

crazy about

micro milling

CRAZYMILL COOL MICRO

A
STAR
IS
BORN





Your benefits

NEW

The most important features

- Material-specific cutting geometry S and SX
- High cutting-edge stability and robustness
- Innovative and efficient cooling concept
- Ultra-fine carbide grade and homogeneous coating

Your advantages

- High-performance milling of difficult-to-machine materials
- Milling with high profile precision
- No overheating of the cutting edges and a chip-free milling zone
- Workpiece almost burr-free

Your benefits

- Excellent surface quality
- Up to 3 x shorter milling process
- Up to 2 x longer tool life
- Highest process reliability under the most challenging conditions

NEW

CrazyMill Cool Micro

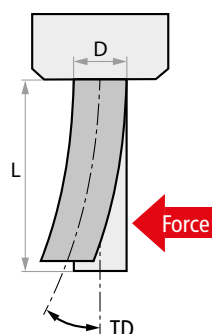
THE NEW HIGH-PERFORMANCE MICRO-ENDMILL FOR DIFFICULT-TO-MACHINE MATERIALS

CrazyMill Cool Micro is a new micro-milling tool specially developed for difficult and very difficult-to-machine materials. It is available in diameters ranging from .008" - .039" (0.2 mm - 1.0 mm) for a maximum milling depth of 5 x d.

By developing this new product, the engineers at Mikron Tool were the first to succeed in transferring complex high-performance cutting geometries to micro-endmill. The new CrazyMill Cool Micro set unprecedented benchmarks.

1. Challenge

Tool deflection



Tool deflection constitutes a significant problem for small diameter milling operations, which is further exacerbated when processing difficult-to-machine materials due to the higher cutting forces involved.

Solution

Custom geometry for optimum cutting performance and stability

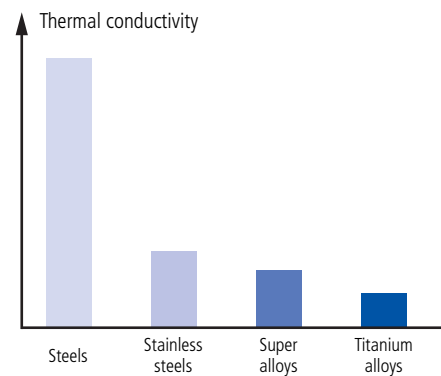
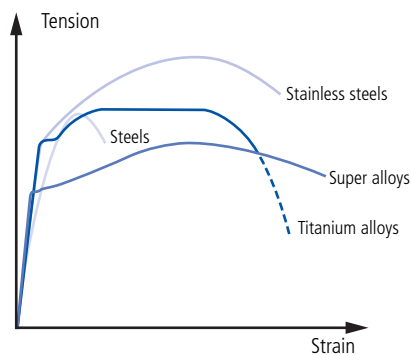
Cutting edge type	Deflection	Cutting-edge stability
Sharp	●	●
Rounded	●	●
CrazyMill Cool Micro	●	●

The newly developed geometry combines cutting performance with robustness, minimising tool deflection and thus increasing tool stability. That results in a significantly higher material removal rate whilst maintaining a consistent shape and ensuring a longer tool life.

NEW

2. Challenge

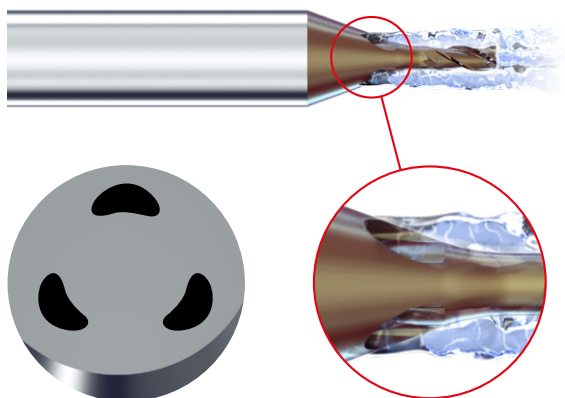
Difficult-to-machine materials



Titanium and heat-resistant alloys are notable for their high toughness and low thermal conductivity. Machining produces extreme temperatures on the cutting edges, resulting in high tool wear.

Solution

Innovative cooling concept



The innovative, patented cooling concept solves this problem. The cooling lubricant is applied directly and extensively to the cutting edges, thereby allowing the heat to dissipate. The result is higher cutting speeds and a significantly higher material removal rate.

The continuous coolant jet ensures that the chips are continuously flushed out of the milling zone. This prevents them from being milled several times, which would damage the milling tool and the milled surface. This ensures a long tool life and an excellent surface finish.

NEW

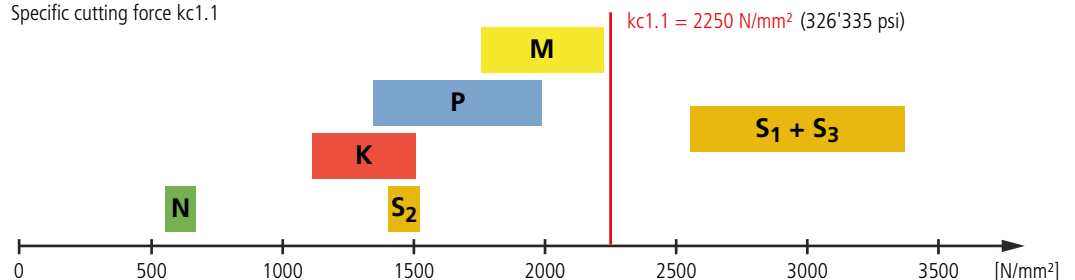
CrazyMill Cool Micro

THE NEW HIGH-PERFORMANCE MICRO-ENDMILL FOR DIFFICULT-TO-MACHINE MATERIALS

3. Challenge

Different material-specific properties

Specific cutting force $kc_{1.1}$

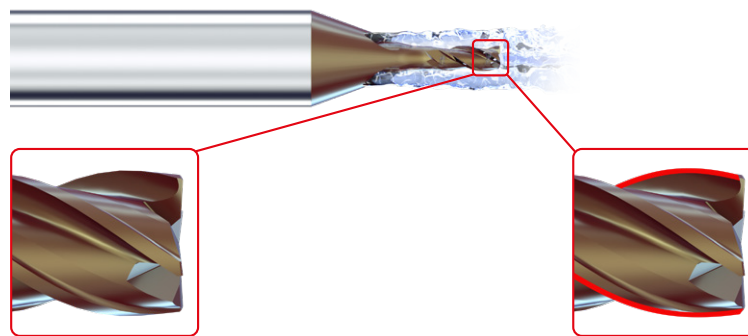


Close attention must be paid to the different mechanical properties of various material categories* in micro-machining. The cutting forces of superalloys and CoCr alloys are up to 45% higher than those of stainless steel and titanium ($kc_{1.1}$ values). As a result, the cutting edge is subjected to high mechanical stress, leading to chipping.

*See page 18: Material groups

Solution

Material-specific cutting-edge geometries



Geometry S M P K N S₂

Stainless steels, structural steels, cast iron, non-ferrous metals and titanium alloys

Geometry with higher cutting performance for materials with a specific cutting force lower than 326'335 psi (2250 N/mm²).

Geometry SX S₁ S₃

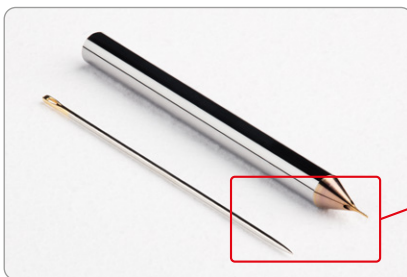
Heat-resistant alloys (e.g. Inconel, Monel, Nilo, Hastelloy) and CoCr alloys

Geometry with dedicated cutting edge protection for materials with a specific cutting force greater than 326'335 psi (2250 N/mm²).

NEW

4. Challenge

Miniaturisation of tools



Miniaturisation presents the challenge of realising complex geometries with diameters less than .039" (1 mm). The smaller the tool's cross-section, the more challenging it becomes to mill complex geometries while ensuring that quality requirements and tolerances are met.

Solution

Suitable production equipment



State-of-the-art grinders with hydrostatic bearings and grinding wheels that meet the latest technological standards are crucial for this purpose. High-precision digital measuring instruments that detect deviations up to a micrometre guarantee perfect results.

The team at Mikron Tool is well trained in using such tools and producing micro tools that meet the highest precision requirements.

NEW

CrazyMill Cool Micro

THE NEW HIGH-PERFORMANCE MICRO-ENDMILL FOR DIFFICULT-TO-MACHINE MATERIALS

5. Challenge

Carbide and coating



With regard to **carbide** – especially with micro tools, the biggest challenge is to strike a balance between high ultimate strength and wear resistance. Moreover, it must be suitable for delicate geometries and high-precision cutting edges.

Even the **coating** has to meet the highest requirements. It must withstand high temperatures to prevent the material from sticking. High surface finishing and perfect geometry profile must also be ensured while avoiding rounding of the cutting edges.

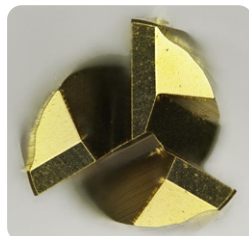
Solution

Ultra-fine carbide grade and state-of-the-art coating technology

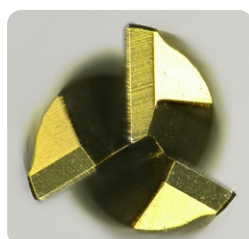
To meet the stringent requirements, Mikron Tool uses state-of-the-art ultra-fine carbide grades offering high wear resistance coupled with fracture toughness with grain sizes below $20\text{ }\mu\text{m}$ ($0.5\text{ }\mu\text{m}$).

The revolutionary eXedur SNP coating of the micro-milling tools provides excellent wear resistance even at extreme operating temperatures. High layer smoothness and precise layer thickness protect all contours and cutting edges evenly. The result: high process safety. This coating significantly increases tool life without compromising cutting performance.

Mikron Tool micro-milling tool

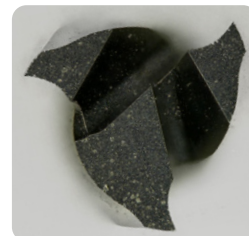


New



Edge wear
after 787" (20 m)
in CoCr alloy

Conventional micro-milling tool



New

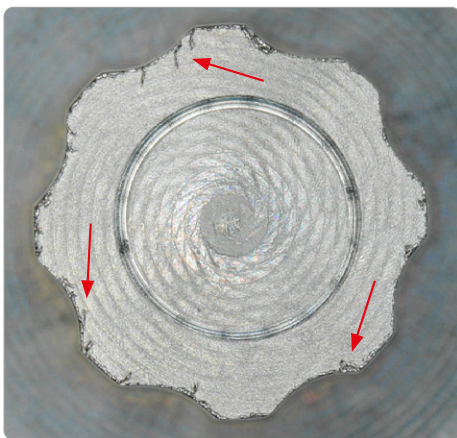


Edge wear
after 276" (7 m)
in CoCr alloy

NEW

6. Challenge

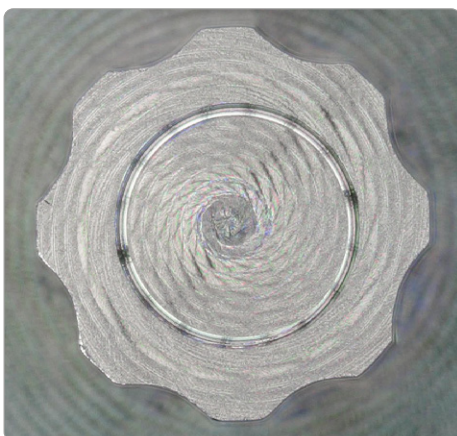
Burr formation



Another challenge is the massive burr formation, which is more pronounced when milling challenging materials.

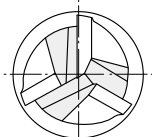
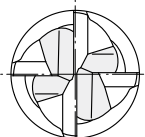
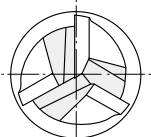
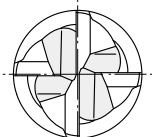
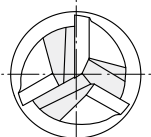
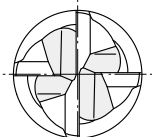
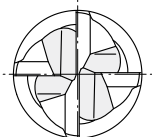
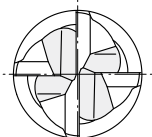
Solution

Nearly burr free



The material-specific geometries cut the material so perfectly that burr formation is nearly avoided.



Geometry S					Geometry SX														
Z3		Z4		Z3		Z4													
Effective length	3 x d	5 x d	3 x d	5 x d	3 x d	5 x d	3 x d	5 x d											
	Type B	Type C	Type B	Type C	Type B	Type C	Type B	Type C											
																			
																			
Cutting length 1.5x d	Diameter range Ø .008" - .039" (0.2 - 1.0 mm)		Diameter range Ø .016" - .039" (0.4 - 1.0 mm)		Diameter range Ø .008" - .039" (0.2 - 1.0 mm)		Diameter range Ø .016" - .039" (0.4 - 1.0 mm)		Diameter range Ø .008" - .039" (0.2 - 1.0 mm)		Diameter range Ø .016" - .039" (0.4 - 1.0 mm)		Diameter range Ø .008" - .039" (0.2 - 1.0 mm)		Diameter range Ø .016" - .039" (0.4 - 1.0 mm)				
page 16		page 17		page 16		page 17		page 16		page 17		page 16		page 17		page 16		page 17	

Geometry S: Stainless steels, steels, cast irons, non-ferrous metals, titanium alloys

Geometry SX: Heat-resistant alloys (Inconel, Monel, Nilo, Hastelloy, etc.), CoCr alloys

NEW

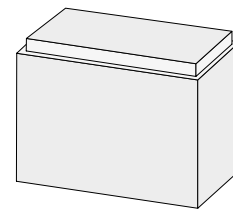
Guaranteed maximum performance

COMPARISON OF MICRO-MACHINING EXAMPLES

■ Example 1

Shorter milling time with a thermocouple

Processing: Side milling;
 Milling depth: **.059"** (1.5 mm);
 Milling width: **.020"** (0.5 mm);
 Total length: **3.94"** (100 mm);
 Coolant: Cutting oil



CoCr alloy: 2.4964 / CoCr20W15Ni / Haynes 25 **S₃**

Tool: CrazyMill Cool Micro – **Geometry SX**
 Diameter: **.020"** (0.5 mm)

Cutting data:

Conventional micro-endmill		CrazyMill Cool Micro	
$v_c = \mathbf{197\ SFM}$ 60 m/min	$f_z = \mathbf{.00024\ IPT}$ 0.006 mm	$v_c = \mathbf{197\ SFM}$ 60 m/min	$f_z = \mathbf{.00020\ IPT}$ 0.005 mm
$a_p = \mathbf{.0016"}$ 0.04 mm	$a_e = \mathbf{.0012"}$ 0.03 mm	$a_p = \mathbf{.0197"}$ 0.50 mm	$a_e = \mathbf{.0040"}$ 0.10 mm

Results:

	Material removal rate	Time
Conventional micro-endmill	.0007 in³ / min 11 mm ³ /min	4 min 30 sec
CrazyMill Cool Micro	.0017 in³ / min 28.6 mm ³ /min	1 min 35 sec

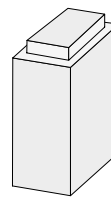
3 x

The unique SX cutting geometry of the CrazyMill Cool Micro is perfect for machining CoCr and heat-resistant alloys. It significantly reduces machining time compared to conventional milling tools.

■ Example 2

Longer tool life when milling a support

Processing: Side milling;
Milling depth: **.049"** (1.25 mm);
Milling width: **.039"** (1 mm);
Total length: **2.36"** (60 mm);
Coolant: Cutting oil



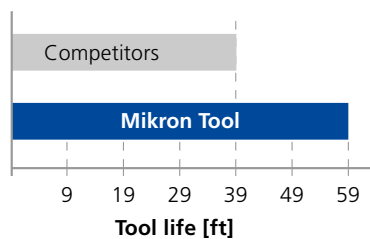
Titanium alloy: 3.7165 / TiAl6V4 / ASTM B348 **S₂**

Tool: CrazyMill Cool Micro – **Geometry S**
Diameter: **.020"** (0.5 mm)

Cutting data:

Conventional micro-endmill		CrazyMill Cool Micro	
$v_c = 131 \text{ SFM}$ 40 m/min	$f_z = .00031 \text{ IPT}$ 0.008 mm	$v_c = 197 \text{ SFM}$ 60 m/min	$f_z = .00039 \text{ IPT}$ 0.010 mm
$a_p = .0016"$ 0.04 mm	$a_e = .0031"$ 0.08 mm	$a_p = .0197"$ 0.50 mm	$a_e = .0040"$ 0.10 mm

Results:

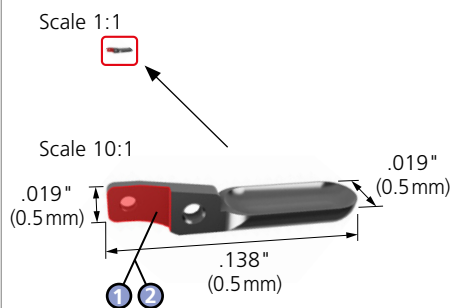


	No. pieces
Conventional micro-endmill	50
CrazyMill Cool Micro	100



NEW

Impressive not only in theory but also in practice

SEMI-FINISHING AND FINISHING WITH THROUGH-TOOL COOLING CHANNELS**COMPONENT**

Biopsy forcep

MATERIAL

X20Cr13 / 1.4021 / S42000

MACHINING

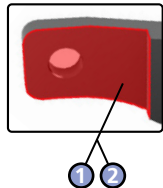
- ① Semi-finishing
- ② Finishing
- Diameter endmill = **.020"** | 0.5 mm
- Width = **.020"** | 0.5 mm
- Depth = **.030"** | 0.75 mm
- Length = **.039"** | 1 mm

MACHINE CONDITIONS

- n_{max} : 40'000 rpm
- Pressure: **580 psi** | 40 bar
- Internal cooling: Oil

MILLING TOOL
 Mikron Tool - CrazyMill Cool Micro Square
 Z4 - Type B

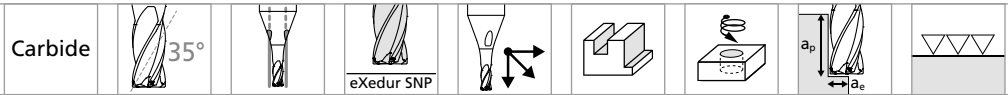
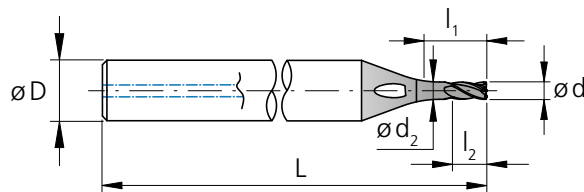
DATA	MIKRON TOOL
Tool type	CrazyMill Cool Micro Square - Z4 - Carbide - Coated - Integrated cooling
Item number	2.CMC35.B1Z4.050.1
Cutting data	① Semi-finishing $v_c = 197 \text{ SFM}$ 60 m/min $f_z = .00051 \text{ IPT}$ 0.013 mm $a_{p, max} = 1.5 \times d$ $a_e = .0020"$ 0.05 mm $Q = .0046 \text{ in}^3/\text{min}$ 75 mm³/min Time= 3 sec ② Finishing $v_c = 197 \text{ SFM}$ 60 m/min $f_z = .00039 \text{ IPT}$ 0.010 mm $a_{p, max} = 1.5 \times d$ $a_e = .0004"$ 0.01 mm $Q = .0009 \text{ in}^3/\text{min}$ 15 mm³/min Time= 1 sec



Applications



APPLICATION DOMAINS		COMPONENTS EXAMPLES	MATERIALS GROUPS	EXAMPLES		
				Mat. no.	DIN	AISI / ASTM / UNS
Dental	Abutment	Medical technology	Group P Unalloyed and alloyed steel	1.0401	C15	1015
Medical technology	Component for endoscope			1.3505	100Cr6	52100
Mechanical engineering	Machine components			1.2436	X210CrW12	D4 / D6
Watches	Watch case	Electronics / Electrics	Group M Stainless steel	1.4105	X6CrMoS17	430F
Electronics / Electrics	Contacts			1.4112	X90CrMoV18	440B
				1.4301	X5CrNi 18-10	304
			Group K Cast iron	0.7040	GGG40	60-40-18
			Group N Non ferrous metals	3.2315	AlMgSi1	6351
				3.2163	GD-AISI9Cu3	A380
				2.004	Cu-OF / CW008A	C10100
				2.0321	CuZn37 CW508L	C27400
				2.102	CuSn6	C51900
				2.096	CuAl9Mn2	C63200
			Group S1 Super alloys	2.4856		INCONEL 625
				2.4665	NiCr22Fe18Mo	HASTELLOY X
			Group S2 Titanium (pure and alloyed)	3.7035	Gr.2	B348 / F67
				3.7165	TiAl6V4	B348 / F136
			Group S3 CrCo alloys	2.4964	CoCr20W15Ni	HAYNES 25

NEW**Type B - 3 x d****Square**

Ø d ₁	.008" - .039" (0.2 - 1.0 mm)	
Tolerance	0 - .00039"	0 - 0.01 mm

L_1 = Effective length
 L_2 = Cutting length

Z3

d ₁	d ₁	d ₁	L ₁	L ₁	L ₂	d ₂	D (h6)	L	L	Item number	Geometry S	Geometry SX	Availability
[inch]	[inch]	[mm]	[inch]	[mm]	[mm]	[mm]	[mm]	[inch]	[mm]				
	.0079	0.2	.0236	0.60	0.3	0.19	3	1.50	38	2.CMC35.B1Z3.020	.1	.C	■
	.0118	0.3	.0354	0.90	0.5	0.28	3	1.50	38	2.CMC35.B1Z3.030	.1	.C	■
1/64	.0156	0.396	.0468	1.19	0.6	0.37	3	1.50	38	2.CMC.SB1Z3.F164		.C	■
	.0157	0.4	.0472	1.20	0.6	0.38	3	1.50	38	2.CMC35.B1Z3.040	.1	.C	■
	.0197	0.5	.0591	1.50	0.8	0.47	3	1.50	38	2.CMC35.B1Z3.050	.1	.C	■
	.0236	0.6	.0709	1.80	0.9	0.56	3	1.50	38	2.CMC35.B1Z3.060	.1	.C	■
	.0276	0.7	.0827	2.10	1.1	0.66	3	1.50	38	2.CMC35.B1Z3.070	.1	.C	■
1/32	.0312	0.793	.0937	2.38	1.2	0.75	3	1.50	38	2.CMC.SB1Z3.F132		.C	■
	.0315	0.8	.0945	2.40	1.2	0.75	3	1.50	38	2.CMC35.B1Z3.080	.1	.C	■
	.0354	0.9	.1063	2.70	1.4	0.85	3	1.50	38	2.CMC35.B1Z3.090	.1	.C	■
	.0394	1.0	.1969	3.00	1.5	0.94	4	1.57	40	2.CMC35.B1Z3.100	.1	.C	■

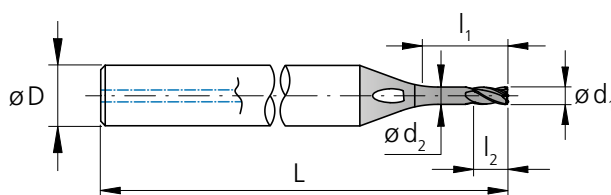
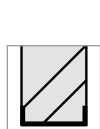
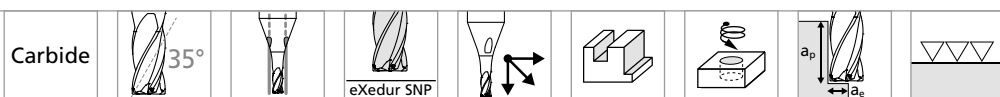
Z4

d ₁	d ₁	d ₁	L ₁	L ₁	L ₂	d ₂	D (h6)	L	L	Item number	Geometry S	Geometry SX	Availability
[inch]	[inch]	[mm]	[inch]	[mm]	[mm]	[mm]	[mm]	[inch]	[mm]				
1/64	.0156	0.396	.0468	1.19	0.6	0.37	3	1.50	38	2.CMC.SB1Z4.F164		.C	■
	.0157	0.4	.0472	1.20	0.6	0.38	3	1.50	38	2.CMC35.B1Z4.040	.1	.C	■
	.0197	0.5	.0591	1.50	0.8	0.47	3	1.50	38	2.CMC35.B1Z4.050	.1	.C	■
	.0236	0.6	.0709	1.80	0.9	0.56	3	1.50	38	2.CMC35.B1Z4.060	.1	.C	■
	.0276	0.7	.0827	2.10	1.1	0.66	3	1.50	38	2.CMC35.B1Z4.070	.1	.C	■
1/32	.0312	0.793	.0937	2.38	1.2	0.75	3	1.50	38	2.CMC.SB1Z4.F132		.C	■
	.0315	0.8	.0945	2.40	1.2	0.75	3	1.50	38	2.CMC35.B1Z4.080	.1	.C	■
	.0354	0.9	.1063	2.70	1.4	0.85	3	1.50	38	2.CMC35.B1Z4.090	.1	.C	■
	.0394	1.0	.1969	3.00	1.5	0.94	4	1.57	40	2.CMC35.B1Z4.100	.1	.C	■

■ Stock item

Geometry S: Stainless steels, steels, cast irons, non-ferrous metals, titanium alloys**Geometry SX:** Heat-resistant alloys (Inconel, Monel, Nilo, Hastelloy, etc.), CoCr alloys

Type C - 5 x d



l_1 = Effective length
 l_2 = Cutting length

$\varnothing d_1$	.008" - .039" (0.2 - 1.0 mm)
Tolerance	0 - .00039" - 0 - 0.01 mm

Z3

d_1 [inch]	d_1 [inch]	d_1 [mm]	l_1 [inch]	l_1 [mm]	l_2 [mm]	d_2 [mm]	D (h6) [mm]	L [inch]	L [mm]	Item number	Geometry S Availability	Geometry SX Availability
	.0079	0.2	.0394	1.00	0.3	0.19	3	1.50	38	2.CMC35.C1Z3.020	.1	.C ■
	.0118	0.3	.0591	1.50	0.5	0.28	3	1.50	38	2.CMC35.C1Z3.030	.1	.C ■
1/64	.0156	0.396	.0780	1.98	0.6	0.37	3	1.50	38	2.CMC.SC1Z3.F164	.C	■
	.0157	0.4	.0787	2.00	0.6	0.38	3	1.50	38	2.CMC35.C1Z3.040	.1	.C ■
	.0197	0.5	.0984	2.50	0.8	0.47	3	1.50	38	2.CMC35.C1Z3.050	.1	.C ■
	.0236	0.6	.1181	3.00	0.9	0.56	3	1.50	38	2.CMC35.C1Z3.060	.1	.C ■
	.0276	0.7	.1378	3.50	1.1	0.66	3	1.50	38	2.CMC35.C1Z3.070	.1	.C ■
1/32	.0312	0.793	.1563	3.97	1.2	0.75	3	1.50	38	2.CMC.SC1Z3.F132	.C	■
	.0315	0.8	.1575	4.00	1.2	0.75	3	1.50	38	2.CMC35.C1Z3.080	.1	.C ■
	.0354	0.9	.1772	4.50	1.4	0.85	3	1.50	38	2.CMC35.C1Z3.090	.1	.C ■
	.0394	1.0	.1969	5.00	1.5	0.94	4	1.57	40	2.CMC35.C1Z3.100	.1	.C ■

Z4

d_1 [inch]	d_1 [inch]	d_1 [mm]	l_1 [inch]	l_1 [mm]	l_2 [mm]	d_2 [mm]	D (h6) [mm]	L [inch]	L [mm]	Item number	Geometry S Availability	Geometry SX Availability
1/64	.0156	0.396	.0780	1.98	0.6	0.37	3	1.50	38	2.CMC.SC1Z4.F164	.C	■
	.0157	0.4	.0787	2.00	0.6	0.38	3	1.50	38	2.CMC35.C1Z4.040	.1	.C ■
	.0197	0.5	.0984	2.50	0.8	0.47	3	1.50	38	2.CMC35.C1Z4.050	.1	.C ■
	.0236	0.6	.1181	3.00	0.9	0.56	3	1.50	38	2.CMC35.C1Z4.060	.1	.C ■
	.0276	0.7	.1378	3.50	1.1	0.66	3	1.50	38	2.CMC35.C1Z4.070	.1	.C ■
1/32	.0312	0.793	.1563	3.97	1.2	0.75	3	1.50	38	2.CMC.SC1Z4.F132	.C	■
	.0315	0.8	.1575	4.00	1.2	0.75	3	1.50	38	2.CMC35.C1Z4.080	.1	.C ■
	.0354	0.9	.1772	4.50	1.4	0.85	3	1.50	38	2.CMC35.C1Z4.090	.1	.C ■
	.0394	1.0	.1969	5.00	1.5	0.94	4	1.57	40	2.CMC35.C1Z4.100	.1	.C ■

■ Stock item

Geometry S: Stainless steels, steels, cast irons, non-ferrous metals, titanium alloys

Geometry SX: Heat-resistant alloys (Inconel, Monel, Nilo, Hastelloy, etc.), CoCr alloys

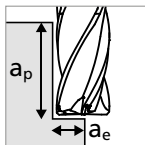
NEW

Type B - Z3 - Side milling - Roughing

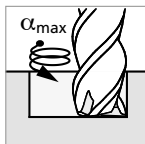
MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

Side milling

Roughing

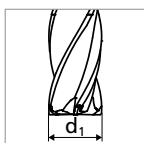
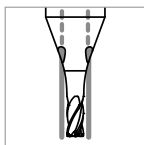


- $a_p = 1 \times d_1$
- $a_e = 0.2 \times d_1$



Note:

In case of helical interpolation milling
see α_{max} on page 35



Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel $R_m < 800 \text{ N/mm}^2$	1.0301	C10	AISI 1010	GEOMETRY S	
		1.0401	C15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel $R_m > 900 \text{ N/mm}^2$	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel $R_m < 1200 \text{ N/mm}^2$	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
		1.3343	HS6-5-2C	AISI M2 / UNS T11302		
		1.3355	HS18-0-1	AISI T1 / UNS T12001		
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
K	Cast iron	1.4441	X2CrNiMo18-15-3	AISI 316LM	GEOMETRY S	
		1.4539	X1NiCrMoCu25-20-5	AISI 904L		
		0.6020	GG20	ASTM 30		
		0.6030	GG30	ASTM 40B		
		0.7040	GGG40	ASTM 60-40-18		
N	Aluminium alloy wrought	0.7060	GGG60	ASTM 80-60-03	GEOMETRY S	
		3.2315	AlMgSi1	ASTM 6351		
	Aluminium alloy cast	3.4365	AlZnMgCu1.5	ASTM 7075		
		3.2163	GD-AlSi9Cu3	ASTM A380		
	Copper	3.2381	GD-AlSi10Mg	UNS A03590		
		2.0040	Cu-OF / CW008A	UNS C10100		
	Brass lead free	2.0065	Cu-ETP / CW004A	UNS C11000		
		2.0321	CuZn37 CW508L	UNS C27400		
	Brass, Bronze $R_m < 400 \text{ N/mm}^2$	2.0360	CuZn40 CW509L	UNS C28000		
		2.0401	CuZn39Pb3 / CW614N	UNS C38500		
	Bronze $R_m < 600 \text{ N/mm}^2$	2.1020	CuSn6	UNS C51900		
		2.0966	CuAl10Ni5Fe4	UNS C63000		
S₁	Super alloys	2.0960	CuAl9Mn2	UNS C63200	GEOMETRY SX	
		2.4856		Inconel 625		
		2.4668		Inconel 718		
		2.4617	NiMo28	Hastelloy B-2		
S₂	Titanium pure	2.4665	NiCr22Fe18Mo	Hastelloy X	GEOMETRY S	
		3.7035	Gr.2	ASTM B348 / F67		
	Titanium alloys	3.7065	Gr.4	ASTM B348 / F68	GEOMETRY S	
		3.7165	TiAl6V4	ASTM B348 / F136		
S₃	CoCr alloys	9.9367	TiAl6Nb7	ASTM F1295	GEOMETRY SX	
		2.4964	CoCr20W15Ni	Haynes 25		
H₁ H₂	Hardened steel $< 55 \text{ HRC}$	CrCoMo28	ASTM F1537			
	Hardened steel $\geq 55 \text{ HRC}$	1.2510	100MnCrMoW4	AISI O1		
		1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ☒ Not recommended

P	N	S ₃
M	S ₁	H ₁
K	S ₂	H ₂

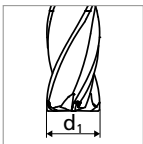
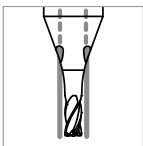
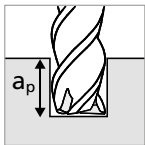
Ød ₁															
.008" 0.2 mm		.012" 0.3 mm		1/64" .016" 0.4 mm		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32" .031" 0.8 mm		.035" - .039" 0.9 - 1.0 mm	
V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00012 0.003	82 - 164 25 - 50	.00016 0.004	98 - 213 30 - 65	.00020 0.005	131 - 246 40 - 75	.00028 0.007	148 - 295 45 - 90	.00031 0.008	164 - 328 50 - 100	.00035 0.009	180 - 377 55 - 115	.00039 0.010
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00012 0.003	82 - 164 25 - 50	.00016 0.004	98 - 213 30 - 65	.00020 0.005	131 - 246 40 - 75	.00028 0.007	148 - 295 45 - 90	.00031 0.008	164 - 328 50 - 100	.00035 0.009	180 - 377 55 - 115	.00039 0.010

NEW

Type B - Z3 - Slot milling

MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

Slot milling



Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel Rm < 800 N/mm²	1.0301	C 10	AISI 1010	GEOMETRY S	
		1.0401	C 15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel Rm > 900 N/mm²	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel Rm < 1200 N/mm²	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
1.3343		HS6-5-2C	AISI M2 / UNS T11302			
1.3355		HS18-0-1	AISI T1 / UNS T12001			
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
		1.4441	X2CrNiMo18-15-3	AISI 316LM		
1.4539		X1NiCrMoCu25-20-5	AISI 904L			
K	Cast iron	0.6020	GG20	ASTM 30	GEOMETRY S	
		0.6030	GG30	ASTM 40B		
		0.7040	GGG40	ASTM 60-40-18		
		0.7060	GGG60	ASTM 80-60-03		
N	Aluminium alloy wrought	3.2315	AlMgSi1	ASTM 6351	GEOMETRY S	
		3.4365	AlZnMgCu1.5	ASTM 7075		
	Aluminium alloy cast	3.2163	GD-AlSi9Cu3	ASTM A380		
		3.2381	GD-AlSi10Mg	UNS A03590		
	Copper	2.0040	Cu-OF / CW008A	UNS C10100		
		2.0065	Cu-ETP / CW004A	UNS C11000		
	Brass lead free	2.0321	CuZn37 CW508L	UNS C27400		
		2.0360	CuZn40 CW509L	UNS C28000		
	Brass, Bronze Rm < 400 N/mm²	2.0401	CuZn39Pb3 / CW614N	UNS C38500		
		2.1020	CuSn6	UNS C51900		
Bronze Rm < 600 N/mm²	2.0966	CuAl10Ni5Fe4	UNS C63000			
	2.0960	CuAl9Mn2	UNS C63200			
S ₁	Super alloys	2.4856		Inconel 625	GEOMETRY SX	
		2.4668		Inconel 718		
		2.4617	NiMo28	Hastelloy B-2		
		2.4665	NiCr22Fe18Mo	Hastelloy X		
S ₂	Titanium pure	3.7035	Gr.2	ASTM B348 / F67	GEOMETRY S	
		3.7065	Gr.4	ASTM B348 / F68		
	Titanium alloys	3.7165	TiAl6V4	ASTM B348 / F136	GEOMETRY S	
		9.9367	TiAl6Nb7	ASTM F1295		
S ₃	CoCr alloys	2.4964	CoCr20W15Ni	Haynes 25	GEOMETRY SX	
			CrCoMo28	ASTM F1537		
H ₁	Hardened steel < 55 HRC	1.2510	100MnCrMoW4	AISI O1		
H ₂	Hardened steel ≥ 55 HRC	1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ☒ Not recommended

P	N	S ₃
M	S ₁	H ₁
K	S ₂	H ₂

a _p		Ød ₁															
		.008" 0.2 mm		.012" 0.3 mm		1/64" .016" 0.4 mm		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32" .031" 0.8 mm		.035"-.039" 0.9-1.0mm	
		V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z
0.5 x d ₁		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.5 x d ₁		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.5 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.5 x d ₁		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
0.25 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00012 0.003	82 - 164 25 - 50	.00016 0.004	98 - 213 30 - 65	.00020 0.005	131 - 246 40 - 75	.00028 0.007	148 - 295 45 - 90	.00031 0.008	164 - 328 50 - 100	.00035 0.009	180 - 377 55 - 115	.00039 0.010
0.5 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.5 x d ₁		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
0.5 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00012 0.003	82 - 164 25 - 50	.00016 0.004	98 - 213 30 - 65	.00020 0.005	131 - 246 40 - 75	.00028 0.007	148 - 295 45 - 90	.00031 0.008	164 - 328 50 - 100	.00035 0.009	180 - 377 55 - 115	.00039 0.010

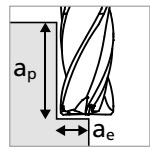
NEW

Type B - Z4 - Side milling - Semi-finishing

MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

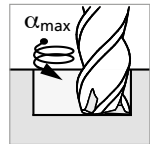
Side milling

Semi-finishing



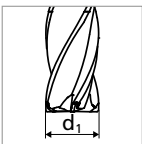
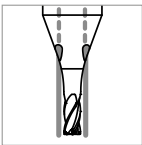
$$a_p = 1.5 \times d_1$$

$$a_e = 0.1 \times d_1$$



Note:

In case of helical interpolation milling see α_{max} on page 35



Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel $R_m < 800 \text{ N/mm}^2$	1.0301	C10	AISI 1010	GEOMETRY S	
		1.0401	C15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel $R_m > 900 \text{ N/mm}^2$	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel $R_m < 1200 \text{ N/mm}^2$	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
		1.3343	HS6-5-2C	AISI M2 / UNS T11302		
		1.3355	HS18-0-1	AISI T1 / UNS T12001		
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
K	Cast iron	1.4441	X2CrNiMo18-15-3	AISI 316LM	GEOMETRY S	
		1.4539	X1NiCrMoCu25-20-5	AISI 904L		
		0.6020	GG20	ASTM 30		
		0.6030	GG30	ASTM 40B		
N	Aluminium alloy wrought	0.7040	GGG40	ASTM 60-40-18	GEOMETRY S	
		0.7060	GGG60	ASTM 80-60-03		
	Aluminium alloy cast	3.2315	AlMgSi1	ASTM 6351		
		3.4365	AlZnMgCu1.5	ASTM 7075		
	Copper	3.2163	GD-AlSi9Cu3	ASTM A380	GEOMETRY S	
		3.2381	GD-AlSi10Mg	UNS A03590		
	Brass lead free	2.0040	Cu-OF / CW008A	UNS C10100		
		2.0065	Cu-ETP / CW004A	UNS C11000		
	Brass, Bronze $R_m < 400 \text{ N/mm}^2$	2.0321	CuZn37 CW508L	UNS C27400		
		2.0360	CuZn40 CW509L	UNS C28000		
	Bronze $R_m < 600 \text{ N/mm}^2$	2.0401	CuZn39Pb3 / CW614N	UNS C38500		
		2.1020	CuSn6	UNS C51900		
S₁	Super alloys	2.0966	CuAl10Ni5Fe4	UNS C63000	GEOMETRY SX	
		2.0960	CuAl9Mn2	UNS C63200		
		2.4856		Inconel 625		
		2.4668		Inconel 718		
S₂	Titanium pure	2.4617	NiMo28	Hastelloy B-2	GEOMETRY S	
		2.4665	NiCr22Fe18Mo	Hastelloy X		
	Titanium alloys	3.7035	Gr.2	ASTM B348 / F67	GEOMETRY S	
		3.7065	Gr.4	ASTM B348 / F68		
S₃	CoCr alloys	3.7165	TiAl6V4	ASTM B348 / F136	GEOMETRY SX	
		9.9367	TiAl6Nb7	ASTM F1295		
H₁ H₂	Hardened steel $< 55 \text{ HRC}$	2.4964	CoCr20W15Ni	Haynes 25	GEOMETRY S	
	Hardened steel $\geq 55 \text{ HRC}$		CrCoMo28	ASTM F1537		
		1.2510	100MnCrMoW4	AISI O1		
		1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ☒ Not recommended

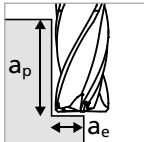
P	N	S ₃	
M	S ₁	H ₁	
K	S ₂	H ₂	

Ød ₁													
1/64"		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32"		.035" - .039" 0.9 - 1.0mm			
	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	
	148 - 246 45 - 75	.00043 0.011	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00071 0.018	295 - 492 90 - 150	.00079 0.020	328 - 558 100 - 170	.00087 0.022	
	148 - 246 45 - 75	.00043 0.011	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00071 0.018	295 - 492 90 - 150	.00079 0.020	328 - 558 100 - 170	.00087 0.022	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00071 0.018	295 - 492 90 - 150	.00079 0.020	328 - 558 100 - 170	.00087 0.022	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00071 0.018	295 - 492 90 - 150	.00079 0.020	328 - 558 100 - 170	.00087 0.022	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00071 0.018	295 - 492 90 - 150	.00079 0.020	328 - 558 100 - 170	.00087 0.022	
	148 - 246 45 - 75	.00028 0.007	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00043 0.011	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00071 0.018	295 - 492 90 - 150	.00079 0.020	328 - 558 100 - 170	.00087 0.022	
	148 - 246 45 - 75	.00047 0.012	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00063 0.016	295 - 492 90 - 150	.00067 0.017	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00047 0.012	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00063 0.016	295 - 492 90 - 150	.00067 0.017	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00047 0.012	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00063 0.016	295 - 492 90 - 150	.00067 0.017	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00047 0.012	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00063 0.016	295 - 492 90 - 150	.00067 0.017	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00047 0.012	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00063 0.016	295 - 492 90 - 150	.00067 0.017	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00047 0.012	180 - 312 55 - 95	.00051 0.013	213 - 377 65 - 115	.00059 0.015	246 - 426 75 - 130	.00063 0.016	295 - 492 90 - 150	.00067 0.017	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00020 0.005	180 - 312 55 - 95	.00028 0.007	213 - 377 65 - 115	.00031 0.008	246 - 426 75 - 130	.00035 0.009	295 - 492 90 - 150	.00039 0.010	328 - 558 100 - 170	.00043 0.011	
	148 - 246 45 - 75	.00028 0.007	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00028 0.007	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00020 0.005	180 - 312 55 - 95	.00028 0.007	213 - 377 65 - 115	.00031 0.008	246 - 426 75 - 130	.00035 0.009	295 - 492 90 - 150	.00039 0.010	328 - 558 100 - 170	.00043 0.011	

NEW

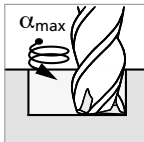
Type B - Z4 - Side milling - Finishing

MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

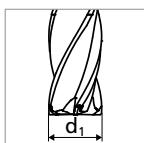
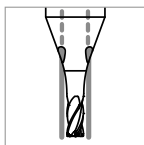
Side milling**Finishing**

$$a_p = 1.5 \times d_1$$

$$a_e = 0.02 \times d_1$$

**Note:**

In case of helical interpolation milling
see α_{max} on page 35

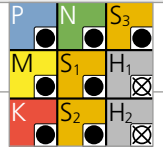


Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel $R_m < 800 \text{ N/mm}^2$	1.0301	C10	AISI 1010	GEOMETRY S	
		1.0401	C15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel $R_m > 900 \text{ N/mm}^2$	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel $R_m < 1200 \text{ N/mm}^2$	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
		1.3343	HS6-5-2C	AISI M2 / UNS T11302		
		1.3355	HS18-0-1	AISI T1 / UNS T12001		
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
K	Cast iron	1.4441	X2CrNiMo18-15-3	AISI 316LM	GEOMETRY S	
		1.4539	X1NiCrMoCu25-20-5	AISI 904L		
		0.6020	GG20	ASTM 30		
		0.6030	GG30	ASTM 40B		
		0.7040	GGG40	ASTM 60-40-18		
N	Aluminium alloy wrought	0.7060	GGG60	ASTM 80-60-03	GEOMETRY S	
		3.2315	AlMgSi1	ASTM 6351		
	Aluminium alloy cast	3.4365	AlZnMgCu1.5	ASTM 7075		
		3.2163	GD-AlSi9Cu3	ASTM A380		
	Copper	3.2381	GD-AlSi10Mg	UNS A03590		
		2.0040	Cu-OF / CW008A	UNS C10100		
	Brass lead free	2.0065	Cu-ETP / CW004A	UNS C11000		
		2.0321	CuZn37 CW508L	UNS C27400		
	Brass, Bronze $R_m < 400 \text{ N/mm}^2$	2.0360	CuZn40 CW509L	UNS C28000		
		2.0401	CuZn39Pb3 / CW614N	UNS C38500		
	Bronze $R_m < 600 \text{ N/mm}^2$	2.1020	CuSn6	UNS C51900		
		2.0966	CuAl10Ni5Fe4	UNS C63000		
S₁	Super alloys	2.0960	CuAl9Mn2	UNS C63200	GEOMETRY SX	
		2.4856		Inconel 625		
		2.4668		Inconel 718		
		2.4617	NiMo28	Hastelloy B-2		
		2.4665	NiCr22Fe18Mo	Hastelloy X		
S₂	Titanium pure	3.7035	Gr.2	ASTM B348 / F67	GEOMETRY S	
		3.7065	Gr.4	ASTM B348 / F68		
	Titanium alloys	3.7165	TiAl6V4	ASTM B348 / F136	GEOMETRY S	
		9.9367	TiAl6Nb7	ASTM F1295		
S₃	CoCr alloys	2.4964	CoCr20W15Ni	Haynes 25	GEOMETRY SX	
			CrCoMo28	ASTM F1537		
H₁	Hardened steel $< 55 \text{ HRC}$	1.2510	100MnCrMoW4	AISI O1		
H₂	Hardened steel $\geq 55 \text{ HRC}$	1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ⊗ Not recommended

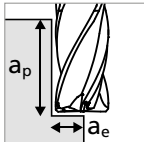


Ød ₁													
1/64"		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32"		.035" - .039" 0.9 - 1.0mm			
	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	
	148 - 246 45 - 75	.00035 0.009	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00035 0.009	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00024 0.006	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00051 0.013	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00024 0.006	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00051 0.013	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00035 0.009	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00055 0.014	295 - 492 90 - 150	.00063 0.016	328 - 558 100 - 170	.00071 0.018	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00051 0.013	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00051 0.013	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00051 0.013	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00051 0.013	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00051 0.013	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00039 0.010	180 - 312 55 - 95	.00039 0.010	213 - 377 65 - 115	.00047 0.012	246 - 426 75 - 130	.00051 0.013	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00016 0.004	180 - 312 55 - 95	.00024 0.006	213 - 377 65 - 115	.00024 0.006	246 - 426 75 - 130	.00028 0.007	295 - 492 90 - 150	.00031 0.008	328 - 558 100 - 170	.00035 0.009	
	148 - 246 45 - 75	.00024 0.006	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00051 0.013	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00024 0.006	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00051 0.013	328 - 558 100 - 170	.00055 0.014	
	148 - 246 45 - 75	.00016 0.004	180 - 312 55 - 95	.00024 0.006	213 - 377 65 - 115	.00024 0.006	246 - 426 75 - 130	.00028 0.007	295 - 492 90 - 150	.00031 0.008	328 - 558 100 - 170	.00035 0.009	

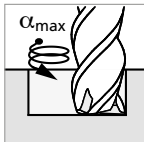
NEW

Type C - Z3 - Side milling - Roughing

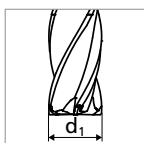
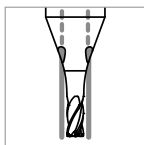
MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

Side milling**Roughing**

- $a_p = 1 \times d_1$
- $a_e = 0.1 \times d_1$

**Note:**

In case of helical interpolation milling
see α_{max} on page 35



Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel $R_m < 800 \text{ N/mm}^2$	1.0301	C10	AISI 1010	GEOMETRY S	
		1.0401	C15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel $R_m > 900 \text{ N/mm}^2$	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel $R_m < 1200 \text{ N/mm}^2$	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
		1.3343	HS6-5-2C	AISI M2 / UNS T11302		
		1.3355	HS18-0-1	AISI T1 / UNS T12001		
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
K	Cast iron	1.4441	X2CrNiMo18-15-3	AISI 316LM	GEOMETRY S	
		1.4539	X1NiCrMoCu25-20-5	AISI 904L		
		0.6020	GG20	ASTM 30		
		0.6030	GG30	ASTM 40B		
		0.7040	GGG40	ASTM 60-40-18		
N	Aluminium alloy wrought	0.7060	GGG60	ASTM 80-60-03	GEOMETRY S	
		3.2315	AlMgSi1	ASTM 6351		
	Aluminium alloy cast	3.4365	AlZnMgCu1.5	ASTM 7075		
		3.2163	GD-AlSi9Cu3	ASTM A380		
	Copper	3.2381	GD-AlSi10Mg	UNS A03590		
		2.0040	Cu-OF / CW008A	UNS C10100		
	Brass lead free	2.0065	Cu-ETP / CW004A	UNS C11000		
		2.0321	CuZn37 CW508L	UNS C27400		
	Brass, Bronze $R_m < 400 \text{ N/mm}^2$	2.0360	CuZn40 CW509L	UNS C28000		
		2.0401	CuZn39Pb3 / CW614N	UNS C38500		
	Bronze $R_m < 600 \text{ N/mm}^2$	2.1020	CuSn6	UNS C51900		
		2.0966	CuAl10Ni5Fe4	UNS C63000		
S₁	Super alloys	2.0960	CuAl9Mn2	UNS C63200	GEOMETRY SX	
		2.4856		Inconel 625		
		2.4668		Inconel 718		
		2.4617	NiMo28	Hastelloy B-2		
S₂	Titanium pure	2.4665	NiCr22Fe18Mo	Hastelloy X	GEOMETRY S	
		3.7035	Gr.2	ASTM B348 / F67		
	Titanium alloys	3.7065	Gr.4	ASTM B348 / F68	GEOMETRY S	
		3.7165	TiAl6V4	ASTM B348 / F136		
S₃	CoCr alloys	9.9367	TiAl6Nb7	ASTM F1295	GEOMETRY SX	
		2.4964	CoCr20W15Ni	Haynes 25		
H₁ H₂	Hardened steel $< 55 \text{ HRC}$	CrCoMo28	ASTM F1537			
	Hardened steel $\geq 55 \text{ HRC}$	1.2510	100MnCrMoW4	AISI O1		
		1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ☒ Not recommended

P	N	S ₃
M	S ₁	H ₁
K	S ₂	H ₂

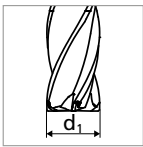
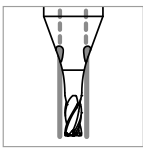
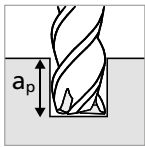
Ød ₁																
.008" 0.2 mm		.012" 0.3 mm		1/64" .016" 0.4 mm		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32" .031" 0.8 mm		.035" - .039" 0.9 - 1.0 mm		
V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00024 0.006	82 - 164 25 - 50	.00039 0.010	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00055 0.014	148 - 295 45 - 90	.00067 0.017	164 - 328 50 - 100	.00075 0.019	180 - 377 55 - 115	.00083 0.021	
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00024 0.006	82 - 164 25 - 50	.00039 0.010	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00055 0.014	148 - 295 45 - 90	.00067 0.017	164 - 328 50 - 100	.00075 0.019	180 - 377 55 - 115	.00083 0.021	
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00035 0.009	131 - 246 40 - 75	.00043 0.011	148 - 295 45 - 90	.00051 0.013	164 - 328 50 - 100	.00059 0.015	180 - 377 55 - 115	.00067 0.017	
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00024 0.006	82 - 164 25 - 50	.00039 0.010	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00055 0.014	148 - 295 45 - 90	.00067 0.017	164 - 328 50 - 100	.00075 0.019	180 - 377 55 - 115	.00083 0.021	
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00024 0.006	82 - 164 25 - 50	.00039 0.010	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00055 0.014	148 - 295 45 - 90	.00067 0.017	164 - 328 50 - 100	.00075 0.019	180 - 377 55 - 115	.00083 0.021	
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00035 0.009	131 - 246 40 - 75	.00043 0.011	148 - 295 45 - 90	.00051 0.013	164 - 328 50 - 100	.00059 0.015	180 - 377 55 - 115	.00067 0.017	
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00035 0.009	131 - 246 40 - 75	.00043 0.011	148 - 295 45 - 90	.00051 0.013	164 - 328 50 - 100	.00059 0.015	180 - 377 55 - 115	.00067 0.017	
49 - 82 15 - 25	.00024 0.006	66 - 131 20 - 40	.00031 0.008	82 - 164 25 - 50	.00043 0.011	98 - 213 30 - 65	.00063 0.016	131 - 246 40 - 75	.00071 0.018	148 - 295 45 - 90	.00075 0.019	164 - 328 50 - 100	.00083 0.021	180 - 377 55 - 115	.00087 0.022	
49 - 82 15 - 25	.00024 0.006	66 - 131 20 - 40	.00031 0.008	82 - 164 25 - 50	.00043 0.011	98 - 213 30 - 65	.00063 0.016	131 - 246 40 - 75	.00071 0.018	148 - 295 45 - 90	.00075 0.019	164 - 328 50 - 100	.00083 0.021	180 - 377 55 - 115	.00087 0.022	
49 - 82 15 - 25	.00024 0.006	66 - 131 20 - 40	.00031 0.008	82 - 164 25 - 50	.00043 0.011	98 - 213 30 - 65	.00063 0.016	131 - 246 40 - 75	.00071 0.018	148 - 295 45 - 90	.00075 0.019	164 - 328 50 - 100	.00083 0.021	180 - 377 55 - 115	.00087 0.022	
49 - 82 15 - 25	.00024 0.006	66 - 131 20 - 40	.00031 0.008	82 - 164 25 - 50	.00043 0.011	98 - 213 30 - 65	.00063 0.016	131 - 246 40 - 75	.00071 0.018	148 - 295 45 - 90	.00075 0.019	164 - 328 50 - 100	.00083 0.021	180 - 377 55 - 115	.00087 0.022	
49 - 82 15 - 25	.00024 0.006	66 - 131 20 - 40	.00031 0.008	82 - 164 25 - 50	.00043 0.011	98 - 213 30 - 65	.00063 0.016	131 - 246 40 - 75	.00071 0.018	148 - 295 45 - 90	.00075 0.019	164 - 328 50 - 100	.00083 0.021	180 - 377 55 - 115	.00087 0.022	
49 - 82 15 - 25	.00024 0.006	66 - 131 20 - 40	.00031 0.008	82 - 164 25 - 50	.00043 0.011	98 - 213 30 - 65	.00063 0.016	131 - 246 40 - 75	.00071 0.018	148 - 295 45 - 90	.00075 0.019	164 - 328 50 - 100	.00083 0.021	180 - 377 55 - 115	.00087 0.022	
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00039 0.010	164 - 328 50 - 100	.00047 0.012	180 - 377 55 - 115	.00055 0.014	
49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00024 0.006	82 - 164 25 - 50	.00031 0.008	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00059 0.015	180 - 377 55 - 115	.00067 0.017	
49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00035 0.009	131 - 246 40 - 75	.00043 0.011	148 - 295 45 - 90	.00051 0.013	164 - 328 50 - 100	.00059 0.015	180 - 377 55 - 115	.00067 0.017	
49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00039 0.010	164 - 328 50 - 100	.00047 0.012	180 - 377 55 - 115	.00055 0.014	

NEW

Type C - Z3 - Slot milling

MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

Slot milling



Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel $R_m < 800 \text{ N/mm}^2$	1.0301	C10	AISI 1010	GEOMETRY S	
		1.0401	C15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel $R_m > 900 \text{ N/mm}^2$	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel $R_m < 1200 \text{ N/mm}^2$	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
		1.3343	HS6-5-2C	AISI M2 / UNS T11302		
		1.3355	HS18-0-1	AISI T1 / UNS T12001		
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
K	Cast iron	1.4441	X2CrNiMo18-15-3	AISI 316LM		
		1.4539	X1NiCrMoCu25-20-5	AISI 904L		
		0.6020	GG20	ASTM 30	GEOMETRY S	
		0.6030	GG30	ASTM 40B		
		0.7040	GGG40	ASTM 60-40-18		
N	Aluminium alloy wrought	0.7060	GGG60	ASTM 80-60-03		
		3.2315	AlMgSi1	ASTM 6351	GEOMETRY S	
	Aluminium alloy cast	3.4365	AlZnMgCu1.5	ASTM 7075		
		3.2163	GD-AlSi9Cu3	ASTM A380		
	Copper	3.2381	GD-AlSi10Mg	UNS A03590		
		2.0040	Cu-OF / CW008A	UNS C10100		
	Brass lead free	2.0065	Cu-ETP / CW004A	UNS C11000		
		2.0321	CuZn37 CW508L	UNS C27400		
	Brass, Bronze $R_m < 400 \text{ N/mm}^2$	2.0360	CuZn40 CW509L	UNS C28000		
		2.0401	CuZn39Pb3 / CW614N	UNS C38500		
	Bronze $R_m < 600 \text{ N/mm}^2$	2.1020	CuSn6	UNS C51900		
		2.0966	CuAl10Ni5Fe4	UNS C63000		
		2.0960	CuAl9Mn2	UNS C63200		
S₁	Super alloys	2.4856		Inconel 625	GEOMETRY SX	
		2.4668		Inconel 718		
		2.4617	NiMo28	Hastelloy B-2		
		2.4665	NiCr22Fe18Mo	Hastelloy X		
S₂	Titanium pure	3.7035	Gr.2	ASTM B348 / F67	GEOMETRY S	
		3.7065	Gr.4	ASTM B348 / F68		
	Titanium alloys	3.7165	TiAl6V4	ASTM B348 / F136	GEOMETRY S	
		9.9367	TiAl6Nb7	ASTM F1295		
S₃	CoCr alloys	2.4964	CoCr20W15Ni	Haynes 25	GEOMETRY SX	
			CrCoMo28	ASTM F1537		
H₁	Hardened steel $< 55 \text{ HRC}$	1.2510	100MnCrMoW4	AISI O1		
H₂	Hardened steel $\geq 55 \text{ HRC}$	1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ☒ Not recommended

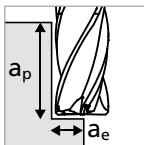
P	N	S ₃
M	S ₁	H ₁
K	S ₂	H ₂

a _p		Ød ₁															
		.008" 0.2 mm		.012" 0.3 mm		1/64" 0.4 mm		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32" 0.8 mm		.035"-.039" 0.9-1.0 mm	
		V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z	V _c	f _z
0.2 x d ₁		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.2 x d ₁		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.2 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.2 x d ₁		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
		49 - 82 15 - 25	.00016 0.004	66 - 131 20 - 40	.00028 0.007	82 - 164 25 - 50	.00035 0.009	98 - 213 30 - 65	.00047 0.012	131 - 246 40 - 75	.00051 0.013	148 - 295 45 - 90	.00059 0.015	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00067 0.017
0.1 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00012 0.003	82 - 164 25 - 50	.00016 0.004	98 - 213 30 - 65	.00020 0.005	131 - 246 40 - 75	.00028 0.007	148 - 295 45 - 90	.00031 0.008	164 - 328 50 - 100	.00035 0.009	180 - 377 55 - 115	.00039 0.010
0.2 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00016 0.004	82 - 164 25 - 50	.00024 0.006	98 - 213 30 - 65	.00031 0.008	131 - 246 40 - 75	.00035 0.009	148 - 295 45 - 90	.00043 0.011	164 - 328 50 - 100	.00051 0.013	180 - 377 55 - 115	.00059 0.015
0.2 x d ₁		49 - 82 15 - 25	.00012 0.003	66 - 131 20 - 40	.00020 0.005	82 - 164 25 - 50	.00028 0.007	98 - 213 30 - 65	.00039 0.010	131 - 246 40 - 75	.00047 0.012	148 - 295 45 - 90	.00055 0.014	164 - 328 50 - 100	.00063 0.016	180 - 377 55 - 115	.00071 0.018
0.2 x d ₁		49 - 82 15 - 25	.00008 0.002	66 - 131 20 - 40	.00012 0.003	82 - 164 25 - 50	.00016 0.004	98 - 213 30 - 65	.00020 0.005	131 - 246 40 - 75	.00028 0.007	148 - 295 45 - 90	.00031 0.008	164 - 328 50 - 100	.00035 0.009	180 - 377 55 - 115	.00039 0.010

NEW

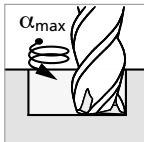
Type C - Z4 - Side milling - Semi-finishing

MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

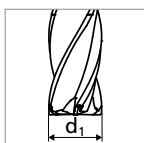
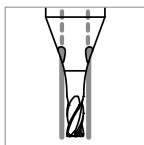
Side milling**Semi-finishing**

$$a_p = 1.5 \times d_1$$

$$a_e = 0.05 \times d_1$$

**Note:**

In case of helical interpolation milling
see α_{max} on page 35



Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel $R_m < 800 \text{ N/mm}^2$	1.0301	C10	AISI 1010	GEOMETRY S	
		1.0401	C15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel $R_m > 900 \text{ N/mm}^2$	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel $R_m < 1200 \text{ N/mm}^2$	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
		1.3343	HS6-5-2C	AISI M2 / UNS T11302		
		1.3355	HS18-0-1	AISI T1 / UNS T12001		
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
K	Cast iron	1.4441	X2CrNiMo18-15-3	AISI 316LM	GEOMETRY S	
		1.4539	X1NiCrMoCu25-20-5	AISI 904L		
		0.6020	GG20	ASTM 30		
		0.6030	GG30	ASTM 40B		
		0.7040	GGG40	ASTM 60-40-18		
N	Aluminium alloy wrought	0.7060	GGG60	ASTM 80-60-03	GEOMETRY S	
		3.2315	AlMgSi1	ASTM 6351		
	Aluminium alloy cast	3.4365	AlZnMgCu1.5	ASTM 7075		
		3.2163	GD-AlSi9Cu3	ASTM A380		
	Copper	3.2381	GD-AlSi10Mg	UNS A03590		
		2.0040	Cu-OF / CW008A	UNS C10100		
	Brass lead free	2.0065	Cu-ETP / CW004A	UNS C11000		
		2.0321	CuZn37 CW508L	UNS C27400		
	Brass, Bronze $R_m < 400 \text{ N/mm}^2$	2.0360	CuZn40 CW509L	UNS C28000		
		2.0401	CuZn39Pb3 / CW614N	UNS C38500		
	Bronze $R_m < 600 \text{ N/mm}^2$	2.1020	CuSn6	UNS C51900		
		2.0966	CuAl10Ni5Fe4	UNS C63000		
S₁	Super alloys	2.0960	CuAl9Mn2	UNS C63200	GEOMETRY SX	
		2.4856		Inconel 625		
		2.4668		Inconel 718		
		2.4617	NiMo28	Hastelloy B-2		
		2.4665	NiCr22Fe18Mo	Hastelloy X		
S₂	Titanium pure	3.7035	Gr.2	ASTM B348 / F67	GEOMETRY S	
		3.7065	Gr.4	ASTM B348 / F68		
	Titanium alloys	3.7165	TiAl6V4	ASTM B348 / F136	GEOMETRY S	
		9.9367	TiAl6Nb7	ASTM F1295		
S₃	CoCr alloys	2.4964	CoCr20W15Ni	Haynes 25	GEOMETRY SX	
			CrCoMo28	ASTM F1537		
H₁	Hardened steel $< 55 \text{ HRC}$	1.2510	100MnCrMoW4	AISI O1		
H₂	Hardened steel $\geq 55 \text{ HRC}$	1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ⊗ Not recommended

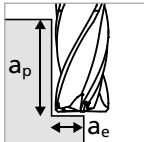
P	N	S ₃	
M	S ₁	H ₁	
K	S ₂	H ₂	

Ød ₁												
1/64"		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32"		.035" - .039" 0.9-1.0mm		
.016" 0.4 mm												
v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	
						</						

NEW

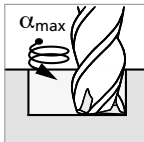
Type C - Z4 - Side milling - Finishing

MILLING WITH INTEGRATED COOLING | CUTTING DATA OVERVIEW

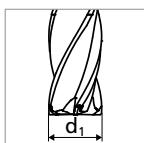
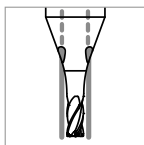
Side milling**Finishing**

$$a_p = 1.5 \times d_1$$

$$a_e = 0.02 \times d_1$$

**Note:**

In case of helical interpolation milling
see α_{max} on page 35



Materials group	Material	Mat. no.	DIN	AISI/ASTM/UNS	Cutting edge geometry	
P	Unalloyed carbon steel $R_m < 800 \text{ N/mm}^2$	1.0301	C10	AISI 1010	GEOMETRY S	
		1.0401	C15	AISI 1015		
		1.1191	C45E/CK45	AISI 1045		
		1.0044	S275JR	AISI 1020		
		1.0715	11SMn30	AISI 1215		
	Low alloyed steel $R_m > 900 \text{ N/mm}^2$	1.5752	15NiCr13	ASTM 3415 / AISI 3310		
		1.7131	16MnCr5	AISI 5115		
		1.3505	100Cr6	AISI 52100		
		1.7225	42CrMo4	AISI 4140		
		1.2842	90MnCrV8	AISI O2		
	High alloyed tool steel $R_m < 1200 \text{ N/mm}^2$	1.2379	X153CrMoV12	AISI D2		
		1.2436	X210CrW12	AISI D4/D6		
		1.3343	HS6-5-2C	AISI M2 / UNS T11302		
		1.3355	HS18-0-1	AISI T1 / UNS T12001		
M	Stainless steel ferritic	1.4016	X6Cr17	AISI 430 / UNS S43000	GEOMETRY S	
		1.4105	X6CrMoS17	AISI 430F		
	Stainless steel martensitic	1.4034	X46Cr13	AISI 420C		
		1.4112	X90CrMoV18	AISI 440B		
	Stainless steel martensitic – PH	1.4542	X5CrNiCuNb16-4	AISI 630 / ASTM 17-4 PH		
		1.4545	X5CrNiCuNb15-5	ASTM 15-5 PH		
	Stainless steel austenitic	1.4301	X5CrNi18-10	AISI 304		
		1.4435	X2CrNiMo18-14-3	AISI 316L		
K	Cast iron	1.4441	X2CrNiMo18-15-3	AISI 316LM	GEOMETRY S	
		1.4539	X1NiCrMoCu25-20-5	AISI 904L		
		0.6020	GG20	ASTM 30		
		0.6030	GG30	ASTM 40B		
		0.7040	GGG40	ASTM 60-40-18		
N	Aluminium alloy wrought	0.7060	GGG60	ASTM 80-60-03	GEOMETRY S	
		3.2315	AlMgSi1	ASTM 6351		
	Aluminium alloy cast	3.4365	AlZnMgCu1.5	ASTM 7075		
		3.2163	GD-AlSi9Cu3	ASTM A380		
	Copper	3.2381	GD-AlSi10Mg	UNS A03590		
		2.0040	Cu-OF / CW008A	UNS C10100		
	Brass lead free	2.0065	Cu-ETP / CW004A	UNS C11000		
		2.0321	CuZn37 CW508L	UNS C27400		
	Brass, Bronze $R_m < 400 \text{ N/mm}^2$	2.0360	CuZn40 CW509L	UNS C28000		
		2.0401	CuZn39Pb3 / CW614N	UNS C38500		
	Bronze $R_m < 600 \text{ N/mm}^2$	2.1020	CuSn6	UNS C51900		
S₁	Super alloys	2.0966	CuAl10Ni5Fe4	UNS C63000	GEOMETRY SX	
		2.0960	CuAl9Mn2	UNS C63200		
		2.4856		Inconel 625		
		2.4668		Inconel 718		
S₂	Titanium pure	2.4617	NiMo28	Hastelloy B-2	GEOMETRY S	
		2.4665	NiCr22Fe18Mo	Hastelloy X		
	Titanium alloys	3.7035	Gr.2	ASTM B348 / F67	GEOMETRY S	
		3.7065	Gr.4	ASTM B348 / F68		
S₃	CoCr alloys	3.7165	TiAl6V4	ASTM B348 / F136	GEOMETRY SX	
		9.9367	TiAl6Nb7	ASTM F1295		
		2.4964	CoCr20W15Ni	Haynes 25		
H₁ H₂	Hardened steel $< 55 \text{ HRC}$	CrCoMo28	ASTM F1537			
	Hardened steel $\geq 55 \text{ HRC}$	1.2510	100MnCrMoW4	AISI O1		
		1.2379	X153CrMoV12	AISI D2		

V_c [SFM] | [m/min]
f_z [IPT] | [mm]

RECOMMENDATION FOR USE

● Excellent | ● Good | ○ Acceptable | ⊗ Not recommended

P	N	S ₃	
M	S ₁	H ₁	
K	S ₂	H ₂	

Ød ₁													
1/64"		.020" 0.5 mm		.024" 0.6 mm		.028" 0.7 mm		1/32"		.035" - .039" 0.9 - 1.0mm			
v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z	v _c	f _z		
	148 - 246 45 - 75	.00028 0.007	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00047 0.012	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00063 0.016	
	148 - 246 45 - 75	.00028 0.007	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00047 0.012	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00063 0.016	
	148 - 246 45 - 75	.00016 0.004	180 - 312 55 - 95	.00024 0.006	213 - 377 65 - 115	.00031 0.008	246 - 426 75 - 130	.00035 0.009	295 - 492 90 - 150	.00043 0.011	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00024 0.006	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00047 0.012	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00063 0.016	
	148 - 246 45 - 75	.00024 0.006	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00047 0.012	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00063 0.016	
	148 - 246 45 - 75	.00024 0.006	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00047 0.012	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00063 0.016	
	148 - 246 45 - 75	.00016 0.004	180 - 312 55 - 95	.00024 0.006	213 - 377 65 - 115	.00031 0.008	246 - 426 75 - 130	.00035 0.009	295 - 492 90 - 150	.00043 0.011	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00028 0.007	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00047 0.012	295 - 492 90 - 150	.00055 0.014	328 - 558 100 - 170	.00063 0.016	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00047 0.012	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00047 0.012	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00047 0.012	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00047 0.012	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00047 0.012	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00047 0.012	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00031 0.008	180 - 312 55 - 95	.00031 0.008	213 - 377 65 - 115	.00039 0.010	246 - 426 75 - 130	.00043 0.011	295 - 492 90 - 150	.00047 0.012	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00008 0.002	180 - 312 55 - 95	.00016 0.004	213 - 377 65 - 115	.00016 0.004	246 - 426 75 - 130	.00020 0.005	295 - 492 90 - 150	.00024 0.006	328 - 558 100 - 170	.00028 0.007	
	148 - 246 45 - 75	.00016 0.004	180 - 312 55 - 95	.00024 0.006	213 - 377 65 - 115	.00031 0.008	246 - 426 75 - 130	.00035 0.009	295 - 492 90 - 150	.00043 0.011	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00016 0.004	180 - 312 55 - 95	.00024 0.006	213 - 377 65 - 115	.00031 0.008	246 - 426 75 - 130	.00035 0.009	295 - 492 90 - 150	.00043 0.011	328 - 558 100 - 170	.00047 0.012	
	148 - 246 45 - 75	.00008 0.002	180 - 312 55 - 95	.00016 0.004	213 - 377 65 - 115	.00016 0.004	246 - 426 75 - 130	.00020 0.005	295 - 492 90 - 150	.00024 0.006	328 - 558 100 - 170	.00028 0.007	

NEW

Process

PRECISE AND EFFICIENT MILLING

Coolant type, pressure and filtration

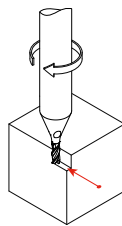
Coolant: for best results, Mikron Tool recommends the use of cutting oil as coolant. Alternatively, emulsion of 8% or more with EP-Additives (Extreme-Pressure-Additives) can be used as well.

Filter: the large cooling channels permit the use of a standard filter with filter quality of $\leq 002''$ (0.05 mm).

Coolant pressure: at least 363 psi (25 bar) coolant pressure is required to achieve reliable milling. High pressure is generally better for the cooling and flushing effect.

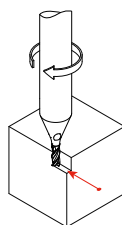
Revolution	[rpm]	$\leq 10'000$	$> 10'000$
Minimal pressure	[psi]	363	508
	[bar]	25	35

Climb milling and conventional milling



For side milling, Mikron Tool recommends climb milling. The chip thickness is greater at the beginning and decreases continuously, and the cutting forces remain low. With conventional milling, however, high cutting forces would push the milling tool away from the workpiece. Thus, the surface quality and precision of the workpiece decrease.

Side milling

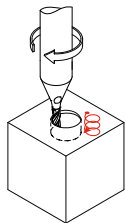


Recommended cutting parameters

v_c and f_z : as specified in the cutting data table

	Type B - Z3	Type C - Z3	Type B - Z4	Type C - Z4
Roughing	$a_p = 1 \times d$ $a_e = 0.2 \times d$	$a_p = 1 \times d$ $a_e = 0.1 \times d$	-	-
Semi-finishing	-	-	$a_p = 1.5 \times d$ $a_e = 0.1 \times d$	$a_p = 1.5 \times d$ $a_e = 0.05 \times d$
Finishing	-	-	$a_p = 1.5 \times d$ $a_e = 0.02 \times d$	$a_p = 1.5 \times d$ $a_e = 0.02 \times d$

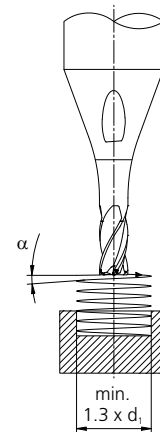
Helical interpolation milling



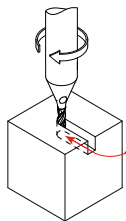
Helical interpolation offers the best and most gentle method of immersion. Note that the minimum diameter to be produced must be $1.3 \times d_1$. The minimum and maximum helical interpolation angle α depends on the material (see tables).

Suggested helical interpolation angles

	Material	α - Helical interpolation	
		min	max
P	Unalloyed and alloyed Steel	5°	15°
M	Stainless steels	5°	10°
K	Cast iron	5°	15°
N	Aluminum and non-ferrous metals	10°	30°
S₁	Super alloys	2°	8°
S₂	Titanium and titanium alloys	2°	8°
S₃	CrCo alloys	2°	8°



Slot milling



For slot milling, Mikron Tool recommends **indirect entry**. During milling with direct entry into the material, very thick chips are produced and the milling tool is subject to asymmetrical stress until it is working with its entire diameter in the material. These stresses can affect the service life of cutting edges.

Recommended cutting parameters

v_c and f_z : as specified in the cutting data table

Note

The recommended $a_{p,max}$ values should not be exceeded

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