mm (DC > ø12)	Spindle Revolution (min ⁻¹)	3,400	2,500	2,000	1,700	1,300	1,000
				Feed Rate (mm/min)	230	290	290	270	270	260
	Superalloy	Shouldering	ap : 4.0DC ae : 0.1DC (DC ≤ ø12) ae : 1.0mm (DC > ø12)	Spindle Revolution (min ⁻¹)	640	480	380	320	240	190
				Feed Rate (mm/min)	20	20	20	20	20	20

* Machining with water soluble coolant is recommended for stainless steel, titanium alloys and Superalloy.

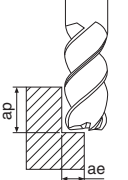
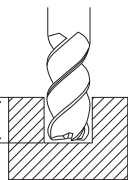
Slotting is not recommended.

Insert Grades
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Recommended Cutting Conditions

3RDSM, 4RDSM, 5RDSM

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p>	Steel	< 22HRC	1.5DC x 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
		22 - 32HRC	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
		32 - 40HRC	1.5DC x 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
	40 - 45HRC	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	
	45 - 50HRC	1.5DC x 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	
	45 - 50HRC	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	
 <p>Slotting</p>	Stainless Steel	40 - 45HRC	1DC x 0.4DC	Spindle Revolution (min ⁻¹)	4,800	3,600	2,900	2,400	1,800	1,400	1,100
				Feed Rate (mm/min)	220	220	260	260	250	250	250
		45 - 50HRC	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
		45 - 50HRC	1DC x 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
	45 - 50HRC	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	1.5DC x 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	
	Stainless Steel	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	1.5DC x 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		
Cast Iron	1DC	Spindle Revolution (min ⁻¹)	7,900	5,900	4,800	4,000	3,000	2,400	1,900		
		Feed Rate (mm/min)	700	700	900	900	900	910	1,140		

* Machining with water soluble coolant is recommended for stainless steel.

3RFRS, 4RFRS

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø4	ø5	ø6	ø8	ø10	ø12
 <p>Shouldering</p>	Steel	< 30HRC	0.8DC x 0.5DC	Spindle Revolution (min ⁻¹)	14,300	11,500	9,600	7,200	5,700	4,800
				Feed Rate (mm/min)	860	860	1,150	1,150	1,150	1,150
		30 - 40HRC	0.8DC	Spindle Revolution (min ⁻¹)	11,500	9,200	7,600	5,700	4,600	3,800
				Feed Rate (mm/min)	690	690	920	920	920	920
		30 - 40HRC	0.8DC x 0.4DC	Spindle Revolution (min ⁻¹)	9,600	7,600	6,400	4,800	3,800	3,200
				Feed Rate (mm/min)	430	460	640	610	610	570
	40 - 50HRC	0.8DC	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	0.8DC x 0.4DC	Spindle Revolution (min ⁻¹)	6,400	5,100	4,200	3,200	2,500	2,100	
			Feed Rate (mm/min)	190	230	320	320	320	340	
	50 - 60HRC	0.5DC	Spindle Revolution (min ⁻¹)	5,100	4,100	3,400	2,500	2,000	1,700	
			Feed Rate (mm/min)	150	180	260	260	260	270	
50 - 60HRC	0.8DC x 0.25DC	Spindle Revolution (min ⁻¹)	4,800	3,800	3,200	2,400	1,900	1,600		
		Feed Rate (mm/min)	100	100	130	140	150	160		
60 - 70HRC	0.3DC	Spindle Revolution (min ⁻¹)	3,800	3,100	2,500	1,900	1,500	1,300		
		Feed Rate (mm/min)	80	80	100	120	120	130		
60 - 70HRC	0.8DC x 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		
60 - 70HRC	0.25DC	Spindle Revolution (min ⁻¹)	2,500	2,000	1,700	1,300	1,000	800		
		Feed Rate (mm/min)	50	50	60	60	60	70		
Titanium Alloys	0.8DC x 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		
Titanium Alloys	0.5DC	Spindle Revolution (min ⁻¹)	4,000	3,200	2,700	2,000	1,600	1,300		
		Feed Rate (mm/min)	80	100	150	140	160	170		

* Machining with water soluble coolant is recommended for titanium alloys.

L

Solid Tools

End Mills

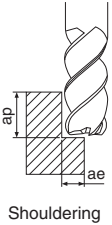
Solid Tools for CFRP

Routers

Drills

Cutting Conditions

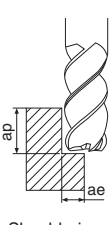
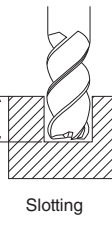
3RDSL, 4RDSL, 5RDSL (Shouldering)

Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25	
	Steel	< 22HRC	2.5DC x 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 x 0.4DC	Spindle Revolution (min ⁻¹)	6,700	5,000	4,000	3,400	2,500	2,000	1,600
				Feed Rate (mm/min)	500	500	600	600	600	640	720
		32 ~ 40HRC	2.5DC x 0.4DC	Spindle Revolution (min ⁻¹)	4,500	3,400	2,700	2,200	1,700	1,300	1,100
				Feed Rate (mm/min)	220	220	290	290	280	280	280
	40 ~ 45HRC	2.5DC x 0.4DC	Spindle Revolution (min ⁻¹)	3,400	2,500	2,000	1,700	1,300	1,000	800	
			Feed Rate (mm/min)	150	150	180	180	180	180	180	
	45 ~ 50HRC	2.5DC x 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 x 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 x 0.5DC	Spindle Revolution (min ⁻¹)	6,700	5,000	4,000	3,400	2,500	2,000	1,600		
		Feed Rate (mm/min)	600	600	720	720	720	770	970		

* Machining with water soluble coolant is recommended for stainless steel.

Slotting is not recommended.

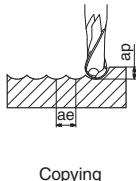
4RFSM, 6RFSM

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16		ø20		ø25	
									4 flutes	6 flutes	4 flutes	6 flutes		
 	Steel	Shouldering	1.5DC x 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	
		Shouldering	1.5DC x 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		
	Shouldering	1.5DC x 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 x 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		
	Titanium Alloys	< 40HRC	Shouldering	2DC x 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 x 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 (Ni-base heat-resistant alloys)	Shouldering	1DC x 0.2DC	Spindle Revolution (min ⁻¹)	1,600	1,200	1,000	800	600	600	500	500	400		
			Feed Rate (mm/min)	100	100	100	100	100	140	100	140	130		
Slotting	0.25DC	Spindle Revolution (min ⁻¹)	1,300	1,000	800	600	500	500	400	400	300			
		Feed Rate (mm/min)	80	80	80	80	80	120	80	120	100			

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

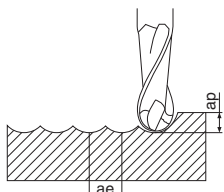
Recommended Cutting Conditions

2SEB

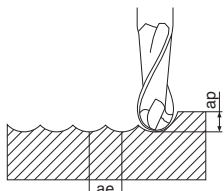
Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø2	ø3	ø4	ø5	ø6	ø8	ø10	ø12	ø16	
 <p>Copying</p>	Carbon Steel, Cast Iron	0.05DC x 0.05DC	Spindle Revolution (min ⁻¹)	25,900	22,800	21,300	19,700	16,000	14,000	12,800	11,800	9,500	
			Feed Rate (mm/min)	3,910	3,570	3,290	3,070	2,890	2,660	2,540	2,500	2,470	
	Tool Steel, Alloy Steel	0.04DC x 0.04DC	Spindle Revolution (min ⁻¹)	23,300	20,500	19,100	17,700	15,200	12,600	11,500	10,600	8,500	
			Feed Rate (mm/min)	3,100	2,880	2,670	2,490	2,330	2,110	2,010	1,980	1,970	
	Stainless Steel	0.05DC x 0.05DC	Spindle Revolution (min ⁻¹)	23,300	20,500	19,100	17,700	15,200	12,600	11,500	10,600	8,500	
			Feed Rate (mm/min)	3,150	2,880	2,660	2,500	2,370	2,190	2,060	1,970	1,920	
	Prehardened steel	30 ~ 38HRC	0.05DC x 0.05DC	Spindle Revolution (min ⁻¹)	23,300	20,500	19,100	17,700	15,200	12,600	11,500	10,600	8,500
				Feed Rate (mm/min)	3,150	2,880	2,660	2,500	2,370	2,190	2,060	1,970	1,920
		38 ~ 45HRC	0.03DC x 0.03DC	Spindle Revolution (min ⁻¹)	20,900	18,500	17,200	15,900	13,700	11,300	10,400	9,500	7,700
	Feed Rate (mm/min)			2,550	2,330	2,170	2,040	1,940	1,800	1,680	1,590	1,550	
	45 ~ 55HRC	0.03DC x 0.03DC	Spindle Revolution (min ⁻¹)	18,600	16,400	15,300	14,200	12,200	10,000	9,200	8,500	6,800	
			Feed Rate (mm/min)	2,060	1,850	1,700	1,600	1,520	1,410	1,320	1,230	1,190	
Heat Treated Steel	45 ~ 55HRC	0.03DC x 0.03DC	Spindle Revolution (min ⁻¹)	18,600	16,400	15,300	14,200	12,200	10,000	9,200	8,500	6,800	
			Feed Rate (mm/min)	2,060	1,850	1,700	1,600	1,520	1,410	1,320	1,230	1,190	
	55 ~ 60HRC	0.03DC x 0.03DC	Spindle Revolution (min ⁻¹)	14,300	12,600	11,800	10,900	9,400	7,700	7,100	6,500	5,200	
Feed Rate (mm/min)			1,230	1,130	1,030	980	930	850	800	780	760		

* Machining with water soluble coolant is recommended for stainless steel.

2UEBS

Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø4	ø6	ø8	ø10	ø12	ø16	ø20	
 <p>Copying</p>	Steel	0.3DC x 0.7DC	< 42HRC	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 x ae) (mm)	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø8	ø10	ø12
 <p>Copying</p>	Carbon Steel, Cast Iron (< 20HRC)	0.2DC x 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 x 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
	Prehardened steel (30 ~ 45HRC)	0.1DC x 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 x 0.1DC	Spindle Revolution (min ⁻¹)	5,800	4,400	3,500	2,900	2,200	1,800	1,500
			Feed Rate (mm/min)	160	180	190	180	190	190	170

* Machining with water soluble coolant is recommended for stainless steel.

L

Solid Tools

End Mills


Solid Tools for CFRP

Routers

Drills

Cutting Conditions

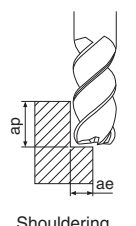
4YE8M

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø5	ø6	ø8	ø10	ø12	ø16	ø20
 <p>Shouldering</p> <p>Slotting</p>	Low Carbon Steel	Shouldering	1DC x 0.5DC	Spindle Revolution (min ⁻¹)	9,400	7,900	5,900	4,700	3,900	2,900	2,400
				Feed Rate (mm/min)	1,020	1,130	1,270	1,020	990	800	760
		Slotting	1DC	Spindle Revolution (min ⁻¹)	8,600	7,200	5,400	4,300	3,600	2,700	2,200
				Feed Rate (mm/min)	930	1,030	1,160	930	900	730	700
	Stainless Steel	Shouldering	1DC x 0.5DC	Spindle Revolution (min ⁻¹)	5,700	4,800	3,600	2,900	2,400	1,800	1,400
				Feed Rate (mm/min)	620	630	630	640	560	450	390
		Slotting	1DC	Spindle Revolution (min ⁻¹)	5,100	4,200	3,200	2,500	2,100	1,600	1,300
				Feed Rate (mm/min)	550	610	570	550	500	400	350
	Titanium Alloys	Shouldering	1DC x 0.3DC	Spindle Revolution (min ⁻¹)	3,200	2,700	2,000	1,600	1,300	1,000	800
				Feed Rate (mm/min)	180	190	220	170	170	160	160
		Slotting	0.5DC	Spindle Revolution (min ⁻¹)	2,900	2,400	1,800	1,400	1,200	900	700
				Feed Rate (mm/min)	160	170	190	170	170	160	160
Heat-resistant Alloys	Shouldering	1DC x 0.2DC	Spindle Revolution (min ⁻¹)	1,700	1,400	1,000	800	700	500	400	
			Feed Rate (mm/min)	70	80	100	80	90	90	80	
	Slotting	0.5DC	Spindle Revolution (min ⁻¹)	1,400	1,200	900	700	600	400	400	
			Feed Rate (mm/min)	60	70	80	80	80	80	70	
Gray Cast Iron	Shouldering	1DC x 0.4DC	Spindle Revolution (min ⁻¹)	7,800	6,500	4,900	3,900	3,200	2,400	1,900	
			Feed Rate (mm/min)	840	930	1,050	840	820	660	630	
	Slotting	1DC	Spindle Revolution (min ⁻¹)	7,000	5,800	4,400	3,500	2,900	2,200	1,800	
			Feed Rate (mm/min)	760	840	950	760	740	600	570	

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

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

4HF8M, 5HF8M, 6HF8M, 7HF8M, 8HF8M (Shouldering)

Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø1	ø2	ø4	ø6	ø8	ø12	
 <p>Shouldering</p>	Tool Steel (< 40HRC) Prehardened steel	1.5DC x 0.05DC (DC < ø3)	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, Heat Treated Steel (40 ~ 45HRC) Prehardened steel	1.5DC x 0.1DC (ø3 ≤ DC)	Spindle Revolution (min ⁻¹)	20,700	20,000	9,900	6,600	5,000	3,300	
			Feed Rate (mm/min)	910	1,750	1,800	2,630	2,650	2,650	
	Heat Treated Steel	45 ~ 55HRC	1.5DC x 0.05DC	Spindle Revolution (min ⁻¹)	20,700	16,000	8,000	5,300	4,000	2,700
				Feed Rate (mm/min)	910	1,400	1,400	2,100	2,100	2,100
		55 ~ 60HRC	1.5DC x 0.02DC	Spindle Revolution (min ⁻¹)	20,700	12,000	6,000	4,000	3,000	2,000
				Feed Rate (mm/min)	640	730	740	1,100	1,100	1,100
		60 ~ 65HRC	1.5DC x 0.02DC	Spindle Revolution (min ⁻¹)	20,700	11,100	5,600	3,700	2,800	1,900
				Feed Rate (mm/min)	550	600	600	880	880	880
		65 ~ 70HRC	1.5DC x 0.02DC	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.

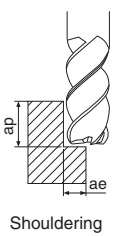
Slotting is not recommended.

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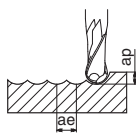
Recommended Cutting Conditions

4UGSM, 6UGSM (Shouldering)

Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø4	ø6	ø8	ø10	ø12	ø16	
	Steel	45 ~ 55HRC	1DC x 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 x 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.

56MB

Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø1	ø1.5	ø3	ø5	ø6	ø10	ø12	ø20	
	Prehardened steel ≤ 40HRC	0.1DC x 0.4DC		Spindle Revolution (min ⁻¹)	60,700	40,500	20,200	12,200	10,100	6,100	5,100	3,000
				Feed Rate (mm/min)	1,820	3,080	3,080	2,480	2,570	2,470	2,570	1,850
		0.03DC x 0.4DC (Finishing)		Spindle Revolution (min ⁻¹)	92,200	61,500	46,100	18,400	15,400	9,200	7,700	4,600
				Feed Rate (mm/min)	3,320	5,290	7,750	4,130	3,600	4,130	4,290	3,040
	Prehardened steel ≤ 50HRC	0.05DC x 0.4DC		Spindle Revolution (min ⁻¹)	72,800	48,600	24,300	14,600	12,100	7,300	6,100	3,600
				Feed Rate (mm/min)	1,890	2,720	2,820	2,210	2,360	2,210	2,320	1,570
		0.02DC x 0.4DC (Finishing)		Spindle Revolution (min ⁻¹)	111,600	74,400	37,200	22,300	18,600	11,200	9,300	5,600
				Feed Rate (mm/min)	3,350	4,470	4,760	3,750	3,980	3,750	3,870	2,840
	Prehardened steel ≤ 60HRC	0.04DC x 0.4DC		Spindle Revolution (min ⁻¹)	48,300	32,200	16,100	9,700	8,100	4,800	4,000	2,400
				Feed Rate (mm/min)	970	1,290	1,390	1,120	1,190	1,100	1,170	770
		0.01DC x 0.4DC (Finishing)		Spindle Revolution (min ⁻¹)	97,000	64,700	32,300	19,400	16,200	9,700	8,100	4,900
				Feed Rate (mm/min)	2,520	2,980	3,100	2,480	2,620	2,460	2,590	1,750

L

Solid Tools

End Mills

Solid Tools
for CFRP

Routers

Drills

Cutting
Conditions

3AFK (Short)

Workpiece Material	Applications	Depth of Cut (mm) ap x ae	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø7	ø8	ø9	ø10	ø11	ø12	ø16
			Spindle Revolution (min ⁻¹)	20,000	20,000	20,000	19,500	16,800	14,700	13,000	11,700	10,700	9,800	7,300
Aluminum Alloys	Shouldering	1.5DC x 0.3DC	Feed Rate (mm/min)	2,400	2,800	3,500	4,200	4,300	4,400	4,500	4,600	4,700	4,700	3,500
	Slotting	1DC		1,600	2,000	2,500	3,000	3,100	3,200	3,300	3,400	3,500	3,500	2,200
	Plunge milling	1DC		350	350	350	350	350	350	350	350	350	350	350
Workpiece Material	Applications	Depth of Cut (mm) ap x ae	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø7	ø8	ø9	ø10	ø11	ø12	ø16
Aluminum Alloy Casting	Shouldering	1.5DC x 0.3DC	Feed Rate (mm/min)	2,400	2,500	2,500	2,500	2,500	2,600	2,600	2,600	2,600	2,600	1,900
	Slotting	1DC		1,300	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,700	1,800
	Plunge milling	1DC		300	250	200	200	190	150	150	100	100	80	60

- Water soluble coolant is recommended.
- The cutting conditions should be adjusted based on the overhang of the tool and the machine or workpiece rigidity.
- Spindle revolution and feed rate should be adjusted by the same percentage.
- Pecking may be necessary if chips become clogged while plunge milling.

3AFK (Medium)

Workpiece Material	Applications	Depth of Cut (mm) ap x ae	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø7	ø8	ø9	ø10	ø11	ø12	ø16
			Spindle Revolution (min ⁻¹)	20,000	20,000	19,000	16,000	13,500	12,000	10,500	9,500	8,500	8,000	6,000
Aluminum Alloys	Shouldering	2.5DC x 0.3DC	Feed Rate (mm/min)	2,300	2,600	3,200	3,600	3,600	3,600	3,700	3,900	4,000	4,000	2,800
	Slotting	0.5DC		1,500	1,900	2,300	2,600	2,600	2,700	2,700	2,800	2,900	2,900	1,600
	Plunge milling	0.5DC		300	300	300	300	300	300	300	300	300	300	300
Workpiece Material	Applications	Depth of Cut (mm) ap x ae	Outside Dia. DC (mm)	ø3	ø4	ø5	ø6	ø7	ø8	ø9	ø10	ø11	ø12	ø16
Aluminum Alloy Casting	Shouldering	2.5DC x 0.3DC	Feed Rate (mm/min)	2,300	2,200	2,000	2,000	2,000	2,000	2,000	2,000	2,100	2,100	1,500
	Slotting	0.5DC		1,300	1,300	1,300	1,400	1,400	1,400	1,400	1,400	1,400	1,500	1,100
	Plunge milling	0.5DC		300	200	150	160	160	120	120	80	80	60	50

- Water soluble coolant is recommended.
- The cutting conditions should be adjusted based on the overhang of the tool and the machine or workpiece rigidity.
- Spindle revolution and feed rate should be adjusted by the same percentage.
- Pecking may be necessary if chips become clogged while plunge milling.

47ML (Square)

Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø12	ø20
Aluminum Alloys	Shouldering	1.0DC x 0.5DC	Spindle Revolution (min ⁻¹)	16,200	9,700
			Feed Rate (mm/min)	4,660	3,630
	1.0DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	26,700	16,000	
		Feed Rate (mm/min)	17,920	14,080	
	Slotting	1.0DC	Spindle Revolution (min ⁻¹)	13,000	7,800
			Feed Rate (mm/min)	3,750	2,910
Aluminum Alloy Casting (High-silicon)	Shouldering	1.0DC x 0.5DC	Spindle Revolution (min ⁻¹)	6,100	3,700
			Feed Rate (mm/min)	1,760	1,370
	1.0DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	10,100	6,100	
		Feed Rate (mm/min)	6,780	5,330	
	Slotting	1.0DC	Spindle Revolution (min ⁻¹)	4,900	2,900
			Feed Rate (mm/min)	1,410	1,100

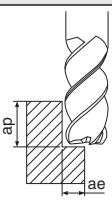
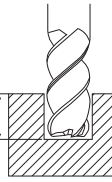
47MB (Ball-nose)

Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø12	ø20	ø25
Aluminum Alloys	Shouldering	0.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	8,100	4,850	3,900
			Feed Rate (mm/min)	2,330	1,815	1,650
	0.5DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	13,350	8,000	6,400	
		Feed Rate (mm/min)	8,960	7,040	6,240	
	Slotting	0.5DC	Spindle Revolution (min ⁻¹)	6,500	3,900	3,100
			Feed Rate (mm/min)	1,875	1,455	1,325
Aluminum Alloy Casting (High-silicon)	Shouldering	0.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	3,050	1,850	1,450
			Feed Rate (mm/min)	880	685	625
	0.5DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	5,050	3,050	2,400	
		Feed Rate (mm/min)	3,390	2,665	2,360	
	Slotting	0.5DC	Spindle Revolution (min ⁻¹)	2,450	1,450	1,200
			Feed Rate (mm/min)	705	550	500

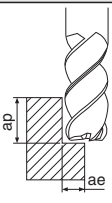
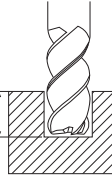
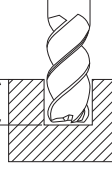
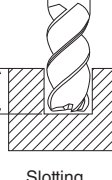
*The ap and feed rate should be adjusted to around 50% of the conditions of above table when overhang of the tool is long.

Recommended Cutting Conditions


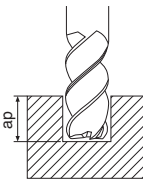

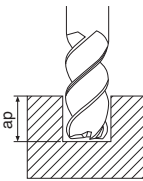
3NESM

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20
 Shouldering	Aluminum Alloys	Shouldering	1.5DC x 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

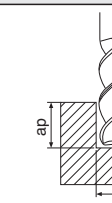
2NFSM

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20	
 Shouldering	Aluminum Alloys	Shouldering	1DC x 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		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	
 Shouldering	High-silicon aluminum	Shouldering	1DC x 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	Slotting	1DC	Spindle Revolution (min ⁻¹)	15,900	7,900	5,900	4,800	4,000	3,000	2,400
					Feed Rate (mm/min)	350	420	420	500	560	640	480

3NFSM

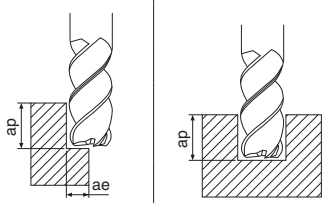
Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø6	ø8	ø10	ø12	ø16	ø20	
 Shouldering	Aluminum Alloys	Shouldering	1DC x 0.5DC	Spindle Revolution (min ⁻¹)	26,500	13,300	10,000	8,000	6,600	5,000	4,000	
				Feed Rate (mm/min)	1,040	1,400	1,400	1,700	1,890	1,490	1,310	
 Slotting		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	
 Shouldering	High-silicon aluminum	Shouldering	1DC x 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	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)

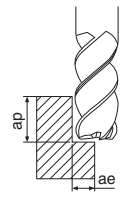
Applications	Workpiece Material	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 Shouldering	Aluminum Alloys	2.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	18,500	9,300	7,000	5,600	4,600	3,500	2,800
			Feed Rate (mm/min)	730	980	980	1,200	1,320	1,040	920
	High-silicon aluminum	1.5DC x 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 x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p> <p>Slotting</p>	Aluminum Alloys	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	33,200	24,900	19,900	16,600	12,400	10,000	8,000	
				Feed Rate (mm/min)	5,370	5,150	5,080	4,980	4,890	4,840	4,780	
		Slotting	1DC	Spindle Revolution (min ⁻¹)	19,900	14,900	11,900	10,000	7,500	6,000	4,800	
				Feed Rate (mm/min)	3,230	3,090	3,050	2,990	2,930	2,900	2,870	
	High-silicon aluminum	Shouldering	1.5DC x 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 x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12	ø16	ø20	ø25
 <p>Shouldering</p>	Aluminum Alloys	2.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	23,000	17,500	14,000	11,600	8,700	7,000	5,600
			Feed Rate (mm/min)	3,760	3,600	3,560	3,490	3,420	3,390	3,350
	High-silicon aluminum		Spindle Revolution (min ⁻¹)	7,400	5,600	4,500	3,700	2,800	2,200	1,800
			Feed Rate (mm/min)	1,000	970	950	920	910	900	900

Slotting is not recommended.

Recommended Cutting Conditions

4FCX-KCD

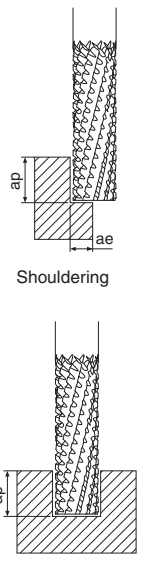
Workpiece Material	Cutting Conditions	DC (mm)		
		ø8	ø10	ø12
CFRP	Spindle Revolution (min ⁻¹)	6,000~10,000	4,800~8,000	4,000~6,600
	Feed Rate (mm/rev)	0.05~0.08	0.05~0.08	0.05~0.08

2ZDF-KCD

Workpiece Material	Cutting Conditions	DC (mm)		
		ø4.763	ø6.350	ø7.938
CFRP	Spindle Revolution (min ⁻¹)	3,400~6,700	2,500~5,000	2,000~4,000
	Feed Rate (mm/rev)	0.04~0.06	0.05~0.08	0.05~0.08

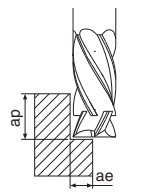
* The recommended cutting conditions are for Dry machining.
 Adjust cutting conditions according to the machine rigidity, the workpiece rigidity and the overhang length.
 Take sufficient measurement against the dust during machining.

29M

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø3	ø6	ø8	ø10
 <p>Shouldering</p> <p>Slotting</p>	Carbon Graphite	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	19,600	9,800	7,400	5,900
				Feed Rate (mm/min)	1,860	1,860	1,860	1,860
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	31,800	15,900	11,900	9,500
		Feed Rate (mm/min)	6,960	6,960	6,960	6,960		
		Slotting	1DC	Spindle Revolution (min ⁻¹)	15,400	7,700	5,800	4,600
				Feed Rate (mm/min)	1,460	1,460	1,460	1,460
	Plastics	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	32,300	16,200	12,100	9,700
				Feed Rate (mm/min)	1,210	1,210	1,210	1,210
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	53,500	26,800	20,100	16,100
		Feed Rate (mm/min)	4,690	4,690	4,690	4,690		
		Slotting	1DC	Spindle Revolution (min ⁻¹)	26,000	13,000	9,700	7,800
				Feed Rate (mm/min)	970	970	970	970
Fiber reinforced plastics CFRP AFRP	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	15,900	8,000	6,000	4,800	
			Feed Rate (mm/min)	970	970	970	970	
		2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	26,500	13,300	9,900	8,000	
	Feed Rate (mm/min)	3,710	3,710	3,710	3,710			
	Slotting	1DC	Spindle Revolution (min ⁻¹)	12,700	6,400	4,800	3,800	
			Feed Rate (mm/min)	780	780	780	780	
Fiber reinforced plastics GFRP	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	12,700	6,400	4,800	3,800	
			Feed Rate (mm/min)	780	780	780	780	
		2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	21,200	10,600	8,000	6,400	
	Feed Rate (mm/min)	2,970	2,970	2,970	2,970			
	Slotting	1DC	Spindle Revolution (min ⁻¹)	10,600	5,300	4,000	3,200	
			Feed Rate (mm/min)	650	650	650	650	

- Adjust parameters based on resin type and fiber structure.
- Reduce speed when overheating causes melting or damage to resin.
- Reduce feed if delamination or fraying occur.
- Rates shown are for dry machining.
- Rates can be increased with coolant.
- Dust collection is needed in dry machining.

25M

Applications	Workpiece Material	Application	Depth of Cut (ap x ae) (mm)	Outside Dia. DC (mm)	ø6	ø8	ø10	ø12
 <p>Shouldering</p>	Fiber reinforced plastics CFRP AFRP	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	8,000	6,000	4,800	4,000
				Feed Rate (mm/min)	1,270	1,550	2,150	3,180
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	13,300	9,900	8,000	6,600
				Feed Rate (mm/min)	5,040	5,770	8,350	12,460
	Fiber reinforced plastics GFRP	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	6,400	4,800	3,800	3,200
				Feed Rate (mm/min)	1,020	1,240	1,720	2,540
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	10,600	8,000	6,400	5,300
				Feed Rate (mm/min)	4,030	4,610	6,680	9,970
	Carbon Graphite	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	9,800	7,400	5,900	4,900
				Feed Rate (mm/min)	1,960	2,350	3,350	4,900
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	15,900	11,900	9,500	8,000
				Feed Rate (mm/min)	7,320	8,830	12,600	18,450
	Plastics	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	16,200	12,100	9,700	8,100
				Feed Rate (mm/min)	3,230	3,880	5,530	8,080
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	26,800	20,100	16,100	13,400
				Feed Rate (mm/min)	12,310	14,860	21,200	31,050
	Machinable Ceramics Machinable Glass	Shouldering	1.5DC x 0.5DC	Spindle Revolution (min ⁻¹)	800	600	500	400
				Feed Rate (mm/min)	60	80	130	160
			2DC x 0.05DC (Finishing)	Spindle Revolution (min ⁻¹)	1,300	1,000	800	700
				Feed Rate (mm/min)	240	300	410	610

- Adjust parameters based on resin type and fiber structure.
- Reduce speed when overheating causes melting or damage to resin.
- Reduce feed if delamination or fraying occur.
- Rates shown are for dry machining.
- Rates can be increased with coolant.
- Dust collection is needed in dry machining.

Slotting is not recommended.

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Recommended Cutting Conditions

IC140 5D type

Workpiece Material		Cutting Speed (m/min)	Spindle Revolution (min ⁻¹)	End Mill Dia. DC (mm)			
				Feed Rate (mm/rev)	ø3	ø6	ø8
Carbon Steel	S15C, etc.	130	Spindle Revolution (min ⁻¹)	13,700	6,900	5,200	4,100
			Feed Rate (mm/rev)	0.10	0.19	0.25	0.32
	≤ 28HRC	120	Spindle Revolution (min ⁻¹)	12,300	6,100	4,600	3,700
			Feed Rate (mm/rev)	0.09	0.17	0.23	0.29
	≤ 45HRC	70	Spindle Revolution (min ⁻¹)	7,100	3,600	2,700	2,100
			Feed Rate (mm/rev)	0.07	0.14	0.19	0.24
Alloy Steel	≤ 28HRC	100	Spindle Revolution (min ⁻¹)	10,700	5,300	4,000	3,200
			Feed Rate (mm/rev)	0.07	0.14	0.19	0.24
	≤ 40HRC	60	Spindle Revolution (min ⁻¹)	6,500	3,200	2,400	1,900
			Feed Rate (mm/rev)	0.06	0.12	0.17	0.21
	≤ 48HRC	45	Spindle Revolution (min ⁻¹)	4,500	2,300	1,700	1,400
			Feed Rate (mm/rev)	0.04	0.09	0.12	0.14
Mold Steel	≤ 40HRC	30	Spindle Revolution (min ⁻¹)	3,100	1,500	1,200	900
			Feed Rate (mm/rev)	0.03	0.06	0.08	0.10
	≤ 50HRC	25	Spindle Revolution (min ⁻¹)	2,700	1,400	1,000	800
			Feed Rate (mm/rev)	0.02	0.04	0.05	0.06
Stainless Steel SUS303, SUS416, etc.	≤ 9HRC	95	Spindle Revolution (min ⁻¹)	9,900	4,900	3,700	3,000
			Feed Rate (mm/rev)	0.06	0.12	0.16	0.21
	≤ 28HRC	60	Spindle Revolution (min ⁻¹)	6,300	3,200	2,400	1,900
			Feed Rate (mm/rev)	0.05	0.10	0.13	0.16
Stainless Steel SUS304, SUS316, etc.	≤ 28HRC	45	Spindle Revolution (min ⁻¹)	4,800	2,400	1,800	1,500
			Feed Rate (mm/rev)	0.05	0.10	0.13	0.16
	≤ 40HRC	35	Spindle Revolution (min ⁻¹)	3,600	1,800	1,300	1,100
			Feed Rate (mm/rev)	0.04	0.08	0.11	0.14
Titanium Alloys	≤ 28HRC	65	Spindle Revolution (min ⁻¹)	6,900	3,500	2,600	2,100
			Feed Rate (mm/rev)	0.04	0.08	0.11	0.13
	≤ 38HRC	50	Spindle Revolution (min ⁻¹)	5,200	2,600	1,900	1,600
			Feed Rate (mm/rev)	0.04	0.08	0.10	0.13
	≤ 47HRC	25	Spindle Revolution (min ⁻¹)	2,700	1,400	1,000	800
			Feed Rate (mm/rev)	0.03	0.06	0.08	0.10
Superalloy Inconel® 625, etc.	≤ 32HRC	30	Spindle Revolution (min ⁻¹)	3,100	1,500	1,200	900
			Feed Rate (mm/rev)	0.02	0.04	0.05	0.07
	≤ 43HRC	15	Spindle Revolution (min ⁻¹)	1,600	800	600	500
			Feed Rate (mm/rev)	0.02	0.03	0.04	0.05
Cast Iron	≤ 19HRC	110	Spindle Revolution (min ⁻¹)	11,600	5,800	4,400	3,500
			Feed Rate (mm/rev)	0.11	0.22	0.29	0.36
	≤ 26HRC	100	Spindle Revolution (min ⁻¹)	10,800	5,400	4,100	3,200
			Feed Rate (mm/rev)	0.11	0.22	0.29	0.36
Aluminum Alloys	A7075, etc.	200	Spindle Revolution (min ⁻¹)	21,300	10,700	8,000	6,400
			Feed Rate (mm/rev)	0.12	0.24	0.32	0.40
Copper alloys	Brass, etc.	170	Spindle Revolution (min ⁻¹)	17,800	8,900	6,700	5,300
			Feed Rate (mm/rev)	0.05	0.10	0.13	0.16
	Beryllium Copper, etc.	135	Spindle Revolution (min ⁻¹)	14,200	7,100	5,300	4,300
			Feed Rate (mm/rev)	0.05	0.10	0.13	0.16

L
Solid Tools

- End Mills
- Solid Tools for CFRP
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- Cutting Conditions

IC140 8D type

Workpiece Material		Cutting Speed (m/min)	Spindle Revolution (min ⁻¹)	End Mill Dia. DC (mm)				
				Feed Rate (mm/rev)	ø3	ø6	ø8	ø10
Carbon Steel	S15C, etc.	125	Spindle Revolution (min ⁻¹)	13,100	6,500	4,900	3,900	
			Feed Rate (mm/rev)	0.09	0.17	0.23	0.29	
	≤ 28HRC	115	Spindle Revolution (min ⁻¹)	12,000	6,000	4,500	3,600	
			Feed Rate (mm/rev)	0.07	0.14	0.19	0.24	
	≤ 45HRC	65	Spindle Revolution (min ⁻¹)	6,800	3,400	2,500	2,000	
			Feed Rate (mm/rev)	0.06	0.12	0.17	0.21	
Alloy Steel	≤ 28HRC	100	Spindle Revolution (min ⁻¹)	10,300	5,200	3,900	3,100	
			Feed Rate (mm/rev)	0.06	0.12	0.16	0.21	
	≤ 40HRC	60	Spindle Revolution (min ⁻¹)	6,100	3,100	2,300	1,800	
			Feed Rate (mm/rev)	0.05	0.10	0.13	0.16	
	≤ 48HRC	40	Spindle Revolution (min ⁻¹)	4,400	2,200	1,600	1,300	
			Feed Rate (mm/rev)	0.04	0.08	0.10	0.13	
Mold Steel	≤ 40HRC	30	Spindle Revolution (min ⁻¹)	2,900	1,500	1,100	900	
			Feed Rate (mm/rev)	0.03	0.05	0.07	0.09	
	≤ 50HRC	25	Spindle Revolution (min ⁻¹)	2,600	1,300	1,000	800	
			Feed Rate (mm/rev)	0.02	0.03	0.04	0.05	
	Stainless Steel SUS303, SUS416, etc.	≤ 9HRC	90	Spindle Revolution (min ⁻¹)	9,400	4,700	3,500	2,800
				Feed Rate (mm/rev)	0.05	0.10	0.13	0.16
≤ 28HRC		55	Spindle Revolution (min ⁻¹)	5,800	2,900	2,200	1,700	
			Feed Rate (mm/rev)	0.04	0.09	0.12	0.15	
Stainless Steel SUS304, SUS316, etc.		≤ 28HRC	40	Spindle Revolution (min ⁻¹)	4,200	2,100	1,600	1,300
				Feed Rate (mm/rev)	0.04	0.09	0.11	0.14
	≤ 40HRC	30	Spindle Revolution (min ⁻¹)	3,100	1,500	1,200	900	
			Feed Rate (mm/rev)	0.04	0.07	0.10	0.12	
	Titanium Alloys	≤ 28HRC	55	Spindle Revolution (min ⁻¹)	6,000	3,000	2,200	1,800
				Feed Rate (mm/rev)	0.04	0.08	0.10	0.13
≤ 38HRC		45	Spindle Revolution (min ⁻¹)	4,500	2,300	1,700	1,400	
			Feed Rate (mm/rev)	0.03	0.06	0.08	0.09	
≤ 47HRC		25	Spindle Revolution (min ⁻¹)	2,400	1,200	900	700	
			Feed Rate (mm/rev)	0.02	0.05	0.06	0.08	
Superalloy Inconel® 625, etc.	≤ 32HRC	20	Spindle Revolution (min ⁻¹)	2,100	1,100	800	600	
			Feed Rate (mm/rev)	0.02	0.04	0.06	0.07	
	≤ 43HRC	10	Spindle Revolution (min ⁻¹)	1,100	600	400	300	
			Feed Rate (mm/rev)	0.01	0.03	0.04	0.05	
	Cast Iron	≤ 19HRC	110	Spindle Revolution (min ⁻¹)	11,300	5,700	4,200	3,400
				Feed Rate (mm/rev)	0.09	0.18	0.24	0.30
≤ 26HRC		95	Spindle Revolution (min ⁻¹)	10,000	5,000	3,800	3,000	
			Feed Rate (mm/rev)	0.09	0.19	0.25	0.31	
Aluminum Alloys		A7075, etc.	195	Spindle Revolution (min ⁻¹)	20,500	10,300	7,700	6,200
				Feed Rate (mm/rev)	0.11	0.22	0.30	0.37
Copper alloys	Brass, etc.	80	Spindle Revolution (min ⁻¹)	8,200	4,100	3,100	2,500	
			Feed Rate (mm/rev)	0.04	0.09	0.12	0.14	
	Beryllium Copper, etc.	70	Spindle Revolution (min ⁻¹)	7,600	3,800	2,800	2,300	
			Feed Rate (mm/rev)	0.04	0.09	0.12	0.15	

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Recommended Cutting Conditions

GP108M

Workpiece Material		Cutting Speed (m/min)	Spindle Revolution (min ⁻¹)		End Mill Dia. DC (mm)					
			Feed Rate (mm/rev)		ø1	ø3	ø6	ø8	ø10	ø12
Carbon Steel	S15C, etc.	80	Spindle Revolution (min ⁻¹)	25,700	8,600	4,300	3,200	2,600	2,100	
			Feed Rate (mm/rev)	0.01	0.04	0.08	0.11	0.14	0.16	
	≤ 32HRC	40	Spindle Revolution (min ⁻¹)	12,100	4,000	2,000	1,500	1,200	1,000	
			Feed Rate (mm/rev)	0.01	0.04	0.07	0.10	0.12	0.14	
	≤ 45HRC	25	Spindle Revolution (min ⁻¹)	8,200	2,700	1,400	1,000	800	700	
			Feed Rate (mm/rev)	0.007	0.02	0.04	0.05	0.07	0.08	
Alloy Steel	≤ 28HRC	70	Spindle Revolution (min ⁻¹)	22,300	7,400	3,700	2,800	2,200	1,900	
			Feed Rate (mm/rev)	0.01	0.04	0.07	0.10	0.12	0.15	
	≤ 40HRC	45	Spindle Revolution (min ⁻¹)	14,100	4,700	2,300	1,800	1,400	1,200	
			Feed Rate (mm/rev)	0.01	0.04	0.07	0.10	0.12	0.15	
	≤ 48HRC	20	Spindle Revolution (min ⁻¹)	5,800	1,900	1,000	700	600	500	
			Feed Rate (mm/rev)	0.005	0.02	0.03	0.04	0.05	0.06	
Mold Steel	≤ 24HRC	25	Spindle Revolution (min ⁻¹)	8,200	2,700	1,400	1,000	800	700	
			Feed Rate (mm/rev)	0.007	0.02	0.04	0.05	0.07	0.08	
	≤ 40HRC	20	Spindle Revolution (min ⁻¹)	5,300	1,800	900	700	500	400	
			Feed Rate (mm/rev)	0.003	0.01	0.02	0.03	0.03	0.04	
	≤ 50HRC	10	Spindle Revolution (min ⁻¹)	3,900	1,300	600	500	400	300	
			Feed Rate (mm/rev)	0.003	0.01	0.02	0.03	0.03	0.04	
Stainless Steel SUS303, SUS416, etc.	≤ 24HRC	65	Spindle Revolution (min ⁻¹)	20,400	6,800	3,400	2,500	2,000	1,700	
			Feed Rate (mm/rev)	0.01	0.03	0.06	0.08	0.10	0.12	
	≤ 36HRC	35	Spindle Revolution (min ⁻¹)	10,700	3,600	1,800	1,300	1,100	900	
			Feed Rate (mm/rev)	0.006	0.02	0.03	0.05	0.06	0.07	
	Stainless Steel SUS304, SUS316, etc.	≤ 28HRC	20	Spindle Revolution (min ⁻¹)	6,300	2,100	1,100	800	600	500
				Feed Rate (mm/rev)	0.007	0.02	0.04	0.06	0.07	0.09
≤ 40HRC		20	Spindle Revolution (min ⁻¹)	5,300	1,800	900	700	500	400	
			Feed Rate (mm/rev)	0.007	0.02	0.04	0.05	0.07	0.08	
Titanium Alloys		≤ 28HRC	25	Spindle Revolution (min ⁻¹)	8,200	2,700	1,400	1,000	800	700
				Feed Rate (mm/rev)	0.01	0.04	0.08	0.11	0.13	0.16
	≤ 38HRC	20	Spindle Revolution (min ⁻¹)	6,300	2,100	1,100	800	600	500	
			Feed Rate (mm/rev)	0.007	0.02	0.04	0.06	0.07	0.09	
	≤ 47HRC	20	Spindle Revolution (min ⁻¹)	5,300	1,800	900	700	500	400	
			Feed Rate (mm/rev)	0.007	0.02	0.04	0.05	0.07	0.08	
Superalloy Inconel® 625, etc.	≤ 19HRC	15	Spindle Revolution (min ⁻¹)	3,900	1,300	600	500	400	300	
			Feed Rate (mm/rev)	0.006	0.02	0.04	0.05	0.06	0.08	
	≤ 34HRC	10	Spindle Revolution (min ⁻¹)	2,400	800	400	300	200	200	
			Feed Rate (mm/rev)	0.006	0.02	0.04	0.05	0.06	0.07	
	≤ 45HRC	5	Spindle Revolution (min ⁻¹)	1,900	600	300	200	200	200	
			Feed Rate (mm/rev)	0.005	0.02	0.03	0.04	0.05	0.06	
Cast Iron	≤ 19HRC	85	Spindle Revolution (min ⁻¹)	27,100	9,000	4,500	3,400	2,700	2,300	
			Feed Rate (mm/rev)	0.02	0.05	0.10	0.13	0.16	0.20	
	≤ 36HRC	75	Spindle Revolution (min ⁻¹)	24,200	8,100	4,000	3,000	2,400	2,000	
			Feed Rate (mm/rev)	0.02	0.05	0.10	0.13	0.17	0.20	
	Aluminum Alloys	A7075, etc.	140	Spindle Revolution (min ⁻¹)	44,100	14,700	7,400	5,500	4,400	3,700
				Feed Rate (mm/rev)	0.02	0.06	0.12	0.16	0.20	0.24
Copper alloys	Brass, etc.	60	Spindle Revolution (min ⁻¹)	18,400	6,100	3,100	2,300	1,800	1,500	
			Feed Rate (mm/rev)	0.01	0.03	0.06	0.08	0.10	0.12	
	Beryllium Copper, etc.	55	Spindle Revolution (min ⁻¹)	17,000	5,700	2,800	2,100	1,700	1,400	
			Feed Rate (mm/rev)	0.01	0.03	0.06	0.08	0.10	0.12	
Plastics	PVC, etc.	150	Spindle Revolution (min ⁻¹)	48,500	16,200	8,100	6,100	4,800	4,000	
			Feed Rate (mm/rev)	0.02	0.06	0.12	0.16	0.20	0.24	

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Workpiece Material		Cutting Speed (m/min)	Spindle Revolution (min ⁻¹)	End Mill Dia. DC (mm)			
				Feed Rate (mm/rev)	ø3	ø6	ø10
Carbon Steel	S15C, etc.	90	Spindle Revolution (min ⁻¹)	9,500	4,800	2,900	2,400
			Feed Rate (mm/rev)	0.06	0.12	0.21	0.25
	≤ 32HRC	80	Spindle Revolution (min ⁻¹)	8,400	4,200	2,500	2,100
			Feed Rate (mm/rev)	0.06	0.11	0.18	0.22
	≤ 45HRC	45	Spindle Revolution (min ⁻¹)	4,800	2,400	1,500	1,200
			Feed Rate (mm/rev)	0.03	0.06	0.11	0.13
Alloy Steel	≤ 28HRC	70	Spindle Revolution (min ⁻¹)	7,400	3,700	2,200	1,900
			Feed Rate (mm/rev)	0.05	0.09	0.16	0.19
	≤ 40HRC	45	Spindle Revolution (min ⁻¹)	4,700	2,300	1,400	1,200
			Feed Rate (mm/rev)	0.05	0.09	0.15	0.18
	≤ 48HRC	35	Spindle Revolution (min ⁻¹)	3,700	1,900	1,100	900
			Feed Rate (mm/rev)	0.01	0.02	0.04	0.05
Mold Steel	≤ 24HRC	25	Spindle Revolution (min ⁻¹)	2,700	1,400	800	700
			Feed Rate (mm/rev)	0.03	0.06	0.10	0.12
	≤ 40HRC	20	Spindle Revolution (min ⁻¹)	2,100	1,100	600	500
			Feed Rate (mm/rev)	0.02	0.03	0.06	0.07
	≤ 50HRC	15	Spindle Revolution (min ⁻¹)	1,600	800	500	400
			Feed Rate (mm/rev)	0.02	0.03	0.05	0.06
Cast Iron	≤ 19HRC	75	Spindle Revolution (min ⁻¹)	8,100	4,000	2,400	2,000
			Feed Rate (mm/rev)	0.06	0.13	0.21	0.25
	≤ 36HRC	60	Spindle Revolution (min ⁻¹)	6,300	3,200	1,900	1,600
			Feed Rate (mm/rev)	0.05	0.11	0.18	0.21
Aluminum Alloys	A7075	140	Spindle Revolution (min ⁻¹)	14,700	7,400	4,400	3,700
			Feed Rate (mm/rev)	0.08	0.16	0.26	0.31
Copper alloys	Brass, etc.	95	Spindle Revolution (min ⁻¹)	9,900	4,900	3,000	2,500
			Feed Rate (mm/rev)	0.05	0.09	0.16	0.19
	Beryllium Copper, etc.	50	Spindle Revolution (min ⁻¹)	5,200	2,600	1,600	1,300
			Feed Rate (mm/rev)	0.04	0.08	0.13	0.16

HP131N

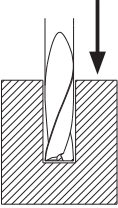
Workpiece Material		Cutting Speed (m/min)	Spindle Revolution (min ⁻¹)	End Mill Dia. DC (mm)				
				Feed Rate (mm/rev)	ø3	ø6	ø8	ø10
Aluminum Alloys Si < 12%	A7075, etc.	245	Spindle Revolution (min ⁻¹)	25,900	12,900	9,700	7,800	6,500
			Feed Rate (mm/rev)	0.13	0.27	0.35	0.44	0.53
Aluminum Alloys Si > 12%	A356, etc.	185	Spindle Revolution (min ⁻¹)	19,400	9,700	7,300	5,800	4,800
			Feed Rate (mm/rev)	0.13	0.26	0.35	0.44	0.52
Copper alloys	Beryllium Copper, etc.	170	Spindle Revolution (min ⁻¹)	17,800	8,900	6,700	5,300	4,400
			Feed Rate (mm/rev)	0.05	0.10	0.13	0.16	0.19
Plastics	PVC, etc.	140	Spindle Revolution (min ⁻¹)	14,500	7,300	5,500	4,400	3,600
			Feed Rate (mm/rev)	0.06	0.12	0.16	0.20	0.24

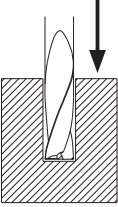
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Recommended Cutting Conditions (Plunge milling)

2ZDK

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø1	ø2	ø3	ø4	ø5	ø6	ø8
 <p>Plunge milling</p>	Structural Steel Carbon Steel	Plunge milling	Spindle Revolution (min ⁻¹)	19,500	11,200	8,300	6,200	5,000	4,200	3,200
			Feed Rate (mm/min)	300	380	520	520	520	520	520
	Alloy Steel		Spindle Revolution (min ⁻¹)	19,000	10,000	7,200	5,400	4,400	3,600	2,700
			Feed Rate (mm/min)	300	320	450	450	450	450	450
	Prehardened steel (30 ~ 45HRC)		Spindle Revolution (min ⁻¹)	16,000	8,000	3,900	2,900	2,300	1,900	1,500
			Feed Rate (mm/min)	210	210	210	210	210	210	210
	Nodular Cast Iron		Spindle Revolution (min ⁻¹)	16,000	10,000	7,200	5,400	4,400	3,600	2,700
			Feed Rate (mm/min)	200	300	390	390	390	390	390
	Aluminum Alloys		Spindle Revolution (min ⁻¹)	20,000	20,000	17,800	13,100	10,500	8,900	6,700
			Feed Rate (mm/min)	500	850	1,270	1,270	1,270	1,270	1,270
	Aluminum Alloy Casting		Spindle Revolution (min ⁻¹)	20,000	20,000	13,100	10,000	8,000	6,700	5,000
			Feed Rate (mm/min)	450	750	820	820	820	820	820

Applications	Workpiece Material	Application	Outside Dia. DC (mm)	ø10	ø12	ø14	ø16	ø18	ø20
 <p>Plunge milling</p>	Structural Steel Carbon Steel	Plunge milling	Spindle Revolution (min ⁻¹)	2,500	2,100	1,800	1,600	1,400	1,300
			Feed Rate (mm/min)	450	450	450	450	450	450
	Alloy Steel		Spindle Revolution (min ⁻¹)	2,200	1,800	1,500	1,350	1,200	1,100
			Feed Rate (mm/min)	400	400	400	400	400	400
	Prehardened steel (30 ~ 45HRC)		Spindle Revolution (min ⁻¹)	1,200	1,000	850	750	650	600
			Feed Rate (mm/min)	190	190	190	190	190	190
	Nodular Cast Iron		Spindle Revolution (min ⁻¹)	2,200	1,800	1,550	1,350	1,200	1,100
			Feed Rate (mm/min)	340	340	340	340	340	340
	Aluminum Alloys		Spindle Revolution (min ⁻¹)	5,400	4,500	3,800	3,400	3,000	2,700
			Feed Rate (mm/min)	1,270	1,270	1,270	1,270	1,270	1,270
	Aluminum Alloy Casting		Spindle Revolution (min ⁻¹)	4,000	3,400	2,900	2,500	2,200	2,000
			Feed Rate (mm/min)	820	820	820	820	820	820

NOT recommended for slotting

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

- Coolant is recommended.
- Adjust cutting conditions to suit machine rigidity.
- Use chuck and machine with as high rigidity as possible.
- Stainless steel machining is NOT recommended.
- Cutting conditions adjustment is required when machining a slant surface, depending on the slant angle. (fig.1)

When workpiece slant angle is 30° or less, reduce the feed rate by 50%.

When workpiece slant angle is more than 30°, reduce the revolution by 70% and the feed rate by 30%.

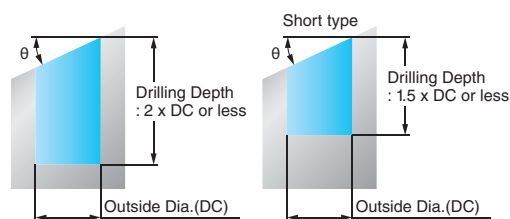


Fig. 1