Engineering Kompetenz

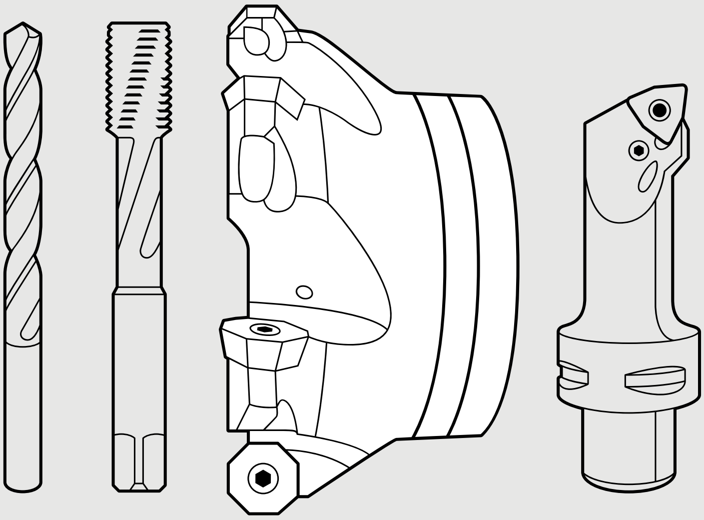
Solid carbide and PCD milling
Indexable insert milling

Technical Compendium – Milling
Edition 2023

_ METAL IS OUR WHOLE WORLD

Technical Compendium

Milling



Technical Compendium – Milling

Solid carbide milling

Cutting data

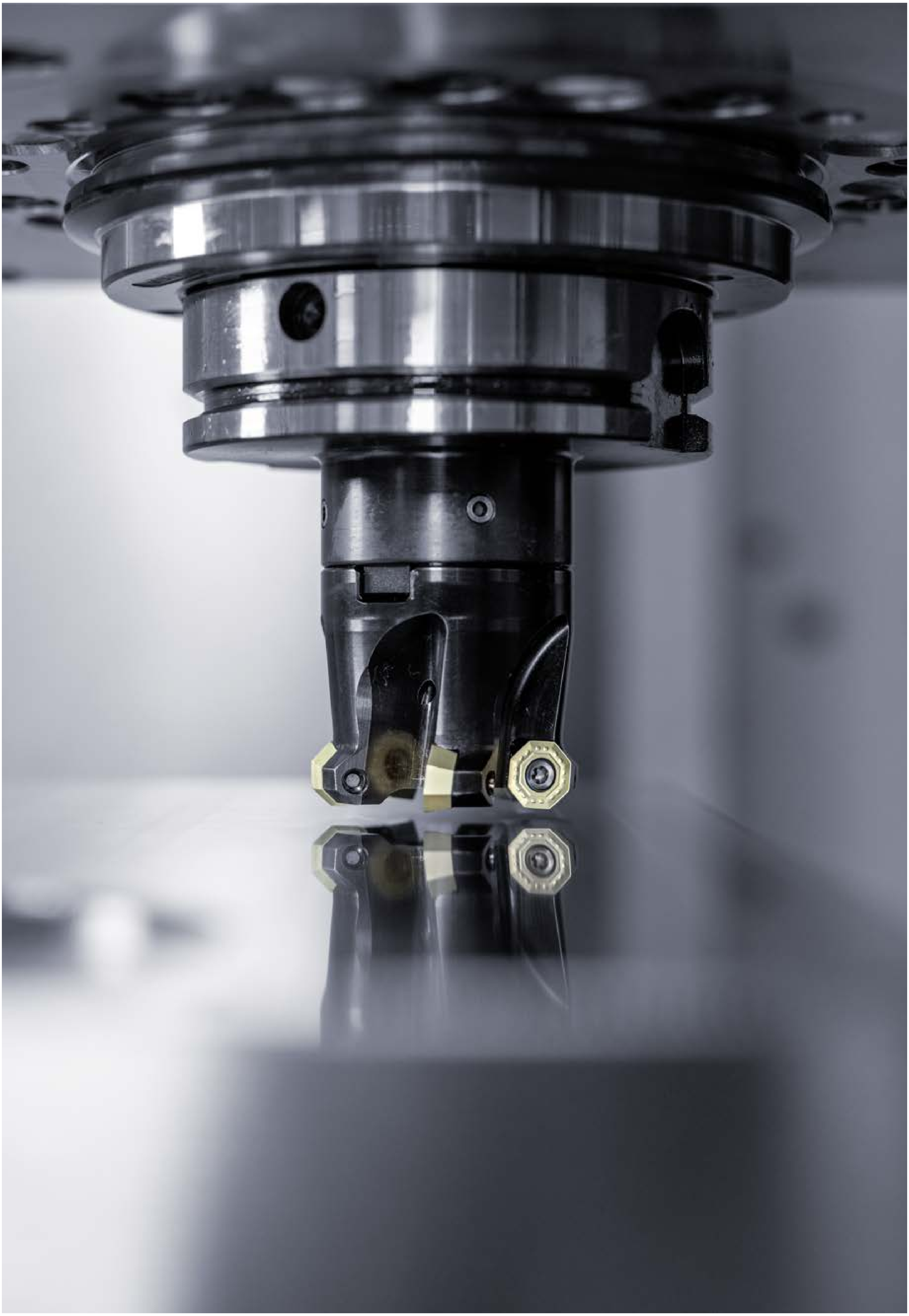
General information

Designation key

Milling with indexable inserts

Cutting data

Feed determination



Technical Compendium – Milling

Application information

General information

Setting and assembly instructions

Designation key

Assembly parts and accessories

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.
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.
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_2 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.
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 Technology	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 line, 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 application – 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_2 emissions through Walter Green.
X·treme Evo	For Walter, the X·treme Evo DC260 and 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.
Walter Capto™	Walter Capto™ is a modular tool adaption system. It is suitable for all turning, milling, drilling and threading operations. Its ISO-standardised polygon taper absorbs torsional moments and bending moments extremely well and ensures optimal repeat accuracy.
ConeFit	Walter ConeFit is an extremely flexible solid carbide milling system with a wide range of high-performance exchangeable heads and shank variants. Its conical thread can self-centre, thereby guaranteeing maximum stability and concentricity.
ScrewFit	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.
QuadFit	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	"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.
SmartLock	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. Indexing 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

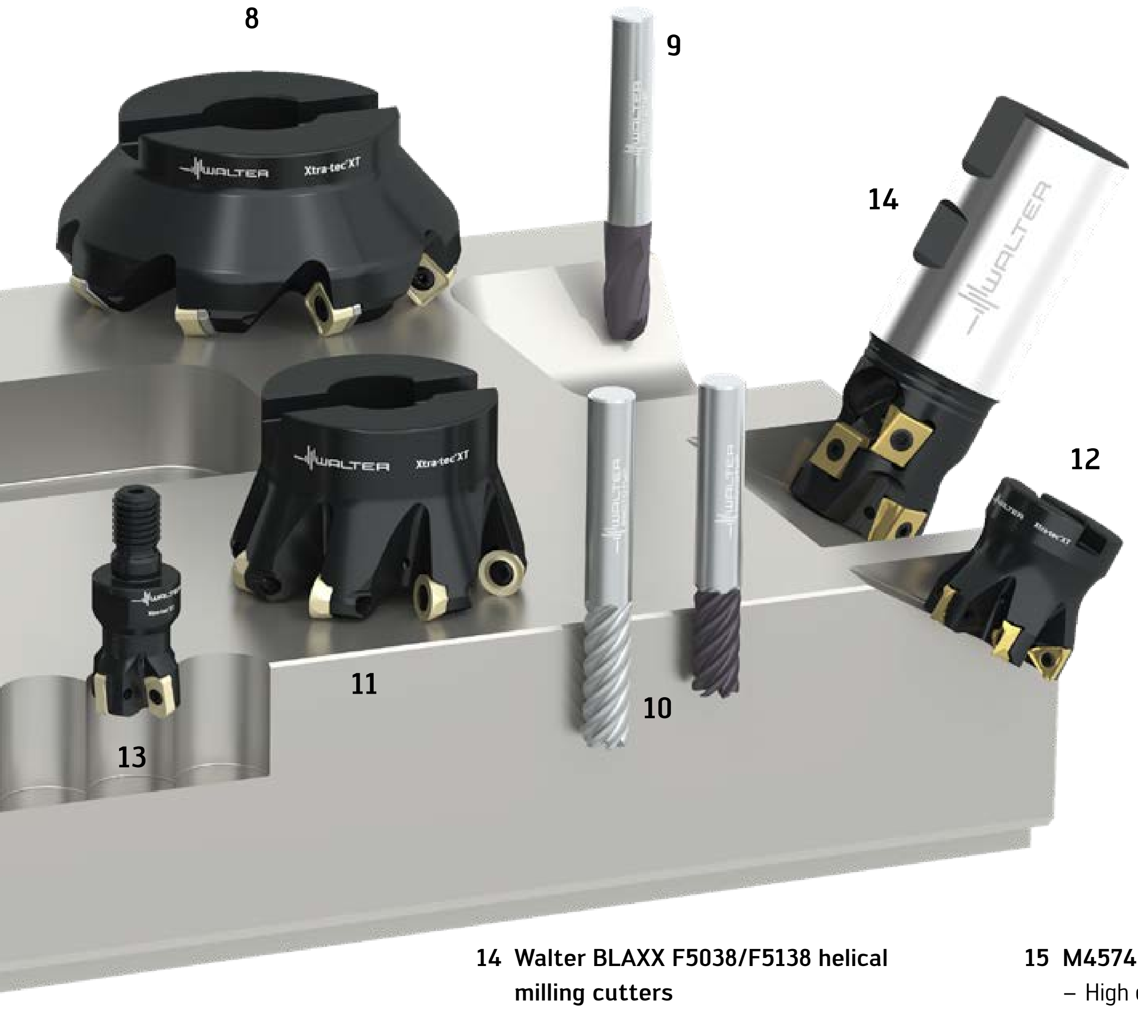
9 MC416 Advance
- For all forms of five-axis machining as well as for machines with three axes and constant Z machining
- High-performance WJ30TF grade

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

$$n = \frac{v_c \times 1\,000}{D_c \times \pi} \qquad [\text{min}^{-1}]$$

Cutting speed

$$v_c = \frac{D_c \times \pi \times n}{1\,000} \qquad [\text{m/min}]$$

Feed rate

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

Feed per tooth

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

Metal removal rate

$$Q = \frac{a_e \times a_p \times v_f}{1\,000} \qquad [\text{cm}^3/\text{min}]$$

Power requirement

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

Average chip thickness

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

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

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

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

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

Engagement angle

where milling cutter is positioned centrally

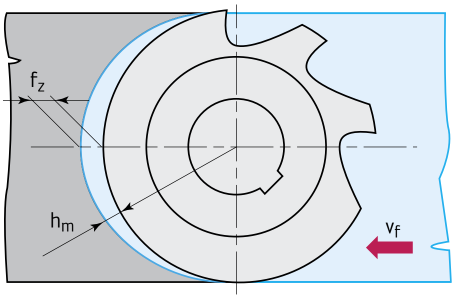
$$\varphi_s = 2 \times \arcsin\left(\frac{a_e}{D_c}\right) \qquad [°]$$

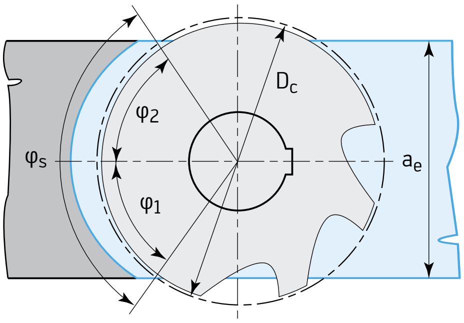
where milling cutter is positioned eccentrically

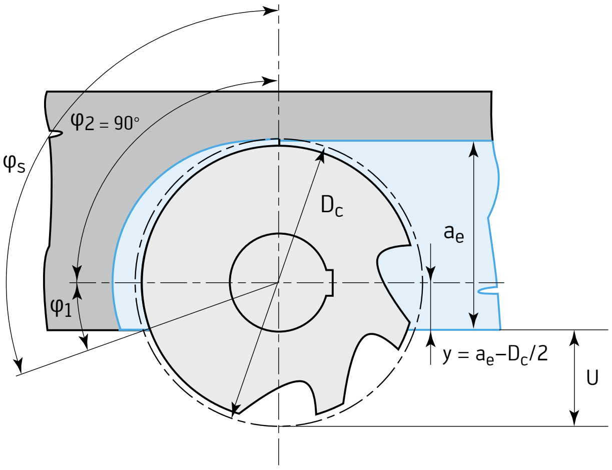
$$\varphi_s = 90° + \arcsin\frac{a_e - \left(\frac{D_c}{2}\right)}{\left(\frac{D_c}{2}\right)} \qquad [°]$$

Specific cutting force

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







n	Speed	rpm
D_c	Cutting diameter	mm
a_p	Depth of cut	mm
a_e	Cutting width	mm
U	Projection	mm
z	Number of teeth	
v_c	Cutting speed	m/min
v_f	Feed rate	mm/min
f_z	Feed per tooth	mm
Q	Metal removal rate	cm^3/min
P_{mot}	Power requirement	kW
h_m	Average chip thickness	mm
η	Machine efficiency (0.7–0.95)	
κ	Lead angle	°
φ_s	Engagement angle	°
φ_1	Conventional milling range	°
φ_2	Climb milling range	°
k_c	Specific cutting force	N/mm^2
$k_{c1.1}$*	Specific cutting force for 1 mm^2 chip cross section	N/mm^2
m_c*	Increase in the k_c curve	
y	Conventional milling engagement	mm

* For m_c and $k_{c1.1}$, see the “General” section of the Technical Compendium, page F7.

Engagement ratio for external circular interpolation

External contour

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

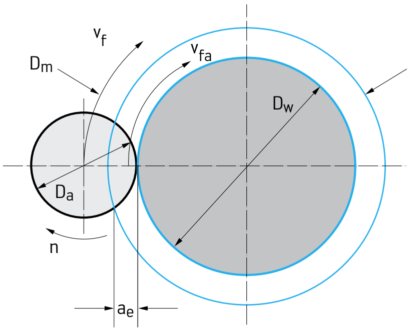
Circular interpolation traverse time

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

$$T_{rev} = \frac{(D_w + D_a)\, D_a \times \pi^2 \times 60}{v_c \times f_z \times z \times 1\,000} \qquad [\text{s}]$$

Engagement width for external circular interpolation

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



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	
T_{rev}	Circular interpolation traverse time	[s]

Engagement ratio for internal circular interpolation of bores

Internal contour

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

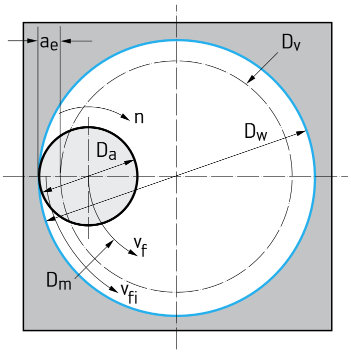
Circular interpolation traverse time

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

$$T_{rev} = \frac{(D_w - D_a)\, D_a \times \pi^2 \times 60}{v_c \times f_z \times z \times 1\,000} \qquad [\text{s}]$$

Engagement width for circular interpolation

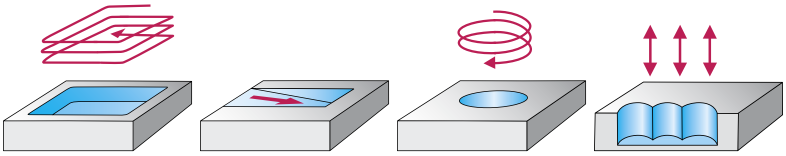
$$a_e = \frac{(D_w^2 - D_v^2)}{4(D_w - D_a)} \qquad [\text{mm}]$$



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	
T_{rev}	Circular interpolation traverse time	[s]

Cutting data for high-feed milling cutters



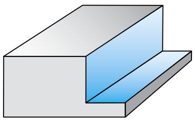
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group [1]	Product family			λ
							MD025 Supreme MD025 ConeFit			50°
							Ø 6–25 mm / 1/4–1 Inch			
							Z = 5–6			
							WJ30RD			
							Starting values for cutting speed v_c [m/min] a_e / D_c			
							1	1/4	1/10	VT[2]
P	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
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			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
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				

[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.
[2] 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.

Product family			λ	Product family			λ	Product family			λ
MD025 Supreme **MD025 ConeFit**			50°	**MC089 Advance**			50°	**MC025 Advance** **MC025 ConeFit**			50°
Ø 6–20 mm / 1/4–1 Inch				Ø 4–16 mm				Ø 1–25 mm / 1/8–1 Inch			
Z = 5–6				Z = 4				Z = 2–4			
WJ30RA				WB10TG				WJ30TF			
Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c			
1	1/4	1/10	VT^2	1	1/4	1/10	VT^2	1	1/4	1/10	VT^2
									105	127	D
									143	174	D
									122	149	D
									122	149	D
									87	105	D
									122	149	D
									122	149	D
									76	92	D
									72	87	D
									61	74	D
									122	149	D
									87	105	D
									72	87	D
									52	64	D
										42	D
		88	B						73	88	D
		50	B							44	D
		68	B						49	59	D
									141	172	D
									110	134	D
									141	172	D
									118	144	D
									141	172	D
									110	134	D
									94	115	D
		556	D								
		556	D								
		185	D								
		60	D								
		40	B						40	48	D
		24	B						24	29	D
		40	B						40	48	D
		24	B						24	29	D
		24	B						24	29	D
		42	B						42	51	D
		22	B						22	27	D
		56	B						55	67	D
		56	B						55	67	D
					90	130	B				
					35	55	B				
					35	55	B				
					80	115	B				

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_m $[N/mm^2]$	Machining group[1]	Ø 6–20 mm			
							Z = 6			
							WJ30TF			
							Starting values for cutting speed v_c [m/min] a_e / D_c			VT
							1/2	1/4	1/10	
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				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				

[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.

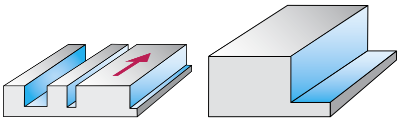
* Tool engagement angle

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

Product family		**λ**	**Product family**		**λ**	**Product family**			**λ**	**Product family**			**λ**
MD128 Supreme **MD128 ConeFit**		50°	**MD128 Supreme** **MD128 ConeFit**		50°	**MC128 Advance** **MC128 ConeFit**			50°	**MC122 Advance**			45°
Ø 6–25 mm			Ø 6–25 mm			Ø 2–25 mm / 1/4–3/4 Inch				Ø 2–25 mm			
Z = 6–8			Z = 6–8			Z = 4–8				Z = 4–8			
WJ30RD			WJ30RA			WJ30TF				WJ30TF			
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]				Starting values for cutting speed v_c [m/min]			
$3 \times D_c$		f_z $3 \times D_c$	$3 \times D_c$		f_z $3 \times D_c$	a_e / D_c				a_e / D_c			
PHIS* [°]	VC	[mm] per tooth	PHIS* [°]	VC	[mm] per tooth	1/2	1/4	1/10	VT	1/2	1/4	1/10	VT
40	225	0,10					162	197	A	162	191	232	A
40	355	0,10					222	270	A	222	261	317	A
40	355	0,10					190	231	A	189	222	270	A
40	300	0,10					190	231	A	189	222	270	A
40	215	0,09					134	163	A	134	157	191	A
40	300	0,10					190	231	A	189	222	270	A
40	300	0,10					190	231	A	189	222	270	A
35	220	0,10					118	143	A	117	138	168	A
40	180	0,08					111	135	A	110	129	157	A
35	160	0,12					94	114	A	93	109	133	A
35	310	0,09					190	231	A	189	222	270	A
30	240	0,11					134	163	A	134	157	191	A
30	195	0,10					111	135	A	110	129	157	A
			20	135	0,21		81	99	A	81	95	116	A
			15	105	0,25		54	65	A	53	63	76	A
			25	165	0,14		113	137	B	96	113	137	B
			15	95	0,20		56	68	B	47	56	68	B
			25	110	0,14		76	92	B	64	76	92	B
40	260	0,11								186	219	266	A
35	210	0,10								145	171	207	A
40	260	0,11								186	219	266	A
35	225	0,10								156	184	223	A
40	260	0,11								186	219	266	A
30	220	0,11								145	171	207	A
40	175	0,10								124	146	178	A
			20	85	0,18		62	75	B	52	62	75	B
			15	50	0,19		37	45	B	32	37	45	B
			15	85	0,19		62	75	B	52	62	75	B
			15	55	0,19		37	45	B	32	37	45	B
			15	50	0,12		37	45	B	32	37	45	B
			35	70	0,12		66	80	B	56	66	80	B
			35	70	0,12		65	79	B	55	65	79	B
			30	40	0,14		34	42	B	29	34	42	B
							86	104	B	73	86	104	B
							86	104	B	73	86	104	B

Cutting data for solid carbide shoulder milling cutters

(continued)



Product family	λ
MC111 Advance MC112 Advance	30°

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group[1]	Ø 2–25 mm			
							Z = 4			
							WJ30TF			
							Starting values for cutting speed v_c [m/min]			
							a_e / D_c			
							1/2	1/4	1/10	VT
P	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
M	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
K	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
N	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
S	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
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				

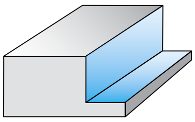
[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
* Tool engagement angle

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] a_e / D_c				Starting values for cutting speed v_c [m/min] $L_c = 3 \times D_c$		f_z $L_c = 3 \times D_c$ [mm] per tooth	Starting values for cutting speed v_c [m/min] $L_c = 5 \times D_c$		f_z $L_c = 5 \times D_c$ [mm] per tooth
1/2	1/4	1/10	VT	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_m $[N/mm^2]$	Machining group [1]	Ø 6–20 mm / 1/4–3/4 Inch Z = 5–6 WJ30RA Starting values for cutting speed v_c [m/min]					
							$L_c = 3 \times D_c$		f_z $L_c = 3 \times D_c$	$L_c = 5 \times D_c$		f_z $L_c = 5 \times D_c$
							PHIS* [°]	VC	[mm] per tooth	PHIS* [°]	VC	[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						

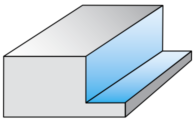
[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] The corresponding feed rates can be found from page D40 onwards.
* Tool engagement angle

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

Product family			λ	Product family			λ	Product family			λ	Product family			λ
MC187 Advance			30°	**MC183 Advance**			30°	**MC111 Advance** **MC112 Advance**			30°	**H7073417**			45°
Ø 3–25 mm / 1/8–3/4 Inch				Ø 6–16 mm				Ø 2–25 mm / 3/32–3/4 Inch				Ø 25 mm			
Z = 4–8				Z = 6–16				Z = 4				Z = 4–5			
WB10TG				WB10TG				WJ30TF				ACN			
Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c			
1/2	1/4	1/10	VT^2	1/2	1/4	1/10	VT^2	1/2	1/4	1/10	VT^2	1/2	1/4	1/10	VT^2
								174	204	248	A				
								237	279	339	A				
								202	238	289	A				
								202	238	289	A				
								143	168	204	A				
								202	238	289	A				
								202	238	289	A				
								125	148	179	A				
								118	139	168	A				
								100	117	142	A				
								202	238	289	A				
								143	168	204	A				
								118	139	168	A				
								87	102	124	A				
								57	67	82	A				
								103	121	147	B				
								51	60	72	B				
								69	81	99	B				
								199	234	285	A				
								155	183	222	A				
								199	234	285	A				
								167	197	239	A				
								199	234	285	A				
								155	183	222	A				
								133	157	190	A				
								1930	1720	1120	C				
								1840	1720	1120	C				
								771	907	1100	C				
								771	907	1100	C				
								257	302	367	C				
											C				
								555	652	793	C				
								555	652	793	C				
								555	652	793	C				
								74	87	106	C				
								56	66	80	B			73	B
								34	40	49	B			44	B
								56	66	80	B			73	B
								34	40	49	B			44	B
								34	40	49	B			44	B
								60	70	85	B				
								59	70	85	B			110	B
								31	37	45	B			57	B
								78	92	112	B				
								78	92	112	B				
		310	B			310	B								
		130	B			130	B								
		130	B			130	B								
		275	B			275	B								

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_m [N/mm^2]	Machining group [1]	Ø 6–25 mm / 3/16–1" Inch		
							Z = 7		
							WJ30EN		
							Starting values for cutting speed v_c [m/min]		
							$L_c = 1{,}2–3 \times D_c$		f_z $L_c = 1{,}2–3 \times D_c$ [mm] per tooth
							PHIS* [°]	VC	
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			
	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	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				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			

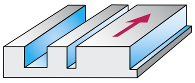
[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

* 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	Product family			λ
MD177 Supreme		38°	**MD173 Supreme**		38°	**MD173 Supreme**		38°	**MC166 Advance**			35°
Ø 6–25 mm / 3/16–1" Inch			Ø 1/4–1" Inch			Ø 1/4–1" Inch			Ø 12–20 mm			
Z = 7			Z = 7			Z = 7			Z = 3			
WJ30EN			WJ30EN			WJ30EN			WJ30UU			
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]			Starting values for cutting speed v_c [m/min]			
$L_c = 4–5 \times D_c$		f_z $L_c = 4–5 \times D_c$ [mm] per tooth	$L_c = 2–3 \times D_c$		f_z $L_c = 2–3 \times D_c$ [mm] per tooth	$L_c = 4–5 \times D_c$		f_z $L_c = 4–5 \times D_c$ [mm] per tooth	a_e / D_c			
PHIS* [°]	VC		PHIS* [°]	VC		PHIS* [°]	VC		1/1	1/2	1/10	VT
25	205	0,09	40	225	0,10	25	205	0,09				
20	340	0,09	40	355	0,10	20	340	0,09				
20	345	0,09	40	355	0,10	20	345	0,09				
20	305	0,11	40	300	0,10	20	305	0,11				
20	220	0,11	40	215	0,09	20	220	0,11				
20	305	0,11	40	300	0,10	20	305	0,11				
20	295	0,90	40	300	0,10	20	295	0,90				
15	230	0,12	35	220	0,10	15	230	0,12				
15	190	0,12	40	180	0,08	15	190	0,12				
15	160	0,11	35	160	0,12	15	160	0,11				
15	325	0,11	35	310	0,09	15	325	0,11				
15	265	0,16	30	240	0,11	15	265	0,16				
15	210	0,15	30	195	0,10	15	210	0,15				
13	130	0,18	20	135	0,21	13	130	0,18				
9	100	0,22	15	105	0,25	9	100	0,22				
16	160	0,10	25	165	0,14	16	160	0,10				
11	105	0,15	15	95	0,20	11	105	0,15				
16	120	0,10	25	110	0,14	16	120	0,10				
									1455	1635	1950	C
									1455	1635	1950	C
									368	456	652	C
									368	456	652	C
									147	183	261	C
									230	250	300	C
									230	250	300	C
									230	250	300	C
									230	250	300	C
10	70	0,13	20	85	0,18	10	70	0,13				
10	50	0,15	15	50	0,19	10	50	0,15				
10	80	0,13	15	85	0,19	10	80	0,13				
10	50	0,17	15	55	0,19	10	50	0,17				
10	50	0,16	15	50	0,12	10	50	0,16				
25	60	0,06	35	70	0,12	25	60	0,06				
20	70	0,07	35	70	0,12	20	70	0,07				
20	35	0,07	30	40	0,14	20	35	0,07				

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_m [N/mm^2]	Machining group [1]	Ø 1–25 mm			
							Z = 3–5			
							WJ30TF / TAX			
							Starting values for cutting speed v_c [m/min]			
							a_e / D_c			
							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				

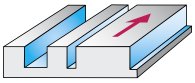
[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.

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 **MC216 Advance**			30°												
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_c [m/min]				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				a_e / D_c				a_e / D_c				a_e / D_c			
1/1	1/2	1/10	VT	1/1	1/2	1/10	VT	1/1	1/2	1/10	VT^2	1/1	1/2	1/10	VT^2
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°
							Ø 2–20 mm / 1/8–3/4 Inch			
							Z = 2–4			
							WJ30ED			
							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^2]	Machining group [1]	1/1	1/2	1/10	VT[2]
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				

[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.

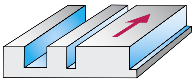
[2] The corresponding feed rates can be found from page D40 onwards.

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

Product family			λ	Product family			λ	Product family			λ	Product family			λ
Xill·tec® MC230 Advance			35°–38°	**MD340 Supreme** **MD344 Supreme**			38° 39°/41°	**MC341 Supreme**			50°	**MC251 Advance**			35°/38°
Ø 2–25 mm				Ø 2–25 mm				Ø 6–20 mm				Ø 3–20 mm			
Z = 2–8				Z = 3 / 4 / 5				Z = 4				Z = 4			
WK40TF				WK40TP				WK40TZ				WK40RC			
Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c			
1/1	1/2	1/10	VT	1	1/2	1/10	VT	1/1	1/2	1/10	VT	1/1	1/2	1/10	VT
150	185	264	A	171	225	310	A	201	265	365	A				
206	253	363	A	269	343	489	A	316	403	575	A				
175	216	310	A	269	343	489	A	316	403	575	A				
175	216	310	A	230	292	417	A	270	344	491	A				
124	153	219	A	162	207	296	A	191	243	348	A				
175	216	310	A	230	292	417	A	270	344	491	A				
175	216	310	A	230	292	417	A	270	344	491	A				
109	135	192	A	162	207	296	A	191	243	348	A				
102	127	181	A												
87	107	153	A												
175	216	310	A	230	292	417	A	270	344	491	A				
124	153	219	A	162	207	296	A	191	243	348	A				
102	127	181	A												
60	74	106	A	80	102	146	A	80	102	146	A				
49	61	87	A	66	99	120	A	66	99	120	A				
71	87	125	B	87	112	160	B	87	112	160	B	58	87	104	B
44	55	78	B	54	69	99	B	54	69	99	B	37	55	65	B
61	75	107	B	73	94	135	B	73	94	135	B	50	75	88	B
164	203	290	A	139	173	247	A								
129	159	226	A	110	135	192	A								
164	203	290	A	139	173	247	A								
138	170	243	A	117	145	207	A								
164	203	290	A	139	173	247	A								
129	159	226	A	110	135	192	A								
110	136	194	A	94	116	165	A								
579	720	1030	C												
579	720	1030	C												
417	518	740	C												
417	518	740	C												
56	70	99	C												
46	57	81	B	38		67	B					38		67	B
29	35	50	B	24		42	B					24		42	B
46	57	81	B	38		67	B					38		67	B
29	35	50	B	24		42	B					24		42	B
29	35	50	B	24		42	B					24		42	B
49	61	87	B												
49	61	87	B												
26	32	46	B												
65	80	114	B												
65	80	114	B												

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

(continued)



Product family	**λ**
H602551 **H6E2211** **H6E2511**	45°

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group [1]	Ø 1–25 mm Z = 2–3 CRN/uncoated Starting values for cutting speed v_c [m/min] a_e / D_c			
							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				
	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				

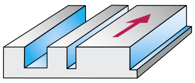
[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

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

	Product family			**λ**	**Product family**				**Product family**			**λ**	**Product family**			**λ**
	MD265 Supreme			30°	**MD266 Supreme**			30°	**MC268 Advance**			30°	**MC267 Advance**			45°
	Ø 16–25 mm				Ø 2–25 mm				Ø 6–25 mm				Ø 1–20 mm			
	Z = 3				Z = 2–3				Z = 3–4				Z = 2–3			
	WJ30DD / WJ30UU				WJ30UU				WJ30UU				WJ30CA / WJ30UU			
	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]				Starting values for cutting speed v_c [m/min]			
	a_e / D_c				a_e / D_c				a_e / D_c				a_e / D_c			
	1	1/2	1/10	VT	1	1/2	1/10	VT	1	1/2	1/10	VT	1/1	1/2	1/10	VT
	2310	2970	1890	C	1590	2050	1890	C	1380	1720	1640	C	1410	1720	2240	C
	2310	2970	1890	C	1590	2050	1890	C	1380	1720	1640	C	1410	1720	2240	C
	616	792	1130	C	398	512	731	C	345	429	613	C	353	429	627	C
	616	792	1130	C	398	512	731	C	345	429	613	C	353	429	627	C
	269	347	495	C	159	205	293	C	138	172	245	C	141	172	251	C
	500	700	900	C					500	700	900	C				
	555	652	793	C					402	428	466	C				
	555	652	793	C					402	428	466	C				
	555	652	793	C					402	428	466	C				

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

(continued)



							Product family			λ
							MD377 Supreme			40°
							Ø 6–25 mm			
							Z = 5			
							WK40TZ			
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group [1]	Starting values for cutting speed v_c [m/min] a_e / D_c			
							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	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
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	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				
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				

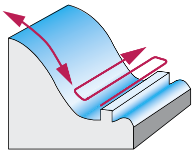
[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

[2] 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.

	Product family			λ	Product family			λ	Product family			λ
	MC377 Advance			40°	MC388 Advance			50°	MC281 Advance			30°
	Ø 2–25 mm				Ø 2–12 mm / 1/8–1/2 Inch				Ø 1–4 mm			
	Z = 3–4				Z = 3–4				Z = 2			
	WK40EA				WB10TG				WB10TG			
	Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c			
	1/1	1/2	1/10	VT	1	1/4	1/10	VT^2	1	1/4	1/10	VT^2
	150	185	264	A								
	206	253	363	A								
	175	216	310	A								
	175	216	310	A								
	124	153	219	A								
	175	216	310	A								
	175	216	310	A								
	109	135	192	A								
	102	127	181	A	165	240	295	A				
	87	107	153	A	140	205	250	A				
	175	216	310	A								
	124	153	219	A								
	102	127	181	A	165	240	295	A				
	60	74	106	A								
	49	61	87	A								
	71	87	125	B								
	44	55	78	B								
	61	75	107	B								
	45	56	80	B								
	27	34	49	B								
	45	56	80	B								
	27	34	49	B								
	27	34	49	B								
	60	85	120	B								
	40	50	70	B								
					130	195	135	B		235	285	B
					55	80	100	B		95	120	B
							100	B		95	120	B
					115	170	210	B		205	250	B

Cutting data for solid carbide circle segment milling cutters



Product family	λ
MD838 Supreme MD838 ConeFit	30°

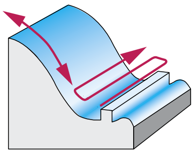
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	Machining group [1]	Ø 6–16 mm			
							Z = 4–8			
							WJ30RD			
							Starting values for cutting speed v_c [m/min]			
							a_e / D_c			
							1/5	1/20	1/50	VT
P	Non-alloyed 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				
	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				

[1] 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
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]				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				a_e / D_c			
1/5	1/20	1/50	VT	1/5	1/20	1/50	VT	1/1	1/2	1/10	VT
				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	λ
H1E0111	10°
H602111	30°

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	Machining group [1]	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
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	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
		> 12% Si, not hardenable		130	450	N5	180	240	280	C
	Magnesium-based alloys			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				
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				

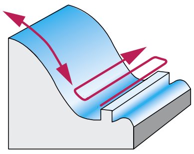
[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.

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
H404691	**H4046918**		30°	**H4046928** **H8004028** **H8004128** **H8004728**	**H8006428** **H80016428** **H8074128** **H8014028** **H8014128**		30°	**H4046988**	**H8004788**		30°	**H4046919** **H8001119** **H8001919**			30°
Ø 0,3–3 mm				Ø 0,3–16 mm				Ø 1–12 mm				Ø 0,3–12 mm			
Z = 2				Z = 2–4				Z = 2				Z = 2–4			
TAX/uncoated				TAX				TAS				DIA			
Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c			
1/5	1/20	1/50	VT	1/5	1/20	1/50	VT	1/5	1/20	1/50	VT	1/5	1/20	1/50	VT
260	340	410	A												
250	330	400	A												
230	280	340	A												
230	280	340	A												
160	200	240	A												
230	280	340	A												
230	280	340	A												
160	200	240	A												
130	170	200	A												
110	140	170	A												
230	280	340	A												
160	200	240	A												
110	140	170	A												
80	100	120	A												
60	70	90	A												
1450	1450	1450	C												
1450	1450	1450	C												
770	1030	1230	C												
770	1030	1230	C												
270	360	430	C												
880	1180	1420	C												
550	740	890	C												
550	740	890	C												
550	740	890	C												
90	100	130	C												
				120	140	170	B	160	220	260	B				
				130	140	170	B	160	220	260	B				
				80	80	100	B	160	220	260	B				
				130	140	170	B								
												500	700	800	C

Cutting data for solid carbide ball nose end mills

(continued)



Product family	λ
H1E01118	10°
MC413 Advance **MC416 Advance**	30°
H8E01118 **H8E11118**	40°

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group [1]	Ø 1–25 mm			
							Z = 2–4			
							WJ30TF / TAX			
							Starting values for cutting speed v_c [m/min]			
							a_e / D_c			
							1/5	1/20	1/50	VT
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	230	310	370	A
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2	220	300	360	A
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3	190	260	310	A
		C > 0,55 %	Annealed	190	640	P4	190	260	310	A
		C > 0,55 %	Heat-treated	300	1010	P5	150	180	220	A
		Free-machining steel (short-chipping)	Annealed	220	750	P6	190	260	310	A
	Low-alloy steel	Annealed		175	590	P7	190	260	310	A
		Heat-treated		285	960	P8	150	180	220	A
		Heat-treated		380	1280	P9	120	150	180	A
		Heat-treated		430	1480	P10	100	130	150	A
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	190	260	310	A
		Hardened and tempered		300	1010	P12	150	180	220	A
		Hardened and tempered		380	1280	P13	100	130	150	A
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	70	90	100	A
		Martensitic, heat-treated		330	1110	P15	50	60	80	A
M	Stainless steel	Austenitic, quench hardened		200	680	M1	80	110	130	B
		Austenitic, precipitation hardened (PH)		300	1010	M2	50	60	80	B
		Austenitic/ferritic, duplex		230	780	M3	70	90	100	B
K	Malleable cast iron	Ferritic		200	400	K1	180	240	290	A
		Pearlitic		260	700	K2	150	190	220	A
	Grey cast iron	Low strength		180	200	K3	180	240	290	A
		High strength/austenitic		245	350	K4	150	200	240	A
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	180	240	290	A
		Pearlitic		265	700	K6	150	190	220	A
	CGI			230	400	K7	130	160	190	A
N	Wrought aluminium alloys	Not hardenable		30	–	N1	1740	1740	1740	C
		Hardenable, hardened		100	340	N2	1740	1740	1740	C
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	690	920	1100	C
		≤ 12% Si, hardenable, hardened		90	310	N4	690	920	1100	C
		> 12% Si, not hardenable		130	450	N5	240	320	390	C
	Magnesium-based alloys			70	250	N6	800	1060	1280	C
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7	500	660	800	C
		Brass, bronze, red brass		90	310	N8	500	660	800	C
		Copper alloys, short-chipping		110	380	N9	500	660	800	C
		High tensile, Ampco		300	1010	N10	80	90	110	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	210	300	380	B
		α and β alloys, hardened		375	1260	S7	60	100	130	B
		β alloys		410	1400	S8	60	100	130	B
	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				

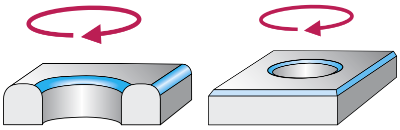
---

[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.
[2] 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.

	Product family			λ	Product family			λ
	MC482 Advance			30°	**MC480 Advance**			30°
	Ø 1–16 mm / 1/8–1/2 Inch				Ø 0,4–5 mm			
	Z = 2–4				Z = 2			
	WB10TG				WB10TG			
	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			
	1/5	1/20	1/50	VT	1/5	1/20	1/50	VT^2
	245	305	260	B	145	255	180	B
	100	125	150	B	100	125	125	B
	100	125	150	B	100	125	125	B
	220	145	320	B	220	255	180	B

Cutting data for solid carbide profiling cutters



Product family		λ
MC500 Advance	**H3E58118**	0°
MC501 Advance	**H3E58318**	
MC502 Advance	**H3E58518**	
H1E58018	**H1E58318**	10°
H1E58118	**H1E58518**	

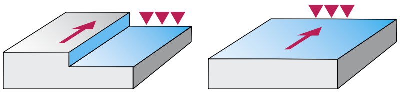
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group [1]	60° / 90° / 120° / 150°			
							Z = 2–6			
							WJ30TF / TAX			
							Starting values for cutting speed v_c [m/min] a_e / D_c			
							1/3	1/10	1/20	VT
P	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				

[1] 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
	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] a_e / D_c				Starting values for cutting speed v_c [m/min] 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



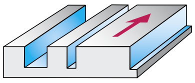
Product family	λ
MP060 **MP160** **MP260**	

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	Machining group [1]	Ø 6–125 mm			
							Z = 2–22			
							WDN20			
							Starting values for cutting speed v_c [m/min]			
							a_e / D_c			
							1/1 1/2	1/4	1/10	VT
P	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				
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				
		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	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				
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	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

[1] 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

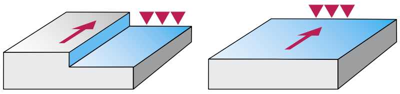


							Product family			λ	Product family			λ
							MC275 Ceramic (Solid) MC275 Ceramic ConeFit			35°	MC075 Ceramic (Solid) MC075 Ceramic ConeFit			35°
							Ø 8–25 mm				Ø 8–25 mm			
							Z = 4–8				Z = 4			
							WIS10				WIS10			
							Starting values for cutting speed v_c [m/min]				Starting values for cutting speed v_c [m/min]			
							a_e / D_c				a_e / D_c			
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group [1]	1	1/4	1/10	VT[2]	1	1/4	1/10	VT[2]
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								
	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	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								
		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								

[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.
[2] 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_m $[N/mm^2]$	Machining group [1]	Ø 20–100 mm			
							Z = 4–8			
							WP40			
							Starting values for cutting speed v_c [m/min] a_e / D_c			
							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				

[1] 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 **Brazed helical milling cutters**				**Product family** **PCD milling cutters**			
	F1675 **F1682**		**F1678**		**F4722**		**F4723**	
	Ø 20–100 mm				Ø 6–80 mm			
	Z = 4–8				Z = 2–6			
	WKM				WCD10			
	Starting values for cutting speed v_c [m/min] a_e / D_c				Starting values for cutting speed v_c [m/min] a_e / D_c			
	1/2	1/4	1/10	VT	1/1 1/2	1/4	1/10	VT
	180	275	320	J				
	135	215	250	J				
	150	250	290	K				
	125	205	240	K				
	180	280	320	J				
	130	205	240	J				
	110	180	210	J				
					3000	4000	4000	G
					2000	2000	2000	G
					1500	1500	1500	H
					1000	1000	1000	H
					500	500	500	H
					600	800	800	I
					500	600	600	I
					600	800	800	I

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_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	0,02	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_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	0,20	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.

B Material groups ISO M, ISO H, heat-resistant alloys, tungsten alloys and molybdenum alloys

	Feed per tooth f_z [mm]									
a_e [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	0,02	0,05	0,07	0,10	0,12	0,12	0,16	
0,05	0,01	0,01	0,02	0,03	0,06	0,08	0,10	0,12	0,16	
0,1	0,01	0,01	0,02	0,03	0,04	0,06	0,08	0,12	0,16	0,16
0,2	0,01	0,01	0,01	0,02	0,03	0,05	0,06	0,12	0,14	0,16
0,5		0,01	0,01	0,02	0,02	0,04	0,06	0,10	0,12	0,12
1			0,01	0,02	0,02	0,03	0,05	0,07	0,10	0,10
2				0,02	0,02	0,02	0,04	0,06	0,09	0,10
3					0,02	0,02	0,04	0,06	0,08	0,10
5						0,02	0,03	0,06	0,08	0,10
6							0,02	0,05	0,06	0,08
8								0,04	0,06	0,07
10									0,05	0,06
12										0,06
14										
16										
18										
20										
25										
32										
40										
50										
63										
80										
100										
160										
200										

B Material groups ISO M, ISO H, heat-resistant alloys, tungsten alloys and molybdenum alloys (continued)

	Feed per tooth f_z [mm]									
a_e [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	0,16	0,16								
0,2	0,16	0,16	0,16	0,20						
0,5	0,12	0,12	0,16	0,20	0,20					
1	0,10	0,10	0,12	0,16	0,20	0,20	0,24	0,24	0,24	0,32
2	0,10	0,10	0,12	0,16	0,16	0,20	0,20	0,20	0,24	0,24
3	0,10	0,10	0,11	0,14	0,16	0,16	0,20	0,20	0,20	0,24
5	0,10	0,10	0,10	0,12	0,16	0,16	0,16	0,20	0,20	0,20
6	0,08	0,10	0,10	0,12	0,16	0,16	0,16	0,16	0,20	0,20
8	0,08	0,10	0,10	0,12	0,16	0,16	0,16	0,16	0,16	0,20
10	0,08	0,10	0,10	0,11	0,13	0,16	0,16	0,16	0,16	0,16
12	0,07	0,09	0,10	0,11	0,13	0,13	0,16	0,16	0,16	0,16
14	0,06	0,08	0,10	0,10	0,12	0,13	0,13	0,16	0,16	0,16
16		0,07	0,08	0,10	0,12	0,12	0,13	0,13	0,16	0,16
18			0,08	0,09	0,10	0,12	0,12	0,13	0,13	0,16
20				0,08	0,10	0,10	0,12	0,12	0,13	0,13
25					0,08	0,10	0,10	0,12	0,12	0,13
32						0,08	0,10	0,10	0,12	0,12
40							0,08	0,10	0,10	0,12
50								0,08	0,10	0,10
63									0,08	0,10
80										0,08
100										
160										
200										

* Radial feed in mm

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

	Feed per tooth f_z [mm]									
a_e [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)

	Feed per tooth f_z [mm]									
a_e [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

	Feed per tooth f_z [mm]									
a_e [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

	Feed per tooth f_z [mm]									
a_e [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

	Feed per tooth f_z [mm]											
a_e [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

	Feed per tooth f_z [mm]													
a_e / D_c	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

	Feed per tooth f_z [mm]													
a_e / D_c	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

	Feed per tooth f_z [mm]													
a_e / D_c	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

	Feed per tooth f_z [mm]								
a_e [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

	Feed per tooth f_z [mm]								
a_e [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

	Feed per tooth f_z [mm]								
a_e [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)

	Feed per tooth f_z [mm]								
a_e [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

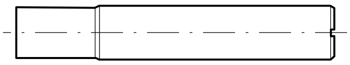
* Radial feed in mm

Cutting speed: Correction factors*

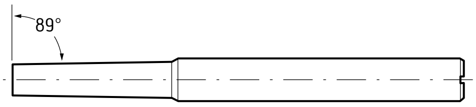
v_c correction factors – toolholder/steel

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

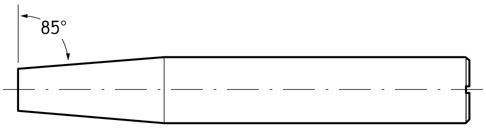
Type A



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 × 0,8	A	20.000
AK610.Z16.E10.100C	v_c × 0,7	B	15.000
AK610.Z12.E12.048C	v_c × 0,9	A	30.000
AK610.Z16.E12.090C	v_c × 0,7	B	15.000
AK610.Z16.E16.080C	v_c × 0,9	A	30.000
AK610.Z20.E16.118C	v_c × 0,6	B	10.000
AK610.Z20.E20.038C	v_c × 1,0	A	30.000
AK610.Z20.E20.110C	v_c × 0,9	A	30.000
AK610.Z25.E25.120C	v_c × 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

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

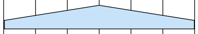
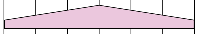
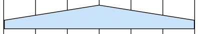
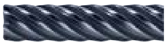
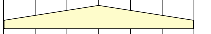
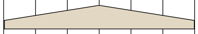
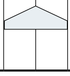
HC = Coated carbide

●● Primary application
● Additional application

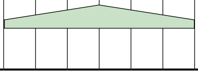
Grade description

(continued)

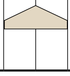
Coated carbide

Walter grade designation	Standard designation	Material groups							Application range	Coating process	Coating composition	Tool example
		P 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			
WJ30RD	HC – P 30	●●								PVD	AlTiN + ZrN	
	HC – K 30			●								
WJ30EN	HC – P 40	●								PVD	nACRo	
	HC – M 40		●									
	HC – S 40					●●						
WB10TG	HC – H 10						●●			PVD	TiAlSiN	

Uncoated carbide

Walter grade designation	Standard designation	Material groups							Application range	Coating process	Coating composition	Tool example
		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			
WJ30UU	HW – N 30				●●					—	—	

Ceramic

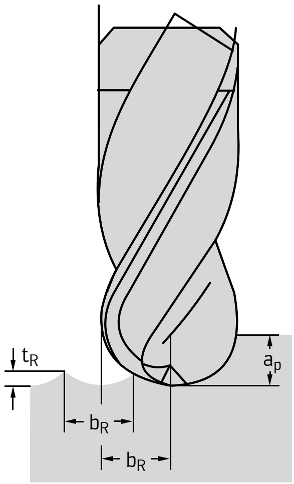
Walter grade designation	Standard designation	Material groups							Application range	Coating process	Coating composition	Tool example
		P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	01 05 10 15 20 25 30 35 40 45			
WIS10	CN – S 10					●●				—	—	

CN = Silicon nitride Si_3N_4
HC = Coated carbide
HW = Uncoated carbide

●● Primary application
● Additional application

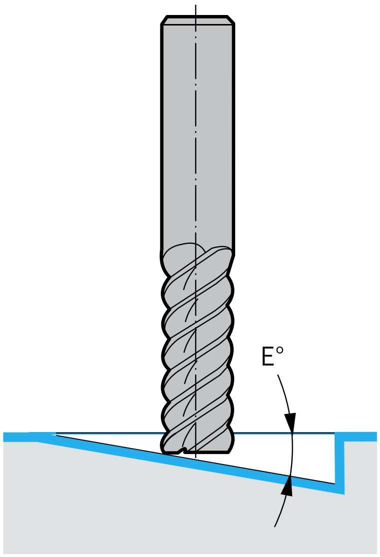
Usage recommendations for copying and finishing

Tool diameter D_c (mm)	Row width (b_R) for groove depth t_R = 5 μm	Row width (b_R) for groove depth t_R = 2 μm
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

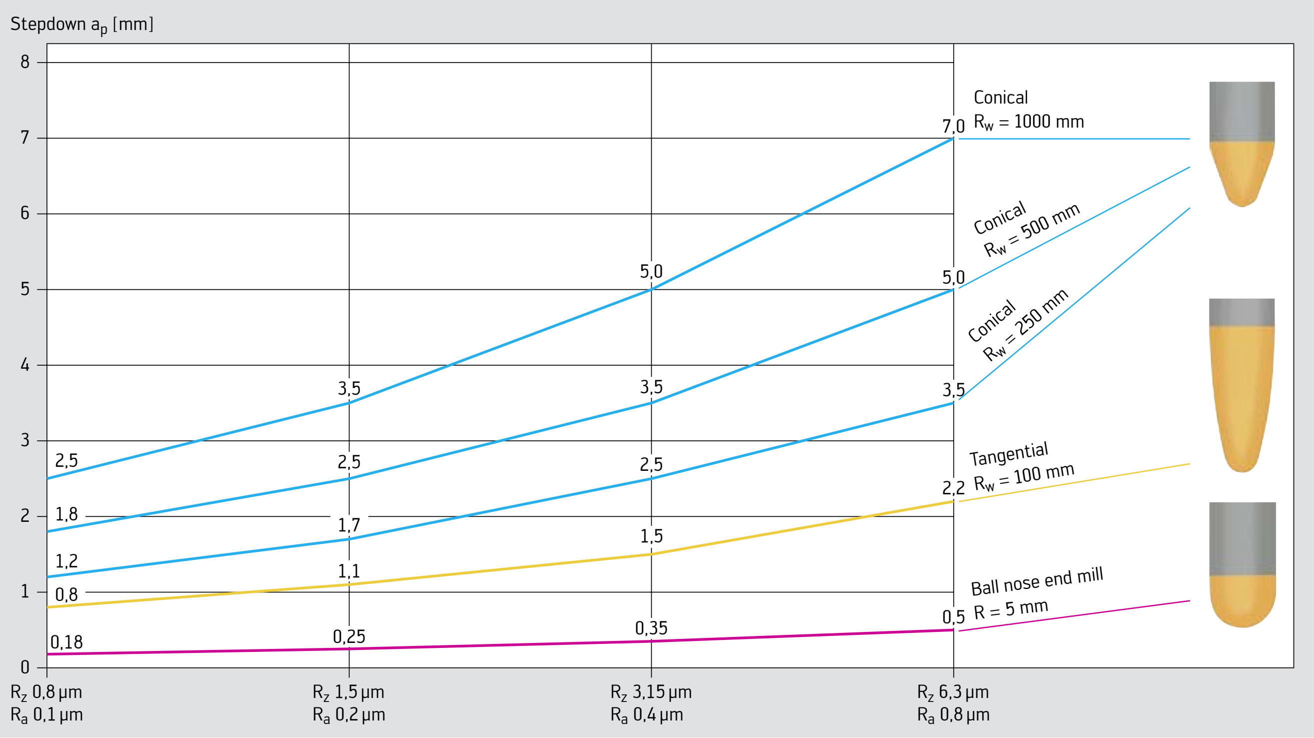
Material groups	Materials	Number of teeth					
		2	3	4	5	6–8	8
P	**Steel**	10*	8*	5	5	4	3
M	**Stainless steel**	5	5	5	5	4	3
K	**Cast iron**	10	10	8	6	5	3
N	**NF metals**	15	15	15	10	10	5
S	**Materials with difficult cutting properties**	5	5	5	5	4	3
H	**Hard materials**	2	2	1,5	1,5	1,5	1
O	**Other**	15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



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

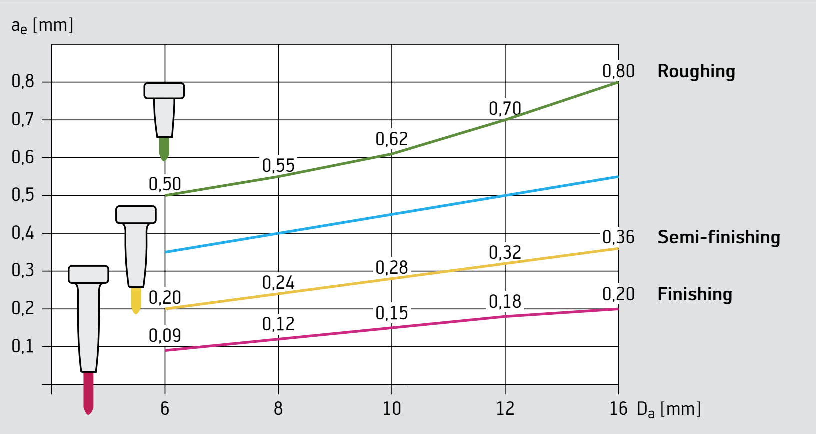
Recommendations for the use of circle segment milling cutters

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



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

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 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^2	300	0,07
	42CrMo4	1000 N/mm^2	220	0,06
		1400 N/mm^2	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

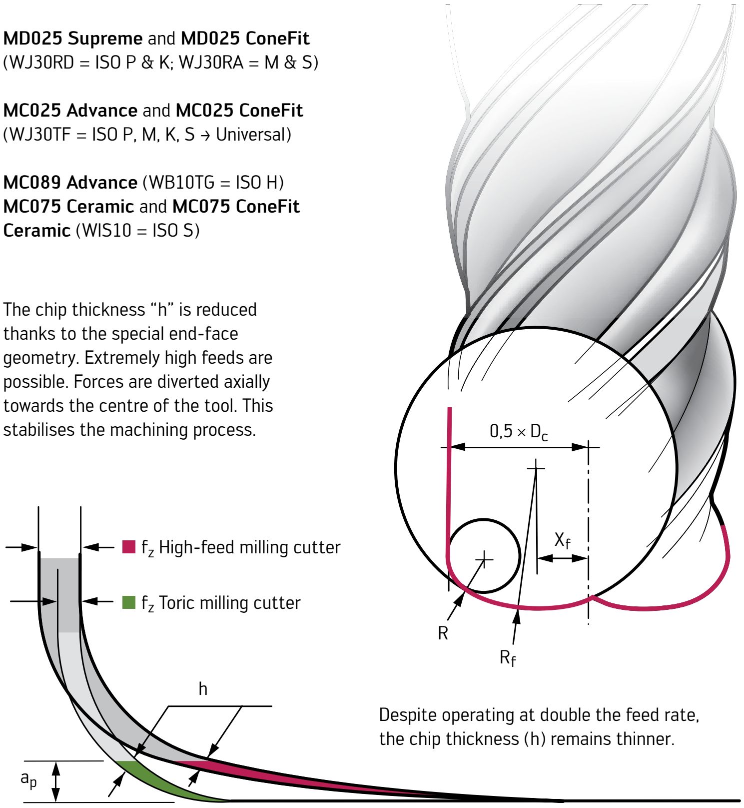
High-feed milling cutters

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

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

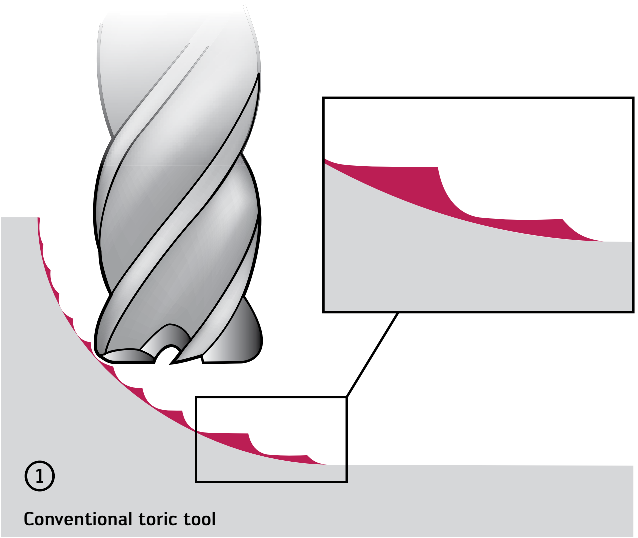
MC089 Advance (WB10TG = ISO H)
MC075 Ceramic and **MC075 ConeFit**
Ceramic (WIS10 = ISO S)

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.

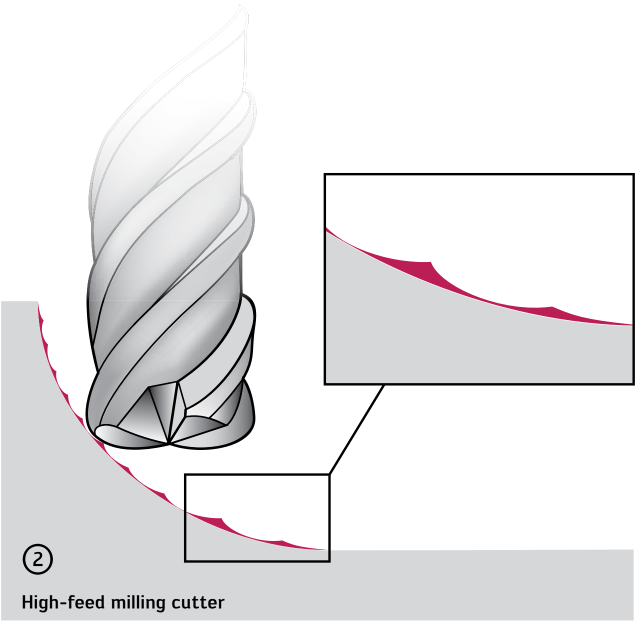


Despite operating at double the feed rate, the chip thickness (h) remains thinner.

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.



① **Conventional toric tool**



② **High-feed milling cutter**

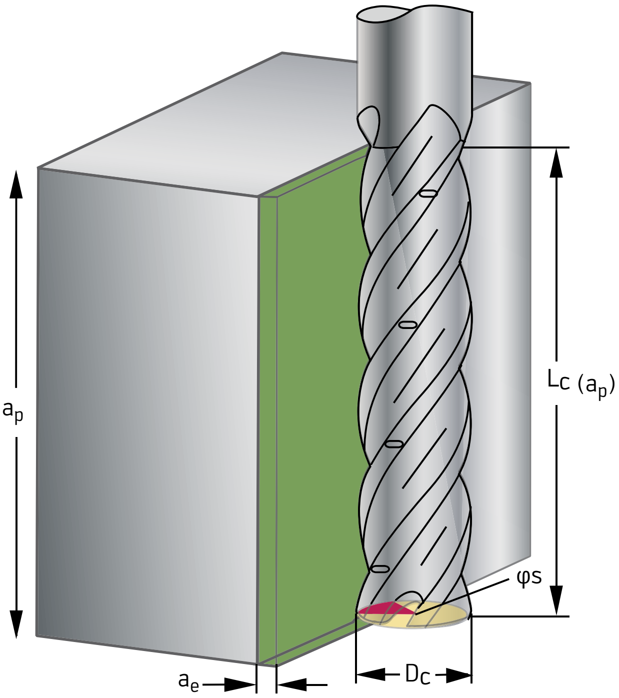
Application information: Dynamic milling

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 (φ_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)

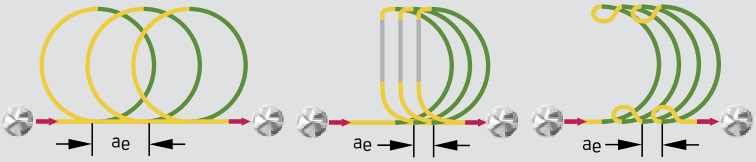
Strategy: High metal removal rate with reduced tool wear

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.

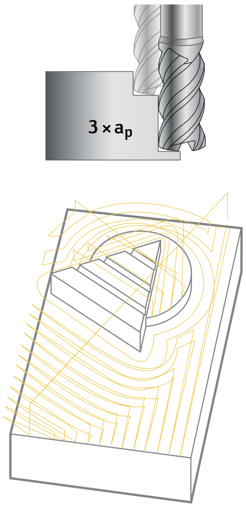


Static trochoidal milling **Dynamic trochoidal milling (1 and 2)**

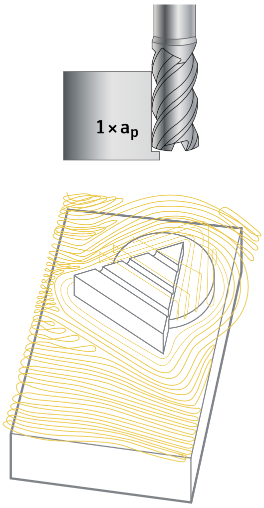
Dynamic or conventional? A comparison of the strategies

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)

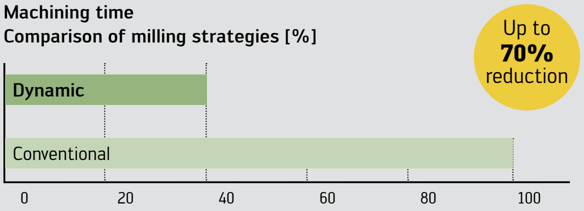


High Dynamic Cutting (HDC)



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%.

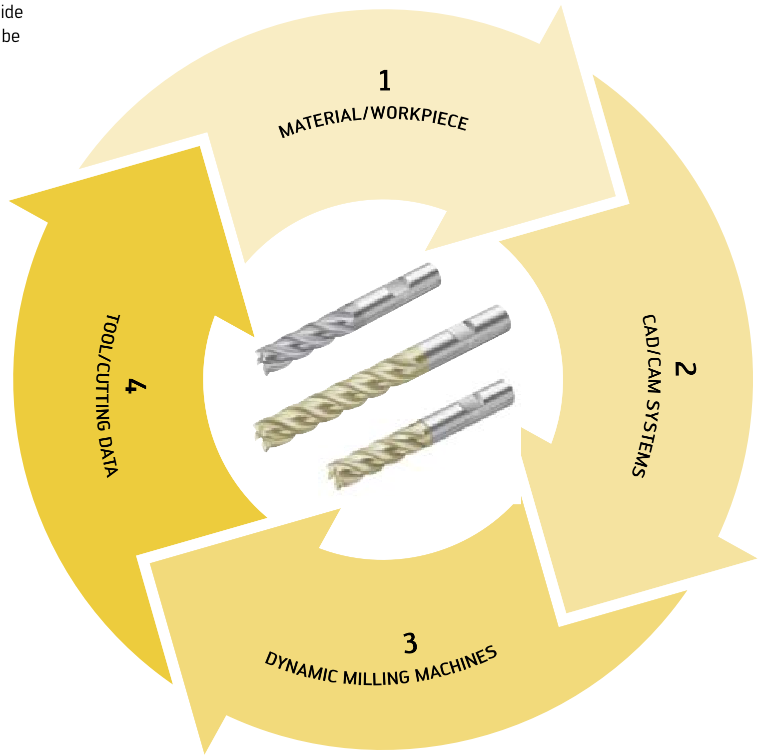
https://www.youtube.com/results?search_query=MD133

Application information:
Dynamic milling (continued)

The four building blocks of dynamic milling

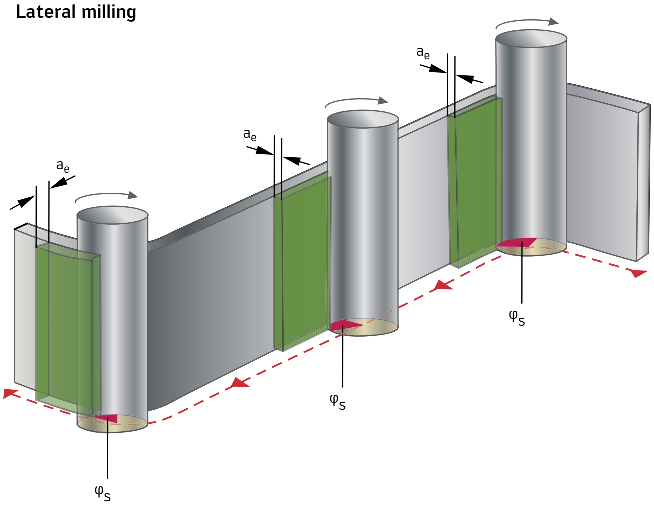
To be able to choose the optimum milling strategy and the ideal solid carbide milling cutter, the relevant factors for the machining operation must first be determined.

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.

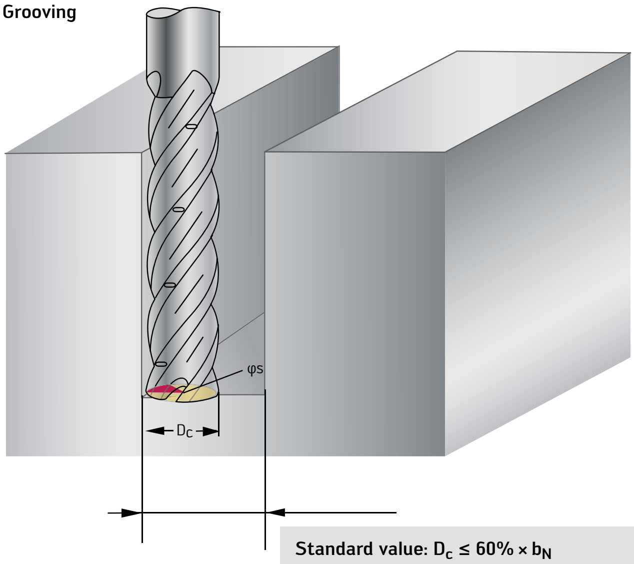


Building block 1: Material/workpiece

Lateral milling



Grooving



Standard value: $D_c \leq 60\% \times b_N$
b_N = groove width

The material dictates the cutting values for the milling tools, i.e.
the maximum permissible radial cutting width (a_e) and the engagement angle (φ_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)

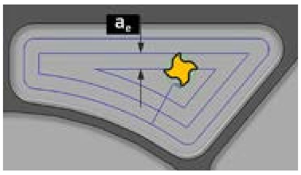
Building block 2: CAD/CAM systems

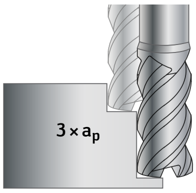
Most CAD/CAM systems feature the modules required for dynamic milling.

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 (φ_s)
- average chip thickness (h_m)

Comparison: Conventional vs. dynamic milling

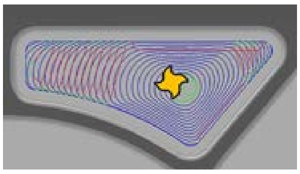
High Performance Cutting (HPC)

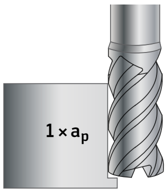




Milling paths, conventional:
a_e → large and constant
a_p → small

High Dynamic Cutting (HDC)





Milling paths, dynamic milling:
a_e → small and variable
a_p → large (max. cutting edge length)

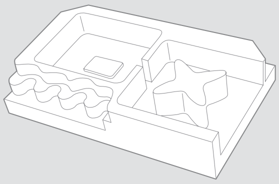
Important functions of CAD/CAM systems:
- Plunging movement can be selected (preferably helical plunging or start hole drilling)
- Milling paths parallel to the contour
- Choice of milling direction (preferably climb milling)
- Arc entry and exit movements
- Rounded roughing paths
- Residual material 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

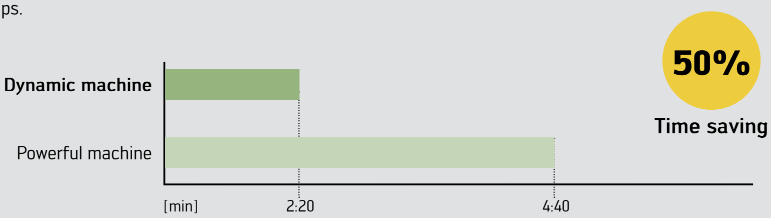
Building block 3: Dynamic milling machine

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

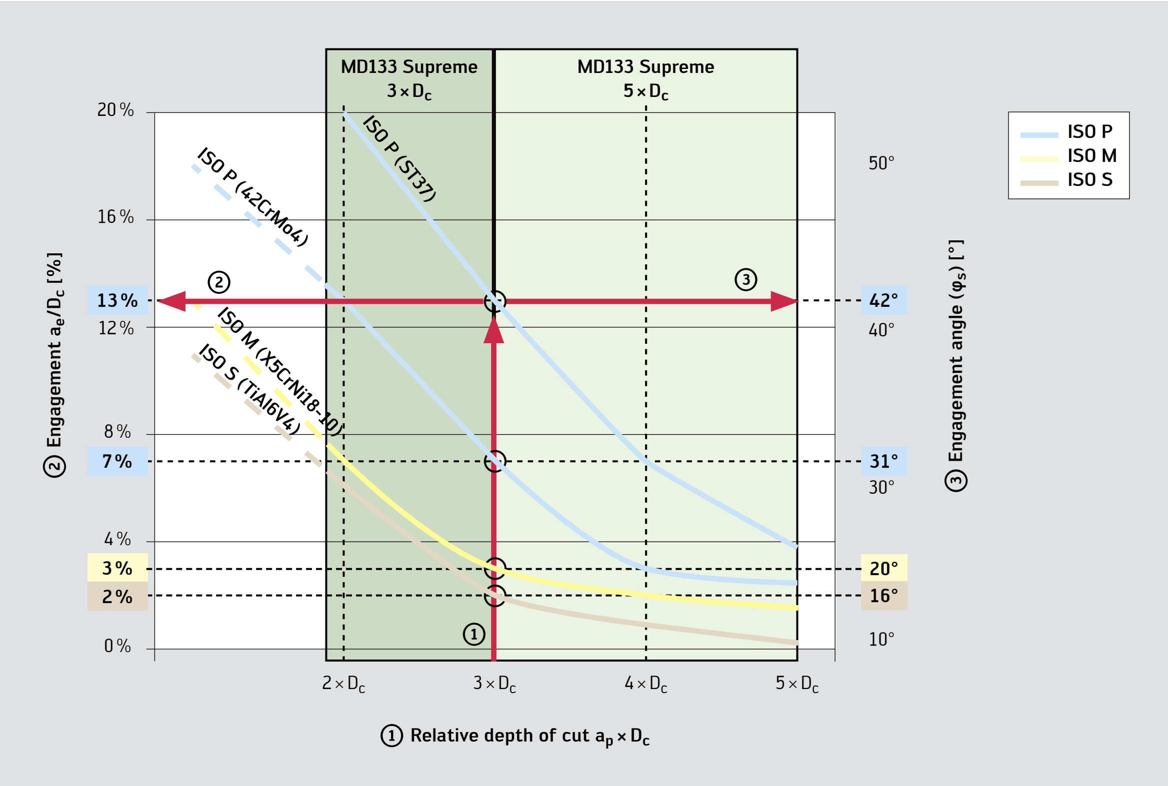
Application information: Dynamic milling (continued)

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 (φ_s) and lateral engagement width for ISO P, ISO M and ISO S materials



Engagement angle (φ_s) ϕ [°] – application examples

a_p	ISO P		ISO M	ISO S
	ST37 – 490 N/mm^2	42CrMo4 – 1.000 N/mm^2	1.4301 – 675 N/mm^2	TiAl6V4 – 1.100 N/mm^2
2 × D_c	53°	42°	31°	28°
3 × D_c	42°	31°	20°	16°
4 × D_c	31°	20°	16°	14°
5 × 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

Tool group

M	Milling

2

Generation

P	Tools with brazed cutting edge

3

Tool type

0	Face milling cutter, high-feed milling cutter
1	Shoulder milling cutter
2	Shoulder/slot/helical milling cutter
3	Shoulder/slot/helical milling cutter, ≥ 40° helix angle
4	Ball nose milling cutter/ copy milling cutter
5	Profiling cutter
7	Routing cutter/ circular interpolation cutter
8	Conical milling cutter/ circle segment milling cutter

4

Tool type

00	Universal	0° helix angle, 60° chamfer milling cutter
01	Universal	0° helix angle, 90° chamfer milling cutter
02	Universal	0° helix angle, 120° chamfer milling cutter
03	Universal	0° helix angle, quadrant profiling cutter
04	Universal	0° helix angle, front/back deburrers
11	Universal	30° helix angle, type N
12	Universal	30° helix angle, type HSC
13	Universal	30° helix angle, type HSC, long version
16	Universal	30° helix angle, type 30
19	Universal	40° helix angle, Kordel profile with internal coolant
20	Universal	40° helix angle, Kordel profile
21	Universal	45° helix angle, short version
22	Universal	45° helix angle, type N
24	Universal	45° helix angle, type 45
25	Universal	50° helix angle, high-feed
26	Universal	50° helix angle, unequal groove depth, differential pitch
28	Universal	50° helix angle, type N, multi-flute
29	Universal	60° helix angle, type N, multi-flute
30	Universal	35°/38° helix angle, UNI, HPC geometry
32	Universal	35° helix angle
33	Universal	35° helix angle + chip breaker
38	Universal	30° helix angle, conical circle segment milling cutter
39	Universal	30° helix angle, tangential circle segment milling cutter
40	ISO P	38°–41° helix angle, HPC geometry
41	ISO P	50° helix angle, HPC, differential pitch
51	ISO M	35°/38° helix angle, without internal coolant
60	ISO N	PCD brazed, continuous cutting edge
65	ISO N	30° helix angle, Al geometry, RAPAX G30 roughing profile, axial internal coolant
66	ISO N	30°–35° helix angle, Al geometry
67	ISO N	45° helix angle, Al geometry
68	ISO N	30° helix angle, aluminium, Kordel profile
77	ISO S	38°–40° helix angle, Ti geometry
80	ISO H	30° helix angle, HSC, type H
81	ISO H	30° helix angle, mini HSC T, type H
82	ISO H	30° helix angle, mini HSC R, type H
83	ISO H	30° helix angle, multi-flute, type H
87	ISO H	50° helix angle, multi-flute, type H
88	ISO H	50° helix angle, HPC, type H
89	ISO H	50° helix angle, high-feed, type H

5

Delimiters

–	Metric
.	Inch

6

Cutting diameter

7

Shank type

A	Cylindrical shank
B	Hole
E	ConeFit
T	ScrewFit
W	Weldon shank

8

Number of teeth

9

Design standard

A	DIN 6527 K
B	DIN 6527 L
C	ANSI stub
D	ANSI standard
L	P standard L
M	P standard mini
P	P standard
S	P standard S
X	P standard XL

10

Corner radius

11

Version

A	l_3 XS
B	l_3 S / 2 × D_c*
C	l_3 M / 3 × D_c*
D	l_3 L / 4 × D_c*
E	l_3 XL / 5 × D_c*
F	l_3 XXL / 6 × D_c*
G	l_3 XXXL / 8 × D_c*
H	l_3 XXXXL / 10 × D_c*
J	L_c S / 3 × D_c*
K	L_c M / 4 × D_c*
L	L_c L / 5 × D_c*
V	Conical neck α ≤ 3°
W	Conical neck α ≤ 6°
X	Conical neck α ≤ 12°

* Standard values

Grade designation key for solid carbide cutting tool materials

Example:

W	K	40	TF
Walter	1	2	3

1

Substrate

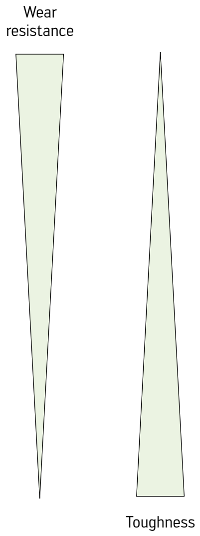
Solid carbide

B	5
	10
	15
	20
	25
J	30
	35
K	40
	45
	50

2

Application range

5
10
15
20
25
30
35
40
45
50



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:

W	D	N	20
Walter	1	2	3

1

Cutting tool material

D	Diamond

2

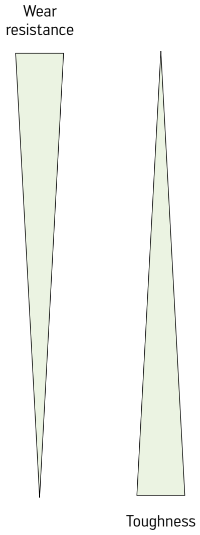
Primary application

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

3

Application range

01
05
10
20
21
23
30
32
33
43



Tiger·tec® Gold

tigertec-gold.walter

WALTER
Engineering Kompetenz

Cutting data for roughing
Face/shoulder milling

🚰 = Cutting data for wet machining
🚰✗ = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	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*	
									1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	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		
		Hardened and tempered		300	1010	P12	●	●●	80	90	110	130		
		Hardened and tempered		380	1280	P13	●	●●	70	80	90	110		
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●	140	160				
		Martensitic, heat-treated		330	1110	P15	●	●●	90	110				
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	●	●●	160	190	180	210	210	230
		Pearlitic		260	700	K2	●	●●	140	170	160	190	190	210
	Grey cast iron	Low strength		180	200	K3	●	●●	300	330	320	350	380	410
		High strength/austenitic		245	350	K4	●	●●	190	220	180	210	230	260
	Cast iron with spheroidal graphite	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[3]			70	250	N6	●●[3]							
	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%

[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] Cutting data can also be used without coolant.
[3] 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]

HC																HF		HW		CN		BH		DP				HT	
WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WXN15		WNN15		WHH15X		WMG40		WK10		WSN10		WCB80		WCD10^2		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*		a_e / D_c*	
1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	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_3N_4

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

Cutting data for roughing
High-feed milling

🚰 = Cutting data for wet machining
🚱 = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	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*	
									1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	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		
		Hardened and tempered		300	1010	P12	●	●●	80	90	110	130		
		Hardened and tempered		380	1280	P13	●	●●	70	80	90	110		
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●	140	160				
		Martensitic, heat-treated		330	1110	P15	●	●●	90	110				
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	●	●●	160	190	180	210	210	230
		Pearlitic		260	700	K2	●	●●	140	170	160	190	190	210
	Grey cast iron	Low strength		180	200	K3	●	●●	300	330	320	350	380	410
		High strength/austenitic		245	350	K4	●	●●	190	220	180	210	230	260
	Cast iron with spheroidal graphite	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 [3]			70	250	N6	●● [3]							
	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%

[1] The assignment of the machining groups can be found in the “General” section of the Technical Compendium, page F7.
[2] Cutting data can also be used without coolant.
[3] 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]																			
HC														HF		HW		BH	
WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WNN15		WHH15X		WMG40		WK10		WDN20	
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 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	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)

🚰 = Cutting data for wet machining
🚱 = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	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*	
									1/2	1/5	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 [2]			70	250	N6	●● [2]					
	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%

[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] 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]															
HC														HW	
WAK15		WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WXN15		WK10	
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*	
1/2	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			70	80
160	180							120	140	140	160			65	65
220	280							160	180	200	260			75	85
160	180							120	140	140	160			55	55
180	190							140	150	160	170			70	80
155	165							105	115	135	145			65	65
210	270							150	170	190	250			70	80
												1800	1800	1500	1500
												1440	1440	1200	1200
												540	640	450	530
												430	430	360	360
												220	260	180	215
												430	430	360	360
												170	210	140	175
												280	280	230	230
												170	210	140	175
												130	170	100	130
		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	400
300	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)

🚰 = Cutting data for wet machining
🚰✗ = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	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
P	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
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
		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
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[2]			70	250	N6	●●[2]			
	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		●●		

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

[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] 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]

HC

WKP25S		**WAK15**		**WSP45G**		**WSM35G**		**WKP35G**		**WKK25G**	
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 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5	1/1 1/2	1/5
210	275			185	230			195	250		
200	255			150	200			170	215		
175	220			130	165			155	190		
200	255			150	200			170	215		
165	200			105	115			130	145		
170	210			125	160			150	210		
200	255			150	190			170	215		
155	200			105	115			130	145		
125	140			60	70			85	100		
120	130			50	60			80	90		
110	130			90	110			100	120		
80	95			65	70			65	75		
80	90			50	60			60	70		
				90	110	95	120	105	120		
				60	70	60	70	60	70		
				85	100	100	120				
				75	90	90	110				
				75	90	90	110				
120	220	210	270					150	170	190	250
130	150	160	180					120	140	140	160
180	230	220	280					160	180	200	260
130	150	160	180					120	140	140	160
150	160	180	190					140	150	160	170
120	125	155	165					105	115	135	145
120	220	210	270					150	170	190	250
				50	55	65	70				
				35	40	50	50				
				40	45	50	55				
				25	30	30	35				
				30	35	50	45				
				50	65	65	80				
				30	35	40	45				
				25	30	35	40				
				30	35	40	45				
				25	30	35	40				
400	400	400	400	400	400	400	400	400	400	400	400
300	300	300	300	300	300	300	300	300	300	300	300
400	500									600	800

HC = Coated carbide

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

Cutting data for roughing
Slot milling with slotting cutters

🚰 = Cutting data for wet machining
🚱 = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	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	
									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 [2]			70	250	N6	●● [2]					
	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%

[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.
* $a_e = a_{e\,max}$

Cutting material grades

Starting values for cutting speed
v_c [m/min]

HC																		HW	
WKP23S		**WAK15**		**WSP45G**		**WSM43S**		**WSM35G**		**WSM33S**		**WKP35G**		**WKK25G**		**WXN15**		**WK10**	
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*	
1/4*	1/10	1/4*	1/10	1/4*	1/10	1/4*	1/10	1/4*	1/10	1/4*	1/10	1/4*	1/10	1/4*	1/10	1/4*	1/10	1/4*	1/10
210	285			185	230	185	230			185	230	195	250						
200	255			150	200	150	200			150	200	170	215						
185	230			135	170	135	170			135	170	160	205						
185	230			135	170	135	170			135	170	160	200						
165	200			105	125	105	125			105	125	130	145						
190	245			140	180	140	180			140	180	160	205						
200	255			150	190	150	190			150	190	170	215						
155	200			105	115	105	115			105	115	125	145						
125	140			75	85	75	85			75	85	85	95						
120	130			65	75	65	75			65	75	80	90						
110	145			90	110	90	110			90	110	100	120						
75	100			60	70	60	70			60	70	65	80						
70	90			55	65	55	65			55	65	60	70						
				90	110	90	110	95	120	90	110	105	130						
				60	80	60	80	65	85	60	80	60	85						
				85	100	85	100	100	120	85	100								
				70	85	70	85	85	100	70	85								
				75	90	75	90	90	110	75	90								
155	180	150	200									140	155	160	200				
100	155	120	170									135	145	110	170				
180	230	220	280									160	180	200	250				
130	150	160	180									120	140	145	165				
170	190	180	190									140	150	185	210				
110	150	150	160									110	120	120	165				
120	165	165	175									120	135	130	170				
																1800	1800	1500	1500
																1440	1440	1200	1200
																540	640	450	530
																430	430	360	360
																220	280	180	230
																430	430	360	360
																170	210	140	175
																280	280	230	230
																385	385	320	320
																150	190	120	160
				55	60	55	60	70	80	55	60								
				40	45	40	45	50	55	40	45								
				45	50	45	50	55	60	45	50								
				30	35	30	35	35	40	30	35								
				35	40	35	40	45	50	35	40								
				55	60	55	60	70	80	55	60								
				30	35	30	35	40	45	30	35								
				25	30	25	30	35	40	25	30								
				30	35	30	35	40	45	30	35								
				25	30	25	30	35	40	25	30								
		400	400	400	400	400	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	300	300	300	300	300
400	500	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
Copy milling

🚰 = Cutting data for wet machining
🚱 = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	Machining group [1]	🚰	🚱	Cutting material grades		
									Starting values for cutting speed v_c [m/min]		
									HC		
									WKP35S		
									a_e / D_c		
									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	160
		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 [2]			70	250	N6	●● [2]				
	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%

[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] 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														
WKP25S			**WAK15**			**WSP45G**			**WSM45X**			WMP45G		
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 1/2	1/5	1/10	1/1 1/2	1/5	1/20
285	375	395				230	290	365						
240	310	330				190	250	315						
230	285	285				155	200	250						
200	255	255				145	170	215						
185	230	230				130	145	180						
240	310	330				190	250	315						
210	265	300				190	240	300						
200	255	275				145	170	215						
185	230	255				130	145	180						
155	200	220				100	110	140						
145	185	200				115	140	175						
100	120	120				75	90	115						
80	90	110				65	80	100						
155	200	220				115	140	175	125	150	185	125	150	185
130	165	165				90	110	140	100	120	150	100	120	150
						110	130	165	120	140	180	120	140	180
						90	110	140	100	120	155	100	120	155
						100	120	150	110	130	165	110	130	165
320	370	400	370	420	450									
270	320	350	320	370	400									
300	350	370	350	400	420									
250	300	320	300	350	370									
300	350	370	350	400	420									
250	300	320	300	350	370									
240	280	320	290	340	370									
						65	70	90	70	80	100	70	80	100
						45	50	65	50	50	65	50	50	65
						50	55	70	55	60	80	55	60	80
						30	35	45	35	40	50	35	40	50
						40	45	55	45	50	60	45	50	60
						65	80	100	70	90	110	70	90	110
						40	45	55	45	50	60	45	50	60
						35	40	50	35	40	50	35	40	50
						40	45	55	45	50	60	45	50	60
						40	45	55	45	50	60	45	50	60
			400	450	500	500	600	700						
			300	350	400	400	500	600						
400	500	600	500	600	700									

HC = Coated carbide

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

Cutting data for roughing
Copy milling (continued)

🚰 = Cutting data for wet machining
🚱 = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm^2]	Machining group [1]	🚰	🚱	Cutting material grades		
									Starting values for cutting speed v_c [m/min]		
									HC		
									WSM35G		
									a_e / D_c		
									1/1	1/5	1/10
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	●	●●	135	165	200
		Martensitic, heat-treated		330	1110	P15	●	●●	110	130	165
M	Stainless steel	Austenitic, quench hardened		200	680	M1	●●	●	130	155	195
		Austenitic, precipitation hardened (PH)		300	1010	M2	●●	●	110	130	170
		Austenitic/ferritic, duplex		230	780	M3	●●	●	120	145	180
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[2]			70	250	N6	●●[2]				
	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	●●		80	90	115
			Hardened	280	940	S2	●●		60	65	70
		Ni- or Co-based	Annealed	250	840	S3	●●		60	70	90
			Hardened	350	1180	S4	●●		40	45	55
			Cast	320	1080	S5	●●		50	55	70
	Titanium alloys	Pure titanium		200	680	S6	●●		80	100	125
		α and β alloys, hardened		375	1260	S7	●●		50	55	70
		β alloys		410	1400	S8	●●		40	45	55
	Tungsten alloys			300	1010	S9	●●		50	55	70
	Molybdenum alloys			300	1010	S10	●●		50	55	70
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	●●	●	500	600	700
	Thermosetting plastics	Without abrasive fillers				O2	●●	●	400	500	600
	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%

[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] 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		
WKP35G			**WXN15**			**WHH15X**			**WMG40**			**WK10**		
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
240	300	300				170	225	305						
200	255	275				150	200	270						
185	240	240				120	160	220						
155	195	210				105	140	190						
145	180	185				80	105	145						
200	255	275				120	160	220						
165	210	230				140	185	250						
155	195	215				120	160	220						
145	180	200				110	150	200						
120	155	170				105	140	190						
110	145	160				105	140	190						
75	100	100				100	130	180						
65	80	90				80	100	140						
120	155	170				120	160	220						
110	145	155				100	130	180						
250	290	310				105	140	190						
200	240	260				90	120	160						
240	280	300				110	150	200						
190	230	250				90	120	160						
240	280	300				110	150	200						
190	230	250				90	130	180						
180	220	250				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			
									40	45	50			
									30	35	40			
									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						
400	450	500	700	800	900	700	800	900	650	800	900	700	850	950
300	350	400	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

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

Cutting data for semi-finishing and finishing
Copy milling

🚰 = Cutting data for wet machining
🚱 = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	Machining group [1]	🚰	🚱	Cutting material grades Starting values for cutting speed v_c [m/min] HC WKP35S a_e / D_c*		
									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[2]			70	250	N6	●●[2]				
	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%

[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.
* a_e/D_c = 1/50, v_c = 40% higher than 1/20

Cutting material grades																				
Starting values for cutting speed v_c [m/min]																				
HC																				
WKP25S			WAK15			WSP46			WSP45G			WSM45X			WSM36			WSM35G		
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	1/20	1/1	1/5	1/20	1/1	1/5	1/20	1/1	1/5	1/20	1/1 1/2	1/5	1/20	1/1	1/5	1/20	1/1	1/5	1/20
255	340	460				345	435	545	345	435	545									
230	310	405				285	375	470	285	375	470									
185	240	330				235	300	375	235	300	375									
155	210	285				220	255	320	220	255	320									
120	155	220				195	220	270	195	220	270									
230	310	410				290	380	470	290	380	470									
210	275	375				285	360	450	285	360	450									
185	240	330				220	255	320	220	255	320									
165	230	310				195	220	270	195	220	270									
155	210	285				150	165	205	150	165	205									
155	210	285				175	210	265	175	210	265									
145	200	265				115	135	170	115	135	170									
120	155	220				110	130	150	110	130	150									
185	240	330				175	210	260	175	210	260	185	230	280	195	250	300	195	250	300
145	200	265				135	160	205	135	160	205	145	180	215	155	200	235	155	200	235
						165	195	245	165	195	245	170	215	265	195	235	290	195	235	290
						130	160	210	130	160	210	140	180	230	160	200	250	160	200	250
						150	180	230	150	180	230	165	200	250	180	220	270	180	220	270
230	330	430	280	380	480															
200	270	370	250	320	420															
250	350	450	300	400	500															
200	270	370	250	320	420															
250	350	450	300	400	500															
210	290	410	260	320	460															
190	260	360	240	310	410															
						100	105	130	100	105	130	110	120	150	120	135	170	120	135	170
						70	75	95	70	75	95	80	85	115	90	100	125	90	100	125
						75	85	105	75	85	105	80	95	115	90	105	130	90	105	130
						45	55	70	45	55	70	50	60	80	60	70	90	60	70	90
						60	70	90	60	70	90	65	75	95	75	85	105	75	85	105
						100	120	150	100	120	150	110	135	170	120	150	190	120	150	190
						60	70	90	60	70	90	65	75	95	75	85	105	75	85	105
						50	60	80	50	60	80	55	65	85	65	75	95	65	75	95
						70	80	100	70	80	100	75	85	105	80	90	110	80	90	110
						70	80	100	70	80	100	75	85	105	80	90	110	80	90	110
			450	500	550	550	650	750	550	650	750				550	650	750	550	650	750
			350	400	450	450	550	650	450	550	650				450	550	650	450	550	650
500	600	700	600	700	800															

HC = Coated carbide

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

Cutting data for semi-finishing and finishing

Copy milling (continued)

🚰 = Cutting data for wet machining
🚱 = Dry machining is possible

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm²]	Machining group [1]	🚰	🚱	Cutting material grades Starting values for cutting speed v_c [m/min] HC WKK25G a_e / D_c*		
									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[2]			70	250	N6	●●[2]				
	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%

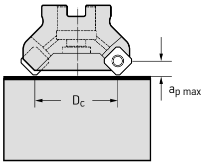
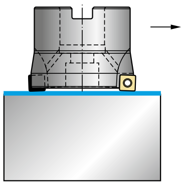
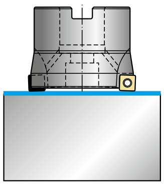
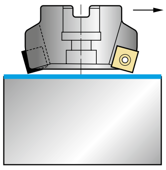
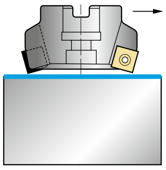
[1] The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.
[2] Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.
* a_e/D_c = 1/50, v_c = 40% higher than 1/20

Cutting material grades											
Starting values for cutting speed v_c [m/min]											
HC						HF			HW		
WXN15			WHH15X			WMG40			WK10		
a_e / D_c*			a_e / D_c*			a_e / D_c*			a_e / D_c*		
1/1	1/5	1/20	1/1	1/5	1/20	1/1	1/5	1/20	1/1	1/5	1/20
			210	280	380						
			190	250	340						
			150	200	270						
			130	170	235						
			100	130	180						
			180	240	330						
			170	230	310						
			150	200	270						
			140	190	250						
			130	170	235						
			130	170	235						
			120	160	220						
			110	150	210						
			150	200	270						
			120	160	220						
			130	170	235						
			110	150	200						
			140	190	250						
			110	150	200						
			140	190	250						
			120	160	220						
			110	150	200						
2400	2400	2640				1600	1600	1760	2000	2000	2200
1800	1800	2040				1200	1200	1360	1500	1500	1700
600	660	720				400	440	480	500	550	600
480	480	530				320	320	350	400	400	440
240	280	310				160	190	210	200	235	260
600	660	720				400	440	480	500	550	600
460	580	640				305	390	430	380	485	535
320	410	450				220	270	300	270	340	375
300	380	430				200	260	280	250	320	355
200	240	270				120	150	180	160	200	230
						55	60	65			
						45	50	55			
						30	40	45			
						80	100	110			
						30	45	50			
			60	80	110						
			40	50	70						
			40	45	60						
			50	70	90						
800	1000	1100	800	900	1000	600	700	750	700	800	900
720	920	1010	700	800	900	480	610	670	600	765	840
600	700	900	700	800	1000				400	500	700

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

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

Feed determination (starting values)
Face milling cutters

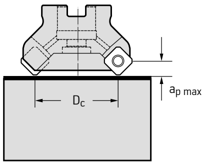
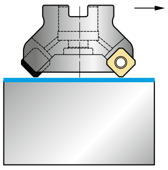
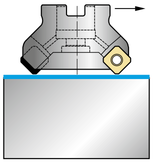
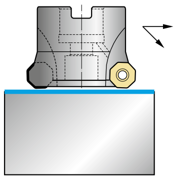
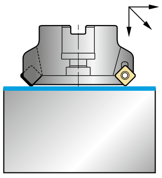
Material group	Cutter type	M5012		M5012 . . . -AP	M5011	M5011 . . . -AP
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT		 Xtra·tec® XT	 Xtra·tec® XT	 Xtra·tec® XT
	Lead angle κ	88°		88°	75°	75°
		f_{Z0} [mm]		f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [mm]
	Tool diameter or diameter 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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,08	0,10	0,12	0,12	0,14
K	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
N	Wrought aluminium alloys	0,09	0,12	0,14		
	Cast aluminium alloys	0,09	0,12	0,14		
	Magnesium-based alloys [3]	0,08	0,10	0,12		
	Copper and copper alloys (bronze/brass)	0,08	0,10	0,12		
S	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
H	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
O	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

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

Material group	Cutter type	M5009		M5009...-AP	M5004		M4003	
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT		 Xtra·tec® XT	 Xtra·tec® XT			
	Lead angle κ	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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,09	0,12	0,14	0,15	0,15	0,10	0,12
K	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
N	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 [3]	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
S	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
H	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		
O	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 **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	1,0
	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 **Ka_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		
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$	8				0,6	0,6		
	$a_{p\,max} = L_c$				0,6	0,6		

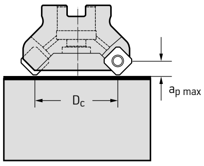
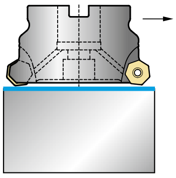
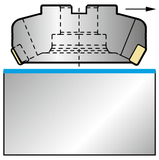
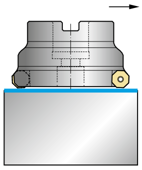
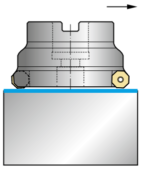
[1] and steel casting

[2] and austenitic/ferritic

[3] 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.

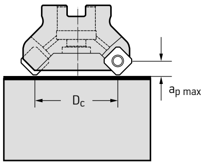
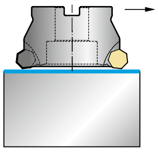
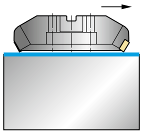
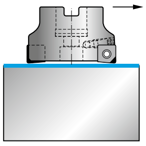
Feed determination (starting values)
Face milling cutters (continued)

	Cutter type	M3024		M3016	M2025	M2026
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$  	 Walter BLAXX		 Walter BLAXX		
	Lead angle κ	45°		60°	42°	42°
Material group		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
P	Non-alloyed steel [1]	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		
M	Stainless steel [2]	0,12	0,17	0,30		
K	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
N	Wrought aluminium alloys					
	Cast aluminium alloys					
	Magnesium-based alloys [3]					
	Copper and copper alloys (bronze/brass)					
S	Heat-resistant alloys					
	Titanium alloys					
	Tungsten alloys					
	Molybdenum alloys					
H	Hardened steel			0,40	0,15	0,15
	Hardened cast iron			0,42	0,17	0,17
O	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 **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

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

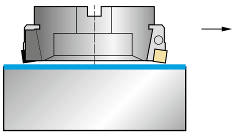
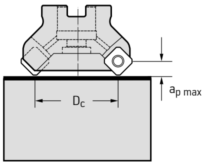
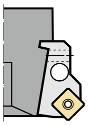
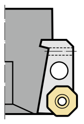
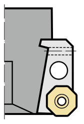
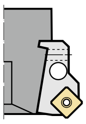
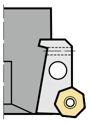
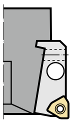
Material group	Cutter type	F4045		F2260	F2250
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec®			
	Lead angle κ	45°		60°	75° + 90°
		f_{Z0} [mm]		f_{Z0} [mm]	f_{Z0} [mm]
	Tool diameter or diameter range [mm]	63–200	80–200	100–250	63–200
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	4	6	11	3
P	Non-alloyed steel [1]			0,60	
	Low-alloy steel			0,45	
	High-alloy steel and tool steel				
	Stainless steel				
M	Stainless steel [2]				
K	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	
N	Wrought aluminium alloys				0,15
	Cast aluminium alloys				0,15
	Magnesium-based alloys [3]				0,15
	Copper and copper alloys (bronze/brass)				0,10
S	Heat-resistant alloys				
	Titanium alloys				
	Tungsten alloys				
	Molybdenum alloys				
H	Hardened steel	0,12	0,15	0,40	
	Hardened cast iron	0,14	0,17	0,42	
O	Thermoplastics				
	Plastic, carbon-fibre reinforced				
	Graphite (technical)				

Indexable insert types		XNHF 0705..	XNHF 0906..	LNMU 1508..	SPHW1204.. WCD10
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
	1/5	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
$f_Z = f_{Z0} \cdot Ka_e$	1/50				

[1] and steel casting
[2] and austenitic/ferritic
[3] 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

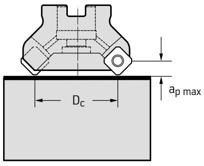
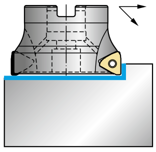
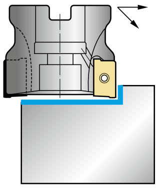
Material group	Cutter type	F2010... 					
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	...R720M  Xtra·tec® XT	...R592M  Xtra·tec® XT	...R681M  Xtra·tec® XT	...R758M 	...R759M  Walter BLAXX	...R500M 
	Lead angle κ	45°	43°	43°	45°	45°	90°
		f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,12	0,15	0,15	0,12	0,12	0,10
K	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
N	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 [3]	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
S	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
H	Hardened steel	0,12	0,15	0,15			0,10
	Hardened cast iron	0,14	0,17	0,17			0,10
O	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 **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						
Correction factor **Ka_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			
$f_z = f_{Z0} \cdot Ka_e \cdot Ka_p$	$a_{p\,max} = L_c$		0,6	0,6			

[1] and steel casting
[2] and austenitic/ferritic
[3] 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

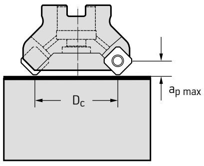
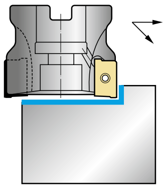
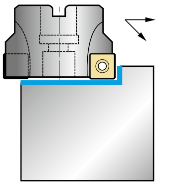
Material group	Cutter type	M5137		M5130			
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT		 Xtra·tec® XT			
	Lead angle κ	90°		90°			
		f_{Z0} [mm]		f_{Z0} [mm]			
	Tool diameter or diameter range [mm]	25–63	50–100	10–63	16–50	25–80	25–160
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	5	8	5	8	11	15
P	Non-alloyed steel [1]	0,15	0,20	0,12	0,16	0,21	0,26
	Low-alloy steel	0,11	1,00	0,08	0,11	0,16	0,19
	High-alloy steel and tool steel	0,11	1,00	0,08	0,11	0,16	0,19
	Stainless steel	0,09	1,00	0,06	0,08	0,13	0,16
M	Stainless steel [2]	0,08	1,00	0,06	0,08	0,11	0,13
K	Malleable cast iron	0,15	1,00	0,10	0,13	0,21	0,26
	Grey cast iron	0,19	1,00	0,12	0,16	0,26	0,32
	Cast iron with spheroidal graphite	0,15	1,00	0,10	0,13	0,21	0,26
	CGI	0,11	1,00	0,08	0,11	0,21	0,19
N	Wrought aluminium alloys		1,00	0,08	0,11	0,13	0,16
	Cast aluminium alloys		1,00	0,10	0,13	0,16	0,16
	Magnesium-based alloys [3]		1,00	0,08	0,11	0,13	0,16
	Copper and copper alloys (bronze/brass)		1,00	0,06	0,08	0,11	0,13
S	Heat-resistant alloys	0,09	1,00	0,06	0,08	0,13	0,16
	Titanium alloys	0,09	1,00	0,06	0,08	0,13	0,16
	Tungsten alloys	0,09	1,00	0,06	0,08	0,13	0,16
	Molybdenum alloys	0,09	1,00	0,06	0,08	0,13	0,16
H	Hardened steel		1,00	0,06	0,08	0,11	0,13
	Hardened cast iron		1,00	0,08	0,11	0,13	0,15
O	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		TNMU 11T304R	TNMU 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						

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

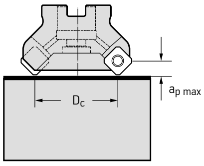
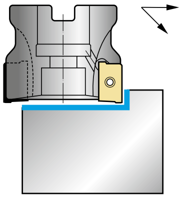
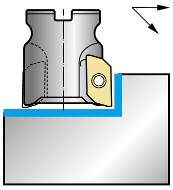
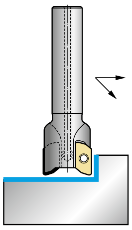
Material group	Cutter type	F4042 / F4042R					M4132		
	 Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$	 Xtra·tec®							
	Lead angle κ	90°					90°		
		f_{Z0} [mm]					f_{Z0} [mm]		
		F4042	F4042R	F4042	F4042	F4042			
	Tool diameter or diameter range [mm]	10–50	16–63	25–315	40–315	50–160	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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,08	0,08	0,10	0,12	0,14	0,06	0,08	0,10
K	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
N	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 [3]	0,10	0,12	0,12	0,15				
	Copper and copper alloys (bronze/brass)	0,08	0,10	0,10	0,12				
S	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
H	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
O	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 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	1,0	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
$f_Z = f_{Z0} \cdot Ka_e$	1/50								

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

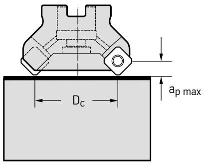
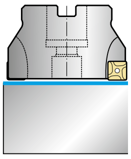
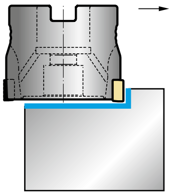
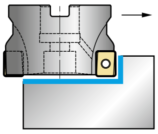
Material group	Cutter type	M4130			M2331		M2131	
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 				 For face/shoulder milling operations			
	Lead angle κ	90°			90°		90°	
		f_{Z0} [mm]			f_{Z0} [mm]		f_{Z0} [mm]	
	Tool diameter or diameter range [mm]	16–25	32–50	50–100	32–50	40–50	25–80	32–63
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	8	13	16	15	20	15	20
P	Non-alloyed steel [1]	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				
M	Stainless steel [2]	0,08	0,10	0,12				
K	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				
N	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 [3]				0,12	0,12	0,12	0,12
	Copper and copper alloys (bronze/brass)				0,10	0,10	0,10	0,10
S	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				
H	Hardened steel							
	Hardened cast iron							
O	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 **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	1,0
	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
$f_Z = f_{Z0} \cdot Ka_e$	1/50							

---

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

Material group	Cutter type	M2136	F5041 / F5141 / F5241			F4041
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 		 Walter BLAXX			 Xtra·tec®
	Lead angle κ	90°	90°			90°
		f_{Z0} [mm]	f_{Z0} [mm]			f_{Z0} [mm]
			F5041	F5141	F5241	
	Tool diameter or diameter range [mm]	50–160	25–315	40–315	50–160	40–315
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	6,5	8,4	12,2	15,2	13
P	Non-alloyed steel [1]		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
M	Stainless steel [2]		0,10	0,12	0,14	0,10
K	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
N	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 [3]		0,12	0,15	0,15	0,12
	Copper and copper alloys (bronze/brass)		0,10	0,12	0,12	0,10
S	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
H	Hardened steel		0,10	0,12	0,14	0,12
	Hardened cast iron		0,12	0,14	0,20	0,14
O	Thermoplastics		0,14	0,20	0,20	0,15
	Plastic, carbon-fibre reinforced					
	Graphite (technical)		0,12	0,18	0,18	0,12

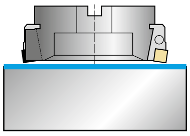
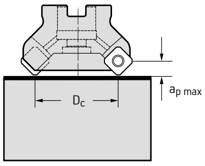
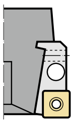
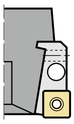
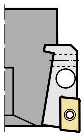
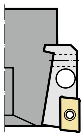
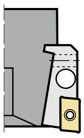
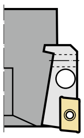
Indexable insert types		SNEF1204..	LN..0904..	LN..1306..	LN..1607..	LNGX1307..
Correction factor **Ka_e** for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c	a_e / D_c = 1/1 – 1/2	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3
$f_z = f_{Z0} \cdot Ka_e$	1/50					

---

[1] and steel casting
[2] and austenitic/ferritic
[3] 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 $a_e = D_c$ $a_p = a_{p\,max} = L_c$  			 Xtra·tec® XT	 Xtra·tec® XT	 Xtra·tec®	 Xtra·tec®
Material group	Lead angle κ	90°	90°	90°	90°	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]	8,4	11,6	11	15	11,7	15
P	Non-alloyed steel [1]	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
	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
M	Stainless steel [2]	0,08	0,10	0,11	0,13	0,10	0,12
K	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
N	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 [3]			0,13	0,16	0,12	0,15
	Copper and copper alloys (bronze/brass)			0,11	0,13	0,10	0,12
S	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
H	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
O	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 **Ka_e**	a_e / D_c =	1/1 – 1/2	1,0	1,0	1,0	1,0	1,0	1,0
for the feed per tooth depending on		1/5	1,1	1,1	1,1	1,1	1,1	1,1
the ratio of cutting width a_e to milling		1/10	1,2	1,2	1,2	1,2	1,2	1,2
cutter diameter D_c		1/20	1,3	1,3	1,3	1,3	1,3	1,3
$f_Z = f_{Z0} \cdot Ka_e$		1/50						

---

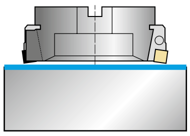
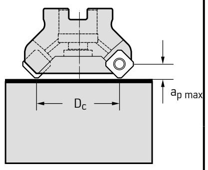
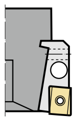
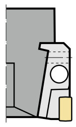
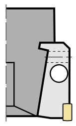
[1] and steel casting

[2] and austenitic/ferritic

[3] 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)

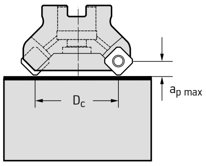
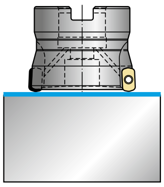
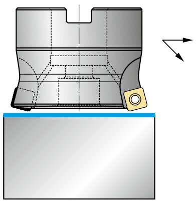
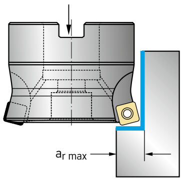
Material group	Cutter type	F2010... 		
		...R722M	...R752M	...R751M
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec®	 Walter BLAXX	 Walter BLAXX
	Lead angle κ	90°	90°	90°
		f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [mm]
	Tool diameter or diameter range [mm]	80–315	80–315	80–315
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	13	12,2	8,4
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,10	0,12	0,10
K	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
N	Wrought aluminium alloys	0,12	0,15	0,12
	Cast aluminium alloys	0,15	0,15	0,15
	Magnesium-based alloys [3]	0,12	0,15	0,12
	Copper and copper alloys (bronze/brass)	0,10	0,12	0,10
S	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
H	Hardened steel	0,12	0,12	0,10
	Hardened cast iron	0,14	0,14	0,12
O	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 **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
	1/5	1,1	1,1	1,1
	1/10	1,2	1,2	1,2
	1/20	1,3	1,3	1,3
$f_Z = f_{Z0} \cdot Ka_e$	1/50			

[1] and steel casting
[2] and austenitic/ferritic
[3] 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

Material group	Cutter type	M5008		M4002			M4002		
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT	For plunging operations				 For plunging operations		
	Lead angle κ	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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,24	0,10	0,3	0,50	0,80	0,10	0,12	0,15
K	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
N	Wrought aluminium alloys								
	Cast aluminium alloys								
	Magnesium-based alloys [3]								
	Copper and copper alloys (bronze/brass)								
S	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
H	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
O	Thermoplastics								
	Plastic, carbon-fibre reinforced								
	Graphite (technical)								

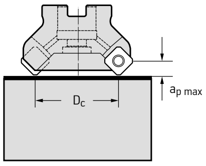
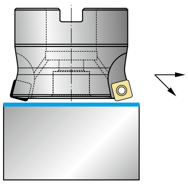
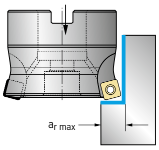
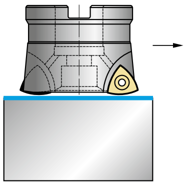
Indexable insert types		ENMX 08T316R..	ENMX 08T316R..	SD.. 06T2…	SD.. 09T3…	SD.. 1204…	SD.. 06T2…	SD.. 09T3…	SD.. 1204…
Correction factor **Ka_e** for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c	a_e / D_c = 1/1 – 1/2	1,0		1,0	1,0	1,0			
	1/5	1,1		1,4	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) = ≤ 2		1,0	1,4	1,4	1,4	1,0	1,0	1,0
	2 < (L : D_c) = ≤ 4		0,7	1,0	1,0	1,0	0,7	0,7	0,7
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p \cdot K$	4 < (L : D_c) = ≤ 6		0,5	0,7	0,7	0,7	0,5	0,5	0,5

[1] and steel casting
[2] and austenitic/ferritic
[3] 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		 **Xtra·tec®**	
	Lead angle κ	15°		75°		0–21°	
Material group		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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,60	0,96	0,10	0,15	0,60	0,80
K	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
N	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys [3]						
	Copper and copper alloys (bronze/brass)						
S	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
H	Hardened steel	0,60	0,96	0,10	0,15		
	Hardened cast iron	0,62	0,98	0,10	0,15		
O	Thermoplastics						
	Plastic, carbon-fibre reinforced						
	Graphite (technical)						

Indexable insert types			SDMX0904ZDR	SDMX1205ZDR	SDMX0904ZDR	SDMX1205ZDR	P23696-1.0	P23696-2.0
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
		1/5	1,4	1,4			1,4	1,3
		1/10	1,8	1,8			1,8	1,6
		1/20						
Correction factor **Ka_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) =	≤ 2	1,4	1,4	1,4	1,4	1,4	1,4
	2 < (L : D_c) =	≤ 4	1,0	1,0	1,0	1,0	1,0	1,0
$f_z = f_{Z0} \cdot Ka_e \cdot Ka_p \cdot K$	4 < (L : D_c) =	≤ 6	0,7	0,7	0,7	0,7	0,7	0,7

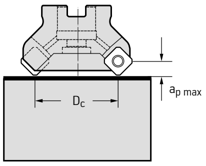
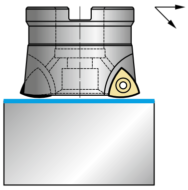
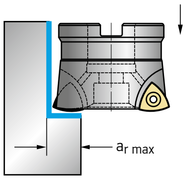
[1] and steel casting

[2] and austenitic/ferritic

[3] 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)

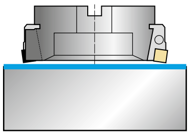
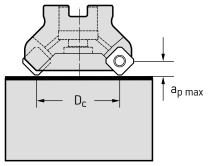
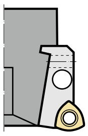
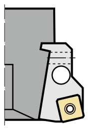
	Cutter type	**F2330**			**F2330**		
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 				 For plunging operations		
Material group	Lead angle κ	0–15°			0–15°		
		f_{Z0} [mm]			f_{Z0} [mm]		
	Tool diameter or diameter range [mm]	20–25	32–85	52–85	20–25	32–85	52–85
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	1,0	1,5	2,0	$a_{r\,max}$ = 7 mm	$a_{r\,max}$ = 10 mm	$a_{r\,max}$ = 15 mm
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,50	0,60	0,80	0,10	0,12	0,15
K	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
N	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys [3]						
	Copper and copper alloys (bronze/brass)						
S	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
H	Hardened steel						
	Hardened cast iron						
O	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 **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			
	1/5	1,4	1,4	1,4			
	1/10	1,8	1,8	1,8			
	1/20						
Correction factor **Ka_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**	$1 < (L : D_c) = \le 2$	1,4	1,4	1,4	1,0	1,0	1,0
	$2 < (L : D_c) = \le 4$	1,0	1,0	1,0	0,7	0,7	0,7
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p \cdot K$	$4 < (L : D_c) = \le 6$	0,7	0,7	0,7	0,5	0,5	0,5

[1] and steel casting
[2] and austenitic/ferritic
[3] 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

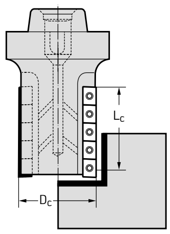
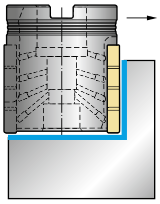
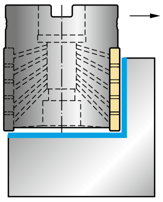
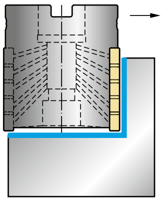
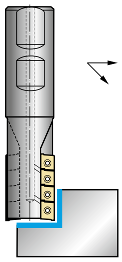
Material group	Cutter type	F2010… 	
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	…R729M  Xtra·tec®	…R755M 
	Lead angle κ	0–21°	15°
		f_{Z0} [mm]	f_{Z0} [mm]
	Tool diameter or diameter range [mm]	80–315	80–315
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	2,0	2,0
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,80	0,80
K	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
N	Wrought aluminium alloys		
	Cast aluminium alloys		
	Magnesium-based alloys [3]		
	Copper and copper alloys (bronze/brass)		
S	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
H	Hardened steel		0,80
	Hardened cast iron		0,82
O	Thermoplastics		
	Plastic, carbon-fibre reinforced		
	Graphite (technical)		

Indexable insert types		P236…R25	SD..1204…
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
	1/5	1,3	1,4
	1/10	1,6	1,8
	1/20		
Correction factor **Ka_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
$f_z = f_{Z0} \cdot Ka_e \cdot Ka_p \cdot K$	$4 < (L : D_c) = \leq 6$	0,7	0,7

[1] and steel casting
[2] and austenitic/ferritic
[3] 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

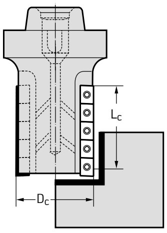
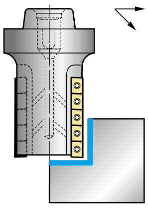
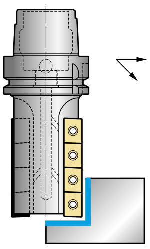
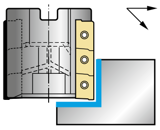
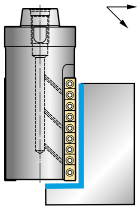
Material group	Cutter type	M3255	F5038	F5138	F4038
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Walter BLAXX	 Walter BLAXX	 Walter BLAXX	 Xtra·tec®
	Lead angle κ	90°	90°	90°	90°
		f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [mm]
	Tool diameter or diameter range [mm]	50–80	25–40	40–80	20–32
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	46–58	24–48	23–56	15–37
P	Non-alloyed steel [1]		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
M	Stainless steel [2]		0,10	0,11	0,08
K	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
N	Wrought aluminium alloys		0,12	0,15	0,12
	Cast aluminium alloys		0,15	0,12	0,10
	Magnesium-based alloys [3]		0,12	0,12	0,10
	Copper and copper alloys (bronze/brass)		0,12	0,12	0,10
S	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
H	Hardened steel				
	Hardened cast iron				
O	Thermoplastics				0,1
	Plastic, carbon-fibre reinforced				
	Graphite (technical)		0,13	0,15	0,1

		M3255	F5038	F5138	F4038
Indexable insert types		XNHX1306.. LNHX1206..	LN..0904..	LNHU1306..	AD..0803..
Correction factor **Ka_e** for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c	$a_e / D_c =$ 1/2	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 **Ka_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
$f_z = f_{Z0} \cdot Ka_e \cdot Ka_p$	$a_{p\,max} = L_c$	0,5*	0,5*	0,5*	0,5*

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

Material group	Cutter type	F4138	F4238	F4338	F2338F
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec®	 Xtra·tec®	 Xtra·tec®	
	Lead angle κ	90°	90°	90°	90°
		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 $a_{p\,max} = L_c$ [mm]	33–76	29–112	31–124	48–103
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,10	0,12	0,15	0,15
K	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
N	Wrought aluminium alloys	0,15	0,15		
	Cast aluminium alloys	0,12	0,12		
	Magnesium-based alloys [3]	0,12	0,12		
	Copper and copper alloys (bronze/brass)	0,12	0,12		
S	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
H	Hardened steel				
	Hardened cast iron				
O	Thermoplastics	0,15	0,15		
	Plastic, carbon-fibre reinforced				
	Graphite (technical)	0,12	0,15		

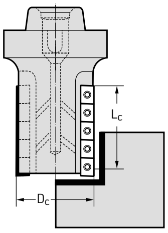
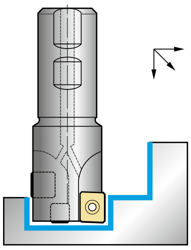
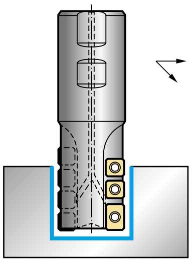
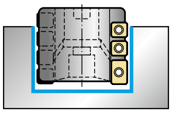
		F4138	F4238	F4338	F2338F
Indexable insert types		AD..1204..	AD..1606..	AD..1807..	SP..1506.. LP..1506..
Correction factor **Ka_e** for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c	a_e / D_c = 1/2	1,0**	1,0**	1,0**	1,0**
	1/5	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3
	1/50	1,5	1,5	1,5	
Correction factor **Ka_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
	$a_{p\,max} = L_c$	0,5*	0,5*	0,5*	0,5*

$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$

[1] and steel casting
[2] and austenitic/ferritic
[3] 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

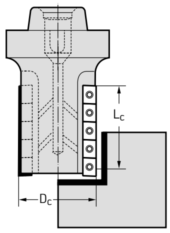
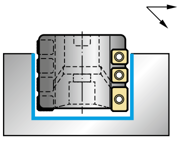
Material group	Cutter type	M4792			M4256	M4257
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 					
	Lead angle κ	90°			90°	90°
		f_{Z0} [mm]			f_{Z0} [mm]	f_{Z0} [mm]
	Tool diameter or diameter range [mm]	18–20	25–32	40	20–32	40–63
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	7 + 13	14 + 22	25,0	27–37	47–54
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,06*	0,08*	0,10*	0,06	0,08
K	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
N	Wrought aluminium alloys					
	Cast aluminium alloys					
	Magnesium-based alloys [3]					
	Copper and copper alloys (bronze/brass)					
S	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
H	Hardened steel					
	Hardened cast iron					
O	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 **Ka_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 **Ka_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
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$	$a_{p\,max} = L_c$				0,5**	0,5**

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

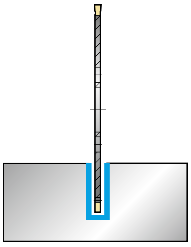
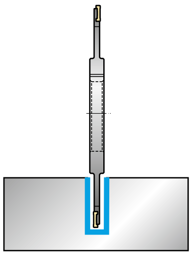
Material group	Cutter type	M4258
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	
	Lead angle κ	90°
		f_{Z0} [mm]
	Tool diameter or diameter range [mm]	80–100
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	67–78
P	Non-alloyed steel [1]	0,20
	Low-alloy steel	0,15
	High-alloy steel and tool steel	0,15
	Stainless steel	0,12
M	Stainless steel [2]	0,10
K	Malleable cast iron	0,25
	Grey cast iron	0,20
	Cast iron with spheroidal graphite	0,20
	CGI	0,20
N	Wrought aluminium alloys	
	Cast aluminium alloys	
	Magnesium-based alloys [3]	
	Copper and copper alloys (bronze/brass)	
S	Heat-resistant alloys	0,10
	Titanium alloys	0,10
	Tungsten alloys	0,10
	Molybdenum alloys	0,10
H	Hardened steel	
	Hardened cast iron	
O	Thermoplastics	
	Plastic, carbon-fibre reinforced	
	Graphite (technical)	

Indexable insert types		SD..120408.. LD..170408..
Correction factor **Ka_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 **Ka_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
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$	$a_{p\,max} = L_c$	0,5**

[1] and steel casting
[2] and austenitic/ferritic
[3] 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

Material group	Cutter type	F5055					F4053
	Feed per tooth f_{Z0} for plunging, central positioning						 cross-toothed **Xtra·tec®**
	Lead angle κ	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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,05	0,06	0,08	0,09	0,05	0,05
K	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
	CGI					0,10	0,09
N	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 [3]		0,07	0,09	0,11	0,12	
	Copper and copper alloys (bronze/brass)		0,07	0,09	0,11	0,12	
S	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
	Molybdenum alloys	0,05	0,06	0,08	0,09	0,09	0,05
H	Hardened steel						
	Hardened cast iron						
O	Thermoplastics						
	Plastic, carbon-fibre reinforced						
	Graphite (technical)						

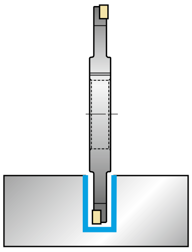
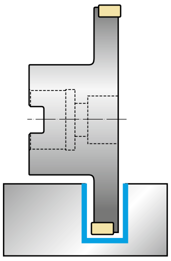
Indexable insert types		SX-1E15..	SX-2E20..	SX-3E30..	SX-4E40..	SX-5E50..	LN.X 0702..
Correction factor **Ka_e** for the feed per tooth depending on the ratio of depth of cut a_e to milling cutter diameter D_c	central	1,5	1,5	1,5	1,5	1,5	1,0
a_e / D_c =	1/3	1,8	1,8	1,8	1,8	1,8	1,5
	1/5	2,5	2,5	2,5	2,5	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
$f_Z = f_{Z0} \cdot Ka_e$	1/50	5,8	5,8	5,8	5,8	5,8	5,8
Correction factor **Ka_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	
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p \cdot K$	5	0,12	0,12	0,12	0,12	0,12	

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

Material group	Cutter type	F4153			F4253				
	Feed per tooth f_{Z0} for plunging, central positioning	 cross-toothed **Xtra·tec®**			 cross-toothed **Xtra·tec®**				
	Lead angle κ	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 [1]	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 [2]	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 [3]								
	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 **Ka_e** 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
$f_Z = f_{Z0} \cdot Ka_e$		1/50	5,8	5,8	5,8	5,8	5,8	5,8	5,8	5,8

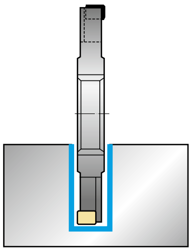
[1] and steel casting
[2] and austenitic/ferritic
[3] Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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)

Material group	Cutter type	F2252					
	Feed per tooth f_{Z0} for plunging, central positioning	 cross-toothed					
	Lead angle κ	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 [1]	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 [2]	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 [3]	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 **Ka_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 =	central	1,0	1,0	1,0	1,0	1,0	1,0
		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
$f_Z = f_{Z0} \cdot Ka_e$		1/50	5,8	5,8	5,8	5,8	5,8	5,8

[1] and steel casting

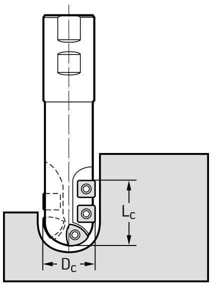
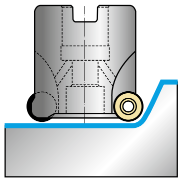
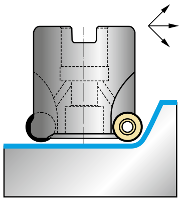
[2] and austenitic/ferritic

[3] 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

Material group	Cutter type	M5468							F2334R	
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT								
	Lead angle κ	–							–	
		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 $a_{p\,max} = L_c$ [mm]	2,5	3,5	4	5	6	8	10	5	6
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,04	0,04	0,07	0,09	0,11	0,13	0,12	0,09	0,11
K	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
N	Wrought aluminium alloys	0,06	0,06					0,16		
	Cast aluminium alloys	0,06	0,06					0,16		
	Magnesium-based alloys [4]	0,06	0,06					0,16		
	Copper and copper alloys (bronze/brass)	0,05	0,05					0,16		
S	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
H	Hardened steel	0,03	0,03					0,06		
	Hardened cast iron	0,04	0,04					0,07		
O	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 **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	1,0	1,0	1,0
	1/5	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
	1/10	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
	1/50	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Correction factor **Ka_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	1,5	1,6
	2,0	1,0	1,0	1,1	1,2	1,3	1,4	1,5	1,2	1,3
	3,0			1,0	1,0	1,1	1,2	1,2	1,0	1,1
	4,0				1,0	1,0	1,1	1,1	1,0	1,0
	6,0						1,0	1,1		
	8,0							1,1		
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$[3]	10,0							1,0		

[1] and steel casting

[2] and austenitic/ferritic

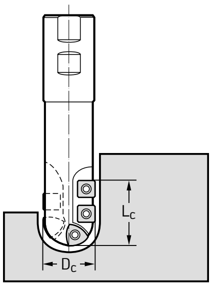
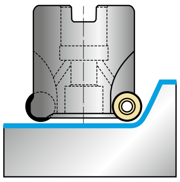
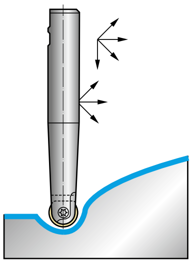
[3] Do not set correction factor $Ka_e \cdot Ka_p$ higher than 3 when finishing

[4] 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**		**M5460**							
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 			 **Xtra·tec® XT**							
Material group	Lead angle κ	90°		–							
		f_{Z0} [mm]		f_{Z0} [mm]							
	Tool diameter or diameter range [mm]	25–52	32–63	8	10	12	16	20	25	30	32
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	5	6	4	5	6	8	10	12	15	16
P	Non-alloyed steel [1]	0,17	0,22	0,08	0,10	0,10	0,12	0,12	0,15	0,15	0,15
	Low-alloy steel	0,17	0,15	0,06	0,08	0,08	0,10	0,10	0,12	0,12	0,12
	High-alloy steel and tool steel	0,13	0,15	0,06	0,08	0,08	0,10	0,10	0,12	0,12	0,12
	Stainless steel	0,09	0,11	0,05	0,06	0,06	0,08	0,08	0,10	0,10	0,10
M	Stainless steel [2]	0,09	0,11	0,05	0,06	0,06	0,08	0,08	0,10	0,10	0,10
K	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
N	Wrought aluminium alloys										
	Cast aluminium alloys										
	Magnesium-based alloys [4]										
	Copper and copper alloys (bronze/brass)										
S	Heat-resistant alloys	0,09	0,11	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
	Titanium alloys	0,09	0,11	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
	Tungsten alloys	0,09	0,11	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
	Molybdenum alloys	0,09	0,11	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
H	Hardened steel			0,04[3]	0,05[3]	0,05[3]	0,06[3]	0,06[3]	0,06[3]	0,06[3]	0,06[3]
	Hardened cast iron			0,05[3]	0,06[3]	0,06[3]	0,07[3]	0,07[3]	0,07[3]	0,07[3]	0,07[3]
O	Thermoplastics										
	Plastic, carbon-fibre reinforced										
	Graphite (technical)										

Indexable insert types		RNMX 1005..	RNMX 1206..	P32..-D08	P32..-D10	P32..-D12	P32..-D16	P32..-D20	P32..-D25	P32..-D30	P32..-D32
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	1,0	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 **Ka_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	1,5	1,6	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	1,2	1,3	0,6	0,7	0,7	0,8	0,8	1,0	1,0	1,0
	3,0	1,0	1,1	0,5	0,6	0,6	0,7	0,7	0,8	0,8	0,8
	4,0	1,0	1,0	0,5	0,5	0,5	0,6	0,6	0,7	0,7	0,7
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$[3]	$a_{p\,max} = L_c$			0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5

---

[1] and steel casting

[2] and austenitic/ferritic

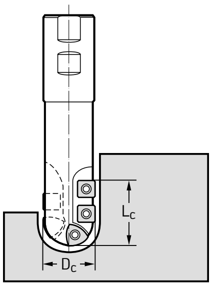
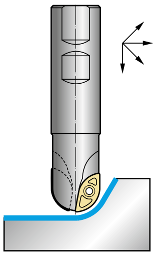
[3] Do not set correction factor $Ka_e \cdot Ka_p$ higher than 3 when finishing

[4] 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)

Material group	Cutter type Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	F2339 Form A 					
	Lead angle κ	–					
		f_{Z0} [mm]					
	Tool diameter or diameter range [mm]	16	20	25	30 / 32	40	50
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	11	15	20	24 / 25	31	40
P	Non-alloyed steel [1]	0,13	0,15	0,20	0,25	0,30	0,35
	Low-alloy steel	0,08	0,10	0,14	0,20	0,25	0,30
	High-alloy steel and tool steel	0,08	0,10	0,14	0,20	0,25	0,30
	Stainless steel	0,06	0,07	0,10	0,12	0,14	0,18
M	Stainless steel [2]	0,06	0,07	0,10	0,12	0,12	0,14
K	Malleable cast iron	0,13	0,15	0,20	0,25	0,30	0,35
	Grey cast iron	0,17	0,20	0,25	0,30	0,35	0,40
	Cast iron with spheroidal graphite	0,13	0,15	0,20	0,25	0,30	0,35
	CGI	0,13	0,15	0,20	0,25	0,30	0,35
N	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys [4]						
	Copper and copper alloys (bronze/brass)						
S	Heat-resistant alloys	0,06	0,07	0,10	0,10	0,10	0,12
	Titanium alloys	0,06	0,07	0,10	0,10	0,10	0,12
	Tungsten alloys	0,06	0,07	0,10	0,10	0,10	0,12
	Molybdenum alloys	0,06	0,07	0,10	0,10	0,10	0,12
H	Hardened steel						
	Hardened cast iron						
O	Thermoplastics						
	Plastic, carbon-fibre reinforced						
	Graphite (technical)						

Indexable insert types			XD.. 130380R..	XD.. 16T3100R..	XD.. 2004125R..	XD.. 2405150R.. XD.. 2506160R..	XD.. 3207200R..	XD.. 4009250R..
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	1,2	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 **Ka_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
		2,0	1,3	1,5	1,6	1,8	1,9	2
		4,0	1,1	1,2	1,3	1,4	1,5	1,6
		6,0	1,0	1,1	1,2	1,2	1,3	1,4
		8,0	1,0	1,1	1,1	1,1	1,2	1,3
		10,0	1,0	1,0	1,1	1,1	1,2	1,2
		12,5		1,0	1,0	1,1	1,1	1,2
		15,0/16,0		1,0	1,0	1,0	1,1	1,1
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$[3]		20,0			1,0	1,0	1,0	1,0
		$a_{p\,max} = L_c$				1,0	1,0	1,0

[1] and steel casting

[2] and austenitic/ferritic

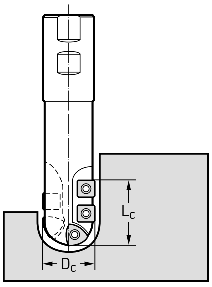
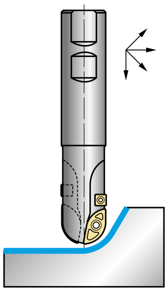
[3] Do not set correction factor $Ka_e \cdot Ka_p$ higher than 3 when finishing

[4] 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)

Material group	Cutter type Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	F2339 Form B 				
	Lead angle κ	–				
		f_{Z0} [mm]				
	Tool diameter or diameter range [mm]	16	20	25	30 / 32	40
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	24	28	32	42 / 43	57
P	Non-alloyed steel [1]	0,13	0,15	0,20	0,25	0,30
	Low-alloy steel	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
	Stainless steel	0,06	0,07	0,10	0,12	0,14
M	Stainless steel [2]	0,06	0,07	0,10	0,12	0,12
K	Malleable cast iron	0,13	0,15	0,20	0,25	0,30
	Grey cast iron	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
	CGI	0,13	0,15	0,20	0,25	0,30
N	Wrought aluminium alloys					
	Cast aluminium alloys					
	Magnesium-based alloys [4]					
	Copper and copper alloys (bronze/brass)					
S	Heat-resistant alloys	0,06	0,07	0,10	0,10	0,10
	Titanium alloys	0,06	0,07	0,10	0,10	0,10
	Tungsten alloys	0,06	0,07	0,10	0,10	0,10
	Molybdenum alloys	0,06	0,07	0,10	0,10	0,10
H	Hardened steel					
	Hardened cast iron					
O	Thermoplastics					
	Plastic, carbon-fibre reinforced					
	Graphite (technical)					

Indexable insert types		XD.. 130880R.. SP.. 0603..	XD.. 16T3100R.. SP.. 0603..	XD.. 2004125R.. SP.. 0603..	XD.. 2405150R.. XD.. 2506160R.. SP..09T3..	XD.. 3207200R.. SP.. 1204..
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	1,2	1,2	1,2	1,2	1,2
	1/10	1,5	1,5	1,5	1,5	1,5
	1/20	1,8	1,8	1,8	1,8	1,8
	1/50	2,0	2,0	2,0	2,0	2,0
Correction factor **Ka_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
	2,0	1,3	1,5	1,6	1,8	1,9
	4,0	1,1	1,2	1,3	1,4	1,5
	6,0	1,0	1,1	1,2	1,2	1,3
	8,0	1,0	1,1	1,1	1,1	1,2
	10,0	1,0	1,0	1,1	1,1	1,2
	12,5	1,0	1,0	1,0	1,1	1,1
	15,0/16,0	1,0	1,0	1,0	1,0	1,1
$f_z = f_{Z0} \cdot Ka_e \cdot Ka_p$ [3]	20,0	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

[1] and steel casting

[2] and austenitic/ferritic

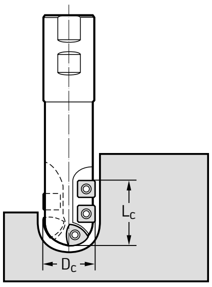
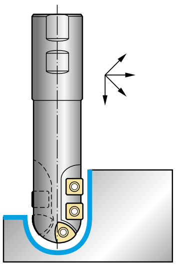
[3] Do not set correction factor $Ka_e \cdot Ka_p$ higher than 3 when finishing

[4] 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)

Material group	Cutter type	F2239					
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$  						
	Lead angle κ	–					
		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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,08	0,12	0,14	0,14	0,14	0,14
K	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
N	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys [4]						
	Copper and copper alloys (bronze/brass)						
S	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
H	Hardened steel						
	Hardened cast iron						
O	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 $\mathbf{Ka_e}$ 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	1,2	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 $\mathbf{Ka_p}$ 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
$f_Z = f_{Z0} \cdot \mathbf{Ka_e} \cdot \mathbf{Ka_p}$[3]	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

[1] and steel casting

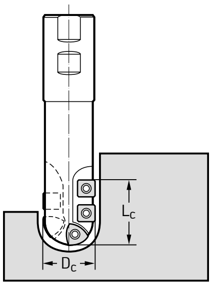
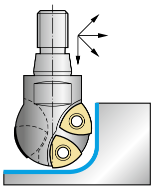
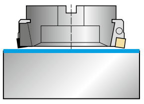
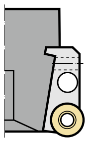
[2] and austenitic/ferritic

[3] Do not set correction factor $Ka_e \cdot Ka_p$ higher than 3 when finishing

[4] 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)

Material group	Cutter type	F2239B					F2010…R723M
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 						 …R723M 
	Lead angle κ	–					–
		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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,08	0,12	0,14	0,14	0,14	0,13
K	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
N	Wrought aluminium alloys						
	Cast aluminium alloys						
	Magnesium-based alloys [3]						
	Copper and copper alloys (bronze/brass)						
S	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
H	Hardened steel						
	Hardened cast iron						
O	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 **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	1,2	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 **Ka_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	
$f_Z = f_{Z0} \cdot Ka_e \cdot Ka_p$	$a_{p\,max} = L_c$	0,5	0,5	0,5	0,5	0,5	

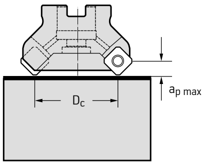
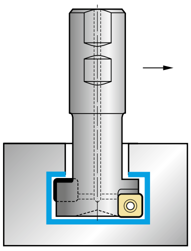
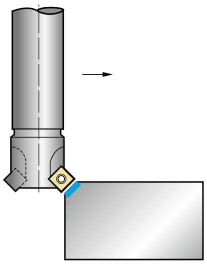
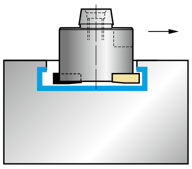
[1] and steel casting

[2] and austenitic/ferritic

[3] 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			
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 										
	Lead angle κ	90°			45°			90°			
Material group		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 $a_{p\,max} = L_c$ [mm]				3	5	7	1,1–1,6	1,3–2,15	2,15–3,15	3,15–5,15
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,06	0,06	0,06	0,08	0,10	0,12				
K	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
N	Wrought aluminium alloys										
	Cast aluminium alloys										
	Magnesium-based alloys [3]										
	Copper and copper alloys (bronze/brass)										
S	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				
H	Hardened steel										
	Hardened cast iron										
O	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 **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	1,5	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				
$f_Z = f_{Z0} \cdot Ka_e$	1/50				1,5	1,5	1,5				

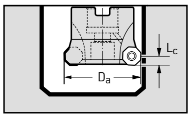
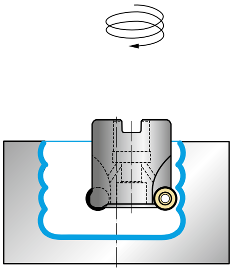
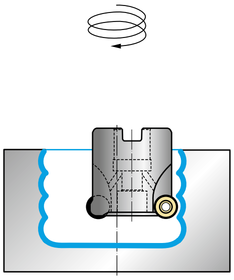
[1] and steel casting

[2] and austenitic/ferritic

[3] 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

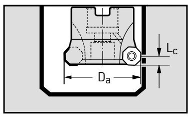
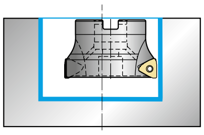
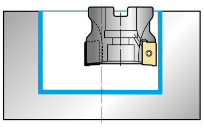
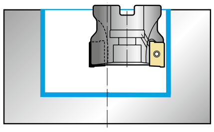
Material group	Cutter type	M5468							F2334R	
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT								
	Lead angle κ	–							–	
		f_{Z0} [mm]							f_{Z0} [mm]	
	Tool diameter or diameter range [mm]	12–20	15–42	25–32	32–66	40–80	52–315	63–160	32–66	40–80
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	2,5	3,5	4	5	6	8	10	5	6
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,04	0,04	0,07	0,09	0,11	0,13	0,12	0,09	0,11
K	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
N	Wrought aluminium alloys	0,06	0,06					0,16		
	Cast aluminium alloys	0,06	0,06					0,16		
	Magnesium-based alloys [3]	0,06	0,06					0,16		
	Copper and copper alloys (bronze/brass)	0,05	0,05					0,16		
S	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
H	Hardened steel	0,03	0,03					0,06		
	Hardened cast iron	0,03	0,03					0,06		
O	Thermoplastics	0,05	0,06	0,07	0,10	0,15	0,20	0,25	0,10	0,15
	Plastic, carbon-fibre reinforced									
	Graphite (technical)	0,05	0,06	0,07	0,10	0,12	0,15	0,20	0,10	0,12
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 **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	1,0	1,0	1,0
	1/5	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
	1/10	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
	1/50	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0

---

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

Material group	Cutter type	M5137		M5130				F4042 / F4042R	
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT		 Xtra·tec® XT				 Xtra·tec®	
	Lead angle κ	90°		90°				90°	
		f_{Z0} [mm]		f_{Z0} [mm]				f_{Z0} [mm]	
								F4042	F4042R
	Tool diameter or diameter range [mm]	10–63	50–100	10–63	16–50	25–80	25–160	10–50	16–50
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	5	8	5	9	11	15	8	10
P	Non-alloyed steel [1]	0,14	0,19	0,10	0,14	0,19	0,23	0,13	0,16
	Low-alloy steel	0,11	0,14	0,07	0,10	0,14	0,17	0,09	0,10
	High-alloy steel and tool steel	0,11	0,14	0,07	0,10	0,14	0,17	0,09	0,10
	Stainless steel	0,09	0,12	0,06	0,09	0,12	0,14	0,07	0,09
M	Stainless steel [2]	0,07	0,09	0,06	0,11	0,09	0,11	0,07	0,09
K	Malleable cast iron	0,14	0,18	0,08	0,12	0,18	0,23	0,10	0,13
	Grey cast iron	0,15	0,20	0,10	0,14	0,20	0,28	0,13	0,18
	Cast iron with spheroidal graphite	0,14	0,18	0,08	0,12	0,18	0,23	0,10	0,13
	CGI	0,14	0,18	0,08	0,12	0,18	0,23	0,10	0,13
N	Wrought aluminium alloys			0,08	0,10	0,13	0,14	0,10	
	Cast aluminium alloys			0,08	0,10	0,13	0,14	0,10	
	Magnesium-based alloys [3]			0,07	0,09	0,12	0,14	0,09	
	Copper and copper alloys (bronze/brass)			0,07	0,07	0,09	0,14	0,09	
S	Heat-resistant alloys	0,08	0,11	0,06	0,08	0,11	0,14	0,07	0,09
	Titanium alloys	0,08	0,11	0,06	0,08	0,11	0,14	0,07	0,09
	Tungsten alloys	0,08	0,11	0,06	0,08	0,11	0,14	0,07	0,09
	Molybdenum alloys	0,08	0,11	0,06	0,08	0,11	0,14	0,07	0,09
H	Hardened steel			0,00			0,00		
	Hardened cast iron			0,00			0,00		
O	Thermoplastics			0,10	0,13	0,18	0,21	0,12	0,15
	Plastic, carbon-fibre reinforced			0,00			0,00		
	Graphite (technical)			0,08	0,10		0,16	0,10	0,12
	Indexable insert types	TNMU 11T304R…	TNMU 160508R..	AC..0602..	BC..0903..	BC..1204..	BC..1605..	AD.T0803..	AD.T10T3..
	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	1,0	1,0
	1/5	1,1	1,1	1.1	1,2	1,1	1.1	1,1	1,1
	1/10	1,2	1,2	1.2	1,5	1,2	1.2	1,2	1,2
	1/20	1,3	1,3	1.3	1,8	1,3	1.3	1,3	1,3
	1/50				2,0				

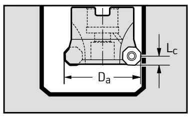
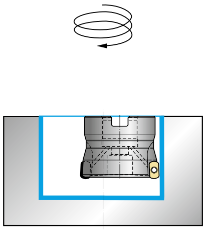
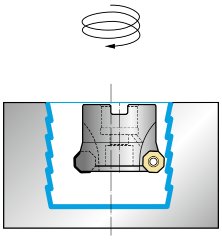
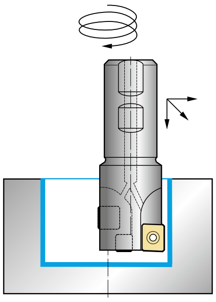
[1] and steel casting

[2] and austenitic/ferritic

[3] 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)

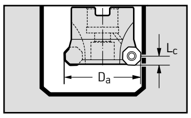
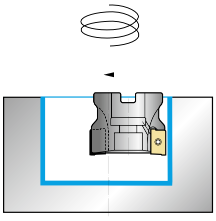
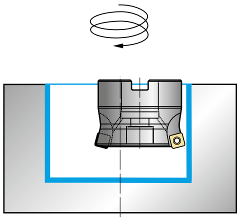
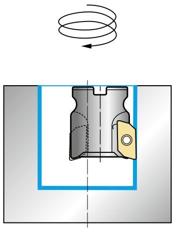
Material group	Cutter type	M5008	M5004		M4792		
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 Xtra·tec® XT	 Xtra·tec® XT				
	Lead angle κ	15°	43°		90°		
		f_{Z0} [mm]	f_{Z0} [mm]		f_{Z0} [mm]		
	Tool diameter or diameter range [mm]	16–66	50–160		17,9–24,9	29,9–31,9	39,9
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	1,0	3	4	13,3	20,8	26,9
P	Non-alloyed steel [1]	0,64	0,40	0,45	0,10*	0,15*	0,20*
	Low-alloy steel	0,64	0,36	0,40	0,10*	0,12*	0,15*
	High-alloy steel and tool steel	0,56	0,27	0,32	0,08*	0,12*	0,15*
	Stainless steel	0,24	0,18	0,32	0,06*	0,08*	0,12*
M	Stainless steel [2]	0,16	0,13	0,13	0,06*	0,08*	0,10*
K	Malleable cast iron	0,16	0,32	0,36	0,12*	0,20*	0,25*
	Grey cast iron	0,80	0,40	0,45	0,10*	0,15*	0,20*
	Cast iron with spheroidal graphite	0,64	0,32	0,36	0,10*	0,15*	0,20*
	CGI	0,64	0,32	0,36	0,10*	0,15*	0,20*
N	Wrought aluminium alloys		0,22	0,22			
	Cast aluminium alloys		0,22	0,22			
	Magnesium-based alloys [3]		0,13	0,13			
	Copper and copper alloys (bronze/brass)		0,13	0,13			
S	Heat-resistant alloys	0,24	0,13	0,13	0,06*	0,10*	0,10*
	Titanium alloys	0,24	0,13	0,13	0,06*	0,10*	0,10*
	Tungsten alloys	0,24	0,13	0,13	0,06*	0,10*	0,10*
	Molybdenum alloys	0,24	0,13	0,13	0,06*	0,10*	0,10*
H	Hardened steel	0,16					
	Hardened cast iron	0,24					
O	Thermoplastics		0,20	0,20			
	Plastic, carbon-fibre reinforced						
	Graphite (technical)		0,15	0,15			
	Indexable insert types	EN..08T3..	OD..0504..	OD..0605..	SD..06T204.. LD..08T204..	SD..09T308.. LD..14T308 ..	SD..120408.. LD..170408..
	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
	1/50						

---

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

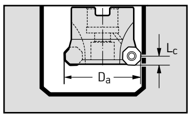
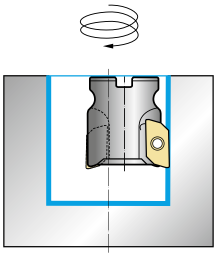
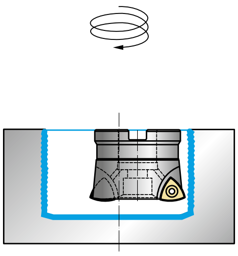
Material group	Cutter type	M4130			M4002			M2331	
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 								
	Lead angle κ	90°			15°			90°	
		f_{Z0} [mm]			f_{Z0} [mm]			f_{Z0} [mm]	
	Tool diameter or diameter range [mm]	16–20	25–50	50–100	20–66	25–66	50–125	32–50	40–50
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	8	13	16	1,0	1,5	2,0	15	20
P	Non-alloyed steel [1]	0,13	0,17	0,22	0,18	0,25	0,30		
	Low-alloy steel	0,09	0,13	0,17	0,16	0,22	0,25		
	High-alloy steel and tool steel	0,09	0,13	0,17	0,12	0,16	0,22		
	Stainless steel	0,07	0,10	0,13	0,10	0,12	0,15		
M	Stainless steel [2]	0,07	0,09	0,10	0,10	0,12	0,15		
K	Malleable cast iron	0,10	0,17	0,22	0,16	0,22	0,28		
	Grey cast iron	0,13	0,22	0,27	0,18	0,25	0,30		
	Cast iron with spheroidal graphite	0,10	0,17	0,22	0,16	0,22	0,28		
	CGI	0,10	0,17	0,22	0,16	0,22	0,28		
N	Wrought aluminium alloys							0,13	0,18
	Cast aluminium alloys							0,13	0,18
	Magnesium-based alloys [3]							0,13	0,18
	Copper and copper alloys (bronze/brass)							0,11	0,13
S	Heat-resistant alloys	0,07	0,10	0,13	0,08	0,10	0,12		
	Titanium alloys	0,07	0,10	0,13	0,08	0,10	0,12		
	Tungsten alloys	0,07	0,10	0,13	0,08	0,10	0,12		
	Molybdenum alloys	0,07	0,10	0,13	0,08	0,10	0,12		
H	Hardened steel								
	Hardened cast iron								
O	Thermoplastics	0,12	0,17	0,20					
	Plastic, carbon-fibre reinforced								
	Graphite (technical)	0,10	0,15	0,15					

Indexable insert types		LD..08T2..	LD..14T3..	LD..1704..	SD..06T2...	SD..09T3...	SD..1204...	ZDGT15A4..	ZDGT20A5..
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	1,0	1,0
	1/5	1,1	1,1	1,1	1,4	1,4	1,4	1,1	1,1
	1/10	1,2	1,2	1,2	1,8	1,8	1,8	1,2	1,2
	1/20	1,3	1,3	1,3				1,3	1,3
Correction factor **K**	1 < (L : D_c) = ≤ 2				1,4	1,4	1,4		
	2 < (L : D_c) = ≤ 4				1,0	1,0	1,0		
$f_Z = f_{Z0} \cdot Ka_e \cdot K$	4 < (L : D_c) = ≤ 6				0,7	0,7	0,7		

[1] and steel casting
[2] and austenitic/ferritic
[3] 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)

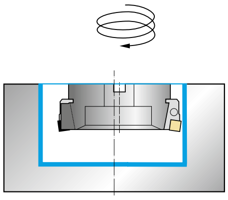
Material group	Cutter type	M2131		F2330		
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 					
	Lead angle κ	90°		0–15°		
		f_{Z0} [mm]		f_{Z0} [mm]		
	Tool diameter or diameter range [mm]	25–80	32–63	20–25	32–85	52–85
	Maximum cutting data $a_{p\,max} = L_c$ [mm]	15	20	1,0	1,5	2,0
P	Non-alloyed steel [1]			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
M	Stainless steel [2]			0,45	0,50	0,70
K	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
N	Wrought aluminium alloys	0,13	0,18			
	Cast aluminium alloys	0,13	0,18			
	Magnesium-based alloys [3]	0,13	0,18			
	Copper and copper alloys (bronze/brass)	0,11	0,13			
S	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
H	Hardened steel					
	Hardened cast iron					
O	Thermoplastics			0,30	0,40	0,50
	Plastic, carbon-fibre reinforced					
	Graphite (technical)			0,20	0,25	0,30

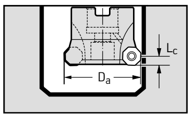
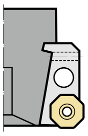
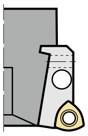
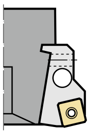
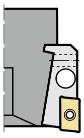
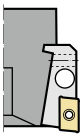
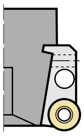
Indexable insert types		ZDGT1504..	ZDGT2005..	P2633.-R10 P26379-R10	P2633.-R14 P26379-R14	P2633.-R25 P26379-R25
Correction factor **Ka_e** for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c	$a_e / D_c =$ 1/1 – 1/2	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,4	1,4	1,4
	1/10	1,2	1,2	1,4	1,4	1,4
	1/20	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
$f_z = f_{Z0} \cdot Ka_e \cdot K$	$4 < (L : D_c) = \leq 6$			0,7	0,7	0,7

[1] and steel casting
[2] and austenitic/ferritic
[3] 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



Material group	**Cutter type F2010…**	**…R592M**	**…R729M**	**…R755M**	**…R718M**	**…R719M**	**…R723M**
	Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\,max} = L_c$ 	 **Xtra·tec® XT**			 **Xtra·tec®**	 **Xtra·tec®**	
	Lead angle κ	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
P	Non-alloyed steel [1]	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
M	Stainless steel [2]	0,13	0,70	0,15	0,09	0,10	0,13
K	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
N	Wrought aluminium alloys	0,22			0,13	0,13	
	Cast aluminium alloys	0,22			0,13	0,13	
	Magnesium-based alloys [3]	0,13			0,10	0,13	
	Copper and copper alloys (bronze/brass)	0,13			0,10	0,13	
S	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
H	Hardened steel						
	Hardened cast iron						
O	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 **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	1,4	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
$f_Z = f_{Z0} \cdot Ka_e$	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			
$f_Z = f_{Z0} \cdot Ka_e \cdot K$	$4 < (L : D_c) = \leq 6$		0,7	0,7			

[1] and steel casting

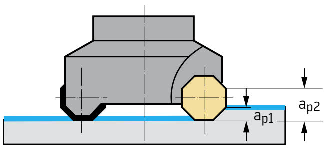
[2] and austenitic/ferritic

[3] 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

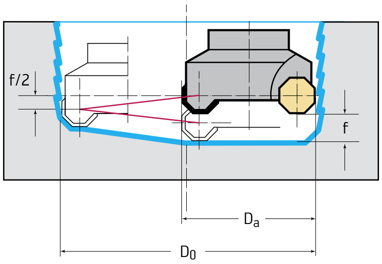
Face milling



Max. milling depth a_p [mm]

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

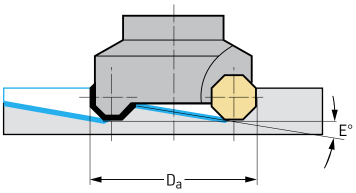
Circular interpolation of a bore into solid material



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

	Indexable insert					
	OD..0504..			OD..0605..		
D_a [mm]	$D_{0\,min}$ [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 [°]

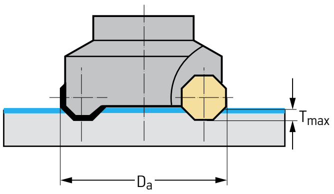
D_a [mm]	OD..0504.. (F4080)	OD..0605.. (F4080)
32	14,0	
36	10,6	
40	8,3	
50	5,5	9,6
52	5,1	8,9
58	4,6	
60		7,7
63	3,8	6,2
66	3,5	5,8
71	3,2	
73		5,4
80	2,7	4,3
88	2,4	

D_a [mm]	OD..050408	OD..0605.. (F4080)	OD..0605.. (F2010.. R592M)
90		4,0	0,40
100	2,0	3,1	
108	2,0		
110		3,1	0,31
125	1,5	2,3	
133	1,5		
135		2,3	0,25
160		1,7	
170		1,7	0,19
210			0,15
260			0,12
325			0,09

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

(continued)

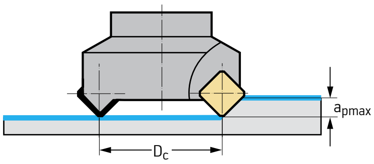
Vertical plunging



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

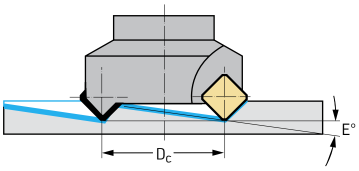
Application information for the M4003 face milling cutter

Face milling



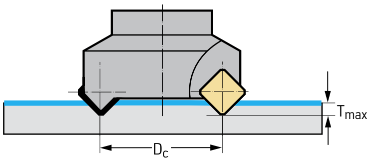
	Max. milling depth a_p [mm]	
	SD..09T3AZN	SD..1204AZN
a_p	4,5	6,5

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

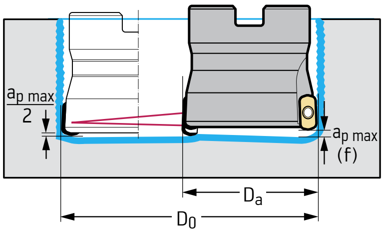


	Max. plunging depth T_{max} [mm]	
	SD..09T3AZN..	SD..1204AZN..
T_{max}	4,5	6,0

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

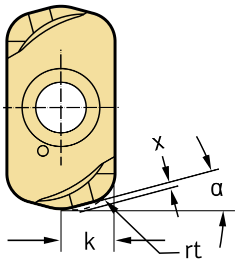
Circular interpolation of a bore into solid material

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



	ENMX08T316R..	
D_a [mm]	$D_{0\,min}$ [mm]	$D_{0\,min}$ [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

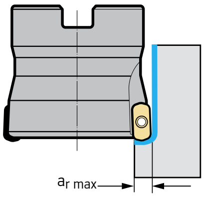


Indexable insert	rt [mm]	x [mm]	k [mm]	α [°]
ENMX08T316R..	2	0,79	3,0	17,7

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

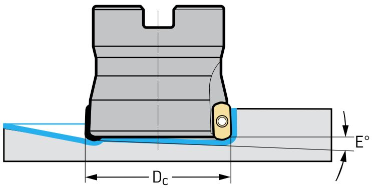
Max. plunging depth [mm]



	ENMX08T316R..
a_r [mm]	3,0

Ramping

Maximum feed angle E [°]



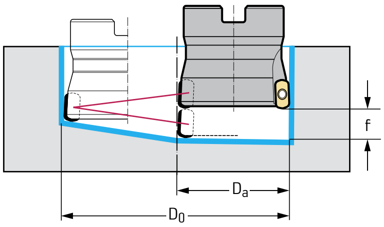
D_a [mm]	ENMX08T316R..
16	2,20
20	1,50
25	1,10
30	0,80
32	0,75
35	0,60
40	0,55
42	0,53
50	0,43
52	0,40
63	0,33
66	0,30

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

(continued)

Circular interpolation of a bore

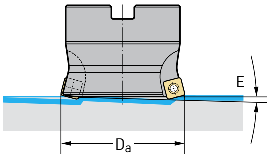
Max. axial feed per tool revolution ("thread pitch") f [mm]



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 [°]

	SD..06T2..						
D_a [mm]	r = 0,4	r = 0,8	r = 1,2	r = 1,6	r = 2,0	r = 2,5	ZDR
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 [°]

	SD..09T3..						
D_a [mm]	r = 0,4	r = 0,8	r = 1,2	r = 1,6	r = 2,0	r = 2,5	ZDR
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 [°]

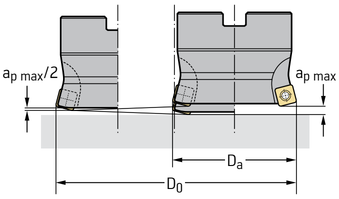
	SD..120408..						
D_a [mm]	r = 0,4	r = 0,8	r = 1,2	r = 1,6	r = 2,0	r = 2,5	ZDR
50		1,9	1,7	1,5	1,3	1	1
52		1,8	1,6	1,4	1,2	0,9	0,9
63		1,2	1,1	0,9	0,8	0,6	0,6
66		1,1	1	0,9	0,7	0,6	0,6
80		0,8	0,7	0,6	0,5	0,4	0,4
85		0,7	0,7	0,6	0,5	0,4	0,3
100		0,5	0,4	0,4	0,3	0,2	0,2
125		0,4	0,4	0,3	0,3	0,2	0,2

Application information for M4002/F2010 high-feed milling cutters

(continued)

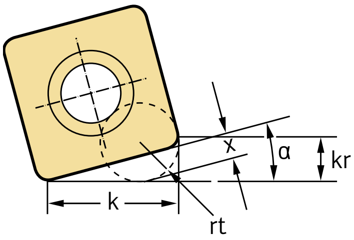
Circular interpolation of a bore into solid material

Diameter range for milling a hole in one pass



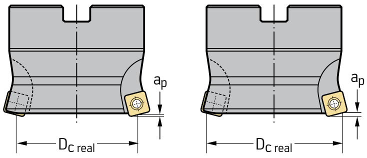
	Indexable insert					
	SD..06T204		SD..09T308		SD..120408	
D_a [mm]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]
20	28,6	40				
25	38,6	50	33,26	50		
32	52,6	64	47,26	64		
35	58,6	70	53,26	70		
40	68,6	80	63,26	80		
42	72,6	84	67,26	84		
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

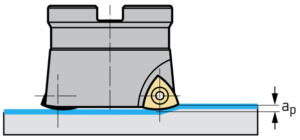


$$D_{c\,real} \approx D_c + 8 \cdot a_p$$

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

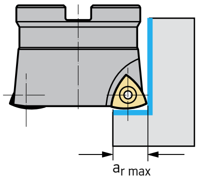
Application information for F4030/F2010 high-feed milling cutters

Face milling



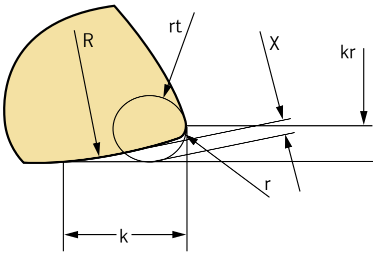
	Max. milling depth a_p [mm]	
	P23696−1.0	P23696−2.0
$a_{p\,max}$	1,0	2,0

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	9,5
50	7	10
52	7	10
63	7	10
66		10
80		10
85		10
100		10

Programming information



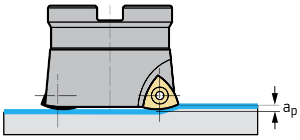
Indexable insert	R [mm]	r [mm]	rt [mm]	k [mm]	kr [mm]	X [mm]
P23696 – R 1.0	14	1,2	2,0	5,8	2,1	0,6
P23696 – R 2.0	18	1,6	3,5	9,2	3,5	1,1

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

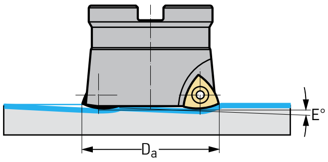
Max. milling depth a_p [mm]



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

Ramping

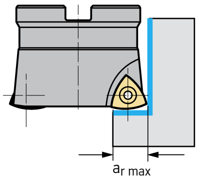
Maximum feed angle E [°]



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]



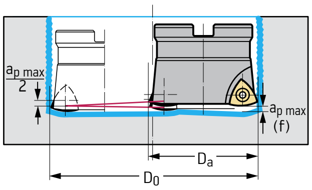
	P2633. – R10 P26379 – R10	P2633. – R14 P26379 – R14	P2633. – R25 P26379 – R25
$a_{r\,max}$	7	10,3	15

Application information for F2330/F2010 high-feed milling cutters

(continued)

Circular interpolation of a bore into solid material

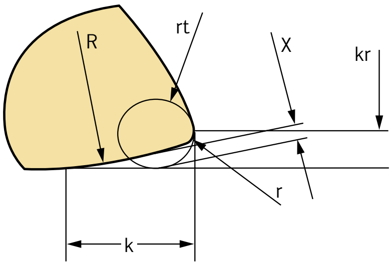
Diameter range for milling a hole in one pass [mm]



	Indexable insert					
	P2633. – R10 P26379 – R10*		P2633. – R14 P26379 – R14*		P2633. – R25 P26379 – R25*	
D_a [mm]	$D_{0\,min}$ [mm]	$D_{0\,min}$ [mm]	$D_{0\,min}$ [mm]	$D_{0\,min}$ [mm]	$D_{0\,min}$ [mm]	$D_{0\,min}$ [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



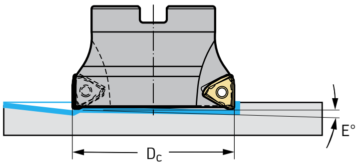
Indexable insert	R [mm]	r [mm]	rt [mm]	k [mm]	kr [mm]	X [mm]
P2633. – R10	10,0	0,8	2,0	4,0	1,8	0,5
P2633. – R14	14,0	1,2	2,5	5,5	2,6	0,8
P2633. – R25	25,0	2,0	3,0	8,0	3,4	0,9
P26379 – R10	10,0	0,4	1,5	4,8	1,5	0,63
P26379 – R14	14,0	0,4	2,2	7,2	2,2	0,91
P26379 – R25	25,0	0,4	2,8	9,6	2,8	1,05

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

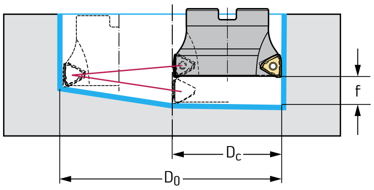
Plunging with the Xtra·tec® XT M5137 shoulder milling cutter/plunging angle E_{max} [°]



Milling cutter dia.	TNMU11T304R… $a_{p\,max}$ = 5 mm				TNMU160508R… $a_{p\,max}$ = 8 mm			
D_c [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

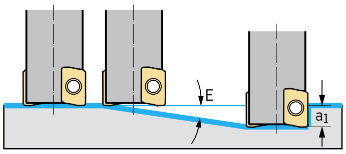
Max. axial feed per tool revolution ("thread pitch") f [mm]

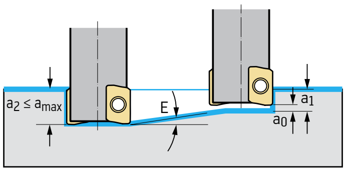


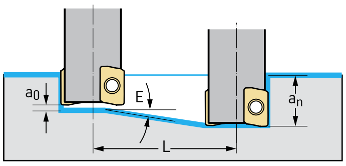
Machined hole diameter	TNMU11T304R… D_c [mm]					TNMU160508R.. D_c [mm]			
D_0 [mm]	25	32	40	50	63	50	63	80	100
30	0,9								
40	2,6	1,0							
50	4,3	2,2	0,9						
60	5,0	3,4	1,9	0,7					
70	5,0	4,6	2,8	1,4	0,3				
80	5,0	5,0	3,7	2,1	0,8				
90	5,0	5,0	4,7	2,9	1,3				
100	5,0	5,0	5,0	3,6	1,8	3,6			
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				

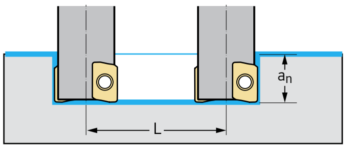
Application information for the Xtra·tec® XT M5130 shoulder milling cutter

Ramping and circular plunging into solid material









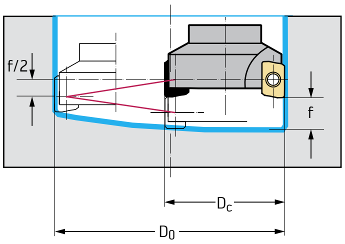
Plunging angle E_{max} [°]

Milling cutter dia.	AC..0602.. $a_{p\,max}$ = 5 mm				BC..0903.. $a_{p\,max}$ = 9 mm			
D_c [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]
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.	BC..1204.. $a_{p\,max}$ = 12 mm				BC..1605.. $a_{p\,max}$ = 15 mm			
D_c [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]
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



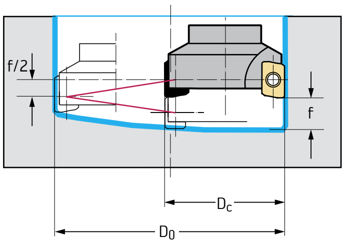
Max. axial feed per tool revolution ("thread pitch") f [mm]

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_0 [mm]	BC..0903.. D_c [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]

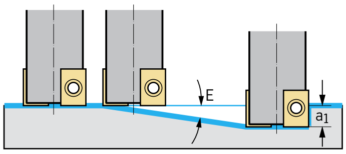
Machined hole diameter D_0 [mm]	BC..1204.. D_c [mm]						
	22	25	32	40	50	63	80
30	3,1						
40	7,0	4,8					
50	11,0	8,0	3,8				
60	12,0	11,2	5,8				
80	12,0	12,0	7,9	4,6			
100	12,0	12,0	10,0	6,1			
120	12,0	12,0	12,0	7,7	4,6		
150	12,0	12,0	12,0	9,2	5,8		
180	12,0	12,0	12,0	12,0	8,1	5,0	
200	12,0	12,0	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

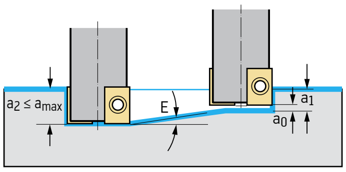
Max. axial feed per tool revolution (“thread pitch”) f [mm]

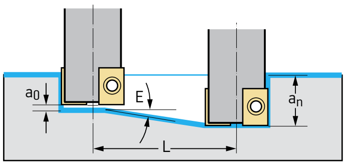
Machined hole diameter D_0 [mm]	BC..1605.. D_c [mm]														
	25	28	32	35	40	42	50	52	63	66	80	85	100	125	160
40	7,3	4,7													
50	12,2	8,6	5,7	4,1											
60	15,0	12,5	8,9	6,9											
70	15,0	15,0	12,1	9,6	6,8	5,8									
80	15,0	15,0	15,0	12,4	9,0	7,9									
90	15,0	15,0	15,0	15,0	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

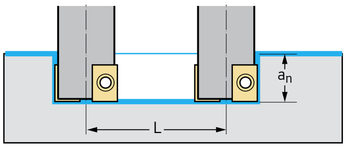
Application information for Xtra·tec® F4042/F4042R shoulder milling cutters

Ramping and circular plunging into solid material









Plunging with Xtra·tec® F4042/F4042R shoulder milling cutters

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

Plunging with the Xtra·tec® F4042 shoulder milling cutter

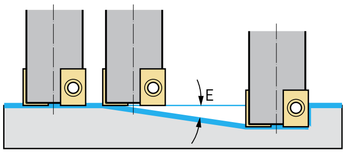
Milling cutter dia.	AD..120408 $a_{p\,max}$ = 11 mm				AD..160608 $a_{p\,max}$ = 15 mm			
D_c [mm]	Plunging angle E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	a_0 [mm]	Plunging angle E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	a_0 [mm]
22	7,4	30	44	2,6				
25	8,5	36	50	2,3	8,5	32	50	1,7
32	5,6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

Plunging with the Xtra·tec® F4042 shoulder milling cutter

Milling cutter dia.	AD..180712 $a_{p\,max}$ = 16 mm			
D_c [mm]	Plunging angle E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [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)



D_c [mm]	AD..1204.. (F2010..R718M)	AD..1606.. (F2010..R719M)
	Maximum feed angle E [°] for F2010	
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:

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

Number of inclined ramping operations:

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

Feed angle:

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

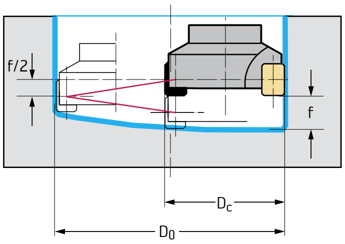
Explanation of abbreviations:

a_0	[mm]	Amount by which the tool must be lifted at the end of plunging before starting the next plunging operation
a_n	[mm]	Groove depth
a_{max}	[mm]	Max. milling depth of the tool
E	[°]	Feed angle
L	[mm]	Groove length without radius
n		Number of inclined ramping operations

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_0 [mm]	AD..080304 D_c [mm]										AD..10T308 D_c [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]

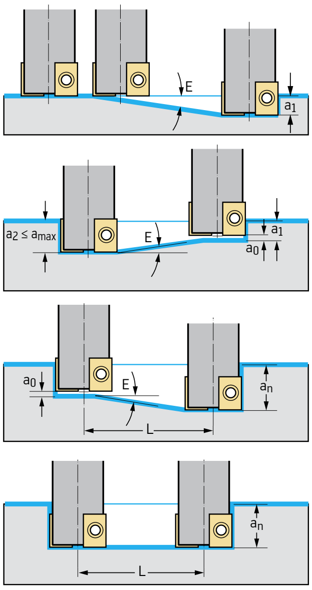
Machined hole diameter D_0 [mm]	AD..120408 D_c [mm]							AD..160608 D_c [mm]													
	22	25	32	40	50	63	80	25	32	36	40	44	50	54	63	66	80	84	100	125	160
32								3,4													
40	7,2	7,0						7,2													
50	11,3	11,0	5,5					11,5	7,6												
60	11,7	11,0	8,6					15,0	11,7	9,4											
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	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	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	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	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	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

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

Machined hole diameter D_0 [mm]	AD..180712 D_c [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

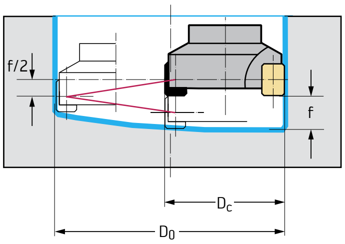
Ramping and circular plunging into solid material



Maximum feed angle E [°]

D_c [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

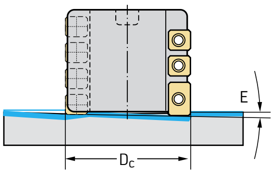


Max. axial feed per tool revolution ("thread pitch") f [mm]

Machined hole diameter		LD..08T204R.. D_c [mm]			LD..14T308R.. D_c [mm]					LD..170408R.. D_c [mm]					
$D_{0\,min}$ [mm]	$D_{0\,max}$ [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

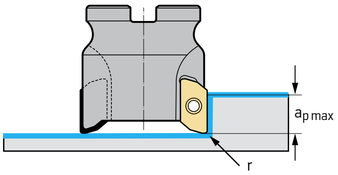


Maximum feed angle E [°]

D_c [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

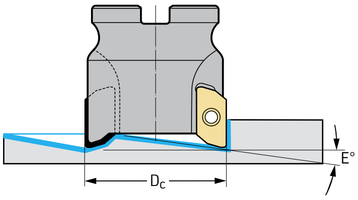
Application information for the M2331 ramping milling cutter

Shoulder milling



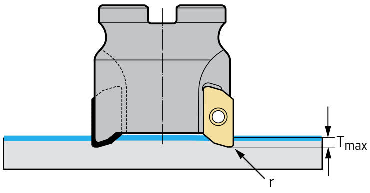
	Max. milling depth a_{max} [mm]	
Corner radius r [mm]	ZDGT15A4..	ZDGT20A5..
0,4	16,0	21,3
0,8	16,0	21,3
1,2	15,9	21,2
1,6	15,8	21,0
2,0	15,7	20,9
2,5	15,5	20,8
3,0	15,4	20,6
4,0	15,1	20,3
5,0		20,0
6,0		19,8
6,4		19,7

Ramping



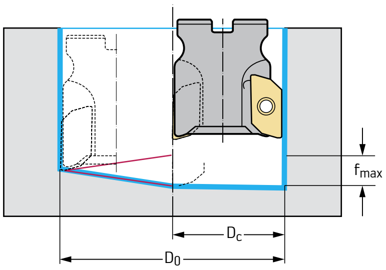
	Maximum feed angle E [°]	
D_c [mm]	ZDGT15A4..	ZDGT20A5..
32	11	
40	7	12
50	5	8

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

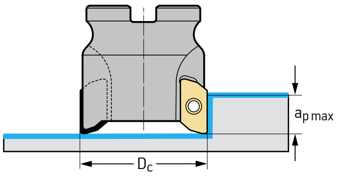


	Possible hole diameters and axial feeds					
Milling cutter dia. D_c [mm]	ZD..15A4..			ZD..20A5..		
	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	f_{max} [mm]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	f_{max} [mm]
32	45	64	7,9			
40	61	80	8,1	54	80	9,3
50	81	100	8,5	74	100	10,6

Application information for the M2131 ramping milling cutter

Shoulder milling

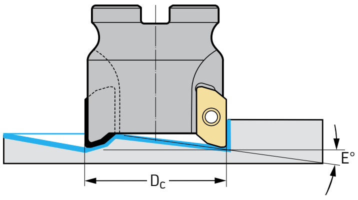
Max. milling depth a_p [mm]



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

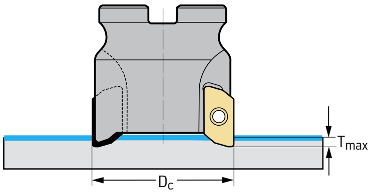
Maximum feed angle E [°]



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

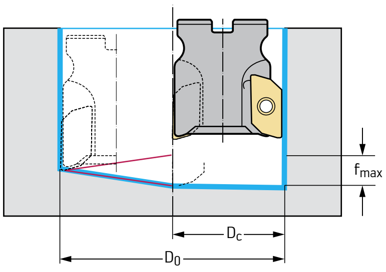
Max. plunging depth T_{max} [mm]



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

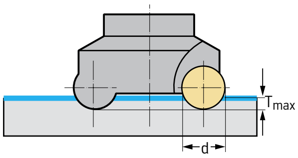
Possible hole diameters and axial feeds



Milling cutter dia. D_c [mm]	ZDGT1504..			ZDGT2005..		
	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	f_{max} [mm]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [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



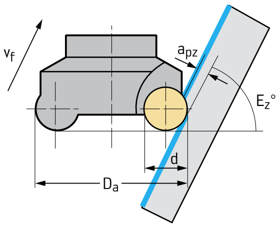
Max. plunging depth T_{max} [mm]

	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
T_{max} [mm]	1,1	1,5	2,0	2,5

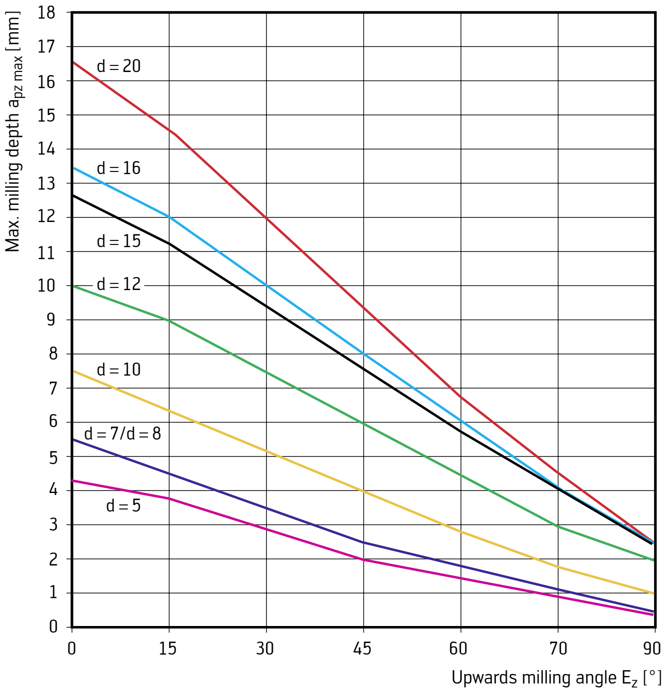
Max. plunging depth T_{max} [mm]

	Indexable insert diameter d [mm]			
	RO.X1204M08.. d = 12 mm	RO.X1605M08.. d = 16 mm	RO.X2006M08.. d = 20 mm	
T_{max} [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]

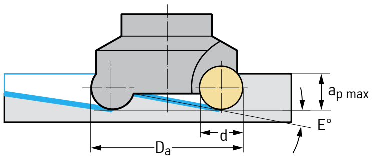


Application information for the Xtra·tec® XT M5468 copy milling cutter

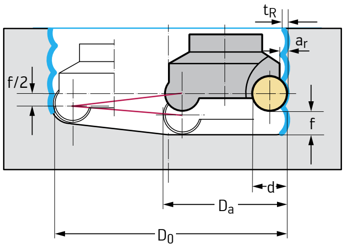
(continued)

Ramping and circular plunging into solid material

Ramping



Circular interpolation of a bore into solid material



Plunging

Milling cutter dia.	Indexable insert diameter d [mm]								
	RD..0501M0.. $a_{p\,max}$ = 2,5 mm			RD..07T1M0.. $a_{p\,max}$ = 3,5 mm			RO.X0804M04.. $a_{p\,max}$ = 4 mm		
D_a [mm]	E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [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.	Indexable insert diameter d [mm]								
	RO.X10T3M08.. $a_{p\,max}$ = 5 mm			RO.X1204M08.. $a_{p\,max}$ = 6 mm			RO.X1605M08.. $a_{p\,max}$ = 8 mm		
D_a [mm]	E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [mm]	E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [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

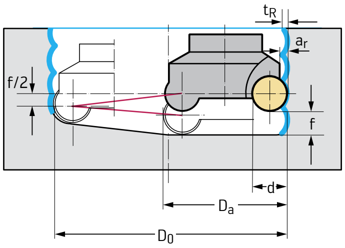
Plunging

Milling cutter dia.	Indexable insert diameter d [mm]								
	RO.X2006M08.. $a_{p\,max}$ = 10 mm								
D_a [mm]	E_{max} [°]	$D_{0\,min}$ [mm]	$D_{0\,max}$ [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)
$a_{r\,max}$	0,5	0,5	1,25	1,5

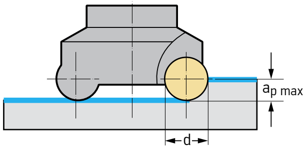
Groove depth on the wall of the hole t_R [mm]

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	
$a_{r\,max}$	2,0	3,0	4,5	

The values in brackets only apply to short bores.

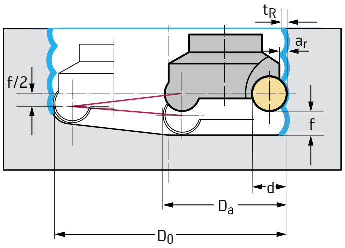
Application information for F2334R/F2010 button insert milling cutters

Face milling



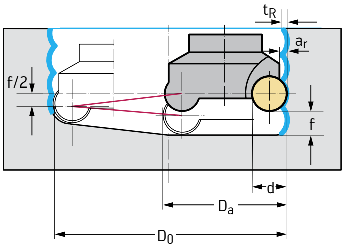
	Indexable insert diameter d [mm]	
	d = 10	d = 12
$a_{p\,max}$ [mm]	5,0	6,0

Circular interpolation of a bore into solid material



	Indexable insert diameter d [mm]			
	d = 10		d = 12	
D_a [mm]	$D_{0\,min}$ [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]

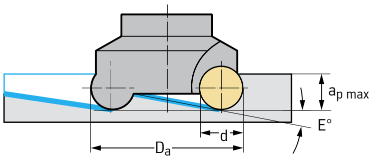


Axial feed per revolution f [mm]	Indexable insert diameter d [mm]	
	d = 10	d = 12
1	0,025	0,02
2	0,010	0,08
3	0,230	0,19
4	0,417	0,34
5	0,670	0,54
6	(1,000)	0,80
7	(1,429)	(1,12)
8		(1,53)
$a_{r\,max}$	1,5	2,0

The values in brackets only apply to short bores.

Ramping

F2334R: Maximum feed angle E [°]



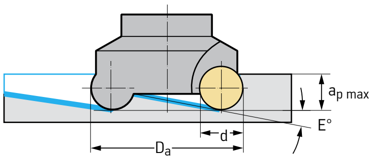
	Indexable insert diameter d [mm]	
D_a [mm]	d = 10	d = 12
25		
32	8,6	
40	5,8	7,9
50	4,0	5,4
52	3,9	5,3
63	3,0	3,4
66	2,8	3,4
80		2,6
$a_{p\,max}$ [mm]	8,8	10,5

Application information for F2334R/F2010 button insert milling cutters

(continued)

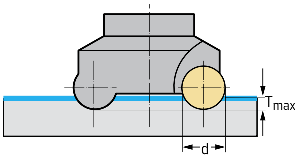
Ramping

F2010: Maximum feed angle E [°]



	Indexable insert diameter d [mm]	
D_a [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	

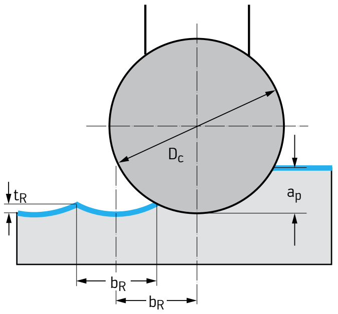
Vertical plunging



	Indexable insert diameter d [mm]	
	d = 10	d = 12
T_{max} [mm]	2,6	3,1

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

Line-by-line milling



Groove depth:

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

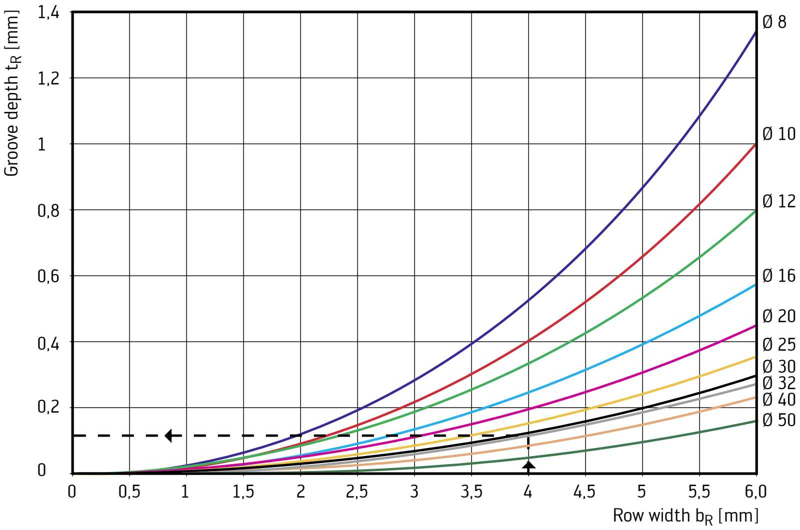
0.3 to 0.5 mm
material removal when
finishing depending on
tool diameter

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

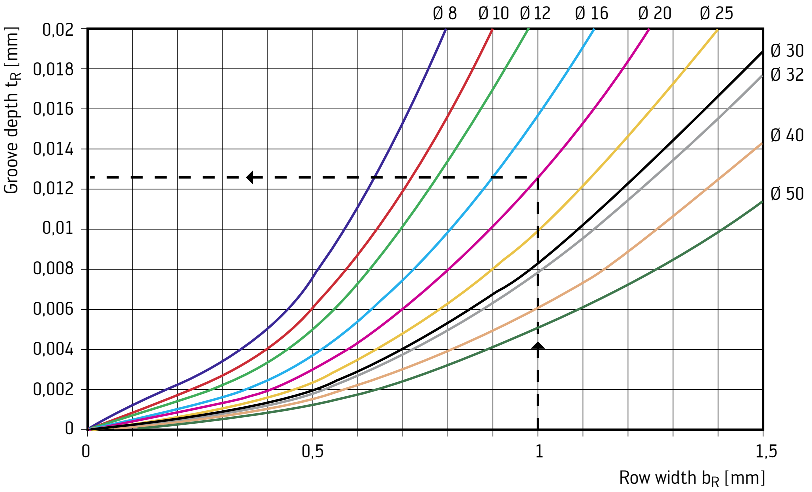
Semi-finishing – Roughing

Example:
D_c = 32 mm
b_R = 4 mm
→ t_R = 0.125 mm



Finishing

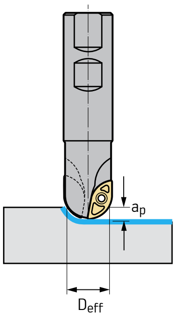
Example:
D_c = 20 mm
b_R = 1.0 mm
→ t_R = 0.0125 mm



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

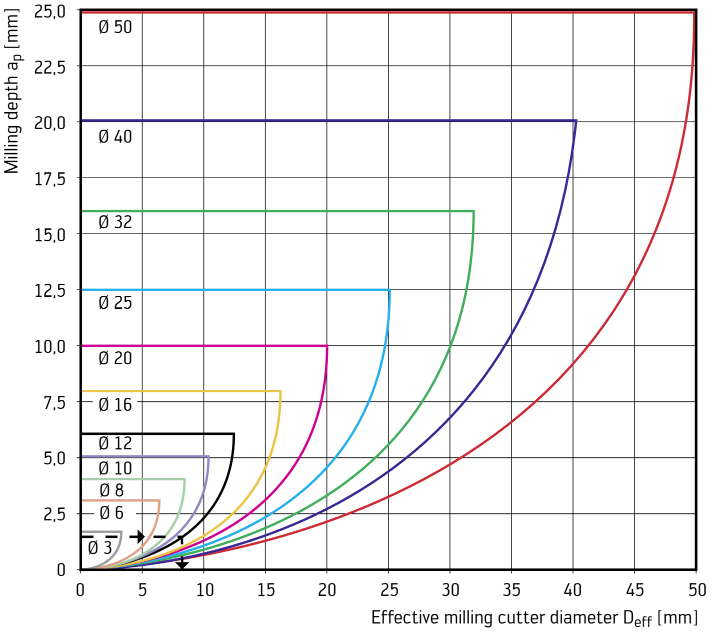
(continued)

Determining the effective cutting diameter



Example:

D_c = 12 mm
a_p = 1,5 mm
→ D_{eff} = 8 mm

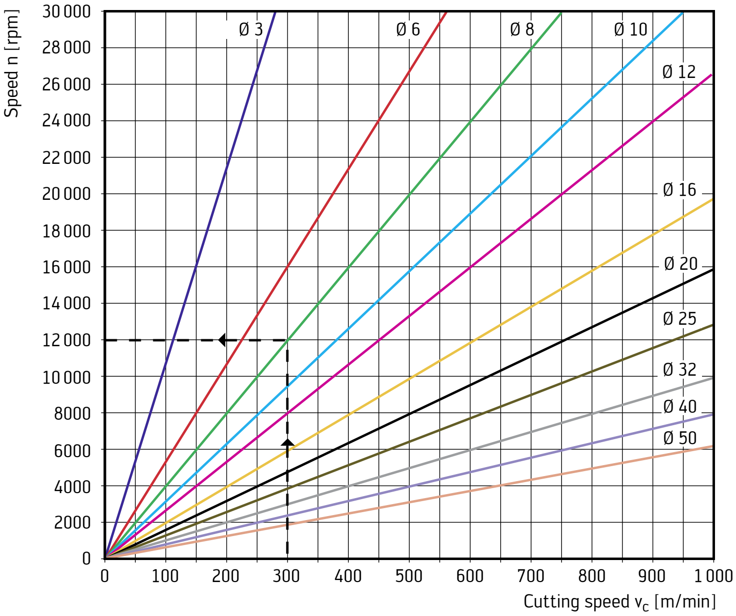


Determining the required speed

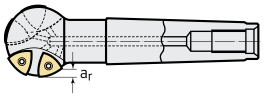
Example:

D_{eff} = 8 mm
v_c = 300 m/min
→ n = 12,000 rpm

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



Radial plunging with F2239B

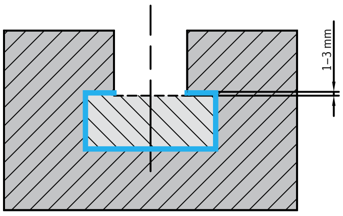


Tool dia. D_c [mm]	a_r [mm]
20	2,0
25	2,8
30	3,5
32	4,4
40	4,6
50	5,0

Strategies for preparing a T-slot

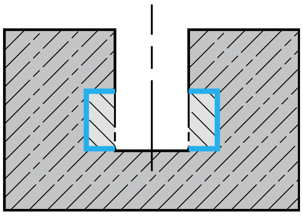
Strategies

Strategy 1



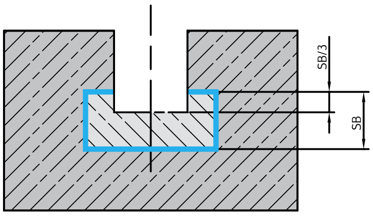
Strategy 1 is recommended if vibration is expected during machining. The prepared slot should protrude 1–3 mm deep into the T-slot so that the shank of the T-slot milling cutter is clear.

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

1. Maximum permissible speeds:
   The limit values specified in the tables should not be exceeded. Otherwise, correct operation and/or reliability are no longer guaranteed.
2. 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.
3. Observe the torque specified in the catalogues.
4. Balancing:
   Balancing in two steps is required when milling at fast speeds (> 6000 rpm) or at circumferential speeds of > 1000 m/min:
   a. 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.
   b. 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.
5. Short projection lengths reduce concentricity faults and 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 ≤ 2.2 × D_c. For tools with longer necks, the speeds must be reduced upon consultation with Walter.

			n_{max} [rpm] with D											
Tool	Safety-related parts	In relation to	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_a		40.000	40.000			40.000		40.000				
	RD . . 07T1M0 . .	D_a					40.000			40.000				40.000
	RO . X0803M04 . .	D_a						40.000						40.000
	RO . X10T3M08 . .	D_a								40.000				40.000
	RO . X1204M08 . .	D_a											36.400	
	RO . X1605M08 . .	D_a												
	RO . X2006M08 . .	D_a												
M5460	P32 . .	D_c						40.000*		40.000*				40.000*
M5137	TNMU11T304R	D_c												24.400
	TNMU160508R	D_c												
M5130	AC . T0602 . .	D_c		40.000	40.000	40.000		40.000	40.000	40.000		40.000		40.000
	BC . T0903 . .	D_c						40.000	40.000	40.000		38.700		36.000
	BC . T1204 . .	D_c												28.100
	BC . T1605 . .	D_c												22.300
M5012	SN . X0904 . .	D_c												
	SN . X1205 . .	D_c												
M5012 . . . -AP	SN . X1205 . .	D_c												
M5011	SN . X1205 . .	D_c												
M5011 . . . -AP	SN . X1205 . .	D_c												
M5009	SN . X0904 . .	D_c												34.100
	SN . X1205 . .	D_c												
M5009 . . . -AP	SN . X1205 . .	D_c												
M5008	ENMX08T316R . .	D_a							32.700	29.200				26.100
M5004	OD . . 0504 . .	D_a												
	OD . . 0504 . .	D_a												
M4792	SD . . 06T204 . .	D_c							14.000	12.000				
	LD . . 08T204 . .	D_c							14.000	12.000				
	SD . . 09T308 . .	D_c												10.000
	LD . . 14T308 . .	D_c												10.000
	SD . . 120408 . .	D_c												
	LD . . 170408 . .	D_c												

[1] 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 guards:
   Appropriate safety guards or machine enclosures must be used to securely collect particles that spin off such as chips or parts of cutting edges 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. Use 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_{max} [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_{max} [rpm] with D											
Tool	Safety-related parts	In relation to	Ø 08	Ø 10	Ø 12	Ø 14	Ø 15	Ø 16	Ø 18	Ø 20	Ø 21	Ø 22	Ø 24	Ø 25
M4574	SD..06T2..	D_c	31.400	29.600	28.100			23.600						
	SD..09T3..	D_c			35.000			32.500		30.400				28.400
	SD..1204..	D_c												20.600
M4575	SD..06T2..	D_c									28.000			25.300
	SD..09T3..	D_c												
	SD..1204..	D_c												
M4256	SD..06T204..	D_c								34.300				29.400
	LD..08T204..	D_c								34.300				29.400
M4257	SD..09T308..	D_c												
	LD..14T308..	D_c												
M4258	SD..1204..	D_c												
	LD..1704..	D_c												
M4132	SD..06T2..	D_c						31.700		28.300				25.300
	SD..09T3..	D_c												34.900
	SD..1204..	D_c												
M4130	LD..08T204...	D_c						40000		34.300				29.400
	LD..14T308...	D_c												40.000
	LD..170408...	D_c												
M4003	SD..09T3...	D_c								40.000				38.000
	SD..1204...	D_c												33.300
M4002	SD..06T2...	D_a								28.300				25.300
	SD..09T3...	D_a												34.900
	SD..1204...	D_a												
M3255	LNHX1206..	D_c												
	XNHX1306..	D_c												
M3024	XN.U0705..	D_c												
	XN.U0906..	D_c												
M3016	LNMX2010..	D_c												
M2471	RNMX1005..	D_c												27.200
	RNMX1206..	D_c												
M2331	ZD..15A4..	D_c												
	ZD..20A5..	D_c												
M2131	ZDGT1504..	D_c												40.000
	ZDGT2005..	D_c												
M2136	SNEF1204..	D_c												
M2025	ONHF..0504..	D_c												
	P45424-1	D_c												
M2026	ONHF..0504..	D_c												
	P45424-2	D_c												
F5041	LN..0904..	D_c												39.600
F5141	LN..1306..	D_c												
F5241	LN..1607..	D_c												

[1] 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_{max} [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
			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	
			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			

Continued →

Notes on high-speed cutting

(continued)

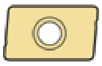
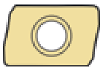
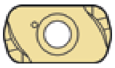
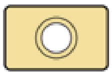
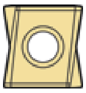
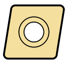
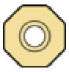
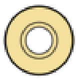
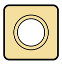
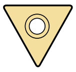
			n_{max} [rpm] with D											
Tool	Safety-related parts	In relation to	Ø 08	Ø 10	Ø 12	Ø 14	Ø 15	Ø 16	Ø 18	Ø 20	Ø 21	Ø 22	Ø 24	Ø 25
F5038	LN..0904..	D_c												39.600
F5138	LN..1306..	D_c												
F5055	SX..	D_c												
F4038	AD..0803..	D_c								40.000*				38.000
F4138	AD..1204..	D_c		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

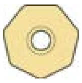
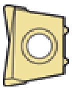
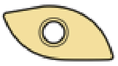
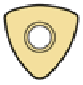
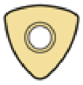
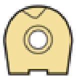
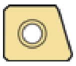
[1] The specified speed of 40,000 rpm refers to the entire tool diameter range of 8–32 mm.

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

n_{max} [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							
								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	

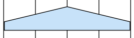
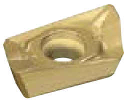
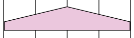
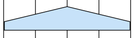
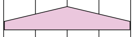
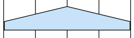
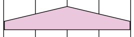
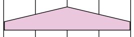
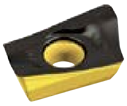
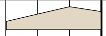
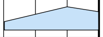
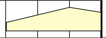
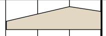
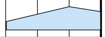
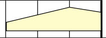
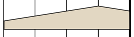
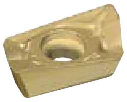
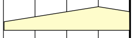
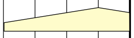
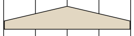
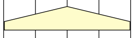
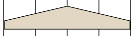
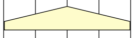
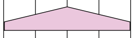
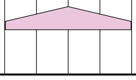
Indexable inserts for milling product range overview

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

Insert shape	Description
 **X**	Double-sided heptagonal for **Walter BLAXX** and **Xtra·tec® XT**
 **X**	Tangential rhombic for **Walter BLAXX**
 **X**	Positive form inserts for copy milling cutters
 P 236..	Double-sided triangular for **Xtra·tec**® high-feed milling cutters
 P 263..	Positive triangular for high-feed milling cutters for copy milling cutters
 P 32..	Indexable inserts for copy finishing cutters for **Xtra·tec® XT**
	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 P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	Application range 01 05 10 15 20 25 30 35 40 45	Coating process	Coating composition	Example of indexable insert
WKP35G	HC – P 35	●●								ULP-CVD	TiAlN+TiN	
	HC – K 35			●●								
WKP35S	HC – P 35	●●								CVD	TiCN + Al_2O_3 (+ TiCN)	
	HC – K 35			●●								
WKP25S	HC – P 25	●●								CVD	TiCN + Al_2O_3 (+ TiCN)	
	HC – K 25			●●								
WAK15	HC – K 15			●●						CVD	TiCN + Al_2O_3 (+ TiN)	
WSP45G	HC – S 45					●●				PVD	TiAlN + Al_2O_3 + (ZrN)	
	HC – P 45	●●										
	HC – M 45		●●									
WSP45S	HC – S 45					●●				PVD	TiAlN + Al_2O_3 (Al)	
	HC – P 45	●●										
	HC – M 45		●●									
WMP45G	HC – S 45					●●				ULP-CVD	TiAlN + TiN	
	HC – M 45		●●									
WSM45X	HC – S 45					●●				CVD	TiCN + Al_2O_3 (+ TiCN)	
	HC – M 45		●●									
WSM35G	HC – S 35					●●				PVD	TiAlN + Al_2O_3 + (ZrN)	
	HC – M 35		●●									
WSM35S	HC – S 35					●●				PVD	TiAlN + Al_2O_3 (Al)	
	HC – M 35		●●									
WKK25G	HC – K 25			●●						PVD	TiAlN + Al_2O_3 + (ZrN)	
WKK25S	HC – K 25			●●						PVD	TiAlN + Al_2O_3 (Al)	

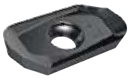
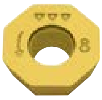
HC = Coated carbide

●● Primary application
● Additional application

Cutting tool material application charts – Milling

(continued)

Coated carbide

		Material groups							Application range			
Walter grade designation	Standard designation	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	Coating process	Coating composition	Example of indexable insert
WSP46	HC – S 45					●●			35–45	PVD	TiAlN + Al_2O_3	
	HC – P 45	●●							35–45			
	HC – M 45		●●						35–45			
WSM36	HC – S 35					●●			25–45	PVD	TiAlN + Al_2O_3	
	HC – M 35		●●						25–45			
WHH15X	HC – H 15						●●		10–20	PVD	TiAlN- TiAlCrSiN	
	HC – P 15	●							10–20			
	HC – K 15			●					10–20			
WNN15	HC – N 15				●●				10–20	PVD	TiAlN	
WXN15	HC – N 15				●●				10–20	PVD	$TiCN^{plus}$	
WXM15	HC – P 15	●●							10–20	PVD	Multilayer TiAlN/ TiN	
	HC – M 15		●						10–20			
	HC – K 15			●					10–20			

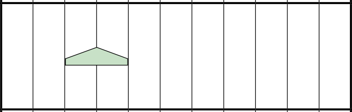
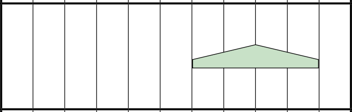
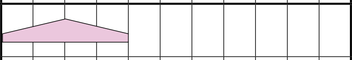
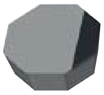
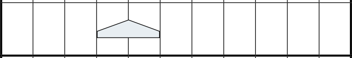
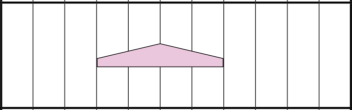
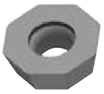
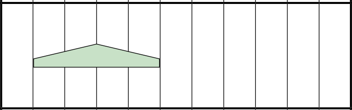
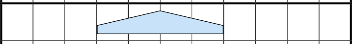
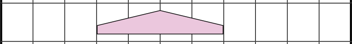
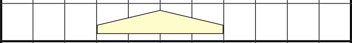
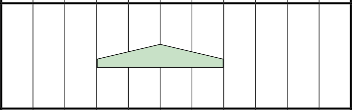
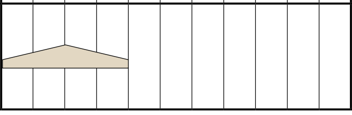
HC = Coated carbide

●● Primary application
● Additional application

Cutting tool material application charts – Milling

(continued)

Uncoated carbide, ceramic, CBN and PCD

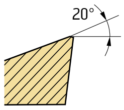
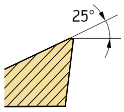
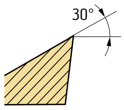
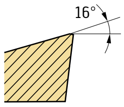
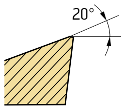
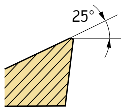
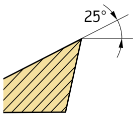
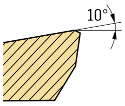
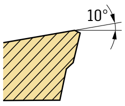
		Material groups							Application range			
Walter grade designation	**Standard designation**	**P** Steel	**M** Stainless steel	**K** Cast iron	**N** NF metals	**S** Materials with difficult cutting properties	**H** Hard materials	**O** Other	01 05 10 15 20 25 30 35 40 45	**Coating process**	**Coating composition**	**Example of indexable insert**
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_3N_4
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

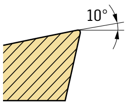
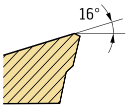
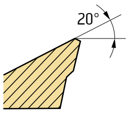
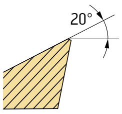
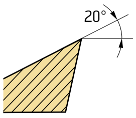
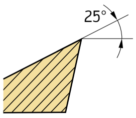
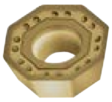
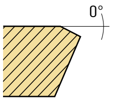
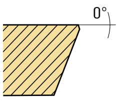
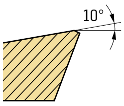
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P Steel	**M** Stainless steel	**K** Cast iron	**N** NF metals	**S** Materials with difficult cutting properties	**H** Hard materials	**O** Other	
 AC.T	**G55/G65 – The universal one** –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

●● Primary application
● Additional application

Geometry overview of positive milling indexable inserts

(continued)

Indexable insert geometries

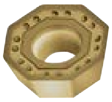
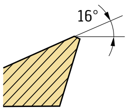
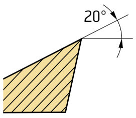
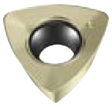
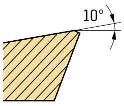
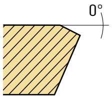
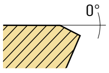
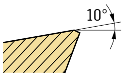
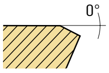
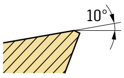
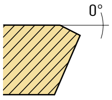
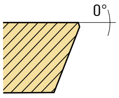
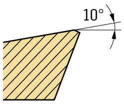
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 AD.T..	**D67 – The powerful one** – High cutting edge stability – 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
	F56 – The universal one – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			
	G56 – The easy-cutting one – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			
	G77 – The special one – For machining titanium materials – Low cutting forces – High level of accuracy		●	●●			●●			
	G88 – The sharp one – For aluminium machining – Low cutting forces – Sharp cutting edges					●●			●	
 ZDGT..	**K85 – The universal one** – For aluminium machining – Low cutting forces – Sharp cutting edges					●●				M2131 M2331
 OD..	**A27 – The stable one** – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					F2010 M5004
	A57 – The special one – For medium machining conditions – Predominantly for cast iron machining		●		●●					
	D57 – The universal one – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			

●● Primary application
● Additional application

Geometry overview of positive 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**	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 OD..	**F57 – The easy-cutting one** – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			**F2010** **M5004**
	G88 – The sharp one – For aluminium machining – Low cutting forces – Sharp cutting edges					●●			●	
 P263..	**P26335 – The easy-cutting one** – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●●		●●			**F2010** **F2330**
	P26337 – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●		●			
	P26339 – The universal one – For medium machining conditions – Universal application for most materials	Cutting corner  Main cutting edge 	●●	●●	●●		●●			
	P26379 – The special one – For circular interpolation machining – Universal application for most materials – Wiper version	Cutting corner  Main cutting edge 	●●	●●	●●		●●			
 RD.X.. / RO.X..	**A27 – The stable one** – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					**F2334R** **M5468**
	A57 – The special one – For medium machining conditions – Specially designed for ISO H machining		●		●●					
	D57 – The universal one – For medium machining conditions – Universal application for most materials		●●	●●	●●		●●			

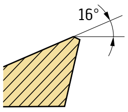
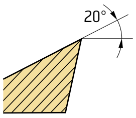
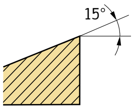
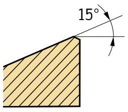
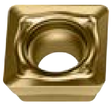
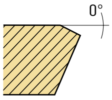
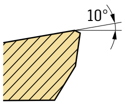
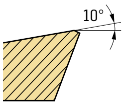
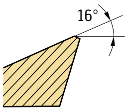
●● Primary application

● Additional application

Geometry overview of positive milling indexable inserts

(continued)

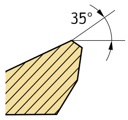
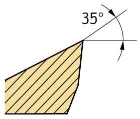
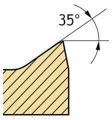
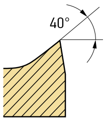
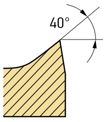
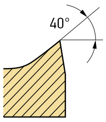
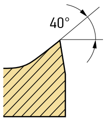
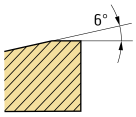
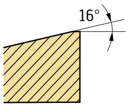
Indexable insert geometries

Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	**M**	**K**	**N**	**S**	**H**	**O**	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 RD.X.. / RO.X..	**F67 – The easy-cutting one** – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●		●●			**F2334R** **M5468**
	G88 – The sharp one – For aluminium machining – Low cutting forces					●●				
 SDMX	**E57 – The universal one** – Curved cutting edge – For medium machining conditions – Moderate feeds		●●	●●	●●		●●			**M4002**
	E27 – The stable one – Curved cutting edge – For medium to unfavourable machining conditions – Moderate to high feeds		●●	●●	●●		●●			
 SD..  LDM..	**A57 – The special one** – For unfavourable machining conditions – Maximum cutting edge stability – High feeds – No waves on the flank face		●●		●●					**M4002** (only SD..) **M4132** (only SD..) **M4574** (only SD..) **M4575** (only SD..) **M4792** (SD.. and LD..) **M4256** (SD.. and LD..) **M4257** (SD.. and LD..) **M4258** (SD.. and LD..)
	D51 – The quiet one – Anti-vibration geometry – For tools with long projection lengths – One wave on the flank face		●●	●	●●		●			
	D57 – The stable one – For medium to unfavourable machining conditions – Moderate to high feeds – One wave on the flank face		●●	●●	●●		●●			
	F57 – The universal one – 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

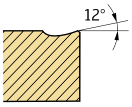
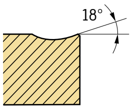
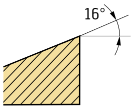
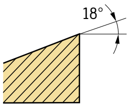
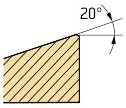
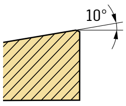
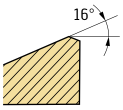
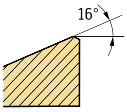
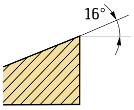
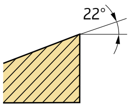
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 LNGX..	**L55 – The universal one** – For medium machining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

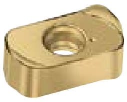
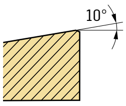
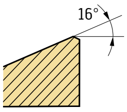
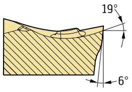
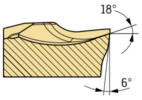
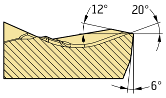
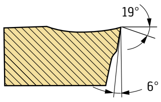
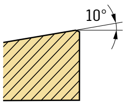
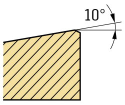
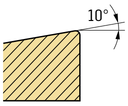
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	
 LN.X..	**D57T – The stable one** – For unfavourable machining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

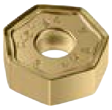
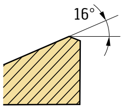
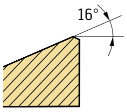
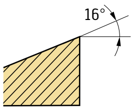
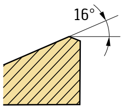
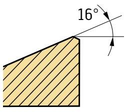
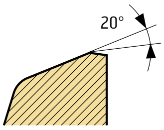
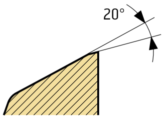
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 ENMX..	**D27 – The stable one** – For unfavourable machining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

●● Primary application
● Additional application

Geometry overview of double-sided milling indexable inserts

(continued)

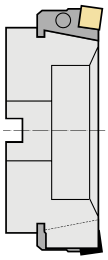
Indexable insert geometries

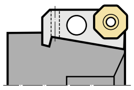
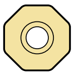
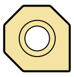
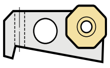
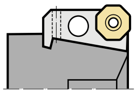
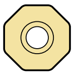
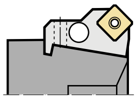
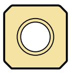
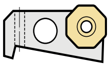
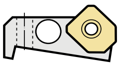
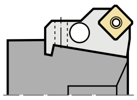
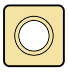
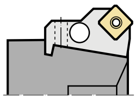
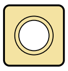
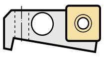
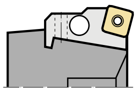
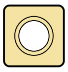
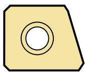
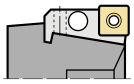
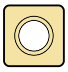
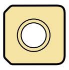
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P Steel	**M** Stainless steel	**K** Cast iron	**N** NF metals	**S** Materials with difficult cutting properties	**H** Hard materials	**O** Other	
 XN.U..	**F27 – The stable one** – For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

●● Primary application
● Additional application

System overview for the F2010 adjustable milling cutter

F2010



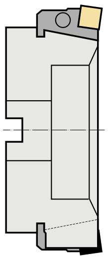
Cartridge design	D_c [mm]	Max. depth of cut [mm]	Indexable inserts	Finishing cartridges for roughing/finishing combination *	As supplement to tool
For face milling					
 κ = 43° F2010…**R592M**	80–315	4,0	 OD..0605..  The ODHX0605ZZR finishing insert is installed in the FR592M cartridge	 Cartridge: FR681M Indexable insert: ODHX0605ZZN	**M5004** D_c = 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	**M5009** D_c = 40–200 mm
 κ = 45° F2010…**R758M**	80–315	7,0	 SD..1204AZN.. SD..1204..		**M4003** D_c = 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		**M5012** D_c = 40–200 mm

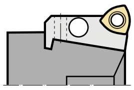
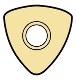
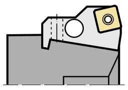
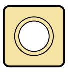
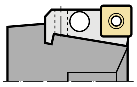
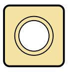
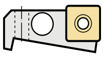
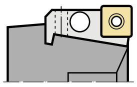
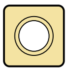
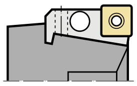
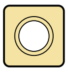
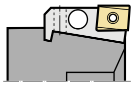
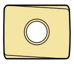
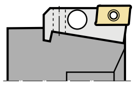
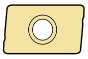
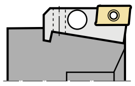
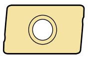
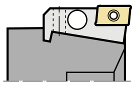
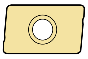
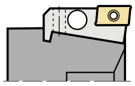
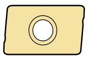
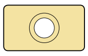
* When using this finishing method, one or more roughing cartridges must be replaced with a finishing cartridge.

System overview for the F2010 adjustable milling cutter

(continued)

F2010



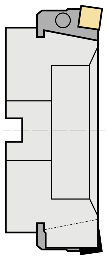
Cartridge design	D_c [mm]	Max. depth of cut [mm]	Indexable inserts	Finishing cartridges for roughing/finishing combination*		As supplement to tool
For high-feed milling						
 κ = 0–15° F2010…**R729M**	70–305	2,0	 P2633.-R25			**F2330** D_a = 52–85 mm
 κ = 15° F2010…**R755M**	80–315	2,0	 SD..1204..			**M4002** D_c = 50–125 mm
For shoulder milling						
 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..			**M4132** D_c = 25–80 mm
 κ = 89°45' F2010…**R757M**	80–315	11,6	 SD..1204..			**M4132** D_c = 50–125 mm
 κ = 90° F2010…**R722M**	80–315	13,0	 LNGX1307..			**F4041** D_c = 40–160 mm
 κ = 90° F2010…**R764M**	80–315	11,0	 BC..1204..			**M5130…12** D_c = 22–80 mm
 κ = 90° F2010…**R765M**	80–315	15,0	 BC..1605..			**M5130…15** D_c = 25–160 mm
 κ = 90° F2010…**R718M**	80–315	11,7	 AD..1204..			**F4042…11** D_c = 22–80 mm
 κ = 90° F2010…**R719M**	80–315	15,0	 AD..1606..  Finishing insert: ADGX1606PER			**F4042…15** D_c = 25–160 mm

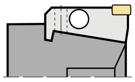
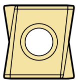
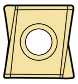
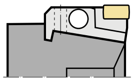
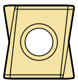
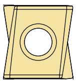
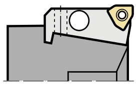
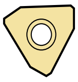
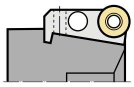
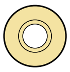
***** When using this finishing method, one or more roughing cartridges must be replaced with a finishing cartridge.

System overview for the F2010 adjustable milling cutter

(continued)

F2010

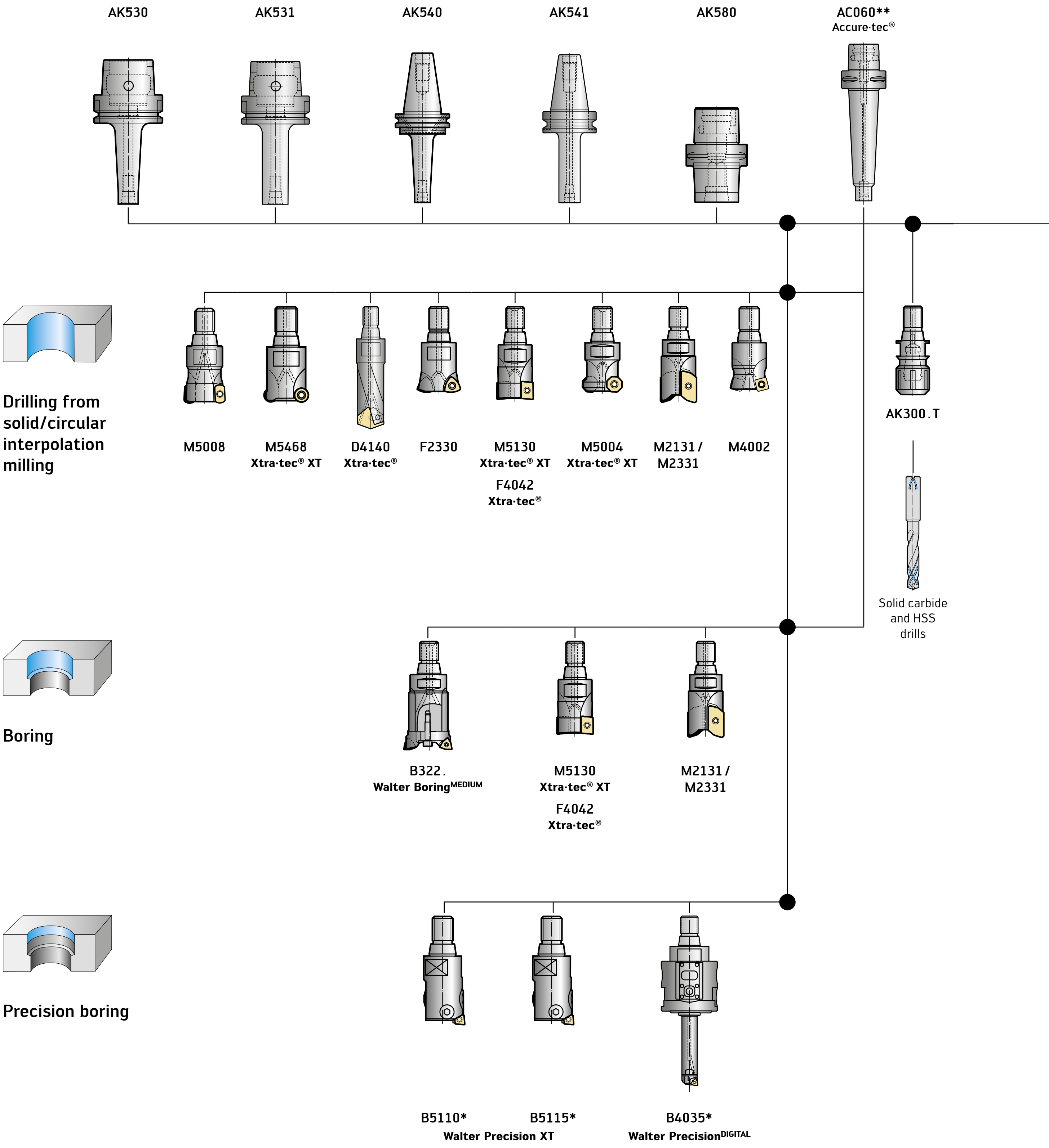


Cartridge design		D_c [mm]	Max. depth of cut [mm]	Indexable inserts		Finishing cartridges for roughing/finishing combination*		As supplement to tool
For shoulder milling								
	κ = 90° F2010...**R751M**	80–315	8,0	 	LNHU0904.. Finishing insert: LNHX0904PDR-L55T			**F5041** D_c = 25–63 mm
	κ = 90° F2010...**R752M**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

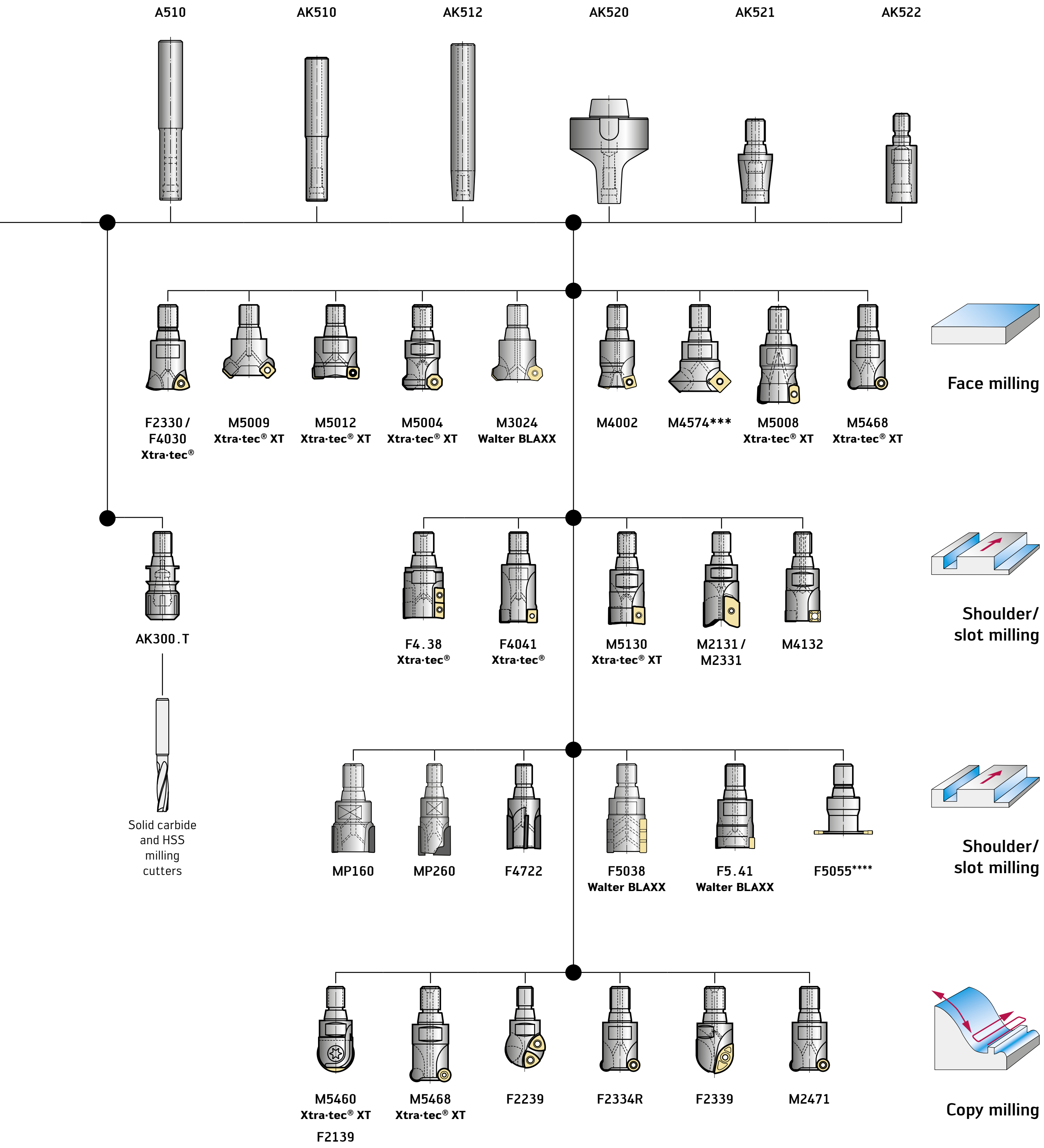


* only in combination with AK53.CO and AK54.CO.

** 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

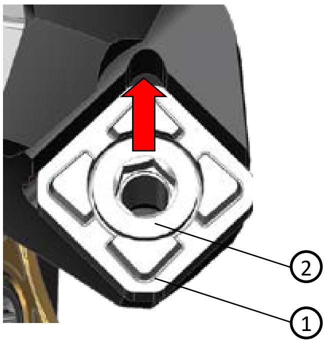
Assembly instructions for Xtra·tec® XT M5009, M5011 and M5012 face milling cutters with carbide shim

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.

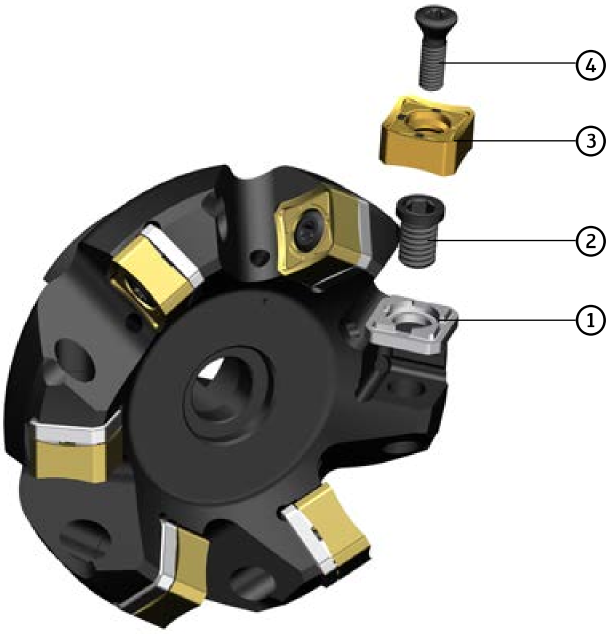
Ensure that the insert seat is clean and that the shim is correctly positioned on the contact surface.



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

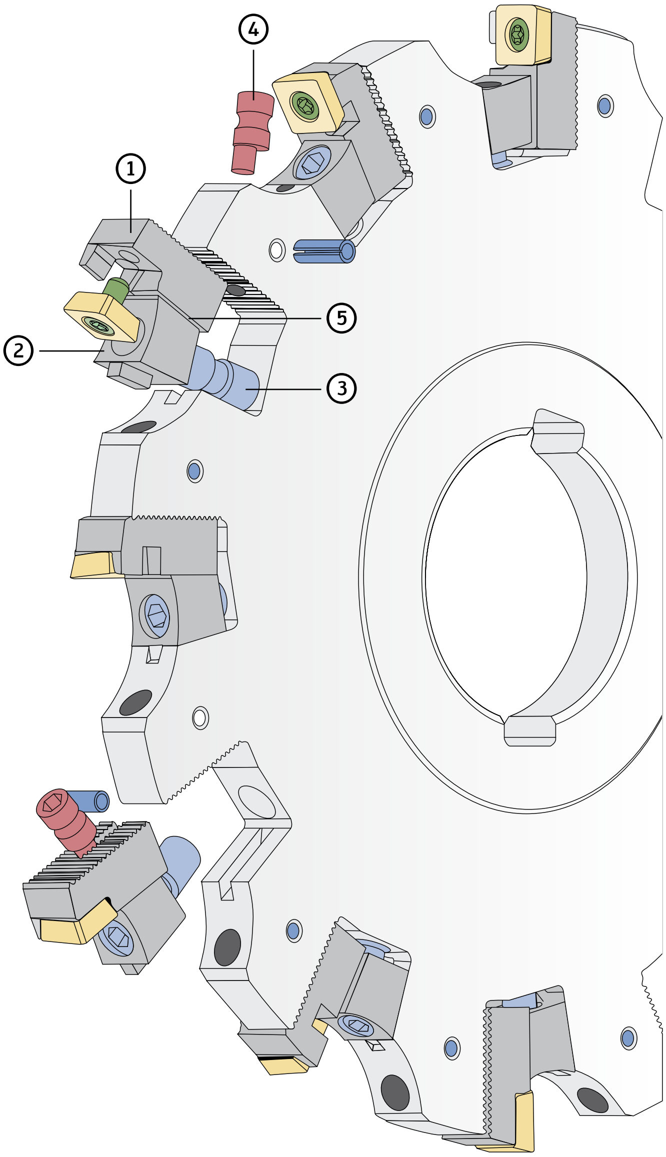
① Cartridge

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

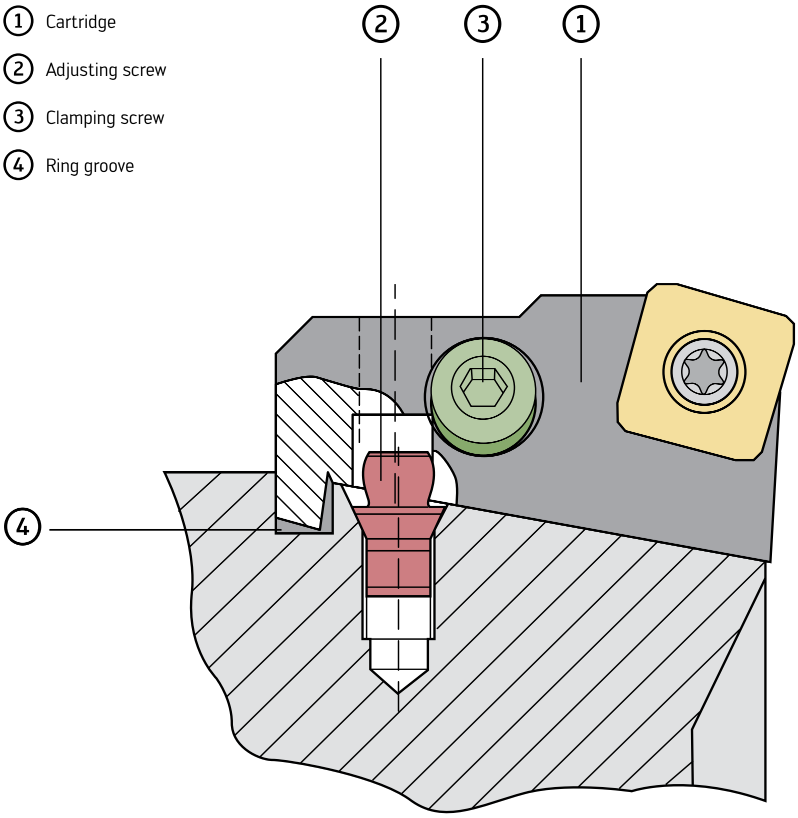
Every milling cutter cartridge seat has a conically countersunk threaded hole in which a screw is inserted.

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.

① Cartridge
② Adjusting screw
③ Clamping screw
④ Ring groove



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

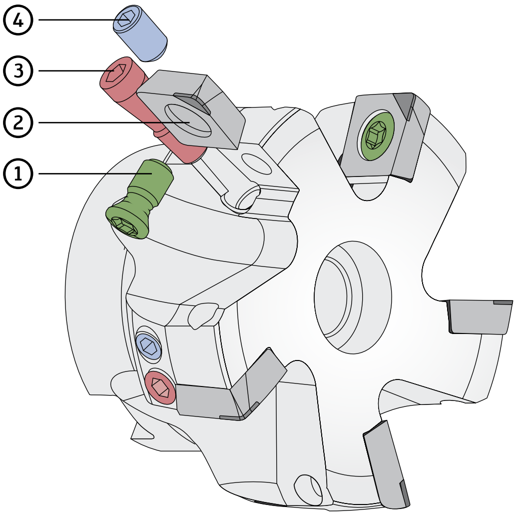
F2250 with fixed insert seat

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.

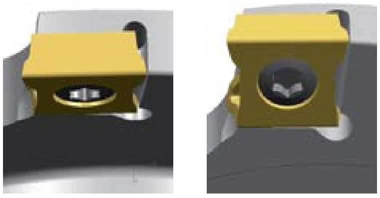
1. Fit the indexable inserts ① and tighten the clamping screws ② to the recommended torque.
2. Check the runout.
3. Move the highest indexable insert approx. 0.05 mm forwards using the adjusting screw ③.
4. Bring all other indexable inserts to the same height.
5. Check the runout again.

Assembly instructions for F4153 and F4253 slotting cutters

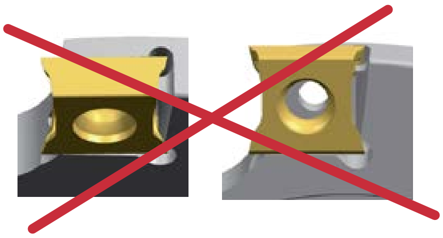
F4153 assembly instructions

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



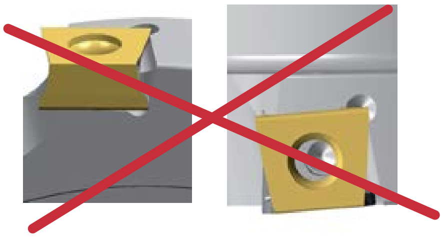
incorrect

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

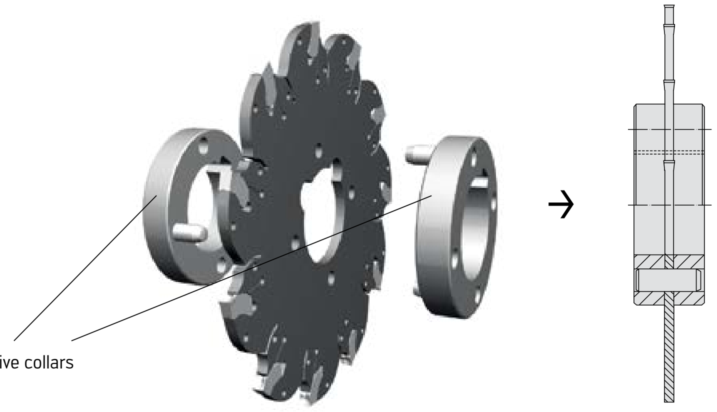


incorrect

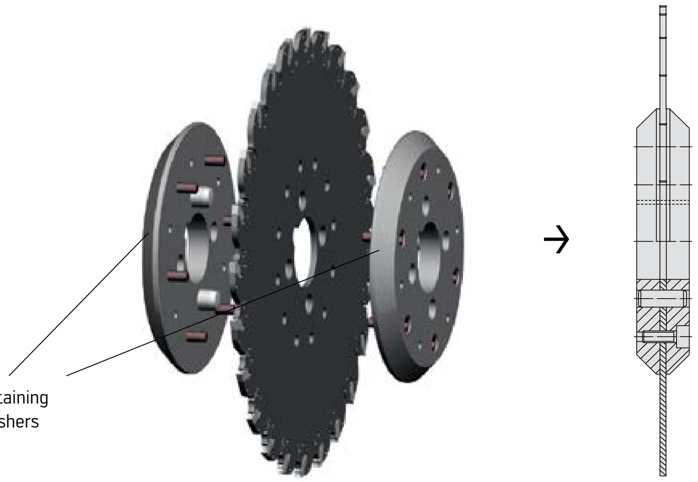
Assembly instructions for Walter BLAXX F5055 slitting cutters

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

Assembly with drive collars



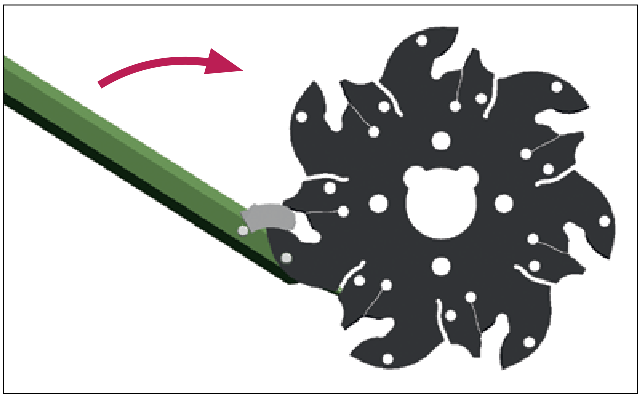
Assembly with retaining washers



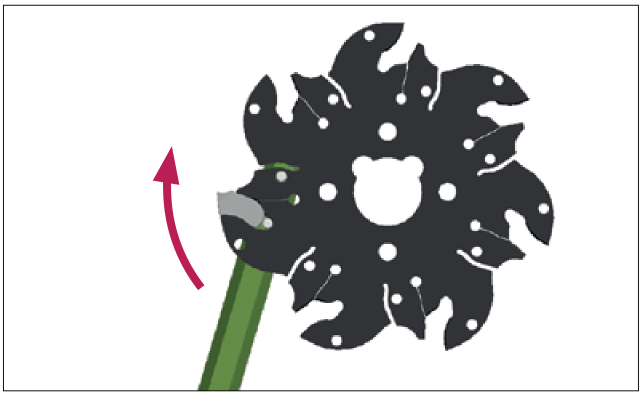
Please note:
When using retaining washers, note the a_e dimension (see page D 3).

Using the mounting wrench

Installing the insert

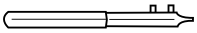
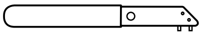


Removing the insert



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).

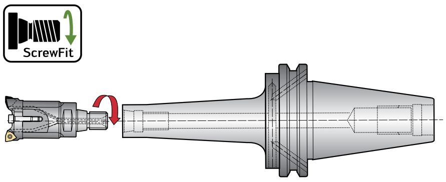
Apply pressure to the rear part of the indexable insert when tightening

Check with 0.01 mm spacer

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

Tightening torques

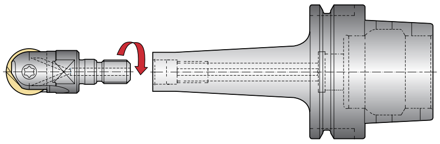
Tightening torques for front pieces with modular ScrewFit interface



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*

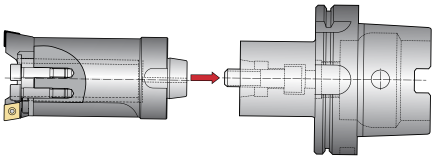
* Use FS1394 adaptor

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

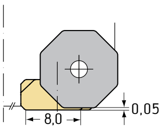
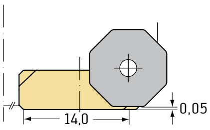
Tightening torques for tools with modular NCT interface



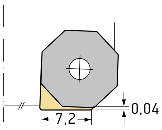
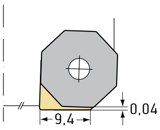
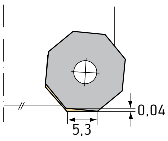
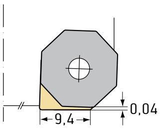
Interface	Thread	Tightening torque	⬡↕	Torque wrench	Socket wrench	Limit speed
NCT 25	M8	18 Nm	5	FS1385	FS402	20,000 rpm
NCT 32	M8	18 Nm	5	FS1385	FS402	30,000 rpm
NCT 40	M12	80 Nm	8	FS1386	FS403	30,000 rpm
NCT 50	M12	80 Nm	8	FS1386	FS403	30,000 rpm
NCT 63	M16	150 Nm	12	FS1386	FS404	30,000 rpm
NCT 80	M20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

Roughing/finishing combinations on Walter milling tools

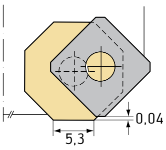
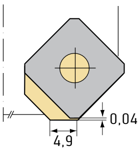
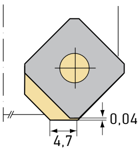
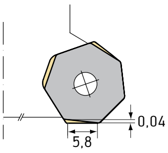
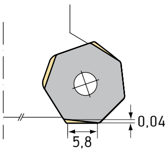
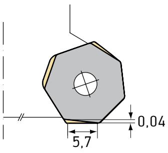
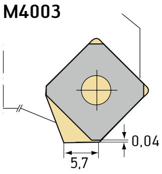
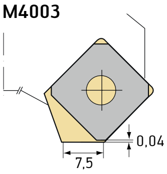
κ = 42°

	Roughing	Finishing
M2025  	Indexable insert ONHF050408-F67	Indexable insert P45424-1-G67
M2026  	Indexable insert ONHF050408-F67	Indexable insert P45424-2-G67

κ = 43°

	Roughing	Finishing
M5004  	Indexable insert ODH.0504ZZN	Indexable insert ODHX0504ZZR
M5004  	Indexable insert ODH.0605ZZN	Indexable insert ODHX0605ZZR
F2010  	Indexable insert OD..0605.. Cartridge FR592M	Indexable insert ODHX0605ZZN Cartridge FR681M
F2010  	Indexable insert ODH.0605.. Cartridge FR592M	Indexable insert ODHX0605ZZR Cartridge FR592M

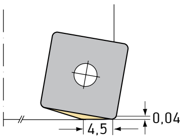
κ = 45°

	Roughing	Finishing
F2010  	Indexable insert SN..1205ANN Cartridge FR720M	Indexable insert ODHX0605ZZN Cartridge FR681M
M5009  	Indexable insert SNGX0904ANN-F57/-F67	Indexable insert XNGX0904ANN-F67
M5009  	Indexable insert SNGX1205ANN-F57/-F67	Indexable insert XNGX1205ANN-F67
F4045  	Indexable insert XNHF070508..	Indexable insert XNHX0705ANN-D67
F4045  	Indexable insert XNHX090612-..	Indexable insert XNHX0906ANN-D67
M3024  	Indexable insert XNGU0705ANN-F57/F67	Indexable insert XNGX0705ANN-F67
M4003  	Indexable insert SDGT09T3AZN-F57	Indexable insert SDHX09T3AZR-A88
M4003  	Indexable insert SDGT1204AZN-F57	Indexable insert SDHX1204AZR-A88

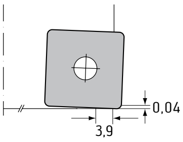
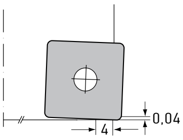
Roughing/finishing combinations on Walter milling tools

(continued)

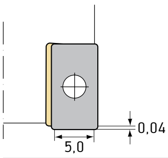
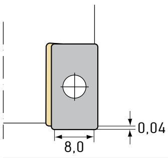
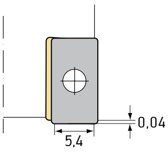
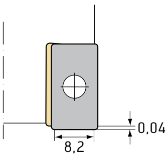
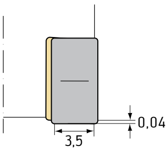
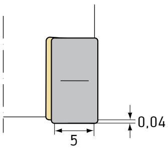
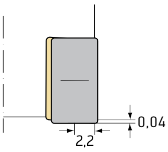
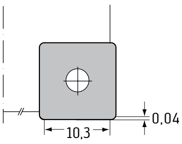
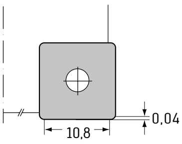
κ = 75°

	Roughing	Finishing
M5011 	Indexable insert SNGX1205ENN-F57/-F67	Indexable insert XNGX1205ENN-F67

κ = 88°

	Roughing	Finishing
M5012 	Indexable insert SNGX0904ZNN-F57/-F67	Indexable insert XNGX0904ZNN-F67
M5012 	Indexable insert SNGX1205ZNN-F57/-F67	Indexable insert XNGX1205ZNN-F67

κ = 90°

	Roughing	Finishing
M5130 	Indexable insert BCGT090304R-G55	Indexable insert BCGT120408R-G55
M5130 	Indexable insert BCGT160508R-G55	Indexable insert BCGX1605PDR-G55
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

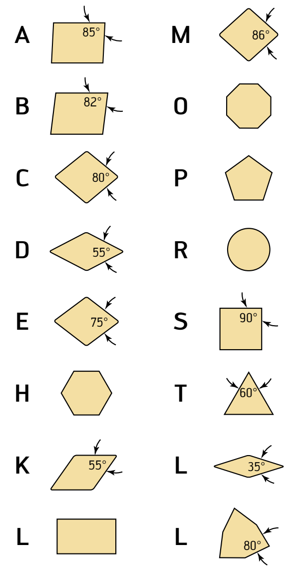
Designation key in accordance with ISO 1832 for indexable inserts for milling

Example:

B	C	G	T	12	04	08		R	–	G55
1	2	3	4	5	6	7	8	9		12

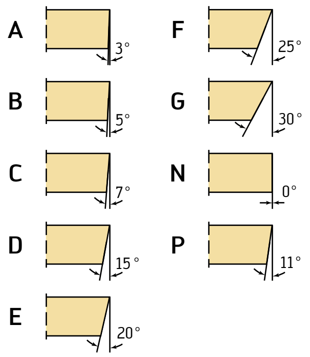
1

Insert shape



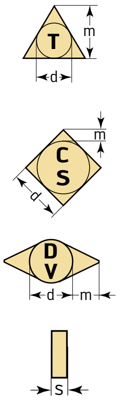
2

Clearance angle



3

Tolerances



Permissible deviation in mm for

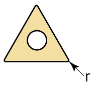
	d	m	s
A	± 0,025	± 0,005	± 0,025
C	± 0,025	± 0,013	± 0,025
E	± 0,025	± 0,025	± 0,025
F	± 0,013	± 0,005	± 0,025
G	± 0,025	± 0,025	± 0,130
H	± 0,013	± 0,013	± 0,025
J[1]	± 0,05–0,15[2]	± 0,005	± 0,025
K[1]	± 0,05–0,15[2]	± 0,013	± 0,025
L[1]	± 0,05–0,15[2]	± 0,025	± 0,025
M	± 0,05–0,15[2]	± 0,08–0,20[2]	± 0,130
N	± 0,05–0,15[2]	± 0,08–0,20[2]	± 0,025
U	± 0,08–0,25[2]	± 0,13–0,38[2]	± 0,130

[1] Inserts with ground planar cutting edges

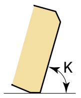
[2] Depending on the insert size (see ISO standard 1832)

7

Corner radius

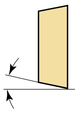


01	r = 0,1
02	r = 0,2
04	r = 0,4
08	r = 0,8
12	r = 1,2
16	r = 1,6
24	r = 2,4



Lead angle

A	45°
D	60°
E	75°
F	85°
P	90°
Z	Other lead angles



Clearance angle of planar cutting edge

A	3°
B	5°
C	7°
D	15°
E	20°
F	25°
G	30°
N	0°
P	11°
Z	Other clearance angles

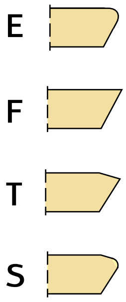
R

00
for diameters converted from imperial units to mm

M0
for diameters in metric units

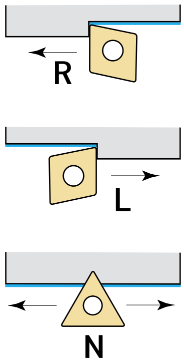
8

Edge formation



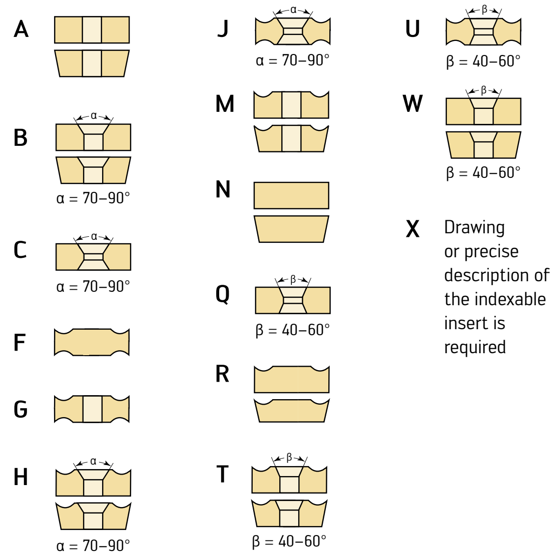
9

Cutting direction



4

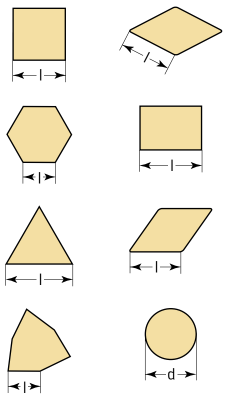
Machining and fastening features



X Drawing or precise description of the indexable insert is required

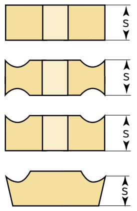
5

Cutting edge length



6

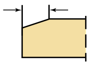
Insert thickness



01	s = 1,59
T1	s = 1,98
T2	s = 2,78
03	s = 3,18
T3	s = 3,97
04	s = 4,76
05	s = 5,56
06	s = 6,35
07	s = 7,94
09	s = 9,52

10

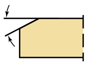
Chamfer width



010 = 0,10 mm
020 = 0,20 mm
025 = 0,25 mm
070 = 0,70 mm
150 = 1,50 mm
200 = 2,00 mm

11

Chamfer angle



15 = 15°
20 = 20°

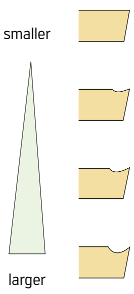
12

Manufacturer specifications/geometry index

Example:

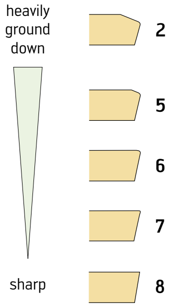
G	5	5	
1	2	3	4

1. Chip breaker groove

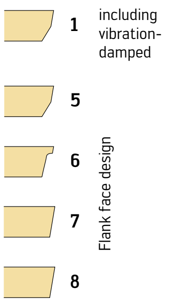


A = 0°
B = 6°
D = 10°
E = 15°
F = 16°
G = 20°
K = 25°
L ≥ 28°
M = 30°

2. Cutting edge



3. Flank face design



1 including vibration-damped

4. Additional information

T Tangential installation

Designation key for coated carbides – Milling

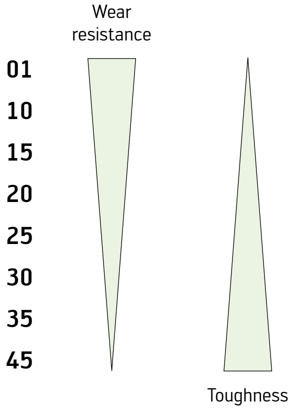
Example:

W	S	P	45	G
Walter	**1**	**2**	**3**	**4**

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

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

3
ISO application range



4	
Generation	
G	Tiger·tec® Gold
S	Tiger·tec® Silver
X	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

Tool group

M	Milling

2

Generation

2	
3	Walter BLAXX
4	M4000
5	Xtra·tec® XT

3

Tool type

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

4

Type

02	High-feed milling cutter κ = 15°, radial, positive, 4 cutting edges per indexable insert
03	Face milling cutter κ = 45°, radial, positive, 4 cutting edges per indexable insert
04	Octagon face milling cutter κ = 43°, radial, positive, 8 cutting edges per indexable insert
08	High-feed milling cutter κ = 17°, radial, double-sided, 4 cutting edges per indexable insert
09	Face milling cutter κ = 45°, radial, double-sided, 8 cutting edges per indexable insert
12	Face milling cutter κ = 88°, radial, double-sided, 8 cutting edges per indexable insert
16	Heavy-duty cutter κ = 60°, tangential, double-sided, 4 cutting edges per indexable insert
24	Heptagon face milling cutter κ = 45°, radial, double-sided, 14 cutting edges per indexable insert, screw clamping
25	Octagon face milling cutter for finishing κ = 42°, radial, double-sided, 16 cutting edges per indexable insert
26	Octagon face milling cutter for finishing κ = 42°, radial, double-sided, 16 cutting edges per indexable insert
30	Shoulder milling cutter κ = 90°, radial, positive, 2 cutting edges per indexable insert
31	Ramping milling cutter κ = 90°, radial, positive, 2 cutting edges per indexable insert
32	Shoulder milling cutter κ = 89°45', radial, positive, 4 cutting edges per indexable insert
37	Shoulder milling cutter κ = 90°, radial, double-sided, 6 cutting edges per indexable insert
55	Helical milling cutter κ = 90°, tangential, double-sided, 2 or 4 cutting edges per indexable insert
56	Helical milling cutter κ=90°, radial, positive, 2 or 4 cutting edges per indexable insert
57	Helical milling cutter κ=90°, radial, positive, 2 or 4 cutting edges per indexable insert
58	Helical milling cutter κ = 90°, radial, positive, 2 or 4 cutting edges per indexable insert
60	Copy milling cutter for finishing radial, positive, 1 cutting edge per full-radius insert
68	Button insert milling cutter radial, positive, 4 or 8 cutting edges per indexable insert
74	Chamfer milling cutter κ = 30°, 45°, 60°, radial, positive, 4 cutting edges per indexable insert
75	T-slot milling cutter κ = 90°, radial, positive, 4 cutting edges per indexable insert
91	Routing cutter κ = 90°, radial, positive, 4 cutting edges per indexable insert
92	Routing cutter κ=90°, radial, positive, 2 or 4 cutting edges per indexable insert

5

1. Delimiters

–	Metric
.	Inch

6

Cutting diameter

7

Adaptor type

A	Cylindrical shank
B	Bore adaption
T	ScrewFit
TC	Cylindrical modular interface
W	Weldon shank
H	HSK

8

Adaptor size

9

Number of teeth

10

Depth of cut

11

Version acc. to length or manufacturer-specific adaptors or other tool characteristics

C	Carbide shank
S	Short version
L	Long version
XL	Extra long version
D	Dörries Scharmann machines
MA	Makino machines

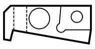
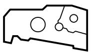
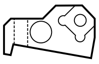
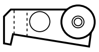
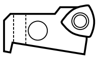
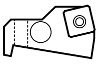
AP	Carbide shim

For helical milling cutters

M	Modular tool design
B	Basic body
F	Front piece

Assembly parts

Spare parts for F2010

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

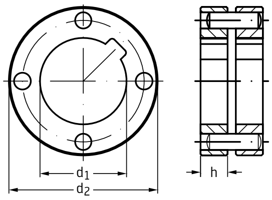
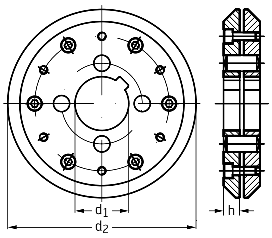
Designation	Tightening screw for adaptor *
F4138.B16.040.Z03.33	M8 × 40 (SW6)
F4138.B16.040.Z03.43	M8 × 50 (SW6)
F4138.B22.050.Z04.43	M10 × 45 (SW8)
F4138.B22.050.Z04.54	M10 × 55 (SW8)
F4138.B27.063.Z05.43	M12 × 45 (SW10)
F4138.B27.063.Z05.54	M12 × 55 (SW10)
F4138.B32.080.Z06.54	M16 × 65 (SW14)
F4138.B32.080.Z06.65	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)

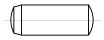
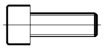
Drive collars and retaining washers for Walter BLAXX F5055 slitting cutters

Tool

	Designation	d_1 mm	d_2 mm	h mm	For D_c 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			

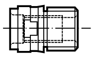
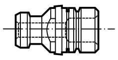
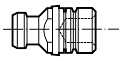
A SET consists of two drive collars or retaining washers.

Assembly parts

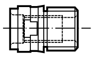
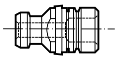
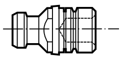
	Designation	FS1346	FS1347	FS1348	FS1349	FS1350	FS1351	FS1352	FS2291	FS2292
	ISO 8734 parallel pin	4 m6 × 16	4 m6 × 16	5 m6 × 20	6 m6 × 20	12 m6 × 20	12 m6 × 20	12 m6 × 20	5 m6 × 16	5 m6 × 16
	DIN 912 cap screw						M6 × 16	M6 × 16		

Accessories for one-piece milling cutters

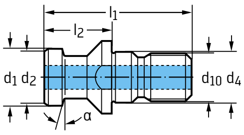
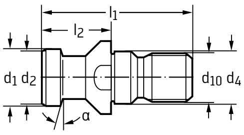
Pull studs without SK40 intermediate bushing

	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

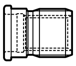
	Pull stud	C100.50.600 for DIN 2080
	Pull stud	C100.50.615 A for DIN 69871 Form AD
	Pull stud	C100.50.615 B for DIN 69871 Form B

Pull studs for milling tools with steep taper*

	Designation	For steep taper	d_1 mm	d_2 mm	d_4 mm	d_{10}	l_1 mm	l_2 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

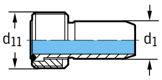
Accessories for boring bars/adaptors

	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

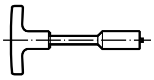
(continued)

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

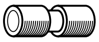
Socket wrench for installing transfer units



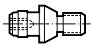
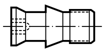
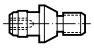
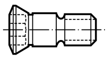
Designation	For HSK
FS952	HSK63–A
FS953	HSK100–A

Assembly parts and accessories

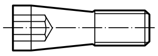
Compound screws

	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

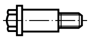
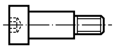
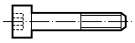
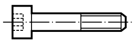
Clamping elements for indexable inserts

	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

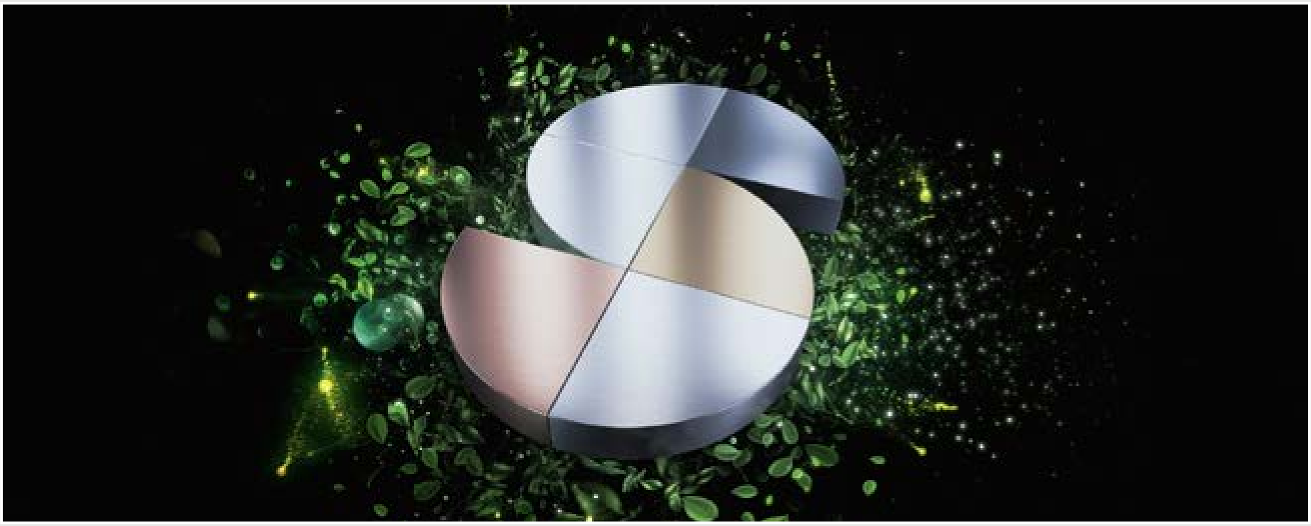
	Designation	Size	Suitable for
	FS1491	M3 × 9,8 (SW 2)	Special tools
	FS2045	M3 × 12 (SW 2)	
	FS2055	M4 × 15 (SW 2,5)	
	FS1148	M5 × 19 (SW 2,5)	
	FS2056	M5 × 23 (SW 3)	
	FS2058	M3 × 13,5 (SW 2,5)	

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_2-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.

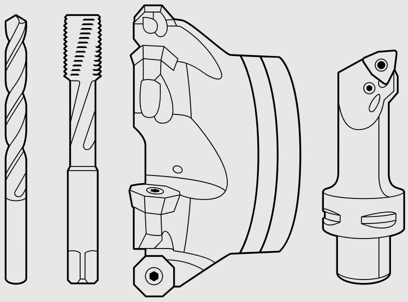
Environmental and energy management
Environmental protection is an important company objective for Walter. We use energy efficiently and deploy practical methods to sustainably reduce the consumption of energy, water and resources.

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.

Walter AG

Derendinger Straße 53, 72072 Tübingen
Postfach 2049, 72010 Tübingen
Germany

walter-tools.com



Europe

Walter Austria GmbH
Wien, Österreich
+43 1 5127300-0, service.at@walter-tools.com

Walter Benelux N.V./S.A.
Zaventem, Belgique
(B) +32 (02) 7258500
(NL) +31 (0) 900 26585-22
service.benelux@walter-tools.com

Walter (Schweiz) AG
Solothurn, Schweiz
+41 (0) 32 617 40 72, service.ch@walter-tools.com

Walter CZ s.r.o
Kurim, Czech Republic
+420 (0) 541 423352, service.cz@walter-tools.com

Walter Deutschland GmbH
Frankfurt, Deutschland
+49 (0) 69 78902-100, service.de@walter-tools.com

Walter France
Soultz-sous-Forêts, France
+33 (0) 3 88 80 20 00, service.fr@walter-tools.com

Walter Hungária Kft.
Budapest, Magyarország
+36 1 464 7160, service.hu@walter-tools.com

Walter Tools Ibérica S.A.U.
El Prat de Llobregat, España
+34 934 796760, service.iberica@walter-tools.com

Walter Italia s.r.l.
Via Volta, s.n.c., 22071 Cadorago - CO, Italia
+39 031 926-111, service.it@walter-tools.com

Walter Norden AB
Halmstad, Sweden
+46 (0) 35 16 53 00, service.norden@walter-tools.com

Walter Polska Sp. z o.o.
Warszawa, Polska
+48 (0) 22 8520495, service.pl@walter-tools.com

Walter Tools SRL
Timisoara, România
+40 (0) 256 406218, service.ro@walter-tools.com

Walter Tools d.o.o.
Maribor, Slovenija
+386 (2) 629 01 30, service.si@walter-tools.com

Walter Slovakia, s.r.o.
Nitra, Slovakia
+421 (0) 37 3260 910, service.sk@walter-tools.com

Walter Kesici Takımlar Sanayi ve Ticaret Ltd. Şti.
Bursa, Türkiye
+90 (0) 224 909 5000 Pbx, service.tr@walter-tools.com

Walter GB Ltd.
Bromsgrove, England
+44 (1527) 839 450, service.uk@walter-tools.com

Asia

Walter Wuxi Co. Ltd.
Wuxi, Jiangsu, P.R. China
+86 (510) 853 72199, service.cn@walter-tools.com

Walter Wuxi Co. Ltd.
中国江苏省无锡市新区新畅南路 3 号
电话：+86-510-8537 2199 邮编：214028
客服热线：400 1510 510
邮箱：service.cn@walter-tools.com

Walter Tools India Pvt. Ltd.
Pune, India
+91 (20) 6773 7300, service.in@walter-tools.com

Walter Japan K.K.
Nagoya, Japan
+81 (52) 533 6135, service.jp@walter-tools.com

ワルタージャパン株式会社
名古屋市中村区名駅二丁目 45 番 7 号
+81 (0) 52 533 6135, service.jp@walter-tools.com

Walter Korea Ltd.
Anyang-si Gyeonggi-do, Korea
+82 (31) 337 6100, service.wkr@walter-tools.com

한국발터(주)
경기도 안양시 동안구 학의로 282
금강펜테리움 106호 14056
+82 (0) 31 337 6100, service.wkr@walter-tools.com

Walter Malaysia Sdn. Bhd.
Selangor D.E., Malaysia
+60(3)-5624 4265, service.my@walter-tools.com

Walter AG Singapore Pte. Ltd.
+65 6773 6180, service.sg@walter-tools.com

Walter (Thailand) Co., Ltd.
Bangkok, 10120, Thailand
+66 2 687 0388, service.th@walter-tools.com

America

Walter do Brasil Ltda.
Sorocaba – SP, Brasil
+55 15 32245700, service.br@walter-tools.com

Walter Canada
Mississauga, Canada
service.ca@walter-tools.com

Walter Tools S.A. de C.V.
El Marqués, Querétaro, México
+52 (442) 478-3500, service.mx@walter-tools.com

Walter USA, LLC
Greer, SC, USA
+1 800-945-5554, service.us@walter-tools.com