


# GUHRING



**NEW** *with optimised  
roughing geometry*

- ▶ **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

## **Roughing end mills** with flatknuckle-teeth

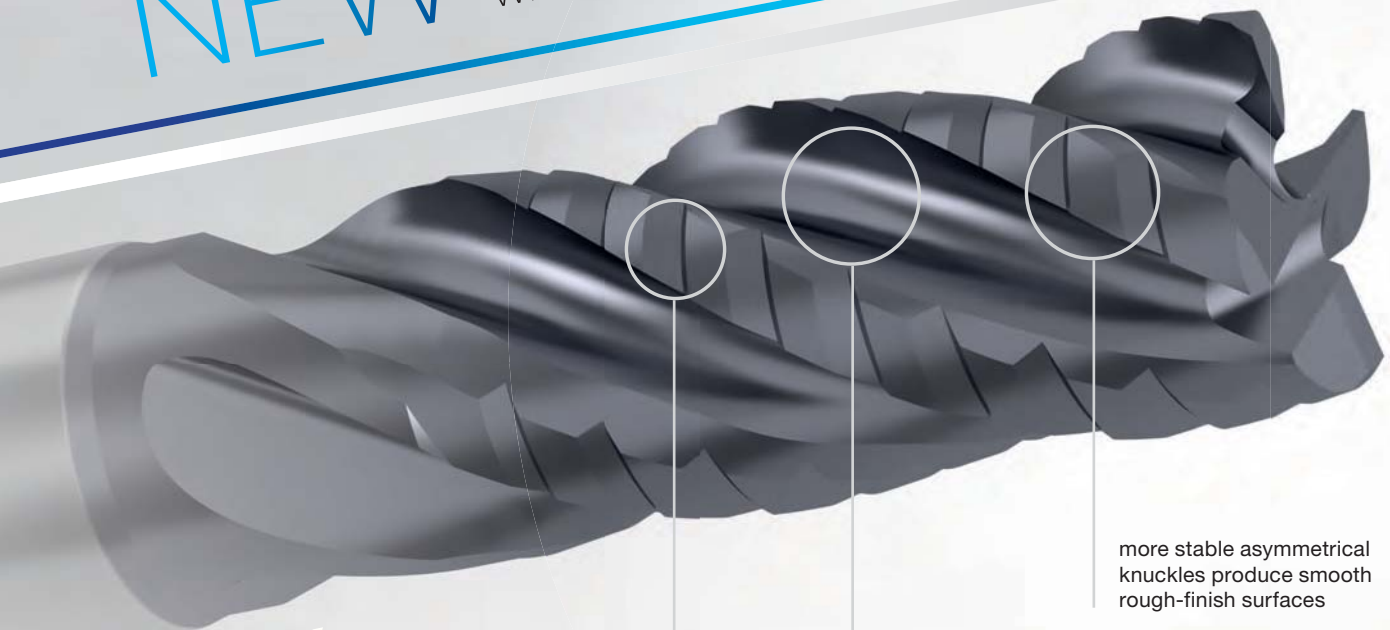
GUHRING - YOUR WORLD-WIDE PARTNER





# RATIO®

## NEW RATIO®-HIGH-PERFORMANCE ROUGHING END MILLS with optimised roughing geometry



Ratio®

roughing geometry reduces the cutting pressure in comparison to smooth cutting milling cutters

larger flutes for optimal chip evacuation

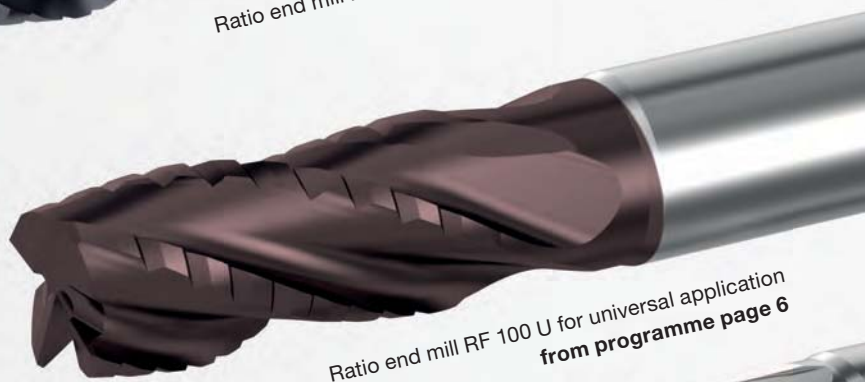
more stable asymmetrical knuckles produce smooth rough-finish surfaces

### OVERVIEW OF ADVANTAGES

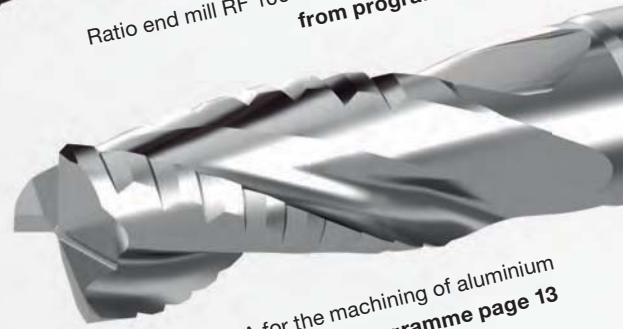
- // increased metal removal rate by utilising the entire cutting edge length
- // up to 60% longer tool life with high process reliability
- // ideal for less powerful machines and unstable clamping



Ratio end mill RF 100 VA for the machining of stainless steels  
from programme page 10



Ratio end mill RF 100 U for universal application  
from programme page 6



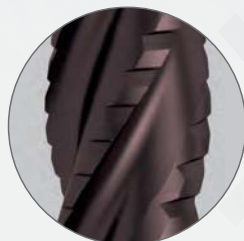
Ratio end mill RF 100 A for the machining of aluminium  
from programme page 13

## Short chips thanks to innovative roughing geometry

RF 100 VA NF  
Article no. 6877



RF 100 U HF  
Article no. 6881



RF 100 A WF  
Article no. 6868



# 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

Recommendations for each tool on the suitability for application groups and information on the max. tensile strength and hardness can be found in the product pages:

- optimal suitability
- limited suitability

# Coatings

- bright
- FIRE/nano FIRE
- a TiAlN nanoA
- Cb Carbo

# Pictograms

Tool material

**VHM**

Solid carbide finest grain (carbide-UF)

Shank form



to DIN 6535

Standard



to DIN

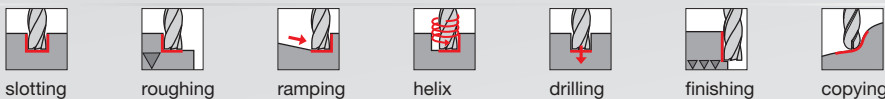


to Guhring standard

Type



Applications



Length



short (DIN)

long (DIN)

extra long

No. of teeth



Number of cutting edges

Helix angle



size of helix angle / no. of different helix angles

Rake angle



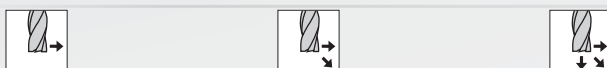
rake angle of circumference cutters

Cutting edge form



corner chamfer

Feed



for lateral feed

for lateral feed and ramping

for lateral feed ramping and drilling



P	M	K	N	S	H	Tool illustration	Z	Hardness	Shank form	Length	Helix angle °	Tool material	Surface	d1/mm	Article no.	Page
---	---	---	---	---	---	-------------------	---	----------	------------	--------	---------------	---------------	---------	-------	-------------	------

Standard Ratio end mills RF 100 U

•	•						4	HA			30° 32°	VHM	F	6.000 - 25.000	6881	6
•	•						4	HB			30° 32°	VHM	F	6.000 - 25.000	6882	6
•	•						4	HA	3xD		30° 32°	VHM	F	6.000 - 20.000	6883	7
•	•						4	HB	3xD		30° 32°	VHM	F	6.000 - 20.000	6884	7
•	•						4	-HA			30° 32°	VHM	F	6.000 - 20.000	6885	8
•	•						4	-HB			30° 32°	VHM	F	6.000 - 20.000	6886	8

High-performance roughing end mills RS 100 F

•	•	○					5-6	48 HRC	HA		45°	VHM	F	6.000 - 25.000	6889	9
•	•	○					5-6	48 HRC	HB		45°	VHM	F	6.000 - 25.000	6890	9

Ratio end mills RF 100 VA

•	•	•	○	○			4	HA			36° 38°	VHM	a	5.000 - 25.000	6877	10
•	•	•	○	○			4	HB			36° 38°	VHM	a	5.000 - 25.000	6878	10
•	•	•	○	○			4	HA			36° 38°	VHM	a	6.000 - 20.000	6879	11
•	•	•	○	○			4	HB			36° 38°	VHM	a	6.000 - 20.000	6880	11

High-performance roughing end mills RS 100 U

•	•	•	○	•			4-5	HA			30°	VHM	F	6.000 - 25.000	6887	12
•	•	•	○	•			4-5	HB			30°	VHM	F	6.000 - 25.000	6888	12

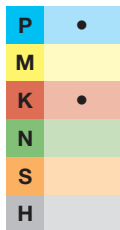
Ratio end mills Alu RF 100 A

		•					3	HA			30° 29° 31°	VHM	○	6.000 - 25.000	6868	13
		•					3	HB			30° 29° 31°	VHM	○	6.000 - 25.000	6869	13
		•					3	HA			30° 29° 31°	VHM	○	6.000 - 20.000	6870	14
		•					3	HB			30° 29° 31°	VHM	○	6.000 - 20.000	6871	14

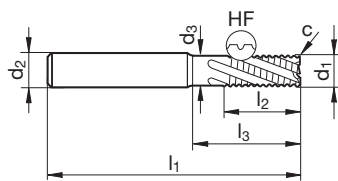
Standard Ratio end mills RF 100 U



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



**GÜHRING NAVIGATOR**  
Cutting data page 15



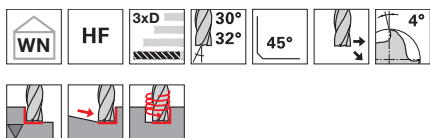
Article no. **6881** **6882**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
6.000	6.000	5.700	57.000	13.000	20.000	0.120	4	6.000
8.000	8.000	7.700	63.000	19.000	26.000	0.160	4	8.000
10.000	10.000	9.500	72.000	22.000	30.000	0.200	4	10.000
12.000	12.000	11.500	83.000	26.000	36.000	0.240	4	12.000
16.000	16.000	15.500	92.000	32.000	42.000	0.320	4	16.000
20.000	20.000	19.500	104.000	38.000	52.000	0.400	4	20.000
25.000	25.000	24.000	121.000	45.000	63.000	0.500	4	25.000

ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
P	≤ 850 N/mm <sup>2</sup>	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/mm <sup>2</sup>	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
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



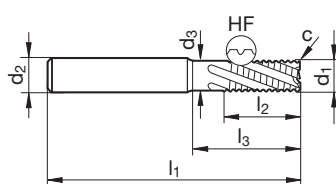
Tool material **Solid carbide**

Surface	<b>F</b>	<b>F</b>
Type	HF	HF
Shank form	HA	HB

P	•
M	
K	•
N	
S	
H	

**GÜHRING** NAVIGATOR

Cutting data page 15

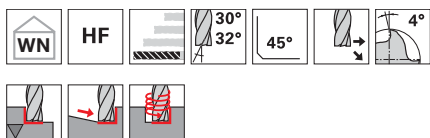


Article no. **6883** **6884**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
6.000	6.000	5.700	65.000	18.000	28.000	0.120	4	6.000
8.000	8.000	7.700	75.000	24.000	38.000	0.160	4	8.000
10.000	10.000	9.500	80.000	30.000	38.000	0.200	4	10.000
12.000	12.000	11.500	93.000	36.000	46.000	0.240	4	12.000
16.000	16.000	15.500	108.000	48.000	58.000	0.320	4	16.000
20.000	20.000	19.500	126.000	60.000	74.000	0.400	4	20.000

ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
<b>P</b>	≤ 850 N/mm <sup>2</sup>	<b>80</b>	0,005	0,011	0,014	0,019	0,023	0,031	0,038	<b>140</b>	0,008	0,016	0,022	0,029	0,035	0,047	0,058
	≥ 850 N/mm <sup>2</sup>	<b>60</b>	0,005	0,010	0,013	0,018	0,022	0,029	0,036	<b>105</b>	0,008	0,015	0,020	0,027	0,033	0,044	0,055
<b>K</b>	≤ 240 HB	<b>70</b>	0,005	0,011	0,014	0,019	0,023	0,031	0,038	<b>125</b>	0,008	0,016	0,022	0,029	0,035	0,047	0,058
	≥ 240 HB	<b>65</b>	0,005	0,010	0,013	0,018	0,022	0,029	0,036	<b>110</b>	0,008	0,015	0,020	0,027	0,033	0,044	0,055

Standard Ratio end mills RF 100 U



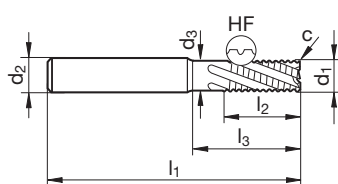
P	•
M	
K	•
N	
S	
H	

**GÜHRING NAVIGATOR**

Cutting data page 15

Tool material **Solid carbide**

Surface	<b>F</b>	<b>F</b>
Type	HF	HF
Shank form	HA	HB



Article no. **6885** **6886**

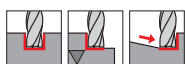
d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
6.000	6.000	5.700	75.000	13.000	34.000	0.120	4	6.000
8.000	8.000	7.700	100.000	19.000	49.000	0.160	4	8.000
10.000	10.000	9.500	100.000	22.000	48.000	0.200	4	10.000
12.000	12.000	11.500	150.000	26.000	58.000	0.240	4	12.000
16.000	16.000	15.500	150.000	32.000	78.000	0.320	4	16.000
20.000	20.000	19.500	150.000	38.000	78.000	0.400	4	20.000

ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
<b>P</b>	≤ 850 N/mm <sup>2</sup>	<b>55</b>	0,003	0,006	0,008	0,011	0,013	0,018	0,022	<b>80</b>	0,004	0,008	0,011	0,015	0,017	0,023	0,029
	≥ 850 N/mm <sup>2</sup>	<b>40</b>	0,003	0,006	0,008	0,011	0,013	0,017	0,021		<b>60</b>	0,004	0,008	0,010	0,014	0,016	0,022
<b>K</b>	≤ 240 HB	<b>50</b>	0,003	0,006	0,008	0,011	0,013	0,018	0,022	<b>70</b>	0,004	0,008	0,011	0,015	0,017	0,023	0,029
	≥ 240 HB	<b>40</b>	0,003	0,006	0,008	0,011	0,013	0,017	0,021		<b>65</b>	0,004	0,008	0,010	0,014	0,016	0,022





High-performance roughing end mills RS 100 F



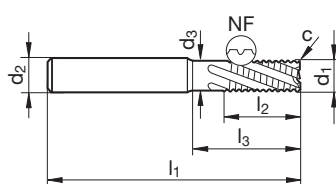
P	•
M	
K	•
N	
S	
H	○

**GÜHRING** NAVIGATOR

Cutting data page 15

Tool material **Solid carbide**

Surface	<b>F</b>	<b>F</b>
Type	NF	NF
Shank form	HA	HB



Article no. **6889** **6890**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
6.000	6.000	5.700	57.000	13.000	20.000	0.300	5	6.000
8.000	8.000	7.700	63.000	19.000	26.000	0.300	5	8.000
10.000	10.000	9.500	72.000	22.000	30.000	0.300	5	10.000
12.000	12.000	11.500	83.000	26.000	36.000	0.500	5	12.000
16.000	16.000	15.500	92.000	32.000	42.000	0.500	6	16.000
20.000	20.000	19.500	104.000	38.000	52.000	0.500	6	20.000
25.000	25.000	24.000	121.000	45.000	63.000	0.600	6	25.000

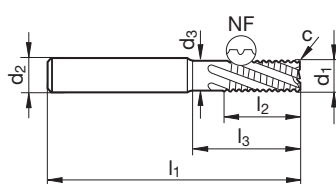
ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø							
			3	6	8	10	12	16	20		3	6	8	10	12	16	20	
<b>P</b>	≤ 850 N/mm <sup>2</sup>	<b>135</b>	0,009	0,018	0,024	0,032	0,038	0,051	0,064		<b>160</b>	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥ 850 N/mm <sup>2</sup>	<b>100</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060			<b>120</b>	0,010	0,019	0,026	0,035	0,041	0,055
<b>K</b>	≤ 240 HB	<b>120</b>	0,009	0,018	0,024	0,032	0,038	0,051	0,064		<b>140</b>	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥ 240 HB	<b>105</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060			<b>130</b>	0,010	0,019	0,026	0,035	0,041	0,055

Ratio end mills RF 100 VA



Tool material	Solid carbide	
Surface	<b>a</b>	<b>a</b>
Type	NF	NF
Shank form	HA	HB

**P** • **GÜHRING NAVIGATOR**  
**M** • Cutting data page 15  
**K** •  
**N** ○  
**S** ○  
**H**



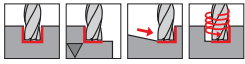
Article no. **6877** **6878**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
5.00	6.00	4.80	57	13.0	18.0	0.10	4	5.000
6.00	6.00	5.70	57	13.0	20.0	0.12	4	6.000
7.00	8.00	6.70	63	16.0	24.9	0.14	4	7.000
8.00	8.00	7.70	63	19.0	26.0	0.16	4	8.000
9.00	10.00	8.70	72	19.0	29.9	0.18	4	9.000
10.00	10.00	9.50	72	22.0	30.0	0.20	4	10.000
12.00	12.00	11.50	83	26.0	36.0	0.24	4	12.000
14.00	14.00	13.50	83	26.0	36.0	0.28	4	14.000
16.00	16.00	15.50	92	32.0	42.0	0.32	4	16.000
18.00	18.00	17.50	92	32.0	42.0	0.36	4	18.000
20.00	20.00	19.50	104	38.0	52.0	0.40	4	20.000
25.00	25.00	24.00	121	45.0	63.0	0.50	4	25.000

ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø							
			3	6	8	10	12	16	20		3	6	8	10	12	16	20	
<b>P</b>	≤ 850 N/mm <sup>2</sup>	<b>135</b>	0,009	0,018	0,024	0,032	0,038	0,051	0,064		<b>160</b>	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥ 850 N/mm <sup>2</sup>	<b>100</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060			<b>120</b>	0,010	0,019	0,026	0,035	0,041	0,055
<b>M</b>	≤ 750 N/mm <sup>2</sup>	<b>90</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060		<b>110</b>	0,010	0,019	0,026	0,035	0,041	0,055	0,069
	≥ 750 N/mm <sup>2</sup>	<b>55</b>	0,007	0,013	0,018	0,025	0,030	0,040	0,050			<b>70</b>	0,008	0,016	0,021	0,030	0,036	0,048
<b>S</b>	Ni-based	<b>25</b>	0,006	0,012	0,016	0,022	0,026	0,035	0,044		<b>40</b>	0,007	0,014	0,019	0,026	0,032	0,042	0,053
	Ti-based	<b>50</b>	0,007	0,013	0,018	0,025	0,030	0,040	0,050			<b>70</b>	0,008	0,016	0,021	0,030	0,036	0,048
<b>K</b>	≤ 240 HB	<b>120</b>	0,009	0,018	0,024	0,032	0,038	0,051	0,064		<b>140</b>	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥ 240 HB	<b>105</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060			<b>130</b>	0,010	0,019	0,026	0,035	0,041	0,055

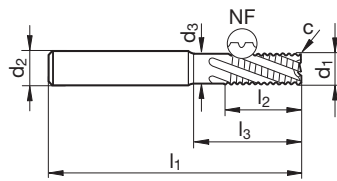


Ratio end mills RF 100 VA



**P** • **GÜHRING NAVIGATOR**  
**M** • Cutting data page 15  
**K** •  
**N** ○  
**S** ○  
**H**

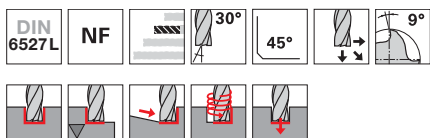
Tool material	Solid carbide	
Surface	<b>a</b>	<b>a</b>
Type	NF	NF
Shank form	HA	HB



								Article no.	6879	6880
d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.		
mm	mm	mm	mm	mm	mm	mm x 45°				
6.00	6.00	5.70	65	10.0	28.0	0.12	4	6.000		
8.00	8.00	7.70	75	12.0	38.0	0.16	4	8.000		
10.00	10.00	9.50	80	14.0	38.0	0.20	4	10.000		
12.00	12.00	11.50	93	16.0	46.0	0.24	4	12.000		
16.00	16.00	15.50	108	22.0	58.0	0.32	4	16.000		
20.00	20.00	19.50	126	26.0	74.0	0.40	4	20.000		

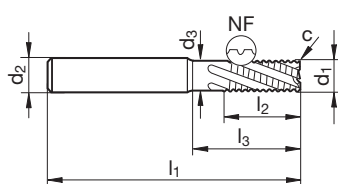
ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
		ap = 1,0 x D		ap = 1,0 x D		ap = 1,0 x D		ap = 1,0 x D		ap = 1,0 x D		ap max = 0,75 x D		ap max = 0,75 x D			
<b>P</b>	≤ 850 N/mm <sup>2</sup>	<b>80</b>	0,005	0,011	0,014	0,019	0,023	0,031	0,038	<b>110</b>	0,007	0,014	0,019	0,026	0,031	0,041	0,052
	≥ 850 N/mm <sup>2</sup>	<b>60</b>	0,005	0,010	0,013	0,018	0,022	0,029	0,036	<b>85</b>	0,007	0,014	0,018	0,024	0,029	0,039	0,048
<b>M</b>	≤ 750 N/mm <sup>2</sup>	<b>55</b>	0,005	0,010	0,013	0,018	0,022	0,029	0,036	<b>75</b>	0,007	0,014	0,018	0,024	0,029	0,039	0,048
	≥ 750 N/mm <sup>2</sup>	<b>35</b>	0,004	0,008	0,011	0,015	0,018	0,024	0,030	<b>50</b>	0,006	0,011	0,015	0,021	0,025	0,034	0,042
<b>S</b>	Ni-based	<b>15</b>	0,004	0,007	0,010	0,013	0,016	0,021	0,026	<b>30</b>	0,005	0,010	0,013	0,018	0,022	0,030	0,037
	Ti-based	<b>30</b>	0,004	0,008	0,011	0,015	0,018	0,024	0,030	<b>50</b>	0,006	0,011	0,015	0,021	0,025	0,034	0,042
<b>K</b>	≤ 240 HB	<b>70</b>	0,005	0,011	0,014	0,019	0,023	0,031	0,038	<b>100</b>	0,007	0,014	0,019	0,026	0,031	0,041	0,052
	≥ 240 HB	<b>65</b>	0,005	0,010	0,013	0,018	0,022	0,029	0,036	<b>90</b>	0,007	0,014	0,018	0,024	0,029	0,039	0,048

High-performance roughing end mills RS 100 U



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

**P** • **GÜHRING NAVIGATOR**  
**M** • Cutting data page 15  
**K** •  
**N** ○  
**S** •  
**H** □



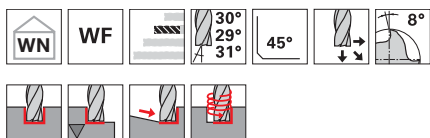
Article no. **6887** **6888**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
6.000	6.000	5.700	57.000	13.000	20.000	0.120	4	6.000
8.000	8.000	7.700	63.000	19.000	26.000	0.160	4	8.000
10.000	10.000	9.500	72.000	22.000	30.000	0.200	4	10.000
12.000	12.000	11.500	83.000	26.000	36.000	0.240	4	12.000
14.000	14.000	13.500	83.000	26.000	36.000	0.280	4	14.000
16.000	16.000	15.500	92.000	32.000	42.000	0.320	4	16.000
18.000	18.000	17.500	92.000	32.000	42.000	0.360	4	18.000
20.000	20.000	19.500	104.000	38.000	52.000	0.400	4	20.000
25.000	25.000	24.000	121.000	45.000	63.000	0.600	5	25.000

ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
<b>P</b>	≤ 850 N/mm <sup>2</sup>	<b>135</b>	0,009	0,018	0,024	0,032	0,038	0,051	0,064	<b>160</b>	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥ 850 N/mm <sup>2</sup>	<b>100</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060		<b>120</b>	0,010	0,019	0,026	0,035	0,041	0,055
<b>M</b>	≤ 750 N/mm <sup>2</sup>	<b>90</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060	<b>110</b>	0,010	0,019	0,026	0,035	0,041	0,055	0,069
	≥ 750 N/mm <sup>2</sup>	<b>55</b>	0,007	0,013	0,018	0,025	0,030	0,040	0,050		<b>70</b>	0,008	0,016	0,021	0,030	0,036	0,048
<b>S</b>	Ni-based	<b>25</b>	0,006	0,012	0,016	0,022	0,026	0,035	0,044	<b>40</b>	0,007	0,014	0,019	0,026	0,032	0,042	0,053
	Ti-based	<b>50</b>	0,007	0,013	0,018	0,025	0,030	0,040	0,050		<b>70</b>	0,008	0,016	0,021	0,030	0,036	0,048
<b>K</b>	≤ 240 HB	<b>120</b>	0,009	0,018	0,024	0,032	0,038	0,051	0,064	<b>140</b>	0,010	0,021	0,028	0,037	0,044	0,059	0,074
	≥ 240 HB	<b>105</b>	0,008	0,017	0,022	0,030	0,036	0,048	0,060		<b>130</b>	0,010	0,019	0,026	0,035	0,041	0,055



Ratio end mills Alu RF 100 A

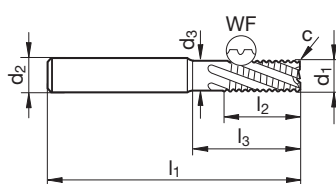


Tool material	Solid carbide	
Surface	○	○
Type	WF	WF
Shank form	HA	HB

P	
M	
K	
N	•
S	
H	

**GÜHRING** NAVIGATOR

Cutting data page 15



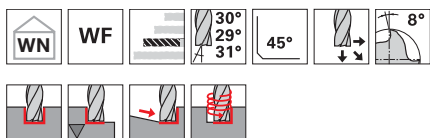
Article no. **6868** **6869**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
6.000	6.000	5.700	57.000	13.000	20.000	0.060	3	6.000
8.000	8.000	7.700	63.000	19.000	26.000	0.080	3	8.000
10.000	10.000	9.500	72.000	22.000	30.000	0.100	3	10.000
12.000	12.000	11.500	83.000	26.000	36.000	0.120	3	12.000
16.000	16.000	15.500	92.000	32.000	42.000	0.160	3	16.000
20.000	20.000	19.500	104.000	38.000	52.000	0.200	3	20.000
25.000	25.000	24.000	121.000	45.000	63.000	0.250	3	25.000

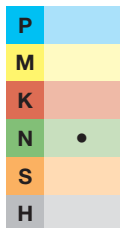
ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø							
			3	6	8	10	12	16	20		3	6	8	10	12	16	20	
N	≤ 5% Si	375	0,011	0,021	0,028	0,037	0,044	0,059	0,074		440	0,012	0,024	0,032	0,043	0,051	0,068	0,085
	≥ 5% Si	180	0,010	0,019	0,026	0,035	0,042	0,056	0,070			210	0,011	0,022	0,029	0,040	0,048	0,064
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

Ratio end mills Alu RF 100 A

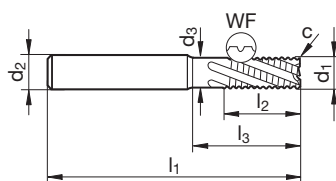


Tool material	Solid carbide	
Surface	○	○
Type	WF	WF
Shank form	HA	HB



**GÜHRING** NAVIGATOR

Cutting data page 15





Article no. **6870** **6871**

d1 h10	d2 h6	d3	l1	l2	l3	c	Z	Code no.
mm	mm	mm	mm	mm	mm	mm x 45°		
6.000	6.000	5.700	65.000	13.000	28.000	0.060	3	6.000
8.000	8.000	7.700	75.000	19.000	38.000	0.080	3	8.000
10.000	10.000	9.500	80.000	22.000	38.000	0.100	3	10.000
12.000	12.000	11.500	93.000	26.000	46.000	0.120	3	12.000
16.000	16.000	15.500	108.000	32.000	58.000	0.160	3	16.000
20.000	20.000	19.500	126.000	38.000	74.000	0.200	3	20.000





ISO	Hardness	vc	fz (mm/z) / Ø							vc	fz (mm/z) / Ø						
			3	6	8	10	12	16	20		3	6	8	10	12	16	20
N	≤ 5% Si	375	ap = 1,0 x D							440	ap = 1,5 x D						
	≥ 5% Si		180	0,011	0,021	0,028	0,037	0,044	0,059		0,074	0,012	0,024	0,032	0,043	0,051	0,068
NE	≤ 850 N/mm <sup>2</sup>	200	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
			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

**Milling conditions**

	unstable machining conditions low drive power
	long tools

**Correction factors:**

	ap roughing > 1,5 x D	vc -25%	fz -25%
	medium length tools	vc -40%	fz -40%
	extra length tools	vc -60%	fz -55%
	uncoated tools	vc -50%	fz -25%



Material	Hardness	RF 100 type	Application	ae max	vc	fz (mm/z) with nom. Ø								
						3	4	6	8	10	12	16	20	25
<b>Struct/free-cutting steels. unall. heat-treat/case hard. steels</b> 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/mm <sup>2</sup>	VA / U	Slotting	1 x D	135	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		VA / U	Roughing	0.75 x D	160	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
<b>Free-cutting steels. unall. case hard. steels. nitr. steels</b> 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/mm <sup>2</sup>	VA / U	Slotting	1 x D	120	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		VA / U	Roughing	0.75 x D	140	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
<b>Alloyed heat-treatable, tool and high speed steels</b> 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/mm <sup>2</sup>	U / F	Slotting	1 x D	100	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		U / F	Roughing	0.75 x D	120	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
<b>Hardened steel</b> Tool steel, heat-treatable steel, spring steel, high speed steel, case hardened steel etc. e.g.: 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	1 x D	55	0.006	0.008	0.012	0.016	0.022	0.026	0.04	0.04	0.06
		U / F	Roughing	0.33 x D	80	0.008	0.010	0.016	0.021	0.029	0.034	0.05	0.06	0.07
	H2		Slotting	1 x D	42	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
<b>Stainless steel</b> 1.4104 X14CrMoS17, 1.4105 X6CrMoS17, 1.4305 X10CrNiS18-9 USA = 303, 410, 420F, 430, 430F	≤ 750 N/mm <sup>2</sup>	VA / U	Slotting	1 x D	90	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		VA / U	Roughing	0.75 x D	110	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
<b>Stainless steel</b> 1.4301 X5CrNi18-10, 1.4303 X5CrNi18-12 1.4310 XCrNi18-8 USA = 304, 304L, 420	750-850 N/mm <sup>2</sup>	VA / U	Slotting	1 x D	65	0.008	0.010	0.015	0.020	0.028	0.034	0.04	0.06	0.07
		VA / U	Roughing	0.75 x D	80	0.009	0.012	0.017	0.023	0.032	0.039	0.05	0.06	0.08
<b>Stainless steel</b> 1.4438 X2CrNiMo18-15-4, 1.4404 X2CrNiMo17-12-2, 1.4571 X6CrNiTi18-10 USA = 310, 316, 316B, 316L, 317	≥ 850 N/mm <sup>2</sup>	VA / U	Slotting	1 x D	55	0.007	0.009	0.013	0.018	0.025	0.030	0.04	0.05	0.06
		VA / U	Roughing	0.60 x D	70	0.008	0.011	0.016	0.021	0.030	0.036	0.05	0.06	0.08
<b>Special alloys (nickel-based "Ni")</b> Nimonic, Inconel, Monel, Hastelloy	≤ 1.300 N/mm <sup>2</sup>	VA / U	Slotting	1 x D	25	0.006	0.008	0.012	0.016	0.022	0.026	0.04	0.04	0.06
		VA / U	Roughing	0.60 x D	40	0.007	0.010	0.014	0.019	0.026	0.032	0.04	0.05	0.07
<b>Titanium alloys ("Ti")</b> 3.7024 Ti99.5, 3.7114 TiAl5Sn2.5, 3.7124 TiCu2 3.7154 TiAl6Zr5, 3.7164 TiAl6V4, 3.7184 TiAl4Mo4Sn2.5	≤ 1.300 N/mm <sup>2</sup>	VA / U	Slotting	1 x D	50	0.007	0.009	0.013	0.018	0.025	0.030	0.04	0.05	0.06
		VA / U	Roughing	0.60 x D	70	0.008	0.011	0.016	0.021	0.030	0.036	0.05	0.06	0.08
<b>Cast/grey cast iron. spher.graphite/mall. cast iron</b> 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	1 x D	120	0.009	0.012	0.018	0.024	0.032	0.038	0.05	0.06	0.08
		U / F	Roughing	0.75 x D	140	0.010	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
<b>Cast/grey cast iron. spher.graphite/mall. cast iron</b> 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	1 x D	105	0.008	0.011	0.017	0.022	0.030	0.036	0.05	0.06	0.08
		U / F	Roughing	0.75 x D	130	0.010	0.013	0.019	0.026	0.035	0.041	0.06	0.07	0.09
<b>Aluminium, Al wrought alloys, Al alloys</b> 3.2131 G-AlSi5Cu1, 3.2315 AlMgSi1, 3.3515 AlMg1 3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 AlMg3Si, 3.4365 AlZnMgCu1.5	≤ 5% Si	A / WF	Slotting	1 x D	375	0.011	0.014	0.021	0.028	0.037	0.044	0.06	0.07	0.09
		A / WF	Roughing	0.75 x D	500	0.012	0.016	0.024	0.032	0.043	0.051	0.07	0.09	0.11
<b>Aluminium cast alloys</b> 3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9 3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, - G-AlSi12CuNiMg	≥ 5% Si	A / WF	Slotting	1 x D	180	0.010	0.013	0.019	0.026	0.035	0.042	0.06	0.07	0.09
		A / WF	Roughing	0.75 x D	300	0.011	0.015	0.022	0.029	0.040	0.048	0.06	0.08	0.10
<b>Magnesium alloys</b> MgMn2, G-MgAl8Zn1, G-MgAl6Zn3	-	VA / A	Slotting	1 x D	140	0.010	0.013	0.019	0.026	0.035	0.042	0.06	0.07	0.09
		VA / A	Roughing	0.75 x D	170	0.011	0.015	0.022	0.029	0.040	0.048	0.06	0.08	0.10
<b>Non-ferr. met. (copper. short-/long-chipp. brass/bronze)</b> 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/mm <sup>2</sup>	VA / A	Slotting	1 x D	200	0.010	0.013	0.019	0.026	0.035	0.042	0.06	0.07	0.09
		VA / A	Roughing	0.75 x D	230	0.011	0.015	0.022	0.029	0.040	0.048	0.06	0.08	0.10



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