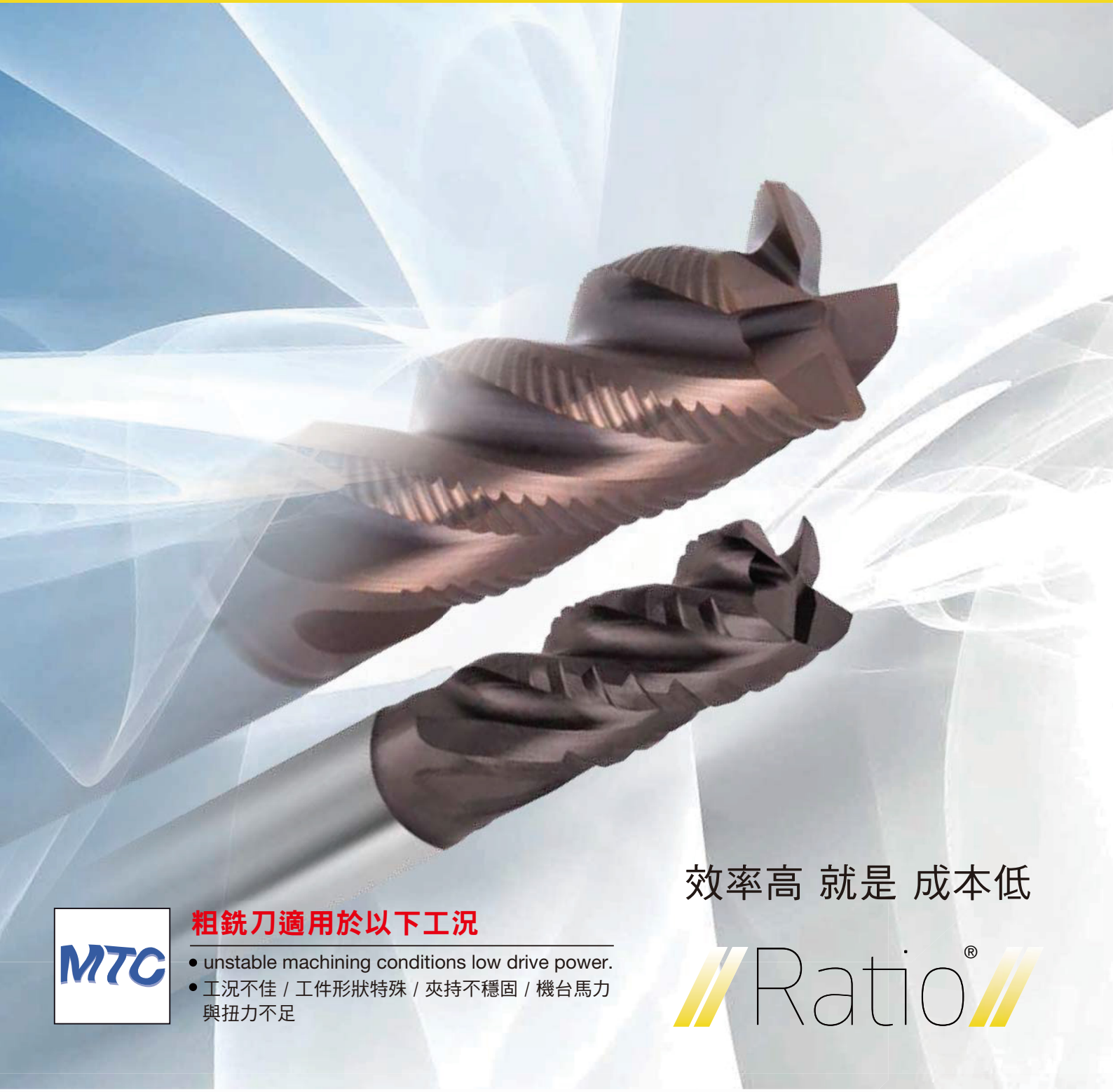
GÜHRING



效率高 就是 成本低

Ratio®

MTC

粗銑刀適用於以下工況

- unstable machining conditions low drive power.
- 工況不佳 / 工件形狀特殊 / 夾持不穩固 / 機台馬力與扭力不足

Roughing End Mills
The complete programme

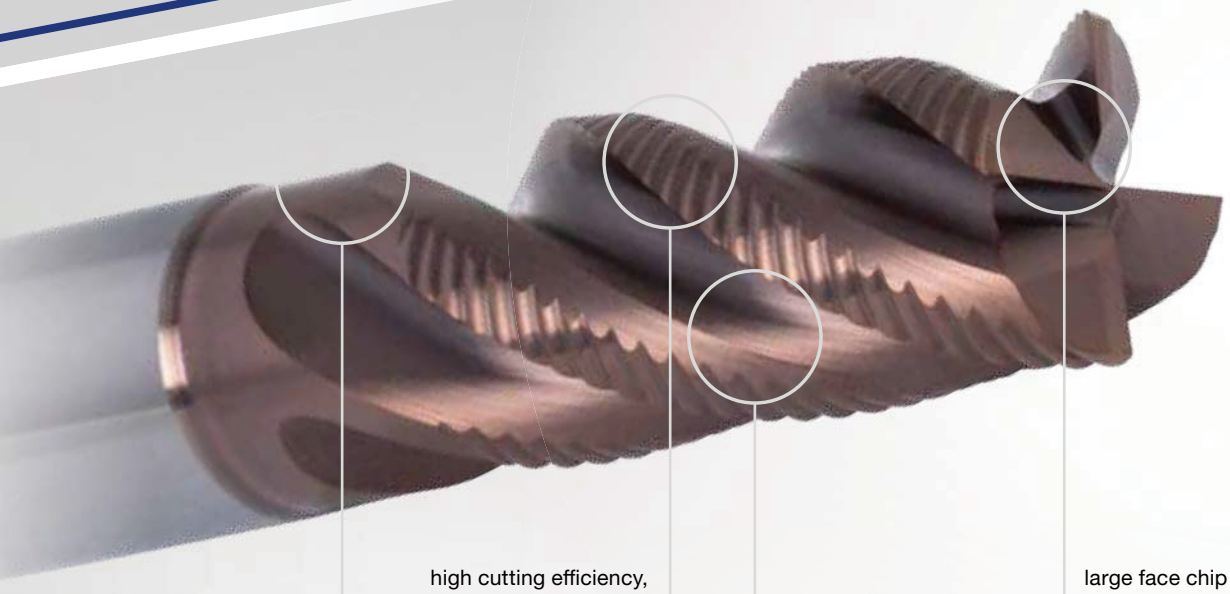
粗銑刀 全系列

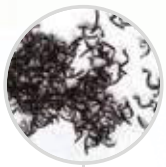
GÜHRING – YOUR WORLDWIDE PARTNER

鈷領是您提升生產效率與整體解決方案的最佳伙伴

NEW

RATIO®-HIGH-PERFORMANCE ROUGHING END MILLS with optimised geometries





the innovative round knuckle HRf geometry ensures particularly small chips

HRf的創新的圓弧形齒形切屑特別的小

with neck clearance and 2 length options

縮頸設計
2種長度選擇

high cutting efficiency, round knuckle HRf geometry for minimum power consumption and lower cutting force

高切削效率，
HRf 圓弧齒形幾何形狀
最低功耗和更低的切削阻力

larger flutes guarantee an optimal chip evacuation with increased feeds

更大的排屑槽
實現最佳排屑性
增加進給效率

large face chip chambers and double protected cutting edge corners for minimum vibration plunging, ramping and orbital milling

刀底容屑空間充足
雙重刃口保護
插銑、斜向銑和開槽削
能降低機台振動與震刀

new roughing end mill with ROUND KNUCKLE-TYPE GEOMETRY
帶有圓角型幾何形狀的新型粗加工立銑刀

// perfect stability thanks to extra-flat round knuckle-type HRf roughing geometry

// lower cutting forces ideal for less powerful machines & clamping conditions

// stable machining conditions allow high metal removal rates with cutting depths up to 2xD

// 由於HRf的創新的圓弧形齒形，實現了完美的穩定性

// 切削阻力低，非常適合功率較小的機器和夾緊條件不佳的工況

// 穩定的加工條件，高的金屬移除率，最高可達2D加工深度

You can find the new roughing end mills with round knuckle-type geometry on page 9 and 10.

HRf 創新的圓弧形齒形粗銑刀，請參考第9、10頁

short chips thanks to innovative roughing geometry
創新的粗加工槽形使切屑變短

more stable asymmetrical knuckles produce smooth rough-finish surfaces
更穩定的不對稱齒形產生光滑的粗銑削表面

larger flutes for optimal chip evacuation
加大的溝槽使排屑性更好

roughing geometry reduces the cutting pressure in comparison to smooth cutting milling cutters
與一般平銑刀相比粗加工幾何形狀降低了切削阻力

new roughing end mill with FLAT KNUCKLE-TYPE TEETH
帶有平角齒的新型粗加工立銑刀

// increased metal removal rate by utilising the entire cutting edge length
// up to 60 % longer tool life with high process reliability
// ideal for less powerful machines and unstable clamping
// 利用整個切削刃長度來提高金屬去除率
// 刀具壽命延長 60 %，加工過程可靠性高
// 適用於功率較小的機器和工件夾緊情況不穩定的情況

You can find the new roughing end mills with flat knuckle-type teeth from page 11.
平角齒的新型粗加工粗銑刀，請參考第11頁

RF 100 A WF 高效率型
鋁合金碳基鍍層粗銑刀，P22～25.

For high-performance roughing of aluminium with Carbo-coating

RF 100 A WF | page 22-25

RF 100 U HF 高抗張力鋼、鑄鐵用，P11～13.

For machining of steel, high tensile and cast iron materials

RF 100 U HF | page 11-13

RF 100 VA NF 軟、韌性鋼材、不銹鋼、碳鋼、鑄鐵、非鐵金屬用，P15～16.

Universal application for soft tough steels, stainless, low-alloyed cast iron and non-ferrous materials

RF 100 VA NF | page 15-16

RATIO

Ratio®

RATIO END MILLS　高效率銑刀

// extremely smooth operation and max. metal removal rates thanks to unequal helix angles and unequal cutting edge

// long tool life and process reliable machining thanks to tough carbide substrates and wear-resistant coatings

// material-specific flute profiles and face cutting for optimal smooth running and perfect chip evacuation

// 由於不等螺旋角和不等分割的切削刃，得到了穩定的銑削加工與得到最大的金屬移除率

// 採用堅韌的鎢鋼材質和耐磨耗塗層，刀具壽命長，加工過程穩定可靠

// 特殊的排屑槽形和端面刃口，實現最佳的平穩加工和完美的排屑

For universal roughing operations

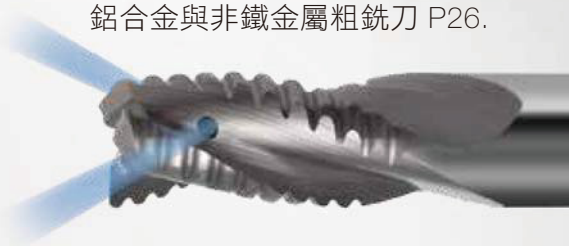
GS 100 U | page 18-19

GS 100 U
泛用型粗銑刀 P18～19.

For high-performance roughing of aluminium and non-ferrous metals

GS 100 A | page 26

GS 100 A 高效率型
鋁合金與非鐵金屬粗銑刀 P26.



For all tough materials

RS 100 U | page 17

RS 100 U
韌性材質用粗銑刀 P17.

Machining of high tensile materials

RS 100 F | page 14

RS 100 U
高抗張力材質用粗銑刀 P14.

UNIVERSAL

ISO code

P	Steel, high-alloyed steel
M	Stainless steel
K	Grey cast iron, spheroidal graphite iron and malleable cast iron
N	Aluminium and other non-ferrous metals
S	Special, super and titanium-alloys
H	Hardened steel and chilled cast iron

On the product pages you will find recommendations on the suitability for the application groups and information on the max. tensile strength and hardness for every tool:

- ● optimal suitability
- ○ limited suitability

Coatings

○ bright Cb Carbo 碳基鍍層 F FIRE/nano FIRE a TiAlN nanoA Y Signum

Pictograms

Tool material

Solid carbide finest grain (carbide-UF)

High speed steel

Shank form

to DIN 6535

Standard

to DIN

to Gühring standard

Type

Application area similar to DIN 1836

Applications

Slotting Roughing Ramping Helix Drilling

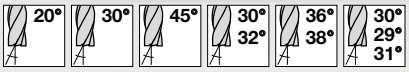
Length

short (DIN) medium length extra length

Number of cutting edges

Number of major cutting edges

Helix angle



Size of helix angle/number of different helix angles

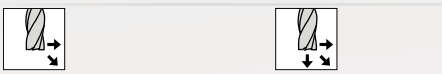
Rake angle

Rake angle of circumference cutting edges

Cutting edge form

Corner chamfer

Feed

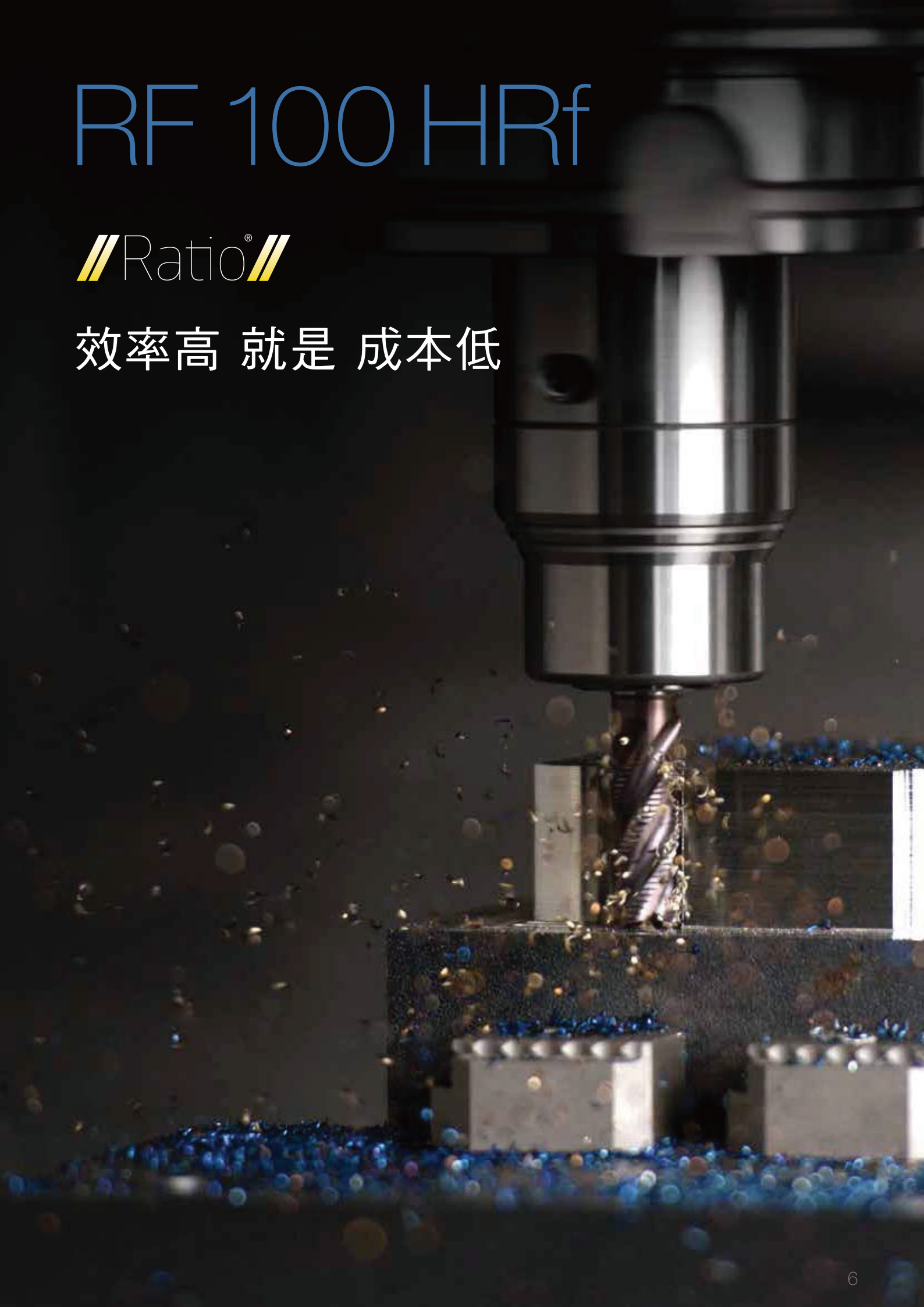


for lateral feed and ramping for lateral feed, ramping and drilling

RF 100 HRf

//Ratio®//

效率高 就是 成本低



P	M	K	N	S	H	Tool illustration 刀具示意圖	刃數 Z	柄部 Hard-ness	長度 Length	螺旋角 Helix angle °	材質 Tool material	鍍層 Sur-face	尺寸範圍 d1/mm	編號 Article no.	頁次 Page

可加工材質種類

Standard Ratio end mills RF 100 U

•	•	•		○	○	NEW	4	48 HRC		36° 38°	VHM	Y	6.000 - 20.000	6970	9
•	•	•		○	○	NEW	4	48 HRC		36° 38°	VHM	Y	6.000 - 20.000	6971	9
•	•	•		○	○	NEW	4	48 HRC		36° 38°	VHM	Y	6.000 - 20.000	6972	10
•	•	•		○	○	NEW	4	48 HRC		36° 38°	VHM	Y	6.000 - 20.000	6973	10
•		•					4			30° 32°	VHM	F	6.000 - 25.000	6881	11
•		•					4			30° 32°	VHM	F	6.000 - 25.000	6882	11
•		•					4		3xD	30° 32°	VHM	F	6.000 - 20.000	6883	12
•		•					4		3xD	30° 32°	VHM	F	6.000 - 20.000	6884	12
•		•					4			30° 32°	VHM	F	6.000 - 20.000	6885	13
•		•					4			30° 32°	VHM	F	6.000 - 20.000	6886	13

High-performance roughing end mills RS 100 F

•		•			○		5-6	48 HRC		45°	VHM	F	6.000 - 25.000	6889	14
•		•			○		5-6	48 HRC		45°	VHM	F	6.000 - 25.000	6890	14

Ratio end mills RF 100 VA

•	•	•	○	○			4			36° 38°	VHM	a	5.000 - 25.000	6877	15
•	•	•	○	○			4			36° 38°	VHM	a	5.000 - 25.000	6878	15
•	•	•	○	○			4			36° 38°	VHM	a	6.000 - 20.000	6879	16
•	•	•	○	○			4			36° 38°	VHM	a	6.000 - 20.000	6880	16

High-performance roughing end mills RS 100 U

•	•	•	○	•			4-5			30°	VHM	F	6.000 - 25.000	6887	17
•	•	•	○	•			4-5			30°	VHM	F	6.000 - 25.000	6888	17

Roughing end mills GS 100 U (fine teeth)

•	•	•	○	○			4-5			30°	VHM	F	6.000 - 25.000	3723	18
•	•	•	○	○			4			30°	VHM	F	6.000 - 20.000	3365	19

可加工材質種類

P	M	K	N	S	H	Tool illustration 刀具示意圖	刃數 Z	柄部 Hard-ness	長度 Length	螺旋角 Helix angle °	材質 Tool material	鍍層 Sur-face	尺寸範圍 d1/mm	編號 Article no.	頁次 Page
Hard roughing end mills GS 100 H (fine teeth)															
•		•			•		4	55 HRC		20°	VHM	Y	6.000 - 25.000	6704	20
•		•			•		4	55 HRC		20°	VHM	Y	6.000 - 25.000	6705	20
•		•			•		4	55 HRC		20°	VHM	Y	6.000 - 20.000	3682	21
Ratio end mills Alu RF 100 A															
			•			 NEW	3			30° 29° 31°	VHM	Cb	6.000 - 20.000	6974	22
			•			 NEW	3			30° 29° 31°	VHM	Cb	6.000 - 20.000	6975	22
			•			 NEW	3			30° 29° 31°	VHM	Cb	6.000 - 20.000	6976	23
			○			 NEW	3			30° 29° 31°	VHM	Cb	6.000 - 20.000	6977	23
			•				3			30° 29° 31°	VHM	○	6.000 - 25.000	6868	24
			•				3			30° 29° 31°	VHM	○	6.000 - 25.000	6869	24
			•				3			30° 29° 31°	VHM	○	6.000 - 20.000	6870	25
			•				3			30° 29° 31°	VHM	○	6.000 - 20.000	6871	25
Roughing end mills GS 100 A (coarse teeth)															
			•				3			30°	VHM	○	6.000 - 25.000	3364	26
			•				3			30°	VHM	○	6.000 - 25.000	3127	26
Roughing end mills GS 40 (fine teeth)															
•	•	•	•	○			3			30°	HSS-E-PM	○	6.000 - 20.000	3322	27
•	•	•	•	○			3			30°	HSS-E-PM	F	6.000 - 20.000	3668	27
•	•	•	•	○			4-6			30°	HSS-E-PM	○	6.000 - 32.000	3340	28
•	•	•	•	○			4-6			30°	HSS-E-PM	F	6.000 - 32.000	3660	28
Roughing end mills GS 80 (fine teeth)															
•	•	•	•	○			3-6			45°	HSS-E-PM	F	4.000 - 25.000	6756	30

M42、HSS-CO 材質粗銑刀系列 31~36

Standard Ratio end mills RF 100 U

RF 100 U HRf

DIN 6527 L | HRf | 4 | 36° 38° | 45° | 7° | 48 HRC

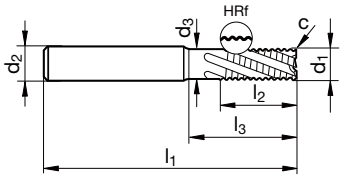
Tool material	Solid carbide	
Surface	Y	Y
Type	HRf	HRf
Shank form	HA	HB
	NEW	NEW

P	•
M	•
K	•
N	
S	○
H	○

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



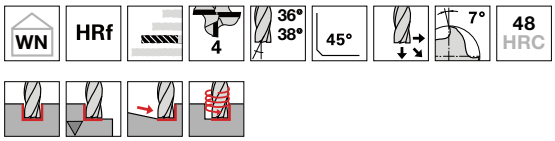
編號	6970	6971
Discount group	106	106

d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
6.00	6.00	5.70	57	13.0	20.0	0.12	4	6.00	2,400	2,400
8.00	8.00	7.70	63	19.0	26.0	0.16	4	8.00	2,900	3,000
10.00	10.00	9.50	72	22.0	30.0	0.20	4	10.00	3,300	3,400
12.00	12.00	11.50	83	26.0	36.0	0.24	4	12.00	3,900	4,100
16.00	16.00	15.50	92	32.0	42.0	0.32	4	16.00	6,300	6,400
20.00	20.00	19.50	104	38.0	52.0	0.40	4	20.00	9,600	9,800

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D					切寬 a_e = 1,0 x D			切深 a_p = 1,5 x D					最大切寬 a_e max = 0,75 x D	
P	≤850 N/mm²	**135**	0,009	0,018	0,024	0,032	0,038	0,051	0,064	**160**	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥850 N/mm²	**100**	0,008	0,017	0,022	0,030	0,036	0,048	0,060	**120**	0,010	0,019	0,026	0,035	0,041	0,055	0,069
M	≤750 N/mm²	**90**	0,008	0,017	0,022	0,030	0,036	0,048	0,060	**110**	0,010	0,019	0,026	0,035	0,041	0,055	0,069
	≥750 N/mm²	**55**	0,007	0,013	0,018	0,025	0,030	0,040	0,050	**70**	0,008	0,016	0,021	0,030	0,036	0,048	0,060
S	Ni-based	**25**	0,006	0,012	0,016	0,022	0,026	0,035	0,044	**40**	0,007	0,014	0,019	0,026	0,032	0,042	0,053
	Ti-based	**50**	0,007	0,013	0,018	0,025	0,030	0,040	0,050	**70**	0,008	0,016	0,021	0,030	0,036	0,048	0,060
K	≤240 HB	**120**	0,009	0,018	0,024	0,032	0,038	0,051	0,064	**140**	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥240 HB	**105**	0,008	0,017	0,022	0,030	0,036	0,048	0,060	**130**	0,010	0,019	0,026	0,035	0,041	0,055	0,069

Standard Ratio end mills RF 100 U

RF 100 U HRf



Tool material	Solid carbide	
Surface	Y	Y
Type	HRf	HRf
Shank form	HA	HB
	NEW	NEW

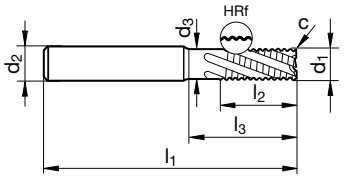
P	•
M	•
K	•
N	
S	○
H	○

GÜHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



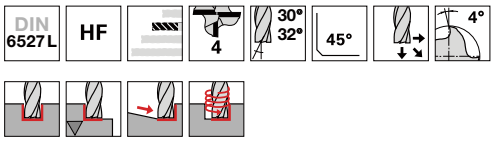
編號	6972	6973
Discount group	106	106

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm	mm x 45°	刃數			
6.00	6.00	5.70	65	13.0	28.0	0.12	4	6.00	2,600	2,700
8.00	8.00	7.70	75	19.0	38.0	0.16	4	8.00	3,200	3,300
10.00	10.00	9.50	80	22.0	38.0	0.20	4	10.00	3,600	3,700
12.00	12.00	11.50	93	26.0	46.0	0.24	4	12.00	4,300	4,500
16.00	16.00	15.50	108	32.0	58.0	0.32	4	16.00	6,900	7,100
20.00	20.00	19.50	126	38.0	74.0	0.40	4	20.00	10,600	10,800

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑							切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 2,0 x D				最大切寬 a_e max = 0,33 x D		
P	≤850 N/mm²	**55**	0,003	0,006	0,008	0,011	0,013	0,018	0,022	**80**	0,004	0,008	0,011	0,015	0,017	0,023	0,029
	≥850 N/mm²	**40**	0,003	0,006	0,008	0,011	0,013	0,017	0,021	**60**	0,004	0,008	0,010	0,014	0,016	0,022	0,027
K	≤240 HB	**50**	0,003	0,006	0,008	0,011	0,013	0,018	0,022	**70**	0,004	0,008	0,011	0,015	0,017	0,023	0,029
	≥240 HB	**40**	0,003	0,006	0,008	0,011	0,013	0,017	0,021	**65**	0,004	0,008	0,010	0,014	0,016	0,022	0,027

Standard Ratio end mills RF 100 U

RF 100 U HF



Tool material	Solid carbide	
Surface	F	F
Type	HF	HF
Shank form	HA	HB

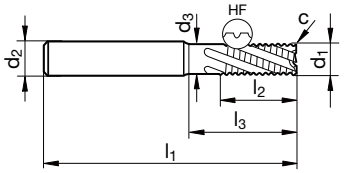
P	•
M	
K	•
N	
S	
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	6881	6882
Discount group	106	106

d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
6.00	6.00	5.70	57	13.0	20.0	0.12	4	6.00	2,400	2,400
8.00	8.00	7.70	63	19.0	26.0	0.16	4	8.00	2,900	3,000
10.00	10.00	9.50	72	22.0	30.0	0.20	4	10.00	3,300	3,400
12.00	12.00	11.50	83	26.0	36.0	0.24	4	12.00	3,900	4,100
16.00	16.00	15.50	92	32.0	42.0	0.32	4	16.00	6,300	6,500
20.00	20.00	19.50	104	38.0	52.0	0.40	4	20.00	9,600	9,800
25.00	25.00	24.00	121	45.0	63.0	0.50	4	25.00	15,300	15,500

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
P	≤850 N/mm²	135	0,009	0,018	0,024	0,032	0,038	0,051	0,064
	≥850 N/mm²	100	0,008	0,017	0,022	0,030	0,036	0,048	0,060
K	≤240 HB	120	0,009	0,018	0,024	0,032	0,038	0,051	0,064
	≥240 HB	105	0,008	0,017	0,022	0,030	0,036	0,048	0,060

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
	切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
160	0,010	0,021	0,028	0,037	0,044	0,059	0,074
120	0,010	0,019	0,026	0,035	0,041	0,055	0,069
140	0,010	0,021	0,028	0,037	0,044	0,059	0,074
130	0,010	0,019	0,026	0,035	0,041	0,055	0,069

Standard Ratio end mills RF 100 U

RF 100 U HF

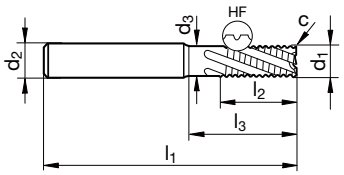
Tool material	Solid carbide	
Surface	F	F
Type	HF	HF
Shank form	HA	HB

P	•
M	
K	•
N	
S	
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



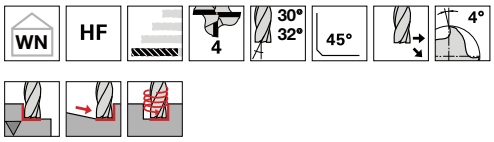
編號	6883	6884
Discount group	106	106

d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
6.00	6.00	5.70	65	18.0	28.0	0.12	4	6.00	2,800	2,900
8.00	8.00	7.70	75	24.0	38.0	0.16	4	8.00	3,500	3,500
10.00	10.00	9.50	80	30.0	38.0	0.20	4	10.00	4,000	4,100
12.00	12.00	11.50	93	36.0	46.0	0.24	4	12.00	4,800	4,900
16.00	16.00	15.50	108	48.0	58.0	0.32	4	16.00	7,600	7,700
20.00	20.00	19.50	126	60.0	74.0	0.40	4	20.00	11,600	11,700

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 3,0 x D				最大切寬 a_e max = 0,33 x D		
P	≤850 N/mm²	**80**	0,005	0,011	0,014	0,019	0,023	0,031	0,038	**140**	0,008	0,016	0,022	0,029	0,035	0,047	0,058
	≥850 N/mm²	**60**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**105**	0,008	0,015	0,020	0,027	0,033	0,044	0,055
K	≤240 HB	**70**	0,005	0,011	0,014	0,019	0,023	0,031	0,038	**125**	0,008	0,016	0,022	0,029	0,035	0,047	0,058
	≥240 HB	**65**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**110**	0,008	0,015	0,020	0,027	0,033	0,044	0,055

Standard Ratio end mills RF 100 U

RF 100 U HF



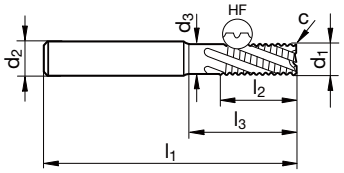
Tool material	Solid carbide	
Surface	F	F
Type	HF	HF
Shank form	HA	HB

P	•
M	
K	•
N	
S	
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	6885	6886
Discount group	106	106

d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
6.00	6.00	5.70	75	13.0	34.0	0.12	4	6.00	3,100	3,200
8.00	8.00	7.70	100	19.0	49.0	0.16	4	8.00	3,800	3,800
10.00	10.00	9.50	100	22.0	48.0	0.20	4	10.00	4,300	4,400
12.00	12.00	11.50	150	26.0	58.0	0.24	4	12.00	5,500	5,700
16.00	16.00	15.50	150	32.0	78.0	0.32	4	16.00	8,900	9,000
20.00	20.00	19.50	150	38.0	78.0	0.40	4	20.00	13,500	13,700

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,0 x D				最大切寬 a_e max = 0,75 x D		
P	≤850 N/mm²	**80**	0,005	0,011	0,014	0,019	0,023	0,031	0,038	**110**	0,007	0,014	0,019	0,026	0,031	0,041	0,052
	≥850 N/mm²	**60**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**85**	0,007	0,014	0,018	0,024	0,029	0,039	0,048
M	≤750 N/mm²	**55**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**75**	0,007	0,014	0,018	0,024	0,029	0,039	0,048
	≥750 N/mm²	**35**	0,004	0,008	0,011	0,015	0,018	0,024	0,030	**50**	0,006	0,011	0,015	0,021	0,025	0,034	0,042
S	Ni-based	**15**	0,004	0,007	0,010	0,013	0,016	0,021	0,026	**30**	0,005	0,010	0,013	0,018	0,022	0,030	0,037
	Ti-based	**30**	0,004	0,008	0,011	0,015	0,018	0,024	0,030	**50**	0,006	0,011	0,015	0,021	0,025	0,034	0,042
K	≤240 HB	**70**	0,005	0,011	0,014	0,019	0,023	0,031	0,038	**100**	0,007	0,014	0,019	0,026	0,031	0,041	0,052
	≥240 HB	**65**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**90**	0,007	0,014	0,018	0,024	0,029	0,039	0,048

High-performance roughing end mills RS 100 F

RS 100 F NF

DIN 6527 L | NF | 5-6 | 45° | 45° | 4° | 48 HRC

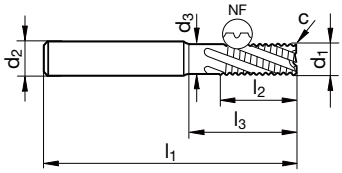
Tool material	Solid carbide	
Surface	F	F
Type	NF	NF
Shank form	HA	HB

P	•
M	
K	•
N	
S	
H	○

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	6889	6890
Discount group	106	106

d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
6.00	6.00	5.70	57	13.0	20.0	0.30	5	6.00	2,700	2,700
8.00	8.00	7.70	63	19.0	26.0	0.30	5	8.00	3,200	3,300
10.00	10.00	9.50	72	22.0	30.0	0.30	5	10.00	3,600	3,700
12.00	12.00	11.50	83	26.0	36.0	0.50	5	12.00	4,200	4,200
14.00	14.00	13.50	83	26.0	36.0	0.50	5	14.00	5,900	6,100
16.00	16.00	15.50	92	32.0	42.0	0.50	6	16.00	6,500	6,700
18.00	18.00	17.50	92	32.0	42.0	0.50	6	18.00	9,000	9,200
20.00	20.00	19.50	104	38.0	52.0	0.50	6	20.00	9,900	10,000
25.00	25.00	24.00	121	45.0	63.0	0.60	6	25.00	14,500	14,600

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
P	≤850 N/mm²	**135**	0,009	0,018	0,024	0,032	0,038	0,051	0,064
	≥850 N/mm²	**100**	0,008	0,017	0,022	0,030	0,036	0,048	0,060
K	≤240 HB	**120**	0,009	0,018	0,024	0,032	0,038	0,051	0,064
	≥240 HB	**105**	0,008	0,017	0,022	0,030	0,036	0,048	0,060

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
	切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
160	0,010	0,021	0,028	0,037	0,044	0,059	0,074
120	0,010	0,019	0,026	0,035	0,041	0,055	0,069
140	0,010	0,021	0,028	0,037	0,044	0,059	0,074
130	0,010	0,019	0,026	0,035	0,041	0,055	0,069

Ratio end mills RF 100 VA

RF 100 VA NF

DIN 6527 L | NF | 4 | 36° 38° | 45° | 7°

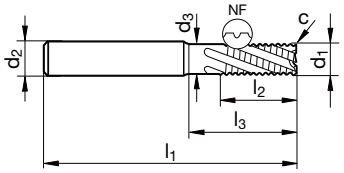
Tool material	Solid carbide	
Surface	a	a
Type	NF	NF
Shank form	HA	HB

P	•
M	•
K	•
N	○
S	○
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心

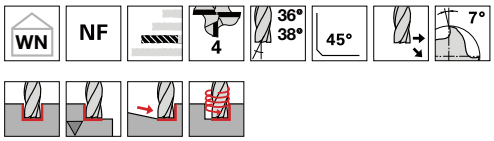


編號	6877	6878
Discount group	106	106

d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
5.00	6.00	4.80	57	13.0	18.0	0.10	4	5.00	2,000	2,000
6.00	6.00	5.70	57	13.0	20.0	0.12	4	6.00	2,400	2,400
7.00	8.00	6.70	63	16.0	24.9	0.14	4	7.00	2,700	2,700
8.00	8.00	7.70	63	19.0	26.0	0.16	4	8.00	2,900	3,000
9.00	10.00	8.70	72	19.0	29.9	0.18	4	9.00	3,100	3,200
10.00	10.00	9.50	72	22.0	30.0	0.20	4	10.00	3,300	3,400
12.00	12.00	11.50	83	26.0	36.0	0.24	4	12.00	3,900	4,100
14.00	14.00	13.50	83	26.0	36.0	0.28	4	14.00	5,200	5,300
16.00	16.00	15.50	92	32.0	42.0	0.32	4	16.00	6,300	6,400
18.00	18.00	17.50	92	32.0	42.0	0.36	4	18.00	8,000	8,200
20.00	20.00	19.50	104	38.0	52.0	0.40	4	20.00	9,600	9,800
25.00	25.00	24.00	121	45.0	63.0	0.50	4	25.00	15,300	15,500

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
P	≤850 N/mm²	135	0,009	0,018	0,024	0,032	0,038	0,051	0,064	160	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥850 N/mm²	100	0,008	0,017	0,022	0,030	0,036	0,048	0,060	120	0,010	0,019	0,026	0,035	0,041	0,055	0,069
M	≤750 N/mm²	90	0,008	0,017	0,022	0,030	0,036	0,048	0,060	110	0,010	0,019	0,026	0,035	0,041	0,055	0,069
	≥750 N/mm²	55	0,007	0,013	0,018	0,025	0,030	0,040	0,050	70	0,008	0,016	0,021	0,030	0,036	0,048	0,060
S	Ni-based	25	0,006	0,012	0,016	0,022	0,026	0,035	0,044	40	0,007	0,014	0,019	0,026	0,032	0,042	0,053
	Ti-based	50	0,007	0,013	0,018	0,025	0,030	0,040	0,050	70	0,008	0,016	0,021	0,030	0,036	0,048	0,060
K	≤240 HB	120	0,009	0,018	0,024	0,032	0,038	0,051	0,064	140	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥240 HB	105	0,008	0,017	0,022	0,030	0,036	0,048	0,060	130	0,010	0,019	0,026	0,035	0,041	0,055	0,069

Ratio end mills RF 100 VA RF 100 VA NF



Tool material	**Solid carbide**	
Surface	a	a
Type	NF	NF
Shank form	HA	HB

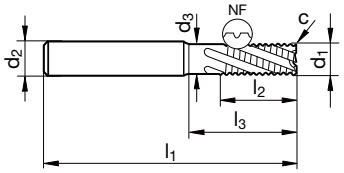
P	•
M	•
K	•
N	○
S	○
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	**6879**	**6880**
Discount group	**106**	**106**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm	mm x 45°	刃數			
6.00	6.00	5.70	65	10.0	28.0	0.12	4	6.00	2,600	2,700
8.00	8.00	7.70	75	12.0	38.0	0.16	4	8.00	3,200	3,300
10.00	10.00	9.50	80	14.0	38.0	0.20	4	10.00	3,600	3,700
12.00	12.00	11.50	93	16.0	46.0	0.24	4	12.00	4,300	4,500
16.00	16.00	15.50	108	22.0	58.0	0.32	4	16.00	6,900	7,100
20.00	20.00	19.50	126	26.0	74.0	0.40	4	20.00	10,600	10,800

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑							切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,0 x D				最大切寬 a_e max = 0,75 x D		
P	≤850 N/mm²	**80**	0,005	0,011	0,014	0,019	0,023	0,031	0,038	**110**	0,007	0,014	0,019	0,026	0,031	0,041	0,052
	≥850 N/mm²	**60**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**85**	0,007	0,014	0,018	0,024	0,029	0,039	0,048
M	≤750 N/mm²	**55**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**75**	0,007	0,014	0,018	0,024	0,029	0,039	0,048
	≥750 N/mm²	**35**	0,004	0,008	0,011	0,015	0,018	0,024	0,030	**50**	0,006	0,011	0,015	0,021	0,025	0,034	0,042
S	Ni-based	**15**	0,004	0,007	0,010	0,013	0,016	0,021	0,026	**30**	0,005	0,010	0,013	0,018	0,022	0,030	0,037
	Ti-based	**30**	0,004	0,008	0,011	0,015	0,018	0,024	0,030	**50**	0,006	0,011	0,015	0,021	0,025	0,034	0,042
K	≤240 HB	**70**	0,005	0,011	0,014	0,019	0,023	0,031	0,038	**100**	0,007	0,014	0,019	0,026	0,031	0,041	0,052
	≥240 HB	**65**	0,005	0,010	0,013	0,018	0,022	0,029	0,036	**90**	0,007	0,014	0,018	0,024	0,029	0,039	0,048

High-performance roughing end mills RS 100 U

RS 100 U NF

DIN 6527 L | NF | 4-5 | 30° | 45° | 9°

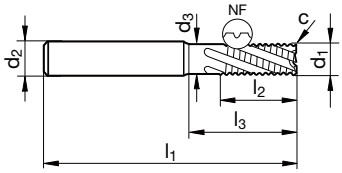
Tool material	Solid carbide	
Surface	F	F
Type	NF	NF
Shank form	HA	HB

P	•
M	•
K	•
N	○
S	•
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	6887	6888
Discount group	106	106

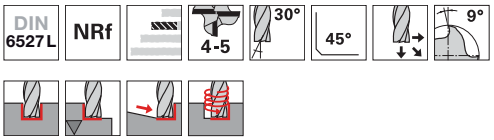
d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
6.00	6.00	5.70	57	13.0	20.0	0.12	4	6.00	2,200	2,300
8.00	8.00	7.70	63	19.0	26.0	0.16	4	8.00	2,700	2,700
10.00	10.00	9.50	72	22.0	30.0	0.20	4	10.00	2,800	2,900
12.00	12.00	11.50	83	26.0	36.0	0.24	4	12.00	3,400	3,500
14.00	14.00	13.50	83	26.0	36.0	0.28	4	14.00	4,900	5,000
16.00	16.00	15.50	92	32.0	42.0	0.32	4	16.00	5,500	5,600
18.00	18.00	17.50	92	32.0	42.0	0.36	4	18.00	7,300	7,500
20.00	20.00	19.50	104	38.0	52.0	0.40	4	20.00	8,300	8,500
25.00	25.00	24.00	121	45.0	63.0	0.60	5	25.00	13,100	13,300

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
P	≤850 N/mm²	135	0,009	0,018	0,024	0,032	0,038	0,051	0,064
	≥850 N/mm²	100	0,008	0,017	0,022	0,030	0,036	0,048	0,060
M	≤750 N/mm²	90	0,008	0,017	0,022	0,030	0,036	0,048	0,060
	≥750 N/mm²	55	0,007	0,013	0,018	0,025	0,030	0,040	0,050
S	Ni-based	25	0,006	0,012	0,016	0,022	0,026	0,035	0,044
	Ti-based	50	0,007	0,013	0,018	0,025	0,030	0,040	0,050
K	≤240 HB	120	0,009	0,018	0,024	0,032	0,038	0,051	0,064
	≥240 HB	105	0,008	0,017	0,022	0,030	0,036	0,048	0,060

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
	切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
160	0,010	0,021	0,028	0,037	0,044	0,059	0,074
120	0,010	0,019	0,026	0,035	0,041	0,055	0,069
110	0,010	0,019	0,026	0,035	0,041	0,055	0,069
70	0,008	0,016	0,021	0,030	0,036	0,048	0,060
40	0,007	0,014	0,019	0,026	0,032	0,042	0,053
70	0,008	0,016	0,021	0,030	0,036	0,048	0,060
140	0,010	0,021	0,028	0,037	0,044	0,059	0,074
130	0,010	0,019	0,026	0,035	0,041	0,055	0,069

Roughing end mills GS 100 U (fine teeth)

GS 100 U NRf



Tool material	Solid carbide	
Surface	◯	F
Type	NRf	NRf
Shank form	HB	HB

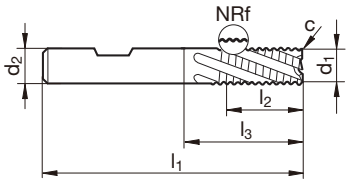
P	•
M	•
K	•
N	○
S	○
H	

GUHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- with internal coolant supply
- centre cutting
- 縮頸設計
- 端刃過中心



編號	3204	3723

d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	價格	
6.00	6.00	57	13.0	21.0	0.30	4	1,600	2,000
8.00	8.00	63	19.0	27.0	0.30	4	1,900	2,500
10.00	10.00	72	22.0	32.0	0.30	4	2,000	2,700
12.00	12.00	83	26.0	38.0	0.50	4	2,400	3,200
14.00	14.00	83	26.0	38.0	0.50	4	3,300	4,500
14.00	16.00	92	32.0	42.0	0.50	4	3,800	5,100
16.00	16.00	92	32.0	44.0	0.50	4	3,800	5,100
18.00	18.00	92	32.0	44.0	0.50	4	5,100	6,700
18.00	20.00	104	38.0	53.0	0.50	4	5,700	7,700
20.00	20.00	104	38.0	54.0	0.50	4	5,700	7,700
25.00	25.00	121	45.0	65.0	0.60	5	10,100	10,800

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
P	≤ 850 N/mm²	**120**	0,008	0,017	0,022	0,030	0,036	0,048	0,060
	≥ 850 N/mm²	**90**	0,008	0,015	0,020	0,028	0,034	0,045	0,056
M	≤ 750 N/mm²	**80**	0,008	0,015	0,020	0,028	0,034	0,045	0,056
	≥ 750 N/mm²	**50**	0,006	0,012	0,016	0,022	0,026	0,035	0,044
S	Ni-based	**20**	0,005	0,011	0,014	0,020	0,024	0,032	0,040
	Ti-based	**45**	0,006	0,012	0,016	0,022	0,026	0,035	0,044
K	≤ 240 HB	**100**	0,008	0,017	0,022	0,030	0,036	0,048	0,060
	≥ 240 HB	**90**	0,008	0,015	0,020	0,028	0,034	0,045	0,056

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
	3	6	8	10	12	16	20
	切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
140	0,010	0,019	0,026	0,035	0,041	0,055	0,069
110	0,009	0,017	0,023	0,032	0,039	0,052	0,064
100	0,009	0,017	0,023	0,032	0,039	0,052	0,064
70	0,007	0,014	0,019	0,026	0,032	0,042	0,053
30	0,006	0,013	0,017	0,024	0,029	0,038	0,048
60	0,007	0,014	0,019	0,026	0,032	0,042	0,053
120	0,010	0,019	0,026	0,035	0,041	0,055	0,069
110	0,009	0,017	0,023	0,032	0,039	0,052	0,064

Please reduce cutting values for bright finish tools: vc -50% and fz -25%

銑刀無鍍層時，需降低切削速度 50%與每刃進給 25%。

Roughing end mills GS 100 U (fine teeth)

GS 100 U NRf

DIN 6527 L | NRf | 4 | 30° | 45° | 9°

Tool material	Solid carbide
Surface	F
Type	NRf
Shank form	HB

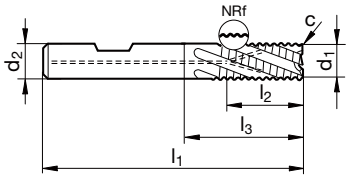
P	•
M	•
K	•
N	○
S	○
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- with internal coolant supply
- centre cutting
- 縮頸設計
- 端刃過中心

溝槽中心出水



編號	3365
Discount group	106

d1 h10	d2 h6	l1	l2	l3	c	Z	Code no.	價格
mm	mm	mm	mm	mm	mm x 45°	刃數		
6.00	6.00	57	13.0	21.0	0.30	4	6.000	3,400
8.00	8.00	63	19.0	27.0	0.30	4	8.000	3,700
10.00	10.00	72	22.0	32.0	0.30	4	10.000	4,100
12.00	12.00	83	26.0	38.0	0.50	4	12.000	5,000
16.00	16.00	92	32.0	44.0	0.50	4	16.000	7,700
20.00	20.00	104	38.0	54.0	0.50	4	20.000	11,400

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑							切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
P	≤850 N/mm²	120	0,008	0,017	0,022	0,030	0,036	0,048	0,060	140	0,010	0,019	0,026	0,035	0,041	0,055	0,069
	≥850 N/mm²	90	0,008	0,015	0,020	0,028	0,034	0,045	0,056	110	0,009	0,017	0,023	0,032	0,039	0,052	0,064
M	≤750 N/mm²	80	0,008	0,015	0,020	0,028	0,034	0,045	0,056	100	0,009	0,017	0,023	0,032	0,039	0,052	0,064
	≥750 N/mm²	50	0,006	0,012	0,016	0,022	0,026	0,035	0,044	70	0,007	0,014	0,019	0,026	0,032	0,042	0,053
S	Ni-based	20	0,005	0,011	0,014	0,020	0,024	0,032	0,040	30	0,006	0,013	0,017	0,024	0,029	0,038	0,048
	Ti-based	45	0,006	0,012	0,016	0,022	0,026	0,035	0,044	60	0,007	0,014	0,019	0,026	0,032	0,042	0,053
K	≤240 HB	100	0,008	0,017	0,022	0,030	0,036	0,048	0,060	120	0,010	0,019	0,026	0,035	0,041	0,055	0,069
	≥240 HB	90	0,008	0,015	0,020	0,028	0,034	0,045	0,056	110	0,009	0,017	0,023	0,032	0,039	0,052	0,064

Hard roughing end mills GS 100 H (fine teeth)

GS 100 H HR

DIN 6527 L | HR | 4 | 20° | 45° | 3° | 55 HRC

Tool material	Solid carbide	
Surface	Y	Y
Type	HR	HR
Shank form	HA	HB

P	•
M	
K	•
N	
S	
H	•

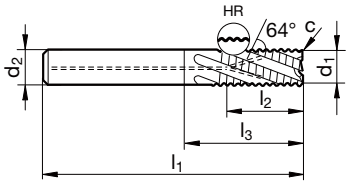
GÜHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- with internal coolant supply
- centre cutting
- 縮頸設計
- 端刃過中心

溝槽中心出水



編號	6704	6705
Discount group	106	106

d1 h10	d2 h6	l1	l2	l3	c	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm x 45°	刃數			
6.00	6.00	57	13.0	21.0	0.30	4	6.000	3,200	3,200
8.00	8.00	63	19.0	27.0	0.30	4	8.000	3,700	3,700
10.00	10.00	72	22.0	32.0	0.30	4	10.000	4,000	4,100
12.00	12.00	83	26.0	38.0	0.50	4	12.000	4,700	4,800
16.00	16.00	92	32.0	44.0	0.50	4	16.000	7,100	7,300
20.00	20.00	104	38.0	54.0	0.50	4	20.000	10,900	11,000
25.00	25.00	121	45.0	65.0	0.60	4	25.000	17,000	17,100

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑							切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,5 x D				最大切寬 a_e max = 0,33 x D		
P	≥850 N/mm²	90	0,008	0,015	0,020	0,028	0,034	0,045	0,056	110	0,009	0,017	0,023	0,032	0,039	0,052	0,064
K	≥240 HB	90	0,008	0,015	0,020	0,028	0,034	0,045	0,056	110	0,009	0,017	0,023	0,032	0,039	0,052	0,064
H	≤55 HRC	50	0,005	0,011	0,014	0,020	0,024	0,032	0,040	70	0,007	0,014	0,019	0,026	0,031	0,042	0,052

Hard roughing end mills GS 100 H (fine teeth)

GS 100 H HR

DIN 6527 L | HR | 4 | 20° | 45° | 3° | 55 HRC

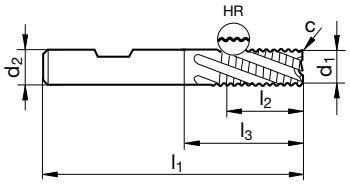
Tool material	Solid carbide
Surface	Y
Type	HR
Shank form	HB

P	•
M	
K	•
N	
S	
H	•

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- centre cutting
- 縮頸設計
- 端刃過中心



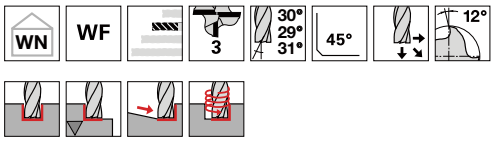
編號	3682
Discount group	117

d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格
6.00	6.00	57	13.0	21.0	0.30	4	6.000	2,400
8.00	8.00	63	19.0	27.0	0.30	4	8.000	2,700
10.00	10.00	72	22.0	32.0	0.30	4	10.000	3,000
12.00	12.00	83	26.0	38.0	0.50	4	12.000	3,500
16.00	16.00	92	32.0	44.0	0.50	4	16.000	5,600
20.00	20.00	104	38.0	54.0	0.50	4	20.000	8,400

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
P	≥850 N/mm²	90	0,008	0,015	0,020	0,028	0,034	0,045	0,056
K	≥240 HB	90	0,008	0,015	0,020	0,028	0,034	0,045	0,056
H	≤55 HRC	50	0,005	0,011	0,014	0,020	0,024	0,032	0,040

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
	切深 a_p = 1,5 x D				最大切寬 a_e max = 0,33 x D		
110	0,009	0,017	0,023	0,032	0,039	0,052	0,064
110	0,009	0,017	0,023	0,032	0,039	0,052	0,064
70	0,007	0,014	0,019	0,026	0,031	0,042	0,052

Ratio end mills Alu RF 100 A RF 100 A WF



Tool material	**Solid carbide**	
Surface	Cb	Cb
Type	WF	WF
Shank form	HA	HB
	NEW	NEW

P	
M	
K	
N	•
S	
H	

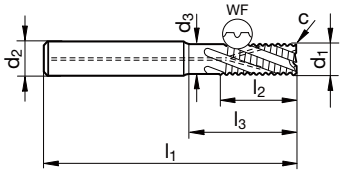
GÜHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- with internal cooling: Radial and axial exits
- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心

刀底及溝槽皆有中心出水



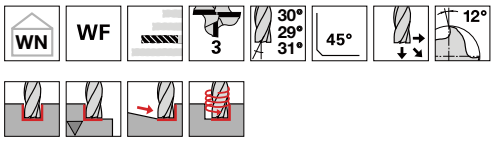
編號	**6974**	**6975**
Discount group	**106**	**106**

d1 js9	d2 h6	d3	l1	l2	l3	c	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm	mm x 45°	刃數			
6.00	6.00	5.70	57	13.0	20.0	0.06	3	6.00	3,100	3,200
8.00	8.00	7.70	63	19.0	26.0	0.08	3	8.00	3,300	3,400
10.00	10.00	9.50	72	22.0	30.0	0.10	3	10.00	4,000	4,200
12.00	12.00	11.50	83	26.0	36.0	0.12	3	12.00	5,000	5,100
16.00	16.00	15.50	92	32.0	42.0	0.16	3	16.00	7,600	7,900
20.00	20.00	19.50	104	38.0	52.0	0.20	3	20.00	14,300	14,600

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
N	≤5 % Si	**375**	0,011	0,021	0,028	0,037	0,044	0,059	0,074	**440**	0,012	0,024	0,032	0,043	0,051	0,068	0,085
	≥5 % Si	**180**	0,010	0,019	0,026	0,035	0,042	0,056	0,070	**210**	0,011	0,022	0,029	0,040	0,048	0,064	0,081
NE	≤850 N/mm²	**200**	0,010	0,019	0,026	0,035	0,042	0,056	0,070	**230**	0,011	0,022	0,029	0,040	0,048	0,064	0,081

Ratio end mills Alu RF 100 A

RF 100 A WF



Tool material	Solid carbide	
Surface	Cb	Cb
Type	WF	W
Shank form	HA	HB
	NEW	NEW

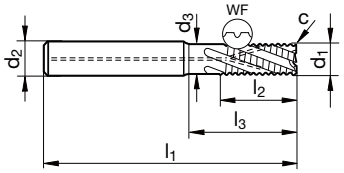
P
M
K
N •
S
H

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- with internal cooling: Radial and axial exits
- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心

刀底和溝槽皆有中心出水

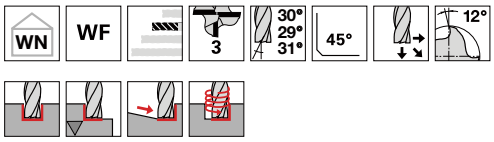


編號	6976	6977
Discount group	106	106

d1 js9	d2 h6	d3	l1	l2	l3	c	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm	mm x 45°	刃數			
6.00	6.00	5.70	65	13.0	28.0	0.06	3	6.00	3,400	3,400
8.00	8.00	7.70	75	19.0	38.0	0.08	3	8.00	3,700	3,800
10.00	10.00	9.50	80	22.0	38.0	0.10	3	10.00	4,300	4,500
12.00	12.00	11.50	93	26.0	46.0	0.12	3	12.00	5,500	5,600
16.00	16.00	15.50	108	32.0	58.0	0.16	3	16.00	8,400	8,600
20.00	20.00	19.50	126	38.0	74.0	0.20	3	20.00	15,600	16,000

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
N	≤5 % Si	375	0,011	0,021	0,028	0,037	0,044	0,059	0,074	440	0,012	0,024	0,032	0,043	0,051	0,068	0,085
	≥5 % Si	180	0,010	0,019	0,026	0,035	0,042	0,056	0,070	210	0,011	0,022	0,029	0,040	0,048	0,064	0,081
NE	≤850 N/mm²	200	0,010	0,019	0,026	0,035	0,042	0,056	0,070	230	0,011	0,022	0,029	0,040	0,048	0,064	0,081

Ratio end mills Alu RF 100 A RF 100 A WF



Tool material	**Solid carbide**	
Surface	◯	◯
Type	WF	WF
Shank form	HA	HB

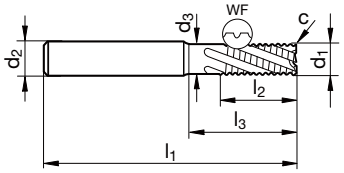
P	
M	
K	
N	•
S	
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	**6868**	**6869**
Discount group	**106**	**106**

d1 js9	d2 h6	d3	l1	l2	l3	c	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm	mm x 45°	刃數			
6.00	6.00	5.70	57	13.0	20.0	0.06	3	6.00	1,800	1,900
8.00	8.00	7.70	63	19.0	26.0	0.08	3	8.00	2,000	2,000
10.00	10.00	9.50	72	22.0	30.0	0.10	3	10.00	2,400	2,500
12.00	12.00	11.50	83	26.0	36.0	0.12	3	12.00	3,000	3,000
16.00	16.00	15.50	92	32.0	42.0	0.16	3	16.00	4,500	4,700
20.00	20.00	19.50	104	38.0	52.0	0.20	3	20.00	8,500	8,600
25.00	25.00	24.00	121	45.0	63.0	0.25	3	25.00	13,000	13,200

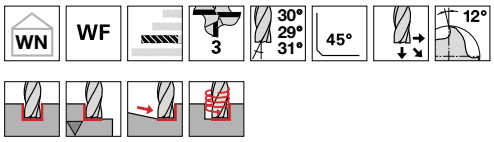
材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
N	≤5 % Si	**375**	0,011	0,021	0,028	0,037	0,044	0,059	0,074
	≥5 % Si	**180**	0,010	0,019	0,026	0,035	0,042	0,056	0,070
NE	≤850 N/mm²	**200**	0,010	0,019	0,026	0,035	0,042	0,056	0,070

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
	3	6	8	10	12	16	20
	切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
440	0,012	0,024	0,032	0,043	0,051	0,068	0,085
210	0,011	0,022	0,029	0,040	0,048	0,064	0,081
230	0,011	0,022	0,029	0,040	0,048	0,064	0,081

Our Carbo-coating is available as an option to improve chip flow and tool life

此銑刀若有碳基鍍層時，可以提升刀具壽命並幫助排屑。

Ratio end mills Alu RF 100 A RF 100 A WF



Tool material	**Solid carbide**	
Surface	◯	◯
Type	WF	WF
Shank form	HA	HB

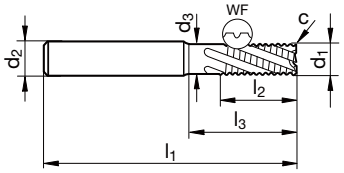
P	
M	
K	
N	•
S	
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38

切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	**6870**	**6871**
Discount group	**106**	**106**

d1 js9	d2 h6	d3	l1	l2	l3	c	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm	mm x 45°	刃數			
6.00	6.00	5.70	65	13.0	28.0	0.06	3	6.00	2,000	2,000
8.00	8.00	7.70	75	19.0	38.0	0.08	3	8.00	2,200	2,200
10.00	10.00	9.50	80	22.0	38.0	0.10	3	10.00	2,600	2,700
12.00	12.00	11.50	93	26.0	46.0	0.12	3	12.00	3,200	3,300
16.00	16.00	15.50	108	32.0	58.0	0.16	3	16.00	4,900	5,100
20.00	20.00	19.50	126	38.0	74.0	0.20	3	20.00	9,200	9,500

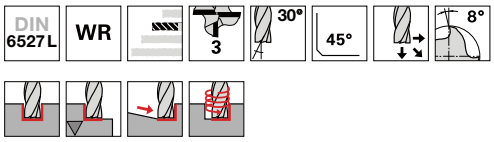
材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑							切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
N	≤5 % Si	**375**	0,011	0,021	0,028	0,037	0,044	0,059	0,074	**440**	0,012	0,024	0,032	0,043	0,051	0,068	0,085
	≥5 % Si	**180**	0,010	0,019	0,026	0,035	0,042	0,056	0,070	**210**	0,011	0,022	0,029	0,040	0,048	0,064	0,081
NE	≤850 N/mm²	**200**	0,010	0,019	0,026	0,035	0,042	0,056	0,070	**230**	0,011	0,022	0,029	0,040	0,048	0,064	0,081

Our Carbo-coating is available as an option to improve chip flow and tool life

此銑刀若有碳基鍍層時，可以提升刀具壽命並幫助排屑。

Roughing end mills GS 100 A (coarse teeth)

GS 100 A WR



Tool material	Solid carbide	
Surface	◯	◯
Type	WR	WR
Shank form	HB	HB

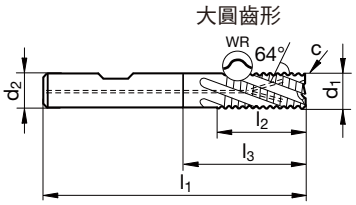
P	
M	
K	
N	•
S	
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- with internal coolant supply
- centre cutting
- 縮頸設計
- 端刃過中心

溝槽中心出水



編號	3364	3127
Discount group	106	117

d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z 刃數	Code no.	價格	
6.00	6.00	57	10.0	21.0	0.30	3	6.000	2,200	1,400
8.00	8.00	63	16.0	27.0	0.30	3	8.000	2,400	1,500
10.00	10.00	72	19.0	32.0	0.30	3	10.000	2,700	1,900
12.00	12.00	83	22.0	38.0	0.50	3	12.000	3,700	2,300
14.00	14.00	83	22.0	38.0	0.50	3	14.000		3,000
16.00	16.00	92	26.0	44.0	0.50	3	16.000	5,200	3,600
18.00	18.00	92	26.0	44.0	0.50	3	18.000		5,100
20.00	20.00	104	32.0	54.0	0.50	3	20.000	9,000	6,600
25.00	25.00	121	45.0	65.0	0.60	3	25.000		10,100

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
N	≤7% Si	350	0,010	0,019	0,026	0,035	0,042	0,056	0,070
	≥7% Si	180	0,009	0,018	0,024	0,032	0,038	0,051	0,064
NE	≤850 N/mm²	180	0,009	0,018	0,024	0,032	0,038	0,051	0,064

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
	切深 a_p = 1,5 x D				最大切寬 a_e max = 0,75 x D		
410	0,011	0,022	0,029	0,040	0,048	0,064	0,081
210	0,010	0,021	0,028	0,037	0,044	0,059	0,074
210	0,010	0,021	0,028	0,037	0,044	0,059	0,074

Our Carbo-coating is available as an option to improve chip flow and tool life
此銑刀若有碳基鍍層時，可以提升刀具壽命並幫助排屑。

Roughing end mills GS 40 (fine teeth)

GS 40 NRf

DIN 844K | NRf | 3 | 30° | 11°

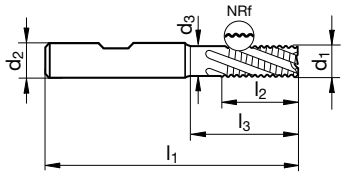
Tool material	HSS-E-PM	
Surface	○	F
Type	NRf	NRf
Shank form	B	B

P	•
M	•
K	•
N	•
S	○
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	3322	3668
Discount group	112	112

d1 js12 mm	d2 mm	d3 mm	l1 mm	l2 mm	l3 mm	Z 刃數	Code no.	價格	
6.00	6.00	5.70	57	13.0	20.0	3	6.000	1,200	1,900
8.00	10.00	7.70	69	19.0	21.5	3	8.000	1,500	2,300
10.00	10.00	9.50	72	22.0	30.0	3	10.000	1,500	2,500
12.00	12.00	11.50	83	26.0	36.0	3	12.000	1,700	2,800
14.00	12.00	12.00	83	26.0	38.0	3	14.000	2,900	4,400
16.00	16.00	15.50	92	32.0	42.0	3	16.000	3,000	4,900
18.00	16.00	16.00	92	32.0	44.0	3	18.000	4,100	6,100
20.00	20.00	19.00	104	38.0	52.0	3	20.000	3,500	5,700

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D		
P	≤850 N/mm²	60	0,013	0,025	0,034	0,045	0,05	0,07	0,09
	≥850 N/mm²	50	0,011	0,023	0,030	0,040	0,05	0,06	0,08
M	≤750 N/mm²	50	0,010	0,020	0,026	0,035	0,04	0,06	0,07
	≥750 N/mm²	30	0,008	0,015	0,020	0,027	0,03	0,04	0,05
K	≤240 HB	50	0,013	0,025	0,034	0,045	0,05	0,07	0,09
N	≥7 % Si	80	0,016	0,032	0,042	0,055	0,07	0,09	0,11

切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑 3	6	8	10	12	16	20
	切深 a_p = 1,0 x D				最大切寬 a_e max = 0,75 x D		
70	0,014	0,029	0,039	0,052	0,06	0,08	0,10
60	0,013	0,026	0,035	0,046	0,06	0,07	0,09
60	0,011	0,023	0,030	0,040	0,05	0,06	0,08
40	0,009	0,018	0,024	0,032	0,04	0,05	0,06
60	0,014	0,029	0,039	0,052	0,06	0,08	0,10
100	0,018	0,037	0,049	0,063	0,08	0,10	0,13

Please reduce cutting values for bright finished tools: vc -50% and fz -25%
銑刀無鍍層時，需降低切削速度50%與每刃進給25%。

Roughing end mills GS 40 (fine teeth)

GS 40 NRf

DIN 844K | NRf | 4-6 | 30° | 11°

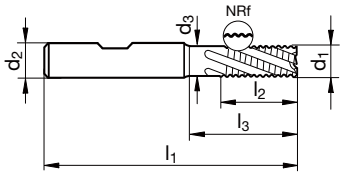
Tool material	HSS-E-PM	
Surface	○	F
Type	NRf	NRf
Shank form	B	B

P	•
M	•
K	•
N	•
S	○
H	

GÜHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	3340	3660
Discount group	112	112

d1 js12	d2	d3	l1	l2	l3	Z	Code no.	價格	
mm	mm	mm	mm	mm	mm	刃數			
6.00	6.00	5.70	57	13.0	20.0	4	6.000	1,400	1,900
7.00	10.00	6.70	66	16.0	17.9	4	7.000	1,900	2,800
8.00	10.00	7.70	69	19.0	21.5	4	8.000	1,400	2,300
9.00	10.00	8.70	69	19.0	24.3	4	9.000	2,200	3,000
10.00	10.00	9.50	72	22.0	30.0	4	10.000	1,500	2,400
11.00	12.00	10.50	79	22.0	30.7	4	11.000	2,300	3,300
12.00	12.00	11.50	83	26.0	36.0	4	12.000	1,600	2,700
13.00	12.00	12.00	83	26.0	38.0	4	13.000	2,700	4,300
14.00	12.00	12.00	83	26.0	38.0	4	14.000	2,500	3,800
15.00	12.00	12.00	83	26.0	38.0	4	15.000	4,000	5,700
16.00	16.00	15.50	92	32.0	42.0	4	16.000	2,700	4,600
18.00	16.00	16.00	92	32.0	44.0	4	18.000	4,000	5,500
20.00	20.00	19.00	104	38.0	52.0	4	20.000	3,300	5,500
25.00	25.00	24.00	121	45.0	63.0	5	25.000	7,500	7,800
28.00	25.00	25.00	121	45.0	65.0	5	28.000	9,800	10,300
30.00	25.00	25.00	121	45.0	65.0	5	30.000	10,400	10,700
32.00	32.00	31.00	133	53.0	71.0	6	32.000	10,600	10,700

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑							切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,0 x D				最大切寬 a_e max = 0,75 x D		
P	≤850 N/mm²	60	0,013	0,025	0,034	0,045	0,05	0,07	0,09	70	0,014	0,029	0,039	0,052	0,06	0,08	0,10
	≥850 N/mm²	50	0,011	0,023	0,030	0,040	0,05	0,06	0,08	60	0,013	0,026	0,035	0,046	0,06	0,07	0,09
M	≤750 N/mm²	50	0,010	0,020	0,026	0,035	0,04	0,06	0,07	60	0,011	0,023	0,030	0,040	0,05	0,06	0,08
	≥750 N/mm²	30	0,008	0,015	0,020	0,027	0,03	0,04	0,05	40	0,009	0,018	0,024	0,032	0,04	0,05	0,06
K	≤240 HB	50	0,013	0,025	0,034	0,045	0,05	0,07	0,09	60	0,014	0,029	0,039	0,052	0,06	0,08	0,10
N	≥7 % Si	80	0,016	0,032	0,042	0,055	0,07	0,09	0,11	100	0,018	0,037	0,049	0,063	0,08	0,10	0,13

Please reduce cutting values for bright finished tools: vc -50% and fz -25%
銑刀無鍍層時，需降低切削速度 50%與每刃進給 25%。

GS 80 – High-performance PM roughing end mills

for difficult applications in steel and high strength steels

GS 80 – 高性能 PM粉末材質粗銑刀

適合用於難切削材質與高抗張力鋼料

MTC

unstable machining conditions low drive power
工況不佳 / 工件形狀特殊 / 夾持不穩固機台 / 馬力與扭力不足

Optimal chip evacuation
thanks to curved, deep flute geometry

最佳排屑性
由於圓弧形及深的溝槽幾何形狀

Minimum cutting pressure and power consumption
thanks to 45° helix angle and fine NRf roughing geometry. Application also on less rigid machines and with unstable clamping.

最小的切削阻力和功耗
由於 45° 螺旋角和 NRf 細圓齒形的粗加工幾何形狀，
也適用於剛性較低且夾緊不穩定的機器。

High heat resistance and toughness
thanks to HSS-E-PM tool material with FIRE-coating. Especially for tough and difficult-to-machine materials.

高耐熱性和韌性
由於Fire塗層的 HSS-E-PM 粉末刀具材料，
特別適用於堅韌和難加工的材料

Innovative roughing geometry
ensures small chips

創新的粗加工齒形幾何形狀
確保了小切屑形成

Roughing end mills GS 80 (fine teeth)

GS 80 NRf

DIN 844K | NRf | 3-6 | 45° | 11°

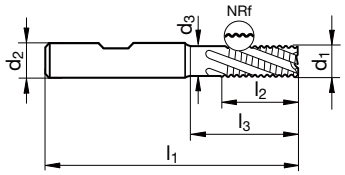
Tool material	**HSS-E-PM**
Surface	F
Type	NRf
Shank form	B

P	•
M	•
K	•
N	•
S	○
H	

GUHRINGNAVIGATOR

Cutting data page 37-38
切削參數 37～38頁

- neck clearance
- centre cutting
- 縮頸設計
- 端刃過中心



編號	6756
Discount group	112

d1 js12	d2	d3	l1	l2	l3	Z	Code no.	價格
mm	mm	mm	mm	mm	mm	刃數		
4.00	6.00	3.70	55	11.0	15.0	3	4.000	2,200
5.00	6.00	4.70	57	13.0	18.0	4	5.000	2,200
6.00	6.00	5.70	57	13.0	20.0	4	6.000	2,100
7.00	10.00	6.70	66	16.0	22.1	4	7.000	3,000
8.00	10.00	7.70	69	19.0	26.0	4	8.000	2,500
9.00	10.00	8.70	69	19.0	26.9	4	9.000	3,300
10.00	10.00	9.50	72	22.0	30.0	4	10.000	2,600
12.00	12.00	11.50	83	26.0	36.0	4	12.000	3,100
14.00	12.00	13.50	83	26.0	38.0	5	14.000	4,200
16.00	16.00	15.50	92	32.0	42.0	5	16.000	5,000
18.00	16.00	17.50	92	32.0	44.0	6	18.000	6,000
20.00	20.00	19.00	104	38.0	52.0	6	20.000	6,100
25.00	25.00	24.00	121	45.0	63.0	6	25.000	8,500

材料 ISO	硬度 Hardness	切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑							切速 v_c	f_z (mm/z) / Ø 每刃進給 / 刃徑						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
			切深 a_p = 1,0 x D				切寬 a_e = 1,0 x D				切深 a_p = 1,0 x D				最大切寬 a_e max = 0,75 x D		
P	≤850 N/mm²	**60**	0,013	0,025	0,034	0,045	0,05	0,07	0,09	**70**	0,014	0,029	0,039	0,052	0,06	0,08	0,10
	≥850 N/mm²	**50**	0,011	0,023	0,030	0,040	0,05	0,06	0,08	**60**	0,013	0,026	0,035	0,046	0,06	0,07	0,09
M	≤750 N/mm²	**50**	0,010	0,020	0,026	0,035	0,04	0,06	0,07	**60**	0,011	0,023	0,030	0,040	0,05	0,06	0,08
	≥750 N/mm²	**30**	0,008	0,015	0,020	0,027	0,03	0,04	0,05	**40**	0,009	0,018	0,024	0,032	0,04	0,05	0,06
K	≤240 HB	**50**	0,013	0,025	0,034	0,045	0,05	0,07	0,09	**60**	0,014	0,029	0,039	0,052	0,06	0,08	0,10
N	≥7 % Si	**80**	0,016	0,032	0,042	0,055	0,07	0,09	0,11	**100**	0,018	0,037	0,049	0,063	0,08	0,10	0,13

Roughing end mills

NR 大圓齒形

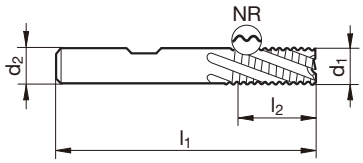
DIN 844K | NR | 4-6 | 30° | 11°

	M42	HSCO
Tool material		
Surface	○	F
Type	NR	NR
Shank form	B	B

P	•
M	○
K	•
N	•
S	
H	

GÜHRINGNAVIGATOR

- centre cutting
- 端刃過中心



編號	3346	3690

d1 js12	d2	l1	l2	Z	價格	
mm	mm	mm	mm	刃數		
6.00	6.00	57	13.0	4	900	1,600
7.00	10.00	66	16.0	4	1,300	2,200
8.00	10.00	69	19.0	4	1,000	1,700
9.00	10.00	69	19.0	4	1,400	2,000
10.00	10.00	72	22.0	4	1,000	1,700
11.00	12.00	79	22.0	4	1,700	2,800
12.00	12.00	83	26.0	4	1,200	2,300
14.00	12.00	83	26.0	4	1,400	2,600
15.00	12.00	83	26.0	4	2,000	3,000
16.00	16.00	92	32.0	4	1,600	2,900
18.00	16.00	92	32.0	4	1,900	3,000
20.00	20.00	104	38.0	4	2,200	4,000
22.00	20.00	104	38.0	4	3,900	6,100
24.00	25.00	121	45.0	4	5,100	8,800
25.00	25.00	121	45.0	4	4,000	6,700
26.00	25.00	121	45.0	4	6,800	10,200
28.00	25.00	121	45.0	4	6,100	9,400
30.00	25.00	121	45.0	4	6,900	11,100
32.00	32.00	133	53.0	4	7,200	10,800
36.00	32.00	133	53.0	6	14,100	17,400
40.00	40.00	155	63.0	6	12,800	21,000

Roughing end mills

NR 大圓齒形

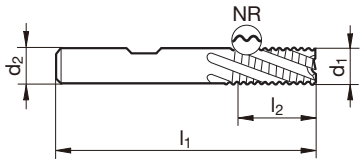
DIN 844L | NR | 4-6 | 30° | 11°

Tool material	HSCO	
Surface	○	Ⓕ
Type	NR	NR
Shank form	B	B

P	•
M	○
K	•
N	•
S	
H	

GÜHRINGNAVIGATOR

- centre cutting
- 端刃過中心



編號	3347	3650

d1 js12	d2	l1	l2	Z	價格	
mm	mm	mm	mm	刃數		
6.00	6.00	68	24.0	4	1,600	2,200
7.00	10.00	80	30.0	4	1,800	3,100
8.00	10.00	88	38.0	4	1,500	2,200
9.00	10.00	88	38.0	4	2,000	3,100
10.00	10.00	95	45.0	4	1,400	2,400
12.00	12.00	110	53.0	4	1,900	3,300
14.00	12.00	110	53.0	4	2,200	3,200
16.00	16.00	123	63.0	4	2,300	3,800
18.00	16.00	123	63.0	4	3,200	4,800
20.00	20.00	141	75.0	4	3,100	5,900
22.00	20.00	141	75.0	4	5,900	10,000
25.00	25.00	166	90.0	4	6,200	10,600
28.00	25.00	166	90.0	4	7,900	14,800
32.00	32.00	186	106.0	4	10,000	15,600
36.00	32.00	186	106.0	6	11,800	20,800

Roughing/finishing end mills NF 方形齒

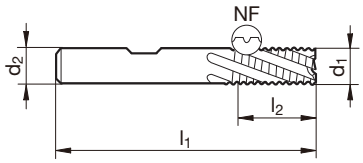
DIN 844 K | NF | 6+ | 30° | 11°

	M42	HSCO
Tool material		
Surface	○	F
Type	NF	NF
Shank form	B	B

P	•
M	○
K	•
N	•
S	
H	

GÜHRINGNAVIGATOR

- centre cutting
- 端刃過中心



編號	3343	3669

d1 js12	d2	l1	l2	Z	價格	
mm	mm	mm	mm	刃數		
6.00	6.00	57	13.0	4	1,400	2,400
7.00	10.00	66	16.0	4	1,600	2,700
8.00	10.00	69	19.0	4	1,400	2,400
9.00	10.00	69	19.0	4	1,700	3,100
10.00	10.00	72	22.0	4	1,600	2,600
11.00	12.00	79	22.0	4	2,100	3,500
12.00	12.00	83	26.0	4	1,900	3,100
14.00	12.00	83	26.0	4	2,300	3,700
15.00	12.00	83	26.0	4	3,100	4,600
16.00	16.00	92	32.0	4	2,600	4,200
18.00	16.00	92	32.0	4	2,800	4,800
20.00	20.00	104	38.0	4	3,200	5,100
22.00	20.00	104	38.0	4	5,700	7,900
24.00	25.00	121	45.0	4	7,200	12,200
25.00	25.00	121	45.0	4	5,200	8,500
26.00	25.00	121	45.0	4	8,400	14,400
28.00	25.00	121	45.0	4	7,800	12,800
30.00	25.00	121	45.0	4	8,300	15,700
32.00	32.00	133	53.0	4	9,000	13,900
36.00	32.00	133	53.0	6	15,800	14,100
40.00	40.00	155	63.0	6	16,100	27,800

Roughing/finishing end mills NF 方形齒

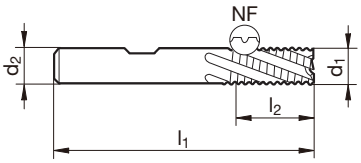
DIN 844L | NF | 4-6 | 30° | 11°

Tool material	HSCO	
Surface	○	F
Type	NF	NF
Shank form	B	B

P	•
M	○
K	•
N	•
S	
H	

GÜHRINGNAVIGATOR

- centre cutting
- 端刃過中心



編號	3342	3698

d1 js12	d2	l1	l2	Z	價格	
mm	mm	mm	mm	刃數		
6.00	6.00	68	24.0	4	2,000	3,100
8.00	10.00	88	38.0	4	2,100	3,000
10.00	10.00	95	45.0	4	2,100	3,400
12.00	12.00	110	53.0	4	2,700	4,600
14.00	12.00	110	53.0	4	3,600	5,500
16.00	16.00	123	63.0	4	3,500	5,800
18.00	16.00	123	63.0	4	4,300	6,700
20.00	20.00	141	75.0	4	4,200	6,900
22.00	20.00	141	75.0	4	10,800	19,700
25.00	25.00	166	90.0	4	12,600	20,500
28.00	25.00	166	90.0	4	18,300	28,700
32.00	32.00	186	106.0	4	18,400	28,800
36.00	32.00	186	106.0	6	21,000	39,000

Morse taper end mills

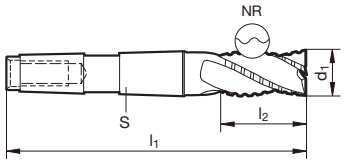
NR 大圓齒形

DIN 845K | NR | 4-8 | 30° | 11°

Tool material	HSCO
Surface	◯
Type	NR
Shank form	MT

P	•
M	○
K	•
N	•
S	
H	

GÜHRINGNAVIGATOR



編號 3117

d1 js12	S	l1	l2	Z	價格
mm		mm	mm	刃數	
10.00	MK-1	92	22.0	4	3,500
14.00	MK-2	111	26.0	4	3,800
16.00	MK-2	117	32.0	4	4,700
18.00	MK-2	117	32.0	4	5,100
20.00	MK-2	123	38.0	4	5,000
25.00	MK-3	147	45.0	5	7,100
26.00	MK-3	147	45.0	5	10,500
28.00	MK-3	147	45.0	5	9,600
30.00	MK-3	147	45.0	5	10,100
32.00	MK-4	201	53.0	6	13,700
40.00	MK-4	211	63.0	6	19,800
50.00	MK-5	261	75.0	8	32,800

Morse taper end mills

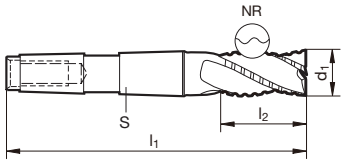
NR 大圓齒形

DIN 845L | NR | 4-8 | 30° | 11°

Tool material	HSCO
Surface	◯
Type	NR
Shank form	MT

P	•
M	○
K	•
N	•
S	
H	

GÜHRINGNAVIGATOR



編號 3121

d1 js12 mm	S	l1 mm	l2 mm	Z 刃數	價格
16.00	MK-2	148	63.0	4	6,400
18.00	MK-2	148	63.0	4	7,200
20.00	MK-2	160	75.0	4	7,600
25.00	MK-3	192	90.0	5	10,900
28.00	MK-3	192	90.0	5	13,900
30.00	MK-3	192	90.0	5	17,400
32.00	MK-4	254	106.0	6	17,700
36.00	MK-4	254	106.0	6	26,800
40.00	MK-4	273	125.0	6	26,200
50.00	MK-5	336	150.0	8	47,300

Milling conditions: 銑削條件

MTC unstable machining conditions
low drive power
工況不佳 / 工件形狀特殊 / 夾持不穩固
機台馬力與扭力不足

long tools

Correction factors: 加減係數因子

	a_p roughing > 1.5xD	v_c -25%	f_z -25%
	medium length tools	v_c -40%	f_z -40%
	extra length tools	v_c -60%	f_z -55%
	uncoated tools	v_c -50%	f_z -25%

Material	Hard-ness	Type	Application	a_e max	v_c	f_z (mm/z) with nom. Ø 每刃進給/ 刃徑								
						3	4	6	8	10	12	16	20	25
Struct./free-cutting steels. unall. heat-treat./case hard. steels 1.0035 S185. 1.0486 P275N. 1.0345 P235GH. 1.0050. 1.0070. 1.8937 1.0718 11SMnPb30. 1.0736 11SMn37 1.0402 C22. 1.1178 C30E 1.0503 C45. 1.1191 C30E 1.0301 C10. 1.1121 C10E 1.1750 C75W. 1.2076 102Cr6. 1.2307 29CrMoV9	≤ 850 N/mm²	VA/U	Slotting	1xD	135	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		VA/U	Roughing	0.75xD	160	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
Free-cutting steels. unall. case hard. steels. nitr. steels 1.0727 46 S20. 1.0728 60 S20. 1.0757 46SPb20 1.0601 C60. 1.1221 C60E 1.7043 38Cr4 1.5752 15NiCr13. 1.7131 16MnCr5. 1.7264 20CrMo5 1.8504 34CrAl6 1.8519 31CrMoV9. 1.8550 34CrAlNi7	850-1.200 N/mm²	VA/U	Slotting	1xD	120	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		VA/U	Roughing	0.75xD	140	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
Alloyed heat-treatable. tool and high speed steels 1.5131 50MnSi4. 1.7003 38Cr2. 1.7030 28Cr4 1.5710 36NiCr6. 1.7035 41Cr4. 1.7225 42CrMo4 1.2080 X210Cr12. 1.2083 X42Cr13. 1.2419 105WCr6. 1.2379 X155CrVMo12-1 1.3243 S 6-5-2-5. 1.3343 S 6-5-2. 1.3344 S 6-5-3 Spring steel = 1.5026 55Si7. 1.7176 55Cr3. 1.8159 51CrV4	850-1.400 N/mm²	U/F	Slotting	1xD	100	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		U/F	Roughing	0.75xD	120	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
Hardened steel Tool steel. heat-treatable steel. spring steel. high-speed steel. case hardened steel. etc. Z.B.: 1.2344 X40CrMoV5-1; 1.2767 X45NiCrMo4; 1.2379 X155CrVMo12-1; 1.2080 X210Cr12; 1.3343 S 6-5-2	≤ 54 HRC	U/F	Slotting	1xD	55	0.006	0.008	0.012	0.016	0.022	0.026	0.04	0.04	0.06
		U/F	Roughing	0.33xD	80	0.008	0.010	0.016	0.021	0.029	0.034	0.05	0.06	0.07
	55 - 63 HRC													
Stainless steel 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	≤ 750 N/mm²	VA/U	Slotting	1xD	90	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		VA/U	Roughing	0.75xD	110	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
Stainless steel 1.4301X5CrNi18-10. 1.4303 X5CrNi18-12 1.4310 XCrNi18-8 USA = 304. 304L. 420	750-850 N/mm²	VA/U	Slotting	1xD	65	0.008	0.010	0.015	0.020	0.028	0.034	0.04	0.06	0.07
		VA/U	Roughing	0.75xD	80	0.009	0.012	0.017	0.023	0.032	0.039	0.05	0.06	0.08
Stainless steel 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	≥ 850 N/mm²	VA/U	Slotting	1xD	55	0.007	0.009	0.013	0.018	0.025	0.030	0.04	0.05	0.06
		VA/U	Roughing	0.60xD	70	0.008	0.011	0.016	0.021	0.030	0.036	0.05	0.06	0.08
Special alloys (nickel based "Ni") Nimonic. Inconel. Monel. Hastelloy	≤ 1.300 N/mm²	VA/U	Slotting	1xD	25	0.006	0.008	0.012	0.016	0.022	0.026	0.04	0.04	0.06
		VA/U	Roughing	0.60xD	40	0.007	0.010	0.014	0.019	0.026	0.032	0.04	0.05	0.07
Titanium alloys ("Ti") 3.7024 Ti99.5. 3.7114 TiAl5Sn2.5. 3.7124 TiCu2 3.7154 TiAl6Zr5. 3.7164 TiAl6V4. 3.7184 TiAl4Mo4Sn2.5	≤ 1.300 N/mm²	VA/U	Slotting	1xD	50	0.007	0.009	0.013	0.018	0.025	0.030	0.04	0.05	0.06
		VA/U	Roughing	0.60xD	70	0.008	0.011	0.016	0.021	0.030	0.036	0.05	0.06	0.08
Cast/grey cast iron. spher.graphite/mall. cast iron 0.6010 EN-GL100 (GG10). 0.6020 EN-GJL-200 (GG20). 0.7050 EN-GJS-500-7 (GGG50). 0.8535 EN-GJMW-350-4 (GTW35)	≤ 240 HB	U/F	Slotting	1xD	120	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		U/F	Roughing	0.75xD	140	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
Cast/grey cast iron. spher.graphite/mall. cast iron 0.6025 EN-GL250 (GG25). 0.6035 EN-GJL-350 (GG35). 0.7070 EN-GJS-700-2 (GGG70). 0.8170 EN-GJMB-700-2 (GTS70)	≥ 240 HB	U/F	Slotting	1xD	105	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		U/F	Roughing	0.75xD	130	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
Aluminium. Al-wrought alloys. Al-alloys 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	≤ 7% Si	A/WF	Slotting	1xD	375	0.011	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
		A/WF	Roughing	0.75xD	500	0.012	0.016	0.024	0.032	0.043	0.051	0.07	0.09	0.11
Aluminium-cast alloys 3.2131 G-AlSi5Cu1. 3.2153 G-AlSi7Cu3. 3.2573 G-AlSi9 3.2581 G-AlSi12. 3.2583 G-AlSi12Cu. - G-AlSi12CuNiMg	≥ 7% Si	A/WF	Slotting	1xD	180	0.010	0.013	0.019	0.026	0.035	0.042	0.06	0.07	0.09
		A/WF	Roughing	0.75xD	300	0.011	0.015	0.022	0.029	0.040	0.048	0.06	0.08	0.10
Magnesium-alloys MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-	VA/A	Slotting	1xD	140	0.010	0.013	0.019	0.026	0.035	0.042	0.06	0.07	0.09
		VA/A	Roughing	0.75xD	170	0.011	0.015	0.022	0.029	0.040	0.048	0.06	0.08	0.10
Non-ferr. met. (copper. short-/long-chipp. brass/bronze) 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 ... 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 ... 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	≤ 850 N/mm²	VA/A	Slotting	1xD	200	0.010	0.013	0.019	0.026	0.035	0.042	0.06	0.07	0.09
		VA/A	Roughing	0.75xD	230	0.011	0.015	0.022	0.029	0.040	0.048	0.06	0.08	0.10

Milling conditions: 銑削條件

MTC unstable machining conditions
low drive power
工況不佳 / 工件形狀特殊 / 夾持不穩固
機台馬力與扭力不足

long tools

Correction factors: 加減係數因子

	a_p roughing > 1.5xD	v_c -25 %	f_z -25 %
	uncoated tools	v_c -50 %	f_z -25 %

Material	Hard-ness	Type	Application	a_e max	v_c	f_z (mm/z) with nom. Ø 每刃進給/ 刃徑								
						3	4	6	8	10	12	16	20	25
Struct./free-cutting steels. unall. heat-treat./case hard. steels 1.0035 S185. 1.0486 P275N. 1.0345 P235GH. 1.0050. 1.0070. 1.8937 1.0718 11SMnPb30. 1.0736 11SMn37 1.0402 C22. 1.1178 C30E 1.0503 C45. 1.1191 C30E 1.0301 C10. 1.1121 C10E 1.1750 C75W. 1.2076 102Cr6. 1.2307 29CrMoV9	≤ 850 N/mm²	U	Slotting	1xD	120	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		U	Roughing	0.75xD	140	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
Free-cutting steels. unall. case hard. steels. nitr. steels 1.0727 46 S20. 1.0728 60 S20. 1.0757 46SPb20 1.0601 C60. 1.1221 C60E 1.7043 38Cr4 1.5752 15NiCr13. 1.7131 16MnCr5. 1.7264 20CrMo5 1.8504 34CrAl6 1.8519 31CrMoV9. 1.8550 34CrAlNi7	850-1.200 N/mm²	U	Slotting	1xD	100	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		U	Roughing	0.75xD	120	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
Alloyed heat-treatable. tool and high speed steels 1.5131 50MnSi4. 1.7003 38Cr2. 1.7030 28Cr4 1.5710 36NiCr6. 1.7035 41Cr4. 1.7225 42CrMo4 1.2080 X210Cr12. 1.2083 X42Cr13. 1.2419 105WCr6. 1.2379 X155CrVMo12-1 1.3243 S 6-5-2-5. 1.3343 S 6-5-2. 1.3344 S 6-5-3 Spring steel = 1.5026 55Si7. 1.7176 55Cr3. 1.8159 51CrV4	850-1.400 N/mm²	H	Slotting	1xD	90	0.008	0.010	0.015	0.020	0.028	0.034	0.04	0.06	0.07
		H	Roughing	0.75xD	110	0.009	0.012	0.017	0.023	0.032	0.039	0.05	0.06	0.08
Hardened steel Tool steel. heat-treatable steel. spring steel. high-speed steel. case hardened steel. etc. Z.B.: 1.2344 X40CrMoV5-1; 1.2767 X45NiCrMo4; 1.2379 X155CrVMo12-1; 1.2080 X210Cr12; 1.3343 S 6-5-2	≤ 54 HRC	H	Slotting	1xD	50	0.005	0.007	0.011	0.014	0.020	0.024	0.03	0.04	0.05
		H	Roughing	0.33xD	70	0.007	0.009	0.014	0.019	0.026	0.031	0.04	0.05	0.07
	55 - 63 HRC													
Stainless steel 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	≤ 750 N/mm²	U	Slotting	1xD	80	0.008	0.010	0.015	0.020	0.028	0.034	0.04	0.06	0.07
		U	Roughing	0.75xD	100	0.009	0.012	0.017	0.023	0.032	0.039	0.05	0.06	0.08
Stainless steel 1.4301X5CrNi18-10. 1.4303 X5CrNi18-12 1.4310 XCrNi18-8 USA = 304. 304L. 420	750-850 N/mm²	U	Slotting	1xD	55	0.007	0.009	0.013	0.018	0.025	0.030	0.04	0.05	0.06
		U	Roughing	0.75xD	70	0.008	0.010	0.015	0.020	0.029	0.035	0.05	0.06	0.07
Stainless steel 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	≥ 850 N/mm²	U	Slotting	1xD	50	0.006	0.008	0.012	0.016	0.022	0.026	0.04	0.04	0.06
		U	Roughing	0.60xD	70	0.007	0.010	0.014	0.019	0.026	0.032	0.04	0.05	0.07
Special alloys (nickel based "Ni") Nimonic. Inconel. Monel. Hastelloy	≤ 1.300 N/mm²	U	Slotting	1xD	20	0.005	0.007	0.011	0.014	0.020	0.024	0.03	0.04	0.05
		U	Roughing	0.60xD	30	0.006	0.009	0.013	0.017	0.024	0.029	0.04	0.05	0.06
Titanium alloys ("Ti") 3.7024 Ti99.5. 3.7114 TiAl5Sn2.5. 3.7124 TiCu2 3.7154 TiAl6Zr5. 3.7164 TiAl6V4. 3.7184 TiAl4Mo4Sn2.5	≤ 1.300 N/mm²	U	Slotting	1xD	45	0.006	0.008	0.012	0.016	0.022	0.026	0.04	0.04	0.06
		U	Roughing	0.60xD	60	0.007	0.010	0.014	0.019	0.026	0.032	0.04	0.05	0.07
Cast/grey cast iron. spher.graphite/mall. cast iron 0.6010 EN-GL100 (GG10). 0.6020 EN-GJL-200 (GG20). 0.7050 EN-GJS-500-7 (GGG50). 0.8535 EN-GJMW-350-4 (GTW35)	≤ 240 HB	U	Slotting	1xD	100	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		U	Roughing	0.75xD	120	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
Cast/grey cast iron. spher.graphite/mall. cast iron 0.6025 EN-GL250 (GG25). 0.6035 EN-GJL-350 (GG35). 0.7070 EN-GJS-700-2 (GGG70). 0.8170 EN-GJMB-700-2 (GTS70)	≥ 240 HB	H	Slotting	1xD	90	0.008	0.010	0.015	0.020	0.028	0.034	0.04	0.06	0.07
		H	Roughing	0.75xD	110	0.009	0.012	0.017	0.023	0.032	0.039	0.05	0.06	0.08
Aluminium. Al-wrought alloys. Al-alloys 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	≤ 7% Si	A	Slotting	1xD	350	0.010	0.013	0.019	0.026	0.035	0.042	0.06	0.07	0.09
		A	Roughing	0.75xD	410	0.011	0.015	0.022	0.029	0.040	0.048	0.06	0.08	0.10
Aluminium-cast alloys 3.2131 G-AlSi5Cu1. 3.2153 G-AlSi7Cu3. 3.2573 G-AlSi9 3.2581 G-AlSi12. 3.2583 G-AlSi12Cu. - G-AlSi12CuNiMg	≥ 7% Si	A	Slotting	1xD	180	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		A	Roughing	0.75xD	210	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
Magnesium-alloys MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-	A	Slotting	1xD	120	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		A	Roughing	0.75xD	140	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
Non-ferr. met. (copper. short-/long-chipp. brass/bronze) 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 ... 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 ... 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	≤ 850 N/mm²	A	Slotting	1xD	180	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		A	Roughing	0.75xD	210	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09

Foundations for economically efficient milling　經濟效益高的銑削加工基礎

Peripheral requirements

Applicable in every material group

- P K H M S N
- easy to machine materials = increase in productivity
- difficult to machine materials = increase in process reliability

High-dynamic machining centres

- short acceleration distances
- higher speed range
- small to medium tool diameters

Heavy machines

- stable feed axes
- high spindle torque
- medium to large tool diameters

Unstable to stable workpiece clamping

- stable = vibration-free machining = maximum metal removal rate
- unstable = reduction of radial forces = increased process reliability

周邊外圍需求的考量因素

適用於每個物料群組

- P K H M S N
- 容易加工的材料 = 提高生產率
- 難加工的材料 = 提高加工過程的穩定性

高轉速加工中心機

- 加速距離短
- 更高的切削速度範圍
- 盡量使用小、中尺寸直徑的刀具

重型機器

- 穩定的進給軸向控制
- 高主軸扭力
- 盡量使用中大尺寸直徑刀具

不穩定或是穩定的工件夾持狀況

- 穩定 = 無振動的加工 = 最大金屬去除率
- 不穩定 = 減少徑向力 = 提高加工過程穩定性

Application parameters

Low cutting width a_e to 0.33 x D
- low angle of engagement <70°
- short time of contact between cutting edge and component

Very high tooth feed f_z
- reduced chip thickness allows considerably higher f_z

Very high cutting speed v_c
- reduced heating up and prolonged cooling down allow very high v_c values

High cutting depth a_p
- improved leverage effect
- high metal removal rate
- increase in contact points between tool and component

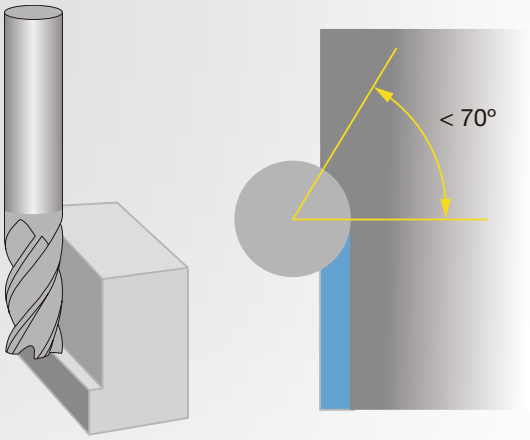
加工參數應用

低的切削寬度 a_e 到 0.33 x D
- 低切削嚙合角<70°
- 切削刃與工件之間的接觸時間短

極高進給率 f_z
- 切屑厚度減少、可顯著提高 f_z

非常高的切削速度 v_c
- 高切削速度時減少加工時熱的產生、並延長冷卻時間

高切削深度 a_p
- 改善槓桿效應
- 高金屬移除率
- 增加刀具與零件之間的接觸點



Tool angle of engagement & tool contact time
刀具切削嚙合角度 & 刀具接觸時間

Metal removal rate　金屬移除率（單位時間內材料切除的體積）

The metal removal rate specifies how high the actual chip removal is per minute. It is especially suitable for comparing different machining strategies.
金屬移除率是指每分鐘實際去除切屑的量，特別適合用於比較不同的加工策略。

$$a_p\ (mm) \times a_e\ (mm) \times v_f\ (m/min) = Q\ (cm^3/min)$$

切深 a_p　　切寬 a_e　　每分鐘進給　　每分鐘移除量 cm^3

General recommendation 一般建議

Steel **Cast iron** **Hardened**	P K H	Dry machining, compressed air, MQL: 乾式切削、噴壓縮空氣、MQL霧化切削液冷卻	• Avoid thermal shock 避免熱產生對刀具的衝擊 • Dissipate machining temperature via chip 切屑把熱帶走 • Supporting chip evacuation 幫助排屑
Stainless **Special alloy**	M S	Soluble oil, neat oil: 乳化液、純油性	• Cooling of tool cutting edge 切削刃口冷卻 • Preventing built-up edge 避免刃口沾黏積屑 • Supporting chip evacuation 幫助排屑
Non-ferrous metals	N	Soluble oil, neat oil: 乳化液、純油性	• Preventing built-up edge 避免刃口沾黏積屑 • Supporting chip evacuation 幫助排屑

Exceptions for material ranges 材料範圍以外的注意事項

P K

When **coolant** is not available the cutting speed (vc) and/or the radial feed (ae) should be reduced.
The resulting reduced temperature reduces the risk of thermal shock.
冷卻條件不佳時，則應該降低切削速度(vc)及降低切寬(ae)，這樣才能降低溫度，降低熱對刀刃的衝擊風險

If there are **chip evacuation problems** the application of coolant should be taken into consideration, poor evacuation of chips can lead to massive tool wear and even tool breakage.
如果沒有排屑不良的問題，則應考慮使用冷卻液，排屑不良會大大導致刀刃磨損甚至斷刀。

When **heat is being generated due to poor chip evacuation**, it should be checked if through coolant is available. By using a specifically directed “coolant jet”, coolant can be supplied where congested without hitting the cutting area. Alternatively, the application of coolant for the entire machining operation is recommended.
當排屑不良而產生熱能時，應檢查是否可以使用冷卻液，透過使用專門的〝冷卻液噴嘴〞，
可以將冷卻液供應到堵塞處而不會碰到切削區域，另外，建議在整個加工過程中使用冷卻液。

Other notes 其他注意事項

A. Finishing
The application of coolant is principally an advantage as a better surface finish can be achieved.

精銑削
- 使用冷卻液原則上是一個優勢，因為可以實現更好的表面光潔度

B. Very long tools
Coolant can result in a smoother process, as the lubricant has a vibration-reducing effect

長刃型銑削
- 使用冷卻液可以使加工過程更順暢，因為潤滑劑具有減振作用

C. Alignment of coolant
- as acurate as possible in the cutting area from at least three directions
- no flushing back of small chips to the cutting area

冷卻液對準加工區域
- 至少有三個方向的切削液噴嘴，需對準切削區域噴射
- 不要將小切屑衝回切削區域

E. Solid carbide milling cutters with internal cooling
- optimal chip evacuation, very good cutting edge cooling, very effective against built-up edges
- to be recommended especially for larger tool diame ters and tough materials

中心出水型銑刀
- 最佳的排屑性，非常好的切削刃口冷卻，避免刃口沾黏積屑非常有效
- 特別推薦用於較大尺寸的刀具和堅韌的難切削材銑削

D. Peripheral cooling/Guhrojet
Best external option: Optimal tool cooling and chip evacuation thanks to the direct route from coolant ecit to cutting area

Guhrojet 刀具周邊外圍冷卻
- 由於冷卻液直接噴到切削區域，達到最佳的刀具冷卻和排屑性

GÜHRO JET

Influence on process through tool engagement
刀具切削與工件的接觸嚙合角度對加工過程的影響

Angle of engagement 切削嚙合角度

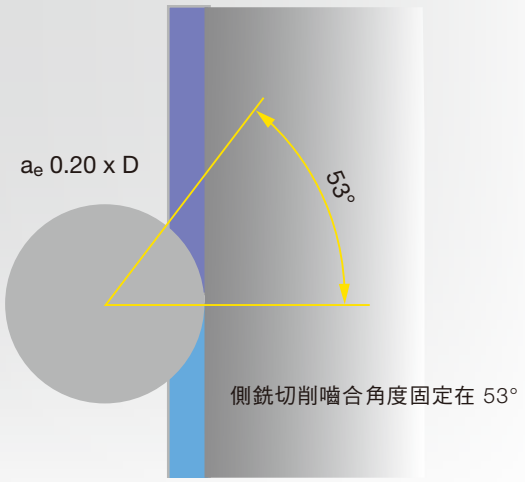
The angle of engagement inscribes the cutting range of the tool from start of chip formation to exit from the material. With these parameters the stress impacting on the tool can be assessed. With straight milling paths the angle is constant, with concave milling paths it increases and with convex milling paths it decreases.

嚙合角度確定了從切屑形成開始到從退出材料時刀具的切削範圍。
利用這些參數，可以評估影響刀具的受力。在直線銑削路徑中，角度是恆定的；在凹形銑削路徑中，角度是逐漸增大的；而在凸形銑削路徑中，角度則是減小。

Straight milling path 直線銑削路徑

- constant angle of engagement 嚙合角度固定
- constant tool stress 刀具的受力固定

Example: a_e 0.20 x D = 53° engagement 切寬a_e 0.2D=53°嚙合角
Engagement remains a constant 53° 53°固定的嚙合角度



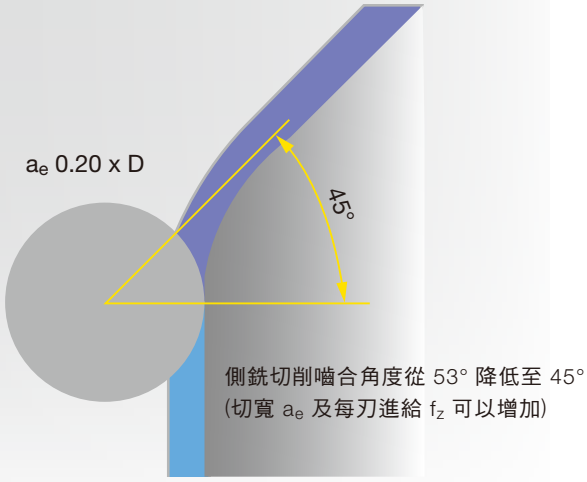
Angle of engagement with convex contour radii
外凸形繞銑嚙合角度變化

Convex milling path 外凸形繞銑路徑

- decreasing angle of engagement 嚙合角度減少
- reduced tool stress 刀具的受力減少

Example: a_e 0.20 x D = 53° engagement 切寬a_e 0.2D＝53°嚙合角
Engagement reduces to 45° 嚙合角度減少至45°

Measures: a_e may be increased
調整方式 f_z can be increased
切寬 a_e 及每刃進給 f_z 可以增加



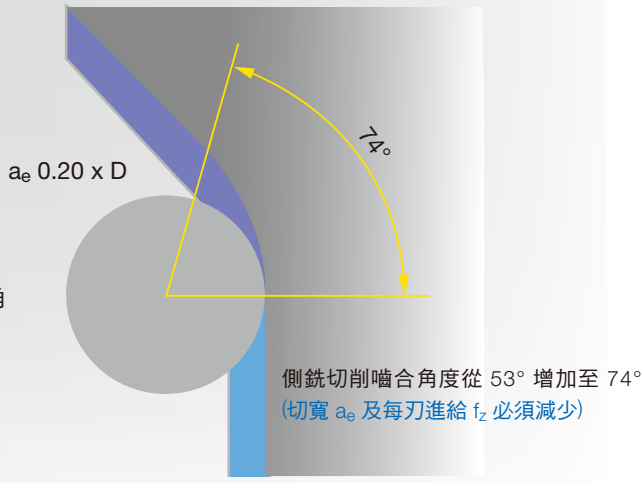
Angle of engagement with concave contour radii
內凹形繞銑嚙合角度變化

Concave milling path 內凹形繞銑路徑

- increasing angle of engagement 嚙合角度增加
- increased tool stress 刀具的受力增加

Example: a_e 0.20 x D = 53° engagement 切寬a_e 0.2D＝53°嚙合角
Engagement increases to 74° 嚙合角度增加至74°

Measures: a_e must be reduced
調整措施 f_z must be reduced in radius
切寬 a_e 及每刃進給 f_z 必須減少



Influence on process through tool engagement
刀具切削與工件的 "接觸嚙合角度" 對加工過程的影響

Angle of engagement with 90° corner radii
90°內凹圓形繞銑嚙合角度變化

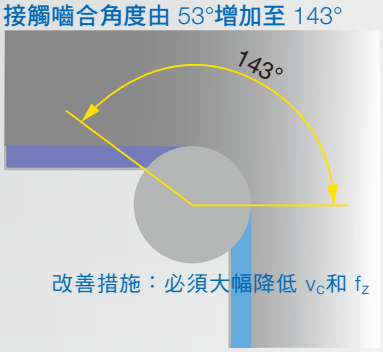
Tool radius = Corner radius 刀具半徑＝工件圓弧半徑
- very unfavourable for tool dynamics 非常不利的刀具動態路徑
- change of stress direction 刀具的受力改變
- abrupt increase in tool stress 刀具受力突然增加

a_e 0.20 x D

Example: Increase of engag. angle from 53° to 143° (270°)
接觸嚙合角度由 53°增加至 143°

Measures: v_c and f_z must be heavily reduced
改善措施：必須大幅降低 v_c 和 f_z

接觸嚙合角度由 53°增加至 143°



改善措施：必須大幅降低 v_c和 f_z

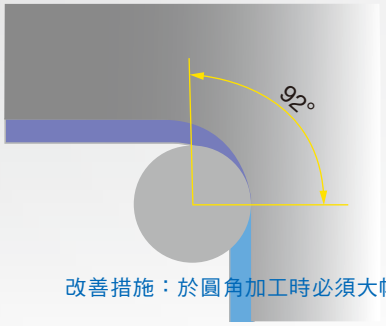
Tool radius < Corner radius 刀具半徑 < 工件圓弧半徑
- machine can interpolate the path 機器可以插補路徑
- no “impact” on tool 對刀具無 “影響”
- lower increase of tool stress 降低刀具受力

a_e 0.20 x D

Example: Increase of engag. angle from 53° to 92° (174°)
接觸嚙合角度由 53°增加至 92°

Measures: a_e must be reduced 切寬 ae必須減少
f_z must be heavily reduced in radius
改善措施：f_z 每刃進給於圓角加工時必須大幅降低

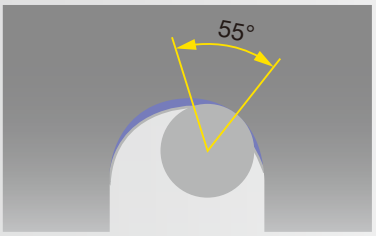
接觸嚙合角度由 53°增加至 92°



改善措施：於圓角加工時必須大幅降低 f_z

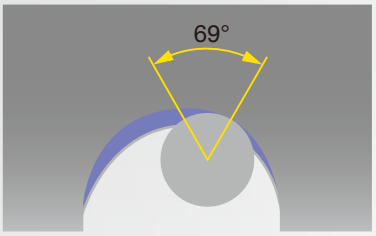
Ratio of flute width to tool diameter with trochoidal milling
擺線銑削時槽寬與刀具直徑之比

Flute width 1.7 – 2.0 x D 槽寬 1.7~2.0 x D
- cut in C arc C形圓弧切削
- a_e max. 0.10 x D (theor. 37°) 切寬 a_e 最多 0.10D（理論上嚙合37°）
- increase of angles of engagement by up to 50%
  切削嚙合角度增加最多至 50%。（37°x 1.5=55.5°）



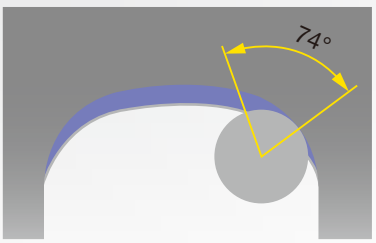
接觸嚙合角度由 37°增加至 55°

Flute width 2.1 – 3.0 x D 槽寬 2.1~3.0 x D
- cut in C arc C形圓弧切削
- a_e max. 0.15 x D (theor. 46°) 切寬 a_e 最多 0.15D（理論上嚙合46°）
- increase of angles of engagement by up to 50%
  切削嚙合角度增加最多至 50%。（46°x 1.5=69°）



接觸嚙合角度由 46°增加至 69°

Flute width from 3.1 x D 槽寬 3.1 x D
- cut in D arc C形圓弧切削
- a_e max. 0,20 x D (theor. 53°) 切寬 a_e 最多 0.20 D（理論上嚙合53°）
- increase of angles of engagement by up to 40%
  切削嚙合角度增加最多至 40°。（53°x 1.4=74.2°）



接觸嚙合角度由 53°增加至 74°

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