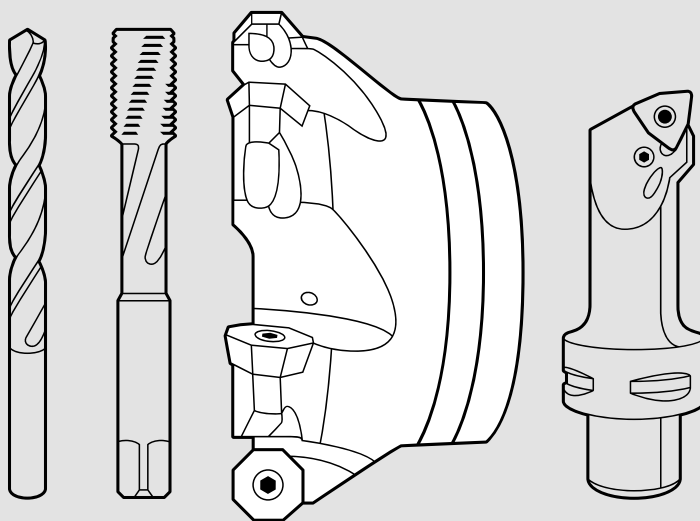


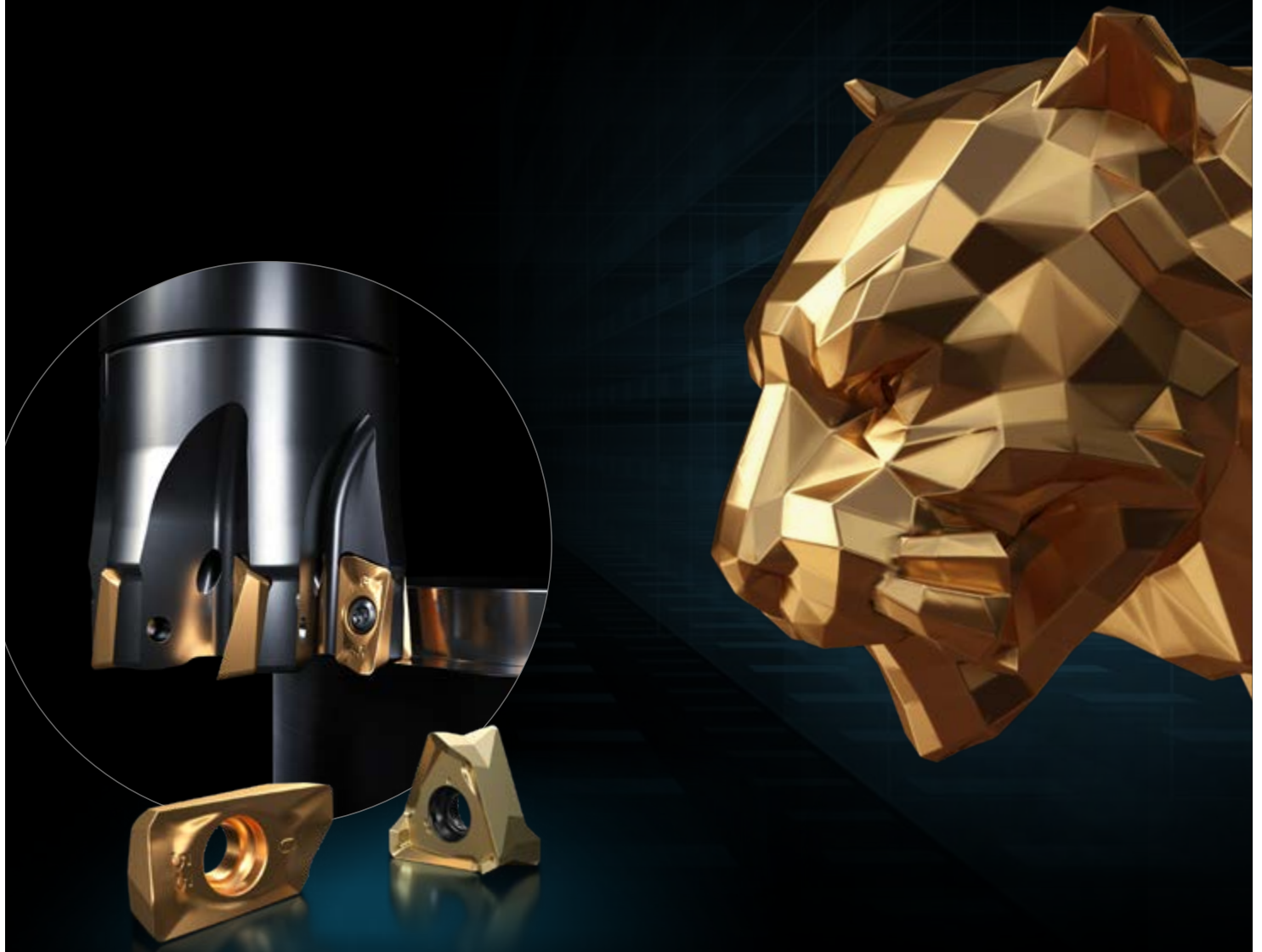
— METAL IS OUR WHOLE WORLD

Technical Compendium

Milling



Tiger-tec® Gold



tigertec-gold.walter

 **WALTER**
Engineering Kompetenz

Technical Compendium – Milling

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Technologies at Walter (continued)

(((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.

Drivox-tec™

Drivox-tec™ drilling tools made of solid carbide or HSS are characterized by high performance, quality, and process reliability. They combine many decades of technological developments at Walter and represent the latest evolution in holemaking. Both in terms of macro and micro geometries, such as flute profiles and edge preparation, and in terms of manufacturing and coating technologies.

Drion-tec®

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

Groov-tec™

Groov-tec™ is the latest generation of Walter high-performance cutting tools. These are characterised by maximum stability, which enables high process parameters (feeds/speeds/depth of cut) and leads to maximum toolholder and indexable insert service life. At the same time, the systems maximise process reliability by means of controlled chip breaking.

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.

Thread-tec™

Thread-tec™ refers to Walter threading tools with high performance and process reliability. Combining the most recent technical developments and proven properties in tool geometries and coatings, Thread-tec™ is a comprehensive product range featuring a variety of lengths and dimensions. This makes the assortment suitable for any application – whether for thread milling, forming, or tapping.

Thrill-tec®

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

Technologies at Walter (continued)

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 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 × Dc without pecking.

Xill-tec®

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

Xtra-tec®

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

Xtra-tec® XT

Xtra-tec® XT is the latest generation of Walter milling tools. As the "Xtended" Xtra-tec® technology, it offers a completely new perspective on productivity and process reliability. It can cover nearly all milling operations in every common material group: More reliable, productive, cost-efficient than ever before – all while compensating for the CO₂ emissions through Walter Green.

X-treme Evo

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

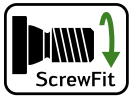
Technologies at Walter (continued)



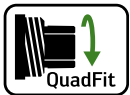
Walter Capto™ is a modular tool adaptor system. It is suitable for all turning, milling, drilling and threading processes. Its ISO-standardised polygon taper absorbs torsional moments and bending moments extremely well and ensures optimal repeat accuracy.



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



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



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



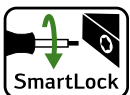
In turning and grooving operations, the Walter precision cooling system provides cooling at the centre of the chip formation. Its dual coolant jets are directed precisely onto the flank and rake faces. In drilling operations, the coolant jets exit close to the cutting edge. This system provides significantly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



Walter DeVibe is an anti-vibration technology for thread milling cutters. At its core, it consists of a »calming chamfer« that reduces the clearance angle on the flank face. This supports the tool; vibrations are minimised. DeVibe enables higher surface qualities and cutting data, particularly for metric fine threads – regardless of clamping conditions, changing cutting data or the milling strategy.



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



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



WedgeFit is an interface for grooving and turning applications. Its double wedge enables the cutting forces to be absorbed not only by the clamping screw, but also by the two wedges. In addition to simple, fast handling, this ensures exceptionally high stability and rigidity. Over 1,000 possible combinations of module and support tool maximise the flexibility of the System.

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 ConeFit

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

2 MD340 Supreme

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

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 M4574 chamfer milling cutter

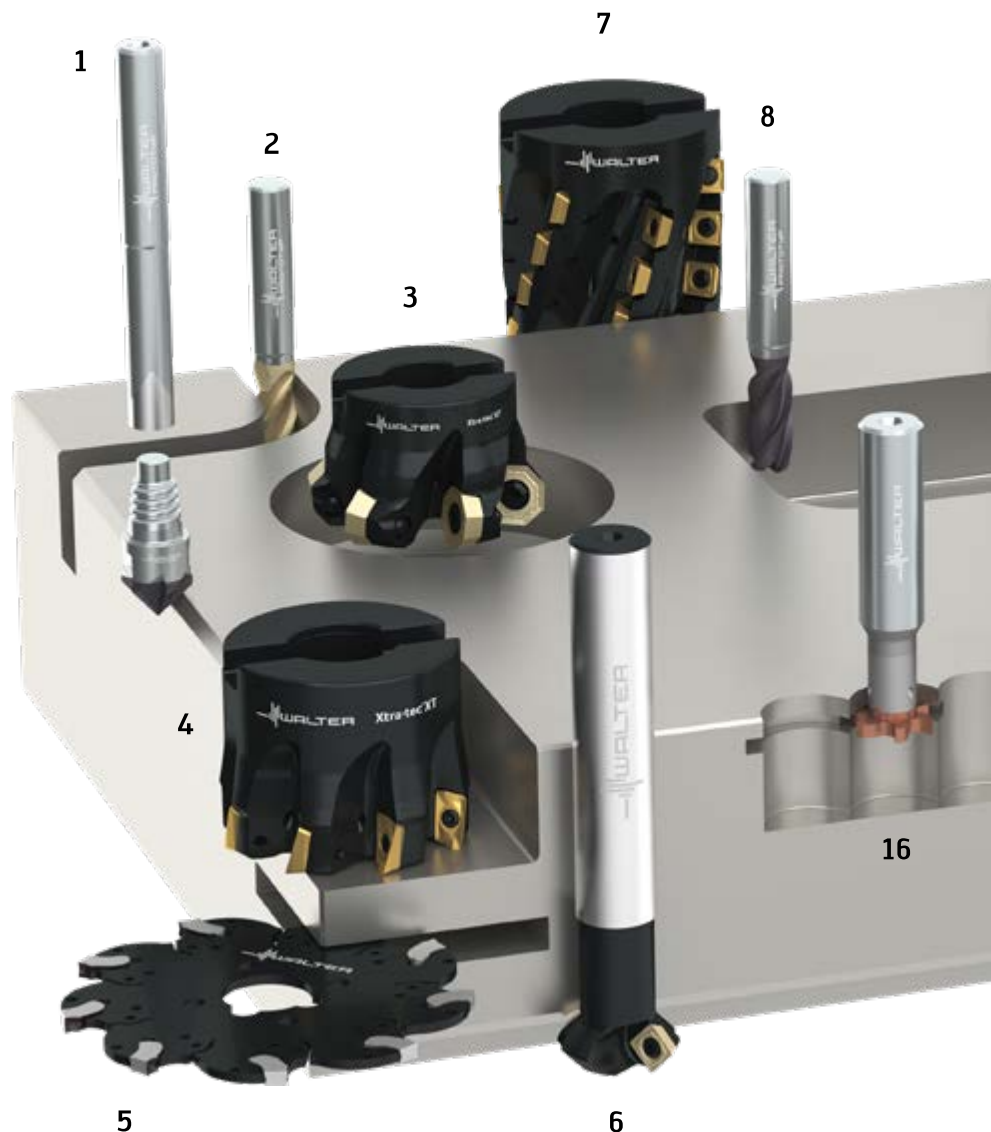
- High degree of cost-efficiency due to system inserts which can be used universally
- For chamfering and back chamfering

7 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

8 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



9 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

10 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

11 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

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 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

14 Xtra-tec® XT M5468 button insert milling cutter

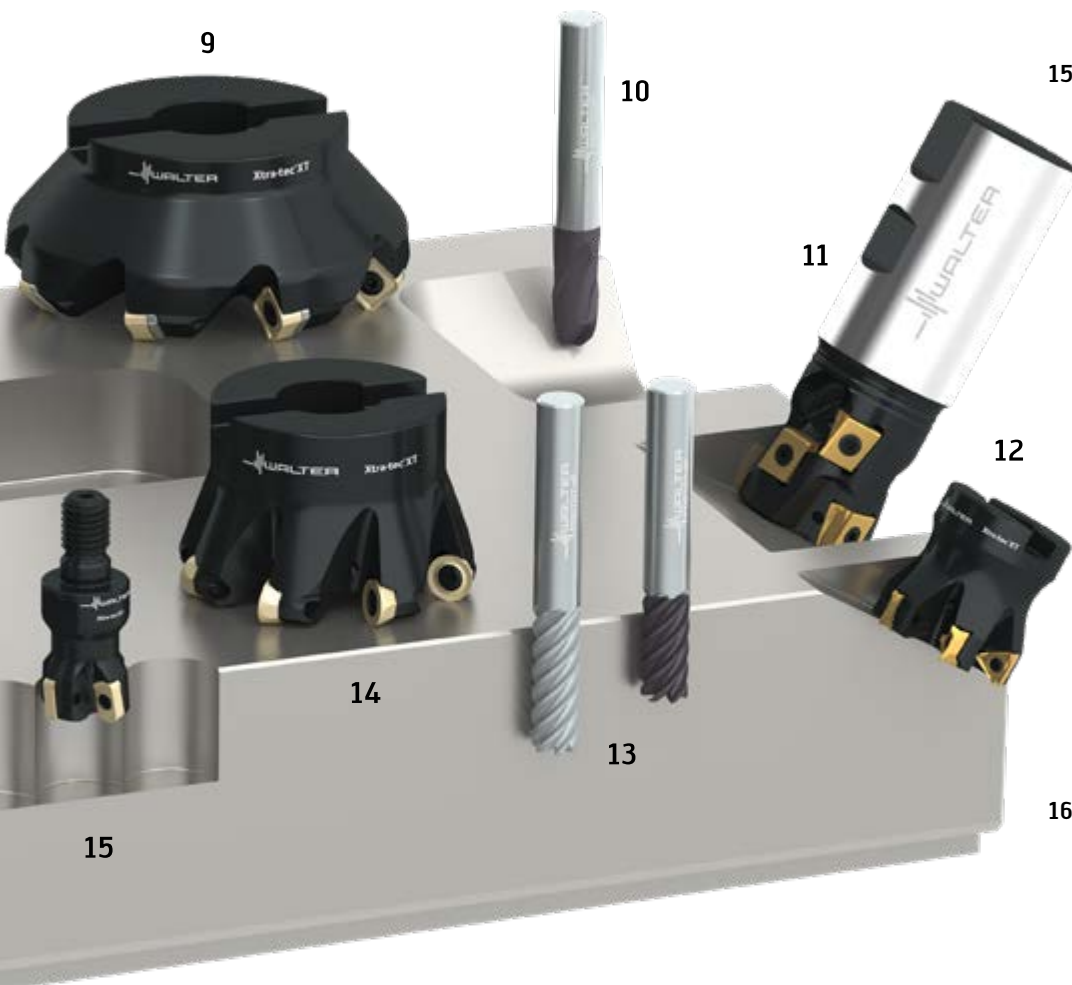
- Maximum security against inadvertent rotation due to detent indexing of the indexable insert
- With up to eight cutting edges
- High flexibility due to seven insert sizes and maximum productivity due to high cutting data and long tool life

15 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

16 Modular circular milling cutters MG510/MG515/MG520/MG545

- Modular solid carbide interchangeable head system for slot milling and forward and reverse chamfer milling
- With different shank variants with and without internal cooling
- Diameter range: 6.7–39.7 mm



How to use Walter GPS

As the market's leading software solution for finding tools and calculating cutting data, Walter GPS offers you many functions that will help you in your day-to-day work: For production on the machine, as good starting values for programming, for process and component planning and much more – the journey from component to production couldn't be quicker. The reason?

➤ **With the GPS cutting data, you can start production immediately!**

SEARCH PRODUCT-RELATED

Would you like to use a specific tool or an existing tool? Do you know the application and material, but don't know what cutting data you should work with? Or do you want to know whether your tool can do this?

Walter GPS gives you the answer in just a few clicks: In the form of cutting data, data models and much more.

SEARCH APPLICATION-RELATED

Do you know your application and your material, but don't know which tool solution is best for it?

Walter GPS suggests one or more solutions – and you choose the best one for you. And that's not all – this also works for indexable insert tools; Walter GPS even puts together different combinations of body and inserts for these!

Enter specific **tool**

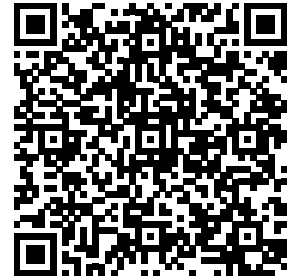
Select **material**
and ...
... **application**

HOW WALTER GPS BENEFITS YOU

- > **Find the right tool solution for your machining task –**
quickly and based on your machining objective (e.g. maximum cost-efficiency).
- > **Get reliable cutting data for your tool –**
calculated according to your specifications: For your tool, your application and your material.
- > **Ideal for calculating profitability –**
this allows you to determine the estimated costs in the shortest possible time.
- > **Benefit from helpful additional information –** e.g. in the form of 2D and 3D models which you can use directly for your machine programming.
- > **CO₂ values for your application –**
divided according to machining operation and machine basic load.

Launch **Walter GPS** now

Your navigation system for the best machining solution



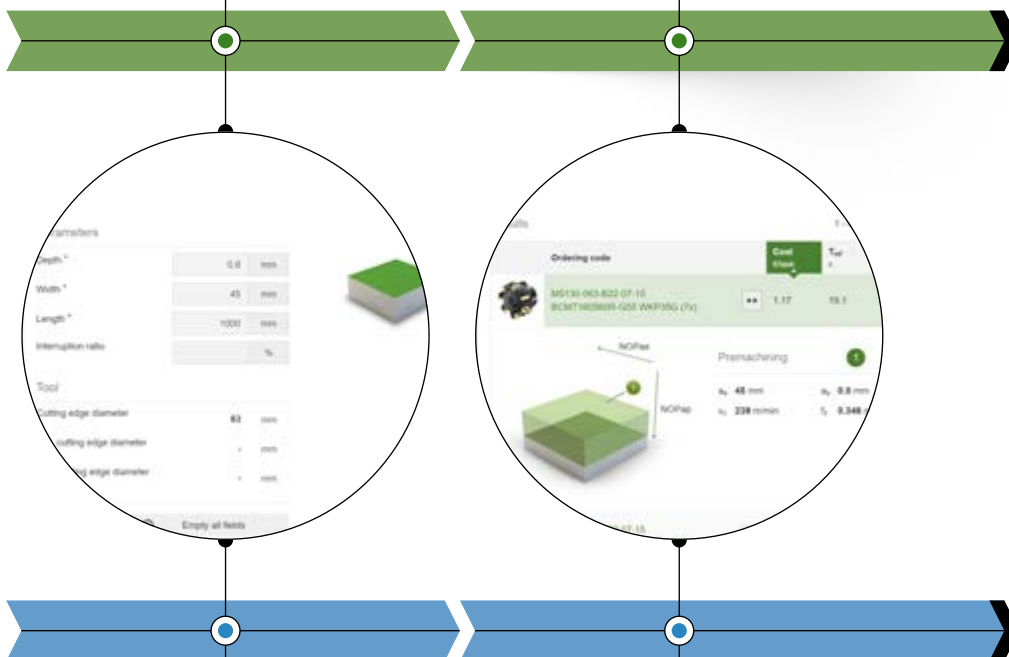
www.walter-tools.com/gps

RESULT



Enter **application parameters**

Tool selection



Enter **application parameters**

Tool selection

Walter offers you one or more possible tool solutions to choose from. In the default settings, the most cost-efficient solution is displayed. If you have a different priority (e.g. the most productive solution, the best surface quality, etc.), you can define it in advance and the tool selection will be adapted accordingly!

Walter offers you the ideal cutting data for your tool, your application and your material! So precise that you can use it immediately for your application or programming! And, of course, you can find out whether your tool is suitable for the application. If it isn't, use the "Application-related search" to immediately find a suitable alternative – in no time at all and with the option to order it directly!

Milling calculation formulae

Speed

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

Cutting speed

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

Feed rate

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

Feed per tooth

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

Metal removal rate

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

Power requirement

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

Average chip thickness

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

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

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

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

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

Engagement angle

where milling cutter is positioned centrally

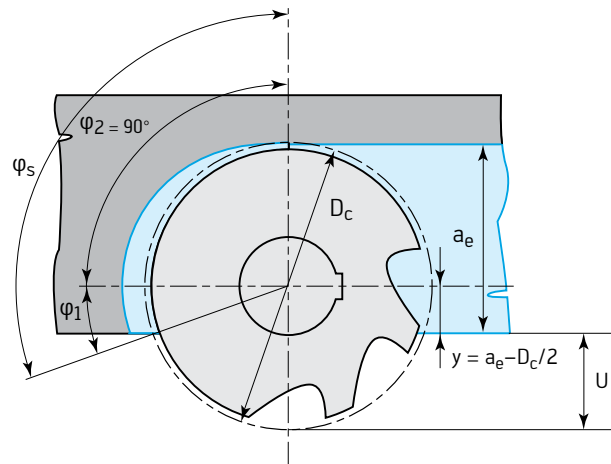
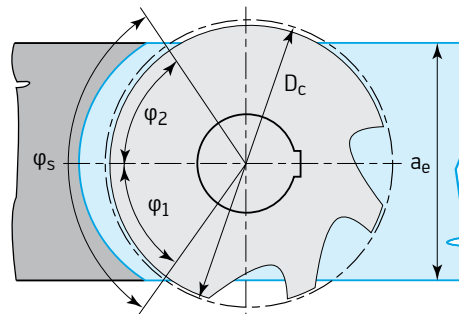
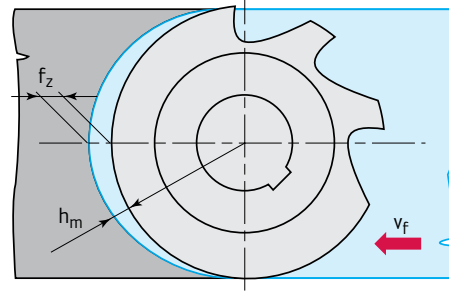
$$\varphi_s = 2 \times \arcsin \left(\frac{a_e}{D_c} \right) \quad [^\circ]$$

where milling cutter is positioned eccentrically

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

Specific cutting force

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



n	Speed	rpm
D _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

$$v_f = v_{fe} \times \frac{D_w + D_a}{D_w} \quad [\text{mm/min}]$$

$$v_{fe} = v_f \times \frac{D_w}{D_w + D_a} \quad [\text{mm/min}]$$

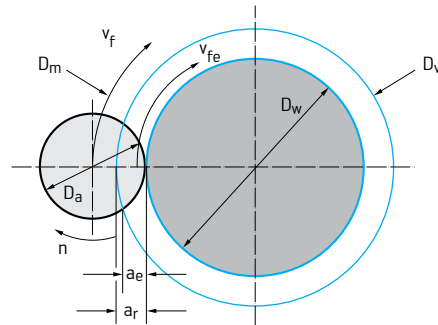
Circular interpolation traverse time

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

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

Engagement width for external circular interpolation

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



External contour

v_f	Tool axis feed rate	[mm/min]
v_{fe}	Effective feed rate at the periphery	[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	Cutting width	[mm]
a_r	Radial 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

$$v_f = v_{fe} \times \frac{D_w - D_a}{D_w} \quad [\text{mm/min}]$$

$$v_{fe} = v_f \times \frac{D_w}{D_w - D_a} \quad [\text{mm/min}]$$

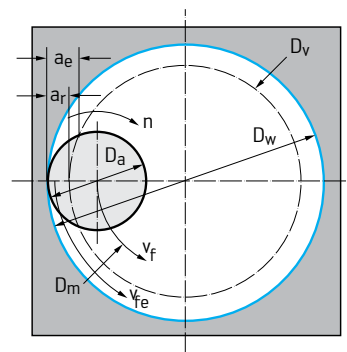
Circular interpolation traverse time

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

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

Engagement width for circular interpolation

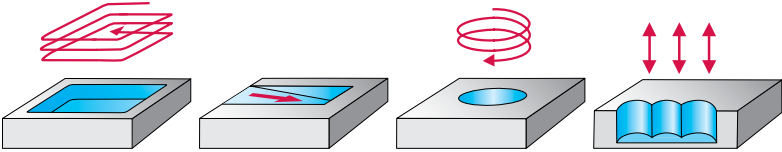
$$a_e = \frac{(D_w^2 - D_v^2)}{4(D_w - D_a)} \quad [\text{mm}]$$



Internal contour

v_f	Tool axis feed rate	[mm/min]
v_{fe}	Effective feed rate at the periphery	[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	Cutting width	[mm]
a_r	Radial 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

				Product family			λ				
				MD025 Supreme MD025 ConeFit			50°				
Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R_m [N/mm ²]	Machining group ¹	Ø 6–25 mm / 1/4–1 Inch				
							Z = 5–6				
							WJ30RD				
							Starting values for cutting speed v_c [m/min]			VT ²	
							1	1/4	1/10		
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					
			Annealed	250	840	S3					
		Ni- or Co-based	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					

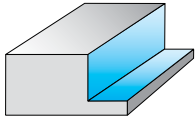
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

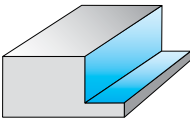
² The corresponding feed rates can be found from page D40 onwards.

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

D 13

Cutting data for solid carbide 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 _g / D _c										
					1/2	1/4	1/10	VT										
P	Unalloyed steel	C ≤ 0.25%	Annealed	125	430	P1		191	232	A								
		C > 0.25% to ≤ 0.55%	Annealed	190	640	P2		261	317	A								
		C > 0.25% to ≤ 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												
		Unalloyed, electrolytic copper		100	340	N7												
	Copper and copper alloys (bronze/brass)	Brass, bronze, red brass		90	310	N8												
		Copper alloys, short-chipping		110	380	N9												
High tensile, Ampco			300	1010	N10													
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1		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				01												
	Thermosetting plastics	Without abrasive fillers				02												
	Plastic, glass-fibre reinforced	GFRP				03												
	Plastic, carbon-fibre reinforced	CFRP				04												
	Plastic, aramid-fibre reinforced	AFRP				05												
	Graphite (technical)		80 Shore			06												

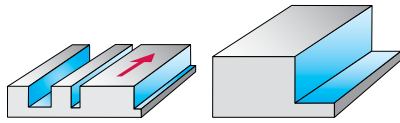
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

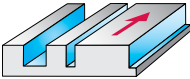
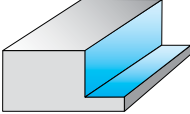
The specified cutting data are average standard values. For specific applications, adjustment is recommended.

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Cutting data for solid carbide 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/mm²]	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	Unalloyed steel	C ≤ 0.25%	Annealed	125	428	P1	174	204	248	A	
		C > 0.25% to ≤ 0.55%	Annealed	190	639	P2	237	279	339	A	
		C > 0.25% to ≤ 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)	Unalloyed, 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					

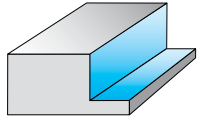
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

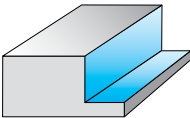
The specified cutting data are average standard values. For specific applications, adjustment is recommended.

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Cutting data for solid carbide 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/mm²]	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	Unalloyed steel	C ≤ 0.25%	Annealed	125	430	P1							
		C > 0.25% to ≤ 0.55%	Annealed	190	640	P2							
		C > 0.25% to ≤ 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)	Unalloyed, 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					O1							
	Thermosetting plastics					O2							
	Plastic, glass-fibre reinforced					O3							
	Plastic, carbon-fibre reinforced					O4							
	Plastic, aramid-fibre reinforced					O5							
	Graphite (technical)			80 Shore		O6							

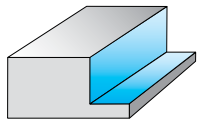
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

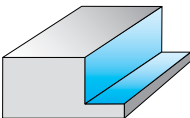
The specified cutting data are average standard values. For specific applications, adjustment is recommended.

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Cutting data for solid carbide milling cutters

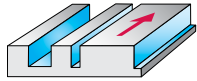
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						Product family		λ			
						MD177 Supreme		38°			
Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R_m [N/mm ²]	Machining group ¹	Ø 6–25 mm / 3/16–1" Inch			
								Z = 7			
								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	
P	Unalloyed steel	C ≤ 0.25%	Annealed	125	428	P1	40	225	0,10		
		C > 0.25% to ≤ 0.55%	Annealed	190	639	P2	40	355	0,10		
		C > 0.25% to ≤ 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					
		≤ 12% Si, not hardenable		75	260	N3					
	Cast aluminium alloys	≤ 12% Si, hardenable, hardened		90	314	N4					
		> 12% Si, not hardenable		130	447	N5					
	Magnesium-based alloys			70	250	N6					
				100	343	N7					
Copper and copper alloys (bronze/brass)	Unalloyed, electrolytic copper		90	314	N8						
	Brass, bronze, red brass		110	382	N9						
	Copper alloys, short-chipping		300	1013	N10						
	High tensile, Ampco										
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					

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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/mm²]	Machining group 1	Ø 1–25 mm			
								Z = 3–5			
								WJ30TF / TAX			
								Starting values for cutting speed v _c [m/min]			
								a _g / D _c			
					1/1	1/2	1/10	VT			
P	Unalloyed 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
	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				
		≤ 12% Si, not hardenable			75	260	N3				
	Cast aluminium alloys	≤ 12% Si, hardenable, hardened			90	310	N4				
		> 12% Si, not hardenable			130	450	N5				
	Magnesium-based alloys				70	250	N6				
					100	340	N7				
	Copper and copper alloys (bronze/brass)	Unalloyed, 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				
	Graphitee (technical)				80 Shore		O6				

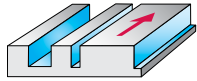
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

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

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

(continued)



					Product family				λ			
					ME232 Perform				30°–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 2–20 mm / 1/8–3/4 Inch				
								Z = 2–6				
								WJ30ED				
								Starting values for cutting speed v _c [m/min]				
								a _e / D _c				
							1/1	1/2	1/10	VT ²		
P	Unalloyed steel	C ≤ 0,25 %	Annealed	125	428	P1	113	139	198	A		
		C > 0,25... ≤ 0,55 %	Annealed	190	639	P2	155	190	272	A		
		C > 0,25... ≤ 0,55 %	Heat-treated	210	708	P3	131	162	233	A		
		C > 0,55 %	Annealed	190	639	P4	131	162	233	A		
		C > 0,55 %	Heat-treated	300	1013	P5	93	115	164	A		
		Free-machining steel (short-chipping)	Annealed	220	745	P6	131	162	233	A		
	Low-alloy steel	Annealed		175	591	P7	131	162	233	A		
		Heat-treated		300	1013	P8	82	101	144	A		
		Heat-treated		380	1282	P9	77	95	136	A		
		Heat-treated		430	1477	P10	65	80	115	A		
	High-alloy steel and high-alloy tool steel	Annealed		200	675	P11	131	162	233	A		
		Hardened and tempered		300	1013	P12	93	115	164	A		
		Hardened and tempered		400	1361	P13	77	95	136	A		
	Stainless steel	Ferritic/martensitic, annealed		200	675	P14	45	56	80	A		
		Martensitic, heat-treated		330	1114	P15	37	46	65	A		
M	Stainless steel	Austenitic, quench hardened		200	675	M1	53	65	94	B		
		Austenitic, precipitation hardened (PH)		300	1013	M2	33	41	59	B		
		Austenitic/ferritic, duplex		230	778	M3	46	56	80	B		
K	Malleable cast iron	Ferritic		200	675	K1	123	152	218	A		
		Pearlitic		260	867	K2	97	119	170	A		
	Grey cast iron	Low strength		180	602	K3	123	152	218	A		
		High strength/austenitic		245	825	K4	104	128	182	A		
	Cast iron with spheroidal graphite	Ferritic		155	518	K5	123	152	218	A		
		Pearlitic		265	885	K6	97	119	170	A		
	CGI			200	675	K7	83	102	146	A		
N	Wrought aluminium alloys	Not hardenable		30	–	N1						
		Hardenable, hardened		100	343	N2						
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	434	540		C		
		≤ 12% Si, hardenable, hardened		90	314	N4	434	540		C		
		> 12% Si, not hardenable		130	447	N5						
	Magnesium-based alloys			70	250	N6						
	Copper and copper alloys (bronze/brass)	Unalloyed, electrolytic copper		100	343	N7						
Brass, bronze, red brass			90	314	N8	313	389		C			
Copper alloys, short-chipping			110	382	N9	313	389		C			
High tensile, Ampco			300	1013	N10	42	53		C			
S	Heat-resistant alloys	Fe-based	Annealed	200	675	S1	35	43		B		
			Hardened	280	943	S2	22	26		B		
		Ni- or Co-based	Annealed	250	839	S3	35	43		B		
			Hardened	350	1177	S4	22	26		B		
			Cast	320	1076	S5	22	26		B		
	Titanium alloys	Pure titanium		200	675	S6	37	46		B		
		α and β alloys, hardened		375	1262	S7	37	46		B		
		β alloys		410	1396	S8	20	24		B		
	Tungsten alloys			300	1013	S9	49	60		B		
	Molybdenum alloys			300	1013	S10	49	60		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						
	Graphitee (technical)		80 Shore			O6						

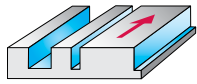
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

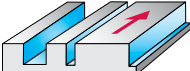
The specified cutting data represents average standard values. For specific applications, adjustment is recommended.

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

(continued)



						Product family		λ			
						MC251 Advance		35°/38°			
Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R _m [N/mm²]	Machining group 1	Ø 3–20 mm			
								Z = 4			
								WK40RC			
								Starting values for cutting speed v _c [m/min]			
						a _e / D _c					
						1/1	1/2	1/10	VT		
P	Unalloyed 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	58	87	104	B	
		Austenitic, precipitation hardened (PH)		300	1010	M2	37	55	65	B	
		Austenitic/ferritic, duplex		230	780	M3	50	75	88	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					
				100	340	N7					
	Copper and copper alloys (bronze/brass)	Unalloyed, 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	38		67	B	
			Hardened	280	940	S2	24		42	B	
		Ni- or Co-based	Annealed	250	840	S3	38		67	B	
			Hardened	350	1180	S4	24		42	B	
			Cast	320	1080	S5	24		42	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					
	Graphitee (technical)			80 Shore		O6					

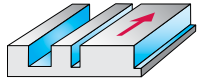
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

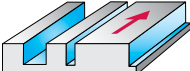
The specified cutting data represents average standard values. For specific applications, adjustment is recommended.

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

(continued)



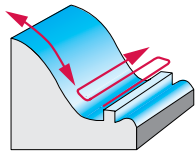
						Product family		λ			
						MC267 Advance MC267 ConeFit		45°			
Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R _m (N/mm ²)	Machining group ¹	Ø 1–20 mm			
								Z = 2–3			
								WJ30CA / WJ30UU			
								Starting values for cutting speed v _c [m/min]			
								a _e / D _c			
							1/1	1/2	1/10	VT	
P	Unalloyed 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)	Unalloyed, 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					
	Graphitee (technical)			80 Shore		O6					

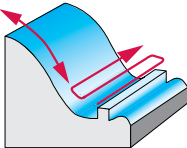
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

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

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Cutting data for solid carbide circle segment milling cutters



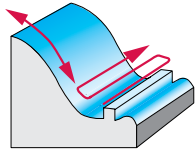
						Product family		λ				
						MD838 Supreme MD838 ConeFit		30°				
Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R_m [N/mm ²]	Machining group ¹	Ø 6–16 mm				
								Z = 4–8				
								WJ30RD				
								Starting values for cutting speed v_c [m/min]			VT	
								1/5	1/20	1/50		
P	Non-alloyed steel	C ≤ 0,25 %	Annealed	125	428	P1	230	330	390	A		
		C > 0,25... ≤ 0,55 %	Annealed	190	639	P2	230	310	380	A		
		C > 0,25... ≤ 0,55 %	Heat-treated	210	708	P3	210	280	310	A		
		C > 0,55 %	Annealed	190	639	P4	210	280	310	A		
		C > 0,55 %	Heat-treated	300	1013	P5	170	200	220	A		
		Free-machining steel (short-chipping)	Annealed	220	745	P6	210	280	330	A		
	Low-alloy steel	Annealed		175	591	P7	210	280	330	A		
		Heat-treated		300	1013	P8	170	200	240	A		
		Heat-treated		380	1282	P9	140	170	200	A		
		Heat-treated		430	1477	P10	120	150	170	A		
	High-alloy steel and high-alloy tool steel	Annealed		200	675	P11	210	280	330	A		
		Hardened and tempered		300	1013	P12	170	200	240	A		
		Hardened and tempered		400	1361	P13	120	150	170	A		
	Stainless steel	Ferritic/martensitic, annealed		200	675	P14	90	110	120	A		
		Martensitic, heat-treated		330	1114	P15	70	80	100	A		
M	Stainless steel	Austenitic, quench hardened		200	675	M1						
		Austenitic, precipitation hardened (PH)		300	1013	M2						
		Austenitic/ferritic, duplex		230	778	M3						
K	Malleable cast iron	Ferritic		200	675	K1	180	240	290	A		
		Pearlitic		260	867	K2	150	190	220	A		
	Grey cast iron	Low strength		180	602	K3	180	240	290	A		
		High strength/austenitic		245	825	K4	150	200	240	A		
	Cast iron with spheroidal graphite	Ferritic		155	518	K5	180	240	290	A		
		Pearlitic		265	885	K6	150	190	220	A		
	CGI		200	675	K7	130	160	190	A			
N	Wrought aluminium alloys	Not hardenable		30	–	N1						
		Hardenable, hardened		100	343	N2						
		≤ 12% Si, not hardenable		75	260	N3						
	Cast aluminium alloys	≤ 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						

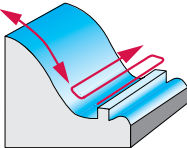
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium, page F7.

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

D 31

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				
								Startwerte für Schnittgeschwindigkeit v _c [m/min]			VT	
								1/5	1/20	1/50		
P	Unalloyed 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		
		Unalloyed, electrolytic copper		100	340	N7	270	350	430	C		
	Copper and copper alloys (bronze/brass)	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						
	Graphitee (technical)		80 Shore			O6						

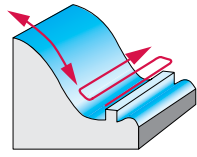
¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

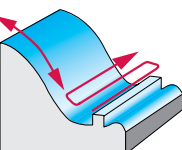
The specified cutting data represents average standard values. For specific applications, adjustment is recommended.

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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 edge speed v _c [m/min]			VT	
								a _e / D _c				
		1/5	1/20	1/50								

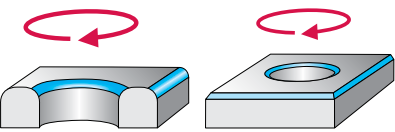
P	Unalloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	230	310	370	A		
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2	220	300	360	A		
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3	190	260	310	A		
		C > 0,55 %	Annealed	190	640	P4	190	260	310	A		
		C > 0,55 %	Heat-treated	300	1010	P5	150	180	220	A		
		Free-machining 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)	Unalloyed, 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						
	Graphitee (technical)		80 Shore			O6						

¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

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

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Cutting data for solid carbide profiling cutters

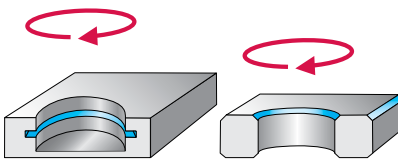
						Product family			λ			
						MC500 Advance	H3E58118	0°				
						MC501 Advance	H3E58318					
						MC502 Advance	H3E58518					
H1E58018		H1E58318	10°									
H1E58118		H1E58518										
Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R _m [N/mm²]	Machining group 1	60° / 90° / 120° / 150°				
								Z = 2–6				
								WJ30TF / TAX				
								Starting values for cutting edge speed vc [m/min]				
								a _g / D _c				
							1/3	1/10	1/20	VT		
P	Unalloyed 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			
			100	340	N7	480	680	840	C			
	Copper and copper alloys (bronze/brass)	Unalloyed, electrolytic copper		90	310	N8	480	680	840	C		
		Brass, bronze, red brass		110	380	N9	480	680	840	C		
		Copper alloys, short-chipping		300	1010	N10	70	100	120	C		
High tensile, Ampco												
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						
	Graphitee (technical)		80 Shore			O6						

¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

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

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Cutting data for modular solid carbide circular milling cutters

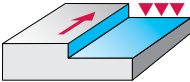
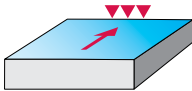
					Product family				metric/ Inch			
					MG510, MG515, MG520							
Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R _m [N/mm²]	Machining group ¹	Ø 6,7–39,7 mm / SB 0,5–6,35 mm				
								Z = 3 + 6				
								WMP35X				
								Starting values for cutting speed v _c [m/min]			VT	
								a _e / D _c				
		30%	20%	10%								
P	Unalloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	220	230	255	A		
		C > 0,25... ≤ 0,55 %	Annealed	190	640	P2	215	225	245	A		
		C > 0,25... ≤ 0,55 %	Heat-treated	210	710	P3	190	195	215	A		
		C > 0,55 %	Annealed	190	640	P4	161	170	190	A		
		C > 0,55 %	Heat-treated	300	1010	P5	160	165	180	A		
		Free-machining steel (short-chipping)	Annealed	220	750	P6	180	185	205	A		
	Low-alloy steel	Annealed		175	590	P7	170	175	195	A		
		Heat-treated		285	960	P8	160	165	180	A		
		Heat-treated		380	1280	P9	164	172	190	A		
		Heat-treated		430	1480	P10	164	172	190	A		
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	165	170	190	A		
		Hardened and tempered		300	1010	P12	100	105	120	A		
		Hardened and tempered		380	1280	P13				A		
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14				A		
		Martensitic, heat-treated		330	1110	P15				A		
M	Stainless steel	Austenitic, quench hardened		200	680	M1	232	244	269	B		
		Austenitic, precipitation hardened (PH)		300	1010	M2	194	200	219	B		
		Austenitic/ferritic, duplex		230	780	M3	145	156	175	B		
K	Malleable cast iron	Ferritic		200	400	K1	215	225	250	A		
		Pearlitic		260	700	K2	195	200	220	A		
	Grey cast iron	Low strength		180	200	K3	156	165	185	A		
		High strength/austenitic		245	350	K4	155	160	175	A		
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	90	95	105	A		
		Pearlitic		265	700	K6	135	140	155	A		
	CGI			230	400	K7	120	125	135	A		
N	Wrought aluminium alloys	Not hardenable		30	–	N1	714	750	825	C		
		Hardenable, hardened		100	340	N2	233	244	266	C		
	Cast aluminium alloys	≤ 12% Si, not hardenable		75	260	N3	573	602	666	C		
		≤ 12% Si, hardenable, hardened		90	310	N4	246	258	285	C		
		> 12% Si, not hardenable		130	450	N5	246	258	285	C		
	Magnesium-based alloys		70	250	N6				C			
	Copper and copper alloys (bronze/brass)	Unalloyed, electrolytic copper		100	340	N7	344	361	400	C		
		Brass, bronze, red brass		90	310	N8	344	361	400	C		
		Copper alloys, short-chipping		110	380	N9	344	361	400	C		
		High tensile, Ampco		300	1010	N10	344	361	400	C		
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	49	52	57	B		
			Hardened	280	940	S2	33	34	38	B		
		Ni- or Co-based	Annealed	250	840	S3	29	30	33	B		
			Hardened	350	1180	S4	18	19	21	B		
			Cast	320	1080	S5	23	24	26	B		
	Titanium alloys	Pure titanium		200	680	S6	90	95	105	B		
		α and β alloys, hardened		375	1260	S7	41	43	48	B		
		β alloys		410	1400	S8	41	43	48	B		
	Tungsten alloys		300	1010	S9				B			
	Molybdenum alloys		300	1010	S10				B			
H	Hardened steel	Hardened and tempered		50 HRC	–	H1	57	60	67	B		
		Hardened and tempered		55 HRC	–	H2	57	60	67	B		
		Hardened and tempered		60 HRC	–	H3	57	60	67	B		
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4	106	112	124	B		
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						
	Graphitee (technical)			80 Shore		O6						

¹ The assignment of the machining groups can be found in the "General" section of the Technical Compendium.

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

	Product family			metric
	MG545			
	Ø 9,7–21,7 mm / 45°			
	Z = 3 + 6			
	WMP35X			
	Starting values for cutting speed v_c [m/min]			
	a_e / D_c			
	15%	10%	5%	VT
	240	255	275	A
	235	245	265	A
	200	215	230	A
	180	190	205	A
	170	180	195	A
	190	205	220	A
	180	195	205	A
	170	180	195	A
	181	190	200	A
	181	190	200	A
	175	190	200	A
	110	120	130	A
				A
				A
				A
	256	269	294	B
	206	219	238	B
	169	175	188	B
	235	250	270	A
	205	220	235	A
	175	185	200	A
	165	175	190	A
	100	105	115	A
	145	155	170	A
	130	135	150	A
	788	825	900	C
	255	266	289	C
	633	666	700	C
	271	285	300	C
	271	285	300	C
				C
	380	400	420	C
	380	400	420	C
	380	400	420	C
	380	400	420	C
	54	57	60	B
	36	38	40	B
	32	33	35	B
	20	21	23	B
	25	26	28	B
	100	105	110	B
	45	48	50	B
	45	48	50	B
				B
				B
	63	67	70	B
	63	67	70	B
	63	67	70	B
	118	124	130	B

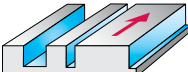
Cutting data for PCD milling

 						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]			VT
								1/1 1/2	a _e / D _c 1/4	1/10	
P	Unalloyed steel	C ≤ 0.25%	Annealed	125	428	P1					
		C > 0.25% to ≤ 0.55%	Annealed	190	639	P2					
		C > 0.25% to ≤ 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)	Unalloyed, 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.

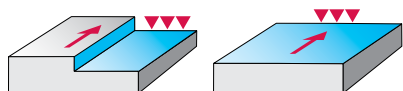
Cutting data for ceramic shoulder/slot milling cutters

						Product family			λ	Product family			λ		
						MC275 Ceramic (Solid)			35°	MC075 Ceramic (Solid)			35°		
						MC275 Ceramic ConeFit				MC075 Ceramic ConeFit					
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 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			VT ²	a _e / D _c			VT ²	
							1	1/4	1/10		1	1/4	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									
		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]			VT	
								a _e / D _c				
							1/2	1/4	1/10			
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						
				100	340	N7						
	Copper and copper alloys (bronze/brass)	Non-alloyed, electrolytic copper		100	340	N7						
Brass, bronze, red brass			90	310	N8							
Copper alloys, short-chipping			110	380	N9							
High tensile, Ampco			300	1010	N10							
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1						
			Hardened	280	940	S2						
		Ni- or Co-based	Annealed	250	840	S3						
			Hardened	350	1180	S4						
			Cast	320	1080	S5						
	Titanium alloys	Pure titanium		200	680	S6						
		α and β alloys, hardened		375	1260	S7						
		β alloys		410	1400	S8						
	Tungsten alloys		300	1010	S9							
	Molybdenum alloys		300	1010	S10							
H	Hardened steel	Hardened and tempered	50 HRC	–	H1							
		Hardened and tempered	55 HRC	–	H2							
		Hardened and tempered	60 HRC	–	H3							
	Hardened cast iron	Hardened and tempered	55 HRC	–	H4							
O	Thermoplastics	Without abrasive fillers				O1						
	Thermosetting plastics	Without abrasive fillers				O2						
	Plastic, glass-fibre reinforced	GFRP				O3						
	Plastic, carbon-fibre reinforced	CFRP				O4						
	Plastic, aramid-fibre reinforced	AFRP				O5						
	Graphite (technical)		80 Shore			O6						

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.

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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

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	0,02	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)

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	0,16	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

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

C Material groups ISO N and ISO O (continued)

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

* Radial feed in mm

Feed determination (continued)

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

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

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

E Flash MC089 Advance ISO H

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

F MD340 + MD344 Supreme

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

* Radial feed in mm

Feed determination for brazed tools

G Wrought aluminium alloys

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

H Magnesium-based alloys/copper and copper alloys

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

I Thermoplastics, thermosetting plastics, plastic, graphite

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

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

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

* Radial feed in mm

Feed determination for brazed tools

(continued)

K Grey cast iron

a_e [mm]*	Feed per tooth f_z [mm]								
	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm
1,0	0,13	0,13	0,13	0,14	0,15				
2,0	0,13	0,13	0,13	0,13	0,14	0,26			
3,0	0,13	0,13	0,13	0,13	0,13	0,25	0,26		
4,0	0,12	0,13	0,13	0,13	0,13	0,24	0,25	0,26	
5,0	0,12	0,12	0,13	0,13	0,13	0,24	0,24	0,25	0,26
6,0	0,12	0,12	0,12	0,13	0,13	0,23	0,24	0,24	0,25
8,0	0,12	0,12	0,12	0,12	0,13	0,22	0,23	0,24	0,24
10,0	0,12	0,12	0,12	0,12	0,12	0,22	0,22	0,23	0,24
12,0	0,12	0,12	0,12	0,12	0,12	0,21	0,22	0,22	0,23
16,0	0,12	0,12	0,12	0,12	0,12	0,20	0,21	0,22	0,22
20,0		0,12	0,12	0,12	0,12	0,20	0,20	0,21	0,22
25,0			0,12	0,12	0,12	0,20	0,20	0,20	0,21
32,0				0,12	0,12	0,20	0,20	0,20	0,20
40,0					0,12	0,20	0,20	0,20	0,20
50,0						0,20	0,20	0,20	0,20
63,0							0,20	0,20	0,20
80,0								0,20	0,20
100,0									0,20

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

a_e [mm]*	Feed per tooth f_z [mm]								
	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm
1,0	0,09	0,09	0,09	0,1	0,10				
2,0	0,09	0,09	0,09	0,09	0,10	0,17			
3,0	0,09	0,09	0,09	0,09	0,09	0,16	0,17		
4,0	0,08	0,09	0,09	0,09	0,09	0,15	0,16	0,17	
5,0	0,08	0,08	0,09	0,09	0,09	0,14	0,15	0,16	0,17
6,0	0,08	0,08	0,08	0,09	0,09	0,14	0,14	0,15	0,16
8,0	0,08	0,08	0,08	0,08	0,09	0,14	0,14	0,14	0,15
10,0	0,08	0,08	0,08	0,08	0,08	0,13	0,14	0,14	0,14
12,0	0,08	0,08	0,08	0,08	0,08	0,13	0,13	0,14	0,14
16,0	0,08	0,08	0,08	0,08	0,08	0,13	0,13	0,13	0,14
20,0		0,08	0,08	0,08	0,08	0,13	0,13	0,13	0,13
25,0			0,08	0,08	0,08	0,12	0,13	0,13	0,13
32,0				0,08	0,08	0,12	0,12	0,13	0,13
40,0					0,08	0,12	0,12	0,12	0,13
50,0						0,12	0,12	0,12	0,12
63,0							0,12	0,12	0,12
80,0								0,12	0,12
100,0									0,12

M Stainless steel (ISO P)

a_e [mm]*	Feed per tooth f_z [mm]								
	Ø 16 mm	Ø 20 mm	Ø 25 mm	Ø 32 mm	Ø 40 mm	Ø 50 mm	Ø 63 mm	Ø 80 mm	Ø 100 mm
1,0	0,07	0,07	0,07	0,08	0,08				
2,0	0,07	0,07	0,07	0,07	0,08	0,14			
3,0	0,07	0,07	0,07	0,07	0,07	0,13	0,14		
4,0	0,06	0,07	0,07	0,07	0,07	0,12	0,13	0,14	
5,0	0,06	0,06	0,07	0,07	0,07	0,12	0,12	0,13	0,14
6,0	0,06	0,06	0,06	0,07	0,07	0,12	0,12	0,12	0,13
8,0	0,06	0,06	0,06	0,06	0,07	0,12	0,12	0,12	0,12
10,0	0,06	0,06	0,06	0,06	0,06	0,11	0,12	0,12	0,12
12,0	0,06	0,06	0,06	0,06	0,06	0,11	0,11	0,12	0,12
16,0	0,06	0,06	0,06	0,06	0,06	0,11	0,11	0,11	0,12
20,0		0,06	0,06	0,06	0,06	0,11	0,11	0,11	0,11
25,0			0,06	0,06	0,06	0,10	0,11	0,11	0,11
32,0				0,06	0,06	0,10	0,10	0,11	0,11
40,0					0,06	0,10	0,10	0,10	0,11
50,0						0,10	0,10	0,10	0,10
63,0							0,10	0,10	0,10
80,0								0,10	0,10
100,0									0,10

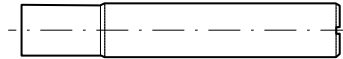
* Radial feed in mm

Cutting speed: Correction factors*

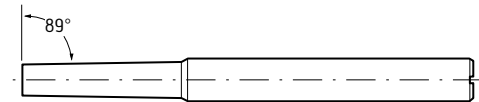
v_c correction factors – toolholder/steel

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

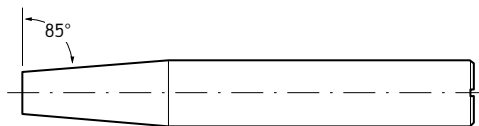
Type A



Type B



Type C



v_c correction factors – toolholder/solid carbide

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

*** Please note:**

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

Grade description

Coated carbide

Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Tool example	
		P 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
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			●																
WJ30TP	HC – P 30	●●															PVD	TiAlN + ZrN		
	HC – M 30		●																	
	HC – K 30			●																
	HC – N 30				●															
	HC – S 30					●														

HC = coated carbide

- Primary application
- Additional application

Grade description

(continued)

Coated carbide

Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Tool example			
		P 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	
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					●●																
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	
WMP35X	HC – P 35	●●																		PVD	TiAlSiN	
	HC – M 35		●●																			
	HC – K 35			●●																		
	HC – N 35				●																	
	HC – S 35					●																
	HC – H 35						●●															

HC = coated carbide

●● Primary application
● Additional application

Grade description

(continued)

Uncoated carbide

Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Tool example		
		P	M	K	N	S	H	O	01	05	10	15	20	25	30	35				40	45
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other													
WJ30UU	HW – N 30				●●								Application range diagram: A green trapezoidal area spanning from 15 to 45 on the application range scale, with a peak at 30.				—	—			

CN = Silicon nitride Si_3N_4

HC = coated carbide

HW = uncoated carbide

●● Primary application

● Additional application

Ceramic

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

CN = Silicon nitride Si_3N_4

HC = coated carbide

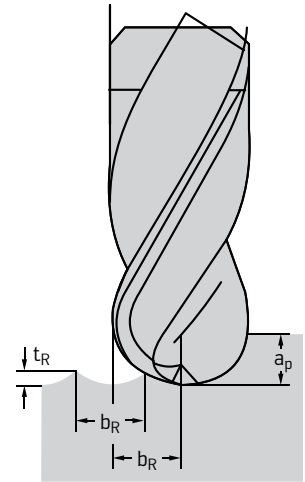
HW = uncoated carbide

●● Primary application

● Additional application

Usage recommendations for copying and finishing

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

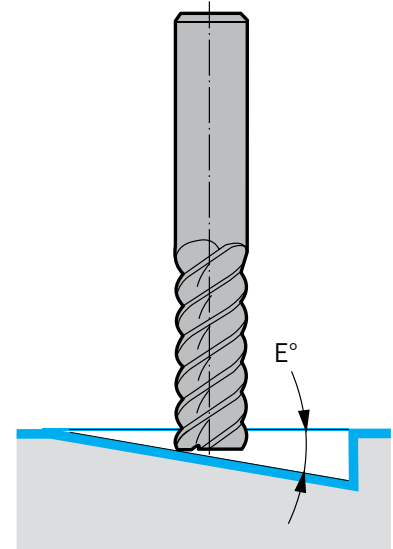


Maximum feed angle with solid carbide

Material groups	Materials	Number of teeth					
		2	3	4	5	6-8	8
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

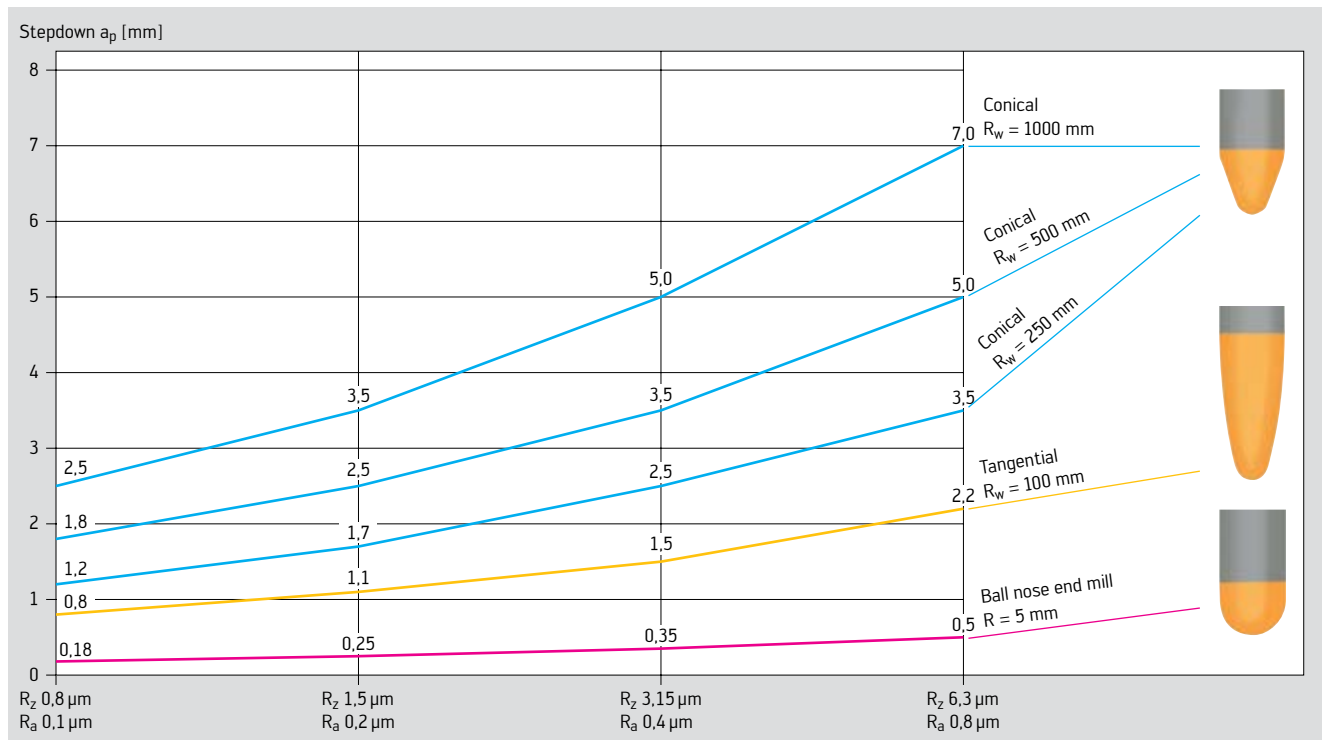
* If $R_m > 1100 \text{ N/mm}^2$, reduce the ramping angle by 25%:

MD344 Supreme – specialist in ramping strategies, feed angles up to 45° possible.



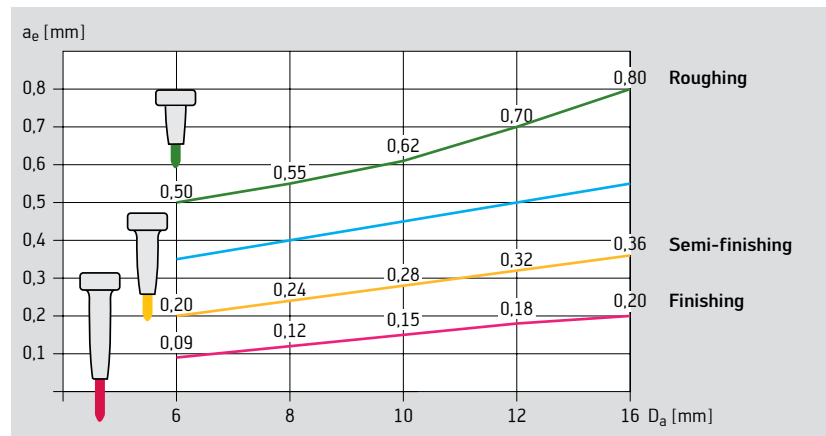
Recommendations for the use of circle segment milling cutters

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

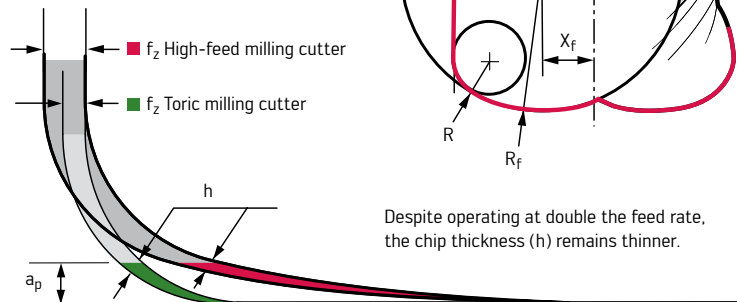
High-feed milling cutters

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

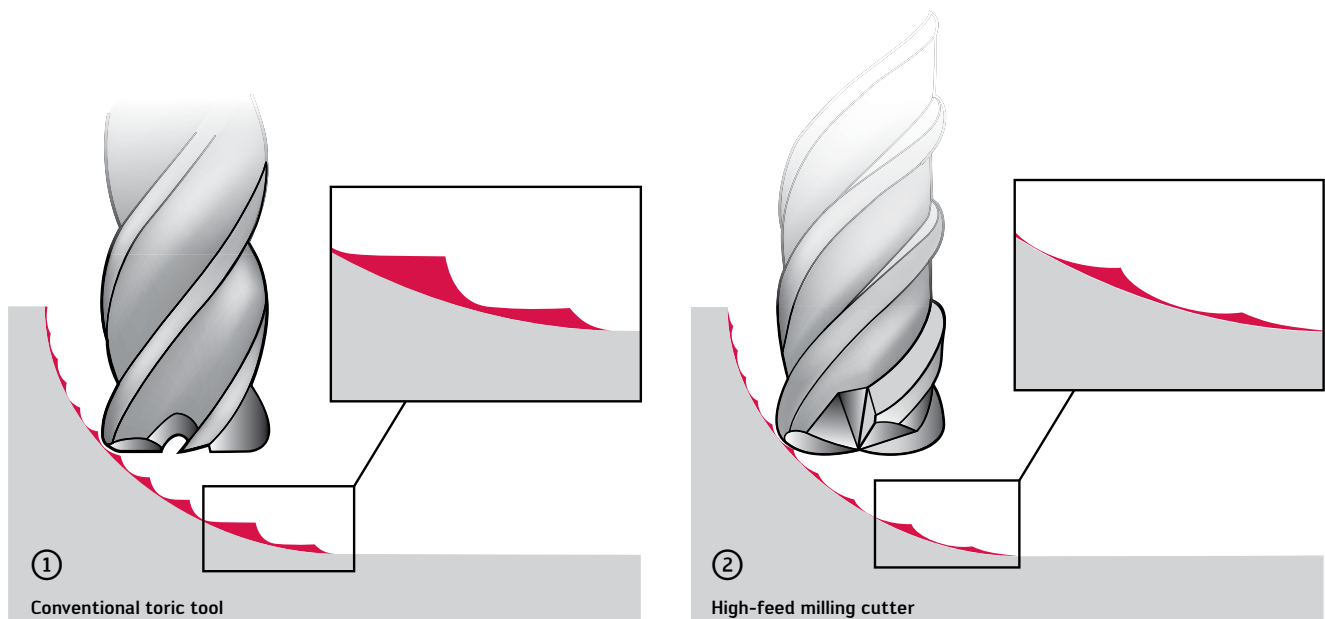
MC025 Advance and MC025 ConeFit
(WJ30TF = ISO P, M, K, S → Universal)

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.



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



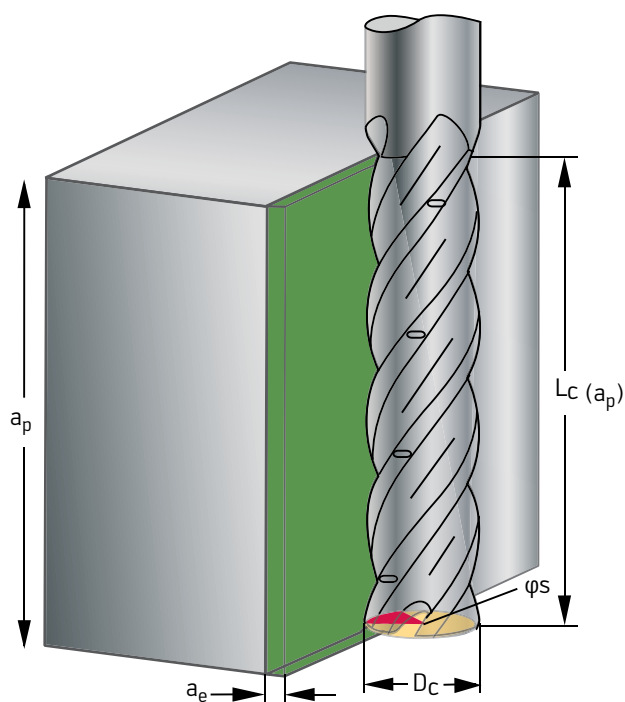
Application information: Dynamic milling

Maximum process reliability plus efficiency

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

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

The machining strategy



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

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

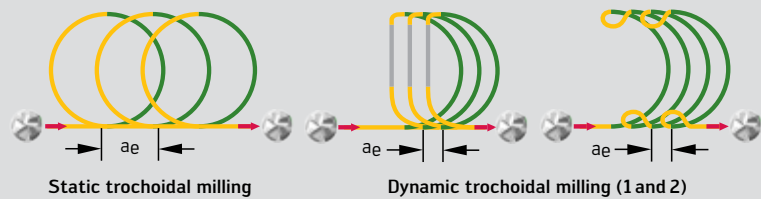
Strategy: High metal removal rate with reduced tool wear

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

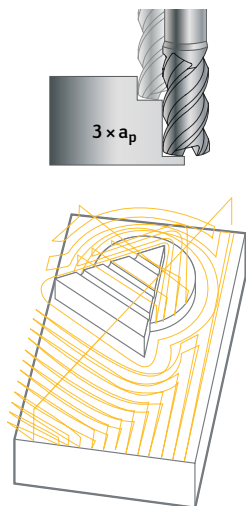
In static trochoidal milling operations (from "trochos" meaning "wheel"), the milling tool moves along circular (trochoidal) paths. The tool paths are optimally adapted to the workpiece in dynamic milling strategies and free travel is avoided, leading to an increase in the metal removal rate.



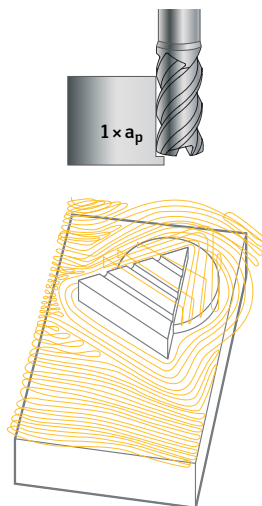
Dynamic or conventional? A comparison of the strategies

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)

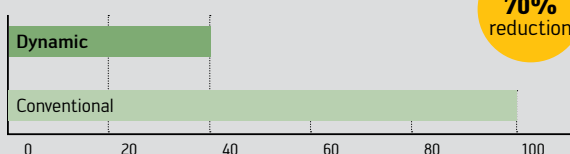


High Dynamic Cutting (HDC)



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 [%]



Up to
70%
reduction

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



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

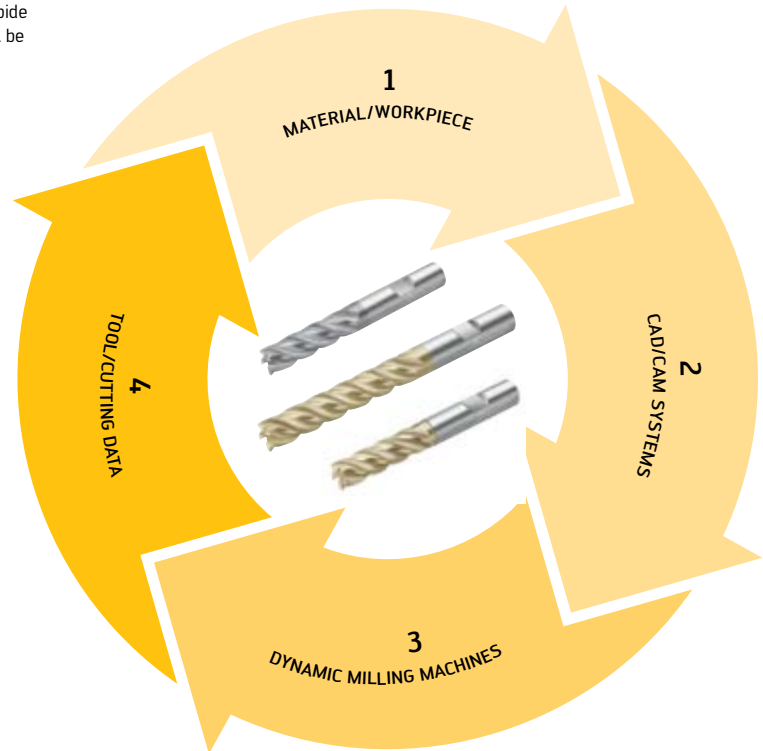
Application information: Dynamic milling (continued)

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.

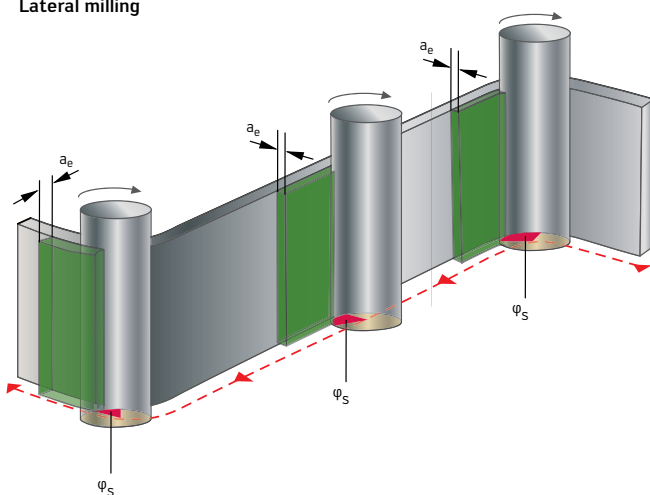
To be able to mill dynamically, the following basic requirements need to be met:

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

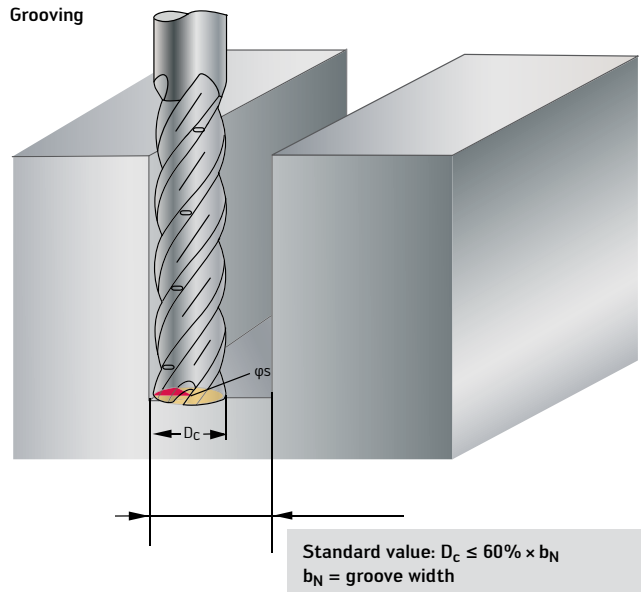


Building block 1: Material/workpiece

Lateral milling



Grooving



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

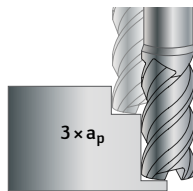
Most CAD/CAM systems feature the modules required for dynamic milling.

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)

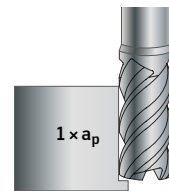
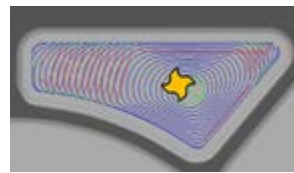
Comparison: Conventional vs. dynamic milling

High Performance Cutting (HPC)



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

High Dynamic Cutting (HDC)



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

Important functions of CAD/CAM systems:

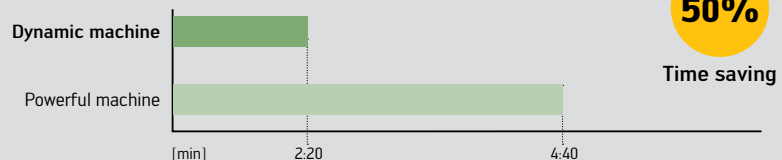
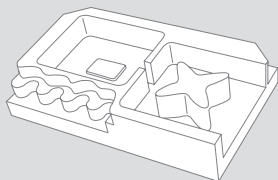
- Plunging movement can be selected (preferably helical plunging or start hole drilling)
- Milling paths parallel to the contour
- Choice of milling direction (preferably climb milling)
- Arc entry and exit movements
- Rounded roughing paths
- Residual material detection
- Reduction of a_e , a_p , v_c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

Building block 3: Dynamic milling machine

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

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

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



Suitable clamping systems

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

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



Weldon chuck



AK182 hydraulic expansion chuck

Application information: Dynamic milling (continued)

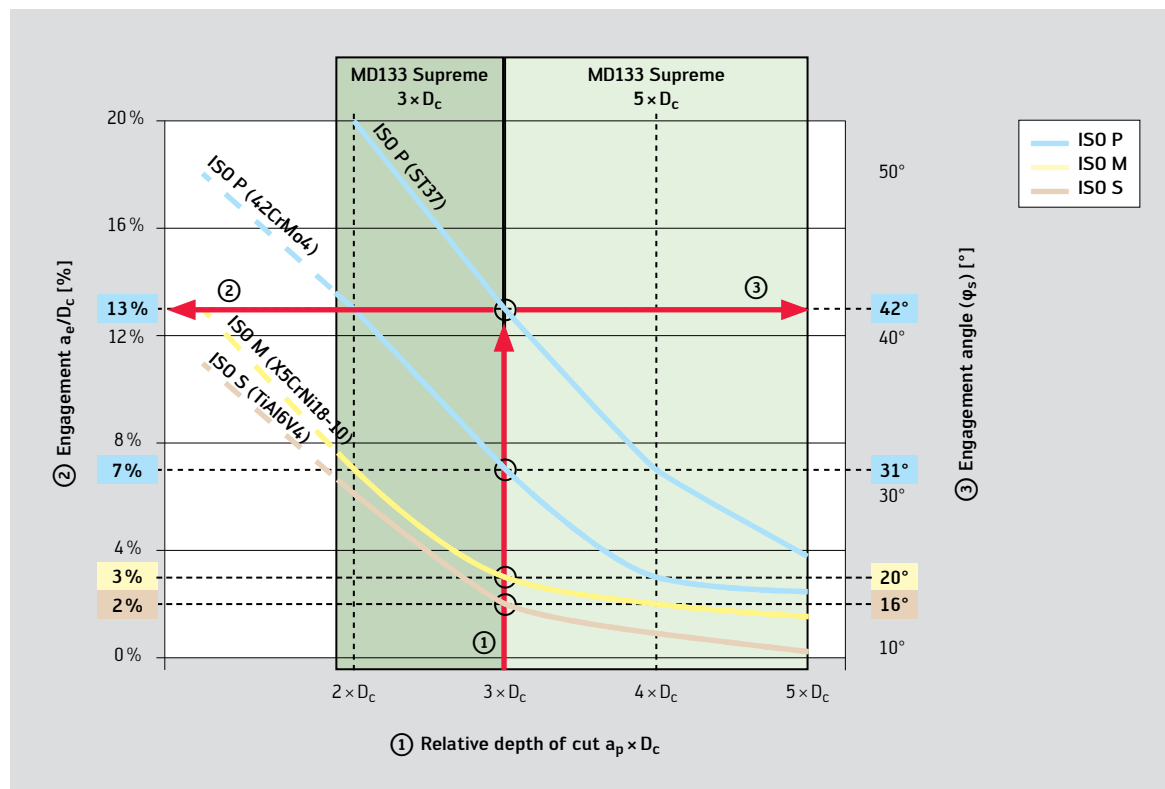
Building block 4: Tool/cutting data

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

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

Cutting data recommendation

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



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

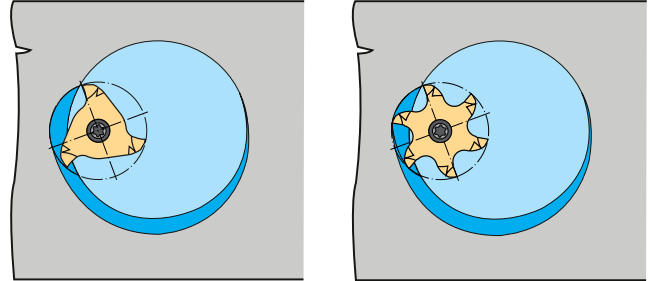
a_p	ISO P		ISO M	ISO S
	ST37 – 490 N/mm ²	42CrMo4 – 1.000 N/mm ²	1.4301 – 675 N/mm ²	TiAl6V4 – 1.100 N/mm ²
2 x D_c	53°	42°	31°	28°
3 x D_c	42°	31°	20°	16°
4 x D_c	31°	20°	16°	14°
5 x D_c	23°	18°	14°	11°

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

Application information: Solid carbide circular interpolation milling cutter with modular interface

Recommendations for circular interpolation

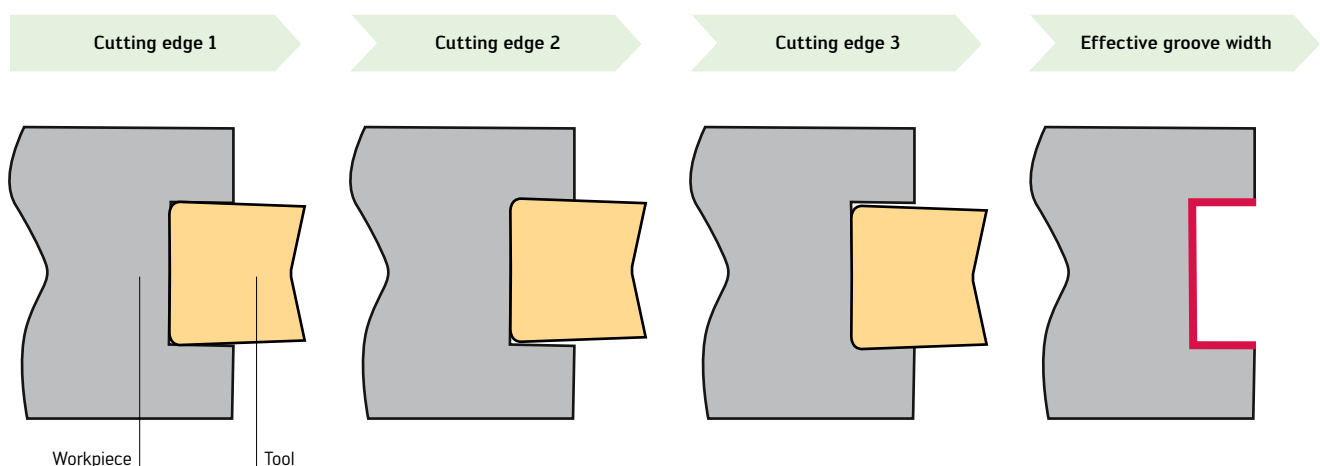
- Circular interpolation using synchronous milling (climb milling) is recommended.
- It is recommended that you use a circular arc of at least 45° to 180° for entrance into the material. This progressive ramp-in strategy prevents vibrations and damage to the milling cutter edges.
- When calculating the cutting data, the engagement ratios must be considered. When employing circular interpolation in an internal groove, you must determine the effective depth of cut and the feed on the tool axis.
- When selecting the number of teeth for a circular interpolation milling cutter, the application and the material must be taken into account.
- To prevent or reduce vibration, the engagement angle of the tool or the number of teeth engaged at the same time should be reduced. If the ratio of cutting diameter to hole diameter is small, the use of a circular interpolation milling cutter with three teeth can also be advantageous.



Effective groove width

Please note:

In addition to the specified cutting width tolerance, a design-related run-out tolerance of up to 0.03 mm must be taken into account. This means that the effective groove width can be up to 0.03 mm wider in relation to the cutting width.



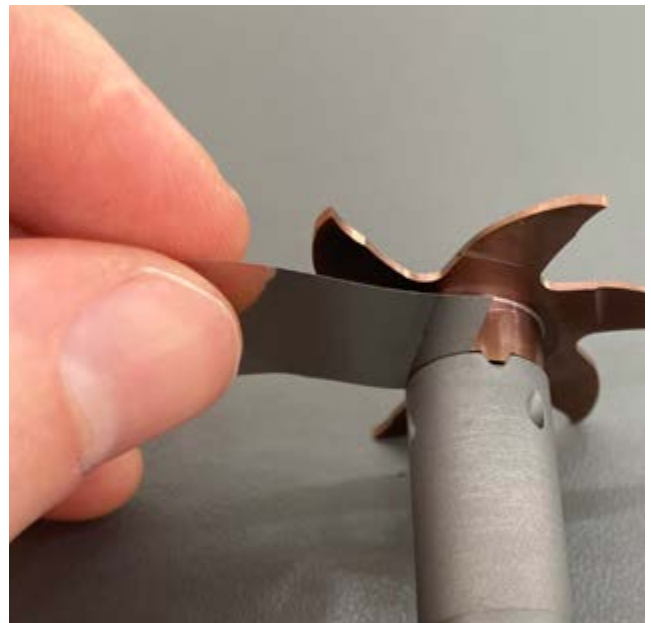
Assembly instructions for solid carbide circular interpolation milling cutters with modular adaptor

- Clean the interface on the solid carbide circular interpolation milling cutter and on the adaptor
- Assemble and tighten the solid carbide circular interpolation milling cutter to the specified torque (see table).
- We recommend that you do not use special copper grease or similar anti-seize lubricants on the screw.

Please note:

After assembling the tool, there will be a gap between the solid carbide circular interpolation milling cutter and the modular adaptor. The contact surface is located on the flanks of the interface (see image).

Type	Screw	Torx	Tightening torque
F05	FS2676	7IP	1.2 Nm
F06	FS2677	8IP	1.2 Nm
F08	FS2678	10IP	3.5 Nm
F09	FS2679	15IP	4.5 Nm
F12	FS2680	20IP	7 Nm
F14	FS2680	20IP	7 Nm



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 milling tools

Example:

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

1	2	3	4
Tool group	Generation	Tool type	Tool type
M Milling		0 Face milling cutter, high-feed milling cutter 1 Shoulder milling cutter 2 Shoulder/slot/helical milling cutter 3 Shoulder/slot/helical milling cutter, Helix angle $\geq 40^\circ$ 4 Ball nose mill/copy milling cutter 5 Profiling cutter 7 Routing cutter/circular interpolation mill 8 Conical/circle segment milling cutter	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 deburrer 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, knurled profile with internal coolant 20 Universal 40° helix angle, knurled 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, multipurpose cutter 29 Universal 60° helix angle, type N, multipurpose cutter 30 Universal Helix angle 35°/38° UNI, HPC geometry 32 Universal Helix angle 30°–38° UNI, HPC geometry 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 Helix angle 38°–41°, HPC geometry 41 ISO P 50° helix angle, HPC, differential pitch 51 ISO M 35°/38° helix angle, without internal coolant 65 ISO N 30° helix angle, AI geometry, RAPAX G30 roughing profile, axial internal coolant 66 ISO N 30°–35° helix angle, AI geometry 67 ISO N 45° helix angle, AI geometry 68 ISO N Helix angle 30°, Aluminium, roughing profile 77 ISO S 40° helix angle, titanium 80 ISO H Spiralwinkel 30°, HSC, Typ H 81 ISO H Spiralwinkel 30°, Mini HSC T, Typ H 82 ISO H Spiralwinkel 30°, Mini HSC R, Typ H 83 ISO H Spiralwinkel 30°, Multi Flute, Typ H 87 ISO H Spiralwinkel 50°, Multi Flute, Typ H 88 ISO H Spiralwinkel 50°, HPC, Typ H 89 ISO H Spiralwinkel 50°, High-Feed, Typ H

5	6	7
Delimiters	Cutting diameter	Shank type
– Metrisch . Inch		A Parallel shank B Bore E ConeFit T ScrewFit W Weldon shank

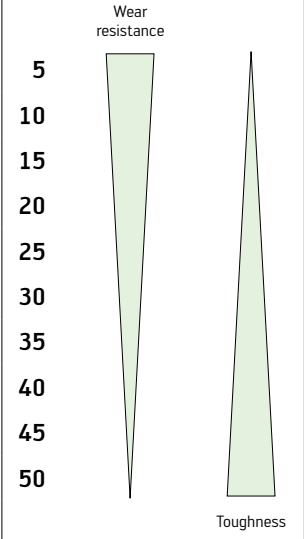
8	9	10	11
Number of teeth	Design standard	Corner radius	Variant
	A DIN 6527 K B DIN 6527 L C ANSI stub D ANSI standard L P standard L M P standard mini P P standard S P standard S X P standard XL		A I_3 XS B I_3 S / $2 \times D_c^*$ C I_3 M / $3 \times D_c^*$ D I_3 L / $4 \times D_c^*$ E I_3 XL / $5 \times D_c^*$ F I_3 XXL / $6 \times D_c^*$ G I_3 XXXL / $8 \times D_c^*$ H I_3 XXXL / $10 \times D_c^*$ J L_c S / $3 \times D_c^*$ K L_c M / $4 \times D_c^*$ L L_c L / $5 \times D_c^*$ V Conical neck $\alpha \leq 3^\circ$ W Conical neck $\alpha \leq 6^\circ$ X Conical neck $\alpha \leq 12^\circ$

* Standard values

Grade designation key for solid carbide cutting tool materials

Example::

W	K	40	TF
Walter	1	2	3

1	2	3
Substrate	Range of applications	Coating
Solid carbide B J K		TF TiAlN UU Uncoated CA CrN RC TiAlN + AlTi TZ AlTiN + ZrN ED AlCRN TG TiAlSiN RD AlTiN + ZrN RA TiAlN + TiAl EA AlCN EN nACRoA TP TiAlN + ZrN DD NHC

Designation key – PCD milling tools

Example:

M	P	0	60	—	040	B	10	P	W	D	N	20
1	2	3	4	5	6	7	8	9	Grade			

1	2	3	4
Tool group	Generation	Tool type	Tool type
M Milling	P Tools with brazed cutting edge	0 Face milling cutters, < 90° approach angle 1 Shoulder milling cutters, 90° approach angle 2 Routing cutters 3 Helical milling cutters 4 Ball-nose end mills 5 Slotting cutters 8 Profile milling cutters	60 ISO N PCD brazed, continuous cutting edge

5	6	7	8	9
Delimiters	Cutting diameter	Shank type	Number of teeth	Corner radius
— Metrisch . Inch		A Parallel shank B Bore E ConeFit T ScrewFit W Weldon shank		

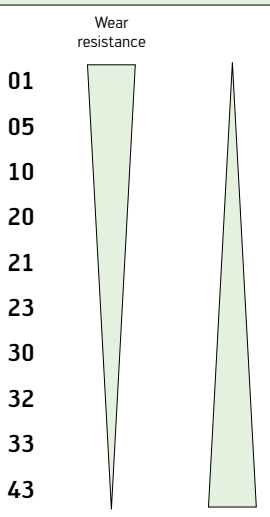
Grade designation key for PCD cutting tool materials

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

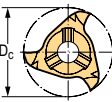
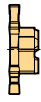
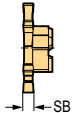
3
Range of applications
 Wear resistance 01 05 10 20 21 23 30 32 33 43 Toughness

Designation key – Solid carbide circular milling cutter with modular adaptor

Example:

M	G	5	10	–	27.1	F	12	3	250	–	WMP35X
1	2	3	4	5	6	7	8	9	10	Grade	

1	2	3	4	5
Tool group	Generation	Tool type	Tool type	Delimiters
M Milling	G Grooving	0 Face milling cutter, high-feed milling cutter 1 Shoulder milling cutter 2 Shoulder/slot/helical milling cutter 3 Shoulder/slot/helical milling cutter, Helix angle $\geq 40^\circ$ 4 Ball nose mill/copy milling cutter 5 Profiling cutter 7 Routing cutter/circular interpolation mill 8 Conical/circle segment milling cutter	10 General slot milling 15 General slot milling with a soft cutting edge 20 Milling of snap ring grooves 45 45° forward and backward chamfer milling with 45°	– Metric . Inch

6	7	8	9	10
Cutting diameter D_c [mm]	Shank type	Interface size d_1 [mm]	Number of teeth	Cutting width SB [mm]
	F modular interface 	 05 4,8 mm 06 6 mm 08 8 mm 09 9 mm 12 12 mm 14 14 mm	3 $Z = 3$  6 $Z = 6$ 	 200 2,0 mm 250 2,5 mm 300 3,0 mm etc.

THE PARTNER OF CHOICE IN INDEXABLE MILLING



Cutting data for roughing

Face/shoulder milling

Material group	= Cutting data for wet machining = Dry machining is possible			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							
												WPP35G		WKP35S		WKP25S			
												a _φ / D _c * 1/1 1/2		a _φ / D _c * 1/1 1/2		a _φ / D _c * 1/1 1/2			
P	Unalloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	250	300	250	300	290	320					
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	220	260	220	260	260	330					
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	215	250	215	250	255	320					
		C > 0,55 %	Annealed	190	640	P4	●	●●	220	260	220	260	260	330					
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	160	180	160	180	220	260					
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	210	240	210	240	250	315					
	Low-alloy steel	Annealed		175	590	P7	●	●●	220	270	220	270	260	320					
		Heat-treated		285	960	P8	●	●●	170	190	170	190	210	250					
		Heat-treated		380	1280	P9	●	●●	130	150	130	150	170	190					
		Heat-treated		430	1480	P10	●	●●	110	130	110	130	150	170					
	High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	●	●●	130	160	130	160	140	170					
		Hardened and tempered		300	1010	P12	●	●●	80	90	80	90	110	130					
		Hardened and tempered		380	1280	P13	●	●●	70	80	70	80	90	110					
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●	140	160	140	160							
		Martensitic, heat-treated		330	1110	P15	●	●●	90	110	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	160	190	180	210					
		Pearlitic		260	700	K2	●	●●	140	170	140	170	160	190					
	Grey cast iron	Low strength		180	200	K3	●	●●	300	330	300	330	320	350					
		High strength/austenitic		245	350	K4	●	●●	190	220	190	220	180	210					
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	●	●●	200	220	200	220	220	240					
		Pearlitic		265	700	K6	●	●●	130	150	130	150	140	170					
	CGI			230	400	K7	●	●●	130	160	130	160	150	180					
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	●●												
		Unalloyed, 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					
		Hardened and tempered		55 HRC	–	H2		●●											
		Hardened and tempered		60 HRC	–	H3		●●											
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4		●●					45	60					
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					

- 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.

² Cutting data can also be used without coolant.

³ Water-miscible coolants 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	
	WAK15		WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WXN15		WNN15		WHH15X		WMG40		WN15		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	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																								
	210	230							160	190	190	230					105	125					900	1000								
	190	210							160	170	170	200					90	110					800	900								
	380	410							300	330	350	380					110	120					1100	1300	1000	1250						
	230	260							190	220	190	230					90	105					900	1000	800	950						
	260	280							200	220	240	260					110	120					750	900	650	800						
	170	200							130	150	150	180					90	105					650	750	600	700						
	180	200							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									65	80					50	60							450	550						
																	35	45							220	280						
																									140	220						
	50	65									50	65					40	50							220	280						
	400	400	400	400			400	400			400	400	400	400			700	400	400	400	400	400										
	300	300	300	300			300	300			300	300	300	300			600	600	300	300	300	300										
	600	800									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 ceramic Si₃N₄

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

Cutting data for roughing

High-feed milling

Material group	= Cutting data for wet machining = Dry machining is possible			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									
												WPP35G		WKP35S		WKP25S					
												a _e / D _c * 1/1 1/2	1/5	a _e / D _c * 1/1 1/2	1/5	a _e / D _c * 1/1 1/2	1/5				
P	Unalloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	250	300	250	300	290	320							
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	220	260	220	260	260	330							
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	215	250	215	250	255	320							
		C > 0,55 %	Annealed	190	640	P4	●	●●	220	260	220	260	260	330							
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	160	180	160	180	220	260							
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	210	240	210	240	250	315							
	Low-alloy steel	Annealed		175	590	P7	●	●●	220	270	220	270	260	320							
		Heat-treated		285	960	P8	●	●●	170	190	170	190	210	250							
		Heat-treated		380	1280	P9	●	●●	130	150	130	150	170	190							
		Heat-treated		430	1480	P10	●	●●	110	130	110	130	150	170							
	Hochlegierter Stahl and hochlegierter Werkzeugstahl	Annealed		200	680	P11	●	●●	130	160	130	160	140	170							
		Hardened and tempered		300	1010	P12	●	●●	80	90	80	90	110	130							
		Hardened and tempered		380	1280	P13	●	●●	70	80	70	80	90	110							
	Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●	140	160	140	160									
		Martensitic, heat-treated		330	1110	P15	●	●●	90	110	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	160	190	180	210							
		Pearlitic		260	700	K2	●	●●	140	170	140	170	160	190							
	Grey cast iron	Low strength		180	200	K3	●	●●	300	330	300	330	320	350							
		High strength/austenitic		245	350	K4	●	●●	190	220	190	220	180	210							
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	●	●●	200	220	200	220	220	240							
		Pearlitic		265	700	K6	●	●●	130	150	130	150	140	170							
	CGI		230	400	K7	●	●●	130	160	130	160	150	180								
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														
		Unalloyed, 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							
		Hardened and tempered		55 HRC	–	H2		●●													
		Hardened and tempered		60 HRC	–	H3		●●													
	Hardened cast iron	Hardened and tempered		55 HRC	–	H4		●●					45	60							
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							

- 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.

² Cutting data can also be used without coolant.

³ Water-miscible coolants 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	
	WAK15		WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WNN15		WHH15X		WMG40		WN15		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^*		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
			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														
	210	230							160	190	190	230			105	125						
	190	210							160	170	170	200			90	110						
	380	410							300	330	350	380			110	120						
	230	260							190	220	190	230			90	105						
	260	280							200	220	240	260			110	120						
	170	200							130	150	150	180			90	105						
	180	200							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									65	80			50	60						
															35	45						
	50	65									50	65			40	50						
	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

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

(F2338F, F4038, F4138, F4238, F4338, F5038, F5138, M3255, M5250)

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Cutting material grades																		
Starting values for cutting speed v_c [m/min]																		
	HC																HW	
	WKP25S		WAK15		WSP45G		WSM45X		WSM35G		WKP35G		WKK25G		WXN15		WN15	
	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^*	
	1/2	1/5	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
	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						
	110	120			60	70					80	90						
	110	130			90	110					100	120						
	80	95			65	70					65	75						
	70	80			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								
	120	220	210	270							150	170	190	250			70	80
	130	150	160	180							120	140	140	160			65	65
	180	230	220	280							160	180	200	260			75	85
	130	150	160	180							120	140	140	160			55	55
	150	160	180	190							140	150	160	170			70	80
	120	125	155	165							105	115	135	145			65	65
	120	220	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
	400	500	600	800									600	800	600	800	400	500

HC = Coated carbide
HW = Uncoated carbide

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

Cutting data for roughing

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

Material group	Overview of the main material groups and code letters				Brinell hardness HB	Tensile strength R _m [N/mm ²]	Machining group ¹			Cutting material grades		Starting values for cutting speed v _c [m/min]	
										HC			
										WPP35G			
										a _e / D _c [*]			
				1/1 1/2	1/5								
P	Unalloyed 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						
		Unalloyed, 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.

² Water-miscible coolants must not be used when machining magnesium-based alloys.

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

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

Cutting data for roughing

Slot milling with disc cutters

Material group	= Cutting data for wet machining = Dry machining is possible			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					
																			WPP35G		WKP35S			
a _e / D _c		a _e / D _c		1/4*	1/10	1/4*	1/10																	
P	Unalloyed steel	C ≤ 0,25 %	Annealed	125	430	P1	●	●●	195	250	195	250												
		C > 0,25 ... ≤ 0,55 %	Annealed	190	640	P2	●	●●	170	215	170	215												
		C > 0,25 ... ≤ 0,55 %	Heat-treated	210	710	P3	●	●●	160	205	160	205												
		C > 0,55 %	Annealed	190	640	P4	●	●●	160	200	160	200												
		C > 0,55 %	Heat-treated	300	1010	P5	●	●●	130	145	130	145												
		Free-machining steel (short-chipping)	Annealed	220	750	P6	●	●●	160	205	160	205												
	Low-alloy steel	Annealed		175	590	P7	●	●●	170	215	170	215												
		Heat-treated		285	960	P8	●	●●	125	145	125	145												
		Heat-treated		380	1280	P9	●	●●	85	95	85	95												
		Heat-treated		430	1480	P10	●	●●	80	90	80	90												
		High-alloy steel and high-alloy tool steel	Annealed		200	680	P11	●	●●	100	120	100	120											
			Hardened and tempered		300	1010	P12	●	●●	65	80	65	80											
			Hardened and tempered		380	1280	P13	●	●●	60	70	60	70											
		Stainless steel	Ferritic/martensitic, annealed		200	680	P14	●	●●	105	130	105	130											
			Martensitic, heat-treated		330	1110	P15	●	●●	60	85	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	140	155												
		Pearlitic		260	700	K2	●	●●	135	145	135	145												
	Grey cast iron	Low strength		180	200	K3	●	●●	160	180	160	180												
		High strength/austenitic		245	350	K4	●	●●	120	140	120	140												
	Cast iron with spheroidal graphite	Ferritic		155	400	K5	●	●●	140	150	140	150												
		Pearlitic		265	700	K6	●	●●	110	120	110	120												
CGI			230	400	K7	●	●●	120	135	120	135													
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)	Unalloyed, 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	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		●●																	

- 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.

² Water-miscible coolants 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		
	WKP25S		WKP23S		WAK15		WSP45G		WSM43S		WSM35G		WSM33S		WKP35G		WKK25G		WXN15		WN15	
	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^*	
	1/4*	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	1/4*	1/10
	210	285	210	285			185	230	185	230			185	230	195	250						
	200	255	200	255			150	200	150	200			150	200	170	215						
	185	230	185	230			135	170	135	170			135	170	160	205						
	185	230	185	230			135	170	135	170			135	170	160	200						
	165	200	165	200			105	125	105	125			105	125	130	145						
	190	245	190	245			140	180	140	180			140	180	160	205						
	200	255	200	255			150	190	150	190			150	190	170	215						
	155	200	155	200			105	115	105	115			105	115	125	145						
	125	140	125	140			75	85	75	85			75	85	85	95						
	120	130	120	130			65	75	65	75			65	75	80	90						
	110	145	110	145			90	110	90	110			90	110	100	120						
	75	100	75	100			60	70	60	70			60	70	65	80						
	70	90	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	155	180	150	200									140	155	160	200				
	100	155	100	155	120	170									135	145	110	170				
	180	230	180	230	220	280									160	180	200	250				
	130	150	130	150	160	180									120	140	145	165				
	170	190	170	190	180	190									140	150	185	210				
	110	150	110	150	150	160									110	120	120	165				
	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	400	500	600	800											600	800	600	800	400	500

HC = Coated carbide
HW = Uncoated carbide

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

Cutting data for roughing

Copy milling

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 a _e / D _c			
									1/1	1/5	1/10	
P	Unalloyed 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					
		Unalloyed, 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						
	Graphitee (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.

² Water-miscible coolants must not be used when machining magnesium-based alloys.

HC = Coated carbide

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Cutting data for roughing

Copy milling (continued)

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				
									WKP35G				
								a _e / D _c					
									1/1	1/5	1/10		
P	Unalloyed 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		
	Heat-treated		285	960	P8	●	●●	155	195	215			
	Heat-treated		380	1280	P9	●	●●	145	180	200			
	Heat-treated		430	1480	P10	●	●●	120	155	170			
	Hardened and tempered		300	1010	P12	●	●●	75	100	100			
	Hardened and tempered		380	1280	P13	●	●●	65	80	90			
	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		
	High strength/austenitic		245	350	K4	●	●●	190	230	250			
	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	●●						
≤ 12% Si, hardenable, hardened			90	310	N4	●●							
> 12% Si, not hardenable			130	450	N5	●●							
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	●●						
	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							
	Graphitree (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.

² Water-miscible coolants must not be used when machining magnesium-based alloys.

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

HC = Coated carbide
 HW = Uncoated carbide
 HF = Uncoated fine-grained carbide
 CN = Silicon nitride ceramic Si_3N_4

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

Cutting data for semi-finishing and finishing

Copy milling

Material group	Overview of the main material groups and code letters			Brinell hardness HB	Tensile strength R _m [N/mm ²]	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	Unalloyed 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					
		Unalloyed, electrolytic copper		100	340	N7	●●					
	Copper and copper alloys (bronze/brass)	Brass, bronze, red brass		90	310	N8	●●					
		Copper alloys, short-chipping		110	380	N9	●●					
High tensile, Ampco		300	1010	N10	●●							
S	Heat-resistant alloys	Fe-based	Annealed	200	680	S1	●●					
			Hardened	280	940	S2	●●					
		Ni- or Co-based	Annealed	250	840	S3	●●					
			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						
	Graphitee (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.

² Water-miscible coolants must not be used when machining magnesium-based alloys.

* $a_e/D_c = 1/50$, $v_c = 40\%$ higher than 1/20

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

Cutting data for semi-finishing and finishing

Copy milling (continued)

Material group	= Cutting data for wet machining = Dry machining is possible			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					
																			WKK25G					
																			a _e / D _c [*]			1/1	1/5	1/20
P	Unalloyed 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																	
		Unalloyed, 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																		
	Graphitex (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.

² Water-miscible coolants must not be used when machining magnesium-based alloys.

* $a_e / D_c = 1/50$, $v_c = 40\%$ higher than 1/20

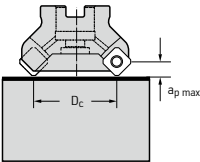
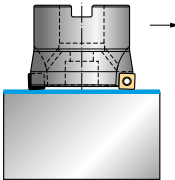
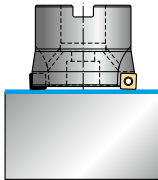
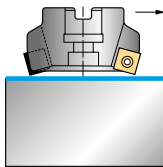
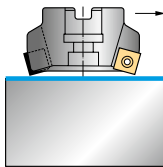
Cutting material grades												
Starting values for cutting speed v_c [m/min]												
	HC						HF			HW		
	WXN15			WHH15X			WMG40			WK10		
	a_e / D_c^*			a_e / D_c^*			a_e / D_c^*			a_e / D_c^*		
	1/1	1/5	1/20	1/1	1/5	1/20	1/1	1/5	1/20	1/1	1/5	1/20
				210	280	380						
				190	250	340						
				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 represents average standard values.
For specific applications, adjustment is recommended.

Feed determination (starting values)

Face milling cutters

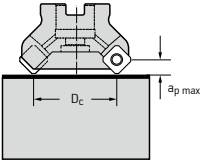
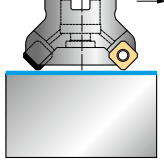
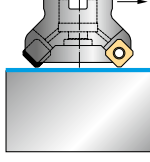
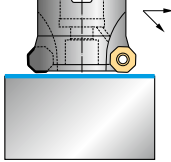
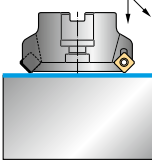
Cutter type		M5012		M5012...-AP	M5011	M5011...-AP
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$					
	Lead angle κ	88°		88°	75°	75°
		f_{z0} [mm]		f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	32–100	50–160	50–160	50–160	50–125
	Maximum cutting 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 K_{a_e}						
for the feed per tooth depending on						
the ratio of cutting width a_e to milling						
cutter diameter D_c						
$a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0	1,0	1,0
1/5		1,1	1,1	1,1	1,1	1,1
1/10		1,2	1,2	1,2	1,2	1,2
1/20		1,3	1,3	1,3	1,3	1,3

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Face milling cutters (continued)

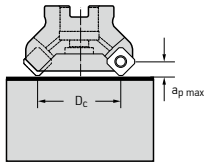
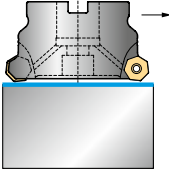
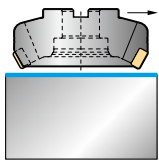
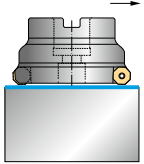
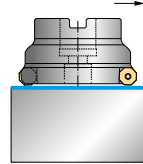
Cutter type			M5009		M5009...-AP		M5004		M4003	
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$			 Xtra-tec® XT		 Xtra-tec® XT		 Xtra-tec® XT			
Material group	Lead angle κ	45°		45°		43°		45°		
		f_{z0} [mm]		f_{z0} [mm]		f_{z0} [mm]		f_{z0} [mm]		
	Tool diameter or diameter range [mm]	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 K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0		1,0	1,0	1,0	
		1/5	1,1	1,1	1,1		1,1	1,1	1,1	
		1/10	1,2	1,2	1,2		1,2	1,2	1,2	
		1/20	1,3	1,3	1,3		1,3	1,3	1,3	
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p		$a_p = 1$			1,0		1,0			
		2			1,0		1,0			
		3			1,0		1,0			
		4			0,6		1,0			
		6			0,6		0,6			
		8			0,6		0,6			
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$		$a_{p\max} = L_c$			0,6		0,6			

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Face milling cutters (continued)

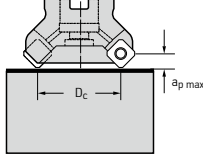
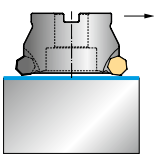
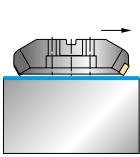
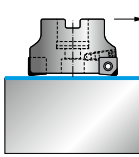
Cutter type		M3024		M3016	M2025	M2026
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$	 Walter BLAXX		 Walter BLAXX		
	Lead angle κ	45°		60°	42°	42°
		f_{z0} [mm]		f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	40–160	63–160	125–315	80–160	200–250
	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 K_{a_e}						
for the feed per tooth depending on						
the ratio of cutting width a_e to milling						
cutter diameter D_c						
	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3	1,3

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Face milling cutters (continued)

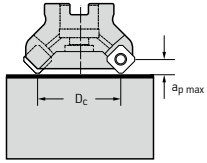
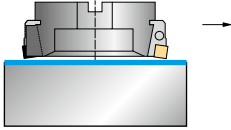
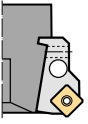
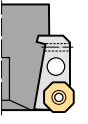
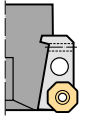
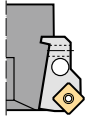
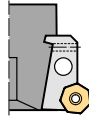
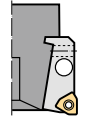
Cutter type		F4045		F2260	F2250
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$	 Xtra-tec®			
	Lead angle κ	45°		60°	75° + 90°
		f_{z0} [mm]		f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	63–200	80–200	100–250	63–200
	Maximum cutting data $a_{p\max} = L_c$ [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 K_{a_e}					
for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c					
	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1
	1/10	1,2	1,2	1,2	1,2
	1/20	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$					
	1/50				

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

F2010 face milling cutter

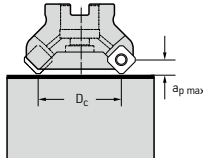
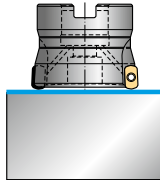
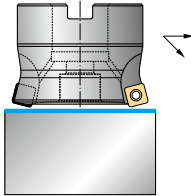
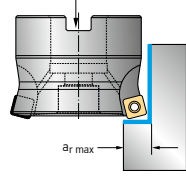
Cutter type		F2010...					
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$							
		...R720M	...R592M	...R681M	...R758M	...R759M	...R500M
							
		Xtra-tec® XT	Xtra-tec® XT	Xtra-tec® XT		Walter BLAXX	
Material group	Lead angle κ	45°	43°	43°	45°	45°	90°
		f_{z0} [mm]	f_{z0} [mm]	f_{z0} [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 K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0
		1/5	1,1	1,1	1,1	1,1	1,1
		1/10	1,2	1,2	1,2	1,2	1,2
		1/20	1,3	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$		1/50					
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p		$a_p = 1$		1,0	1,0		
		2		1,0	1,0		
		3		1,0	1,0		
		4		1,0	1,0		
		6		0,6	0,6		
		8		0,6	0,6		
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$		$a_{p\max} = L_c$		0,6	0,6		

¹ and steel casting² and austenitic/ferritic³ 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 cutter

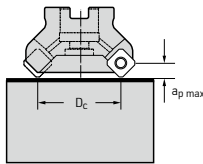
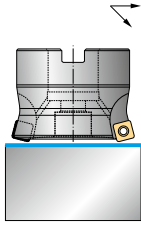
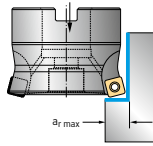
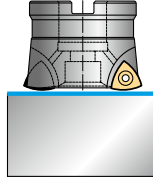
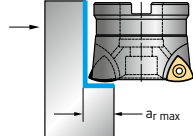
Cutter type		M5008		M4002			M4002		
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$		 Xtra-tec® XT for plunging operations					 for plunging operations		
Material group	Lead angle κ	0°–20°	73°	15°			75°		
		f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]			f_{z0} [mm]		
	Tool Ø or diameter range [mm]	16–66	16–66	20–66	25–66	50–125	20–66	25–66	50–125
	Maximum cutting values $a_{p\max} = L_c$ [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	0,25	1	1,50	2,00	0,18	0,25	0,30
	Low-alloy steel	0,80	0,22	1	1,40	1,80	0,16	0,22	0,25
	High-alloyed steel and tool steel	0,72	0,16	0,9	1,20	1,60	0,12	0,16	0,22
	Stainless steel	0,32	0,12	0,4	0,80	1,00	0,10	0,12	0,15
M	Stainless steel ²	0,24	0,12	0,3	0,50	0,80	0,10	0,12	0,15
K	Malleable cast iron	0,24	0,22	0,3	0,50	0,80	0,16	0,22	0,28
	Grey cast iron	0,96	0,25	1,2	1,40	1,60	0,18	0,25	0,30
	Cast iron with nodular graphite	0,80	0,22	1	1,20	1,40	0,16	0,22	0,28
	GGV (CGI)	0,80	0,22	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		0,4	0,60	0,80	0,08	0,10	0,12
	Molybdenum alloys	0,32		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	0,12	0,32	0,52	0,82	0,10	0,12	0,14
O	Thermoplastic								
	Carbon-fibre-reinforced plastic								
	Graphite (technical)								
Type of indexable insert		ENMX 08T316R...	ENMX 08T316R...	SD... 06T2...	SD... 09T3...	SD... 1204...	SD... 06T2...	SD... 09T3...	SD... 1204...
Correction factor Ka_e dependent on the feed per tooth from cutting width ratio a_e to cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0				
		1/5	1,1	1,4	1,4	1,4			
		1/10	1,2	1,8	1,8	1,8			
		1/20	1,3						
Correction factor K		$1 < (L : D_c) = \leq 2$	1,0	1,4	1,4	1,4	1,0	1,0	1,0
		$2 < (L : D_c) = \leq 4$	0,7	1,0	1,0	1,0	0,7	0,7	0,7
f_z = f_{z0} · Ka_e · Ka_p · K		$4 < (L : D_c) = \leq 6$	0,5	0,7	0,7	0,7	0,5	0,5	0,5

¹ and cast steel² and austenitic / ferritic³ Do not use water-miscible cooling lubricants when machining Magnesium-based alloys.

The specified feed rates are average standard values. Adaptation in special applications is recommended.

Feed determination (starting values)

High-feed milling cutter (continued)

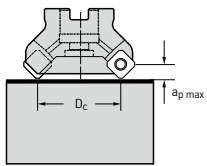
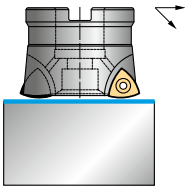
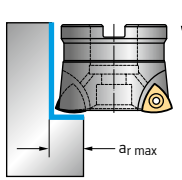
Cutter type		M4002		M4002		F4030		F4030	
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$			 for plunging operations		 Xtra-tec®		 for plunging operations Xtra-tec®	
	Lead angle κ	15°		75°		0–21°		0–21°	
		f_{z0} [mm]		f_{z0} [mm]		f_{z0} [mm]		f_{z0} [mm]	
	Tool Ø or diameter range [mm]	25–66	50–125	25–66	50–125	25–52	50–100	20–25	32–85
	Maximum cutting values $a_{p \max} = L_c$ [mm]	1,5	2	8,4	11,4	1,0	2,0	$a_{r \max} = 7 \text{ mm}$	$a_{r \max} = 10 \text{ mm}$
P	Non-alloyed steel ¹	1,80	2,40	0,29	0,38	1,60	2,00	0,18	0,25
	Low-alloy steel	1,68	2,16	0,27	0,34	1,40	1,80	0,16	0,22
	High-alloyed steel and tool steel	1,44	1,92	0,23	0,31	1,00	1,20	0,12	0,16
	Stainless steel	0,96	1,20	0,15	0,19	0,60	0,80	0,10	0,12
M	Stainless steel ²	0,60	0,96	0,10	0,15	0,60	0,80	0,10	0,12
K	Malleable cast iron	0,60	0,96	0,10	0,15	1,60	1,80	0,16	0,22
	Grey cast iron	1,68	1,92	0,27	0,31	1,40	2,00	0,18	0,25
	Cast iron with nodular graphite	1,44	1,68	0,23	0,27	1,40	1,80	0,16	0,22
	GGV (CGI)	1,44	1,68	0,23	0,27	1,40	1,80	0,16	0,22
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	0,08	0,10
	Titanium alloys	0,72	0,96	0,11	0,15	0,60	0,80	0,08	0,10
	Tungsten alloys	0,72	0,96	0,11	0,15	0,60	0,80	0,08	0,10
	Molybdenum alloys	0,72	0,96	0,11	0,15	0,60	0,80	0,08	0,10
H	Hardened steel	0,60	0,96	0,10	0,15				
	Hardened cast iron	0,62	0,98	0,10	0,15				
O	Thermoplastic								
	Carbon-fibre-reinforced plastic								
	Graphite (technical)								
Type of indexable insert		SDMX 0904ZDR	SDMX 1205ZDR	SDMX 0904ZDR	SDMX 1205ZDR	P23696-1.0	P23696-2.0	P2633.-R10 P26379-R10	P2633.-R14 P26379-R14
Correction factor K_{a_e} dependent on the feed per tooth from cutting width ratio a_e to cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$	1,0	1,0		1,0	1,0		
		1/5	1,4	1,4		1,4	1,3		
		1/10	1,8	1,8		1,8	1,6		
		1/20							
Correction factor K_{a_p} dependent on the feed per tooth on the depth of cut a_p		$a_p = 0,5$				1,4	1,5		
		1				1,0	1,4		
		1,5					1,2		
		2					1,0		
Correction factor K		$1 < (L : D_c) = \leq 2$	1,4	1,4	1,4	1,4	1,4	1,0	1,0
		$2 < (L : D_c) = \leq 4$	1,0	1,0	1,0	1,0	1,0	0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$		$4 < (L : D_c) = \leq 6$	0,7	0,7	0,7	0,7	0,7	0,5	0,5

¹ and cast steel² and austenitic / ferritic³ Do not use water-miscible cooling lubricants when machining Magnesium-based alloys.

The specified feed rates are average standard values. Adaptation in special applications is recommended.

Feed determination (starting values)

High-feed milling cutter (continued)

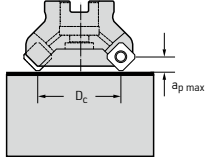
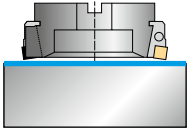
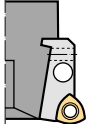
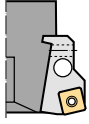
Cutter type		F2330			F2330		
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$				 for plunging operations		
	Lead angle κ	0–15°			0–15°		
		f_{z0} [mm]			f_{z0} [mm]		
	Tool Ø or diameter range [mm]	20–25	32–85	52–85	20–25	32–85	52–85
	Maximum cutting values $a_{p\max} = L_c$ [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-alloyed 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 nodular graphite	1,00	1,40	1,80	0,16	0,22	0,28
	GGV (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	Thermoplastic						
	Carbon-fibre-reinforced plastic						
	Graphite (technical)						
Type of indexable insert		P2633.-R10 P26379-R10	P2633.-R14 P26379-R14	P2633.-R25 P26379-R25	P2633.-R10 P26379-R10	P2633.-R14 P26379-R14	P2633.-R25 P26379-R25
Correction factor K_{a_e}							
dependent on the feed per tooth							
from cutting width ratio a_e							
to cutter diameter D_c							
	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0			
	1/5	1,4	1,4	1,4			
	1/10	1,8	1,8	1,8			
	1/20						
Correction factor K_{a_p}							
dependent on the feed per tooth							
on the depth of cut a_p							
	$a_p = 0,5$	1,3	1,4	1,5			
	1	1,0	1,2	1,4			
	1,5		1,0	1,2			
Correction factor K							
	$1 < (L : D_c) \leq 2$	1,4	1,4	1,4	1,0	1,0	1,0
	$2 < (L : D_c) \leq 4$	1,0	1,0	1,0	0,7	0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$							
	$4 < (L : D_c) \leq 6$	0,7	0,7	0,7	0,5	0,5	0,5

¹ and cast steel² and austenitic / ferritic³ Do not use water-miscible cooling lubricants when machining Magnesium-based alloys.

The specified feed rates are average standard values. Adaptation in special applications is recommended.

Feed determination (starting values)

F2010 high-feed milling cutter

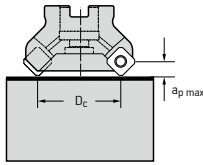
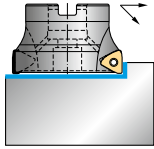
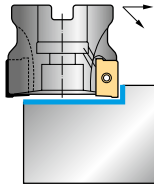
Cutter type		F2010...	
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$			
Material group		...R729M	...R755M
			
	Lead angle κ	0–21°	15°
		f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	80–315	80–315
	Maximum cutting data $a_{p \max} = L_c$ [mm]	2,0	2,0
P	Non-alloyed steel 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 K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c	$a_e / D_c = 1/1 - 1/2$	1,0	1,0
	1/5	1,3	1,4
	1/10	1,6	1,8
	1/20		
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p	$a_p = 0,5$	1,5	
	1	1,4	
	1,5	1,2	
	2	1,0	
Correction factor K	$1 < (L : D_c) \leq 2$	1,4	1,4
	$2 < (L : D_c) \leq 4$	1,0	1,0
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$		$4 < (L : D_c) \leq 6$	0,7

¹ and steel casting² and austenitic/ferritic³ 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 cutter

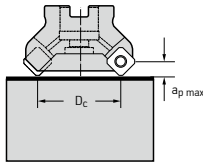
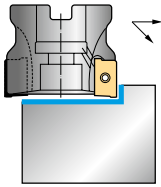
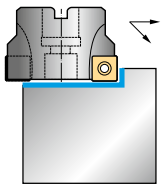
Cutter type		M5137		M5130			
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$		 Xtra-tec® XT		 Xtra-tec® XT			
Lead angle κ		90°		90°			
Material group		f_{z0} [mm]		f_{z0} [mm]			
	Tool diameter or diameter range [mm]	25–63	50–160	10–63	16–50	25–80	25–160
	Maximum cutting data $a_{p \max}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

¹ and cast steel² and austenitic/ferritic³ Water-miscible coolants 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 cutter (continued)

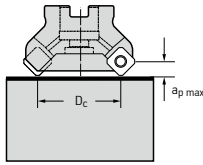
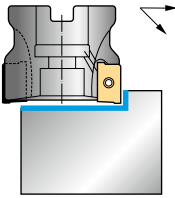
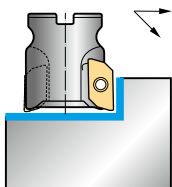
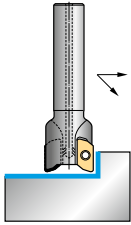
Cutter type		F4042 / F4042R					M4132		
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$		 Xtra-tec®							
Material group	Lead angle κ	90°					90°		
		f_{z0} [mm]					f_{z0} [mm]		
		F4042	F4042R	F4042	F4042	F4042			
	Tool diameter or diameter range [mm]	10–50	16–63	25–315	40–315	50–160	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	Unalloyed 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 K_{a_e}		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
For the feed per tooth depending on the ratio of width of cut a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$							
		1/5	1,1	1,1	1,1	1,1	1,1	1,1	1,1
		1/10	1,2	1,2	1,2	1,2	1,2	1,2	1,2
		1/20	1,3	1,3	1,3	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$		1/50							

¹ and cast steel² and austenitic/ferritic³ Water-miscible coolants 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 cutter (continued)

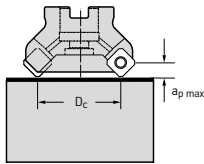
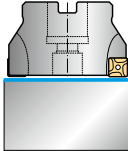
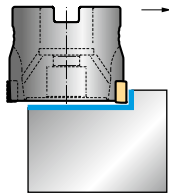
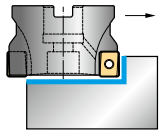
Cutter type		M4130			M2331		M2131	
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$					 für Plan-/ Eckfräsoperationen			
Material group	Lead angle κ	90°			90°		90°	
		f_{z0} [mm]			f_{z0} [mm]		f_{z0} [mm]	
	Tool diameter or diameter range [mm]	16–25	32–50	50–100	32–50	40–50	25–80	32–63
	Maximum cutting data $a_{p \max} = L_c$ [mm]	8	13	16	15	20	15	20
P	Unalloyed 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 K_{a_e}								
$a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0	1,0	1,0	1,0	1,0
For the feed per tooth depending on the ratio of width of cut a_e to milling cutter diameter D_c		1/5	1,1	1,1	1,1	1,1	1,1	1,1
		1/10	1,2	1,2	1,2	1,2	1,2	1,2
		1/20	1,3	1,3	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$		1/50						

¹ and cast steel² and austenitic/ferritic³ Water-miscible coolants 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 cutter (continued)

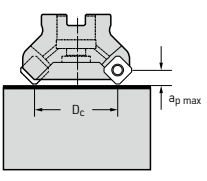
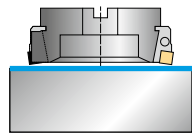
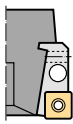
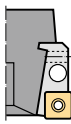
Cutter type		M2136	F5041 / F5141 / F5241			F4041
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$						
			Walter BLAXX			Xtra-tec®
Material group	Lead angle κ	90°	90°			90°
		f_{z0} [mm]	f_{z0} [mm]			f_{z0} [mm]
			F5041	F5141	F5241	
	Tool diameter or diameter range [mm]	50–160	25–315	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	Unalloyed 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 K_{a_e}						
		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0
For the feed per tooth depending on the ratio of width of cut a_e to milling cutter diameter D_c		1/5	1,1	1,1	1,1	1,1
		1/10	1,2	1,2	1,2	1,2
		1/20	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$		1/50				

¹ and cast steel² and austenitic/ferritic³ Water-miscible coolants 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

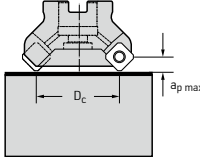
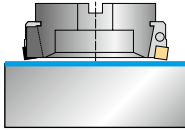
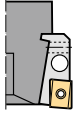
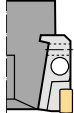
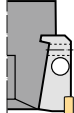
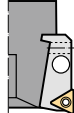
Cutter type		F2010...					
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$							
		...R756M	...R757M	...R764M	...R765M	...R718M	...R719M
							
				Xtra-tec® XT	Xtra-tec® XT	Xtra-tec®	Xtra-tec®
Material group	Lead angle κ	90°	90°	90°	90°	90°	90°
		f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]	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	Unalloyed 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 K_{a_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 the ratio of width of cut a_e to milling cutter diameter D_c		1/5	1,1	1,1	1,1	1,1	1,1
		1/10	1,2	1,2	1,2	1,2	1,2
		1/20	1,3	1,3	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$ $1/50$							

¹ and cast steel² and austenitic/ferritic³ Water-miscible coolants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

F2010 Shoulder milling cutter (continued)

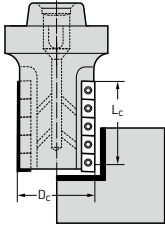
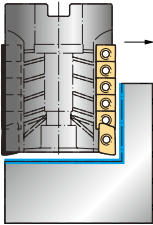
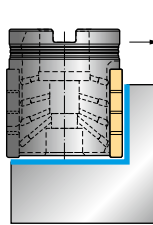
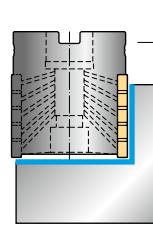
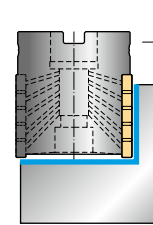
Cutter type		F2010...			
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$					
		...R722M	...R752M	...R751M	...R769M
					
		Xtra-tec®	Walter BLAXX	Walter BLAXX	Xtra-tec® XT
Material group	Lead angle κ	90°	90°	90°	90°
		f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	80–315	80–315	80–315	80–315
	Maximum cutting data $a_{p \max} = L_c$ [mm]	13	12,2	8,4	8,0
	P Unalloyed steel ¹	0,20	0,24	0,18	0,20
	Low-alloy steel	0,15	0,18	0,12	0,15
	High-alloy steel and tool steel	0,15	0,18	0,12	0,15
	Stainless steel	0,12	0,14	0,10	0,12
	M Stainless steel ²	0,10	0,12	0,10	0,10
	K Malleable cast iron	0,20	0,24	0,14	0,20
K	Grey cast iron	0,25	0,30	0,18	0,25
	Cast iron with spheroidal graphite	0,20	0,24	0,14	0,20
	CGI	0,15	0,18	0,12	0,15
	N Wrought aluminium alloys	0,12	0,15	0,12	
N	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	0,12
S	Titanium alloys	0,12	0,14	0,10	0,12
	Tungsten alloys	0,12	0,14	0,10	0,12
	Molybdenum alloys	0,12	0,14	0,10	0,12
	H Hardened steel	0,12	0,12	0,10	
H	Hardened cast iron	0,14	0,14	0,12	
	O Thermoplastics	0,15	0,20	0,14	
	Plastic, carbon-fibre reinforced				
O	Graphite (technical)	0,12	0,18	0,12	
Indexable insert types		LNGX1307..	LN..1306..	LN..0904..	TN MU 1605..
Correction factor K_{a_e} $a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0	1,0
For the feed per tooth depending on the ratio of width of cut a_e to milling cutter diameter D_c		1/5	1,1	1,1	1,1
		1/10	1,2	1,2	1,2
		1/20	1,3	1,3	1,3
$f_z = f_{z0} \cdot K_{a_e}$		1/50			

¹and cast steel²and austenitic/ferritic³Water-miscible coolants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Shoulder/helical milling cutters, full effective

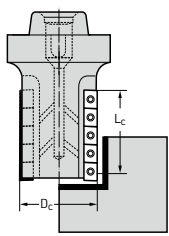
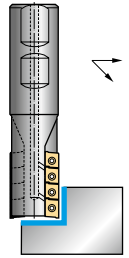
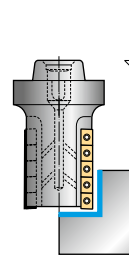
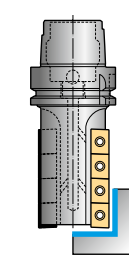
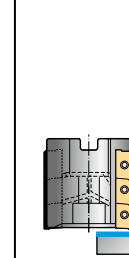
Cutter type		M5250	M3255	F5038	F5138
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$	 Xtra-tec® XT	 Walter BLAXX	 Walter BLAXX	 Walter BLAXX
	Lead angle κ	90°	90°	90°	90°
	f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	40–85	50–80	25–40	40–80
	Maximum cutting data $a_{p\max} = L_c$ [mm]	29–112	46–58	24–48	23–56
P	Non-alloyed steel ¹	0,25		0,18	0,23
	Low-alloy steel	0,20		0,13	0,17
	High-alloy steel and tool steel	0,18		0,13	0,17
	Stainless steel	0,12		0,10	0,12
M	Stainless steel ²	0,12		0,10	0,11
K	Malleable cast iron	0,28		0,20	0,23
	Grey cast iron	0,22		0,18	0,28
	Cast iron with spheroidal graphite	0,22		0,15	0,22
	CGI	0,22		0,15	0,17
N	Wrought aluminium alloys	0,15		0,12	0,15
	Cast aluminium alloys	0,12		0,15	0,12
	Magnesium-based alloys ³	0,12		0,12	0,12
	Copper and copper alloys (bronze/brass)	0,12		0,12	0,12
S	Heat-resistant alloys	0,12	0,15	0,10	0,12
	Titanium alloys	0,12	0,15	0,10	0,12
	Tungsten alloys	0,12	0,15	0,10	0,12
	Molybdenum alloys	0,12	0,15	0,10	0,12
H	Hardened steel				
	Hardened cast iron				
O	Thermoplastics	0,15			
	Plastic, carbon-fibre reinforced				
	Graphite (technical)	0,15		0,13	0,15
Indexable insert types		SC . T1105.. BC . T1605..	XNHX1306.. LNHX1206..	LN ..0904..	LNHU1306..
Correction factor K_{a_e}					
for the feed per tooth depending					
on the ratio of cutting width a_e					
to milling cutter diameter D_c					
$a_e / D_c = 1/2$		1,0**	1,0**	1,0**	1,0**
$1/5$		1,1	1,1	1,1	1,1
$1/10$		1,2	1,2	1,2	1,2
$1/20$		1,3	1,3	1,3	1,3
$1/50$		1,5	1,5	1,5	1,5
Correction factor K_{a_p}					
for the feed per tooth depending					
on the depth of cut a_p					
$a_p = 6$		1,0	1,0	1,0	1,0
9		1,0	1,0		1,0
12		1,0	1,0		1,0
$0,5 \times D_c$		1,0	1,0		1,0
$0,75 \times D_c$		0,8	0,8		0,8
$1 \times D_c$		0,7	0,7		0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$					
$a_{p\max} = L_c$		0,5*	0,5*	0,5*	0,5*

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.* Only possible if $a_e/D_c < 1/5$ ** Only possible if $a_p < 0,75 \times D_c$

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

Feed determination (starting values)

Shoulder/helical milling cutters, full effective (continued)

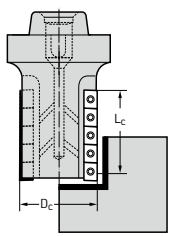
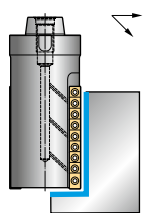
Cutter type		F4038	F4138	F4238	F4338
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$				
	Lead angle κ	90°	90°	90°	90°
	f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	20–32	32–80	40–85	63–125
	Maximum cutting data $a_{p\max} = L_c$ [mm]	15–37	33–76	29–112	31–124
P	Non-alloyed steel ¹	0,15	0,20	0,25	0,25
	Low-alloy steel	0,10	0,15	0,20	0,20
	High-alloy steel and tool steel	0,10	0,15	0,18	0,20
	Stainless steel	0,08	0,12	0,12	0,15
M	Stainless steel ²	0,08	0,10	0,12	0,15
K	Malleable cast iron	0,15	0,25	0,28	0,30
	Grey cast iron	0,12	0,20	0,22	0,25
	Cast iron with spheroidal graphite	0,12	0,20	0,22	0,25
	CGI	0,12	0,20	0,22	0,25
N	Wrought aluminium alloys	0,12	0,15	0,15	
	Cast aluminium alloys	0,10	0,12	0,12	
	Magnesium-based alloys ³	0,10	0,12	0,12	
	Copper and copper alloys (bronze/brass)	0,10	0,12	0,12	
S	Heat-resistant alloys	0,08	0,12	0,12	0,12
	Titanium alloys	0,08	0,12	0,12	0,12
	Tungsten alloys	0,08	0,12	0,12	0,12
	Molybdenum alloys	0,08	0,12	0,12	0,12
H	Hardened steel				
	Hardened cast iron				
O	Thermoplastics	0,1	0,15	0,15	
	Plastic, carbon-fibre reinforced				
	Graphite (technical)	0,1	0,12	0,15	
Indexable insert types		AD..0803..	AD..1204..	AD..1606..	AD..1807..
Correction factor K_{a_e}					
for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c					
$a_e / D_c = 1/2$		1,0**	1,0**	1,0**	1,0**
$1/5$		1,1	1,1	1,1	1,1
$1/10$		1,2	1,2	1,2	1,2
$1/20$		1,3	1,3	1,3	1,3
$1/50$		1,5	1,5	1,5	1,5
Correction factor K_{a_p}					
for the feed per tooth depending on the depth of cut a_p					
$a_p = 6$		1,0	1,0	1,0	1,0
9		1,0	1,0	1,0	1,0
12		1,0	1,0	1,0	1,0
$0,5 \times D_c$		1,0	1,0	1,0	1,0
$0,75 \times D_c$		0,8	0,8	0,8	0,8
$1 \times D_c$		0,7	0,7	0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$					
$a_{p\max} = L_c$		0,5*	0,5*	0,5*	0,5*

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.* Only possible if $a_e/D_c < 1/5$ ** Only possible if $a_p < 0,75 \times D_c$

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

Feed determination (starting values)

Shoulder/helical milling cutters, full effective (continued)

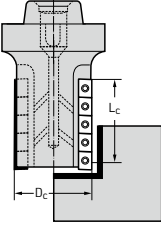
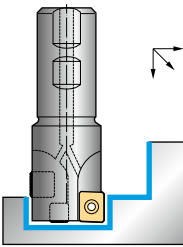
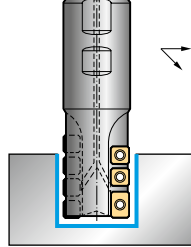
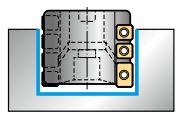
Cutter type		F2338F
		
Material group	Lead angle κ	90°
		f_{z0} [mm]
	Tool diameter or diameter range [mm]	63–100
	Maximum cutting data $a_{p\max} = L_c$ [mm]	48–103
P	Non-alloyed steel ¹	0,30
	Low-alloy steel	0,25
	High-alloy steel and tool steel	0,20
	Stainless steel	0,15
M	Stainless steel ²	0,15
K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

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.* Only possible if $a_e/D_c < 1/5$ ** Only possible if $a_p < 0,75 \times D_c$

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

Feed determination (starting values)

Slot milling cutters

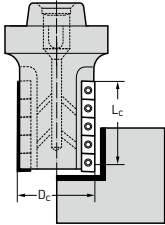
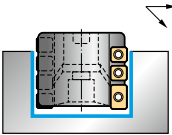
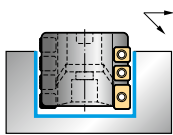
Cutter type		M4792			M4256	M4257
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$					
	Lead angle κ	90°			90°	90°
		f_{z0} [mm]			f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	18–20	25–32	40	20–32	40–63
	Maximum cutting data $a_{p\max} = L_c$ [mm]	7 + 13	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 K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c						
		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0
		1/5	1,1	1,1	1,1	1,1
		1/10	1,2	1,2	1,2	1,2
		1/20	1,3	1,3	1,3	1,3
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p						
		$a_p = 6$			1,6	1,6
		9			1,0	1,6
		12			1,0	1,0
		$0,5 \times D_c$			1,0	1,0
		$0,75 \times D_c$			0,8	0,8
		$1 \times D_c$			0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$		$a_{p\max} = L_c$			0,5**	0,5**

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.* Only possible if $a_p < 0,75 \times D_c$ ** only with $a_e / D_c < 1/5$

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

Feed determination (starting values)

Slot milling cutters (continued)

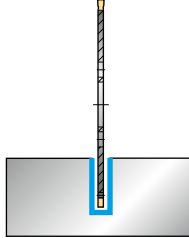
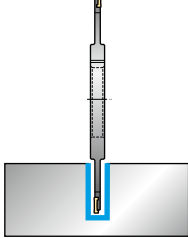
Cutter type		M4258	M5250
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$		 Xtra-tec® XT
	Lead angle κ	90°	90°
		f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	80–100	50–80
	Maximum cutting data $a_{p\max} = L_c$ [mm]	67–78	43–80
P	Non-alloyed steel ¹	0,20	0,20
	Low-alloy steel	0,15	0,15
	High-alloy steel and tool steel	0,15	0,15
	Stainless steel	0,12	0,12
M	Stainless steel ²	0,10	0,10
K	Malleable cast iron	0,25	0,25
	Grey cast iron	0,20	0,2
	Cast iron with spheroidal graphite	0,20	0,2
	CGI	0,20	0,2
N	Wrought aluminium alloys		
	Cast aluminium alloys		
	Magnesium-based alloys ³		
	Copper and copper alloys (bronze/brass)		
S	Heat-resistant alloys	0,10	0,1
	Titanium alloys	0,10	0,1
	Tungsten alloys	0,10	0,1
	Molybdenum alloys	0,10	0,1
H	Hardened steel		0,1
	Hardened cast iron		
O	Thermoplastics		
	Plastic, carbon-fibre reinforced		
	Graphite (technical)		
Indexable insert types		SD..120408.. LD..170408..	
Correction factor K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c			
$a_e / D_c = 1/1 - 1/2$		1,0	0,8
1/5		1,1	1,0
1/10		1,2	1,2
1/20		1,3	1,4
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p			
$a_p = 6$		1,6	$a_e / D_c < 0$
9		1,6	$a_e / D_c = 0,5$
12		1,6	
$0,1 \times D_c$			1,4
$0,25 \times D_c$			1,2
$0,5 \times D_c$		1,0	0,8
$0,75 \times D_c$		0,8	0,6
$1 \times D_c$		0,7	0,4
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$			
$a_{p\max} = L_c$		0,5**	

¹ and steel casting² and austenitic/ferritic³ 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 cutter

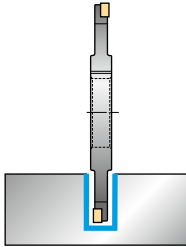
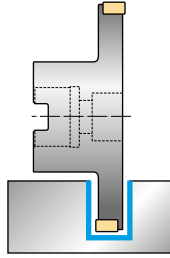
Cutter type		F5055					F4053
Material group	Feed per tooth f_{Z0} for plunging centred positioning						
	Lead angle κ	90°					90°
		f_{Z0} [mm]					f_{Z0} [mm]
	Tool Ø or diameter range [mm]	63–125	63–160	63–250	63–250	500	80–160
	Maximum cutting values $a_{p\max} = L_c$ [mm]	1,5	2,0	3,0	4,0	5,0	4
P	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-alloyed 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 nodular graphite	0,06	0,07	0,09	0,11	0,12	0,11
	GGV (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	Thermoplastic						
	Carbon-fibre-reinforced plastic						
	Graphite (technical)						
Type of indexable insert		SX-1E15..	SX-2E20..	SX-3E30..	SX-4E40..	SX-5E50..	LN.X 0702..
Correction factor K_{a_e} dependent on the feed per tooth from the ratio of depth of cut a_e to cutter diameter D_c	Centre	1,5	1,5	1,5	1,5	1,5	1,0
	$a_e / D_c = 1/3$	1,8	1,8	1,8	1,8	1,8	1,5
	1/5	2,5	2,5	2,5	2,5	2,5	1,8
	1/10	3,3	3,3	3,3	3,3	3,3	2,5
	1/20	5,8	5,8	5,8	5,8	5,8	3,3
$f_Z = f_{Z0} \cdot K_{a_e}$	1/50	5,8	5,8	5,8	5,8	5,8	5,8
Correction factor K_{a_p} dependent on the feed per tooth on the depth of cut a_p	1,5						
	2	0,07	0,07	0,07	0,07	0,07	
	3	0,09	0,09	0,09	0,09	0,09	
	4	0,11	0,11	0,11	0,11	0,11	
$f_Z = f_{Z0} \cdot K_{a_e} \cdot K_{a_p} \cdot K$	5	0,12	0,12	0,12	0,12	0,12	

¹ and cast steel² and austenitic / ferritic³ Do not use water-miscible cooling lubricants when machining Magnesium-based alloys.**Please note: Feed per tooth fZ not greater than 0.6 mm**

The specified feed rates are average standard values. Adaptation in special applications is recommended.

Feed determination (starting values)

Slotting cutter (continued)

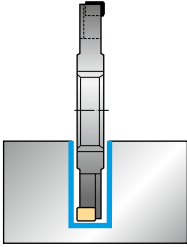
Cutter type		F4153			F4253				
Feed per tooth f_{Z0} for plunging centred positioning		 cross-toothed Xtra-tec®			 cross-toothed Xtra-tec®				
		90°			90°				
		f_{Z0} [mm]			f_{Z0} [mm]				
		Tool Ø or diameter range [mm]			Tool Ø or diameter range [mm]				
Material group	Maximum cutting values $a_{p\max} = L_c$ [mm]	6	8	10	12	14	16	20	25
	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-alloyed steel and tool steel	0,10	0,12	0,12	0,13	0,13	0,17	0,17	0,20
P	Stainless steel	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,13
	Stainless steel ²	0,05	0,07	0,07	0,08	0,08	0,10	0,10	0,13
	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
K	Cast iron with nodular graphite	0,12	0,13	0,13	0,15	0,15	0,20	0,20	0,22
	GGV (CGI)	0,10	0,12	0,12	0,13	0,13	0,17	0,17	0,20
	Wrought aluminium alloys								
	Cast aluminium alloys								
N	Magnesium-based alloys ³								
	Copper and copper alloys (bronze/brass)								
	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
S	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
	Hardened steel								
	Hardened cast iron								
H	Thermoplastic								
	Carbon-fibre-reinforced plastic								
	Graphite (technical)								
Type of indexable insert		LN . U 0803 ..	LN . U 0804 ..	LN . U 1005 ..	LN . U 0804 ..	LN . U 0804 ..	LN . U 1005 ..	LN . U 1206 ..	LN . U 1605 ..
Correction factor K_{a_e}		Centre	1,0	1,0	1,0	1,0	1,0	1,0	1,0
dependent on the feed per tooth from the ratio of depth of cut a_e to cutter diameter D_c		$a_e / D_c = 1/3$	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
		1/10	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
$f_Z = f_{Z0} \cdot K_{a_e}$		1/50	5,8	5,8	5,8	5,8	5,8	5,8	5,8

¹ and cast steel² and austenitic / ferritic³ Do not use water-miscible cooling lubricants when machining Magnesium-based alloys.**Please note: Feed per tooth f_Z not greater than 0.6 mm**

The specified feed rates are average standard values. Adaptation in special applications is recommended.

Feed determination (starting values)

Slotting cutter (continued)

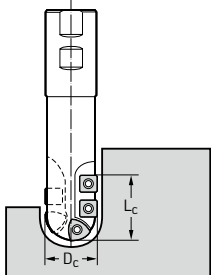
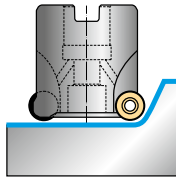
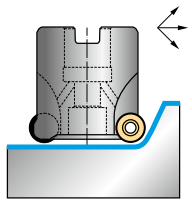
Cutter type		F2252								
Material group		 cross-toothed								
		Lead angle κ								
		90°								
		f_{Z0} [mm]								
Tool Ø or diameter range [mm]		100–160	125–200	125–200	100–160	125–315	125–250	80–160	100–160	125–315
Maximum cutting values $a_{p\max} = L_c$ [mm]		12–16	16–22	22–25	12–16	16–22	22–25	8–10	10–16	16–23,5
P	Non-alloyed steel ¹	0,1	0,14	0,2	0,10	0,14	0,20	0,10	0,10	0,17
	Low-alloy steel	0,07	0,1	0,14	0,07	0,10	0,14	0,07	0,07	0,13
	High-alloyed steel and tool steel	0,07	0,1	0,14	0,07	0,10	0,14	0,07	0,07	0,13
	Stainless steel	0,05	0,07	0,1	0,05	0,07	0,10	0,05	0,05	0,10
M	Stainless steel ²	0,05	0,07	0,1	0,05	0,07	0,10	0,05	0,05	0,08
K	Malleable cast iron	0,08	0,12	0,18	0,08	0,12	0,18	0,08	0,08	0,17
	Grey cast iron	0,1	0,15	0,23	0,10	0,15	0,23	0,10	0,10	0,20
	Cast iron with nodular graphite	0,08	0,12	0,18	0,08	0,12	0,18	0,08	0,08	0,17
	GGV (CGI)	0,07	0,1	0,14	0,07	0,10	0,14	0,07	0,07	0,13
N	Wrought aluminium alloys	0,1	0,12	0,14	0,10	0,12	0,14	0,10	0,10	0,12
	Cast aluminium alloys	0,08	0,1	0,12	0,08	0,10	0,12	0,08	0,08	0,10
	Magnesium-based alloys ³	0,08	0,1	0,12	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	0,09	0,11	0,07	0,07	0,10
S	Heat-resistant alloys	0,05	0,07	0,1	0,05	0,07	0,10	0,05	0,05	0,10
	Titanium alloys	0,05	0,07	0,1	0,05	0,07	0,10	0,05	0,05	0,10
	Tungsten alloys	0,05	0,07	0,1	0,05	0,07	0,10	0,05	0,05	0,10
	Molybdenum alloys	0,05	0,07	0,1	0,05	0,07	0,10	0,05	0,05	0,10
H	Hardened steel									
	Hardened cast iron									
O	Thermoplastic	0,07	0,1	0,15	0,07	0,10	0,15	0,07	0,10	0,12
	Carbon-fibre-reinforced plastic									
	Graphite (technical)	0,07	0,1	0,15	0,07	0,10	0,15	0,07	0,10	0,12
Type of indexable insert		BC... 0903...R/L	BC... 1204...R/L	BC... 1605...R/L	AD... 0803...R/L	AD... 1204...R/L	AD... 1606...R/L	MP... 0603...	MP... 0803...	MP... 1204...
Correction factor K_{a_e}		Centre	1	1	1	1,0	1,0	1,0	1,0	1,0
dependent on the feed per tooth from the ratio of depth of cut a_e to cutter diameter D_c		$a_e / D_c = 1/3$	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
		1/5	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
		1/10	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
		1/20	3,3	3,3	3,3	3,3	3,3	3,3	3,3	3,3
$f_Z = f_{Z0} \cdot K_{a_e}$		1/50	5,8	5,8	5,8	5,8	5,8	5,8	5,8	5,8

¹ and cast steel² and austenitic / ferritic³ Do not use water-miscible cooling lubricants when machining Magnesium-based alloys.**Please note: Feed per tooth f_Z not greater than 0.6 mm**

The specified feed rates are average standard values. Adaptation in special applications is recommended.

Feed determination (starting values)

Copy milling cutters

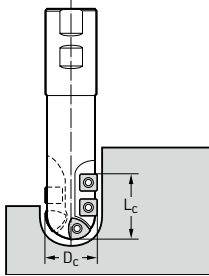
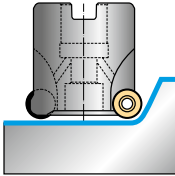
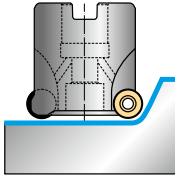
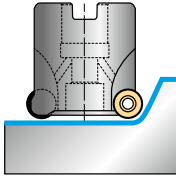
Cutter type		M5468							F2334R	
 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{pmax} = L_c$		 Xtra-tec® XT								
Material group	Lead angle κ	—							—	
		f_{z0} [mm]							f_{z0} [mm]	
	Tool diameter or diameter range [mm]	12–20	15–42	25–32	32–66	40–80	52–315	63–160	32–66	40–80
	Maximum cutting data $a_{pmax} = L_c$ [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 K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
		1/5	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
		1/10	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
		1/20	1,8	1,8	1,8	1,8	1,8	1,8	1,8	1,8
		1/50	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p		$a_p = 1,0$	1,3	1,3	1,4	1,5	1,6	1,8	1,5	1,6
		2,0	1,0	1,0	1,1	1,2	1,3	1,4	1,5	1,3
		3,0			1,0	1,1	1,2	1,2	1,0	1,1
		4,0				1,0	1,1	1,1	1,0	1,0
		6,0					1,0	1,1		
		8,0						1,1		
		10,0						1,0		
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}^3$										

¹ and steel casting² and austenitic/ferritic³ Do not set correction factor $K_{a_e} \cdot K_{a_p}$ higher than 3 when finishing⁴ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Copy milling cutters (continued)

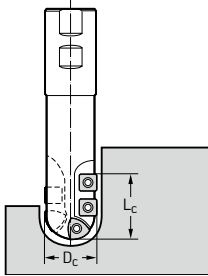
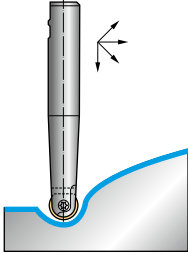
Cutter type		M2471		M2472	M2473
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$				
	Lead angle κ	90°		–	–
		f_{z0} [mm]		f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	25–52	32–63	32–50	40–63
	Maximum cutting data $a_{p\max} = L_c$ [mm]	5	6		
P	Non-alloyed steel ¹	0,17	0,22		
	Low-alloy steel	0,17	0,15		
	High-alloy steel and tool steel	0,13	0,15		
	Stainless steel	0,09	0,11		
M	Stainless steel ²	0,09	0,11		
K	Malleable cast iron				
	Grey cast iron				
	Cast iron with spheroidal graphite				
	CGI				
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	0,08	0,08
	Titanium alloys	0,09	0,11		
	Tungsten alloys	0,09	0,11		
	Molybdenum alloys	0,09	0,11		
H	Hardened steel				
	Hardened cast iron				
O	Thermoplastics				
	Plastic, carbon-fibre reinforced				
	Graphite (technical)				
Indexable insert types		RNMx 1005..	RNMx 1206..	RP .. 1204 ..	RN .. 1207 ..
Correction factor K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$		1,0	1,0
		1/5	1,2	1,2	1,2
		1/10	1,5	1,5	1,5
		1/20	1,8	1,8	1,8
		1/50	2,0	2,0	2,0
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p		$a_p = 0,2$			
		0,4			
		0,6			
		0,8			
		1,0	1,5	1,6	1,6
		1,5			
		2,0	1,2	1,3	1,3
		3,0	1,0	1,1	1,1
		4,0	1,0	1,0	1,0
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}^3$		$a_{p\max} = L_c$			

¹ and steel casting² and austenitic/ferritic³ Do not set correction factor $K_{a_e} \cdot K_{a_p}$ higher than 3 when finishing⁴ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Copy milling cutters (continued)

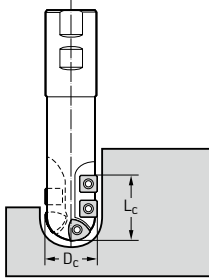
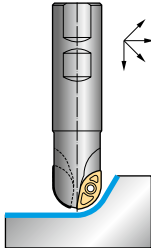
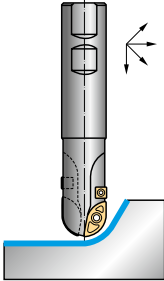
Cutter type		M5460							
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{pmax} = L_c$	 Xtra-tec® XT							
	Lead angle κ	—							
		f_{z0} [mm]							
	Tool diameter or diameter range [mm]	8	10	12	16	20	25	30	32
	Maximum cutting data $a_{pmax} = L_c$ [mm]	4	5	6	8	10	12	15	16
P	Non-alloyed steel ¹	0,08	0,10	0,10	0,12	0,12	0,15	0,15	0,15
	Low-alloy steel	0,06	0,08	0,08	0,10	0,10	0,12	0,12	0,12
	High-alloy steel and tool steel	0,06	0,08	0,08	0,10	0,10	0,12	0,12	0,12
	Stainless steel	0,05	0,06	0,06	0,08	0,08	0,10	0,10	0,10
M	Stainless steel ²	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	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
	Titanium alloys	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
	Tungsten alloys	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
	Molybdenum alloys	0,04	0,05	0,05	0,06	0,06	0,06	0,06	0,06
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		P32...-D08	P32...-D10	P32...-D12	P32...-D16	P32...-D20	P32...-D25	P32...-D30	P32...-D32
Correction factor K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$							
		1/5	1,2	1,2	1,2	1,2	1,2	1,2	1,2
		1/10	1,5	1,5	1,5	1,5	1,5	1,5	1,5
		1/20	1,8	1,8	1,8	1,8	1,8	1,8	1,8
		1/50	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p		$a_p = 0,2$							
		0,4	1,5	2,0	2,0	2,2	2,2	2,4	2,4
		0,6	1,2	1,7	1,7	1,9	1,9	2,1	2,1
		0,8	1,0	1,3	1,3	1,5	1,5	1,7	1,7
		1,0	0,8	1,0	1,0	1,2	1,2	1,4	1,4
		1,5	0,7	0,8	0,8	1,0	1,0	1,2	1,2
		2,0	0,6	0,7	0,7	0,8	0,8	1,0	1,0
		3,0	0,5	0,6	0,6	0,7	0,7	0,8	0,8
		4,0	0,5	0,5	0,5	0,6	0,6	0,7	0,7
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}^3$		$a_{pmax} = L_c$							
		0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5

¹ and steel casting² and austenitic/ferritic³ Do not set correction factor $K_{a_e} \cdot K_{a_p}$ higher than 3 when finishing⁴ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Copy milling cutters (continued)

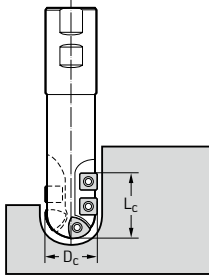
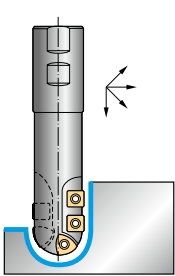
Cutter type		F2339 Form A						F2339 Form B					
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{pmax} = L_c$												
	Lead angle κ	-						-					
		f_{z0} [mm]						f_{z0} [mm]					
	Tool diameter or diameter range [mm]	16	20	25	30 / 32	40	50	16	20	25	30 / 32	40	
	Maximum cutting data $a_{pmax} = L_c$ [mm]	11	15	20	24 / 25	31	40	24	28	32	42 / 43	57	
P	Non-alloyed steel ¹	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30	
	Low-alloy steel	0,08	0,10	0,14	0,20	0,25	0,30	0,08	0,10	0,14	0,20	0,25	
	High-alloy steel and tool steel	0,08	0,10	0,14	0,20	0,25	0,30	0,08	0,10	0,14	0,20	0,25	
	Stainless steel	0,06	0,07	0,10	0,12	0,14	0,18	0,06	0,07	0,10	0,12	0,14	
M	Stainless steel ²	0,06	0,07	0,10	0,12	0,12	0,14	0,06	0,07	0,10	0,12	0,12	
K	Malleable cast iron	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30	
	Grey cast iron	0,17	0,20	0,25	0,30	0,35	0,40	0,17	0,20	0,25	0,30	0,35	
	Cast iron with spheroidal graphite	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30	
	CGI	0,13	0,15	0,20	0,25	0,30	0,35	0,13	0,15	0,20	0,25	0,30	
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	0,06	0,07	0,10	0,10	0,10	
	Titanium alloys	0,06	0,07	0,10	0,10	0,10	0,12	0,06	0,07	0,10	0,10	0,10	
	Tungsten alloys	0,06	0,07	0,10	0,10	0,10	0,12	0,06	0,07	0,10	0,10	0,10	
	Molybdenum alloys	0,06	0,07	0,10	0,10	0,10	0,12	0,06	0,07	0,10	0,10	0,10	
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...	XD... 130880R... SP...0603...	XD... 16T3100R... SP...0603...	XD... 2004125R... SP...0603...	XD... 2405150R... XD... 2506160R... SP...09T3...	XD... 3207200R... SP...1204...	
Correction factor K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$											
		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
		1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2	1,2
		1,5	1,5	1,5	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	1,8	1,8	1,8	1,8
		2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p		$a_p = 1,0$											
		1,6	1,9	2,1	2,3	2,5	2,7	1,6	1,9	2,1	2,3	2,5	
		2,0	1,3	1,5	1,6	1,8	1,9	1,3	1,5	1,6	1,8	1,9	
		4,0	1,1	1,2	1,3	1,4	1,5	1,1	1,2	1,3	1,4	1,5	
		6,0	1,0	1,1	1,2	1,3	1,4	1,0	1,1	1,2	1,3	1,4	
		8,0	1,0	1,1	1,1	1,1	1,2	1,0	1,1	1,1	1,1	1,2	
		10,0	1,0	1,0	1,1	1,1	1,2	1,0	1,0	1,1	1,1	1,2	
		12,5		1,0	1,0	1,1	1,1	1,0	1,0	1,0	1,1	1,1	
		15,0/16,0		1,0	1,0	1,1	1,1	1,0	1,0	1,0	1,0	1,1	
		20,0			1,0	1,0	1,0	0,5	0,5	1,0	1,0	1,0	
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}^3$		$a_{pmax} = L_c$											
					1,0	1,0	1,0	0,5	0,5	0,5	0,5	0,5	0,5

¹ and steel casting² and austenitic/ferritic³ Do not set correction factor $K_{a_e} \cdot K_{a_p}$ higher than 3 when finishing⁴ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Copy milling cutters (continued)

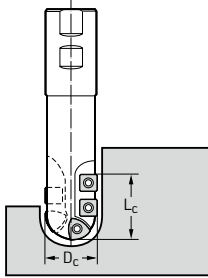
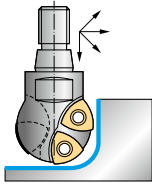
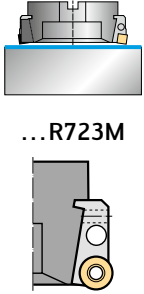
Cutter type		F2239					
							
Material group	Lead angle κ	—					
		f_{z0} [mm]					
	Tool diameter or diameter range [mm]	20	25	30 / 32	40	50	63
	Maximum cutting data $a_{p\max} = L_c$ [mm]	25	28	38	51	77	84
P	Non-alloyed steel ¹	0,18	0,24	0,30	0,36	0,36	0,36
	Low-alloy steel	0,12	0,17	0,24	0,30	0,30	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 K_{a_e}							
for the feed per tooth depending							
on the ratio of cutting width a_e							
to milling cutter diameter D_c							
$a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0	1,0	1,0	1,0
$1/5$		1,2	1,2	1,2	1,2	1,2	1,2
$1/10$		1,5	1,5	1,5	1,5	1,5	1,5
$1/20$		1,8	1,8	1,8	1,8	1,8	1,8
$1/50$		2,0	2,0	2,0	2,0	2,0	2,0
Correction factor K_{a_p}							
for the feed per tooth depending							
on the depth of cut a_p							
$a_p = 1,0$		1,9	2,1	2,3	2,5	2,8	3,0
$2,0$		1,5	1,6	1,8	1,9	2,1	2,3
$4,0$		1,2	1,3	1,4	1,5	1,6	1,8
$6,0$		1,1	1,2	1,2	1,3	1,4	1,5
$8,0$		1,1	1,1	1,1	1,2	1,3	1,4
$10,0$		1,0	1,1	1,1	1,2	1,2	1,3
$12,5$		0,5	1,0	1,1	1,1	1,1	1,2
$15,0/16,0$		0,5	0,5	1,0	1,1	1,1	1,1
$20,0$		0,5	0,5	0,5	1,0	1,0	1,0
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}^3$							
$a_{p\max} = L_c$		0,5	0,5	0,5	0,5	0,5	0,5

¹ and steel casting² and austenitic/ferritic³ Do not set correction factor $K_{a_e} \cdot K_{a_p}$ higher than 3 when finishing⁴ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Copy milling cutters and F2010 copy milling cutter (continued)

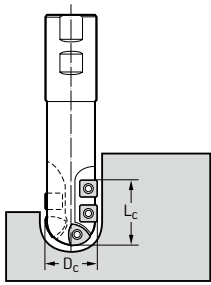
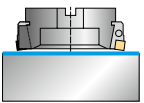
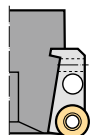
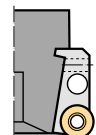
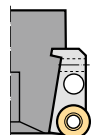
Cutter type		F2239B						F2010...R723M
Material group								
	Lead angle κ	-						-
		f_{z0} [mm]						f_{z0} [mm]
	Tool diameter or diameter range [mm]	20	25	30 / 32	40	50	80-315	
	Maximum cutting data $a_{p \max} = L_c$ [mm]	15	20	26	32	39	8	
P	Non-alloyed steel ¹	0,18	0,24	0,30	0,36	0,36	0,28	
	Low-alloy 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 K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	
		1/5	1,2	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 K_{a_p} for the feed per tooth depending on the depth of cut a_p		$a_p = 1$	1,9	2,1	2,3	2,5	1,8	
		2	1,5	1,6	1,8	1,9	1,4	
		3					1,2	
		4	1,2	1,3	1,4	1,5	1,1	
		6	1,1	1,2	1,2	1,3	1,4	
		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		
		15/16	0,5	0,5	1,0	1,1		
		20	0,5	0,5	0,5	1,0		
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}$		$a_{p \max} = L_c$	0,5	0,5	0,5	0,5		

¹ and steel casting² and austenitic/ferritic³ 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 Copy milling cutters

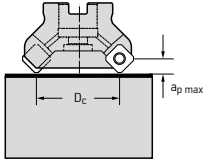
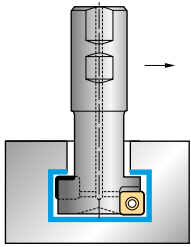
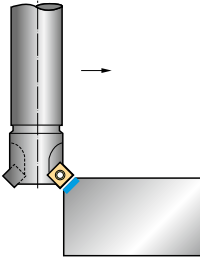
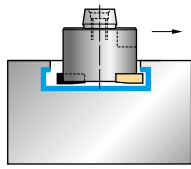
Cutter type		F2010...		
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{p \max} = L_c$	 ...R723M ...R771M ...R770M    Xtra-tec® XT Xtra-tec® XT		
	Lead angle κ	—	—	—
		f_{z0} [mm]	f_{z0} [mm]	f_{z0} [mm]
	Tool diameter or diameter range [mm]	80–315	80–315	80–315
	Maximum cutting data $a_{p \max} = L_c$ [mm]	8	6	8
P	Non-alloyed steel ¹	0,28	0,22	0,28
	Low-alloy steel	0,22	0,15	0,22
	High-alloy steel and tool steel	0,22	0,15	0,22
	Stainless steel	0,13	0,11	0,13
M	Stainless steel ²	0,13	0,11	0,13
K	Malleable cast iron	0,28	0,22	0,28
	Grey cast iron	0,33	0,28	0,33
	Cast iron with spheroidal graphite	0,28	0,22	0,28
	CGI	0,28	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	0,11	0,11	0,11
	Titanium alloys	0,11	0,11	0,11
	Tungsten alloys	0,11	0,11	0,11
	Molybdenum alloys	0,11	0,11	0,11
H	Hardened steel			
	Hardened cast iron			
O	Thermoplastics			
	Plastic, carbon-fibre reinforced			
	Graphite (technical)			
Indexable insert types		RO X 1605M0-..	RO X 1204M08	RO X 1605M08
Correction factor K_{a_e} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c				
		$a_e / D_c = 1/1 - 1/2$	1,0	1,0
		1/5	1,2	1,2
		1/10	1,5	1,5
		1/20	1,8	1,8
		1/50	2,0	2,0
Correction factor K_{a_p} for the feed per tooth depending on the depth of cut a_p				
		$a_p = 1$	1,8	1,6
		2	1,4	1,3
		3	1,2	1,1
		4	1,1	1,0
		6	1,0	
		8		1,0
		10		
$f_z = f_{z0} \cdot K_{a_e} \cdot K_{a_p}^3$				

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Profile milling cutters

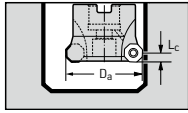
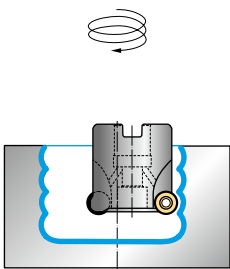
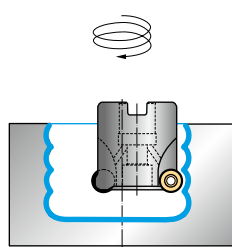
Cutter type		M4575			M4574			F2036			
Material group	 Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$										
	Lead angle κ	90°			45°			90°			
		f_{Z0} [mm]			f_{Z0} [mm]			f_{Z0} [mm]			
	Tool diameter or diameter range [mm]	21–25	32–40	50	12–16	20–40	32–40	16	25	40	63
	Maximum cutting data $a_{p\max} = L_c$ [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 K_{a_e}		$a_e / D_c = 1/1 - 1/2$									
for the feed per tooth depending on		1/5									
the ratio of cutting width a_e to milling		1/10									
cutter diameter D_c		1/20									
$f_z = f_{Z0} \cdot K_{a_e}$		1/50									

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Circular interpolation cutters

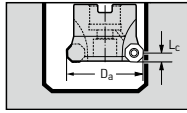
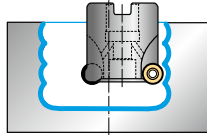
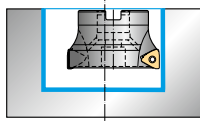
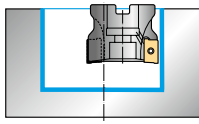
Cutter type		M5468							M2472
Material group	 Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{pmax} = L_c$	 Xtra-tec® XT							
	Lead angle κ	—							—
		f_{Z0} [mm]							f_{Z0} [mm]
	Tool diameter or diameter range [mm]	12–20	15–42	25–32	32–66	40–80	52–315	63–160	32–50
	Maximum cutting data $a_{pmax}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

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Circular interpolation cutters (continued)

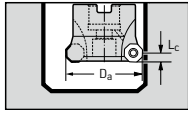
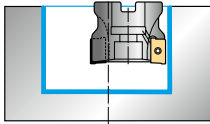
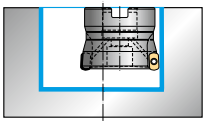
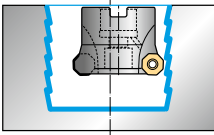
Cutter type		F2334R		M5137		M5130			
Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$ 									
				Xtra-tec® XT		Xtra-tec® XT			
		—		90°		90°			
		f_{Z0} [mm]		f_{Z0} [mm]		f_{Z0} [mm]			
Material group	Tool diameter or diameter range [mm]	32–66	40–80	10–63	50–100	10–63	16–50	25–80	25–160
	Maximum cutting data $a_{p\max} = L_c$ [mm]	5	6	5	8	5	9	11	15
	Non-alloyed steel ¹	0,17	0,22	0,14	0,19	0,10	0,14	0,19	0,23
	Low-alloy steel	0,13	0,15	0,11	0,14	0,07	0,10	0,14	0,17
P	High-alloy steel and tool steel	0,13	0,15	0,11	0,14	0,07	0,10	0,14	0,17
	Stainless steel	0,09	0,11	0,09	0,12	0,06	0,09	0,12	0,14
	Stainless steel ²	0,09	0,11	0,07	0,09	0,06	0,11	0,09	0,11
	Malleable cast iron	0,17	0,22	0,14	0,18	0,08	0,12	0,18	0,23
K	Grey cast iron	0,22	0,28	0,15	0,20	0,10	0,14	0,20	0,28
	Cast iron with spheroidal graphite	0,17	0,22	0,14	0,18	0,08	0,12	0,18	0,23
	CGI	0,17	0,22	0,14	0,18	0,08	0,12	0,18	0,23
	Wrought aluminium alloys					0,08	0,10	0,13	0,14
N	Cast aluminium alloys					0,08	0,10	0,13	0,14
	Magnesium-based alloys ³					0,07	0,09	0,12	0,14
	Copper and copper alloys (bronze/brass)					0,07	0,07	0,09	0,14
	Heat-resistant alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
S	Titanium alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
	Tungsten alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
	Molybdenum alloys	0,09	0,11	0,08	0,11	0,06	0,08	0,11	0,14
	Hardened steel					0,00			0,00
H	Hardened cast iron					0,00			0,00
	Thermoplastics	0,10	0,15			0,10	0,13	0,18	0,21
	Plastic, carbon-fibre reinforced					0,00			0,00
	Graphite (technical)	0,10	0,12			0,08	0,10		0,16
Indexable insert types		RO.X 10T3..	RO.X 1204..	TN MU 11T304R...	TN MU 160508R..	AC.. 0602..	BC.. 0903..	BC.. 1204..	BC.. 1605..
Correction factor K_{a_e}									
for the feed per tooth depending									
on the ratio of cutting width a_e									
to milling cutter diameter D_c									
$a_e / D_c = 1/1 - 1/2$		1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
1/5		1,2	1,2	1,1	1,1	1,1	1,2	1,1	1,1
1/10		1,5	1,5	1,2	1,2	1,2	1,5	1,2	1,2
1/20		1,8	1,8	1,3	1,3	1,3	1,8	1,3	1,3
1/50		2,0	2,0				2,0		

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Circular interpolation cutters (continued)

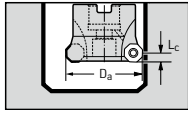
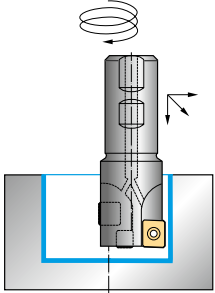
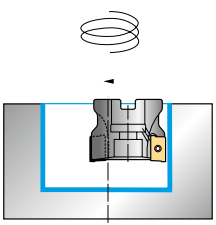
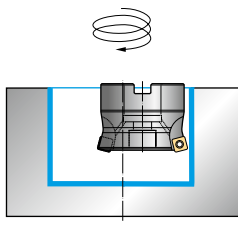
Cutter type		F4042 / F4042R		M5008	M5004	
Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$ 						
		Xtra-tec®		Xtra-tec® XT	Xtra-tec® XT	
Lead angle κ		90°		15°	43°	
Material group		f_{Z0} [mm]		f_{Z0} [mm]	f_{Z0} [mm]	
		F4042	F4042R			
		10–50	16–50	16–66	50–160	
Maximum cutting data $a_{p\max} = L_c$ [mm]		8	10	1,0	3	4
P	Non-alloyed steel ¹	0,13	0,16	0,64	0,40	0,45
	Low-alloy steel	0,09	0,10	0,64	0,36	0,40
	High-alloy steel and tool steel	0,09	0,10	0,56	0,27	0,32
	Stainless steel	0,07	0,09	0,24	0,18	0,32
M	Stainless steel ²	0,07	0,09	0,16	0,13	0,13
K	Malleable cast iron	0,10	0,13	0,16	0,32	0,36
	Grey cast iron	0,13	0,18	0,80	0,40	0,45
	Cast iron with spheroidal graphite	0,10	0,13	0,64	0,32	0,36
	CGI	0,10	0,13	0,64	0,32	0,36
N	Wrought aluminium alloys	0,10			0,22	0,22
	Cast aluminium alloys	0,10			0,22	0,22
	Magnesium-based alloys ³	0,09			0,13	0,13
	Copper and copper alloys (bronze/brass)	0,09			0,13	0,13
S	Heat-resistant alloys	0,07	0,09	0,24	0,13	0,13
	Titanium alloys	0,07	0,09	0,24	0,13	0,13
	Tungsten alloys	0,07	0,09	0,24	0,13	0,13
	Molybdenum alloys	0,07	0,09	0,24	0,13	0,13
H	Hardened steel			0,16		
	Hardened cast iron			0,24		
O	Thermoplastics	0,12	0,15		0,20	0,20
	Plastic, carbon-fibre reinforced					
	Graphite (technical)	0,10	0,12		0,15	0,15
Indexable insert types		AD..T0803..	AD..T10T3..	EN..08T3..	OD..0504..	OD..0605..
Correction factor K_{a_e}						
for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c		$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0
		1/5	1,1	1,1	1,1	1,1
		1/10	1,2	1,2	1,2	1,2
		1/20	1,3	1,3	1,3	1,3
		1/50				

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.* Only possible if $a_e/D_c < 1/5$

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

Feed determination (starting values)

Circular interpolation cutters (continued)

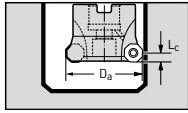
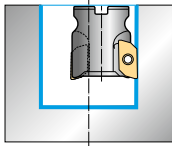
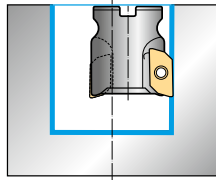
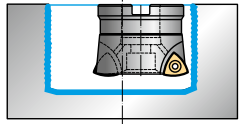
Cutter type		M4792			M4130			M4002		
Material group	 Feed per tooth f_{z0} for $a_e = D_c$ $a_p = a_{pmax} = L_c$									
	Lead angle κ	90°			90°			15°		
		f_{z0} [mm]			f_{z0} [mm]			f_{z0} [mm]		
	Tool diameter or diameter range [mm]	17,9–24,9	29,9–31,9	39,9	16–20	25–50	50–100	20–66	25–66	50–125
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

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

Circular interpolation cutters (continued)

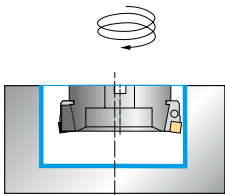
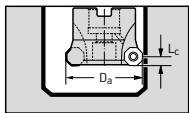
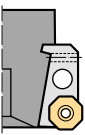
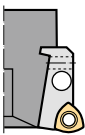
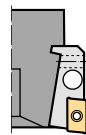
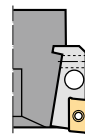
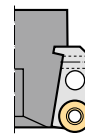
Cutter type		M2331		M2131		F2330		
Material group	 Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{pmax} = L_c$							
	Lead angle κ	90°		90°		0–15°		
		f_{Z0} [mm]		f_{Z0} [mm]		f_{Z0} [mm]		
	Tool diameter or diameter range [mm]	32–50	40–50	25–80	32–63	20–25	32–85	52–85
	Maximum cutting data $a_{pmax} = L_c$ [mm]	15	20	15	20	1,0	1,5	2,0
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	0,13	0,18			
	Cast aluminium alloys	0,13	0,18	0,13	0,18			
	Magnesium-based alloys ³	0,13	0,18	0,13	0,18			
	Copper and copper alloys (bronze/brass)	0,11	0,13	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		ZDGT15A4..	ZDGT20A5..	ZDGT1504..	ZDGT2005..	P2633..-R10 P26379-R10	P2633..-R14 P26379-R14	P2633..-R25 P26379-R25
Correction factor K_{aE} for the feed per tooth depending on the ratio of cutting width a_e to milling cutter diameter D_c	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,1	1,1	1,1	1,4	1,4	1,4
	1/10	1,2	1,2	1,2	1,2	1,4	1,4	1,4
	1/20	1,3	1,3	1,3	1,3			
	1/50							
Correction factor K	$1 < (L : D_c) \leq 2$					1,4	1,4	1,4
	$2 < (L : D_c) \leq 4$					1,0	1,0	1,0
$f_Z = f_{Z0} \cdot K_{aE} \cdot K$	$4 < (L : D_c) \leq 6$					0,7	0,7	0,7

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

Feed determination (starting values)

F2010 circular interpolation cutter

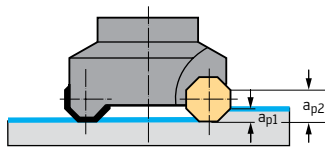
Cutter type F2010...							
 Feed per tooth f_{Z0} for $a_e = D_c$ $a_p = a_{p\max} = L_c$		...R592M	...R729M	...R755M	...R718M	...R719M	...R723M
							
		Xtra-tec® XT			Xtra-tec®	Xtra-tec®	
Material group	Lead angle κ	43°	0–15°	15°	90°	90°	–
		f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [mm]	f_{Z0} [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 K_{a_e}							
for the feed per tooth depending on							
the ratio of cutting width a_e to milling							
cutter diameter D_c							
	$a_e / D_c = 1/1 - 1/2$	1,0	1,0	1,0	1,0	1,0	1,0
	1/5	1,1	1,4	1,4	1,1	1,1	1,2
	1/10	1,2	1,4	1,8	1,2	1,2	1,5
	1/20	1,3			1,3	1,3	1,8
$f_Z = f_{Z0} \cdot K_{a_e}$							2,0
	1/50						
Correction factor K							
	$1 < (L : D_c) \leq 2$		1,4	1,4			
	$2 < (L : D_c) \leq 4$		1,0	1,0			
$f_Z = f_{Z0} \cdot K_{a_e} \cdot K$							
	$4 < (L : D_c) \leq 6$		0,7	0,7			

¹ and steel casting² and austenitic/ferritic³ Water-miscible cooling lubricants must not be used when machining magnesium-based alloys.

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

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

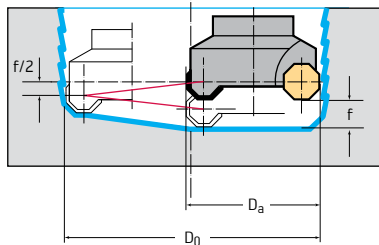
Face milling



Max. milling depth a_p [mm]

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

Circular interpolation of a bore into solid material

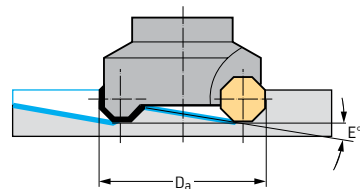


Diameter range for milling a hole in one pass [mm]

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

Ramping

Maximum feed angle E [°]

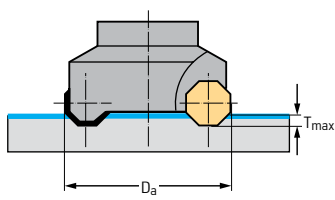


D_a [mm]	OD..0504.. (F4080)	OD..0605.. (F4080)	D_a [mm]	OD..050408	OD..0605.. (F4080)	OD..0605.. (F2010.. R592M)
32	14,0		90		4,0	0,40
36	10,6		100	2,0	3,1	
40	8,3		108	2,0		
50	5,5	9,6	110		3,1	0,31
52	5,1	8,9	125	1,5	2,3	
58	4,6		133	1,5		
60		7,7	135		2,3	0,25
63	3,8	6,2	160		1,7	
66	3,5	5,8	170	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

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

(continued)

Vertical plunging

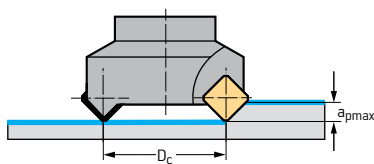


Max. plunging depth T_{max} [mm]

	OD...0504..	OD...0605..
T_{max}	2,8	4,0

Application information for the M4003 face milling cutter

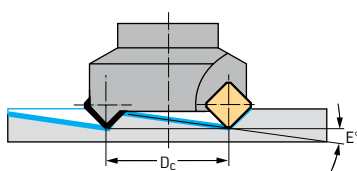
Face milling



Max. milling depth a_p [mm]

	SD...09T3AZN	SD...1204AZN
a_p	4,5	6,5

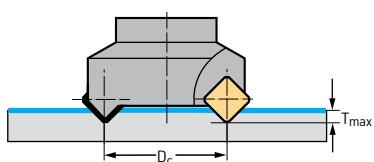
Ramping



Maximum feed angle E [°]

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

Vertical plunging

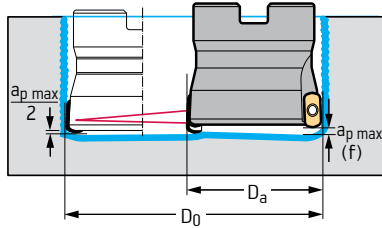


Max. plunging depth T_{max} [mm]

	SD...09T3AZN..	SD...1204AZN..
T_{max}	4,5	6,0

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

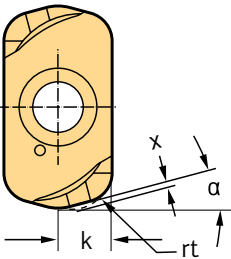
Circular interpolation of a bore into solid material



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

D _a [mm]	ENMX08T316R..	
	D _{0 min} [mm]	D _{0 max} [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



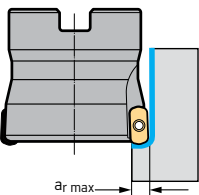
Indexable insert	r _t [mm]	x [mm]	k [mm]	α [°]
ENMX08T316R..	2	0,79	3,0	17,7

Important:

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

Plunge milling

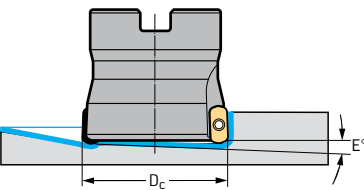
Max. plunging depth [mm]



a _r [mm]	ENMX08T316R..
	3,0

Ramping

Maximum feed angle E [°]

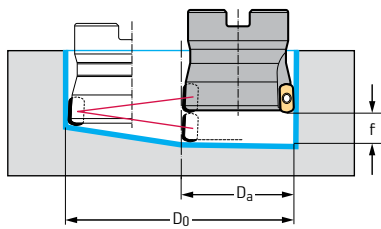


D _a [mm]	ENMX08T316R..
16	2,20
20	1,50
25	1,10
30	0,80
32	0,75
35	0,60
40	0,55
42	0,53
50	0,43
52	0,40
63	0,33
66	0,30

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

(continued)

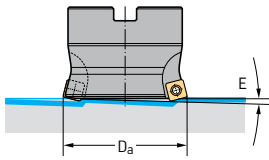
Circular interpolation of a bore

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 [°]

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

Maximum feed angle E [°]

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

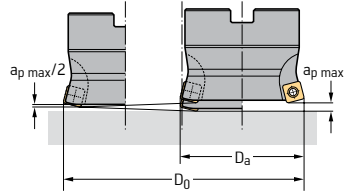
Maximum feed angle E [°]

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

Application information for M4002/F2010 high-feed milling cutters

(continued)

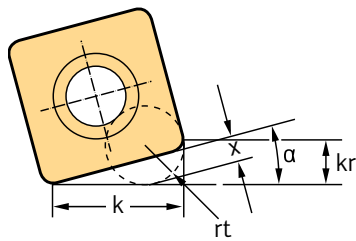
Circular interpolation of a bore into solid material



Diameter range for milling a hole in one pass

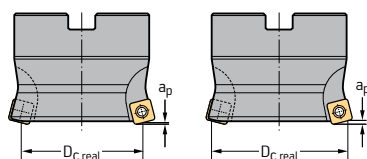
Da [mm]	Indexable insert					
	SD...06T204		SD...09T308		SD...120408	
	D0 min [mm]	D0 max [mm]	D0 min [mm]	D0 max [mm]	D0 min [mm]	D0 max [mm]
20	28,6	40				
25	38,6	50	33,26	50		
32	52,6	64	47,26	64		
35	58,6	70	53,26	70		
40	68,6	80	63,26	80		
42	72,6	84	67,26	84		
50	88,6	100	83,26	100	77,12	100
52	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

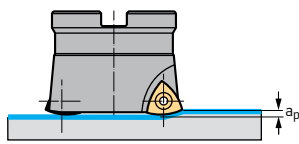


$$D_{c \text{ real}} \approx D_c + 8 \cdot a_p$$

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

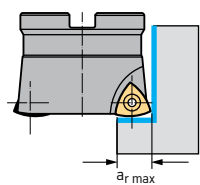
Application information for F4030/F2010 high-feed milling cutters

Face milling



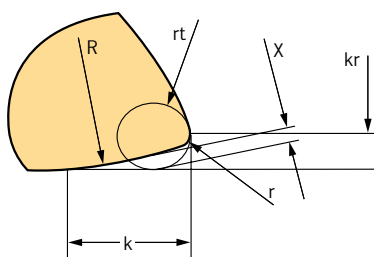
	Max. milling depth a_p [mm]	
	P23696-1.0	P23696-2.0
$a_{p \max}$	1,0	2,0

Plunge milling



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

Programming information

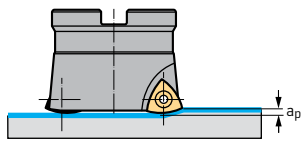


Indexable insert	R [mm]	r [mm]	r_t [mm]	k [mm]	kr [mm]	X [mm]
P23696 - R 1.0	14	1,2	2,0	5,8	2,1	0,6
P23696 - R 2.0	18	1,6	3,5	9,2	3,5	1,1

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

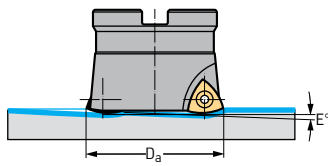
Application information for F2330/F2010 high-feed milling cutters

Face milling



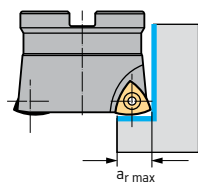
Max. milling depth a_p [mm]			
	P2633... – R10 P26379 – R10	P2633... – R14 P26379 – R14	P2633... – R25 P26379 – R25
$a_{p \max}$	1	1,5	2

Ramping



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

Plunge milling



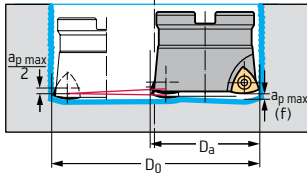
Max. plunging depth a_r [mm]			
	P2633... – R10 P26379 – R10	P2633... – R14 P26379 – R14	P2633... – R25 P26379 – R25
$a_{r \max}$	7	10,3	15

Application information for F2330/F2010 high-feed milling cutters

(continued)

Circular interpolation of a bore into solid material

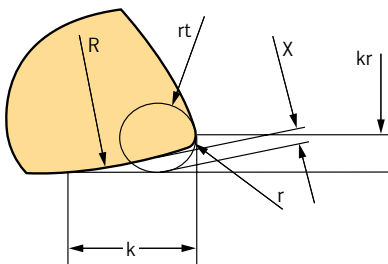
Diameter range for milling a hole in one pass [mm]



D _a [mm]	Indexable insert					
	P2633. – R10 P26379 – R10*		P2633. – R14 P26379 – R14*		P2633. – R25 P26379 – R25*	
	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 135).

Programming information



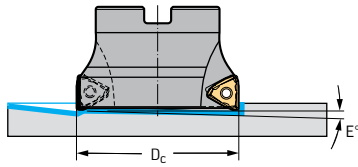
Indexable insert	R [mm]	r [mm]	r _t [mm]	k [mm]	kr [mm]	X [mm]
P2633. – R10	10,0	0,8	2,0	4,0	1,8	0,5
P2633. – R14	14,0	1,2	2,5	5,5	2,6	0,8
P2633. – R25	25,0	2,0	3,0	8,0	3,4	0,9
P26379 – R10	10,0	0,4	1,5	4,8	1,5	0,63
P26379 – R14	14,0	0,4	2,2	7,2	2,2	0,91
P26379 – R25	25,0	0,4	2,8	9,6	2,8	1,05

Important:

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

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

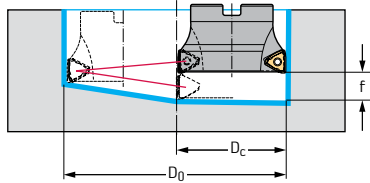
Ramping and circular plunging into solid material



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

Milling cutter dia. D_c [mm]	TNMU11T3... $a_{p \max} = 5 \text{ mm}$				TNMU1605... $a_{p \max} = 8 \text{ mm}$			
	$E_{\max}$ [°]	$D_{0 \min}$ [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
125					0,7	241	250	1,0
160					0,5	311	320	1,0

Circular interpolation of a hole into solid material

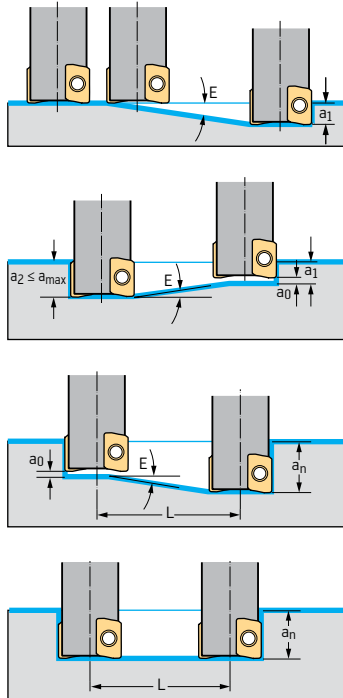


Max. axial feed per tool revolution ("thread pitch") f [mm]

Machined hole diameter D_0 [mm]	TNMU11T3... D_c [mm]					TNMU1605... D_c [mm]					
	25	32	40	50	63	50	63	80	100	125	160
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	4,1	
300	5,0	5,0	5,0	5,0	5,0	8,0	8,0	8,0	6,6	5,7	
350	5,0	5,0	5,0	5,0	5,0	8,0	8,0	8,0	8,0	7,4	5,2
400	5,0	5,0	5,0	5,0	5,0	8,0	8,0	8,0	8,0	8,0	6,6
450	5,0	5,0	5,0	5,0	5,0					8,0	8,0
500	5,0	5,0	5,0	5,0	5,0					8,0	8,0

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

Ramping and circular plunging into solid material



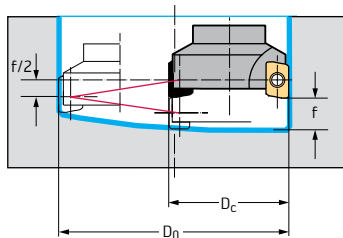
Plunging angle $E_{\max}$ [°]

Milling cutter dia. D_c [mm]	AC...0602.. $a_{p\max} = 5 \text{ mm}$				BC...0903.. $a_{p\max} = 9 \text{ mm}$			
	$E_{\max}$ [°]	$D_{0\min}$ [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. D_c [mm]	BC...1204.. $a_{p\max} = 12 \text{ mm}$				BC...1605.. $a_{p\max} = 15 \text{ mm}$			
	$E_{\max}$ [°]	$D_{0\min}$ [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



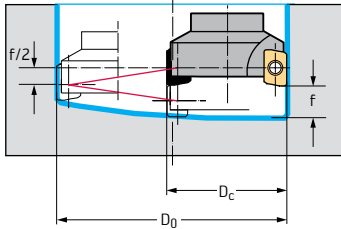
Max. axial feed per tool revolution ("thread pitch") f [mm]

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]

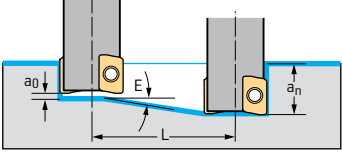
Machined hole diameter D ₀ [mm]	BC...1204.. D _c [mm]														
	22	25	32	40	50	63	80								
30	3,1														
40	7,0	4,8													
50	11,0	8,0	3,8												
60	12,0	11,2	5,8												
80	12,0	12,0	7,9	4,6											
100	12,0	12,0	10,0	6,1											
120	12,0	12,0	12,0	7,7	4,6								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

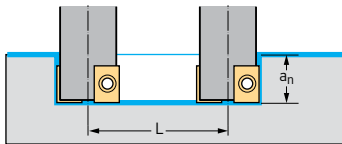
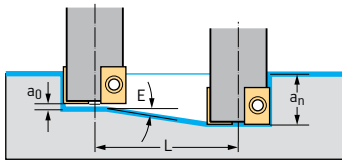
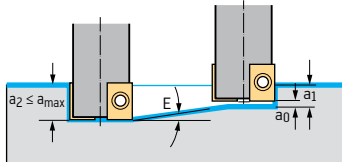
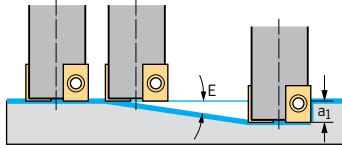
Application information for the Xtra-tec® XT M5250 helical milling cutter

Ramping

		Plunging angle $E_{\max}$ [°]			
		BC..1605.. $a_{p \max} = L_c$			
Milling cutter dia.	D_c [mm]	$E_{\max}$ [°]	$D_{0 \min}$ [mm]	$D_{0 \max}$ [mm]	a_0 [mm]
	50	2,9	82	100	2
	63	2,0	108	126	2
	80	1,6	142	160	2

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

Ramping and circular plunging into solid material



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

Milling cutter dia. D_c [mm]	Plunging angle E_{max} [°]	AD...080304 $a_{pmax} = 8$ mm			Plunging angle E_{max} [°]	AD...10T308 $a_{pmax} = 10$ mm		
		D_{0min} [mm]	D_{0max} [mm]	a_0 [mm]		D_{0min} [mm]	D_{0max} [mm]	a_0 [mm]
10	12,1	15	20	0,75				
12	9,9	17	24	0,8				
16	13,7	21	32	2,0	6,6	20	32	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

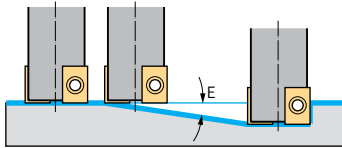
Milling cutter dia. D_c [mm]	Plunging angle E_{max} [°]	AD...120408 $a_{pmax} = 11$ mm			Plunging angle E_{max} [°]	AD...160608 $a_{pmax} = 15$ mm		
		D_{0min} [mm]	D_{0max} [mm]	a_0 [mm]		D_{0min} [mm]	D_{0max} [mm]	a_0 [mm]
22	7,4	30	44	2,6				
25	8,5	36	50	2,3	8,5	32	50	1,7
32	5,6	50	64	2,2	7,5	46	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. D_c [mm]	Plunging angle E_{max} [°]	AD...180712 $a_{pmax} = 16$ mm		
		D_{0min} [mm]	D_{0max} [mm]	a_0 [mm]
50	2,9	74	100	1,7
63	2,1	100	126	1,7
80	1,5	134	160	1,7
100	1,2	174	200	1,7
125	0,9	224	250	1,7
160	0,7	294	320	1,7

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

(continued)

Maximum feed angle E [°] for F2010		
	D _c [mm]	
		AD...1204.. (F2010...R718M)
	80	0,65
	100	0,51
	125	0,40
	160	0,31
	200	0,25
	250	0,19
	315	0,15
		AD...1606.. (F2010...R719M)
		0,75
		0,58
		0,46
		0,35
		0,28
		0,22
		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:

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

Feed angle:

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

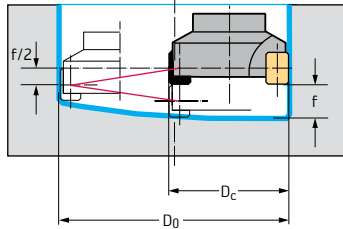
Explanation of abbreviations:

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
E	[°]	Actual 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]

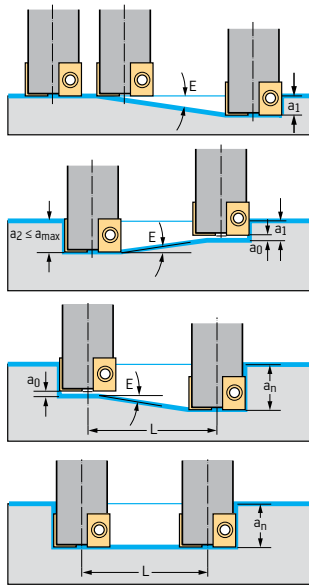
Machined hole diameter D ₀ [mm]	AD..120408 D _c [mm]							AD..160608 D _c [mm]													
	22	25	32	40	50	63	80	25	32	36	40	44	50	54	63	66	80	84	100	125	160
32								3,4													
40	7,2	7,0						7,2													
50	11,3	11,0	5,5					11,5	7,6												
60	11,7	11,0	8,6					15,0	11,7	9,4				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

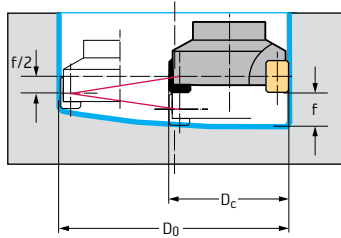


Maximum feed angle E [°]

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

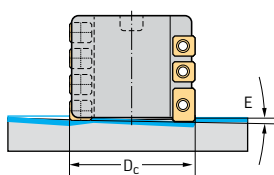
Max. axial feed per tool revolution ("thread pitch") f [mm]



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

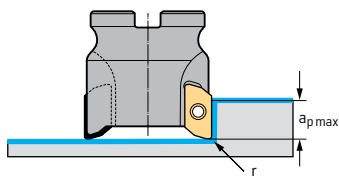


Maximum feed angle E [°]

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

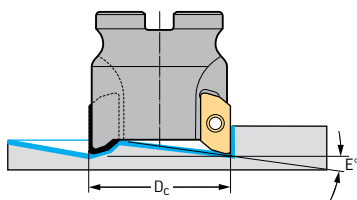
Application information for the M2331 ramping milling cutter

Shoulder milling



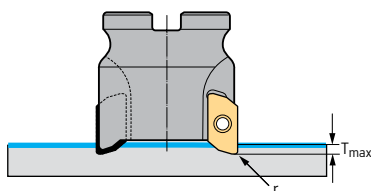
Corner radius r [mm]	Max. milling depth $a_{p\max}$ [mm]	
	ZDGT15A4..	ZDGT20A5..
0,4	16,0	21,3
0,8	16,0	21,3
1,2	15,9	21,2
1,6	15,8	21,0
2,0	15,7	20,9
2,5	15,5	20,8
3,0	15,4	20,6
4,0	15,1	20,3
5,0		20,0
6,0		19,8
6,4		19,7

Ramping



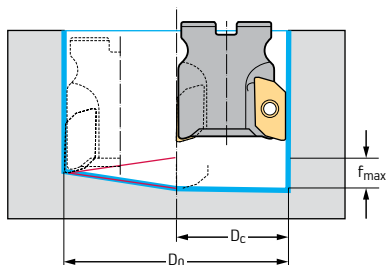
D_c [mm]	Maximum feed angle E°	
	ZDGT15A4..	ZDGT20A5..
32	11	
40	7	12
50	5	8

Vertical plunging



Corner radius r [mm]	Max. plunging depth $T_{\max}$ [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

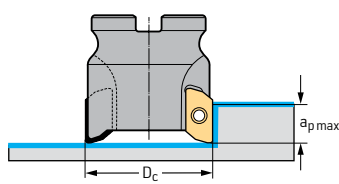
Circular interpolation of a bore into solid material



Milling cutter dia. D_c [mm]	Possible hole diameters and axial feeds					
	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

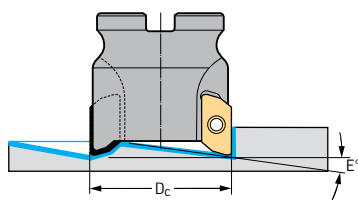
Shoulder milling



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

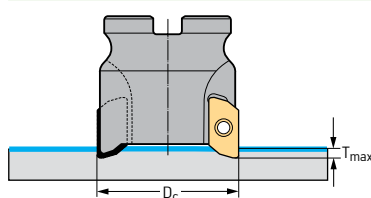
Ramping



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	

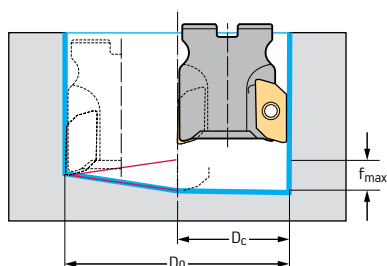
Vertical plunging



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

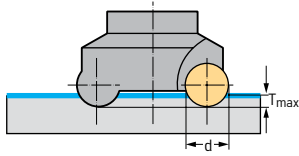


Possible hole diameters and axial feeds

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

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

Vertical plunging



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

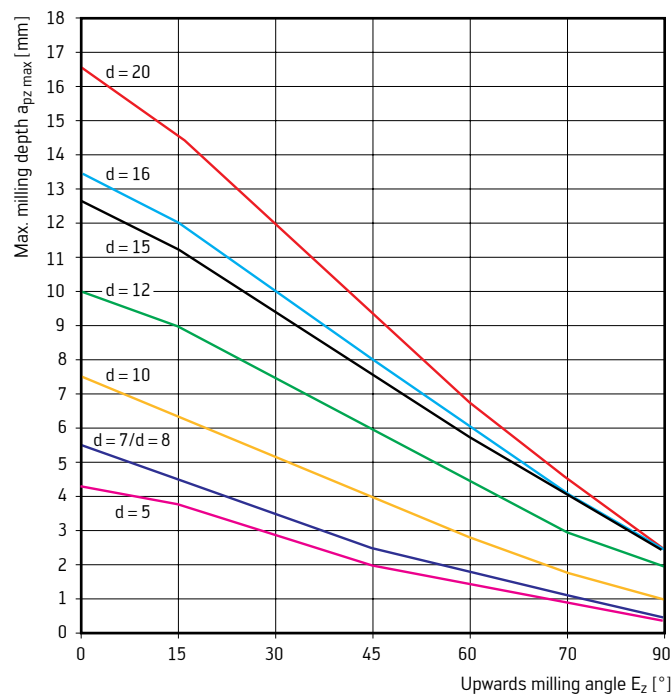
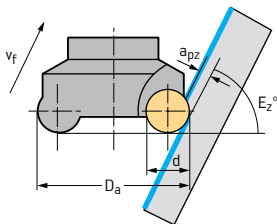
$T_{\max}$ [mm]	Indexable insert diameter d [mm]			
	RD..0501M0.. d = 5 mm	RD..07T1M0.. d = 7 mm	RO..X0804M04.. d = 8 mm	RO..X10T3M08.. d = 10 mm
	1,1	1,5	2,0	2,5

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

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

Milling upwards on inclined surfaces

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

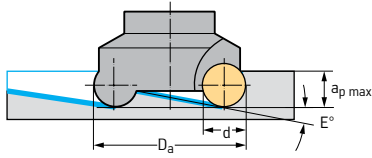


Application information for the Xtra-tec® XT M5468 copy milling cutter

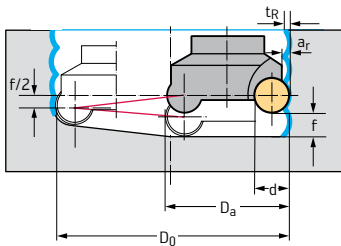
(continued)

Ramping and circular plunging into solid material

Ramping



Circular interpolation of a bore into solid material



Plunging

Milling cutter dia. D _a [mm]	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		
	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. D _a [mm]	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		
	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

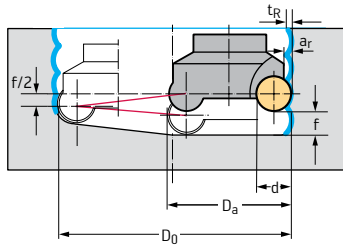
Plunging

Milling cutter dia. D _a [mm]	Indexable insert diameter d [mm]								
	RO...X2006M08... a _{p max} = 10 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

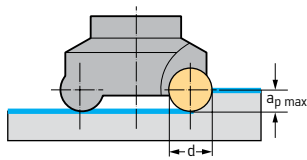
Groove depth on the wall of the hole t_R [mm]

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.

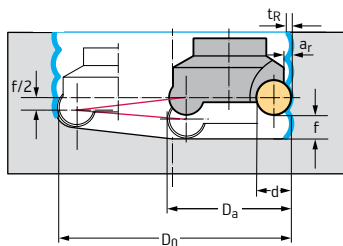
Application information for F2334R/F2010 button insert milling cutters

Face milling



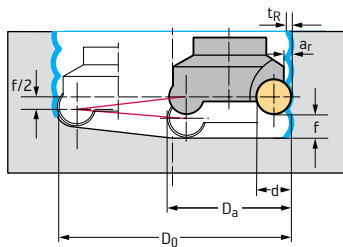
	Indexable insert diameter d [mm]	
	d = 10	d = 12
$a_{p \max}$ [mm]	5,0	6,0

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		
35	51,0	70		
40	61	80	57,4	80
50	81,4	100	77,2	100
52	85	104	81,2	104
63	102,4	126	103,2	126
66	113	132	109,4	132
80			137,8	160

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

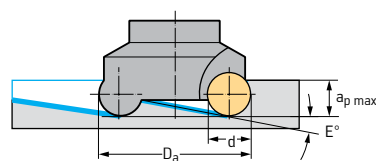


Axial feed per revolution f [mm]	Indexable insert diameter d [mm]	
	d = 10	d = 12
1	0,025	0,02
2	0,010	0,08
3	0,230	0,19
4	0,417	0,34
5	0,670	0,54
6	(1,000)	0,80
7	(1,429)	(1,12)
8		(1,53)
$a_r \max$	1,5	2,0

The values in brackets only apply to short bores.

Ramping

F2334R: Maximum feed angle E [°]



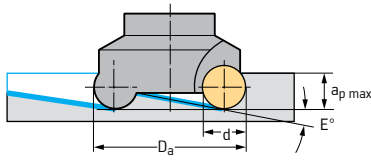
D_a [mm]	Indexable insert diameter d [mm]	
	d = 10	d = 12
25		
32	8,6	
35	7,4	
40	5,8	7,9
50	4,0	5,4
52	3,9	5,3
63	3,0	3,4
66	2,8	3,4
80		2,6
$a_{p \max}$ [mm]	8,8	10,5

Application information for F2334R/F2010 button insert milling cutters

(continued)

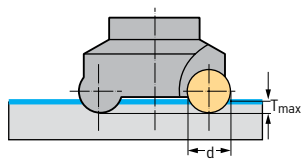
Ramping

F2010: Maximum feed angle $E [^\circ]$



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

Vertical plunging



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

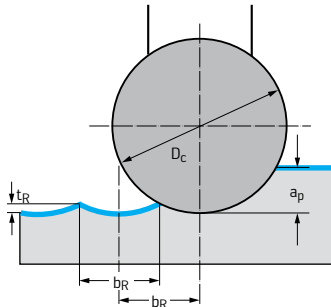
Application information for M5460/F2139/F2239/F2339 ball nose cutters

Line-by-line milling

Groove depth:

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

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



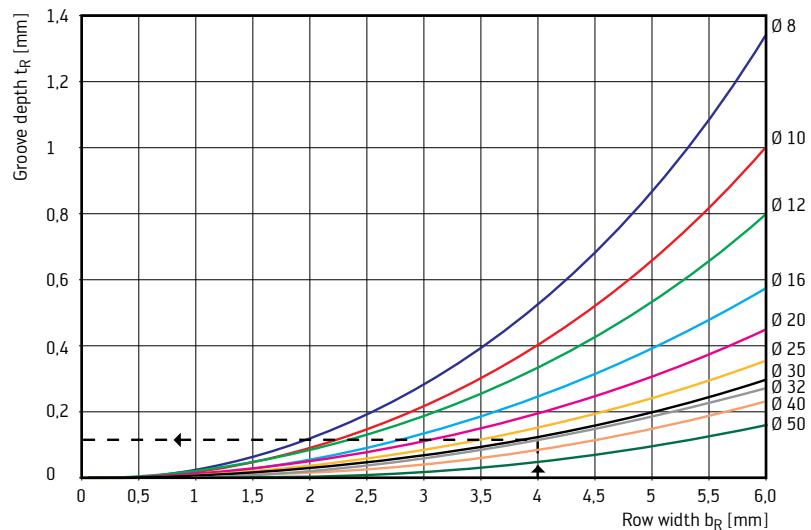
Usage recommendations
for copy and finish milling F2139

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

Semi-finishing – Roughing

Example:

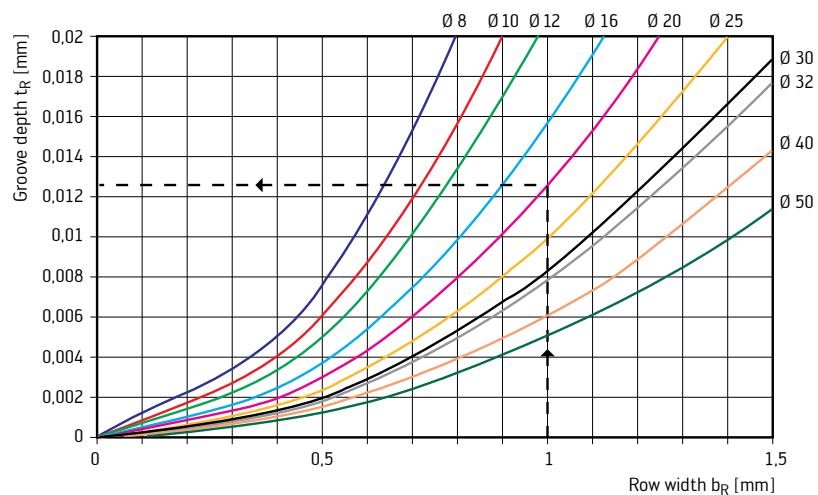
$D_c = 32$ mm
 $b_R = 4$ mm
→ $t_R = 0.125$ mm



Finishing

Example:

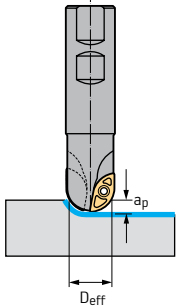
$D_c = 20$ mm
 $b_R = 1.0$ mm
→ $t_R = 0.0125$ mm



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

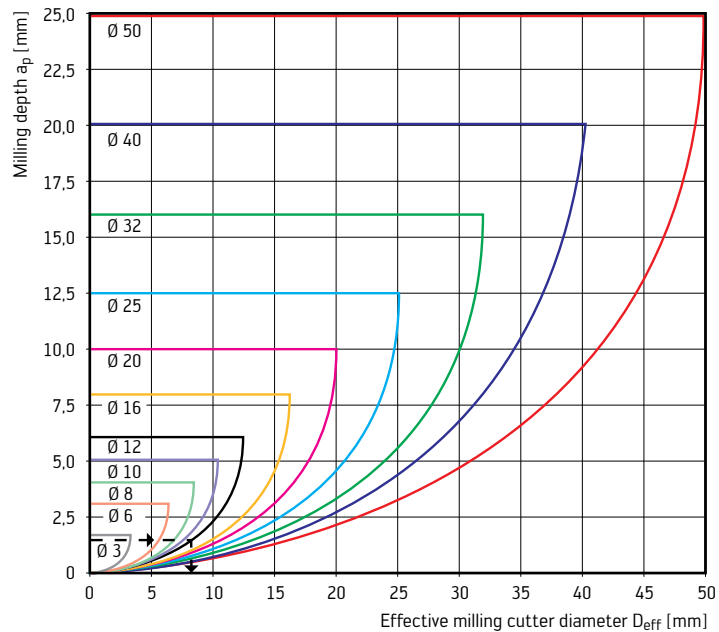
(continued)

Determining the effective cutting diameter



Example:

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

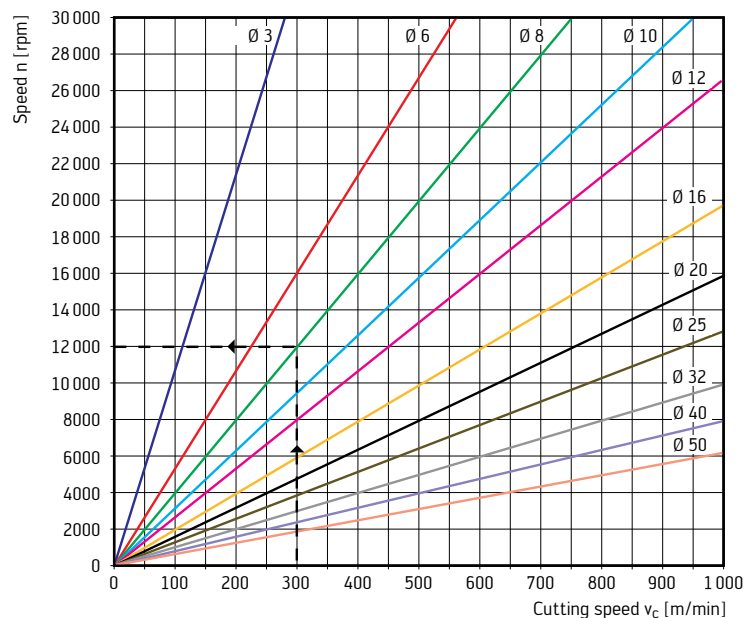


Determining the required speed

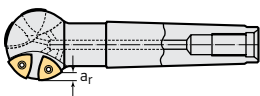
Example:

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

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



Radial plunging with F2239B



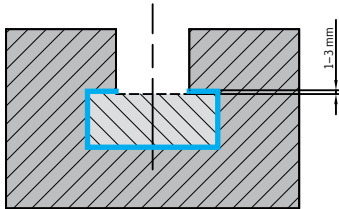
Tool dia. D_c [mm]	a_r [mm]
20	2,0
25	2,8
30	3,5

Tool dia. D_c [mm]	a_r [mm]
32	4,4
40	4,6
50	5,0

Strategies for preparing a T-slot

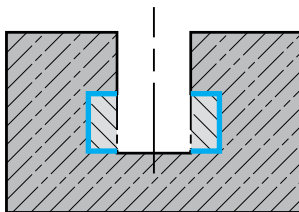
Strategies

Strategy 1



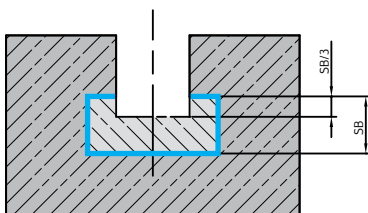
Strategy 1 is recommended if vibration is expected during machining. The prepared slot should protrude 1–3 mm deep into the T-slot so that the shank of the T-slot milling cutter is clear.

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

- Maximum permissible speeds:
The limit values specified in the tables should not be exceeded. Otherwise, correct operation and/or reliability are no longer guaranteed.
- Only use original Walter indexable inserts and assembly parts (screws, etc.). New screws should be used after having replaced the indexable inserts a maximum of five times.
- Observe the torque specified in the catalogues.
- Balancing:
Balancing in two steps is required when milling at fast speeds (> 6000 rpm) or at circumferential speeds of > 1000 m/min:
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.
- Short projection lengths reduce concentricity faults or an imbalance, and increase spindle service life. The specified speeds only apply to the use of tools without additional extensions and for tools with a neck length of $\leq 2.2 \times D_c$. For tools with longer neck lengths, the speeds must be reduced upon consultation with Walter.

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												
M5460¹	P32..	D _c						40.000*		40.000*				40.000*
M5250	BC.T1605..	D _c												
	SC.T1105..	D _c												
M5137	TN MU11T3..	D _c												24.400
	TN MU1605..	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 guard:

Appropriate safety guards or machine encapsulations must be used to safely collect particles which spin off, such as chips or cutting edge parts that are broken as a result of collisions.

7. Damaged tools:

The operating speed must be specified for the repair of an HSC tool. The table values only apply to tools with a condition equivalent to new condition following repair.

8. Application of standards:

Walter recommends using the balancing standard DIN 69888, which describes the balancing of tools and the requirements in the machining sector. DIN 69888 is tailored to the needs of the machining sector, and describes the tool balancing requirements in a practical manner. DIN ISO 1940, which was previously often used, describes balancing for all areas of mechanical engineering. The requirements when working at circumferential speeds of > 1000 m/min are described in DIN ISO 15641.

n _{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	12.100			
		40.000*															
						14.900		13.200		11.600							
						14.900		13.200		11.600							
		21.600		19.300		17.200		15.400									
						10.700		9.600		8.500		7.600	6.800	6.000			
		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													
M2472	RP..1204..WIS	D _a													
M2473	RN..1207..WIS	D _a													
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													

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 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	Ø 500
	25.000																
	18.200		16.800														
	30.800		27.600														
					17.900												
	25.100																
	25.100																
			28.800		25.000		21.750										
			28.800		25.000		21.750										
					17.300		15.000		12.900		11.400						
					17.300		15.000		12.900								
		30.800		27.600		24.600		22.000		19.500							
						17.900		16.000		14.100		12.600	11.300				
		33.600		28.800		25.000											
						17.300		15.000		12.900		11.400	10.000				
		33.600		30.100		26.900		24.000				19.000			4.200	3.800	3.350
		29.400		26.300		23.500		21.000				16.600	14.900	13.100	4.200	3.800	3.350
		22.400		20.000		17.900	17.600	16.000	15.600								
		30.800	29.500	27.600		24.600	24.200	22.000	21.400								
						17.900	17.600	16.000	15.600	14.100		12.600	11.300		4.200	3.800	3.350
						20.200		18.000		15.900							
						20.200		18.000		15.900							
				12.800		11.300		10.000		8.700		7.800	6.900	6.100			
								8.500		7.400		6.500	5.200	4.100			
													1.100	1.000	900	800	700
		40.000		36.200		32.400											
				25.600		22.800		20.400									
		23.400		20.500		18.100	17.700										
		26.600		23.300		20.400	20.000	18.000									
		40.000		39.800		34.400											
				40.000		34.000											
		37.900		32.400		28.000		24.300		21.100							
		38.100		31.700		26.900		23.100		19.900							
									4.900		4.400	3.900	3.500				
									4.900		4.400	3.900	3.500				
														3.100	2.800		
														3.100	2.800		

Continued →

Notes on high-speed cutting

(continued)

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
F5041	LN..0904..	D _c												39.600
F5141	LN..1306..	D _c												
F5241	LN..1607..	D _c												
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	ohne Kassetten	D _c												
F2010	alle Kassetten													

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 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	Ø 500
	35.000		31.300		28.000		25.000										
			22.500		20.200		18.000		15.900		14.200	12.700	11.200				
					20.200		18.000		15.900		14.200	12.700	11.200				
	35.000		31.300		28.000		25.000										
			22.500		20.200		18.000		15.900								
							5.100		4.000		3.200	2.600	2.000	1.600	1.300		350
	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	35.500	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							Application range								Coating process	Coating composition	Example of indexable insert		
		P Steel	M Stainless steel	K Cast iron	N NF metals	S Materials with difficult cutting properties	H Hard materials	O Other	01	05	10	15	20	25	30	35				40	45
WKP35G	HC – P 35	●●																	ULP-CVD	TiAlN+TiN	
	HC – K 35			●●																	
WKP35S	HC – P 35	●●																	CVD	TiCN + Al ₂ O ₃ (+ TiCN)	
	HC – K 35			●●																	
WKP25S	HC – P 25	●●																	CVD	TiCN + Al ₂ O ₃ (+ TiCN)	
	HC – K 25			●●																	
WAK15	HC – K 15			●●															CVD	TiCN + Al ₂ O ₃ (+ TiN)	
WSP45G	HC – S 45					●●													PVD	TiAlN + Al ₂ O ₃ + (ZrN)	
	HC – P 45	●●																			
	HC – M 45		●●																		
WSP45S	HC – S 45					●●													PVD	TiAlN + Al ₂ O 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 ₂ O ₃ (+ TiCN)		
	HC – M 45		●●																		
WSM35G	HC – S 35					●●												PVD	TiAlN + Al ₂ O ₃ + (ZrN)		
	HC – M 35		●●																		
WSM35S	HC – S 35					●●												PVD	TiAlN + Al ₂ O ₃ (Al)		
	HC – M 35		●●																		
WKK25G	HC – K 25			●●														PVD	TiAlN + Al ₂ O ₃ + (ZrN)		
WKK25S	HC – K 25			●●														PVD	TiAlN + Al ₂ O ₃ (Al)		

HC = coated carbide

●● Primary application
● Additional application

Cutting tool material application charts – Milling

(continued)

Coated carbide																					
Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Example of indexable insert		
		P 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	
WSP46G	HC – S 45					●●													PVD	AlTiN + ZrN	
	HC – P 45	●●																			
	HC – M 45		●●																		
WSP46	HC – S 45					●●												PVD	TiAlN + Al ₂ O ₃		
	HC – P 45	●●																			
	HC – M 45		●●																		
WSM36G	HC – S 35					●●												PVD	AlTiN + ZrN		
	HC – M 35		●●																		
WSM36	HC – S 35					●●												PVD	TiAlN + Al ₂ O ₃		
	HC – M 35		●●																		
WHH15X	HC – H 15						●●											PVD	TiAlN- TiAlCrSiN		
	HC – P 15	●																			
	HC – K 15			●																	
WNN15	HC – N 15				●●													PVD	TiAlN		
WXN15	HC – N 15				●●													PVD	TiCN ^{plus}		
WPM15G	HC – P 15	●●																PVD	AlTiN + ZrN		
	HC – M 15		●●																		
	HC – K 15			●																	
WXM15	HC – P 15	●●															PVD	Multilayer TiAlN/ TiN			
	HC – M 15		●																		
	HC – K 15			●																	

HC = coated carbide

- Primary application
- Additional application

Cutting tool material application charts – Milling

(continued)

Uncoated carbide, ceramic, CBN and PCD

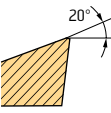
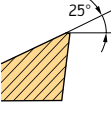
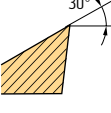
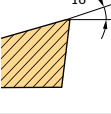
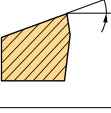
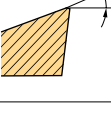
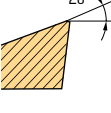
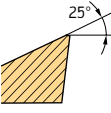
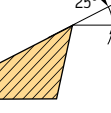
Walter grade designation	Standard designation	Material groups							Application range								Coating process	Coating composition	Example of indexable insert		
		P	M	K	N	S	H	O	01	05	10	15	20	25	30	35				40	45
		Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other													
WK10	HW – N 10				●●														—	—	
WMG40	HF – N 35				●●														—	—	
WCB80	BH – K 05			●●															—	—	
	BH – H 15						●														
WSN10	CN – K 20			●●															—	—	
WCD10	DP – N 10				●●														—	—	
WEP20	HT – P 20	●●																	—	—	
	HT – K 20			●●															—	—	
	HT – M 20		●●																—	—	
WDN20	DP – N 20				●●														—	—	
WIS10	CN – S 10					●●													—	—	

BH = CBN with high CBN content
 CN = Silicon nitride ceramic Si_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

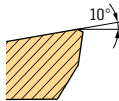
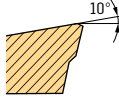
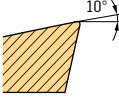
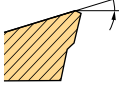
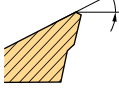
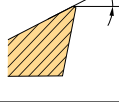
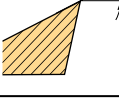
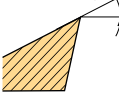
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
 AC.T	G55/G65 – The universal one – For average machining conditions – Can be used universally for most materials		●●	●●	●●		●●			M5130...05
	K55 – The easy-cutting one – 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		●●	●	●●		●			F2010 F2252 M5130 M5250
	G51 – The quiet one – Anti-vibration geometry – For tools with long projection lengths		●●	●●	●●		●			
	G55 – The universal one – For average machining conditions – Can be used universally for most materials		●●	●●	●●		●●			
	G55W – The special one – "WaveCut" – geometry with wave-shaped cutting edge – For machining titanium materials and stainless steels – Anti-vibration geometry – For tools with long projection lengths		●●	●●			●●			
	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					●●				

●● Primary application
 ● Additional application

Geometry overview of positive milling indexable inserts

(continued)

Indexable insert geometries

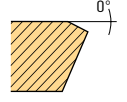
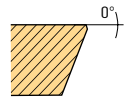
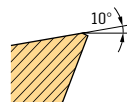
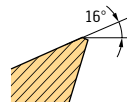
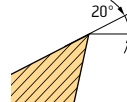
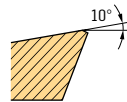
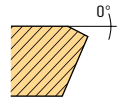
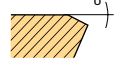
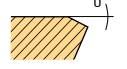
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 AD.T..	D51 – The quiet one – Anti-vibration geometry – For 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		••	•	••		•			
	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		••	••	•		••			
	F56 – The universal one – For average machining conditions – Can be used universally 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

- Primary application
 • Additional application

Geometry overview of positive milling indexable inserts

(continued)

Indexable insert geometries

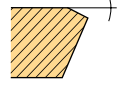
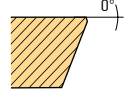
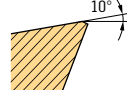
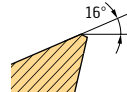
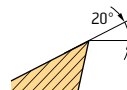
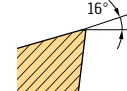
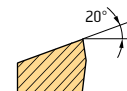
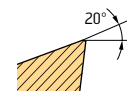
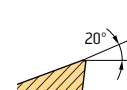
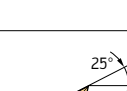
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
 OD..	A27 – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		••		••					F2010 M5004
	A57 – The special one – For average machining conditions – Predominantly for cast iron machining		•		••					
	D57 – The universal one – For average machining conditions – Can be used universally for most materials		••	••	••		••			
	F57 – The easy-cutting one – For good machining conditions – Low cutting forces – Moderate feeds		••	••	••		••			
	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 average machining conditions – Can be used universally for most materials	Cutting corner  Main cutting edge 	••	••	••		••			
	P26379 – The special one – For circular interpolation machining – Can be used universally for most materials – Wiper version	Cutting corner  Main cutting edge 	••	••	••		••			

•• Primary application
 • Additional application

Geometry overview of positive milling indexable inserts

(continued)

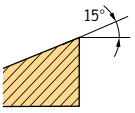
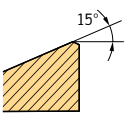
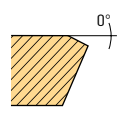
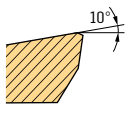
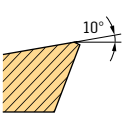
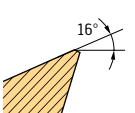
Indexable insert geometries

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...	A27 – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					F2010 F2334R M5468
	A57 – The special one – For average machining conditions – Specially designed for ISO H machining		●		●●					
	D57 – The universal one – For average machining conditions – Can be used universally for most materials		●●	●●	●●		●●			
	F67 – The easy-cutting one – For good machining conditions – Low cutting forces – Moderate feeds		●●	●●	●		●●			
	G88 – The sharp one – For aluminium machining – Low cutting forces					●●				
 SC.T	F55 – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●		●			M5250
	G51 – The quiet one – Anti-vibration geometry – For tools with long projection lengths		●●	●●	●●		●			
	G55 – The universal one – For average machining conditions – Can be used universally for most materials		●●	●●	●●		●●			
	G55W – The special one – “WaveCut” – geometry with wave-shaped cutting edge – For machining titanium materials and stainless steels – Anti-vibration geometry – For tools with long projection lengths		●●	●●			●●			
	K85 – The sharp one – For aluminium machining – Low cutting forces – Sharp cutting edges					●●				

●● Primary application
● Additional application

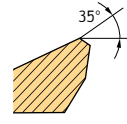
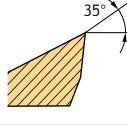
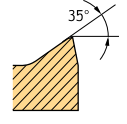
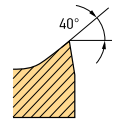
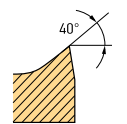
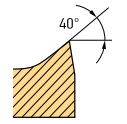
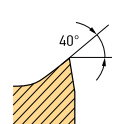
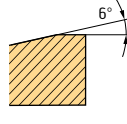
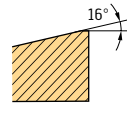
Geometry overview of positive milling indexable inserts

(continued)

Indexable insert geometries			Material groups							Suitable tool families
Geometry example	Remarks/application area	Main cutting edge section	P	M	K	N	S	H	O	
 SDMX	E57 – The universal one – Curved cutting edge – For average machining conditions – Moderate feeds		••	••	••		••			F2010 M4002
	E27 – The stable one – Curved cutting edge – For average to unfavourable machining conditions – Moderate to high feeds		••	••	••		••			
 SD..	A57 – The special one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds – No waves on the flank face		••		••					F2010 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..)
 LDM..	D51 – The quiet one – Anti-vibration geometry – For tools with long projection lengths – One wave on the flank face		••	•	••		•			
	D57 – The stable one – For average to unfavourable machining conditions – Moderate to high feeds – One wave on the flank face		••	••	••		••			
	F57 – The universal one – For average machining conditions – Moderate feeds – Two waves on the flank face		••	••	••		••			

•• Primary application
 • Additional application

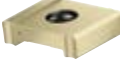
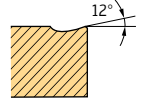
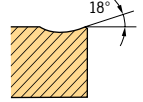
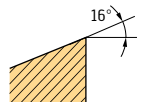
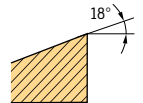
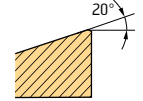
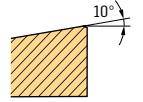
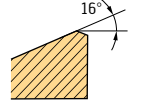
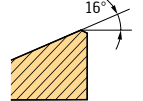
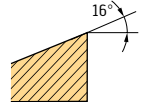
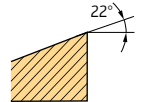
Geometry overview of double-sided milling indexable inserts

Indexable insert geometries			Material groups							Suitable tool families
Geometry example	Remarks/application area	Main cutting edge section	P	M	K	N	S	H	O	
 LNGX..	L55 – The universal one – For average machining conditions – Can be used universally for most materials		••	••	••		••			F2010 F4041
	L88 – The sharp one – For aluminium machining – Low cutting forces – Sharp cutting edges					••			•	
 LNHU..	L55T – The universal one – For average machining conditions – Can be used universally 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 universal one – For machining titanium materials and stainless steels – Low cutting forces						••			M3255
	L65W – The special 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 average machining conditions – Can be used universally for most materials		••	••	••		••			

•• Primary application
 • Additional application

Geometry overview of double-sided milling indexable inserts

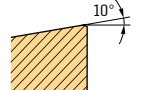
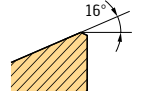
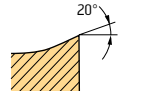
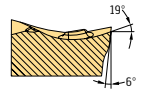
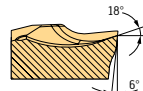
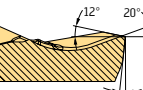
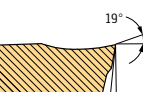
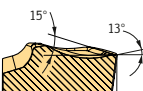
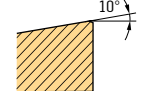
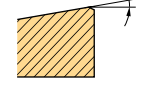
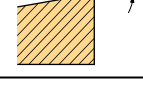
(continued)

Indexable insert geometries			Material groups							Suitable tool families
Geometry example	Remarks/application area	Main cutting edge section	P	M	K	N	S	H	O	
 LN.X..	D57T – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		••		••					F4053
	F57T – The universal one – For average machining conditions – Can be used universally for most materials		••	••	••		••			
 ONHF..	F67 – The universal one – For average machining conditions – Universal application				••					M2025 M2026
 P45424	G67 – The universal one – For finishing operations – For homogeneous surface structures				••					
 P23696	P23696 – The universal one – For average to unfavourable machining conditions – Can be used universally 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 average machining conditions – Can be used universally 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			Material groups							Suitable tool families
Geometry example	Remarks/application area	Main cutting edge section	P	M	K	N	S	H	O	
 ENMX...	D27 – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		••	••	••		••	••		M5008
	F47 – The universal one – For average machining conditions – Can be used universally for most materials		••	••	••		••	••		
	G67 – The special one – For machining ISO M and ISO S – For average machining conditions – Low cutting forces		•	••			••			
 SX...	CF6 – The easy-cutting one – Good machining conditions – Low feeds – Low cutting force		••	•		•	•		•	F5055
	SF5 – The universal one – Can be used universally 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					••				
	SE6 – The special one – For steel processing – Good chip control, formation of spiral chips with low volume – Low cutting forces / Easy-cutting		••							
 XNHF...	D27 – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds				••					F4045
	D57 – The universal one – For average 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

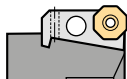
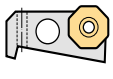
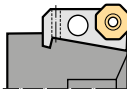
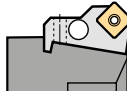
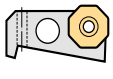
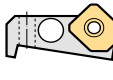
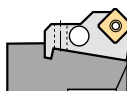
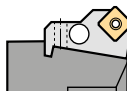
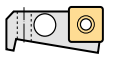
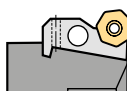
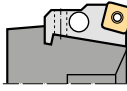
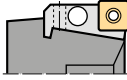
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Indexable insert geometries										
Geometry example	Remarks/application area	Main cutting edge section	Material groups							Suitable tool families
			P	M	K	N	S	H	O	
			Steel	Stainless steel	Cast iron	NF metals	Materials with difficult cutting properties	Hard materials	Other	
	F27 – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●		●●					M3024
XN.U..	F57 – The universal one – For average machining conditions – Can be used universally for most materials		●●		●●					
	F67 – The easy-cutting one – For good machining conditions – Low cutting forces – Moderate feeds		●●	●	●●					
	F27T – The stable one – For unfavourable machining conditions – Maximum cutting edge stability – High feeds		●●	●	●●					M3016
LNMX..	F57T – The universal one – For average machining conditions – Can be used universally for most materials		●●	●	●●		●			
	G27 – The universal one – For unfavourable machining conditions – Can be used universally for most materials – High feeds		●●	●	●●		●			F2010 M5137
TNMU..	G57 – The easy-cutting one – For average to good machining conditions – Low cutting forces – Moderate feeds		●●	●	●●		●			

●● Primary application
 ● Additional application

System overview for F2010 adjustable milling cutter

F2010

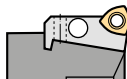
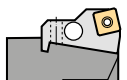
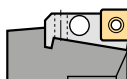
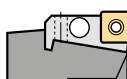
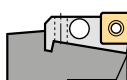
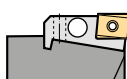
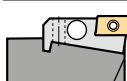
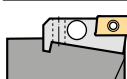
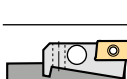
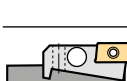
Cartridge version	D _c [mm]	Max. depth of cut [mm]	Indexable inserts	Finishing cartridges for roughing/finishing combination*	As supplement to tool
For face milling					
 κ = 43° F2010...R592M	80–315	4,0	 OD..0605..  The ODHX-0605ZZR finishing insert is installed in the FR592M cartridge	 Cartridge: FR681M 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 = 45° F2010...R759M	80–315	4,0	 XN..0705.. Finishing insert: XNGX0705ANN		M3024 D _c = 40–160 mm
 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 F2010 adjustable milling cutter

(continued)

F2010

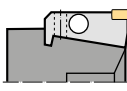
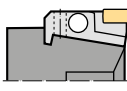
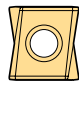
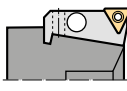
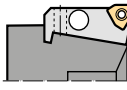
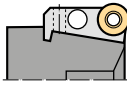
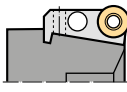
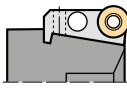
Cartridge version	D _c [mm]	Max. depth of cut [mm]	Indexable inserts	Finishing cartridges for roughing/finishing combination*	As supplement to tool
For high-feed milling					
 κ = 0–15° F2010...R729M	70–305	2,0	 P2633..R25		F2330 D _a = 52–85 mm
 κ = 15° F2010...R755M	80–315	2,0	 SD..1204..		M4002 D _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.. Finishing insert: BCGX1605PDR-G55		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 F2010 adjustable milling cutter

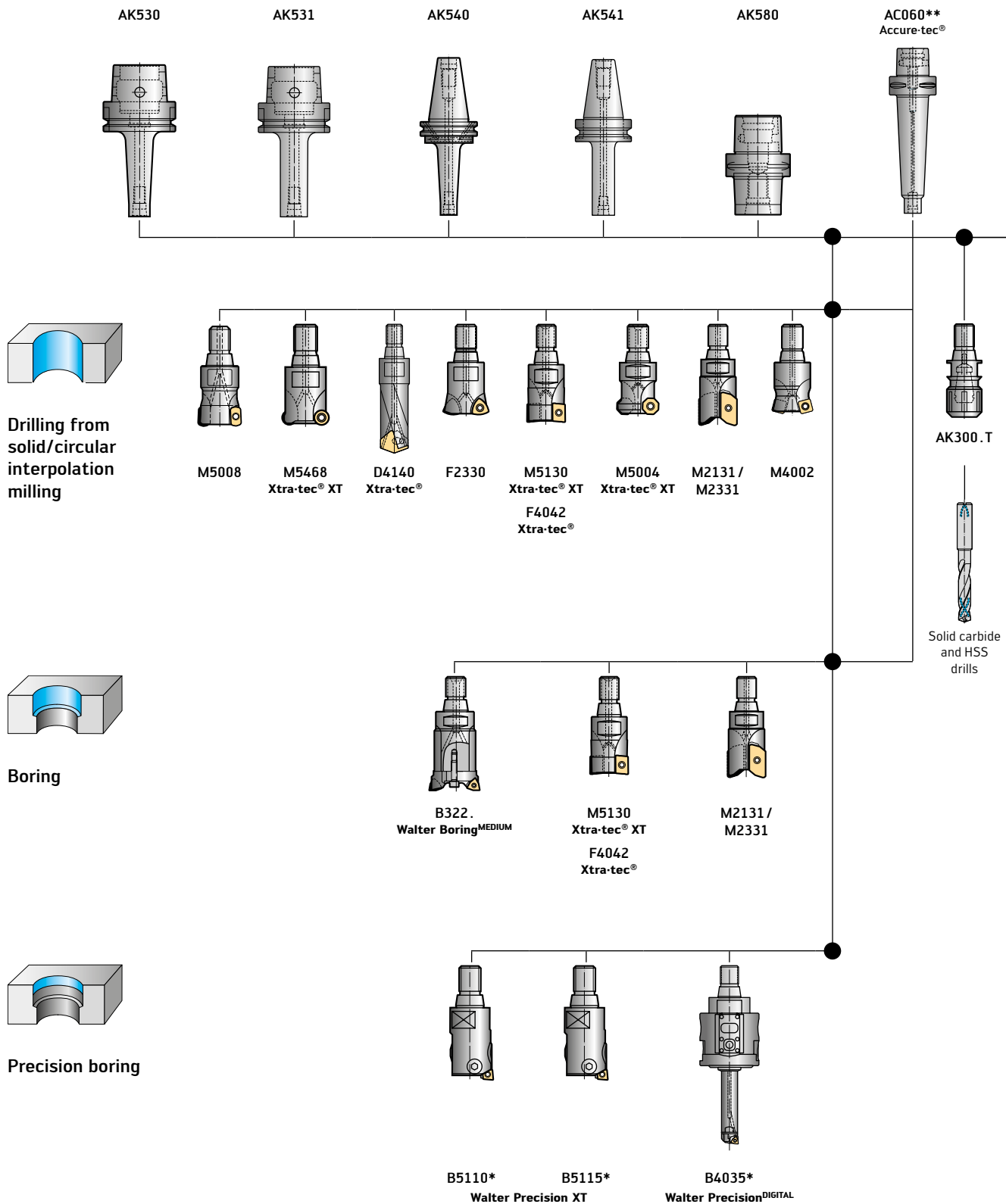
(continued)

F2010

Cartridge version	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 LNHU0904PDR-L55T		F5041 D _c = 25–63 mm
 κ = 90° F2010...R752M	80–315	12,0	 LNHU1306..  Finishing inserts: LNHU1306PDR-L55T LNHU130608R-L55T		F5141 D _c = 40–125 mm
 κ = 90° F2010...R769M	80–315	8,0	 TNMU1605..		M5137
 κ = 90° F2010...R500M 	80–315	0,5–1,0 (9,0)	 P2903-2R		
For copy milling					
 F2010...R723M	74–309	8,0	 RO.X 1605M0-..		
 F2010...R771M	80–315	6,0	 RO.X 1204M08..		M5468
 F2010...R770M	80–315	8,0	 RO.X 160508M08..		M5468

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

System overview of ScrewFit for holemaking and circular interpolation milling

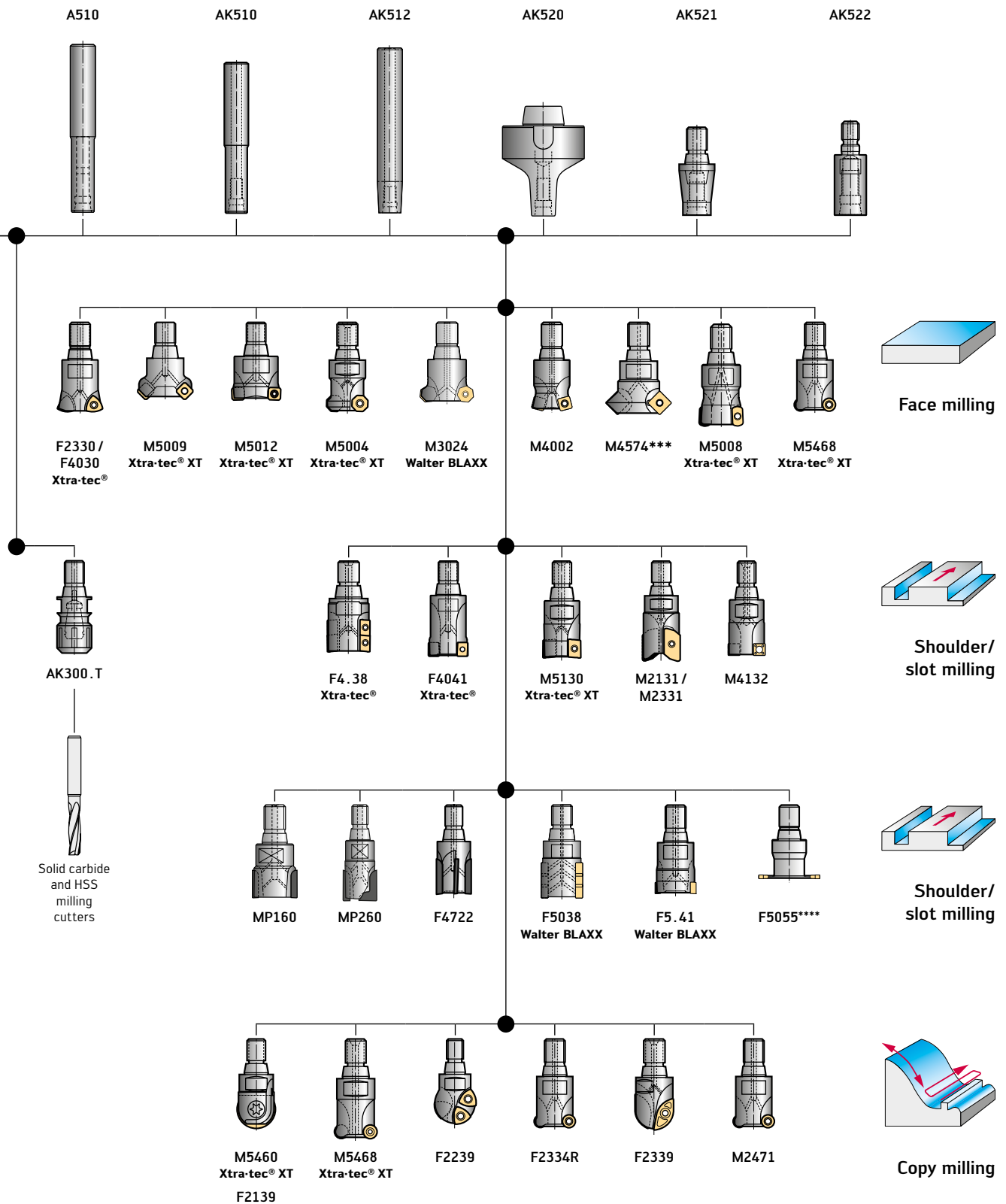


* only in combination with AK53.CO and AK54.CO.

** AC060 also available with hollow shank taper, steep taper and MAS-BT interface

For the cutting edge orientation of ScrewFit precision boring tools, see the "Holemaking" section of the Technical Compendium, page B140.

System overview of ScrewFit for milling



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

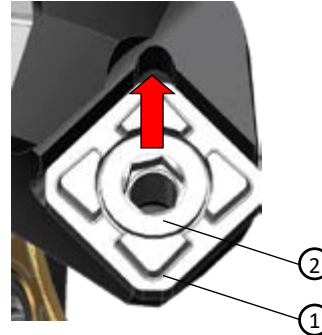
Assembly instructions for Xtra-tec® XT M5009, M5011 and M5012 face milling cutters with carbide shim

1. Fitting the shim

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

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

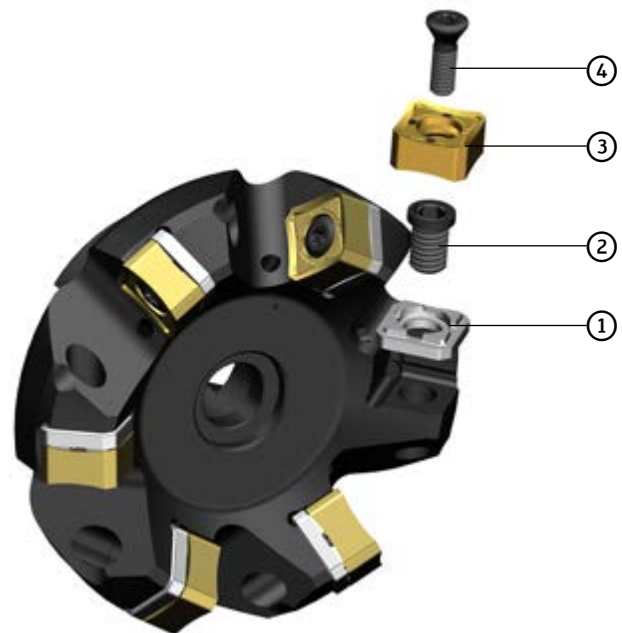
Ensure that the insert seat is clean and that the shim is correctly positioned on the contact surface.



2. Fitting the indexable insert

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

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



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

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

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



① Position the indexable insert



② Fit the indexable insert



③ Secure the indexable insert



④ Check that the indexable insert is securely fitted

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

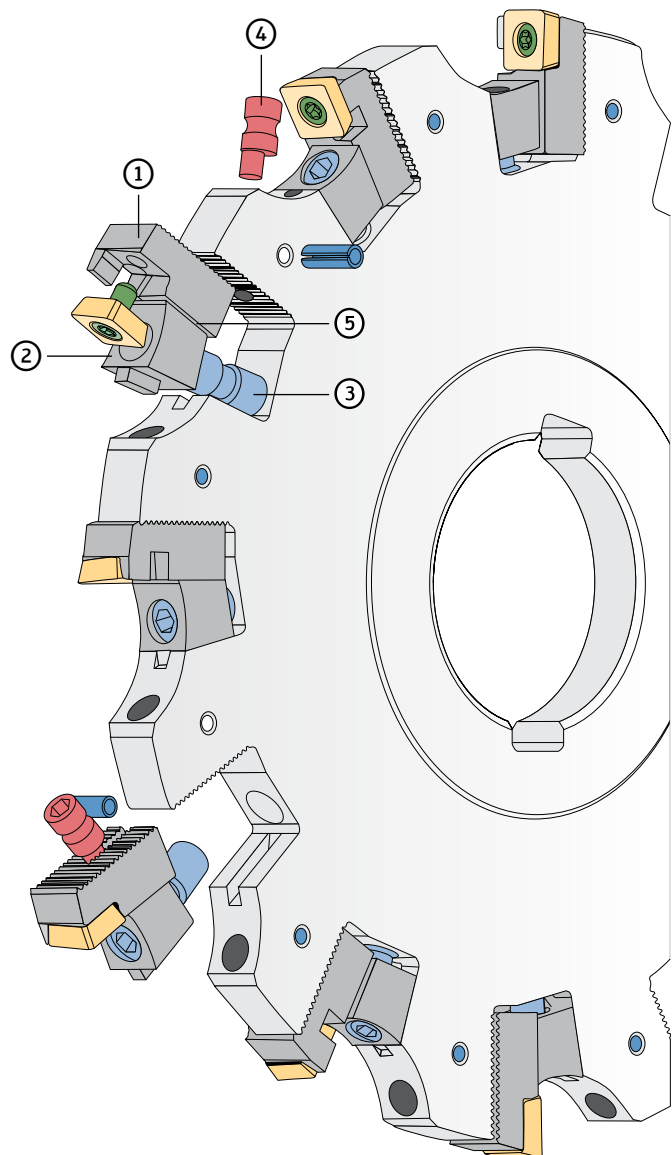
- ① Cartridge
- ② Clamping wedge
- ③ Compound screw
- ④ Eccentric bolt
- ⑤ Spring washer

Adjusting the cutting width

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

Note:

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



Setting instructions for the F2010 milling cutter

Design principle

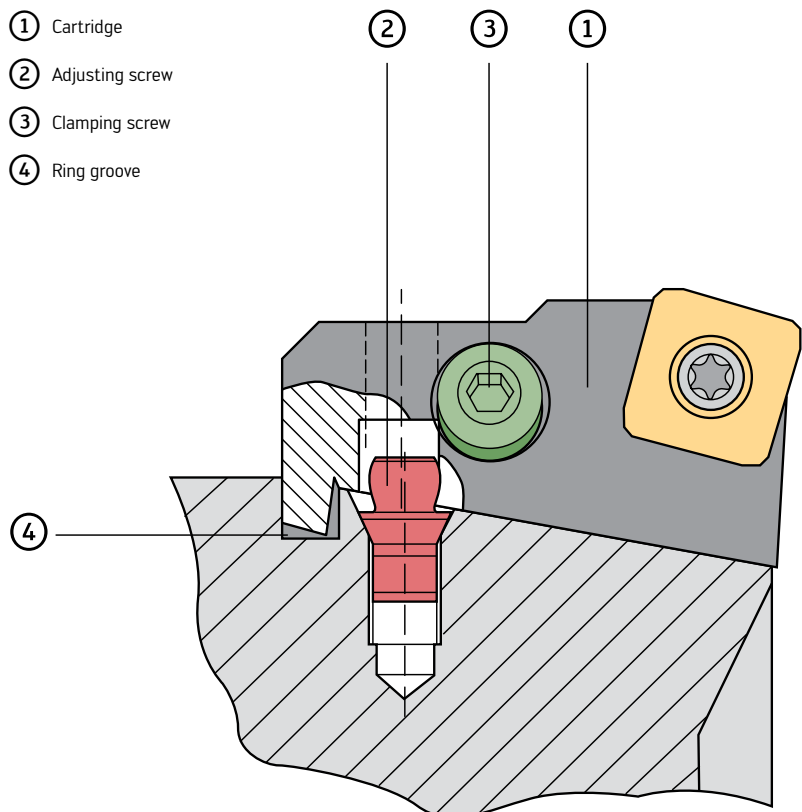
Every milling cutter cartridge seat has a conically countersunk threaded hole in which a screw is inserted.

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



Axial fine adjustment

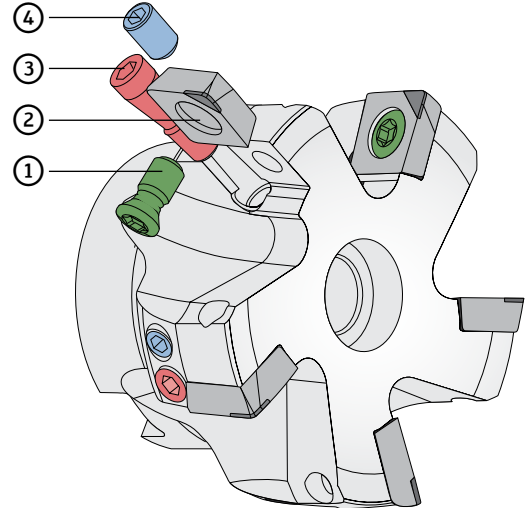
1. Before the cartridge ① is installed, the adjusting screw ② is screwed in so that the taper is approx. 0.3–0.5 mm above the bottom of the milling cutter cartridge seat.
2. Now the cartridge is installed and the clamping screw ③ is tightened. It is important to ensure that the cartridge is in contact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



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

F2250 with fixed insert seat

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



Adjusting the runout amount

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

Note:

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

Setting instructions for the F4253 slotting cutter

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

Instructions for adjusting the runout amount of the F4253

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

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



Assembly instructions for F4153 and F4253 slotting cutters

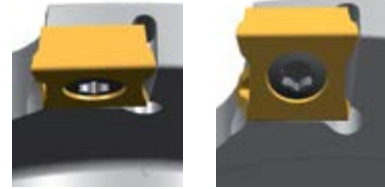
F4153 assembly instructions

Please note:

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

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

correct



incorrect



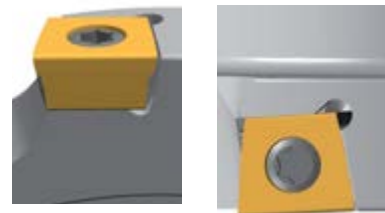
F4253 assembly instructions

Please note:

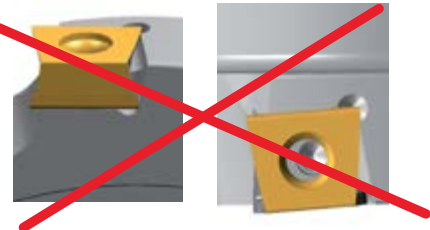
Indexable insert sizes LNHU0803.. and LNHU0804.. can be fitted incorrectly.

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

correct

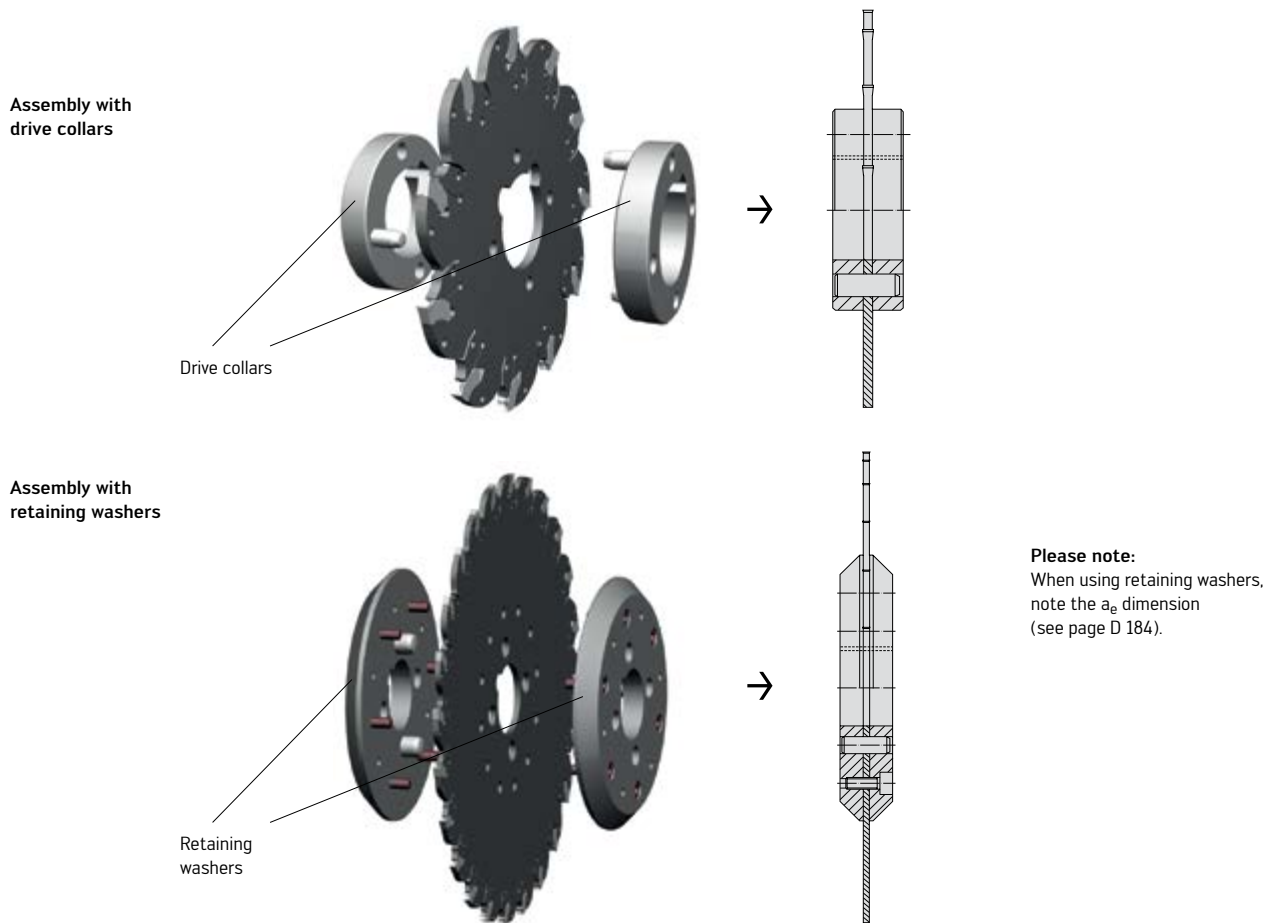


incorrect



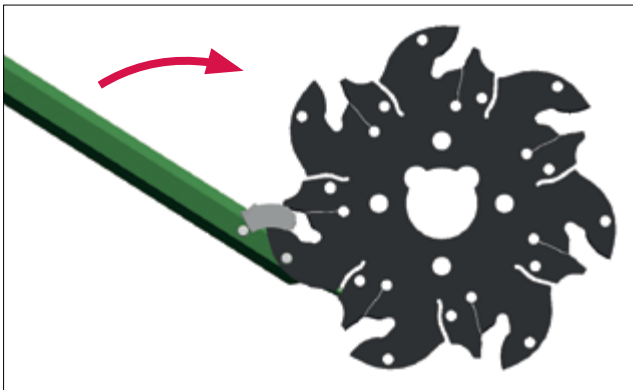
Assembly instructions for Walter BLAXX F5055 slitting cutters

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

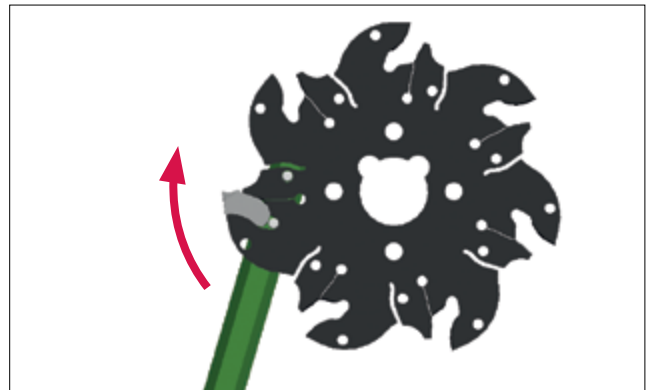


Using the mounting wrench

Installing the insert



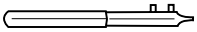
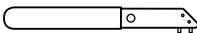
Removing the insert



Note:

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

Mounting wrench

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

Safety information for M2131/M2331 ramping milling cutters

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

Always tighten the indexable insert screws using a torque wrench.

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

Do not apply lubricant to indexable insert screws.

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

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

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

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



Check with 0.01 mm spacer



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

Assembly instructions for M2472 button insert milling cutter

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

Open the insert seat by loosening the compound screw.

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

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

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

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

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

Note the indexable insert's direction of cut!



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



② Fit the ceramic indexable insert



③ Secure the ceramic indexable insert



④ Check that the indexable insert is securely fitted

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

For wedge mounting, note:

First screw the compound screw into the clamping wedge **1 revolution**, then place the wedge with the compound screw on the body and screw it in. Follow all further steps according to the installation instructions above.



Incorrect installation



Incorrect installation



Correct installation



Assembly instructions for M2473 button insert milling cutter

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

Open the insert seat by loosening the compound screw.

Insert the ceramic indexable insert into the insert seat.

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

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

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



① Insert the ceramic indexable insert



② Fit the ceramic indexable insert



③ Secure the ceramic indexable insert



④ Check that the indexable insert is securely fitted

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

For wedge mounting, note:

First screw the compound screw into the clamping wedge **1 revolution**, then place the wedge with the compound screw on the body and screw it in. Follow all further steps according to the installation instructions above.



Incorrect installation

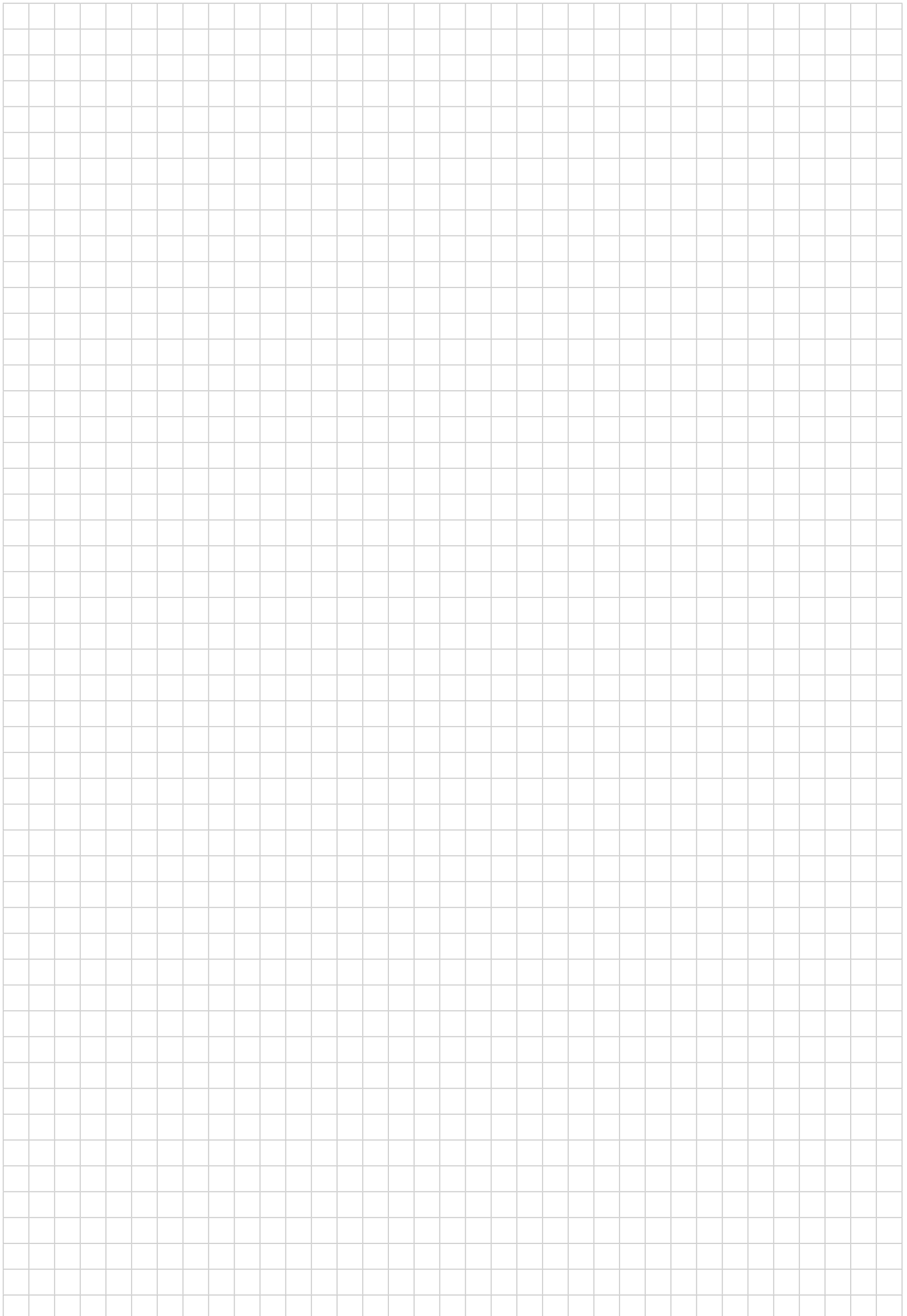


Incorrect installation



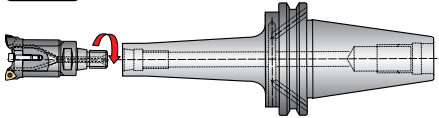
Correct installation





Tightening torques

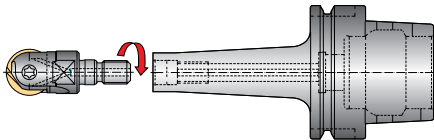
Tightening torques for front pieces with modular ScrewFit interface



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

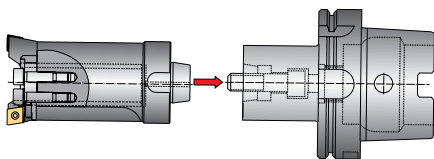
* Use FS1394 adaptor

Tightening torques for front pieces with cylindrical modular interface



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

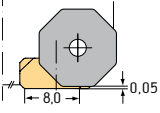
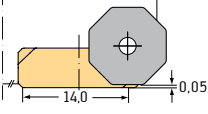
Tightening torques for tools with modular NCT interface



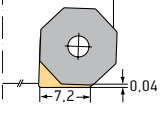
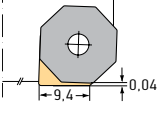
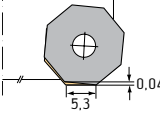
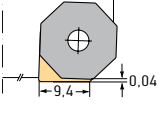
Interface	Thread	Tightening torque		Torque wrench	Socket wrench	Limit speed
NCT 25	M8	18 Nm	5	FS1385	FS402	20,000 rpm
NCT 32	M8	18 Nm	5	FS1385	FS402	30,000 rpm
NCT 40	M12	80 Nm	8	FS1386	FS403	30,000 rpm
NCT 50	M12	80 Nm	8	FS1386	FS403	30,000 rpm
NCT 63	M16	150 Nm	12	FS1386	FS404	30,000 rpm
NCT 80	M20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

Roughing/finishing combinations on Walter milling tools

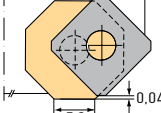
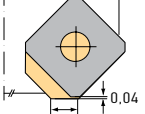
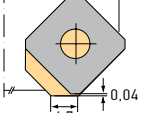
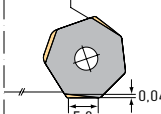
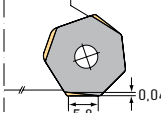
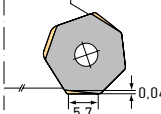
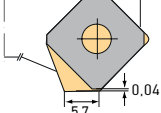
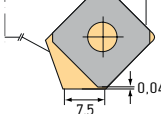
 $\kappa = 42^\circ$

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

 $\kappa = 43^\circ$

	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

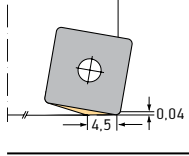
 $\kappa = 45^\circ$

	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 XNHX070508... 	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

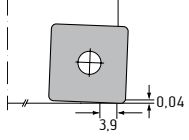
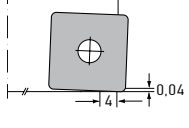
Roughing/finishing combinations on Walter milling tools

(continued)

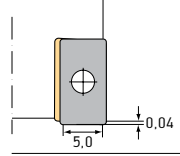
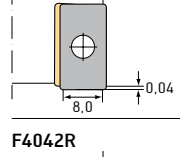
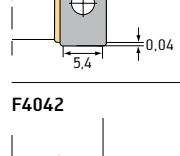
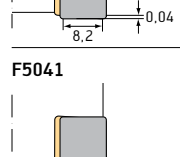
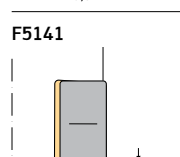
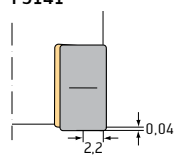
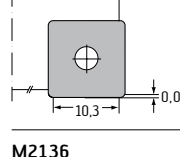
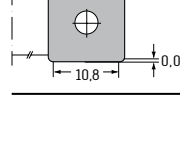
 $\kappa = 75^\circ$

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

 $\kappa = 88^\circ$

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

 $\kappa = 90^\circ$

	Roughing	Finishing
M5130	Indexable insert BCGT090304R-G55	Indexable insert BCGX0903PDR-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

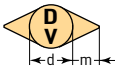
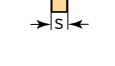
1	
Insert shape	
A 	M 
B 	O 
C 	P 
D 	R 
E 	S 
H 	T 
K 	L 
L 	L 

2	
Clearance angle	
A 	F 
B 	G 
C 	N 
D 	P 
E 	

3

Tolerances

Permissible deviation in mm for

	d	m	s
	A $\pm 0,025$	$\pm 0,005$	$\pm 0,025$
	C $\pm 0,025$	$\pm 0,013$	$\pm 0,025$
	E $\pm 0,025$	$\pm 0,025$	$\pm 0,025$
	F $\pm 0,013$	$\pm 0,005$	$\pm 0,025$
	G $\pm 0,025$	$\pm 0,025$	$\pm 0,130$
	H $\pm 0,013$	$\pm 0,013$	$\pm 0,025$
	J ¹ $\pm 0,05-0,15^2$	$\pm 0,005$	$\pm 0,025$
	K ¹ $\pm 0,05-0,15^2$	$\pm 0,013$	$\pm 0,025$
	L ¹ $\pm 0,05-0,15^2$	$\pm 0,025$	$\pm 0,025$
	M $\pm 0,05-0,15^2$	$\pm 0,08-0,20^2$	$\pm 0,130$
	N $\pm 0,05-0,15^2$	$\pm 0,08-0,20^2$	$\pm 0,025$
	U $\pm 0,08-0,25^2$	$\pm 0,13-0,38^2$	$\pm 0,130$

¹ Inserts with ground planar cutting edges

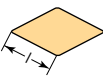
² Depending on the insert size (see ISO standard 1832)

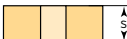
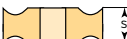
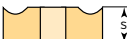
7	
Corner radius	
	
01 r = 0,1 02 r = 0,2 04 r = 0,4 08 r = 0,8 12 r = 1,2 16 r = 1,6 24 r = 2,4	Lead angle A 45° D 60° E 75° F 85° P 90° Z Other lead angles
	
00 for diameters converted from imperial units to mm M0 for diameters in metric units	Clearance angle of planar cutting edge A 3° B 5° C 7° D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

8	
Edge formation	
E 	
F 	
T 	
S 	

9	
Cutting direction	
R 	
L 	
N 	

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

	
l	
	
l	l
	
l	l
	
l	d

	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	11	12											
Chamfer width	Chamfer angle	Manufacturer specifications/geometry index											
		Example: <table><tr><td>G</td><td>5</td><td>5</td><td></td></tr><tr><td>1</td><td>2</td><td>3</td><td>4</td></tr></table>				G	5	5		1	2	3	4
G	5	5											
1	2	3	4										
010 = 0,10 mm 020 = 0,20 mm 025 = 0,25 mm 070 = 0,70 mm 150 = 1,50 mm 200 = 2,00 mm	15 = 15° 20 = 20°	1. Chip breaker groove smaller  A = 0° B = 6°  D = 10° E = 15°  F = 16° G = 20°  K = 25° L ≥ 28° M = 30° larger heavily ground down  2  5  6  7  8 sharp 3. Flank face design  1 including vibration-damped  5  6  7  8 Flank face design 4. Additional information T Tangential installation											

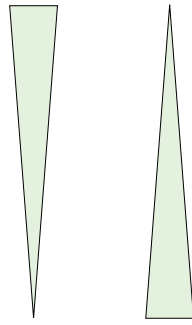
Designation key for coated carbides – Milling

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
Wear resistance 01 10 15 20 25 30 35 45  Toughness

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	2	3	4
Tool group	Generation	Tool type	Type
M Milling	2 3 Walter BLAXX 4 M4000 5 Xtra-tec® XT	0 Face milling cutter 1 Shoulder milling cutter 2 Shoulder/slot/helical milling cutter 3 Other milling cutters 4 Copy milling cutter 5 Profiling cutter 7 Routing cutter	02 High-feed milling cutter $\kappa = 15^\circ$, radial, positive, 4 cutting edges per indexable insert 03 Face milling cutter $\kappa = 45^\circ$, radial, positive, 4 cutting edges per indexable insert 04 Octagon face milling cutter $\kappa = 43^\circ$, radial, positive, 8 cutting edges per indexable insert 08 High-feed milling cutter $\kappa = 17^\circ$, radial, double-sided, 4 cutting edges per indexable insert 09 Face milling cutter $\kappa = 45^\circ$, radial, double-sided, 8 cutting edges per indexable insert 12 Face milling cutter $\kappa = 88^\circ$, radial, double-sided, 8 cutting edges per indexable insert 16 Heavy-duty cutter $\kappa = 60^\circ$, tangential, double-sided, 4 cutting edges per indexable insert 24 Heptagon face milling cutter $\kappa = 45^\circ$, radial, double- sided, 14 cutting edges per indexable insert, screw clamping 25 Octagon face milling cutter for finishing $\kappa = 42^\circ$, radial, double-sided, 16 cutting edges per indexable insert 26 Octagon face milling cutter for finishing $\kappa = 42^\circ$, radial, double-sided, 16 cutting edges per indexable insert 30 Shoulder milling cutter $\kappa = 90^\circ$, radial, positive, 2 cutting edges per indexable insert 31 Ramping milling cutter $\kappa = 90^\circ$, radial, positive, 2 cutting edges per indexable insert 32 Shoulder milling cutter $\kappa = 89^\circ 45'$, radial, positive, 4 cutting edges per indexable insert 37 Shoulder milling cutter $\kappa = 90^\circ$, radial, double- sided, 6 cutting edges per indexable insert 55 Helical milling cutter $\kappa = 90^\circ$, tangential, double-sided, 2 or 4 cutting edges per indexable insert 56 Helical milling cutter $\kappa = 90^\circ$, radial, positive, 2 or 4 cutting edges per indexable insert 57 Helical milling cutter $\kappa = 90^\circ$, radial, positive, 2 or 4 cutting edges per indexable insert 58 Helical milling cutter $\kappa = 90^\circ$, 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 $\kappa = 30^\circ, 45^\circ, 60^\circ$, radial, positive, 4 cutting edges per indexable insert 75 T-slot milling cutter $\kappa = 90^\circ$, radial, positive, 4 cutting edges per indexable insert 91 Routing cutter $\kappa = 90^\circ$, radial, positive, 4 cutting edges per indexable insert 92 Routing cutter $\kappa = 90^\circ$, radial, positive, 2 or 4 cutting edges per indexable insert
5	6	7	
1. Delimiters	Cutting diameter	Adaptor type	
– Metric . Inch		A Cylindrical shank B Bore adaption T ScrewFit TC Cylindrical modular interface W Weldon shank H HSK	
8	9	10	
Adaptor size	Number of teeth	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, $\kappa = 75^\circ$	SP...1204EDR..	FS243 (Torx 20)	5,0 Nm
	FR445M	Shoulder milling cutter, $\kappa = 89^\circ 45'$	SP...120408..	FS243 (Torx 20)	5,0 Nm
	FR447M	Shoulder milling cutter, $\kappa = 90^\circ$	P27...-4R	FS243 (Torx 20)	5,0 Nm
	FR451M	Face milling cutter, $\kappa = 75^\circ$	SF...1203EFR	FS260 (Torx 20)	5,0 Nm
	FR455M	Face milling cutter, $\kappa = 45^\circ$	P2894-1	FS243 (Torx 20)	5,0 Nm
	FR495M	Face milling cutter, $\kappa = 45^\circ$	SP...1204A..	FS243 (Torx 20)	5,0 Nm
	FR728M	Face milling cutter, $\kappa = 88^\circ$	SNGX1205ZNN.. XNGX1205ZNN..	FS1459 (Torx 15IP)	4,0 Nm
	FR732M	Face milling cutter, $\kappa = 45^\circ$	SN.X1606..	FS1495 (Torx 20IP)	5,0 Nm
	FR750M	Face milling cutter, $\kappa = 21^\circ$	P23696-2.0	FS1032 (Torx 20)	5,0 Nm
	FR755M	Face milling cutter, $\kappa = 15^\circ$	SD...1204..	FS1453 (Torx 15IP)	3,5 Nm

Tightening screws for face mill adaptors

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

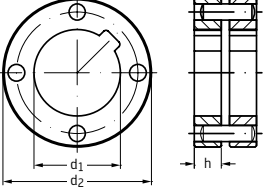
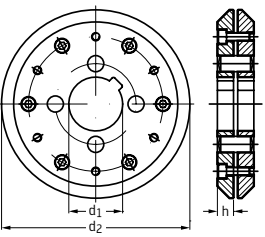
Designation	Tightening screw for adaptor *
F4138.B16.040.Z03.33	M8 × 40 (SW6)
F4138.B16.040.Z03.43	M8 × 50 (SW6)
F4138.B22.050.Z04.43	M10 × 45 (SW8)
F4138.B22.050.Z04.54	M10 × 55 (SW8)
F4138.B27.063.Z05.43	M12 × 45 (SW10)
F4138.B27.063.Z05.54	M12 × 55 (SW10)
F4138.B32.080.Z06.54	M16 × 65 (SW14)
F4138.B32.080.Z06.65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

Designation	Tightening screw for adaptor *
F5038.B16.040.Z03.32	M8 × 40 (SW6)
F5038.B16.040.Z03.40	M8 × 50 (SW6)
F5138.B22.040.Z02.34	M10 × 40 (SW8)
F5138.B22.040.Z02.45	M10 × 45 (SW8)
F5138.B22.050.Z03.34	M10 × 40 (SW8)
F5138.B22.050.Z03.45	M10 × 45 (SW8)
F5138.B27.063.Z04.45	M12 × 50 (SW10)
F5138.B27.063.Z04.56	M12 × 60 (SW10)
F5138.B32.080.Z05.56	M16 × 65 (SW14)
M2131-040-B16-03-15	M8 × 40 (SW6)
M2131-050-B22-04-15	M10 × 35 (SW8)
M2131-063-B22-05-15	M10 × 35 (SW8)
M2131-080-B27-05-15	M12 × 40 (SW10)
M2131-050-B22-03-20	M10 × 40 (SW8)
M2131-063-B22-04-20	M10 × 35 (SW8)
M2331-040-B16-03-15	M8 × 40 (SW6)
M2331-050-B22-02-15	M10 × 35 (SW8)
M2331-050-B22-03-15	M10 × 35 (SW8)
M2331-050-B27-04-15	M10 × 35 (SW8)
M2331-050-B22-02-20	M10 × 40 (SW8)
M2331-050-B22-03-20	M10 × 40 (SW8)
M3255-050-B22-04-46	M10 × 45 (SW8)
M3255-050-B22-05-46	M10 × 45 (SW8)
M3255-063-B27-05-46	M12 × 50 (SW10)
M3255-063-B27-06-46	M12 × 50 (SW10)
M3255-080-B32-05-58	M16 × 65 (SW14)
M3255-080-B32-06-58	M16 × 65 (SW14)
M4257-050-B22-02-47	M10 × 45 (SW8)
M4257-063-B27-03-54	M12 × 70 (SW10)
M4258-080-B32-03-67	M16 × 90 (SW14)
M4258-100-B40-04-77	M20 × 80 (SW17)
M5250-050-B22-03-43-16	M10X045 ISO4762 12.9
M5250-050-B22-03-62-16	M10X065 ISO4762 12.9
M5250-063-B27-04-43-16	M12X050 ISO4762 12.9
M5250-063-B27-04-62-16	M12X070 ISO4762 12.9
M5250-080-B32-05-62-16	M16X070 ISO4762 12.9
M5250-080-B32-05-80-16	M16X090 ISO4762 12.9

* 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

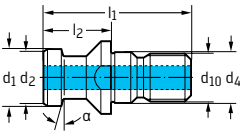
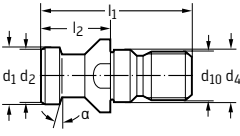
Pull studs without SK40 intermediate bushing

	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

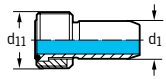
Accessories for boring bars/adaptors

	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

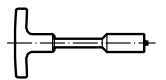
(continued)

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

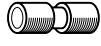
Socket wrench for installing transfer units



Designation	For HSK
FS952	HSK63-A
FS953	HSK100-A

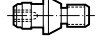
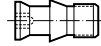
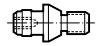
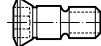
Assembly parts and accessories

Compound screws



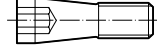
Designation	Size	Suitable for
FS231	M8 × 24 (SW 4)	FK240, FR/FL281, FR/FL282, FR/FL283, F249
FS234	M10 × 40 (SW 5)	FR/FL238, FR/FL239, FR/FL243, FR/FL244, FR/FL247, FR/FL248, FR/FL249, FR/FL250, FR/FL259, FR/FL260, FR/FL261, FR/FL262, FR/FL263, FR/FL264, FR/FL265, FR/FL266, FR/FL283, FR/FL285, FR/FL287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

Clamping elements for indexable inserts

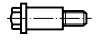
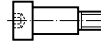
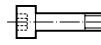
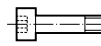
Designation	Size	Suitable for
FS248	M4 × 10,7 (Torx 8)	Milling system 2000
FS249	M5 × 11,3 (Torx 15)	
FS250	M6 × 11,6 (Torx 20)	
FS293	M5 × 11 (Torx 15)	Milling system 2000
FS305	M5 × 11,6 (Torx 20)	F2044
FS1015	M3 × 12 (Torx 20)	F2253

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	Clamping screw
FS935	M2,2 × 6,4 (Torx 7)	
FS966	M16 × 16	Cap screw

Miscellaneous

Designation	Size	Suitable for
FS663	100 g	COPASLIP



Sustainable action in all Business divisions

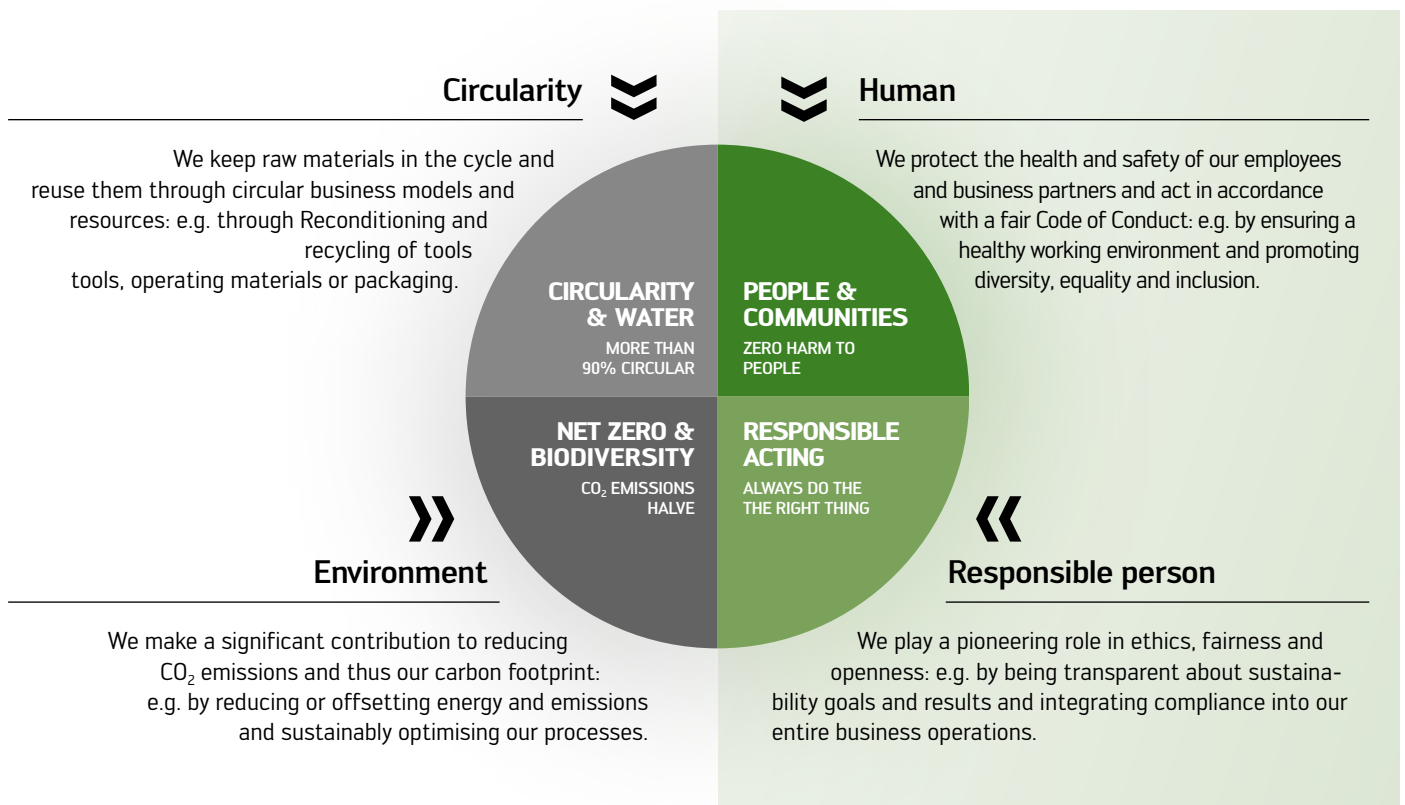
Create
the
Change

Sustainability is an essential Requirement for Walter to be successful as a company on the market in the long term. It is therefore a key component of our corporate strategy. Our responsible person for sustainability encompasses all areas: from product recycling, sustainable packaging, energy efficiency and the reduction of CO₂ emissions to our commitment to health and safety and responsible behaviour towards our business partners.



Visit our website:
www.walter-tools.com/en-gb/company/sustainable-company

THE WALTER SUSTAINABILITY GOALS BY 2030



PROVEN TO BE MANUFACTURED TO HIGH STANDARDS

All processes, procedures, methods and resources that we use are audited and evaluated by an independent body according to Hardness criteria: Occupational health and safety, Quality assurance and environmentally friendly behaviour are examples of this. Our social commitment shows that Walter takes his responsibility much further.

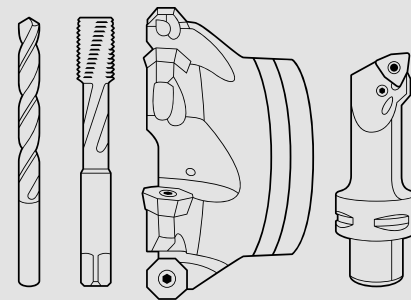


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