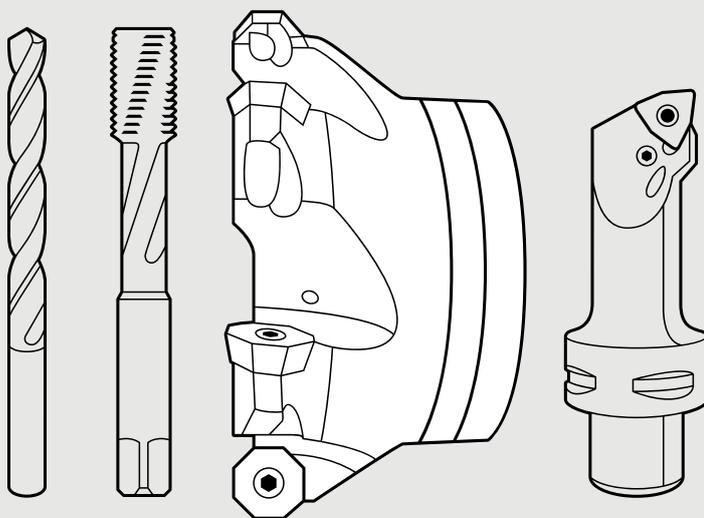


– METAL IS OUR WHOLE WORLD

# Technical Compendium

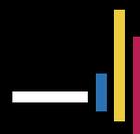
## Milling



# Tiger-tec<sup>®</sup>Gold



[tigertec-gold.walter](http://tigertec-gold.walter)

 **WALTER**  
Engineering Kompetenz

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# Technologies at Walter

## ((( Accure-tec®

The patented Walter Accure-tec® technology ensures maximum vibration damping on boring bars for turning and adaptors for milling. Ideal for turning, milling and drilling operations involving extended tool applications.

## Drion-tec™

Drion-tec™ is the name for Walter's drilling and reaming tool solutions with a replaceable cutting edge – both with indexable inserts and exchangeable inserts. Drion-tec™ drills are set apart by their cost-efficiency, high precision and versatility. Thanks to a wide product range, they are suitable for specialised mass production as well as for specific applications and mixed-mode manufacturing.

## Krato-tec™

Krato-tec™ is a unique Walter coating technology for solid carbide tools. The core of this consists of an extraordinarily fracture-resistant AlTiN multi-layer coating with a textured top layer. The special layer architecture is highly wear- and adhesion-resistant, even at high cutting speeds, and ensures the tools have universal application.

## Tiger-tec® Gold

Tiger-tec® Gold, the new Walter generation platform for unique indexable insert coatings, enables maximum tool life and process reliability. The new grades are based on PVD, CVD or ULP technology, depending on the application. Unique coating properties, protected by multiple patents, guarantee the best protection against tool life-limiting types of wear and ensure outstanding performance.

## Tiger-tec® Silver

With Tiger-tec® Silver, Walter is offering a world first in coating technology for indexable inserts. The special aluminium oxide layer with optimised microstructure reduces wear during turning, milling and drilling operations, and increases toughness and temperature resistance for significantly higher cutting data.

## Thrill-tec™

Thrill-tec™ circular drill/thread mills combine three functions in one tool and operation: Chamfering, drilling core holes and producing threads. The tools boast a special combination of substrate, coating and geometry, resulting in long tool life. Bringing together multiple machining steps makes incredibly short machining times possible and reduces the number of tools used and machine slots required.

## Walter BLAXX

Walter BLAXX is the benchmark for a new generation of milling cutters: The milling bodies are extremely robust thanks to their special surface treatment. The milling systems, which are mainly positioned tangentially, are equipped with Tiger-tec® indexable inserts. Tools with the "Walter BLAXX" designation combine high wear resistance with unbeatable performance data.

## Walter Green

Walter Green: Sustainability and responsible use of resources are central components of our company principles. We use our "Walter Green" seal to show how we implement these principles – such as by offsetting our CO<sub>2</sub> emissions with environmental conservation projects.

## Walter Xpress

Walter Xpress is the rapid ordering and delivery service offered by Walter Multiply for high-quality special tools. It is available for around 10,000 tool varieties, with a maximum delivery time of two to four weeks from the order date. The ordering process is clearly structured and guarantees absolute planning security. Quotations for all enquiries are calculated and provided within 24 hours.

## Technologies at Walter (continued)

### **Walter Precision XT**

Precision boring tools are always used to finish an existing bore or to improve the precision of existing bores, for instance by correcting their position, narrowing the hole tolerance, or enhancing the surface quality. Precision boring is typically performed using a depth of cut < 0.5 mm (0.02 inches).

### **Walter Boring XT**

Tools for rough boring are used to expand existing bores. Material removal is a key element of this process. The bore to be enlarged is machined in advance or created using casting or forging processes. The rough boring tools themselves can also be used for radial offsetting and multi-edge boring.

### **XD Technologie**

Walter Titex solid carbide drilling and reaming tools stand for precision, high performance and cost-efficiency when drilling in practically any material. Walter Titex XD Technology offers the greatest precision and cost-efficiency in deep-hole drilling operations up to  $70 \times D_c$  without pecking.

### **Xill-tec®**

With Xill-tec®, the solid carbide milling cutters from the MC230 Advance product range, Walter offers a uniquely wide range, with different dimensions, numbers of teeth and shank versions. This means that users are well-equipped for all conceivable milling operations and ISO materials. Universal use – with excellent quality.

### **Xtra-tec®**

Xtra-tec® indexable insert milling cutters and drills guarantee extremely soft cutting action and optimal surface quality on almost all materials. Indexable inserts with highly positive geometries and the Tiger-tec® coating have a particularly beneficial hardness/toughness ratio. For maximum productivity and process reliability.

### **Xtra-tec®XT**

Xtra-tec® XT is the latest generation of Walter milling tools. As the "Xtended" Xtra-tec® technology, it offers a completely new perspective on productivity and process reliability. It can cover nearly all milling operations in every common material group: More reliable, productive, cost-efficient than ever before – all while compensating for the CO<sub>2</sub> emissions through Walter Green.

### **X-treme Evo**

For Walter, the X-treme Evo DC260 & DC160 Advance solid carbide drills as well as the X-treme Evo Plus DC180 Supreme and X-treme Evo 3 DC183 Supreme are the embodiment of the "next generation of drilling", offering versatility for a wide range of materials and machine concepts – with outstanding tool life, productivity and process reliability.

## Technologies at Walter (continued)



Walter Capto™ is a modular tool adaptor system. It is suitable for all turning, milling, drilling and threading processes. Its ISO-standardised polygon taper absorbs torsional moments and bending moments extremely well and ensures optimal repeat accuracy.



Walter ConeFit is an extremely flexible solid carbide milling system with a wide range of high-performance exchangeable heads and shaft variants. Its conical thread can self-centre, thereby guaranteeing maximum stability and concentricity.



Walter ScrewFit users benefit from maximum flexibility. Its modular interface is suitable for a wide variety of boring bars and adaptors and a wide range of tool diameters and lengths for milling and drilling.



The precision-ground QuadFit interface with taper and support face characterises the precision of the vibration-damped boring bars for turning and thread turning with Walter Accure-tec® technology. The exchangeable head system, which can be rotated by 180°, makes it possible to rapidly replace tools with high indexing accuracy.



In turning and grooving operations, the Walter precision cooling system provides cooling at the centre of the chip formation. Its dual coolant jets are directed precisely onto the flank and rake faces. In drilling operations, the coolant jets exit close to the cutting edge. This system provides significantly increased tool life, improved chip breaking and chip removal, greater efficiency and higher quality.



“Flash” refers to specialised solid carbide milling cutters for high-feed milling. Their end-face geometry reduces the chip thickness “h” and therefore enables an extremely high feed per tooth. Forces that occur are diverted axially towards the centre of the tool, which helps to stabilise the machining process.



On Walter turning toolholders with “SmartLock”, the clamping screw can be operated from the side of the tool. This makes it possible to index the inserts in the machine quickly and easily. Tool change times are reduced as a result. Ideal for use on CNC lathe and multi-spindle machines.

## Walter tools for milling

The Walter and Walter Prototyp competence brands offer you the ideal solution for your workpiece and material requirements.

A wide range of milling tool types and geometries: From mini milling cutters with diameters of 0.3 mm made from solid carbide to cartridge-type face milling cutters with indexable inserts with diameters of up to 315 mm. In addition, the wide variety of available cutting tool materials, such as coated carbide, PCD, CBN or HSS, ensures a broad application range.

### 1 MD340 Supreme

- Solid carbide high-performance milling cutter specially developed for steel
- For roughing with maximum metal removal rates and for finishing

### 2 ConeFit

- Modular solid carbide milling system with maximum concentricity
- In a wide range of shank variants and geometries
- Diameter range: 10–25 mm

### 3 Xtra-tec® XT M5004 octagon face milling cutter

- For face milling, circular interpolation milling, ramping and pocketing
- Cost-effective eight-edge indexable insert and maximum number of teeth for high productivity

### 4 Xtra-tec® XT M5130 shoulder milling cutter

- Wide product selection: Four insert sizes, corner radii from 0.2 to 6.0 mm
- Additional geometries – adapted to suit the specific machining task

### 5 Walter BLAXX F5055 slitting cutter

- Extremely high retaining forces due to the optimised top clamp design
- System insert: Suitable for use in slitting cutters and groove turning holders

### 6 M4000 helical milling cutters M4256/M4257/M4258

- For shoulder milling and trimming in a wide variety of materials
- Diameter range: 20–100 mm; Cutting lengths: Up to 116 mm

### 7 Xill-tec® MC230 Advance

- The top choice for universal application in roughing and finishing
- Shoulder milling, full slotting, ramping and dynamic milling
- Universal, tough milling grade WK40TF with TiAlN coating



**8 Xtra-tec® XT M5009/M5011/M5012 face milling cutters**

- Eight-edge system inserts for a wide range of approach angles
- Maximum productivity for face milling due to highly positive geometries and stable, negative indexable inserts

**9 MC416 Advance**

- For all forms of five-axis machining as well as for machines with three axes and constant Z machining
- High-performance WJ30TF grade

**10 MD128 Supreme & MC128 Advance**

- Universal application for semi-finishing and finishing
- Secondary application: Dynamic milling
- Finishing of additively manufactured components
- Optimum chip removal and minimal burr formation due to 50° helix angle

**11 Xtra-tec® XT M5468 button insert milling cutter**

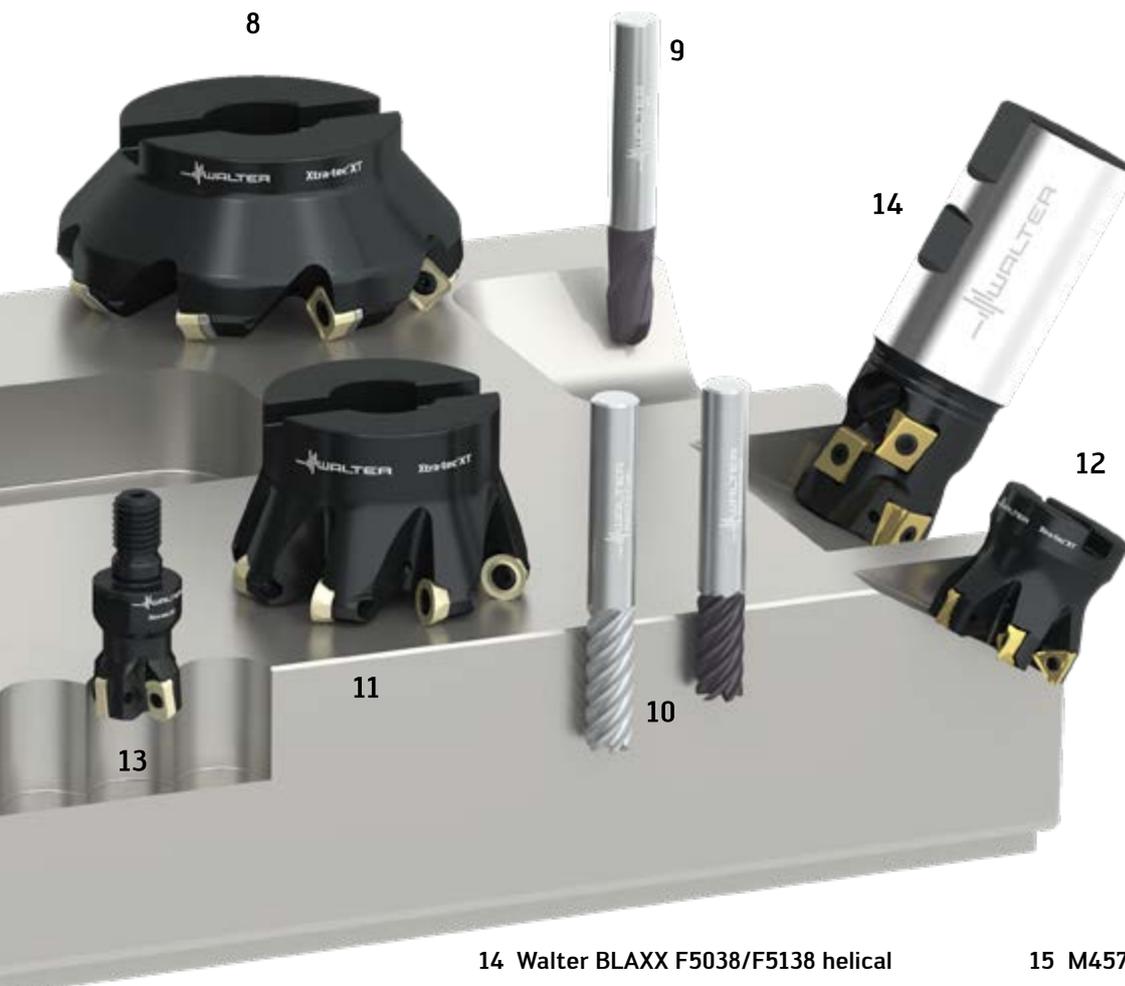
- Maximum security against inadvertent rotation due to detent indexing of the indexable insert
- With up to eight cutting edges
- High flexibility due to seven insert sizes and maximum productivity due to high cutting data and long tool life

**12 Xtra-tec® XT M5137 shoulder milling cutter**

- Reduced process costs and high cost-efficiency in face and shoulder milling, ramping, pocket milling and circular interpolation milling due to six cutting edges per insert and exact 90° corners at the shoulder

**13 Xtra-tec® XT M5008 high-feed milling cutter**

- High cost-efficiency due to double-sided, rhombic indexable inserts with four cutting edges
- Stable cutting edge combined with easy-cutting geometries



**14 Walter BLAXX F5038/F5138 helical milling cutters**

- Unique indexable insert design with four cutting edges per insert and exact 90° corners at the shoulder
- System insert from the Walter BLAXX shoulder milling cutter range

**15 M4574 chamfer milling cutter**

- High degree of cost-efficiency due to system inserts which can be used universally
- For chamfering and back chamfering

## Milling calculation formulae

### Speed

$$n = \frac{v_c \times 1000}{D_c \times \pi} \quad [\text{min}^{-1}]$$

### Cutting speed

$$v_c = \frac{D_c \times \pi \times n}{1000} \quad [\text{m/min}]$$

### Feed rate

$$v_f = f_z \times z \times n \quad [\text{mm/min}]$$

### Feed per tooth

$$f_z = \frac{v_f}{z \times n} \quad [\text{mm/z}]$$

### Metal removal rate

$$Q = \frac{a_e \times a_p \times v_f}{1000} \quad [\text{cm}^3/\text{min}]$$

### Power requirement

$$P_{\text{mot}} = \frac{Q \times k_c}{60\,000 \times \eta} \quad [\text{kW}]$$

### Average chip thickness

$$h_m = \frac{\left( 114,7 \times f_z \times \sin \kappa \times \left( \frac{a_e}{D_c} \right) \right)}{\varphi_s} \quad [\text{mm}]$$

$$f_z = \frac{h_m \times \varphi_s}{114,7 \times \sin \kappa \times \left( \frac{a_e}{D_c} \right)} \quad [\text{mm}]$$

or  $h_m \cong f_z \times \sqrt{\frac{a_e}{D_c}} \quad [\text{mm}]$

$$f_z = \frac{h_m}{\sqrt{\frac{a_e}{D_c}}} \quad [\text{mm}]$$

as approximation formula for  $\frac{a_e}{D_c} < 30^\circ$

### Engagement angle

where milling cutter is positioned centrally

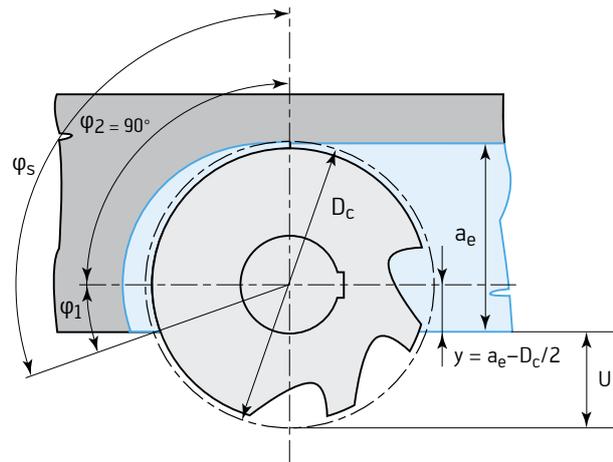
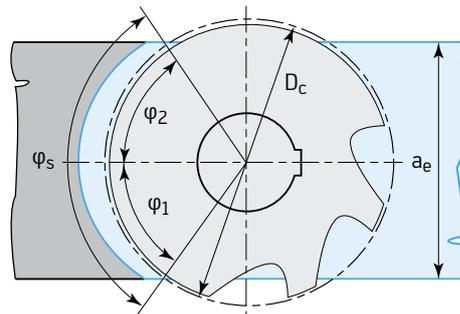
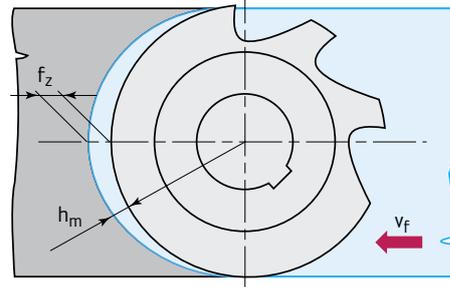
$$\varphi_s = 2 \times \arcsin \left( \frac{a_e}{D_c} \right) \quad [^\circ]$$

where milling cutter is positioned eccentrically

$$\varphi_s = 90^\circ + \arcsin \frac{a_e - \left( \frac{D_c}{2} \right)}{\left( \frac{D_c}{2} \right)} \quad [^\circ]$$

### Specific cutting force

$$k_c = \frac{1 - 0,01 \times y_0}{h_m^{m_c}} \times k_{c1.1} \quad [\text{N/mm}^2]$$



n	Speed	rpm
D <sub>c</sub>	Cutting diameter	mm
a <sub>p</sub>	Depth of cut	mm
a <sub>e</sub>	Cutting width	mm
U	Projection	mm
z	Number of teeth	
v <sub>c</sub>	Cutting speed	m/min
v <sub>f</sub>	Feed rate	mm/min
f <sub>z</sub>	Feed per tooth	mm
Q	Metal removal rate	cm <sup>3</sup> /min
P <sub>mot</sub>	Power requirement	kW
h <sub>m</sub>	Average chip thickness	mm
η	Machine efficiency (0.7–0.95)	
κ	Lead angle	°
φ <sub>s</sub>	Engagement angle	°
φ <sub>1</sub>	Conventional milling range	°
φ <sub>2</sub>	Climb milling range	°
k <sub>c</sub>	Specific cutting force	N/mm <sup>2</sup>
k <sub>c1.1</sub> *	Specific cutting force for 1 mm <sup>2</sup> chip cross section	N/mm <sup>2</sup>
m <sub>c</sub> *	Increase in the k <sub>c</sub> curve	
y	Conventional milling engagement	mm

\* For m<sub>c</sub> and k<sub>c1.1</sub>, see the "General" section of the Technical Compendium, page F7.

## Engagement ratio for external circular interpolation

### External contour

$$v_{fa} = \left( 1 + \frac{D_a}{D_w + D_a} \right) \times v_f \quad [\text{mm/min}]$$

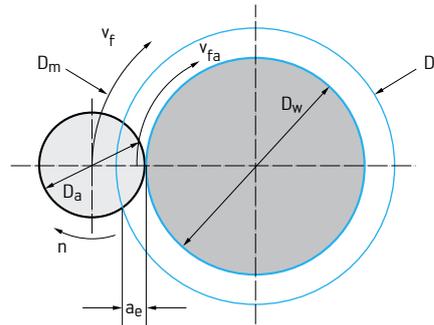
### Circular interpolation traverse time

$$T_{rev} = \frac{D_m \times \pi}{n \times f_z \times z} \quad [\text{min}]$$

$$T_{rev} = \frac{(D_w + D_a) D_a \times \pi^2 \times 60}{v_c \times f_z \times z \times 1000} \quad [\text{s}]$$

### Engagement width for external circular interpolation

$$a_e = \frac{(D_v^2 - D_w^2)}{4(D_w + D_a)} \quad [\text{mm}]$$



### External contour

$v_f$	Feed rate	[mm/min]
$v_{fa}$	Tool axis feed rate	[mm/min]
$D_a$	Milling cutter outer diameter	[mm]
$D_m$	Mid-point path diameter	[mm]
$D_v$	Workpiece raw diameter	[mm]
$D_w$	Workpiece finished diameter	[mm]
$a_e$	Material removal	[mm]
$n$	Speed	[rpm]
$f_z$	Feed per tooth	[mm]
$z$	Number of teeth	[mm]
$T_{rev}$	Circular interpolation traverse time	[s]

## Engagement ratio for internal circular interpolation of bores

### Internal contour

$$v_{fi} = \left( 1 - \frac{D_c}{D_w} \right) \times v_f \quad [\text{mm/min}]$$

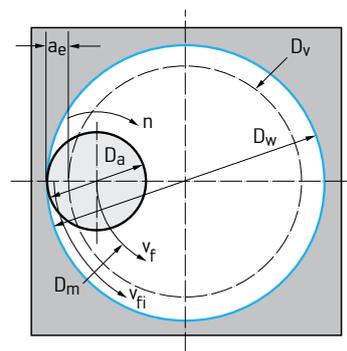
### Circular interpolation traverse time

$$T_{rev} = \frac{D_m \times \pi}{n \times f_z \times z} \quad [\text{min}]$$

$$T_{rev} = \frac{(D_w - D_a) D_a \times \pi^2 \times 60}{v_c \times f_z \times z \times 1000} \quad [\text{s}]$$

### Engagement width for circular interpolation

$$a_e = \frac{(D_w^2 - D_v^2)}{4(D_w - D_a)} \quad [\text{mm}]$$



### Internal contour

$v_f$	Feed rate	[mm/min]
$v_{fi}$	Tool axis feed rate	[mm/min]
$D_a$	Milling cutter outer diameter	[mm]
$D_m$	Mid-point path diameter	[mm]
$D_v$	Workpiece raw diameter	[mm]
$D_w$	Workpiece finished diameter	[mm]
$a_e$	Material removal	[mm]
$n$	Speed	[rpm]
$f_z$	Feed per tooth	[mm]
$z$	Number of teeth	[mm]
$T_{rev}$	Circular interpolation traverse time	[s]

## Cutting data for high-feed milling cutters

				Product family		λ					
				MD025 Supreme MD025 ConeFit		50°					
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1	Ø 6–25 mm / 1/4–1 Inch				
							Z = 5–6				
							WJ30RD				
							Starting values for cutting speed v <sub>c</sub> [m/min]				
							a <sub>e</sub> / D <sub>c</sub>				
							1	1/4	1/10	VT <sup>2</sup>	
<b>P</b>	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1			142	D	
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2			224	D	
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3			224	D	
		C > 0,55 %	Annealed	190	640	P4			191	D	
		C > 0,55 %	Heat-treated	300	1010	P5			135	D	
		Free-machining steel (short-chipping)	Annealed	220	750	P6			191	D	
	Low-alloy steel			Annealed	175	590	P7			191	D
				Heat-treated	285	960	P8			135	D
				Heat-treated	380	1280	P9			111	D
				Heat-treated	430	1480	P10			94	D
	High-alloy steel and high-alloy tool steel			Annealed	200	680	P11			191	D
				Hardened and tempered	300	1010	P12			135	D
				Hardened and tempered	380	1280	P13			111	D
	Stainless steel			Ferritic/martensitic, annealed	200	680	P14			68	D
				Martensitic, heat-treated	330	1110	P15			46	D
<b>M</b>	Stainless steel			Austenitic, quench hardened	200	680	M1				
				Austenitic, precipitation hardened (PH)	300	1010	M2				
				Austenitic/ferritic, duplex	230	780	M3				
<b>K</b>	Malleable cast iron			Ferritic	200	400	K1			165	D
				Pearlitic	260	700	K2			129	D
	Grey cast iron			Low strength	180	200	K3			165	D
				High strength/austenitic	245	350	K4			139	D
	Cast iron with spheroidal graphite			Ferritic	155	400	K5			165	D
				Pearlitic	265	700	K6			129	D
CGI				230	400	K7			110	D	
<b>N</b>	Wrought aluminium alloys			Not hardenable	30	–	N1				
				Hardenable, hardened	100	340	N2				
	Cast aluminium alloys			≤ 12% Si, not hardenable	75	260	N3				
				≤ 12% Si, hardenable, hardened	90	310	N4				
				> 12% Si, not hardenable	130	450	N5				
	Magnesium-based alloys				70	250	N6				
Copper and copper alloys (bronze/brass)			Non-alloyed, electrolytic copper	100	340	N7					
			Brass, bronze, red brass	90	310	N8					
			Copper alloys, short-chipping	110	380	N9					
			High tensile, Ampco	300	1010	N10					
<b>S</b>	Heat-resistant alloys	Fe-based	Annealed	200	680	S1					
			Hardened	280	940	S2					
		Ni- or Co-based	Annealed	250	840	S3					
			Hardened	350	1180	S4					
			Cast	320	1080	S5					
	Titanium alloys			Pure titanium	200	680	S6				
				α and β alloys, hardened	375	1260	S7				
				β alloys	410	1400	S8				
Tungsten alloys				300	1010	S9					
Molybdenum alloys				300	1010	S10					
<b>H</b>	Hardened steel			Hardened and tempered	50 HRC	–	H1				
				Hardened and tempered	55 HRC	–	H2				
				Hardened and tempered	60 HRC	–	H3				
	Hardened cast iron			Hardened and tempered	55 HRC	–	H4				
<b>O</b>	Thermoplastics			Without abrasive fillers			O1				
	Thermosetting plastics			Without abrasive fillers			O2				
	Plastic, glass-fibre reinforced			GFRP			O3				
	Plastic, carbon-fibre reinforced			CFRP			O4				
	Plastic, aramid-fibre reinforced			AFRP			O5				
	Graphite (technical)				80 Shore		O6				

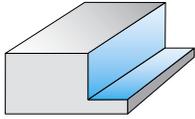
<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> The corresponding feed rates can be found from page D40 onwards.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.



## Cutting data for solid carbide shoulder milling cutters



				Product family		λ					
				MC129		60°					
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Ø 6–20 mm				
							Z = 6				
							WJ30TF				
							Starting values for cutting speed v <sub>c</sub> [m/min]				
							a <sub>e</sub> / D <sub>c</sub>				
							1/2	1/4	1/10	VT	
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1		191	232	A	
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2		261	317	A	
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3		222	270	A	
		C > 0,55 %	Annealed	190	640	P4		222	270	A	
		C > 0,55 %	Heat-treated	300	1010	P5		157	191	A	
		Free-machining steel (short-chipping)	Annealed	220	750	P6		222	270	A	
	Low-alloy steel	Annealed			175	590	P7		222	270	A
		Heat-treated			285	960	P8		138	168	A
		Heat-treated			380	1280	P9		129	157	A
		Heat-treated			430	1480	P10		109	133	A
High-alloy steel and high-alloy tool steel	Annealed			200	680	P11		222	270	A	
	Hardened and tempered			300	1010	P12		157	191	A	
	Hardened and tempered			380	1280	P13		129	157	A	
Stainless steel	Ferritic/martensitic, annealed			200	680	P14		95	116	A	
	Martensitic, heat-treated			330	1110	P15		63	76	A	
M	Stainless steel	Austenitic, quench hardened		200	680	M1		113	137	B	
		Austenitic, precipitation hardened (PH)		300	1010	M2		56	68	B	
		Austenitic/ferritic, duplex		230	780	M3		76	92	B	
K	Malleable cast iron	Ferritic		200	400	K1		219	266	A	
		Pearlitic		260	700	K2		171	207	A	
	Grey cast iron	Low strength		180	200	K3		219	266	A	
		High strength/austenitic		245	350	K4		184	223	A	
	Cast iron with spheroidal graphite	Ferritic		155	400	K5		219	266	A	
Pearlitic		265	700	K6		171	207	A			
	CGI			230	400	K7		146	178	A	
N	Wrought aluminium alloys	Not hardenable		30	–	N1					
		Hardenable, hardened		100	340	N2					
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3					
		≤ 12% Si, hardenable, hardened		90	310	N4					
		> 12% Si, not hardenable		130	450	N5					
	Magnesium-based alloys				70	250	N6				
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper			100	340	N7				
Brass, bronze, red brass			90	310	N8						
Copper alloys, short-chipping			110	380	N9						
High tensile, Ampco			300	1010	N10						
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1		62	75	B	
			Hardened	280	940	S2		37	45	B	
		Ni- or Co-based	Annealed	250	840	S3		62	75	B	
			Hardened	350	1180	S4		37	45	B	
			Cast	320	1080	S5		37	45	B	
	Titanium alloys	Pure titanium			200	680	S6		66	80	B
		α and β alloys, hardened			375	1260	S7		65	79	B
		β alloys			410	1400	S8		34	42	B
Tungsten alloys				300	1010	S9		86	104	B	
Molybdenum alloys				300	1010	S10		86	104	B	
H	Hardened steel	Hardened and tempered		50 HRC	–	H1					
		Hardened and tempered		55 HRC	–	H2					
		Hardened and tempered		60 HRC	–	H3					
	Hardened cast iron		Hardened and tempered		55 HRC	–	H4				
O	Thermoplastics		Without abrasive fillers								
	Thermosetting plastics		Without abrasive fillers								
	Plastic, glass-fibre reinforced		GFRP								
	Plastic, carbon-fibre reinforced		CFRP								
	Plastic, aramid-fibre reinforced		AFRP								
	Graphite (technical)				80 Shore						

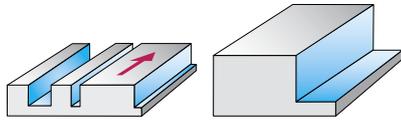
<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.  
<sup>\*</sup> Tool engagement angle

The specified cutting data are average standard values. For specific applications, adjustment is recommended.



# Cutting data for solid carbide shoulder milling cutters

(continued)



		Product family		λ		MC111 Advance		MC112 Advance				
Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Ø 2–25 mm						
						Z = 4						
						WJ30TF						
						Starting values for cutting speed v <sub>c</sub> [m/min]						
				a <sub>e</sub> / D <sub>c</sub>								
						1/2	1/4	1/10	VT			
<b>P</b>	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	428	P1	174	204	248	A		
		C > 0,25... ≤ 0,55 %	Annealed	190	639	P2	237	279	339	A		
		C > 0,25... ≤ 0,55 %	Heat-treated	210	708	P3	202	238	289	A		
		C > 0,55 %	Annealed	190	639	P4	202	238	289	A		
		C > 0,55 %	Heat-treated	300	1013	P5	143	168	204	A		
		Free-machining steel (short-chipping)	Annealed	220	745	P6	202	238	289	A		
	Low-alloy steel	Annealed	175	591	P7	202	238	289	A			
		Heat-treated	300	1013	P8	125	148	179	A			
		Heat-treated	380	1282	P9	118	139	168	A			
		Heat-treated	430	1477	P10	100	117	142	A			
High-alloy steel and high-alloy tool steel	Annealed	200	675	P11	202	238	289	A				
	Hardened and tempered	300	1013	P12	143	168	204	A				
	Hardened and tempered	400	1361	P13	118	139	168	A				
Stainless steel	Ferritic/martensitic, annealed	200	675	P14	87	102	124	A				
	Martensitic, heat-treated	330	1114	P15	57	67	82	A				
<b>M</b>	Stainless steel	Austenitic, quench hardened	200	675	M1	103	121	147	B			
		Austenitic, precipitation hardened (PH)	300	1013	M2	51	60	72	B			
		Austenitic/ferritic, duplex	230	778	M3	69	81	99	B			
<b>K</b>	Malleable cast iron	Ferritic	200	675	K1	199	234	285	A			
		Pearlitic	260	867	K2	155	183	222	A			
	Grey cast iron	Low strength	180	602	K3	199	234	285	A			
		High strength/austenitic	245	825	K4	167	197	239	A			
	Cast iron with spheroidal graphite	Ferritic	155	518	K5	199	234	285	A			
		Pearlitic	265	885	K6	155	183	222	A			
CGI		200	675	K7	133	157	190	A				
<b>N</b>	Wrought aluminium alloys	Not hardenable	30	–	N1	1930	1720	1120	C			
		Hardenable, hardened	100	343	N2	1840	1720	1120	C			
	Cast aluminium alloys	≤ 12% Si, not hardenable	75	260	N3	771	907	1100	C			
		≤ 12% Si, hardenable, hardened	90	314	N4	771	907	1100	C			
		> 12% Si, not hardenable	130	447	N5	257	302	367	C			
	Magnesium-based alloys		70	250	N6				C			
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper	100	343	N7	555	652	793	C			
Brass, bronze, red brass		90	314	N8	555	652	793	C				
Copper alloys, short-chipping		110	382	N9	555	652	793	C				
High tensile, Ampco		300	1013	N10	74	87	106	C				
<b>S</b>	Heat-resistant alloys	Fe-based	Annealed	200	675	S1	56	66	80	B		
			Hardened	280	943	S2	34	40	49	B		
		Ni- or Co-based	Annealed	250	839	S3	56	66	80	B		
			Hardened	350	1177	S4	34	40	49	B		
			Cast	320	1076	S5	34	40	49	B		
	Titanium alloys	Pure titanium	200	675	S6	60	70	85	B			
		α and β alloys, hardened	375	1262	S7	59	70	85	B			
		β alloys	410	1396	S8	31	37	45	B			
	Tungsten alloys		300	1013	S9	78	92	112	B			
	Molybdenum alloys		300	1013	S10	78	92	112	B			
<b>H</b>	Hardened steel	Hardened and tempered	50 HRC	–	H1							
		Hardened and tempered	55 HRC	–	H2							
		Hardened and tempered	60 HRC	–	H3							
	Hardened cast iron	Hardened and tempered	55 HRC	–	H4							
<b>O</b>	Thermoplastics	Without abrasive fillers			O1							
	Thermosetting plastics	Without abrasive fillers			O2							
	Plastic, glass-fibre reinforced	GFRP			O3							
	Plastic, carbon-fibre reinforced	CFRP			O4							
	Plastic, aramid-fibre reinforced	AFRP			O5							
	Graphite (technical)		80 Shore			O6						

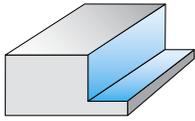
<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.  
 \* Tool engagement angle

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

Product family	λ			Product family	λ			Product family	λ		
H4044918	30°			MD133 Supreme	35°			MD133 Supreme	35°		
Ø 0,4–25 mm				Ø 6–20 mm / 1/4–3/4 Inch				Ø 6–20 mm / 1/4–3/4 Inch			
Z = 2–6				Z = 5–6				Z = 5–6			
TAX/uncoated				WJ30RD				WJ30RD			
Starting values for cutting speed $v_c$ [m/min]				Starting values for cutting speed $v_c$ [m/min]				Starting values for cutting speed $v_c$ [m/min]			
$a_e / D_c$			VT	$L_c = 3 \times D_c$		$f_z L_c = 3 \times D_c$ [mm] per tooth	$L_c = 5 \times D_c$		$f_z L_c = 5 \times D_c$ [mm] per tooth		
1/2	1/4	1/10		PHIS* [°]	VC		PHIS* [°]	VC			
161	189	230	A	40	225	0.10	25	205	0.09		
220	259	314	A	40	355	0.10	20	340	0.09		
188	221	269	A	40	355	0.10	20	345	0.09		
188	221	269	A	40	300	0.10	20	305	0.11		
133	156	190	A	40	215	0.09	20	220	0.11		
188	221	269	A	40	300	0.10	20	305	0.11		
188	221	269	A	40	300	0.10	20	295	0.90		
117	137	167	A	35	220	0.10	15	230	0.12		
110	129	157	A	40	180	0.08	15	190	0.12		
93	109	133	A	35	160	0.12	15	160	0.11		
188	221	269	A	35	310	0.09	15	325	0.11		
133	156	190	A	30	240	0.11	15	265	0.16		
110	129	157	A	30	195	0.10	15	210	0.15		
80	95	115	A								
53	62	76	A								
112	131	160	B								
55	65	79	B								
75	88	107	B								
				40	260	0.11	20	255	0.10		
				35	210	0.10	15	225	0.13		
				40	260	0.11	25	245	0.09		
				35	225	0.10	15	235	0.13		
				40	260	0.11	25	230	0.08		
				30	220	0.11	15	230	0.14		
				40	175	0.10	15	180	0.11		
503	503	503	C								
503	503	503	C								
502	503	503	C								
502	503	503	C								
240	282	343	C								
402	428	466	C								
402	428	466	C								
402	428	466	C								
62	73	88	C								

## Cutting data for solid carbide shoulder milling cutters

(continued)



				Product family		λ						
				MD133 Supreme		35°						
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Starting values for cutting speed v <sub>c</sub> (m/min)					
							Ø 6–20 mm / 1/4–3/4 Inch		Z = 5–6		WJ30RA	
							PHIS* [°]	VC	f <sub>z</sub> (mm) per tooth	PHIS* [°]	VC	f <sub>z</sub> (mm) per tooth
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1						
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2						
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3						
		C > 0,55 %	Annealed	190	640	P4						
		C > 0,55 %	Heat-treated	300	1010	P5						
		Free-machining steel (short-chipping)	Annealed	220	750	P6						
	Low-alloy steel	Annealed		175	590	P7						
		Heat-treated		285	960	P8						
		Heat-treated		380	1280	P9						
		Heat-treated		430	1480	P10						
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11						
		Hardened and tempered		300	1010	P12						
		Hardened and tempered		380	1280	P13						
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	20	135	0.21	13	130	0.18
		Martensitic, heat-treated		330	1110	P15	15	105	0.25	9	100	0.22
M	Stainless steel	Austenitic, quench hardened		200	680	M1	25	165	0.14	16	160	0.1
		Austenitic, precipitation hardened (PH)		300	1010	M2	15	95	0.20	11	105	0.15
		Austenitic/ferritic, duplex		230	780	M3	25	110	0.14	16	120	0.1
K	Malleable cast iron	Ferritic		200	400	K1						
		Pearlitic		260	700	K2						
	Grey cast iron	Low strength		180	200	K3						
		High strength/austenitic		245	350	K4						
	Cast iron with spheroidal graphite	Ferritic		155	400	K5						
		Pearlitic		265	700	K6						
	CGI		230	400	K7							
N	Wrought aluminium alloys	Not hardenable		30	–	N1	20	500	0.50	25	770	0.2
		Hardenable, hardened		100	340	N2	30	695	0.36	30	770	0.19
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	40	775	0.32	30	770	0.19
		≤ 12% Si, hardenable, hardened		90	310	N4	40	775	0.32	30	770	0.19
		> 12% Si, not hardenable		130	450	N5	40	295	0.32	30	770	0.19
	Magnesium-based alloys		70	250	N6							
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	20	465	0.54	15	680	0.29
Brass, bronze, red brass			90	310	N8	25	650	0.39	15	670	0.38	
Copper alloys, short-chipping			110	380	N9	40	630	0.33	30	540	0.19	
High tensile, Ampco			300	1010	N10	20	125	0.47	20	100	0.25	
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	20	85	0.18	10	70	0.13
			Hardened	280	940	S2	15	50	0.19	10	50	0.15
		Ni- or Co-based	Annealed	250	840	S3	15	85	0.19	10	80	0.13
			Hardened	350	1180	S4	15	55	0.19	10	50	0.17
			Cast	320	1080	S5	15	50	0.12	10	50	0.16
	Titanium alloys	Pure titanium		200	680	S6	35	70	0.12	25	60	0.06
		α and β alloys, hardened		375	1260	S7	35	70	0.12	20	70	0.07
		β alloys		410	1400	S8	30	40	0.14	20	35	0.07
	Tungsten alloys		300	1010	S9							
	Molybdenum alloys		300	1010	S10							
H	Hardened steel	Hardened and tempered		50 HRC	–	H1						
		Hardened and tempered		55 HRC	–	H2						
		Hardened and tempered		60 HRC	–	H3						
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4						
O	Thermoplastics	Without abrasive fillers				O1						
	Thermosetting plastics	Without abrasive fillers				O2						
	Plastic, glass-fibre reinforced	GFRP				O3						
	Plastic, carbon-fibre reinforced	CFRP				O4						
	Plastic, aramid-fibre reinforced	AFRP				O5						
	Graphite (technical)		80 Shore			O6						

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> The corresponding feed rates can be found from page D40 onwards.

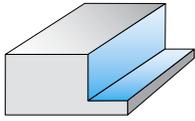
\* Tool engagement angle

The specified cutting data are average standard values. For specific applications, adjustment is recommended.



# Cutting data for solid carbide shoulder milling cutters

(continued)



				Product family		λ				
				MD177 Supreme		38°				
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Ø 6–25 mm / 3/16–1" Inch			
							Starting values for cutting speed v <sub>c</sub> [m/min]			
							Z = 7			
							WJ30EN			
							L <sub>c</sub> = 1,2–3 × D <sub>c</sub>		f <sub>z</sub> L <sub>c</sub> = 1,2–3 × D <sub>c</sub>	
							PHIS* [°]		[mm] per tooth	
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	428	P1	40	225	0,10	
		C > 0,25... ≤ 0,55 %	Annealed	190	639	P2	40	355	0,10	
		C > 0,25... ≤ 0,55 %	Heat-treated	210	708	P3	40	355	0,10	
		C > 0,55 %	Annealed	190	639	P4	40	300	0,10	
		C > 0,55 %	Heat-treated	300	1013	P5	40	215	0,09	
		Free-machining steel (short-chipping)	Annealed	220	745	P6	40	300	0,10	
	Low-alloy steel	Annealed		175	591	P7	40	300	0,10	
		Heat-treated		300	1013	P8	35	220	0,10	
		Heat-treated		380	1282	P9	40	180	0,08	
		Heat-treated		430	1477	P10	35	160	0,12	
High-alloy steel and high-alloy tool steel	Annealed		200	675	P11	35	310	0,09		
	Hardened and tempered		300	1013	P12	30	240	0,11		
	Hardened and tempered		400	1361	P13	30	195	0,10		
Stainless steel	Ferritic/martensitic, annealed		200	675	P14	20	135	0,21		
	Martensitic, heat-treated		330	1114	P15	15	105	0,25		
M	Stainless steel	Austenitic, quench hardened		200	675	M1	25	165	0,14	
		Austenitic, precipitation hardened (PH)		300	1013	M2	15	95	0,20	
		Austenitic/ferritic, duplex		230	778	M3	25	110	0,14	
K	Malleable cast iron	Ferritic		200	675	K1				
		Pearlitic		260	867	K2				
	Grey cast iron	Low strength		180	602	K3				
		High strength/austenitic		245	825	K4				
	Cast iron with spheroidal graphite	Ferritic		155	518	K5				
Pearlitic			265	885	K6					
CGI			200	675	K7					
N	Wrought aluminium alloys	Not hardenable		30	–	N1				
		Hardenable, hardened		100	343	N2				
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3				
		≤ 12% Si, hardenable, hardened		90	314	N4				
		> 12% Si, not hardenable		130	447	N5				
	Magnesium-based alloys			70	250	N6				
		Non-alloyed, electrolytic copper		100	343	N7				
Copper and copper alloys (bronze/brass)	Brass, bronze, red brass		90	314	N8					
	Copper alloys, short-chipping		110	382	N9					
	High tensile, Ampco		300	1013	N10					
S	Heat-resistant alloys	Fe-based	Annealed	200	675	S1	20	85	0,18	
			Hardened	280	943	S2	15	50	0,19	
		Ni- or Co-based	Annealed	250	839	S3	15	85	0,19	
			Hardened	350	1177	S4	15	55	0,19	
			Cast	320	1076	S5	15	50	0,12	
	Titanium alloys	Pure titanium		200	675	S6	35	70	0,12	
		α and β alloys, hardened		375	1262	S7	35	70	0,12	
		β alloys		410	1396	S8	30	40	0,14	
	Tungsten alloys			300	1013	S9				
	Molybdenum alloys			300	1013	S10				
H	Hardened steel	Hardened and tempered		50 HRC	–	H1				
		Hardened and tempered		55 HRC	–	H2				
		Hardened and tempered		60 HRC	–	H3				
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4				
O	Thermoplastics	Without abrasive fillers							01	
	Thermosetting plastics	Without abrasive fillers							02	
	Plastic, glass-fibre reinforced	GFRP							03	
	Plastic, carbon-fibre reinforced	CFRP							04	
	Plastic, aramid-fibre reinforced	AFRP							05	
	Graphite (technical)			80 Shore					06	

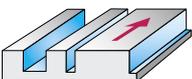
<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

\* Tool engagement angle

The specified cutting data are average standard values. For specific applications, adjustment is recommended.



## Cutting data for solid carbide shoulder milling cutters/slot milling cutters



		Product family		λ		MC321 Advance MC322 Advance MC324 Advance		H3E29148		45°	
Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1	Ø 1–25 mm					
						Z = 3–5					
						WJ30TF / TAX					
						Starting values for cutting speed v <sub>c</sub> [m/min]					
				a <sub>e</sub> / D <sub>c</sub>		1/1	1/2	1/10	VT		
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	140	174	248	A	
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2	191	237	339	A	
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3	163	202	289	A	
		C > 0,55 %	Annealed	190	640	P4	163	202	289	A	
		C > 0,55 %	Heat-treated	300	1010	P5	115	143	204	A	
		Free-machining steel (short-chipping)	Annealed	220	750	P6	163	202	289	A	
	Low-alloy steel	Annealed		175	590	P7	163	202	289	A	
		Heat-treated		285	960	P8	101	125	179	A	
		Heat-treated		380	1280	P9	95	118	168	A	
		Heat-treated		430	1480	P10	80	100	142	A	
High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	163	202	289	A		
	Hardened and tempered		300	1010	P12	115	143	204	A		
	Hardened and tempered		380	1280	P13	95	118	168	A		
Stainless steel	Ferritic/martensitic, annealed		200	680	P14	70	87	124	A		
	Martensitic, heat-treated		330	1110	P15	46	57	82	A		
M	Stainless steel	Austenitic, quench hardened		200	680	M1	83	103	147	B	
		Austenitic, precipitation hardened (PH)		300	1010	M2	41	51	72	B	
		Austenitic/ferritic, duplex		230	780	M3	56	69	99	B	
K	Malleable cast iron	Ferritic		200	400	K1	160	199	285	A	
		Pearlitic		260	700	K2	125	155	222	A	
	Grey cast iron	Low strength		180	200	K3	160	199	285	A	
		High strength/austenitic		245	350	K4	135	167	239	A	
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	160	199	285	A	
		Pearlitic		265	700	K6	125	155	222	A	
CGI			230	400	K7	107	133	190	A		
N	Wrought aluminium alloys	Not hardenable		30	–	N1					
		Hardenable, hardened		100	340	N2					
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3					
		≤ 12% Si, hardenable, hardened		90	310	N4					
		> 12% Si, not hardenable		130	450	N5					
	Magnesium-based alloys				70	250	N6				
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7					
Brass, bronze, red brass		90	310	N8							
Copper alloys, short-chipping		110	380	N9							
High tensile, Ampco		300	1010	N10							
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	45	56	80	B	
			Hardened	280	940	S2	27	34	49	B	
		Ni- or Co-based	Annealed	250	840	S3	45	56	80	B	
			Hardened	350	1180	S4	27	34	49	B	
			Cast	320	1080	S5	27	34	49	B	
	Titanium alloys	Pure titanium		200	680	S6	48	60	85	B	
		α and β alloys, hardened		375	1260	S7	48	59	85	B	
		β alloys		410	1400	S8	25	31	45	B	
Tungsten alloys			300	1010	S9	63	78	112	B		
Molybdenum alloys			300	1010	S10	63	78	112	B		
H	Hardened steel	Hardened and tempered		50 HRC	–	H1					
		Hardened and tempered		55 HRC	–	H2					
		Hardened and tempered		60 HRC	–	H3					
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4					
O	Thermoplastics	Without abrasive fillers				O1					
	Thermosetting plastics	Without abrasive fillers				O2					
	Plastic, glass-fibre reinforced	GFRP				O3					
	Plastic, carbon-fibre reinforced	CFRP				O4					
	Plastic, aramid-fibre reinforced	AFRP				O5					
	Graphite (technical)			80 Shore		O6					

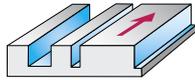
<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

Product family	λ			Product family	λ			Product family	λ			Product family	λ		
H1E2018	10°			MC716 Advance	30°			MC326 Supreme MC326 ConeFit	50°			MC319 Advance MC320 Advance MC320 ConeFit	40°		
MC213 Advance	30°														
MC216 Advance															
Ø 0,6–20 mm				Ø 1,8–20 mm				Ø 2–25 mm / 1/4–1 Inch				Ø 4–25 mm / 1/4–3/4 Inch			
Z = 2–4				Z = 2–3				Z = 4–5				Z = 3–8			
WJ30TF / TAX				WJ30TF				WK40TF				WK40TF			
Starting values for cutting speed v <sub>c</sub> [m/min]				Starting values for cutting speed v <sub>c</sub> [m/min]				Starting values for cutting speed v <sub>c</sub> [m/min]				Starting values for cutting speed v <sub>c</sub> [m/min]			
a <sub>e</sub> / D <sub>c</sub>			VT	a <sub>e</sub> / D <sub>c</sub>			VT	a <sub>e</sub> / D <sub>c</sub>			VT <sup>2</sup>	a <sub>e</sub> / D <sub>c</sub>			VT <sup>2</sup>
1/1	1/2	1/10		1/1	1/2	1/10		1/1	1/2	1/10		1/1	1/2	1/10	
123	180	219	A	145	180	257	A	150	185	264	A	123	153	218	A
175	247	300	A	198	246	352	A	206	253	363	A	169	210	300	A
149	210	256	A	169	210	300	A	175	216	310	A	144	179	256	A
149	210	256	A	169	210	300	A	175	216	310	A	144	179	256	A
105	149	181	A	119	148	212	A	124	153	219	A	102	127	181	A
149	210	256	A	169	210	300	A	175	216	310	A	144	179	256	A
149	210	256	A	169	210	300	A	175	216	310	A	144	179	256	A
92	130	158	A	105	130	186	A	109	135	192	A	90	111	159	A
87	122	149	A	98	122	175	A	102	127	181	A	84	105	150	A
73	103	126	A	83	103	147	A	87	107	153	A	71	88	126	A
149	210	256	A	169	210	300	A	175	216	310	A	144	179	256	A
107	149	181	A	119	148	212	A	124	153	219	A	102	127	181	A
89	122	149	A	98	122	175	A	102	127	181	A	84	105	150	A
64	90	110	A	73	90	129	A	60	74	106	A	49	61	88	A
43	59	72	A	48	59	85	A	49	61	87	A	41	50	72	A
76	107	130	B	86	106	152	B	71	87	125	B	58	73	104	B
38	53	64	B	42	53	75	B	44	55	78	B	37	46	65	B
51	72	87	B	58	72	102	B	61	75	107	B	50	62	88	B
142	207	252	A	166	207	295	A	164	203	290	A	135	168	240	A
114	161	196	A	130	161	230	A	129	159	226	A	106	131	188	A
142	207	252	A	166	207	295	A	164	203	290	A	135	168	240	A
123	174	211	A	139	173	248	A	138	170	243	A	113	141	201	A
142	207	252	A	166	207	295	A	164	203	290	A	135	168	240	A
114	161	196	A	130	161	230	A	129	159	226	A	106	131	188	A
98	138	168	A	111	138	197	A	110	136	194	A	91	112	161	A
												522	649	927	C
												522	649	927	C
												376	467	667	C
												376	467	667	C
												51	63	90	C
41	58	71	B	47	58	83	B	46	57	81	B				
25	35	43	B	28	35	50	B	29	35	50	B				
41	58	71	B	47	58	83	B	46	57	81	B				
26	35	43	B	28	35	50	B	29	35	50	B				
26	35	43	B	28	35	50	B	29	35	50	B				
43	62	76	B	50	62	89	B	49	61	87	B				
42	61	75	B	49	61	88	B	49	61	87	B				
23	32	39	B	26	32	46	B	26	32	46	B				
58	81	99	B	65	81	116	B	65	80	114	B				
58	81	99	B	65	81	116	B	65	80	114	B				

# Cutting data for solid carbide shoulder milling cutters/slot milling cutters

(continued)



						Product family		λ			
						MC232 Perform		35°			
Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1	Ø 2–20 mm / 1/8–3/4 Inch			
								Z = 2–4			
								WJ30ED			
								Starting values for cutting speed v <sub>c</sub> (m/min)			
								a <sub>e</sub> / D <sub>c</sub>			
								1/1	1/2	1/10	VT <sup>2</sup>
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	428	P1	89	111	158	A	
		C > 0,25... ≤ 0,55 %	Annealed	190	639	P2	122	151	216	A	
		C > 0,25... ≤ 0,55 %	Heat-treated	210	708	P3	104	130	185	A	
		C > 0,55 %	Annealed	190	639	P4	104	130	185	A	
		C > 0,55 %	Heat-treated	300	1013	P5	74	92	131	A	
		Free-machining steel (short-chipping)	Annealed	220	745	P6	104	130	185	A	
	Low-alloy steel	Annealed		175	591	P7	104	130	185	A	
		Heat-treated		300	1013	P8	65	81	115	A	
		Heat-treated		380	1282	P9	61	76	108	A	
		Heat-treated		430	1477	P10	52	64	92	A	
	High-alloy steel and high-alloy tool steel	Annealed		200	675	P11	104	130	185	A	
		Hardened and tempered		300	1013	P12	77	92	131	A	
		Hardened and tempered		400	1361	P13	63	76	108	A	
Stainless steel	Ferritic/martensitic, annealed		200	675	P14	44	55	79	A		
	Martensitic, heat-treated		330	1114	P15	31		52	A		
M	Stainless steel	Austenitic, quench hardened		200	675	M1	62	77	110	B	
		Austenitic, precipitation hardened (PH)		300	1013	M2	32	40	55	B	
		Austenitic/ferritic, duplex		230	778	M3	42	52	75	B	
K	Malleable cast iron	Ferritic		200	675	K1	120	149	213	A	
		Pearlitic		260	867	K2	94	117	167	A	
	Grey cast iron	Low strength		180	602	K3	120	149	213	A	
		High strength/austenitic		245	825	K4	101	125	179	A	
	Cast iron with spheroidal graphite	Ferritic		155	518	K5	120	149	213	A	
		Pearlitic		265	885	K6	94	117	167	A	
	CGI			200	675	K7	80	100	142	A	
N	Wrought aluminium alloys	Not hardenable		30	–	N1					
		Hardenable, hardened		100	343	N2					
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3					
		≤ 12% Si, hardenable, hardened		90	314	N4					
		> 12% Si, not hardenable		130	447	N5					
	Magnesium-based alloys			70	250	N6					
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	343	N7					
Brass, bronze, red brass		90	314	N8							
Copper alloys, short-chipping		110	382	N9							
	High tensile, Ampco		300	1013	N10						
S	Heat-resistant alloys	Fe-based	Annealed	200	675	S1					
			Hardened	280	943	S2					
		Ni- or Co-based	Annealed	250	839	S3					
			Hardened	350	1177	S4					
			Cast	320	1076	S5					
	Titanium alloys	Pure titanium		200	675	S6					
		α and β alloys, hardened		375	1262	S7					
		β alloys		410	1396	S8					
Tungsten alloys			300	1013	S9						
Molybdenum alloys			300	1013	S10						
H	Hardened steel	Hardened and tempered		50 HRC	–	H1					
		Hardened and tempered		55 HRC	–	H2					
		Hardened and tempered		60 HRC	–	H3					
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4					
O	Thermoplastics	Without abrasive fillers				O1					
	Thermosetting plastics	Without abrasive fillers				O2					
	Plastic, glass-fibre reinforced	GFRP				O3					
	Plastic, carbon-fibre reinforced	CFRP				O4					
	Plastic, aramid-fibre reinforced	AFRP				O5					
	Graphite (technical)			80 Shore		O6					

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

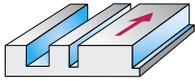
<sup>2</sup> The corresponding feed rates can be found from page D40 onwards.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.



# Cutting data for solid carbide shoulder milling cutters/slot milling cutters

(continued)



Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Product family		λ	
							H602551		45°	
							H6E2211			
							H6E2511			
							Ø 1–25 mm			
							Z = 2–3			
							CRN/uncoated			
							Starting values for cutting speed v <sub>c</sub> [m/min]			
							a <sub>e</sub> / D <sub>c</sub>			
							1/1	1/2	1/10	VT
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1				
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2				
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3				
		C > 0,55 %	Annealed	190	640	P4				
		C > 0,55 %	Heat-treated	300	1010	P5				
		Free-machining steel (short-chipping)	Annealed	220	750	P6				
	Low-alloy steel	Annealed		175	590	P7				
		Heat-treated		285	960	P8				
		Heat-treated		380	1280	P9				
		Heat-treated		430	1480	P10				
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11				
		Hardened and tempered		300	1010	P12				
		Hardened and tempered		380	1280	P13				
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14				
		Martensitic, heat-treated		330	1110	P15				
M	Stainless steel	Austenitic, quench hardened		200	680	M1				
		Austenitic, precipitation hardened (PH)		300	1010	M2				
		Austenitic/ferritic, duplex		230	780	M3				
K	Malleable cast iron	Ferritic		200	400	K1				
		Pearlitic		260	700	K2				
	Grey cast iron	Low strength		180	200	K3				
		High strength/austenitic		245	350	K4				
	Cast iron with spheroidal graphite	Ferritic		155	400	K5				
		Pearlitic		265	700	K6				
	CGI			230	400	K7				
N	Wrought aluminium alloys	Not hardenable		30	–	N1	1410	1720	2240	C
		Hardenable, hardened		100	340	N2	1410	1720	2240	C
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	353	429	627	C
		≤ 12% Si, hardenable, hardened		90	310	N4	353	429	627	C
		> 12% Si, not hardenable		130	450	N5	141	172	251	C
	Magnesium-based alloys			70	250	N6				
				100	340	N7				
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7				
		Brass, bronze, red brass		90	310	N8				
		Copper alloys, short-chipping		110	380	N9				
High tensile, Ampco			300	1010	N10					
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1				
			Hardened	280	940	S2				
		Ni- or Co-based	Annealed	250	840	S3				
			Hardened	350	1180	S4				
			Cast	320	1080	S5				
	Titanium alloys	Pure titanium		200	680	S6				
		α and β alloys, hardened		375	1260	S7				
		β alloys		410	1400	S8				
	Tungsten alloys		300	1010	S9					
	Molybdenum alloys		300	1010	S10					
H	Hardened steel	Hardened and tempered		50 HRC	–	H1				
		Hardened and tempered		55 HRC	–	H2				
		Hardened and tempered		60 HRC	–	H3				
Hardened cast iron	Hardened and tempered		55 HRC	–	H4					
O	Thermoplastics	Without abrasive fillers				O1				
	Thermosetting plastics	Without abrasive fillers				O2				
	Plastic, glass-fibre reinforced	GFRP				O3				
	Plastic, carbon-fibre reinforced	CFRP				O4				
	Plastic, aramid-fibre reinforced	AFRP				O5				
	Graphite (technical)		80 Shore			O6				

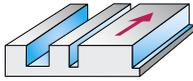
<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

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# Cutting data for solid carbide shoulder milling cutters/slot milling cutters

(continued)



		Product family		λ						
		MD377 Supreme		40°						
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Starting values for cutting speed v <sub>c</sub> [m/min]			
							a <sub>e</sub> / D <sub>c</sub>			VT
							Ø 6–25 mm			
							Z = 5			
							WK40TZ			
							1/1	1/2	1/10	VT
<b>P</b>	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1				
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2				
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3				
		C > 0,55 %	Annealed	190	640	P4				
		C > 0,55 %	Heat-treated	300	1010	P5				
		Free-machining steel (short-chipping)	Annealed	220	750	P6				
	Low-alloy steel	Annealed		175	590	P7				
		Heat-treated		285	960	P8				
		Heat-treated		380	1280	P9				
		Heat-treated		430	1480	P10				
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11				
		Hardened and tempered		300	1010	P12				
		Hardened and tempered		380	1280	P13				
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14				
		Martensitic, heat-treated		330	1110	P15				
<b>M</b>	Stainless steel	Austenitic, quench hardened		200	680	M1	87	112	160	B
		Austenitic, precipitation hardened (PH)		300	1010	M2	54	69	99	B
		Austenitic/ferritic, duplex		230	780	M3	73	94	135	B
<b>K</b>	Malleable cast iron	Ferritic		200	400	K1				
		Pearlitic		260	700	K2				
	Grey cast iron	Low strength		180	200	K3				
		High strength/austenitic		245	350	K4				
	Cast iron with spheroidal graphite	Ferritic		155	400	K5				
		Pearlitic		265	700	K6				
	CGI			230	400	K7				
<b>N</b>	Wrought aluminium alloys	Not hardenable		30	–	N1				
		Hardenable, hardened		100	340	N2				
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3				
		≤ 12% Si, hardenable, hardened		90	310	N4				
		> 12% Si, not hardenable		130	450	N5				
	Magnesium-based alloys			70	250	N6				
				100	340	N7				
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7				
		Brass, bronze, red brass		90	310	N8				
		Copper alloys, short-chipping		110	380	N9				
High tensile, Ampco			300	1010	N10					
<b>S</b>	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	54	67	96	B
			Hardened	280	940	S2	32	41	59	B
		Ni- or Co-based	Annealed	250	840	S3	54	67	96	B
			Hardened	350	1180	S4	32	41	59	B
			Cast	320	1080	S5	32	41	59	B
	Titanium alloys	Pure titanium		200	680	S6				
		α and β alloys, hardened		375	1260	S7	65	95	130	B
		β alloys		410	1400	S8	45	55	80	B
	Tungsten alloys			300	1010	S9				
	Molybdenum alloys			300	1010	S10				
<b>H</b>	Hardened steel	Hardened and tempered		50 HRC	–	H1				
		Hardened and tempered		55 HRC	–	H2				
		Hardened and tempered		60 HRC	–	H3				
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4				
<b>O</b>	Thermoplastics	Without abrasive fillers				O1				
	Thermosetting plastics	Without abrasive fillers				O2				
	Plastic, glass-fibre reinforced	GFRP				O3				
	Plastic, carbon-fibre reinforced	CFRP				O4				
	Plastic, aramid-fibre reinforced	AFRP				O5				
	Graphite (technical)			80 Shore			O6			

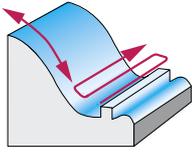
<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> The corresponding feed rates can be found from page D40 onwards.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.



## Cutting data for solid carbide circle segment milling cutters



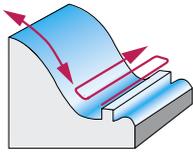
		Product family		λ		MD838 Supreme		MD838 ConeFit			
Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Ø 6–16 mm		Z = 4–8		WJ30RD	
						Starting values for cutting speed v <sub>c</sub> [m/min]		a <sub>e</sub> / D <sub>c</sub>		VT	
						1/5	1/20	1/50			
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	428	P1	230	330	390	A	
		C > 0,25... ≤ 0,55 %	Annealed	190	639	P2	230	310	380	A	
		C > 0,25... ≤ 0,55 %	Heat-treated	210	708	P3	210	280	310	A	
		C > 0,55 %	Annealed	190	639	P4	210	280	310	A	
		C > 0,55 %	Heat-treated	300	1013	P5	170	200	220	A	
		Free-machining steel (short-chipping)	Annealed	220	745	P6	210	280	330	A	
	Low-alloy steel	Annealed		175	591	P7	210	280	330	A	
		Heat-treated		300	1013	P8	170	200	240	A	
		Heat-treated		380	1282	P9	140	170	200	A	
		Heat-treated		430	1477	P10	120	150	170	A	
	High-alloy steel and high-alloy tool steel	Annealed		200	675	P11	210	280	330	A	
		Hardened and tempered		300	1013	P12	170	200	240	A	
		Hardened and tempered		400	1361	P13	120	150	170	A	
Stainless steel	Ferritic/martensitic, annealed		200	675	P14	90	110	120	A		
	Martensitic, heat-treated		330	1114	P15	70	80	100	A		
M	Stainless steel	Austenitic, quench hardened		200	675	M1					
		Austenitic, precipitation hardened (PH)		300	1013	M2					
		Austenitic/ferritic, duplex		230	778	M3					
K	Malleable cast iron	Ferritic		200	675	K1	180	240	290	A	
		Pearlitic		260	867	K2	150	190	220	A	
	Grey cast iron	Low strength		180	602	K3	180	240	290	A	
		High strength/austenitic		245	825	K4	150	200	240	A	
	Cast iron with spheroidal graphite	Ferritic		155	518	K5	180	240	290	A	
Pearlitic			265	885	K6	150	190	220	A		
CGI			200	675	K7	130	160	190	A		
N	Wrought aluminium alloys	Not hardenable		30	–	N1					
		Hardenable, hardened		100	343	N2					
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3					
		≤ 12% Si, hardenable, hardened		90	314	N4					
		> 12% Si, not hardenable		130	447	N5					
	Magnesium-based alloys			70	250	N6					
				100	343	N7					
Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		90	314	N8						
	Brass, bronze, red brass		110	382	N9						
	Copper alloys, short-chipping		300	1013	N10						
S	Heat-resistant alloys	Fe-based	Annealed		200	675	S1				
			Hardened		280	943	S2				
		Ni- or Co-based	Annealed		250	839	S3				
			Hardened		350	1177	S4				
			Cast		320	1076	S5				
	Titanium alloys	Pure titanium		200	675	S6					
		α and β alloys, hardened		375	1262	S7					
		β alloys		410	1396	S8					
	Tungsten alloys			300	1013	S9					
	Molybdenum alloys			300	1013	S10					
H	Hardened steel	Hardened and tempered		50 HRC	–	H1					
		Hardened and tempered		55 HRC	–	H2					
		Hardened and tempered		60 HRC	–	H3					
	Hardened cast iron			55 HRC	–	H4					
O	Thermoplastics	Without abrasive fillers				O1					
	Thermosetting plastics	Without abrasive fillers				O2					
	Plastic, glass-fibre reinforced	GFRP				O3					
	Plastic, carbon-fibre reinforced	CFRP				O4					
	Plastic, aramid-fibre reinforced	AFRP				O5					
	Graphite (technical)			80 Shore			O6				

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

Product family					$\lambda$	Product family					$\lambda$	Product family					$\lambda$
MD838 Supreme MD838 ConeFit					30°	MD839 Supreme					30°	MD839 Supreme					30°
Ø 6–16 mm						Ø 6–16 mm						Ø 6–16 mm					
Z = 4–8						Z = 4						Z = 4					
WJ30RA						WJ30RD						WJ30RA					
Starting values for cutting speed $v_c$ [m/min]				VT	Starting values for cutting speed $v_c$ [m/min]				VT	Starting values for cutting speed $v_c$ [m/min]				VT			
$a_e / D_c$					$a_e / D_c$					$a_e / D_c$							
1/5	1/20	1/50			1/5	1/20	1/50			1/1	1/2	1/10					
					230	330	390	A									
					230	310	380	A									
					210	280	310	A									
					210	280	310	A									
					170	200	220	A									
					210	280	330	A									
					210	280	330	A									
					170	200	240	A									
					140	170	200	A									
					120	150	170	A									
					210	280	330	A									
					170	200	240	A									
					120	150	170	A									
					90	110	120	A									
					70	80	100	A									
	110	150	190	B						110	150	190	B				
	70	90	130	B						70	90	130	B				
	100	140	180	B						100	140	180	B				
					180	240	290	A									
					150	190	220	A									
					180	240	290	A									
					150	200	240	A									
					180	240	290	A									
					150	190	220	A									
					130	160	190	A									
	1000	1200	1500	C						1000	1200	1500	C				
	1000	1200	1500	C						1000	1200	1500	C				
	690	920	1100	C						690	920	1100	C				
	690	920	1100	C						690	920	1100	C				
	240	320	390	C						240	320	390	C				
	800	1060	1280	C						800	1060	1280	C				
	500	650	800	C						500	650	800	C				
	500	650	800	C						500	650	800	C				
	500	650	800	C						500	650	800	C				
	80	90	110	C						80	90	110	C				
	80	110	130	B						80	110	130	B				
	60	70	90	B						60	70	90	B				
	80	90	110	B						80	90	110	B				
	60	80	110	B						60	80	110	B				
	60	80	110	B						60	80	110	B				
	80	110	130	B						80	110	130	B				
	60	100	130	B						60	100	130	B				
	60	110	130	B						60	110	130	B				

## Cutting data for solid carbide ball nose end mills



		Product family		$\lambda$						
		H1E0111		10°						
		H602111		30°						
Material group	Overview of the main material groups and code letters					Ø 2–16 mm				
						Z = 2				
						Uncoated				
						Starting values for cutting speed $v_c$ [m/min]				
						$a_e / D_c$				
						1/5	1/20	1/50	VT	
<b>P</b>	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1				
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2				
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3				
		C > 0,55 %	Annealed	190	640	P4				
		C > 0,55 %	Heat-treated	300	1010	P5				
		Free-machining steel (short-chipping)	Annealed	220	750	P6				
	Low-alloy steel	Annealed		175	590	P7				
		Heat-treated		285	960	P8				
		Heat-treated		380	1280	P9				
		Heat-treated		430	1480	P10				
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11				
		Hardened and tempered		300	1010	P12				
		Hardened and tempered		380	1280	P13				
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14				
		Martensitic, heat-treated		330	1110	P15				
<b>M</b>	Stainless steel	Austenitic, quench hardened		200	680	M1				
		Austenitic, precipitation hardened (PH)		300	1010	M2				
		Austenitic/ferritic, duplex		230	780	M3				
<b>K</b>	Malleable cast iron	Ferritic		200	400	K1				
		Pearlitic		260	700	K2				
	Grey cast iron	Low strength		180	200	K3				
		High strength/austenitic		245	350	K4				
	Cast iron with spheroidal graphite	Ferritic		155	400	K5				
		Pearlitic		265	700	K6				
	CGI			230	400	K7				
<b>N</b>	Wrought aluminium alloys	Not hardenable		30	–	N1	1770	1790	1790	C
		Hardenable, hardened		100	340	N2	1790	1790	1790	C
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	440	590	710	C
		≤ 12% Si, hardenable, hardened		90	310	N4	440	590	710	C
	Magnesium-based alloys	> 12% Si, not hardenable		130	450	N5	180	240	280	C
				70	250	N6	440	590	710	C
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	270	350	430	C
		Brass, bronze, red brass		90	310	N8	270	350	430	C
Copper alloys, short-chipping			110	380	N9	270	350	430	C	
High tensile, Ampco			300	1010	N10					
<b>S</b>	Heat-resistant alloys	Fe-based	Annealed		200	680	S1			
			Hardened		280	940	S2			
		Ni- or Co-based	Annealed		250	840	S3			
			Hardened		350	1180	S4			
			Cast		320	1080	S5			
	Titanium alloys	Pure titanium		200	680	S6				
		α and β alloys, hardened		375	1260	S7				
		β alloys		410	1400	S8				
	Tungsten alloys			300	1010	S9				
	Molybdenum alloys			300	1010	S10				
<b>H</b>	Hardened steel	Hardened and tempered		50 HRC	–	H1				
		Hardened and tempered		55 HRC	–	H2				
		Hardened and tempered		60 HRC	–	H3				
	Hardened cast iron			55 HRC	–	H4				
<b>O</b>	Thermoplastics	Without abrasive fillers				O1				
	Thermosetting plastics	Without abrasive fillers				O2				
	Plastic, glass-fibre reinforced	GFRP				O3				
	Plastic, carbon-fibre reinforced	CFRP				O4				
	Plastic, aramid-fibre reinforced	AFRP				O5				
	Graphite (technical)			80 Shore			O6			

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

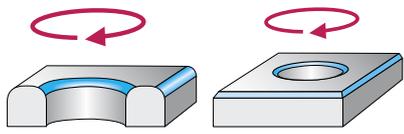
The specified cutting data are average standard values. For specific applications, adjustment is recommended.







## Cutting data for solid carbide profiling cutters



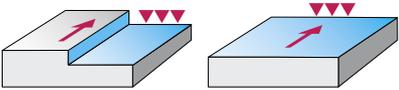
Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1	Product family			λ	
						MC500 Advance	H3E58118			
						MC501 Advance	H3E58318		0°	
						MC502 Advance	H3E58518			
						H1E58018	H1E58318		10°	
						H1E58118	H1E58518			
						60° / 90° / 120° / 150°				
						Z = 2-6				
						WJ30TF / TAX				
						Starting values for cutting speed v <sub>c</sub> [m/min]				
						a <sub>e</sub> / D <sub>c</sub>				
						1/3	1/10	1/20	VT	
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	220	320	380	A
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2	220	320	380	A
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3	180	260	320	A
		C > 0,55 %	Annealed	190	640	P4	180	260	30	A
		C > 0,55 %	Heat-treated	300	1010	P5	130	180	230	A
		Free-machining steel (short-chipping)	Annealed	220	750	P6	180	260	320	A
	Low-alloy steel	Annealed		175	590	P7	180	260	320	A
		Heat-treated		285	960	P8	130	180	230	A
		Heat-treated		380	1280	P9	110	150	170	A
		Heat-treated		430	1480	P10	90	130	160	A
High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	180	260	320	A	
	Hardened and tempered		300	1010	P12	130	180	230	A	
	Hardened and tempered		380	1280	P13	90	130	160	A	
Stainless steel	Ferritic/martensitic, annealed		200	680	P14	60	90	110	A	
	Martensitic, heat-treated		330	1110	P15	50	70	80	A	
M	Stainless steel	Austenitic, quench hardened		200	680	M1	80	110	130	B
		Austenitic, precipitation hardened (PH)		300	1010	M2	50	70	80	B
		Austenitic/ferritic, duplex		230	780	M3	60	90	110	B
K	Malleable cast iron	Ferritic		200	400	K1	170	240	300	A
		Pearlitic		260	700	K2	130	190	230	A
	Grey cast iron	Low strength		180	200	K3	170	240	300	A
		High strength/austenitic		245	350	K4	170	240	300	A
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	170	240	300	A
		Pearlitic		265	700	K6	130	190	230	A
	CGI		230	400	K7	110	160	200	A	
N	Wrought aluminium alloys	Not hardenable		30	-	N1	1600	2300	2900	C
		Hardenable, hardened		100	340	N2	1600	2300	2900	C
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	260	370	450	C
		≤ 12% Si, hardenable, hardened		90	310	N4	260	370	450	C
		> 12% Si, not hardenable		130	450	N5	170	240	300	C
	Magnesium-based alloys		70	250	N6	750	1100	1300	C	
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	480	680	840	C
Brass, bronze, red brass			90	310	N8	480	680	840	C	
Copper alloys, short-chipping			110	380	N9	480	680	840	C	
High tensile, Ampco		300	1010	N10	70	100	120	C		
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	60	90	110	B
			Hardened	280	940	S2	40	50	70	B
		Ni- or Co-based	Annealed	250	840	S3	60	90	110	B
			Hardened	350	1180	S4	40	50	70	B
			Cast	320	1080	S5	40	50	70	B
	Titanium alloys	Pure titanium		200	680	S6	200	290	370	B
		α and β alloys, hardened		375	1260	S7	60	90	120	B
		β alloys		410	1400	S8	60	90	120	B
	Tungsten alloys		300	1010	S9	70	100	120	B	
	Molybdenum alloys		300	1010	S10	70	100	120	B	
H	Hardened steel	Hardened and tempered		50 HRC	-	H1				
		Hardened and tempered		55 HRC	-	H2				
		Hardened and tempered		60 HRC	-	H3				
	Hardened cast iron		Hardened and tempered		55 HRC	-	H4			
O	Thermoplastics	Without abrasive fillers				O1				
	Thermosetting plastics	Without abrasive fillers				O2				
	Plastic, glass-fibre reinforced	GFRP				O3				
	Plastic, carbon-fibre reinforced	CFRP				O4				
	Plastic, aramid-fibre reinforced	AFRP				O5				
	Graphite (technical)		80 Shore				O6			

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

Product family		$\lambda$	Product family		$\lambda$		
MC503 Advance	H3E68118	0°	MC504 Advance		0°		
R 0,5–6 mm			Ø 6–12 mm				
Z = 3–4			Z = 4–6				
WJ30TF / TAX			WJ30TF				
Starting values for cutting speed $v_c$ [m/min]				Starting values for cutting speed $v_c$ [m/min]			
$a_e / D_c$				$a_e / D_c$			
1/1	1/2	1/10	VT	1/3	1/10	1/20	VT
310			A	220	320	380	A
310			A	220	320	380	A
260			A	180	260	320	A
260			A	180	260	30	A
190			A	130	180	230	A
260			A	180	260	320	A
260			A	180	260	320	A
190			A	130	180	230	A
150			A	110	150	170	A
130			A	90	130	160	A
260			A	180	260	320	A
190			A	130	180	230	A
130			A	90	130	160	A
90			A	60	90	110	A
70			A	50	70	80	A
100			B	80	110	130	B
70			B	50	70	80	B
90			B	60	90	110	B
240			A	170	240	300	A
190			A	130	190	230	A
240			A	170	240	300	A
200			A	170	240	300	A
240			A	170	240	300	A
190			A	130	190	230	A
120			A	110	160	200	A
2300			C	1600	2300	2900	C
2300			C	1600	2300	2900	C
370			C	260	370	450	C
370			C	260	370	450	C
240			C	170	240	300	C
1100			C	750	1100	1300	C
680			C	480	680	840	C
680			C	480	680	840	C
680			C	480	680	840	C
100			C	70	100	120	C
90			B	60	90	110	B
50			B	40	50	70	B
90			B	60	90	110	B
50			B	40	50	70	B
50			B	40	50	70	B
280			B	200	290	370	B
80			B	60	90	120	B
80			B	60	90	120	B
100			B	70	100	120	B
100			B	70	100	120	B

## Cutting data for PCD milling cutters



		Product family		λ		Ø 6–125 mm		Z = 2–22		WDN20		Starting values for cutting speed $v_c$ [m/min]			
												$a_e / D_c$			
Material group	Overview of the main material groups and code letters	Brinell hardness HB	Tensile strength $R_m$ [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	1/1	1/2	1/4	1/10	VT						
					<b>P</b>	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	428	P1				
C > 0,25... ≤ 0,55 %	Annealed	190	639	P2											
C > 0,25... ≤ 0,55 %	Heat-treated	210	708	P3											
C > 0,55 %	Annealed	190	639	P4											
C > 0,55 %	Heat-treated	300	1013	P5											
Free-machining steel (short-chipping)	Annealed	220	745	P6											
Low-alloy steel	Annealed	175	591	P7											
	Heat-treated	300	1013	P8											
	Heat-treated	380	1282	P9											
	Heat-treated	430	1477	P10											
High-alloy steel and high-alloy tool steel	Annealed	200	675	P11											
	Hardened and tempered	300	1013	P12											
	Hardened and tempered	400	1361	P13											
Stainless steel	Ferritic/martensitic, annealed	200	675	P14											
	Martensitic, heat-treated	330	1114	P15											
	Austenitic, quench hardened	200	675	M1											
<b>M</b>	Stainless steel	Austenitic, precipitation hardened (PH)	300	1013	M2										
		Austenitic/ferritic, duplex	230	778	M3										
		Ferritic	200	675	K1										
<b>K</b>	Malleable cast iron	Pearlitic	260	867	K2										
		Low strength	180	602	K3										
	Grey cast iron	High strength/austenitic	245	825	K4										
		Ferritic	155	518	K5										
	Cast iron with spheroidal graphite	Pearlitic	265	885	K6										
		CGI	200	675	K7										
	<b>N</b>	Wrought aluminium alloys	Not hardenable	30	–	N1	1200	1200	1500	G					
Hardenable, hardened			100	343	N2	1000	1200	1200	G						
Cast aluminium alloys		≤ 12% Si, not hardenable	75	260	N3	1000	1000	1000	H						
		≤ 12% Si, hardenable, hardened	90	314	N4	1000	1000	1000	H						
		> 12% Si, not hardenable	130	447	N5	800	800	800	H						
Magnesium-based alloys			70	250	N6										
Copper and copper alloys (bronze/brass)		Non-alloyed, electrolytic copper	100	343	N7										
	Brass, bronze, red brass	90	314	N8											
	Copper alloys, short-chipping	110	382	N9											
	High tensile, Ampco	300	1013	N10											
<b>S</b>	Heat-resistant alloys	Fe-based	Annealed	200	675	S1									
			Hardened	280	943	S2									
		Ni- or Co-based	Annealed	250	839	S3									
			Hardened	350	1177	S4									
			Cast	320	1076	S5									
	Titanium alloys	Pure titanium	200	675	S6										
		α and β alloys, hardened	375	1262	S7										
		β alloys	410	1396	S8										
Tungsten alloys		300	1013	S9											
Molybdenum alloys		300	1013	S10											
<b>H</b>	Hardened steel	Hardened and tempered	50 HRC	–	H1										
		Hardened and tempered	55 HRC	–	H2										
		Hardened and tempered	60 HRC	–	H3										
	Hardened cast iron	Hardened and tempered	55 HRC	–	H4										
<b>O</b>	Thermoplastics	Without abrasive fillers			O1	400	400	400	I						
	Thermosetting plastics	Without abrasive fillers			O2	500	500	500	I						
	Plastic, glass-fibre reinforced	GFRP			O3										
	Plastic, carbon-fibre reinforced	CFRP			O4										
	Plastic, aramid-fibre reinforced	AFRP			O5										
	Graphite (technical)		80 Shore			O6	600	800	800	I					

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

## Cutting data for ceramic shoulder/slot milling cutters



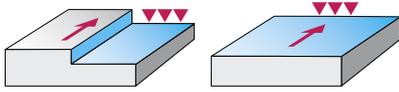
		Product family	$\lambda$	Product family	$\lambda$									
		MC275 Ceramic (Solid)	35°	MC075 Ceramic (Solid)	35°									
		MC275 Ceramic ConeFit		MC075 Ceramic ConeFit										
Material group	Overview of the main material groups and code letters			$\emptyset$ 8–25 mm	$\emptyset$ 8–25 mm									
				Z = 4–8	Z = 4									
				WIS10										
				Starting values for cutting speed $v_c$ [m/min]										
		$a_e / D_c$		$a_e / D_c$										
		1	1/4	1/10	VT <sup>2</sup>									
		1	1/4	1/10	VT <sup>2</sup>									
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1								
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2								
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3								
		C > 0,55 %	Annealed	190	640	P4								
		C > 0,55 %	Heat-treated	300	1010	P5								
		Free-machining steel (short-chipping)	Annealed	220	750	P6								
	Low-alloy steel	Annealed	175	590	P7									
		Heat-treated	285	960	P8									
		Heat-treated	380	1280	P9									
		Heat-treated	430	1480	P10									
	High-alloy steel and high-alloy tool steel	Annealed	200	680	P11									
		Hardened and tempered	300	1010	P12									
		Hardened and tempered	380	1280	P13									
	Stainless steel	Ferritic/martensitic, annealed	200	680	P14									
		Martensitic, heat-treated	330	1110	P15									
M	Stainless steel	Austenitic, quench hardened	200	680	M1									
		Austenitic, precipitation hardened (PH)	300	1010	M2									
		Austenitic/ferritic, duplex	230	780	M3									
K	Malleable cast iron	Ferritic	200	400	K1									
		Pearlitic	260	700	K2									
	Grey cast iron	Low strength	180	200	K3									
		High strength/austenitic	245	350	K4									
	Cast iron with spheroidal graphite	Ferritic	155	400	K5									
		Pearlitic	265	700	K6									
	CGI	230	400	K7										
N	Wrought aluminium alloys	Not hardenable	30	–	N1									
		Hardenable, hardened	100	340	N2									
		≤ 12% Si, not hardenable	75	260	N3									
	Cast aluminium alloys	≤ 12% Si, hardenable, hardened	90	310	N4									
		> 12% Si, not hardenable	130	450	N5									
	Magnesium-based alloys	Non-alloyed, electrolytic copper	100	340	N7									
		Copper and copper alloys (bronze/brass)	Brass, bronze, red brass	90	310	N8								
			Copper alloys, short-chipping	110	380	N9								
			High tensile, Ampco	300	1010	N10								
	S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1							
Hardened				280	940	S2								
Ni- or Co-based			Annealed	250	840	S3	690	1070	1300	B	480	378	378	B
			Hardened	350	1180	S4	690	1070	1300	B	480	378	378	B
			Cast	320	1080	S5	690	1070	1300	B	480	378	378	B
Titanium alloys		Pure titanium	200	680	S6									
		$\alpha$ and $\beta$ alloys, hardened	375	1260	S7									
		$\beta$ alloys	410	1400	S8									
Tungsten alloys		300	1010	S9										
Molybdenum alloys		300	1010	S10										
H	Hardened steel	Hardened and tempered	50 HRC	–	H1									
		Hardened and tempered	55 HRC	–	H2									
		Hardened and tempered	60 HRC	–	H3									
	Hardened cast iron	Hardened and tempered	55 HRC	–	H4									
O	Thermoplastics	Without abrasive fillers			O1									
		Thermosetting plastics	Without abrasive fillers		O2									
		Plastic, glass-fibre reinforced	GFRP		O3									
		Plastic, carbon-fibre reinforced	CFRP		O4									
		Plastic, aramid-fibre reinforced	AFRP		O5									
		Graphite (technical)		80 Shore		O6								

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> The corresponding feed rates can be found from page D40 onwards.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

## Cutting data for end milling cutters with PCD/brazed cutting edges



		Product family		Brazed helical milling cutters						
				F1675 F1678	F1676 F1682					
Material group	Overview of the main material groups and code letters	Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>	Ø 20–100 mm					
					Z = 4–8					
					WP40					
					Starting values for cutting speed v <sub>c</sub> [m/min]					
					a <sub>e</sub> / D <sub>c</sub>					
					1/2	1/4	1/10	VT		
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	200	325	375	J
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2	140	225	265	J
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3	120	200	230	J
		C > 0,55 %	Annealed	190	640	P4	140	225	265	J
		C > 0,55 %	Heat-treated	300	1010	P5	110	180	215	J
		Free-machining steel (short-chipping)	Annealed	220	750	P6	130	220	280	J
	Low-alloy steel	Annealed	175	590	P7	155	250	290	L	
		Heat-treated	285	960	P8	120	190	225	L	
		Heat-treated	380	1280	P9	100	170	195	L	
		Heat-treated	430	1480	P10	90	160	170	L	
High-alloy steel and high-alloy tool steel	Annealed	200	680	P11	115	190	220	L		
	Hardened and tempered	300	1010	P12	100	160	180	L		
	Hardened and tempered	380	1280	P13	90	150	170	L		
Stainless steel	Ferritic/martensitic, annealed	200	680	P14	75	125	145	L		
	Martensitic, heat-treated	330	1110	P15	70	115	135	L		
M	Stainless steel	Austenitic, quench hardened	200	680	M1					
		Austenitic, precipitation hardened (PH)	300	1010	M2					
		Austenitic/ferritic, duplex	230	780	M3					
K	Malleable cast iron	Ferritic	200	400	K1					
		Pearlitic	260	700	K2					
	Grey cast iron	Low strength	180	200	K3					
		High strength/austenitic	245	350	K4					
	Cast iron with spheroidal graphite	Ferritic	155	400	K5					
		Pearlitic	265	700	K6					
CGI		230	400	K7						
N	Wrought aluminium alloys	Not hardenable	30	–	N1					
		Hardenable, hardened	100	340	N2					
	Cast aluminium alloys	≤ 12% Si, not hardenable	75	260	N3					
		≤ 12% Si, hardenable, hardened	90	310	N4					
		> 12% Si, not hardenable	130	450	N5					
	Magnesium-based alloys		70	250	N6					
		Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper	100	340	N7				
Brass, bronze, red brass			90	310	N8					
Copper alloys, short-chipping	110		380	N9						
High tensile, Ampco	300		1010	N10						
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1				
			Hardened	280	940	S2				
		Ni- or Co-based	Annealed	250	840	S3				
			Hardened	350	1180	S4				
			Cast	320	1080	S5				
	Titanium alloys	Pure titanium	200	680	S6					
		α and β alloys, hardened	375	1260	S7					
		β alloys	410	1400	S8					
	Tungsten alloys		300	1010	S9					
	Molybdenum alloys		300	1010	S10					
H	Hardened steel	Hardened and tempered	50 HRC	–	H1					
		Hardened and tempered	55 HRC	–	H2					
		Hardened and tempered	60 HRC	–	H3					
	Hardened cast iron	Hardened and tempered	55 HRC	–	H4					
O	Thermoplastics	Without abrasive fillers			O1					
	Thermosetting plastics	Without abrasive fillers			O2					
	Plastic, glass-fibre reinforced	GFRP			O3					
	Plastic, carbon-fibre reinforced	CFRP			O4					
	Plastic, aramid-fibre reinforced	AFRP			O5					
	Graphite (technical)		80 Shore			O6				

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

The specified cutting data are average standard values. For specific applications, adjustment is recommended.



## Feed determination

The specified feed rates are average standard values.  
For specific applications, adjustment is recommended.

### A Material groups ISO P, ISO K and titanium alloys

a <sub>e</sub> [mm]*	Feed per tooth f <sub>z</sub> [mm]									
	Ø 0,3 mm	Ø 0,5 mm	Ø 1 mm	Ø 2 mm	Ø 3 mm	Ø 4 mm	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm
0,01	0,02	0,02	0,03	0,06	0,09	0,12	0,15	0,15	0,20	
0,05	0,01	0,01	0,02	0,04	0,07	0,10	0,12	0,15	0,20	
0,1	0,01	0,01	0,02	0,03	0,05	0,08	0,10	0,15	0,20	0,20
0,2	0,01	0,01	0,01	0,03	0,04	0,06	0,08	0,15	0,18	0,20
0,5		0,01	0,01	0,02	0,03	0,05	0,07	0,12	0,15	0,15
1			0,01	0,02	0,03	0,04	0,06	0,09	0,12	0,12
2				0,02	0,03	0,03	0,05	0,08	0,11	0,12
3					0,02	0,02	0,04	0,07	0,10	0,12
5						0,02	0,04	0,07	0,10	0,12
6							0,03	0,06	0,08	0,10
8								0,05	0,07	0,09
10									0,06	0,08
12										0,07
14										
16										
18										
20										
25										
32										
40										
50										
63										
80										
100										
160										
200										

### A Material groups ISO P, ISO K and titanium alloys (continued)

a <sub>e</sub> [mm]*	Feed per tooth f <sub>z</sub> [mm]									
	Ø 14 mm	Ø 16 mm	Ø 18 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm
0,01										
0,05										
0,1	0,20	0,20								
0,2	0,20	0,20	0,20	0,25						
0,5	0,15	0,15	0,20	0,25	0,25					
1	0,12	0,12	0,15	0,20	0,25	0,25	0,30	0,30	0,30	0,40
2	0,12	0,12	0,15	0,20	0,20	0,25	0,25	0,25	0,30	0,30
3	0,12	0,12	0,14	0,18	0,20	0,20	0,25	0,25	0,25	0,30
5	0,12	0,12	0,12	0,15	0,20	0,20	0,20	0,25	0,25	0,25
6	0,10	0,12	0,12	0,15	0,20	0,20	0,20	0,20	0,25	0,25
8	0,10	0,12	0,12	0,15	0,20	0,20	0,20	0,20	0,20	0,25
10	0,10	0,12	0,12	0,14	0,16	0,20	0,20	0,20	0,20	0,20
12	0,09	0,11	0,12	0,14	0,16	0,16	0,20	0,20	0,20	0,20
14	0,08	0,10	0,12	0,13	0,15	0,16	0,16	0,20	0,20	0,20
16		0,09	0,10	0,12	0,15	0,15	0,16	0,16	0,20	0,20
18			0,10	0,11	0,13	0,15	0,15	0,16	0,16	0,20
20				0,10	0,12	0,13	0,15	0,15	0,16	0,16
25					0,10	0,12	0,13	0,15	0,15	0,16
32						0,10	0,12	0,13	0,15	0,15
40							0,10	0,12	0,13	0,15
50								0,10	0,12	0,13
63									0,10	0,12
80										0,10
100										
160										
200										

\* Radial feed in mm

The specified feed rates are average standard values.  
For specific applications, adjustment is recommended.

## Feed determination (continued)

The specified feed rates are average standard values.  
For specific applications, adjustment is recommended.

## Feed determination (continued)

The specified feed rates are average standard values.  
For specific applications, adjustment is recommended.

### C Material groups ISO N and ISO O

$a_e$ [mm]*	Feed per tooth $f_z$ [mm]									
	Ø 0,3 mm	Ø 0,5 mm	Ø 1 mm	Ø 2 mm	Ø 3 mm	Ø 4 mm	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm
0,01	0,04	0,04	0,07	0,13	0,20	0,26	0,33	0,33	0,44	
0,05	0,03	0,03	0,06	0,09	0,15	0,22	0,26	0,33	0,44	
0,1	0,02	0,03	0,04	0,08	0,11	0,18	0,22	0,33	0,44	0,44
0,2	0,02	0,02	0,03	0,07	0,09	0,13	0,18	0,33	0,40	0,44
0,5		0,02	0,03	0,06	0,07	0,11	0,15	0,26	0,33	0,33
1			0,02	0,06	0,07	0,09	0,13	0,20	0,26	0,26
2				0,04	0,07	0,07	0,11	0,18	0,24	0,26
3					0,04	0,06	0,10	0,17	0,23	0,26
5						0,04	0,09	0,15	0,22	0,26
6							0,07	0,13	0,18	0,22
8								0,11	0,15	0,20
10									0,13	0,18
12										0,15
14										
16										
18										
20										
25										
32										
40										
50										
63										
80										
100										
160										
200										

### C Material groups ISO N and ISO O (continued)

$a_e$ [mm]*	Feed per tooth $f_z$ [mm]									
	Ø 14 mm	Ø 16 mm	Ø 18 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm
0,01										
0,05										
0,1	0,44	0,44								
0,2	0,44	0,44	0,44	0,50						
0,5	0,33	0,33	0,44	0,50	0,50					
1	0,26	0,26	0,33	0,44	0,50	0,50	0,50	0,50	0,50	0,50
2	0,26	0,26	0,33	0,44	0,44	0,50	0,50	0,50	0,50	0,50
3	0,26	0,26	0,30	0,39	0,44	0,44	0,50	0,50	0,50	0,50
5	0,26	0,26	0,26	0,33	0,44	0,44	0,44	0,50	0,50	0,50
6	0,22	0,26	0,26	0,33	0,44	0,44	0,44	0,44	0,50	0,50
8	0,22	0,26	0,26	0,33	0,44	0,44	0,44	0,44	0,44	0,55
10	0,22	0,26	0,26	0,31	0,35	0,44	0,44	0,44	0,44	0,44
12	0,20	0,24	0,26	0,31	0,35	0,35	0,44	0,44	0,44	0,44
14	0,18	0,22	0,26	0,29	0,33	0,35	0,35	0,44	0,44	0,44
16		0,20	0,22	0,26	0,33	0,33	0,35	0,35	0,44	0,44
18			0,22	0,24	0,29	0,33	0,33	0,35	0,35	0,44
20				0,22	0,26	0,29	0,33	0,33	0,35	0,35
25					0,22	0,26	0,29	0,33	0,33	0,35
32						0,22	0,26	0,29	0,33	0,33
40							0,22	0,26	0,29	0,33
50								0,22	0,26	0,29
63									0,22	0,26
80										0,22
100										
160										
200										

\* Radial feed in mm

## Feed determination (continued)

The specified feed rates are average standard values.  
For specific applications, adjustment is recommended.

### D Flash MD128 Supreme MC128 Advance ISO P, M, K, N, S, O

$a_e$ [mm]*	Feed per tooth $f_z$ [mm]										
	Ø 3 mm	Ø 4 mm	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm	Ø 14 mm	Ø 16 mm	Ø 18 mm	Ø 20 mm	Ø 25 mm
0,8	0,07	0,10									
1,5	0,07	0,10	0,16	0,25							
3	0,07	0,10	0,16	0,25	0,30						
5		0,10	0,16	0,25	0,30	0,35					
6			0,16	0,25	0,30	0,35	0,40	0,50	0,60		
8				0,25	0,30	0,35	0,40	0,50	0,60	0,70	0,70
10					0,30	0,35	0,40	0,50	0,60	0,70	0,70
12							0,40	0,50	0,60	0,70	0,70
14							0,40	0,50	0,60	0,70	0,70
16								0,50	0,60	0,70	0,70
18									0,60	0,70	0,70
20										0,70	0,70
25											0,70

### E Flash MC089 Advance ISO H

$a_e$ [mm]*	Feed per tooth $f_z$ [mm]										
	Ø 3 mm	Ø 4 mm	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm	Ø 14 mm	Ø 16 mm	Ø 18 mm	Ø 20 mm	Ø 25 mm
0,8	0,06	0,08									
1,5	0,06	0,08	0,13	0,20							
3	0,06	0,08	0,13	0,20	0,24						
5		0,08	0,13	0,20	0,24	0,28					
6			0,13	0,20	0,24	0,28	0,32	0,40	0,48		
8				0,20	0,24	0,28	0,32	0,40	0,48	0,56	0,56
10					0,24	0,28	0,32	0,40	0,48	0,56	0,56
12							0,32	0,40	0,48	0,56	0,56
14							0,32	0,40	0,48	0,56	0,56
16								0,40	0,48	0,56	0,56
18									0,48	0,56	0,56
20										0,56	0,56
25											0,56

### F MD340 + MD344 Supreme

$a_e$ [mm]*	Feed per tooth $f_z$ [mm]												
	Ø 1 mm	Ø 2 mm	Ø 3 mm	Ø 4 mm	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm	Ø 14 mm	Ø 16 mm	Ø 18 mm	Ø 20 mm	Ø 25 mm
0,01	0,04	0,08	0,11	0,14	0,18	0,18	0,24						
0,05	0,03	0,05	0,09	0,12	0,14	0,18	0,24						
0,1	0,02	0,04	0,06	0,10	0,12	0,18	0,24	0,24	0,24	0,24			
0,2	0,02	0,04	0,05	0,07	0,10	0,18	0,22	0,24	0,24	0,24	0,24	0,3	
0,5	0,01	0,03	0,04	0,06	0,08	0,14	0,18	0,18	0,18	0,18	0,24	0,3	0,30
1	0,01	0,03	0,04	0,05	0,07	0,11	0,14	0,14	0,14	0,14	0,18	0,24	0,30
2		0,02	0,04	0,04	0,06	0,10	0,13	0,14	0,14	0,14	0,18	0,24	0,24
3			0,02	0,03	0,05	0,09	0,13	0,14	0,14	0,14	0,16	0,21	0,24
5				0,02	0,05	0,08	0,12	0,14	0,14	0,14	0,14	0,18	0,24
6					0,04	0,07	0,10	0,12	0,12	0,14	0,14	0,18	0,24
8						0,06	0,08	0,11	0,12	0,14	0,14	0,18	0,24
10							0,07	0,10	0,12	0,14	0,14	0,17	0,19
12								0,08	0,11	0,13	0,14	0,17	0,19
14									0,10	0,12	0,14	0,16	0,18
16										0,11	0,12	0,14	0,18
18											0,12	0,13	0,16
20												0,12	0,14
25													0,12

\* Radial feed in mm

## Feed determination for brazed tools

### G Wrought aluminium alloys

$a_e/D_c$	Feed per tooth $f_z$ [mm]													
	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm	Ø 125 mm
1/50	0,08	0,07	0,09	0,09	0,12	0,12	0,12	0,15	0,15					
1/20	0,07	0,06	0,08	0,08	0,10	0,10	0,10	0,13	0,13					
1/10	0,06	0,06	0,07	0,07	0,10	0,07	0,10	0,12	0,12	0,12	0,12	0,12	0,12	0,12
1/5	0,06	0,06	0,07	0,07	0,09	0,09	0,09	0,11	0,11	0,11	0,11	0,11	0,11	0,11
1/2	0,05	0,05	0,06	0,06	0,08	0,08	0,08	0,10	0,10	0,10	0,10	0,10	0,10	0,10
1/1	0,05	0,05	0,06	0,06	0,08	0,08	0,08	0,10	0,10	0,10	0,10	0,10	0,10	0,10

### H Magnesium-based alloys/copper and copper alloys

$a_e/D_c$	Feed per tooth $f_z$ [mm]													
	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm	Ø 125 mm
1/50	0,04	0,04	0,06	0,06	0,09	0,09	0,09	0,11	0,11					
1/20	0,04	0,04	0,05	0,05	0,08	0,08	0,08	0,10	0,10					
1/10	0,04	0,04	0,05	0,05	0,07	0,07	0,07	0,09	0,09	0,09	0,09	0,09	0,09	0,09
1/5	0,03	0,03	0,04	0,04	0,07	0,07	0,07	0,08	0,08	0,08	0,08	0,08	0,08	0,08
1/2	0,03	0,03	0,04	0,04	0,06	0,06	0,06	0,07	0,07	0,07	0,07	0,07	0,07	0,07
1/1	0,03	0,03	0,04	0,04	0,06	0,06	0,06	0,07	0,07	0,07	0,07	0,07	0,07	0,07

### I Thermoplastics, thermosetting plastics, plastic, graphite

$a_e/D_c$	Feed per tooth $f_z$ [mm]													
	Ø 6 mm	Ø 8 mm	Ø 10 mm	Ø 12 mm	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm	Ø 125 mm
1/50	0,05	0,05	0,07	0,07	0,10	0,10	0,10	0,13	0,13					
1/20	0,05	0,05	0,06	0,06	0,09	0,09	0,09	0,11	0,11					
1/10	0,04	0,04	0,06	0,06	0,08	0,08	0,08	0,10	0,10	0,10	0,10	0,10	0,10	0,10
1/5	0,04	0,04	0,05	0,05	0,08	0,08	0,08	0,09	0,09	0,09	0,09	0,09	0,09	0,09
1/2	0,03	0,03	0,05	0,05	0,07	0,07	0,07	0,08	0,08	0,08	0,08	0,08	0,08	0,08
1/1	0,03	0,03	0,05	0,05	0,07	0,07	0,07	0,08	0,08	0,08	0,08	0,08	0,08	0,08

### J Non-alloyed steel, malleable cast iron, ductile cast iron and compacted graphite iron

$a_e$ [mm]*	Feed per tooth $f_z$ [mm]								
	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm
1,0	0,12	0,12	0,12	0,12	0,13				
2,0	0,12	0,12	0,12	0,12	0,12	0,20			
3,0	0,11	0,12	0,12	0,12	0,12	0,19	0,20		
4,0	0,10	0,11	0,12	0,12	0,12	0,18	0,19	0,20	
5,0	0,10	0,10	0,11	0,12	0,12	0,18	0,18	0,19	0,20
6,0	0,10	0,10	0,10	0,11	0,12	0,17	0,18	0,18	0,19
8,0	0,10	0,10	0,10	0,10	0,11	0,17	0,17	0,18	0,18
10,0	0,10	0,10	0,10	0,10	0,10	0,17	0,17	0,17	0,18
12,0	0,10	0,10	0,10	0,10	0,10	0,16	0,17	0,17	0,17
16,0	0,10	0,10	0,10	0,10	0,10	0,15	0,16	0,17	0,17
20,0		0,10	0,10	0,10	0,10	0,15	0,15	0,16	0,17
25,0			0,10	0,10	0,10	0,15	0,15	0,15	0,16
32,0				0,10	0,10	0,15	0,15	0,15	0,15
40,0					0,10	0,15	0,15	0,15	0,15
50,0						0,15	0,15	0,15	0,15
63,0							0,15	0,15	0,15
80,0								0,15	0,15
100,0									0,15

\* Radial feed in mm

## Feed determination for brazed tools

(continued)

### K Grey cast iron

a <sub>e</sub> [mm]*	Feed per tooth f <sub>z</sub> [mm]								
	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm
1,0	0,13	0,13	0,13	0,14	0,15				
2,0	0,13	0,13	0,13	0,13	0,14	0,26			
3,0	0,13	0,13	0,13	0,13	0,13	0,25	0,26		
4,0	0,12	0,13	0,13	0,13	0,13	0,24	0,25	0,26	
5,0	0,12	0,12	0,13	0,13	0,13	0,24	0,24	0,25	0,26
6,0	0,12	0,12	0,12	0,13	0,13	0,23	0,24	0,24	0,25
8,0	0,12	0,12	0,12	0,12	0,13	0,22	0,23	0,24	0,24
10,0	0,12	0,12	0,12	0,12	0,12	0,22	0,22	0,23	0,24
12,0	0,12	0,12	0,12	0,12	0,12	0,21	0,22	0,22	0,23
16,0	0,12	0,12	0,12	0,12	0,12	0,20	0,21	0,22	0,22
20,0		0,12	0,12	0,12	0,12	0,20	0,20	0,21	0,22
25,0			0,12	0,12	0,12	0,20	0,20	0,20	0,21
32,0				0,12	0,12	0,20	0,20	0,20	0,20
40,0					0,12	0,20	0,20	0,20	0,20
50,0						0,20	0,20	0,20	0,20
63,0							0,20	0,20	0,20
80,0								0,20	0,20
100,0									0,20

### L Low-alloy steel, high-alloy steel and high-alloy tool steel

a <sub>e</sub> [mm]*	Feed per tooth f <sub>z</sub> [mm]								
	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm
1,0	0,09	0,09	0,09	0,1	0,10				
2,0	0,09	0,09	0,09	0,09	0,10	0,17			
3,0	0,09	0,09	0,09	0,09	0,09	0,16	0,17		
4,0	0,08	0,09	0,09	0,09	0,09	0,15	0,16	0,17	
5,0	0,08	0,08	0,09	0,09	0,09	0,14	0,15	0,16	0,17
6,0	0,08	0,08	0,08	0,09	0,09	0,14	0,14	0,15	0,16
8,0	0,08	0,08	0,08	0,08	0,09	0,14	0,14	0,14	0,15
10,0	0,08	0,08	0,08	0,08	0,08	0,13	0,14	0,14	0,14
12,0	0,08	0,08	0,08	0,08	0,08	0,13	0,13	0,14	0,14
16,0	0,08	0,08	0,08	0,08	0,08	0,13	0,13	0,13	0,14
20,0		0,08	0,08	0,08	0,08	0,13	0,13	0,13	0,13
25,0			0,08	0,08	0,08	0,12	0,13	0,13	0,13
32,0				0,08	0,08	0,12	0,12	0,13	0,13
40,0					0,08	0,12	0,12	0,12	0,13
50,0						0,12	0,12	0,12	0,12
63,0							0,12	0,12	0,12
80,0								0,12	0,12
100,0									0,12

### M Stainless steel (ISO P)

a <sub>e</sub> [mm]*	Feed per tooth f <sub>z</sub> [mm]								
	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm
1,0	0,07	0,07	0,07	0,08	0,08				
2,0	0,07	0,07	0,07	0,07	0,08	0,14			
3,0	0,07	0,07	0,07	0,07	0,07	0,13	0,14		
4,0	0,06	0,07	0,07	0,07	0,07	0,12	0,13	0,14	
5,0	0,06	0,06	0,07	0,07	0,07	0,12	0,12	0,13	0,14
6,0	0,06	0,06	0,06	0,07	0,07	0,12	0,12	0,12	0,13
8,0	0,06	0,06	0,06	0,06	0,07	0,12	0,12	0,12	0,12
10,0	0,06	0,06	0,06	0,06	0,06	0,11	0,12	0,12	0,12
12,0	0,06	0,06	0,06	0,06	0,06	0,11	0,11	0,12	0,12
16,0	0,06	0,06	0,06	0,06	0,06	0,11	0,11	0,11	0,12
20,0		0,06	0,06	0,06	0,06	0,11	0,11	0,11	0,11
25,0			0,06	0,06	0,06	0,10	0,11	0,11	0,11
32,0				0,06	0,06	0,10	0,10	0,11	0,11
40,0					0,06	0,10	0,10	0,10	0,11
50,0						0,10	0,10	0,10	0,10
63,0							0,10	0,10	0,10
80,0								0,10	0,10
100,0									0,10

\* Radial feed in mm

## Cutting speed: Correction factors\*

### $v_c$ correction factors – toolholder/steel

Designation	$v_c$ correction factors	Type	Max. speed
AK610.Z16.E10.005	$v_c \times 1,0$	A	40.000
AK610.Z12.E10.005	$v_c \times 1,0$	A	40.000
AK610.Z10.E10.020	$v_c \times 0,9$	A	30.000
AK610.Z16.E10.050	$v_c \times 0,6$	B	12.000
AK610.Z16.E10.036	$v_c \times 0,7$	C	15.000
AK610.Z12.E10.036	$v_c \times 0,7$	C	15.000
AK610.Z16.E12.005	$v_c \times 1,0$	A	40.000
AK610.Z12.E12.022	$v_c \times 0,9$	A	30.000
AK610.Z16.E12.060	$v_c \times 0,6$	B	10.000
AK610.Z16.E12.025	$v_c \times 0,7$	C	15.000
AK610.Z20.E16.005	$v_c \times 1,0$	A	40.000
AK610.Z16.E16.025	$v_c \times 0,9$	A	30.000
AK610.Z20.E16.025	$v_c \times 0,9$	A	30.000
AK610.Z20.E16.075	$v_c \times 0,6$	B	10.000
AK610.Z25.E16.054	$v_c \times 0,7$	C	15.000
AK610.Z25.E20.005	$v_c \times 1,0$	A	30.000
AK610.Z20.E20.030	$v_c \times 0,8$	A	20.000
AK610.Z32.E20.073	$v_c \times 0,7$	C	20.000
AK610.Z32.E25.005	$v_c \times 1,0$	A	30.000
AK610.Z25.E25.040	$v_c \times 0,7$	A	15.000
AK610.Z32.E25.045	$v_c \times 0,7$	C	20.000

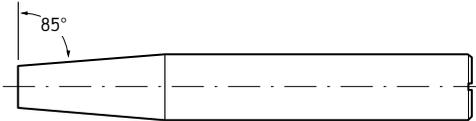
Type A



Type B



Type C



### $v_c$ correction factors – toolholder/solid carbide

Designation	$v_c$ correction factors	Type	Max. speed
AK610.Z10.E10.050C	$v_c \times 0,8$	A	20.000
AK610.Z16.E10.100C	$v_c \times 0,7$	B	15.000
AK610.Z12.E12.048C	$v_c \times 0,9$	A	30.000
AK610.Z16.E12.090C	$v_c \times 0,7$	B	15.000
AK610.Z16.E16.080C	$v_c \times 0,9$	A	30.000
AK610.Z20.E16.118C	$v_c \times 0,6$	B	10.000
AK610.Z20.E20.038C	$v_c \times 1,0$	A	30.000
AK610.Z20.E20.110C	$v_c \times 0,9$	A	30.000
AK610.Z25.E25.120C	$v_c \times 0,6$	A	10.000

**\* Please note:**

With ConeFit heads, the cutting speed should be adjusted based on the projection length and shank type.  
Do not exceed the maximum speed. For cutting data, see page D10 onwards.

## Grade description

Coated carbide																					
Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Tool example		
		P	M	K	N	S	H	O	01	05	10	15	20	25	30	35				40	45
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other													
WK40TF	HC – P 40	●●																			
	HC – M 40		●																		
	HC – K 40			●																	
	HC – S 40					●															
WJ30TF	HC – P 30	●●																			
	HC – M 30		●																		
	HC – K 30			●																	
	HC – N 30				●																
	HC – S 30					●															
WJ30CA	HC – N 30				●●																
WK40RC	HC – M 40		●●																		
	HC – S 40					●															
WK40TZ	HC – P 40	●●																			
	HC – M 40		●																		
WJ30ED	HC – P 30	●●																			
	HC – M 30		●																		
	HC – K 30			●																	
WK40TP	HC – P 40	●●																			
	HC – K 40			●																	
WK40EA	HC – P 40	●																			
	HC – M 40		●																		
	HC – S 40					●●															
WJ30DD	HC – N 30				●●																
WJ30RA	HC – M 30		●●																		
	HC – N 30				●																
	HC – S 30					●●															

HC = Coated carbide

- Primary application
- Additional application

## Grade description

(continued)

Coated carbide																				
Walter grade designation	Standard designation	Material groups						Application range								Coating process	Coating composition	Tool example		
		P	M	K	N	S	H	O	01	05	10	15	20	25	30				35	40
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other												
WJ30RD	HC – P 30	●●												[Application range diagram: 15-45]				PVD	AlTiN + ZrN	
	HC – K 30			●										[Application range diagram: 15-35]						
WJ30EN	HC – P 40	●												[Application range diagram: 15-45]				PVD	nACRo	
	HC – M 40		●											[Application range diagram: 15-45]						
	HC – S 40					●●								[Application range diagram: 15-45]						
WB10TG	HC – H 10						●●							[Application range diagram: 10-15]				PVD	TiAlSiN	

Uncoated carbide																				
Walter grade designation	Standard designation	Material groups						Application range								Coating process	Coating composition	Tool example		
		P	M	K	N	S	H	O	01	05	10	15	20	25	30				35	40
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other												
WJ30UU	HW – N 30				●●									[Application range diagram: 15-45]				–	–	

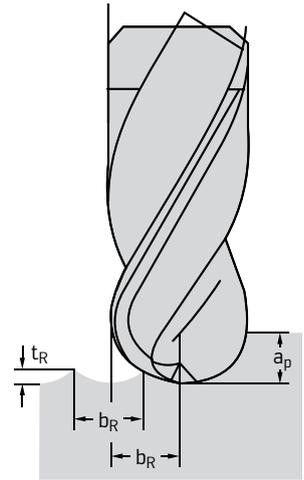
Ceramic																				
Walter grade designation	Standard designation	Material groups						Application range								Coating process	Coating composition	Tool example		
		P	M	K	N	S	H	O	01	05	10	15	20	25	30				35	40
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other												
WIS10	CN – S 10					●●								[Application range diagram: 10-15]				–	–	

CN = Silicon nitride Si<sub>3</sub>N<sub>4</sub>  
 HC = Coated carbide  
 HW = Uncoated carbide

●● Primary application  
 ● Additional application

## Usage recommendations for copying and finishing

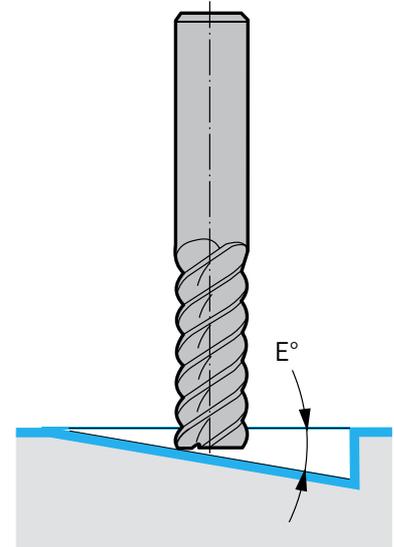
Tool diameter $D_c$ (mm)	Row width ( $b_R$ ) for groove depth $t_R = 5 \mu\text{m}$	Row width ( $b_R$ ) for groove depth $t_R = 2 \mu\text{m}$
0,3	0,08	0,04
0,4	0,09	0,05
0,5	0,10	0,06
0,6	0,11	0,07
0,8	0,12	0,08
1,0	0,14	0,09
1,5	0,17	0,11
2,0	0,20	0,12
2,5	0,22	0,14
3,0	0,25	0,16
4,0	0,28	0,18
5,0	0,31	0,20
6,0	0,34	0,22
8,0	0,40	0,25
10,0	0,45	0,28
12,0	0,49	0,31
16,0	0,56	0,36
20,0	0,63	0,40
25,0	0,71	0,45
32,0	0,80	0,50



## Maximum feed angle with solid carbide

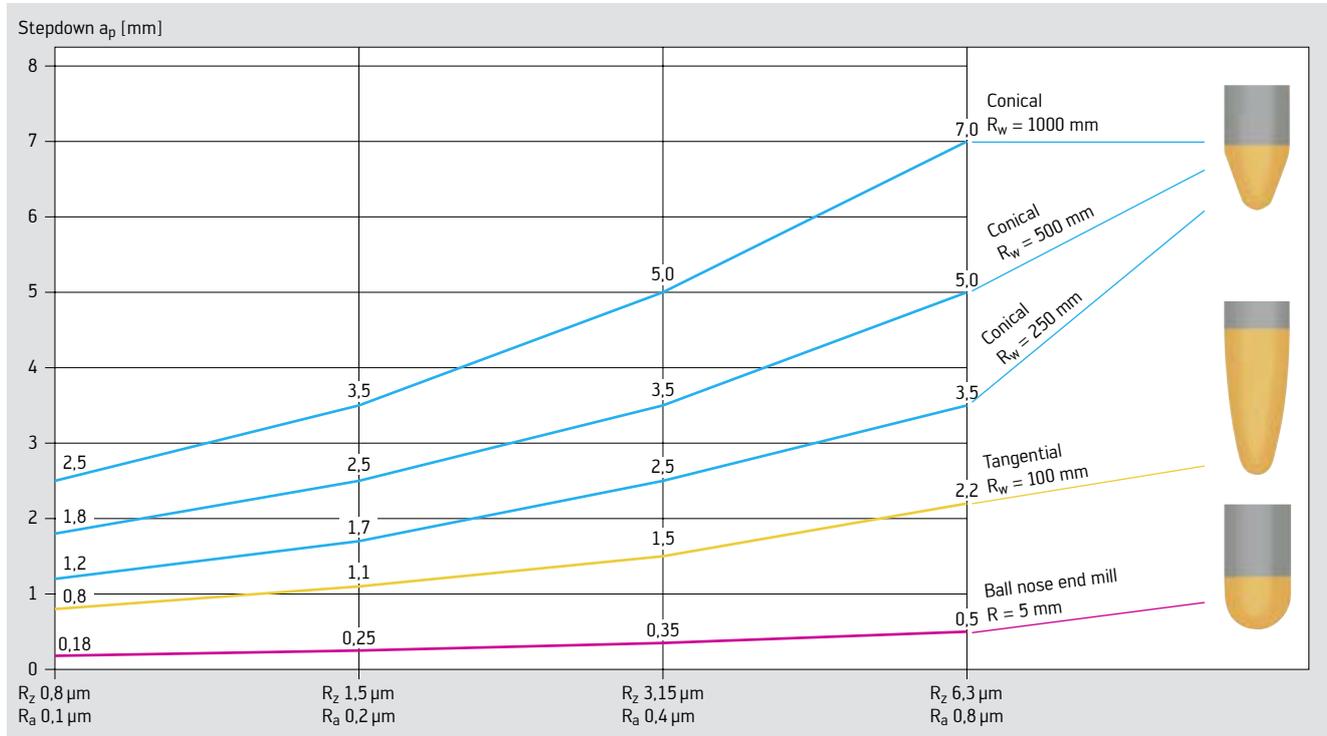
Material groups	Materials	Number of teeth					
		2	3	4	5	6-8	8
<b>P</b>	Steel	10*	8*	5	5	4	3
<b>M</b>	Stainless steel	5	5	5	5	4	3
<b>K</b>	Cast iron	10	10	8	6	5	3
<b>N</b>	NF metals	15	15	15	10	10	5
<b>S</b>	Materials with difficult cutting properties	5	5	5	5	4	3
<b>H</b>	Hard materials	2	2	1,5	1,5	1,5	1
<b>O</b>	Other	15	15	15	10	10	5

\* If  $R_m > 1100 \text{ N/mm}^2$ , reduce the ramping angle by 25%:  
MD344 Supreme – specialist in ramping strategies, feed angles up to  $45^\circ$  possible.



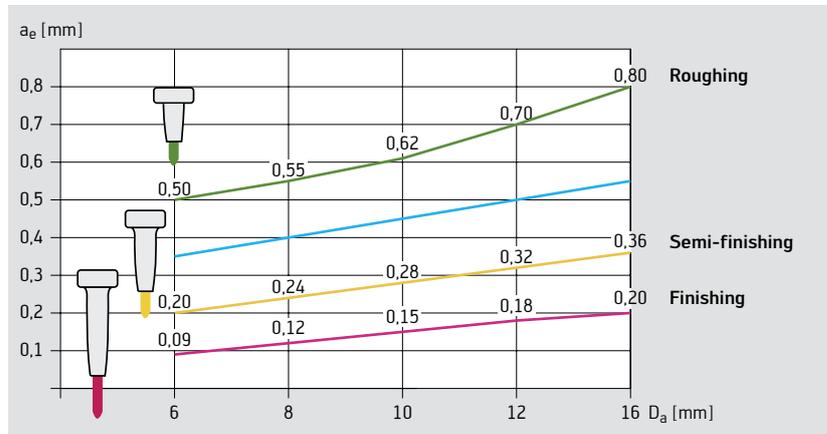
## Recommendations for the use of circle segment milling cutters

Standard values for axial depth of cut  $a_p$  [mm] depending on the tool type and depth of surface roughness



Example based on a profiling capability  $b_R/a_p$  of 5 mm  
 With lower  $a_p$ , higher  $a_e$  is possible due to the effect of force.

Standard values  $a_e$  [mm] depending on the outer diameter  $D_a$  [mm] and projection length



Standard values for cutting speed and feed per tooth

	Material designation	Tensile strength/hardness	$v_c$ [m/min]	$f_z$ [mm]
ISO P	S2335	800 N/mm <sup>2</sup>	300	0,07
	42CrMo4	1000 N/mm <sup>2</sup>	220	0,06
		1400 N/mm <sup>2</sup>	180	0,05
ISO M	1.4301		200	0,07
	1.4571		180	0,05
ISO K			350	0,15
ISO S	TiAl6V4		110	0,08
	Inconel 718		50	0,035
ISO N			400	0,2
ISO H	1.2344	bis 54 HRC	150	0,03

## High-feed geometry

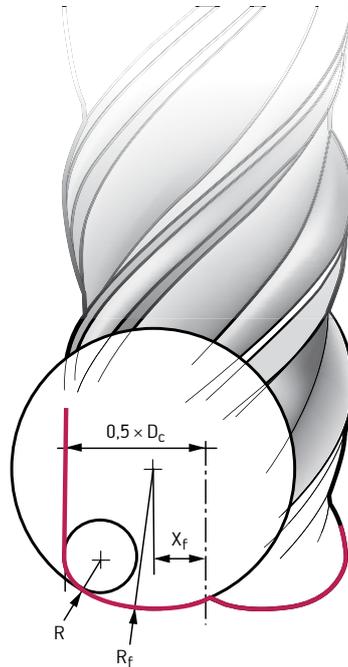
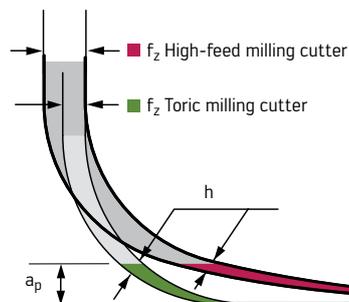
### High-feed milling cutters

**MD025 Supreme** and **MD025 ConeFit**  
(WJ30RD = ISO P & K; WJ30RA = M & S)

**MC025 Advance** and **MC025 ConeFit**  
(WJ30TF = ISO P, M, K, S → Universal)

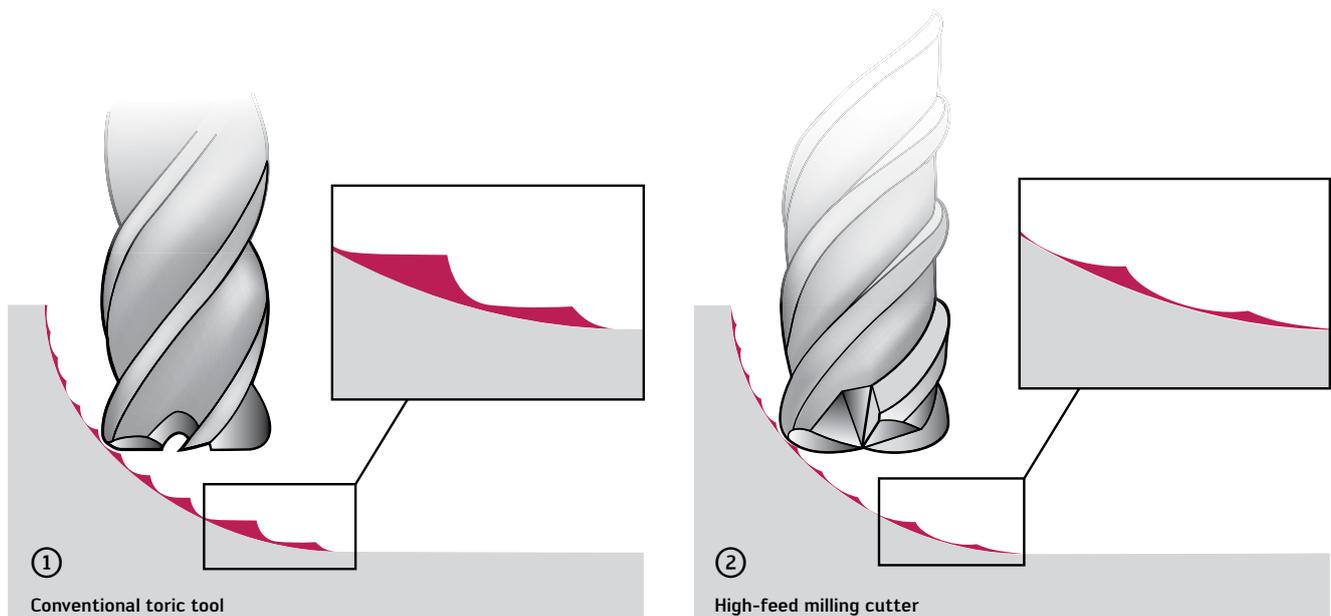
**MC089 Advance** (WB10TG = ISO H)  
**MC075 Ceramic** and **MC075 ConeFit Ceramic** (WIS10 = ISO S)

The chip thickness "h" is reduced thanks to the special end-face geometry. Extremely high feeds are possible. Forces are diverted axially towards the centre of the tool. This stabilises the machining process.



Despite operating at double the feed rate, the chip thickness (h) remains thinner.

In comparison with conventional toric tools (image 1), the high-feed milling cutter (image 2) reduces the amount of residual material produced. This is due to the special geometry that minimises the machining of residual material and increases the tool life of the subsequent finishing tool.



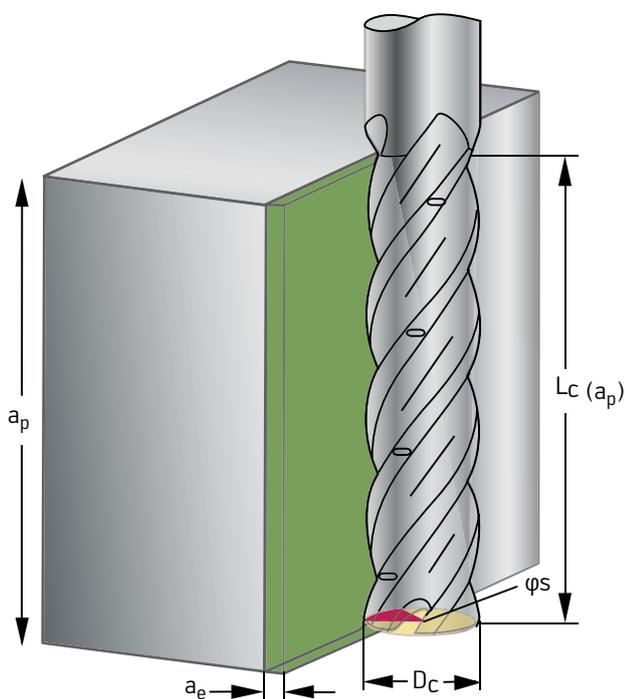
## Application information: Dynamic milling

### Maximum process reliability plus efficiency

Process reliability, productivity, cost-efficiency... The demands made on machining are constantly increasing. At the same time, the result must be of guaranteed high quality. To achieve this, modern machine tools and CAD/CAM systems are making milling operations more and more efficient.

Dynamic milling is a good example of this: It reduces machining times and simultaneously increases process reliability, tool life and metal removal rate.

### The machining strategy



Dynamic milling (High Dynamic Cutting – HDC) is based on the following factors:

- Maximum metal removal rates ( $Q_{max}$ )
- Small radial widths of cut ( $a_e$ )
- Large axial depths of cut ( $a_p$ )
- Constant  $h_m$  = constant average chip thickness ( $h_m$ )
- Engagement angle ( $\varphi_s$ ), adapted to the material to be machined



#### Prerequisites:

- Dynamic tools
- Dynamic machines
- CAM system for programming

#### BENEFITS FOR YOU

- High process reliability and metal removal rate
- Large depths of cut are possible
- Low thermal loading of the tool cutting edges
- Reduced tool wear
- Low power consumption, resulting in a longer service life for the machine spindle

## Application information: Dynamic milling (continued)

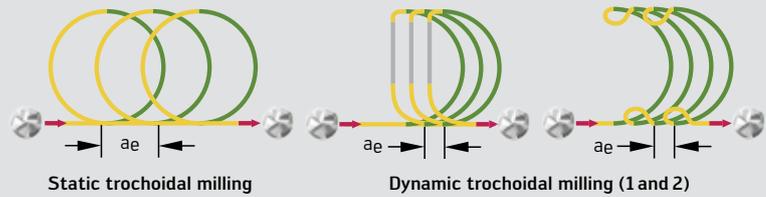
### Strategy: High metal removal rate with reduced tool wear

In comparison with conventional methods such as High Performance Cutting (HPC), High Dynamic Cutting (HDC) is set apart by its extremely low constant mechanical load and reduced contact times between the cutting edge and the material.

Result: Higher cutting parameters, higher metal removal rate, reduced tool wear.

### Trochoidal milling avoids idling

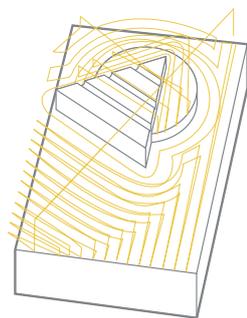
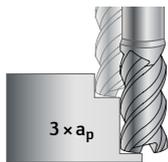
In static trochoidal milling operations (from "trochos" meaning "wheel"), the milling tool moves along circular (trochoidal) paths. The tool paths are optimally adapted to the workpiece in dynamic milling strategies and free travel is avoided, leading to an increase in the metal removal rate.



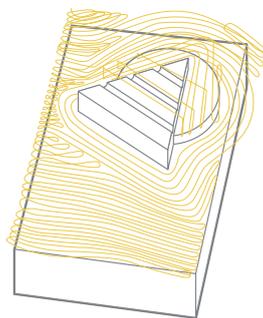
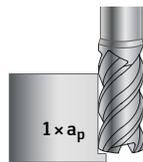
### Dynamic or conventional? A comparison of the strategies

High Performance Cutting (HPC) and High Dynamic Cutting (HDC) are milling strategies for roughing operations. The task at hand and component geometry determine which strategy is used.

#### High Performance Cutting (HPC)

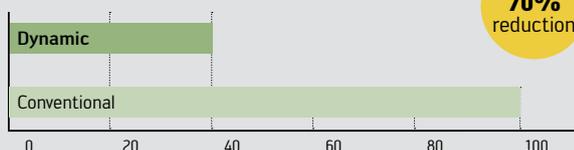


#### High Dynamic Cutting (HDC)



Features	HPC	HDC
Radial engagement ( $a_e$ )	Large	Low
Depth of cut ( $a_p$ )	Low	Large
Engagement angle	Large (up to 180°)	Low
Machining forces	High	Low
Machine	Powerful	Dynamic
Programming/software	Machine control unit	CAD/CAM system
Thermal load on the tool	High	Moderate

Machining time  
Comparison of milling strategies [%]



Dynamic milling can reduce the machining time by up to 70%.

[https://www.youtube.com/results?search\\_query=MD133](https://www.youtube.com/results?search_query=MD133)

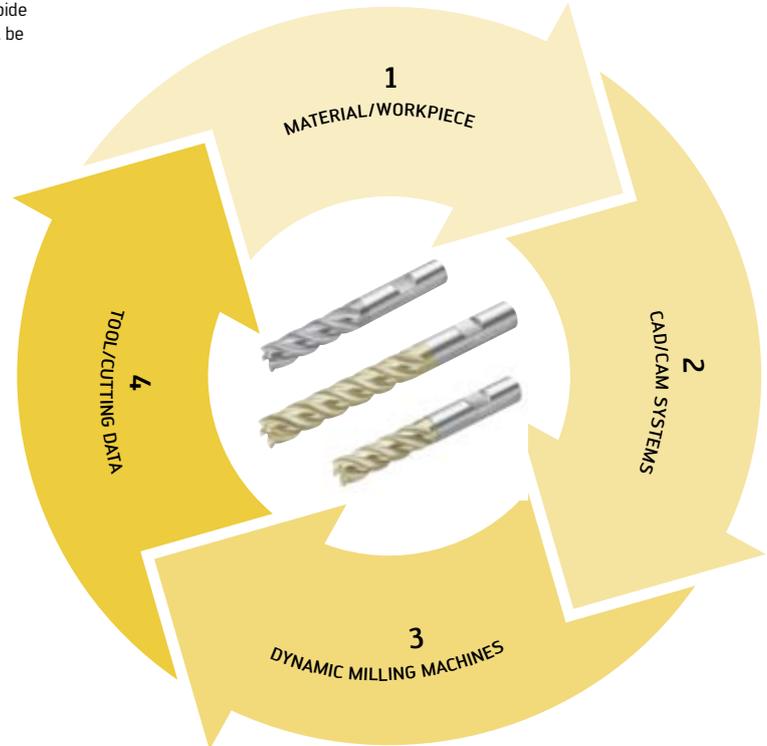
## Application information: Dynamic milling (continued)

### The four building blocks of dynamic milling

To be able to choose the optimum milling strategy and the ideal solid carbide milling cutter, the relevant factors for the machining operation must first be determined.

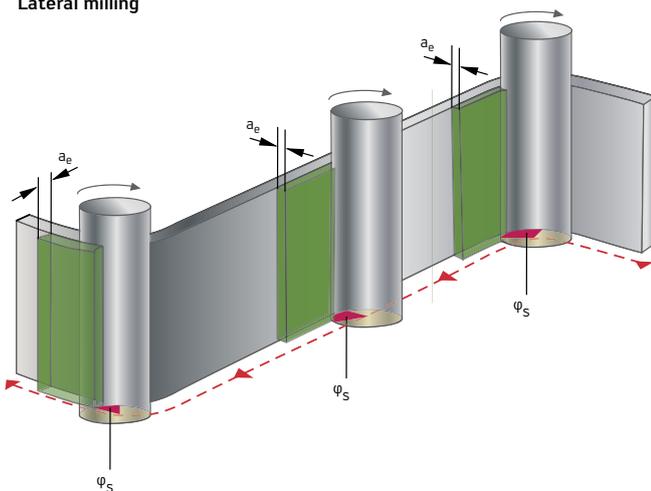
To be able to mill dynamically, the following basic requirements need to be met:

- A workpiece or material that can be dynamically machined,
- a corresponding CAD/CAM system,
- a dynamic milling machine and a suitable tool.

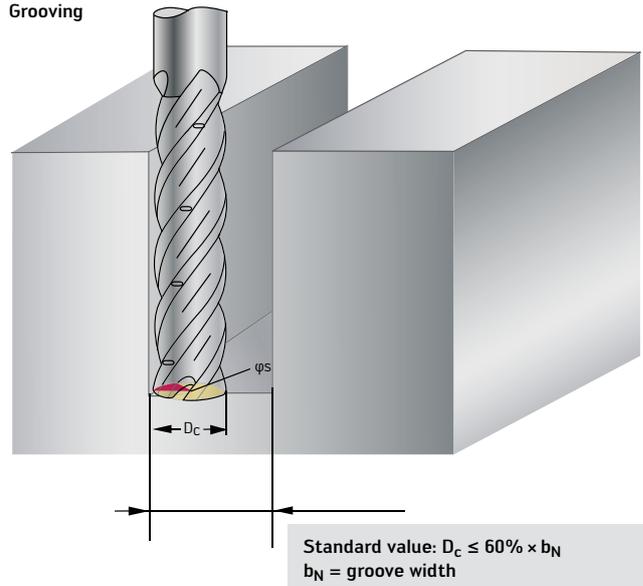


### Building block 1: Material/workpiece

#### Lateral milling



#### Grooving



The material dictates the cutting values for the milling tools, i.e. the maximum permissible radial cutting width ( $a_e$ ) and the engagement angle ( $\varphi_s$ ). The workpiece geometry determines the strategy, the cutting edge length ( $L_c$ ) and the tool diameter ( $D_c$ ), taking a maximum of 60% of the groove or pocket width to be produced as a standard value.

## Application information: Dynamic milling (continued)

### Building block 2: CAD/CAM systems

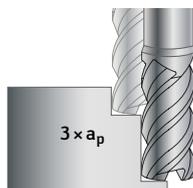
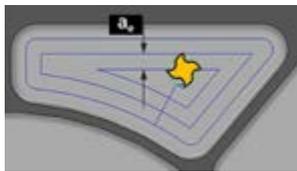
Most CAD/CAM systems feature the modules required for dynamic milling.

The software avoids full-depth cutting as well as collisions and calculates all important parameters such as

- milling direction
- optimal milling paths
- speed (n)
- feed ( $v_f$ )
- compliance with the engagement angle ( $\varphi_s$ )
- average chip thickness ( $h_m$ )

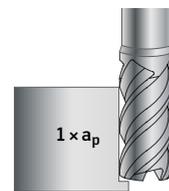
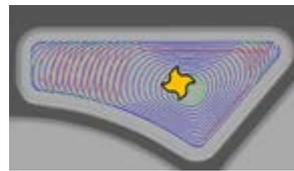
#### Comparison: Conventional vs. dynamic milling

##### High Performance Cutting (HPC)



**Milling paths, conventional:**  
 $a_e \rightarrow$  large and constant  
 $a_p \rightarrow$  small

##### High Dynamic Cutting (HDC)



**Milling paths, dynamic milling:**  
 $a_e \rightarrow$  small and variable  
 $a_p \rightarrow$  large (max. cutting edge length)

#### Important functions of CAD/CAM systems:

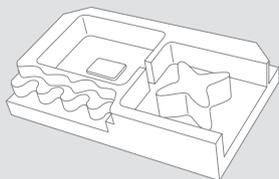
- Plunging movement can be selected (preferably helical plunging or start hole drilling)
- Milling paths parallel to the contour
- Choice of milling direction (preferably climb milling)
- Arc entry and exit movements
- Rounded roughing paths
- Residual material detection
- Reduction of  $a_e$ ,  $a_p$ ,  $v_c$ ,  $f_z$  if necessary
- Avoids the use of full-depth cutting
- Collision monitoring and simulation
- Special milling geometry can be programmed

### Building block 3: Dynamic milling machine

The term "dynamic milling machine" refers to the acceleration of the machine. In general, the machine has to have sufficient acceleration as well as excellent acceleration characteristics around corners.

Furthermore, it should have high rapid traverse and feed rates. Short calculation and switching times as well as a wide range of speeds are further fundamental requirements.

The advantages of horizontal machining, due to the high metal removal rate, are not to be underestimated when it comes to the removal of chips.



#### Suitable clamping systems

Weldon chucks, because they are held in place by screws, are protected from being pulled out during the machining process. Modern hydraulic expansion chucks achieve high retention forces and are distinguished by their excellent vibration damping.

Most chucks can be used for dynamic milling. However, Walter recommends a positive-locking chuck and the MD133 Supreme solid carbide milling cutter with Weldon shank.



Weldon chuck



AK182 hydraulic expansion chuck

## Application information: Dynamic milling (continued)

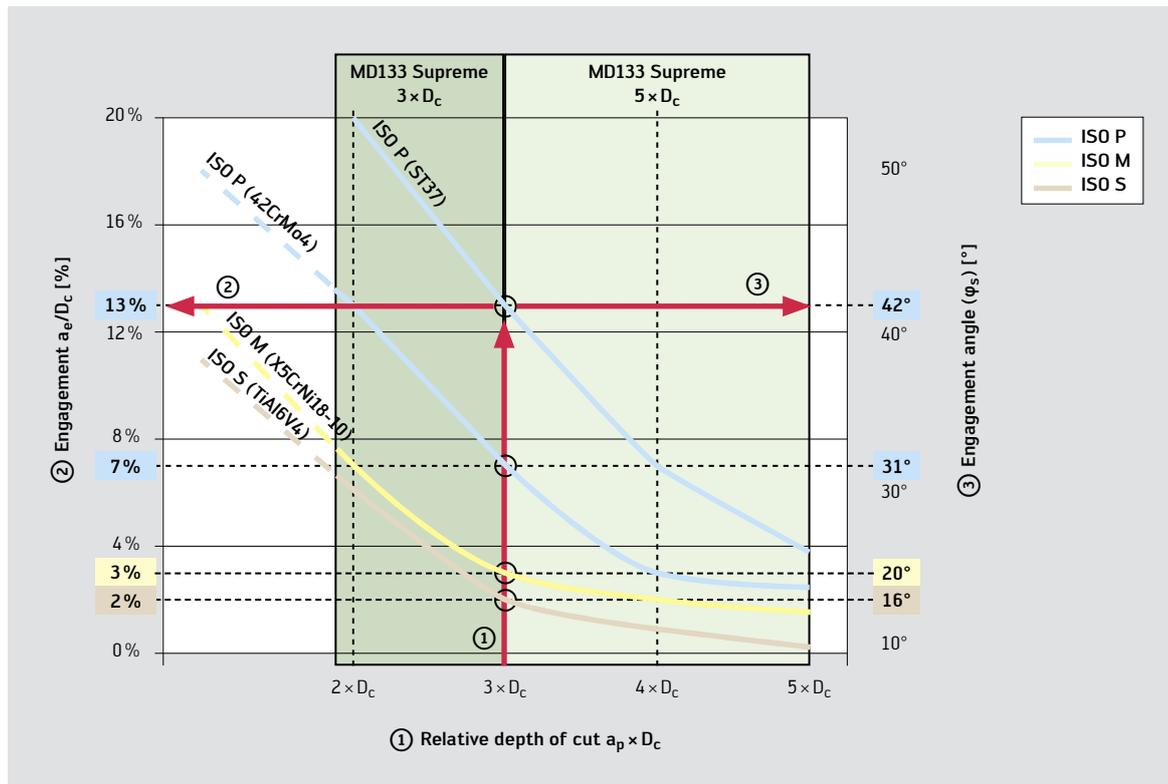
### Building block 4: Tool/cutting data

The cutting edge length ( $L_c$ ) and diameter ( $D_c$ ) are defined by the geometry of the workpiece. Optimally coordinated recommendations for tools and cutting data for each machine and task can be found with Walter GPS\*.

With usage recommendations for shoulder milling, face milling, slot milling and pocket milling, Walter GPS\* covers almost all milling operations that are conceivable in practice.

#### Cutting data recommendation

Recommendation for engagement angle ( $\phi_s$ ) and lateral engagement width for ISO P, ISO M and ISO S materials



#### Engagement angle ( $\phi_s$ ) $\phi$ [°] – application examples

$a_p$	ISO P		ISO M	ISO S
	ST37 – 490 N/mm <sup>2</sup>	42CrMo4 – 1.000 N/mm <sup>2</sup>	1.4301 – 675 N/mm <sup>2</sup>	TiAl6V4 – 1.100 N/mm <sup>2</sup>
$2 \times D_c$	53°	42°	31°	28°
$3 \times D_c$	42°	31°	20°	16°
$4 \times D_c$	31°	20°	16°	14°
$5 \times D_c$	23°	18°	14°	11°

\* For more detailed information on Walter GPS, go to:  
walter-tools.com

## Assembly instructions

### ConeFit



#### Safety information:

Please wear **safety gloves** during assembly with the tool holder, as the edges of the ConeFit milling cutter heads are sharp.

- Clean the interface and support face on the milling tool and tool holder
- Fit the ConeFit™ tool holder into its adaptor
- Screw the ConeFit milling tool by hand into the ConeFit tool holder until it is hand-tight (image 1)
- Using a torque wrench, tighten the ConeFit milling tool to the specified torque (see table) to ensure a positive-locking connection
- Ensure that the gap is closed and contact is made between supporting faces (image 2)

#### Torques for fitting the milling cutter heads

E	SW	Nm
10	8	12
12	10	15
16	12	30
20	16	50
25	20	65

## Designation key – Solid carbide and PCD milling tools

Example:

M	C	3	26	–	12.0	A	4	B	200	A	–	W	K	40	TF
1	2	3	4	5	6	7	8	9	10	11	Grade				

1	2	3	4
Tool group	Generation	Tool type	Tool type
<b>M</b> Milling	<b>P</b> Tools with brazed cutting edge	<b>0</b> Face milling cutter, high-feed milling cutter <b>1</b> Shoulder milling cutter <b>2</b> Shoulder/slot/helical milling cutter <b>3</b> Shoulder/slot/helical milling cutter, $\geq 40^\circ$ helix angle <b>4</b> Ball nose milling cutter/copy milling cutter <b>5</b> Profiling cutter <b>7</b> Routing cutter/circular interpolation cutter <b>8</b> Conical milling cutter/circle segment milling cutter	<b>00</b> Universal 0° helix angle, 60° chamfer milling cutter <b>01</b> Universal 0° helix angle, 90° chamfer milling cutter <b>02</b> Universal 0° helix angle, 120° chamfer milling cutter <b>03</b> Universal 0° helix angle, quadrant profiling cutter <b>04</b> Universal 0° helix angle, front/back deburrers <b>11</b> Universal 30° helix angle, type N <b>12</b> Universal 30° helix angle, type HSC <b>13</b> Universal 30° helix angle, type HSC, long version <b>16</b> Universal 30° helix angle, type 30 <b>19</b> Universal 40° helix angle, Kordel profile with internal coolant <b>20</b> Universal 40° helix angle, Kordel profile <b>21</b> Universal 45° helix angle, short version <b>22</b> Universal 45° helix angle, type N <b>24</b> Universal 45° helix angle, type 45 <b>25</b> Universal 50° helix angle, high-feed <b>26</b> Universal 50° helix angle, unequal groove depth, differential pitch <b>28</b> Universal 50° helix angle, type N, multi-flute <b>29</b> Universal 60° helix angle, type N, multi-flute <b>30</b> Universal 35°/38° helix angle, UNI, HPC geometry <b>32</b> Universal 35° helix angle <b>33</b> Universal 35° helix angle + chip breaker <b>38</b> Universal 30° helix angle, conical circle segment milling cutter <b>39</b> Universal 30° helix angle, tangential circle segment milling cutter <b>40</b> ISO P 38°–41° helix angle, HPC geometry <b>41</b> ISO P 50° helix angle, HPC, differential pitch <b>51</b> ISO M 35°/38° helix angle, without internal coolant <b>60</b> ISO N PCD brazed, continuous cutting edge <b>65</b> ISO N 30° helix angle, Al geometry, RAPAX G30 roughing profile, axial internal coolant <b>66</b> ISO N 30°–35° helix angle, Al geometry <b>67</b> ISO N 45° helix angle, Al geometry <b>68</b> ISO N 30° helix angle, aluminium, Kordel profile <b>77</b> ISO S 38°–40° helix angle, Ti geometry <b>80</b> ISO H 30° helix angle, HSC, type H <b>81</b> ISO H 30° helix angle, mini HSC T, type H <b>82</b> ISO H 30° helix angle, mini HSC R, type H <b>83</b> ISO H 30° helix angle, multi-flute, type H <b>87</b> ISO H 50° helix angle, multi-flute, type H <b>88</b> ISO H 50° helix angle, HPC, type H <b>89</b> ISO H 50° helix angle, high-feed, type H
5	6	7	
Delimiters	Cutting diameter	Shank type	
– Metric · Inch		<b>A</b> Cylindrical shank <b>B</b> Hole <b>E</b> ConeFit <b>T</b> ScrewFit <b>W</b> Weldon shank	
8	9	10	11
Number of teeth	Design standard	Corner radius	Version
	<b>A</b> DIN 6527 K <b>B</b> DIN 6527 L <b>C</b> ANSI stub <b>D</b> ANSI standard <b>L</b> P standard L <b>M</b> P standard mini <b>P</b> P standard <b>S</b> P standard S <b>X</b> P standard XL		<b>A</b> $I_3$ XS <b>B</b> $I_3$ S / $2 \times D_c^*$ <b>C</b> $I_3$ M / $3 \times D_c^*$ <b>D</b> $I_3$ L / $4 \times D_c^*$ <b>E</b> $I_3$ XL / $5 \times D_c^*$ <b>F</b> $I_3$ XXL / $6 \times D_c^*$ <b>G</b> $I_3$ XXXL / $8 \times D_c^*$ <b>H</b> $I_3$ XXXXL / $10 \times D_c^*$ <b>J</b> $L_c$ S / $3 \times D_c^*$ <b>K</b> $L_c$ M / $4 \times D_c^*$ <b>L</b> $L_c$ L / $5 \times D_c^*$ <b>V</b> Conical neck $\alpha \leq 3^\circ$ <b>W</b> Conical neck $\alpha \leq 6^\circ$ <b>X</b> Conical neck $\alpha \leq 12^\circ$

\* Standard values

## Grade designation key for solid carbide cutting tool materials

Example:

<b>W</b>	<b>K</b>	<b>40</b>	<b>TF</b>
Walter	1	2	3

1
Substrate
B
J
K

Solid carbide

2
Application range
Wear resistance
5
10
15
20
25
30
35
40
45
50
Toughness

3
Coating
TF TiAlN
UU Uncoated
CA CrN
RC TiAlN + AlTi
TZ AlTiN + ZrN
ED AlCrN
TG TiAlSiN
RD AlTiN + ZrN
RA TiAlN + TiAl
EA ACN
EN nACRoA
TP TiAlN + ZrN
DD NHC

## Grade designation key for PCD cutting tool materials

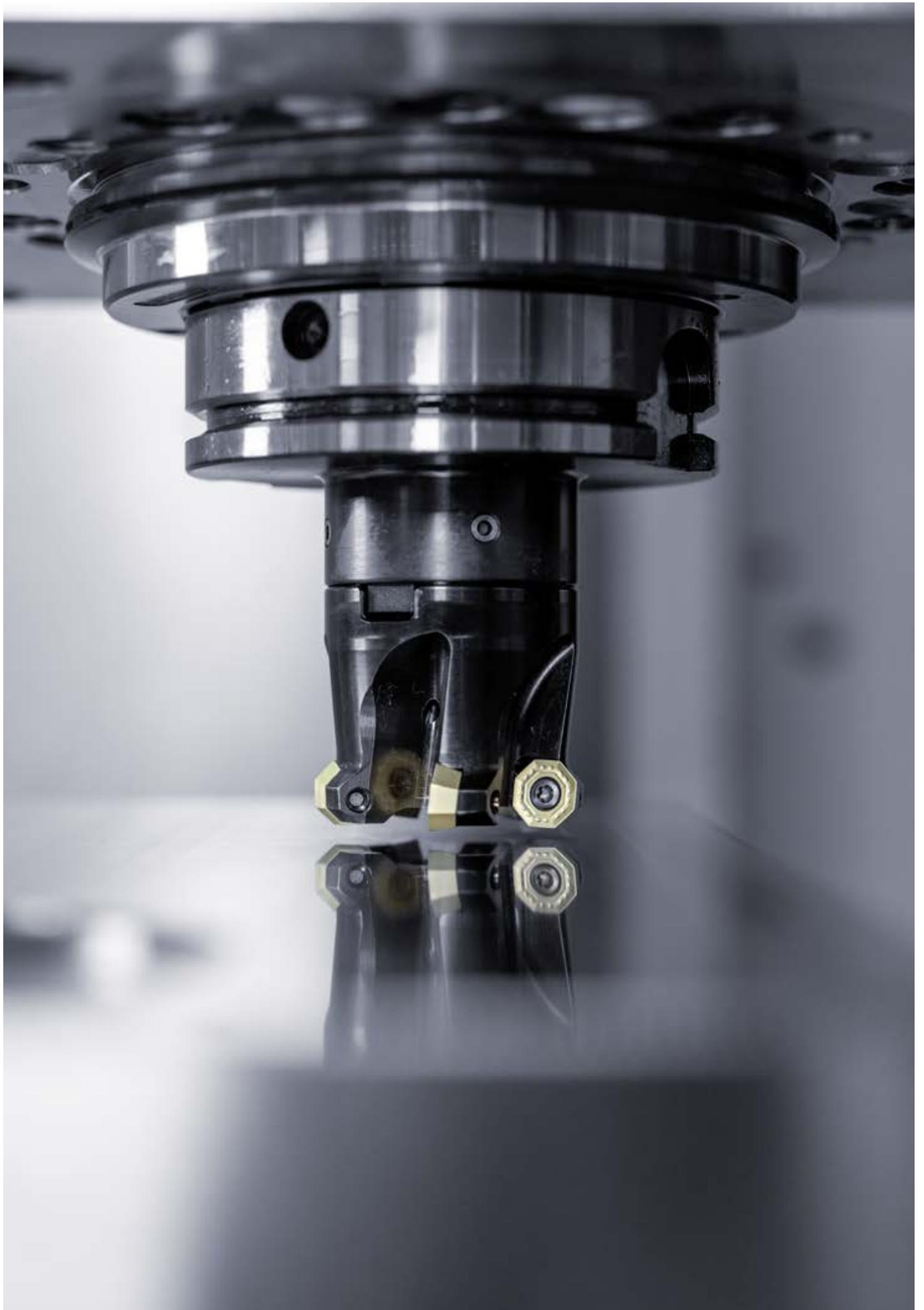
Example:

<b>W</b>	<b>D</b>	<b>N</b>	<b>20</b>
Walter	1	2	3

1
Cutting tool material
D Diamond

2
Primary application
P Steel
M Stainless steel
K Cast iron
N NF metals
S Materials with difficult cutting properties
H Hard materials

3
Application range
Wear resistance
01
05
10
20
21
23
30
32
33
43
Toughness



# Cutting data for roughing

## Face/shoulder milling

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength $R_m$ (N/mm <sup>2</sup> )	Machining group 1		Cutting material grades										
							Starting values for cutting speed $v_c$ [m/min]										
							HC										
							WKP35S		WKP25S		WAK15						
$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$											
1/1 1/2		1/1 1/2		1/1 1/2		1/1 1/2		1/1 1/2									
1/5		1/5		1/5		1/5		1/5									
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	250	300	290	320					
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	220	260	260	330					
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	215	250	255	320					
		C > 0,55 %	Annealed	190	640	P4	●	●●	220	260	260	330					
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	160	180	220	260					
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	210	240	250	315					
	Low-alloy steel	Annealed		175	590	P7	●	●●	220	270	260	320					
		Heat-treated		285	960	P8	●	●●	170	190	210	250					
		Heat-treated		380	1280	P9	●	●●	130	150	170	190					
		Heat-treated		430	1480	P10	●	●●	110	130	150	170					
		High-alloy steel and high-alloy tool steel	Annealed	200	680	P11	●	●●	130	160	140	170					
	Stainless steel	Hardened and tempered		300	1010	P12	●	●●	80	90	110	130					
		Hardened and tempered		380	1280	P13	●	●●	70	80	90	110					
		Ferritic/martensitic, annealed		200	680	P14	●	●●	140	160							
	M	Stainless steel	Martensitic, heat-treated		330	1110	P15	●	●●	90	110						
Austenitic, quench hardened				200	680	M1	●●	●									
Austenitic, precipitation hardened (PH)				300	1010	M2	●●	●									
K	Malleable cast iron	Austenitic/ferritic, duplex		230	780	M3	●●	●									
		Ferritic		200	400	K1	●	●●	160	190	180	210	210	230			
	Grey cast iron	Pearlitic		260	700	K2	●	●●	140	170	160	190	190	210			
		Low strength		180	200	K3	●	●●	300	330	320	350	380	410			
	Cast iron with spheroidal graphite	High strength/austenitic		245	350	K4	●	●●	190	220	180	210	230	260			
Ferritic			155	400	K5	●	●●	200	220	220	240	260	280				
Pearlitic			265	700	K6	●	●●	130	150	140	170	170	200				
CGI		230	400	K7	●	●●	130	160	150	180	180	200					
N	Wrought aluminium alloys	Not hardenable		30	-	N1	●●										
		Hardenable, hardened		100	340	N2	●●										
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	●●										
		≤ 12% Si, hardenable, hardened		90	310	N4	●●										
		> 12% Si, not hardenable		130	450	N5	●●										
	Magnesium-based alloys <sup>3</sup>			70	250	N6	●● <sup>3</sup>										
		Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	●●									
			Brass, bronze, red brass		90	310	N8	●●									
			Copper alloys, short-chipping		110	380	N9	●●									
	High tensile, Ampco			300	1010	N10	●●										
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●										
		Hardened		280	940	S2	●●										
		Ni- or Co-based	Annealed	250	840	S3	●●										
		Hardened		350	1180	S4	●●										
		Cast		320	1080	S5	●●										
	Titanium alloys	Pure titanium		200	680	S6	●●										
		α and β alloys, hardened		375	1260	S7	●●										
		β alloys		410	1400	S8	●●										
	Tungsten alloys		300	1010	S9	●●											
	Molybdenum alloys		300	1010	S10	●●											
H	Hardened steel	Hardened and tempered		50 HRC	-	H1	●●			60	75	65	80				
		Hardened and tempered		55 HRC	-	H2	●●										
		Hardened and tempered		60 HRC	-	H3	●●										
	Hardened cast iron	Hardened and tempered		55 HRC	-	H4	●●			45	60	50	65				
O	Thermoplastics	Without abrasive fillers				O1	●●	●	400	400			400	400			
	Thermosetting plastics	Without abrasive fillers				O2	●●	●	300	300			300	300			
	Plastic, glass-fibre reinforced	GFRP				O3											
	Plastic, carbon-fibre reinforced	CFRP				O4											
	Plastic, aramid-fibre reinforced	AFRP				O5											
	Graphite (technical)		80 Shore			O6	●●			400	500	600	800				

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Cutting data can also be used without coolant.

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\*  $a_e/D_c = 1/10$ ,  $v_c = 10\%$  higher than 1/5

Cutting material grades

Starting values for cutting speed  $v_c$  [m/min]

		WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WXN15		WNN15		WHH15X		WMG40		WK10		WSN10		WCB80		WCD10 <sup>2</sup>		WDN20		WEP20	
		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$			
		1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5
		230	290					250	300							170	215													250	300
		190	250					220	260							150	195													200	250
		180	230					215	250							120	155													200	250
		190	250					220	260							105	140													200	250
		130	145					160	180							80	100													150	210
		175	225					210	260							120	155													200	250
		190	240					220	270							140	175													150	210
		130	145					170	190							110	125													150	210
		100	110					130	150							110	120													150	210
		80	90					110	130							110	125													200	250
		115	140					130	160																					150	210
		75	90					80	90																					150	210
		65	80					70	80																					150	210
		115	140	125	155	130	160	160	160																						
		80	100	85	110	80	115	90	110																						
		110	130	120	145	130	155																								
		90	100	95	110	100	120																								
		100	120	115	130	120	140																								
								160	190	190	230					105	125					900	1000								
								160	170	170	200					90	110					800	900								
								300	330	350	380					110	120					1100	1300	1000	1250						
								190	220	190	230					90	105					900	1000	800	950						
								200	220	240	260					110	120					750	900	650	800						
								130	150	150	180					90	105					650	750	600	700						
								130	160	160	190					80	100					650	750	600	700						
												2640	2640	2640	2640			1500	1500	2200	2200					3000	4000	3000	4000		
												1980	1980	1980	1980			1000	1000	1650	1650					2000	2000	2000	2000		
												660	730	660	730					550	605					1500	1500	1500	1500		
												530	530	530	530					440	440					1000	1000	1000	1000		
												265	310	265	310					220	260					500	500	500	500		
												530	530	530	530					440	440										
												460	460	460	460					380	380										
												260	300	260	300					220	260										
												190	200	190	200					160	170										
												150	160	150	160					120	130										
		65	70	75	80	80	90											75	80												
		45	50	50	60	60	65											45	50												
		50	55	55	65	60	70											55	60												
		30	35	35	40	40	45											25	30												
		40	45	45	50	50	55											35	40												
		65	70	75	80	80	90											75	80												
		30	35	35	40	40	45											25	30												
		30	35	30	40	30	45											30	40												
		70	80	70	80	70	80											70	80												
		70	80	70	80	70	80											70	80												
										65	80					50	60								450	550					
																35	45							220	280						
																								140	220						
										50	65					40	50							220	280						
		400	400			400	400			400	400	400	400			700	400	400	400	400	400										
		300	300			300	300			300	300	300	300			600	600	300	300	300	300										
										600	800	600	800			600	600					400	500								

HC = Coated carbide  
 HW = Uncoated carbide  
 HF = Uncoated fine-grained carbide  
 HT = Cermet

BH = CBN with high CBN content  
 DP = Polycrystalline diamond  
 CN = Silicon nitride Si<sub>3</sub>N<sub>4</sub>

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

# Cutting data for roughing

## High-feed milling

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1		Cutting material grades										
							Starting values for cutting speed v <sub>c</sub> [m/min]										
							HC										
							WKP35S		WKP25S		WAK15						
a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *													
1/1 1/2		1/1 1/2		1/1 1/2													
1/5		1/5		1/5													
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	250	300	290	320					
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	220	260	260	330					
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	215	250	255	320					
		C > 0,55 %	Annealed	190	640	P4	●	●●	220	260	260	330					
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	160	180	220	260					
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	210	240	250	315					
	Low-alloy steel	Annealed		175	590	P7	●	●●	220	270	260	320					
		Heat-treated		285	960	P8	●	●●	170	190	210	250					
		Heat-treated		380	1280	P9	●	●●	130	150	170	190					
		Heat-treated		430	1480	P10	●	●●	110	130	150	170					
		High-alloy steel and high-alloy tool steel	Annealed	200	680	P11	●	●●	130	160	140	170					
	Stainless steel	Hardened and tempered		300	1010	P12	●	●●	80	90	110	130					
		Hardened and tempered		380	1280	P13	●	●●	70	80	90	110					
		Ferritic/martensitic, annealed		200	680	P14	●	●●	140	160							
	M	Stainless steel	Martensitic, heat-treated		330	1110	P15	●	●●	90	110						
Austenitic, quench hardened				200	680	M1	●●	●									
Austenitic, precipitation hardened (PH)				300	1010	M2	●●	●									
K	Malleable cast iron	Austenitic/ferritic, duplex		230	780	M3	●●	●									
		Ferritic		200	400	K1	●	●●	160	190	180	210	210	230			
	Grey cast iron	Pearlitic		260	700	K2	●	●●	140	170	160	190	190	210			
		Low strength		180	200	K3	●	●●	300	330	320	350	380	410			
	Cast iron with spheroidal graphite	High strength/austenitic		245	350	K4	●	●●	190	220	180	210	230	260			
		Ferritic		155	400	K5	●	●●	200	220	220	240	260	280			
Pearlitic			265	700	K6	●	●●	130	150	140	170	170	200				
CGI		230	400	K7	●	●●	130	160	150	180	180	200					
N	Wrought aluminium alloys	Not hardenable		30	-	N1	●●										
		Hardenable, hardened		100	340	N2	●●										
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	●●										
		≤ 12% Si, hardenable, hardened		90	310	N4	●●										
		> 12% Si, not hardenable		130	450	N5	●●										
	Magnesium-based alloys <sup>3</sup>			70	250	N6	●● <sup>3</sup>										
		Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	●●									
			Brass, bronze, red brass		90	310	N8	●●									
			Copper alloys, short-chipping		110	380	N9	●●									
	High tensile, Ampco			300	1010	N10	●●										
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●										
		Hardened		280	940	S2	●●										
		Ni- or Co-based	Annealed	250	840	S3	●●										
		Hardened		350	1180	S4	●●										
		Cast		320	1080	S5	●●										
	Titanium alloys	Pure titanium		200	680	S6	●●										
		α and β alloys, hardened		375	1260	S7	●●										
		β alloys		410	1400	S8	●●										
	Tungsten alloys		300	1010	S9	●●											
	Molybdenum alloys		300	1010	S10	●●											
H	Hardened steel	Hardened and tempered		50 HRC	-	H1	●●			60	75	65	80				
		Hardened and tempered		55 HRC	-	H2	●●										
		Hardened and tempered		60 HRC	-	H3	●●										
	Hardened cast iron	Hardened and tempered		55 HRC	-	H4	●●			45	60	50	65				
O	Thermoplastics	Without abrasive fillers				O1	●●	●	400	400			400	400			
	Thermosetting plastics	Without abrasive fillers				O2	●●	●	300	300			300	300			
	Plastic, glass-fibre reinforced	GFRP				O3											
	Plastic, carbon-fibre reinforced	CFRP				O4											
	Plastic, aramid-fibre reinforced	AFRP				O5											
	Graphite (technical)		80 Shore			O6	●●			400	500	600	800				

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Cutting data can also be used without coolant.

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\* a<sub>e</sub>/D<sub>c</sub> = 1/10, v<sub>c</sub> = 10% higher than 1/5

Cutting material grades																			
Starting values for cutting speed v <sub>c</sub> [m/min]																			
HC												HF		HW		BH			
WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WNN15		WHH15X		WMG40		WK10		WDN20	
a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *	
1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5	1/1	1/5
230	290					250	300					170	215						
190	250					220	260					150	195						
180	230					215	250					120	155						
190	250					220	260					105	140						
130	145					160	180					80	100						
175	225					210	260					120	155						
190	240					220	270					140	175						
130	145					170	190					110	125						
100	110					130	150					110	120						
80	90					110	130					110	125						
115	140					130	160												
75	90					80	90												
65	80					70	80												
115	140	125	155	130	160	160	160												
80	100	85	110	80	115	90	110												
110	130	120	145	130	155														
90	100	95	110	100	120														
100	120	115	130	120	140														
						160	190	190	230			105	125						
						160	170	170	200			90	110						
						300	330	350	380			110	120						
						190	220	190	230			90	105						
						200	220	240	260			110	120						
						130	150	150	180			90	105						
						130	160	160	190			80	100						
										2640	2640			1500	1500	2200	2200	3000	4000
										1980	1980			1000	1000	1650	1650	2000	2000
										660	730					550	605	1500	1500
										530	530					440	440	1000	1000
										265	310					220	260	500	500
										530	530					440	440		
										460	460					380	380		
										260	300					220	260		
										190	200					160	170		
										150	160					120	130		
65	70	75	80	80	90									75	80				
45	50	50	60	60	65									45	50				
50	55	55	65	60	70									55	60				
30	35	35	40	40	45									25	30				
40	45	45	50	50	55									35	40				
65	70	75	80	80	90									75	80				
30	35	35	40	40	45									25	30				
30	35	30	40	30	45									30	40				
70	80	70	80	70	80									70	80				
70	80	70	80	70	80									70	80				
								65	80			50	60						
												35	45						
								50	65			40	50						
400	400			400	400			400	400			700	400	400	400	400	400		
300	300			300	300			300	300			600	600	300	300	300	300		
								600	800			600	600			400	500		

HC = Coated carbide  
 HW = Uncoated carbide  
 HF = Uncoated fine-grained carbide  
 HT = Cermet

The specified cutting data are average standard values.  
 For specific applications, adjustment is recommended.

# Cutting data for roughing

## Shoulder milling with full effective helical milling cutters

### (F2338F, F4038, F4138, F4238, F4338, F5038, F5138, M3255)

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength $R_{m}$ (N/mm <sup>2</sup> )	Machining group 1		Cutting material grades				
							Starting values for cutting speed $v_c$ (m/min)				
							HC				
							WKP35S		WKP25S		
$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$		$a_e / D_c^*$					
				1/2		1/5					
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	● ●	195	250	210	275
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	● ●	170	215	200	255
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	● ●	155	190	175	220
		C > 0,55 %	Annealed	190	640	P4	● ●	170	215	200	255
		C > 0,55 %	Heat-treated	300	1010	P5	● ●	130	145	165	200
		Free-machining steel (short-chipping)	Annealed	220	750	P6	● ●	150	210	170	210
	Low-alloy steel	Annealed	175	590	P7	● ●	170	215	200	255	
		Heat-treated	285	960	P8	● ●	130	145	155	200	
		Heat-treated	380	1280	P9	● ●	85	100	125	140	
		Heat-treated	430	1480	P10	● ●	80	90	110	120	
	High-alloy steel and high-alloy tool steel	Annealed	200	680	P11	● ●	100	120	110	130	
		Hardened and tempered	300	1010	P12	● ●	65	75	80	95	
		Hardened and tempered	380	1280	P13	● ●	60	70	70	80	
	Stainless steel	Ferritic/martensitic, annealed	200	680	P14	● ●	105	120			
Martensitic, heat-treated		330	1110	P15	● ●	60	70				
M	Stainless steel	Austenitic, quench hardened	200	680	M1	● ●					
		Austenitic, precipitation hardened (PH)	300	1010	M2	● ●					
		Austenitic/ferritic, duplex	230	780	M3	● ●					
K	Malleable cast iron	Ferritic	200	400	K1	● ●	150	170	120	220	
		Pearlitic	260	700	K2	● ●	120	140	130	150	
	Grey cast iron	Low strength	180	200	K3	● ●	160	180	180	230	
		High strength/austenitic	245	350	K4	● ●	120	140	130	150	
	Cast iron with spheroidal graphite	Ferritic	155	400	K5	● ●	140	150	150	160	
		Pearlitic	265	700	K6	● ●	105	115	120	125	
	CGI		230	400	K7	● ●	150	170	120	220	
N	Wrought aluminium alloys	Not hardenable	30	-	N1	● ●					
		Hardenable, hardened	100	340	N2	● ●					
	Cast aluminium alloys	≤ 12% Si, not hardenable	75	260	N3	● ●					
		≤ 12% Si, hardenable, hardened	90	310	N4	● ●					
		> 12% Si, not hardenable	130	450	N5	● ●					
	Magnesium-based alloys <sup>2</sup>		70	250	N6	● ● <sup>2</sup>					
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper	100	340	N7	● ●					
		Brass, bronze, red brass	90	310	N8	● ●					
		Copper alloys, short-chipping	110	380	N9	● ●					
		High tensile, Ampco	300	1010	N10	● ●					
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	● ●				
			Hardened	280	940	S2	● ●				
		Ni- or Co-based	Annealed	250	840	S3	● ●				
			Hardened	350	1180	S4	● ●				
			Cast	320	1080	S5	● ●				
	Titanium alloys	Pure titanium	200	680	S6	● ●					
		α and β alloys, hardened	375	1260	S7	● ●					
		β alloys	410	1400	S8	● ●					
	Tungsten alloys		300	1010	S9	● ●					
	Molybdenum alloys		300	1010	S10	● ●					
H	Hardened steel	Hardened and tempered	50 HRC	-	H1	● ●					
		Hardened and tempered	55 HRC	-	H2	● ●					
		Hardened and tempered	60 HRC	-	H3	● ●					
	Hardened cast iron	Hardened and tempered	55 HRC	-	H4	● ●					
O	Thermoplastics	Without abrasive fillers			O1	● ●	400	400			
	Thermosetting plastics	Without abrasive fillers			O2	● ●	300	300			
	Plastic, glass-fibre reinforced	GFRP			O3						
	Plastic, carbon-fibre reinforced	CFRP			O4						
	Plastic, aramid-fibre reinforced	AFRP			O5						
	Graphite (technical)		80 Shore			O6	● ●		400	500	

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\*  $a_e/D_c = 1/10$ ,  $v_c = 10\%$  higher than 1/5

Cutting material grades															
Starting values for cutting speed v <sub>c</sub> [m/min]															
HC														HW	
WAK15		WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WXN15		WK10	
a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *		a <sub>e</sub> / D <sub>c</sub> *	
1/2	1/5	1/2	1/5	1/1 1/2	1/5	1/2	1/5	1/2	1/5	1/2	1/5	1/2	1/5	1/2	1/5
			185	230						195	250				
			150	200						170	215				
			130	165						155	190				
			150	200						170	215				
			105	115						130	145				
			125	160						150	210				
			150	190						170	215				
			105	115						130	145				
			60	70						85	100				
			60	70						80	90				
			90	110						100	120				
			65	70						65	75				
			60	70						60	70				
			90	110	95	120	100	130	105	120					
			60	70	65	80	70	90	60	70					
			85	100	95	110	100	120							
			70	80	75	90	80	100							
			75	90	85	100	90	110							
	210	270								150	170	190	250		
	160	180								120	140	140	160		
	220	280								160	180	200	260		
	160	180								120	140	140	160		
	180	190								140	150	160	170		
	155	165								105	115	135	145		
	210	270								150	170	190	250		
														1800	1800
														1440	1440
														540	640
														430	430
														220	260
														430	430
														170	210
														280	280
														170	210
														130	170
			50	55	60	65	65	70							
			35	40	40	45	50	50							
			40	45	45	50	50	55							
			25	30	25	30	30	35							
			30	35	40	40	50	45							
			50	65	60	75	65	80							
			30	35	35	40	40	45							
			25	30	30	35	35	40							
			30	35	35	40	40	45							
			25	30	30	35	35	40							
	400	400	400	400			400	400	400	400	400	400	400	400	400
	300	300	300	300			300	300	300	300	300	300	300	300	300
	600	800								600	800	600	800	400	500

HC = Coated carbide  
HW = Uncoated carbide

The specified cutting data are average standard values.  
For specific applications, adjustment is recommended.

# Cutting data for roughing

## Slot milling with half effective helical milling cutters (M4256, M4257, M4258, M4792)

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength $R_m$ (N/mm <sup>2</sup> )	Machining group 1		Cutting material grades		
							Starting values for cutting speed $v_c$ (m/min)		
							HC WKP35S $a_e / D_c^*$		
							1/1 1/2	1/5	
<b>P</b>	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	● ●	195	250
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	● ●	170	215
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	● ●	155	190
		C > 0,55 %	Annealed	190	640	P4	● ●	170	215
		C > 0,55 %	Heat-treated	300	1010	P5	● ●	130	145
		Free-machining steel (short-chipping)	Annealed	220	750	P6	● ●	150	210
	Low-alloy steel		Annealed	175	590	P7	● ●	170	215
			Heat-treated	285	960	P8	● ●	130	145
			Heat-treated	380	1280	P9	● ●	85	100
			Heat-treated	430	1480	P10	● ●	80	90
	High-alloy steel and high-alloy tool steel		Annealed	200	680	P11	● ●	100	120
			Hardened and tempered	300	1010	P12	● ●	65	75
			Hardened and tempered	380	1280	P13	● ●	60	70
	Stainless steel		Ferritic/martensitic, annealed	200	680	P14	● ●	105	120
			Martensitic, heat-treated	330	1110	P15	● ●	60	70
<b>M</b>	Stainless steel		Austenitic, quench hardened	200	680	M1	● ●		
			Austenitic, precipitation hardened (PH)	300	1010	M2	● ●		
			Austenitic/ferritic, duplex	230	780	M3	● ●		
<b>K</b>	Malleable cast iron		Ferritic	200	400	K1	● ●	150	170
			Pearlitic	260	700	K2	● ●	120	140
	Grey cast iron		Low strength	180	200	K3	● ●	160	180
			High strength/austenitic	245	350	K4	● ●	120	140
	Cast iron with spheroidal graphite		Ferritic	155	400	K5	● ●	140	150
			Pearlitic	265	700	K6	● ●	105	115
		CGI		230	400	K7	● ●	150	170
<b>N</b>	Wrought aluminium alloys		Not hardenable	30	-	N1	● ●		
			Hardenable, hardened	100	340	N2	● ●		
	Cast aluminium alloys		≤ 12% Si, not hardenable	75	260	N3	● ●		
			≤ 12% Si, hardenable, hardened	90	310	N4	● ●		
			> 12% Si, not hardenable	130	450	N5	● ●		
	Magnesium-based alloys <sup>2</sup>			70	250	N6	● ● <sup>2</sup>		
	Copper and copper alloys (bronze/brass)		Non-alloyed, electrolytic copper	100	340	N7	● ●		
			Brass, bronze, red brass	90	310	N8	● ●		
			Copper alloys, short-chipping	110	380	N9	● ●		
			High tensile, Ampco	300	1010	N10	● ●		
<b>S</b>	Heat-resistant alloys	Fe-based		Annealed	200	680	S1	● ●	
				Hardened	280	940	S2	● ●	
		Ni- or Co-based		Annealed	250	840	S3	● ●	
				Hardened	350	1180	S4	● ●	
				Cast	320	1080	S5	● ●	
	Titanium alloys		Pure titanium	200	680	S6	● ●		
			α and β alloys, hardened	375	1260	S7	● ●		
			β alloys	410	1400	S8	● ●		
		Tungsten alloys		300	1010	S9	● ●		
		Molybdenum alloys		300	1010	S10	● ●		
<b>H</b>	Hardened steel		Hardened and tempered	50 HRC	-	H1	● ●		
			Hardened and tempered	55 HRC	-	H2	● ●		
			Hardened and tempered	60 HRC	-	H3	● ●		
		Hardened cast iron		Hardened and tempered	55 HRC	-	H4	● ●	
<b>O</b>	Thermoplastics	Without abrasive fillers				O1	● ●	400	400
	Thermosetting plastics	Without abrasive fillers				O2	● ●	300	300
	Plastic, glass-fibre reinforced	GFRP				O3			
	Plastic, carbon-fibre reinforced	CFRP				O4			
	Plastic, aramid-fibre reinforced	AFRP				O5			
	Graphite (technical)			80 Shore			O6	● ●	

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\*  $a_e / D_c = 1/10$ ,  $v_c = 10\%$  higher than 1/5



# Cutting data for roughing

## Slot milling with slotting cutters

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1		Cutting material grades				
							Starting values for cutting speed v <sub>c</sub> [m/min]				
							HC				
							WKP35S		WKP25S		
		a <sub>e</sub> / D <sub>c</sub>		a <sub>e</sub> / D <sub>c</sub>							
		1/4*	1/10	1/4*	1/10						
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	● ●	195	250	210	285
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	● ●	170	215	200	255
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	● ●	160	205	185	230
		C > 0,55 %	Annealed	190	640	P4	● ●	160	200	185	230
		C > 0,55 %	Heat-treated	300	1010	P5	● ●	130	145	165	200
		Free-machining steel (short-chipping)	Annealed	220	750	P6	● ●	160	205	190	245
	Low-alloy steel	Annealed	175	590	P7	● ●	170	215	200	255	
		Heat-treated	285	960	P8	● ●	125	145	155	200	
		Heat-treated	380	1280	P9	● ●	85	95	125	140	
		Heat-treated	430	1480	P10	● ●	80	90	120	130	
	High-alloy steel and high-alloy tool steel	Annealed	200	680	P11	● ●	100	120	110	145	
		Hardened and tempered	300	1010	P12	● ●	65	80	75	100	
		Hardened and tempered	380	1280	P13	● ●	60	70	70	90	
	Stainless steel	Ferritic/martensitic, annealed	200	680	P14	● ●	105	130			
Martensitic, heat-treated		330	1110	P15	● ●	60	85				
M	Stainless steel	Austenitic, quench hardened	200	680	M1	● ●					
		Austenitic, precipitation hardened (PH)	300	1010	M2	● ●					
		Austenitic/ferritic, duplex	230	780	M3	● ●					
K	Malleable cast iron	Ferritic	200	400	K1	● ●	140	155	155	180	
		Pearlitic	260	700	K2	● ●	135	145	100	155	
	Grey cast iron	Low strength	180	200	K3	● ●	160	180	180	230	
		High strength/austenitic	245	350	K4	● ●	120	140	130	150	
	Cast iron with spheroidal graphite	Ferritic	155	400	K5	● ●	140	150	170	190	
		Pearlitic	265	700	K6	● ●	110	120	110	150	
	CGI		230	400	K7	● ●	120	135	120	165	
N	Wrought aluminium alloys	Not hardenable	30	-	N1	● ●					
		Hardenable, hardened	100	340	N2	● ●					
	Cast aluminium alloys	≤ 12% Si, not hardenable	75	260	N3	● ●					
		≤ 12% Si, hardenable, hardened	90	310	N4	● ●					
		> 12% Si, not hardenable	130	450	N5	● ●					
	Magnesium-based alloys <sup>2</sup>		70	250	N6	● ● <sup>2</sup>					
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper	100	340	N7	● ●					
		Brass, bronze, red brass	90	310	N8	● ●					
		Copper alloys, short-chipping	110	380	N9	● ●					
		High tensile, Ampco	300	1010	N10	● ●					
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	● ●				
			Hardened	280	940	S2	● ●				
		Ni- or Co-based	Annealed	250	840	S3	● ●				
			Hardened	350	1180	S4	● ●				
			Cast	320	1080	S5	● ●				
	Titanium alloys	Pure titanium	200	680	S6	● ●					
		α and β alloys, hardened	375	1260	S7	● ●					
		β alloys	410	1400	S8	● ●					
	Tungsten alloys		300	1010	S9	● ●					
	Molybdenum alloys		300	1010	S10	● ●					
H	Hardened steel	Hardened and tempered	50 HRC	-	H1	● ●					
		Hardened and tempered	55 HRC	-	H2	● ●					
		Hardened and tempered	60 HRC	-	H3	● ●					
	Hardened cast iron	Hardened and tempered	55 HRC	-	H4	● ●					
O	Thermoplastics	Without abrasive fillers			O1	● ●	400	400			
	Thermosetting plastics	Without abrasive fillers			O2	● ●	300	300			
	Plastic, glass-fibre reinforced	GFRP			O3						
	Plastic, carbon-fibre reinforced	CFRP			O4						
	Plastic, aramid-fibre reinforced	AFRP			O5						
	Graphite (technical)		80 Shore		O6	● ●		400	500		

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\* a<sub>e</sub> = a<sub>e max</sub>



# Cutting data for roughing

## Copy milling

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> (N/mm <sup>2</sup> )	Machining group 1		Cutting material grades				
							Starting values for cutting speed v <sub>c</sub> [m/min]				
							HC WKP35S a <sub>e</sub> / D <sub>c</sub>				
			1/1	1/5	1/10						
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	240	300	300
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	200	255	275
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	185	240	240
		C > 0,55 %	Annealed	190	640	P4	●	●●	155	195	210
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	145	180	185
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	200	255	275
	Low-alloy steel	Annealed		175	590	P7	●	●●	165	210	230
		Heat-treated		285	960	P8	●	●●	155	195	215
		Heat-treated		380	1280	P9	●	●●	145	180	200
		Heat-treated		430	1480	P10	●	●●	120	155	170
		Annealed		200	680	P11	●	●●	110	145	160
		Heat-treated		300	1010	P12	●	●●	75	100	100
	High-alloy steel and high-alloy tool steel	Hardened and tempered		380	1280	P13	●	●●	65	80	90
		Annealed		200	680	P14	●	●●	120	155	170
		Martensitic, heat-treated		330	1110	P15	●	●●	110	145	155
M	Stainless steel	Austenitic, quench hardened	200	680	M1	●●	●				
		Austenitic, precipitation hardened (PH)	300	1010	M2	●●	●				
		Austenitic/ferritic, duplex	230	780	M3	●●	●				
K	Malleable cast iron	Ferritic	200	400	K1	●	●●	250	290	310	
		Pearlitic	260	700	K2	●	●●	200	240	260	
	Grey cast iron	Low strength	180	200	K3	●	●●	240	280	300	
		High strength/austenitic	245	350	K4	●	●●	190	230	250	
	Cast iron with spheroidal graphite	Ferritic	155	400	K5	●	●●	240	280	300	
		Pearlitic	265	700	K6	●	●●	190	230	250	
	CGI		230	400	K7	●	●●	180	220	250	
N	Wrought aluminium alloys	Not hardenable	30	-	N1	●●					
		Hardenable, hardened	100	340	N2	●●					
	Cast aluminium alloys	≤ 12% Si, not hardenable	75	260	N3	●●					
		≤ 12% Si, hardenable, hardened	90	310	N4	●●					
		> 12% Si, not hardenable	130	450	N5	●●					
	Magnesium-based alloys <sup>2</sup>		70	250	N6	●● <sup>2</sup>					
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	●●				
		Brass, bronze, red brass		90	310	N8	●●				
		Copper alloys, short-chipping		110	380	N9	●●				
		High tensile, Ampco		300	1010	N10	●●				
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●				
			Hardened	280	940	S2	●●				
		Ni- or Co-based	Annealed	250	840	S3	●●				
			Hardened	350	1180	S4	●●				
			Cast	320	1080	S5	●●				
	Titanium alloys	Pure titanium		200	680	S6	●●				
		α and β alloys, hardened		375	1260	S7	●●				
		β alloys		410	1400	S8	●●				
	Tungsten alloys		300	1010	S9	●●					
	Molybdenum alloys		300	1010	S10	●●					
H	Hardened steel	Hardened and tempered		50 HRC	-	H1	●●				
		Hardened and tempered		55 HRC	-	H2	●●				
		Hardened and tempered		60 HRC	-	H3	●●				
	Hardened cast iron	Hardened and tempered		55 HRC	-	H4	●●				
O	Thermoplastics	Without abrasive fillers				O1	●●	●	400	450	500
	Thermosetting plastics	Without abrasive fillers				O2	●●	●	300	350	400
	Plastic, glass-fibre reinforced	GFRP				O3					
	Plastic, carbon-fibre reinforced	CFRP				O4					
	Plastic, aramid-fibre reinforced	AFRP				O5					
	Graphite (technical)		80 Shore			O6	●●				

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.



# Cutting data for roughing

## Copy milling (continued)

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1		Cutting material grades				
							Starting values for cutting speed v <sub>c</sub> [m/min]				
							HC WKP35G a <sub>e</sub> / D <sub>c</sub>				
			1/1	1/5	1/10						
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	240	300	300
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	200	255	275
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	185	240	240
		C > 0,55 %	Annealed	190	640	P4	●	●●	155	195	210
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	145	180	185
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	200	255	275
	Low-alloy steel	Annealed		175	590	P7	●	●●	165	210	230
		Heat-treated		285	960	P8	●	●●	155	195	215
		Heat-treated		380	1280	P9	●	●●	145	180	200
		Heat-treated		430	1480	P10	●	●●	120	155	170
		High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	●	●●	110	145
	Hardened and tempered		300	1010	P12	●	●●	75	100	100	
	Hardened and tempered		380	1280	P13	●	●●	65	80	90	
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●	120	155	170
		Martensitic, heat-treated		330	1110	P15	●	●●	110	145	155
M	Stainless steel	Austenitic, quench hardened	200	680	M1	●●	●				
		Austenitic, precipitation hardened (PH)	300	1010	M2	●●	●				
		Austenitic/ferritic, duplex	230	780	M3	●●	●				
K	Malleable cast iron	Ferritic	200	400	K1	●	●●	250	290	310	
		Pearlitic	260	700	K2	●	●●	200	240	260	
	Grey cast iron	Low strength	180	200	K3	●	●●	240	280	300	
		High strength/austenitic	245	350	K4	●	●●	190	230	250	
	Cast iron with spheroidal graphite	Ferritic	155	400	K5	●	●●	240	280	300	
		Pearlitic	265	700	K6	●	●●	190	230	250	
	CGI		230	400	K7	●	●●	180	220	250	
N	Wrought aluminium alloys	Not hardenable	30	-	N1	●●					
		Hardenable, hardened	100	340	N2	●●					
	Cast aluminium alloys	≤ 12% Si, not hardenable	75	260	N3	●●					
		≤ 12% Si, hardenable, hardened	90	310	N4	●●					
		> 12% Si, not hardenable	130	450	N5	●●					
	Magnesium-based alloys <sup>2</sup>		70	250	N6	●● <sup>2</sup>					
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	●●				
		Brass, bronze, red brass		90	310	N8	●●				
		Copper alloys, short-chipping		110	380	N9	●●				
		High tensile, Ampco		300	1010	N10	●●				
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●				
			Hardened	280	940	S2	●●				
		Ni- or Co-based	Annealed	250	840	S3	●●				
			Hardened	350	1180	S4	●●				
			Cast	320	1080	S5	●●				
	Titanium alloys	Pure titanium		200	680	S6	●●				
		α and β alloys, hardened		375	1260	S7	●●				
		β alloys		410	1400	S8	●●				
	Tungsten alloys		300	1010	S9	●●					
	Molybdenum alloys		300	1010	S10	●●					
H	Hardened steel	Hardened and tempered		50 HRC	-	H1	●●				
		Hardened and tempered		55 HRC	-	H2	●●				
		Hardened and tempered		60 HRC	-	H3	●●				
	Hardened cast iron	Hardened and tempered		55 HRC	-	H4	●●				
O	Thermoplastics	Without abrasive fillers				O1	●●	●	400	450	500
	Thermosetting plastics	Without abrasive fillers				O2	●●	●	300	350	400
	Plastic, glass-fibre reinforced	GFRP				O3					
	Plastic, carbon-fibre reinforced	CFRP				O4					
	Plastic, aramid-fibre reinforced	AFRP				O5					
	Graphite (technical)		80 Shore			O6	●●				

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

Cutting material grades																		
Starting values for cutting speed $v_c$ [m/min]																		
HC						HF			HW			CN						
WXN15			WHH15X			WMG40			WK10			WIS10			WIS30			
$a_e / D_c$			$a_e / D_c$			$a_e / D_c$			$a_e / D_c$			$a_e / D_c$			$a_e / D_c$			
1/1	1/5	1/10	1/1	1/5	1/10	1/1	1/5	1/10	1/1	1/5	1/10	1/1	1/5	1/10	1/1	1/5	1/10	
			170	225	305													
			150	200	270													
			120	160	220													
			105	140	190													
			80	105	145													
			120	160	220													
			140	185	250													
			120	160	220													
			110	150	200													
			105	140	190													
			105	140	190													
			100	130	180													
			80	100	140													
			120	160	220													
			100	130	180													
			105	140	190													
			90	120	160													
			110	150	200													
			90	120	160													
			110	150	200													
			90	130	180													
			80	110	150													
	1920	1920	2110				1600	1600	1760	2000	2000	2200						
	1440	1440	1630				1200	1200	1360	1500	1500	1700						
	480	530	580				400	440	480	500	550	600						
	385	385	420				320	320	350	400	400	440						
	190	225	250				160	190	210	200	235	260						
	480	530	580				400	440	480	500	550	600						
	240	310	340				200	260	280	250	320	355						
	260	325	360				220	270	300	270	340	375						
	365	465	515				305	390	430	380	485	535						
	210	280	340				170	230	280	190	260	320						
							50	55	60				690	1070	1300	690	1070	1300
							40	45	50				690	1070	1300	690	1070	1300
							30	35	40				690	1070	1300	690	1070	1300
							70	90	100									
							30	40	45									
							30	40	45									
							40	45	50									
							40	45	50									
				50	65	85												
				35	50	70												
				35	45	60												
				40	55	80												
	700	800	900	700	800	900	650	800	900	700	850	950						
	580	735	810	600	700	800	550	700	800	600	765	840						
	600	700	800	600	700	800												

HC = Coated carbide  
 HW = Uncoated carbide  
 HF = Uncoated fine-grained carbide  
 CN = Silicon nitride ceramic Si<sub>3</sub>N<sub>4</sub>

The specified cutting data are average standard values. For specific applications, adjustment is recommended.

# Cutting data for semi-finishing and finishing Copy milling

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group <sup>1</sup>		Cutting material grades				
							Starting values for cutting speed v <sub>c</sub> [m/min]				
							HC WKP35S a <sub>e</sub> / D <sub>c</sub> * 1/1   1/5   1/20				
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	210	275	375
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	185	255	340
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	145	185	260
		C > 0,55 %	Annealed	190	640	P4	●	●●	120	165	220
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	90	120	160
	Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	190	260	340	
	Low-alloy steel	Annealed		175	590	P7	●	●●	165	220	295
		Heat-treated		285	960	P8	●	●●	145	185	260
		Heat-treated		380	1280	P9	●	●●	130	175	240
		Heat-treated		430	1480	P10	●	●●	120	165	220
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	●	●●	130	175	240
		Hardened and tempered		300	1010	P12	●	●●	120	165	220
		Hardened and tempered		380	1280	P13	●	●●	90	120	160
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●	145	185	260
		Martensitic, heat-treated		330	1110	P15	●	●●	110	145	200
M	Stainless steel	Austenitic, quench hardened		200	680	M1	●●	●			
		Austenitic, precipitation hardened (PH)		300	1010	M2	●●	●			
		Austenitic/ferritic, duplex		230	780	M3	●●	●			
K	Malleable cast iron	Ferritic		200	400	K1	●	●●	170	230	290
		Pearlitic		260	700	K2	●	●●	140	200	250
	Grey cast iron	Low strength		180	200	K3	●	●●	190	250	300
		High strength/austenitic		245	350	K4	●	●●	140	200	250
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	●	●●	190	250	300
		Pearlitic		265	700	K6	●	●●	150	210	260
	CGI		230	400	K7	●	●●	130	190	240	
N	Wrought aluminium alloys	Not hardenable		30	-	N1	●●				
		Hardenable, hardened		100	340	N2	●●				
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	●●				
		≤ 12% Si, hardenable, hardened		90	310	N4	●●				
		> 12% Si, not hardenable		130	450	N5	●●				
	Magnesium-based alloys <sup>2</sup>		70	250	N6	●● <sup>2</sup>					
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	●●				
Brass, bronze, red brass			90	310	N8	●●					
Copper alloys, short-chipping			110	380	N9	●●					
High tensile, Ampco			300	1010	N10	●●					
S	Heat-resistant alloys	Fe-based	Annealed		200	680	S1	●●			
			Hardened		280	940	S2	●●			
		Ni- or Co-based	Annealed		250	840	S3	●●			
			Hardened		350	1180	S4	●●			
			Cast		320	1080	S5	●●			
	Titanium alloys	Pure titanium		200	680	S6	●●				
		α and β alloys, hardened		375	1260	S7	●●				
		β alloys		410	1400	S8	●●				
	Tungsten alloys		300	1010	S9	●●					
	Molybdenum alloys		300	1010	S10	●●					
H	Hardened steel	Hardened and tempered		50 HRC	-	H1	●●				
		Hardened and tempered		55 HRC	-	H2	●●				
		Hardened and tempered		60 HRC	-	H3	●●				
	Hardened cast iron	Hardened and tempered		55 HRC	-	H4	●●				
O	Thermoplastics	Without abrasive fillers				O1	●●	●	450	500	550
	Thermosetting plastics	Without abrasive fillers				O2	●●	●	350	400	450
	Plastic, glass-fibre reinforced	GFRP				O3					
	Plastic, carbon-fibre reinforced	CFRP				O4					
	Plastic, aramid-fibre reinforced	AFRP				O5					
	Graphite (technical)		80 Shore			O6	●●				

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

<sup>2</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\* a<sub>e</sub>/D<sub>c</sub> = 1/50, v<sub>c</sub> = 40% higher than 1/20



# Cutting data for semi-finishing and finishing

## Copy milling (continued)

Material group	Overview of the main material groups and code letters		Brinell hardness HB	Tensile strength R <sub>m</sub> [N/mm <sup>2</sup> ]	Machining group 1		Cutting material grades				
							Starting values for cutting speed v <sub>c</sub> [m/min]				
							HC WKK25G a <sub>e</sub> / D <sub>c</sub> *				
							1/1	1/5	1/20		
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●			
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●			
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●			
		C > 0,55 %	Annealed	190	640	P4	●	●●			
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●			
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●			
	Low-alloy steel	Annealed		175	590	P7	●	●●			
		Heat-treated		285	960	P8	●	●●			
		Heat-treated		380	1280	P9	●	●●			
		Heat-treated		430	1480	P10	●	●●			
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	●	●●			
		Hardened and tempered		300	1010	P12	●	●●			
		Hardened and tempered		380	1280	P13	●	●●			
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●			
		Martensitic, heat-treated		330	1110	P15	●	●●			
M	Stainless steel	Austenitic, quench hardened	200	680	M1	●●	●				
		Austenitic, precipitation hardened (PH)	300	1010	M2	●●	●				
		Austenitic/ferritic, duplex	230	780	M3	●●	●				
K	Malleable cast iron	Ferritic	200	400	K1	●	●●	250	340	430	
		Pearlitic	260	700	K2	●	●●	225	280	375	
	Grey cast iron	Low strength	180	200	K3	●	●●	270	360	450	
		High strength/austenitic	245	350	K4	●	●●	225	280	375	
	Cast iron with spheroidal graphite	Ferritic	155	400	K5	●	●●	270	360	450	
		Pearlitic	265	700	K6	●	●●	230	280	410	
	CGI		230	400	K7	●	●●	210	270	360	
N	Wrought aluminium alloys	Not hardenable	30	-	N1	●●					
		Hardenable, hardened	100	340	N2	●●					
	Cast aluminium alloys	≤ 12% Si, not hardenable	75	260	N3	●●					
		≤ 12% Si, hardenable, hardened	90	310	N4	●●					
		> 12% Si, not hardenable	130	450	N5	●●					
	Magnesium-based alloys <sup>2</sup>		70	250	N6	●● <sup>2</sup>					
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	●●				
		Brass, bronze, red brass		90	310	N8	●●				
		Copper alloys, short-chipping		110	380	N9	●●				
		High tensile, Ampco		300	1010	N10	●●				
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●				
			Hardened	280	940	S2	●●				
		Ni- or Co-based	Annealed	250	840	S3	●●				
			Hardened	350	1180	S4	●●				
			Cast	320	1080	S5	●●				
	Titanium alloys	Pure titanium	200	680	S6	●●					
		α and β alloys, hardened	375	1260	S7	●●					
		β alloys	410	1400	S8	●●					
	Tungsten alloys		300	1010	S9	●●					
	Molybdenum alloys		300	1010	S10	●●					
H	Hardened steel	Hardened and tempered		50 HRC	-	H1	●●				
		Hardened and tempered		55 HRC	-	H2	●●				
		Hardened and tempered		60 HRC	-	H3	●●				
	Hardened cast iron	Hardened and tempered		55 HRC	-	H4	●●				
O	Thermoplastics	Without abrasive fillers				O1	●●	●	700	800	900
	Thermosetting plastics	Without abrasive fillers				O2	●●	●	600	700	800
	Plastic, glass-fibre reinforced	GFRP				O3					
	Plastic, carbon-fibre reinforced	CFRP				O4					
	Plastic, aramid-fibre reinforced	AFRP				O5					
	Graphite (technical)		80 Shore			O6	●●		600	700	900

- Recommended application (the specified cutting data is regarded as starting values for the recommended application)
- Possible application, reduce cutting data by 30–50%

<sup>1</sup> The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

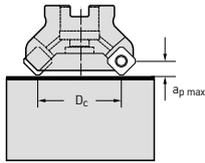
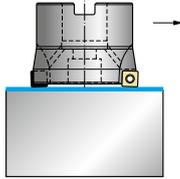
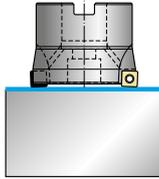
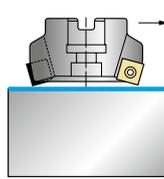
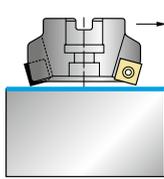
<sup>2</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\* a<sub>e</sub>/D<sub>c</sub> = 1/50, v<sub>c</sub> = 40% higher than 1/20



## Feed determination (starting values)

### Face milling cutters

Cutter type		M5012		M5012...-AP	M5011	M5011...-AP
 <p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>		 <p><b>Xtra-tec® XT</b></p>		 <p><b>Xtra-tec® XT</b></p>	 <p><b>Xtra-tec® XT</b></p>	 <p><b>Xtra-tec® XT</b></p>
Material group	Lead angle $\kappa$	88°		88°	75°	75°
		$f_{Z0}$ [mm]		$f_{Z0}$ [mm]	$f_{Z0}$ [mm]	$f_{Z0}$ [mm]
	Tool diameter or diameter range [mm]	32–100	50–160	50–160	50–160	50–125
	Maximum cutting data $a_{p\max} = L_c$ [mm]	8	10	10	8	8
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,15	0,20	0,24	0,22	0,26
	Low-alloy steel	0,14	0,18	0,22	0,20	0,24
	High-alloy steel and tool steel	0,14	0,18	0,22	0,20	0,24
	Stainless steel	0,09	0,12	0,14	0,15	0,18
<b>M</b>	Stainless steel <sup>2</sup>	0,08	0,10	0,12	0,12	0,14
<b>K</b>	Malleable cast iron	0,15	0,20	0,24	0,22	0,26
	Grey cast iron	0,17	0,22	0,26	0,25	0,30
	Cast iron with spheroidal graphite	0,15	0,20	0,24	0,22	0,26
	CGI	0,14	0,18	0,22	0,20	0,24
<b>N</b>	Wrought aluminium alloys	0,09	0,12	0,14		
	Cast aluminium alloys	0,09	0,12	0,14		
	Magnesium-based alloys <sup>3</sup>	0,08	0,10	0,12		
	Copper and copper alloys (bronze/brass)	0,08	0,10	0,12		
<b>S</b>	Heat-resistant alloys	0,06	0,08	0,10	0,10	0,12
	Titanium alloys	0,06	0,08	0,10	0,10	0,12
	Tungsten alloys	0,06	0,08	0,10	0,10	0,12
	Molybdenum alloys	0,06	0,08	0,10	0,10	0,12
<b>H</b>	Hardened steel	0,06	0,08	0,10	0,10	0,12
	Hardened cast iron	0,08	0,10	0,12	0,12	0,14
<b>O</b>	Thermoplastics	0,09	0,12	0,14		
	Plastic, carbon-fibre reinforced					
	Graphite (technical)	0,09	0,12	0,14		
Indexable insert types		SN. X090408.. SN. X0904ZNN..	SN. X1205ZNN SN. X120512.. SN. X120520..	SN. X1205ZNN SN. X120512.. SN. X120520..	SN. X120512.. SN. X120520.. SN. X1205ENN	SN. X120512.. SN. X120520.. SN. X1205ENN
Correction factor $Ka_e$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Face milling cutters (continued)

Cutter type		M5009		M5009...-AP	M5004		M4003	
Material group	<p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>	<p><b>Xtra-tec® XT</b></p>		<p><b>Xtra-tec® XT</b></p>	<p><b>Xtra-tec® XT</b></p>			
	Lead angle $\kappa$	45°		45°	43°		45°	
		$f_{z0}$ [mm]		$f_{z0}$ [mm]	$f_{z0}$ [mm]		$f_{z0}$ [mm]	
	Tool diameter or diameter range [mm]	25–100	50–160	40–160	50–160	20–100	25–160	
Maximum cutting data $a_{p\max} = L_c$ [mm]	5	6	6	3	4	4,5	6,5	
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,19	0,25	0,30	0,45	0,50	0,20	0,25
	Low-alloy steel	0,15	0,20	0,24	0,40	0,45	0,15	0,20
	High-alloy steel and tool steel	0,15	0,20	0,24	0,30	0,35	0,15	0,20
	Stainless steel	0,11	0,15	0,18	0,20	0,25	0,12	0,15
<b>M</b>	Stainless steel <sup>2</sup>	0,09	0,12	0,14	0,15	0,15	0,10	0,12
<b>K</b>	Malleable cast iron	0,19	0,25	0,30	0,40	0,45	0,20	0,25
	Grey cast iron	0,23	0,30	0,36	0,50	0,55	0,25	0,30
	Cast iron with spheroidal graphite	0,19	0,25	0,30	0,40	0,45	0,20	0,25
	CGI	0,15	0,20	0,24	0,25	0,25	0,17	0,20
<b>N</b>	Wrought aluminium alloys	0,11	0,15	0,18	0,25	0,25	0,12	0,15
	Cast aluminium alloys	0,11	0,15	0,18	0,20	0,20	0,12	0,15
	Magnesium-based alloys <sup>3</sup>	0,09	0,12	0,14	0,15	0,15	0,10	0,12
	Copper and copper alloys (bronze/brass)	0,09	0,12	0,14	0,15	0,15	0,10	0,12
<b>S</b>	Heat-resistant alloys	0,09	0,12	0,14	0,15	0,15	0,10	0,12
	Titanium alloys	0,09	0,12	0,14	0,15	0,15	0,10	0,12
	Tungsten alloys	0,09	0,12	0,14	0,15	0,15	0,10	0,12
	Molybdenum alloys	0,09	0,12	0,14	0,15	0,15	0,10	0,12
<b>H</b>	Hardened steel	0,09	0,12	0,14	0,15	0,15		
	Hardened cast iron	0,11	0,14	0,17	0,17	0,17		
<b>O</b>	Thermoplastics	0,11	0,15	0,18	0,20	0,20	0,10	0,15
	Plastic, carbon-fibre reinforced							0,15
	Graphite (technical)	0,11	0,15	0,18	0,15	0,15	0,10	
Indexable insert types		SN.X 0904ANN.. SN.X 090408..	SN.X1205ANN SN.X120512.. SN.X120520..	SN.X1205ANN SN.X120512.. SN.X120520..	OD.. 0504..	OD.. 0605..	SD.. 09T3AZN..	SD.. 1204AZN..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3	1,3	1,3
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 1$				1,0	1,0		
	2				1,0	1,0		
	3				1,0	1,0		
	4				0,6	1,0		
	6				0,6	0,6		
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$	8				0,6	0,6		
	$a_{p\max} = L_c$				0,6	0,6		

<sup>1</sup> and steel casting

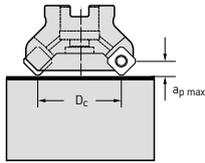
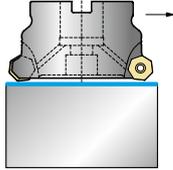
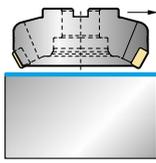
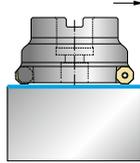
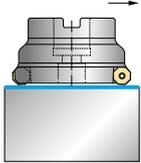
<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Face milling cutters (continued)

Cutter type		M3024		M3016	M2025	M2026
Material group	 <p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>	 <p>Walter BLAXX</p>		 <p>Walter BLAXX</p>		
	Lead angle $\kappa$	45°		60°	42°	42°
		$f_{z0}$ [mm]		$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	40–160	63–160	125–315	80–160	200–250
	Maximum cutting data $a_{p\max} = L_c$ [mm]	4,0	6,0	16,0	3,0	3,0
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,25	0,45	0,80		
	Low-alloy steel	0,20	0,40	0,70		
	High-alloy steel and tool steel	0,20	0,32	0,50		
	Stainless steel	0,15	0,22	0,40		
<b>M</b>	Stainless steel <sup>2</sup>	0,12	0,17	0,30		
<b>K</b>	Malleable cast iron	0,25	0,32	0,80	0,30	0,30
	Grey cast iron	0,30	0,55	1,00	0,35	0,35
	Cast iron with spheroidal graphite	0,25	0,45	0,80	0,30	0,30
	CGI	0,20	0,27	0,35	0,20	0,20
<b>N</b>	Wrought aluminium alloys					
	Cast aluminium alloys					
	Magnesium-based alloys <sup>3</sup>					
	Copper and copper alloys (bronze/brass)					
<b>S</b>	Heat-resistant alloys					
	Titanium alloys					
	Tungsten alloys					
	Molybdenum alloys					
<b>H</b>	Hardened steel			0,40	0,15	0,15
	Hardened cast iron			0,42	0,17	0,17
<b>O</b>	Thermoplastics					
	Plastic, carbon-fibre reinforced					
	Graphite (technical)					
Indexable insert types		XN.U 070508.. XN.U 0705ANN..	XNMU 0906..	LNMX 201012R-..	ON..0504.. P45424-1	ON..0504.. P45424-2
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Face milling cutters (continued)

Cutter type		F4045		F2260	F2250
Material group	<p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>	<p><b>Xtra-tec®</b></p>			
	Lead angle $\kappa$	45°		60°	75° + 90°
		$f_{Z0}$ [mm]		$f_{Z0}$ [mm]	$f_{Z0}$ [mm]
	Tool diameter or diameter range [mm]	63–200	80–200	100–250	63–200
	Maximum cutting data $a_{p\max} = L_c$ [mm]	4	6	11	3
<b>P</b>	Non-alloyed steel <sup>1</sup>			0,60	
	Low-alloy steel			0,45	
	High-alloy steel and tool steel				
	Stainless steel				
<b>M</b>	Stainless steel <sup>2</sup>				
<b>K</b>	Malleable cast iron	0,25	0,30	0,80	
	Grey cast iron	0,30	0,50	1,00	
	Cast iron with spheroidal graphite	0,25	0,40	0,80	
	CGI	0,20	0,25	0,35	
<b>N</b>	Wrought aluminium alloys				0,15
	Cast aluminium alloys				0,15
	Magnesium-based alloys <sup>3</sup>				0,15
	Copper and copper alloys (bronze/brass)				0,10
<b>S</b>	Heat-resistant alloys				
	Titanium alloys				
	Tungsten alloys				
	Molybdenum alloys				
<b>H</b>	Hardened steel	0,12	0,15	0,40	
	Hardened cast iron	0,14	0,17	0,42	
<b>O</b>	Thermoplastics				
	Plastic, carbon-fibre reinforced				
	Graphite (technical)				
Indexable insert types		XNHF 0705..	XNHF 0906..	LNMU 1508..	SPHW1204.. WCD10
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3
$f_z = f_{Z0} \cdot K_{a_e}$	1/50				

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) F2010 face milling cutter

Cutter type		F2010...					
		...R720M	...R592M	...R681M	...R758M	...R759M	...R500M
<p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>							
		<b>Xtra-tec® XT</b>	<b>Xtra-tec® XT</b>	<b>Xtra-tec® XT</b>		<b>Walter BLAXX</b>	
Material group	Lead angle $\kappa$	45°	43°	43°	45°	45°	90°
		$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	80–315	80–315	80–315	80–315	80–315	80–315
	Maximum cutting data $a_{p\max} = L_c$ [mm]	6	4 / 10	4 / 10	6,5	4,0	9
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,25	0,50	0,50	0,25	0,25	0,20
	Low-alloy steel	0,20	0,45	0,45	0,20	0,20	0,15
	High-alloy steel and tool steel	0,20	0,35	0,35	0,20	0,20	0,15
	Stainless steel	0,15	0,25	0,25	0,15	0,15	0,12
<b>M</b>	Stainless steel <sup>2</sup>	0,12	0,15	0,15	0,12	0,12	0,10
<b>K</b>	Malleable cast iron	0,25	0,45	0,45	0,25	0,25	0,20
	Grey cast iron	0,30	0,55	0,55	0,30	0,30	0,25
	Cast iron with spheroidal graphite	0,25	0,45	0,45	0,25	0,25	0,20
	CGI	0,20	0,25	0,25	0,20	0,20	0,20
<b>N</b>	Wrought aluminium alloys	0,15	0,25	0,25	0,15		0,15
	Cast aluminium alloys	0,15	0,20	0,20	0,15		0,15
	Magnesium-based alloys <sup>3</sup>	0,12	0,15	0,15	0,12		0,12
	Copper and copper alloys (bronze/brass)	0,12	0,15	0,15	0,12		0,12
<b>S</b>	Heat-resistant alloys	0,12	0,15	0,15	0,12		0,10
	Titanium alloys	0,12	0,15	0,15	0,12		0,10
	Tungsten alloys	0,12	0,15	0,15	0,12		0,10
	Molybdenum alloys	0,12	0,15	0,15	0,12		0,10
<b>H</b>	Hardened steel	0,12	0,15	0,15			0,10
	Hardened cast iron	0,14	0,17	0,17			0,10
<b>O</b>	Thermoplastics	0,15	0,20	0,20	0,15		
	Plastic, carbon-fibre reinforced				0,15		
	Graphite (technical)	0,15	0,15	0,15			
Indexable insert types		SN.X 1205..	OD..0605..	ODHX0605ZZN	SD..1204AZN..	XN.U070508.. XN.U0705ANN..	P2903-2R..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$	1/50						
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 1$		1,0	1,0			
	2		1,0	1,0			
	3		1,0	1,0			
	4		1,0	1,0			
	6		0,6	0,6			
	8		0,6	0,6			
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$	$a_{p\max} = L_c$		0,6	0,6			

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Shoulder milling cutters

Cutter type		M5137		M5130			
<p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>		<p><b>Xtra-tec® XT</b></p>		<p><b>Xtra-tec® XT</b></p>			
Lead angle $\kappa$		90°		90°			
Material group		$f_{z0}$ [mm]		$f_{z0}$ [mm]			
	Tool diameter or diameter range [mm]	25–63	50–160	10–63	16–50	25–80	25–160
	Maximum cutting data $a_{p\max} = L_c$ [mm]	5	8	5	8	11	15
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,15	0,20	0,12	0,16	0,21	0,26
	Low-alloy steel	0,11	0,15	0,08	0,11	0,16	0,19
	High-alloy steel and tool steel	0,11	0,15	0,08	0,11	0,16	0,19
	Stainless steel	0,09	0,12	0,06	0,08	0,13	0,16
<b>M</b>	Stainless steel <sup>2</sup>	0,08	0,10	0,06	0,08	0,11	0,13
<b>K</b>	Malleable cast iron	0,15	0,20	0,10	0,13	0,21	0,26
	Grey cast iron	0,19	0,25	0,12	0,16	0,26	0,32
	Cast iron with spheroidal graphite	0,15	0,20	0,10	0,13	0,21	0,26
	CGI	0,11	0,15	0,08	0,11	0,21	0,19
<b>N</b>	Wrought aluminium alloys			0,08	0,11	0,13	0,16
	Cast aluminium alloys			0,10	0,13	0,16	0,16
	Magnesium-based alloys <sup>3</sup>			0,08	0,11	0,13	0,16
	Copper and copper alloys (bronze/brass)			0,06	0,08	0,11	0,13
<b>S</b>	Heat-resistant alloys	0,09	0,12	0,06	0,08	0,13	0,16
	Titanium alloys	0,09	0,12	0,06	0,08	0,13	0,16
	Tungsten alloys	0,09	0,12	0,06	0,08	0,13	0,16
	Molybdenum alloys	0,09	0,12	0,06	0,08	0,13	0,16
<b>H</b>	Hardened steel			0,06	0,08	0,11	0,13
	Hardened cast iron			0,08	0,11	0,13	0,15
<b>O</b>	Thermoplastics			0,10	0,13	0,18	0,21
	Plastic, carbon-fibre reinforced						
	Graphite (technical)			0,08	0,11	0,16	0,16
Indexable insert types		TN MU 11T304R	TN MU 160508R..	AC.. 0602..	BC.. 0903..	BC.. 1204..	BC.. 1605..
Correction factor $Ka_e$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot Ka_e$	1/50						

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Shoulder milling cutters (continued)

Cutter type		F4042 / F4042R					M4132		
<p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>		<p><b>Xtra-tec®</b></p>							
Lead angle $\kappa$		90°					90°		
Material group		$f_{Z0}$ [mm]					$f_{Z0}$ [mm]		
		F4042	F4042R	F4042	F4042	F4042			
	Tool diameter or diameter range [mm]	10–50	16–63	25–315	40–315	50–160	15–25	25–80	50–125
	Maximum cutting data $a_{p\max} = L_c$ [mm]	8	10	11,7	15	16,7	5,6	8,4	11,6
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,15	0,18	0,20	0,25	0,30	0,10	0,15	0,20
	Low-alloy steel	0,10	0,12	0,15	0,18	0,22	0,08	0,12	0,15
	High-alloy steel and tool steel	0,10	0,12	0,15	0,18	0,22	0,08	0,12	0,15
	Stainless steel	0,08	0,10	0,12	0,15	0,18	0,06	0,10	0,12
<b>M</b>	Stainless steel <sup>2</sup>	0,08	0,08	0,10	0,12	0,14	0,06	0,08	0,10
<b>K</b>	Malleable cast iron	0,12	0,18	0,20	0,25	0,30	0,10	0,15	0,20
	Grey cast iron	0,15	0,20	0,25	0,30	0,40	0,12	0,20	0,25
	Cast iron with spheroidal graphite	0,12	0,15	0,20	0,25	0,30	0,10	0,15	0,20
	CGI	0,10	0,12	0,15	0,18	0,20	0,08	0,10	0,15
<b>N</b>	Wrought aluminium alloys	0,10	0,12	0,12	0,15				
	Cast aluminium alloys	0,12	0,15	0,15	0,15				
	Magnesium-based alloys <sup>3</sup>	0,10	0,12	0,12	0,15				
	Copper and copper alloys (bronze/brass)	0,08	0,10	0,10	0,12				
<b>S</b>	Heat-resistant alloys	0,08	0,10	0,12	0,15	0,18	0,06	0,10	0,10
	Titanium alloys	0,08	0,10	0,12	0,15	0,18	0,06	0,10	0,10
	Tungsten alloys	0,08	0,10	0,12	0,15	0,18	0,06	0,10	0,10
	Molybdenum alloys	0,08	0,10	0,12	0,15	0,18	0,06	0,10	0,10
<b>H</b>	Hardened steel	0,08	0,08	0,10	0,12	0,14	0,04	0,08	0,10
	Hardened cast iron	0,10	0,10	0,12	0,14	0,16	0,08	0,10	0,12
<b>O</b>	Thermoplastics	0,12	0,15	0,17	0,20				
	Plastic, carbon-fibre reinforced								
	Graphite (technical)	0,10	0,12	0,15	0,15				
Indexable insert types		AD.. 0803..	AD.. 10T3..	AD.. 1204..	AD.. 1606..	AD.. 1807..	SD.. 06T2...	SD.. 09T3...	SD.. 1204...
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3	1,3	1,3	1,3
$f_Z = f_{Z0} \cdot K_{a_e}$	1/50								

<sup>1</sup> and steel casting

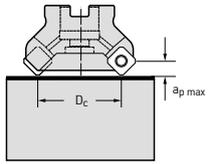
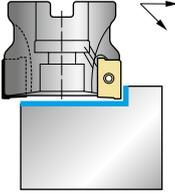
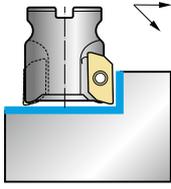
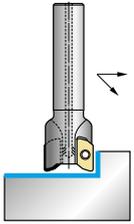
<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Shoulder milling cutters (continued)

Cutter type		M4130			M2331		M2131	
 <p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>					 <p>For face/shoulder milling operations</p>			
Material group	Lead angle $\kappa$	90°			90°		90°	
		$f_{Z0}$ [mm]			$f_{Z0}$ [mm]		$f_{Z0}$ [mm]	
	Tool diameter or diameter range [mm]	16–25	32–50	50–100	32–50	40–50	25–80	32–63
	Maximum cutting data $a_{p\max} = L_c$ [mm]	8	13	16	15	20	15	20
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,15	0,20	0,25				
	Low-alloy steel	0,10	0,15	0,17				
	High-alloy steel and tool steel	0,10	0,15	0,17				
	Stainless steel	0,08	0,12	0,15				
<b>M</b>	Stainless steel <sup>2</sup>	0,08	0,10	0,12				
<b>K</b>	Malleable cast iron	0,12	0,20	0,25				
	Grey cast iron	0,15	0,25	0,30				
	Cast iron with spheroidal graphite	0,12	0,20	0,25				
	CGI	0,10	0,15	0,17				
<b>N</b>	Wrought aluminium alloys				0,15	0,20	0,15	0,20
	Cast aluminium alloys				0,12	0,15	0,12	0,15
	Magnesium-based alloys <sup>3</sup>				0,12	0,12	0,12	0,12
	Copper and copper alloys (bronze/brass)				0,10	0,10	0,10	0,10
<b>S</b>	Heat-resistant alloys	0,08	0,12	0,15				
	Titanium alloys	0,08	0,12	0,15				
	Tungsten alloys	0,08	0,12	0,15				
	Molybdenum alloys	0,08	0,12	0,15				
<b>H</b>	Hardened steel							
	Hardened cast iron							
<b>O</b>	Thermoplastics	0,12	0,17	0,20	0,15	0,15	0,15	0,15
	Plastic, carbon-fibre reinforced							
	Graphite (technical)	0,10	0,15	0,15	0,12	0,12	0,12	0,12
Indexable insert types		LD.. 08T2..	LD.. 14T3..	LD.. 1704..	ZDGT 15A4..	ZDGT 20A..	ZDGT1504..	ZDGT2005..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3	1,3	1,3
$f_Z = f_{Z0} \cdot K_{a_e}$	1/50							

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Shoulder milling cutters (continued)

Cutter type		M2136	F5041 / F5141 / F5241			F4041
<p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>						
			<b>Walter BLAXX</b>			<b>Xtra-tec®</b>
Material group	Lead angle $\kappa$	90°	90°			90°
		$f_{Z0}$ [mm]	$f_{Z0}$ [mm]			$f_{Z0}$ [mm]
	Tool diameter or diameter range [mm]	50–160	F5041	F5141	F5241	40–315
	Maximum cutting data $a_{p\max} = L_c$ [mm]	6,5	8,4	12,2	15,2	13
<b>P</b>	Non-alloyed steel <sup>1</sup>		0,18	0,24	0,28	0,20
	Low-alloy steel		0,12	0,18	0,22	0,15
	High-alloy steel and tool steel		0,12	0,18	0,22	0,15
	Stainless steel		0,10	0,14	0,16	0,12
<b>M</b>	Stainless steel <sup>2</sup>		0,10	0,12	0,14	0,10
<b>K</b>	Malleable cast iron	0,20	0,14	0,24	0,28	0,20
	Grey cast iron	0,25	0,18	0,30	0,35	0,25
	Cast iron with spheroidal graphite	0,20	0,14	0,24	0,28	0,20
	CGI	0,15	0,12	0,18	0,20	0,15
<b>N</b>	Wrought aluminium alloys		0,12	0,15	0,15	0,12
	Cast aluminium alloys		0,15	0,15	0,15	0,15
	Magnesium-based alloys <sup>3</sup>		0,12	0,15	0,15	0,12
	Copper and copper alloys (bronze/brass)		0,10	0,12	0,12	0,10
<b>S</b>	Heat-resistant alloys		0,10	0,14	0,17	0,12
	Titanium alloys		0,10	0,14	0,17	0,12
	Tungsten alloys		0,10	0,14	0,17	0,12
	Molybdenum alloys		0,10	0,14	0,17	0,12
<b>H</b>	Hardened steel		0,10	0,12	0,14	0,12
	Hardened cast iron		0,12	0,14	0,20	0,14
<b>O</b>	Thermoplastics		0,14	0,20	0,20	0,15
	Plastic, carbon-fibre reinforced					
	Graphite (technical)		0,12	0,18	0,18	0,12
Indexable insert types		SNEF1204..	LN..0904..	LN..1306..	LN..1607..	LNGX1307..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3
$f_Z = f_{Z0} \cdot K_{a_e}$	1/50					

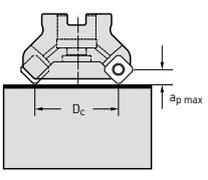
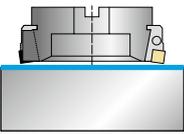
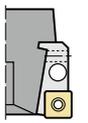
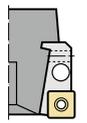
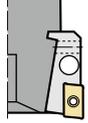
<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) F2010 shoulder milling cutter

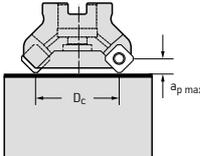
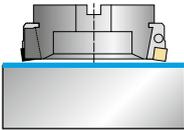
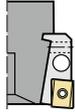
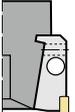
Cutter type		F2010...									
		...R756M	...R757M	...R764M	...R765M	...R718M	...R719M				
Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{p\max} = L_c$ 											
											
Lead angle $\kappa$		90°	90°	90°	90°	90°	90°				
Material group		$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]				
	Tool diameter or diameter range [mm]	80–315	80–315	80–315	80–315	80–315	80–315				
	Maximum cutting data $a_{p\max} = L_c$ [mm]	8,4	11,6	11	15	11,7	15				
	Non-alloyed steel <sup>1</sup>	0,15	0,20	0,21	0,26	0,20	0,25				
	Low-alloy steel	0,12	0,15	0,16	0,19	0,15	0,18				
<b>P</b>	High-alloy steel and tool steel	0,12	0,15	0,16	0,19	0,15	0,18				
	Stainless steel	0,10	0,12	0,13	0,16	0,12	0,15				
	<b>M</b>	Stainless steel <sup>2</sup>	0,08	0,10	0,11	0,13	0,10	0,12			
	<b>K</b>	Malleable cast iron	0,15	0,20	0,21	0,26	0,20	0,25			
Grey cast iron		0,20	0,25	0,26	0,32	0,25	0,30				
Cast iron with spheroidal graphite		0,15	0,20	0,21	0,26	0,20	0,25				
CGI		0,10	0,15	0,21	0,19	0,15	0,18				
<b>N</b>	Wrought aluminium alloys			0,13	0,16	0,12	0,15				
	Cast aluminium alloys			0,16	0,16	0,15	0,15				
	Magnesium-based alloys <sup>3</sup>			0,13	0,16	0,12	0,15				
	Copper and copper alloys (bronze/brass)			0,11	0,13	0,10	0,12				
<b>S</b>	Heat-resistant alloys	0,10	0,10	0,13	0,16	0,12	0,15				
	Titanium alloys	0,10	0,10	0,13	0,16	0,12	0,15				
	Tungsten alloys	0,10	0,10	0,13	0,16	0,12	0,15				
	Molybdenum alloys	0,10	0,10	0,13	0,16	0,12	0,15				
<b>H</b>	Hardened steel	0,08	0,10	0,11	0,13	0,10	0,12				
	Hardened cast iron	0,10	0,12	0,13	0,15	0,12	0,14				
<b>O</b>	Thermoplastics			0,18	0,21	0,17	0,20				
	Plastic, carbon-fibre reinforced										
	Graphite (technical)			0,16	0,16	0,15	0,15				
Indexable insert types		SD..09T3...	SD..1204...	BC..1204..	BC..1605..	AD..1204..	AD..1606..				
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0				
	1/5	1,1	1,1	1,1	1,1	1,1	1,1				
	1/10	1,2	1,2	1,2	1,2	1,2	1,2				
	1/20	1,3	1,3	1,3	1,3	1,3	1,3				
$f_z = f_{z0} \cdot K_{a_e}$	1/50										

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### F2010 shoulder milling cutter (continued)

Cutter type		F2010...		
Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{p\max} = L_c$ 				
		...R722M	...R752M	...R751M
		 <b>Xtra-tec®</b>	 <b>Walter BLAXX</b>	 <b>Walter BLAXX</b>
Lead angle $\kappa$		90°	90°	90°
Material group		$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	80–315	80–315	80–315
	Maximum cutting data $a_{p\max} = L_c$ [mm]	13	12,2	8,4
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,20	0,24	0,18
	Low-alloy steel	0,15	0,18	0,12
	High-alloy steel and tool steel	0,15	0,18	0,12
	Stainless steel	0,12	0,14	0,10
<b>M</b>	Stainless steel <sup>2</sup>	0,10	0,12	0,10
<b>K</b>	Malleable cast iron	0,20	0,24	0,14
	Grey cast iron	0,25	0,30	0,18
	Cast iron with spheroidal graphite	0,20	0,24	0,14
	CGI	0,15	0,18	0,12
<b>N</b>	Wrought aluminium alloys	0,12	0,15	0,12
	Cast aluminium alloys	0,15	0,15	0,15
	Magnesium-based alloys <sup>3</sup>	0,12	0,15	0,12
	Copper and copper alloys (bronze/brass)	0,10	0,12	0,10
<b>S</b>	Heat-resistant alloys	0,12	0,14	0,10
	Titanium alloys	0,12	0,14	0,10
	Tungsten alloys	0,12	0,14	0,10
	Molybdenum alloys	0,12	0,14	0,10
<b>H</b>	Hardened steel	0,12	0,12	0,10
	Hardened cast iron	0,14	0,14	0,12
<b>O</b>	Thermoplastics	0,15	0,20	0,14
	Plastic, carbon-fibre reinforced			
	Graphite (technical)	0,12	0,18	0,12
Indexable insert types		LNGX1307..	LN..1306..	LN..0904..
Correction factor $K_{a_e}$				
for the feed per tooth depending on				
the ratio of cutting width $a_e$ to milling				
cutter diameter $D_c$				
$a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0
1/5		1,1	1,1	1,1
1/10		1,2	1,2	1,2
1/20		1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$				
1/50				

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) High-feed milling cutters

Cutter type		M5008		M4002			M4002		
<p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>		<p><b>Xtra-tec® XT</b></p>							
Material group	Lead angle $\kappa$	0°–20°	73°	15°			75°		
		$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]			$f_{z0}$ [mm]		
	Tool diameter or diameter range [mm]	16–66	16–66	20–66	25–66	50–125	20–66	25–66	50–125
	Maximum cutting data $a_{p\max} = L_c$ [mm]	1	1,0	1	1,5	2,0	$a_{r\max} = 5,7$	$a_{r\max} = 8,4$	$a_{r\max} = 11,4$
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,80	0,10	1	1,50	2,00	0,18	0,25	0,30
	Low-alloy steel	0,80	0,10	1	1,40	1,80	0,16	0,22	0,25
	High-alloy steel and tool steel	0,72	0,10	0,9	1,20	1,60	0,12	0,16	0,22
	Stainless steel	0,32	0,10	0,4	0,80	1,00	0,10	0,12	0,15
<b>M</b>	Stainless steel <sup>2</sup>	0,24	0,10	0,3	0,50	0,80	0,10	0,12	0,15
<b>K</b>	Malleable cast iron	0,24	0,10	0,3	0,50	0,80	0,16	0,22	0,28
	Grey cast iron	0,96	0,10	1,2	1,40	1,60	0,18	0,25	0,30
	Cast iron with spheroidal graphite	0,80	0,10	1	1,20	1,40	0,16	0,22	0,28
	CGI	0,80	0,10	1	1,20	1,40	0,16	0,22	0,28
<b>N</b>	Wrought aluminium alloys								
	Cast aluminium alloys								
	Magnesium-based alloys <sup>3</sup>								
	Copper and copper alloys (bronze/brass)								
<b>S</b>	Heat-resistant alloys	0,32	0,10	0,4	0,60	0,80	0,08	0,10	0,12
	Titanium alloys	0,32	0,10	0,4	0,60	0,80	0,08	0,10	0,12
	Tungsten alloys	0,32	0,10	0,4	0,60	0,80	0,08	0,10	0,12
	Molybdenum alloys	0,32	0,10	0,4	0,60	0,80	0,08	0,10	0,12
<b>H</b>	Hardened steel	0,24	0,10	0,30	0,50	0,80	0,08	0,10	0,12
	Hardened cast iron	0,26	0,10	0,32	0,52	0,82	0,10	0,12	0,14
<b>O</b>	Thermoplastics								
	Plastic, carbon-fibre reinforced								
	Graphite (technical)								
Indexable insert types		ENMX 08T316R..	ENMX 08T316R..	SD.. 06T2...	SD.. 09T3...	SD.. 1204...	SD.. 06T2...	SD.. 09T3...	SD.. 1204...
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0		1,0	1,0	1,0			
	1/5	1,1		1,4	1,4	1,4			
	1/10	1,2		1,8	1,8	1,8			
	1/20	1,3							
Correction factor $K$	$1 < (L : D_c) = \leq 2$		1,0	1,4	1,4	1,4	1,0	1,0	1,0
	$2 < (L : D_c) = \leq 4$		0,7	1,0	1,0	1,0	0,7	0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$	$4 < (L : D_c) = \leq 6$		0,5	0,7	0,7	0,7	0,5	0,5	0,5

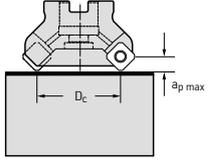
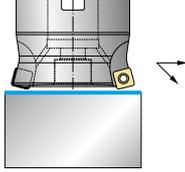
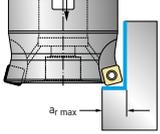
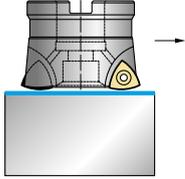
<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) High-feed milling cutters (continued)

Cutter type		M4002		M4002		F4030	
Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{p\max} = L_c$ 				For plunging operations 			
Material group	Lead angle $\kappa$	15°		75°		0–21°	
		$f_{z0}$ [mm]		$f_{z0}$ [mm]		$f_{z0}$ [mm]	
	Tool diameter or diameter range [mm]	25–66	50–125	25–66	50–125	25–52	50–100
	Maximum cutting data $a_{p\max} = L_c$ [mm]	1,5	2	8,4	11,4	1,0	2,0
<b>P</b>	Non-alloyed steel <sup>1</sup>	1,80	2,40	0,29	0,38	1,60	2,00
	Low-alloy steel	1,68	2,16	0,27	0,34	1,40	1,80
	High-alloy steel and tool steel	1,44	1,92	0,23	0,31	1,00	1,20
	Stainless steel	0,96	1,20	0,15	0,19	0,60	0,80
<b>M</b>	Stainless steel <sup>2</sup>	0,60	0,96	0,10	0,15	0,60	0,80
<b>K</b>	Malleable cast iron	0,60	0,96	0,10	0,15	1,60	1,80
	Grey cast iron	1,68	1,92	0,27	0,31	1,40	2,00
	Cast iron with spheroidal graphite	1,44	1,68	0,23	0,27	1,40	1,80
	CGI	1,44	1,68	0,23	0,27	1,40	1,80
<b>N</b>	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys <sup>3</sup>						
	Copper and copper alloys (bronze/brass)						
<b>S</b>	Heat-resistant alloys	0,72	0,96	0,11	0,15	0,60	0,80
	Titanium alloys	0,72	0,96	0,11	0,15	0,60	0,80
	Tungsten alloys	0,72	0,96	0,11	0,15	0,60	0,80
	Molybdenum alloys	0,72	0,96	0,11	0,15	0,60	0,80
<b>H</b>	Hardened steel	0,60	0,96	0,10	0,15		
	Hardened cast iron	0,62	0,98	0,10	0,15		
<b>O</b>	Thermoplastics						
	Plastic, carbon-fibre reinforced						
	Graphite (technical)						
Indexable insert types		SDMX0904ZDR	SDMX1205ZDR	SDMX0904ZDR	SDMX1205ZDR	P23696-1.0	P23696-2.0
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0			1,0	1,0
	1/5	1,4	1,4			1,4	1,3
	1/10	1,8	1,8			1,8	1,6
	1/20						
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 0,5$					1,4	1,5
	1					1,0	1,4
	1,5						1,2
	2						1,0
Correction factor $K$	$1 < (L : D_c) = \leq 2$	1,4	1,4	1,4	1,4	1,4	1,4
	$2 < (L : D_c) = \leq 4$	1,0	1,0	1,0	1,0	1,0	1,0
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$	$4 < (L : D_c) = \leq 6$	0,7	0,7	0,7	0,7	0,7	0,7

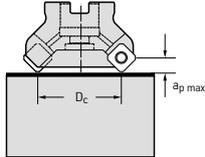
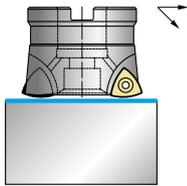
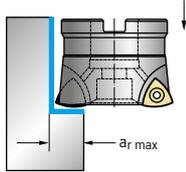
<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) High-feed milling cutters (continued)

Cutter type		F2330			F2330		
Material group	Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{pmax} = L_c$ 				 <p>For plunging operations</p>		
	Lead angle $\kappa$	0–15°			0–15°		
		$f_{z0}$ [mm]			$f_{z0}$ [mm]		
	Tool diameter or diameter range [mm]	20–25	32–85	52–85	20–25	32–85	52–85
Maximum cutting data $a_{pmax} = L_c$ [mm]	1,0	1,5	2,0	$a_{rmax} = 7$ mm	$a_{rmax} = 10$ mm	$a_{rmax} = 15$ mm	
<b>P</b>	Non-alloyed steel <sup>1</sup>	1,20	1,60	2,00	0,18	0,25	0,30
	Low-alloy steel	1,00	1,40	1,80	0,16	0,22	0,25
	High-alloy steel and tool steel	0,70	1,00	1,20	0,12	0,16	0,22
	Stainless steel	0,50	0,60	0,80	0,10	0,12	0,15
<b>M</b>	Stainless steel <sup>2</sup>	0,50	0,60	0,80	0,10	0,12	0,15
<b>K</b>	Malleable cast iron	1,00	1,40	1,80	0,16	0,22	0,28
	Grey cast iron	1,20	1,60	2,00	0,18	0,25	0,30
	Cast iron with spheroidal graphite	1,00	1,40	1,80	0,16	0,22	0,28
	CGI	1,00	1,40	1,80	0,16	0,22	0,28
<b>N</b>	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys <sup>3</sup>						
	Copper and copper alloys (bronze/brass)						
<b>S</b>	Heat-resistant alloys	0,50	0,60	0,80	0,08	0,10	0,12
	Titanium alloys	0,50	0,60	0,80	0,08	0,10	0,12
	Tungsten alloys	0,50	0,60	0,80	0,08	0,10	0,12
	Molybdenum alloys	0,50	0,60	0,80	0,08	0,10	0,12
<b>H</b>	Hardened steel						
	Hardened cast iron						
<b>O</b>	Thermoplastics						
	Plastic, carbon-fibre reinforced						
	Graphite (technical)						
Indexable insert types		P2633.-R10 P26379-R10	P2633.-R14 P26379-R14	P2633.-R25 P26379-R25	P2633.-R10 P26379-R10	P2633.-R14 P26379-R14	P2633.-R25 P26379-R25
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0			
	$1/5$	1,4	1,4	1,4			
	$1/10$	1,8	1,8	1,8			
	$1/20$						
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 0,5$	1,3	1,4	1,5			
	1	1,0	1,2	1,4			
	1,5		1,0	1,2			
Correction factor $K$	$1 < (L : D_c) \leq 2$	1,4	1,4	1,4	1,0	1,0	1,0
	$2 < (L : D_c) \leq 4$	1,0	1,0	1,0	0,7	0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$	$4 < (L : D_c) \leq 6$	0,7	0,7	0,7	0,5	0,5	0,5

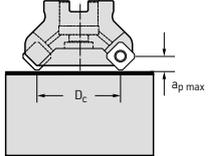
<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) F2010 high-feed milling cutter

Cutter type		F2010...	
		...R729M	...R755M
Material group	Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{p\max} = L_c$ 	 <b>Xtra-tec®</b>	
	Lead angle $\kappa$	0–21°	15°
		$f_{z0}$ [mm]	$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	80–315	80–315
Maximum cutting data $a_{p\max} = L_c$ [mm]	2,0	2,0	
<b>P</b>	Non-alloyed steel <sup>1</sup>	2,00	2,00
	Low-alloy steel	1,80	1,80
	High-alloy steel and tool steel	1,20	1,60
	Stainless steel	0,80	1,00
<b>M</b>	Stainless steel <sup>2</sup>	0,80	0,80
<b>K</b>	Malleable cast iron	1,80	0,80
	Grey cast iron	2,00	1,60
	Cast iron with spheroidal graphite	1,80	1,40
	CGI	1,80	1,40
<b>N</b>	Wrought aluminium alloys		
	Cast aluminium alloys		
	Magnesium-based alloys <sup>3</sup>		
	Copper and copper alloys (bronze/brass)		
<b>S</b>	Heat-resistant alloys	0,80	0,80
	Titanium alloys	0,80	0,80
	Tungsten alloys	0,80	0,80
	Molybdenum alloys	0,80	0,80
<b>H</b>	Hardened steel		0,80
	Hardened cast iron		0,82
<b>O</b>	Thermoplastics		
	Plastic, carbon-fibre reinforced		
	Graphite (technical)		
Indexable insert types		P236 ... R25	SD..1204 ...
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0
	1/5	1,3	1,4
	1/10	1,6	1,8
	1/20		
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 0,5$	1,5	
	1	1,4	
	1,5	1,2	
	2	1,0	
Correction factor $K$	$1 < (L : D_c) \leq 2$	1,4	1,4
	$2 < (L : D_c) \leq 4$	1,0	1,0
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$	$4 < (L : D_c) \leq 6$	0,7	0,7

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Shoulder/helical milling cutters, full effective

Cutter type		M3255	F5038	F5138	F4038
Material group		 Walter BLAXX	 Walter BLAXX	 Walter BLAXX	 Xtra-tec®
	Lead angle $\kappa$	90°	90°	90°	90°
	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	50–80	25–40	40–80	20–32
	Maximum cutting data $a_{p\max} = L_c$ [mm]	46–58	24–48	23–56	15–37
<b>P</b>	Non-alloyed steel <sup>1</sup>		0,18	0,23	0,15
	Low-alloy steel		0,13	0,17	0,10
	High-alloy steel and tool steel		0,13	0,17	0,10
	Stainless steel		0,10	0,12	0,08
<b>M</b>	Stainless steel <sup>2</sup>		0,10	0,11	0,08
<b>K</b>	Malleable cast iron		0,20	0,23	0,15
	Grey cast iron		0,18	0,28	0,12
	Cast iron with spheroidal graphite		0,15	0,22	0,12
	CGI		0,15	0,17	0,12
<b>N</b>	Wrought aluminium alloys		0,12	0,15	0,12
	Cast aluminium alloys		0,15	0,12	0,10
	Magnesium-based alloys <sup>3</sup>		0,12	0,12	0,10
	Copper and copper alloys (bronze/brass)		0,12	0,12	0,10
<b>S</b>	Heat-resistant alloys	0,15	0,10	0,12	0,08
	Titanium alloys	0,15	0,10	0,12	0,08
	Tungsten alloys	0,15	0,10	0,12	0,08
	Molybdenum alloys	0,15	0,10	0,12	0,08
<b>H</b>	Hardened steel				
	Hardened cast iron				
<b>O</b>	Thermoplastics				0,1
	Plastic, carbon-fibre reinforced				
	Graphite (technical)		0,13	0,15	0,1
Indexable insert types		XNHX1306.. LNHX1206..	LN..0904..	LNHU1306..	AD..0803..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/2$	1,0**	1,0**	1,0**	1,0**
	1/5	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3
	1/50	1,5	1,5	1,5	1,5
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 6$	1,0	1,0	1,0	1,0
	9	1,0		1,0	1,0
	12	1,0		1,0	1,0
	$0,5 \times D_c$	1,0		1,0	1,0
	$0,75 \times D_c$	0,8		0,8	0,8
	$1 \times D_c$	0,7		0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$	$a_{p\max} = L_c$	0,5*	0,5*	0,5*	0,5*

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\* only possible if  $a_e/D_c < 1/5$

\*\* only possible if  $a_p < 0,75 \times D_c$

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Shoulder/helical milling cutters, full effective (continued)

Cutter type		F4138	F4238	F4338	F2338F
Material group	<p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{pmax} = L_c</math></p>				
	Lead angle $\kappa$	90°	90°	90°	90°
	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	32–80	40–85	63–125	63–100
	Maximum cutting data $a_{pmax} = L_c$ [mm]	33–76	29–112	31–124	48–103
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,20	0,25	0,25	0,30
	Low-alloy steel	0,15	0,20	0,20	0,25
	High-alloy steel and tool steel	0,15	0,18	0,20	0,20
	Stainless steel	0,12	0,12	0,15	0,15
<b>M</b>	Stainless steel <sup>2</sup>	0,10	0,12	0,15	0,15
<b>K</b>	Malleable cast iron	0,25	0,28	0,30	0,40
	Grey cast iron	0,20	0,22	0,25	0,30
	Cast iron with spheroidal graphite	0,20	0,22	0,25	0,30
	CGI	0,20	0,22	0,25	0,30
<b>N</b>	Wrought aluminium alloys	0,15	0,15		
	Cast aluminium alloys	0,12	0,12		
	Magnesium-based alloys <sup>3</sup>	0,12	0,12		
	Copper and copper alloys (bronze/brass)	0,12	0,12		
<b>S</b>	Heat-resistant alloys	0,12	0,12	0,12	0,12
	Titanium alloys	0,12	0,12	0,12	0,12
	Tungsten alloys	0,12	0,12	0,12	0,12
	Molybdenum alloys	0,12	0,12	0,12	0,12
<b>H</b>	Hardened steel				
	Hardened cast iron				
<b>O</b>	Thermoplastics	0,15	0,15		
	Plastic, carbon-fibre reinforced				
	Graphite (technical)	0,12	0,15		
Indexable insert types	AD..1204..	AD..1606..	AD..1807..	SP..1506.. LP..1506..	
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/2$	1,0**	1,0**	1,0**	1,0**
	1/5	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3
	1/50	1,5	1,5	1,5	
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 6$	1,0	1,0	1,0	1,0
	9	1,0	1,0	1,0	1,0
	12	1,0	1,0	1,0	1,0
	$0,5 \times D_c$	1,0	1,0	1,0	1,0
	$0,75 \times D_c$	0,8	0,8	0,8	0,8
	$1 \times D_c$	0,7	0,7	0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$	$a_{pmax} = L_c$	0,5*	0,5*	0,5*	0,5*

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

\* only possible if  $a_e/D_c < 1/5$

\*\* only possible if  $a_p < 0,75 \times D_c$

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Slot milling cutters

Cutter type		M4792			M4256	M4257
Material group	<p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{pmax} = L_c</math></p>					
	Lead angle $\kappa$	90°			90°	90°
		$f_{Z0}$ [mm]			$f_{Z0}$ [mm]	$f_{Z0}$ [mm]
	Tool diameter or diameter range [mm]	18–20	25–32	40	20–32	40–63
Maximum cutting data $a_{pmax} = L_c$ [mm]	7 + 13	14 + 22	25,0	27–37	47–54	
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,10*	0,15*	0,20*	0,10	0,15
	Low-alloy steel	0,10*	0,12*	0,15*	0,08	0,12
	High-alloy steel and tool steel	0,08*	0,12*	0,15*	0,08	0,12
	Stainless steel	0,06*	0,08*	0,12*	0,06	0,08
<b>M</b>	Stainless steel <sup>2</sup>	0,06*	0,08*	0,10*	0,06	0,08
<b>K</b>	Malleable cast iron	0,12*	0,20*	0,25*	0,12	0,20
	Grey cast iron	0,10*	0,15*	0,20*	0,10	0,15
	Cast iron with spheroidal graphite	0,10*	0,15*	0,20*	0,10	0,15
	CGI	0,10*	0,15*	0,20*	0,10	0,15
<b>N</b>	Wrought aluminium alloys					
	Cast aluminium alloys					
	Magnesium-based alloys <sup>3</sup>					
	Copper and copper alloys (bronze/brass)					
<b>S</b>	Heat-resistant alloys	0,06*	0,10*	0,10*	0,06	0,10
	Titanium alloys	0,06*	0,10*	0,10*	0,06	0,10
	Tungsten alloys	0,06*	0,10*	0,10*	0,06	0,10
	Molybdenum alloys	0,06*	0,10*	0,10*	0,06	0,10
<b>H</b>	Hardened steel					
	Hardened cast iron					
<b>O</b>	Thermoplastics					
	Plastic, carbon-fibre reinforced					
	Graphite (technical)					
Indexable insert types		SD..06T204.. LD..08T204..	SD..09T308.. LD..14T308..	SD..120408.. LD..170408..	SD..06T204.. LD..08T204..	SD..09T308.. LD..14T308..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of depth of cut $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 6$				1,6	1,6
	9				1,0	1,6
	12				1,0	1,0
	$0,5 \times D_c$				1,0	1,0
	$0,75 \times D_c$				0,8	0,8
	$1 \times D_c$				0,7	0,7
$f_Z = f_{Z0} \cdot K_{a_e} \cdot K_{a_p}$					0,5**	0,5**
	$a_{pmax} = L_c$					

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

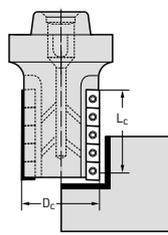
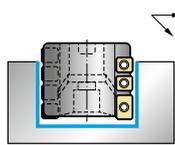
\* only possible if  $a_p < 0,75 \times D_c$

\*\* only with  $a_e/D_c < 1/5$

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Slot milling cutters (continued)

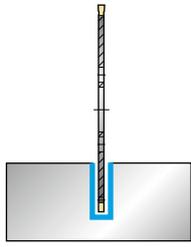
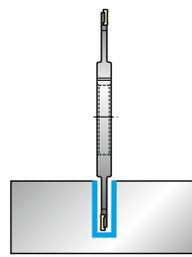
Cutter type		M4258
 <p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{pmax} = L_c</math></p>		
Material group	Lead angle $\kappa$	90°
		$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	80–100
	Maximum cutting data $a_{pmax} = L_c$ [mm]	67–78
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,20
	Low-alloy steel	0,15
	High-alloy steel and tool steel	0,15
	Stainless steel	0,12
<b>M</b>	Stainless steel <sup>2</sup>	0,10
<b>K</b>	Malleable cast iron	0,25
	Grey cast iron	0,20
	Cast iron with spheroidal graphite	0,20
	CGI	0,20
<b>N</b>	Wrought aluminium alloys	
	Cast aluminium alloys	
	Magnesium-based alloys <sup>3</sup>	
	Copper and copper alloys (bronze/brass)	
<b>S</b>	Heat-resistant alloys	0,10
	Titanium alloys	0,10
	Tungsten alloys	0,10
	Molybdenum alloys	0,10
<b>H</b>	Hardened steel	
	Hardened cast iron	
<b>O</b>	Thermoplastics	
	Plastic, carbon-fibre reinforced	
	Graphite (technical)	
Indexable insert types		SD..120408.. LD..170408..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of depth of cut $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0
	1/5	1,1
	1/10	1,2
	1/20	1,3
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 6$	1,6
	9	1,6
	12	1,6
	$0,5 \times D_c$	1,0
	$0,75 \times D_c$	0,8
	$1 \times D_c$	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$	$a_{pmax} = L_c$	0,5**

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.\* only possible if  $a_p < 0,75 \times D_c$ \*\* only with  $a_e/D_c < 1/5$ 

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Slotting cutters

Cutter type		F5055					F4053
Material group	Feed per tooth $f_{Z0}$ for plunging, central positioning						 cross-toothed <b>Xtra-tec®</b>
	Lead angle $\kappa$	90°					90°
		$f_{Z0}$ [mm]					$f_{Z0}$ [mm]
	Tool diameter or diameter range [mm]	63–125	63–160	63–250	63–250	500	80–160
	Maximum cutting data $a_{p\max} = L_c$ [mm]	1,5	2,0	3,0	4,0	5,0	4
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,06	0,08	0,10	0,12	0,12	0,11
	Low-alloy steel	0,06	0,07	0,09	0,11	0,10	0,09
	High-alloy steel and tool steel	0,06	0,07	0,09	0,11	0,10	0,09
	Stainless steel	0,05	0,06	0,08	0,09	0,05	0,05
<b>M</b>	Stainless steel <sup>2</sup>	0,05	0,06	0,08	0,09	0,05	0,05
	Malleable cast iron	0,06	0,07	0,09	0,11	0,12	0,11
	Grey cast iron	0,06	0,08	0,10	0,12	0,14	0,12
	Cast iron with spheroidal graphite	0,06	0,07	0,09	0,11	0,12	0,11
<b>K</b>	CGI					0,10	0,09
	Wrought aluminium alloys		0,07	0,09	0,11	0,12	
	Cast aluminium alloys		0,07	0,09	0,11	0,12	
	Magnesium-based alloys <sup>3</sup>		0,07	0,09	0,11	0,12	
<b>N</b>	Copper and copper alloys (bronze/brass)		0,07	0,09	0,11	0,12	
	Heat-resistant alloys	0,05	0,06	0,08	0,09	0,09	0,05
	Titanium alloys	0,05	0,06	0,08	0,09	0,09	0,05
	Tungsten alloys	0,05	0,06	0,08	0,09	0,09	0,05
<b>S</b>	Molybdenum alloys	0,05	0,06	0,08	0,09	0,09	0,05
	Hardened steel						
	Hardened cast iron						
	Thermoplastics						
<b>O</b>	Plastic, carbon-fibre reinforced						
	Graphite (technical)						
	Indexable insert types	SX-1E15..	SX-2E20..	SX-3E30..	SX-4E40..	SX-5E50..	LN.X 0702..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of depth of cut $a_e$ to milling cutter diameter $D_c$	central	1,5	1,5	1,5	1,5	1,5	1,0
	$a_e / D_c = 1/3$	1,8	1,8	1,8	1,8	1,8	1,5
	1/5	2,5	2,5	2,5	2,5	2,5	1,8
	1/10	3,3	3,3	3,3	3,3	3,3	2,5
	1/20	5,8	5,8	5,8	5,8	5,8	3,3
$f_Z = f_{Z0} \cdot K_{a_e}$	1/50	5,8	5,8	5,8	5,8	5,8	5,8
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	1,5						
	2	0,07	0,07	0,07	0,07	0,07	
	3	0,09	0,09	0,09	0,09	0,09	
	4	0,11	0,11	0,11	0,11	0,11	
$f_Z = f_{Z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$	5	0,12	0,12	0,12	0,12	0,12	

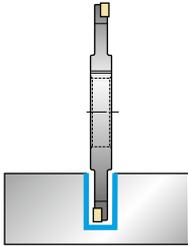
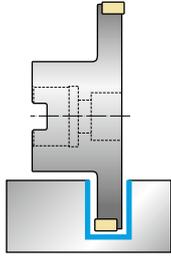
<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

**Please note: The feed per tooth  $f_Z$  should not exceed 0.6 mm**

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Slotting cutters (continued)

Cutter type		F4153			F4253				
Material group	Feed per tooth $f_{z0}$ for plunging, central positioning								
	Lead angle $\kappa$	90°			90°				
		$f_{z0}$ [mm]			$f_{z0}$ [mm]				
	Tool diameter or diameter range [mm]	80–200	80–200	80–200	100–200	100–200	125–200	160–200	160–315
	Maximum cutting data $a_{p\max} = L_c$ [mm]	6	8	10	12	14	16	20	25
P	Non-alloyed steel <sup>1</sup>	0,12	0,13	0,14	0,15	0,15	0,20	0,20	0,23
	Low-alloy steel	0,10	0,12	0,12	0,13	0,13	0,17	0,17	0,20
	High-alloy steel and tool steel	0,10	0,12	0,12	0,13	0,13	0,17	0,17	0,20
	Stainless steel	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,13
M	Stainless steel <sup>2</sup>	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,13
K	Malleable cast iron	0,12	0,13	0,13	0,15	0,15	0,20	0,20	0,22
	Grey cast iron	0,13	0,15	0,15	0,18	0,18	0,23	0,23	0,25
	Cast iron with spheroidal graphite	0,12	0,13	0,13	0,15	0,15	0,20	0,20	0,22
	CGI	0,10	0,12	0,12	0,13	0,13	0,17	0,17	0,20
N	Wrought aluminium alloys								
	Cast aluminium alloys								
	Magnesium-based alloys <sup>3</sup>								
	Copper and copper alloys (bronze/brass)								
S	Heat-resistant alloys	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,12
	Titanium alloys	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,12
	Tungsten alloys	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,12
	Molybdenum alloys	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,12
H	Hardened steel								
	Hardened cast iron								
O	Thermoplastics								
	Plastic, carbon-fibre reinforced								
	Graphite (technical)								
Indexable insert types		LN.U 0803..	LN.U 0804..	LN.U 1005..	LN.U 0804..	LN.U 0804..	LN.U 1005..	LN.U 1206..	LN.U 1605..
Correction factor $K_{ae}$ for the feed per tooth depending on the ratio of depth of cut $a_e$ to milling cutter diameter $D_c$	central	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	$a_e / D_c = 1/3$	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
	1/5	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
	1/10	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
	1/20	3,3	3,3	3,3	3,3	3,3	3,3	3,3	3,3
$f_z = f_{z0} \cdot K_{ae}$	1/50	5,8	5,8	5,8	5,8	5,8	5,8	5,8	5,8

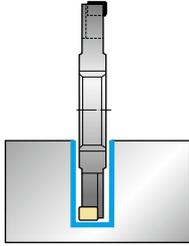
<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

**Please note: The feed per tooth  $f_z$  should not exceed 0.6 mm**

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Slotting cutters (continued)

Cutter type		F2252					
Material group	Feed per tooth $f_{z0}$ for plunging, central positioning	 <p>cross-toothed</p>					
	Lead angle $\kappa$	90°					
		$f_{z0}$ [mm]					
	Tool diameter or diameter range [mm]	100–160	125–315	125–250	80–160	100–160	125–315
	Maximum cutting data $a_{p\max} = L_c$ [mm]	12–16	16–22	22–25	8–10	10–16	16–23,5
P	Non-alloyed steel <sup>1</sup>	0,10	0,14	0,20	0,10	0,10	0,17
	Low-alloy steel	0,07	0,10	0,14	0,07	0,07	0,13
	High-alloy steel and tool steel	0,07	0,10	0,14	0,07	0,07	0,13
	Stainless steel	0,05	0,07	0,10	0,05	0,05	0,10
M	Stainless steel <sup>2</sup>	0,05	0,07	0,10	0,05	0,05	0,08
K	Malleable cast iron	0,08	0,12	0,18	0,08	0,08	0,17
	Grey cast iron	0,10	0,15	0,23	0,10	0,10	0,20
	Cast iron with spheroidal graphite	0,08	0,12	0,18	0,08	0,08	0,17
	CGI	0,07	0,10	0,14	0,07	0,07	0,13
N	Wrought aluminium alloys	0,10	0,12	0,14	0,10	0,10	0,12
	Cast aluminium alloys	0,08	0,10	0,12	0,08	0,08	0,10
	Magnesium-based alloys <sup>3</sup>	0,08	0,10	0,12	0,08	0,08	0,10
	Copper and copper alloys (bronze/brass)	0,07	0,09	0,11	0,07	0,07	0,10
S	Heat-resistant alloys	0,05	0,07	0,10	0,05	0,05	0,10
	Titanium alloys	0,05	0,07	0,10	0,05	0,05	0,10
	Tungsten alloys	0,05	0,07	0,10	0,05	0,05	0,10
	Molybdenum alloys	0,05	0,07	0,10	0,05	0,05	0,10
H	Hardened steel						
	Hardened cast iron						
O	Thermoplastics	0,07	0,10	0,15	0,07	0,10	0,12
	Plastic, carbon-fibre reinforced						
	Graphite (technical)	0,07	0,10	0,15	0,07	0,10	0,12
Indexable insert types		AD.. 0803..R/L	AD.. 1204..R/L	AD.. 1606..R/L	MP.. 0603..	MP.. 0803..	MP.. 1204..
Correction factor $K_{ae}$ for the feed per tooth depending on the ratio of depth of cut $a_e$ to milling cutter diameter $D_c$	central	1,0	1,0	1,0	1,0	1,0	1,0
	$a_e / D_c = 1/3$	1,5	1,5	1,5	1,5	1,5	1,5
	1/5	1,8	1,8	1,8	1,8	1,8	1,8
	1/10	2,5	2,5	2,5	2,5	2,5	2,5
	1/20	3,3	3,3	3,3	3,3	3,3	3,3
$f_z = f_{z0} \cdot K_{ae}$	1/50	5,8	5,8	5,8	5,8	5,8	5,8

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

**Please note: The feed per tooth  $f_z$  should not exceed 0.6 mm**

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Copy milling cutters

Cutter type		M5468						F2334R		
<p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{pmax} = L_c</math></p>		<p><b>Xtra-tec® XT</b></p>								
Material group	Lead angle $\kappa$	-						-		
		$f_{Z0}$ [mm]						$f_{Z0}$ [mm]		
	Tool diameter or diameter range [mm]	12-20	15-42	25-32	32-66	40-80	52-315	63-160	32-66	40-80
	Maximum cutting data $a_{pmax} = L_c$ [mm]	2,5	3,5	4	5	6	8	10	5	6
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,06	0,06	0,11	0,17	0,22	0,28	0,30	0,17	0,22
	Low-alloy steel	0,05	0,05	0,09	0,13	0,15	0,22	0,25	0,13	0,15
	High-alloy steel and tool steel	0,05	0,05	0,09	0,13	0,15	0,22	0,25	0,13	0,15
	Stainless steel	0,04	0,04	0,07	0,09	0,11	0,13	0,15	0,09	0,11
<b>M</b>	Stainless steel <sup>2</sup>	0,04	0,04	0,07	0,09	0,11	0,13	0,12	0,09	0,11
<b>K</b>	Malleable cast iron	0,06	0,06	0,11	0,17	0,22	0,28	0,30	0,17	0,22
	Grey cast iron	0,08	0,08	0,13	0,22	0,28	0,33	0,35	0,22	0,28
	Cast iron with spheroidal graphite	0,06	0,06	0,11	0,17	0,22	0,28	0,30	0,17	0,22
	CGI	0,06	0,06	0,11	0,17	0,22	0,28	0,30	0,17	0,22
<b>N</b>	Wrought aluminium alloys	0,06	0,06					0,16		
	Cast aluminium alloys	0,06	0,06					0,16		
	Magnesium-based alloys <sup>4</sup>	0,06	0,06					0,16		
	Copper and copper alloys (bronze/brass)	0,05	0,05					0,16		
<b>S</b>	Heat-resistant alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	0,09	0,11
	Titanium alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	0,09	0,11
	Tungsten alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	0,09	0,11
	Molybdenum alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	0,09	0,11
<b>H</b>	Hardened steel	0,03	0,03					0,06		
	Hardened cast iron	0,04	0,04					0,07		
<b>O</b>	Thermoplastics	0,05	0,06					0,25		
	Plastic, carbon-fibre reinforced									
	Graphite (technical)	0,05	0,06					0,20		
Indexable insert types		RD.. 0501..	RD.. 07T1..	RO.X 0803..	RO.X 10T3..	RO.X 1204..	RO.X 1605..	RO.X 2006..	RO.X 10T3..	RO.X 1204..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$		$a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0	1,0	1,0	1,0	1,0
		1/5		1,2	1,2	1,2	1,2	1,2	1,2	1,2
		1/10		1,5	1,5	1,5	1,5	1,5	1,5	1,5
		1/20		1,8	1,8	1,8	1,8	1,8	1,8	1,8
		1/50		2,0	2,0	2,0	2,0	2,0	2,0	2,0
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$		$a_p = 1,0$		1,3	1,3	1,4	1,5	1,6	1,8	2,0
		2,0		1,0	1,0	1,1	1,2	1,3	1,4	1,5
		3,0				1,0	1,0	1,1	1,2	1,2
		4,0					1,0	1,0	1,1	1,1
		6,0						1,0	1,1	
		8,0							1,1	
		10,0							1,0	

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Do not set correction factor  $K_{a_e} \cdot K_{a_p}$  higher than 3 when finishing

<sup>4</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Copy milling cutters (continued)

Cutter type		M2471		M2472	M2473
Material group	<p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{pmax} = L_c</math></p>				
	Lead angle $\kappa$	90°		–	–
	Tool diameter or diameter range [mm]	25–52	32–63	32–50	40–63
	Maximum cutting data $a_{pmax} = L_c$ [mm]	5	6		
		$f_{Z0}$ [mm]	$f_{Z0}$ [mm]	$f_{Z0}$ [mm]	$f_{Z0}$ [mm]
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,17	0,22		
	Low-alloy steel	0,17	0,15		
	High-alloy steel and tool steel	0,13	0,15		
	Stainless steel	0,09	0,11		
<b>M</b>	Stainless steel <sup>2</sup>	0,09	0,11		
<b>K</b>	Malleable cast iron				
	Grey cast iron				
	Cast iron with spheroidal graphite				
	CGI				
<b>N</b>	Wrought aluminium alloys				
	Cast aluminium alloys				
	Magnesium-based alloys <sup>4</sup>				
	Copper and copper alloys (bronze/brass)				
<b>S</b>	Heat-resistant alloys	0,09	0,11	0,08	0,08
	Titanium alloys	0,09	0,11		
	Tungsten alloys	0,09	0,11		
	Molybdenum alloys	0,09	0,11		
<b>H</b>	Hardened steel				
	Hardened cast iron				
<b>O</b>	Thermoplastics				
	Plastic, carbon-fibre reinforced				
	Graphite (technical)				
Indexable insert types		RNMX 1005 ..	RNMX 1206 ..	RP .. 1204 ..	RN .. 1207 ..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0
	1/5	1,2	1,2	1,2	1,2
	1/10	1,5	1,5	1,5	1,5
	1/20	1,8	1,8	1,8	1,8
	1/50	2,0	2,0	2,0	2,0
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 0,2$				
	0,4				
	0,6				
	0,8				
	1,0	1,5	1,6	1,6	1,6
	1,5				
	2,0	1,2	1,3	1,3	1,3
	3,0	1,0	1,1	1,1	1,1
$f_Z = f_{Z0} \cdot K_{a_e} \cdot K_{a_p}^3$	4,0	1,0	1,0	1,0	1,0
	$a_{pmax} = L_c$				

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Do not set correction factor  $K_{a_e} \cdot K_{a_p}$  higher than 3 when finishing

<sup>4</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Copy milling cutters (continued)

Cutter type		M5460															
Material group	<p>Feed per tooth <math>f_{Z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p,max} = L_c</math></p>	<p><b>Xtra-tec® XT</b></p>															
	Lead angle $\kappa$	-															
	Tool diameter or diameter range [mm]	$f_{Z0}$ [mm] <table border="1"> <tr> <td>8</td><td>10</td><td>12</td><td>16</td><td>20</td><td>25</td><td>30</td><td>32</td> </tr> </table>								8	10	12	16	20	25	30	32
	8	10	12	16	20	25	30	32									
Maximum cutting data $a_{p,max} = L_c$ [mm]	<table border="1"> <tr> <td>4</td><td>5</td><td>6</td><td>8</td><td>10</td><td>12</td><td>15</td><td>16</td> </tr> </table>								4	5	6	8	10	12	15	16	
4	5	6	8	10	12	15	16										
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,08	0,10	0,10	0,12	0,12	0,15	0,15	0,15								
	Low-alloy steel	0,06	0,08	0,08	0,10	0,10	0,12	0,12	0,12								
	High-alloy steel and tool steel	0,06	0,08	0,08	0,10	0,10	0,12	0,12	0,12								
	Stainless steel	0,05	0,06	0,06	0,08	0,08	0,10	0,10	0,10								
<b>M</b>	Stainless steel <sup>2</sup>	0,05	0,06	0,06	0,08	0,08	0,10	0,10	0,10								
<b>K</b>	Malleable cast iron	0,08	0,10	0,10	0,12	0,12	0,15	0,15	0,15								
	Grey cast iron	0,10	0,12	0,12	0,15	0,15	0,18	0,18	0,18								
	Cast iron with spheroidal graphite	0,08	0,10	0,10	0,12	0,12	0,15	0,15	0,15								
	CGI	0,08	0,10	0,10	0,12	0,12	0,15	0,15	0,15								
<b>N</b>	Wrought aluminium alloys																
	Cast aluminium alloys																
	Magnesium-based alloys <sup>4</sup>																
	Copper and copper alloys (bronze/brass)																
<b>S</b>	Heat-resistant alloys	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06								
	Titanium alloys	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06								
	Tungsten alloys	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06								
	Molybdenum alloys	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06								
<b>H</b>	Hardened steel	0,04 <sup>3</sup>	0,05 <sup>3</sup>	0,05 <sup>3</sup>	0,06 <sup>3</sup>												
	Hardened cast iron	0,05 <sup>3</sup>	0,06 <sup>3</sup>	0,06 <sup>3</sup>	0,07 <sup>3</sup>												
<b>O</b>	Thermoplastics																
	Plastic, carbon-fibre reinforced																
	Graphite (technical)																
Indexable insert types		P32...-D08	P32...-D10	P32...-D12	P32...-D16	P32...-D20	P32...-D25	P32...-D30	P32...-D32								
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0								
	1/5	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2								
	1/10	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5								
	1/20	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8								
	1/50	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0								
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 0,2$	1,8	2,3	2,3	2,5	2,5	2,7	2,7	2,7								
	0,4	1,5	2,0	2,0	2,2	2,2	2,4	2,4	2,4								
	0,6	1,2	1,7	1,7	1,9	1,9	2,1	2,1	2,1								
	0,8	1,0	1,3	1,3	1,5	1,5	1,7	1,7	1,7								
	1,0	0,8	1,0	1,0	1,2	1,2	1,4	1,4	1,4								
	1,5	0,7	0,8	0,8	1,0	1,0	1,2	1,2	1,2								
	2,0	0,6	0,7	0,7	0,8	0,8	1,0	1,0	1,0								
	3,0	0,5	0,6	0,6	0,7	0,7	0,8	0,8	0,8								
	4,0	0,5	0,5	0,5	0,6	0,6	0,7	0,7	0,7								
	$a_{p,max} = L_c$	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5								
$f_z = f_{Z0} \cdot K_{a_e} \cdot K_{a_p}^3$		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5								

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Do not set correction factor  $K_{a_e} \cdot K_{a_p}$  higher than 3 when finishing

<sup>4</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Copy milling cutters (continued)

Cutter type	F2339 Form A						F2339 Form B						
Lead angle $\kappa$	-						-						
	$f_{Z0}$ [mm]						$f_{Z0}$ [mm]						
Tool diameter or diameter range [mm]	16	20	25	30 / 32	40	50	16	20	25	30 / 32	40		
Maximum cutting data $a_{pmax} = L_c$ [mm]	11	15	20	24 / 25	31	40	24	28	32	42 / 43	57		
<b>P</b> Non-alloyed steel <sup>1</sup>	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30		
Low-alloy steel	0,08	0,10	0,14	0,20	0,25	0,30	0,08	0,10	0,14	0,20	0,25		
High-alloy steel and tool steel	0,08	0,10	0,14	0,20	0,25	0,30	0,08	0,10	0,14	0,20	0,25		
Stainless steel	0,06	0,07	0,10	0,12	0,14	0,18	0,06	0,07	0,10	0,12	0,14		
<b>M</b> Stainless steel <sup>2</sup>	0,06	0,07	0,10	0,12	0,12	0,14	0,06	0,07	0,10	0,12	0,12		
<b>K</b> Malleable cast iron	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30		
Grey cast iron	0,17	0,20	0,25	0,30	0,35	0,40	0,17	0,20	0,25	0,30	0,35		
Cast iron with spheroidal graphite	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30		
CGI	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30		
<b>N</b> Wrought aluminium alloys													
Cast aluminium alloys													
Magnesium-based alloys <sup>4</sup>													
Copper and copper alloys (bronze/brass)													
<b>S</b> Heat-resistant alloys	0,06	0,07	0,10	0,10	0,10	0,12	0,06	0,07	0,10	0,10	0,10		
Titanium alloys	0,06	0,07	0,10	0,10	0,10	0,12	0,06	0,07	0,10	0,10	0,10		
Tungsten alloys	0,06	0,07	0,10	0,10	0,10	0,12	0,06	0,07	0,10	0,10	0,10		
Molybdenum alloys	0,06	0,07	0,10	0,10	0,10	0,12	0,06	0,07	0,10	0,10	0,10		
<b>H</b> Hardened steel													
Hardened cast iron													
<b>O</b> Thermoplastics													
Plastic, carbon-fibre reinforced													
Graphite (technical)													
Indexable insert types	XD.. 130380R..	XD.. 16T3100R..	XD.. 2004125R..	XD.. 2506160R..	XD.. 3207200R..	XD.. 4009250R..	XD.. 130880R..	XD.. 16T3100R..	XD.. 2004125R..	XD.. 2405150R..	XD.. 2506160R..	XD.. 3207200R..	
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
	1/5		1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	
	1/10		1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5	
	1/20		1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8	
	1/50		2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 1,0$		1,6	1,9	2,1	2,3	2,5	2,7	1,6	1,9	2,1	2,3	2,5
	2,0		1,3	1,5	1,6	1,8	1,9	2	1,3	1,5	1,6	1,8	1,9
	4,0		1,1	1,2	1,3	1,4	1,5	1,6	1,1	1,2	1,3	1,4	1,5
	6,0		1,0	1,1	1,2	1,2	1,3	1,4	1,0	1,1	1,2	1,2	1,3
	8,0		1,0	1,1	1,1	1,1	1,2	1,3	1,0	1,1	1,1	1,1	1,2
	10,0		1,0	1,0	1,1	1,1	1,2	1,2	1,0	1,0	1,1	1,1	1,2
	12,5			1,0	1,0	1,1	1,1	1,2	1,0	1,0	1,0	1,1	1,1
	15,0/16,0			1,0	1,0	1,0	1,1	1,1	1,0	1,0	1,0	1,0	1,1
	20,0				1,0	1,0	1,0	1,0	0,5	0,5	1,0	1,0	1,0
$f_z = f_{Z0} \cdot K_{a_e} \cdot K_{a_p}^3$	$a_{pmax} = L_c$				1,0	1,0	1,0	1,0	0,5	0,5	0,5	0,5	0,5

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Do not set correction factor  $K_{a_e} \cdot K_{a_p}$  higher than 3 when finishing

<sup>4</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Copy milling cutters (continued)

Cutter type		F2239						
Material group	Lead angle $\kappa$	-						
		$f_{z0}$ [mm]						
	Tool diameter or diameter range [mm]	20	25	30 / 32	40	50	63	
	Maximum cutting data $a_{p\max} = L_c$ [mm]	25	28	38	51	77	84	
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,18	0,24	0,30	0,36	0,36	0,36	
	Low-alloy steel	0,12	0,17	0,24	0,30	0,30	0,30	
	High-alloy steel and tool steel	0,12	0,17	0,24	0,30	0,30	0,30	
	Stainless steel	0,08	0,12	0,16	0,20	0,20	0,20	
<b>M</b>	Stainless steel <sup>2</sup>	0,08	0,12	0,14	0,14	0,14	0,14	
<b>K</b>	Malleable cast iron	0,18	0,24	0,30	0,36	0,36	0,36	
	Grey cast iron	0,24	0,30	0,36	0,42	0,42	0,42	
	Cast iron with spheroidal graphite	0,18	0,24	0,30	0,36	0,36	0,36	
	CGI	0,18	0,24	0,30	0,36	0,36	0,36	
<b>N</b>	Wrought aluminium alloys							
	Cast aluminium alloys							
	Magnesium-based alloys <sup>4</sup>							
	Copper and copper alloys (bronze/brass)							
<b>S</b>	Heat-resistant alloys	0,08	0,12	0,12	0,12	0,12	0,12	
	Titanium alloys	0,08	0,12	0,12	0,12	0,12	0,12	
	Tungsten alloys	0,08	0,12	0,12	0,12	0,12	0,12	
	Molybdenum alloys	0,08	0,12	0,12	0,12	0,12	0,12	
<b>H</b>	Hardened steel							
	Hardened cast iron							
<b>O</b>	Thermoplastics							
	Plastic, carbon-fibre reinforced							
	Graphite (technical)							
Indexable insert types		P26315-R10 SP..0603..	P26315-R12 SP..0603..	P26315-R15 P26315-R16 SP..09T3..	P26315-R20 SP..1204..	P26315-R25 SP..1204..	P26315-R32 SP..1204..	
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	
	1/5	1,2	1,2	1,2	1,2	1,2	1,2	
	1/10	1,5	1,5	1,5	1,5	1,5	1,5	
	1/20	1,8	1,8	1,8	1,8	1,8	1,8	
	1/50	2,0	2,0	2,0	2,0	2,0	2,0	
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 1,0$	1,9	2,1	2,3	2,5	2,8	3,0	
	2,0	1,5	1,6	1,8	1,9	2,1	2,3	
	4,0	1,2	1,3	1,4	1,5	1,6	1,8	
	6,0	1,1	1,2	1,2	1,3	1,4	1,5	
	8,0	1,1	1,1	1,1	1,2	1,3	1,4	
	10,0	1,0	1,1	1,1	1,2	1,2	1,3	
	12,5	0,5	1,0	1,1	1,1	1,1	1,2	
	15,0/16,0	0,5	0,5	1,0	1,1	1,1	1,1	
	20,0	0,5	0,5	0,5	1,0	1,0	1,0	
	$a_{p\max} = L_c$	0,5	0,5	0,5	0,5	0,5	0,5	
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}^3$								

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Do not set correction factor  $K_{a_e} \cdot K_{a_p}$  higher than 3 when finishing

<sup>4</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

### Feed determination (starting values) Copy milling cutters and F2010 copy milling cutter (continued)

Cutter type		F2239B					F2010...R723M
Material group	<p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{p\max} = L_c</math></p>						<p>...R723M</p>
	Lead angle $\kappa$	-					-
		$f_{z0}$ [mm]					$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	20	25	30 / 32	40	50	80-315
	Maximum cutting data $a_{p\max} = L_c$ [mm]	15	20	26	32	39	8
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,18	0,24	0,30	0,36	0,36	0,28
	Low-alloy steel	0,12	0,17	0,24	0,30	0,30	0,22
	High-alloy steel and tool steel	0,12	0,17	0,24	0,30	0,30	0,22
	Stainless steel	0,08	0,12	0,16	0,20	0,20	0,13
<b>M</b>	Stainless steel <sup>2</sup>	0,08	0,12	0,14	0,14	0,14	0,13
<b>K</b>	Malleable cast iron	0,18	0,24	0,30	0,36	0,36	0,28
	Grey cast iron	0,24	0,30	0,36	0,42	0,42	0,33
	Cast iron with spheroidal graphite	0,18	0,24	0,30	0,36	0,36	0,28
	CGI	0,18	0,24	0,30	0,36	0,36	0,28
<b>N</b>	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys <sup>3</sup>						
	Copper and copper alloys (bronze/brass)						
<b>S</b>	Heat-resistant alloys	0,08	0,12	0,12	0,12	0,12	0,11
	Titanium alloys	0,08	0,12	0,12	0,12	0,12	0,11
	Tungsten alloys	0,08	0,12	0,12	0,12	0,12	0,11
	Molybdenum alloys	0,08	0,12	0,12	0,12	0,12	0,11
<b>H</b>	Hardened steel						
	Hardened cast iron						
<b>O</b>	Thermoplastics						
	Plastic, carbon-fibre reinforced						
	Graphite (technical)						
Indexable insert types		P26315-R10	P26315-R12	R26315-R15 P26315-R16	P26315-R20	P26315-R25	RO.X 1605..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,2	1,2	1,2	1,2	1,2	1,2
	1/10	1,5	1,5	1,5	1,5	1,5	1,5
	1/20	1,8	1,8	1,8	1,8	1,8	1,8
	1/50	2,0	2,0	2,0	2,0	2,0	2,0
Correction factor $K_{a_p}$ for the feed per tooth depending on the depth of cut $a_p$	$a_p = 1$	1,9	2,1	2,3	2,5	2,8	1,8
	2	1,5	1,6	1,8	1,9	2,1	1,4
	3						1,2
	4	1,2	1,3	1,4	1,5	1,6	1,1
	6	1,1	1,2	1,2	1,3	1,4	1,0
	8	1,1	1,1	1,1	1,2	1,3	
	10	1,0	1,1	1,1	1,2	1,2	
	12,5	0,5	1,0	1,1	1,1	1,1	
	15/16	0,5	0,5	1,0	1,1	1,1	
	20	0,5	0,5	0,5	1,0	1,0	
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$							
$a_{p\max} = L_c$	0,5	0,5	0,5	0,5	0,5		

<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Profile milling cutters

Cutter type		M4575			M4574			F2036			
Material group	<p>Feed per tooth <math>f_{z0}</math> for <math>a_e = D_c</math> <math>a_p = a_{pmax} = L_c</math></p>										
	Lead angle $\kappa$	90°			45°			90°			
		$f_{z0}$ [mm]			$f_{z0}$ [mm]			$f_{z0}$ [mm]			
	Tool diameter or diameter range [mm]	21–25	32–40	50	12–16	20–40	32–40	16	25	40	63
Maximum cutting data $a_{pmax} = L_c$ [mm]				3	5	7	1,1–1,6	1,3–2,15	2,15–3,15	3,15–5,15	
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,10	0,12	0,16	0,15	0,20	0,25	0,10	0,16	0,24	0,30
	Low-alloy steel	0,08	0,09	0,10	0,12	0,15	0,20	0,10	0,16	0,24	0,30
	High-alloy steel and tool steel	0,08	0,06	0,08	0,12	0,15	0,20	0,08	0,14	0,19	0,25
	Stainless steel	0,06	0,06	0,08	0,10	0,12	0,15	0,08	0,14	0,19	0,25
<b>M</b>	Stainless steel <sup>2</sup>	0,06	0,06	0,06	0,08	0,10	0,12				
<b>K</b>	Malleable cast iron	0,08	0,08	0,10	0,15	0,20	0,25	0,08	0,14	0,19	0,25
	Grey cast iron	0,12	0,16	0,18	0,20	0,25	0,30	0,10	0,16	0,24	0,30
	Cast iron with spheroidal graphite	0,10	0,12	0,12	0,15	0,20	0,25	0,09	0,15	0,22	0,28
	CGI	0,08	0,08	0,10	0,15	0,20	0,25	0,08	0,14	0,19	0,25
<b>N</b>	Wrought aluminium alloys										
	Cast aluminium alloys										
	Magnesium-based alloys <sup>3</sup>										
	Copper and copper alloys (bronze/brass)										
<b>S</b>	Heat-resistant alloys	0,06	0,06	0,06	0,08	0,10	0,12				
	Titanium alloys	0,06	0,06	0,06	0,08	0,10	0,12				
	Tungsten alloys	0,06	0,06	0,06	0,08	0,10	0,12				
	Molybdenum alloys	0,06	0,06	0,06	0,08	0,10	0,12				
<b>H</b>	Hardened steel										
	Hardened cast iron										
<b>O</b>	Thermoplastics										
	Plastic, carbon-fibre reinforced										
	Graphite (technical)										
Indexable insert types		SD.. 06T204..	SD.. 09T308	SD.. 120408..	SP.. 0603..	SP.. 09T3..	SP..1 204..	P20200- 1.1 P20200- 1.2 P20200- 1.3	P20200- 1.2 P20200- 1.3 P20200- 1.4 P20200- 1.5	P20200- 2.1 P20200- 2.2 P20200- 2.3	P20200- 3.1 P20200- 3.2 P20200- 3.4
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0				
	1/5	1,5	1,5	1,5	1,1	1,1	1,1				
	1/10	1,8	1,8	1,8	1,2	1,2	1,2				
	1/20	2,5	2,5	2,5	1,3	1,3	1,3				
$f_z = f_{z0} \cdot K_{a_e}$	1/50				1,5	1,5	1,5				

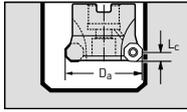
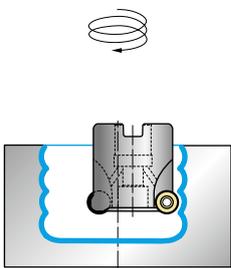
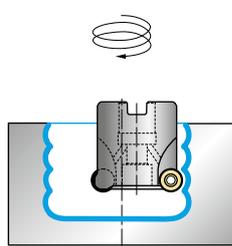
<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

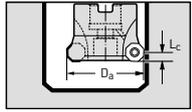
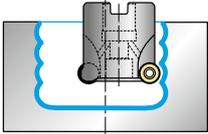
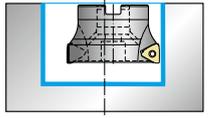
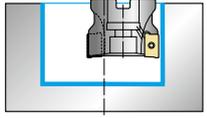
## Feed determination (starting values) Circular interpolation cutters

Cutter type		M5468							M2472
Feed per tooth $f_{Z0}$ for $a_e = D_c$ $a_p = a_{pmax} = L_c$ 									
		Xtra-tec® XT							-
Material group	Lead angle $\kappa$	-							-
		$f_{Z0}$ [mm]							$f_{Z0}$ [mm]
	Tool diameter or diameter range [mm]	12-20	15-42	25-32	32-66	40-80	52-315	63-160	32-50
	Maximum cutting data $a_{pmax} = L_c$ [mm]	2,5	3,5	4	5	6	8	10	6
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,06	0,06	0,11	0,17	0,22	0,28	0,30	
	Low-alloy steel	0,05	0,05	0,09	0,13	0,15	0,22	0,25	
	High-alloy steel and tool steel	0,05	0,05	0,09	0,13	0,15	0,22	0,25	
	Stainless steel	0,04	0,04	0,07	0,09	0,11	0,13	0,15	
<b>M</b>	Stainless steel <sup>2</sup>	0,04	0,04	0,07	0,09	0,11	0,13	0,12	
<b>K</b>	Malleable cast iron	0,06	0,06	0,11	0,17	0,22	0,28	0,30	
	Grey cast iron	0,08	0,08	0,13	0,22	0,28	0,33	0,35	
	Cast iron with spheroidal graphite	0,06	0,06	0,11	0,17	0,22	0,28	0,30	
	CGI	0,06	0,06	0,11	0,17	0,22	0,28	0,30	
<b>N</b>	Wrought aluminium alloys	0,06	0,06					0,16	
	Cast aluminium alloys	0,06	0,06					0,16	
	Magnesium-based alloys <sup>3</sup>	0,06	0,06					0,16	
	Copper and copper alloys (bronze/brass)	0,05	0,05					0,16	
<b>S</b>	Heat-resistant alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	0,08
	Titanium alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	
	Tungsten alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	
	Molybdenum alloys	0,04	0,04	0,07	0,09	0,11	0,11	0,10	
<b>H</b>	Hardened steel	0,03	0,03					0,06	
	Hardened cast iron	0,03	0,03					0,06	
<b>O</b>	Thermoplastics	0,05	0,06	0,07	0,10	0,15	0,20	0,25	
	Plastic, carbon-fibre reinforced								
	Graphite (technical)	0,05	0,06	0,07	0,10	0,12	0,15	0,20	
Indexable insert types		RD.. 0501..	RD.. 07T1..	RO.X 0803..	RO.X 10T3..	RO.X 1204..	RO.X 1605..	RO.X 2006..	RP.. 1204..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
	1/10	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
	1/20	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
	1/50	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Circular interpolation cutters (continued)

Cutter type		F2334R		M5137		M5130			
Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{pmax} = L_c$ 									
		Lead angle $\kappa$		-		90°		90°	
Material group		$f_{z0}$ [mm]		$f_{z0}$ [mm]		$f_{z0}$ [mm]			
	Tool diameter or diameter range [mm]	32-66	40-80	10-63	50-100	10-63	16-50	25-80	25-160
	Maximum cutting data $a_{pmax} = L_c$ [mm]	5	6	5	8	5	9	11	15
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,17	0,22	0,14	0,19	0,10	0,14	0,19	0,23
	Low-alloy steel	0,13	0,15	0,11	0,14	0,07	0,10	0,14	0,17
	High-alloy steel and tool steel	0,13	0,15	0,11	0,14	0,07	0,10	0,14	0,17
	Stainless steel	0,09	0,11	0,09	0,12	0,06	0,09	0,12	0,14
<b>M</b>	Stainless steel <sup>2</sup>	0,09	0,11	0,07	0,09	0,06	0,11	0,09	0,11
<b>K</b>	Malleable cast iron	0,17	0,22	0,14	0,18	0,08	0,12	0,18	0,23
	Grey cast iron	0,22	0,28	0,15	0,20	0,10	0,14	0,20	0,28
	Cast iron with spheroidal graphite	0,17	0,22	0,14	0,18	0,08	0,12	0,18	0,23
	CGI	0,17	0,22	0,14	0,18	0,08	0,12	0,18	0,23
<b>N</b>	Wrought aluminium alloys					0,08	0,10	0,13	0,14
	Cast aluminium alloys					0,08	0,10	0,13	0,14
	Magnesium-based alloys <sup>3</sup>					0,07	0,09	0,12	0,14
	Copper and copper alloys (bronze/brass)					0,07	0,07	0,09	0,14
<b>S</b>	Heat-resistant alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
	Titanium alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
	Tungsten alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
	Molybdenum alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
<b>H</b>	Hardened steel					0,00			0,00
	Hardened cast iron					0,00			0,00
<b>O</b>	Thermoplastics	0,10	0,15			0,10	0,13	0,18	0,21
	Plastic, carbon-fibre reinforced					0,00			0,00
	Graphite (technical)	0,10	0,12			0,08	0,10		0,16
Indexable insert types		RO.X 10T3..	RO.X 1204..	TNMU 11T304R...	TNMU 160508R..	AC.. 0602..	BC.. 0903..	BC.. 1204..	BC.. 1605..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,2	1,2	1,1	1,1	1,1	1,2	1,1	1,1
	1/10	1,5	1,5	1,2	1,2	1,2	1,5	1,2	1,2
	1/20	1,8	1,8	1,3	1,3	1,3	1,8	1,3	1,3
	1/50	2,0	2,0				2,0		

<sup>1</sup> and steel casting

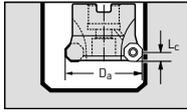
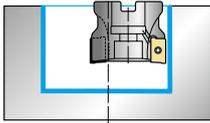
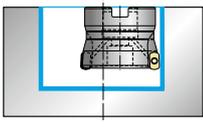
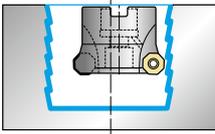
<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

### Circular interpolation cutters (continued)

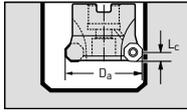
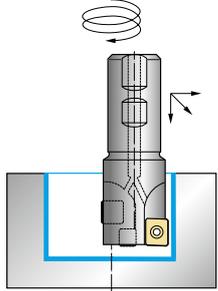
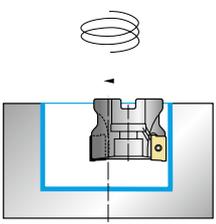
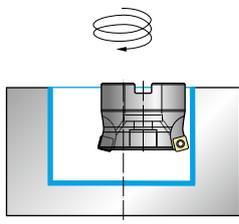
Cutter type		F4042 / F4042R		M5008	M5004	
Material group	Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{pmax} = L_c$ 					
	Lead angle $\kappa$	90°		15°	43°	
		$f_{z0}$ [mm]		$f_{z0}$ [mm]	$f_{z0}$ [mm]	
		F4042	F4042R			
	Tool diameter or diameter range [mm]	10–50	16–50	16–66	50–160	
Maximum cutting data $a_{pmax} = L_c$ [mm]	8	10	1,0	3	4	
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,13	0,16	0,64	0,40	0,45
	Low-alloy steel	0,09	0,10	0,64	0,36	0,40
	High-alloy steel and tool steel	0,09	0,10	0,56	0,27	0,32
	Stainless steel	0,07	0,09	0,24	0,18	0,32
<b>M</b>	Stainless steel <sup>2</sup>	0,07	0,09	0,16	0,13	0,13
<b>K</b>	Malleable cast iron	0,10	0,13	0,16	0,32	0,36
	Grey cast iron	0,13	0,18	0,80	0,40	0,45
	Cast iron with spheroidal graphite	0,10	0,13	0,64	0,32	0,36
	CGI	0,10	0,13	0,64	0,32	0,36
<b>N</b>	Wrought aluminium alloys	0,10			0,22	0,22
	Cast aluminium alloys	0,10			0,22	0,22
	Magnesium-based alloys <sup>3</sup>	0,09			0,13	0,13
	Copper and copper alloys (bronze/brass)	0,09			0,13	0,13
<b>S</b>	Heat-resistant alloys	0,07	0,09	0,24	0,13	0,13
	Titanium alloys	0,07	0,09	0,24	0,13	0,13
	Tungsten alloys	0,07	0,09	0,24	0,13	0,13
	Molybdenum alloys	0,07	0,09	0,24	0,13	0,13
<b>H</b>	Hardened steel			0,16		
	Hardened cast iron			0,24		
<b>O</b>	Thermoplastics	0,12	0,15		0,20	0,20
	Plastic, carbon-fibre reinforced					
	Graphite (technical)	0,10	0,12		0,15	0,15
Indexable insert types		AD.T0803..	AD.T10T3..	EN..08T3..	OD..0504..	OD..0605..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0		1,0	1,0
	1/5	1,1	1,1		1,1	1,1
	1/10	1,2	1,2		1,2	1,2
	1/20	1,3	1,3		1,3	1,3
	1/50					

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.\* Only possible if  $a_e/D_c < 1/5$ 

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values)

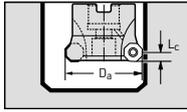
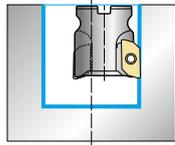
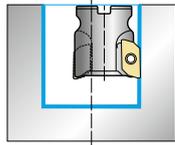
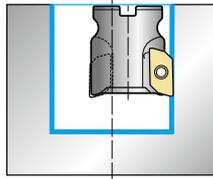
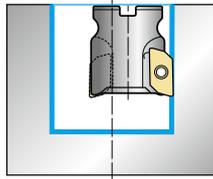
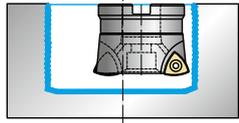
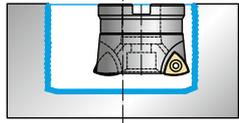
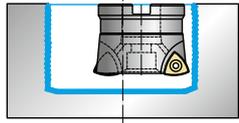
### Circular interpolation cutters (continued)

Cutter type		M4792			M4130			M4002		
Material group	Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{pmax} = L_c$ 									
	Lead angle $\kappa$	90°			90°			15°		
		$f_{z0}$ [mm]			$f_{z0}$ [mm]			$f_{z0}$ [mm]		
	Tool diameter or diameter range [mm]	17,9–24,9	29,9–31,9	39,9	16–20	25–50	50–100	20–66	25–66	50–125
Maximum cutting data $a_{pmax} = L_c$ [mm]	13,3	20,8	26,9	8	13	16	1,0	1,5	2,0	
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,10*	0,15*	0,20*	0,13	0,17	0,22	0,18	0,25	0,30
	Low-alloy steel	0,10*	0,12*	0,15*	0,09	0,13	0,17	0,16	0,22	0,25
	High-alloy steel and tool steel	0,08*	0,12*	0,15*	0,09	0,13	0,17	0,12	0,16	0,22
	Stainless steel	0,06*	0,08*	0,12*	0,07	0,10	0,13	0,10	0,12	0,15
<b>M</b>	Stainless steel <sup>2</sup>	0,06*	0,08*	0,10*	0,07	0,09	0,10	0,10	0,12	0,15
<b>K</b>	Malleable cast iron	0,12*	0,20*	0,25*	0,10	0,17	0,22	0,16	0,22	0,28
	Grey cast iron	0,10*	0,15*	0,20*	0,13	0,22	0,27	0,18	0,25	0,30
	Cast iron with spheroidal graphite	0,10*	0,15*	0,20*	0,10	0,17	0,22	0,16	0,22	0,28
	CGI	0,10*	0,15*	0,20*	0,10	0,17	0,22	0,16	0,22	0,28
<b>N</b>	Wrought aluminium alloys									
	Cast aluminium alloys									
	Magnesium-based alloys <sup>3</sup>									
	Copper and copper alloys (bronze/brass)									
<b>S</b>	Heat-resistant alloys	0,06*	0,10*	0,10*	0,07	0,10	0,13	0,08	0,10	0,12
	Titanium alloys	0,06*	0,10*	0,10*	0,07	0,10	0,13	0,08	0,10	0,12
	Tungsten alloys	0,06*	0,10*	0,10*	0,07	0,10	0,13	0,08	0,10	0,12
	Molybdenum alloys	0,06*	0,10*	0,10*	0,07	0,10	0,13	0,08	0,10	0,12
<b>H</b>	Hardened steel									
	Hardened cast iron									
<b>O</b>	Thermoplastics				0,12	0,17	0,20			
	Plastic, carbon-fibre reinforced									
	Graphite (technical)				0,10	0,15	0,15			
Indexable insert types		SD.. 06T204.. LD.. 08T204..	SD.. 09T308.. LD.. 14T308..	SD.. 120408.. LD.. 170408..	LD.. 08T2..	LD.. 14T3..	LD.. 1704..	SD.. 06T2...	SD.. 09T3...	SD.. 1204...
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1	1,1	1,4	1,4	1,4
	1/10	1,2	1,2	1,2	1,2	1,2	1,2	1,8	1,8	1,8
	1/20	1,3	1,3	1,3	1,3	1,3	1,3			
Correction factor $K$	$1 < (L : D_c) \leq 2$							1,4	1,4	1,4
	$2 < (L : D_c) \leq 4$							1,0	1,0	1,0
$f_z = f_{z0} \cdot K_{a_e} \cdot K$	$4 < (L : D_c) \leq 6$							0,7	0,7	0,7

<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) Circular interpolation cutters (continued)

Cutter type		M2331		M2131		F2330		
Material group	Feed per tooth $f_{Z0}$ for $a_e = D_c$ $a_p = a_{pmax} = L_c$ 							
	Lead angle $\kappa$	90°		90°		0-15°		
		$f_{Z0}$ [mm]		$f_{Z0}$ [mm]		$f_{Z0}$ [mm]		
	Tool diameter or diameter range [mm]	32-50	40-50	25-80	32-63	20-25	32-85	52-85
Maximum cutting data $a_{pmax} = L_c$ [mm]	15	20	15	20	1.0	1.5	2.0	
<b>P</b>	Non-alloyed steel <sup>1</sup>					1,00	1,40	1,80
	Low-alloy steel					0,90	1,25	1,60
	High-alloy steel and tool steel					0,60	0,90	1,00
	Stainless steel					0,45	0,50	0,70
<b>M</b>	Stainless steel <sup>2</sup>					0,45	0,50	0,70
<b>K</b>	Malleable cast iron					1,00	1,40	1,80
	Grey cast iron					0,90	1,25	1,60
	Cast iron with spheroidal graphite					0,90	1,25	1,60
	CGI					1,00	1,40	1,80
<b>N</b>	Wrought aluminium alloys	0,13	0,18	0,13	0,18			
	Cast aluminium alloys	0,13	0,18	0,13	0,18			
	Magnesium-based alloys <sup>3</sup>	0,13	0,18	0,13	0,18			
	Copper and copper alloys (bronze/brass)	0,11	0,13	0,11	0,13			
<b>S</b>	Heat-resistant alloys					0,45	0,50	0,70
	Titanium alloys					0,45	0,50	0,70
	Tungsten alloys					0,45	0,50	0,70
	Molybdenum alloys					0,45	0,50	0,70
<b>H</b>	Hardened steel							
	Hardened cast iron							
<b>O</b>	Thermoplastics					0,30	0,40	0,50
	Plastic, carbon-fibre reinforced							
	Graphite (technical)					0,20	0,25	0,30
Indexable insert types		ZDGT15A4..	ZDGT20A5..	ZDGT1504..	ZDGT2005..	P2633..-R10 P26379-R10	P2633..-R14 P26379-R14	P2633..-R25 P26379-R25
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,4	1,4	1,4
	1/10	1,2	1,2	1,2	1,2	1,4	1,4	1,4
	1/20	1,3	1,3	1,3	1,3			
	1/50							
Correction factor $K$	$1 < (L : D_c) \leq 2$					1,4	1,4	1,4
	$2 < (L : D_c) \leq 4$					1,0	1,0	1,0
$f_z = f_{Z0} \cdot K_{a_e} \cdot K$	$4 < (L : D_c) \leq 6$					0,7	0,7	0,7

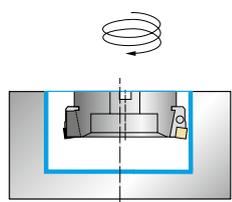
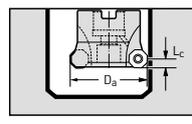
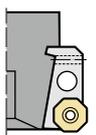
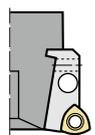
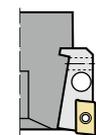
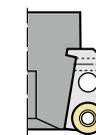
<sup>1</sup> and steel casting

<sup>2</sup> and austenitic/ferritic

<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Feed determination (starting values) F2010 circular interpolation cutter

Cutter type F2010...							
 Feed per tooth $f_{z0}$ for $a_e = D_c$ $a_p = a_{p\max} = L_c$		...R592M	...R729M	...R755M	...R718M	...R719M	...R723M
		 Xtra-tec® XT			 Xtra-tec®	 Xtra-tec®	
Material group	Lead angle $\kappa$	43°	0–15°	15°	90°	90°	–
		$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]	$f_{z0}$ [mm]
	Tool diameter or diameter range [mm]	80–315	80–315	80–315	80–315	80–315	80–315
	Maximum cutting data $a_{p\max} = L_c$ [mm]	4	2,0	2,0	11,7	15	8
<b>P</b>	Non-alloyed steel <sup>1</sup>	0,45	1,80	0,30	0,18	0,22	0,28
	Low-alloy steel	0,40	1,60	0,25	0,13	0,16	0,22
	High-alloy steel and tool steel	0,32	1,00	0,22	0,13	0,16	0,22
	Stainless steel	0,22	0,70	0,15	0,10	0,13	0,13
<b>M</b>	Stainless steel <sup>2</sup>	0,13	0,70	0,15	0,09	0,10	0,13
<b>K</b>	Malleable cast iron	0,36	1,80	0,28	0,18	0,22	0,28
	Grey cast iron	0,45	1,60	0,30	0,22	0,27	0,33
	Cast iron with spheroidal graphite	0,36	1,60	0,28	0,18	0,22	0,28
	CGI	0,36	1,80	0,28	0,18	0,22	0,28
<b>N</b>	Wrought aluminium alloys	0,22			0,13	0,13	
	Cast aluminium alloys	0,22			0,13	0,13	
	Magnesium-based alloys <sup>3</sup>	0,13			0,10	0,13	
	Copper and copper alloys (bronze/brass)	0,13			0,10	0,13	
<b>S</b>	Heat-resistant alloys	0,13	0,70	0,12	0,10	0,13	0,11
	Titanium alloys	0,13	0,70	0,12	0,10	0,13	0,11
	Tungsten alloys	0,13	0,70	0,12	0,10	0,13	0,11
	Molybdenum alloys	0,13	0,70	0,12	0,10	0,13	0,11
<b>H</b>	Hardened steel						
	Hardened cast iron						
<b>O</b>	Thermoplastics	0,20	0,50		0,17	0,20	0,20
	Plastic, carbon-fibre reinforced						
	Graphite (technical)	0,15	0,30		0,15	0,15	0,15
Indexable insert types		OD..0605..	P2633..-R25 P26379-R25	SD..1204...	AD..1204..	AD.T1606..	RO.X1605..
Correction factor $K_{a_e}$ for the feed per tooth depending on the ratio of cutting width $a_e$ to milling cutter diameter $D_c$	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,4	1,4	1,1	1,1	1,2
	1/10	1,2	1,4	1,8	1,2	1,2	1,5
	1/20	1,3			1,3	1,3	1,8
$f_z = f_{z0} \cdot K_{a_e}$	1/50						2,0
Correction factor $K$	$1 < (L : D_c) \leq 2$		1,4	1,4			
	$2 < (L : D_c) \leq 4$		1,0	1,0			
$f_z = f_{z0} \cdot K_{a_e} \cdot K$	$4 < (L : D_c) \leq 6$		0,7	0,7			

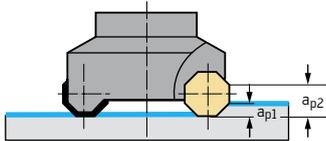
<sup>1</sup> and steel casting<sup>2</sup> and austenitic/ferritic<sup>3</sup> Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

The specified feed rates are average standard values. For specific applications, adjustment is recommended.

## Application information for Xtra-tec® XT M5004/F2010 octagon face milling cutters

### Face milling

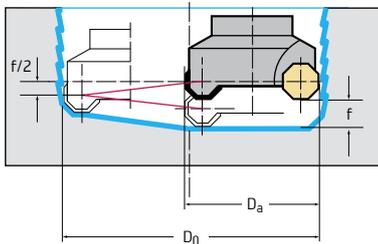
Max. milling depth  $a_p$  [mm]



	OD..0504..	OD..0605..
$a_{p1}$	3	4
$a_{p2}$	8	10

### Circular interpolation of a bore into solid material

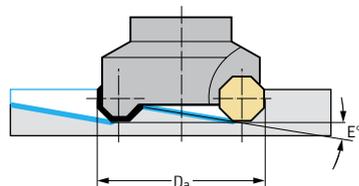
Diameter range for milling a hole in one pass [mm]



$D_a$ [mm]	Indexable insert					
	OD..0504..			OD..0605..		
	$D_{0\min}$ [mm]	$D_{0\max}$ [mm]	$f_{\max}$ [mm]	$D_{0\min}$ [mm]	$D_{0\max}$ [mm]	$f_{\max}$ [mm]
32	40,4	64	4,5			
40	56,4	80	4,5			
50	76,4	100	4,5	69,5	100	5,8
52	80,4	104	4,5	73,5	104	5,8
58	92,4	116	4,5			
60				89,5	120	5,8
63	102,4	126	4,5	95,5	126	5,8
66	108,4	132	4,5	101,5	132	5,8
71	118,4	142	4,5			
73				115,5	146	5,8
80	136,4	160	4,5	129,5	160	5,8
88	152,4	176	4,5			
90				149,5	180	5,8
100	176,4	200	4,5	169,5	200	5,8
108	192,4	216	4,5			
110				189,5	220	5,8
125	226,4	250	4,5	219,5	250	5,8
133	242,4	266	4,5			
135				239,5	270	5,8
160				289,5	320	5,8
170				309,5	340	5,8

### Ramping

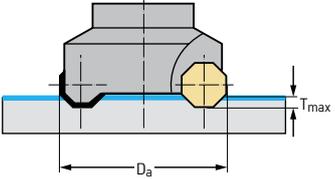
Maximum feed angle  $E$  [°]



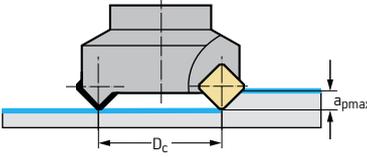
$D_a$ [mm]	OD..0504.. (F4080)	OD..0605.. (F4080)	$D_a$ [mm]	OD..050408	OD..0605.. (F4080)	OD..0605.. (F2010.. R592M)
32	14,0		90		4,0	0,40
36	10,6		100	2,0	3,1	
40	8,3		108	2,0		
50	5,5	9,6	110		3,1	0,31
52	5,1	8,9	125	1,5	2,3	
58	4,6		133	1,5		
60		7,7	135		2,3	0,25
63	3,8	6,2	160		1,7	
66	3,5	5,8	170		1,7	0,19
71	3,2		210			0,15
73		5,4	260			0,12
80	2,7	4,3	325			0,09
88	2,4					

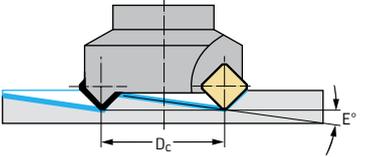
## Application information for Xtra-tec® XT M5004/F2010 octagon face milling cutters

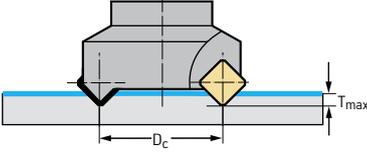
(continued)

Vertical plunging		Max. plunging depth $T_{max}$ [mm]	
		OD..0504..	OD..0605..
	$T_{max}$	2,8	4,0

## Application information for the M4003 face milling cutter

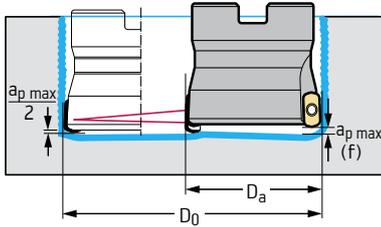
Face milling		Max. milling depth $a_p$ [mm]	
		SD..09T3AZN	SD..1204AZN
	$a_p$	4,5	6,5

Ramping		Maximum feed angle E [°]	
	$D_c$ [mm]	SD..09T3AZN..	SD..1204AZN..
	20	23,2	
	25	16,9	25,9
	32	12,1	17,9
	40	9,1	13,2
	50	7,0	9,8
	63	5,3	7,4
	80	4,0	5,6
	100	3,1	4,3
	125		3,4
160	6,8	2,6	

Vertical plunging		Max. plunging depth $T_{max}$ [mm]	
		SD..09T3AZN..	SD..1204AZN..
	$T_{max}$	4,5	6,0

## Application information for the Xtra-tec® XT M5008 high-feed milling cutter

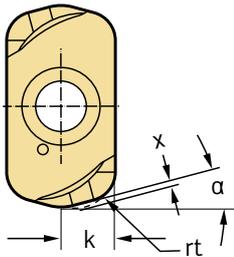
### Circular interpolation of a bore into solid material



#### Diameter range for milling a hole in one pass [mm]

D <sub>a</sub> [mm]	ENMX08T316R..	
	D <sub>0 min</sub> [mm]	D <sub>0 min</sub> [mm]
16	26,2	32
20	34,2	40
25	44,2	50
30	54,2	60
32	58,2	64
35	64,2	70
40	74,2	80
42	78,2	84
50	94,2	100
52	98,2	104
63	120,2	126
66	126,2	132

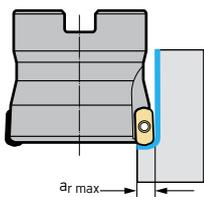
### Programming information



Indexable insert	rt [mm]	x [mm]	k [mm]	α [°]
ENMX08T316R..	2	0,79	3,0	17,7

**Important:**  
Programming the theoretical tool radius "rt" results in a maximum deviation from the final contour as shown. The minimum difference (only in the corners) is corrected by the subsequent tools for the remaining machining operations.

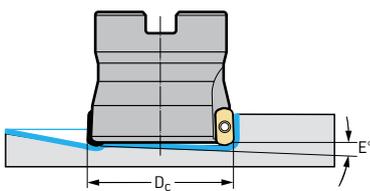
### Plunge milling



#### Max. plunging depth [mm]

a <sub>r</sub> [mm]	ENMX08T316R..
	3,0

### Ramping



#### Maximum feed angle E [°]

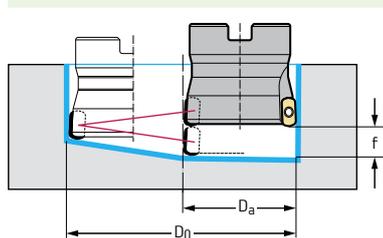
D <sub>a</sub> [mm]	ENMX08T316R..
	16
20	1,50
25	1,10
30	0,80
32	0,75
35	0,60
40	0,55
42	0,53
50	0,43
52	0,40
63	0,33
66	0,30

## Application information for the Xtra-tec® XT M5008 high-feed milling cutter

(continued)

### Circular interpolation of a bore

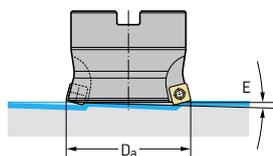
Max. axial feed per tool revolution ("thread pitch")  $f$  [mm]



Machined hole diameter $D_0$ [mm]	ENMX08T316R.. $D_a$ [mm]												
	16	20	25	30	32	35	40	42	50	52	63	66	
20	0,5												
30	1,0	0,8	0,3										
40	1,0	1,0	0,8	0,4	0,3	0,2							
50	1,0	1,0	1,0	0,9	0,7	0,5	0,3	0,2					
60	1,0	1,0	1,0	1,0	1,0	0,8	0,6	0,5	0,2	0,2			
70	1,0	1,0	1,0	1,0	1,0	1,0	0,9	0,8	0,5	0,4	0,1	0,1	
80	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,7	0,6	0,3	0,2	
90	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,9	0,8	0,5	0,4	
100	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,7	0,6	
120	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	0,9	
150	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
180	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
200	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	
250	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	

## Application information for M4002/F2010 high-feed milling cutters

### Ramping



#### Maximum feed angle E [°]

D <sub>a</sub> [mm]	SD..06T2..						ZDR
	r = 0,4	r = 0,8	r = 1,2	r = 1,6	r = 2,0	r = 2,5	
20	3,7	2,9	2,2				1,5
25	2,2	1,8	1,4				0,6
32	1,3	1	0,7				0,4
35	1,2	1	0,7				0,5
40	1,1	0,9	0,7				0,3
42	0,8	0,7	0,5				0,3
50	0,8	0,7	0,5				0,3
52	0,7	0,6	0,5				0,3
63	0,6	0,4	0,3				0,2
66	0,5	0,4	0,3				0,2

#### Maximum feed angle E [°]

D <sub>a</sub> [mm]	SD..09T3..						ZDR
	r = 0,4	r = 0,8	r = 1,2	r = 1,6	r = 2,0	r = 2,5	
25	4,3	3,5	2,8	2,3	1,2		1,2
32	3,6	3,1	2,7	2,3	1,9		1,8
35	2,9	2,5	2,2	1,9	1,5		1,6
40	2,2	1,9	1,6	1,4	1,2		1,2
42	2	1,7	1,5	1,3	1		1
50	1,5	1,3	1,1	1	0,8		0,8
52	1,3	1,2	1	0,8	0,7		0,7
63	1	0,8	0,7	0,6	0,5		0,5
66	0,9	0,8	0,7	0,6	0,4		0,4

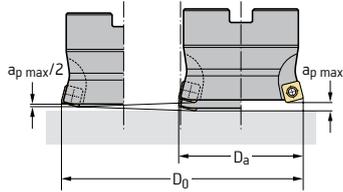
#### Maximum feed angle E [°]

D <sub>a</sub> [mm]	SD..120408..						ZDR
	r = 0,4	r = 0,8	r = 1,2	r = 1,6	r = 2,0	r = 2,5	
50		1,9	1,7	1,5	1,3	1	1
52		1,8	1,6	1,4	1,2	0,9	0,9
63		1,2	1,1	0,9	0,8	0,6	0,6
66		1,1	1	0,9	0,7	0,6	0,6
80		0,8	0,7	0,6	0,5	0,4	0,4
85		0,7	0,7	0,6	0,5	0,4	0,3
100		0,5	0,4	0,4	0,3	0,2	0,2
125		0,4	0,4	0,3	0,3	0,2	0,2

## Application information for M4002/F2010 high-feed milling cutters

(continued)

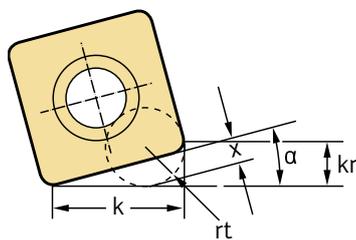
### Circular interpolation of a bore into solid material



### Diameter range for milling a hole in one pass

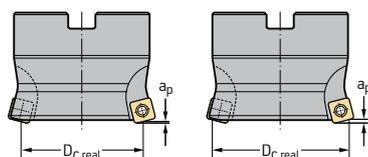
D <sub>a</sub> [mm]	Indexable insert					
	SD..06T204		SD..09T308		SD..120408	
	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]
20	28,6	40				
25	38,6	50	33,26	50		
32	52,6	64	47,26	64		
35	58,6	70	53,26	70		
40	68,6	80	63,26	80		
42	72,6	84	67,26	84		
50	88,6	100	83,26	100	77,12	100
52	92,6	104	87,26	104	81,12	104
63	114,6	126	109,26	126	103,12	126
66	120,6	132	115,26	132	109,12	132
80					137,12	160
85					147,12	170
100					177,12	200
125					227,12	250

### Programming information



Indexable insert	α [°]	rt [mm]	x [mm]	kr [mm]	k [mm]	
SD..06T204	15	1,8	1,00	1,83	5,76	
SD..06T208		2,0	0,84	2,02	5,39	
SD..06T212		2,2	0,68	2,21	5,02	
SD..06T2ZDR		1,3	0,72	2,63	4,29	
SD..09T304	15	2,65	1,58	2,65	7,40	
SD..09T308		2,8	1,43	2,83	8,47	
SD..09T312		3,0	1,26	3,03	8,08	
SD..09T316		3,2	1,11	3,22	7,71	
SD..09T320		3,4	0,97	3,38	7,40	
SD..09T3ZDR		2,4	1,09	3,65	6,90	
SD..X0904ZDR		2,8	1,20	2,80	8,30	
SD..120408		15	3,65	2,02	3,65	11,54
SD..120412			3,8	1,85	3,86	11,15
SD..120416			4,0	1,69	4,05	10,76
SD..120420	4,2		1,53	4,23	10,40	
SD..120425	4,5		1,33	4,47	9,94	
SD..1204ZDR	3,1		1,58	4,85	9,31	
SD..X1205ZDR	3,9		1,40	3,90	10,80	

### Increase in productivity

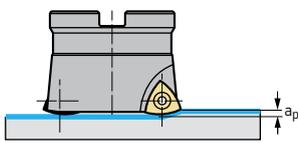


$$D_{C \text{ real}} \approx D_C + 8 \cdot a_p$$

- In order to achieve an increase in productivity, it is recommended to use the  $D_{C \text{ real}}$  when calculating the cutting data.
- The  $D_{C \text{ real}}$  depends on the depth of cut  $a_p$  (see image).

## Application information for F4030/F2010 high-feed milling cutters

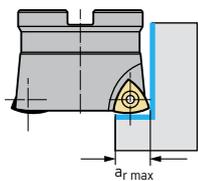
### Face milling



#### Max. milling depth $a_p$ [mm]

	P23696-1.0	P23696-2.0
$a_{p \max}$	1,0	2,0

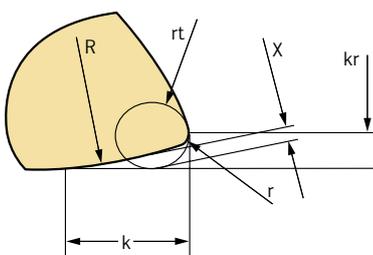
### Plunge milling



#### Max. plunging depth $a_r$ [mm]

$D_a$ [mm]	P23696-1.0	P23696-2.0
25	6	
32	7	
35	7	
40	7	
42	7	
50	7	9,5
52	7	10
63	7	10
66		10
80		10
85		10
100		10

### Programming information



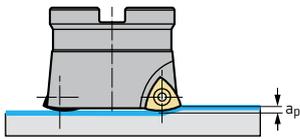
Indexable insert	R [mm]	r [mm]	rt [mm]	k [mm]	kr [mm]	X [mm]
P23696 - R 1.0	14	1,2	2,0	5,8	2,1	0,6
P23696 - R 2.0	18	1,6	3,5	9,2	3,5	1,1

#### Important:

Programming the theoretical tool radius "rt" results in a maximum deviation from the final contour as shown. The minimum difference (only in the corners) is corrected by the subsequent tools for the remaining machining operations.

## Application information for F2330/F2010 high-feed milling cutters

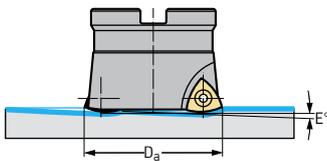
### Face milling



#### Max. milling depth $a_p$ [mm]

	P2633.- R10 P26379 - R10	P2633.- R14 P26379 - R14	P2633.- R25 P26379 - R25
$a_{p \max}$	1	1,5	2

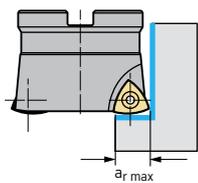
### Ramping



#### Maximum feed angle E [°]

$D_a$ [mm]	P2633.- R10 P26379 - R10 (F2330)	P2633.- R14 P26379 - R14	P2633.- R25 P26379 - R25	P2633.- R25 P26379 - R25 (F2010...R729M)
20	4,0			
25	2,3			
32		2,5		
35		2,0		
40		1,5		
42		1,4		
52		1,2	2,3	
66		0,9	1,4	
85		0,6	1,0	
87				1,12
107				0,84
132				0,63
167				0,47
207				0,36
257				0,28
322				0,22

### Plunge milling



#### Max. plunging depth $a_r$ [mm]

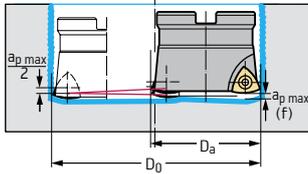
	P2633.- R10 P26379 - R10	P2633.- R14 P26379 - R14	P2633.- R25 P26379 - R25
$a_{r \max}$	7	10,3	15

## Application information for F2330/F2010 high-feed milling cutters

(continued)

### Circular interpolation of a bore into solid material

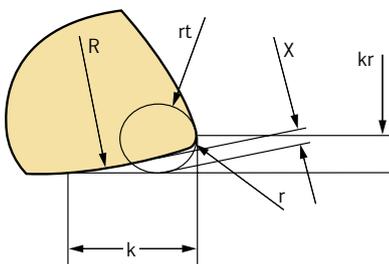
Diameter range for milling a hole in one pass [mm]



D <sub>a</sub> [mm]	Indexable insert					
	P2633. – R10 P26379 – R10*		P2633. – R14 P26379 – R14*		P2633. – R25 P26379 – R25*	
	D <sub>0 min</sub> [mm]	D <sub>0 min</sub> [mm]	D <sub>0 min</sub> [mm]	D <sub>0 min</sub> [mm]	D <sub>0 min</sub> [mm]	D <sub>0 min</sub> [mm]
20	24,2	40				
25	34,2	50				
32			41,8	64		
35			47,8	70		
40			57,8	80		
42			61,8	84		
50			77,8	100	67,8	100
52			81,8	104	70,4	102,6
63			103,8	126	93,8	126
66			109,8	132	98,4	130,6
80			137,8	160	127,8	160
85			147,8	170	136,4	168,6

\* Special geometry for circular interpolation milling (see geometry description on page D 3).

### Programming information



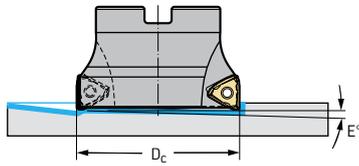
Indexable insert	R [mm]	r [mm]	rt [mm]	k [mm]	kr [mm]	X [mm]
P2633. – R10	10,0	0,8	2,0	4,0	1,8	0,5
P2633. – R14	14,0	1,2	2,5	5,5	2,6	0,8
P2633. – R25	25,0	2,0	3,0	8,0	3,4	0,9
P26379 – R10	10,0	0,4	1,5	4,8	1,5	0,63
P26379 – R14	14,0	0,4	2,2	7,2	2,2	0,91
P26379 – R25	25,0	0,4	2,8	9,6	2,8	1,05

**Important:**

Programming the theoretical tool radius "rt" results in a maximum deviation from the final contour as shown. The minimum difference (only in the corners) is corrected by the subsequent tools for the remaining machining operations.

## Application information for the Xtra-tec® XT M5137 shoulder milling cutter

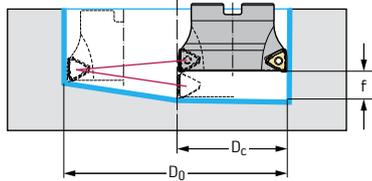
### Ramping and circular plunging into solid material



Plunging with the Xtra-tec® XT M5137 shoulder milling cutter/plunging angle  $E_{max}$  [°]

Milling cutter dia. $D_c$ [mm]	TNMU11T304R... $a_{p max} = 5$ mm				TNMU160508R... $a_{p max} = 8$ mm			
	$E_{max}$ [°]	$D_{0 min}$ [mm]	$D_{0 max}$ [mm]	$a_0$ [mm]	$E_{max}$ [°]	$D_{0 min}$ [mm]	$D_{0 max}$ [mm]	$a_0$ [mm]
25	3,1	41	50	0,5				
32	2,2	55	64	0,5				
40	1,7	71	80	0,5				
50	1,3	91	100	0,5	1,3	91	100	1,0
63	0,9	117	126	0,5	1,0	117	126	1,0
80					0,8	151	160	1,0
100					0,6	191	200	1,0

### Circular interpolation of a bore into solid material

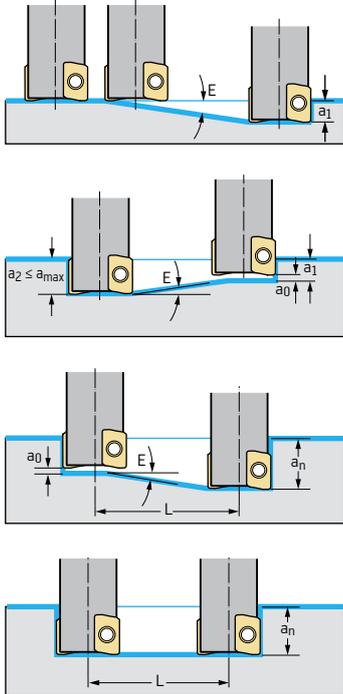


Max. axial feed per tool revolution ("thread pitch")  $f$  [mm]

Machined hole diameter $D_0$ [mm]	TNMU11T304R... $D_c$ [mm]					TNMU160508R... $D_c$ [mm]			
	25	32	40	50	63	50	63	80	100
30	0,9								
40	2,6	1,0							
50	4,3	2,2	0,9						
60	5,0	3,4	1,9	0,7					
70	5,0	4,6	2,8	1,4	0,3				
80	5,0	5,0	3,7	2,1	0,8				
90	5,0	5,0	4,7	2,9	1,3				
100	5,0	5,0	5,0	3,6	1,8	3,6			
120	5,0	5,0	5,0	5,0	2,8	5,0	3,1		
150						7,8	5,3	3,5	
160	5,0	5,0	5,0	5,0	4,8				
180	5,0	5,0	5,0	5,0	5,0	8,0	6,4	4,4	
200	5,0	5,0	5,0	5,0	5,0	8,0	7,5	5,3	3,3
250	5,0	5,0	5,0	5,0	5,0	8,0	8,0	7,5	4,9
300	5,0	5,0	5,0	5,0	5,0	8,0	8,0	8,0	6,6
350	5,0	5,0	5,0	5,0	5,0	8,0	8,0	8,0	8,0
400	5,0	5,0	5,0	5,0	5,0	8,0	8,0	8,0	8,0
450	5,0	5,0	5,0	5,0	5,0				
500	5,0	5,0	5,0	5,0	5,0				

## Application information for the Xtra-tec® XT M5130 shoulder milling cutter

### Ramping and circular plunging into solid material



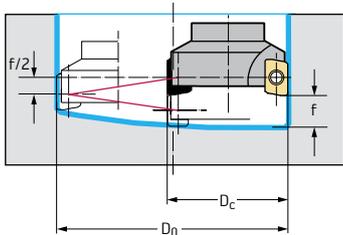
#### Plunging angle $E_{max}$ [°]

Milling cutter dia. $D_c$ [mm]	AC..0602.. $a_{pmax} = 5$ mm				BC..0903.. $a_{pmax} = 9$ mm			
	$E_{max}$ [°]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]	$E_{max}$ [°]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]
10	6,7	15	20	0,58				
12	4,0	18	24	0,57				
14	3,7	21	28	0,57				
16	3,0	25	32	0,56	8,4	20,2	32	1,2
18	2,5	29	36	0,56	6,7	24,2	36	1,2
20	2,1	33	40	0,56	5,4	28,2	40	1,1
22	1,9	37	44	0,56	4,6	32,2	44	1,1
25	1,6	43	50	0,56	3,8	38,2	50	1,1
32	1,2	57	64	0,56	2,6	52,2	64	1,1
40	0,9	73	80	0,56	2,0	68,2	80	1,1
50	0,7	73	100	0,56	1,6	88,2	100	1,1
63	0,5	119	126	0,56	1,2	114,2	126	1,1

#### Plunging angle $E_{max}$ [°]

Milling cutter dia. $D_c$ [mm]	BC..1204.. $a_{pmax} = 12$ mm				BC..1605.. $a_{pmax} = 15$ mm			
	$E_{max}$ [°]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]	$E_{max}$ [°]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]
22	7,1	30	44	1,6				
25	5,8	36	50	1,6	8,8	32	50	2
28					7,1	38	56	2
32	3,8	50	64	1,5	5,8	46	64	2
35					5,0	52	70	2
40	2,8	66	80	1,5	4,1	62	80	2
42					3,8	66	84	2
50	2,1	86	100	1,5	3,0	82	100	2
52					2,9	86	104	2
63	1,6	112	126	1,5	2,3	108	126	2
66					2,1	114	132	2
80	1,2	146	160	1,5	1,7	142	160	2
85					1,6	152	170	2
100					1,3	182	200	2
125					1,0	232	250	2
160					0,8	302	320	2

### Circular interpolation of a bore into solid material



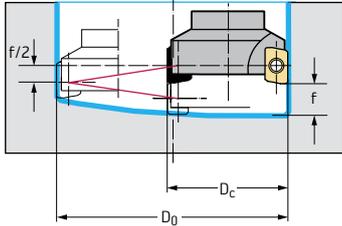
#### Max. axial feed per tool revolution ("thread pitch") $f$ [mm]

Machined hole diameter $D_0$ [mm]	AC..0602.. $D_c$ [mm]											
	10	12	14	16	18	20	22	25	32	40	50	63
15	1,8											
20	3,7	2,1										
30	5,0	4,7	3,3	2,3	1,6							
40	5,0	5,0	5,0	4,0	3,0	2,3	1,9					
50	5,0	5,0	5,0	5,0	4,4	3,5	2,9	2,2				
60	5,0	5,0	5,0	5,0	5,0	4,6	4,0	3,1	1,8			
70	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,9	2,5			
80	5,0	5,0	5,0	5,0	5,0	5,0	5,0	4,8	3,2	2,0		
90	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,8	2,5		
100	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	4,5	3,0	1,9	
120	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,9	2,7	1,6
150	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,8	2,4
180	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,2
200	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	3,8
250	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0	5,0

# Application information for the Xtra-tec® XT M5130 shoulder milling cutter

(continued)

## Circular interpolation of a bore into solid material



Max. axial feed per tool revolution ("thread pitch") f [mm]

Machined hole diameter D <sub>0</sub> [mm]	BC..0903.. D <sub>c</sub> [mm]							
	16	18	20	25	32	40	50	63
25	3,0	1,5						
30	6,1	4,0	1,5					
40	8,8	8,2	5,5	1,7				
50	8,8	8,8	8,2	5,0				
60	8,8	8,8	8,8	6,5	3,5			
70	8,8	8,8	8,8	8,8	5,5	1,5		
80	8,8	8,8	8,8	8,8	7,5	4,0		
90	8,8	8,8	8,8	8,8	8,8	5,5	1,5	
100	8,8	8,8	8,8	8,8	8,8	6,7	3,8	
120	8,8	8,8	8,8	8,8	8,8	8,8	6,0	3,0
150	8,8	8,8	8,8	8,8	8,8	8,8	8,8	5,5
180	8,8	8,8	8,8	8,8	8,8	8,8	8,8	7,5
200	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8
250	8,8	8,8	8,8	8,8	8,8	8,8	8,8	8,8

Max. axial feed per tool revolution ("thread pitch") f [mm]

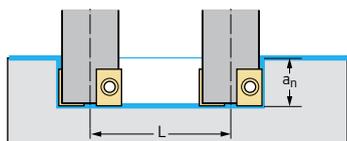
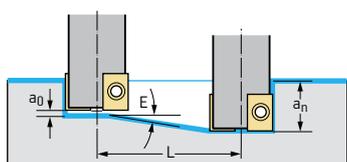
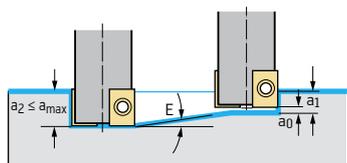
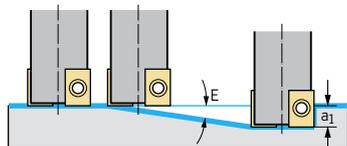
Machined hole diameter D <sub>0</sub> [mm]	BC..1204.. D <sub>c</sub> [mm]						
	22	25	32	40	50	63	80
30	3,1						
40	7,0	4,8					
50	11,0	8,0	3,8				
60	12,0	11,2	5,8				
80	12,0	12,0	7,9	4,6			
100	12,0	12,0	10,0	6,1			
120	12,0	12,0	12,0	7,7	4,6		
150	12,0	12,0	12,0	9,2	5,8		
180	12,0	12,0	12,0	12,0	8,1	5,0	
200	12,0	12,0	12,0	12,0	11,5	7,6	4,6
250	12,0	12,0	12,0	12,0	12,0	10,3	6,6
300	12,0	12,0	12,0	12,0	12,0	12,0	7,9
350	12,0	12,0	12,0	12,0	12,0	12,0	11,2
400	12,0	12,0	12,0	12,0	12,0	12,0	12,0
450	12,0	12,0	12,0	12,0	12,0	12,0	12,0
500	12,0	12,0	12,0	12,0	12,0	12,0	12,0

Max. axial feed per tool revolution ("thread pitch") f [mm]

Machined hole diameter D <sub>0</sub> [mm]	BC..1605.. D <sub>c</sub> [mm]														
	25	28	32	35	40	42	50	52	63	66	80	85	100	125	160
40	7,3	4,7													
50	12,2	8,6	5,7	4,1											
60	15,0	12,5	8,9	6,9											
70	15,0	15,0	12,1	9,6	6,8	5,8									
80	15,0	15,0	15,0	12,4	9,0	7,9									
90	15,0	15,0	15,0	15,0	11,3	10,0	6,6	6,0							
100	15,0	15,0	15,0	15,0	13,5	12,1	8,2	7,6							
120	15,0	15,0	15,0	15,0	15,0	15,0	11,5	10,8	7,2	6,2					
150	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	11,0	9,7	6,5	5,7			
180	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	14,8	13,1	9,3	8,3			
200	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	11,2	10,1	7,1		
250	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	14,5	10,7	6,9	
300	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	14,3	9,6	
350	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	12,3	8,3
400	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	10,5
450	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	12,7
500	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	14,9

## Application information for Xtra-tec® F4042/F4042R shoulder milling cutters

### Ramping and circular plunging into solid material



### Plunging with Xtra-tec® F4042/F4042R shoulder milling cutters

Milling cutter dia. $D_c$ [mm]	Plunging angle $E_{max}$ [°]	AD..080304 $a_{pmax} = 8$ mm			AD..10T308 $a_{pmax} = 10$ mm		
		$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]
10	12,1	15	20	0,75			
12	9,9	17	24	0,8			
16	13,7	21	32	2,0	6,6	20	32
18	6,95	25	36	2,0			
20	8,9	29	40	1,9	2,9	28	40
22	4,76	33	44	1,7			
25	5,6	39	50	1,7	2	38	50
32	3,8	53	64	1,6	1,4	52	64
40	2,8	69	80	1,6	1,1	68	80
50	2,2	89	100	1,6	0,8	88	100
63					0,6	114	126

### Plunging with the Xtra-tec® F4042 shoulder milling cutter

Milling cutter dia. $D_c$ [mm]	Plunging angle $E_{max}$ [°]	AD..120408 $a_{pmax} = 11$ mm			AD..160608 $a_{pmax} = 15$ mm		
		$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]
22	7,4	30	44	2,6			
25	8,5	36	50	2,3	8,5	32	50
32	5,6	50	64	2,2	7,5	46	64
36					7,0	54	72
40	3,9	66	80	2,1	5,9	62	80
44					4,5	70	88
50	2,7	86	100	1,9	3,9	82	100
54					2,7	90	108
63	2,0	112	126	1,9	2,6	108	126
66					1,8	114	132
80	1,5	146	160	1,9	1,9	142	160
84					1,6	150	168
100					1,5	182	200
125					1,2	232	250
160					0,9	302	320

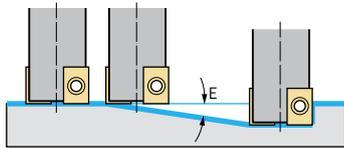
### Plunging with the Xtra-tec® F4042 shoulder milling cutter

Milling cutter dia. $D_c$ [mm]	Plunging angle $E_{max}$ [°]	AD..180712 $a_{pmax} = 16$ mm		
		$D_{0min}$ [mm]	$D_{0max}$ [mm]	$a_0$ [mm]
50	2,9	74	100	1,7
63	2,1	100	126	1,7
80	1,5	134	160	1,7
100	1,2	174	200	1,7
125	0,9	224	250	1,7
160	0,7	294	320	1,7

## Application information for Xtra-tec® F4042/F4042R/F2010 shoulder milling cutters

(continued)

Maximum feed angle E [°] for F2010



D <sub>c</sub> [mm]	AD..1204.. (F2010..R718M)	AD..1606.. (F2010..R719M)
80	0,65	0,75
100	0,51	0,58
125	0,40	0,46
160	0,31	0,35
200	0,25	0,28
250	0,19	0,22
315	0,15	0,17

Groove depth after two plunging operations:

$$a_2 = 2 \cdot L \cdot \tan E - a_0$$

Groove depth after ramping:

$$a_n = n \cdot L \cdot \tan E - (n - 1) \cdot a_0$$

Explanation of abbreviations:

a <sub>0</sub>	[mm]	Amount by which the tool must be lifted at the end of plunging before starting the next plunging operation
a <sub>n</sub>	[mm]	Groove depth
E	[°]	Actual feed angle
L	[mm]	Groove length without radius
n		Number of inclined ramping operations

Number of inclined ramping operations:

$$n = \frac{(a_n - a_0)}{(L \cdot \tan E - a_0)}$$

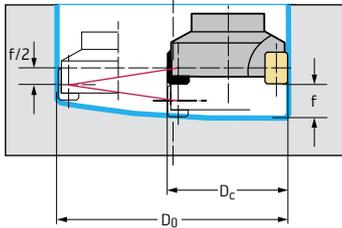
Feed angle:

$$\tan E = \frac{[a_n + (n - 1) \cdot a_0]}{(n \cdot L)}$$

## Application information for Xtra-tec® F4042/F4042R shoulder milling cutters

(continued)

### Circular interpolation



Max. axial feed per tool revolution ("thread pitch") f [mm]

Machined hole diameter D <sub>0</sub> [mm]	AD..080304 D <sub>c</sub> [mm]										AD..10T308 D <sub>c</sub> [mm]									
	10	12	16	18	20	22	25	32	40	50	16	20	25	32	40	50	63			
15	3,4																			
20	6,7	4,4										1,5								
30	8,0	8,0	8,0	4,4	4,9						5,1	1,6								
40	8,0	8,0	8,0	8,0	8,0	4,6	4,7				8,7	3,2	1,6							
50	8,0	8,0	8,0	8,0	8,0	7,2	7,8				10,0	4,8	2,7							
60	8,0	8,0	8,0	8,0	8,0	8,0	8,0	5,8			10,0	6,4	3,8	2,1						
80	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	6,2		10,0	9,5	6,0	3,7	2,4					
100	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	6,0	10,0	10,0	8,2	5,2	3,6	2,2				
120	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	10,0	10,0	10,0	6,8	4,8	3,1	1,9			
150	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	10,0	10,0	10,0	9,1	6,6	4,4	2,9			
180	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	10,0	10,0	10,0	10,0	8,4	5,7	3,8			
200	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	10,0	10,0	10,0	10,0	9,7	6,6	4,5			
250	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	10,0	10,0	10,0	10,0	10,0	8,8	6,2			

Max. axial feed per tool revolution ("thread pitch") f [mm]

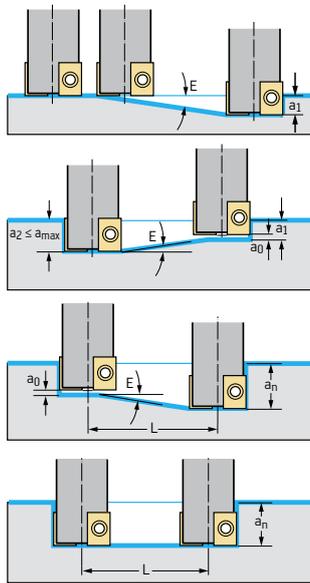
Machined hole diameter D <sub>0</sub> [mm]	AD..120408 D <sub>c</sub> [mm]							AD..160608 D <sub>c</sub> [mm]														
	22	25	32	40	50	63	80	25	32	36	40	44	50	54	63	66	80	84	100	125	160	
32								3,4														
40	7,2	7,0						7,2														
50	11,3	11,0	5,5					11,5	7,6													
60	11,7	11,0	8,6					15,0	11,7	9,4												
80	11,7	11,0	11,0	8,7				15,0	15,0	15,0	13,1	9,1										
100	11,7	11,0	11,0	11,0	7,4			15,0	15,0	15,0	15,0	14,0	10,8	7,0								
120	11,7	11,0	11,0	11,0	10,3	6,4		15,0	15,0	15,0	15,0	15,0	15,0	9,9	8,1	5,5						
150	11,7	11,0	11,0	11,0	11,0	9,7	6,4	15,0	15,0	15,0	15,0	15,0	15,0	14,4	12,4	8,4	7,5	5,9				
180	11,7	11,0	11,0	11,0	11,0	11,0	5,9	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	11,4	10,7	8,6				
200	11,7	11,0	11,0	11,0	11,0	11,0	8,5	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	13,4	12,8	10,3	8,2			
250	11,7	11,0	11,0	11,0	11,0	11,0	10,2	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	14,7	12,3	8,0
300	11,7	11,0	11,0	11,0	11,0	11,0	11,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	11,2
350	11,7	11,0	11,0	11,0	11,0	11,0	11,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	14,4	9,3
400	11,7	11,0	11,0	11,0	11,0	11,0	11,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	11,7
450	11,7	11,0	11,0	11,0	11,0	11,0	11,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	14,2
500	11,7	11,0	11,0	11,0	11,0	11,0	11,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0	15,0

Max. axial feed per tool revolution ("thread pitch") f [mm]

Machined hole diameter D <sub>0</sub> [mm]	AD..180712 D <sub>c</sub> [mm]					
	50	63	80	100	125	160
80	4,8					
100	7,9	4,2				
120	11,1	6,5				
150	15,9	10,0	5,9			
180	16,0	13,4	8,4			
200	16,0	15,7	10,1	5,1		
250	16,0	16,0	14,3	6,4	6,1	
300	16,0	16,0	16,0	9,6	8,6	5,2
350	16,0	16,0	16,0	12,8	11,1	7,1
400	16,0	16,0	16,0	16,0	13,5	8,9
450	16,0	16,0	16,0	16,0	16,0	10,8
500	16,0	16,0	16,0	16,0	16,0	12,6

## Application information for the M4130 shoulder milling cutter

### Ramping and circular plunging into solid material

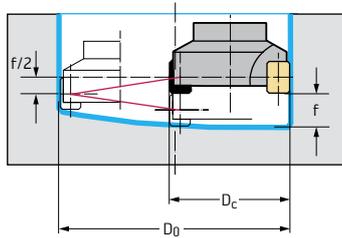


#### Maximum feed angle E [°]

D <sub>c</sub> [mm]	LD..08T204R..	LD..14T308R..	LD..170408R
16	4,6		
20	2,7		
25	1,9	5,5	
32		2,9	
40		1,9	
50		1,4	1,9
63		1,0	1,3
80			1
100			0,7
125			0,6

### Circular interpolation

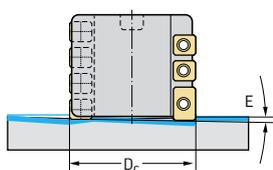
#### Max. axial feed per tool revolution ("thread pitch") f [mm]



Machined hole diameter		LD..08T204R.. D <sub>c</sub> [mm]			LD..14T308R.. D <sub>c</sub> [mm]					LD..170408R.. D <sub>c</sub> [mm]					
D <sub>0min</sub> [mm]	D <sub>0max</sub> [mm]	16	20	25	25	32	40	50	63	40	50	63	80	100	125
20,6	32	5,7													
28,6	40	5,7	5,7												
38,6	50	5,7	5,7	5,7											
31,6	50	5,7	5,7	5,7	9,2										
45,6	64	5,7	5,7	5,7	9,2	9,2									
61,6	80	5,7	5,7	5,7	9,2	9,2	9,2								
81,6	100	5,7	5,7	5,7	9,2	9,2	9,2	9,2							
107,6	126	5,7	5,7	5,7	9,2	9,2	9,2	9,2	9,2						
57,6	80	5,7	5,7	5,7	9,2	9,2	9,2	9,2	9,2	11,2					
77,6	100	5,7	5,7	5,7	9,2	9,2	9,2	9,2	9,2	11,2	11,2				
103,6	126	5,7	5,7	5,7	9,2	9,2	9,2	9,2	9,2	11,2	11,2	11,2			
137,6	160	5,7	5,7	5,7	9,2	9,2	9,2	9,2	9,2	11,2	11,2	11,2	11,2		
177,6	200	5,7	5,7	5,7	9,2	9,2	9,2	9,2	9,2	11,2	11,2	11,2	11,2	11,2	
227,6	250	5,7	5,7	5,7	9,2	9,2	9,2	9,2	9,2	11,2	11,2	11,2	11,2	11,2	11,2

## Application information for M4256/M4257/M4258 helical milling cutters

### Ramping

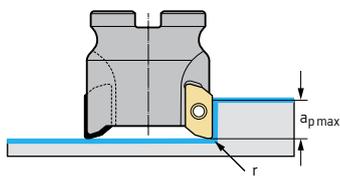


#### Maximum feed angle E [°]

D <sub>c</sub> [mm]	SD..06T2.. LD..08T2..	SD..09T3.. LD..14T3..	SD..1204.. LD..1704..
20	1		
25	2		
32	1,5		
40		1,4	
50		1	
63		0,5	
80			0,5
100			0,4

## Application information for the M2331 ramping milling cutter

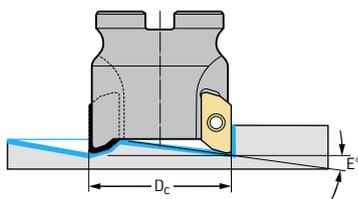
### Shoulder milling



#### Max. milling depth $a_{max}$ [mm]

Corner radius r [mm]	ZDGT15A4..	ZDGT20A5..
0,4	16,0	21,3
0,8	16,0	21,3
1,2	15,9	21,2
1,6	15,8	21,0
2,0	15,7	20,9
2,5	15,5	20,8
3,0	15,4	20,6
4,0	15,1	20,3
5,0		20,0
6,0		19,8
6,4		19,7

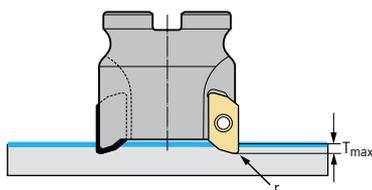
### Ramping



#### Maximum feed angle E [°]

$D_c$ [mm]	ZDGT15A4..	ZDGT20A5..
32	11	
40	7	12
50	5	8

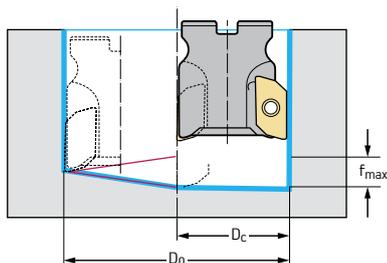
### Vertical plunging



#### Max. plunging depth $T_{max}$ [mm]

Corner radius r [mm]	ZDGT15A4..	ZDGT20A5..
0,4	4,5	6,0
0,8	4,5	6,0
1,2	4,4	5,9
1,6	4,2	5,7
2,0	4,1	5,6
2,5	4,0	5,5
3,0	3,8	5,3
4,0	3,5	5,0
5,0		4,7
6,0		4,5
6,4		4,4

### Circular interpolation of a bore into solid material

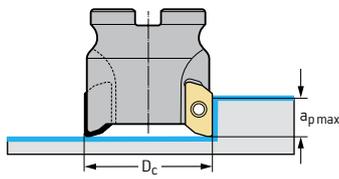


#### Possible hole diameters and axial feeds

Milling cutter dia. $D_c$ [mm]	ZD...15A4..			ZD...20A5..		
	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$f_{max}$ [mm]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$f_{max}$ [mm]
32	45	64	7,9			
40	61	80	8,1	54	80	9,3
50	81	100	8,5	74	100	10,6

## Application information for the M2131 ramping milling cutter

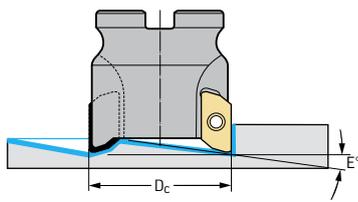
### Shoulder milling



#### Max. milling depth $a_p$ [mm]

Corner radius [mm]	ZD..1504..	ZD..2005..
0,4	16,0	21,3
0,8	16,0	21,3
1,2	15,9	21,2
1,6	15,8	21,0
2,0	15,7	20,9
2,5	15,5	20,8
3,0	15,4	20,6
4,0	15,1	20,3
5,0		20,0
6,0		19,8
6,4		19,7

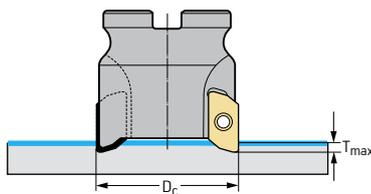
### Ramping



#### Maximum feed angle $E$ [°]

$D_c$ [mm]	ZD..1504..	ZD..2005..
25	16	
32	11	16
40	7	12
50	5	8
63	4	6
80	2	

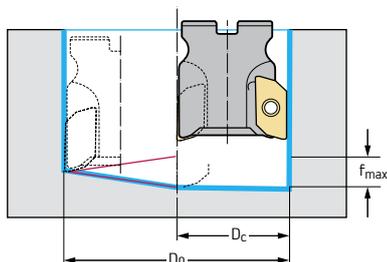
### Vertical plunging



#### Max. plunging depth $T_{max}$ [mm]

Corner radius [mm]	ZD..1504..	ZD..2005..
0,4	4,5	6,0
0,8	4,5	6,0
1,2	4,4	5,9
1,6	4,2	5,7
2,0	4,1	5,6
2,5	4,0	5,5
3,0	3,8	5,3
4,0	3,5	5,0
5,0		4,7
6,0		4,5
6,4		4,4

### Circular interpolation of a bore into solid material

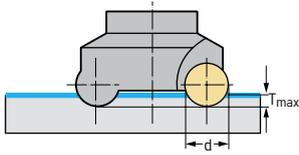


#### Possible hole diameters and axial feeds

Milling cutter dia. $D_c$ [mm]	ZDGT1504..			ZDGT2005..		
	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$f_{max}$ [mm]	$D_{0min}$ [mm]	$D_{0max}$ [mm]	$f_{max}$ [mm]
25	31	50	5,4			
32	45	64	7,9	38	64	5,4
40	61	80	8,1	54	80	9,3
50	81	100	8,5	74	100	10,6
63	107	126	9,7	100	126	12,2
80	141	160	6,5			

## Application information for the Xtra-tec® XT M5468 copy milling cutter

### Vertical plunging



#### Max. plunging depth $T_{max}$ [mm]

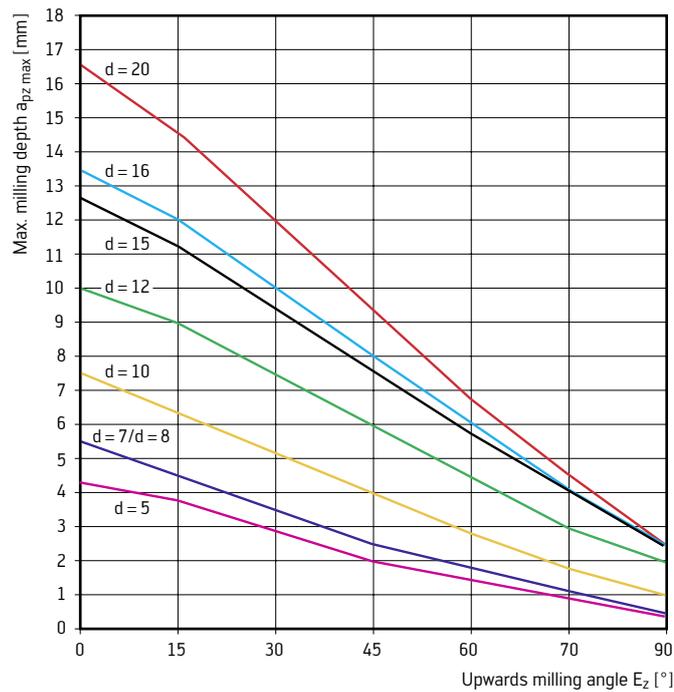
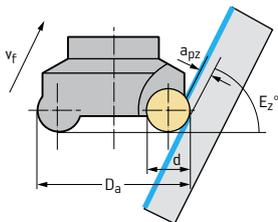
$T_{max}$ [mm]	Indexable insert diameter d [mm]			
	RD..0501M0.. d = 5 mm	RD..07T1M0.. d = 7 mm	RO..X0804M04.. d = 8 mm	RO..X10T3M08.. d = 10 mm
	1,1	1,5	2,0	2,5

#### Max. plunging depth $T_{max}$ [mm]

$T_{max}$ [mm]	Indexable insert diameter d [mm]		
	RO..X1204M08.. d = 12 mm	RO..X1605M08.. d = 16 mm	RO..X2006M08.. d = 20 mm
	$D_a < 40 = 3,5$ $D_a \geq 40 = 4,5$	$D_a < 52 = 6$ $D_a \geq 52 = 7$	$D_a < 100 = 6,5$ $D_a \geq 100 = 3,5$

### Milling upwards on inclined surfaces

#### Max. plunging depth $T_{max}$ [mm]

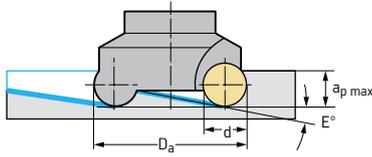


# Application information for the Xtra-tec® XT M5468 copy milling cutter

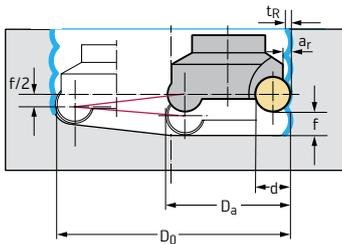
(continued)

## Ramping and circular plunging into solid material

### Ramping



### Circular interpolation of a bore into solid material



### Plunging

Milling cutter dia. D <sub>a</sub> [mm]	Indexable insert diameter d [mm]								
	RD..0501M0.. a <sub>p max</sub> = 2,5 mm			RD..071M0.. a <sub>p max</sub> = 3,5 mm			RO..X0804M04.. a <sub>p max</sub> = 4 mm		
	E <sub>max</sub> [°]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]	E <sub>max</sub> [°]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]	E <sub>max</sub> [°]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]
10	3,5	10	20						
12	14,1	14,6	24						
15				32,5	16,6	30			
16	7,7	22,6	32				8	16	32
20	5,3	30,6	40	8,5	27,2	40			
24									
25				5,7	37,2	50	12,5	34,3	50
30				4,2	47,2	60			
32							8,2	48,3	64

### Plunging

Milling cutter dia. D <sub>a</sub> [mm]	Indexable insert diameter d [mm]								
	RO..X10T3M08.. a <sub>p max</sub> = 5 mm			RO..X1204M08.. a <sub>p max</sub> = 6 mm			RO..X1605M08.. a <sub>p max</sub> = 8 mm		
	E <sub>max</sub> [°]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]	E <sub>max</sub> [°]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]	E <sub>max</sub> [°]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]
20	11	20	40						
24				15	24	48			
25	17,3	31	50						
30	11,8	41	60						
32	10,5	45	64	14,4	41	64	15	32	64
35	8,9	51	70						
40	8,3	61	80	14,5	57	80			
42				13,4	61	84			
50	6,0	81	100	10,1	77	100			
52	5,6	85	104	9,5	81	104	13	73	104
63				7,2	103	126	11	95	126
66				6,7	109	132	10	101	132
80				5,2	137	160	8	129	160
100				3,9	177	200	6	169	200
125				3,9	177	200	4	219	250

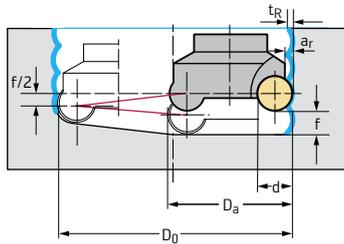
### Plunging

Milling cutter dia. D <sub>a</sub> [mm]	Indexable insert diameter d [mm]								
	RO..X2006M08.. a <sub>p max</sub> = 10 mm								
	E <sub>max</sub> [°]	D <sub>0 min</sub> [mm]	D <sub>0 max</sub> [mm]						
40	19,0	40,0	80,0						
63	13,0	86,5	126,0						
80	8,7	120,5	160,0						
100	2,8	164,7	200,0						
125	2,7	213,0	250,0						

## Application information for the Xtra-tec® XT M5468 copy milling cutter

(continued)

### Ramping and circular plunging into solid material



#### Groove depth on the wall of the hole $t_R$ [mm]

Axial feed per revolution $f$ [mm]	Indexable insert diameter $d$ [mm]			
	RD..0501M0.. $d = 5$ mm	RD..07T1M0.. $d = 7$ mm	RO.X0804M04.. $d = 8$ mm	RO.X10T3M08.. $d = 10$ mm
1	0,051	0,036	0,031	0,025
2	0,209	0,146	0,127	0,100
3	0,500	0,338	0,292	0,230
4			0,536	0,417
5			0,878	0,670
6				(1,000)
7				(1,429)
$a_{rmax}$	0,5	0,5	1,25	1,5

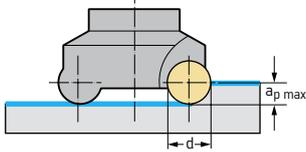
#### Groove depth on the wall of the hole $t_R$ [mm]

Axial feed per revolution $f$ [mm]	Indexable insert diameter $d$ [mm]		
	RO.X1204M08.. $d = 12$ mm	RO.X1605M08.. $d = 16$ mm	RO.X2006M08.. $d = 20$ mm
1	0,020	0,015	0,010
2	0,080	0,060	0,050
3	0,190	0,140	0,110
4	0,340	0,250	0,200
5	0,540	0,400	0,320
6	0,800	0,580	0,460
7	(1,120)	0,810	0,630
8	(1,530)	(1,07)	0,840
$a_{rmax}$	2,0	3,0	4,5

The values in brackets only apply to short bores.

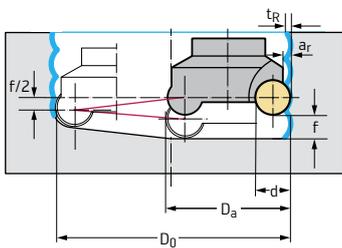
## Application information for F2334R/F2010 button insert milling cutters

### Face milling



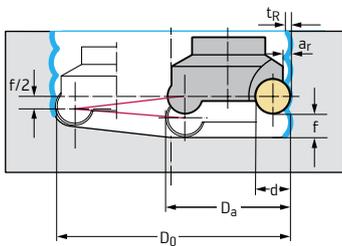
$a_{p \max}$ [mm]	Indexable insert diameter d [mm]	
	d = 10	d = 12
	5,0	6,0

### Circular interpolation of a bore into solid material



$D_a$ [mm]	Indexable insert diameter d [mm]			
	d = 10		d = 12	
	$D_{0 \min}$ [mm]	$D_{0 \max}$ [mm]	$D_{0 \min}$ [mm]	$D_{0 \max}$ [mm]
32	45	64		
40	61	80	57,4	80
50	81,4	100	77,2	100
52	85	104	81,2	104
63	102,4	126	103,2	126
66	113	132	109,4	132
80			137,8	160

### Groove depth on the wall of the hole $t_R$ [mm]

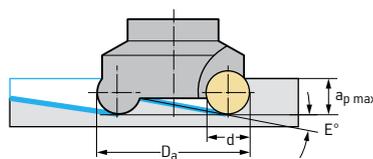


Axial feed per revolution f [mm]	Indexable insert diameter d [mm]	
	d = 10	d = 12
1	0,025	0,02
2	0,010	0,08
3	0,230	0,19
4	0,417	0,34
5	0,670	0,54
6	(1,000)	0,80
7	(1,429)	(1,12)
8		(1,53)
$a_r \max$	1,5	2,0

The values in brackets only apply to short bores.

### Ramping

#### F2334R: Maximum feed angle E [°]



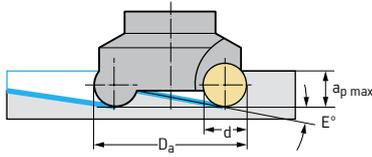
$D_a$ [mm]	Indexable insert diameter d [mm]	
	d = 10	d = 12
25		
32	8,6	
40	5,8	7,9
50	4,0	5,4
52	3,9	5,3
63	3,0	3,4
66	2,8	3,4
80		2,6
$a_{p \max}$ [mm]	8,8	10,5

## Application information for F2334R/F2010 button insert milling cutters

(continued)

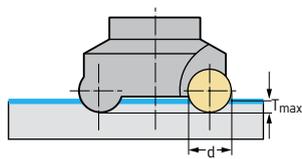
### Ramping

F2010: Maximum feed angle E [°]



D <sub>a</sub> [mm]	Indexable insert diameter d [mm]	
	RO.X1605.. (F2010...R723M)	
83	2,50	
103	1,89	
128	1,44	
163	1,08	
203	0,84	
253	0,66	
318	0,51	

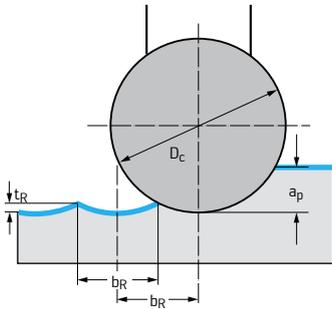
### Vertical plunging



T <sub>max</sub> [mm]	Indexable insert diameter d [mm]	
	d = 10	d = 12
	2,6	3,1

## Application information for M5460/F2139/F2239/F2339 ball nose cutters

### Line-by-line milling



Groove depth:

$$t_R = 0,5 \cdot (D_c - \sqrt{D_c^2 - b_R^2})$$

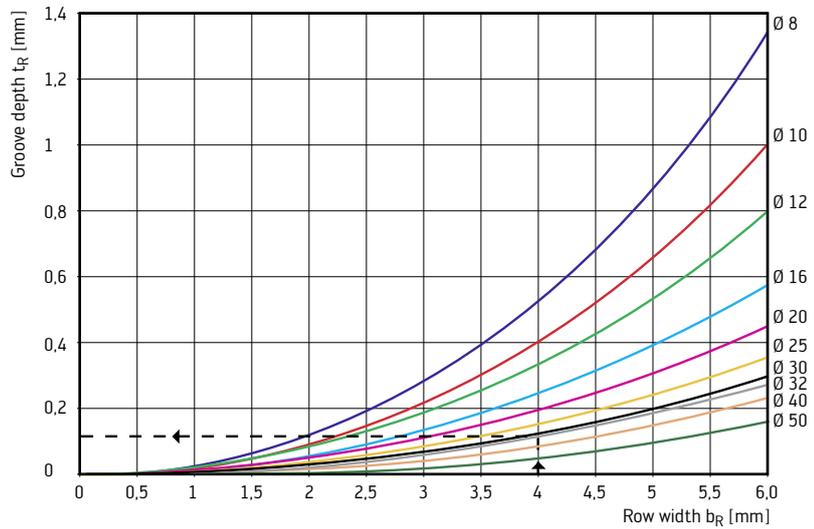
0.3 to 0.5 mm material removal when finishing depending on tool diameter

Usage recommendations for copy and finish milling F2139

Tool dia. $D_c$ [mm]	Row width $b_R$ [mm]	Groove depth $t_R$ [mm]
8	0,5	0,008
10	0,6	0,009
12	0,7	0,010
16	0,8	0,010
20	1,0	0,012
25	1,2	0,014
30	1,3	0,014
32	1,4	0,015

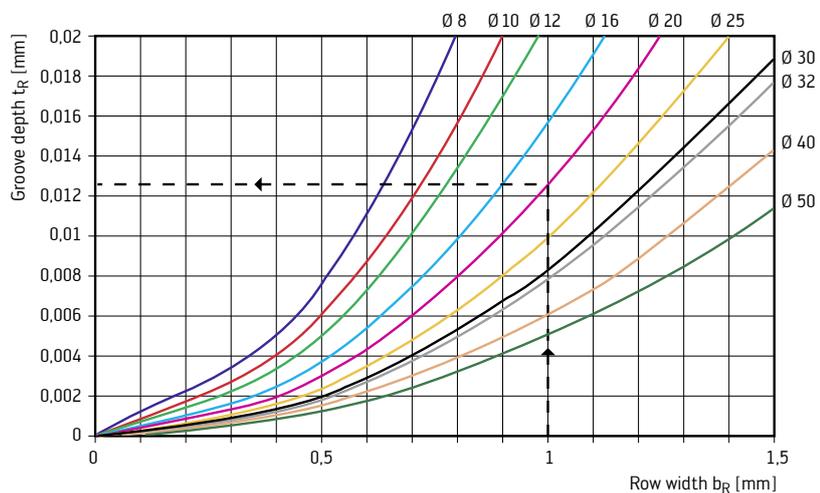
### Semi-finishing – Roughing

Example:  
 $D_c = 32$  mm  
 $b_R = 4$  mm  
 $\rightarrow t_R = 0.125$  mm



### Finishing

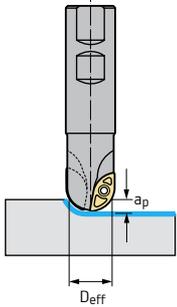
Example:  
 $D_c = 20$  mm  
 $b_R = 1.0$  mm  
 $\rightarrow t_R = 0.0125$  mm



## Application information for M5460/F2139/F2239/F2339 ball nose cutters

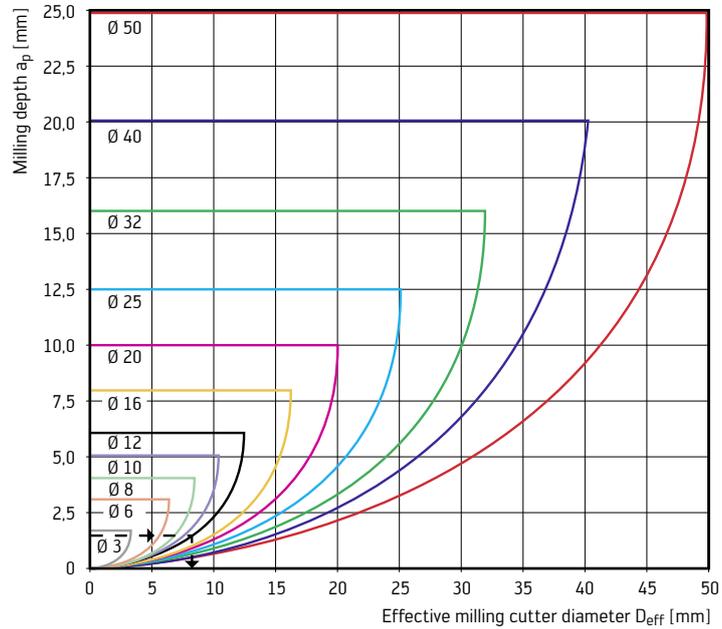
(continued)

### Determining the effective cutting diameter



Example:

$D_c = 12 \text{ mm}$   
 $a_p = 1,5 \text{ mm}$   
 $\rightarrow D_{\text{eff}} = 8 \text{ mm}$

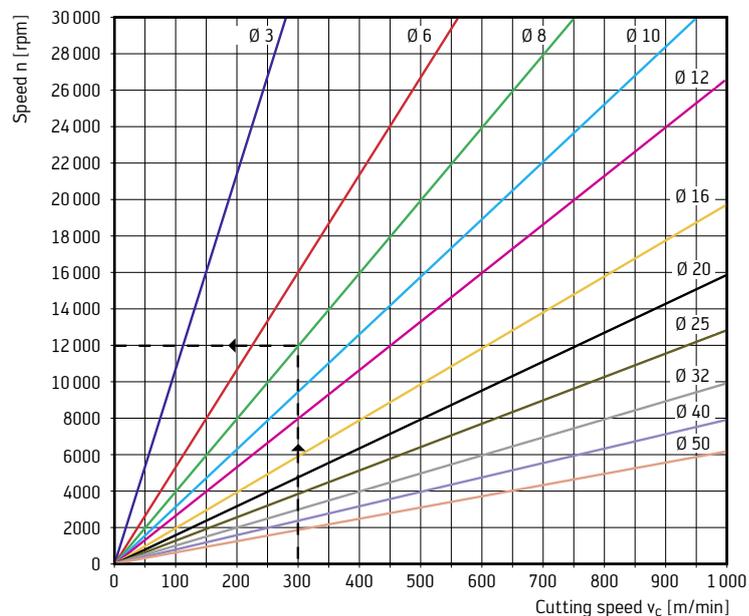


### Determining the required speed

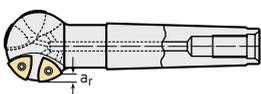
Example:

$D_{\text{eff}} = 8 \text{ mm}$   
 $v_c = 300 \text{ m/min}$   
 $\rightarrow n = 12,000 \text{ rpm}$

$$n = \frac{v_c \cdot 1000}{\pi \cdot D_{\text{eff}}} \text{ [rpm]}$$



### Radial plunging with F2239B

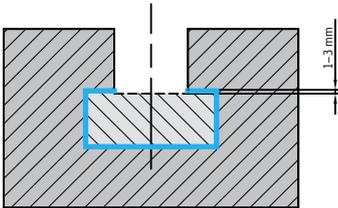


Tool dia. $D_c$ [mm]	$a_r$ [mm]	Tool dia. $D_c$ [mm]	$a_r$ [mm]
20	2,0	32	4,4
25	2,8	40	4,6
30	3,5	50	5,0

## Strategies for preparing a T-slot

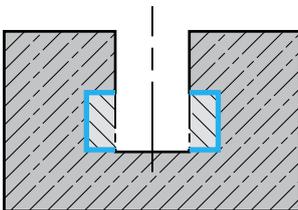
### Strategies

#### Strategy 1



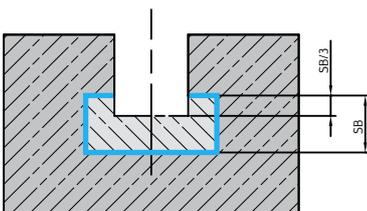
Strategy 1 is recommended if vibration is expected during machining. The prepared slot should protrude 1–3 mm deep into the T-slot so that the shank of the T-slot milling cutter is clear.

#### Strategy 2

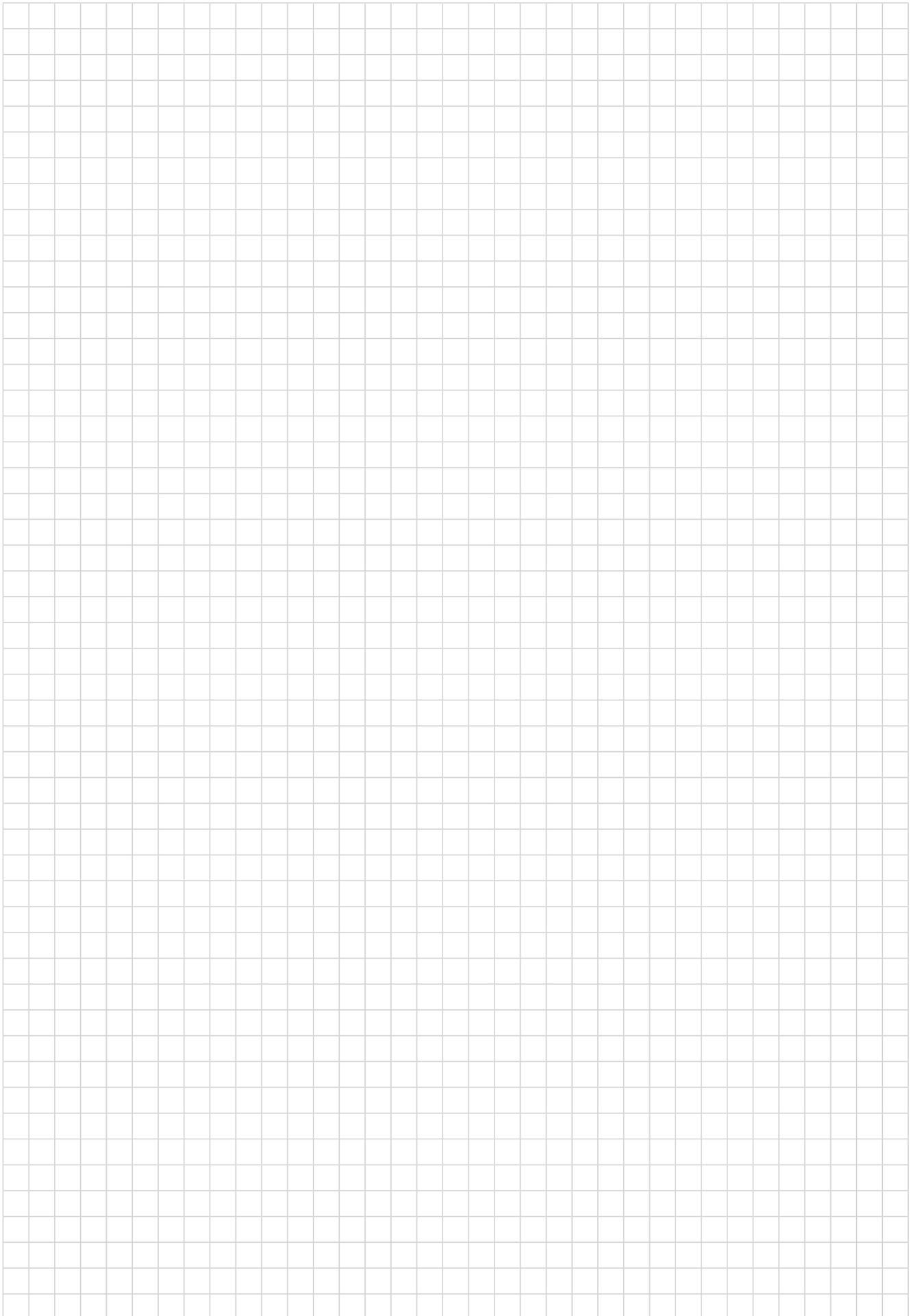


Strategy 2 is recommended for machining on low-power machines and for long-chipping materials.

#### Strategy 3



Strategy 3 is the preferred strategy. The prepared slot should protrude into approx. 1/3 of the T-slot.



## Notes on high-speed cutting

- Maximum permissible speeds:  
The limit values specified in the tables should not be exceeded. Otherwise, correct operation and/or reliability are no longer guaranteed.
- Only use original Walter indexable inserts and assembly parts (screws, etc.). New screws should be used after having replaced the indexable inserts a maximum of five times.
- Observe the torque specified in the catalogues.
- Balancing:  
Balancing in two steps is required when milling at fast speeds (> 6000 rpm) or at circumferential speeds of > 1000 m/min:
  - Basic balancing of the tool body including indexable inserts (can be carried out by Walter if required). In this case, tool adaptors that have been balanced separately beforehand must be used.
  - Fine balancing of the tool when fully mounted on the adaptor. The fine balancing operation is strongly recommended, as even the smallest concentricity fault can seriously affect the balance status.
- Short projection lengths reduce concentricity faults or an imbalance, and increase spindle service life. The specified speeds only apply to the use of tools without additional extensions and for tools with a neck length of  $\leq 2.2 \times D_c$ . For tools with longer neck lengths, the speeds must be reduced upon consultation with Walter.

Tool	Safety-related parts	In relation to	$n_{max}$ [rpm] with D											
			Ø 8	Ø 10	Ø 12	Ø 14	Ø 15	Ø 16	Ø 18	Ø 20	Ø 21	Ø 22	Ø 24	Ø 25
M5468	RD..0501M0..	D <sub>a</sub>		40.000	40.000			40.000		40.000				
	RD..07T1M0..	D <sub>a</sub>					40.000			40.000				40.000
	RO.X0803M04..	D <sub>a</sub>						40.000						40.000
	RO.X10T3M08..	D <sub>a</sub>								40.000				40.000
	RO.X1204M08..	D <sub>a</sub>											36.400	
	RO.X1605M08..	D <sub>a</sub>												
	RO.X2006M08..	D <sub>a</sub>												
M5460 <sup>1</sup>	P32..	D <sub>c</sub>						40.000*		40.000*				40.000*
M5137	TN MU11T304R	D <sub>c</sub>												24.400
	TN MU160508R	D <sub>c</sub>												
M5130	AC.T0602..	D <sub>c</sub>		40.000	40.000	40.000		40.000	40.000	40.000		40.000		40.000
	BC.T0903..	D <sub>c</sub>						40.000	40.000	40.000		38.700		36.000
	BC.T1204..	D <sub>c</sub>												28.100
	BC.T1605..	D <sub>c</sub>												22.300
M5012	SN.X0904..	D <sub>c</sub>												
	SN.X1205..	D <sub>c</sub>												
M5012...-AP	SN.X1205..	D <sub>c</sub>												
M5011	SN.X1205..	D <sub>c</sub>												
M5011...-AP	SN.X1205..	D <sub>c</sub>												
M5009	SN.X0904..	D <sub>c</sub>												34.100
	SN.X1205..	D <sub>c</sub>												
M5009...-AP	SN.X1205..	D <sub>c</sub>												
M5008	ENMX08T316R..	D <sub>a</sub>								32.700	29.200			26.100
M5004	OD..0504..	D <sub>a</sub>												
	OD..0504..	D <sub>a</sub>												
M4792	SD..06T204..	D <sub>c</sub>								14.000	12.000			
	LD..08T204..	D <sub>c</sub>								14.000	12.000			
	SD..09T308..	D <sub>c</sub>												10.000
	LD..14T308..	D <sub>c</sub>												10.000
	SD..120408..	D <sub>c</sub>												
	LD..170408..	D <sub>c</sub>												

<sup>1</sup> The specified speed of 40,000 rpm refers to the entire tool diameter range of 8–32 mm.

\* Speeds higher than 40,000 rpm are possible under favourable conditions and for short projection lengths upon consultation with Walter.

- 6. Safety guard:  
Appropriate safety guards or machine encapsulations must be used to safely collect particles which spin off, such as chips or cutting edge parts that are broken as a result of collisions.
- 7. Damaged tools:  
The operating speed must be specified for the repair of an HSC tool. The table values only apply to tools with a condition equivalent to new condition following repair.
- 8. Application of standards:  
Walter recommends using the balancing standard DIN 69888, which describes the balancing of tools and the requirements in the machining sector. DIN 69888 is tailored to the needs of the machining sector, and describes the tool balancing requirements in a practical manner. DIN ISO 1940, which was previously often used, describes balancing for all areas of mechanical engineering. The requirements when working at circumferential speeds of > 1000 m/min are described in DIN ISO 15641.

n <sub>max</sub> [rpm] with D																		
	Ø 28	Ø 30	Ø 32	Ø 35	Ø 40	Ø 42	Ø 50	Ø 52	Ø 63	Ø 66	Ø 80	Ø 85	Ø 100	Ø 125	Ø 160	Ø 200	Ø 250	Ø 315
		36.200																
			36.500															
		38.400	37.100	35.500	33.200		29.700	29.100	26.500									
			31.500		28.200	27.500	25.200	24.700	22.500	21.900	19.900		17.800					
			28.700					22.500	20.500	20.000	18.100		16.200	14.500				
					24.300				19.400		17.200		15.300	13.700				
			40.000*															
			21.600		19.300		17.200		15.400									
							10.700		9.600		8.500		7.600					
			36.600		32.500		28.900		25.700									
			31.300		27.500		24.600		21.800									
			24.400		21.500		19.100		16.900		14.800							
	20.900		19.300	18.300	16.900	16.500	14.900	14.600	13.200	12.800	11.600	11.200	10.300	9.100	8.000			
			27.300		24.400		21.800		19.500		17.300		15.400					
							16.800		15.000		13.300		11.900	10.600	9.400			
							14.500		13.000		11.500		10.300	9.200	8.100			
					20.000		17.900		16.000		14.100		12.600	11.300	10.000			
							15.300		13.700		12.100		10.800	9.700	8.500			
			30.100		26.900		24.100		21.500		19.000		17.000					
					20.000		17.900		16.000		14.100		12.600	11.300	10.000			
							15.300		13.700		12.100		10.800	9.700	8.500			
			23.100	22.100	20.700	20.200	18.500	18.100	16.500	16.100								
			29.400		26.300		23.500		21.000		18.600		16.600	14.900	13.100			
							19.600		17.500		15.500		13.800	12.400	10.900	9.800		
		7.500	7.200															
		7.500	7.200															
					5.500													
					5.500													

Continued →

## Notes on high-speed cutting

(continued)

		n <sub>max</sub> [rpm] with D														
Tool	Safety-related parts	In relation to	Ø													
			08	10	12	14	15	16	18	20	21	22	24	25		
M4574	SD..06T2..	D <sub>c</sub>	31.400	29.600	28.100			23.600								
	SD..09T3..	D <sub>c</sub>			35.000			32.500		30.400					28.400	
	SD..1204..	D <sub>c</sub>													20.600	
M4575	SD..06T2..	D <sub>c</sub>									28.000				25.300	
	SD..09T3..	D <sub>c</sub>														
	SD..1204..	D <sub>c</sub>														
M4256	SD..06T204..	D <sub>c</sub>								34.300					29.400	
	LD..08T204..	D <sub>c</sub>								34.300					29.400	
M4257	SD..09T308..	D <sub>c</sub>														
	LD..14T308..	D <sub>c</sub>														
M4258	SD..1204..	D <sub>c</sub>														
	LD..1704..	D <sub>c</sub>														
M4132	SD..06T2..	D <sub>c</sub>						31.700		28.300					25.300	
	SD..09T3..	D <sub>c</sub>													34.900	
	SD..1204..	D <sub>c</sub>														
M4130	LD..08T204...	D <sub>c</sub>						40000		34.300					29.400	
	LD..14T308...	D <sub>c</sub>													40.000	
	LD..170408...	D <sub>c</sub>														
M4003	SD..09T3...	D <sub>c</sub>								40.000					38.000	
	SD..1204...	D <sub>c</sub>													33.300	
M4002	SD..06T2...	D <sub>a</sub>								28.300					25.300	
	SD..09T3...	D <sub>a</sub>													34.900	
	SD..1204...	D <sub>a</sub>														
M3255	LNHX1206..	D <sub>c</sub>														
	XNHX1306..	D <sub>c</sub>														
M3024	XN.U0705..	D <sub>c</sub>														
	XN.U0906..	D <sub>c</sub>														
M3016	LNMX2010..	D <sub>c</sub>														
M2472	RP..1204..WIS	D <sub>a</sub>														
M2473	RN..1207..WIS	D <sub>a</sub>														
M2471	RNMX1005..	D <sub>c</sub>													27.200	
	RNMX1206..	D <sub>c</sub>														
M2331	ZD..15A4..	D <sub>c</sub>														
	ZD..20A5..	D <sub>c</sub>														
M2131	ZDGT1504..	D <sub>c</sub>													40.000	
	ZDGT2005..	D <sub>c</sub>														
M2136	SNEF1204..	D <sub>c</sub>														
M2025	ONHF..0504..	D <sub>c</sub>														
	P45424-1	D <sub>c</sub>														
M2026	ONHF..0504..	D <sub>c</sub>														
	P45424-2	D <sub>c</sub>														

<sup>1</sup> The specified speed of 40,000 rpm refers to the entire tool diameter range of 8–32 mm.

\* Speeds higher than 40,000 rpm are possible under favourable conditions and for short projection lengths upon consultation with Walter.

n <sub>max</sub> [rpm] with D																	
Ø 28	Ø 30	Ø 32	Ø 35	Ø 40	Ø 42	Ø 50	Ø 52	Ø 63	Ø 66	Ø 80	Ø 85	Ø 100	Ø 125	Ø 160	Ø 200	Ø 250	Ø 315
	25.000																
	18.200		16.800														
	30.800		27.600														
					17.900												
	25.100																
	25.100																
			28.800		25.000		21.750										
			28.800		25.000		21.750										
					17.300		15.000		12.900		11.400						
					17.300		15.000		12.900								
		30.800		27.600		24.600		22.000		19.500							
						17.900		16.000		14.100		12.600	11.300				
		33.600		28.800		25.000											
						17.300		15.000		12.900		11.400	10.000				
		33.600		30.100		26.900		24.000				19.000			4.200	3.800	3.350
		29.400		26.300		23.500		21.000				16.600	14.900	13.100	4.200	3.800	3.350
		22.400		20.000		17.900	17.600	16.000	15.600								
		30.800	29.500	27.600		24.600	24.200	22.000	21.400								
						17.900	17.600	16.000	15.600	14.100		12.600	11.300		4.200	3.800	3.350
						20.200		18.000		15.900							
						20.200		18.000		15.900							
				12.800		11.300		10.000		8.700		7.800	6.900	6.100			
								8.500		7.400		6.500	5.200	4.100			
													1.100	1.000	900	800	700
		40.000		36.200		32.400											
				25.600		22.800		20.400									
		23.400		20.500		18.100	17.700										
		26.600		23.300		20.400	20.000	18.000									
		40.000		39.800		34.400											
				40.000		34.000											
		37.900		32.400		28.000		24.300		21.100							
		38.100		31.700		26.900		23.100		19.900							
										4.900		4.400	3.900	3.500			
										4.900		4.400	3.900	3.500			
															3.100	2.800	
															3.100	2.800	

Continued →

## Notes on high-speed cutting

(continued)

Tool	Safety-related parts	In relation to	n <sub>max</sub> [rpm] with D											
			Ø 08	Ø 10	Ø 12	Ø 14	Ø 15	Ø 16	Ø 18	Ø 20	Ø 21	Ø 22	Ø 24	Ø 25
F5041	LN..0904..	D <sub>c</sub>												39.600
F5141	LN..1306..	D <sub>c</sub>												
F5241	LN..1607..	D <sub>c</sub>												
F5038	LN..0904..	D <sub>c</sub>												39.600
F5138	LN..1306..	D <sub>c</sub>												
F5055	SX..	D <sub>c</sub>												
F4038	AD..0803..	D <sub>c</sub>								40.000*				38.000
F4138	AD..1204..	D <sub>c</sub>												
F4238	AD..1606..	D <sub>c</sub>												
F4338	AD..1807..	D <sub>c</sub>												
F4053	LN.X0702..	D <sub>c</sub>												
F4153	LN.U0803..	D <sub>c</sub>												
	LN.U0804..	D <sub>c</sub>												
	LN.U1005..	D <sub>c</sub>												
F4253	LN.U0804..	D <sub>c</sub>												
	LN.U1005..	D <sub>c</sub>												
	LN.U1206..	D <sub>c</sub>												
	LN.U1608..	D <sub>c</sub>												
F4045	XN.F0705..	D <sub>c</sub>												
	XN.F0906..	D <sub>c</sub>												
F4042 / F4042R	AD..0803..	D <sub>c</sub>							40.000*	40.000*				38.000
	AD..10T3..	D <sub>c</sub>							39.600	35.400				31.700
	AD..1204..	D <sub>c</sub>												28.400
	AD..1606..	D <sub>c</sub>												
	AD..1807..	D <sub>c</sub>												
F4041	LNGX1307..	D <sub>c</sub>												
F4030	P23696-1.0	D <sub>a</sub>												34.900
	P23696-2.0	D <sub>a</sub>												
F2334R	RO..10T3M0	D <sub>a</sub>												
	RO..1204M0	D <sub>a</sub>												
F2330	P2633..	D <sub>c</sub>								35.400				31.700
F2250	Without cartridges	D <sub>c</sub>												
F2010	All cartridges													

<sup>1</sup> The specified speed of 40,000 rpm refers to the entire tool diameter range of 8–32 mm.

\* Speeds higher than 40,000 rpm are possible under favourable conditions and for short projection lengths upon consultation with Walter.

n <sub>max</sub> [rpm] with D																	
Ø 28	Ø 30	Ø 32	Ø 35	Ø 40	Ø 42	Ø 50	Ø 52	Ø 63	Ø 66	Ø 80	Ø 85	Ø 100	Ø 125	Ø 160	Ø 200	Ø 250	Ø 315
		35.000		31.300		28.000		25.000									
				22.500		20.200		18.000		15.900		14.200	12.700	11.200			
						20.200		18.000		15.900		14.200	12.700	11.200			
		35.000		31.300		28.000		25.000									
				22.500		20.200		18.000		15.900							
								5.100		4.000		3.200	2.600	2.000	1.600	1.300	
		33.600															
		25.100		22.400		20.000		17.900		15.800							
				15.800		14.100		12.600		11.100							
								12.600		11.100		10.000	8.900				
										21.200		19.000	17.000	15.000			
										11.000		9.900	8.800	7.800			
										9.300		8.300	7.400	6.500			
										13.700		12.300	11.000	9.700			
													17.000	15.000			
													16.100	14.200			
													12.400	10.900	9.800	8.700	
														7.800	7.000	6.200	5.500
								10.000	8.800			7.900	7.000	6.200	5.600		
									5.700			5.100	4.600	4.000	3.600		
		33.600		30.100		26.900											
		28.000		25.000		22.400		20.000									
		25.100		22.400		20.000		17.900		15.800							
				15.800		14.100		12.600		11.100		10.000	8.900	7.900			
				17.600		15.800		14.100		12.600		11.100	10.000	8.900	7.900		
				16.800		15.000		13.400		12.000		10.600	9.500	8.500	7.500		
				30.800		27.600		24.600		22.000							
						20.200		18.000		15.900	14.200						
				37.100		28.200		29.700		26.500		23.500					
						25.200		22.500		19.900							
				28.000		25.000		22.400		20.000		17.700					
						22.800		20.400		18.100		16.100	14.400	12.800	11.400	10.200	
										6.700		6.000	5.400	4.700	4.200	3.350	

## Indexable inserts for milling product range overview



Insert shape		Description
	<b>A</b>	Positive rhombic for <b>Xtra-tec®</b>
	<b>B</b>	Positive rhombic for <b>Xtra-tec® XT</b>
	<b>E</b>	Double-sided rhombic for <b>Xtra-tec® XT</b>
	<b>L</b>	Double-sided rhombic for <b>Xtra-tec®</b>
		Tangential rhombic for <b>Walter BLAXX</b>
	<b>M</b>	Positive rhombic
	<b>O</b>	Positive octagonal for <b>Xtra-tec® XT</b>
		Double-sided octagonal
	<b>R</b>	Positive round for <b>Xtra-tec® XT</b>
	<b>S</b>	Positive square
		Double-sided square for <b>Xtra-tec® XT</b>
	<b>T</b>	Double-sided triangular for <b>Xtra-tec® XT</b>

Insert shape		Description
	<b>X</b>	Double-sided heptagonal for <b>Walter BLAXX</b> and <b>Xtra-tec® XT</b>
	<b>X</b>	Tangential rhombic for <b>Walter BLAXX</b>
	<b>X</b>	Positive form inserts for copy milling cutters
	<b>P 236..</b>	Double-sided triangular for <b>Xtra-tec®</b> high-feed milling cutters
	<b>P 263..</b>	Positive triangular for high-feed milling cutters for copy milling cutters
	<b>P 32..</b>	Indexable inserts for copy finishing cutters for <b>Xtra-tec® XT</b>
		Positive finishing inserts
		Double-sided finishing inserts
		Tangential finishing inserts

### Cutting tool material application charts – Milling

Coated carbide																						
Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Example of indexable insert			
		P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	01	05	10	15	20	25	30	35				40	45	
WKP35G	HC – P 35	●●																	ULP-CVD	TiAlN+TiN		
	HC – K 35	●		●●																		
WKP35S	HC – P 35	●●																	CVD	TiCN + Al <sub>2</sub> O <sub>3</sub> (+ TiCN)		
	HC – K 35	●		●●																		
WKP25S	HC – P 25	●●																	CVD	TiCN + Al <sub>2</sub> O <sub>3</sub> (+ TiCN)		
	HC – K 25	●		●●																		
WAK15	HC – K 15			●●															CVD	TiCN + Al <sub>2</sub> O <sub>3</sub> (+ TiN)		
WSP45G	HC – S 45					●●																
	HC – P 45	●●																		PVD	TiAlN + Al <sub>2</sub> O <sub>3</sub> + (ZrN)	
	HC – M 45		●●																			
WSP45S	HC – S 45					●●																
	HC – P 45	●●																		PVD	TiAlN + Al <sub>2</sub> O <sub>3</sub> (Al)	
	HC – M 45		●●																			
WMP45G	HC – S 45					●●														ULP-CVD	TiAlN + TiN	
	HC – M 45		●●																			
WSM45X	HC – S 45					●●														CVD	TiCN + Al <sub>2</sub> O <sub>3</sub> (+ TiCN)	
	HC – M 45		●●																			
WSM35G	HC – S 35					●●														PVD	TiAlN + Al <sub>2</sub> O <sub>3</sub> + (ZrN)	
	HC – M 35		●●																			
WSM35S	HC – S 35					●●														PVD	TiAlN + Al <sub>2</sub> O <sub>3</sub> (Al)	
	HC – M 35		●●																			
WKK25G	HC – K 25			●●															PVD	TiAlN + Al <sub>2</sub> O <sub>3</sub> + (ZrN)		
WKK25S	HC – K 25			●●															PVD	TiAlN + Al <sub>2</sub> O <sub>3</sub> (Al)		

HC = Coated carbide

- Primary application
- Additional application

## Cutting tool material application charts – Milling

(continued)

Coated carbide																				
Walter grade designation	Standard designation	Material groups						Application range								Coating process	Coating composition	Example of indexable insert		
		P	M	K	N	S	H	O	01	05	10	15	20	25	30				35	40
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other												
WSP46	HC – S 45					●●														
	HC – P 45	●●																		
	HC – M 45		●●																	
WSP46G	HC – S 45					●●														
	HC – P 45	●●																		
	HC – M 45		●●																	
WSM36	HC – S 35					●●														
	HC – M 35		●●																	
WHH15X	HC – H 15						●●													
	HC – P 15	●																		
	HC – K 15			●																
WNN15	HC – N 15				●●															
WXN15	HC – N 15				●●															
WXM15	HC – P 15	●●																		
	HC – M 15		●																	
	HC – K 15			●																

HC = Coated carbide

- Primary application
- Additional application

## Cutting tool material application charts – Milling

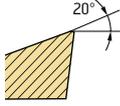
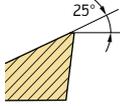
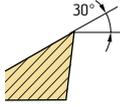
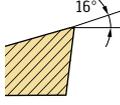
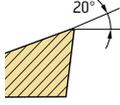
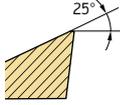
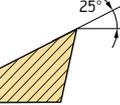
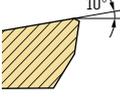
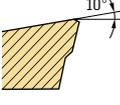
(continued)

Uncoated carbide, ceramic, CBN and PCD																				
Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Example of indexable insert	
		P	M	K	N	S	H	O	01	05	10	15	20	25	30	35				40
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other												
WK10	HW – N 10				••															
WMG40	HF – N 35				••															
WCB80	BH – K 05			••																
	BH – H 15						•													
WSN10	CN – K 20			••																
WCD10	DP – N 10				••															
WEP20	HT – P 20	••																		
	HT – K 20			••																
	HT – M 20		••																	
WDN20	DP – N 20				••															
WIS10	CN – S 10					••														

BH = CBN with high CBN content  
 CN = Silicon nitride ceramic Si<sub>3</sub>N<sub>4</sub>  
 DP = Polycrystalline diamond  
 HF = Uncoated fine-grained carbide  
 HT = Uncoated cermet  
 HW = Uncoated carbide

•• Primary application  
 • Additional application

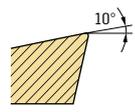
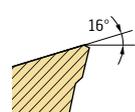
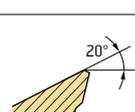
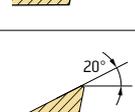
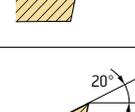
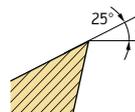
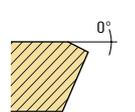
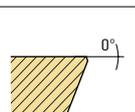
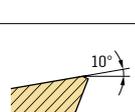
## Geometry overview of positive milling indexable inserts

Indexable insert geometries		Material groups							Suitable tool families	
Geometry example	Remarks/application area	Main cutting edge section	P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials		O Other
 AC.T	<b>G55/G65 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			M5130...05
	<b>K55 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			
	<b>M85 – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●				
 BC.T	<b>F55 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●		●			M5130
	<b>G55 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			
	<b>K55 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			
	<b>K85 – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●				
 AD.T..	<b>D51 – The quiet one</b> – Anti-vibration geometry – For tools with long projection lengths		●●	●	●●		●			F2010 F2252 F4042 F4042R F4038 F4138 F4238 F4338
	<b>D56 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●		●			

●● Primary application  
 ● Additional application

## Geometry overview of positive milling indexable inserts

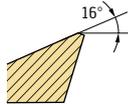
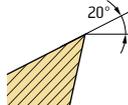
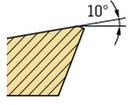
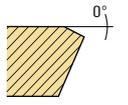
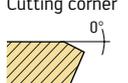
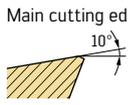
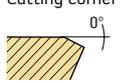
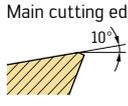
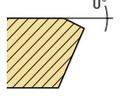
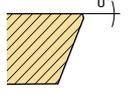
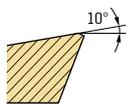
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Indexable insert geometries		Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
Geometry example	Remarks/application area		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 AD.T..	<b>D67 – The powerful one</b> – High cutting edge stability – For machining high-alloy and high tensile steels and Ni-based alloys (such as Inconel) – High level of accuracy		●●	●●	●		●●			F2010 F2252 F4042 F4042R F4038 F4138 F4238 F4338
	<b>F56 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			
	<b>G56 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			
	<b>G77 – The special one</b> – For machining titanium materials – Low cutting forces – High level of accuracy		●	●●			●●			
	<b>G88 – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges						●●		●	
 ZDGT..	<b>K85 – The universal one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●				M2131 M2331
 OD..	<b>A27 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					F2010 M5004
	<b>A57 – The special one</b> – For medium machining conditions – Predominantly for cast iron machining		●		●●					
	<b>D57 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			

●● Primary application  
 ● Additional application

## Geometry overview of positive milling indexable inserts

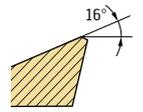
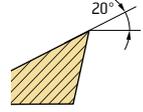
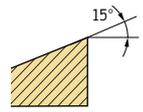
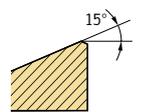
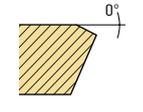
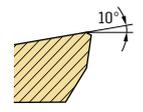
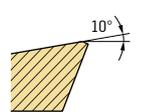
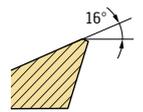
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Indexable insert geometries			Material groups							Suitable tool families
			P	M	K	N	S	H	O	
Geometry example	Remarks/application area	Main cutting edge section	Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 OD..	<b>F57 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			F2010 M5004
	<b>G88 – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●			●	
 P263..	<b>P26335 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			F2010 F2330
	<b>P26337 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●		●			
	<b>P26339 – The universal one</b> – For medium machining conditions – Universal application for most materials	Cutting corner  Main cutting edge 	●●	●●	●●		●●			
	<b>P26379 – The special one</b> – For circular interpolation machining – Universal application for most materials – Wiper version	Cutting corner  Main cutting edge 	●●	●●	●●		●●			
 RD..X.. / RO..X..	<b>A27 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					F2334R M5468
	<b>A57 – The special one</b> – For medium machining conditions – Specially designed for ISO H machining		●		●●					
	<b>D57 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			

●● Primary application  
 ● Additional application

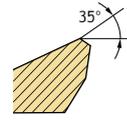
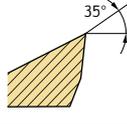
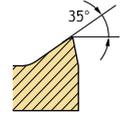
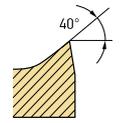
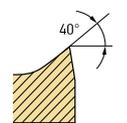
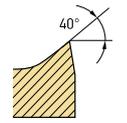
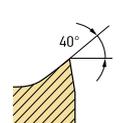
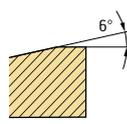
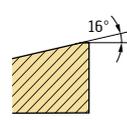
## Geometry overview of positive milling indexable inserts

(continued)

Indexable insert geometries			Material groups							Suitable tool families
Geometry example	Remarks/application area	Main cutting edge section	P	M	K	N	S	H	O	
 RD.X.. / RO.X..	<b>F67 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●		●●			
	<b>G88 – The sharp one</b> – For aluminium machining – Low cutting forces					●●				
 SDMX	<b>E57 – The universal one</b> – Curved cutting edge – For medium machining conditions – Moderate feeds		●●	●●	●●		●●			
	<b>E27 – The stable one</b> – Curved cutting edge – For medium to unfavourable machining conditions – Moderate to high feeds			●●	●●		●●			
 SD..	<b>A57 – The special one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds – No waves on the flank face		●●		●●					
 LDM..	<b>D51 – The quiet one</b> – Anti-vibration geometry – For tools with long projection lengths – One wave on the flank face		●●	●	●●		●			
	<b>D57 – The stable one</b> – For medium to unfavourable machining conditions – Moderate to high feeds – One wave on the flank face		●●	●●	●●		●●			
	<b>F57 – The universal one</b> – For medium machining conditions – Moderate feeds – Two waves on the flank face			●●	●●	●●		●●		

●● Primary application  
 ● Additional application

## Geometry overview of double-sided milling indexable inserts

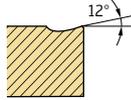
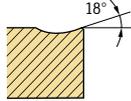
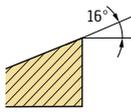
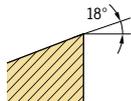
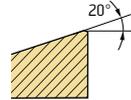
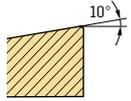
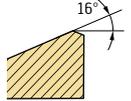
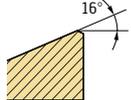
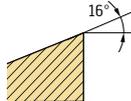
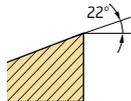
Indexable insert geometries		Material groups							Suitable tool families	
Geometry example	Remarks/application area	Main cutting edge section	P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials		O Other
 LNGX..	<b>L55 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			F2010 F4041
	<b>L88 – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●			●	
 LNHU..	<b>L55T – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			F2010 F5041 F5141 F5241 F5038 F5138
	<b>L65T – The special one</b> – For machining titanium materials and stainless steels – Low cutting forces		●	●●			●●			
	<b>L85T – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●				
 LN.X XN.X	<b>L65T – The special one</b> – For machining titanium materials and stainless steels – Low cutting forces						●●			M3255
	<b>L65W – The quiet one</b> – “WaveCut” – geometry with wave-shaped cutting edge – For machining titanium materials and stainless steels – Anti-vibration geometry – For tools with long projection lengths		●●	●●			●●			
 LN.U..	<b>B57T – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					F4153 F4253
	<b>F57T – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			

●● Primary application  
 ● Additional application

## Geometry overview of double-sided milling indexable inserts

(continued)

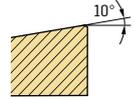
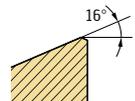
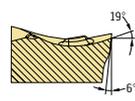
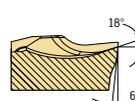
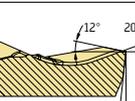
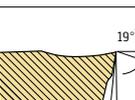
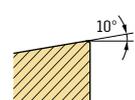
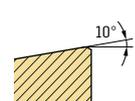
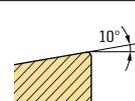
### Indexable insert geometries

Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
 LN.X..	<b>D57T – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					F4053
	<b>F57T – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			
 ONHF..	<b>F67 – The universal one</b> – For medium machining conditions – Universal application				●●				M2025 M2026	
 P45424	<b>G67 – The universal one</b> – For finishing operations – For homogeneous surface structures				●●					
 P23696	<b>P23696 – The universal one</b> – For medium to unfavourable machining conditions – Universal application for most materials		●●	●●	●●		●●		F4030 F2010	
 SN.X..	<b>D27 – The special one</b> – For machining cast iron materials – For sand inclusions or cast skin – Maximum process reliability		●		●●				F2010 M5009 M5011 M5012	
	<b>F27 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●		●			
	<b>F57 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			
	<b>F67 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			
	<b>K88 – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●		●		

●● Primary application  
 ● Additional application

## Geometry overview of double-sided milling indexable inserts

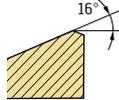
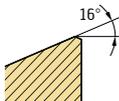
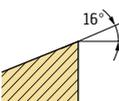
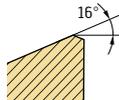
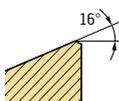
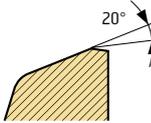
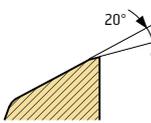
(continued)

Indexable insert geometries		Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
Geometry example	Remarks/application area		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 ENMX..	<b>D27 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●●	●●		●●	●●		M5008
	<b>F47 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●	●●		
 SX..	<b>CF6 – The easy-cutting one</b> – Good machining conditions – Low feeds – Low cutting force		●●	●		●	●		●	F5055
	<b>SF5 – The universal one</b> – Universal application for most materials – Light to moderate feeds		●●	●	●		●		●	
	<b>CE4 – The stable one</b> – Moderate to high feeds – Good chip constriction – Stable cutting edge		●●		●●					
	<b>SK8 – The sharp one</b> – For aluminium machining – Low cutting forces – Sharp cutting edges					●●				
 XNHF..	<b>D27 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds				●●					F4045
	<b>D57 – The universal one</b> – For medium machining conditions – Universal application				●●					
	<b>D67 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds				●●					

●● Primary application  
 ● Additional application

## Geometry overview of double-sided milling indexable inserts

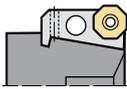
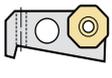
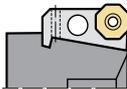
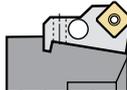
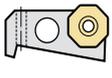
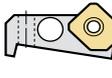
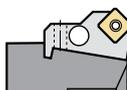
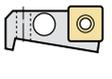
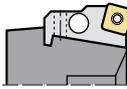
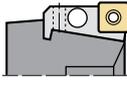
(continued)

Indexable insert geometries			Material groups							
Geometry example	Remarks/application area	Main cutting edge section	P	M	K	N	S	H	O	Suitable tool families
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 XN.U..	<b>F27 – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					M3024
	<b>F57 – The universal one</b> – For medium machining conditions – Universal application for most materials		●●		●●					
	<b>F67 – The easy-cutting one</b> – For good machining conditions – Low cutting forces – Moderate feeds		●●	●	●●					
 LNMX..	<b>F27T – The stable one</b> – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●					M3016
	<b>F57T – The universal one</b> – For medium machining conditions – Universal application for most materials		●●	●	●●		●			
 TNMU..	<b>G27 – The universal one</b> – For unfavourable machining conditions – Universal application for most materials – High feeds		●●	●	●●		●			M5137
	<b>G57 – The easy-cutting one</b> – For medium to good machining conditions – Low cutting forces – Moderate feeds		●●	●	●●		●			

●● Primary application  
 ● Additional application

## System overview for the F2010 adjustable milling cutter

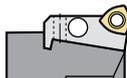
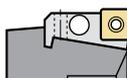
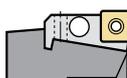
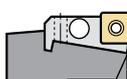
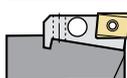
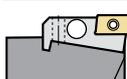
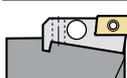
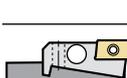
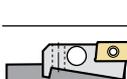
## F2010

Cartridge design	D <sub>c</sub> [mm]	Max. depth of cut [mm]	Indexable inserts	Finishing cartridges for roughing/finishing combination*	As supplement to tool
<b>For face milling</b>					
 κ = 43° F2010...R592M	80–315	4,0	 OD..0605..  The ODHX0605ZZR finishing insert is installed in the FR592M cartridge	 Cartridge: FR681M Indexable insert: ODHX0605ZZN	<b>M5004</b> D <sub>c</sub> = 40–160 mm
 κ = 45° F2010...R681M	80–315	0,5–2,0 (4,0)	 ODHX0605ZZN		
 κ = 45° F2010...R720M	80–315	6,5	 SN..X1205ANN SN..X120512 SN..X120520	 Cartridge: FR681M Indexable insert: ODHX0605ZZN   Cartridge: FR730M Indexable insert: XNGX1205ANN	<b>M5009</b> D <sub>c</sub> = 40–200 mm
 κ = 45° F2010...R758M	80–315	7,0	 SD..1204AZN.. SD..1204..		<b>M4003</b> D <sub>c</sub> = 25–160 mm
 κ = 45° F2010...R495M	80–315	7,0	 SP..1204AE..	 Cartridge: FR448M Indexable insert: P2905-1	
 κ = 75° F2010...R441M	80–315	10,0	 SP..1204E...   The P2901-1 finishing insert is installed in the FR441M cartridge		
 κ = 88° F2010...R728M	80–315	10,0	 SN..1205ZNN SN..X120512 SN..X120520   Finishing insert: XNGX1205ZNN		<b>M5012</b> D <sub>c</sub> = 40–200 mm

\* When using this finishing method, one or more roughing cartridges must be replaced with a finishing cartridge.

## System overview for the F2010 adjustable milling cutter

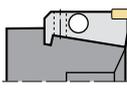
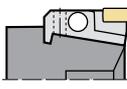
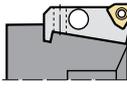
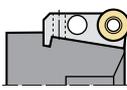
(continued)

F2010					
Cartridge design	D <sub>c</sub> [mm]	Max. depth of cut [mm]	Indexable inserts	Finishing cartridges for roughing/finishing combination*	As supplement to tool
<b>For high-feed milling</b>					
 κ = 0–15° F2010...R729M	70–305	2,0	 P2633..R25		<b>F2330</b> D <sub>a</sub> = 52–85 mm
 κ = 15° F2010...R755M	80–315	2,0	 SD..1204..		<b>M4002</b> D <sub>c</sub> = 50–125 mm
<b>For shoulder milling</b>					
 κ = 89°45' F2010...R445M	80–315	11,0	 SP..120408..	 Cartridge: FR448M Indexable insert: P2905-1	
 κ = 89°45' F2010...R756M	80–315	8,4	 SD..09T3..		<b>M4132</b> D <sub>c</sub> = 25–80 mm
 κ = 89°45' F2010...R757M	80–315	11,6	 SD..1204..		<b>M4132</b> D <sub>c</sub> = 50–125 mm
 κ = 90° F2010...R722M	80–315	13,0	 LNGX1307..		<b>F4041</b> D <sub>c</sub> = 40–160 mm
 κ = 90° F2010...R764M	80–315	11,0	 BC..1204..		<b>M5130...12</b> D <sub>c</sub> = 22–80 mm
 κ = 90° F2010...R765M	80–315	15,0	 BC..1605.. Finishing insert: BCGX1605P-DR-G55		<b>M5130...15</b> D <sub>c</sub> = 25–160 mm
 κ = 90° F2010...R718M	80–315	11,7	 AD..1204..		<b>F4042...11</b> D <sub>c</sub> = 22–80 mm
 κ = 90° F2010...R719M	80–315	15,0	 AD..1606.. Finishing insert: ADGX1606PER		<b>F4042...15</b> D <sub>c</sub> = 25–160 mm

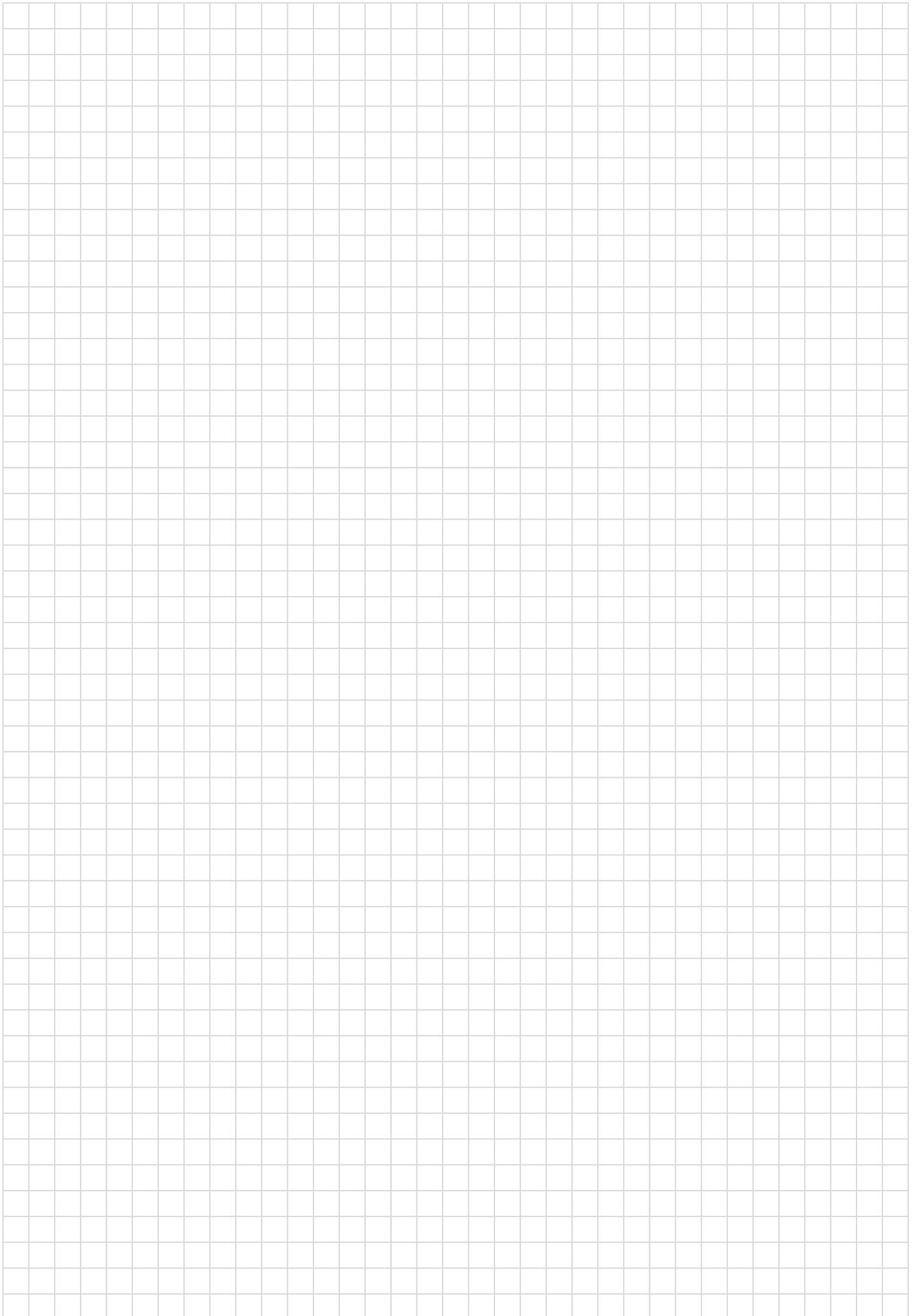
\* When using this finishing method, one or more roughing cartridges must be replaced with a finishing cartridge.

## System overview for the F2010 adjustable milling cutter

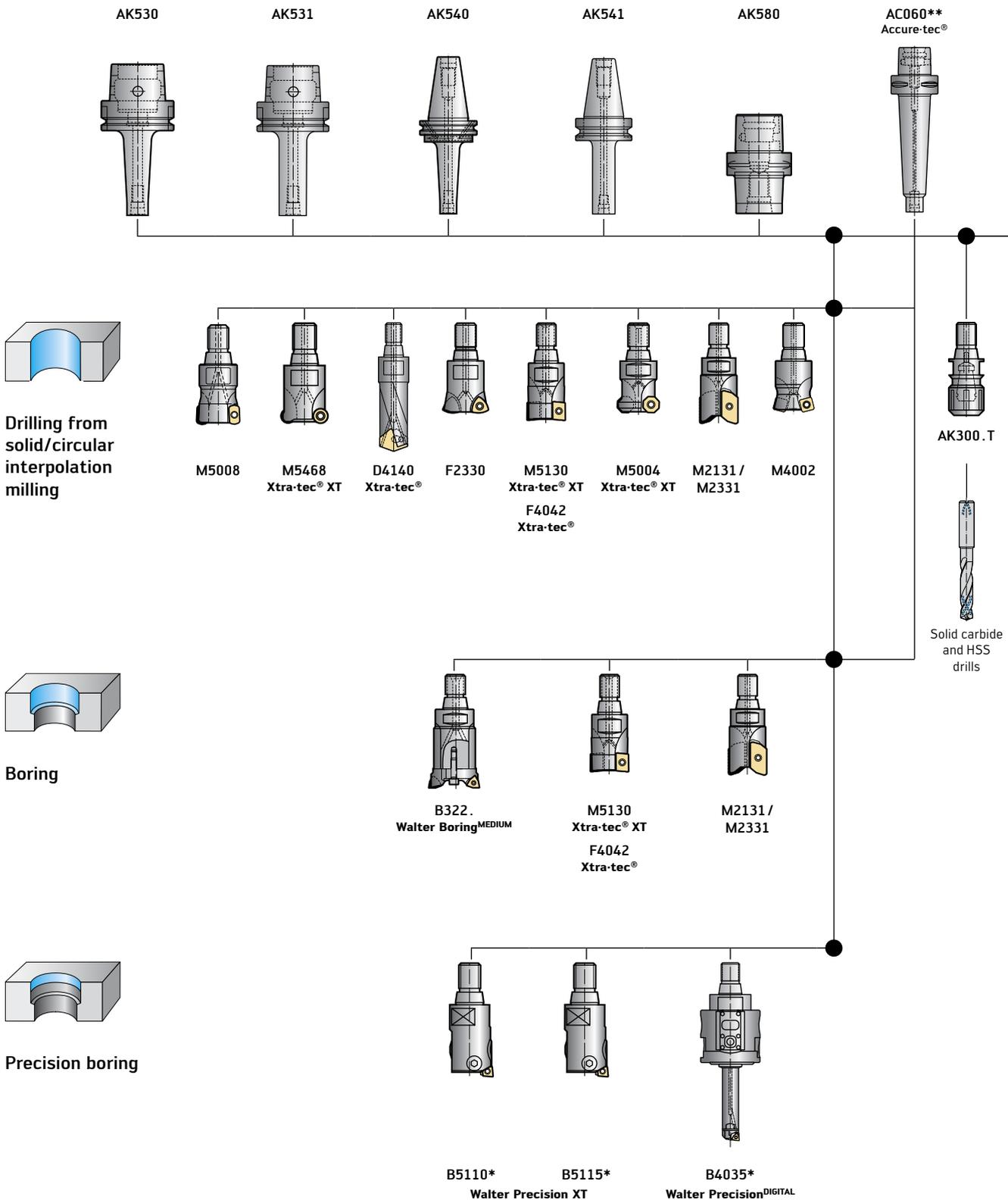
(continued)

F2010					
Cartridge design	D <sub>c</sub> [mm]	Max. depth of cut [mm]	Indexable inserts	Finishing cartridges for roughing/finishing combination*	As supplement to tool
<b>For shoulder milling</b>					
 κ = 90° F2010...R751M	80–315	8,0	 LNHU0904 ..   Finishing insert: LNHX0904PDR-L55T		<b>F5041</b> D <sub>c</sub> = 25–63 mm
 κ = 90° F2010...R752M	80–315	12,0	 LNHU1306 ..   Finishing inserts: LNHX1306PDR-L55T LNHX130608R-L55T		<b>F5141</b> D <sub>c</sub> = 40–125 mm
 κ = 90° F2010...R500M 	80–315	0,5–1,0 (9,0)	 P2903-2R		
<b>For copy milling</b>					
 F2010...R723M	74–309	8,0	 RO.X1605.		

\* When using this finishing method, one or more roughing cartridges must be replaced with a finishing cartridge.

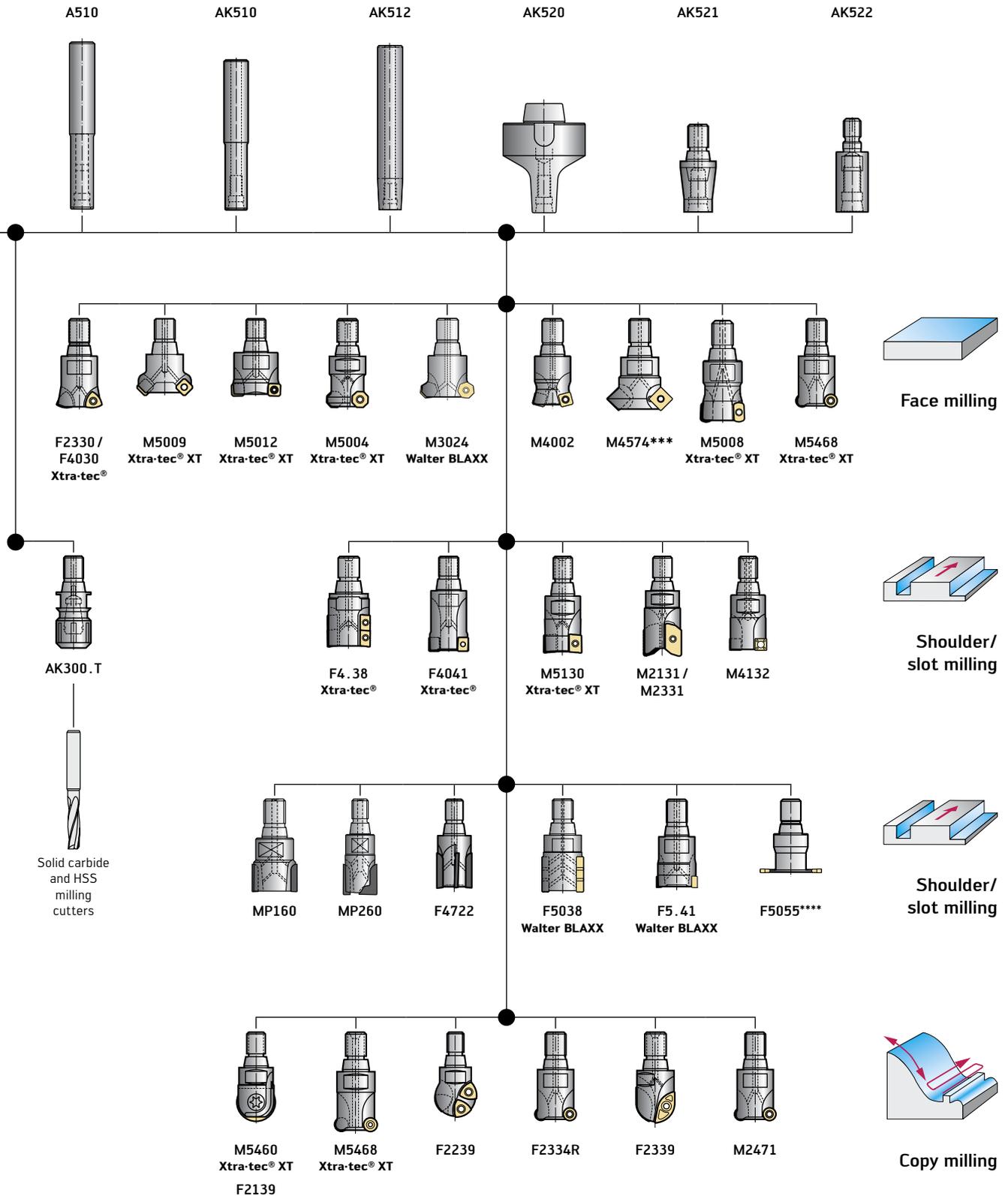


# System overview of ScrewFit for holemaking and circular interpolation milling



\* only in combination with AK53.CO and AK54.CO.  
 \*\* AC060 also available with hollow shank taper, steep taper and MAS-BT interface  
 For the cutting edge orientation of ScrewFit precision boring tools, see the "Holemaking" section of the Technical Compendium, page B140.

# System overview of ScrewFit for milling



\*\*\* for 45° chamfering  
 \*\*\*\* for slot milling and slitting

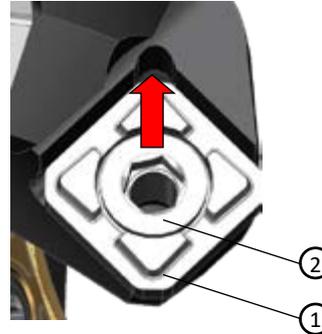
## Assembly instructions for Xtra-tec® XT M5009, M5011 and M5012 face milling cutters with carbide shim

### 1. Fitting the shim

The shim (AP800-SN1205) ① is inserted in the insert seat with the four raised areas facing upwards.

The shim (AP800-SN1205) is fixed in the basic body with the clamping sleeve (FS2069) ② and tightened to a torque of 7.0 Nm. While doing so, the shim (AP800-SN1205) ① must be pushed back into the insert seat.

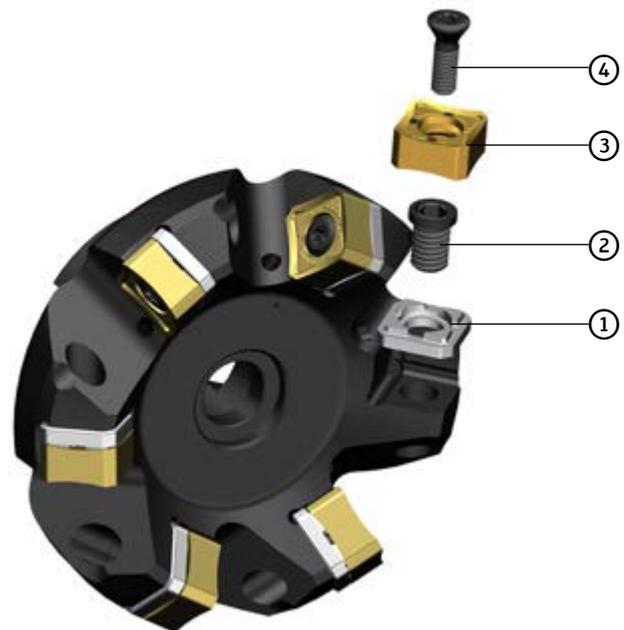
Ensure that the insert seat is clean and that the shim is correctly positioned on the contact surface.



### 2. Fitting the indexable insert

The indexable insert (SN..1205..) ③ is now placed in the insert seat on the shim that is already fitted (AP800-SN1205) ① and fixed with the clamping screw (FS2617) ④.

The clamping screw (FS2617) ④ must be tightened to a torque of 4.0 Nm.



## Assembly instructions for Xtra-tec® XT M5468 button insert milling cutter

**When using the M5468, the following information must be observed:**  
 Press the indexable insert against the contact surface in the insert seat, then push it against the radial and axial contact surface.  
 Then tighten the indexable insert clamping screw with a torque screwdriver.  
 Finally, check that the indexable insert is fitted correctly: A 1/100 mm spacer must not be able to fit between the indexable insert and insert seat support surfaces and contact surfaces.

Tool	Indexable insert	Torque
M5468...02.5	RD..0501M0	0,4 Nm
M5468...03.5	RD..07T1M0	1,2 Nm
M5468...04	RO.X0804M04	2,0 Nm
M5468...05	RO.X10T3M08	3,0 Nm
M5468...06	RO.X1204M08	3,5 Nm
M5468...08	RO.X1605M08	5,0 Nm
M5468...10	RO.X2006M08	5,0 Nm



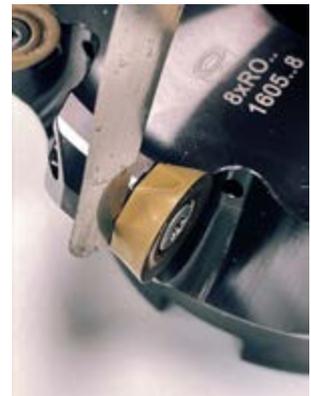
① Position the indexable insert



② Fit the indexable insert



③ Secure the indexable insert



④ Check that the indexable insert is securely fitted

## Setting instructions for the cutting width of the F2252 slotting cutter, axially adjustable

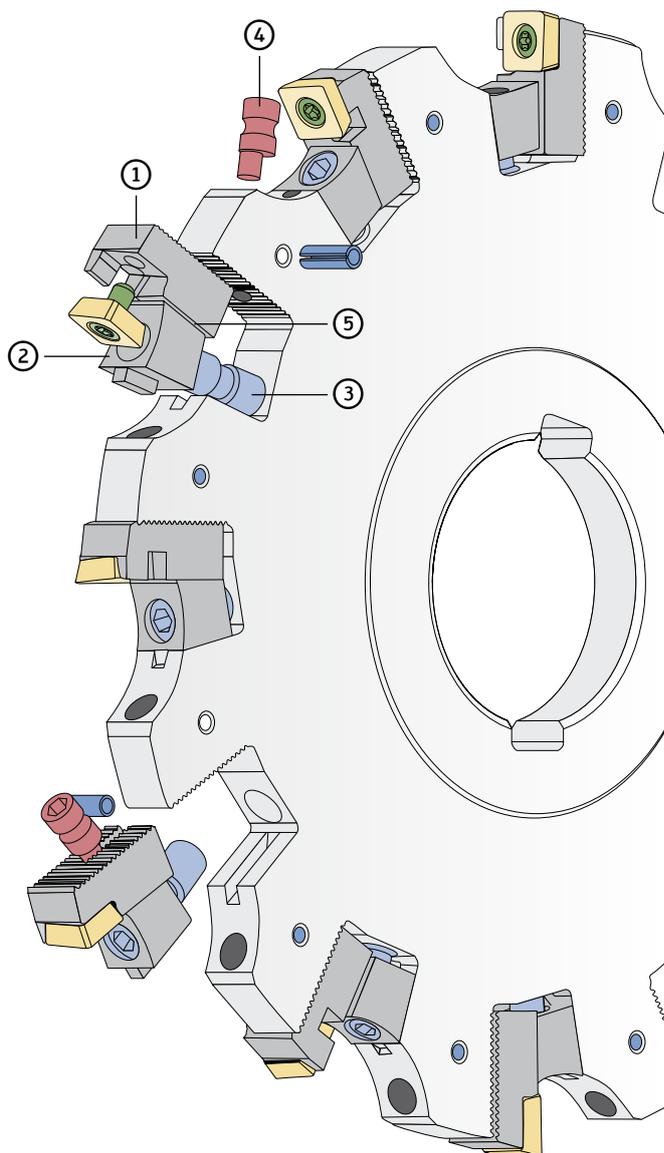
- ① Cartridge
- ② Clamping wedge
- ③ Compound screw
- ④ Eccentric bolt
- ⑤ Spring washer

### Adjusting the cutting width

1. Undo the compound screw ③ of the clamping wedge ② and then screw it back in until the spring washer ⑤ between the clamping wedge and the front contact surface of the cartridge has built up pre-tension.
2. Set the right-hand cartridge ① with the cutting edge of the indexable insert to half the cutting width (symmetrical to the cutter body for a cross-toothed milling cutter) by turning the eccentric bolt ④.
3. Then set the left-hand cartridge ① in the same way as described under point 2 (half the cutting width for a cross-toothed milling cutter).
4. Ensure that there is sufficient tension against the eccentric bolt ④. Tighten the compound screw ③ further if necessary, i.e. increase the pre-tension via the spring washer ⑤.
5. Tighten the compound screw ③ to the prescribed torque.
6. Check the cutting width and runout again.

#### Note:

Coat the eccentric bolt ④ and spring washer ⑤ with special copper grease (FS663).



## Setting instructions for the F2010 milling cutter

### Design principle

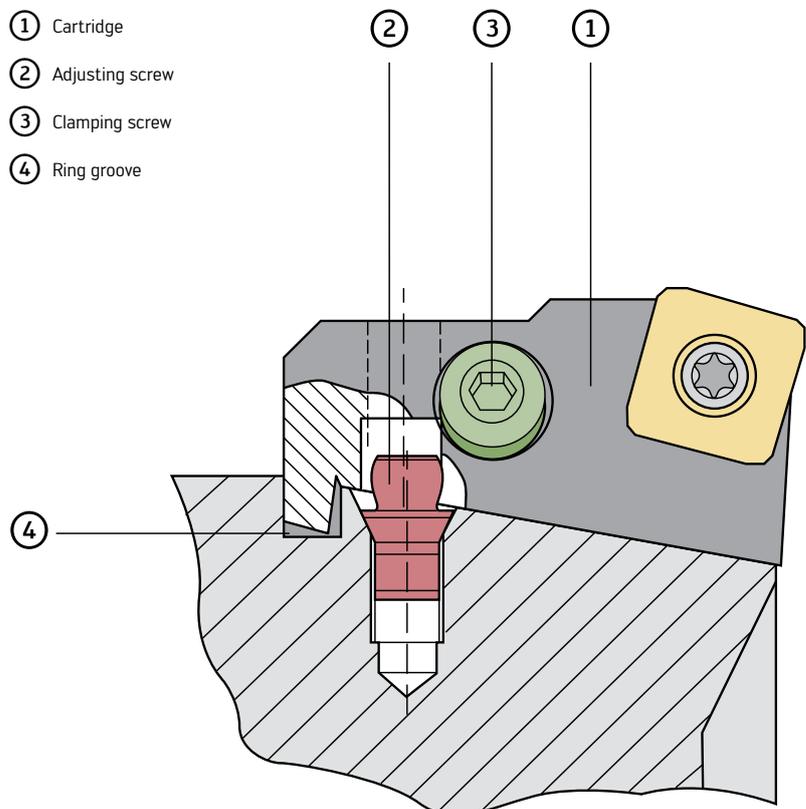
Every milling cutter cartridge seat has a conically countersunk threaded hole in which a screw is inserted.

This screw engages in a corresponding hole in the cartridge. Screwing in the adjusting screw causes it to move, pushing the cartridge upwards in the axial direction of the milling cutter with precision down to the micrometre (see image).



### Axial fine adjustment

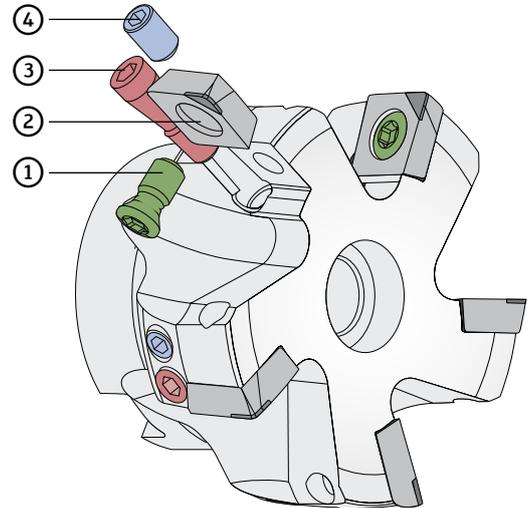
1. Before the cartridge ① is installed, the adjusting screw ② is screwed in so that the taper is approx. 0.3–0.5 mm above the bottom of the milling cutter cartridge seat.
2. Now the cartridge is installed and the clamping screw ③ is tightened. It is important to ensure that the cartridge is in contact with the fixed stop (rear ring groove ④) and that the adjusting screw is not under load.
3. The cartridge ① can be adjusted to the required flatness by tightening the adjusting screw ② clockwise. When doing so, it is important to ensure that the pre-tension on the adjusting screw is released following adjustment with precision down to the micrometre. This can be achieved by unscrewing the adjusting screw anticlockwise to release the tension on it and then screwing it back in without pre-tension. There is approx. 0.2 mm of adjustment.
4. To reset the cartridge, the adjusting screw ② must be returned to its starting position. The cartridge ① is moved back to the axial starting position after undoing the clamping screw ③.



## Setting instructions for the runout of the F2250 light alloy milling cutter

### F2250 with fixed insert seat

- ① Clamping screw for indexable insert
- ② PCD indexable insert
- ③ Countersunk screw
- ④ Fine balancing screw



### Adjusting the runout amount

1. Tighten the indexable inserts ② to a torque of 5 Nm. The countersunk screw ③ must not yet be screwed in.
2. Then screw in the countersunk screw ③ and pre-tension the indexable insert with a maximum installation height of approx. 0.05–0.08 mm.
3. Then set all indexable inserts to the same installation height. Check the runout again.

#### Note:

Do not retighten the indexable insert clamping screw ①. Coat the countersunk screw with special copper grease (FS663).

## Setting instructions for the F4253 slotting cutter

- ① Indexable insert
- ② Clamping screw for indexable insert
- ③ Adjusting screw

### Instructions for adjusting the runout amount of the F4253

If the tool is to be used with an adjustable runout amount, the adjusting screws ③ must be fitted.

1. Fit the indexable inserts ① and tighten the clamping screws ② to the recommended torque.
2. Check the runout.
3. Move the highest indexable insert approx. 0.05 mm forwards using the adjusting screw ③.
4. Bring all other indexable inserts to the same height.
5. Check the runout again.



## Assembly instructions for F4153 and F4253 slotting cutters

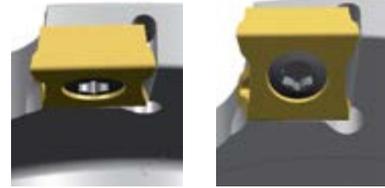
### F4153 assembly instructions

**Please note:**

Indexable insert sizes LNHU0803.. and LNHU0804.. can be fitted incorrectly.

The indexable insert is fitted correctly if the insert seat is closed on all sides and the cutting edge tapers towards the centre of the milling cutter.

correct



incorrect



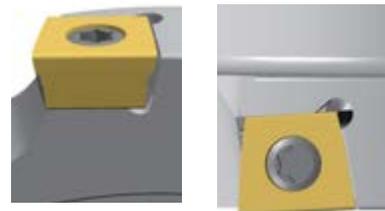
### F4253 assembly instructions

**Please note:**

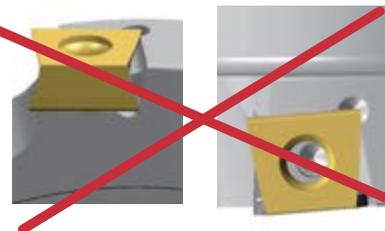
Indexable insert sizes LNHU0803.. and LNHU0804.. can be fitted incorrectly.

The indexable insert is fitted correctly if the insert seat is closed on all sides and the cutting edge tapers towards the centre of the milling cutter.

correct

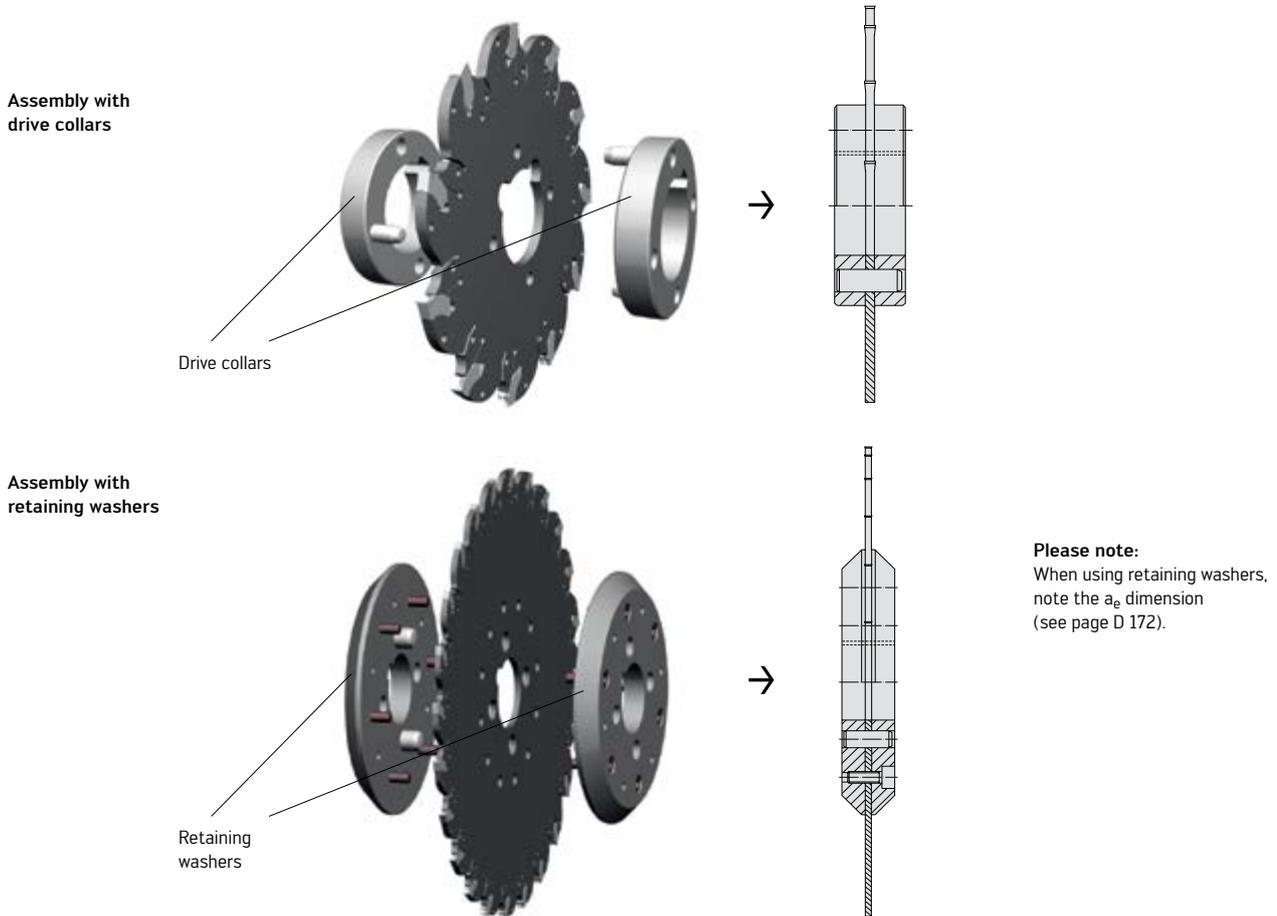


incorrect



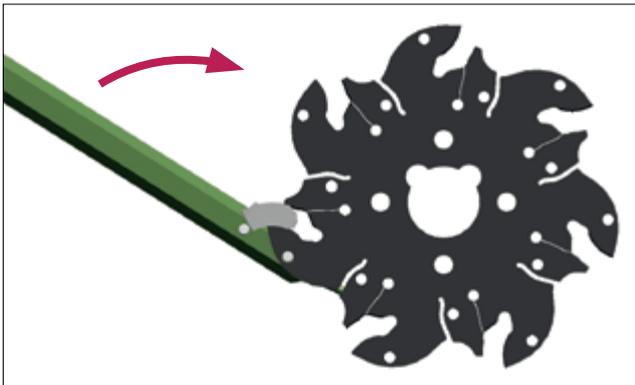
## Assembly instructions for Walter BLAXX F5055 slitting cutters

F5055 slitting cutters must always be used with two drive collars or retaining washers (to be ordered separately):

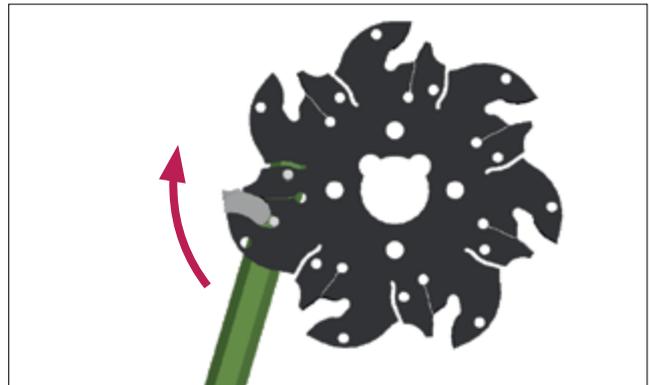


### Using the mounting wrench

Installing the insert

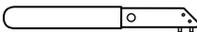


Removing the insert



**Note:**  
Only use the mounting wrench as shown in the table. When mounting the indexable insert, always position the wrench in the hole below the insert.

#### Mounting wrench

	$D_c$ [mm]	63	80	100	125	160	200	250	500
	Mounting wrench	FS2249	FS1494	FS2249	FS2249	FS1494	FS1494	FS1494	FS1494
	Ergonomic mounting wrench		FS2290 (PINS)				FS2290 (PINS)	FS2290 (PINS)	FS2290 (PINS)

## Safety information for M2131/M2331 ramping milling cutters

**When using M2131/M2331 ramping milling cutters, the following information must be observed:**

Always tighten the indexable insert screws using a torque wrench.

For the tightening torque, see the "General" section of the Technical Compendium, page F4.

Do not apply lubricant to indexable insert screws.

After having replaced the indexable insert five times, replace the indexable insert screws.

The indexable insert must be in contact with the insert seat across the whole surface (see images).

Check to ensure that the concentricity and balance status of the adaptor are adequate (also see DIN 69888).

Apply pressure to the rear part of the indexable insert when tightening



Check with 0.01 mm spacer



The spacer must **not** be able to fit between the indexable insert and insert seat.

## Assembly instructions for M2472 button insert milling cutter

### When using the M2472, the following information must be observed:

Open the insert seat by loosening the compound screw.

Insert the ceramic indexable insert into the insert seat in accordance with the drawing on the milling body.

Press the ceramic indexable insert against the contact surface in the insert seat, then push it against the axial and radial contact surface.

Then use a torque screwdriver to tighten the clamping wedge via the compound screw.

Finally, check that the ceramic indexable insert is fitted correctly:

A 1/100 mm spacer must not be able to fit between the indexable insert and insert seat support surfaces and contact surfaces.

### Note the indexable insert's direction of cut!



① Insert the ceramic indexable insert  
Note the direction of cut!



② Fit the ceramic indexable insert



③ Secure the ceramic indexable insert



④ Check that the indexable insert is securely fitted

Tool	Ceramic indexable insert	Clamping wedge	Compound screw	Torque
M2472...06	RPGN1204... WIS10 RPGN1204... WIS30	CW1002-RXGN12	FS1161	3,5 Nm

## Assembly instructions for M2473 button insert milling cutter

When using the M2473, the following information must be observed:

Open the insert seat by loosening the compound screw.

Insert the ceramic indexable insert into the insert seat.

Press the ceramic indexable insert against the contact surface in the insert seat, then push it against the axial and radial contact surface.

Then use a torque screwdriver to tighten the clamping wedge via the compound screw.

Finally, check that the indexable insert is fitted correctly: A 1/100 mm spacer must not be able to fit between the indexable insert and insert seat support surfaces and contact surfaces.



① Insert the ceramic indexable insert



② Fit the ceramic indexable insert

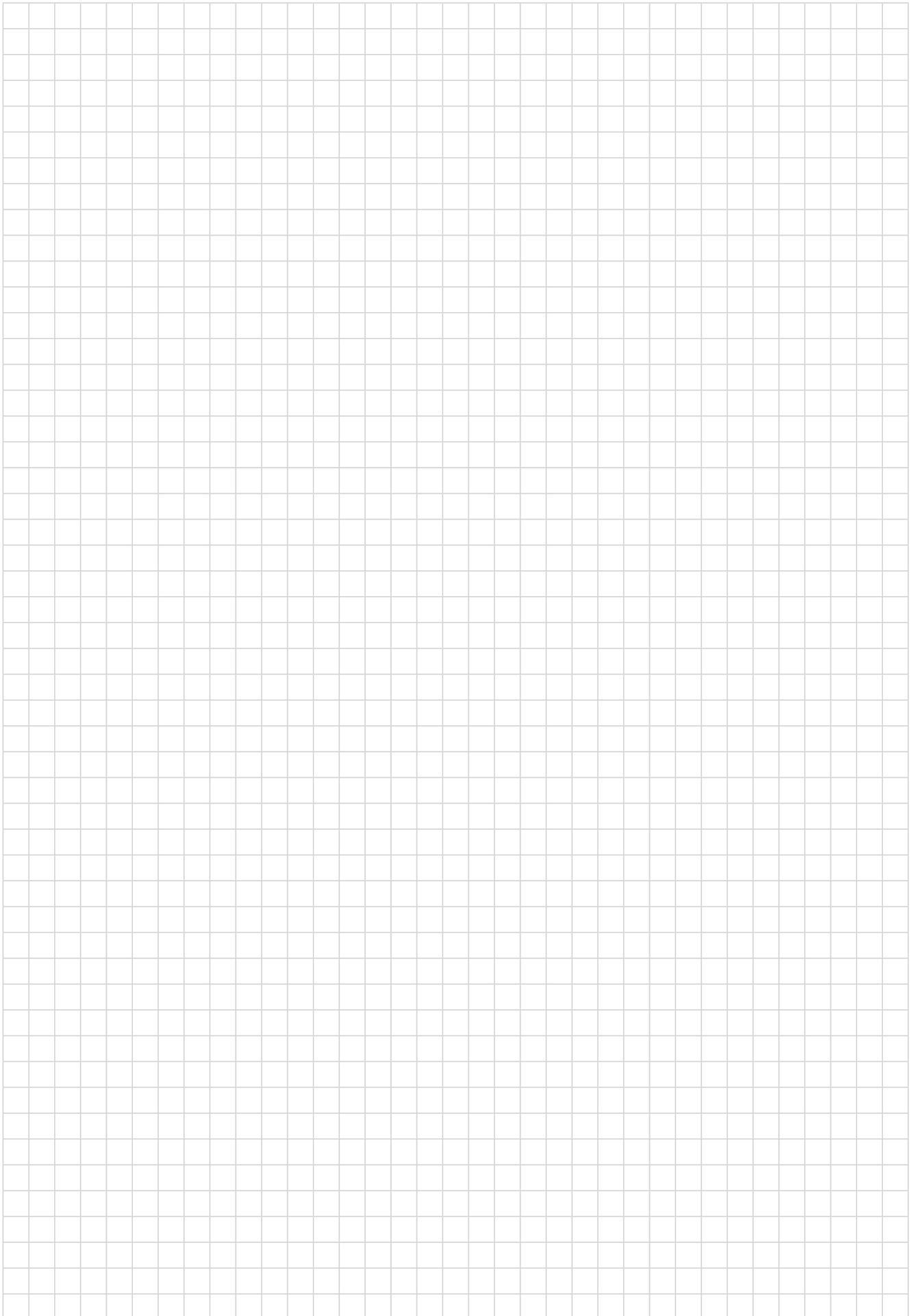


③ Secure the ceramic indexable insert



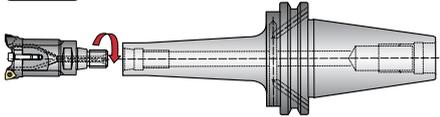
④ Check that the indexable insert is securely fitted

Tool	Ceramic indexable insert	Clamping wedge	Compound screw	Torque
M2473...06	RNGN1207... WIS10 RNGN1207... WIS30	CW1002-RXGN12	FS1161	3,5 Nm



## Tightening torques

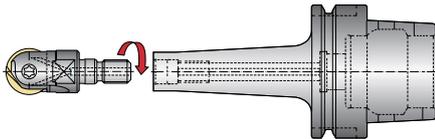
### Tightening torques for front pieces with modular ScrewFit interface



Interface	Thread	Tightening torque	Wrench size	Torque wrench	Fork head
T9	M5	6 Nm	8 mm	FS1384	FS1387
T14	M8	25 Nm	12 mm	FS1385	FS1388
T18	M10	50 Nm	14 mm	FS1385	FS1389
T22	M12	80 Nm	17 mm	FS1386	FS1390
T28	M16	150 Nm	21 mm	FS1386	FS1391
T36	M20	200 Nm	30 mm	FS1386	FS1392
T45	M20	200 Nm	36 mm	FS1386	FS1393*

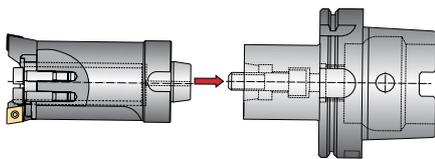
\* Use FS1394 adaptor

### Tightening torques for front pieces with cylindrical modular interface



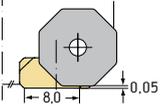
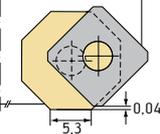
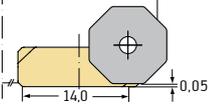
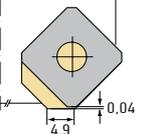
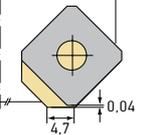
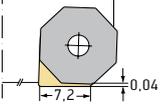
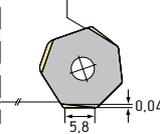
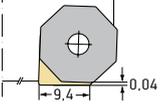
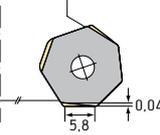
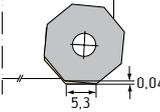
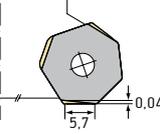
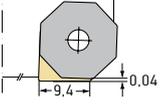
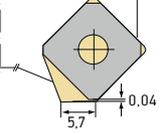
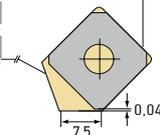
Interface	Thread	Tightening torque	Wrench size	Torque wrench	Fork head
TC06	M6	10 Nm	8 mm	FS1384	FS1387
TC08	M8	25 Nm	12 mm	FS1385	FS1388
TC10	M10	40 Nm	14 mm	FS1385	FS1389
TC12	M12	60 Nm	17 mm	FS1386	FS1390
TC16	M16	80 Nm	21 mm	FS1386	FS1391

### Tightening torques for tools with modular NCT interface



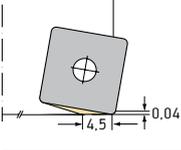
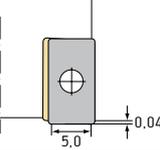
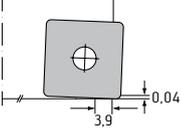
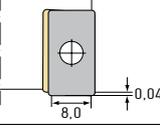
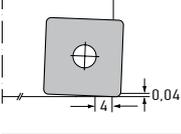
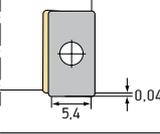
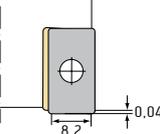
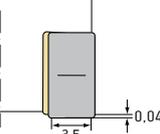
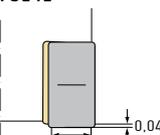
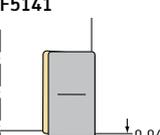
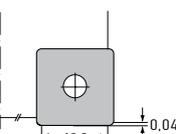
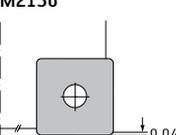
Interface	Thread	Tightening torque		Torque wrench	Socket wrench	Limit speed
NCT 25	M8	18 Nm	5	FS1385	FS402	20,000 rpm
NCT 32	M8	18 Nm	5	FS1385	FS402	30,000 rpm
NCT 40	M12	80 Nm	8	FS1386	FS403	30,000 rpm
NCT 50	M12	80 Nm	8	FS1386	FS403	30,000 rpm
NCT 63	M16	150 Nm	12	FS1386	FS404	30,000 rpm
NCT 80	M20	200 Nm	14	FS1386	FS405	30,000 rpm

## Roughing/finishing combinations on Walter milling tools

$\kappa = 42^\circ$			$\kappa = 45^\circ$		
	Roughing	Finishing		Roughing	Finishing
<b>M2025</b> 	Indexable insert ONHF050408-F67	Indexable insert P45424-1-G67	<b>F2010</b> 	Indexable insert SN...1205ANN  Cartridge FR720M	Indexable insert ODHX0605ZZN  Cartridge FR681M
<b>M2026</b> 	Indexable insert ONHF050408-F67	Indexable insert P45424-2-G67	<b>M5009</b> 	Indexable insert SNGX0904ANN-F57/-F67	Indexable insert XNGX0904ANN-F67
<b><math>\kappa = 43^\circ</math></b>			<b>M5009</b> 	Indexable insert SNGX1205ANN-F57/-F67	Indexable insert XNGX1205ANN-F67
<b>M5004</b> 	Indexable insert ODH.0504ZZN	Indexable insert ODHX0504ZZR	<b>F4045</b> 	Indexable insert XNHF070508...	Indexable insert XNHX0705ANN-D67
<b>M5004</b> 	Indexable insert ODH.0605ZZN	Indexable insert ODHX0605ZZR	<b>F4045</b> 	Indexable insert XNHX090612-...	Indexable insert XNHX0906ANN-D67
<b>F2010</b> 	Indexable insert OD...0605...  Cartridge FR592M	Indexable insert ODHX0605ZZN  Cartridge FR681M	<b>M3024</b> 	Indexable insert XNGU0705ANN-F57/F67	Indexable insert XNGX0705ANN-F67
<b>F2010</b> 	Indexable insert ODH.0605...  Cartridge FR592M	Indexable insert ODHX0605ZZR  Cartridge FR592M	<b>M4003</b> 	Indexable insert SDGT09T3AZN-F57	Indexable insert SDHX09T3AZR-A88
			<b>M4003</b> 	Indexable insert SDGT1204AZN-F57	Indexable insert SDHX1204AZR-A88

## Roughing/finishing combinations on Walter milling tools

(continued)

$\kappa = 75^\circ$			$\kappa = 90^\circ$		
	Roughing	Finishing		Roughing	Finishing
M5011	Indexable insert SNGX1205ENN-F57/-F67 	Indexable insert XNGX1205ENN-F67	M5130	Indexable insert BCGT090304R-G55 	Indexable insert BCGX0903PDR-G55
M5012	Indexable insert SNGX0904ZNN-F57/-F67 	Indexable insert XNGX0904ZNN-F67	M5130	Indexable insert BCGT160508R-G55 	Indexable insert BCGX1605PDR-G55
M5012	Indexable insert SNGX1205ZNN-F57/-F67 	Indexable insert XNGX1205ZNN-F67	F4042R	Indexable insert ADGT10T3PER-D67/-G77 	Indexable insert ADGX10T3PER-F56
			F4042	Indexable insert ADGT1606PER-D67/ -F56/-G77 	Indexable insert ADGX1606PER-F56
			F5041	Indexable insert LNHU0904..R-L55T/L65T 	Indexable insert LNHX0904PDR-L55T
			F5141	Indexable insert LNHU1306..R-L55T/L65T 	Indexable insert LNHX1306PDR-L55T
			F5141	Indexable insert LNHU1306..R-L55T/L65T 	Indexable insert LNHX130608R-L55T
			M2136	Indexable insert SNEF120408R-B67 	Indexable insert SNEX1204PNN-A27
			M2136	Indexable insert SNEF120408R-B67 	Indexable insert SNEX1204PNR-B67

## Designation key in accordance with ISO 1832 for indexable inserts for milling

Example:

<b>B</b>	<b>C</b>	<b>G</b>	<b>T</b>	<b>12</b>	<b>04</b>	<b>08</b>	<b>R</b>	<b>—</b>	<b>G55</b>
1	2	3	4	5	6	7	8	9	12

1	
Insert shape	
<b>A</b>	<b>M</b>
<b>B</b>	<b>O</b>
<b>C</b>	<b>P</b>
<b>D</b>	<b>R</b>
<b>E</b>	<b>S</b>
<b>H</b>	<b>T</b>
<b>K</b>	<b>L</b>
<b>L</b>	<b>L</b>

2	
Clearance angle	
<b>A</b>	<b>F</b>
<b>B</b>	<b>G</b>
<b>C</b>	<b>N</b>
<b>D</b>	<b>P</b>
<b>E</b>	

3				
Tolerances				
	Permissible deviation in mm for			
	d	m	s	
	<b>A</b>	$\pm 0,025$	$\pm 0,005$	$\pm 0,025$
	<b>C</b>	$\pm 0,025$	$\pm 0,013$	$\pm 0,025$
	<b>E</b>	$\pm 0,025$	$\pm 0,025$	$\pm 0,025$
	<b>F</b>	$\pm 0,013$	$\pm 0,005$	$\pm 0,025$
	<b>G</b>	$\pm 0,025$	$\pm 0,025$	$\pm 0,130$
	<b>H</b>	$\pm 0,013$	$\pm 0,013$	$\pm 0,025$
	<b>J</b> <sup>1</sup>	$\pm 0,05-0,15^2$	$\pm 0,005$	$\pm 0,025$
	<b>K</b> <sup>1</sup>	$\pm 0,05-0,15^2$	$\pm 0,013$	$\pm 0,025$
<b>L</b> <sup>1</sup>	$\pm 0,05-0,15^2$	$\pm 0,025$	$\pm 0,025$	
<b>M</b>	$\pm 0,05-0,15^2$	$\pm 0,08-0,20^2$	$\pm 0,130$	
<b>N</b>	$\pm 0,05-0,15^2$	$\pm 0,08-0,20^2$	$\pm 0,025$	
<b>U</b>	$\pm 0,08-0,25^2$	$\pm 0,13-0,38^2$	$\pm 0,130$	
<sup>1</sup> Inserts with ground planar cutting edges <sup>2</sup> Depending on the insert size (see ISO standard 1832)				

7			
Corner radius			
<b>01</b> r = 0,1	<b>Lead angle</b>	<b>Clearance angle of planar cutting edge</b>	<b>00</b> for diameters converted from imperial units to mm
<b>02</b> r = 0,2	<b>A</b> 45°	<b>A</b> 3°	<b>M0</b> for diameters in metric units
<b>04</b> r = 0,4	<b>D</b> 60°	<b>B</b> 5°	
<b>08</b> r = 0,8	<b>E</b> 75°	<b>C</b> 7°	
<b>12</b> r = 1,2	<b>F</b> 85°	<b>D</b> 15°	
<b>16</b> r = 1,6	<b>P</b> 90°	<b>E</b> 20°	
<b>24</b> r = 2,4	<b>Z</b> Other lead angles	<b>F</b> 25°	
		<b>G</b> 30°	
		<b>N</b> 0°	
		<b>P</b> 11°	
		<b>Z</b> Other clearance angles	

8	
Edge formation	
<b>E</b>	
<b>F</b>	
<b>T</b>	
<b>S</b>	

9	
Cutting direction	

4			5	6
Machining and fastening features			Cutting edge length	Insert thickness
<p><b>A</b> </p> <p><b>B</b> <math>\alpha = 70-90^\circ</math></p> <p><b>C</b> <math>\alpha = 70-90^\circ</math></p> <p><b>F</b> </p> <p><b>G</b> </p> <p><b>H</b> <math>\alpha = 70-90^\circ</math></p>	<p><b>J</b> <math>\alpha = 70-90^\circ</math></p> <p><b>M</b> </p> <p><b>N</b> </p> <p><b>Q</b> <math>\beta = 40-60^\circ</math></p> <p><b>R</b> </p> <p><b>T</b> <math>\beta = 40-60^\circ</math></p>	<p><b>U</b> <math>\beta = 40-60^\circ</math></p> <p><b>W</b> <math>\beta = 40-60^\circ</math></p> <p><b>X</b> Drawing or precise description of the indexable insert is required</p>	<p></p> <p></p> <p></p> <p></p> <p></p> <p></p> <p></p> <p></p>	<p> <b>01</b> <math>s = 1,59</math></p> <p> <b>T1</b> <math>s = 1,98</math></p> <p> <b>T2</b> <math>s = 2,78</math></p> <p> <b>03</b> <math>s = 3,18</math></p> <p><b>T3</b> <math>s = 3,97</math></p> <p><b>04</b> <math>s = 4,76</math></p> <p><b>05</b> <math>s = 5,56</math></p> <p><b>06</b> <math>s = 6,35</math></p> <p><b>07</b> <math>s = 7,94</math></p> <p><b>09</b> <math>s = 9,52</math></p>

10
Chamfer width
<p><b>010</b> = 0,10 mm</p> <p><b>020</b> = 0,20 mm</p> <p><b>025</b> = 0,25 mm</p> <p><b>070</b> = 0,70 mm</p> <p><b>150</b> = 1,50 mm</p> <p><b>200</b> = 2,00 mm</p>

11
Chamfer angle
<p><b>15</b> = <math>15^\circ</math></p> <p><b>20</b> = <math>20^\circ</math></p>

12											
Manufacturer specifications/geometry index											
<p>Example:</p> <table border="1"> <tr> <td><b>G</b></td> <td><b>5</b></td> <td><b>5</b></td> <td></td> </tr> <tr> <td>1</td> <td>2</td> <td>3</td> <td>4</td> </tr> </table>				<b>G</b>	<b>5</b>	<b>5</b>		1	2	3	4
<b>G</b>	<b>5</b>	<b>5</b>									
1	2	3	4								
<p><b>1. Chip breaker groove</b></p> <p>smaller </p> <p><b>A</b> = <math>0^\circ</math></p> <p><b>B</b> = <math>6^\circ</math></p> <p><b>D</b> = <math>10^\circ</math></p> <p><b>E</b> = <math>15^\circ</math></p> <p><b>F</b> = <math>16^\circ</math></p> <p><b>G</b> = <math>20^\circ</math></p> <p><b>K</b> = <math>25^\circ</math></p> <p><b>L</b> <math>\geq 28^\circ</math></p> <p><b>M</b> = <math>30^\circ</math></p> <p>larger </p>	<p><b>2. Cutting edge</b></p> <p>heavily ground down </p> <p><b>2</b></p> <p></p> <p><b>5</b></p> <p></p> <p><b>6</b></p> <p></p> <p><b>7</b></p> <p></p> <p><b>8</b></p> <p>sharp </p>	<p><b>3. Flank face design</b></p> <p> <b>1</b> including vibration-damped</p> <p> <b>5</b></p> <p> <b>6</b></p> <p> <b>7</b></p> <p> <b>8</b></p> <p>Flank face design</p>	<p><b>4. Additional information</b></p> <p><b>T</b> Tangential installation</p>								

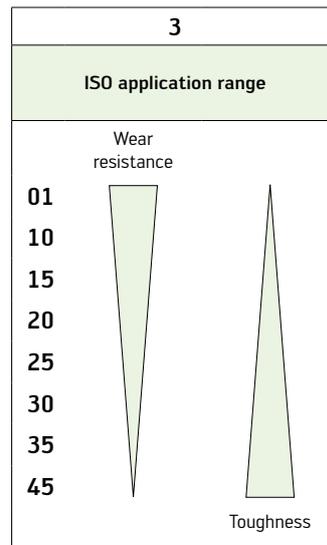
## Designation key for coated carbides – Milling

Example:

<b>W</b>	<b>S</b>	<b>P</b>	<b>45</b>	<b>G</b>
Walter	1	2	3	4

1
<b>1. Primary application</b>
<b>P</b> Steel
<b>M</b> Stainless steel
<b>K</b> Cast iron
<b>N</b> NF metals
<b>S</b> Materials with difficult cutting properties
<b>H</b> Hard materials

2
<b>2. Primary application</b>
<b>P</b> Steel
<b>M</b> Stainless steel
<b>K</b> Cast iron
<b>N</b> NF metals
<b>S</b> Materials with difficult cutting properties
<b>H</b> Hard materials



4
<b>Generation</b>
<b>G</b> Tiger-tec® Gold
<b>S</b> Tiger-tec® Silver
<b>X</b> Special

## Designation key for Walter milling tools

Example:

M	5	0	12	-	050	-	B	22	-	04	-	10	-	AP
1	2	3	4	5	6		7	8		9		10		11

1	2	3	4		5	6	7	8	9	10	11	
Tool group	Generation	Tool type	Type		1. Delimiters	Cutting diameter	Adaptor type	Adaptor size	Number of teeth	Depth of cut	Version acc. to length or manufacturer-specific adaptors or other tool characteristics	
<b>M</b> Milling	2 3 Walter BLAXX 4 M4000 5 Xtra-tec® XT	0 Face milling cutter 1 Shoulder milling cutter 2 Shoulder/slot/helical milling cutter 3 Other milling cutters 4 Copy milling cutter 5 Profiling cutter 7 Routing cutter	<b>02</b> High-feed milling cutter $\kappa = 15^\circ$ , radial, positive, 4 cutting edges per indexable insert	<b>32</b> Shoulder milling cutter $\kappa = 89^\circ 45'$ , radial, positive, 4 cutting edges per indexable insert	- Metric . Inch		A Cylindrical shank B Bore adaption T ScrewFit TC Cylindrical modular interface W Weldon shank H HSK				<b>C</b> Carbide shank <b>S</b> Short version <b>L</b> Long version <b>XL</b> Extra long version <b>D</b> Dörries Scharmann machines <b>MA</b> Makino machines	<b>AP</b> Carbide shim For helical milling cutters <b>M</b> Modular tool design <b>B</b> Basic body <b>F</b> Front piece
			<b>03</b> Face milling cutter $\kappa = 45^\circ$ , radial, positive, 4 cutting edges per indexable insert	<b>37</b> Shoulder milling cutter $\kappa = 90^\circ$ , radial, double- sided, 6 cutting edges per indexable insert								
			<b>04</b> Octagon face milling cutter $\kappa = 43^\circ$ , radial, positive, 8 cutting edges per indexable insert	<b>55</b> Helical milling cutter $\kappa = 90^\circ$ , tangential, double-sided, 2 or 4 cutting edges per indexable insert								
			<b>08</b> High-feed milling cutter $\kappa = 17^\circ$ , radial, double-sided, 4 cutting edges per indexable insert	<b>56</b> Helical milling cutter $\kappa = 90^\circ$ , radial, positive, 2 or 4 cutting edges per indexable insert								
			<b>09</b> Face milling cutter $\kappa = 45^\circ$ , radial, double-sided, 8 cutting edges per indexable insert	<b>57</b> Helical milling cutter $\kappa = 90^\circ$ , radial, positive, 2 or 4 cutting edges per indexable insert								
			<b>12</b> Face milling cutter $\kappa = 88^\circ$ , radial, double-sided, 8 cutting edges per indexable insert	<b>58</b> Helical milling cutter $\kappa = 90^\circ$ , radial, positive, 2 or 4 cutting edges per indexable insert								
			<b>16</b> Heavy-duty cutter $\kappa = 60^\circ$ , tangential, double-sided, 4 cutting edges per indexable insert	<b>60</b> Copy milling cutter for finishing radial, positive, 1 cutting edge per full-radius insert								
			<b>24</b> Heptagon face milling cutter $\kappa = 45^\circ$ , radial, double- sided, 14 cutting edges per indexable insert, screw clamping	<b>68</b> Button insert milling cutter radial, positive, 4 or 8 cutting edges per indexable insert								
			<b>25</b> Octagon face milling cutter for finishing $\kappa = 42^\circ$ , radial, double-sided, 16 cutting edges per indexable insert	<b>74</b> Chamfer milling cutter $\kappa = 30^\circ, 45^\circ, 60^\circ$ , radial, positive, 4 cutting edges per indexable insert								
			<b>26</b> Octagon face milling cutter for finishing $\kappa = 42^\circ$ , radial, double-sided, 16 cutting edges per indexable insert	<b>75</b> T-slot milling cutter $\kappa = 90^\circ$ , radial, positive, 4 cutting edges per indexable insert								
			<b>30</b> Shoulder milling cutter $\kappa = 90^\circ$ , radial, positive, 2 cutting edges per indexable insert	<b>91</b> Routing cutter $\kappa = 90^\circ$ , radial, positive, 4 cutting edges per indexable insert								
			<b>31</b> Ramping milling cutter $\kappa = 90^\circ$ , radial, positive, 2 cutting edges per indexable insert	<b>92</b> Routing cutter $\kappa = 90^\circ$ , radial, positive, 2 or 4 cutting edges per indexable insert								

## Assembly parts

### Spare parts for F2010

	Designation	Suitable for	For indexable insert	Clamping screw	Tightening torque
	FR441M	Face milling cutter, $\kappa = 75^\circ$	SP..1204EDR..	FS243 (Torx 20)	5,0 Nm
	FR445M	Shoulder milling cutter, $\kappa = 89^\circ 45'$	SP..120408..	FS243 (Torx 20)	5,0 Nm
	FR447M	Shoulder milling cutter, $\kappa = 90^\circ$	P27...-4R	FS243 (Torx 20)	5,0 Nm
	FR451M	Face milling cutter, $\kappa = 75^\circ$	SF..1203EFR	FS260 (Torx 20)	5,0 Nm
	FR455M	Face milling cutter, $\kappa = 45^\circ$	P2894-1	FS243 (Torx 20)	5,0 Nm
	FR495M	Face milling cutter, $\kappa = 45^\circ$	SP..1204A..	FS243 (Torx 20)	5,0 Nm
	FR728M	Face milling cutter, $\kappa = 88^\circ$	SNGX1205ZNN.. XNGX1205ZNN..	FS1459 (Torx 15IP)	4,0 Nm
	FR732M	Face milling cutter, $\kappa = 45^\circ$	SN.X1606..	FS1495 (Torx 20IP)	5,0 Nm
	FR750M	Face milling cutter, $\kappa = 21^\circ$	P23696-2.0	FS1032 (Torx 20)	5,0 Nm
	FR755M	Face milling cutter, $\kappa = 15^\circ$	SD..1204..	FS1453 (Torx 15IP)	3,5 Nm

## Tightening screws for face mill adaptors

When using the A150, A155 and AK155 face mill adaptors in combination with helical and ramping milling cutters with parallel bore and transverse keyway in accordance with DIN 138, the tightening screw of the adaptor must be replaced.

Designation	Tightening screw for adaptor *
F4138.B16.040.Z03.33	M8 × 40 (SW6)
F4138.B16.040.Z03.43	M8 × 50 (SW6)
F4138.B22.050.Z04.43	M10 × 45 (SW8)
F4138.B22.050.Z04.54	M10 × 55 (SW8)
F4138.B27.063.Z05.43	M12 × 45 (SW10)
F4138.B27.063.Z05.54	M12 × 55 (SW10)
F4138.B32.080.Z06.54	M16 × 65 (SW14)
F4138.B32.080.Z06.65	M16 × 70 (SW14)
F4238.B22.050.Z03.43	M10 × 45 (SW8)
F4238.B27.063.Z04.43	M12 × 55 (SW10)
F4238.B27.063.Z04.57	M12 × 70 (SW10)
F4238.B27.066.Z04.57	M12 × 70 (SW10)
F4238.B32.080.Z05.57	M16 × 70 (SW14)
F4238.B32.080.Z05.71	M16 × 90 (SW14)
F4238.B32.085.Z05.71	M16 × 90 (SW14)
F4338.B27.063.Z04.31	M12 × 40 (SW10)
F4338.B27.063.Z04.47	M12 × 50 (SW10)
F4338.B27.063.Z04.63	M12 × 65 (SW10)
F4338.B32.080.Z05.31	M16 × 35 (SW14)
F4338.B32.080.Z05.63	M16 × 70 (SW14)
F4338.B32.080.Z05.78	M16 × 90 (SW14)
F4338.B40.100.Z05.78	M20 × 80 (SW17)
F4338.B40.125.Z06.94	M20 × 90 (SW17)

Designation	Tightening screw for adaptor *
F5038.B16.040.Z03.32	M8 × 40 (SW6)
F5038.B16.040.Z03.40	M8 × 50 (SW6)
F5138.B22.040.Z02.34	M10 × 40 (SW8)
F5138.B22.040.Z02.45	M10 × 45 (SW8)
F5138.B22.050.Z03.34	M10 × 40 (SW8)
F5138.B22.050.Z03.45	M10 × 45 (SW8)
F5138.B27.063.Z04.45	M12 × 50 (SW10)
F5138.B27.063.Z04.56	M12 × 60 (SW10)
F5138.B32.080.Z05.56	M16 × 65 (SW14)
M2131-040-B16-03-15	M8 × 40 (SW6)
M2131-050-B22-04-15	M10 × 35 (SW8)
M2131-063-B22-05-15	M10 × 35 (SW8)
M2131-080-B27-05-15	M12 × 40 (SW10)
M2131-050-B22-03-20	M10 × 40 (SW8)
M2131-063-B22-04-20	M10 × 35 (SW8)
M2331-040-B16-03-15	M8 × 40 (SW6)
M2331-050-B22-02-15	M10 × 35 (SW8)
M2331-050-B22-03-15	M10 × 35 (SW8)
M2331-050-B27-04-15	M10 × 35 (SW8)
M2331-050-B22-02-20	M10 × 40 (SW8)
M2331-050-B22-03-20	M10 × 40 (SW8)
M3255-050-B22-04-46	M10 × 45 (SW8)
M3255-050-B22-05-46	M10 × 45 (SW8)
M3255-063-B27-05-46	M12 × 50 (SW10)
M3255-063-B27-06-46	M12 × 50 (SW10)
M3255-080-B32-05-58	M16 × 65 (SW14)
M3255-080-B32-06-58	M16 × 65 (SW14)
M4257-050-B22-02-47	M10 × 45 (SW8)
M4257-063-B27-03-54	M12 × 70 (SW10)
M4258-080-B32-03-67	M16 × 90 (SW14)
M4258-100-B40-04-77	M20 × 80 (SW17)

\* ISO 4762 cap screw (12.9)

## Drive collars and retaining washers for Walter BLAXX F5055 slitting cutters

### Tool

Designation	d <sub>1</sub> mm	d <sub>2</sub> mm	h mm	For D <sub>c</sub> mm	For cutting width mm	kg			
FS1346-SET	16	32	8	63	1,5 + 2,0	0,1			
FS2291-SET	16	32	8	63	3,0 + 4,0	0,1			
FS1347-SET	16	38	8	80	1,5 + 2,0	0,1			
FS2292-SET	16	38	8	80	3,0 + 4,0	0,1			
FS1348-SET	22	46	10	100	1,5-4,0	0,1			
FS1349-SET	32	55	10	125	1,5-4,0	0,1			
FS1350-SET	40	80	12	160-250	2,0-4,0	0,4			
FS1351-SET	40	140	12	200 + 250	3,0 + 4,0	1,3			
FS1352-SET	40	190	12	250	3,0 + 4,0	2,5			

A SET consists of two drive collars or retaining washers.

### Assembly parts

Designation	FS1346	FS1347	FS1348	FS1349	FS1350	FS1351	FS1352	FS2291	FS2292
ISO 8734 parallel pin	4 m6 × 16	4 m6 × 16	5 m6 × 20	6 m6 × 20	12 m6 × 20	12 m6 × 20	12 m6 × 20	5 m6 × 16	5 m6 × 16
DIN 912 cap screw						M6 × 16	M6 × 16		

## Accessories for one-piece milling cutters

### Pull studs without SK40 intermediate bushing

	Pull stud	C100.40.600 for DIN 2080
	Pull stud	C100.40.615 A for DIN 69871 Form AD
	Pull stud	C100.40.615 B for DIN 69871 Form B

### Pull studs without SK50 intermediate bushing

	Pull stud	C100.50.600 for DIN 2080
	Pull stud	C100.50.615 A for DIN 69871 Form AD
	Pull stud	C100.50.615 B for DIN 69871 Form B

### Pull studs for milling tools with steep taper\*

	Designation	For steep taper	d <sub>1</sub> mm	d <sub>2</sub> mm	d <sub>4</sub> mm	d <sub>10</sub>	l <sub>1</sub> mm	l <sub>2</sub> mm	α
DIN 69872, Form AD 	C100.40.115	40	19	14	17	M16	54	26	15°
	C100.50.115	50	28	21	25	M24	74	34	15°
DIN 69872, Form B 	C100.40.215	40	19	14	17	M16	54	26	15°
	C100.50.215	50	28	21	25	M24	74	34	15°

\* with FS1079/FS1080 intermediate bushing

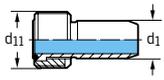
### Accessories for boring bars/adaptors

	Designation	Size	Description	Suitable for
	FS1079	For SK40	Intermediate bushing for pull stud	Tools with steep taper
	FS1080	For SK50	Intermediate bushing for pull stud	Tools with steep taper

## Accessories for one-piece milling cutters

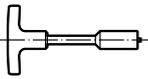
(continued)

### Transfer units for tools with hollow shank taper



Designation	$d_{11}$	$d_1 f_8$ mm	For HSK
FS1064	M18 × 1	12	HSK63-A
FS1065	M24 × 1,5	16	HSK100-A

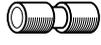
### Socket wrench for installing transfer units



Designation	For HSK
FS952	HSK63-A
FS953	HSK100-A

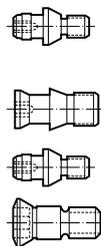
## Assembly parts and accessories

### Compound screws



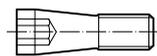
Designation	Size	Suitable for
FS231	M8 × 24 (SW 4)	FK240, FR/FL281, FR/FL282, FR/FL283, F249
FS234	M10 × 40 (SW 5)	FR/FL238, FR/FL239, FR/FL243, FR/FL244, FR/FL247, FR/FL248, FR/FL249, FR/FL250, FR/FL259, FR/FL260, FR/FL261, FR/FL262, FR/FL263, FR/FL264, FR/FL265, FR/FL266, FR/FL283, FR/FL285, FR/FL287
FS235	M8 × 32 (SW 5)	
FS929	M12 × 76 (Torx 45)	Boring bars/adaptors

### Clamping elements for indexable inserts



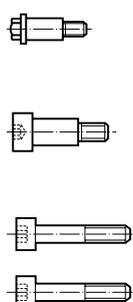
Designation	Size	Suitable for
FS248	M4 × 10,7 (Torx 8)	Milling system 2000
FS249	M5 × 11,3 (Torx 15)	
FS250	M6 × 11,6 (Torx 20)	
FS293	M5 × 11 (Torx 15)	Milling system 2000
FS305	M5 × 11,6 (Torx 20)	F2044
FS1015	M3 × 12 (Torx 20)	F2253

### Countersunk screws



Designation	Size	Suitable for
FS1491	M3 × 9,8 (SW 2)	Special tools
FS2045	M3 × 12 (SW 2)	
FS2055	M4 × 15 (SW 2,5)	
FS1148	M5 × 19 (SW 2,5)	
FS2056	M5 × 23 (SW 3)	
FS2058	M3 × 13,5 (SW 2,5)	

### Miscellaneous screws

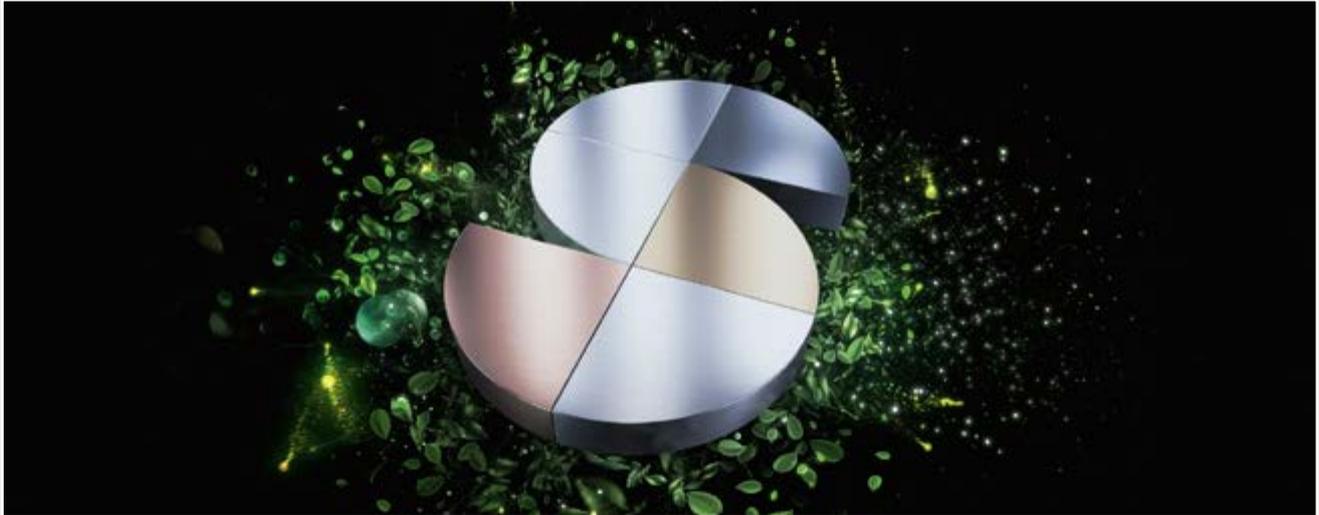


Designation	Size	Suitable for
FS370	SW 10	Clamping screw for front piece, F2038
FS371	SW 10	Clamping screw for front piece, F2038
FS372	SW 10	
FS373	SW 12	
FS374	SW 12	
FS935	M2,2 × 6,4 (Torx 7)	Clamping screw
FS966	M16 × 16	Cap screw

### Miscellaneous

Designation	Size	Suitable for
FS663	100 g	COPASLIP





# Sustainable products and services – certified and transparent

Walter is a company that takes responsibility for people and the environment. Sustainability is a central component of our corporate strategy. It pervades our products and business divisions and is reviewed and certified by independent third parties on a regular basis.

## Proven to be produced to high standards

All processes, procedures, methods and instruments that we use are checked and certified by an independent body according to strict criteria. Occupational health and safety, quality assurance and environmentally friendly actions (for example through resource-saving, energy-efficient and CO<sub>2</sub>-offset production) are examples of this. Our social commitment shows that Walter has a broader definition of responsibility.

## Transparency throughout the entire process chain – for your peace of mind

The integrated management system at Walter includes the sustainable use of resources and production equipment as well as of people – our customers, partners and employees. So that you can count on all of our products meeting these requirements throughout the entire process chain, we apply our own benchmarks to our suppliers too.

## Certification

The integrated management system at Walter includes certification in accordance with:

- ISO 9001 (Quality management)
- VDA 6.4 (Production equipment for the automotive industry)
- ISO 14001 (Environmental management)
- ISO 45001 (Occupational health and safety management)
- ISO 50001 (Energy management)



You can find more information on Walter certification here:



### Occupational health and safety

Walter protects its employees against health hazards. To prevent accidents, we continuously review our processes and take proactive measures as a precaution.



### Environmental and energy management

Environmental protection is an important company objective for Walter. We use energy efficiently and deploy practical methods to sustainably reduce the consumption of energy, water and resources.



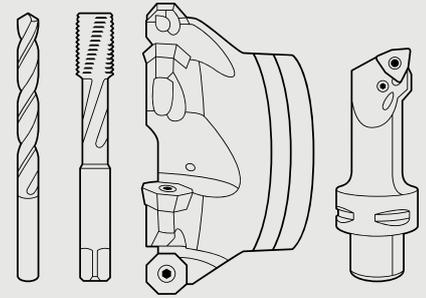
### Quality management

Walter is continuously improving its products and processes. We ensure our product quality using effective measures and procedures – and check it on a regular basis with our comprehensive quality management system.

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