

# HARTNER

Precision Cutting Tools

## MILLING CUTTERS

MADE OF SOLID CARBIDE




















































































+ NEW FULL PROGRAMME 2017

# ISO code

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

# Pictograms

Application	      
	Slotting    Roughing    Ramping    Helix    Drilling    Finishing    Copying
Tool material	<b>VHM</b>
	Solid carbide
Shank form	  
	to DIN 6535
Surface	     
	bright    TiAlN    TiAlN nano    FIRE    TiAlSiN    AlTiN
Type	            
	  
	Application range similar to DIN 1835
Standard	  
	to DIN                      to Hartner Standard
No. of cutting edges	     
	no. of major cutting edges
Cutting edge form	          
	Corner chamfer                      Radius with tolerance                      Chamfer end mill angles
Tolerance on Ø	   
Length	      
	short (DIN)    long (DIN)    medium length    extra length
Helix angle	          
	Size of helix angle / no. of unequal helix angles
Feed	  
	for lateral feed                      for lateral feed and oblique plunging                      for lateral feed, oblique plunging and drilling
Cutting direction	
	right
Rake angle	             

Whether universal milling cutters or technically sophisticated and specialised cutters, from roughing end mills and ball nose cutters to high-performance cutters for most different materials being machined:

The comprehensive programme of Hartner offers the suitable precision tool for every application.

In-house developed and manufactured micro-grain carbide as well as application-oriented geometries and surface coatings ensure a long tool life and maximum performance whilst maintaining a high process reliability

# top line



The Hartner **top line** is a high-performance end mill programme for demanding machining operations.

Next to features like unequal helix angles or innovative micro geometries that prevent vibration and reduce noise, the top line is especially suited for modern milling strategies such as trochoidal milling, HPC and HSC. All the aforementioned attributes result in a maximum metal removal rate.

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programme from **page 13**

# basic line
















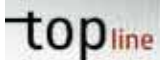




















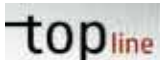






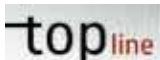













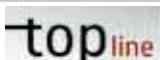






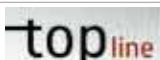






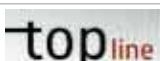
The universal milling cutters of the Hartner **basic line** offer an established quality at an excellent price-performance-ratio. Whether ball nose end mills, chamfer cutters or slot drills – for the economical metal cutting, end mills are available for the machining of materials up to 1400 N/mm<sup>2</sup>.

contents from **page 8**














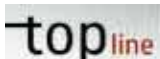
programme from **page 45**

P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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## High-performance end mills TF 100 U

																		
• • • • •	Company std.	TF 100 U	Solid carbide	F											3.000 - 20.000	84952	16	
																		
• • • • •	Company std.	TF 100 U	Solid carbide	F											3.000 - 20.000	84953	16	
																		
• • • • •	DIN 6527K	TF 100 U	Solid carbide	F											3.000 - 20.000	84900	17	
																		
• • • • •	DIN 6527L	TF 100 U	Solid carbide	F											3.000 - 25.000	84901	18	
																		
• • • • •	DIN 6527L	TF 100 U	Solid carbide	F											3.000 - 25.000	84902	18	
																		
• • • • •	DIN 6527L	TF 100 U	Solid carbide	A											6.000 - 25.000	84954	19	
																		
• • • • •	DIN 6527L	TF 100 U	Solid carbide	A											6.000 - 25.000	84955	19	
																		
• • • • •	Company std.	TF 100 U	Solid carbide	F											6.000 - 20.000	84956	21	
																		
• • • • •	Company std.	TF 100 U	Solid carbide	F											6.000 - 20.000	84957	21	
																		
• • • • •	Company std.	TF 100 U	Solid carbide	F											10.000 - 25.000	84980	22	





























## TF 100 MULTI-MILL

																		
• • • • •	DIN 6527L	TF 100 MULTI-MILL	Solid carbide	Y											4.000 - 20.000	84951	23	
																		
• • • • •	DIN 6527L	TF 100 MULTI-MILL	Solid carbide	Y											4.000 - 20.000	84950	23	










P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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








## High-performance end mills TF 100 INOX

						DIN 6527K	TF 100 INOX	Solid carbide									top line
•	•	•	•	•											4.000 - 20.000	84958	24
						DIN 6527K	TF 100 INOX	Solid carbide									top line
•	•	•	•	•											4.000 - 20.000	84959	24
						DIN 6527L	TF 100 INOX	Solid carbide									top line
•	•	•	•	•											3.000 - 25.000	84972	25
						DIN 6527L	TF 100 INOX	Solid carbide									top line
•	•	•	•	•											3.000 - 25.000	84973	25






















## High-performance roughing end mills HS 100 U (coarse teeth)

						DIN 6527L	HS 100 U	Solid carbide									top line
•	•	•	•	•											5.000 - 25.000	84974	26
						DIN 6527L	HS 100 U	Solid carbide									top line
•	•	•	•	•											5.000 - 25.000	84975	26

## Multi-tooth end mills TF 100 SF



						Company std.	TF 100 SF	Solid carbide									top line
•	•	•	•	•											4.000 - 20.000	84976	27
						Company std.	TF 100 SF	Solid carbide									top line
•	•	•	•	•											4.000 - 20.000	84977	27

## Multi-tooth end mills HP 100 U


						Company std.	HP 100 U	Solid carbide									top line
•	•	•	•	•											3.000 - 25.000	84908	28
						Company std.	HP 100 U	Solid carbide									top line
•	•	•	•	•											3.000 - 25.000	84909	28
						Company std.	HP 100 U	Solid carbide									top line
•	•	•	•	•											6.000 - 20.000	84910	29

P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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## Aluminium end mills TF 100 W

						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HA	39° 40° 41°	3					84960	30
						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HB	39° 40° 41°	3					84961	30
						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HA	39° 40° 41°	3					84962	31
						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HB	39° 40° 41°	3					84963	31
						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HA	39° 40° 41°	3					84964	32
						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HB	39° 40° 41°	3					84965	32
						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HA	39° 40° 41°	3	4xD				84966	33
						Company std.	TF 100 W	Solid carbide	<input type="radio"/>	HB	39° 40° 41°	3	4xD				84967	33
						DIN 6527L	TF 100 W	Solid carbide	<input type="radio"/>	HA	40° 42°	4					84968	34

## Aluminium end mills TP 100 W with oil feed





























						Company std.	TP 100 W	Solid carbide	<input type="radio"/>	HA	45°	3					84970	35
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## Hard profile cutters HP 100 H







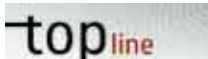







						Company std.	HP 100 H	Solid carbide	<input checked="" type="radio"/>	HA	30°	2					84934	36
						Company std.	HP 100 H	Solid carbide	<input checked="" type="radio"/>	HA	30°	2					84935	37

P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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







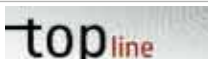
## Hard profile cutters HP 100 H

																		
○ ● ● ● ●	Company std.	HP 100 H	Solid carbide	Y									2.000 - 12.000	84938			38	
																		
○ ● ● ● ●	Company std.	HP 100 H	Solid carbide	Y									2.000 - 12.000	84939			39	
																		
○ ● ● ● ●	Company std.	HP 100 H	Solid carbide	Y									3.000 - 16.000	84930			40	
																		
○ ● ● ● ●	Company std.	HP 100 H	Solid carbide	Y									6.000 - 16.000	84931			41	

## Hard milling cutters HP 100 H


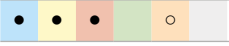








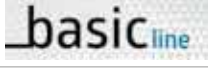





















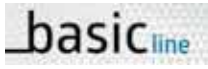












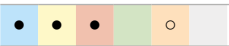










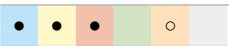









																		
○ ● ● ● ●	DIN 6527L	HP 100 H	Solid carbide	Y									6.000 - 20.000	84936			42	
																		
○ ● ● ● ●	DIN 6527L	HP 100 H	Solid carbide	Y									6.000 - 20.000	84937			42	

## Hard multi-tooth end mills HP 100 H











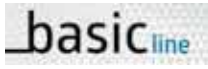

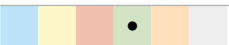









																		
○ ● ● ● ●	Company std.	HP 100 H	Solid carbide	Y									3.000 - 20.000	84932			43	
																		
○ ● ● ● ●	Company std.	HP 100 H	Solid carbide	Y									6.000 - 20.000	84933			44	

P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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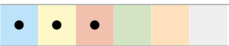










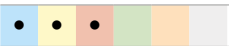































## Chamfering milling cutters

		Company std.	N	<b>Solid carbide</b>													
													4.000 - 12.000	84921	46		
		Company std.	N	<b>Solid carbide</b>													
													4.000 - 12.000	84922	46		
		Company std.	N	<b>Solid carbide</b>													
													4.000 - 12.000	84923	47		
		Company std.	N	<b>Solid carbide</b>													
													4.000 - 12.000	84924	47		
		Company std.	N	<b>Solid carbide</b>													
													4.000 - 12.000	84925	48		
		Company std.	N	<b>Solid carbide</b>													
													4.000 - 12.000	84926	48		

## Al slot drills (2-fluted)

		DIN 6527L	W	<b>Solid carbide</b>													
													3.000 - 20.000	84940	49		
		DIN 6527L	W	<b>Solid carbide</b>													
													3.000 - 20.000	84914	49		







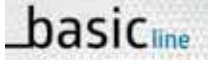
## Slot drills (2-fluted)

		DIN 6527K	N	<b>Solid carbide</b>													
													2.000 - 20.000	84942	50		
		DIN 6527K	N	<b>Solid carbide</b>													
													2.000 - 20.000	84943	50		
		DIN 6527L	N	<b>Solid carbide</b>													
													2.000 - 20.000	84911	51		
		DIN 6527L	N	<b>Solid carbide</b>													
													2.000 - 20.000	84912	51		






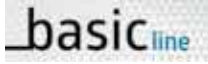





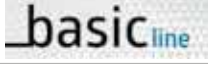


P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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
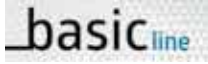






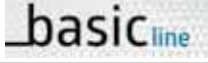





















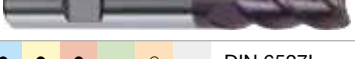






## Slot drills (2-fluted)

							Company std.	N	Solid carbide	F						3.000 - 20.000	84913	52				
																						







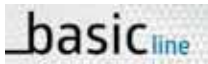






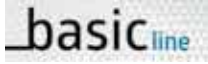
## Mini slot drills (3-fluted)

							Company std.	N	Solid carbide	F						0.300 - 20.000	84945	53		
																				
							Company std.	N	Solid carbide	F						1.000 - 10.000	84905	54		
																				

## Slot drills (3-fluted)



							DIN 6527L	N	Solid carbide	F						2.000 - 20.000	84946	55				
																						
							DIN 6527L	N	Solid carbide	F						2.000 - 20.000	84947	55				
																						
							DIN 6527K	NH	Solid carbide	F						3.000 - 20.000	84948	56				
																						
							DIN 6527K	NH	Solid carbide	F						3.000 - 20.000	84949	56				
																						
							DIN 6527L	NH	Solid carbide	F						3.000 - 20.000	84903	57				
																						
							DIN 6527L	NH	Solid carbide	F						3.000 - 20.000	84904	57				
																						

## End mills (4-fluted)



							DIN 6527L	N	Solid carbide	F						2.000 - 20.000	84915	58				
																						
							Company std.	N	Solid carbide	F						3.000 - 20.000	84916	59				
																						

P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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## End mills (4-fluted)

						DIN 6527K	N	Solid carbide	F	HA	30°	4					2.000 - 20.000	84944	60
						DIN 6527K	N	Solid carbide	F	HB	30°	4					2.000 - 20.000	84941	60

## Roughing end mills with fine teeth

						DIN 6527L	U	Solid carbide	F	HB	30°	4					6.000 - 20.000	84906	61
						DIN 6527L	HR	Solid carbide	Y	HB	20°	4					6.000 - 20.000	84907	62

## Ball nose end mills

						DIN 6527L	N	Solid carbide	F	HA	30°	2					0.500 - 20.000	84917	63
						DIN 6527L	N	Solid carbide	F	HB	30°	2					0.500 - 20.000	84918	63
						DIN 6527L	N	Solid carbide	F	HB	30°	4					3.000 - 20.000	84919	64

P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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### High-performance end mills TF 100 U, set

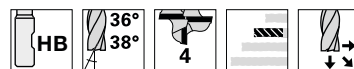


•	○	•	•	•	○	DIN 6527L	TF 100 U	Solid carbide								84920	65
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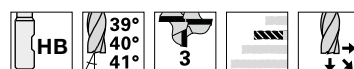
•	•	•	•	•	○	Company std.	TF 100 U	Solid carbide								84927	65
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### High-performance end mills TF 100 INOX, set



•	•	•	•	•	○	DIN 6527L	TF 100 INOX	Solid carbide								84928	66
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### High-performance end mills TF 100 W, set



•	•	•	•	•	○	Company std.	TF 100 W	Solid carbide								84997	67
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P	M	K	N	S	H	Standard	Type	Tool material	Surface	Shank form	Helix angle °	Z	Length	Feed	d1/mm	Article no.	Progr. page
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## High-performance end mills TF 100 MULTI-MILL, set

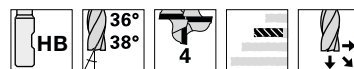


•	•	•	•	•		DIN 6527L	TF 100 MULTI-MILL	Solid carbide	Y							84999	68
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•	•	•	•	•		DIN 6527L	TF 100 MULTI-MILL	Solid carbide	Y							84998	68
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## High-performance end mills HS 100 U, set



•	•	•	○	•		DIN 6527L	HS 100 U	Solid carbide	a							84929	69
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# top line



## γ HIGH-PERFORMANCE END MILLS

- γ High-performance milling cutters for demanding machining tasks
- γ for modern milling strategies such as trochoidal milling, HPC and HSC
- γ minimal vibration and the reduced noise due to unequal helix angles
- γ maximum metal removal rate



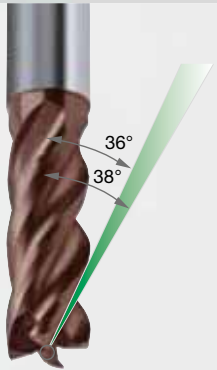
# High-performance end mills

## Types and their characteristics



### TF 100 U

- for materials up to 1600 N/mm<sup>2</sup> (48 HRC)
- slotting, roughing, finishing in steel, cast iron and high-tensile materials
- short machining times thanks to maximum rate of metal removal
- unequal helix angle 35/38° for vibration-free operation
- feed depths up to  $a_p$  3xD for HPC applications



### TF 100 MULTI-MILL

- suitable for all materials
- ramping, drilling, slotting, roughing and finishing with only one tool
- plunge angle up to 45° reduces machining time of slotting and pockets
- high rate of metal removal achievable
- thanks to undersize dia all tolerances for holes and slots can be produced



### TF 100 U (3-fluted)

- can be applied for extreme cutting depths thanks to increased flute space
- for materials up to 1400 N/mm<sup>2</sup> (44 HRC)
- low power consumption allows application on less powerful machines



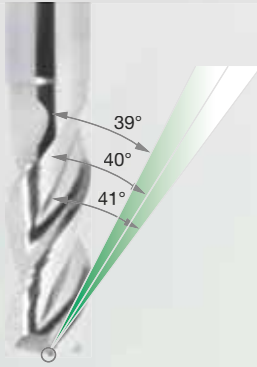
### HS 100 U

- innovative roughing geometry produces smaller chips
- slotting and roughing with large cutting widths and depths
- low power consumption and cutting forces therefore suitability on non-rigid machines



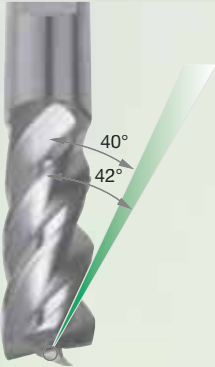
### TF 100 INOX

- for slotting, roughing and finishing operations in VA and stainless steels
- improved chip evacuation and low machining temperature thanks to optimised flute profile
- high contour accuracy and low deflection
- applicable with large protrusion lengths



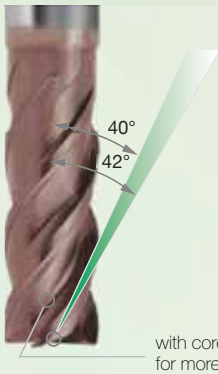
### TF 100 W

- slotting, roughing, finishing in aluminium and aluminium alloys
- symmetrical face grind for drilling, recessing, ramping at high feed rates
- low-vibration thanks to nano-polished cutting edges with micro guide chamfers
- 39/40/41° helix for the machining of long-chipping materials



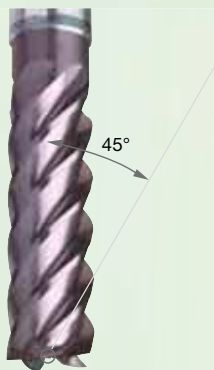
### TF 100 W (4-fluted)

- suitable for roughing and finishing
- with good cooling also for slotting in aluminium and aluminium alloys
- unequal helix for long-chipping materials and non-ferrous metals



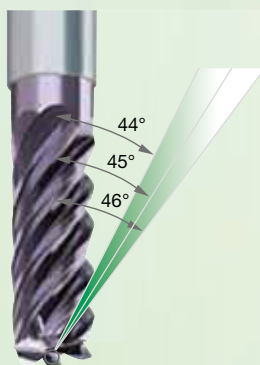
### HP 100 H

- roughing and finishing of hardened steels, tool steels and hard cast iron
- flute design with re-inforced core for roughing up to  $a_p$  1xD (from 32 to 54 HRC)
- finishing and HPC milling over the complete cutting edge length up to in excess of 63 HRC



### TF 100 SF (5-fluted)

- for semi-roughing with  $a_e$  up to 0.3xD with complete cutting edge length
- optimal surface finish with fine-finishing or HSC operations
- universal for all materials up to 1600 N/mm<sup>2</sup> (48 HRC)
- with HPC strategy for roughing over the complete cutting edge length
- also available in 3xD cutting edge length



### TF 100 SF (6-fluted)

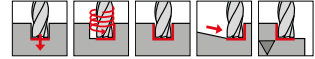
- for semi-roughing with  $a_e$  up to 0.3xD with complete cutting edge length
- optimal surface finish with fine-finishing or HSC operations
- universal for all materials up to 1600 N/mm<sup>2</sup> (48 HRC)
- with HPC strategy for roughing over the complete cutting edge length

## High-performance end mills TF 100 U

### Article no. 84952



P	M	K	N	S	H
•	•	•			○

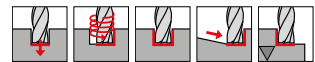


unequal flute spacing • centre cutting • universal application

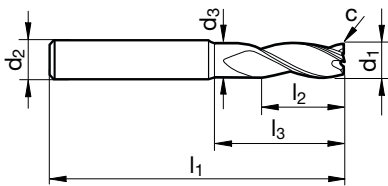
### Article no. 84953



P	M	K	N	S	H
•	•	•			○



unequal flute spacing • centre cutting • universal application



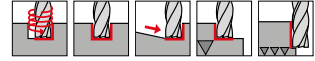
d1 e8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	2.800	57.000	8.000	15.000	0.050	3	3.000
3.500	6.000	3.300	57.000	10.000	15.000	0.050	3	3.500
3.700	6.000	3.500	57.000	11.000	15.000	0.060	3	3.700
4.000	6.000	3.800	57.000	11.000	18.000	0.060	3	4.000
4.500	6.000	4.300	57.000	11.000	18.000	0.070	3	4.500
4.700	6.000	4.500	57.000	13.000	18.000	0.070	3	4.700
5.000	6.000	4.800	57.000	13.000	18.000	0.080	3	5.000
5.500	6.000	5.300	57.000	13.000	19.400	0.080	3	5.500
5.700	6.000	5.500	57.000	13.000	19.600	0.090	3	5.700
6.000	6.000	5.700	57.000	13.000	20.000	0.090	3	6.000
6.500	8.000	6.200	63.000	16.000	24.400	0.100	3	6.500
7.000	8.000	6.700	63.000	16.000	24.900	0.110	3	7.000
7.500	8.000	7.200	63.000	19.000	25.300	0.110	3	7.500
8.000	8.000	7.700	63.000	19.000	26.000	0.120	3	8.000
8.500	10.000	8.200	72.000	19.000	29.400	0.130	3	8.500
9.000	10.000	8.700	72.000	19.000	29.900	0.140	3	9.000
9.500	10.000	9.200	72.000	22.000	30.300	0.140	3	9.500
10.000	10.000	9.500	72.000	22.000	30.000	0.150	3	10.000
12.000	12.000	11.500	83.000	26.000	36.000	0.180	3	12.000
16.000	16.000	15.500	92.000	32.000	42.000	0.190	3	16.000
20.000	20.000	19.500	104.000	38.000	52.000	0.240	3	20.000

## High-performance end mills TF 100 U

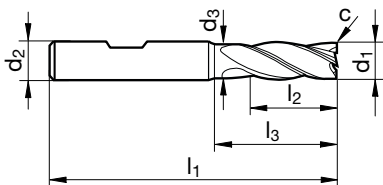
Article no. 84900



P	M	K	N	S	H
•		•			○



unequal flute spacing • centre cutting • universal application



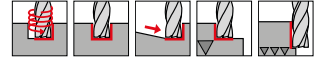
d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	2.800	50.000	5.000	9.400	0.100	4	3.000
4.000	6.000	3.800	54.000	8.000	12.900	0.100	4	4.000
5.000	6.000	4.800	54.000	9.000	15.400	0.100	4	5.000
6.000	6.000	5.700	54.000	10.000	18.000	0.150	4	6.000
8.000	8.000	7.700	58.000	12.000	22.000	0.150	4	8.000
10.000	10.000	9.500	66.000	14.000	26.000	0.200	4	10.000
12.000	12.000	11.500	73.000	16.000	28.000	0.200	4	12.000
14.000	14.000	13.500	75.000	18.000	30.000	0.250	4	14.000
16.000	16.000	15.500	82.000	22.000	34.000	0.350	4	16.000
18.000	18.000	17.500	84.000	24.000	36.000	0.400	4	18.000
20.000	20.000	19.500	92.000	26.000	42.000	0.450	4	20.000

## High-performance end mills TF 100 U

### Article no. 84901



P	M	K	N	S	H
•		•			○

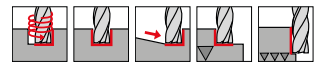


unequal flute spacing • centre cutting • universal application

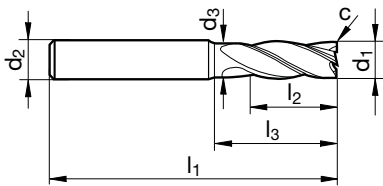
### Article no. 84902



P	M	K	N	S	H
•		•			○



unequal flute spacing • centre cutting • universal application



d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	2.800	57.000	8.000	12.400	0.100	4	3.000
4.000	6.000	3.800	57.000	11.000	15.900	0.100	4	4.000
5.000	6.000	4.800	57.000	13.000	19.400	0.100	4	5.000
6.000	6.000	5.700	57.000	13.000	21.000	0.150	4	6.000
8.000	8.000	7.700	63.000	19.000	27.000	0.150	4	8.000
10.000	10.000	9.500	72.000	22.000	32.000	0.200	4	10.000
12.000	12.000	11.500	83.000	26.000	38.000	0.200	4	12.000
14.000	14.000	13.500	83.000	26.000	38.000	0.250	4	14.000
16.000	16.000	15.500	92.000	32.000	44.000	0.350	4	16.000
18.000	18.000	17.500	92.000	32.000	44.000	0.400	4	18.000
20.000	20.000	19.500	104.000	38.000	54.000	0.450	4	20.000
25.000	25.000	24.000	121.000	45.000	65.000	0.600	4	25.000

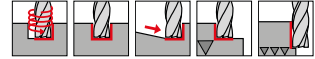


## High-performance end mills TF 100 U

### Article no. 84954



P	M	K	N	S	H
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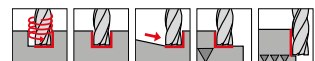


unequal flute spacing • centre cutting • universal application  
Titanium and Titanium alloys • stainless steels • special alloys

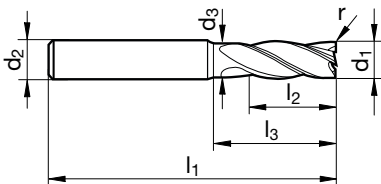
### Article no. 84955



P	M	K	N	S	H
•	•	•		•	○



unequal flute spacing • centre cutting • universal application  
Titanium and Titanium alloys • stainless steels • special alloys



d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	r mm	Z	Code no.
6.000	6.000	5.700	57.000	13.000	20.000	0.500	4	6.005
6.000	6.000	5.700	57.000	13.000	20.000	0.800	4	6.008
6.000	6.000	5.700	57.000	13.000	20.000	1.000	4	6.010
6.000	6.000	5.700	57.000	13.000	20.000	1.500	4	6.015
6.000	6.000	5.700	57.000	13.000	20.000	2.000	4	6.020
8.000	8.000	7.700	63.000	19.000	26.000	0.500	4	8.005
8.000	8.000	7.700	63.000	19.000	26.000	0.800	4	8.008
8.000	8.000	7.700	63.000	19.000	26.000	1.000	4	8.010
8.000	8.000	7.700	63.000	19.000	26.000	1.500	4	8.015
8.000	8.000	7.700	63.000	19.000	26.000	2.000	4	8.020
10.000	10.000	9.500	72.000	22.000	30.000	0.500	4	10.005
10.000	10.000	9.500	72.000	22.000	30.000	0.800	4	10.008
10.000	10.000	9.500	72.000	22.000	30.000	1.000	4	10.010
10.000	10.000	9.500	72.000	22.000	30.000	1.500	4	10.015
10.000	10.000	9.500	72.000	22.000	30.000	2.000	4	10.020
12.000	12.000	11.500	83.000	26.000	36.000	0.500	4	12.005
12.000	12.000	11.500	83.000	26.000	36.000	0.800	4	12.008
12.000	12.000	11.500	83.000	26.000	36.000	1.000	4	12.010
12.000	12.000	11.500	83.000	26.000	36.000	1.500	4	12.015
12.000	12.000	11.500	83.000	26.000	36.000	2.000	4	12.020
12.000	12.000	11.500	83.000	26.000	36.000	2.500	4	12.025
12.000	12.000	11.500	83.000	26.000	36.000	3.000	4	12.030
12.000	12.000	11.500	83.000	26.000	36.000	3.175	4	12.031
12.000	12.000	11.500	83.000	26.000	36.000	4.000	4	12.040
16.000	16.000	15.500	92.000	32.000	42.000	0.500	4	16.005
16.000	16.000	15.500	92.000	32.000	42.000	0.800	4	16.008
16.000	16.000	15.500	92.000	32.000	42.000	1.000	4	16.010
16.000	16.000	15.500	92.000	32.000	42.000	1.500	4	16.015
16.000	16.000	15.500	92.000	32.000	42.000	2.000	4	16.020
16.000	16.000	15.500	92.000	32.000	42.000	2.500	4	16.025

High-performance end mills TF 100 U

d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	r mm	Z	Code no.
16.000	16.000	15.500	92.000	32.000	42.000	3.000	4	16.030
16.000	16.000	15.500	92.000	32.000	42.000	3.175	4	16.031
16.000	16.000	15.500	92.000	32.000	42.000	4.000	4	16.040
20.000	20.000	19.500	104.000	38.000	52.000	0.500	4	20.005
20.000	20.000	19.500	104.000	38.000	52.000	1.000	4	20.010
20.000	20.000	19.500	104.000	38.000	52.000	1.500	4	20.015
20.000	20.000	19.500	104.000	38.000	52.000	2.000	4	20.020
20.000	20.000	19.500	104.000	38.000	52.000	2.500	4	20.025
20.000	20.000	19.500	104.000	38.000	52.000	3.000	4	20.030
20.000	20.000	19.500	104.000	38.000	52.000	3.175	4	20.031
20.000	20.000	19.500	104.000	38.000	52.000	4.000	4	20.040
25.000	25.000	24.000	121.000	45.000	63.000	1.500	4	25.015
25.000	25.000	24.000	121.000	45.000	63.000	2.000	4	25.020
25.000	25.000	24.000	121.000	45.000	63.000	2.500	4	25.025
25.000	25.000	24.000	121.000	45.000	63.000	3.000	4	25.030
25.000	25.000	24.000	121.000	45.000	63.000	3.175	4	25.031
25.000	25.000	24.000	121.000	45.000	63.000	4.000	4	25.040
25.000	25.000	24.000	121.000	45.000	63.000	5.000	4	25.050

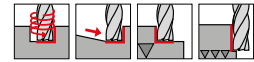
top line

## High-performance end mills TF 100 U

### Article no. 84956



P	M	K	N	S	H
•		•			○

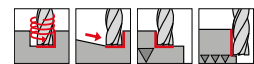
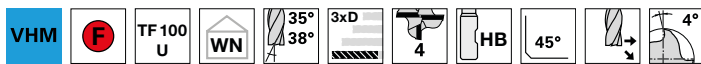


unequal flute spacing • centre cutting • universal application

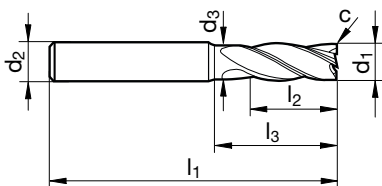
### Article no. 84957



P	M	K	N	S	H
•		•			○



unequal flute spacing • centre cutting • universal application



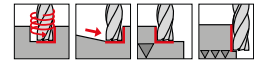
d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	5.700	65.000	18.000	28.000	0.150	4	6.000
8.000	8.000	7.700	75.000	24.000	38.000	0.150	4	8.000
10.000	10.000	9.500	80.000	30.000	38.000	0.200	4	10.000
12.000	12.000	11.500	93.000	36.000	46.000	0.200	4	12.000
16.000	16.000	15.500	108.000	48.000	58.000	0.350	4	16.000
20.000	20.000	19.500	126.000	60.000	74.000	0.450	4	20.000

## High-performance end mills TF 100 U

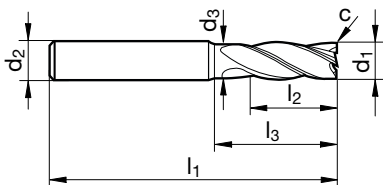
Article no. 84980



P	M	K	N	S	H
•		•			○



unequal flute spacing • centre cutting • universal application



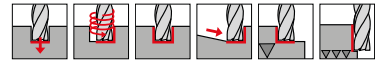
d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
10.000	10.000	9.500	100.000	40.000	48.000	0.200	4	10.000
12.000	12.000	11.500	150.000	45.000	58.000	0.200	4	12.000
14.000	14.000	13.500	150.000	45.000	58.000	0.250	4	14.000
16.000	16.000	15.500	150.000	65.000	78.000	0.350	4	16.000
18.000	18.000	17.500	150.000	65.000	78.000	0.400	4	18.000
20.000	20.000	19.500	150.000	65.000	78.000	0.450	4	20.000
25.000	25.000	24.000	150.000	75.000	92.000	0.600	4	25.000

## TF 100 MULTI-MILL

### Article no. 84951



P	M	K	N	S	H
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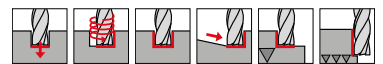


multifunctional end mill for ramping, drilling, slotting, roughing and finishing • universal application

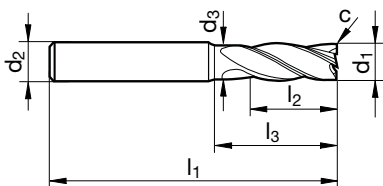
### Article no. 84950



P	M	K	N	S	H
•	•	•		•	



multifunctional end mill for ramping, drilling, slotting, roughing and finishing • universal application



d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
4.000	6.000	3.800	57.000	11.000	15.900	0.040	4	4.000
5.000	6.000	4.800	57.000	13.000	19.400	0.050	4	5.000
5.700	6.000	5.500	57.000	13.000	20.400	0.060	4	5.700
6.000	6.000	5.700	57.000	13.000	21.000	0.060	4	6.000
7.700	8.000	7.400	63.000	19.000	26.900	0.080	4	7.700
8.000	8.000	7.700	63.000	19.000	27.000	0.080	4	8.000
9.700	10.000	9.400	72.000	22.000	31.400	0.100	4	9.700
10.000	10.000	9.500	72.000	22.000	32.000	0.100	4	10.000
11.700	12.000	11.200	83.000	26.000	36.400	0.120	4	11.700
12.000	12.000	11.500	83.000	26.000	38.000	0.120	4	12.000
13.700	14.000	13.200	83.000	26.000	31.000	0.140	4	13.700
14.000	14.000	13.500	83.000	26.000	38.000	0.140	4	14.000
15.600	16.000	15.100	92.000	32.000	36.000	0.160	4	15.600
16.000	16.000	15.500	92.000	32.000	44.000	0.160	4	16.000
19.500	20.000	19.000	104.000	38.000	54.000	0.200	4	19.500
20.000	20.000	19.500	104.000	38.000	54.000	0.200	4	20.000

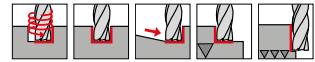


## High-performance end mills TF 100 INOX

### Article no. 84958



P	M	K	N	S	H
•	•			•	

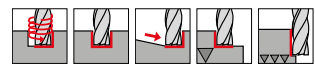


unequal flute spacing • centre cutting • especially suitable for stainless steels

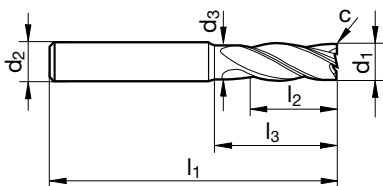
### Article no. 84959



P	M	K	N	S	H
•	•			•	



unequal flute spacing • centre cutting • especially suitable for stainless steels



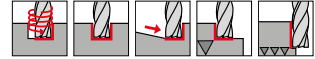
d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
4.000	6.000	3.800	54.000	8.000	15.000	0.150	4	4.000
5.000	6.000	4.800	54.000	9.000	15.000	0.150	4	5.000
6.000	6.000	5.700	54.000	10.000	17.000	0.200	4	6.000
8.000	8.000	7.700	58.000	12.000	21.000	0.250	4	8.000
10.000	10.000	9.500	66.000	14.000	24.000	0.300	4	10.000
12.000	12.000	11.500	73.000	16.000	26.000	0.350	4	12.000
16.000	16.000	15.500	82.000	22.000	32.000	0.500	4	16.000
20.000	20.000	19.500	92.000	26.000	40.000	0.600	4	20.000

## High-performance end mills TF 100 INOX

### Article no. 84972



P	M	K	N	S	H
•	•			•	

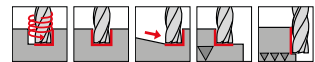


unequal flute spacing • centre cutting • especially suitable for stainless steels

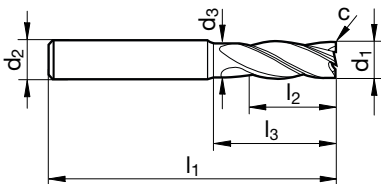
### Article no. 84973



P	M	K	N	S	H
•	•			•	



unequal flute spacing • centre cutting • especially suitable for stainless steels



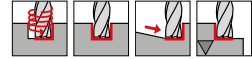
d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	2.800	57.000	8.000	15.000	0.100	4	3.000
3.500	6.000	3.300	57.000	10.000	15.000	0.100	4	3.500
4.000	6.000	3.800	57.000	11.000	18.000	0.150	4	4.000
4.500	6.000	4.300	57.000	11.000	18.000	0.150	4	4.500
5.000	6.000	4.800	57.000	13.000	18.000	0.150	4	5.000
5.500	6.000	5.300	57.000	13.000	19.400	0.200	4	5.500
6.000	6.000	5.700	57.000	13.000	20.000	0.200	4	6.000
6.500	8.000	6.200	63.000	16.000	24.400	0.250	4	6.500
7.000	8.000	6.700	63.000	16.000	24.900	0.250	4	7.000
7.500	8.000	7.200	63.000	19.000	25.300	0.250	4	7.500
8.000	8.000	7.700	63.000	19.000	26.000	0.250	4	8.000
8.500	10.000	8.200	72.000	19.000	29.400	0.300	4	8.500
9.000	10.000	8.700	72.000	19.000	29.900	0.300	4	9.000
9.500	10.000	9.200	72.000	22.000	30.300	0.300	4	9.500
10.000	10.000	9.500	72.000	22.000	30.000	0.300	4	10.000
11.000	12.000	10.500	83.000	26.000	34.700	0.350	4	11.000
12.000	12.000	11.500	83.000	26.000	36.000	0.350	4	12.000
14.000	14.000	13.500	83.000	26.000	36.000	0.400	4	14.000
16.000	16.000	15.500	92.000	32.000	42.000	0.500	4	16.000
18.000	18.000	17.500	92.000	32.000	42.000	0.600	4	18.000
20.000	20.000	19.500	104.000	38.000	52.000	0.600	4	20.000
25.000	25.000	24.000	121.000	45.000	63.000	0.750	4	25.000

## High-performance roughing end mills HS 100 U (coarse teeth)

### Article no. 84974



P	M	K	N	S	H
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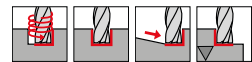


unequal flute spacing • centre cutting • universal application

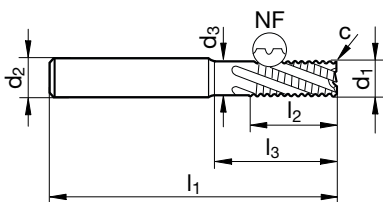
### Article no. 84975



P	M	K	N	S	H
•	•	•			



unequal flute spacing • centre cutting • universal application



d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
5.000	6.000	4.800	57.000	13.000	18.000	0.200	4	5.000
6.000	6.000	5.700	57.000	13.000	20.000	0.300	4	6.000
7.000	8.000	6.700	63.000	16.000	24.900	0.300	4	7.000
8.000	8.000	7.700	63.000	19.000	26.000	0.300	4	8.000
9.000	10.000	8.700	72.000	19.000	29.900	0.300	4	9.000
10.000	10.000	9.500	72.000	22.000	30.000	0.300	4	10.000
12.000	12.000	11.500	83.000	26.000	36.000	0.500	4	12.000
14.000	14.000	13.500	83.000	26.000	36.000	0.500	4	14.000
16.000	16.000	15.500	92.000	32.000	42.000	0.500	4	16.000
18.000	18.000	17.500	92.000	32.000	42.000	0.500	4	18.000
20.000	20.000	19.500	104.000	38.000	52.000	0.500	4	20.000
25.000	25.000	24.000	121.000	45.000	63.000	0.600	4	25.000

## Multi-tooth end mills TF 100 SF

### Article no. 84976



P	M	K	N	S	H
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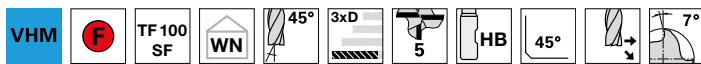


centre cutting • universal application

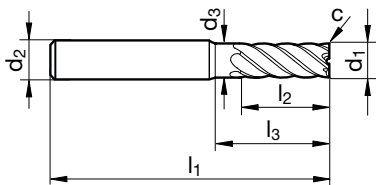
### Article no. 84977



P	M	K	N	S	H
•	•	•		•	



centre cutting • universal application



d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
4.000	6.000	3.800	65.000	12.000	26.000	0.050	5	4.000
5.000	6.000	4.800	65.000	15.000	26.000	0.050	5	5.000
6.000	6.000	5.700	65.000	18.000	28.000	0.050	5	6.000
8.000	8.000	7.700	75.000	24.000	38.000	0.100	5	8.000
10.000	10.000	9.500	80.000	30.000	38.000	0.100	5	10.000
12.000	12.000	11.500	93.000	36.000	46.000	0.100	5	12.000
16.000	16.000	15.500	108.000	48.000	58.000	0.150	5	16.000
20.000	20.000	19.500	126.000	60.000	74.000	0.150	5	20.000

## Multi-tooth end mills HP 100 U

### Article no. 84908



P	M	K	N	S	H
•	•	•		•	



centre cutting • universal application

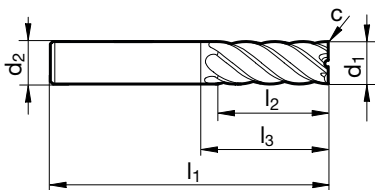
### Article no. 84909



P	M	K	N	S	H
•	•	•		•	



centre cutting • universal application



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	57.000	8.000	21.000	0.050	6	3.000
4.000	6.000	57.000	11.000	21.000	0.050	6	4.000
5.000	6.000	57.000	13.000	21.000	0.050	6	5.000
6.000	6.000	57.000	13.000	21.000	0.050	6	6.000
8.000	8.000	63.000	19.000	27.000	0.100	6	8.000
10.000	10.000	72.000	22.000	32.000	0.100	6	10.000
12.000	12.000	83.000	26.000	38.000	0.100	6	12.000
16.000	16.000	92.000	32.000	44.000	0.150	6	16.000
20.000	20.000	104.000	38.000	54.000	0.150	8	20.000
25.000	25.000	121.000	45.000	65.000	0.200	10	25.000



## Multi-tooth end mills HP 100 U

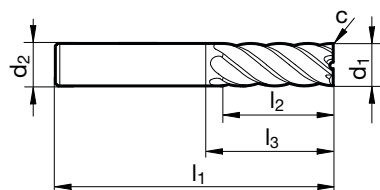
Article no. 84910



P	M	K	N	S	H
•	•	•			



centre cutting • universal application



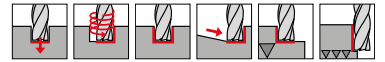
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	75.000	30.000	39.000	0.050	6	6.000
8.000	8.000	100.000	40.000	64.000	0.100	6	8.000
10.000	10.000	100.000	40.000	60.000	0.100	6	10.000
12.000	12.000	150.000	45.000	105.000	0.100	6	12.000
16.000	16.000	150.000	65.000	102.000	0.150	6	16.000
20.000	20.000	150.000	65.000	100.000	0.150	8	20.000

## Aluminium end mills TF 100 W

### Article no. 84960



P	M	K	N	S	H
			•		

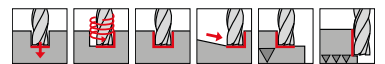


centre cutting  
aluminium and Al-alloys • plastics • non-ferrous metals

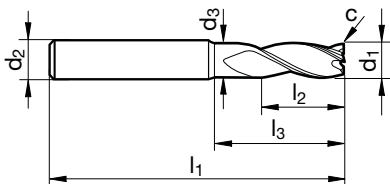
### Article no. 84961



P	M	K	N	S	H
			•		



centre cutting  
aluminium and Al-alloys • plastics • non-ferrous metals



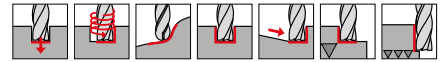
d1 e8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	2.800	57.000	8.000	15.000	0.060	3	3.000
4.000	6.000	3.800	57.000	11.000	18.000	0.080	3	4.000
5.000	6.000	4.800	57.000	13.000	18.000	0.100	3	5.000
6.000	6.000	5.700	57.000	13.000	20.000	0.120	3	6.000
8.000	8.000	7.700	63.000	19.000	26.000	0.160	3	8.000
10.000	10.000	9.500	72.000	22.000	30.000	0.200	3	10.000
12.000	12.000	11.500	83.000	26.000	36.000	0.240	3	12.000
16.000	16.000	15.500	92.000	32.000	42.000	0.320	3	16.000
20.000	20.000	19.500	104.000	38.000	52.000	0.200	3	20.000

## Aluminium end mills TF 100 W

### Article no. 84962



P	M	K	N	S	H
			•		



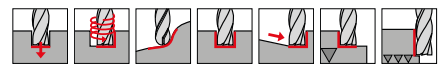
centre cutting

aluminium and Al-alloys • plastics • non-ferrous metals

### Article no. 84963

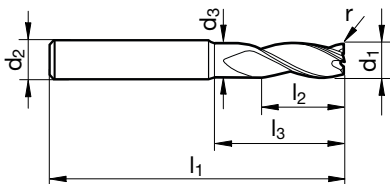


P	M	K	N	S	H
			•		



centre cutting

aluminium and Al-alloys • plastics • non-ferrous metals



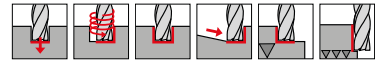
d1 e8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	r mm	Z	Code no.
6.000	6.000	5.700	57.000	13.000	20.000	0.500	3	6.005
6.000	6.000	5.700	57.000	13.000	20.000	1.000	3	6.010
8.000	8.000	7.700	63.000	19.000	26.000	0.500	3	8.005
8.000	8.000	7.700	63.000	19.000	26.000	1.000	3	8.010
10.000	10.000	9.500	72.000	22.000	30.000	0.500	3	10.005
10.000	10.000	9.500	72.000	22.000	30.000	1.000	3	10.010
10.000	10.000	9.500	72.000	22.000	30.000	1.500	3	10.015
12.000	12.000	11.500	83.000	26.000	36.000	0.500	3	12.005
12.000	12.000	11.500	83.000	26.000	36.000	1.000	3	12.010
12.000	12.000	11.500	83.000	26.000	36.000	1.500	3	12.015
12.000	12.000	11.500	83.000	26.000	36.000	2.000	3	12.020
12.000	12.000	11.500	83.000	26.000	36.000	2.500	3	12.025
12.000	12.000	11.500	83.000	26.000	36.000	3.000	3	12.030
12.000	12.000	11.500	83.000	26.000	36.000	4.000	3	12.040
16.000	16.000	15.500	92.000	32.000	42.000	1.000	3	16.010
16.000	16.000	15.500	92.000	32.000	42.000	2.000	3	16.020
16.000	16.000	15.500	92.000	32.000	42.000	2.500	3	16.025
16.000	16.000	15.500	92.000	32.000	42.000	3.000	3	16.030
16.000	16.000	15.500	92.000	32.000	42.000	4.000	3	16.040
20.000	20.000	19.500	104.000	38.000	52.000	1.000	3	20.010
20.000	20.000	19.500	104.000	38.000	52.000	2.000	3	20.020
20.000	20.000	19.500	104.000	38.000	52.000	2.500	3	20.025
20.000	20.000	19.500	104.000	38.000	52.000	3.000	3	20.030
20.000	20.000	19.500	104.000	38.000	52.000	4.000	3	20.040
25.000	25.000	24.000	121.000	45.000	63.000	2.000	3	25.020
25.000	25.000	24.000	121.000	45.000	63.000	3.000	3	25.030
25.000	25.000	24.000	121.000	45.000	63.000	4.000	3	25.040

## Aluminium end mills TF 100 W

### Article no. 84964



P	M	K	N	S	H
			•		



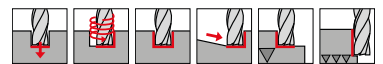
centre cutting

aluminium and Al-alloys • plastics • non-ferrous metals

### Article no. 84965

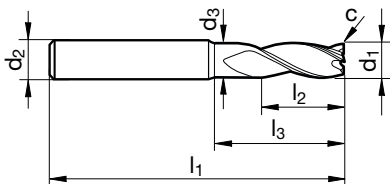


P	M	K	N	S	H
			•		



centre cutting

aluminium and Al-alloys • plastics • non-ferrous metals



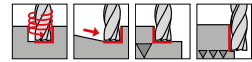
d1 e8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	5.500	65.000	13.000	28.000	0.120	3	6.000
8.000	8.000	7.500	75.000	19.000	38.000	0.160	3	8.000
10.000	10.000	9.200	80.000	22.000	38.000	0.200	3	10.000
12.000	12.000	11.200	93.000	26.000	46.000	0.240	3	12.000
16.000	16.000	15.000	108.000	32.000	58.000	0.320	3	16.000
20.000	20.000	19.000	126.000	38.000	74.000	0.200	3	20.000

## Aluminium end mills TF 100 W

### Article no. 84966



P	M	K	N	S	H
			•		

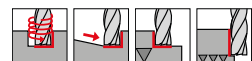


centre cutting  
aluminium and Al-alloys • plastics • non-ferrous metals

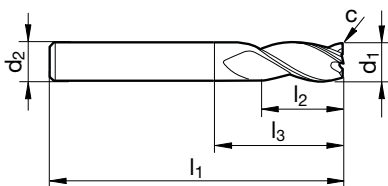
### Article no. 84967



P	M	K	N	S	H
			•		



centre cutting  
aluminium and Al-alloys • plastics • non-ferrous metals



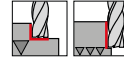
d1 e8 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	65.000	24.000	29.000	0.060	3	6.000
8.000	8.000	75.000	32.000	39.000	0.080	3	8.000
10.000	10.000	100.000	40.000	60.000	0.100	3	10.000
12.000	12.000	100.000	48.000	55.000	0.120	3	12.000
16.000	16.000	125.000	64.000	77.000	0.160	3	16.000
20.000	20.000	150.000	80.000	100.000	0.200	3	20.000

## Aluminium end mills TF 100 W

Article no. 84968

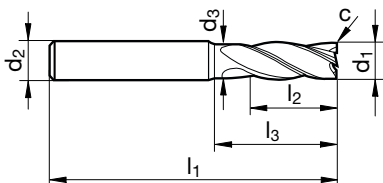


P	M	K	N	S	H
			•		



centre cutting

aluminium and Al-alloys • plastics • non-ferrous metals

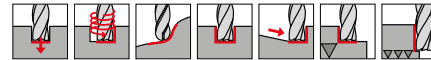


d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	2.800	57.000	8.000	15.000	0.100	4	3.000
4.000	6.000	3.800	57.000	11.000	18.000	0.100	4	4.000
5.000	6.000	4.800	57.000	13.000	18.000	0.100	4	5.000
6.000	6.000	5.700	57.000	13.000	20.000	0.150	4	6.000
8.000	8.000	7.700	63.000	19.000	26.000	0.150	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	0.200	4	12.000
16.000	16.000	15.500	92.000	32.000	42.000	0.350	4	16.000
20.000	20.000	19.500	104.000	38.000	52.000	0.450	4	20.000

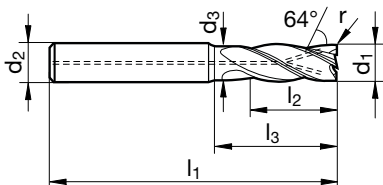


## Aluminium end mills TP 100 W with oil feed

Article no. 84970



centre cutting • with internal coolant supply  
aluminium and Al-alloys • plastics • non-ferrous metals



d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	r mm x 45°	Z	Code no.
6.000	6.000	5.700	57.000	10.000	20.000	1.000	3	6.000
8.000	8.000	7.700	63.000	16.000	26.000	1.000	3	8.000
10.000	10.000	9.500	72.000	19.000	30.000	1.500	3	10.000
12.000	12.000	11.500	83.000	22.000	36.000	1.500	3	12.000
12.000	12.000	11.500	83.000	22.000	36.000	2.000	3	12.020
12.000	12.000	11.500	83.000	22.000	36.000	2.500	3	12.025
12.000	12.000	11.500	83.000	22.000	36.000	4.000	3	12.040
16.000	16.000	15.500	92.000	26.000	42.000	2.000	3	16.000
16.000	16.000	15.500	92.000	26.000	42.000	2.500	3	16.025
16.000	16.000	15.500	92.000	26.000	42.000	3.000	3	16.030
16.000	16.000	15.500	92.000	26.000	42.000	4.000	3	16.040
20.000	20.000	19.500	104.000	32.000	52.000	2.500	3	20.000
20.000	20.000	19.500	104.000	32.000	52.000	2.000	3	20.020
20.000	20.000	19.500	104.000	32.000	52.000	3.000	3	20.030
20.000	20.000	19.500	104.000	32.000	52.000	4.000	3	20.040
25.000	25.000	24.500	121.000	38.000	63.000	2.000	3	25.020
25.000	25.000	24.500	121.000	38.000	63.000	3.000	3	25.030
25.000	25.000	24.500	121.000	38.000	63.000	4.000	3	25.040

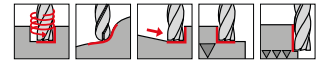
top line

## Hard profile cutters HP 100 H

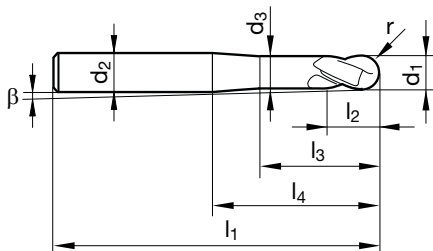
Catalog no. 84934



P	M	K	N	S	H
○		●			●



centre cutting • ball nose  
steel to 63 HRC • cast materials



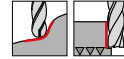
d1 h8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	l4 mm	r mm	$\beta$ °	Z	Code no.
0.500	3.000	0.400	38.000	0.750	2.600	10.000	0.250	7.400	2	0.500
0.800	3.000	0.700	38.000	1.200	3.500	10.000	0.400	6.600	2	0.800
1.000	3.000	0.900	38.000	1.500	4.000	10.000	0.500	6.100	2	1.000
1.500	3.000	1.400	38.000	2.250	5.500	10.000	0.750	4.700	2	1.500
2.000	6.000	1.900	57.000	3.000	9.400	21.000	1.000	5.800	2	2.000
3.000	6.000	2.700	57.000	5.000	11.600	21.000	1.500	4.400	2	3.000
4.000	6.000	3.700	57.000	6.000	14.500	21.000	2.000	3.100	2	4.000
5.000	6.000	4.700	57.000	8.000	17.300	21.000	2.500	1.600	2	5.000
6.000	6.000	5.700	57.000	9.000	20.000	21.000	3.000		2	6.000
8.000	8.000	7.700	63.000	12.000	26.000	27.000	4.000		2	8.000
10.000	10.000	9.500	72.000	15.000	30.000	32.000	5.000		2	10.000
12.000	12.000	11.500	83.000	18.000	36.000	38.000	6.000		2	12.000
16.000	16.000	15.500	92.000	24.000	42.000	44.000	8.000		2	16.000

## Hard profile cutters HP 100 H

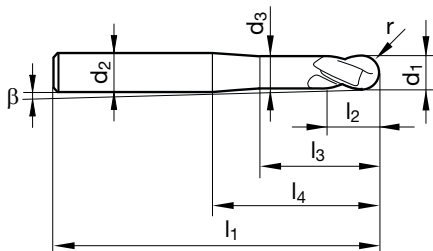
Catalog no. 84935



P	M	K	N	S	H
○		●			●



centre cutting • ball nose  
steel to 63 HRC • cast materials



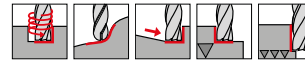
d1 h8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	l4 mm	r mm	$\beta$ °	Z	Code no.
3.000	6.000	2.700	75.000	5.000	20.000	39.000	1.500	2.300	2	3.000
4.000	6.000	3.700	75.000	6.000	20.000	39.000	2.000	1.600	2	4.000
5.000	6.000	4.700	75.000	8.000	20.000	39.000	2.500	0.800	2	5.000
6.000	6.000	5.700	75.000	9.000	38.000	39.000	3.000		2	6.000
8.000	8.000	7.700	100.000	12.000	63.000	64.000	4.000		2	8.000
10.000	10.000	9.500	100.000	15.000	58.000	60.000	5.000		2	10.000
12.000	12.000	11.500	150.000	18.000	103.000	105.000	6.000		2	12.000
16.000	16.000	15.500	150.000	24.000	100.000	102.000	8.000		2	16.000

## Hard profile cutters HP 100 H

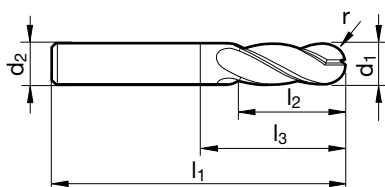
Article no. 84938



P	M	K	N	S	H
○		●			●



centre cutting • ball nose  
steel to 63 HRC • cast materials



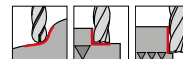
d1 e8 mm	d2 h6 mm	l1 mm	l2 mm	l4 mm	r mm	Z	Code no.
2.000	6.000	57.000	3.000	21.000	1.000	4	2.000
3.000	6.000	57.000	3.500	21.000	1.500	4	3.000
4.000	6.000	57.000	4.000	21.000	2.000	4	4.000
5.000	6.000	57.000	5.000	21.000	2.500	4	5.000
6.000	6.000	57.000	6.000	21.000	3.000	4	6.000
8.000	8.000	63.000	7.000	27.000	4.000	4	8.000
10.000	10.000	72.000	8.000	32.000	5.000	4	10.000
12.000	12.000	83.000	10.000	38.000	6.000	4	12.000

## Hard profile cutters HP 100 H

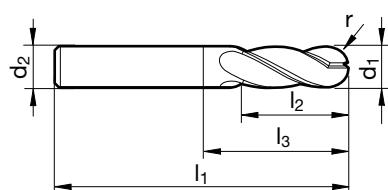
Article no. 84939



P	M	K	N	S	H
○		●			●



centre cutting • ball nose  
steel to 63 HRC • cast materials



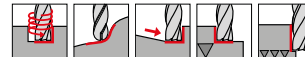
d1 e8 mm	d2 h6 mm	l1 mm	l2 mm	l4 mm	r mm	Z	Code no.
2.000	6.000	80.000	3.000	40.000	1.000	4	2.000
3.000	6.000	80.000	3.500	40.000	1.500	4	3.000
4.000	6.000	80.000	4.000	40.000	2.000	4	4.000
5.000	6.000	100.000	5.000	50.000	2.500	4	5.000
6.000	6.000	100.000	6.000	64.000	3.000	4	6.000
8.000	8.000	100.000	7.000	64.000	4.000	4	8.000
10.000	10.000	100.000	8.000	60.000	5.000	4	10.000
12.000	12.000	120.000	10.000	75.000	6.000	4	12.000

## Hard profile cutters HP 100 H

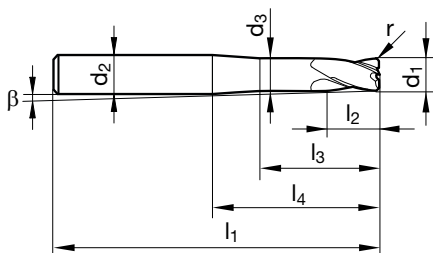
Catalog no. 84930



P	M	K	N	S	H
○		●			●



centre cutting • with corner radius  
steel to 63 HRC • cast materials



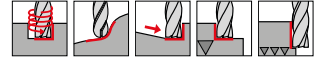
d1 h8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	l4 mm	r mm	$\beta$ °	Z	Code no.
3.000	6.000	2.800	57.000	5.000	14.000	21.000	0.500	4.200	4	3.000
4.000	6.000	3.800	57.000	6.000	16.000	21.000	0.500	2.800	4	4.000
5.000	6.000	4.800	57.000	8.000	18.000	21.000	0.500	1.400	4	5.000
6.000	6.000	5.700	57.000	9.000	20.000	21.000	1.000		4	6.000
8.000	8.000	7.700	63.000	12.000	26.000	27.000	1.000		4	8.000
10.000	10.000	9.500	72.000	15.000	30.000	32.000	1.500		4	10.000
12.000	12.000	11.500	83.000	18.000	36.000	38.000	1.500		4	12.000
16.000	16.000	15.500	92.000	24.000	42.000	44.000	2.000		4	16.000

## Hard profile cutters HP 100 H

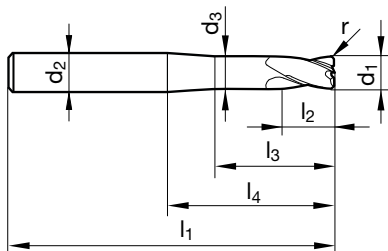
Catalog no. 84931



P	M	K	N	S	H
○		●			●



centre cutting • with corner radius  
steel to 63 HRC • cast materials



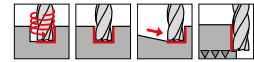
d1 h8 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	l4 mm	r mm	Z	Code no.
6.000	6.000	5.700	75.000	9.000	38.000	39.000	1.000	4	6.000
8.000	8.000	7.700	100.000	12.000	63.000	64.000	1.000	4	8.000
10.000	10.000	9.500	100.000	15.000	58.000	60.000	1.500	4	10.000
12.000	12.000	11.500	150.000	18.000	103.000	105.000	1.500	4	12.000
16.000	16.000	15.500	150.000	24.000	100.000	102.000	2.000	4	16.000

## Hard milling cutters HP 100 H

### Article no. 84936



P	M	K	N	S	H
○		●			●

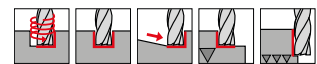


centre cutting  
steel to 63 HRC • cast materials

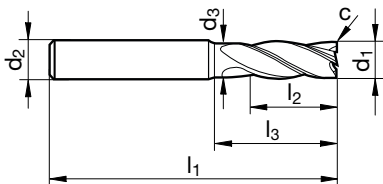
### Article no. 84937



P	M	K	N	S	H
○		●			●



centre cutting  
steel to 63 HRC • cast materials



d1 h10 mm	d2 h6 mm	d3 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	5.700	57.000	13.000	20.000	0.150	4	6.000
8.000	8.000	7.700	63.000	19.000	26.000	0.150	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	0.200	4	12.000
16.000	16.000	15.500	92.000	32.000	42.000	0.350	4	16.000
20.000	20.000	19.500	104.000	38.000	52.000	0.450	4	20.000



Hard multi-tooth end mills HP 100 H

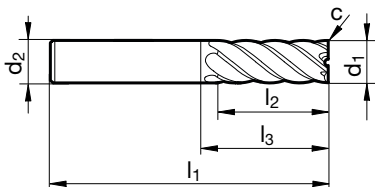
Article no. 84932



P	M	K	N	S	H
		•			•



centre cutting  
steel to 63 HRC • cast materials



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	57.000	8.000	21.000	0.050	6	3.000
4.000	6.000	57.000	11.000	21.000	0.050	6	4.000
5.000	6.000	57.000	13.000	21.000	0.050	6	5.000
6.000	6.000	57.000	13.000	21.000	0.050	6	6.000
8.000	8.000	63.000	19.000	27.000	0.100	6	8.000
10.000	10.000	72.000	22.000	32.000	0.100	6	10.000
12.000	12.000	83.000	26.000	38.000	0.100	6	12.000
14.000	14.000	83.000	26.000	38.000	0.150	6	14.000
14.000	16.000	92.000	32.000	44.000	0.150	6	14.001
16.000	16.000	92.000	32.000	44.000	0.150	6	16.000
18.000	18.000	92.000	32.000	44.000	0.150	8	18.000
18.000	20.000	104.000	38.000	54.000	0.150	8	18.001
20.000	20.000	104.000	38.000	54.000	0.150	8	20.000

Hard multi-tooth end mills HP 100 H

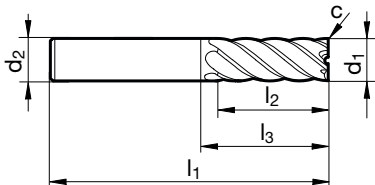
Article no. 84933



P	M	K	N	S	H
		•			•



centre cutting  
steel to 63 HRC • cast materials



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	75.000	30.000	39.000	0.050	6	6.000
8.000	8.000	100.000	40.000	64.000	0.100	6	8.000
10.000	10.000	100.000	40.000	60.000	0.100	6	10.000
12.000	12.000	150.000	45.000	105.000	0.100	6	12.000
16.000	16.000	150.000	65.000	102.000	0.150	6	16.000
20.000	20.000	150.000	65.000	100.000	0.150	8	20.000

# basic line



## ▼ UNIVERSAL CUTTERS

- ▼ Universal end mills at an outstanding price-performance-ratio
- ▼ economical milling operations
- ▼ For the machining of materials up to 1400 N/mm<sup>2</sup>

## Chamfering milling cutters

### Article no. 84921



P	M	K	N	S	H
•	•	•		○	



universal application • radial relieved • chamfering, de-burring and contour operations

### Article no. 84922



P	M	K	N	S	H
•	•	•		○	



universal application • radial relieved • chamfering, de-burring and contour operations



d1 js9 mm	d2 h6 mm	l1 mm	l2 mm	Z	Code no.
4.000	4.000	50.000	3.500	4	4.000
6.000	6.000	57.000	5.200	4	6.000
8.000	8.000	63.000	7.000	4	8.000
10.000	10.000	72.000	8.700	4	10.000
12.000	12.000	83.000	10.400	4	12.000

## Chamfering milling cutters

### Article no. 84923



P	M	K	N	S	H
•	•	•		○	



universal application • radial relieved • chamfering, de-burring and contour operations

### Article no. 84924



P	M	K	N	S	H
•	•	•		○	



universal application • radial relieved • chamfering, de-burring and contour operations



d1 js9 mm	d2 h6 mm	l1 mm	l2 mm	Z	Code no.
4.000	4.000	50.000	2.000	4	4.000
6.000	6.000	57.000	3.000	4	6.000
8.000	8.000	63.000	4.000	4	8.000
10.000	10.000	72.000	5.000	4	10.000
12.000	12.000	83.000	6.000	4	12.000

## Chamfering milling cutters

### Article no. 84925



P	M	K	N	S	H
•	•	•		○	



universal application • radial relieved • chamfering, de-burring and contour operations

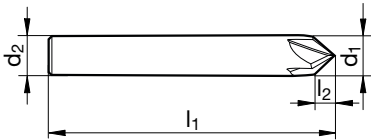
### Article no. 84926



P	M	K	N	S	H
•	•	•		○	



universal application • radial relieved • chamfering, de-burring and contour operations



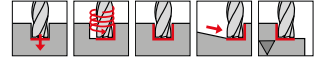
d1 js9 mm	d2 h6 mm	l1 mm	l2 mm	Z	Code no.
4.000	4.000	50.000	1.200	4	4.000
6.000	6.000	57.000	1.800	4	6.000
8.000	8.000	63.000	2.400	4	8.000
10.000	10.000	72.000	2.900	4	10.000
12.000	12.000	83.000	3.500	4	12.000

## Al slot drills (2-fluted)

### Article no. 84940



P	M	K	N	S	H
			•		



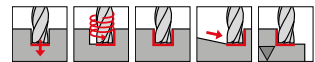
centre cutting

aluminium and Al-alloys • plastics • non-ferrous metals

### Article no. 84914

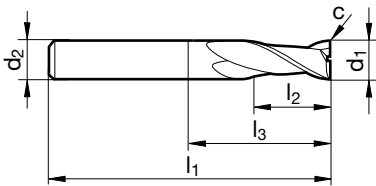


P	M	K	N	S	H
			•		



centre cutting

aluminium and Al-alloys • plastics • non-ferrous metals



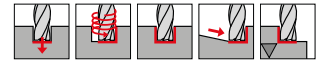
d1 e8 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	57.000	7.000	21.000	0.030	2	3.000
4.000	6.000	57.000	8.000	21.000	0.030	2	4.000
5.000	6.000	57.000	10.000	21.000	0.030	2	5.000
6.000	6.000	57.000	10.000	21.000	0.030	2	6.000
8.000	8.000	63.000	16.000	27.000	0.050	2	8.000
10.000	10.000	72.000	19.000	32.000	0.050	2	10.000
12.000	12.000	83.000	22.000	38.000	0.100	2	12.000
14.000	14.000	83.000	22.000	38.000	0.100	2	14.000
16.000	16.000	92.000	26.000	44.000	0.100	2	16.000
18.000	18.000	92.000	26.000	44.000	0.100	2	18.000
20.000	20.000	104.000	32.000	54.000	0.100	2	20.000

## Slot drills (2-fluted)

### Article no. 84942



P	M	K	N	S	H
•	•	•			

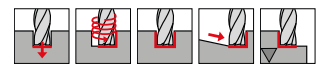


centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>

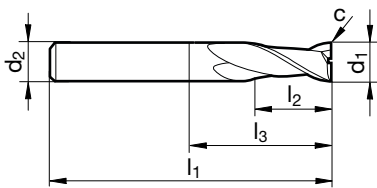
### Article no. 84943



P	M	K	N	S	H
•	•	•			



centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
2.000	6.000	50.000	3.000	14.000	0.025	2	2.000
2.500	6.000	50.000	3.000	14.000	0.050	2	2.500
3.000	6.000	50.000	4.000	14.000	0.050	2	3.000
4.000	6.000	54.000	5.000	18.000	0.050	2	4.000
5.000	6.000	54.000	6.000	18.000	0.050	2	5.000
6.000	6.000	54.000	7.000	18.000	0.050	2	6.000
6.500	8.000	58.000	8.000	22.000	0.100	2	6.500
8.000	8.000	58.000	9.000	22.000	0.100	2	8.000
10.000	10.000	66.000	11.000	26.000	0.100	2	10.000
12.000	12.000	73.000	12.000	28.000	0.100	2	12.000
14.000	14.000	75.000	14.000	30.000	0.150	2	14.000
16.000	16.000	82.000	16.000	34.000	0.150	2	16.000
18.000	18.000	84.000	18.000	36.000	0.150	2	18.000
20.000	20.000	92.000	20.000	42.000	0.150	2	20.000

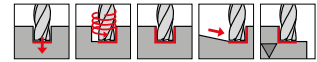


## Slot drills (2-fluted)

### Article no. 84911



P	M	K	N	S	H
•	•	•			

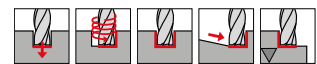


centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>

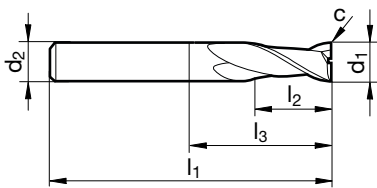
### Article no. 84912



P	M	K	N	S	H
•	•	•			



centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>



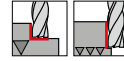
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
2.000	6.000	57.000	6.000	21.000	0.025	2	2.000
3.000	6.000	57.000	7.000	21.000	0.050	2	3.000
4.000	6.000	57.000	8.000	21.000	0.050	2	4.000
5.000	6.000	57.000	10.000	21.000	0.050	2	5.000
6.000	6.000	57.000	10.000	21.000	0.050	2	6.000
8.000	8.000	63.000	16.000	27.000	0.100	2	8.000
10.000	10.000	72.000	19.000	32.000	0.100	2	10.000
12.000	12.000	83.000	22.000	38.000	0.100	2	12.000
16.000	16.000	92.000	26.000	44.000	0.150	2	16.000
20.000	20.000	104.000	32.000	54.000	0.150	2	20.000

## Slot drills (2-fluted)

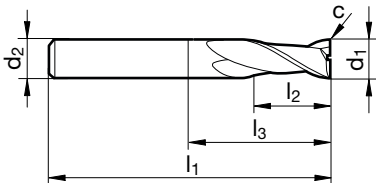
Article no. 84913



P	M	K	N	S	H
•	•	•			



centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	3.000	75.000	20.000	47.000	0.050	2	3.000
4.000	4.000	75.000	25.000	47.000	0.050	2	4.000
5.000	5.000	75.000	30.000	47.000	0.050	2	5.000
6.000	6.000	75.000	30.000	39.000	0.050	2	6.000
8.000	8.000	100.000	40.000	64.000	0.100	2	8.000
10.000	10.000	100.000	40.000	60.000	0.100	2	10.000
12.000	12.000	150.000	45.000	105.000	0.100	2	12.000
16.000	16.000	150.000	65.000	102.000	0.150	2	16.000
20.000	20.000	150.000	65.000	100.000	0.150	2	20.000

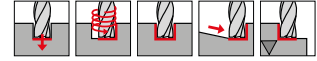
basicline

## Mini slot drills (3-fluted)

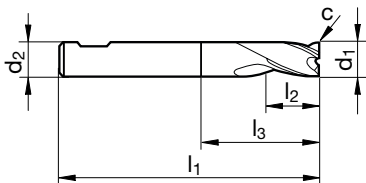
Article no. 84945



P	M	K	N	S	H
•	•	○		•	



centre cutting • universal application •  $\geq \varnothing 2.0$  mm with clamping surface • shank similar to HA/HB



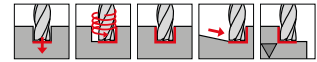
d1 e8 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
0.300	3.000	38.000	1.000	13.000		3	0.300
0.400	3.000	38.000	1.000	13.000		3	0.400
0.500	3.000	38.000	1.500	13.000	0.025	3	0.500
0.600	3.000	38.000	1.500	13.000	0.025	3	0.600
0.800	3.000	38.000	2.000	12.000	0.025	3	0.800
1.000	3.000	38.000	2.000	12.000	0.025	3	1.000
1.200	3.000	38.000	2.000	12.000	0.025	3	1.200
1.500	3.000	38.000	2.000	13.000	0.025	3	1.500
1.800	3.000	38.000	2.000	13.000	0.025	3	1.800
2.000	6.000	38.000	4.000	14.000	0.025	3	2.000
2.500	6.000	38.000	5.000	14.000	0.050	3	2.500
3.000	6.000	38.000	5.000	14.000	0.050	3	3.000
3.500	6.000	38.000	6.000	14.000	0.050	3	3.500
4.000	6.000	38.000	7.000	14.000	0.050	3	4.000
4.500	6.000	38.000	8.000	14.000	0.050	3	4.500
5.000	6.000	38.000	8.000	14.000	0.050	3	5.000
5.500	6.000	38.000	8.000	14.000	0.050	3	5.500
5.750	6.000	38.000	8.000	14.000	0.050	3	5.750
6.000	6.000	38.000	8.000	14.000	0.050	3	6.000
6.750	8.000	42.000	10.000	18.000	0.100	3	6.750
7.000	8.000	42.000	10.000	18.000	0.100	3	7.000
7.750	8.000	42.000	10.000	18.000	0.100	3	7.750
8.000	8.000	43.000	11.000	19.000	0.100	3	8.000
8.700	10.000	48.000	11.000	21.000	0.100	3	8.700
9.000	10.000	48.000	11.000	21.000	0.100	3	9.000
9.700	10.000	48.000	11.000	21.000	0.100	3	9.700
10.000	10.000	50.000	13.000	23.000	0.100	3	10.000
12.000	12.000	55.000	15.000	25.000	0.100	3	12.000
14.000	14.000	58.000	15.000	28.000	0.150	3	14.000
16.000	16.000	62.000	18.000	29.000	0.150	3	16.000
18.000	18.000	70.000	20.000	37.000	0.150	3	18.000
20.000	20.000	75.000	22.000	41.000	0.150	3	20.000

## Mini slot drills (3-fluted)

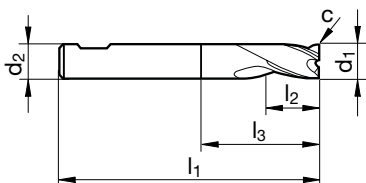
Article no. 84905



P	M	K	N	S	H
•	•	○		○	



centre cutting • universal application •  $\geq \varnothing 2.0$  mm with clamping surface • shank similar to HA/HB



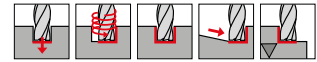
d1 e8 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
1.000	3.000	38.000	2.000	12.000	0.025	3	1.000
1.200	3.000	38.000	2.000	12.000	0.025	3	1.200
1.500	3.000	38.000	3.000	13.000	0.025	3	1.500
1.800	3.000	38.000	3.000	13.000	0.025	3	1.800
2.000	6.000	45.000	4.000	15.000	0.025	3	2.000
2.500	6.000	45.000	5.000	15.000	0.050	3	2.500
3.000	6.000	45.000	6.000	15.000	0.050	3	3.000
3.500	6.000	45.000	6.000	15.000	0.050	3	3.500
4.000	6.000	45.000	7.000	15.000	0.050	3	4.000
4.500	6.000	45.000	8.000	15.000	0.050	3	4.500
5.000	6.000	45.000	8.000	15.000	0.050	3	5.000
5.500	6.000	45.000	8.000	15.000	0.050	3	5.500
5.750	6.000	45.000	10.000	15.000	0.050	3	5.750
6.000	6.000	45.000	10.000	15.000	0.050	3	6.000
6.750	8.000	55.000	10.000	19.000	0.100	3	6.750
7.000	8.000	55.000	12.000	19.000	0.100	3	7.000
7.750	8.000	55.000	12.000	19.000	0.100	3	7.750
8.000	8.000	55.000	13.000	19.000	0.100	3	8.000
8.700	10.000	55.000	14.000	25.000	0.100	3	8.700
9.000	10.000	55.000	14.000	25.000	0.100	3	9.000
9.700	10.000	55.000	16.000	25.000	0.100	3	9.700
10.000	10.000	55.000	16.000	25.000	0.100	3	10.000

## Slot drills (3-fluted)

### Article no. 84946



P	M	K	N	S	H
•	•	•			

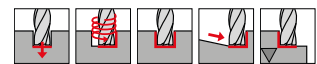


centre cutting • for materials up to 1400 N/mm<sup>2</sup>

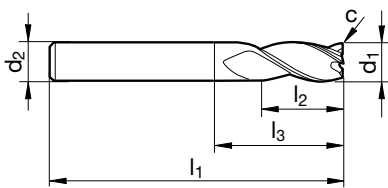
### Article no. 84947



P	M	K	N	S	H
•	•	•			



centre cutting • for materials up to 1400 N/mm<sup>2</sup>



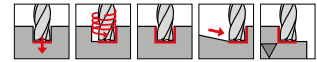
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
2.000	6.000	57.000	6.000	21.000	0.025	3	2.000
2.500	6.000	57.000	7.000	21.000	0.050	3	2.500
3.000	6.000	57.000	7.000	21.000	0.050	3	3.000
3.500	6.000	57.000	7.000	21.000	0.050	3	3.500
4.000	6.000	57.000	8.000	21.000	0.050	3	4.000
4.500	6.000	57.000	8.000	21.000	0.050	3	4.500
5.000	6.000	57.000	10.000	21.000	0.050	3	5.000
6.000	6.000	57.000	10.000	21.000	0.050	3	6.000
7.000	8.000	63.000	13.000	27.000	0.100	3	7.000
8.000	8.000	63.000	16.000	27.000	0.100	3	8.000
8.500	10.000	72.000	16.000	32.000	0.100	3	8.500
9.000	10.000	72.000	16.000	32.000	0.100	3	9.000
10.000	10.000	72.000	19.000	32.000	0.100	3	10.000
12.000	12.000	83.000	22.000	38.000	0.100	3	12.000
14.000	14.000	83.000	22.000	38.000	0.150	3	14.000
16.000	16.000	92.000	26.000	44.000	0.150	3	16.000
18.000	18.000	92.000	26.000	44.000	0.150	3	18.000
20.000	20.000	104.000	32.000	54.000	0.150	3	20.000

## Slot drills (3-fluted)

### Article no. 84948



P	M	K	N	S	H
•	•	•		○	

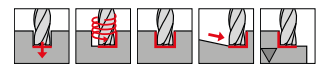


centre cutting • for materials up to 1400 N/mm<sup>2</sup>

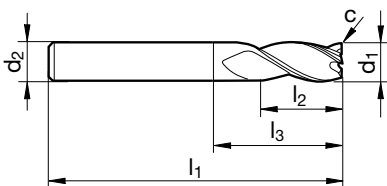
### Article no. 84949



P	M	K	N	S	H
•	•	•		○	



centre cutting • for materials up to 1400 N/mm<sup>2</sup>



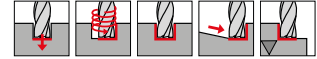
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	50.000	4.000	14.000	0.050	3	3.000
4.000	6.000	54.000	5.000	18.000	0.060	3	4.000
5.000	6.000	54.000	6.000	18.000	0.080	3	5.000
6.000	6.000	54.000	7.000	18.000	0.090	3	6.000
7.000	8.000	58.000	8.000	22.000	0.110	3	7.000
8.000	8.000	58.000	9.000	22.000	0.120	3	8.000
9.000	10.000	66.000	10.000	26.000	0.140	3	9.000
10.000	10.000	66.000	11.000	26.000	0.150	3	10.000
12.000	12.000	73.000	12.000	28.000	0.180	3	12.000
14.000	14.000	75.000	14.000	30.000	0.210	3	14.000
16.000	16.000	82.000	16.000	34.000	0.190	3	16.000
18.000	18.000	84.000	18.000	36.000	0.220	3	18.000
20.000	20.000	92.000	20.000	42.000	0.240	3	20.000

## Slot drills (3-fluted)

### Article no. 84903



P	M	K	N	S	H
•	•	•	○		

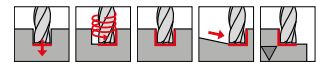


centre cutting • for materials up to 1400 N/mm<sup>2</sup>

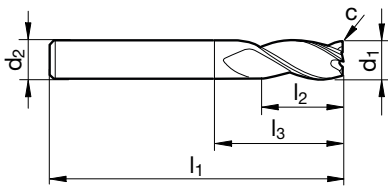
### Article no. 84904



P	M	K	N	S	H
•	•	•	○		



centre cutting • for materials up to 1400 N/mm<sup>2</sup>



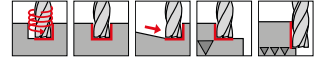
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	6.000	57.000	7.000	21.000	0.050	3	3.000
3.500	6.000	57.000	7.000	21.000	0.050	3	3.500
4.000	6.000	57.000	8.000	21.000	0.060	3	4.000
4.500	6.000	57.000	8.000	21.000	0.070	3	4.500
5.000	6.000	57.000	10.000	21.000	0.080	3	5.000
6.000	6.000	57.000	10.000	21.000	0.090	3	6.000
7.000	8.000	63.000	13.000	27.000	0.110	3	7.000
8.000	8.000	63.000	16.000	27.000	0.120	3	8.000
9.000	10.000	72.000	16.000	32.000	0.140	3	9.000
10.000	10.000	72.000	19.000	32.000	0.150	3	10.000
12.000	12.000	83.000	22.000	38.000	0.180	3	12.000
14.000	14.000	83.000	22.000	38.000	0.210	3	14.000
16.000	16.000	92.000	26.000	44.000	0.190	3	16.000
20.000	20.000	104.000	32.000	54.000	0.240	3	20.000

## End mills (4-fluted)

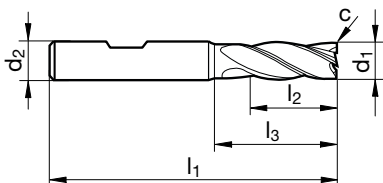
Article no. 84915



P	M	K	N	S	H
•	•	•			



centre cutting • for materials up to 1400 N/mm<sup>2</sup>



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
2.000	6.000	57.000	7.000	21.000	0.025	4	2.000
3.000	6.000	57.000	8.000	21.000	0.050	4	3.000
4.000	6.000	57.000	11.000	21.000	0.050	4	4.000
5.000	6.000	57.000	13.000	21.000	0.050	4	5.000
6.000	6.000	57.000	13.000	21.000	0.050	4	6.000
7.000	8.000	63.000	16.000	27.000	0.100	4	7.000
8.000	8.000	63.000	19.000	27.000	0.100	4	8.000
9.000	10.000	72.000	19.000	32.000	0.100	4	9.000
10.000	10.000	72.000	22.000	32.000	0.100	4	10.000
12.000	12.000	83.000	26.000	38.000	0.100	4	12.000
14.000	14.000	83.000	26.000	38.000	0.150	4	14.000
16.000	16.000	92.000	32.000	44.000	0.150	4	16.000
18.000	18.000	92.000	32.000	44.000	0.150	4	18.000
20.000	20.000	104.000	38.000	54.000	0.150	4	20.000

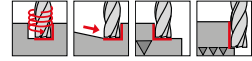


## End mills (4-fluted)

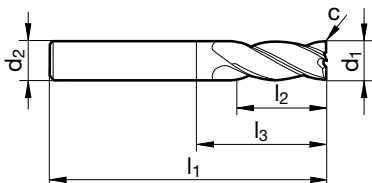
Article no. 84916



P	M	K	N	S	H
•	•	•			



centre cutting • for materials up to 1400 N/mm<sup>2</sup>



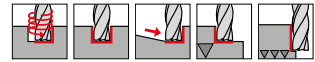
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
3.000	3.000	75.000	20.000	47.000	0.050	4	3.000
4.000	4.000	75.000	25.000	47.000	0.050	4	4.000
5.000	5.000	75.000	30.000	47.000	0.050	4	5.000
6.000	6.000	75.000	30.000	39.000	0.050	4	6.000
8.000	8.000	100.000	40.000	64.000	0.100	4	8.000
10.000	10.000	100.000	40.000	60.000	0.100	4	10.000
12.000	12.000	150.000	45.000	105.000	0.100	4	12.000
16.000	16.000	150.000	65.000	102.000	0.150	4	16.000
20.000	20.000	150.000	65.000	100.000	0.150	4	20.000

## End mills (4-fluted)

### Article no. 84944



P	M	K	N	S	H
•	•	•			

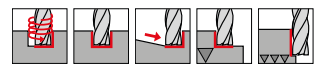


centre cutting • for materials up to 1400 N/mm<sup>2</sup>

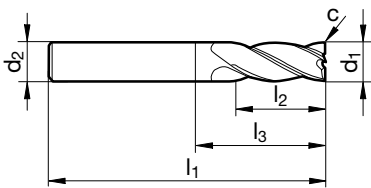
### Article no. 84941



P	M	K	N	S	H
•	•	•			



centre cutting • for materials up to 1400 N/mm<sup>2</sup>



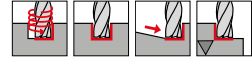
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
2.000	6.000	50.000	4.000	14.000	0.025	4	2.000
3.000	6.000	50.000	5.000	14.000	0.050	4	3.000
4.000	6.000	54.000	8.000	18.000	0.050	4	4.000
5.000	6.000	54.000	9.000	18.000	0.050	4	5.000
6.000	6.000	54.000	10.000	18.000	0.050	4	6.000
8.000	8.000	58.000	12.000	22.000	0.100	4	8.000
10.000	10.000	66.000	14.000	26.000	0.100	4	10.000
12.000	12.000	73.000	16.000	28.000	0.100	4	12.000
14.000	14.000	75.000	18.000	30.000	0.150	4	14.000
16.000	16.000	82.000	22.000	34.000	0.150	4	16.000
18.000	18.000	84.000	24.000	36.000	0.150	4	18.000
20.000	20.000	92.000	26.000	42.000	0.150	4	20.000

## Roughing end mills with fine teeth

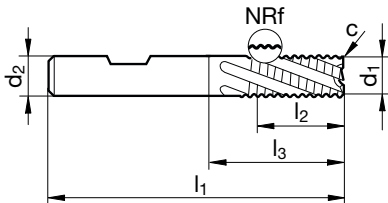
Article no. 84906



P	M	K	N	S	H
•	•	•			



centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>



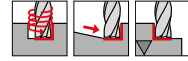
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	57.000	13.000	21.000	0.300	4	6.000
8.000	8.000	63.000	19.000	27.000	0.300	4	8.000
10.000	10.000	72.000	22.000	32.000	0.300	4	10.000
12.000	12.000	83.000	26.000	38.000	0.500	4	12.000
16.000	16.000	92.000	32.000	44.000	0.500	4	16.000
20.000	20.000	104.000	38.000	54.000	0.500	4	20.000

## Roughing end mills with fine teeth

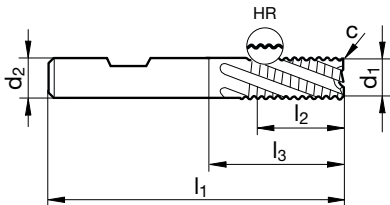
Article no. 84907



P	M	K	N	S	H
•		•			•



centre cutting  
steels up to 54 HRC • cast materials



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	c mm x 45°	Z	Code no.
6.000	6.000	57.000	13.000	21.000	0.300	4	6.000
8.000	8.000	63.000	19.000	27.000	0.300	4	8.000
10.000	10.000	72.000	22.000	32.000	0.300	4	10.000
12.000	12.000	83.000	26.000	38.000	0.500	4	12.000
16.000	16.000	92.000	32.000	44.000	0.500	4	16.000
20.000	20.000	104.000	38.000	54.000	0.500	4	20.000

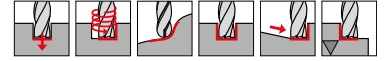
basic line

## Ball nose end mills

### Article no. 84917



P	M	K	N	S	H
•	•	•		•	○



centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>

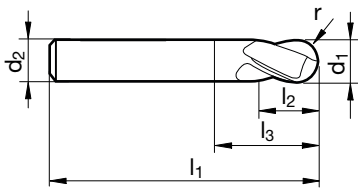
### Article no. 84918



P	M	K	N	S	H
•	•	•		•	○



centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>



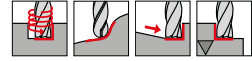
d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	r mm	Z	Code no.
0.500	3.000	38.000	1.000	10.000	0.250	2	0.500
1.000	3.000	38.000	2.000	10.000	0.500	2	1.000
1.500	3.000	38.000	3.000	10.000	0.750	2	1.500
2.000	6.000	57.000	6.000	21.000	1.000	2	2.000
3.000	6.000	57.000	7.000	21.000	1.500	2	3.000
4.000	6.000	57.000	8.000	21.000	2.000	2	4.000
5.000	6.000	57.000	10.000	21.000	2.500	2	5.000
6.000	6.000	57.000	10.000	21.000	3.000	2	6.000
8.000	8.000	63.000	16.000	27.000	4.000	2	8.000
10.000	10.000	72.000	19.000	32.000	5.000	2	10.000
12.000	12.000	83.000	22.000	38.000	6.000	2	12.000
20.000	20.000	104.000	32.000	54.000	10.000	2	20.000

## Ball nose end mills

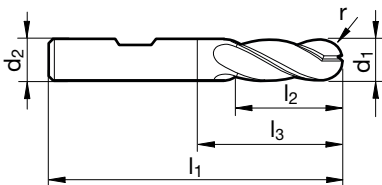
Article no. 84919



<b>P</b>	<b>M</b>	<b>K</b>	<b>N</b>	<b>S</b>	<b>H</b>
•	○	•	○	•	○



centre cutting • for materials with tensile strengths of up to approx. 1200 N/mm<sup>2</sup>



d1 h10 mm	d2 h6 mm	l1 mm	l2 mm	l3 mm	r mm	Z	Code no.
3.000	6.000	57.000	8.000	21.000	1.500	4	3.000
4.000	6.000	57.000	11.000	21.000	2.000	4	4.000
5.000	6.000	57.000	13.000	21.000	2.500	4	5.000
6.000	6.000	57.000	13.000	21.000	3.000	4	6.000
8.000	8.000	63.000	19.000	27.000	4.000	4	8.000
10.000	10.000	72.000	22.000	32.000	5.000	4	10.000
12.000	12.000	83.000	26.000	38.000	6.000	4	12.000
20.000	20.000	104.000	38.000	54.000	10.000	4	20.000



## High-performance end mills, sets

### Article no. 84920



P	M	K	N	S	H
•	○	•			○



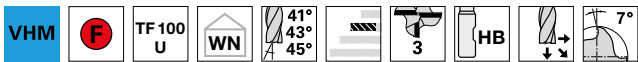
contains item no. 84902, Ø 6 / 8 / 10 / 12 / 16 mm, 1 each in a set box

Ø-range mm	Pieces/set Piece	Code no.
6.0-16.0	5	1.000

### Article no. 84927



P	M	K	N	S	H
•	•	•	•		○



contains item no. 84953, Ø 6 / 8 / 10 / 12 mm, 1 each in a set box

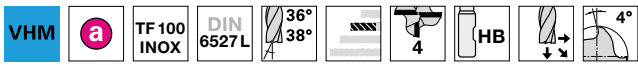
Ø-range mm	Pieces/set Piece	Code no.
6,0-12,0	4	1.000



## High-performance end mills, sets

Article no. 84928

P	M	K	N	S	H
•	•			•	



contains item no. 84973, Ø 6 / 8 / 10 / 12 / 16 mm, 1 each in a set box

Ø-range mm	Pieces/set Piece	Code no.
6.0-16.0	5	1.000

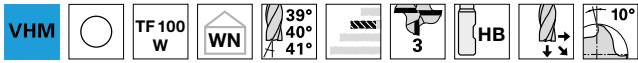




## High-performance end mills, sets

Article no. 84997

P	M	K	N	S	H
			•		



contains item no. 84961, Ø 6 / 8 / 10 / 12 / 16 mm, 1 each in a set box

Ø-range mm	Pieces/set Piece	Code no.
6.0-16.0	5	1.000

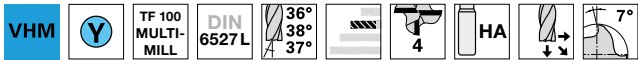


## High-performance end mills, sets

Article no. 84999



P	M	K	N	S	H
•	•	•	•	•	



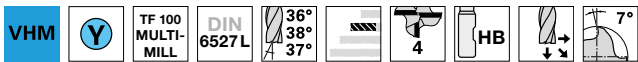
contains item no. 84951, Ø 6 / 8 / 10 / 12 / 16 mm, 1 each in a set box

Ø-range mm	Pieces/set Piece	Code no.
6.0-16.0	5	2.000

Article no. 84998



P	M	K	N	S	H
•	•	•	•	•	



contains item no. 84950, Ø 6 / 8 / 10 / 12 / 16 mm, 1 each in a set box

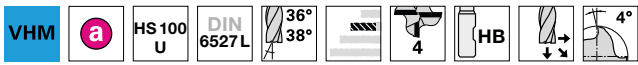
Ø-range mm	Pieces/set Piece	Code no.
6.0-16.0	5	2.000



## High-performance end mills, sets

Article no. 84929

P	M	K	N	S	H
•	•	•	○		



contains item no. 84975, Ø 6 / 8 / 10 / 12 / 16 mm, 1 each in a set box

Ø-range mm	Pieces/set Piece	Code no.
6.0-16.0	5	1.000

## TF 100 MULTI-MILL



### PLUNGING\* AND RAMPING\*

Material/ISO material	Hardness	Ramping depth* (a <sub>p</sub> max.)	Ramping* max. angle in °	Cutting speed (v <sub>c</sub> )	fz (mm/z) with nom. Ø					
					5.7	7.7	9.7	11.7	15.6	19.5
<b>P</b> Struct./free-cutting steels. unall. heat-treat./case hard. steels Free-cutting steels. unalloyed case hard. steels. nitr. steels Alloyed heat-treatable. tool and high speed steels	up to 850 N/mm <sup>2</sup>	1xd	45°	270	0.020	0.030	0.040	0.045	0.050	0.060
	850 - 1200 N/mm <sup>2</sup>	1xd	45°	240	0.015	0.020	0.035	0.040	0.045	0.050
	850 - 1400 N/mm <sup>2</sup>	1xd	30°	200	0.010	0.015	0.025	0.030	0.035	0.040
<b>M</b> Stainless steel - easy to machine / sulphured Stainless steel - moderately difficult to machine	up to 750 N/mm <sup>2</sup>	1xd	10°	60	0.010	0.015	0.025	0.030	0.035	0.040
	over 750 - 950 N/mm <sup>2</sup>	0.5xd	5°	50	0.010	0.015	0.020	0.025	0.030	0.035
<b>K</b> Cast iron. grey cast iron. sph. graphite/malleable cast iron	over 240 HB 30	1xd	45°	150	0.020	0.030	0.040	0.045	0.050	0.060
<b>N</b> Aluminium. Al-wrought alloys. Al-alloys Aluminium-cast alloys	up to 3% Si	1xd	30°	180	0.015	0.020	0.035	0.040	0.045	0.050
	over 3% Si	1xd	45°	140	0.020	0.030	0.040	0.045	0.050	0.060
<b>S</b> Titanium. Titanium alloys	up to 1400 N/mm <sup>2</sup>	0.5xd	10°	45	0.010	0.015	0.020	0.025	0.030	0.035

\* peripheral cooling recommended for optimal chip evacuation and tool life

### SLOTING\*

Material/ISO material	Hardness	Cutting depth (a <sub>p</sub> )	Cutting width (a <sub>e</sub> )	Cutting speed (v <sub>c</sub> )	fz (mm/z) with nom. Ø					
					5.7	7.7	9.7	11.7	15.6	19.5
<b>P</b> Struct./free-cutting steels. unall. heat-treat./case hard. steels Free-cutting steels. unalloyed case hard. steels. nitr. steels Alloyed heat-treatable. tool and high speed steels	up to 850 N/mm <sup>2</sup>	1xd	1xd	270	0.025	0.035	0.050	0.060	0.080	0.100
	850 - 1200 N/mm <sup>2</sup>	1xd	1xd	240	0.025	0.035	0.050	0.060	0.080	0.100
	850 - 1400 N/mm <sup>2</sup>	1xd	1xd	200	0.025	0.030	0.045	0.050	0.070	0.085
<b>M</b> Stainless steel - easy to machine / sulphured Stainless steel - moderately difficult to machine	up to 750 N/mm <sup>2</sup>	1xd	1xd	120	0.020	0.030	0.045	0.060	0.065	0.075
	over 750 - 950 N/mm <sup>2</sup>	1xd	1xd	80	0.020	0.030	0.040	0.045	0.060	0.070
<b>K</b> Cast iron. grey cast iron. sph. graphite/malleable cast iron	over 240 HB 30	1xd	1xd	160	0.025	0.035	0.050	0.060	0.080	0.100
<b>N</b> Aluminium. Al-wrought alloys. Al-alloys Aluminium-cast alloys	up to 3% Si	1xd	1xd	500	0.030	0.040	0.065	0.080	0.095	0.110
	over 3% Si	1xd	1xd	340	0.020	0.030	0.055	0.065	0.080	0.100
<b>S</b> Titanium. Titanium alloys	up to 1400 N/mm <sup>2</sup>	1xd	1xd	60	0.020	0.030	0.040	0.045	0.060	0.070

\* Peripheral cooling recommended for optimal chip evacuation and tool life

### HPC-ROUGHING\* AND HSC-FINISHING\*\*

Material/ISO material	Hardness	Cutting depth (a <sub>p</sub> )	Cutting width*** (a <sub>e</sub> )	Cutting speed (v <sub>c</sub> )	fz (mm/z) with nom. Ø					
					5.7	7.7	9.7	11.7	15.6	19.5
<b>P</b> Struct./free-cutting steels. unall. heat-treat./case hard. steels Free-cutting steels. unalloyed case hard. steels. nitr. steels Alloyed heat-treatable. tool and high speed steels	up to 850 N/mm <sup>2</sup>	2xd	0.4xd	350	0.030	0.045	0.060	0.075	0.090	0.110
	850 - 1200 N/mm <sup>2</sup>	2xd	0.4xd	290	0.030	0.045	0.060	0.075	0.090	0.110
	850 - 1400 N/mm <sup>2</sup>	2xd	0.3xd	240	0.025	0.030	0.055	0.070	0.085	0.100
<b>M</b> Stainless steel - easy to machine / sulphured Stainless steel - moderately difficult to machine	up to 750 N/mm <sup>2</sup>	2xd	0.3xd	140	0.025	0.035	0.055	0.065	0.080	0.090
	over 750 - 950 N/mm <sup>2</sup>	2xd	0.25xd	120	0.020	0.030	0.045	0.050	0.065	0.075
<b>K</b> Cast iron. grey cast iron. sph. graphite/malleable cast iron	over 240 HB 30	2xd	0.4xd	180	0.030	0.045	0.060	0.075	0.090	0.110
<b>N</b> Aluminium. Al-wrought alloys. Al-alloys Aluminium-cast alloys	up to 3% Si	2xd	0.5xd	600	0.040	0.060	0.080	0.100	0.120	0.150
	over 3% Si	2xd	0.4xd	420	0.030	0.045	0.060	0.075	0.090	0.110
<b>S</b> Titanium. Titanium alloys	up to 1400 N/mm <sup>2</sup>	2xd	0.4xd	120	0.020	0.030	0.045	0.050	0.065	0.075

\* Peripheral cooling recommended for optimal chip evacuation and tool life

\*\* for HSC machining the cutting speed can be increased by 50%. feed rate fz can be reduced depending on surface requirements.

\*\*\* for trochoidal milling and imachining with a<sub>e</sub> = 0.1-0.2xd the cutting speed v<sub>c</sub> and the feed rate can be increased by 50 %.

### DRILLING\*

Material/ISO material	Hardness	Drilling depth* (a <sub>p</sub> max.)	Cutting speed (v <sub>c</sub> )	fz (mm/z) with nom. Ø					
				5.7	7.7	9.7	11.7	15.6	19.5
<b>P</b> Struct./free-cutting steels. unall. heat-treat./case hard. steels Free-cutting steels. unalloyed case hard. steels. nitr. steels Alloyed heat-treatable. tool and high speed steels	up to 850 N/mm <sup>2</sup>	2xd	270	0.020	0.030	0.040	0.045	0.050	0.060
	850 - 1200 N/mm <sup>2</sup>	2xd	240	0.015	0.020	0.035	0.040	0.045	0.050
	850 - 1400 N/mm <sup>2</sup>	1xd	200	0.010	0.015	0.025	0.030	0.035	0.040
<b>K</b> Cast iron. grey cast iron. sph. graphite/malleable cast iron	over 240 HB 30	2xd	150	0.020	0.030	0.040	0.045	0.050	0.060
<b>N</b> Aluminium. Al-wrought alloys. Al-alloys Aluminium-cast alloys	up to 3% Si	1xd	180	0.015	0.020	0.035	0.040	0.045	0.050
	over 3% Si	1xd	140	0.020	0.030	0.040	0.045	0.050	0.060

\* pecking recommended from drilling depth 1XD

\* peripheral cooling recommended for optimal chip evacuation and tool life

## TF 100 U, TF 100 SF, TF 100 INOX, HP 100 H, TF 100 W



Application	v <sub>c</sub> factor	f <sub>z</sub> factor	Feed width (a <sub>e</sub> )	Feed depth (a <sub>p</sub> )
Slotting	1	1 (0.7 for a <sub>p</sub> = 2xd)	1xd	0.5 up to 1xd
Roughing	1	1 (0.7 for a <sub>p</sub> = 2xd)	0.4 up to 0.9xd	0.5 up to 1xd
Finishing	1	1	0.01 up to 0.1xd	1 up to 2xd
HPC-roughing	1.3	1.5	0.15 up to 0.4xd	1 up to 2xd
HSC-roughing	1.5	2	0.05 up to 0.15xd	1 up to 2xd

Material	Hardness	recommended TF 100 Type	Type of application	cut v <sub>c</sub>	f <sub>z</sub> (mm/z) with nom. Ø								
					3	6	8	10	12	16	20	25	
<b>Structural + free-cutting steels. unalloyed heat-treatable + case hardened 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	up to 850 N/mm <sup>2</sup>	INOX	Slotting	180	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
		INOX	Roughing	200	0.02	0.04	0.055	0.07	0.085	0.1	0.12	0.17	
		SF	Finishing	280	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
<b>Free-cutting steels. unalloyed 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>	U	Slotting	160	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
		U	Roughing	180	0.02	0.04	0.055	0.07	0.085	0.1	0.12	0.17	
		SF	Finishing	220	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
<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	Slotting	135	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
		U	Roughing	160	0.02	0.04	0.05	0.065	0.08	0.095	0.11	0.16	
		SF	Finishing	200	0.015	0.03	0.04	0.05	0.06	0.07	0.09	0.13	
<b>Hardened steel</b> 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	up to 54 HRC	U	Slotting	70	0.012	0.025	0.03	0.04	0.045	0.06	0.07	0.1	
		U	Roughing	110	0.015	0.025	0.035	0.045	0.05	0.065	0.08	0.12	
		SF	Finishing	150	0.015	0.03	0.04	0.05	0.06	0.07	0.09	0.13	
	54-60 HRC		Slotting										
		HP 100 H	Finishing	110	0.01	0.015	0.025	0.035	0.042	0.05	0.08	0.09	
<b>Stainless steel</b> 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	up to 750 N/mm <sup>2</sup>	INOX	Slotting	120	0.015	0.03	0.04	0.05	0.06	0.07	0.09	0.13	
		INOX	Roughing	140	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
		SF	Finishing	180	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
<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>	INOX	Slotting	80	0.015	0.025	0.035	0.045	0.05	0.065	0.08	0.12	
		INOX	Roughing	120	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
		SF	Finishing	140	0.015	0.03	0.04	0.05	0.06	0.07	0.09	0.13	
<b>Stainless steel</b> 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	over 850 N/mm <sup>2</sup>	INOX	Slotting	70	0.012	0.025	0.03	0.04	0.045	0.06	0.07	0.1	
		INOX	Roughing	100	0.015	0.025	0.035	0.045	0.05	0.065	0.08	0.12	
		SF	Finishing	120	0.015	0.025	0.035	0.045	0.05	0.065	0.08	0.12	
<b>Special alloys (nickel based "Ni")</b> Nimonic. Inconel. Monel. Hastelloy	up to 1.300 N/mm <sup>2</sup>	U	Slotting	30	0.01	0.015	0.02	0.025	0.03	0.04	0.05	0.06	
		U	Roughing	35	0.01	0.02	0.03	0.035	0.04	0.055	0.065	0.08	
		SF	Finishing	45	0.015	0.025	0.035	0.045	0.05	0.065	0.08	0.12	
<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	up to 1.300 N/mm <sup>2</sup>	U	Slotting	60	0.015	0.025	0.035	0.045	0.05	0.065	0.08	0.12	
		U	Roughing	90	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
		SF	Finishing	130	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30	INOX	Slotting	160	0.02	0.04	0.05	0.065	0.08	0.095	0.11	0.16	
		INOX	Roughing	180	0.02	0.04	0.055	0.07	0.085	0.1	0.12	0.17	
		SF	Finishing	220	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30	U	Slotting	140	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
		U	Roughing	160	0.02	0.04	0.05	0.065	0.08	0.095	0.11	0.16	
		SF	Finishing	200	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
<b>Aluminium. Al-wrought alloys. Al-alloys</b> 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	up to 3% Si	W	Slotting	500	0.02	0.04	0.05	0.065	0.08	0.095	0.11	0.16	
		W	Roughing	600	0.02	0.04	0.055	0.07	0.085	0.1	0.12	0.17	
		W	Finishing	1000	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
<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	over 3% Si	W	Slotting	230	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
		W	Roughing	280	0.02	0.04	0.05	0.065	0.08	0.095	0.11	0.16	
		W	Finishing	350	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
<b>Magnesium-alloys</b> MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-	W	Slotting	180	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
		W	Roughing	220	0.02	0.04	0.05	0.065	0.08	0.095	0.11	0.16	
		W	Finishing	280	0.018	0.035	0.045	0.06	0.07	0.09	0.1	0.15	
<b>Non-ferrous metals (copper. short- or long-chipping brass or bronze)</b> 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 CuZn43Pb2 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 CuPb10Sn 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	up to 850 N/mm <sup>2</sup>	W	Slotting	250	0.015	0.025	0.035	0.045	0.05	0.065	0.08	0.12	
		W	Roughing	300	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	
		SF	Finishing	400	0.016	0.03	0.04	0.055	0.065	0.08	0.095	0.14	

## High-performance roughing end mills HS 100 U



Application	$v_c$ factor	$f_z$ factor	Feed width ( $a_e$ )	Feed depth ( $a_p$ )
Slotting	1	1 (0.7 for $a_p = 2x_d$ )	1xd	0.5 up to 1xd
Roughing	1	1 (0.7 for $a_p = 2x_d$ )	0.4 up to 0.9xd	0.5 up to 1xd
Finishing	1	1	0.01 up to 0.1xd	1 up to 2xd
HPC-roughing	1.3	1.5	0.15 up to 0.4xd	1 up to 2xd
HSC-roughing	1.5	2	0.05 up to 0.15xd	1 up to 2xd

Material	Hardness	recommended HS 100 Type	Type of application	cut $v_c$	$f_z$ (mm/z) with nom. $\emptyset$							
					3	6	8	10	12	16	20	25
<b>Structural + free-cutting steels. unalloyed heat-treatable + case hardened 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	up to 850 N/mm <sup>2</sup>	U	Slotting	140	0.011	0.023	0.027	0.036	0.041	0.054	0.063	0.090
			Roughing	160	0.014	0.023	0.032	0.041	0.045	0.059	0.072	0.108
			Finishing									
<b>Free-cutting steels. unalloyed 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>	U	Slotting	130	0.011	0.023	0.027	0.036	0.041	0.054	0.063	0.090
			Roughing	150	0.014	0.023	0.032	0.041	0.045	0.059	0.072	0.108
			Finishing									
<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	Slotting	110	0.009	0.014	0.023	0.027	0.032	0.041	0.054	0.063
			Roughing	130	0.009	0.018	0.027	0.032	0.036	0.050	0.059	0.072
			Finishing									
<b>Hardened steel</b> 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	up to 54 HRC	U	Slotting	55	0.009	0.014	0.018	0.023	0.027	0.036	0.045	0.054
			Roughing	90	0.011	0.014	0.023	0.027	0.032	0.041	0.054	0.063
			Finishing									
	54-60 HRC	U	Slotting									
			Roughing									
			Finishing									
<b>Stainless steel</b> 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	up to 750 N/mm <sup>2</sup>	U	Slotting	100	0.011	0.023	0.027	0.036	0.041	0.054	0.063	0.090
			Roughing	115	0.014	0.023	0.032	0.041	0.045	0.059	0.072	0.108
			Finishing									
<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>	U	Slotting	65	0.009	0.014	0.023	0.027	0.032	0.041	0.054	0.063
			Roughing	100	0.011	0.018	0.027	0.032	0.036	0.050	0.059	0.072
			Finishing									
<b>Stainless steel</b> 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	over 850 N/mm <sup>2</sup>	U	Slotting	55	0.009	0.014	0.018	0.023	0.027	0.036	0.045	0.054
			Roughing	80	0.011	0.014	0.023	0.027	0.032	0.041	0.054	0.063
			Finishing									
<b>Special alloys (nickel based "Ni")</b> Nimonic. Inconel. Monel. Hastelloy	up to 1.300 N/mm <sup>2</sup>	U	Slotting	25	0.007	0.009	0.014	0.018	0.023	0.032	0.036	0.045
			Roughing	30	0.009	0.014	0.018	0.023	0.027	0.036	0.045	0.054
			Finishing									
<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	up to 1.300 N/mm <sup>2</sup>	U	Slotting	55	0.009	0.014	0.023	0.027	0.032	0.041	0.054	0.063
			Roughing	80	0.011	0.018	0.027	0.032	0.036	0.050	0.059	0.072
			Finishing									
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30	U	Slotting	150	0.014	0.023	0.032	0.041	0.045	0.059	0.072	0.108
			Roughing	160	0.014	0.027	0.036	0.045	0.054	0.063	0.081	0.117
			Finishing									
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30	U	Slotting	130	0.011	0.023	0.027	0.036	0.041	0.054	0.063	0.090
			Roughing	150	0.014	0.023	0.032	0.041	0.045	0.059	0.072	0.108
			Finishing									
<b>Aluminium. Al-wrought alloys. Al-alloys</b> 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	up to 3% Si	U	Slotting	450	0.014	0.027	0.036	0.050	0.059	0.072	0.086	0.126
			Roughing	540	0.016	0.032	0.041	0.054	0.063	0.081	0.090	0.135
			Finishing									
<b>Aluminium-cast alloys</b> 3.2131 G-AISi5Cu1. 3.2153 G-AISi7Cu3. 3.2573 G-AISi9 3.2581 G-AISi12. 3.2583 G-AISi12Cu. - G-AISi12CuNiMg	over 3% Si	U	Slotting	200	0.014	0.023	0.032	0.041	0.045	0.059	0.072	0.108
			Roughing	250	0.014	0.027	0.036	0.045	0.054	0.063	0.081	0.117
			Finishing									
<b>Magnesium-alloys</b> MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-	U	Slotting	160	0.011	0.023	0.027	0.036	0.041	0.054	0.063	0.090
			Roughing	200	0.014	0.027	0.036	0.045	0.054	0.063	0.081	0.117
			Finishing									
<b>Non-ferrous metals (copper. short- or long-chipping brass or bronze)</b> 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 CuZn43Pb2 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 CuPb10Sn 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	up to 850 N/mm <sup>2</sup>	U	Slotting	225	0.011	0.023	0.027	0.036	0.041	0.054	0.063	0.090
			Roughing	270	0.014	0.027	0.036	0.045	0.054	0.063	0.081	0.117
			Finishing									



## Hard profile cutters HP 100 H



Tool length/reach up to 3xD      vc and fz 100%  
 Tool length/reach 3-5xD        vc and fz 80%  
 Tool length/reach > 5-10xD    vc and fz 60%

Application	Width/depth	Nom. diameter (mm)								
		2	3	4	6	8	10	12	16	
Roughing	ae (mm)	0.1	0.15	0.2	0.4	0.6	0.75	1	1.2	
	ap (mm)	0.15	0.15	0.3	0.5	0.75	1	1.5	1.5	
Finishing	ae (mm)	0.05	0.07	0.1	0.14	0.16	0.18	0.2	0.3	
	ap (mm)	0.05	0.05	0.07	0.1	0.15	0.2	0.25	0.3	

Material	Hardness	recommended Typ	Type of application	cut v <sub>c</sub>	fz (mm/z) with nom. Ø							
					3	6	8	10	12	16	20	25
<b>Structural + free-cutting steels. unalloyed heat-treatable + case hardened 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	up to 850 N/mm <sup>2</sup>	2-/4-fluted	Roughing	200	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	300	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
<b>Free-cutting steels. unalloyed 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>	2-/4-fluted	Roughing	200	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	300	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
<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>	2-/4-fluted	Roughing	180	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	280	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
<b>Hardened steel</b> 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	up to 54 HRC	2-/4-fluted	Roughing	140	0.02	0.03	0.035	0.04	0.05	0.07	0.08	0.1
		2-/4-fluted	Finishing	200	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
	54-60 HRC	2-/4-fluted	Roughing	80	0.02	0.03	0.035	0.04	0.05	0.07	0.08	0.1
		2-/4-fluted	Finishing	130	0.025	0.03	0.04	0.045	0.05	0.07	0.1	0.12
<b>Stainless steel</b> 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	up to 750 N/mm <sup>2</sup>	2-/4-fluted	Roughing	180	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	280	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
<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>	2-/4-fluted	Roughing	120	0.02	0.03	0.035	0.04	0.05	0.07	0.08	0.1
		2-/4-fluted	Finishing	180	0.025	0.03	0.04	0.045	0.05	0.07	0.1	0.12
<b>Stainless steel</b> 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	over 850 N/mm <sup>2</sup>	2-/4-fluted	Roughing	80	0.02	0.03	0.035	0.04	0.05	0.07	0.08	0.1
		2-/4-fluted	Finishing	130	0.025	0.03	0.04	0.045	0.05	0.07	0.1	0.12
<b>Special alloys (nickel based "Ni")</b> Nimonic. Inconel. Monel. Hastelloy	up to 1.300 N/mm <sup>2</sup>	2-/4-fluted	Roughing	40	0.01	0.02	0.03	0.035	0.04	0.05	0.07	0.08
		2-/4-fluted	Finishing	60	0.02	0.025	0.03	0.04	0.045	0.06	0.08	0.09
<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	up to 1.300 N/mm <sup>2</sup>	2-/4-fluted	Roughing	90	0.02	0.03	0.035	0.04	0.05	0.07	0.08	0.1
		2-/4-fluted	Finishing	150	0.025	0.03	0.04	0.045	0.05	0.07	0.1	0.12
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30	2-/4-fluted	Roughing	200	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	300	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	over 240 HB 30	2-/4-fluted	Roughing	150	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	230	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
<b>Aluminium. Al-wrought alloys. Al-alloys</b> 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	up to 3% Si											
<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	over 3% Si	2-/4-fluted	Roughing	280	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	350	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
<b>Magnesium-alloys</b> MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-											
<b>Non-ferrous metals (copper. short- or long-chipping brass or bronze)</b> 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 CuZn43Pb2 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 CuPb10Sn 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	up to 850 N/mm <sup>2</sup>	2-/4-fluted	Roughing	250	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15
		2-/4-fluted	Finishing	400	0.03	0.04	0.045	0.05	0.07	0.1	0.12	0.15

## Universal end mills 2-/3-/4-/6-/8-fluted



Application	$v_c$ factor	$f_z$ factor	Feed width ( $a_e$ )	Feed depth ( $a_p$ )
Slotting	1	1 (0.7 for $a_p = 2x_d$ )	1xd	0.5 up to 1xd
Roughing	1	1 (0.7 for $a_p = 2x_d$ )	0.4 up to 0.9xd	0.5 up to 1xd
Finishing	1	1	0.01 up to 0.1xd	1 up to 2xd
HPC-Roughing	1.3	1.5	0.15 up to 0.4xd	1 up to 2xd
HSC-Roughing	1.5	2	0.05 up to 0.15xd	1 up to 2xd

Material	Hardness	recommended Type	Type of application	cut $v_c$	$f_z$ (mm/z) with nom. $\emptyset$								
					3	6	8	10	12	16	20	25	
<b>Structural + free-cutting steels. unalloyed heat-treatable + case hardened 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	up to 850 N/mm <sup>2</sup>	2-fluted	Slotting	125	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105	
		2-/3-fluted	Roughing	140	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119	
		4-fluted	Finishing	190	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098	
<b>Free-cutting steels. unalloyed 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>	2-fluted	Slotting	110	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105	
		2-/3-fluted	Roughing	130	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119	
		4-fluted	Finishing	150	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098	
<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>	2-fluted	Slotting	95	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098	
		2-/3-fluted	Roughing	115	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112	
		4-fluted	Finishing	140	0.011	0.021	0.028	0.035	0.042	0.049	0.063	0.091	
<b>Hardened steel</b> 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	up to 54 HRC	2-fluted	Slotting	50	0.007	0.015	0.018	0.024	0.027	0.036	0.042	0.060	
		2-/3-fluted	Roughing	75	0.009	0.015	0.021	0.027	0.030	0.039	0.048	0.072	
		4-fluted	Finishing	105	0.009	0.018	0.024	0.030	0.036	0.042	0.054	0.078	
	54-60 HRC	2-fluted	Slotting										
		2-/3-fluted	Roughing										
<b>Stainless steel</b> 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	up to 750 N/mm <sup>2</sup>	2-fluted	Slotting	85	0.009	0.018	0.024	0.030	0.036	0.042	0.054	0.078	
		2-/3-fluted	Roughing	100	0.011	0.021	0.027	0.036	0.042	0.054	0.060	0.090	
		4-fluted	Finishing	125	0.010	0.018	0.024	0.033	0.039	0.048	0.057	0.084	
<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>	2-fluted	Slotting	55	0.009	0.015	0.021	0.027	0.030	0.039	0.048	0.072	
		2-/3-fluted	Roughing	85	0.010	0.018	0.024	0.033	0.039	0.048	0.057	0.084	
		4-fluted	Finishing	100	0.009	0.018	0.024	0.030	0.036	0.042	0.054	0.078	
<b>Stainless steel</b> 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	over 850 N/mm <sup>2</sup>	2-fluted	Slotting	50	0.007	0.015	0.018	0.024	0.027	0.036	0.042	0.060	
		2-/3-fluted	Roughing	70	0.009	0.015	0.021	0.027	0.030	0.039	0.048	0.072	
		4-fluted	Finishing	85	0.009	0.015	0.021	0.027	0.030	0.039	0.048	0.072	
<b>Special alloys (nickel based "Ni")</b> Nimonic. Inconel. Monel. Hastelloy	up to 1.300 N/mm <sup>2</sup>	2-fluted	Slotting	20	0.006	0.009	0.012	0.015	0.018	0.024	0.030	0.036	
		2-/3-fluted	Roughing	25	0.006	0.012	0.018	0.021	0.024	0.033	0.039	0.048	
		4-fluted	Finishing	30	0.009	0.015	0.021	0.027	0.030	0.039	0.048	0.072	
<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	up to 1.300 N/mm <sup>2</sup>	2-fluted	Slotting	40	0.009	0.015	0.021	0.027	0.030	0.039	0.048	0.072	
		2-/3-fluted	Roughing	60	0.010	0.018	0.024	0.033	0.039	0.048	0.057	0.084	
		4-fluted	Finishing	90	0.010	0.018	0.024	0.033	0.039	0.048	0.057	0.084	
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30	2-fluted	Slotting	115	0.012	0.024	0.030	0.039	0.048	0.057	0.066	0.096	
		2-/3-fluted	Roughing	125	0.012	0.024	0.033	0.042	0.051	0.060	0.072	0.102	
		4-fluted	Finishing	155	0.011	0.021	0.027	0.036	0.042	0.054	0.060	0.090	
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	over 240 HB 30	2-fluted	Slotting	100	0.010	0.018	0.024	0.033	0.039	0.048	0.057	0.084	
		2-/3-fluted	Roughing	115	0.012	0.024	0.030	0.039	0.048	0.057	0.066	0.096	
		4-fluted	Finishing	140	0.011	0.021	0.027	0.036	0.042	0.054	0.060	0.090	
<b>Aluminium. Al-wrought alloys. Al-alloys</b> 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	up to 3% Si	2-fluted	Slotting	350	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112	
		2-/3-fluted	Roughing	420	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119	
		4-fluted	Finishing	700	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105	
<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	over 3% Si	2-fluted	Slotting	160	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098	
		2-/3-fluted	Roughing	200	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112	
		4-fluted	Finishing	245	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105	
<b>Magnesium-alloys</b> MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-	2-fluted	Slotting	125	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098	
		2-/3-fluted	Roughing	150	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112	
		4-fluted	Finishing	200	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105	
<b>Non-ferrous metals (copper. short- or long-chipping brass or bronze)</b> 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 CuZn43Pb2 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 CuPb10Sn 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	up to 850 N/mm <sup>2</sup>	2-fluted	Slotting	175	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084	
		2-/3-fluted	Roughing	210	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098	
		4-fluted	Finishing	280	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098	



## Al slot drills (2-fluted) Type W



Application	$v_c$ factor	$f_z$ factor	feed width ( $a_e$ )	feed depth ( $a_p$ )
Slotting	1	1 (0.7 bei $a_p = 2x_d$ )	1xd	0.5 up to 1xd
Roughing	1	1 (0.7 bei $a_p = 2x_d$ )	0.4 up to 0.9xd	0.5 up to 1xd
Finishing	1	1	0.01 up to 0.1xd	1 up to 2xd
HPC-Roughing	1.3	1.5	0.15 up to 0.4xd	1 up to 2xd
HSC-Roughing	1.5	2	0.05 up to 0.15xd	1 up to 2xd

Material	Hardness	recommended Type	Type of application	cut $v_c$	fz (mm/z) with nom. Ø													
					3	6	8	10	12	16	20	25						
<b>Structural + free-cutting steels. unalloyed heat-treatable + case hardened 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	up to 850 N/mm <sup>2</sup>																	
<b>Free-cutting steels. unalloyed 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>																	
<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 Federstahl = 1.5026 55Si7. 1.7176 55Cr3. 1.8159 51CrV4	850-1.400 N/mm <sup>2</sup>																	
<b>Hardened steel</b> Werkzeugstahl. Vergütungsstahl. Federstahl. Schnellarbeitsstahl. Einsatzstahl. etc. Z.B.: 1.2344 X40CrMoV5-1; 1.2767 X45NiCrMo4; 1.2379 X155CrVMo12-1; 1.2080 X210Cr12 1.3343 S 6-5-2	up to 54 HRC  54-60 HRC																	
<b>Stainless steel</b> 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	up to 750 N/mm <sup>2</sup>																	
<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>																	
<b>Stainless steel</b> 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	over 850 N/mm <sup>2</sup>																	
<b>Special alloys (nickel based "Ni")</b> Nimonic. Inconel. Monel. Hastelloy	up to 1.300 N/mm <sup>2</sup>																	
<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	up to 1.300 N/mm <sup>2</sup>																	
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30																	
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	over 240 HB 30																	
<b>Aluminium. Alu-Knetlegierungen. Alulegierungen</b> 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	up to 3% Si	2-fluted	Slotting	350	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112						
<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	over 3% Si	2-fluted	Roughing	420	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119						
		2-fluted	Finishing	700	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105						
		2-fluted	Slotting	160	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098						
<b>Magnesium-alloys</b> MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-	2-fluted	Roughing	200	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112						
		2-fluted	Finishing	245	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105						
		2-fluted	Slotting	125	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098						
<b>Non-ferrous metals (copper. short- or long-chipping brass or bronze)</b> 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 CuZn43Pb2 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 CuPb10Sn 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	up to 850 N/mm <sup>2</sup>	2-fluted	Roughing	150	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.105						
		2-fluted	Slotting	175	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084						
		2-fluted	Finishing	280	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098						

## Roughing end mills with knuckle-type teeth



Application	$v_c$ factor	$f_z$ factor	Feed width ( $a_e$ )	Feed depth ( $a_p$ )
Slotting	1	1 (0.7 for $a_p = 2x_d$ )	1xd	0.5 up to 1xd
Roughing	1	1 (0.7 for $a_p = 2x_d$ )	0.4 up to 0.9xd	0.5 up to 1xd
Finishing	1	1	0.01 up to 0.1xd	1 up to 2xd
HPC-Roughing	1.3	1.5	0.15 up to 0.4xd	1 up to 2xd
HSC-Roughing	1.5	2	0.05 up to 0.15xd	1 up to 2xd

Material	Hardness	recommended HS 100 Typ	Type of application	cut $v_c$	$f_z$ (mm/z) with nom. $\emptyset$								
					3	6	8	10	12	16	20	25	
<b>Structural + free-cutting steels. unalloyed heat-treatable + case hardened 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	up to 850 N/mm <sup>2</sup>	U	Slotting	140	0.010	0.020	0.024	0.032	0.036	0.048	0.056	0.080	
			Roughing	160	0.012	0.020	0.028	0.036	0.040	0.052	0.064	0.096	
			Finishing										
<b>Free-cutting steels. unalloyed 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>	U	Slotting	130	0.010	0.020	0.024	0.032	0.036	0.048	0.056	0.080	
			Roughing	150	0.012	0.020	0.028	0.036	0.040	0.052	0.064	0.096	
			Finishing										
<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	Slotting	110	0.008	0.012	0.020	0.024	0.028	0.036	0.048	0.056	
			HR	Roughing	130	0.008	0.016	0.024	0.028	0.032	0.044	0.052	0.064
				Finishing									
<b>Hardened steel</b> 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	up to 54 HRC	HR	Slotting	55	0.008	0.012	0.016	0.020	0.024	0.032	0.040	0.048	
			Roughing	90	0.010	0.012	0.020	0.024	0.028	0.036	0.048	0.056	
				Finishing									
	54-60 HRC		Roughing										
			Finishing										
<b>Stainless steel</b> 1.4104 X14CrMoS17. 1.4105 X6CrMoS17. 1.4305 X10CrNiS18-9 USA = 303. 410. 420F. 430. 430F	up to 750 N/mm <sup>2</sup>	U	Slotting	100	0.010	0.020	0.024	0.032	0.036	0.048	0.056	0.080	
			Roughing	115	0.012	0.020	0.028	0.036	0.040	0.052	0.064	0.096	
				Finishing									
<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>	U	Slotting	65	0.007	0.011	0.018	0.021	0.025	0.032	0.042	0.049	
			Roughing	100	0.008	0.014	0.021	0.025	0.028	0.039	0.046	0.056	
				Finishing									
<b>Stainless steel</b> 1.4438 X2CrNiMo18-15-4. 1.4404 X2CrNiMo17-12-2. 1.4571 X6CrNiTi18-10 USA = 310. 316. 316B. 316L. 317	over 850 N/mm <sup>2</sup>	U	Slotting	55	0.007	0.011	0.014	0.018	0.021	0.028	0.035	0.042	
			Roughing	80	0.008	0.011	0.018	0.021	0.025	0.032	0.042	0.049	
				Finishing									
<b>Special alloys (nickel based "Ni")</b> Nimonic. Inconel. Monel. Hastelloy	up to 1.300 N/mm <sup>2</sup>	U	Slotting	25	0.006	0.007	0.011	0.014	0.018	0.025	0.028	0.035	
			Roughing	30	0.007	0.011	0.014	0.018	0.021	0.028	0.035	0.042	
				Finishing									
<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	up to 1.300 N/mm <sup>2</sup>	U	Slotting	50	0.007	0.011	0.018	0.021	0.025	0.032	0.042	0.049	
			Roughing	70	0.008	0.014	0.021	0.025	0.028	0.039	0.046	0.056	
				Finishing									
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	up to 240 HB 30	U	Slotting	130	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084	
			Roughing	140	0.011	0.021	0.028	0.035	0.042	0.049	0.063	0.091	
				Finishing									
<b>Cast iron. grey cast iron. spher. graphite/malleable 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)	over 240 HB 30	H	Slotting	110	0.008	0.018	0.021	0.028	0.032	0.042	0.049	0.070	
			Roughing	130	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084	
				Finishing									
<b>Aluminium, Al-wrought alloys, Al-alloys</b> 3.0255 Al99.5. 3.2315 AlMgSi1. 3.3515 AlMg1 3.0615 AlMgSiPb. 3.1325 AlCuMg1. 3.3245 AlMg3Si. 3.4365 AlZnMgCu1.5	up to 3% Si		Slotting	450	0.013	0.024	0.032	0.044	0.052	0.064	0.076	0.112	
			Roughing	540	0.014	0.028	0.036	0.048	0.056	0.072	0.080	0.120	
				Finishing									
<b>Aluminium-cast alloys</b> 3.2131 G-AISI5Cu1. 3.2153 G-AISI7Cu3. 3.2573 G-AISI9 3.2581 G-AISI12. 3.2583 G-AISI12Cu. - G-AISI12CuNiMg	over 3% Si		Slotting	200	0.012	0.020	0.028	0.036	0.040	0.052	0.064	0.096	
			Roughing	250	0.012	0.024	0.032	0.040	0.048	0.056	0.072	0.104	
				Finishing									
<b>Magnesium-alloys</b> MgMn2. G-MgAl8Zn1. G-MgAl6Zn3	-		Slotting	160	0.010	0.020	0.024	0.032	0.036	0.048	0.056	0.080	
			Roughing	200	0.012	0.024	0.032	0.040	0.048	0.056	0.072	0.104	
				Finishing									
<b>Non-ferrous metals (copper. short- or long-chipping brass or bronze)</b> 2.0070 SE-Cu. 2.1020 CuSn6. 2.1096 G-CuSn5ZnPb 2.0380 CuZn39Pb2. 2.0401 CuZn39Pb3. 2.0410 CuZn43Pb2 2.0250 CuZn20. 2.0280 CuZn33. 2.0332 CuZn37Pb0.5 2.1090 CuSn7ZnPb. 2.1170 CuPb5Sn5. 2.1176 CuPb10Sn 2.0916 CuAl5. 2.0960 CuAl9Mn. 2.1050 CuSn10	up to 850 N/mm <sup>2</sup>		Slotting	225	0.010	0.020	0.024	0.032	0.036	0.048	0.056	0.080	
			Roughing	270	0.012	0.024	0.032	0.040	0.048	0.056	0.072	0.104	
				Finishing									



## HPC & HSC – milling strategies with solid carbide milling cutters

Objectives: Higher efficiency through greater metal removal rate

Technical Part

### HPC = High Performance Cutting:

max. machining volume / time; stable conditions; short chip creation; high performance; good cooling

Milling with a tool contact angle of less than 70° and cutting depths of 2-3 x tool diameter

*i*machining, roughing, trochoid

- low cutting width ( $a_e$ ):  $<0.4 \times d$
- high depth of cut ( $a_p$ ): up to 2-3 x d
- very high tooth feed rate ( $f_z$ )
- very high cutting speed ( $v_c$ )

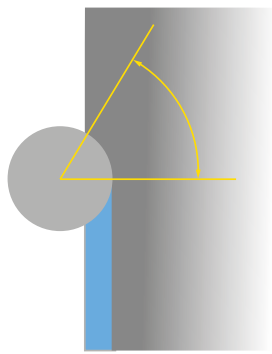
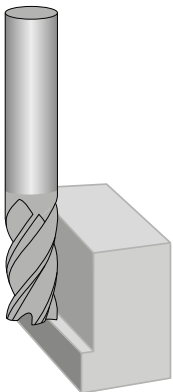
### HSC = High Speed Cutting:

at higher cutting speed/ high feed; low power; low feed function

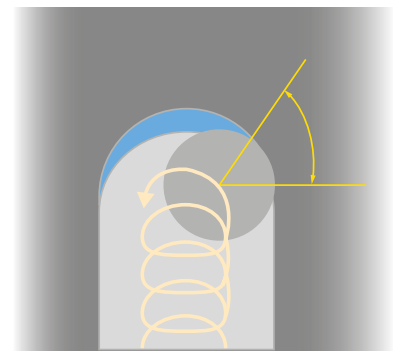
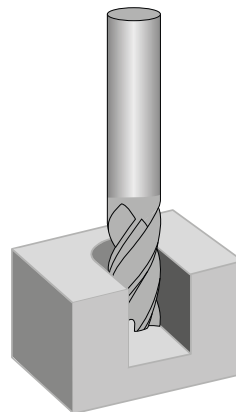
Milling with a tool contact angle of less than 37° and cutting depths up to 3x tool diameter

Semi roughing, finishing and fine-finishing

- minimum cutting width ( $a_e$ ):  $0.15 \times d$
- high depth of cut ( $a_p$ ): up to 3 x d
- high tooth feed rate ( $f_z$ )
- maximum cutting speed ( $v_c$ )



Tool Contact Angle



Tool Contact Angle

### HPC Linear Milling

Milling internal and external contours with high axial depth ( $a_p$ ) and low radial widths ( $a_e$ ). Increasing the cutting parameters due to the tool contact angle.

### HPC Milling – Trochoid / *i*machining

Machining of grooves or complex contours with long lengths ( $a_p$ ) and small radial depths ( $a_e$ ). Increasing the cutting parameters due to the limited angle of contact. Programming cycles or CAM-program.

### Operating Principals

- reducing the contact time of tool and workpiece results in less stress and greater thermal efficiency on the cutting edge
- the reduction of the pressure angle between the tool and workpiece reduces the average chip thickness
- less force on the tool, workpiece and machine

### Benefits

- extreme increase in cutting speed
- significant increase in the feed rate per tooth
- significant increase in the removal rate
- process-reliable for difficult-to-machine materials
- increase in tool life
- machinery is conserved

## HPC & HSC – milling strategies with solid carbide milling cutters

Benchmarks for increasing the cutting values

### HPC Roughing & HSC Finishing

Application	Radial feed in % from Ø	* v <sub>c</sub> factor	* f <sub>z</sub> factor	Contact Angle
slotting	100%	1	1	180°
HPC Roughing	33%	1.5	1.3	70°
HPC Roughing	25%	1.6	1.5	60°
HPC Roughing	20%	1.7	1.6	53°
HPC Roughing	15%	1.8	1.9	46°
HSC Roughing	10%	1.9	2.3	37°
HSC Roughing	8%	2.0	2.5	31°
HSC Roughing	5%	2.1	3.3	26°
HSC Finishing	3%	2.0	1.1	20°
HSC Finishing	2%	2.0	1.4	18°
HSC Finishing	1%	2.1	1.8	11°
Fine finishing	<1%	2.2	1.0	<11°

\* Basis for the calculation with the v<sub>c</sub> and f<sub>z</sub> factors is provided within the application recommendations section for „grooves“ in the appropriate material group.

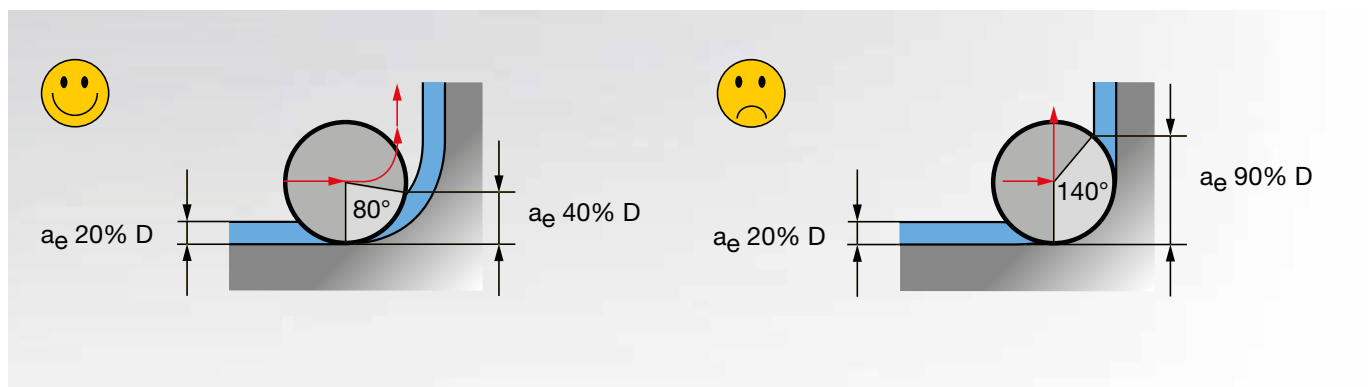
### Example: steel C45

Tools: Milling cutter Ø 12 mm, 4-fluted  
 Feed: Radial feed (a<sub>e</sub>) 1.8 mm  
 % Calculation: a<sub>e</sub> 1.8 mm = 15% of Ø 12 mm  
 Standard values: v<sub>c</sub> slotting = 180 m/min, f<sub>z</sub> slotting = 0.07 mm  
 Conversion: v<sub>c</sub> factor = 1.8 → v<sub>c</sub>: 180 m/min x 1.8 = v<sub>c</sub> 324 m/min  
 f<sub>z</sub> Faktor = 1.9 → f<sub>z</sub>: 0.07 mm x 1,9 = f<sub>z</sub> 0.133  
 Increased Values: v<sub>c</sub> 324 m/min / f<sub>z</sub> 0.133 mm  
 N 8594 U/min / v<sub>f</sub> 4572 mm/min  
 a<sub>p</sub>= 24 mm, a<sub>e</sub>=1.8 mm → Q=197 cm<sup>3</sup>/min

$$Q_{(\text{cm}^3/\text{min})} = a_p (\text{mm}) \times a_e (\text{mm}) \times V_f (\text{m}/\text{min})$$

The increase in the corner contact angle overloads the milling cutters.

Solution: the pocket radius must be much larger than the milling cutter radius to keep the contact angle less than 80° (max load).





### General notes

All the cutting rate recommendations specified in this catalogue are standard values valid exclusively for new tools or tools re-ground to Hartner specifications. Pre-requisites are stable machines, optimal cooling, optimal tool clamping and maximum concentricity of the tool and the machine spindle. Our

recommended cutting rates must be reduced if the conditions deviate. The values may also be adjusted to influence surface quality, machining rate or tool life.

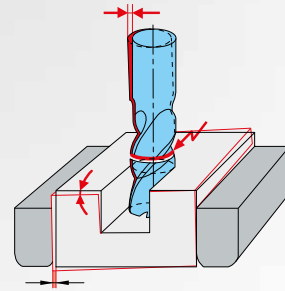
#### 1. Workpiece clamping

Loss of tool life or tool breakage through unstable clamping

- improve workpiece clamping

**Alternative:**

- reduce feed
- reduce cutting width or depth



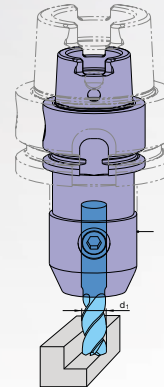
#### 2. Tool clamping

Loss of tool life or tool breakage through unstable, worn or too small/long/thin tool holder

- apply new or larger tool holder or holder with increased clamping force and increased concentricity

**Alternative:**

- reduce cutting rates
- reduce clamping length
- apply tool with smaller diameter
- check clamping screws for wear



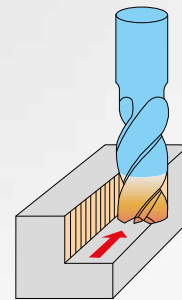
#### 3. Surface quality

Excessive peak-to-valley height  $R_a/R_z$  at the tool surface through excessive feed and feed rates or vibrations

- improve workpiece clamping and tool clamping (see points 1 and 2)

**Alternative:**

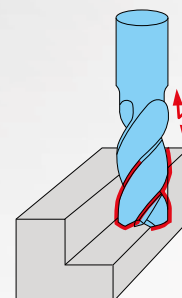
- reduce feed and feed rate
- increase cutting speed



#### 4. Vibrations

High tool wear, insufficient workpiece surface quality and insufficient dimensional accuracy through vibration

- improve workpiece and tool clamping (see points 1 and 2)
- increase tooth feed, because the chip centre thickness is too small
- modify speed
- modify milling strategy, i.e. select alternative cutting distribution
- change tool selection, i.e. reduce no. of teeth or spiral





## Application/Troubleshooting

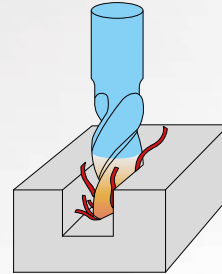
### 5. Chip congestion/cooling

Significant reduction in tool life, crumbling on cutting lips, edge build-up or conglutination of flutes through insufficient chip evacuation

- select milling cutters with internal cooling

#### Alternative:

- peripheral cooling via GM 300 chuck
- increase volume flow
- adjust coolant flow
- apply compressed air cooling (according to tool and material)
- reduce feed rate
- modify cutting distribution



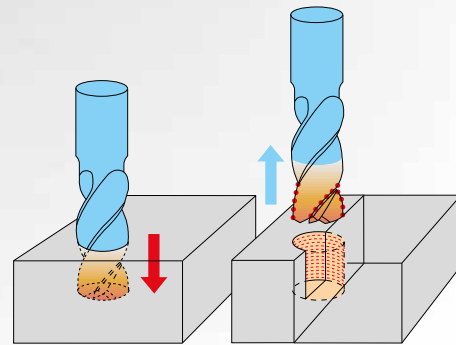
### 6. Pecking when drilling

Significant reduction in tool life as well as crumbling of cutting lips through insufficient chip evacuation and thermal stresses

- select milling cutter with internal cooling
- with drilling depths  $> 0.5 \times D$  pecking in stages

#### Alternative:

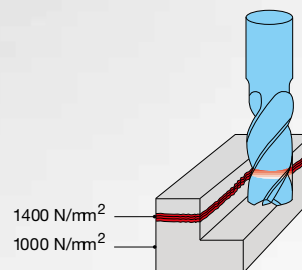
- peripheral cooling via GM 300 chuck
- increase volume flow
- adjust coolant flow
- reduce feed rate



### 7. Thermal influence on materials

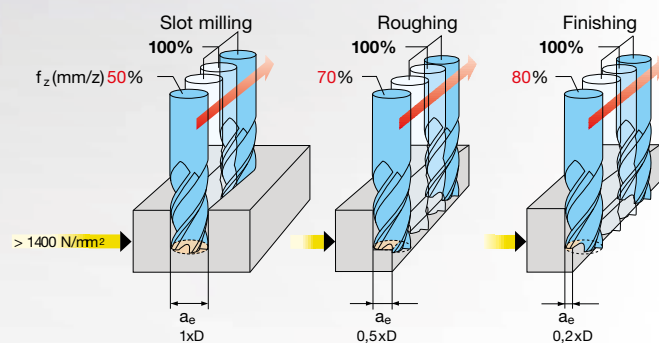
Through welding or torch cutting, the material characteristics at the parting line do not correspond with the specified material class

- reduce cutting rates
- select tool for materials with a higher tensile strength



### 8. Entry in hardened materials

For entering materials over  $1400 \text{ N/mm}^2$  (44HRC), reduce the feed rate  $v_f$  (mm/min) in accordance with the illustration on the right



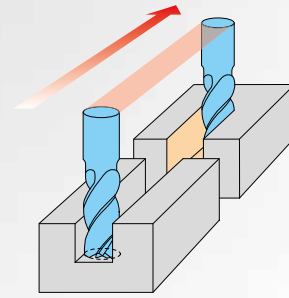


## Application/Troubleshooting

### 9. Loss in tool life with interrupted cutting

Significant loss in tool life through interrupted cutting (especially with milling angles of 90°)

- modify cutting distribution
- reduce feed rate for entry and exit
- reduce approach angle



### 10. Feed rate adjustment: Modifying the cutting width

- when modifying the cutting width  $a_e$ , the feed rate must be reduced in accordance with the illustration on the right
- cutting speed or revolutions remain unchanged
- double reduction applies when also modifying the cutting depth  $a_p$



$a_e = 1 \times D$   
 $f_z = 25 \%$



$a_e = 0,5 \times D$   
 $f_z = 50 \%$



$a_e = 0,25 \times D$   
 $f_z = 100 \%$

### 11. Feed rate adjustment: Modifying the cutting depth

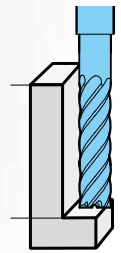
- when modifying the cutting depth  $a_p$ , the feed rate must be reduced in accordance with the illustration on the right
- cutting speed or revolutions remain unchanged up to cutting depths of  $3 \times D$ , must only be adapted over  $3 \times D$
- double reduction applies when also modifying the cutting width  $a_e$



$a_p = 1 \times D$   
 $f_z = 100 \%$



$a_p = 2 \times D$   
 $f_z = 50 \%$



$a_p = 3 \times D$   
 $f_z = 25 \%$

### 12. Plunging strategies

#### for drilling:

- reduced feed rate  $v_f$  (mm/min.)
  - additional pecking for drilling depths  $> 0.5 \times D$  or transition to radial machining
- Attention: Danger of breakage through abrupt load increase!

#### Oblique plunging up to 15° (preferred):

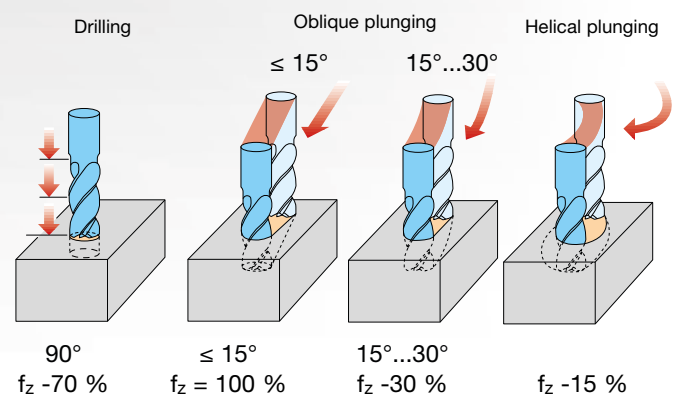
- reduction in feed rate  $v_f$  (mm/min.) not required

#### Oblique plunging between 15° and 30°:

- reduce feed rate  $v_f$  (mm/min.) in accordance with the illustration on the right

#### Helical plunging:

- for helical plunging on a milling cycle, we recommend a feed of 0.1 to 0.2 per cycle
- reduce feed rate  $v_f$  (mm/min.) in accordance with the illustration on the right
- select preferred hole diameter  $1.8 \times D$





## Application/Troubleshooting

### 13. HSC milling with ball nosed copy milling cutters

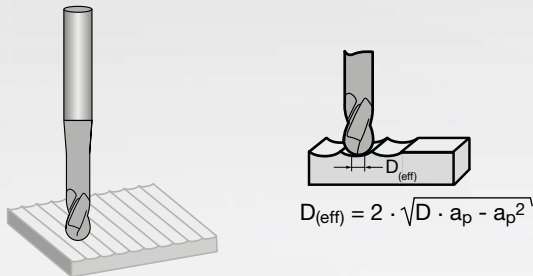
#### HSC = High Speed Cutting:

Milling operations with very low metal removal but with consideration of the effective tool diameter.

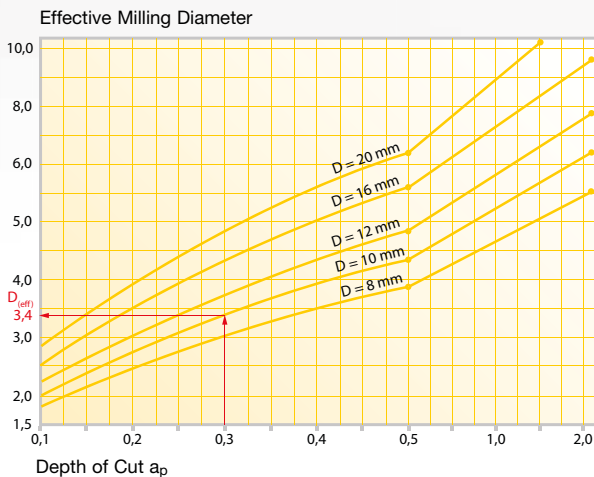
3D machining with ball or Torus milling.

- low cutting width ( $a_e$ )
- low cutting depth ( $a_p$ )
- high feed rate per tooth ( $f_z$ )
- very high cutting speed ( $V_C$ )

At cutting depths  $a_p < 0.2 \times D$  the actual engaged effective diameter  $D_{(eff)}$  must be used to calculate the speed. It is derived from the graphic below with the spindle not engaged. To increase the tool life, we recommend machining with a tilted spindle.



The ball-nosed milling cutter is perpendicular to the machining surface. In the centre of the tool is the cutting speed = 0 . Tool life and surface quality are not optimal.



Example: For a full copy milling radius  $\varnothing$  10 mm and a depth of cut  $a_p$  of 0.3 mm results in an effective diameter  $D_{(eff)} = 3.4$  mm. This  $D_{(eff)}$  shall be used to calculate the cutting speed  $V_C$ .

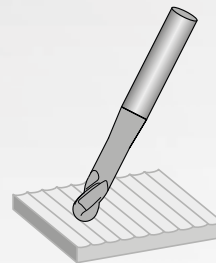
#### Function and Advantages

Calculation of the effective tool diameter

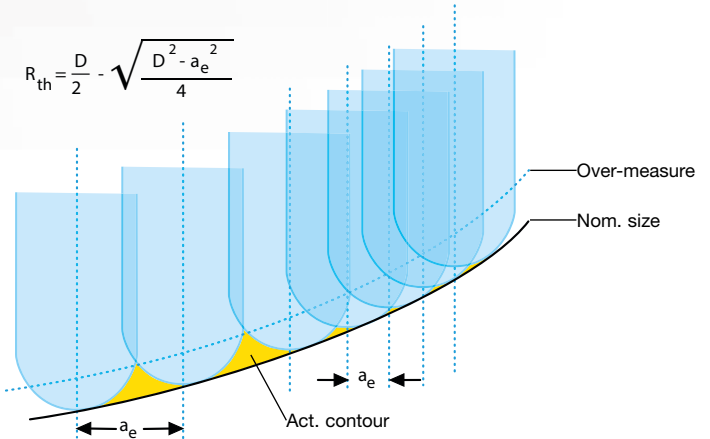
- adjusting speed to effective tool diameter
- increasing the overall feed rate
- improving the surface quality

Consideration of the pressure angle / width

- adjusting the tooth feed to achieve the required surface quality

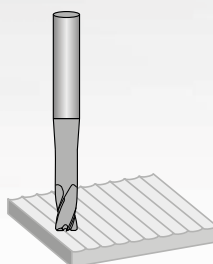


The ball-nosed milling cutter is oblique to the machining surface. The centre of the tool is not engaged. Tool life and surface quality are improved.



The reduction of the cutting width,  $a_e$ , leads to an improvement of the surface quality of the workpiece (reduced peak-to-valley height).

### 14. HSC milling with corner radius - copy milling cutters / Torus milling



#### HSC milling & Torus milling

3D-machining with Torus milling cutters. Engagement of the tool predominantly on the corner radius. Improves the surface quality and the tool life. Of advantage when 3D-machining flat contour areas on 3-axis machines.

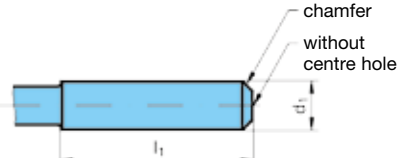


## Straight shanks

### Carbide straight shanks DIN 6535 for twist drills and end mills (extract)

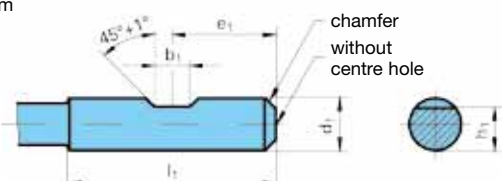
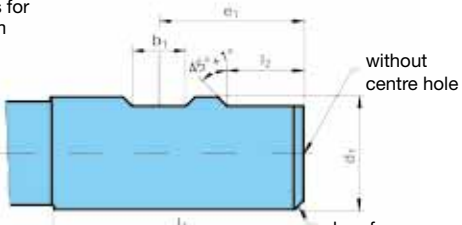
**Form HA, plain**

Dimensions in mm

	$d_1$	$l_1$	$d_1$	$l_1$	$d_1$	$l_1$
	h6	+2 0	h6	+2 0	h6	+2 0
	2	28	8	36	18	48
	3	28	10	40	20	50
	4	28	12	45	25	56
	5	28	14	45	32	60
	6	36	16	48		

**Form HB, with drive flat**

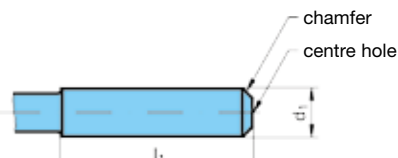
Dimension in mm

with one drive flat for $d_1 = 6$ and 20 mm 	$d_1$	$b_1$	$e_1$	$h_1$	$l_1$	$l_2$
	h6	+0,05 0	0 -1	h11	+2 0	+1 0
	6	4,2	18	5.1	36	-
	8	5,5	18	6.9	36	-
	10	7	20	8.5	40	-
	12	8	22.5	10.4	45	-
14	8	22.5	12.7	45	-	
16	10	24	14.2	48	-	
18	10	24	16.2	48	-	
20	11	25	18.2	50	-	
with two drive flats for $d_1 = 25$ and 32 mm 	25	12	32	23	56	17
	32	14	36	30	60	19

### High speed steel straight shanks, DIN 1835-1 (extract)

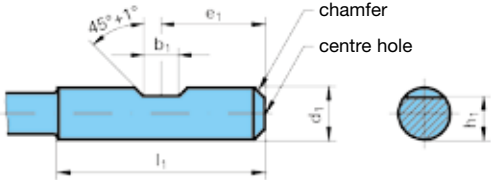
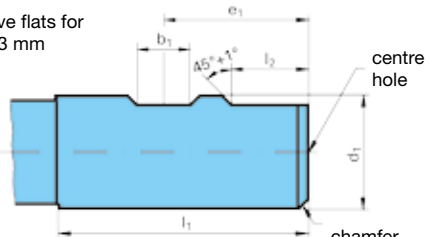
**Form A, plain**

Dimensions in mm

	$d_1$	$l_1$	$d_1$	$l_1$	$d_1$	$l_1$
	h8	+2 0	h8	+2 0	h8	+2 0
	3	28	10	40	32	60
	4	28	12	45	40	70
	5	28	16	48	50	60
	6	36	20	50	63	90
	8	36	25	56		

**Form B, with drive flat**

Dimensions in mm

with one drive flat for $d_1 = 6 \dots 20$ mm 	$d_1$	$b_1$	$e_1$	$h_1$	$l_1$	$l_2$	centre hole form R DIN 332 sect. 1
	h6	+0,05 0	0 -1	h13	+2 0	+1 0	
	6	4.2	18	4.8	36	-	1.6x2.5
	8	5.5	18	6.6	36	-	1.6x3.35
	10	7	20	8.4	40	-	1.6x3.35
	12	8	22.5	10.4	45	-	1.6x3.35
16	10	24	14.2	48	-	2.0x4.25	
20	11	25	18.2	50	-	2.5x5.3	
with two drive flats for $d_1 = 25 \dots 63$ mm 	25	12	32	23	56	17	2.5x5.3
	32	14	36	30	60	19	3.15x6.7
	40	14	40	38	70	19	3.15x6.7
	50	18	45	47.8	80	23	3.15x6.7
	63	18	50	60.8	90	23	3.15x6.7

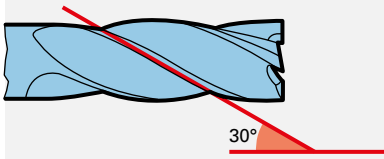


## Comparison of Hardness

Tens. strength (N/mm <sup>2</sup> )	HRC	HB30	HV10	Tens. strength (N/mm <sup>2</sup> )	HRC	HB30	HV10
240		71	75	1200	38	354	373
255		76	80	1230	39	363	382
270		81	85	1260	40	372	392
285		86	90	1300	41	383	403
305		90	95	1330	42	393	413
320		95	100	1360	43	402	423
335		100	105	1400	44	413	434
350		105	110	1440	45	424	446
370		109	115	1480	46	435	458
385		114	120	1530	47	449	473
400		119	125	1570	48	460	484
415		124	130	1620	49	472	497
430		128	135	1680	50	488	514
450		133	140	1730	51	501	527
465		138	145	1790	52	517	544
480		143	150	1845	53	532	560
495		147	155	1910	54	549	578
510		152	160	1980	55	567	596
530		157	165	2050	56	584	615
545		162	170	2140	57	607	639
560		166	175	2180	58	622	655
575		171	180		59		675
595		176	185		60		698
610		181	190		61		720
625		185	195		62		745
640		190	200		63		773
660		195	205		64		800
675		199	210		65		829
690		204	215		66		864
705		209	220		67		900
720		214	225		68		940
740		219	230				
755		223	235				
770		228	240				
785		233	245				
800	22	238	250				
820	23	242	255				
835	24	247	260				
860	25	255	268				
870	26	258	272				
900	27	266	280				
920	28	273	287				
940	29	278	293				
970	30	287	302				
995	31	295	310				
1020	32	301	317				
1050	33	311	327				
1080	34	319	336				
1110	35	328	345				
1140	36	337	355				
1170	37	346	364				

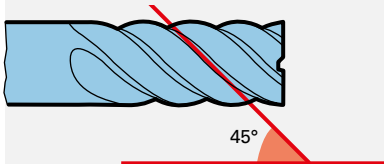


## Milling cutter types and their primary fields of application

**Type N**

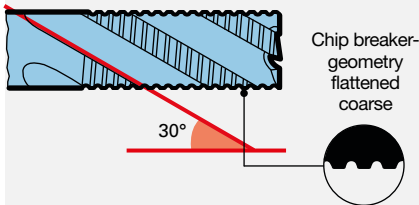
Quick spiral with 30° helical pitch, suitable for finish milling structural, case hardened and heat-treatable steels as well as short-chipping nonferrous metals and materials up to

- 1200 N/ mm<sup>2</sup> tensile strength applying high speed steel milling cutters
- 1600 N/ mm<sup>2</sup> tensile strength applying solid carbide milling cutters

**Type NH**

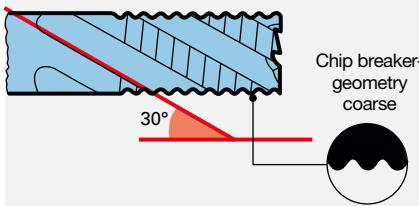
Quick spiral with high 45° helical pitch, suitable for super fine finishing high-alloyed materials and grey cast iron up to appr.

- 1600 N/ mm<sup>2</sup> tensile strength

**Type NF**

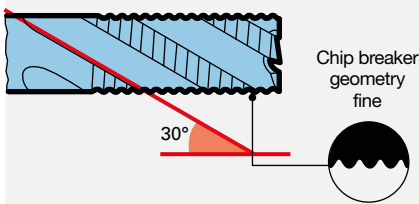
Flat knuckle-type teeth/quick spiral, produces short chips and improved smoother surface quality in comparison to type NR or NRf. Suitable for milling standard materials up to appr.

- 1200 N/ mm<sup>2</sup> tensile strength applying high speed steel milling cutters
- 1600 N/ mm<sup>2</sup> tensile strength applying solid carbide milling cutters

**Type NR**

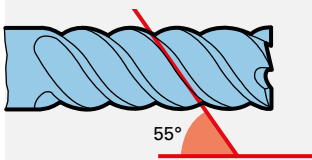
Standard knuckle-type teeth, produces short chips and good chip evacuation. Suitable for milling standard materials up to appr.

- 1000 N/ mm<sup>2</sup> tensile strength applying high speed steel milling cutters
- 1200 N/ mm<sup>2</sup> tensile strength applying solid carbide milling cutters

**Type NRf**

Fine knuckle-type teeth, produces short chips and good chip evacuation. Better feed rates possible than with type NR. Suitable for milling materials with a high tensile strength up to appr.

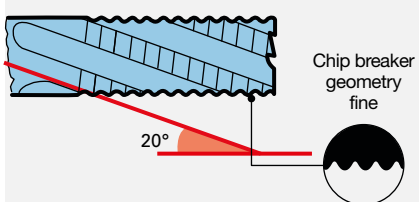
- 1400 N/ mm<sup>2</sup> tensile strength applying high speed steel milling cutters
- 1600 N/ mm<sup>2</sup> tensile strength applying solid carbide milling cutters

**Type H**

Quick spiral with high 55° helical pitch, suitable for super-fine finishing as well as HSC\* machining of all hardened materials and chilled cast iron up to appr.

- 62 HRC hardness

\*High Speed Cutting

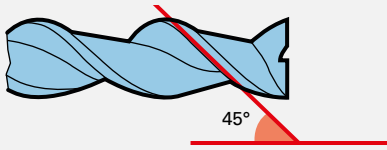
**Type HR**

Fine knuckle-type teeth, produces short chips with good chip evacuation. Suitable for milling hardened materials as well as grey and chilled cast iron with up to appr.

- 56 HRC hardness



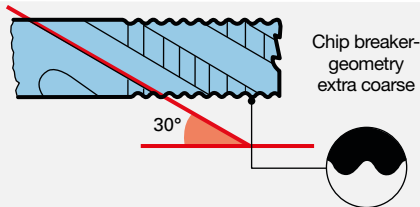
## Milling cutter types and their primary fields of application



### Type W

Quick spiral with 45° helical pitch, suitable for finish milling soft materials such as aluminium, Al-alloys and non-ferrous metals up to appr.

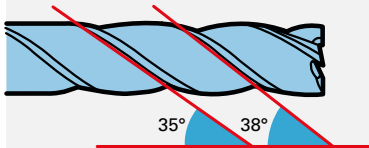
- 600 N/ mm<sup>2</sup> tensile strength



### Type WR

Coarse knuckle-type teeth, produces short chips with good chip evacuation. Suitable for milling aluminium, non-ferrous metals as well as soft steels up to appr.

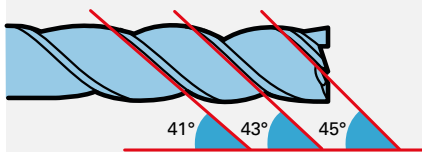
- 600 N/ mm<sup>2</sup> tensile strength.



### TF 100 U (Type N)

35°/38° helix. Suitable for slotting, roughing and finishing steel, high-alloyed steel and hardened steel up to

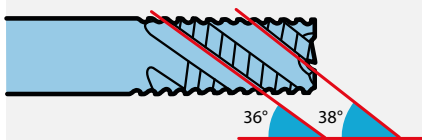
- 1600 N/ mm<sup>2</sup> tensile strength ( 48 HRC )



### TF 100 U (Type NH) 3-fluted

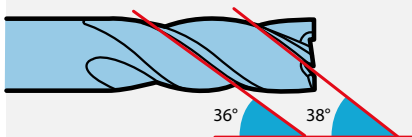
41°/43°/45° helix. Suitable for slotting, roughing and finishing steel, high-alloyed steel and stainless steel up to

- 1400 N/ mm<sup>2</sup> tensile strength ( 44 HRC )
- 3-fluted suitable for extreme cutting depths



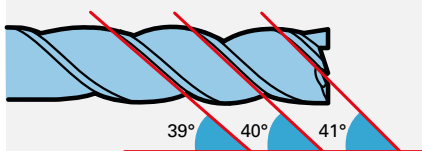
### HS 100 U (Type NF)

36°/38° helix and roughing and finishing geometry. Suitable for slotting and roughing VA steels and stainless materials



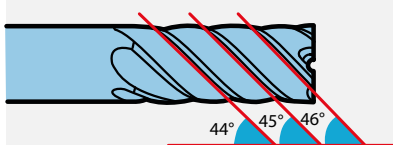
### TF 100 INOX (Type N)

36°/38° helix. Suitable for slotting, roughing and finishing VA steels and stainless materials



### TF 100 W (Type W)

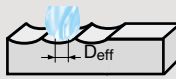
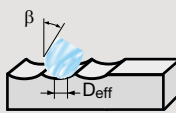
39°/40°/41° helix. Suitable for slotting, roughing and finishing aluminium and Al-alloys as well as long-chipping materials and non-ferrous metals



### TF 100 SF (Type NH)

44°/45°/46° helix. Suitable for HSC super fine finishing for semi-roughing with feed widths up to max. 0.3xD and HPC roughing over the entire cutting edge length for standard steels, cast iron, non-ferrous metals and high-alloyed materials

## Formula

Symbol	Description	metric	Formula
<b>z</b>	No. of teeth		
<b>D</b>	Milling cutter diameter	mm	
<b>a<sub>p</sub></b>	Depth of cut	mm	
<b>a<sub>e</sub></b>	Width of cut	mm	
<b>l<sub>f</sub></b>	Milling length	mm	
<b>n</b>	Revolution per min.	U/min	$n = \frac{v_c \cdot 1000}{\pi \cdot D}$
<b>v<sub>c</sub></b>	Cutting speed	m/min	$v_c = \frac{\pi \cdot D \cdot n}{1000}$
<b>v<sub>f</sub></b>	Feed per min.	mm	$v_f = n \cdot z \cdot f_z$
<b>f<sub>z</sub></b>	Feed per tooth	mm	$f_z = \frac{v_f}{n \cdot z}$
<b>f/U</b>	Feed per revolution	mm	$f/U = \frac{v_f}{n}$
<b>f/U</b>	Feed per revolution	mm	$f/U = f_z \cdot z$
<b>Q</b>	Chip volume	cm <sup>3</sup> /min	$Q = \frac{a_p \cdot a_e \cdot v_f}{1000}$
<b>T</b>	Milling time	min	$T = \frac{l_f}{v_f}$
<b>hm</b>	Average chip thickness	mm	$hm = f_z \cdot \sqrt{\frac{a_e}{D}}$
<b>D<sub>(eff)</sub></b>	Effective diameter	mm	$D_{(eff)} = 2 \cdot \sqrt{D \cdot a_p - a_p^2}$
	 <p>Effective diameter with approach angle</p>		
		mm	$D_{(eff)} = D \cdot \sin \left[ \beta + \arccos \left( \frac{D - 2a_p}{D} \right) \right]$
<b>R<sub>th</sub></b>	Peak-to-valley height	mm	$R_{th} = \frac{D}{2} = \sqrt{\frac{D^2 - a_e^2}{4}}$
<b>Z<sub>b</sub></b>	Optimal step over for torus milling	mm	$Z_b = \frac{D - 2 \times R}{2}$

## Our programme:



FU500/FN500



Gun Drills



INOX Drills



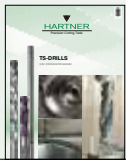
Multiplex



Micro Precision Drills



Multiplex HPC



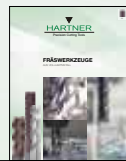
TS-Drills



TM Vending Machines



Threading Tools



Solid Carbide  
High Performance Milling Cutters



TF 100 Multi-Mill



Chamfering Milling Cutters

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