



Standard programme

Solid carbide end-mills

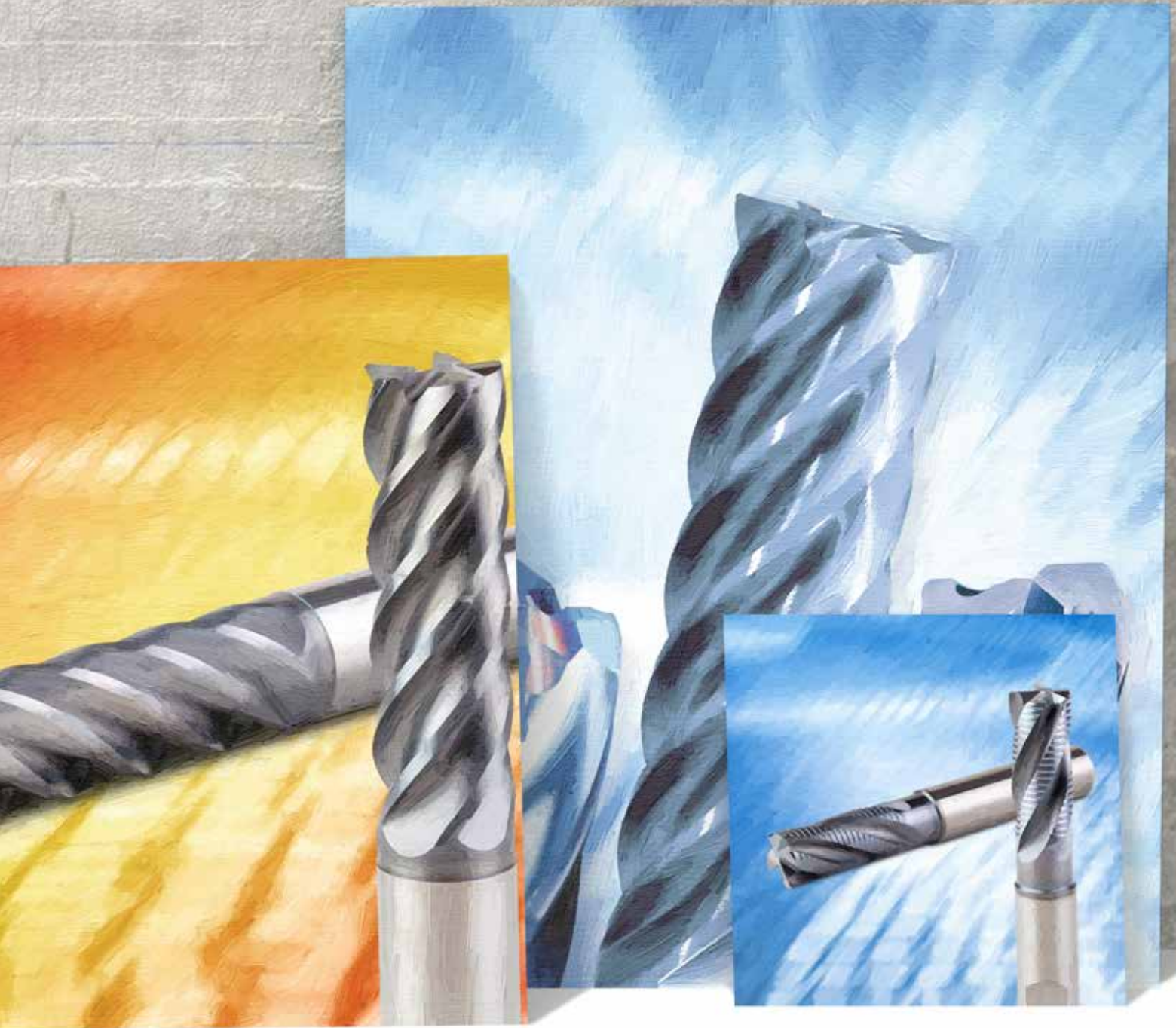
INNOVATIVE PRODUCTION STRATEGIES FOR YOUR TECHNICAL ADVANCE

Miller GmbH & Co. KG, Präzisionswerkzeuge in Altenstadt produces solid carbide precision tools for drilling and milling with resounding success and an innovative production strategy. PCD tools for drilling into the solid round off the product portfolio.

The greatest strengths of MILLER are its extensive range of standard products with application-specific catalogue tools as well as its high degree of flexibility in developing outstanding complex special tools made of solid carbide.



tool-tra



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with fixed cutting edges

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MILLING COMPETENCE

In the area of milling, MILLER tool experts have developed numerous machining solutions in recent years. The focus has been on tools adapted to the related customer requirements. Along with these individual tool solutions, however, the usage of high-performance standard tools plays a major role in many applications. Therefore a comprehensive standard programme has evolved from these custom tools.

MILLER's many years of experience, accumulated know-how and high level of process understanding in the area of milling are reflected in the standard programme. Process reliability, efficiency and the highest productivity for customers are therefore guaranteed.

Milling cutters from MILLER arrive at the customer after extensive research and development work, design and simulation using the latest software, production and finally inspection on the latest manufacturing equipment. In conjunction with the most efficient cutting materials, MILLER therefore offers the optimal milling tool for almost all applications and workpiece materials.

For all applications

MILLER offers a suitable tool for every milling task. All types of machining – whether general machining operation such as groove milling, face milling, shoulder milling, for roughing and finishing, or special machining operations such as trochoidal or helix milling – are covered with innovative tool solutions.

For every material

Along with the type of machining operation, the workpiece material is the most important criterion for selecting a suitable milling cutter. Along with tools for machining steel, cast iron and aluminium, the programme from MILLER also includes solutions for the cost-effective, reliable milling of titanium, super alloys, plastics and composite materials.

Custom solutions

Special machining tasks require special tools. For this reason MILLER offers custom milling tools individually tailored to the requirements of the customer. For instance, complex shapes and contours can be realised using specifically designed milling cutters, or machining times and tools changes reduced using combination tools.





High-performance coatings

A crucial criterion for the service life of the tool and optimal machining results is the coating of the cutting edges. MILLER offers a large selection of substrates and coatings, each matched to the specific machining case.

Latest manufacturing equipment

The latest 3D design and simulations form the basis for the manufacture of MILLER tools. The data are transferred via interfaces to the related machining centre that forms part of the modern, comprehensive range of machinery available on-site. In this way the production of MILLER milling tools for the highest quality requirements is monitored and controlled by experienced staff.

Reconditioning in original quality

By reconditioning solid carbide tools with original grinding and original coating, almost 100 percent of the tool life of new tools can be achieved again. Upon request, MILLER will collect and deliver the tools for quick processing.



PROGRAMME OVERVIEW

At a glance

END-MILLS WITH FIXED CUTTING EDGES



1 Groove milling and general applications

1.1 OptiMill standard programme

P M K N S H

Diameter range: 1-32 mm

1.2 High volume machining of structural parts

N

Diameter range: 6-32 mm

1.3 Milling modern lightweight materials

N C

Diameter range: 1-20 mm

► more from page 27

2 Shoulder milling – roughing

P M K N

Diameter range: 4-25 mm

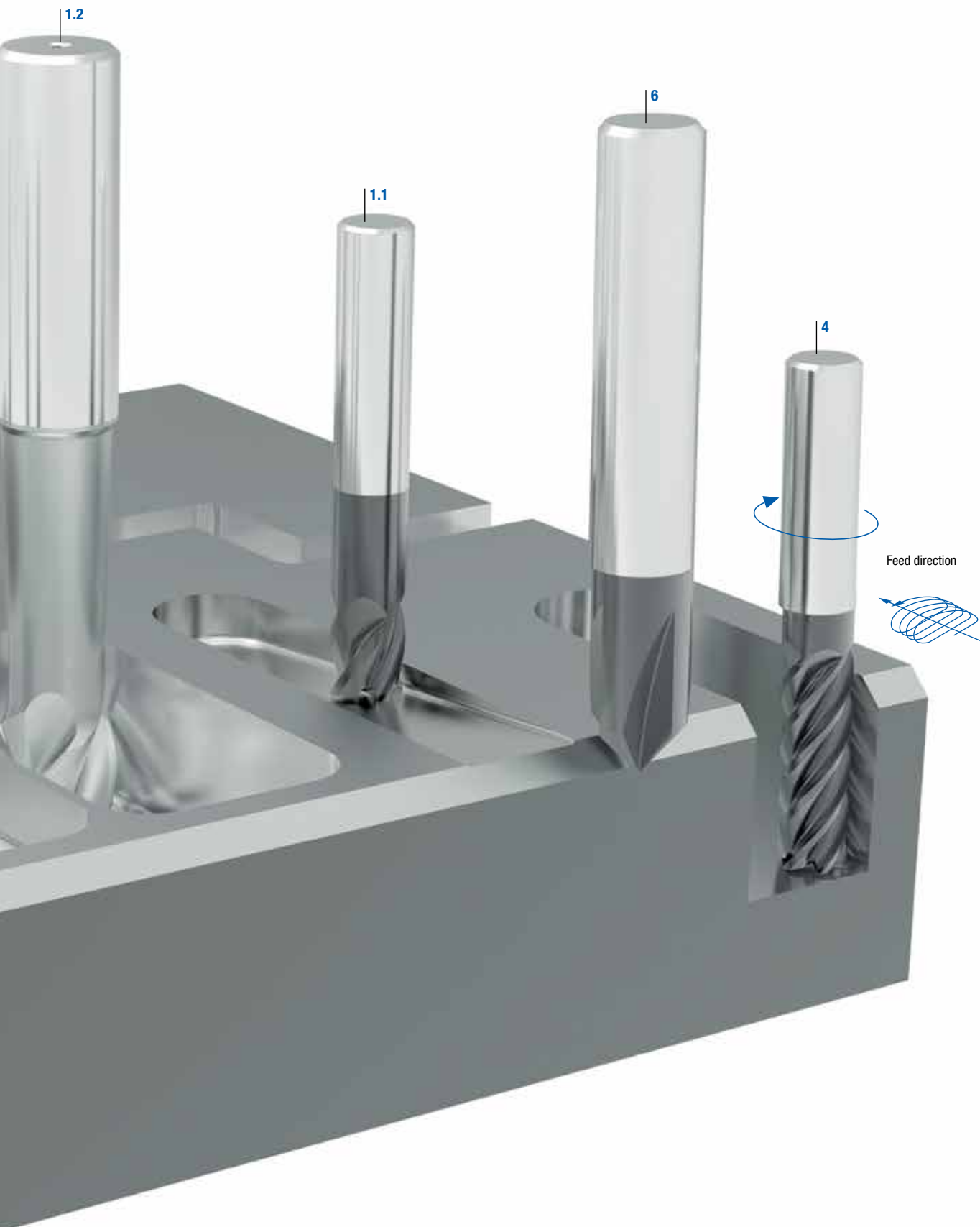
► more from page 77

3 Shoulder milling – finishing

P M K N H

Diameter range: 4-32 mm

► more from page 83



4 Trochoidal milling

P M K S H

Diameter range: 5-25 mm
▶ more from page 91

5 Profile milling

P M K N C H

Diameter range: 1-25 mm
▶ more from page 99

6 Chamfering, deburring, drill milling

P M K N

Diameter range: 3-20 mm
▶ more from page 105

INNOVATIONS | HIGHLIGHTS

End-mills with fixed cutting edges

OptiMill®-Uni-HPC-Plus

A new dimension for universal machining in relation to quality, precision and durability

► [more on pages 42-45](#)



The OptiMill-Uni-HPC-Plus is the logical further development of the OptiMill-Uni-HPC. A high-performance substrate in combination with a newly developed coating guarantees excellent tool lives. The precise rounding of the cutting edges ensures low wear with good surface quality at the same time. Very smooth running, large cutting volumes, high process reliability and low machine load are achieved during the machining operation by means of the use of varying pitch and

unequal tooth spacing. The OptiMill-Uni-HPC-Plus is designed for the highly cost-effective universal machining of steel, stainless steel and cast iron. It is available in the diameter range from 3 to 25 mm in the designs short, long, overlong and extra long.

AT A GLANCE

- High-performance substrate and high-end coating for excellent tool lives
- Dynamic helix pitch and unequal spacing for particularly smooth running
- Precise cutting edge for a high surface quality

OptiMill®-Uni-HPC-Rough

The guarantor for highly cost-effective roughing

► [more on pages 79/80](#)



The high-performance roughing milling cutter OptiMill-Uni-HPC-Rough is a highlight in the series of MILLER HPC milling cutters. The new knurled profile guarantees an optimal distribution of cutting forces and in this way ensures better chip formation. Due to the unequal spacing of the cutting edges, significantly less oscillation and vibration are produced. As a consequence higher cutting speeds and feed rates are possible. In conjunction with a newly developed coating, the

highest material removal rates are achieved with increased tool life at the same. The range includes milling cutters in the diameter range from 4 to 25 mm and is available in short and long designs.

AT A GLANCE

- Unequal spacing for low vibration running
- High-performance coating for maximum tool lives
- New knurled profile for optimised force distribution on the cutting edges and therefore better chip formation

OptiMill®-Trochoid

Maximum machining efficiency during trochoidal milling

► [more from page 90](#)



For trochoidal milling, MILLER has expanded its OptiMill solid carbide range with milling cutters that have a cutting length of 3xD. Especially developed for trochoidal machining, these milling cutters have five cutting edges with optimised unequal spacing and geometry. These features combined with the balancing of the cutting tool to G2.5 ensure reduced vibration and high surface finishes. Workpiece-specific chip breakers ensure the trouble-free removal of chips. The range

includes milling cutters in the diameter range from 5 to 25 mm for machining steel, cast steel, inox, titanium, high-alloy steels as well as hard machining.

AT A GLANCE

- Cutting depths of 3xD with special chip breaker geometry
- Maximum material removal rate
- Shorter machining times
- Low machining forces
- Highest tool lives
- Optimal chip transport

OptiMill®-Volume-N

New generation of high-volume milling cutters for machining aluminium

► [more on Page 55](#)



MILLER has developed a new range of aluminium roughing end-mills. The OptiMill-Volume-N high-performance end-mills are characterised by a high level of rigidity thanks to rounded transitions on the tool shank for preventing notch effects as well as large flute angles and axial angles. Large chip flutes with rounded surfaces result in reliable chip removal, thereby ensuring process reliability. Regenerative chatter vibrations when machining aluminium is counteracted by tool

flank chamfers and uneven cutting edge pitches on the tools.

AT A GLANCE

- Diameter range from 6,00 to 32,00 mm
- Short (M3593) and long (M3591) design available from stock
- Three cutting edges with highly polished flutes

ADVANTAGES

- High material removal rate
- Soft, low-vibration cutting thanks to highly positive rake angle and increased axis angle: Higher quality, lower power consumption
- Optimised chip flow: No corners or sharp edges along the chip flute
- High level of rigidity

MILLING CUTTERS WITH FIXED CUTTING EDGES

Optimal milling cutters for almost all applications and workpiece materials





PRODUCT OVERVIEW

End-mills with fixed cutting edges

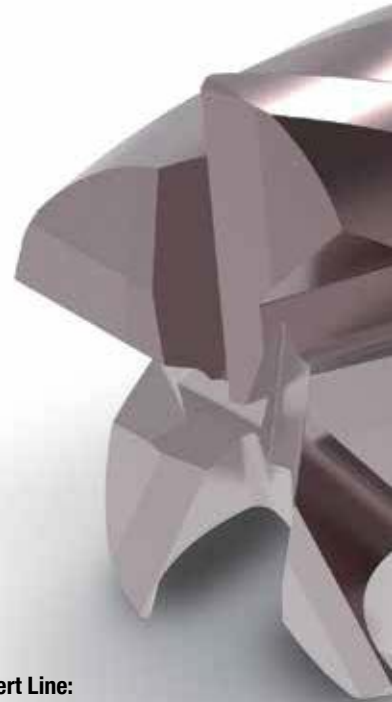
The high-performance end-mill programme OptiMill from MILLER ensures excellent, reliable results during all machining tasks. The focus is on cost-effectiveness and product quality, along with meeting customer requirements.

Always the right choice

Irrespective of whether you need a cost-effective milling cutter for universal machining or an expert for a complex machining task – MILLER offers the right tool.

Application-orientated

The end-mill programme from MILLER includes shoulder milling cutters for groove milling, roughing, finishing and trochoidal milling, as well as milling cutters for high feed milling, profile milling and chamfering.



Basic Line:

Universal tools, broad application area, low procurement costs



Performance Line:

High-performance tools, broad application area, high productivity in series production manufacturing



Expert Line:

Specialist tools for selected applications, maximum precision and productivity

Shoulder milling cutters



Groove milling and general applications

Milling cutters for general applications. Excellently suited to groove milling.

- Contact width a_e up to $1xD$
- Diameter range from 1 to 25 mm
- Optimal chip transport
- Large selection of lengths and geometries for all applications
- High-performance substrate and modern coatings for excellent tool lives



Shoulder milling – roughing

To achieve the highest material removal. Ideal for pre-machining with high stock removal.

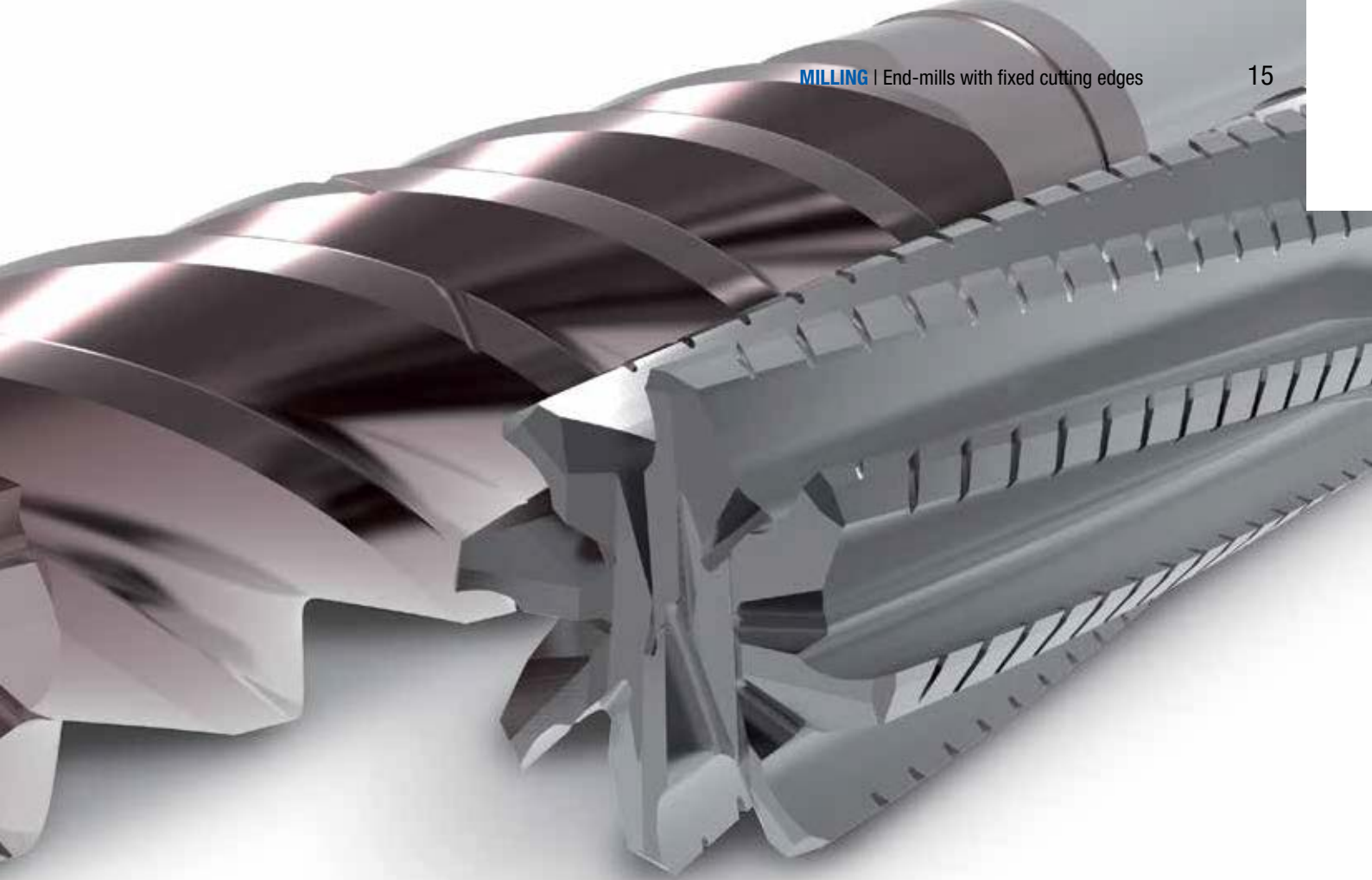
- High material removal rate ($a_e \sim 0.6xD$)
- Diameter range from 4 to 25 mm
- New knurled profile for optimal force distribution on the cutting edge
- Profile undercut roughing teeth
- Unequal spacing for low vibration running






Shoulder milling – finishing

Ideal for producing the best surface finishes. Fine machining with low stock removal.

- Low material removal rate ($a_e \leq 0.1xD$)
- Diameter range from 4 to 32 mm
- Large number of teeth
- Optimal distribution of the cutting forces
- Special design for hardened steels of 50-65 HRC







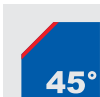





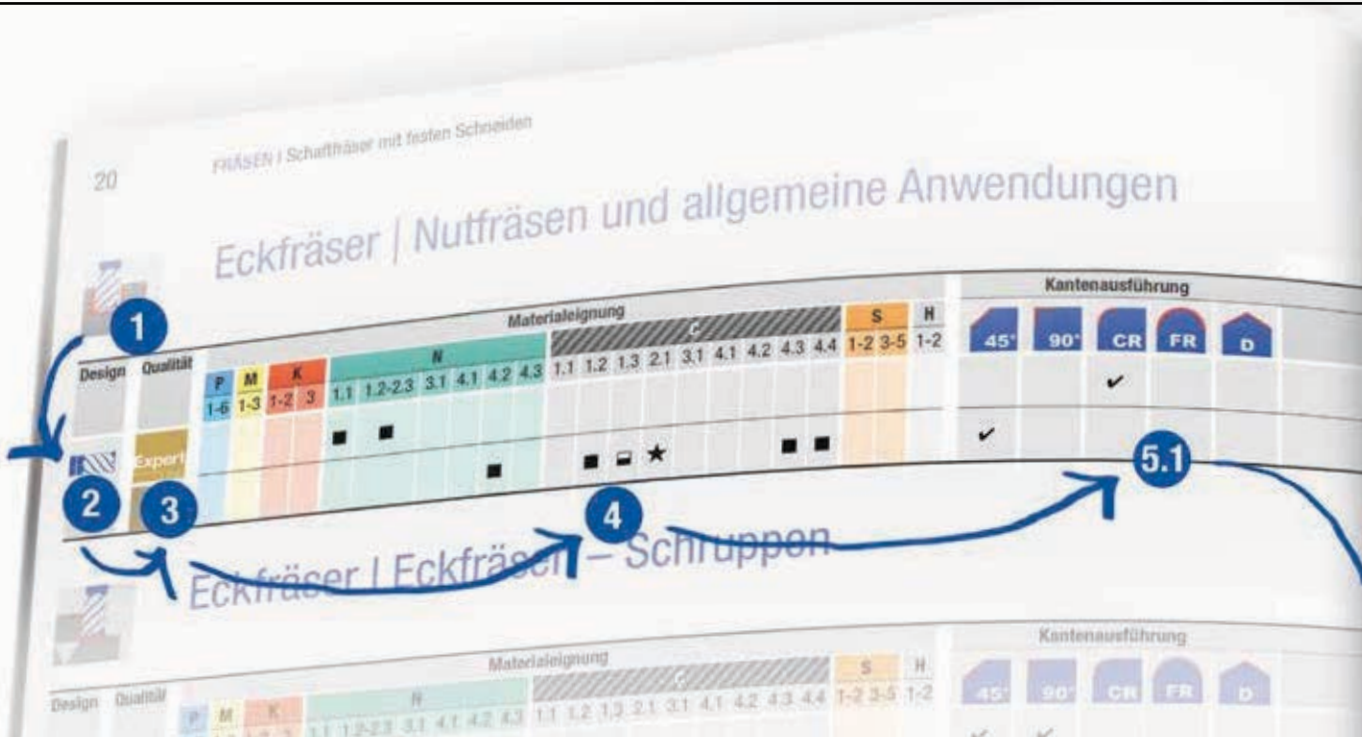
	Profile milling cutters	Chamfering, drill and deburring milling cutters
		
<p>Trochoidal milling</p> <p>Maximum material removal rate with high surface finish at the same time. Pre-machining and fine machining using one tool.</p> <ul style="list-style-type: none"> - Cutting depths up to 3xD - Diameter range from 4 to 25 mm - Extra long cutting tool - Optimised unequal spacing and finely balanced cutting tool to protect the machine spindle and longer tool lives - Optimal chip transport - Usage with modern CAM system (further information on page 116/117) 	<p>Profile milling</p> <p>Contour and copy milling with high shape accuracy.</p> <ul style="list-style-type: none"> - Low material removal rate (ap ~ 0.1xD, ae ~ 0.1xD) - Diameter range from 1 to 25 mm - Small diameter (from 1 mm) especially for milling tool steel and hardened steels from 50 to 65 HRC - Highest precision for tool and mould building - Close radius tolerances with full radius and toric end milling cutters 	<p>Chamfering, deburring and drill milling</p> <p>Cost-effective chamfering and deburring of pre-machined parts.</p> <ul style="list-style-type: none"> - Diameter range from 3 to 20 mm - Drill milling cutter for combination machining in one machining step, in particular for sheet metal and thin-walled parts
<p>Page 90</p>	<p>Page 98</p>	<p>Page 104</p>

SELECTION OF A MILLING CUTTER

Step-by-step to the right milling cutter

You are looking for an end-mill especially for trochoidal milling difficult-to-machine materials such as titanium and nickel-based alloys? This selection aid will lead you step-by-step to the right milling cutter.

1	Application	Select your main application.		Groove milling and general applications		Shoulder milling – roughing
2	Design	Select your preferred design.		Monolithic		
3	Product class	Decide for a product class.		Basic Line: Universal tools, broad application area, low procurement costs		
4	Material suitability	Identify your workpiece material as per the MMG (MILLER machining group).		Steel		Stainless steel
5.1	Cutting edge design	Select the required cutting edge design.		45° chamfer		Sharp edged
5.2	Other geometry features	Check whether the geometric features meet your requirements.		Diameter range	Number of teeth	
6	Product	Select your milling cutter. If there are several possible selections, select the milling cutter that is marked as ★ 1st choice for material suitability.				





Shoulder milling – finishing



Trochoidal milling



Profile milling



Chamfering and deburring



Performance Line:
High-performance tools, broad application area, high productivity in series production manufacturing



Expert Line:
Specialist tools for selected applications, maximum precision and productivity



Cast iron



Non-ferrous metals and plastics



Composite materials



Super alloys and titanium



Hardened steel and cast steel



Corner radius



Full radius



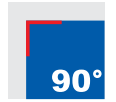
Drill tip

Axis/helix angle

Cutting material

Cooling supply



Step 1:
ApplicationStep 2:
DesignStep 3:
Product classStep 4:
Material suitabilityStep 5:
Design

	Design					Product			
	Ø [mm]	z	Axis-, helix angle	Mat.		Product name	Specification		Page
	3 - 20	4	36° / 38,5°	Solid carbide		ECU-Mill-Uni-LV	M4090, M4094		37/38
	1 - 20	2/4	30°	Solid carbide		OptiMill-Uni	M3032, M3034		29/31
	2,8 - 20	3	30°	Solid carbide	✓	OptiMill-Uni	M3030, M3033, M3133		28/30/32
	1 - 20	3	45°	Solid carbide		OptiMill-Uni	M3040, M3041, M3043		33-35
	2 - 20	4	30°	Solid carbide		OptiMill-Inox	M3634		47
	2 - 12,7	1	30°	Solid carbide		OptiMill-Mono-Alu	Type 200R, 200L, 200RY		50-52
	2 - 20	2	45°	Solid carbide		OptiMill-Alu	M3442		53
	2 - 12,7	1	25°	Solid carbide		OptiMill-Mono-Plastic	Type 100R, 100L		56/57
	4 - 20	VZ		Solid carbide		OptiMill-Composite-MT	M7001-M7004 M7011-M7014		62-65
	2,5 - 25	4	36° / 38°	Solid carbide		OptiMill-Uni-HPC	M3090, M3091, M3094		39-41
	2,5 - 25	4	36° / 38°	Solid carbide		OptiMill-Uni-HPC-Plus	M3090P, M3190P, M3094P, M3194P		42-45
	1 - 20	3	42° - 43°	Solid carbide		OptiMill-Uni-HPC-Slot	M3293		36
	6 - 25	5	41° - 42°	Solid carbide		OptiMill-Uni-HPC-Silent	M3095		46
	6 - 20	4	39°	Solid carbide	✓	OptiMill-Titan-HPC	M3694, M3794		48/49
	3 - 20	3	42° - 43°	Solid carbide		OptiMill-Alu-HPC	M3493		54
	4 - 16	4	6°	Solid carbide		OptiMill-Softfoam	M7624		58
	6 - 20	8	0°	Solid carbide	✓	OptiMill-Hardfoam	M7718		59
	3 - 20	4	0° / 3°	Solid carbide		OptiMill-Thermoplastic	M7614		60
	4 - 20	4	0°	Solid carbide		OptiMill-Thermoplastic-FR	M7644		61
	4 - 20	8	0° / ±8°	Solid carbide		OptiMill-Composite-Speed	M7218, M7228, M7238		66-68
	1 - 3	VZ		Solid carbide		MICRO-Router	M7901		69
	3 - 20	2	15°	Solid carbide		OptiMill-Composite-Duo	M7222		70
	4 - 20	2	0°	Solid carbide		OptiMill-Composite-TwinCut	M7402		73
	4 - 20	6 / 8	15°	Solid carbide		OptiMill-Honeycomb	M7526, M7528		74

Step 1:
Application



Step 2:
Design



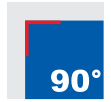
Step 3:
Product class



Step 4:
Material suitability



Step 5:
Design



Design						Product			
\emptyset [mm]	z	Axis-, helix angle	Mat.			Product name	Specification		Page
6 - 32	3	43°	Solid carbide			OptiMill-Volume-N	M3591, M3593		55
4 - 20	2	15°	Solid carbide			OptiMill-Composite-UD	M7212, M7242		71/72

Design						Product			
\emptyset [mm]	z	Axis-, helix angle	Mat.			Product name	Specification		Page
6 - 20	3 / 4	30°	Solid carbide			OptiMill-Uni-Rough & Finish	M3060		78
4 - 25	3 - 5	30°	Solid carbide			OptiMill-Uni-HPC-Rough	M3081, M3181		79/80

Design						Product			
\emptyset [mm]	z	Axis-, helix angle	Mat.			Product name	Specification		Page
4 - 32	6 / 8	45°	Solid carbide			OptiMill-Uni-Finish	M3046, M3048, M3049		84/85
4 - 20	6 / 8	50°	Solid carbide			OptiMill-Hardened	M3076, M3078, M3071		87/88
6 - 20	6	39° / 41°	Solid carbide			OptiMill-Uni-HPC-Finish	M3096		86

Design						Product			
\emptyset [mm]	z	Axis-, helix angle	Mat.			Product name	Specification		Page
4 - 25	5	41° - 42°	Solid carbide			OptiMill-Tro-Uni	M3099		92
4 - 25	5	41° - 42°	Solid carbide			OptiMill-Tro-PM	M3299		93
5 - 25	5	41° - 42°	Solid carbide			OptiMill-Tro-S	M3699		94
5 - 25	5	41° - 42°	Solid carbide			OptiMill-Tro-Titan	M3799		95
5 - 25	5	41° - 42°	Solid carbide			OptiMill-Tro-H	M3079		96

Step 1:
Application



Step 2:
Design



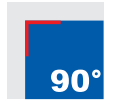
Step 3:
Product class



Step 4:
Material suitability



Step 5:
Design

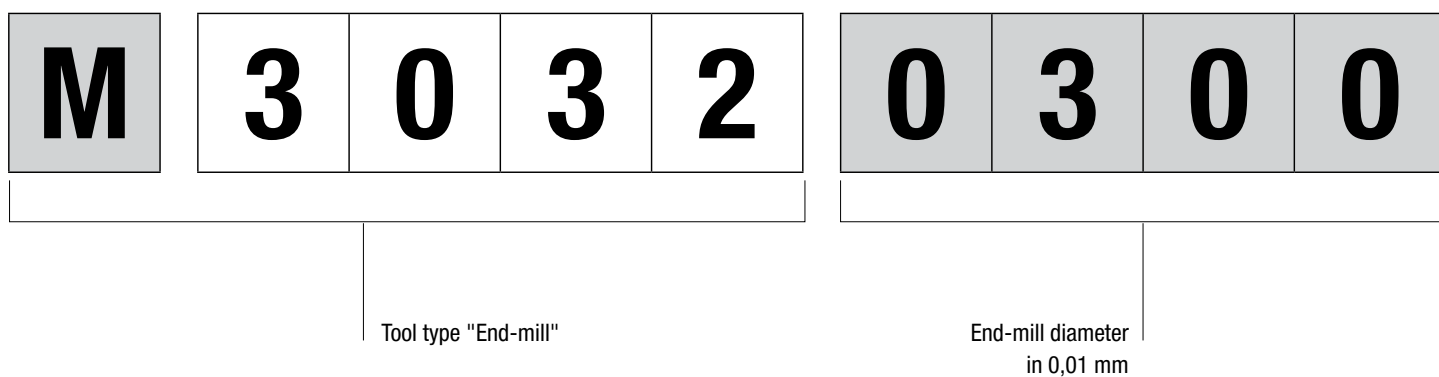


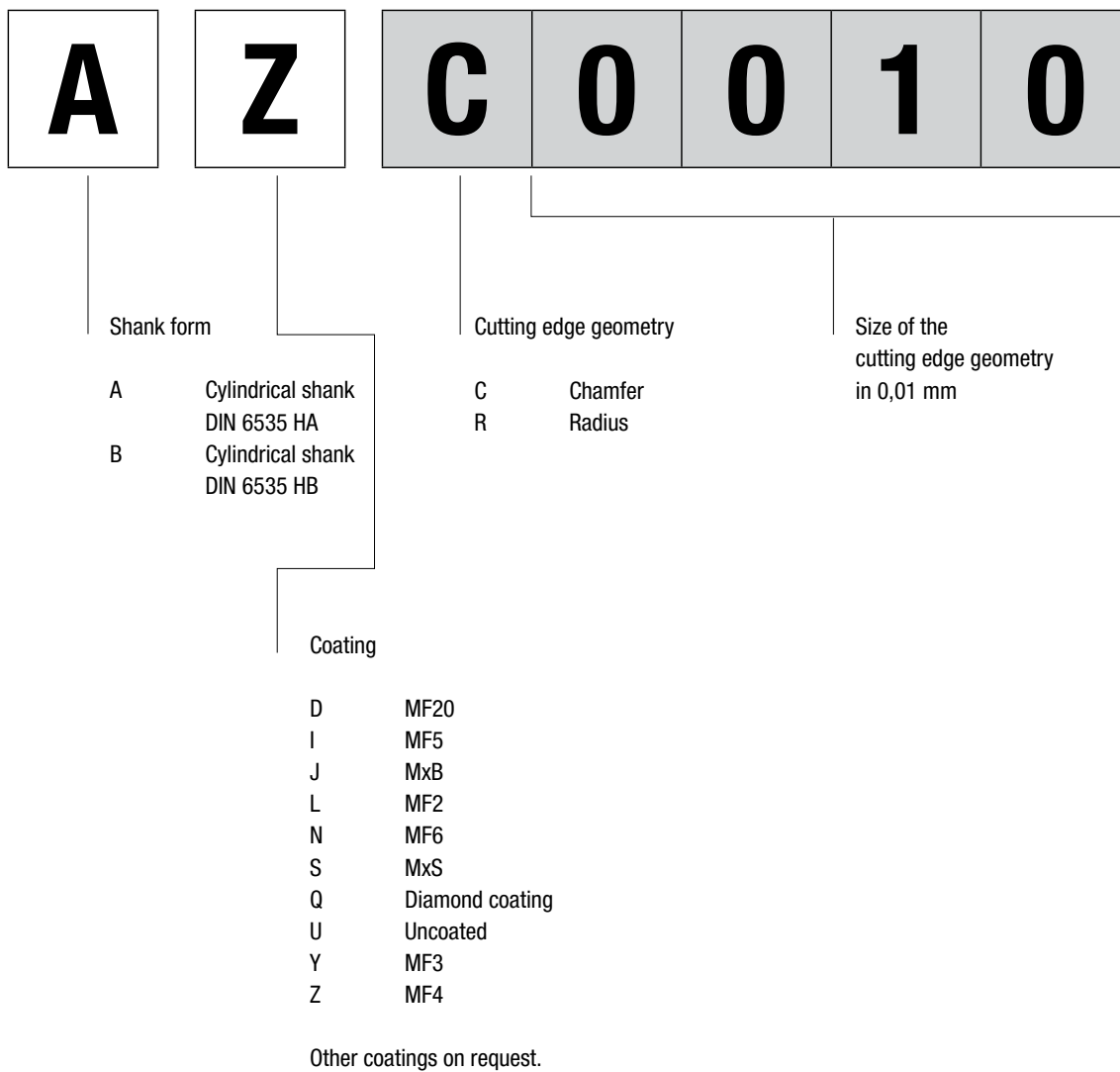
Design						Product			
\emptyset [mm]	z	Axis-, helix angle	Mat.		Product name	Specification		Page	
2 - 20	2	30°	Solid carbide		OptiMill-Uni-Radius	M3832		100	
1 - 20	2	30°	Solid carbide		OptiMill-Hardened-Radius	M3872		101	
4 - 20	VZ	25°	Solid carbide		OptiMill-Composite-MT-Radius	M7801		102	

Design						Product			
\emptyset [mm]	z	Axis-, helix angle	Mat.		Product name	Specification		Page	
4 - 20	4	0°	Solid carbide		OptiMill-Chamfer	M5390		106	
3 - 16	2	30°	Solid carbide		OptiMill-DrillMill	M5490		107	

Model key

End-mills with fixed cutting edges







GROOVE MILLING AND GENERAL APPLICATIONS

Universal use

OptiMill-Uni _____	28
OptiMill-Uni-HPC-Slot _____	36
ECU-Mill-Uni-LV _____	37
OptiMill-Uni-HPC _____	39
OptiMill-Uni-HPC-Plus _____	42
OptiMill-Uni-HPC-Silent _____	46

Inox, titanium and super alloys

OptiMill-Inox _____	47
OptiMill-Titan-HPC _____	48

Non-ferrous metals

OptiMill-Mono-Alu _____	50
OptiMill-Alu _____	53
OptiMill-Alu-HPC _____	54
OptiMill-Volume-N _____	55

Plastics and fibre composite materials

OptiMill-Mono-Plastic _____	56
OptiMill-Softfoam _____	58
OptiMill-Hardfoam _____	59
OptiMill-Thermoplastic _____	60
OptiMill-Thermoplastic-FR _____	61
OptiMill-Composite-MT _____	62
OptiMill-Composite-Speed _____	66
MICRO-Router _____	69
OptiMill-Composite-Duo _____	70
OptiMill-Composite-UD _____	71
OptiMill-Composite-TwinCut _____	73
OptiMill-Honeycomb _____	74

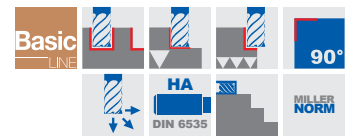
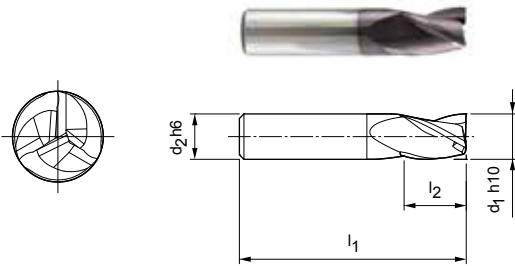


OptiMill®-Uni

Short design, 30° helix angle
M3030

Design:

Milling cutter diameter: 2,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 3
Helix angle: 30°



Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
2,00	6	40	4	3	M3030-0200AZ	30247244
2,50	6	40	4	3	M3030-0250AZ	30247245
3,00	6	40	5	3	M3030-0300AZ	30247246
3,50	6	40	5	3	M3030-0350AZ	30247247
4,00	6	40	7	3	M3030-0400AZ	30247248
4,50	6	40	7	3	M3030-0450AZ	30247249
5,00	6	40	8	3	M3030-0500AZ	30247250
5,50	6	40	8	3	M3030-0550AZ	30247251
*5,75	6	40	8	3	M3030-0575AZ	30247252
6,00	6	40	8	3	M3030-0600AZ	30247253
*6,75	8	43	11	3	M3030-0675AZ	30247254
7,00	8	43	11	3	M3030-0700AZ	30247255
*7,75	8	43	11	3	M3030-0775AZ	30247256
8,00	8	43	11	3	M3030-0800AZ	30247257
8,70	10	50	13	3	M3030-0870AZ	30247258
9,00	10	50	13	3	M3030-0900AZ	30247259
*9,70	10	50	13	3	M3030-0970AZ	30247260
10,00	10	50	13	3	M3030-1000AZ	30247261
12,00	12	55	15	3	M3030-1200AZ	30247262
14,00	14	58	15	3	M3030-1400AZ	30247263
16,00	16	62	18	3	M3030-1600AZ	30247264
18,00	18	70	20	3	M3030-1800AZ	30247265
20,00	20	75	22	3	M3030-2000AZ	30247266

Dimensions in mm.

*Undersizes especially for keyway milling.

Cutting data recommendation from page 118.

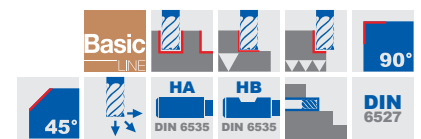
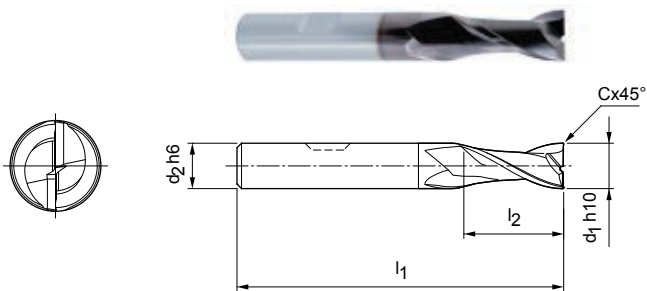
Special designs and other coatings on request.

OptiMill®-Uni

Long design, 30° helix angle
M3032

Design:

Milling cutter diameter: 1,00-20,00 mm
Coating: MF4
Number of cutting edges: $z = 2$
Helix angle: 30°



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
1,00	3	50	3	–	2	M3032-0100AZ	30247129
1,50	3	50	4	–	2	M3032-0150AZ	30247130
2,00	3	50	5	–	2	M3032-0200AZ	30247131
2,50	3	50	6	–	2	M3032-0250AZ	30247132
3,00	6	57	8	0,03	2	M3032-0300BZ	30247133
4,00	6	57	11	0,04	2	M3032-0400BZ	30247134
5,00	6	57	13	0,05	2	M3032-0500BZ	30247135
6,00	6	57	13	0,06	2	M3032-0600BZ	30247136
8,00	8	63	19	0,08	2	M3032-0800BZ	30247137
10,00	10	72	22	0,10	2	M3032-1000BZ	30247138
12,00	12	83	26	0,12	2	M3032-1200BZ	30247139
16,00	16	92	32	0,16	2	M3032-1600BZ	30247140
20,00	20	104	38	0,20	2	M3032-2000BZ	30247141

Dimensions in mm.

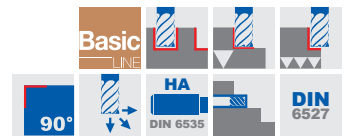
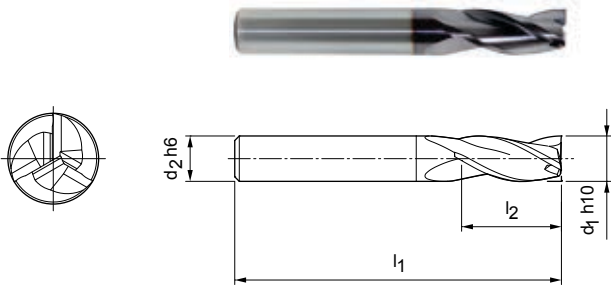
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill®-Uni

Long design, 30° helix angle
M3033

Design:
Milling cutter diameter: 2,80-20,00 mm
Coating: MF4
Number of cutting edges: z = 3
Helix angle: 30°



Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
*2,80	6	57	8	3	M3033-0280AZ	30247267
3,00	6	57	8	3	M3033-0300AZ	30247268
*3,80	6	57	11	3	M3033-0380AZ	30247271
4,00	6	57	11	3	M3033-0400AZ	30247272
*4,80	6	57	13	3	M3033-0480AZ	30247277
5,00	6	57	13	3	M3033-0500AZ	30247278
*5,80	6	57	13	3	M3033-0580AZ	30247281
6,00	6	57	13	3	M3033-0600AZ	30247282
*6,80	8	63	16	3	M3033-0680AZ	30247286
7,00	8	63	16	3	M3033-0700AZ	30247287
*7,80	8	63	19	3	M3033-0780AZ	30247291
8,00	8	63	19	3	M3033-0800AZ	30247292
*8,70	10	72	19	3	M3033-0870AZ	30247294
9,00	10	72	19	3	M3033-0900AZ	30247295
*9,70	10	72	22	3	M3033-0970AZ	30247298
10,00	10	72	22	3	M3033-1000AZ	30247299
*10,70	12	83	26	3	M3033-1070AZ	30247301
11,00	12	83	26	3	M3033-1100AZ	30247302
*11,70	12	83	26	3	M3033-1170AZ	30247303
12,00	12	83	26	3	M3033-1200AZ	30247304
*13,70	14	83	26	3	M3033-1370AZ	30247309
14,00	14	83	26	3	M3033-1400AZ	30247310
*15,70	16	92	32	3	M3033-1570AZ	30247312
16,00	16	92	32	3	M3033-1600AZ	30247313
*17,70	18	92	32	3	M3033-1770AZ	30247314
18,00	18	92	32	3	M3033-1800AZ	30247315
*19,70	20	104	38	3	M3033-1970AZ	30247316
20,00	20	104	38	3	M3033-2000AZ	30247317

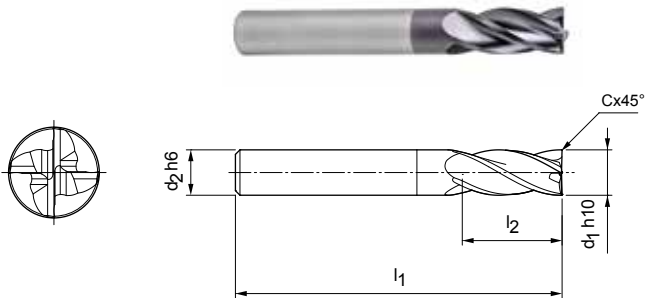
Dimensions in mm.
*Undersizes especially for keyway milling.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Uni

Long design, 30° helix angle
M3034

Design:

Milling cutter diameter: 4,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 4
Helix angle: 30°



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	57	11	-	4	M3034-0400AZ	30262368
4,50	6	57	11	-	4	M3034-0450AZ	30262369
5,00	6	57	13	-	4	M3034-0500AZ	30262370
5,50	6	57	13	-	4	M3034-0550AZ	30262371
6,00	6	57	13	-	4	M3034-0600AZ	30262372
6,50	8	63	16	-	4	M3034-0650AZ	30262373
7,00	8	63	16	-	4	M3034-0700AZ	30262374
7,50	8	63	19	-	4	M3034-0750AZ	30262375
8,00	8	63	19	0,08	4	M3034-0800AZ	30262376
8,50	10	72	19	0,09	4	M3034-0850AZ	30262377
9,00	10	72	19	0,09	4	M3034-0900AZ	30262378
9,50	10	72	22	0,10	4	M3034-0950AZ	30262379
10,00	10	72	22	0,10	4	M3034-1000AZ	30262380
11,00	12	83	26	0,11	4	M3034-1100AZ	30262381
12,00	12	83	26	0,12	4	M3034-1200AZ	30262382
13,00	14	83	26	0,13	4	M3034-1300AZ	30262383
14,00	14	83	26	0,14	4	M3034-1400AZ	30262384
15,00	16	92	32	0,15	4	M3034-1500AZ	30262385
16,00	16	92	32	0,16	4	M3034-1600AZ	30262386
17,00	18	92	32	0,17	4	M3034-1700AZ	30262387
18,00	18	92	32	0,18	4	M3034-1800AZ	30262388
19,00	20	104	38	0,19	4	M3034-1900AZ	30262389
20,00	20	104	38	0,20	4	M3034-2000AZ	30262390

Dimensions in mm.

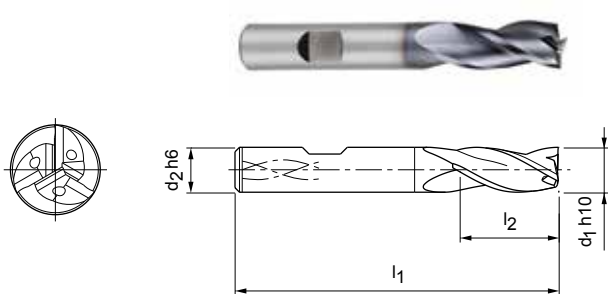
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill®-Uni

Long design, 30° helix angle, with internal cooling
M3133

Design:
Milling cutter diameter: 4,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 3
Helix angle: 30°



Material and application compatibility chart:

P	1	2	3	4	5	6	M	1	2	3	K	1	2	3	N	1	2	3	4	S	1	2	3	4	5	H	1	2		
■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

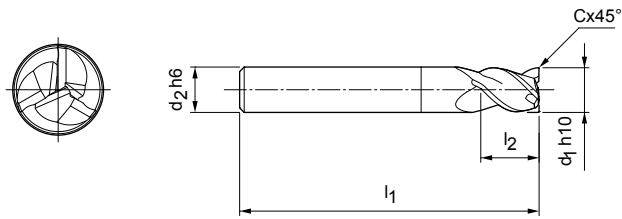
Additional icons: 90° angle, cooling, HB (DIN 6535), and DIN 6527.

Dimensions				z	Specification	Order No.
d1 h10	d2 h6	l1	l2			
4,00	6	57	8	3	M3133-0400BZ	30259519
6,00	6	57	10	3	M3133-0600BZ	30259520
6,50	8	63	13	3	M3133-0650BZ	30259521
7,00	8	63	13	3	M3133-0700BZ	30259522
7,50	8	63	16	3	M3133-0750BZ	30259523
8,00	8	63	16	3	M3133-0800BZ	30259524
8,50	10	72	16	3	M3133-0850BZ	30259525
9,00	10	72	16	3	M3133-0900BZ	30259526
9,50	10	72	19	3	M3133-0950BZ	30259527
10,00	10	72	19	3	M3133-1000BZ	30259528
12,00	12	83	22	3	M3133-1200BZ	30259529
14,00	14	83	22	3	M3133-1400BZ	30259530
16,00	16	92	26	3	M3133-1600BZ	30259531
18,00	18	92	26	3	M3133-1800BZ	30259532
19,00	20	104	32	3	M3133-1900BZ	30259533
20,00	20	104	32	3	M3133-2000BZ	30259534

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

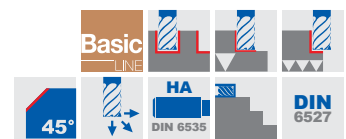
OptiMill® -Uni-Undersize

Short design, 45° helix angle
M3040



Design:
Milling cutter diameter: 2,80-19,70 mm
Coating: MF4
Number of cutting edges: z = 3
Helix angle: 45°

Application:
For keyway milling



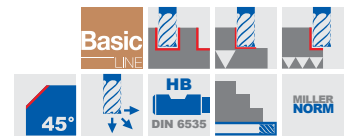
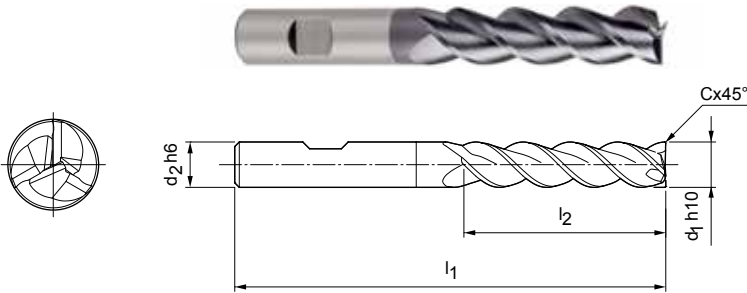
Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
2,80	6	50	5	0,04	3	M3040-0280AZ	30259535
3,80	6	54	6	0,06	3	M3040-0380AZ	30259536
4,80	6	54	7	0,07	3	M3040-0480AZ	30259537
5,75	6	54	8	0,09	3	M3040-0575AZ	30259538
6,75	8	58	9	0,10	3	M3040-0675AZ	30259539
7,75	8	58	10	0,12	3	M3040-0775AZ	30259540
8,70	10	66	11	0,13	3	M3040-0870AZ	30259541
9,70	10	66	12	0,15	3	M3040-0970AZ	30259542
11,70	12	73	12	0,18	3	M3040-1170AZ	30259543
13,70	14	75	14	0,21	3	M3040-1370AZ	30259544
15,70	16	82	16	0,24	3	M3040-1570AZ	30259545
17,70	18	84	18	0,27	3	M3040-1770AZ	30259546
19,70	20	92	20	0,30	3	M3040-1970AZ	30259547

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Uni

Extra long design, 45° helix angle
M3041

Design:
Milling cutter diameter: 4,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 3
Helix angle: 45°



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	63	19	0,06	3	M3041-0400BZ	30247145
5,00	6	68	24	0,08	3	M3041-0500BZ	30247148
6,00	6	68	24	0,09	3	M3041-0600BZ	30247151
8,00	8	88	38	0,12	3	M3041-0800BZ	30247154
10,00	10	95	45	0,15	3	M3041-1000BZ	30247157
12,00	12	110	53	0,18	3	M3041-1200BZ	30247160
16,00	16	123	63	0,24	3	M3041-1600BZ	30247163
20,00	20	141	75	0,30	3	M3041-2000BZ	30247166

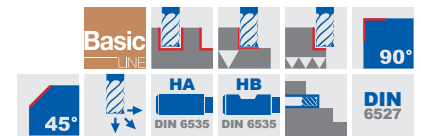
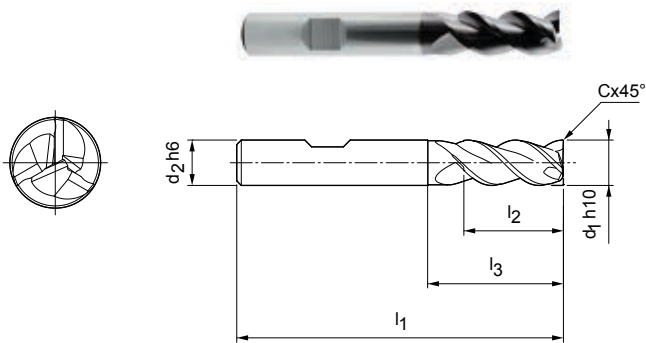
Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Uni

Long design with neck, 45° helix angle
M3043

Design:

Milling cutter diameter: 1,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 3
Helix angle: 45°



Dimensions						z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
*1,00	3	38	2	–	–	3	M3043-0100AZ	30247167
*1,50	3	38	3	–	–	3	M3043-0150AZ	30247168
*2,00	3	54	4	–	–	3	M3043-0200AZ	30247169
*2,50	6	54	6	–	–	3	M3043-0250BZ	30247170
*3,00	6	57	8	–	0,05	3	M3043-0300BZ	30247142
*3,50	6	57	11	–	0,05	3	M3043-0350BZ	30247143
*4,00	6	57	11	–	0,06	3	M3043-0400BZ	30247144
*4,50	6	57	13	–	0,07	3	M3043-0450BZ	30247146
*5,00	6	57	13	–	0,08	3	M3043-0500BZ	30247147
*5,50	6	57	13	–	0,08	3	M3043-0550BZ	30247149
6,00	6	57	13	20	0,09	3	M3043-0600BZ	30247150
*7,00	8	63	16	–	0,11	3	M3043-0700BZ	30247152
8,00	8	63	19	25	0,12	3	M3043-0800BZ	30247153
*9,50	10	72	22	–	0,14	3	M3043-0950BZ	30247155
10,00	10	72	22	30	0,15	3	M3043-1000BZ	30247156
*11,00	12	83	26	–	0,17	3	M3043-1100BZ	30247158
12,00	12	83	26	36	0,18	3	M3043-1200BZ	30247159
14,00	14	83	26	36	0,21	3	M3043-1400BZ	30247161
16,00	16	92	32	42	0,24	3	M3043-1600BZ	30247162
18,00	18	92	32	42	0,27	3	M3043-1800BZ	30247164
20,00	20	104	38	55	0,30	3	M3043-2000BZ	30247165

Dimensions in mm.

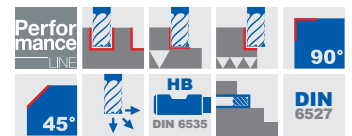
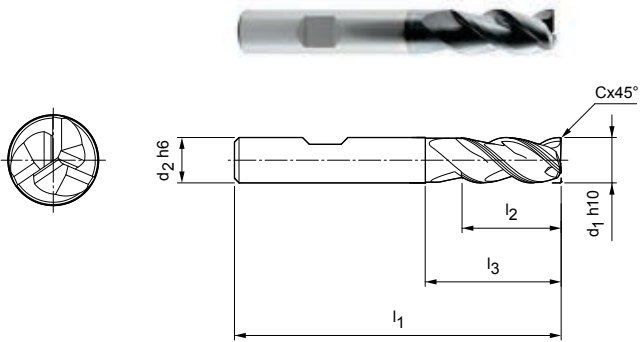
* Design without neck.

Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Uni-HPC-Slot

Long design with neck
M3293



Design:

Milling cutter diameter: 1,00-20,00 mm
Coating: MF6 (up to \varnothing 2,50 mm)
MF3 (from \varnothing 3,00 mm)

Number of cutting edges: $z = 3$

Helix angle: 42° - 43°

Special features: Unequal spacing

Dimensions						z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
1,00	6	54	2,5	4	–	3	M3293-0100BN	30566813
1,50	6	54	4	6	–	3	M3293-0150BN	30486525
2,00	6	54	5	8	–	3	M3293-0200BN	30486524
2,50	6	54	6,5	10	–	3	M3293-0250BN	30566814
3,00	6	57	8	12,5	0,06	3	M3293-0300BY	30247171
4,00	6	57	11	15	0,08	3	M3293-0400BY	30247172
5,00	6	57	13	16	0,10	3	M3293-0500BY	30247173
6,00	6	57	13	20	0,12	3	M3293-0600BY	30247174
8,00	8	63	21	27	0,16	3	M3293-0800BY	30247175
10,00	10	72	22	30	0,20	3	M3293-1000BY	30247176
12,00	12	83	26	36	0,24	3	M3293-1200BY	30247177
14,00	14	83	26	36	0,28	3	M3293-1400BY	30247178
16,00	16	92	36	44	0,32	3	M3293-1600BY	30247179
18,00	18	92	36	44	0,36	3	M3293-1800BY	30247180
20,00	20	104	41	55	0,40	3	M3293-2000BY	30247181

Dimensions in mm.

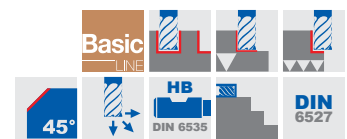
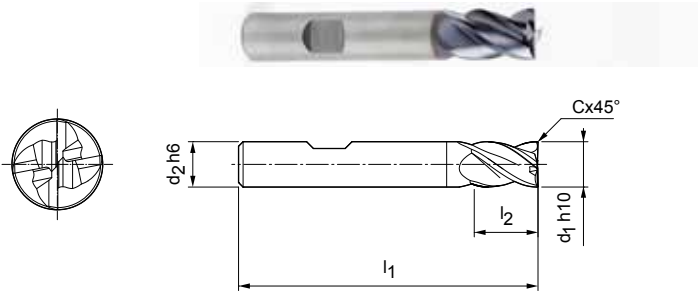
Cutting data recommendation from page 118.

Special designs and other coatings on request.

ECU-Mill-Uni-LV

Short design
M4090

Design:
Milling cutter diameter: 3,00-20,00 mm
Coating: MF20
Number of cutting edges: $z = 4$
Helix angle: $36^\circ/38,5^\circ$
Special features: Unequal spacing



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
3,00	6	50	6	0,06	4	M4090-0300BD	30656917
4,00	6	54	8	0,08	4	M4090-0400BD	30656918
5,00	6	54	9	0,10	4	M4090-0500BD	30656919
6,00	6	54	10	0,12	4	M4090-0600BD	30656920
8,00	8	58	12	0,16	4	M4090-0800BD	30656921
10,00	10	66	14	0,20	4	M4090-1000BD	30656922
12,00	12	73	16	0,24	4	M4090-1200BD	30656923
14,00	14	73	16	0,28	4	M4090-1400BD	30656924
16,00	16	82	22	0,32	4	M4090-1600BD	30656925
18,00	18	82	22	0,36	4	M4090-1800BD	30656926
20,00	20	92	26	0,40	4	M4090-2000BD	30656927

Dimensions in mm.

Cutting data recommendation from page 118.

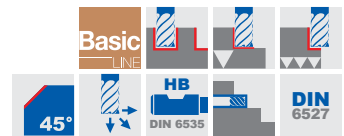
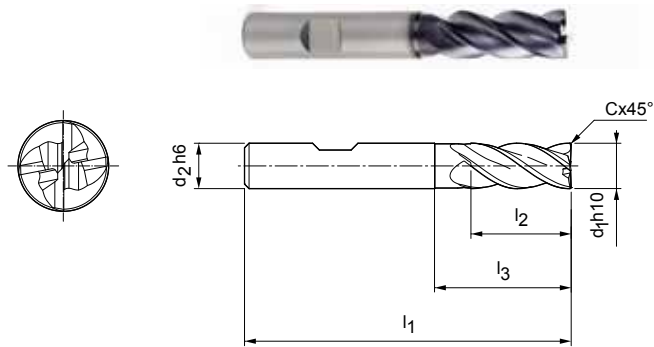
Special designs and other coatings on request.

ECU-Mill-Uni-LV

Long design with neck
M4094

Design:

Milling cutter diameter: 3,00-20,00 mm
Coating: MF20
Number of cutting edges: $z = 4$
Helix angle: $36^\circ/38,5^\circ$
Special features: Unequal spacing



Dimensions						z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
*3,00	6	57	8	-	0,06	4	M4094-0300BD	30656905
*4,00	6	57	11	-	0,08	4	M4094-0400BD	30656906
*5,00	6	57	13	-	0,10	4	M4094-0500BD	30656907
6,00	6	57	13	20	0,12	4	M4094-0600BD	30656908
8,00	8	63	21	25	0,16	4	M4094-0800BD	30656909
10,00	10	72	22	30	0,20	4	M4094-1000BD	30656910
12,00	12	83	26	36	0,24	4	M4094-1200BD	30656911
14,00	14	83	26	36	0,28	4	M4094-1400BD	30656912
16,00	16	92	36	42	0,32	4	M4094-1600BD	30656913
18,00	18	92	36	42	0,36	4	M4094-1800BD	30656914
20,00	20	104	41	53	0,40	4	M4094-2000BD	30656915

Dimensions in mm.

* Design without neck.

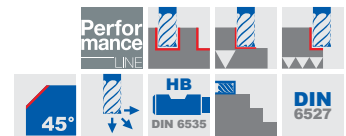
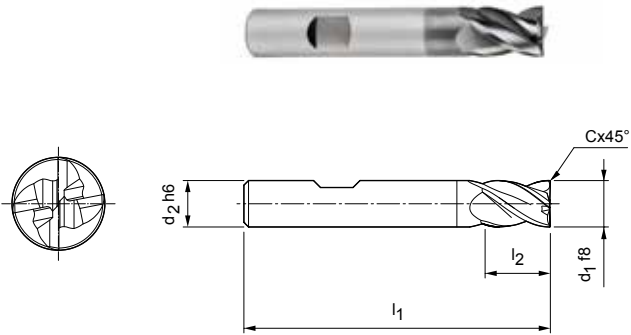
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Uni-HPC

Short design
M3090

Design:
Milling cutter diameter: 3,00-20,00 mm
Coating: MF3
Number of cutting edges: z = 4
Helix angle: 36°/38°
Special features: Unequal spacing



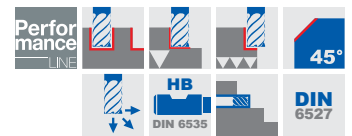
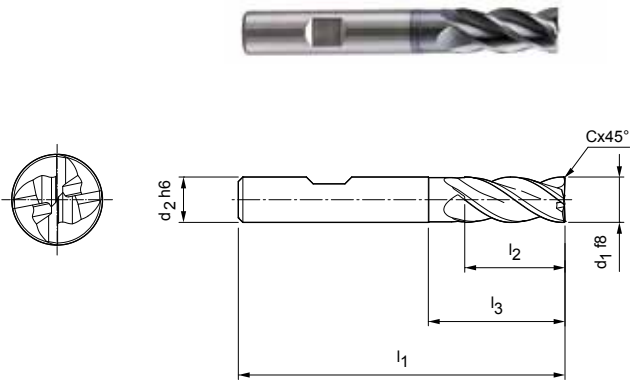
Dimensions					z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	C x 45°			
3,00	6	50	6	0,06	4	M3090-0300BY	30347219
4,00	6	54	8	0,08	4	M3090-0400BY	30347222
5,00	6	54	9	0,10	4	M3090-0500BY	30347223
6,00	6	54	10	0,12	4	M3090-0600BY	30347225
8,00	8	58	12	0,16	4	M3090-0800BY	30347226
10,00	10	66	14	0,20	4	M3090-1000BY	30343554
12,00	12	73	16	0,24	4	M3090-1200BY	30347228
14,00	14	73	16	0,28	4	M3090-1400BY	30347229
16,00	16	82	22	0,32	4	M3090-1600BY	30347231
18,00	18	82	22	0,36	4	M3090-1800BY	30347232
20,00	20	92	26	0,40	4	M3090-2000BY	30347233

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Uni-HPC

Long design with neck
M3094

Design:
Milling cutter diameter: 2,50-25,00 mm
Coating: MF3
Number of cutting edges: z = 4
Helix angle: 36°/38°
Special features: Unequal spacing

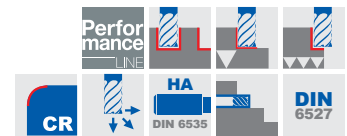
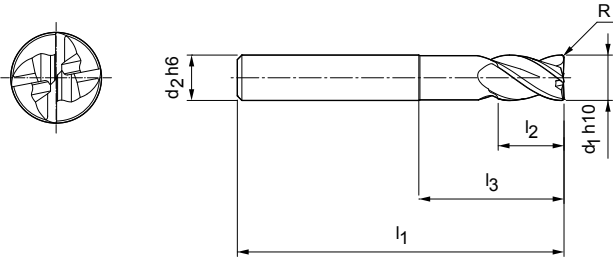


Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
2,50	6	57	8	-	-	4	M3094-0250BY	30486523
3,00	6	57	8	-	0,06	4	M3094-0300BY	30247226
4,00	6	57	11	-	0,08	4	M3094-0400BY	30247227
5,00	6	57	13	-	0,10	4	M3094-0500BY	30247228
6,00	6	57	13	20	0,12	4	M3094-0600BY	30247229
8,00	8	63	21	25	0,16	4	M3094-0800BY	30247230
10,00	10	72	22	30	0,20	4	M3094-1000BY	30247231
12,00	12	83	26	36	0,24	4	M3094-1200BY	30247232
14,00	14	83	26	36	0,28	4	M3094-1400BY	30247233
16,00	16	92	36	42	0,32	4	M3094-1600BY	30247234
18,00	18	92	36	47	0,36	4	M3094-1800BY	30247235
20,00	20	104	41	55	0,40	4	M3094-2000BY	30247236
25,00	25	136	68	80	0,50	4	M3094-2500BY	30345169

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill® -Uni-HPC-CR

Long design with neck
M3091



Dimensions						z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃	R			
3,00	6	50	5	-	0,30	4	M3091-0300AY	30269832
4,00	6	50	6	-	0,30	4	M3091-0400AY	30269833
5,00	6	57	8	-	0,30	4	M3091-0500AY	30269835
6,00	6	57	9	20	0,30	4	M3091-0600AY	30269836
8,00	8	63	12	26	0,50	4	M3091-0800AY	30269837
10,00	10	72	15	32	0,50	4	M3091-1000AY	30269838
12,00	12	83	18	38	0,50	4	M3091-1200AY	30269839
16,00	16	98	24	50	1,00	4	M3091-1600AY	30269840
20,00	20	112	30	62	1,00	4	M3091-2000AY	30269841

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

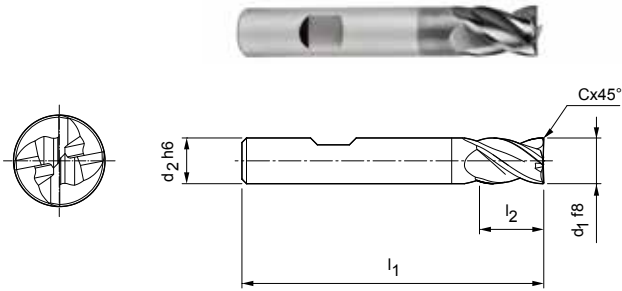
OptiMill® -Uni-HPC-Plus

Short design

M3090P (follow-up product of OptiMill-Uni-HPC)

Design:

Milling cutter diameter: 3,00-20,00 mm
 Coating: MF2
 Number of cutting edges: z = 4
 Helix angle: 36°/38°
 Special features: Unequal spacing, rounded cutting edge



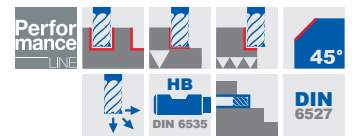
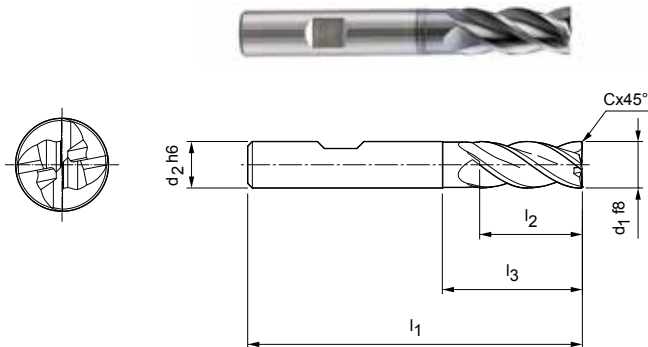
Dimensions					z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	C x 45°			
3,00	6	50	6	0,06	4	M3090P-0300BL	30673398
4,00	6	54	8	0,08	4	M3090P-0400BL	30673399
5,00	6	54	9	0,10	4	M3090P-0500BL	30673400
6,00	6	54	10	0,12	4	M3090P-0600BL	30673401
8,00	8	58	12	0,16	4	M3090P-0800BL	30673402
10,00	10	66	14	0,20	4	M3090P-1000BL	30673403
12,00	12	73	16	0,24	4	M3090P-1200BL	30673404
14,00	14	73	16	0,28	4	M3090P-1400BL	30673405
16,00	16	82	22	0,32	4	M3090P-1600BL	30673406
18,00	18	82	22	0,36	4	M3090P-1800BL	30673407
20,00	20	92	26	0,40	4	M3090P-2000BL	30673408

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

OptiMill® -Uni-HPC-Plus

Long design with neck
M3094P (follow-up product of OptiMill-Uni-HPC)

Design:
Milling cutter diameter: 2,50-25,00 mm
Coating: MF2
Number of cutting edges: $z = 4$
Helix angle: $36^\circ/38^\circ$
Special features: Unequal spacing, rounded cutting edge



Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
*2,50	6	57	8	-	0,05	4	M3094P-0250BL	30673409
*3,00	6	57	8	-	0,06	4	M3094P-0300BL	30673410
*4,00	6	57	11	-	0,08	4	M3094P-0400BL	30673411
*5,00	6	57	13	-	0,10	4	M3094P-0500BL	30673412
6,00	6	57	13	20	0,12	4	M3094P-0600BL	30673413
7,00	8	63	16	25	0,14	4	M3094P-0700BL	30673414
8,00	8	63	21	25	0,16	4	M3094P-0800BL	30673415
9,00	10	72	22	30	0,18	4	M3094P-0900BL	30673416
10,00	10	72	22	30	0,20	4	M3094P-1000BL	30673417
12,00	12	83	26	36	0,24	4	M3094P-1200BL	30673418
14,00	14	83	26	36	0,28	4	M3094P-1400BL	30673419
16,00	16	92	36	42	0,32	4	M3094P-1600BL	30673420
18,00	18	92	36	47	0,36	4	M3094P-1800BL	30673421
20,00	20	104	41	55	0,40	4	M3094P-2000BL	30673422
25,00	25	136	68	80	0,50	4	M3094P-2500BL	30673423

* Design without neck.

Dimensions in mm.

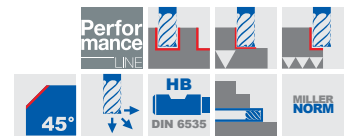
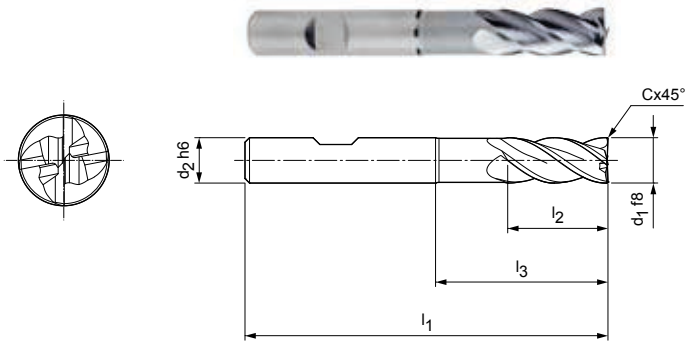
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Uni-HPC-Plus

Overlong design with neck
M3190P

Design:
Milling cutter diameter: 5,00-25,00 mm
Coating: MF2
Number of cutting edges: z = 4
Helix angle: 36°/38°
Special features: Unequal spacing, rounded cutting edge



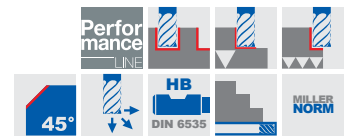
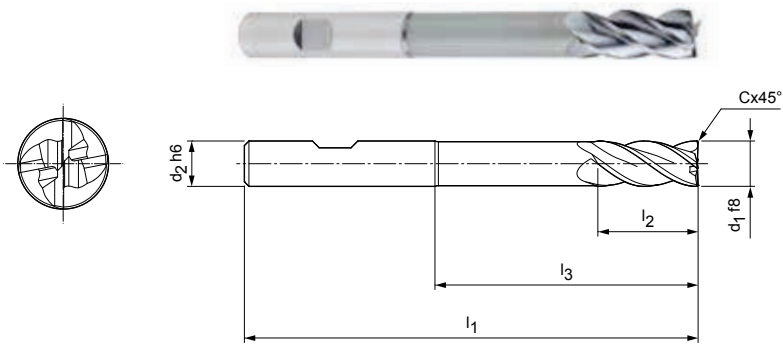
Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
5,00	6	62	13	24	0,10	4	M3190P-0500BL	30636550
6,00	6	62	13	25	0,12	4	M3190P-0600BL	30636585
8,00	8	68	21	30	0,16	4	M3190P-0800BL	30636586
10,00	10	80	22	38	0,20	4	M3190P-1000BL	30636588
12,00	12	93	26	46	0,24	4	M3190P-1200BL	30636590
14,00	14	99	26	52	0,28	4	M3190P-1400BL	30636591
16,00	16	108	36	58	0,32	4	M3190P-1600BL	30636592
18,00	18	117	36	67	0,36	4	M3190P-1800BL	30651264
20,00	20	126	41	74	0,40	4	M3190P-2000BL	30636594
25,00	25	150	50	92	0,50	4	M3190P-2500BL	30636595

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill® -Uni-HPC-Plus

Extra long design with neck
M3194P

Design:
Milling cutter diameter: 5,00-25,00 mm
Coating: MF2
Number of cutting edges: z = 4
Helix angle: 36°/38°
Special features: Unequal spacing, rounded cutting edge



Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
5,00	6	80	13	41	0,10	4	M3194P-0500BL	30652455
6,00	6	80	13	42	0,12	4	M3194P-0600BL	30652456
8,00	8	100	21	62	0,16	4	M3194P-0800BL	30652457
10,00	10	100	22	58	0,20	4	M3194P-1000BL	30652458
12,00	12	120	26	73	0,24	4	M3194P-1200BL	30652459
14,00	14	120	26	73	0,28	4	M3194P-1400BL	30652461
16,00	16	150	36	100	0,32	4	M3194P-1600BL	30652462
18,00	18	150	36	100	0,36	4	M3194P-1800BL	30652463
20,00	20	150	41	98	0,40	4	M3194P-2000BL	30652464
25,00	25	175	50	117	0,50	4	M3194P-2500BL	30652465

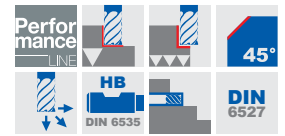
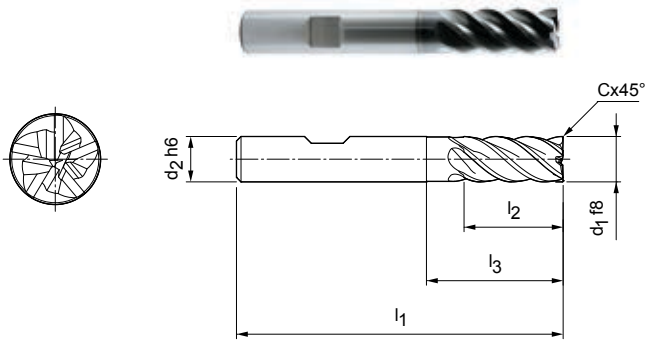
Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill® -Uni-HPC-Silent

Long design with neck
M3095

Design:

Milling cutter diameter: 6,00-25,00 mm
Coating: MF2
Number of cutting edges: z = 5
Helix angle: 41°-42°
Special features: Unequal spacing



Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
6,00	6	57	13	20	0,12	5	M3095-0600BL	30479500
8,00	8	63	19	25	0,16	5	M3095-0800BL	30482153
10,00	10	72	22	30	0,20	5	M3095-1000BL	30482154
12,00	12	83	26	36	0,24	5	M3095-1200BL	30482155
14,00	14	83	26	36	0,28	5	M3095-1400BL	30491448
16,00	16	92	32	42	0,32	5	M3095-1600BL	30482156
18,00	18	92	32	42	0,36	5	M3095-1800BL	30491450
20,00	20	104	41	52	0,40	5	M3095-2000BL	30482157
25,00	25	125	50	65	0,50	5	M3095-2500BL	30482158

Dimensions in mm.

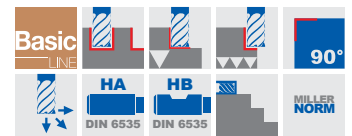
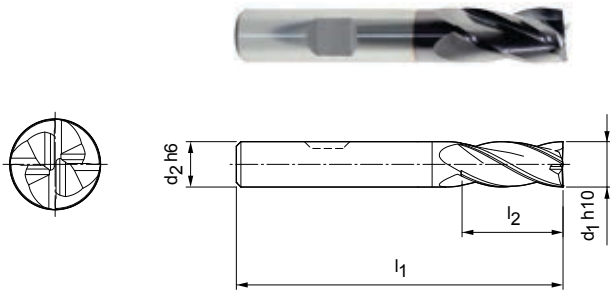
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Inox

Short design
M3634

Design:
Milling cutter diameter: 2,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 4
Helix angle: 30°



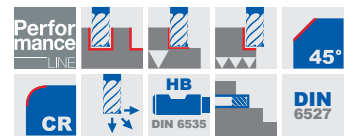
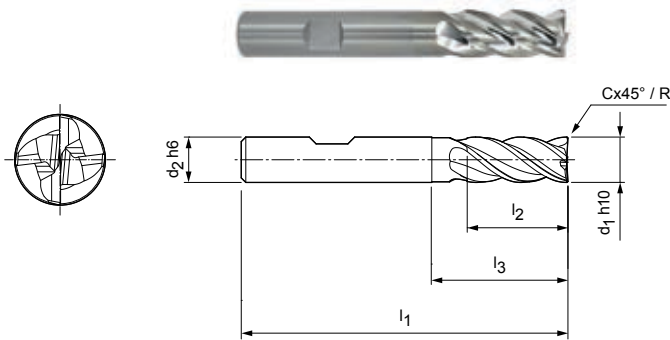
Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
2,00	2	32	8	4	M3634-0200AZ	30247216
3,00	3	32	12	4	M3634-0300AZ	30247217
4,00	4	40	12	4	M3634-0400AZ	30247218
5,00	5	50	14	4	M3634-0500AZ	30247219
6,00	6	50	16	4	M3634-0600BZ	30247220
8,00	8	60	20	4	M3634-0800BZ	30247221
10,00	10	72	22	4	M3634-1000BZ	30247222
12,00	12	72	22	4	M3634-1200BZ	30247223
16,00	16	75	25	4	M3634-1600BZ	30247224
20,00	20	100	32	4	M3634-2000BZ	30247225

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Titan-HPC

Long design with neck
M3694

Design:
Milling cutter diameter: 6,00-20,00 mm
Coating: Uncoated
Number of cutting edges: z = 4
Helix angle: ~ 39°



Dimensions							z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃	C x 45°	R			
6,00	6	57	13	20	0,12	–	4	M3694-0600BU-C0012	30395299
6,00	6	57	13	20	–	0,50	4	M3694-0600BU-R0050	30395300
8,00	8	63	19	25	0,16	–	4	M3694-0800BU-C0016	30395305
8,00	8	63	19	25	–	0,50	4	M3694-0800BU-R0050	30395306
10,00	10	72	22	30	0,20	–	4	M3694-1000BU-C0020	30395307
10,00	10	72	22	30	–	0,50	4	M3694-1000BU-R0050	30395308
10,00	10	72	22	30	–	1,00	4	M3694-1000BU-R0100	30395309
12,00	12	83	26	36	0,24	–	4	M3694-1200BU-C0024	30395313
12,00	12	83	26	36	–	0,50	4	M3694-1200BU-R0050	30395316
12,00	12	83	26	36	–	1,00	4	M3694-1200BU-R0100	30395319
12,00	12	83	26	36	–	1,50	4	M3694-1200BU-R0150	30395320
14,00	14	83	26	36	0,28	–	4	M3694-1400BU-C0028	30395321
14,00	14	83	26	36	–	1,00	4	M3694-1400BU-R0100	30395322
16,00	16	92	36	42	0,32	–	4	M3694-1600BU-C0032	30395325
16,00	16	92	36	42	–	1,00	4	M3694-1600BU-R0100	30395327
16,00	16	92	36	42	–	1,50	4	M3694-1600BU-R0150	30395328
16,00	16	92	36	42	–	2,00	4	M3694-1600BU-R0200	30395329
20,00	20	104	41	52	0,40	–	4	M3694-2000BU-C0040	30395330
20,00	20	104	41	52	–	1,50	4	M3694-2000BU-R0150	30395332
20,00	20	104	41	52	–	2,00	4	M3694-2000BU-R0200	30395334
20,00	20	104	41	52	–	2,50	4	M3694-2000BU-R0250	30395336

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Titan-HPC

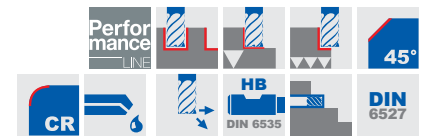
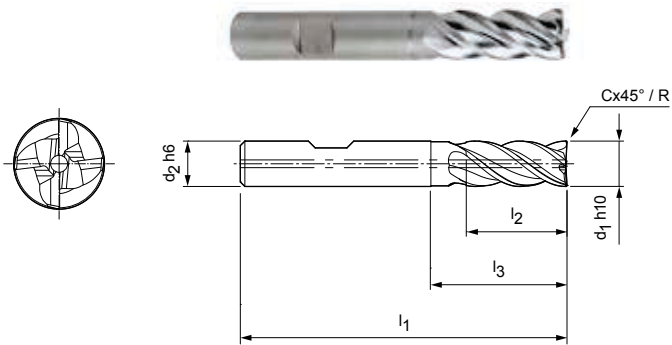
Long design with neck, with internal cooling
M3794

Design:

Milling cutter diameter: 6,00-20,00 mm
Coating: Uncoated
Number of cutting edges: $z = 4$
Helix angle: $\sim 39^\circ$

Application:

Axial plunging not possible – max. 3° ramp.



Dimensions							z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃	C x 45°	R			
6,00	6	57	13	20	0,12	–	4	M3794-0600BU-C0012	30395230
6,00	6	57	13	20	–	0,50	4	M3794-0600BU-R0050	30395235
8,00	8	63	19	25	0,16	–	4	M3794-0800BU-C0016	30395241
8,00	8	63	19	25	–	0,50	4	M3794-0800BU-R0050	30395242
10,00	10	72	22	30	0,20	–	4	M3794-1000BU-C0020	30395243
10,00	10	72	22	30	–	0,50	4	M3794-1000BU-R0050	30395245
10,00	10	72	22	30	–	1,00	4	M3794-1000BU-R0100	30395246
12,00	12	83	26	36	0,24	–	4	M3794-1200BU-C0024	30395251
12,00	12	83	26	36	–	0,50	4	M3794-1200BU-R0050	30395252
12,00	12	83	26	36	–	1,00	4	M3794-1200BU-R0100	30395254
12,00	12	83	26	36	–	1,50	4	M3794-1200BU-R0150	30395255
14,00	14	83	26	36	0,28	–	4	M3794-1400BU-C0028	30395256
14,00	14	83	26	36	–	1,00	4	M3794-1400BU-R0100	30395257
16,00	16	92	36	42	0,32	–	4	M3794-1600BU-C0032	30395258
16,00	16	92	36	42	–	1,00	4	M3794-1600BU-R0100	30395259
16,00	16	92	36	42	–	1,50	4	M3794-1600BU-R0150	30395261
16,00	16	92	36	42	–	2,00	4	M3794-1600BU-R0200	30395262
20,00	20	104	41	52	0,40	–	4	M3794-2000BU-C0040	30395264
20,00	20	104	41	52	–	1,50	4	M3794-2000BU-R0150	30395266
20,00	20	104	41	52	–	2,00	4	M3794-2000BU-R0200	30395268
20,00	20	104	41	52	–	2,50	4	M3794-2000BU-R0250	30395269

Dimensions in mm.

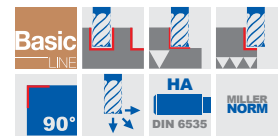
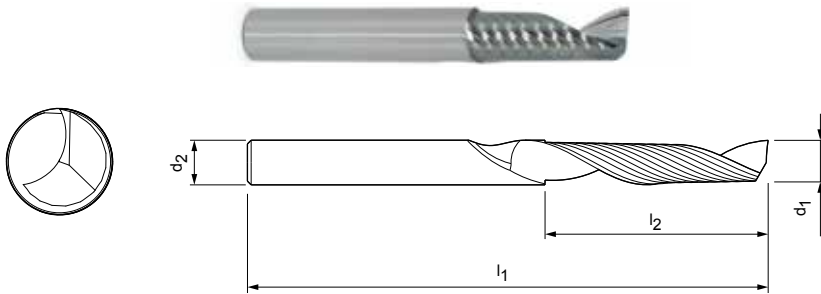
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Mono-Alu

Different designs, right-hand helix groove
Type 200R

Design:
Milling cutter diameter: 2,00-12,70 mm
Coating: Uncoated
Number of cutting edges: z = 1
Helix angle: 30°



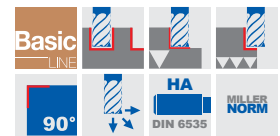
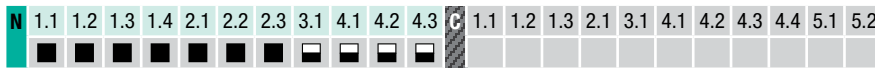
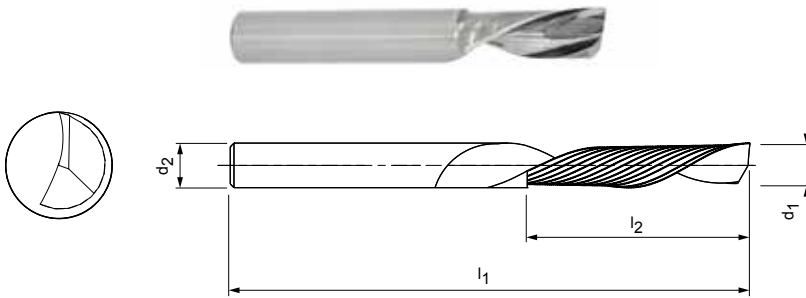
Dimensions				z	Specification	Order No.
d ₁	d ₂	l ₁	l ₂			
2,00	3	38	5	1	MN7MA1A0200	30253284
2,50	3	38	6	1	MN7MA1A0250	30230396
3,00	3	38	8	1	MN7MA1A0300	30218904
3,00	4	38	8	1	MN7MA1B0300	30218905
3,17	3,17	38	8	1	MN7MA1A0317	30218906
3,17	4,76	38	8	1	MN7MA1B0317	30218907
3,17	6,35	38	8	1	MN7MA1C0317	30218908
4,00	4	40	12	1	MN7MA1A0400	30218919
4,00	4	70	30	1	MN7MA1B0400	30218920
4,00	6	50	10	1	MN7MA1C0400	30218921
4,76	4,76	51	13	1	MN7MA1A0476	30218922
4,76	6,35	51	13	1	MN7MA1B0476	30230397
5,00	5	60	15	1	MN7MA1A0500	30218923
5,00	5	70	30	1	MN7MA1B0500	30218924
5,00	6	50	12	1	MN7MA1C0500	30218925
6,00	6	60	20	1	MN7MA1A0600	30218926
6,00	6	70	30	1	MN7MA1B0600	30218927
6,00	6	80	38	1	MN7MA1C0600	30218928
6,00	6	70	15	1	MN7MA1D0600	30218929
6,00	6	50	12	1	MN7MA1E0600	30218930
6,35	6,35	51	16	1	MN7MA1A0635	30218931
8,00	8	60	20	1	MN7MA1A0800	30218932
8,00	8	80	38	1	MN7MA1B0800	30218933
10,00	10	75	30	1	MN7MA1A1000	30218934
10,00	10	60	25	1	MN7MA1B1000	30218935
10,00	10	100	25	1	MN7MA1C1000	30218936
10,00	12	90	25	1	MN7MA1D1000	30218937
12,70	12,70	89	29	1	MN7MA1A1270	30218938

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Mono-Alu

Different designs, left-hand helix groove
Type 200L

Design:
Milling cutter diameter: 2,50-10,00 mm
Coating: Uncoated
Number of cutting edges: z = 1
Helix angle: 30°



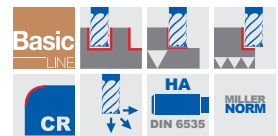
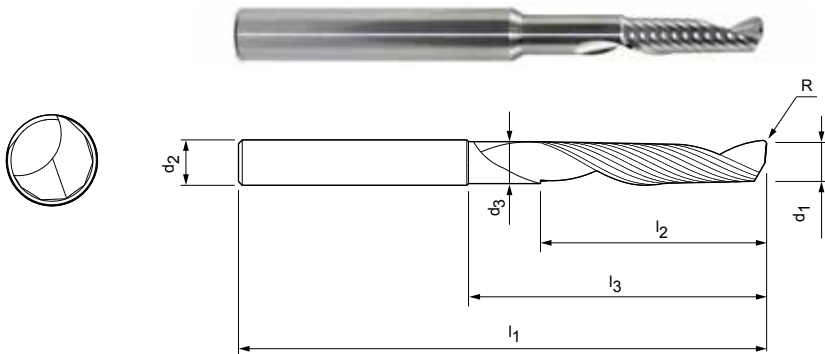
Dimensions				z	Specification	Order No.
d ₁	d ₂	l ₁	l ₂			
2,50	3	38	6	1	MN7MA2A0250	30230591
3,00	4	38	8	1	MN7MA2A0300	30230592
3,17	6,35	38	8	1	MN7MA2A0317	30230596
4,00	4	40	12	1	MN7MA2A0400	30230597
4,00	6	50	10	1	MN7MA2B0400	30230601
4,76	6,35	51	13	1	MN7MA2A0476	30230603
5,00	5	60	15	1	MN7MA2A0500	30230608
5,00	6	50	12	1	MN7MA2B0500	30230609
6,00	6	60	15	1	MN7MA2A0600	30230611
6,35	6,35	51	16	1	MN7MA2A0635	30230614
8,00	8	60	20	1	MN7MA2A0800	30230616
10,00	10	60	25	1	MN7MA2A1000	30230618

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Mono-Alu

Different designs with neck and corner radius, right-hand helix groove
Type 200RY

Design:
Milling cutter diameter: 5,00-12,00 mm
Coating: Uncoated
Number of cutting edges: z = 1
Helix angle: 30°



Dimensions							z	Specification	Order No.
d ₁	d ₂	d ₃	l ₁	l ₂	l ₃	R			
5,00	6	4,9	70	20	30	1,00	1	MN7MA3A0500	30237645
6,00	8	5,6	80	20	35	1,50	1	MN7MA3A0600	30237646
8,00	10	7,6	90	22	45	1,50	1	MN7MA3A0800	30237647
10,00	10	9,5	100	25	50	2,00	1	MN7MA3A1000	30237649
10,00	12	9,5	90	25	50	2,00	1	MN7MA3A1000	30237650
12,00	12	11,5	120	30	60	2,50	1	MN7MA3A1200	30237651

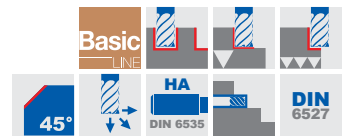
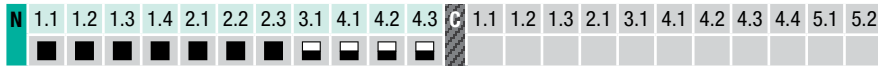
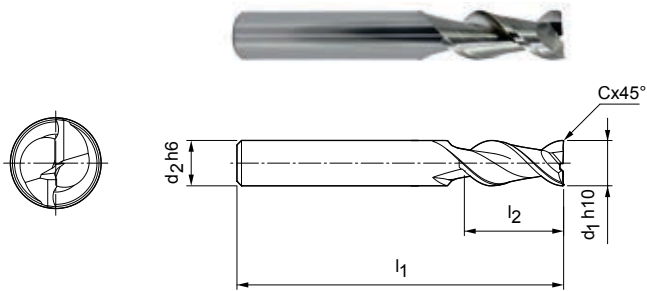
Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Alu

Long design
M3442

Design:

Milling cutter diameter: 2,00-20,00 mm
Coating: Uncoated
Number of cutting edges: $z = 2$
Helix angle: 45°



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
2,00	6	57	6	0,03	2	M3442-0200AU	30269763
3,00	6	57	8	0,05	2	M3442-0300AU	30247120
4,00	6	57	11	0,06	2	M3442-0400AU	30247121
5,00	6	57	13	0,08	2	M3442-0500AU	30247122
6,00	6	57	13	0,09	2	M3442-0600AU	30247123
8,00	8	63	19	0,12	2	M3442-0800AU	30247124
10,00	10	72	22	0,15	2	M3442-1000AU	30247125
12,00	12	83	26	0,18	2	M3442-1200AU	30247126
16,00	16	92	32	0,24	2	M3442-1600AU	30247127
20,00	20	104	38	0,30	2	M3442-2000AU	30247128

Dimensions in mm.

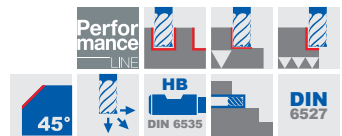
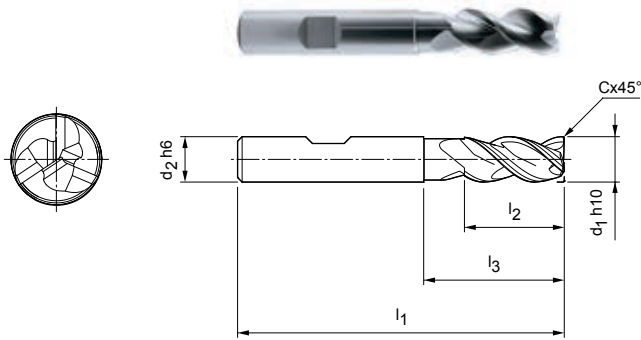
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Alu-HPC

Long design with neck
M3493

Design:
Milling cutter diameter: 3,00-20,00 mm
Coating: Uncoated
Number of cutting edges: z = 3,
Helix angle: 42°-43°
Special features: Unequal spacing,
grooves polished



Dimensions						z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
*3,00	6	57	8	–	0,06	3	M3493-0300BU	30248238
*4,00	6	57	11	–	0,08	3	M3493-0400BU	30248241
*5,00	6	57	13	–	0,10	3	M3493-0500BU	30248242
6,00	6	57	13	18	0,12	3	M3493-0600BU	30248243
8,00	8	63	21	25	0,16	3	M3493-0800BU	30248244
10,00	10	72	22	30	0,20	3	M3493-1000BU	30248245
12,00	12	83	26	36	0,24	3	M3493-1200BU	30248246
16,00	16	92	36	42	0,32	3	M3493-1600BU	30248247
20,00	20	104	41	52	0,40	3	M3493-2000BU	30248248

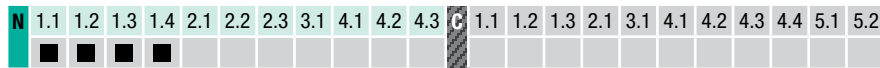
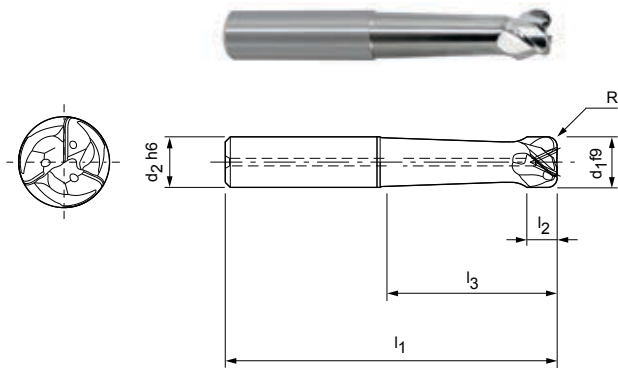
Dimensions in mm.
* Design without neck.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill® -Volume-N

Different designs with internal cooling
M3591/M3593

Design:
Milling cutter diameter: 6,00-32,00 mm
Coating: Uncoated
Number of cutting edges: z = 3
Helix angle: 43°

Application:
For machining of structural parts made of aluminium.



Short design | M3593

Dimensions						z	Specification	Order No.
d ₁ f9	d ₂ h6	l ₁	l ₂	l ₃	R			
14,00	16	77	11,2	24,5	3,00	3	M3593-1400AU	30612310
15,00	16	78	12	26,25	3,00	3	M3593-1500AU	30612311
16,00	16	81	12,8	28	3,00	3	M3593-1600AU	30612312
18,00	20	87	14,4	31,5	3,00	3	M3593-1800AU	30612313
20,00	20	90	16	35	3,00	3	M3593-2000AU	30612314
25,00	25	107	20	43,75	4,00	3	M3593-2500AU	30612315
32,00	32	125	25,6	56	4,00	3	M3593-3200AU	30612316

Long design | M3591

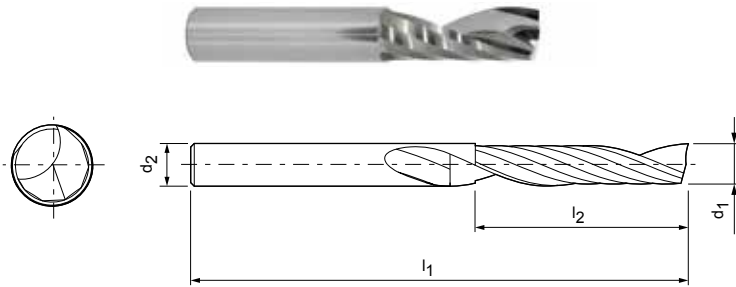
6,00	6	60	4,8	19,5	1,00	3	M3591-0600AU	30612317
8,00	8	70	6,4	26	1,00	3	M3591-0800AU	30612318
10,00	10	80	8	32,5	2,00	3	M3591-1000AU	30612319
12,00	12	90	9,6	39	2,00	3	M3591-1200AU	30612320
14,00	16	99	11,2	45,5	3,00	3	M3591-1400AU	30612321
15,00	16	100	12	48,75	3,00	3	M3591-1500AU	30612322
16,00	16	105	12,8	52	3,00	3	M3591-1600AU	30612323
18,00	20	114	14,4	58,5	3,00	3	M3591-1800AU	30612324
20,00	20	120	16	65	3,00	3	M3591-2000AU	30612325
25,00	25	145	20	81,25	4,00	3	M3591-2500AU	30612326
32,00	32	173	25,6	104	4,00	3	M3591-3200AU	30612327

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

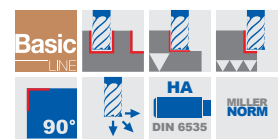
OptiMill® -Mono-Plastic

Different designs, right-hand helix groove
Type 100R

Design:
Milling cutter diameter: 2,00-12,70 mm
Coating: Uncoated
Number of cutting edges: z = 1



N	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	4.1	4.2	4.3	C	1.1	1.2	1.3	2.1	3.1	4.1	4.2	4.3	4.4	5.1	5.2
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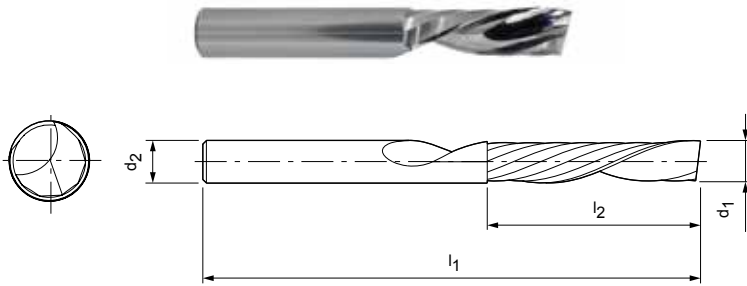
Dimensions				z	Specification	Order No.
d ₁	d ₂	l ₁	l ₂			
2,00	3	38	8	1	MN7MP1A0200	30253277
2,50	3	38	8	1	MN7MP1A0250	30230388
3,00	3	38	10	1	MN7MP1A0300	30216602
3,00	4	38	10	1	MN7MP1B0300	30216609
3,00	4	50	15	1	MN7MP1C0300	30216610
3,00	6	50	10	1	MN7MP1D0300	30216611
3,17	6,35	38	13	1	MN7MP1A0317	30216612
3,17	4,76	38	13	1	MN7MP1B0317	30216613
3,17	3,17	51	13	1	MN7MP1C0317	30216614
4,00	4	40	12	1	MN7MP1A0400	30216615
4,00	4	60	20	1	MN7MP1B0400	30216616
4,00	4	70	30	1	MN7MP1C0400	30216617
4,00	6	50	15	1	MN7MP1D0400	30216618
4,00	4	50	13	1	MN7MP1E0400	30230389
4,76	4,76	51	16	1	MN7MP1A0476	30216619
5,00	5	50	16	1	MN7MP1A0500	30216620
5,00	5	70	30	1	MN7MP1B0500	30216621
5,00	5	60	15	1	MN7MP1C0500	30230390
5,00	6	50	16	1	MN7MP1D0500	30231256
6,00	6	60	21	1	MN7MP1A0600	30216622
6,00	6	70	30	1	MN7MP1B0600	30216623
6,00	6	80	38	1	MN7MP1C0600	30216624
6,35	6,35	51	19	1	MN7MP1A0635	30216625
6,35	6,35	77	38	1	MN7MP1B0635	30216626
8,00	8	60	25	1	MN7MP1A0800	30216627
8,00	8	80	38	1	MN7MP1B0800	30216628
9,52	9,52	77	29	1	MN7MP1A0952	30274466
10,00	10	75	30	1	MN7MP1A1000	30216629
10,00	10	75	20	1	MN7MP1B1000	30219773
12,00	12	75	30	1	MN7MP1A1200	30216630
12,70	12,7	77	32	1	MN7MP1A1270	30216632

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

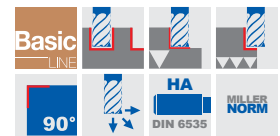
OptiMill® -Mono-Plastic

Different designs, left-hand helix groove
Type 100L

Design:
Milling cutter diameter: 2,00-10,00 mm
Coating: Uncoated
Number of cutting edges: z = 1



N	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	4.1	4.2	4.3	C	1.1	1.2	1.3	2.1	3.1	4.1	4.2	4.3	4.4	5.1	5.2
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Dimensions				z	Specification	Order No.
d ₁	d ₂	l ₁	l ₂			
2,00	3	38	8	1	MN7MP2A0200	30253278
2,50	3	38	8	1	MN7MP2A0250	30230391
3,00	3	38	10	1	MN7MP2A0300	30216634
3,00	4	38	10	1	MN7MP2B0300	30216636
3,00	4	50	15	1	MN7MP2C0300	30216637
3,00	6	50	10	1	MN7MP2D0300	30216638
3,17	6,35	38	13	1	MN7MP2A0317	30216640
4,00	4	40	12	1	MN7MP2A0400	30216641
4,00	4	60	20	1	MN7MP2B0400	30216642
4,00	4	70	30	1	MN7MP2C0400	30216643
4,00	6	50	15	1	MN7MP2D0400	30216644
4,00	4	50	13	1	MN7MP2E0400	30230392
4,76	4,76	51	16	1	MN7MP2A0476	30216645
4,76	6,35	51	16	1	MN7MP2B0476	30274465
5,00	5	50	16	1	MN7MP2A0500	30216646
5,00	5	70	30	1	MN7MP2B0500	30231254
5,00	5	60	15	1	MN7MP2C0500	30230393
6,00	6	60	20	1	MN7MP2A0600	30216647
6,00	6	70	30	1	MN7MP2B0600	30216648
6,00	6	80	38	1	MN7MP2C0600	30230394
6,35	6,35	51	19	1	MN7MP2A0635	30216649
8,00	8	60	25	1	MN7MP2A0800	30216650
8,00	8	80	38	1	MN7MP2B0800	30230395
10,00	10	75	30	1	MN7MP2A1000	30216651
10,00	10	75	20	1	MN7MP2B1000	30216652

Dimensions in mm.

Cutting data recommendation from page 118.

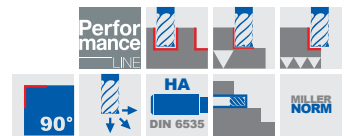
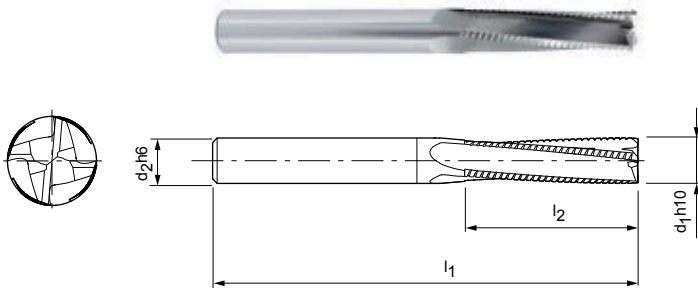
Special designs and other coatings on request.

OptiMill®-Softfoam

Long design
M7624

Design:
Milling cutter diameter: 4,00-16,00 mm
Coating: Uncoated
Number of cutting edges: $z = 4$
Helix angle: 6°

Application:
Especially for milling soft foam.



Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
4,00	4	60	25	4	M7624-0400AU	30313788
6,00	6	64,7	30	4	M7624-0600AU	30291377
8,00	8	75	30	4	M7624-0800AU	30313789
12,00	12	83	32	4	M7624-1200AU	30313790
16,00	16	92	36	4	M7624-1600AU	30313791

Dimensions in mm.

Cutting data recommendation from page 118.

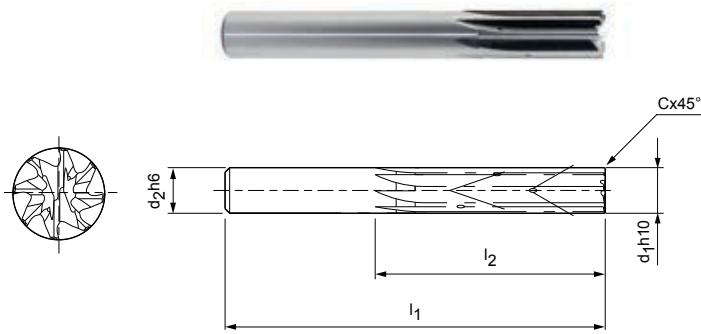
Special designs and other coatings on request.

OptiMill®-Hardfoam

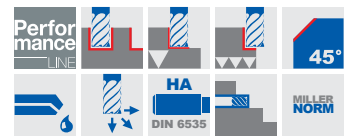
Long design with internal cooling
M7718

Design:
Milling cutter diameter: 6,00-20,00 mm
Coating: Uncoated
Number of cutting edges: z = 8
Helix angle: 0°

Application:
Especially for milling hard foam.



N	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	4.1	4.2	4.3	C	1.1	1.2	1.3	2.1	3.1	4.1	4.2	4.3	4.4	5.1	5.2
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Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
6,00	6	75	28	0,12	8	M7718-0600AU-C0012	30661254
6,35	8	75	28	0,13	8	M7718-0635AU-C0013	30671646
8,00	8	75	32	0,16	8	M7718-0800AU-C0016	30661261
9,53	10	72	32	0,19	8	M7718-0953AU-C0019	30671647
10,00	10	72	32	0,20	8	M7718-1000AU-C0020	30661262
12,00	12	83	32	0,24	8	M7718-1200AU-C0024	30671648
16,00	16	92	36	0,32	8	M7718-1600AU-C0032	30671649
20,00	20	104	45	0,40	8	M7718-2000AU-C0040	30671650

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Thermoplastic

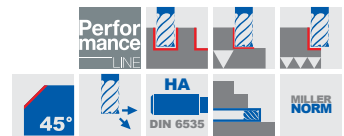
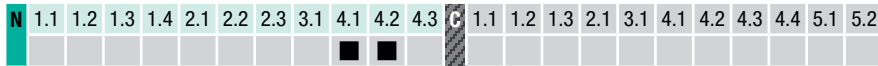
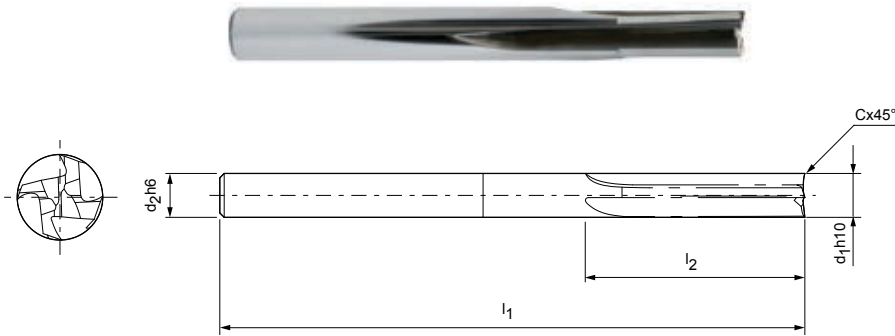
Overlong design
M7614

Design:

Milling cutter diameter: 3,00-20,00 mm
Coating: Uncoated
Number of cutting edges: $z = 4$
Helix angle: $0^\circ/3^\circ$

Application:

Especially for milling thermoplastics. Very sharp cutting edges reduce the heat produced during milling to a minimum and ensure optimal removal of the chips.



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
3,00	6	62	8	0,03	4	M7614-0300AU-C0003	30671651
4,00	6	62	11	0,04	4	M7614-0400AU-C0004	30661232
5,00	6	62	13	0,05	4	M7614-0500AU-C0005	30671652
6,00	6	62	13	0,06	4	M7614-0600AU-C0006	30661233
6,35	8	68	15	0,06	4	M7614-0635AU-C0006	30671653
8,00	8	68	19	0,08	4	M7614-0800AU-C0008	30661235
9,53	10	80	22	0,10	4	M7614-0953AU-C0010	30671654
10,00	10	80	22	0,10	4	M7614-1000AU-C0010	30661228
12,00	12	93	26	0,12	4	M7614-1200AU-C0012	30671655
16,00	16	108	32	0,16	4	M7614-1600AU-C0016	30671656
20,00	20	126	38	0,20	4	M7614-2000AU-C0020	30671657

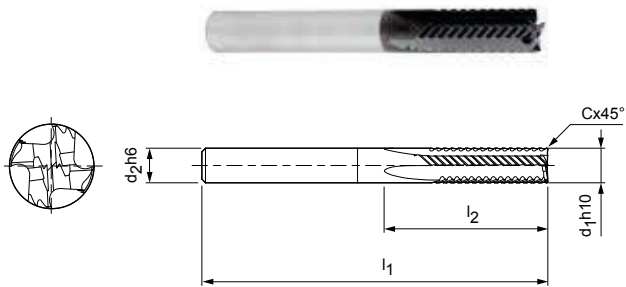
Dimensions in mm.

Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill®-Thermoplastic-FR

Overlong design
M7644



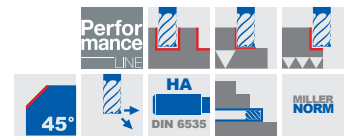
Design:

Milling cutter diameter: 4,00-20,00 mm
Coating: Diamond coating
Number of cutting edges: $z = 4$
Helix angle: 0°
Special features: Diamond coating for long tool life

Application:

For the cost-effective machining of thermoplastics with fibre reinforcement. Due to special high-performance teeth, the fibres are cut cleanly at the cutting edge without burr formation.

N	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	4.1	4.2	4.3	C	1.1	1.2	1.3	2.1	3.1	4.1	4.2	4.3	4.4	5.1	5.2	



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	62	11	0,08	4	M7644-0400AQ-C0008	30661550
5,00	6	62	13	0,10	4	M7644-0500AQ-C0010	30661551
6,00	6	62	13	0,12	4	M7644-0600AQ-C0012	30661552
6,35	8	68	15	0,13	4	M7644-0635AQ-C0013	30661554
8,00	8	68	19	0,16	4	M7644-0800AQ-C0016	30661555
9,53	10	80	22	0,19	4	M7644-0953AQ-C0019	30661556
10,00	10	80	22	0,20	4	M7644-1000AQ-C0020	30661557
12,00	12	93	26	0,24	4	M7644-1200AQ-C0024	30661558
16,00	16	108	32	0,32	4	M7644-1600AQ-C0032	30661559
20,00	20	126	38	0,40	4	M7644-2000AQ-C0040	30661560

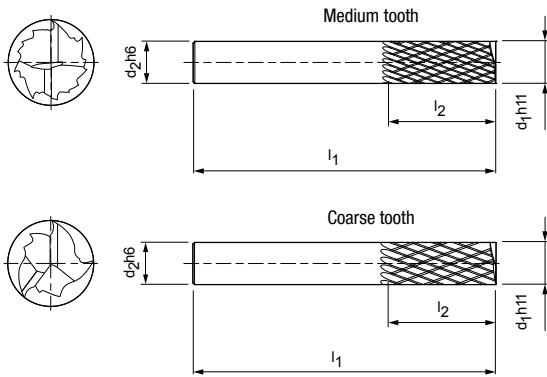
Dimensions in mm.

Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill®-Composite-MT

Long/overlong design, pulling cutting edge
M7001/M7002



Design:
Milling cutter diameter: 4,00-20,00 mm
Coating: Uncoated
Number of cutting edges: Multiple

Application:
Pulling cutting edge for better removal of the chips/dust (e.g. on milling pockets and slots). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the underside of the part.

Medium tooth for CFRP/GFRP > 40 % fibre portion

Coarse tooth for CFRP/GFRP < 40 % fibre portion



Medium tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7001-0400AU	30290439
5,00	5	50	16	Multiple	M7001-0500AU	30290440
5,00	5	75	16	Multiple	M7001-0500AU	30290441
6,00	6	60	19	Multiple	M7001-0600AU	30290442
6,00	6	75	30	Multiple	M7001-0600AU	30290443
8,00	8	63	25	Multiple	M7001-0800AU	30290444
8,00	8	75	35	Multiple	M7001-0800AU	30290445
10,00	10	72	25	Multiple	M7001-1000AU	30290446
12,00	12	83	32	Multiple	M7001-1200AU	30290447
16,00	16	92	36	Multiple	M7001-1600AU	30290448
20,00	20	104	45	Multiple	M7001-2000AU	30290449

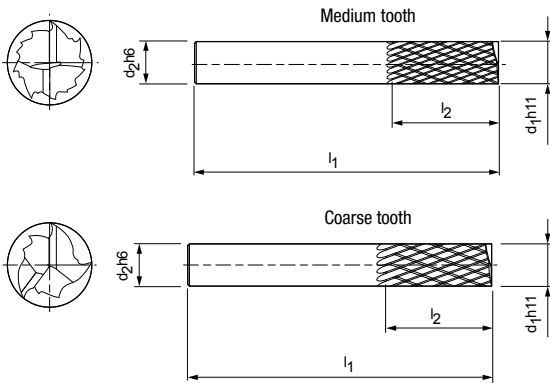
Coarse tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7002-0400AU	30290450
5,00	5	50	16	Multiple	M7002-0500AU	30290451
5,00	5	75	16	Multiple	M7002-0500AU	30290452
6,00	6	60	19	Multiple	M7002-0600AU	30290453
6,00	6	75	30	Multiple	M7002-0600AU	30290454
8,00	8	63	25	Multiple	M7002-0800AU	30290455
8,00	8	75	35	Multiple	M7002-0800AU	30290456
10,00	10	72	25	Multiple	M7002-1000AU	30290457
12,00	12	83	32	Multiple	M7002-1200AU	30290458
16,00	16	92	36	Multiple	M7002-1600AU	30290459
20,00	20	104	45	Multiple	M7002-2000AU	30290460

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Composite-MT

Long design, pushing cutting edge
M7003/M7004

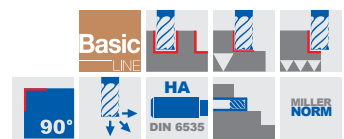
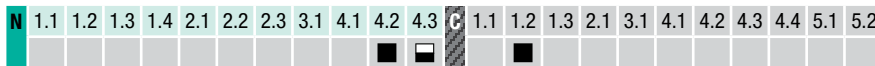


Design:
Milling cutter diameter: 4,00-10,00 mm
Coating: Uncoated
Number of cutting edges: Multiple

Application:
Pushing cutting edge, the material is pressed onto the substrate (e.g. very suitable for vacuum clamping). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the upper side of the part.

Medium tooth for CFRP/GFRP > 40 % fibre portion

Coarse tooth for CFRP/GFRP < 40 % fibre portion



Medium tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7003-0400AU	30290461
5,00	5	50	16	Multiple	M7003-0500AU	30290462
6,00	6	60	19	Multiple	M7003-0600AU	30290463
10,00	10	72	25	Multiple	M7003-1000AU	30290464

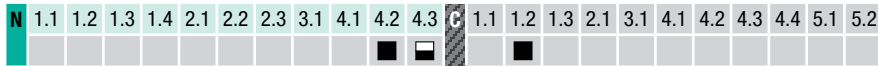
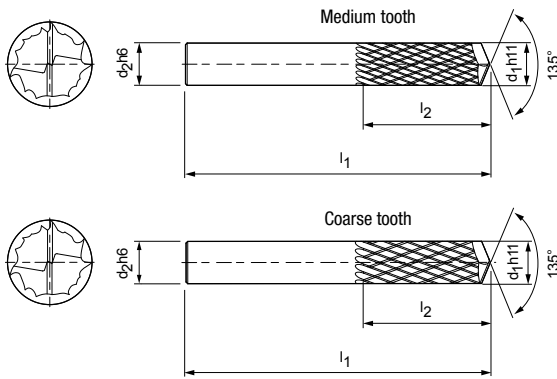
Coarse tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7004-0400AU	30290465
5,00	5	50	16	Multiple	M7004-0500AU	30290466
6,00	6	60	19	Multiple	M7004-0600AU	30290467
10,00	10	72	25	Multiple	M7004-1000AU	30290468

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Composite-MT

Long / overlong design with drill point, pulling cutting edge
M7011/M7012



Design:
Milling cutter diameter: 4,00-20,00 mm
Coating: Uncoated
Number of cutting edges: Multiple

Application:
Pulling cutting edge for better removal of the chips/dust (e.g. on milling pockets and slots). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the underside of the part.

Medium tooth for CFRP/GFRP > 40 % fibre portion

Coarse tooth for CFRP/GFRP < 40 % fibre portion



Medium tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7011-0400AU	30290469
5,00	5	50	16	Multiple	M7011-0500AU	30290470
5,00	5	75	16	Multiple	M7011-0500AU	30290471
6,00	6	60	19	Multiple	M7011-0600AU	30290472
6,00	6	75	30	Multiple	M7011-0600AU	30290473
8,00	8	60	25	Multiple	M7011-0800AU	30290474
8,00	8	75	35	Multiple	M7011-0800AU	30290475
10,00	10	72	30	Multiple	M7011-1000AU	30290476
12,00	12	83	32	Multiple	M7011-1200AU	30290477
16,00	16	92	36	Multiple	M7011-1600AU	30290478
20,00	20	104	45	Multiple	M7011-2000AU	30290479

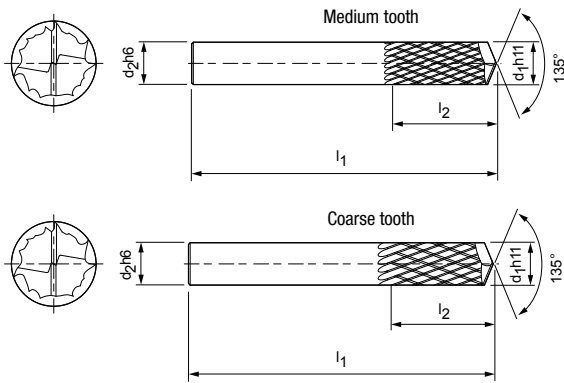
Coarse tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7012-0400AU	30290480
5,00	5	50	16	Multiple	M7012-0500AU	30290481
5,00	5	75	16	Multiple	M7012-0500AU	30290482
6,00	6	60	19	Multiple	M7012-0600AU	30290483
6,00	6	75	30	Multiple	M7012-0600AU	30290484
8,00	8	60	25	Multiple	M7012-0800AU	30290485
8,00	8	75	35	Multiple	M7012-0800AU	30290486
10,00	10	72	30	Multiple	M7012-1000AU	30290487
12,00	12	83	32	Multiple	M7012-1200AU	30290488
16,00	16	92	36	Multiple	M7012-1600AU	30290489
20,00	20	104	45	Multiple	M7012-2000AU	30290490

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Composite-MT

Long design with drill point, pushing cutting edge
M7013/M7014

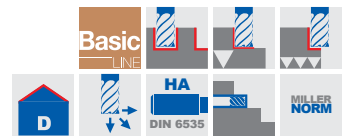


Design:
Milling cutter diameter: 4,00-10,00 mm
Coating: Uncoated
Number of cutting edges: Multiple

Application:
Pushing cutting edge, the material is pressed onto the substrate (e.g. very suitable for vacuum clamping). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the upper side of the part.

Medium tooth for CFRP/GFRP > 40 % fibre portion

Coarse tooth for CFRP/GFRP < 40 % fibre portion



Medium tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7013-0400AU	30290491
5,00	5	50	16	Multiple	M7013-0500AU	30290492
6,00	6	60	19	Multiple	M7013-0600AU	30290493
10,00	10	72	25	Multiple	M7013-1000AU	30290494

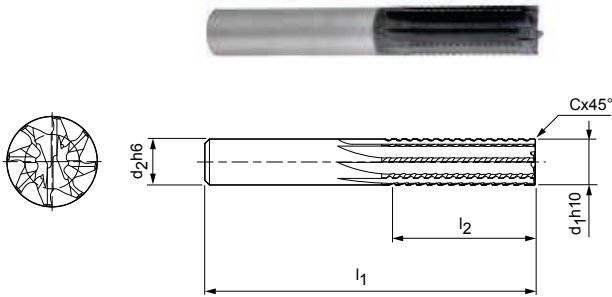
Coarse tooth

Dimensions				z	Specification	Order No.
d ₁ h11	d ₂ h6	l ₁	l ₂			
4,00	4	50	16	Multiple	M7014-0400AU	30290495
5,00	5	50	16	Multiple	M7014-0500AU	30290496
6,00	6	60	19	Multiple	M7014-0600AU	30290497
10,00	10	72	25	Multiple	M7014-1000AU	30290498

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

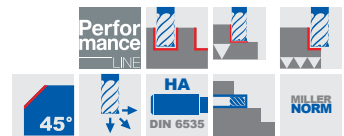
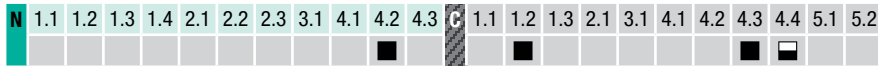
OptiMill® -Composite-Speed

Long design, straight cutting edge
M7218



Design:
 Milling cutter diameter: 4,00-20,00 mm
 Coating: Diamond coating
 Number of cutting edges: z = 8
 Helix angle: 0°
 Special features: Diamond coating for long tool life

Application:
 Roughing and finishing CFRP in one machining step, neutral cut.

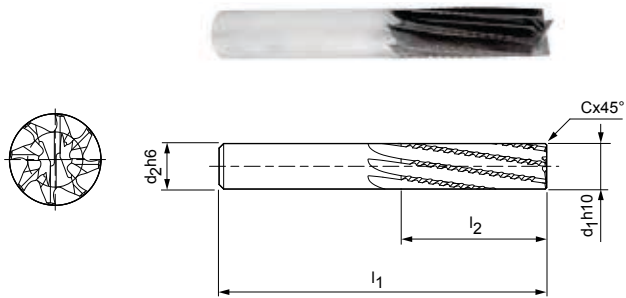


Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	60	16	0,08	8	M7218-0400AQ	30290499
5,00	6	60	18	0,1	8	M7218-0500AQ	30290500
6,00	6	60	20	0,12	8	M7218-0600AQ	30290501
6,00	6	65	25	0,12	8	M7218-0600AQ	30290502
6,00	6	75	28	0,12	8	M7218-0600AQ	30290503
8,00	8	63	22	0,16	8	M7218-0800AQ	30290504
8,00	8	75	32	0,16	8	M7218-0800AQ	30290505
10,00	10	72	32	0,2	8	M7218-1000AQ	30290506
12,00	12	83	32	0,2	8	M7218-1200AQ	30313781
16,00	16	92	36	0,2	8	M7218-1600AQ	30290507
20,00	20	104	45	0,2	8	M7218-2000AQ	30290508

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

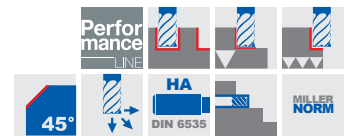
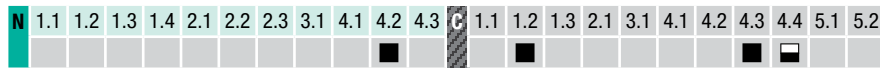
OptiMill® -Composite-Speed

Long design, pulling cutting edge
M7228



Design:
 Milling cutter diameter: 4,00-20,00 mm
 Coating: Diamond coating
 Number of cutting edges: z = 8
 Helix angle: 8°
 Special features: Diamond coating for long tool life

Application:
 Pulling cutting edge for better removal of the chips/dust (e.g. on milling pockets and slots). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the underside of the part.

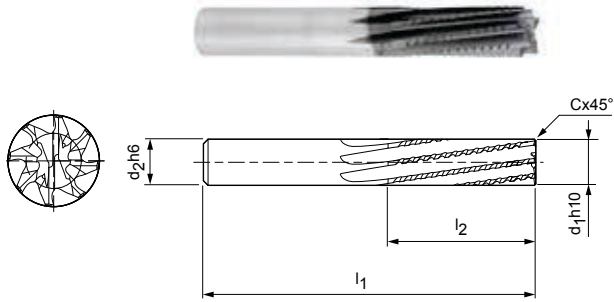


Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	60	16	0,08	8	M7228-0400AQ	30290509
5,00	6	60	18	0,1	8	M7228-0500AQ	30290510
6,00	6	60	20	0,12	8	M7228-0600AQ	30290511
6,00	6	65	25	0,12	8	M7228-0600AQ	30290512
6,00	6	75	28	0,12	8	M7228-0600AQ	30290513
8,00	8	63	22	0,16	8	M7228-0800AQ	30290514
8,00	8	75	32	0,16	8	M7228-0800AQ	30290515
10,00	10	72	32	0,2	8	M7228-1000AQ	30290516
12,00	12	83	32	0,2	8	M7228-1200AQ	30290517
16,00	16	92	36	0,2	8	M7228-1600AQ	30290518
20,00	20	104	45	0,2	8	M7228-2000AQ	30290519

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

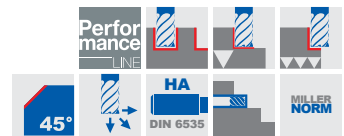
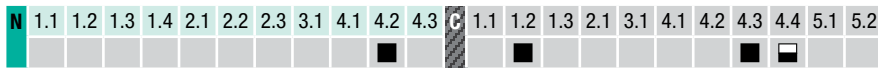
OptiMill® -Composite-Speed

Long design, pushing cutting edge
M7238



Design:
 Milling cutter diameter: 4,00-20,00 mm
 Coating: Diamond coating
 Number of cutting edges: z = 8
 Helix angle: -8°
 Special features: Diamond coating for long tool life

Application:
 Pushing cutting edge, the material is pressed onto the substrate (e.g. very suitable for vacuum clamping). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the upper side of the part.

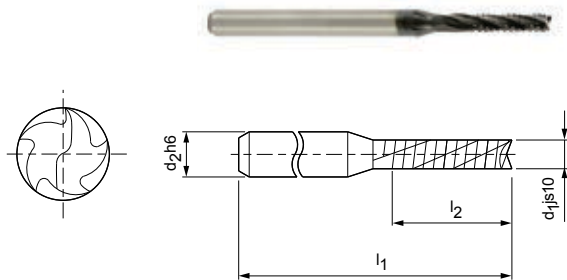


Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	60	16	0,08	8	M7238-0400AQ	30290520
5,00	6	60	18	0,1	8	M7238-0500AQ	30290521
6,00	6	60	20	0,12	8	M7238-0600AQ	30290522
6,00	6	65	25	0,12	8	M7238-0600AQ	30290523
6,00	6	75	28	0,12	8	M7238-0600AQ	30290524
8,00	8	63	22	0,16	8	M7238-0800AQ	30290525
8,00	8	75	32	0,16	8	M7238-0800AQ	30290526
10,00	10	72	32	0,2	8	M7238-1000AQ	30290527
12,00	12	83	32	0,2	8	M7238-1200AQ	30290528
16,00	16	92	36	0,2	8	M7238-1600AQ	30290529
20,00	20	104	45	0,2	8	M7238-2000AQ	30290530

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

MICRO-Router

Short design, pulling cutting edge
M7901



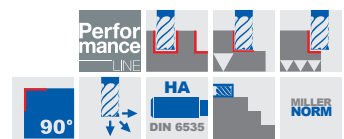
Design:

Milling cutter diameter: 1,00-3,00 mm
 Coating: Diamond coating
 Number of cutting edges: Multiple
 Special features: Diamond coating for long tool life

Application:

Pulling cutting edge for better removal of the chips/dust (e.g. on milling pockets and slots). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the underside of the part.

N	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	4.1	4.2	4.3	C	1.1	1.2	1.3	2.1	3.1	4.1	4.2	4.3	4.4	5.1	5.2
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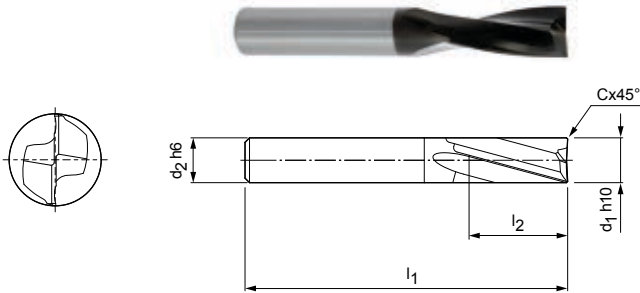
Medium tooth

Dimensions				z	Specification	Order No.
d ₁ js10	d ₂ h6	l ₁	l ₂			
1,00	3	38	5	Multiple	M7901-0100AQ	30467717
2,00	3	38	9	Multiple	M7901-0200AQ	30467719
3,00	3	38	9	Multiple	M7901-0300AQ	30467721

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

OptiMill® -Composite-Duo

Long design
M7222

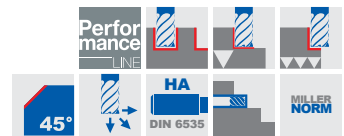
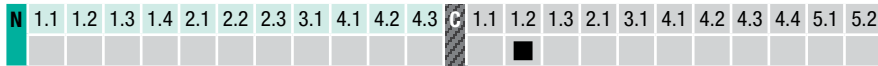


Design:

Milling cutter diameter: 3,00-20,00 mm
Coating: Diamond coating
Number of cutting edges: $z = 2$
Helix angle: 15°
Special features: Point geometry
Diamond coating
for long tool life

Application:

For finishing CFRP/GFRP parts with high surface finish requirements.



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
3,00	6	57	8	0,06	2	M7222-0300AQ	30355245
4,00	6	57	11	0,08	2	M7222-0400AQ	30355246
5,00	6	57	13	0,10	2	M7222-0500AQ	30355247
6,00	6	57	13	0,12	2	M7222-0600AQ	30355248
8,00	8	63	19	0,16	2	M7222-0800AQ	30355250
10,00	10	72	22	0,20	2	M7222-1000AQ	30340685
12,00	12	83	26	0,20	2	M7222-1200AQ	30355251
14,00	14	83	26	0,20	2	M7222-1400AQ	30355252
16,00	16	92	32	0,20	2	M7222-1600AQ	30355253
18,00	18	92	32	0,20	2	M7222-1800AQ	30355254
20,00	20	104	38	0,20	2	M7222-2000AQ	30355255

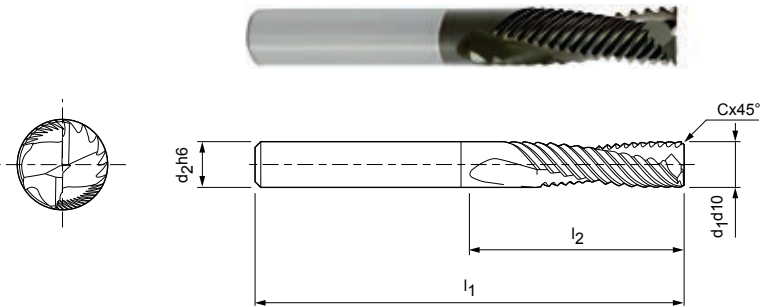
Dimensions in mm.

Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill®-Composite-UD

Overlong design, medium tooth
M7212

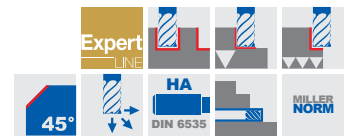


Design:

Milling cutter diameter: 4,00-20,00 mm
Coating: Diamond coating
Number of cutting edges: $z = 2$
Helix angle: 15°
Special features: Diamond coating for long tool life

Application:

Medium tooth for CFRP/GFRP > 40 % fibre portion. Simultaneously pulling and pushing cut generates a compression effect in the part. In this way delamination and fibre protrusions are prevented.



Dimensions					z	Specification	Order No.
d ₁ d10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	62	11	0,08	2	M7212-0400AQ-C0008	30661345
5,00	6	62	13	0,10	2	M7212-0500AQ-C0010	30661346
6,00	6	62	13	0,12	2	M7212-0600AQ-C0012	30661347
6,35	8	68	15	0,13	2	M7212-0635AQ-C0013	30661348
8,00	8	68	19	0,16	2	M7212-0800AQ-C0016	30661349
9,53	10	80	22	0,19	2	M7212-0953AQ-C0019	30661350
10,00	10	80	22	0,20	2	M7212-1000AQ-C0020	30661351
12,00	12	93	26	0,24	2	M7212-1200AQ-C0024	30661352
16,00	16	108	32	0,32	2	M7212-1600AQ-C0032	30661353
20,00	20	126	38	0,40	2	M7212-2000AQ-C0040	30661354

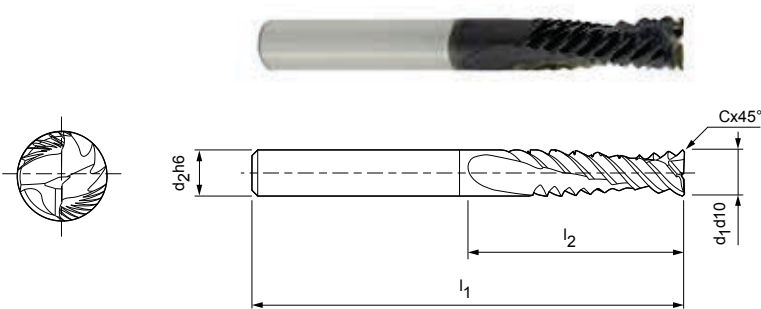
Dimensions in mm.

Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Composite-UD

Overlong design, coarse tooth
M7242

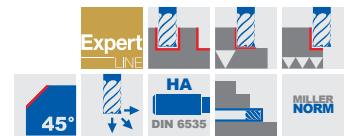
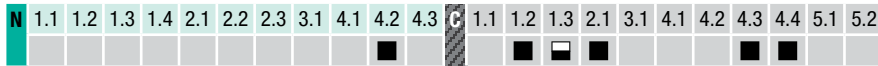


Design:

Milling cutter diameter: 6,00-20,00 mm
Coating: Diamond coating
Number of cutting edges: $z = 2$
Helix angle: 15°
Special features: Diamond coating for long tool life

Application:

Coarse tooth for CFRP/GFRP < 40 % fibre portion. Simultaneously pulling and pushing cut generates a compression effect in the part. In this way delamination and fibre protrusions are prevented.



Dimensions					z	Specification	Order No.
d ₁ d ₁₀	d ₂ h ₆	l ₁	l ₂	C x 45°			
6,00	6	62	13	0,12	2	M7242-0600AQ-C0012	30661284
6,35	8	68	15	0,13	2	M7242-0635AQ-C0013	30671633
8,00	8	68	19	0,16	2	M7242-0800AQ-C0016	30661288
9,53	10	80	22	0,19	2	M7242-0953AQ-C0019	30671634
10,00	10	80	22	0,20	2	M7242-1000AQ-C0020	30661290
12,00	12	93	26	0,24	2	M7242-1200AQ-C0024	30671635
16,00	16	108	32	0,32	2	M7242-1600AQ-C0032	30671636
20,00	20	126	38	0,40	2	M7242-2000AQ-C0040	30671637

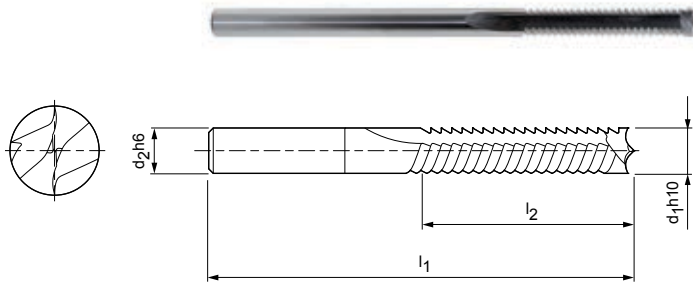
Dimensions in mm.

Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Composite-TwinCut

Extra long design
M7402

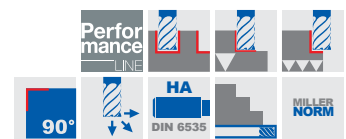
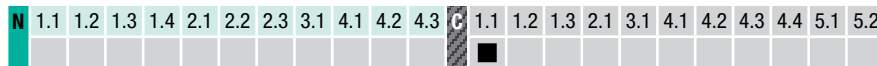


Design:

Milling cutter diameter: 4,00-20,00 mm
Coating: Uncoated
Number of cutting edges: z = 2
Helix angle: 0°

Application:

For milling aramide fibre-reinforced plastics in the roughing area. The alternate arrangement of the cutting edges prevents delamination with plaited fibres and with textile fibre structures.

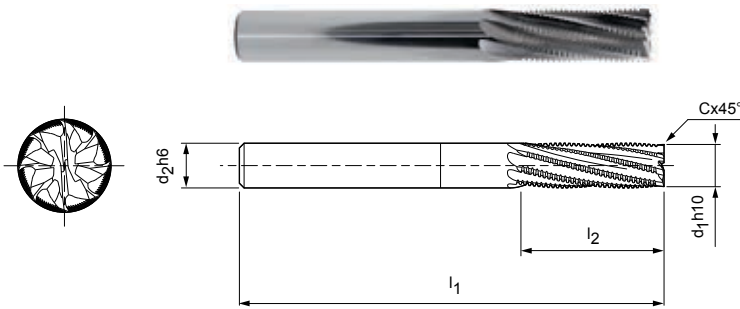


Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
4,00	4	75	20	2	M7402-0400AU	30290531
5,00	5	75	25	2	M7402-0500AU	30290532
6,00	6	100	35	2	M7402-0600AU	30290533
8,00	8	100	40	2	M7402-0800AU	30290534
10,00	10	125	50	2	M7402-1000AU	30290535
12,00	12	125	60	2	M7402-1200AU	30290536
16,00	16	150	75	2	M7402-1600AU	30290537
20,00	20	104	45	2	M7402-2000AU	30290538

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Honeycomb

Long design
M7526/M7528

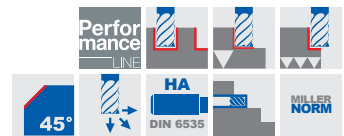
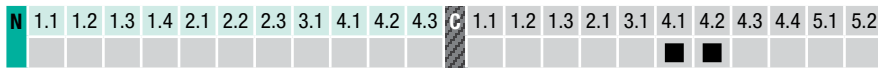


Design:

Milling cutter diameter: 4,00-20,00 mm
Coating: Uncoated
Number of cutting edges: z = 6/8
Helix angle: 15°

Application:

For milling honeycomb with a very wide range of surface layers. Twisted high-performance fine teeth and sharp-edged face cut make it possible to produce clean areas without damaging the unstable honeycomb structures.



Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
4,00	6	57	11	0,04	6	M7526-0400AU-C0004	30661239
5,00	6	57	13	0,05	6	M7526-0500AU-C0005	30671638
6,00	6	57	13	0,06	8	M7528-0600AU-C0006	30661241
6,35	8	63	15	0,06	8	M7528-0635AU-C0006	30671639
8,00	8	63	19	0,08	8	M7528-0800AU-C0008	30661242
9,53	10	72	22	0,10	8	M7528-0953AU-C0010	30671640
10,00	10	72	22	0,10	8	M7528-1000AU-C0010	30661244
12,00	12	83	26	0,12	8	M7528-1200AU-C0012	30671641
16,00	16	92	32	0,16	8	M7528-1600AU-C0016	30671642
20,00	20	104	38	0,20	8	M7528-2000AU-C0020	30671643

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.





SHOULDER MILLING – ROUGHING

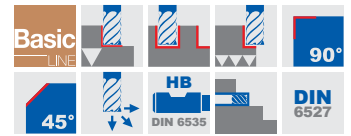
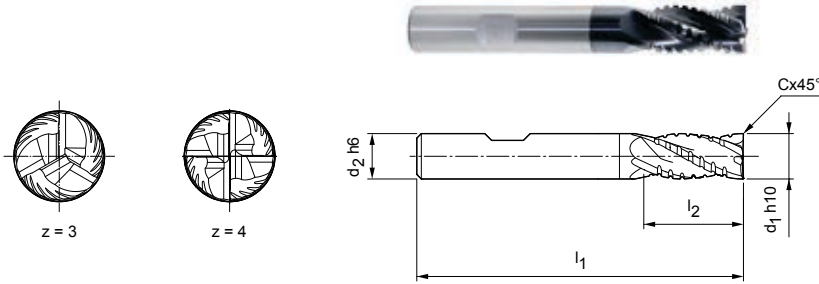
Universal use

OptiMill-Uni-Rough & Finish	78
OptiMill-Uni-HPC-Rough	79

OptiMill® -Uni-Rough & Finish

Long design
M3060

Design:
Milling cutter diameter: 6,00-20,00 mm
Coating: MF5
Number of cutting edges: z = 3 up to ø 8 mm
z = 4 from ø 10 mm
Helix angle: 30°



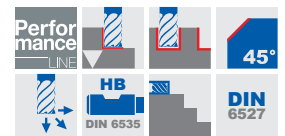
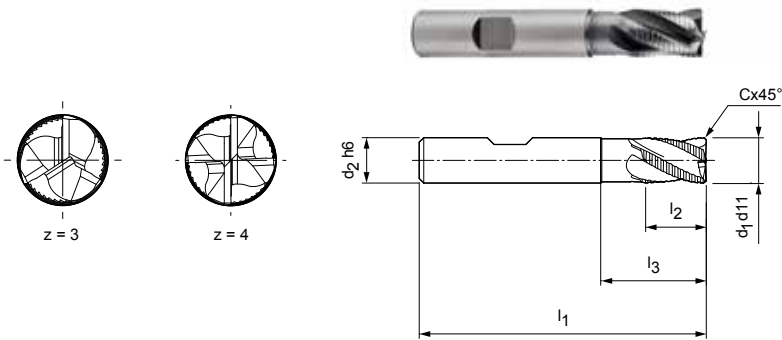
Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°			
6,00	6	57	13	–	3	M3060-0600BI	30126317
8,00	8	63	19	0,08	3	M3060-0800BI	30126318
10,00	10	72	22	0,10	4	M3060-1000BI	30089974
12,00	12	83	26	0,12	4	M3060-1200BI	30126320
14,00	14	83	26	0,14	4	M3060-1400BI	30126352
16,00	16	92	32	0,16	4	M3060-1600BI	30061834
18,00	18	92	32	0,18	4	M3060-1800BI	30126353
20,00	20	104	38	0,20	4	M3060-2000BI	30126354

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill® -Uni-HPC-Rough

Short design with neck
M3081

Design:
 Milling cutter diameter: 5,00-20,00 mm
 Coating: MF3
 Number of cutting edges: z = 3 up to ø 8 mm
 z = 4 from ø 9 mm
 Helix angle: 30°
 Special features: Unequal spacing, profile undercut HPC roughing teeth



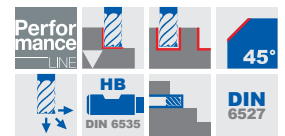
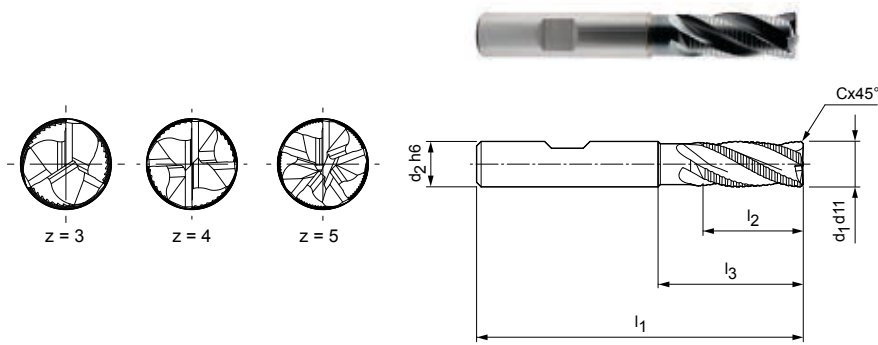
Dimensions						z	Specification	Order No.
d ₁ d ₁₁	d ₂ h ₆	l ₁	l ₂	l ₃	C x 45°			
*5,00	6	54	8	–	0,30	3	M3081-0500BY	30427454
6,00	6	54	8	18	0,30	3	M3081-0600BY	30427457
*7,00	8	58	11	–	0,30	3	M3081-0700BY	30427458
8,00	8	58	11	22	0,30	3	M3081-0800BY	30427460
*9,00	10	66	13	–	0,50	4	M3081-0900BY	30427461
10,00	10	66	13	26	0,50	4	M3081-1000BY	30427462
12,00	12	73	16	28	0,50	4	M3081-1200BY	30427464
14,00	14	76	16	31	0,50	4	M3081-1400BY	30427465
16,00	16	82	19	34	0,50	4	M3081-1600BY	30427466
18,00	18	84	19	36	0,50	4	M3081-1800BY	30427467
20,00	20	92	20	42	0,50	4	M3081-2000BY	30427468

Dimensions in mm.
 * Design without neck.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

OptiMill® -Uni-HPC-Rough

Long design with neck
M3181

Design:
Milling cutter diameter: 4,00-25,00 mm
Coating: MF3
Number of cutting edges: z = 3 up to ø 8 mm
z = 4 from ø 9 mm
z = 5 from ø 25 mm
Helix angle: 30°
Special features: Unequal spacing, profile undercut HPC roughing teeth



Dimensions						z	Specification	Order No.
d ₁ d ₁₁	d ₂ h ₆	l ₁	l ₂	l ₃	C x 45°			
*4,00	6	57	8	–	0,30	3	M3181-0400BY	30427427
*5,00	6	57	13	–	0,30	3	M3181-0500BY	30427428
6,00	6	57	13	21	0,30	3	M3181-0600BY	30427430
*7,00	8	63	16	–	0,30	3	M3181-0700BY	30427432
8,00	8	63	16	26	0,30	3	M3181-0800BY	30427433
*9,00	10	72	19	–	0,50	4	M3181-0900BY	30427434
10,00	10	72	22	32	0,50	4	M3181-1000BY	30427437
*11,00	12	83	26	–	0,50	4	M3181-1100BY	30427438
12,00	12	83	26	38	0,50	4	M3181-1200BY	30427439
*13,00	14	83	26	–	0,50	4	M3181-1300BY	30427440
14,00	14	83	26	42	0,50	4	M3181-1400BY	30427441
16,00	16	92	32	44	0,50	4	M3181-1600BY	30427443
18,00	18	92	32	48	0,50	4	M3181-1800BY	30427444
20,00	20	104	38	54	0,50	4	M3181-2000BY	30427447
25,00	25	121	45	65	0,50	5	M3181-2500BY	30427448

Dimensions in mm.
* Design without neck.
Cutting data recommendation from page 118.
Special designs and other coatings on request.





SHOULDER MILLING – FINISHING

Universal use

OptiMill-Uni-Finish _____ 84

OptiMill-Uni-HPC-Finish _____ 86

Hardened steel

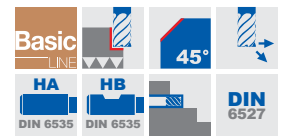
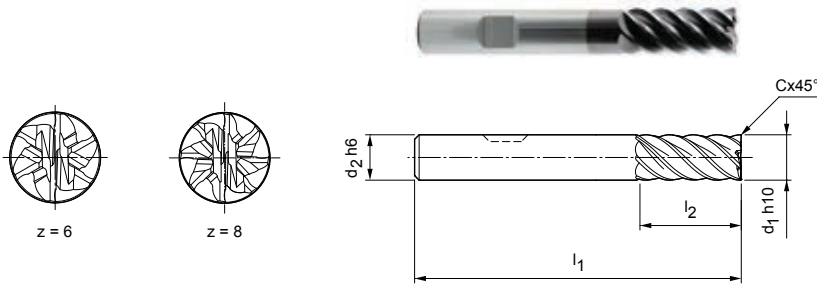
OptiMill-Hardened _____ 87

OptiMill® -Uni-Finish

Long design
M3046/M3048

Design:

Milling cutter diameter: 4,00-32,00 mm
Coating: MF4
Number of cutting edges: z = 6 up to ø 16 mm
z = 8 from ø 20 mm
Helix angle: 45°



Dimensions					z	Shank form HA		Shank form HB	
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°		Specification	Order No.	Specification	Order No.
4,00	6	57	11	0,04	6	M3046-0400AZ	30259561	M3046-0400BZ	30247182
5,00	6	57	13	0,05	6	M3046-0500AZ	30259563	M3046-0500BZ	30247184
6,00	6	57	13	0,06	6	M3046-0600AZ	30259565	M3046-0600BZ	30247186
8,00	8	63	19	0,08	6	M3046-0800AZ	30259567	M3046-0800BZ	30247188
10,00	10	72	22	0,10	6	M3046-1000AZ	30259569	M3046-1000BZ	30247190
12,00	12	83	26	0,12	6	M3046-1200AZ	30259571	M3046-1200BZ	30247192
16,00	16	92	32	0,16	6	M3046-1600AZ	30259573	M3046-1600BZ	30247194
20,00	20	104	38	0,20	8	M3048-2000AZ	30259575	M3048-2000BZ	30247196
25,00	25	150	75	0,25	8	M3048-2500AZ	30259577	M3048-2500BZ	30247373
32,00	32	150	75	0,32	8	M3048-3200AZ	30259579	M3048-3200BZ	30247384

Dimensions in mm.

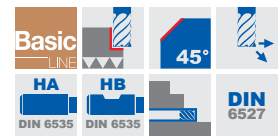
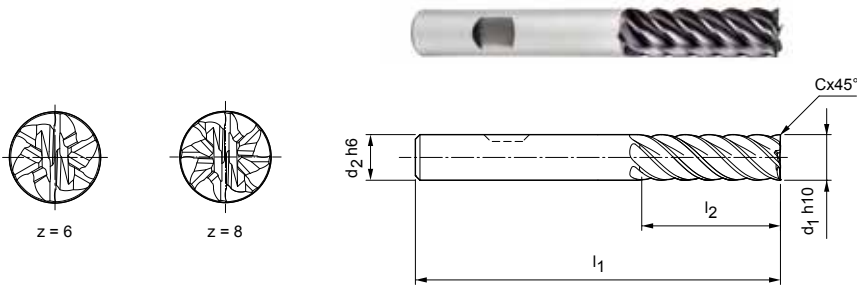
Cutting data recommendation from page 118.

Special designs and other coatings on request.

OptiMill® -Uni-Finish

Overlong design
M3049

Design:
Milling cutter diameter: 4,00-32,00 mm
Coating: MF4
Number of cutting edges: z = 6 up to ø 16 mm
z = 8 from ø 20 mm
Helix angle: 45°



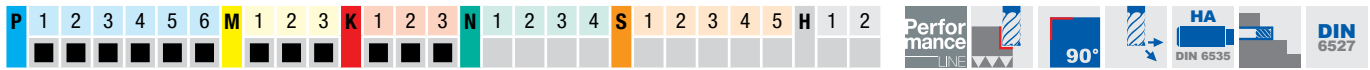
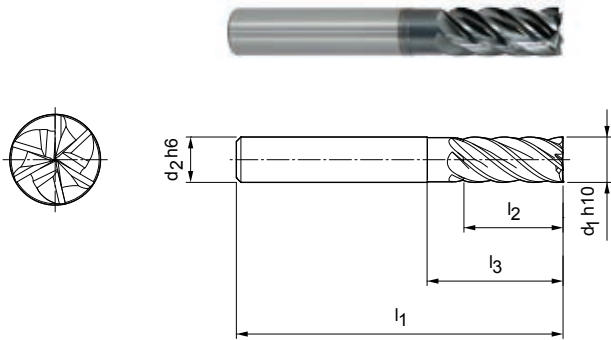
Dimensions					z	Shank form HA		Shank form HB	
d ₁ h10	d ₂ h6	l ₁	l ₂	C x 45°		Specification	Order No.	Specification	Order No.
4,00	6	62	16	0,04	6	M3049-0400AZ	30259562	M3049-0400BZ	30247183
5,00	6	62	18	0,05	6	M3049-0500AZ	30259564	M3049-0500BZ	30247185
6,00	6	62	18	0,06	6	M3049-0600AZ	30259566	M3049-0600BZ	30247187
8,00	8	68	24	0,08	6	M3049-0800AZ	30259568	M3049-0800BZ	30247189
10,00	10	80	30	0,10	6	M3049-1000AZ	30259570	M3049-1000BZ	30247191
12,00	12	93	36	0,12	6	M3049-1200AZ	30259572	M3049-1200BZ	30247193
16,00	16	108	48	0,16	6	M3049-1600AZ	30259574	M3049-1600BZ	30247195
20,00	20	126	60	0,20	8	M3049-2000AZ	30259576	M3049-2000BZ	30247197
20,00	20	135	75	0,20	8	M3049-2000AZ	30259582	M3049-2000BZ	30254401
20,00	20	150	95	0,20	8	M3049-2000AZ	30259583	M3049-2000BZ	30254402
25,00	25	160	95	0,25	8	M3049-2500AZ	30259578	M3049-2500BZ	30247376
32,00	32	160	95	0,32	8	M3049-3200AZ	30259581	M3049-3200BZ	30247386

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill® -Uni-HPC-Finish

Long design with neck
M3096

Design:
Milling cutter diameter: 6,00-20,00 mm
Coating: MF3
Number of cutting edges: z = 6
Helix angle: 39°/41°
Special features: Unequal spacing



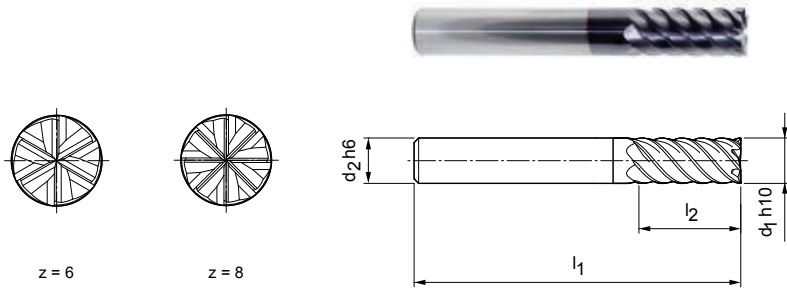
Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	l ₃			
6,00	6	57	15	20	6	M3096-0600AY	30270000
8,00	8	63	21	25	6	M3096-0800AY	30270002
10,00	10	72	22	30	6	M3096-1000AY	30270003
12,00	12	83	26	36	6	M3096-1200AY	30270004
16,00	16	92	36	42	6	M3096-1600AY	30270005
20,00	20	104	41	55	6	M3096-2000AY	30270006

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Hardened

Long design
M3076/M3078

Design:
Milling cutter diameter: 4,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 6 up to ø 14 mm
z = 8 from ø 16 mm
Helix angle: 50°



Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
4,00	6	57	11	6	M3076-0400AZ	30247198
5,00	6	57	13	6	M3076-0500AZ	30247199
6,00	6	57	13	6	M3076-0600AZ	30247200
8,00	8	63	19	6	M3076-0800AZ	30247202
10,00	10	72	22	6	M3076-1000AZ	30247204
12,00	12	83	26	6	M3076-1200AZ	30247206
14,00	14	83	26	6	M3076-1400AZ	30247208
16,00	16	92	32	8	M3078-1600AZ	30247210
18,00	18	92	32	8	M3078-1800AZ	30247212
20,00	20	104	38	8	M3078-2000AZ	30247214

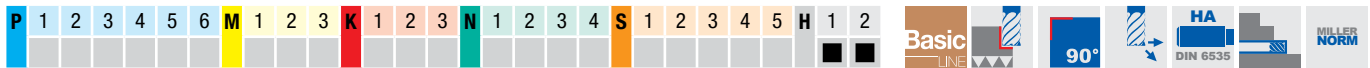
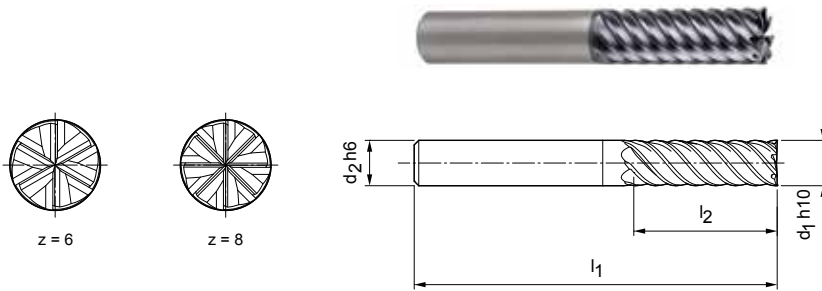
Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Hardened

Overlong design
M3071

Design:

Milling cutter diameter: 6,00-20,00 mm
 Coating: MF4
 Number of cutting edges: z = 6 up to ø 14 mm
 z = 8 from ø 16 mm
 Helix angle: 50°



Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
6,00	6	62	18	6	M3071-0600AZ	30247201
8,00	8	68	24	6	M3071-0800AZ	30247203
10,00	10	80	30	6	M3071-1000AZ	30247205
12,00	12	93	36	6	M3071-1200AZ	30247207
14,00	14	99	42	6	M3071-1400AZ	30247209
16,00	16	108	48	8	M3071-1600AZ	30247211
18,00	18	114	54	8	M3071-1800AZ	30247213
20,00	20	126	60	8	M3071-2000AZ	30247215

Dimensions in mm.

Cutting data recommendation from page 118.

Special designs and other coatings on request.





TROCHOIDAL MILLING

Universal use

OptiMill-Tro-Uni _____ 92

Steel and stainless steel

OptiMill-Tro-PM _____ 93

Titanium and nickel-based alloys

OptiMill-Tro-S _____ 94

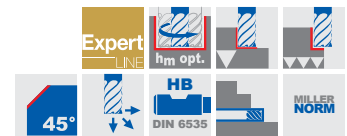
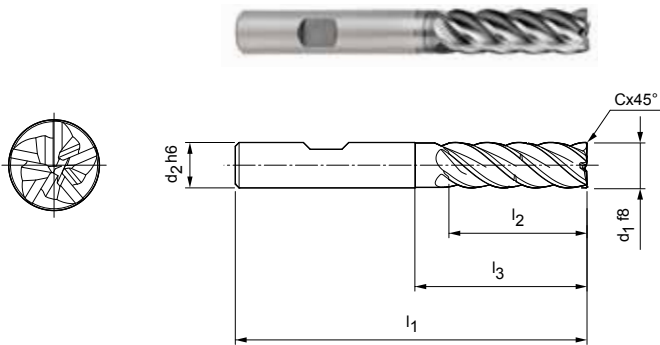
OptiMill-Tro-Titan _____ 95

Hardened steel

OptiMill-Tro-H _____ 96

OptiMill® -Tro-Uni

3xD design with neck
M3099



Design:

- Milling cutter diameter: 4,00-25,00 mm
- Coating: MF3
- Number of cutting edges: z = 5
- Helix angle: 41°-42°
- Balancing quality: Cutting edge portion balanced to G2.5 in acc. with DIN ISO 1940-G2.5
- Special features: Unequal spacing

Application:

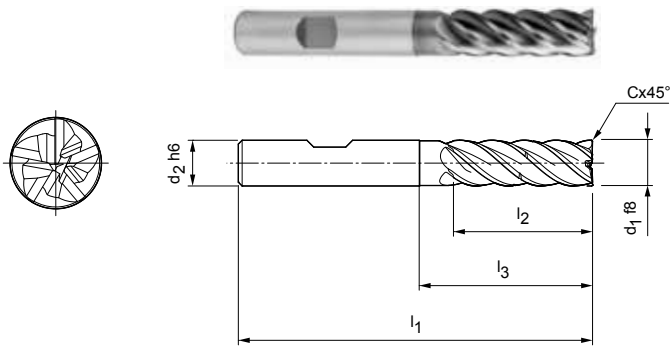
Especially for trochoidal milling – part-contact cutting/trimming. For cutting depths up to 3xD with special chip breaker for optimum chip control.

Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
4,00	6	62	16	23	0,08	5	M3099-0400BY-C0008	30547814
5,00	6	62	17	24	0,10	5	M3099-0500BY-C0010	30547815
6,00	6	62	18	25	0,12	5	M3099-0600BY-C0012	30547816
8,00	8	68	24	30	0,16	5	M3099-0800BY-C0016	30547818
10,00	10	80	30	35	0,20	5	M3099-1000BY-C0020	30547819
12,00	12	93	36	45	0,24	5	M3099-1200BY-C0024	30547820
14,00	14	99	42	50	0,28	5	M3099-1400BY-C0028	30547821
16,00	16	108	48	55	0,32	5	M3099-1600BY-C0032	30547822
18,00	18	117	54	67	0,36	5	M3099-1800BY-C0036	30547823
20,00	20	126	60	70	0,40	5	M3099-2000BY-C0040	30547825
25,00	25	150	75	92	0,50	5	M3099-2500BY-C0050	30547834

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

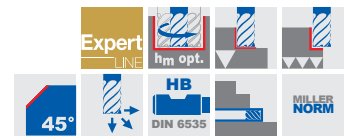
OptiMill®-Tro-PM

3xD design with neck
M3299



Design:
 Milling cutter diameter: 4,00-25,00 mm
 Coating: MF2
 Number of cutting edges: z = 5
 Helix angle: 41°-42°
 Balancing quality: Cutting edge portion balanced to G2.5 in acc. with DIN ISO 1940-G2.5
Special features: Unequal spacing

Application:
 Especially for trochoidal milling – part-contact cutting/trimming. For cutting depths up to 3xD with special chip breaker for optimum chip control.

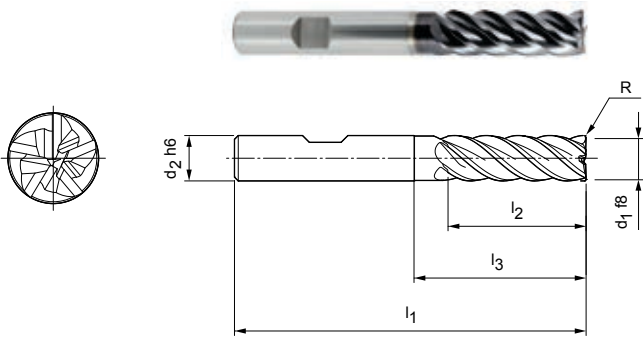


Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	C x 45°			
4,00	6	62	16	23	0,08	5	M3299-0400BL-C0008	30543767
5,00	6	62	17	24	0,10	5	M3299-0500BL-C0010	30543765
6,00	6	62	18	25	0,12	5	M3299-0600BL-C0012	30524804
8,00	8	68	24	30	0,16	5	M3299-0800BL-C0016	30524805
10,00	10	80	30	35	0,20	5	M3299-1000BL-C0020	30524806
12,00	12	93	36	45	0,24	5	M3299-1200BL-C0024	30524807
14,00	14	99	42	50	0,28	5	M3299-1400BL-C0028	30524808
16,00	16	108	48	55	0,32	5	M3299-1600BL-C0032	30524809
18,00	18	117	54	67	0,36	5	M3299-1800BL-C0036	30566345
20,00	20	126	60	70	0,40	5	M3299-2000BL-C0040	30524810
25,00	25	150	75	92	0,50	5	M3299-2500BL-C0050	30566346

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

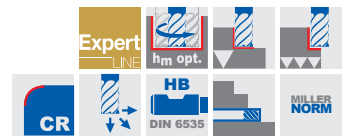
OptiMill®-Tro-S

3xD design with neck
M3699



Design:
 Milling cutter diameter: 5,00-25,00 mm
 Coating: MF5
 Number of cutting edges: z = 5
 Helix angle: 41°-42°
 Balancing quality: Cutting edge portion balanced to G2.5 in acc. with DIN ISO 1940-G2.5
 Special features: Unequal spacing

Application:
 Especially for trochoidal milling – part-contact cutting/trimming. For cutting depths up to 3xD.

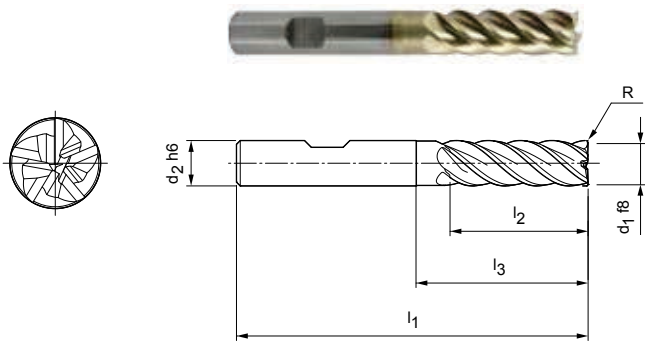


Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	R			
5,00	6	62	17	24	0,10	5	M3699-0500BI-R0010	30543756
6,00	6	62	18	25	0,10	5	M3699-0600BI-R0010	30524811
8,00	8	68	24	30	0,20	5	M3699-0800BI-R0020	30524812
10,00	10	80	30	35	0,20	5	M3699-1000BI-R0020	30524813
12,00	12	93	36	45	0,30	5	M3699-1200BI-R0030	30524814
14,00	14	99	42	50	0,30	5	M3699-1400BI-R0030	30524815
16,00	16	108	48	55	0,30	5	M3699-1600BI-R0030	30524816
18,00	18	117	54	67	0,30	5	M3699-1800BI-R0030	30566343
20,00	20	126	60	70	0,30	5	M3699-2000BI-R0030	30524817
25,00	25	150	75	92	0,40	5	M3699-2500BI-R0040	30566344

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

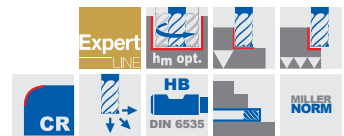
OptiMill® -Tro-Titan

3xD design with neck
M3799



Design:
 Milling cutter diameter: 5,00-25,00 mm
 Coating: MxB
 Number of cutting edges: z = 5
 Helix angle: 41°-42°
 Balancing quality: Cutting edge portion balanced to G2.5 in acc. with DIN ISO 1940-G2.5
 Special features: Unequal spacing

Application:
 Especially for trochoidal milling – part-contact cutting/trimming. For cutting depths up to 3xD.

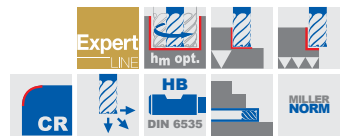
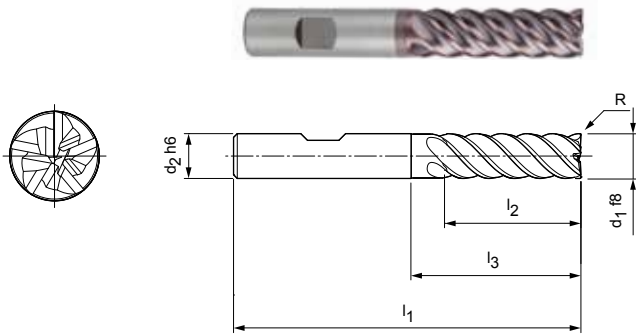


Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	R			
5,00	6	62	17	24	0,10	5	M3799-0500BJ-R0010	30651018
6,00	6	62	18	25	0,10	5	M3799-0600BJ-R0010	30651019
8,00	8	68	24	30	0,20	5	M3799-0800BJ-R0020	30651020
10,00	10	80	30	35	0,20	5	M3799-1000BJ-R0020	30651021
12,00	12	93	36	45	0,30	5	M3799-1200BJ-R0030	30651022
14,00	14	99	42	50	0,30	5	M3799-1400BJ-R0030	30651023
16,00	16	108	48	55	0,30	5	M3799-1600BJ-R0030	30651024
18,00	18	117	54	67	0,30	5	M3799-1800BJ-R0030	30651025
20,00	20	126	60	70	0,30	5	M3799-2000BJ-R0030	30651026
25,00	25	150	75	92	0,40	5	M3799-2500BJ-R0040	30651027

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

OptiMill®-Tro-H

3xD design with neck
M3079



Design:
 Milling cutter diameter: 5,00-25,00 mm
 Coating: MxS
 Number of cutting edges: z = 5
 Helix angle: 41°-42°
 Balancing quality: Cutting edge portion balanced to G2.5 in acc. with DIN ISO 1940-G2.5
 Special features: Unequal spacing

Application:
 Especially for trochoidal milling – part-contact cutting/trimming. For cutting depths up to 3xD.

Dimensions						z	Specification	Order No.
d ₁ f8	d ₂ h6	l ₁	l ₂	l ₃	R			
5,00	6	62	17	24	0,10	5	M3079-0500BS-R0010	30580124
6,00	6	62	18	25	0,10	5	M3079-0600BS-R0010	30580125
8,00	8	68	24	30	0,20	5	M3079-0800BS-R0020	30580127
10,00	10	80	30	35	0,20	5	M3079-1000BS-R0020	30580128
12,00	12	93	36	45	0,30	5	M3079-1200BS-R0030	30580129
14,00	14	99	42	50	0,30	5	M3079-1400BS-R0030	30580130
16,00	16	108	48	55	0,30	5	M3079-1600BS-R0030	30580132
18,00	18	117	54	67	0,30	5	M3079-1800BS-R0030	30580133
20,00	20	126	60	70	0,30	5	M3079-2000BS-R0030	30580135
25,00	25	150	75	92	0,40	5	M3079-2500BS-R0040	30580136

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.







PROFILE MILLING CUTTERS

Universal use

OptiMill-Uni-Radius _____ 100

Hardened steel

OptiMill-Hardened-Radius _____ 101

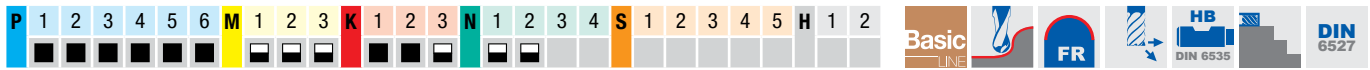
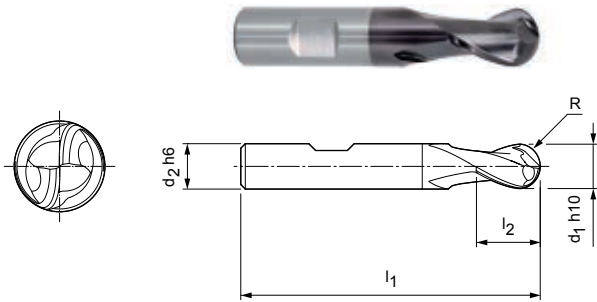
Fibre-reinforced plastic

OptiMill-Composite-MT-Radius _____ 102

OptiMill® -Uni-Radius

Short design
M3832

Design:
Milling cutter diameter: 2,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 2
Helix angle: 30°



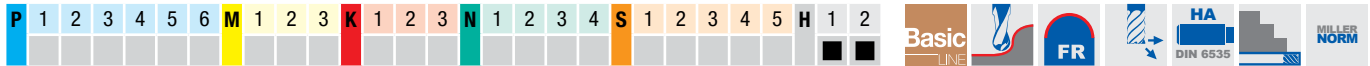
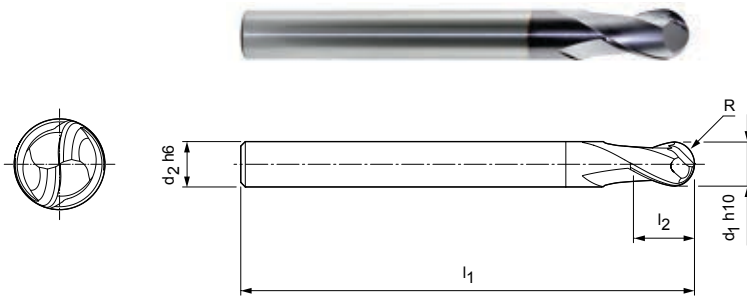
Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	R			
2,00	6	54	5	1,00	2	M3832-0200BZ	30247110
3,00	6	54	5	1,50	2	M3832-0300BZ	30247111
4,00	6	54	8	2,00	2	M3832-0400BZ	30247112
5,00	6	54	9	2,50	2	M3832-0500BZ	30247113
6,00	6	54	10	3,00	2	M3832-0600BZ	30247114
8,00	8	58	12	4,00	2	M3832-0800BZ	30247115
10,00	10	66	14	5,00	2	M3832-1000BZ	30247116
12,00	12	73	16	6,00	2	M3832-1200BZ	30247117
16,00	16	82	22	8,00	2	M3832-1600BZ	30247118
20,00	20	92	26	10,00	2	M3832-2000BZ	30247119

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill® -Hardened-Radius

Extra long design
M3872

Design:
Milling cutter diameter: 1,00-20,00 mm
Coating: MF4
Number of cutting edges: z = 2
Helix angle: 30°

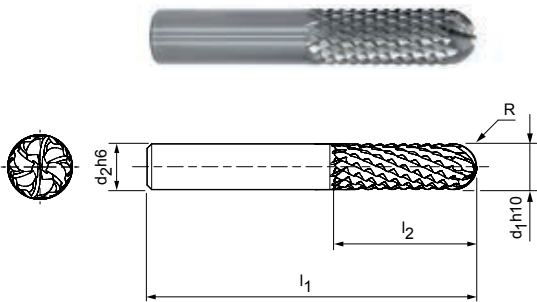


Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	R			
1,00	4	50	1,5	0,50	2	M3872-0100AZ	30259548
1,50	4	50	2,5	0,75	2	M3872-0150AZ	30259549
2,00	6	50	3	1,00	2	M3872-0200AZ	30259550
2,50	6	50	4	1,25	2	M3872-0250AZ	30259551
3,00	6	70	5	1,50	2	M3872-0300AZ	30259552
4,00	6	70	6	2,00	2	M3872-0400AZ	30259553
5,00	6	80	8	2,50	2	M3872-0500AZ	30259554
6,00	6	90	9	3,00	2	M3872-0600AZ	30259555
8,00	8	100	12	4,00	2	M3872-0800AZ	30259556
10,00	10	100	15	5,00	2	M3872-1000AZ	30259557
12,00	12	110	18	6,00	2	M3872-1200AZ	30259558
16,00	16	140	25	8,00	2	M3872-1600AZ	30259559
20,00	20	160	30	10,00	2	M3872-2000AZ	30259560

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.

OptiMill®-Composite-MT-Radius

Long / overlong design, pulling cutting edge
M7801



N	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	4.1	4.2	4.3	C	1.1	1.2	1.3	2.1	3.1	4.1	4.2	4.3	4.4	5.1	5.2	
										■	■	■		■										



Design:
Milling cutter diameter: 4,00-20,00 mm
Coating: Uncoated
Number of cutting edges: Multiple

Application:
Pulling cutting edge for better removal of the chips/dust (e.g. on milling pockets and slots). Particularly suitable for difficult-to-machine surface layers (e.g. UD or copper mesh) to prevent delamination on the underside of the part.

Medium tooth

Dimensions					z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂	R			
4,00	4	50	19	2,00	Multiple	M7801-0400AU	30355129
5,00	5	50	19	2,50	Multiple	M7801-0500AU	30355131
5,00	5	75	19	2,50	Multiple	M7801-0500AU	30355132
6,00	6	60	22	3,00	Multiple	M7801-0600AU	30355133
6,00	6	75	33	3,00	Multiple	M7801-0600AU	30355134
8,00	8	63	29	4,00	Multiple	M7801-0800AU	30355135
8,00	8	75	39	4,00	Multiple	M7801-0800AU	30355136
10,00	10	72	30	5,00	Multiple	M7801-1000AU	30342831
12,00	12	83	38	6,00	Multiple	M7801-1200AU	30355137
16,00	16	92	44	8,00	Multiple	M7801-1600AU	30355138
20,00	20	104	55	10,00	Multiple	M7801-2000AU	30355139

Dimensions in mm.
Cutting data recommendation from page 118.
Special designs and other coatings on request.





CHAMFERING, DRILL AND DEBURRING MILLING CUTTERS

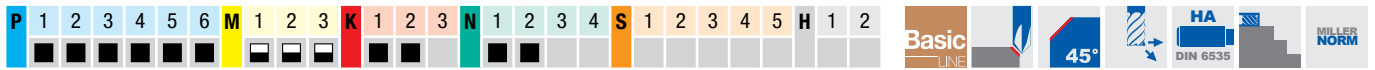
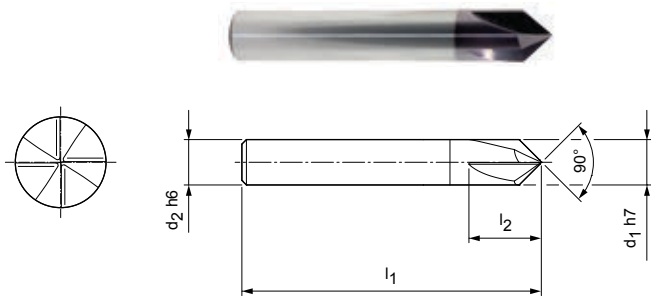
Universal use

OptiMill-Chamfer	_____	106
OptiMill-DrillMill	_____	107

OptiMill®-Chamfer

Short design
M5390

Design:
 Milling cutter diameter: 4,00-20,00 mm
 Coating: MF4
 Number of cutting edges: z = 4
 Point angle: 90°
 Helix angle: 0°



Dimensions				z	Specification	Order No.
d1 h7	d2 h6	l1	l2			
4,00	4	54	9	4	M5390-0400AZ	30247388
6,00	6	54	12	4	M5390-0600AZ	30241828
8,00	8	58	15	4	M5390-0800AZ	30241829
10,00	10	66	16	4	M5390-1000AZ	30241830
12,00	12	73	18	4	M5390-1200AZ	30241831
16,00	16	82	25	4	M5390-1600AZ	30269759
20,00	20	92	30	4	M5390-2000AZ	30269760

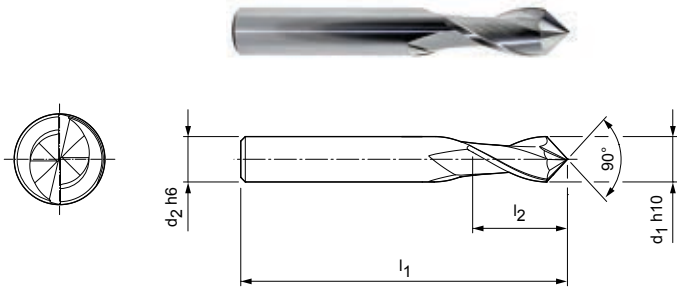
Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

OptiMill®-DrillMill

Long design with drill point
M5490

Design:
 Milling cutter diameter: 3,00-16,00 mm
 Coating: Uncoated
 Number of cutting edges: $z = 2$
 Point angle: 90°
 Helix angle: 30°

Application:
 Drill milling cutter for milling, chamfering and drilling.



Dimensions				z	Specification	Order No.
d ₁ h10	d ₂ h6	l ₁	l ₂			
3,00	6	57	8	2	M5490-0300AU	30247237
4,00	6	57	11	2	M5490-0400AU	30247238
5,00	6	57	13	2	M5490-0500AU	30247239
6,00	6	57	13	2	M5490-0600AU	30247240
8,00	8	63	19	2	M5490-0800AU	30247241
10,00	10	72	22	2	M5490-1000AU	30247242
12,00	12	83	26	2	M5490-1200AU	30247243
16,00	16	92	32	2	M5490-1600AU	30269758

Dimensions in mm.
 Cutting data recommendation from page 118.
 Special designs and other coatings on request.

CUSTOM SOLUTIONS

End-mills with fixed cutting edges

Along with a comprehensive standard programme of end-mills with fixed cutting edges, MILLER also offers custom milling cutters, which are specially tailored to the related machining tasks. Complex geometries and contours can be realised for high-precision, flexible manufacturing options. Even unusual tool concepts for the combination of machining steps or combination machining processes can be created at short notice – from the complex form cutter to the solid carbide disc milling cutter.





Application examples for customer milling cutters

- 1 PCD circular milling cutter, two cutting edges, for recesses in aluminium parts.
- 2 Solid carbide end-mill, five cutting edges, special coating and radial coolant outlets in the chip flute. Used for machining automotive steering housings made of AISI9Cu3.
- 3 Solid carbide end-mill, five cutting edges, left-hand helix with special roughing profile for machining automotive tailgates.
- 4 Solid carbide custom form cutter, four cutting edges, special unequal spacing with eroded forming step. Optimisation of the machining of a bearing carrier made of AISi1. Halving of the machining time.
- 5 Solid carbide customer disc milling cutter, 16 cutting edges, closely tolerated contour on the form cutting edges. Used for machining automotive hinges made of S355J2.
- 6 Solid carbide radial groove milling cutter, four cutting edges, straight fluted – form cutter with eroded circumferential cutting edges. Cost-effective, reliable machining of the fuel feed on a common rail housing.
- 7 Solid carbide ball cutter, four cutting edges for deburring wheel carriers made of AIMgSi1.
- 8 Solid carbide custom form cutter, four cutting edges, prism form and radius form. Highly efficient machining of the combustion chamber on an aluminium cylinder head.



$$\frac{2 \cdot a_e}{D}$$

TECHNICAL APPENDIX

Notes on usage, handling and cutting data



TECHNICAL APPENDIX

General technical information

Terminology and formulae	114
Technical information	115
Application notes trochoidal milling	116

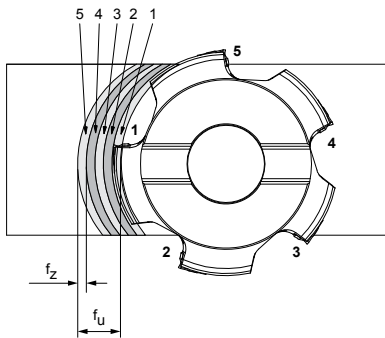
Cutting data recommendation

Shoulder milling cutters	
Groove milling and general applications	120
Shoulder milling – roughing	132
Shoulder milling – finishing	134
Trochoidal milling	136
Profile milling cutters	138
Chamfering, drill and deburring milling cutters	139

Terminology and formulae

Formulae

Feed per revolution	$f_U = \left[\frac{\text{mm}}{\text{rev}} \right]$	$f_U = z \cdot f_Z$
Feed per tooth	$f_Z = \left[\frac{\text{mm}}{\text{tooth}} \right]$	$f_Z = \frac{v_f}{n \cdot z}$

f_z during face milling

Spindle speed	$n = [\text{min}^{-1}]$	$n = \frac{v_c \cdot 1000}{\pi \cdot D}$
Average chip thickness	$h_m = [\text{mm}]$	$h_m = \sin \kappa \cdot f_z \cdot \sqrt{\frac{a_e}{D}}$
Cutting speed	$v_c = \left[\frac{\text{m}}{\text{min}} \right]$	$v_c = \frac{\pi \cdot D_c \cdot n}{1000}$
Feed rate	$v_f = \left[\frac{\text{mm}}{\text{min}} \right]$	$v_f = f_z \cdot z \cdot n$
Material removal rate	$Q = \left[\frac{\text{cm}^3}{\text{min}} \right]$	$Q = \frac{a_e \cdot a_p \cdot v_f}{1000}$

Trochoidal milling – basic principles

Definition

Trochoidal milling is a milling strategy with the objective of reducing process forces and at the same time increasing the material removal rate. By superimposing a circular movement of the tool on the feed movement, the contact conditions can be improved. Material is removed cyclically with changing contact conditions that can be matched to the tool usage as well as variable cutting widths along the circular path of the tool.



Example, full slot milling

Conventional milling

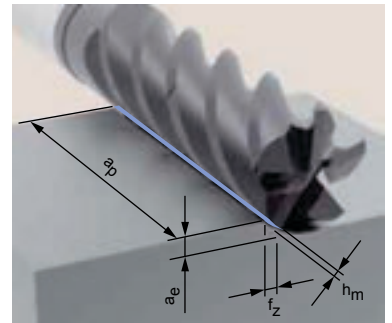
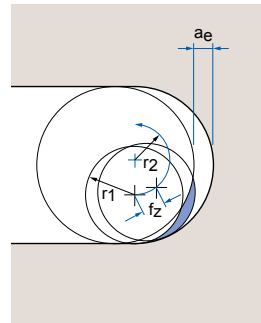
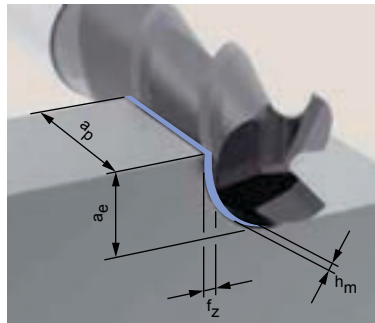
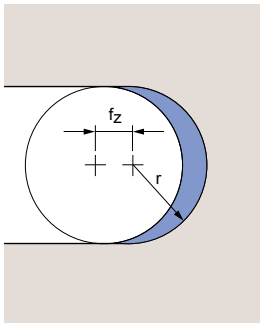
During roughing with full contact the contact conditions for the milling cutter are defined at a wrap angle of 180°.

Along with the production of longer chips, this results in a comparatively high load on the tool due to the long tooth contact. The resulting large cutting cross-section also results in high machining forces, as a consequence the infeed depths, feeds and cutting speeds for a stable process are limited.

Trochoidal milling

The specific kinematics of trochoidal milling make it possible, due to superimposing a circular movement of the tool on the feed movement, to improve the contact conditions. The contact angle is correspondingly low.

This technological approach has the consequence that a reduced cutting width and cut length result in significantly reduced process forces. In this way it is in turn possible to realise greater cutting depths.



a_p : small (cutting depth $\sim 1 \times D$)
 a_e : large ($1 \times D$)
 f_z : small
 v_c : low

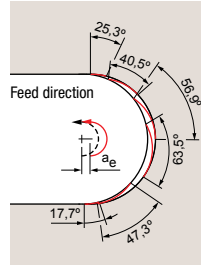
a_p : large (full utilisation of the cutting edge length possible)
 a_e : small
 f_z : large
 v_c : high

Trochoidal milling – in detail

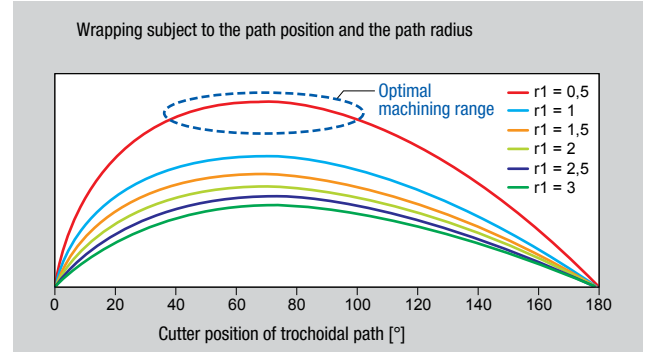
Trochoidal milling – circular path

In the case of a circular path with constant radius, the wrap angles at the tool cutting edge vary as a function of the absolute radial material removal rate within one revolution.

- Contact conditions change continuously
- Optimal working area for the milling cutter
- Limited to a small area
- Low material removal rate
- Increased tendency to vibration
- Increased tool wear



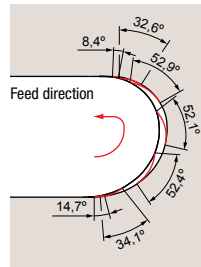
Wrapping as a function of the path position – circular path



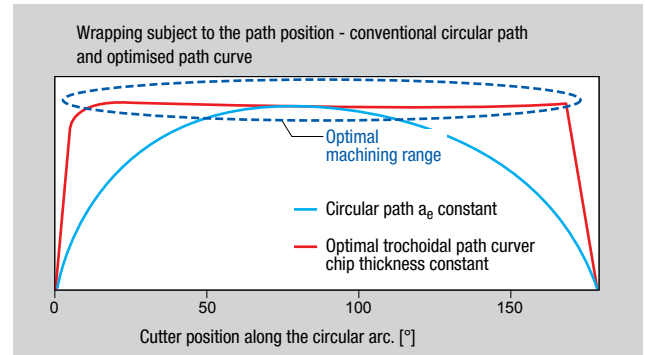
Trochoidal milling – optimised path curve

Due to the adapted path movement of the tool, the milling cutter's contact ratio can be maintained constant at every point on the path over almost the entire machining operation. In this way the milling process can always be operated at the optimal point. Within a path the feed is adjusted such that the average chip thickness remains constant.

- Constant contact conditions
- Constant force level
- Lower tool wear
- Maximum material removal rate



Wrapping as a function of the path position – optimise path curve



Feed movement – optimised air cut

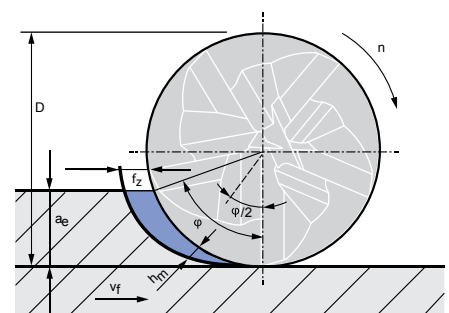
For holistic process optimisation, along with the tool path, the movements in the air cut during machining must also be considered. The goal is, after the milling cutter leaves the material, to realise a movement to the next entry point that is as fast as possible. As a circular path is not advantageous at this point, a path as direct as possible is selected depending on the dynamic behaviour of the machine.



Feed
Ramp
Rapid traverse

Average chip thickness h_m and contact angle φ

Contact angle	$\varphi = [^\circ]$	$\cos \varphi = 1 - \frac{2 \cdot a_e}{D}$	Is dependent on the contact ratio a_e/D and is limited subject to the workpiece material.
Average chip thickness	$h_m = [mm]$	$h_m = f_z \cdot \sqrt{\frac{a_e}{D}}$	Is maintained almost constant during trochoidal milling by means of dynamic feed. The average chip thickness is measured at $\varphi/2$.
Feed per tooth	$f_z = [\frac{mm}{tooth}]$		Limited variable, is adjusted by the CAM system during the machining.
Contact width	$a_e = [mm]$		Is continuously re-calculated by the CAM software and limits the contact angle φ .
Tool diameter	$D = [mm]$		



NOTE

- Trochoidal milling requires, along with a modern CAM system or a modern machine control system, also a machining centre that is as dynamic as possible.
- Full performance is achieved by using OptiMill milling cutters from the Trochoid series.

Cutting data recommendation

Note:

The cutting data stated on the following pages are guideline values. The optimal data for the specific machining case should be determined in trials or during machining.

End-mills with fixed cutting edges



Shoulder milling cutters | Groove milling and general applications

Product name	Specification	Page
OptiMill-Uni	M3030, M3032, M3033, M3034, M3040, M3041, M3043, M3133	120
OptiMill-Uni-HPC-Slot	M3293	124
ECU-Mill-Uni-LV	M4090, M4094	120
OptiMill-Uni-HPC	M3090, M3091, M3094	126
OptiMill-Uni-HPC-Plus	M3090P, M3190P, M3094P, M3194P	124
OptiMill-Uni-HPC-Silent	M3095	126
OptiMill-Inox	M3634	122
OptiMill-Titan-HPC	M3694, M3794	128
OptiMill-Mono-Alu	Type 200R, 200L, 200RY	122
OptiMill-Alu	M3442	122
OptiMill-Alu-HPC	M3493	128
OptiMill-Volume-N	M3591, M3593	134
OptiMill-Mono-Plastic	Type 100R, 100L	122
OptiMill-Softfoam	M7624	130
OptiMill-Hardfoam	M7718	130
OptiMill-Thermoplastic	M7614	130
OptiMill-Thermoplastic-FR	M7644	130
OptiMill-Composite-MT	M7001-M7004, M7011-M7014	130
OptiMill-Composite-Speed	M7218, M7228, M7238	128
MICRO-Router	M7901	128
OptiMill-Composite-Duo	M7222	130
OptiMill-Composite-UD	M7212, M7242	130
OptiMill-Composite-TwinCut	M7402	130
OptiMill-Honeycomb	M7526, M7528	130



Shoulder milling cutters | Shoulder milling – roughing

Product name	Specification	Page
OptiMill-Uni-Rough & Finish	M3060	132
OptiMill-Uni-HPC-Rough	M3081, M3181	132



Shoulder milling cutters | Shoulder milling – finishing

Product name	Specification	Page
OptiMill-Uni-Finish	M3046, M3048, M3049	134
OptiMill-Uni-HPC-Finish	M3096	135
OptiMill-Hardened	M3076, M3078, M3071	134



Shoulder milling cutters I Trochoidal milling

Product name	Specification	Page
OptiMill-Tro-Uni	M3099	136
OptiMill-Tro-PM	M3299	136
OptiMill-Tro-S	M3699	136
OptiMill-Tro-Titan	M3799	136
OptiMill-Tro-H	M3079	136



Chamfering, deburring and drill milling

Product name	Specification	Page
OptiMill-Chamfer	M5390	139
OptiMill-DrillMill	M5490	140



Profile milling

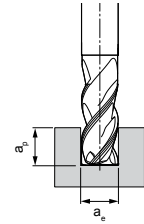
Product name	Specification	Page
OptiMill-Uni-Radius	M3832	138
OptiMill-Hardened-Radius	M3872	139
OptiMill-Composite-MT-Radius	M7801	130

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Tool length/ Correction factor:	
Length	f_z & v_c
Short	1
Long	0,9
Overlong	0,8
Extra long	0,6

Groove milling



$$a_p = 1 \times D$$

$$a_e = 1 \times D$$

ECU-Mill-Uni-LV | M4090, M4094

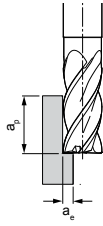
MMG*		Material	Strength/ hardness [N/mm ²] [HRC]	Cooling			v_c [m/min]	f_z [mm/tooth]								
				MQL/air	Dry	Wet		Milling cutter diameter [mm]								
								2	4	6	8	10	12	16	20	
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	170	0,012	0,021	0,03	0,038	0,046	0,054	0,067	0,078
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	140	0,011	0,019	0,028	0,036	0,043	0,05	0,063	0,073
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	155	0,012	0,021	0,03	0,038	0,046	0,054	0,067	0,078
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓		✓	105	0,01	0,017	0,025	0,032	0,038	0,045	0,056	0,065
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	100	0,011	0,02	0,028	0,036	0,044	0,051	0,064	0,074
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓		✓	85	0,01	0,018	0,026	0,033	0,04	0,047	0,058	0,068
P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	70	0,008	0,014	0,02	0,025	0,031	0,036	0,045	0,052	
P5	P5.1	Cast steel					105	0,011	0,02	0,029	0,037	0,045	0,052	0,065	0,075	
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	70	0,005	0,01	0,014	0,018	0,022	0,025	0,031	0,036	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	45	0,007	0,012	0,017	0,022	0,027	0,031	0,039	0,045
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	45	0,006	0,01	0,014	0,018	0,022	0,026	0,033	0,038
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	50	0,007	0,013	0,019	0,024	0,029	0,034	0,043	0,049
M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	45	0,006	0,01	0,015	0,019	0,023	0,027	0,034	0,039	
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	185	0,02	0,035	0,049	0,063	0,077	0,09	0,112	0,13
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	170	0,017	0,029	0,042	0,054	0,065	0,076	0,095	0,11
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	140	0,014	0,024	0,034	0,044	0,054	0,063	0,078	0,091
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	75	0,008	0,014	0,02	0,025	0,031	0,036	0,045	0,052
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	120	0,014	0,024	0,034	0,044	0,054	0,063	0,078	0,091
K3.2		Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	115	0,012	0,021	0,03	0,038	0,046	0,054	0,067	0,078	

OptiMill-Uni | M3030, M3032, M3033, M3034, M3040, M3041, M3043, M3133

P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	140	0,01	0,018	0,026	0,034	0,041	0,048	0,06	0,069
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	115	0,01	0,017	0,025	0,032	0,038	0,045	0,056	0,065
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	125	0,01	0,018	0,026	0,034	0,041	0,048	0,06	0,069
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓		✓	90	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	80	0,01	0,018	0,025	0,032	0,039	0,045	0,057	0,066
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓		✓	70	0,009	0,016	0,023	0,029	0,036	0,041	0,052	0,06
P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	55	0,007	0,012	0,018	0,023	0,027	0,032	0,04	0,046	
P5	P5.1	Cast steel					85	0,01	0,018	0,025	0,033	0,04	0,046	0,058	0,067	
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	55	0,005	0,009	0,012	0,016	0,019	0,022	0,028	0,032	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	40	0,006	0,011	0,015	0,02	0,024	0,028	0,035	0,04
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	35	0,005	0,009	0,013	0,016	0,02	0,023	0,029	0,033
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	40	0,007	0,012	0,017	0,021	0,026	0,03	0,038	0,044
M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	40	0,005	0,009	0,013	0,017	0,021	0,024	0,03	0,035	
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	150	0,017	0,031	0,044	0,056	0,068	0,08	0,1	0,115
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	140	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	115	0,012	0,022	0,031	0,039	0,048	0,056	0,07	0,081
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	65	0,007	0,012	0,018	0,023	0,027	0,032	0,04	0,046
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	100	0,012	0,022	0,031	0,039	0,048	0,056	0,07	0,081
K3.2		Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	95	0,01	0,018	0,026	0,034	0,041	0,048	0,06	0,069	
N	N1	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	525	0,017	0,031	0,044	0,056	0,068	0,08	0,1	0,115
		N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	350	0,018	0,032	0,046	0,059	0,072	0,084	0,105	0,121
		N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	280	0,019	0,034	0,048	0,062	0,075	0,088	0,11	0,127
		N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	200	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139
	N2	N2.1	Copper, non-alloyed and low alloyed	< 300	✓	✓	✓	200	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,092
		N2.2	Copper, alloyed	> 300	✓	✓	✓	150	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,092
N2.3		Brass, bronze, gun metal	< 1200	✓	✓	✓	250	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058	

* MILLER machining groups

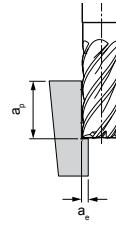
Roughing



$$a_p = 1,5 \times D$$

$$a_e = 0,25 \times D$$

Finishing



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

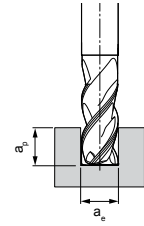
	v_c [m/min]	f_z [mm/tooth]								v_c [m/min]	f_z [mm/tooth]								
		Milling cutter diameter [mm]									Milling cutter diameter [mm]								
		2	4	6	8	10	12	16	20		2	4	6	8	10	12	16	20	
	345	0,02	0,035	0,05	0,065	0,078	0,091	0,114	0,132	505	0,031	0,056	0,079	0,102	0,124	0,144	0,18	0,209	
	280	0,019	0,033	0,047	0,06	0,073	0,085	0,106	0,123	415	0,029	0,052	0,074	0,095	0,115	0,135	0,168	0,195	
	315	0,02	0,035	0,05	0,065	0,078	0,091	0,114	0,132	460	0,031	0,056	0,079	0,102	0,124	0,144	0,18	0,209	
	220	0,017	0,029	0,042	0,054	0,065	0,076	0,095	0,11	320	0,026	0,046	0,066	0,085	0,103	0,12	0,15	0,174	
	205	0,019	0,033	0,048	0,061	0,074	0,087	0,108	0,126	300	0,03	0,053	0,075	0,097	0,118	0,137	0,171	0,199	
	170	0,017	0,031	0,043	0,056	0,068	0,079	0,099	0,115	250	0,027	0,048	0,069	0,088	0,107	0,125	0,156	0,181	
	140	0,013	0,023	0,033	0,043	0,052	0,061	0,076	0,088	205	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139	
	210	0,019	0,034	0,048	0,062	0,076	0,088	0,11	0,128	310	0,03	0,054	0,077	0,099	0,12	0,139	0,174	0,202	
	140	0,009	0,016	0,023	0,03	0,037	0,043	0,053	0,062	205	0,015	0,026	0,037	0,048	0,058	0,067	0,084	0,098	
	95	0,012	0,021	0,029	0,038	0,046	0,053	0,067	0,077	140	0,018	0,032	0,046	0,06	0,072	0,084	0,105	0,122	
	90	0,01	0,017	0,024	0,031	0,038	0,044	0,055	0,064	130	0,015	0,027	0,038	0,049	0,06	0,07	0,087	0,101	
	105	0,013	0,022	0,032	0,041	0,05	0,058	0,072	0,084	150	0,02	0,035	0,05	0,065	0,078	0,091	0,114	0,132	
	95	0,01	0,018	0,025	0,032	0,039	0,046	0,057	0,066	140	0,016	0,028	0,04	0,051	0,062	0,072	0,09	0,105	
	375	0,033	0,059	0,084	0,108	0,13	0,152	0,19	0,22	550	0,052	0,093	0,132	0,17	0,206	0,24	0,301	0,348	
	345	0,028	0,05	0,071	0,091	0,111	0,129	0,162	0,187	505	0,045	0,079	0,112	0,145	0,175	0,204	0,256	0,296	
	280	0,023	0,041	0,059	0,075	0,091	0,106	0,133	0,154	415	0,037	0,065	0,092	0,119	0,144	0,168	0,21	0,244	
	155	0,013	0,023	0,033	0,043	0,052	0,061	0,076	0,088	230	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139	
	250	0,023	0,041	0,059	0,075	0,091	0,106	0,133	0,154	365	0,037	0,065	0,092	0,119	0,144	0,168	0,21	0,244	
	235	0,02	0,035	0,05	0,065	0,078	0,091	0,114	0,132	345	0,031	0,056	0,079	0,102	0,124	0,144	0,18	0,209	

	285	0,018	0,031	0,045	0,057	0,07	0,081	0,101	0,118	415	0,028	0,05	0,07	0,091	0,11	0,128	0,16	0,186	
	230	0,017	0,029	0,042	0,054	0,065	0,076	0,095	0,11	340	0,026	0,046	0,066	0,085	0,103	0,12	0,15	0,173	
	260	0,018	0,031	0,045	0,057	0,07	0,081	0,101	0,118	380	0,028	0,05	0,07	0,091	0,11	0,128	0,16	0,186	
	180	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	265	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	
	165	0,017	0,03	0,042	0,054	0,066	0,077	0,096	0,112	245	0,027	0,047	0,067	0,086	0,104	0,122	0,152	0,177	
	140	0,015	0,027	0,039	0,05	0,06	0,07	0,088	0,102	210	0,024	0,043	0,061	0,079	0,095	0,111	0,139	0,161	
	115	0,012	0,021	0,03	0,038	0,046	0,054	0,068	0,078	170	0,019	0,033	0,047	0,06	0,073	0,085	0,107	0,124	
	175	0,017	0,03	0,043	0,055	0,067	0,078	0,098	0,114	255	0,027	0,048	0,068	0,088	0,106	0,124	0,155	0,18	
	115	0,008	0,015	0,021	0,027	0,032	0,038	0,047	0,055	170	0,013	0,023	0,033	0,042	0,051	0,06	0,075	0,087	
	75	0,01	0,018	0,026	0,033	0,041	0,047	0,059	0,069	115	0,016	0,029	0,041	0,053	0,064	0,075	0,094	0,108	
	70	0,009	0,015	0,022	0,028	0,034	0,039	0,049	0,057	105	0,014	0,024	0,034	0,044	0,053	0,062	0,077	0,09	
	85	0,011	0,02	0,028	0,036	0,044	0,051	0,064	0,074	125	0,018	0,031	0,045	0,057	0,07	0,081	0,102	0,118	
	75	0,009	0,016	0,022	0,029	0,035	0,041	0,051	0,059	115	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,093	
	310	0,03	0,052	0,074	0,096	0,116	0,135	0,169	0,196	455	0,047	0,083	0,117	0,151	0,183	0,214	0,267	0,31	
	285	0,025	0,044	0,063	0,081	0,099	0,115	0,144	0,166	415	0,04	0,07	0,1	0,128	0,156	0,182	0,227	0,263	
	230	0,021	0,037	0,052	0,067	0,081	0,095	0,118	0,137	340	0,033	0,058	0,082	0,106	0,128	0,149	0,187	0,217	
	130	0,012	0,021	0,03	0,038	0,046	0,054	0,068	0,078	190	0,019	0,033	0,047	0,06	0,073	0,085	0,107	0,124	
	205	0,021	0,037	0,052	0,067	0,081	0,095	0,118	0,137	300	0,033	0,058	0,082	0,106	0,128	0,149	0,187	0,217	
	195	0,018	0,031	0,045	0,057	0,07	0,081	0,101	0,118	285	0,028	0,05	0,07	0,091	0,11	0,128	0,16	0,186	
	1075	0,03	0,052	0,074	0,096	0,116	0,135	0,169	0,196	1580	0,047	0,083	0,117	0,151	0,183	0,214	0,267	0,31	
	715	0,031	0,055	0,078	0,1	0,122	0,142	0,177	0,206	1050	0,049	0,087	0,123	0,159	0,192	0,224	0,281	0,325	
	570	0,032	0,057	0,082	0,105	0,128	0,149	0,186	0,215	840	0,051	0,091	0,129	0,166	0,202	0,235	0,294	0,341	
	410	0,035	0,063	0,089	0,115	0,139	0,162	0,203	0,235	605	0,056	0,099	0,141	0,181	0,22	0,256	0,321	0,372	
	410	0,024	0,042	0,059	0,076	0,093	0,108	0,135	0,157	605	0,037	0,066	0,094	0,121	0,147	0,171	0,214	0,248	
	310	0,024	0,042	0,059	0,076	0,093	0,108	0,135	0,157	455	0,037	0,066	0,094	0,121	0,147	0,171	0,214	0,248	
	515	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	755	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Groove milling



$$a_p = 1 \times D$$

$$a_e = 1 \times D$$

OptiMill-Inox | M3634

MMG*	Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]									
			MQL/air	Dry	Wet		Milling cutter diameter [mm]									
							2	4	6	8	10	12	16	20		
M	M1.1	Stainless steel, austenitic	< 700	✓		✓	50	0,007	0,012	0,017	0,022	0,027	0,031	0,039	0,045	
	M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	45	0,006	0,01	0,014	0,018	0,022	0,026	0,033	0,038	
	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	55	0,007	0,013	0,019	0,024	0,029	0,034	0,043	0,049	
	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	50	0,006	0,01	0,015	0,019	0,023	0,027	0,034	0,039	
S	S1.1	Titanium, titanium alloy	< 400			✓	80	0,011	0,019	0,027	0,035	0,042	0,049	0,062	0,071	
	S2	S2.1	Titanium, titanium alloy	< 1200			✓	75	0,009	0,016	0,022	0,029	0,035	0,04	0,05	0,058
		S2.2	Titanium, titanium alloy	> 1200			✓	50	0,008	0,014	0,02	0,025	0,031	0,036	0,045	0,052
	S3	S3.1	Nickel, non-alloyed and alloyed	< 900			✓	30	0,01	0,017	0,025	0,032	0,038	0,045	0,056	0,065
		S3.2	Nickel, non-alloyed and alloyed	> 900			✓	24	0,006	0,01	0,015	0,019	0,023	0,027	0,034	0,039
	S4.1	Heat resistant super alloys, Ni, Co, and Fe based				✓	24	0,005	0,009	0,012	0,016	0,019	0,022	0,028	0,032	
	S5.1	Tungsten and molybdenum alloys				✓	24	0,008	0,014	0,02	0,025	0,031	0,036	0,045	0,052	

OptiMill-Alu | M3442

N1	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	600	0,017	0,031	0,044	0,056	0,068	0,08	0,1	0,115
	N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	400	0,018	0,032	0,046	0,059	0,072	0,084	0,105	0,121
	N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	320	0,019	0,034	0,048	0,062	0,075	0,088	0,11	0,127
	N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	230	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139
N2	N2.1	Copper, non-alloyed and low alloyed	< 300	✓	✓	✓	230	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,092
	N2.2	Copper, alloyed	> 300	✓	✓	✓	175	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,092
	N2.3	Brass, bronze, gun metal	< 1200	✓	✓	✓	290	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
N4	N4.1	Plastic, thermoplastic		✓	✓	✓	80	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	N4.2	Plastic, thermosetting plastic (duroplast)		✓	✓	✓	120	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	N4.3	Plastic, foam		✓	✓		960	0,005	0,009	0,013	0,017	0,021	0,024	0,03	0,035

OptiMill-Mono-Alu | Type 200R, 200L, 200RY

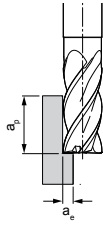
MMG*	Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	2	3	4	5	6	8	10	12	
			MQL/air	Dry	Wet										
N1	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	755	0,043	0,06	0,077	0,093	0,109	0,141	0,171	0,199
	N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	500	0,046	0,063	0,081	0,098	0,115	0,148	0,179	0,209
	N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	400	0,048	0,066	0,085	0,103	0,12	0,155	0,188	0,219
	N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	290	0,052	0,072	0,092	0,112	0,131	0,169	0,205	0,239
N2	N2.1	Copper, non-alloyed and low alloyed	< 300	✓	✓	✓	290	0,035	0,048	0,062	0,075	0,088	0,113	0,137	0,159
	N2.2	Copper, alloyed	> 300	✓	✓	✓	215	0,035	0,048	0,062	0,075	0,088	0,113	0,137	0,159
	N2.3	Brass, bronze, gun metal	< 1200	✓	✓	✓	360	0,022	0,03	0,038	0,047	0,055	0,07	0,085	0,1
N4	N4.1	Plastic, thermoplastic		✓	✓	✓	100	0,022	0,03	0,038	0,047	0,055	0,07	0,085	0,1
	N4.2	Plastic, thermosetting plastic (duroplast)		✓	✓	✓	150	0,022	0,03	0,038	0,047	0,055	0,07	0,085	0,1
	N4.3	Plastic, foam		✓	✓		1200	0,013	0,018	0,023	0,028	0,033	0,042	0,051	0,06

OptiMill-Mono-Plastic | Type 100R, 100L

N	N4	N4.1	Plastic, thermoplastic		✓	✓	✓	100	0,022	0,03	0,038	0,047	0,055	0,07	0,085	0,1
		N4.2	Plastic, thermosetting plastic (duroplast)		✓	✓	✓	150	0,022	0,03	0,038	0,047	0,055	0,07	0,085	0,1
		N4.3	Plastic, foam		✓	✓		1200	0,013	0,018	0,023	0,028	0,033	0,042	0,051	0,06

* MILLER machining groups

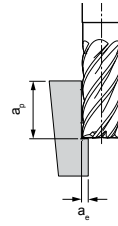
Roughing



$$a_p = 1,5 \times D$$

$$a_e = 0,25 \times D$$

Finishing



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

	v_c [m/min]	f_z [mm/tooth]								v_c [m/min]	f_z [mm/tooth]							
		Milling cutter diameter [mm]									Milling cutter diameter [mm]							
		2	4	6	8	10	12	16	20		2	4	6	8	10	12	16	20
	100	0,012	0,021	0,029	0,038	0,046	0,053	0,067	0,077	145	0,018	0,032	0,046	0,06	0,072	0,084	0,105	0,122
	95	0,01	0,017	0,024	0,031	0,038	0,044	0,055	0,064	135	0,015	0,027	0,038	0,049	0,06	0,07	0,087	0,101
	110	0,013	0,022	0,032	0,041	0,05	0,058	0,072	0,084	160	0,02	0,035	0,05	0,065	0,078	0,091	0,114	0,132
	100	0,01	0,018	0,025	0,032	0,039	0,046	0,057	0,066	145	0,016	0,028	0,04	0,051	0,062	0,072	0,09	0,105
	165	0,018	0,032	0,046	0,059	0,072	0,084	0,105	0,121	245	0,029	0,051	0,073	0,094	0,113	0,132	0,165	0,192
	150	0,015	0,026	0,038	0,048	0,059	0,068	0,086	0,099	220	0,024	0,042	0,059	0,077	0,093	0,108	0,135	0,157
	100	0,013	0,023	0,033	0,043	0,052	0,061	0,076	0,088	145	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139
	65	0,017	0,029	0,042	0,054	0,065	0,076	0,095	0,11	95	0,026	0,046	0,066	0,085	0,103	0,12	0,15	0,174
	50	0,01	0,018	0,025	0,032	0,039	0,046	0,057	0,066	75	0,016	0,028	0,04	0,051	0,062	0,072	0,09	0,105
	50	0,008	0,015	0,021	0,027	0,033	0,038	0,048	0,055	75	0,013	0,023	0,033	0,043	0,052	0,06	0,075	0,087
	50	0,013	0,023	0,033	0,043	0,052	0,061	0,076	0,088	75	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139

	1230	0,03	0,052	0,074	0,096	0,116	0,135	0,169	0,196	1805	0,047	0,083	0,117	0,151	0,183	0,214	0,267	0,31
	820	0,031	0,055	0,078	0,1	0,122	0,142	0,177	0,206	1200	0,049	0,087	0,123	0,159	0,192	0,224	0,281	0,325
	655	0,032	0,057	0,082	0,105	0,128	0,149	0,186	0,215	960	0,051	0,091	0,129	0,166	0,202	0,235	0,294	0,341
	470	0,035	0,063	0,089	0,115	0,139	0,162	0,203	0,235	690	0,056	0,099	0,141	0,181	0,22	0,256	0,321	0,372
	470	0,024	0,042	0,059	0,076	0,093	0,108	0,135	0,157	690	0,037	0,066	0,094	0,121	0,147	0,171	0,214	0,248
	355	0,024	0,042	0,059	0,076	0,093	0,108	0,135	0,157	520	0,037	0,066	0,094	0,121	0,147	0,171	0,214	0,248
	590	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	865	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155
	160	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	240	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155
	240	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	355	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155
	1960	0,009	0,016	0,022	0,029	0,035	0,041	0,051	0,059	2875	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,093

		2	3	4	5	6	8	10	12		2	3	4	5	6	8	10	12
	1540	0,074	0,102	0,13	0,158	0,186	0,239	0,29	0,338	2255	0,117	0,162	0,206	0,25	0,294	0,378	0,458	0,534
	1025	0,077	0,107	0,137	0,166	0,195	0,251	0,304	0,355	1500	0,122	0,17	0,217	0,263	0,308	0,397	0,481	0,561
	815	0,081	0,113	0,144	0,174	0,204	0,263	0,319	0,371	1200	0,128	0,178	0,227	0,275	0,323	0,416	0,504	0,587
	590	0,089	0,123	0,157	0,19	0,223	0,287	0,348	0,405	865	0,14	0,194	0,248	0,3	0,352	0,453	0,55	0,641
	590	0,059	0,082	0,104	0,127	0,149	0,191	0,232	0,27	865	0,093	0,129	0,165	0,2	0,235	0,302	0,367	0,427
	440	0,059	0,082	0,104	0,127	0,149	0,191	0,232	0,27	650	0,093	0,129	0,165	0,2	0,235	0,302	0,367	0,427
	735	0,037	0,051	0,065	0,079	0,093	0,119	0,145	0,169	1080	0,058	0,081	0,103	0,125	0,147	0,189	0,229	0,267
	200	0,037	0,051	0,065	0,079	0,093	0,119	0,145	0,169	295	0,058	0,081	0,103	0,125	0,147	0,189	0,229	0,267
	300	0,037	0,051	0,065	0,079	0,093	0,119	0,145	0,169	445	0,058	0,081	0,103	0,125	0,147	0,189	0,229	0,267
	2450	0,022	0,031	0,039	0,047	0,056	0,072	0,087	0,101	3595	0,035	0,049	0,062	0,075	0,088	0,113	0,137	0,16

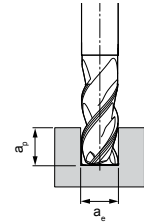
	200	0,037	0,051	0,065	0,079	0,093	0,119	0,145	0,169	295	0,058	0,081	0,103	0,125	0,147	0,189	0,229	0,267
	300	0,037	0,051	0,065	0,079	0,093	0,119	0,145	0,169	445	0,058	0,081	0,103	0,125	0,147	0,189	0,229	0,267
	2450	0,022	0,031	0,039	0,047	0,056	0,072	0,087	0,101	3595	0,035	0,049	0,062	0,075	0,088	0,113	0,137	0,16

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Tool length/ Correction factor:	
Length	f_z & v_c
Short	1
Long	0,9
Overlong	0,8
Extra long	0,6

Groove milling



$$a_p = 1 \times D$$

$$a_e = 1 \times D$$

OptiMill-Uni-HPC-Plus | M3090P, M3190P, M3094P, M3194P

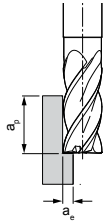
MMG*		Material	Strength/ hardness [N/mm ²] [HRC]	Cooling			v_c [m/min]	f_z [mm/tooth]								
				MQL/Air	Dry	Wet		Milling cutter diameter [mm]								
								2	4	6	8	10	12	16	20	
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	220	0,016	0,029	0,041	0,053	0,064	0,075	0,093	0,108
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	180	0,015	0,027	0,038	0,049	0,06	0,07	0,087	0,101
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	200	0,016	0,029	0,041	0,053	0,064	0,075	0,093	0,108
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓	✓	✓	140	0,014	0,024	0,034	0,044	0,053	0,062	0,078	0,09
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	130	0,015	0,027	0,039	0,05	0,061	0,071	0,089	0,103
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓	✓	✓	110	0,014	0,025	0,036	0,046	0,056	0,065	0,081	0,094
	P4	P4.1	Stainless steel, ferritic and martensitic		✓	✓		90	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
	P5	P5.1	Cast steel					135	0,016	0,028	0,04	0,051	0,062	0,072	0,09	0,105
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	90	0,008	0,013	0,019	0,025	0,03	0,035	0,044	0,051	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓	✓	✓	60	0,01	0,017	0,024	0,031	0,037	0,044	0,054	0,063
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	55	0,008	0,014	0,02	0,026	0,031	0,036	0,045	0,052
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓	✓	✓	65	0,01	0,018	0,026	0,033	0,041	0,047	0,059	0,069
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	60	0,008	0,014	0,021	0,026	0,032	0,037	0,047	0,054
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	240	0,027	0,048	0,068	0,088	0,107	0,124	0,156	0,18
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	220	0,023	0,041	0,058	0,075	0,091	0,106	0,132	0,153
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	180	0,019	0,034	0,048	0,062	0,075	0,087	0,109	0,126
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	160	0,019	0,034	0,048	0,062	0,075	0,087	0,109	0,126
		K3.2	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	150	0,016	0,029	0,041	0,053	0,064	0,075	0,093	0,108

OptiMill-Uni-HPC-Slot | M3293

P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	200	0,013	0,023	0,033	0,042	0,051	0,06	0,075	0,087
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	160	0,012	0,022	0,031	0,039	0,048	0,056	0,07	0,081
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	180	0,013	0,023	0,033	0,042	0,051	0,06	0,075	0,087
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓	✓	✓	125	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	115	0,012	0,022	0,031	0,04	0,049	0,057	0,071	0,082
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓	✓	✓	100	0,011	0,02	0,028	0,037	0,044	0,052	0,065	0,075
	P4	P4.1	Stainless steel, ferritic and martensitic		✓	✓		80	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	P5	P5.1	Cast steel					120	0,013	0,022	0,032	0,041	0,05	0,058	0,072	0,084
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	80	0,006	0,011	0,015	0,02	0,024	0,028	0,035	0,04	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓	✓	✓	55	0,008	0,013	0,019	0,025	0,03	0,035	0,044	0,051
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	50	0,006	0,011	0,016	0,02	0,025	0,029	0,036	0,042
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓	✓	✓	60	0,008	0,015	0,021	0,027	0,032	0,038	0,047	0,055
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	55	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	215	0,022	0,038	0,055	0,07	0,085	0,1	0,125	0,144
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	200	0,018	0,033	0,047	0,06	0,073	0,085	0,106	0,123
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	160	0,015	0,027	0,038	0,049	0,06	0,07	0,087	0,101
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	90	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	145	0,015	0,027	0,038	0,049	0,06	0,07	0,087	0,101
		K3.2	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	135	0,013	0,023	0,033	0,042	0,051	0,06	0,075	0,087

* MILLER machining groups

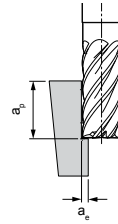
Roughing



$$a_p = 1,5 \times D$$

$$a_e = 0,25 \times D$$

Finishing



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

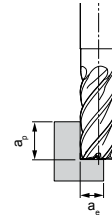
	v_c [m/min]	f_z [mm/tooth]								v_c [m/min]	f_z [mm/tooth]								
		Milling cutter diameter [mm]									Milling cutter diameter [mm]								
		2	4	6	8	10	12	16	20		2	4	6	8	10	12	16	20	
	445	0,028	0,049	0,07	0,09	0,109	0,127	0,158	0,184	655	0,044	0,077	0,11	0,142	0,172	0,2	0,251	0,29	
	365	0,026	0,046	0,065	0,084	0,101	0,118	0,148	0,171	535	0,041	0,072	0,103	0,132	0,16	0,187	0,234	0,271	
	405	0,028	0,049	0,07	0,09	0,109	0,127	0,158	0,184	595	0,044	0,077	0,11	0,142	0,172	0,2	0,251	0,29	
	285	0,023	0,041	0,058	0,075	0,091	0,106	0,132	0,153	415	0,036	0,064	0,092	0,118	0,143	0,167	0,209	0,242	
	265	0,026	0,046	0,066	0,085	0,103	0,12	0,151	0,174	385	0,042	0,073	0,105	0,135	0,163	0,19	0,238	0,276	
	225	0,024	0,042	0,06	0,078	0,094	0,11	0,137	0,159	325	0,038	0,067	0,095	0,123	0,149	0,174	0,217	0,252	
	180	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	265	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194	
	270	0,027	0,047	0,067	0,087	0,105	0,122	0,153	0,177	400	0,042	0,075	0,106	0,137	0,166	0,194	0,242	0,281	
	180	0,013	0,023	0,033	0,042	0,051	0,059	0,074	0,086	265	0,02	0,036	0,051	0,066	0,08	0,093	0,117	0,135	
	120	0,016	0,029	0,041	0,052	0,063	0,074	0,092	0,107	180	0,026	0,045	0,064	0,083	0,1	0,117	0,146	0,169	
	115	0,013	0,024	0,034	0,043	0,053	0,061	0,077	0,089	165	0,021	0,037	0,053	0,068	0,083	0,097	0,121	0,14	
	135	0,018	0,031	0,044	0,057	0,069	0,08	0,1	0,116	195	0,028	0,049	0,07	0,09	0,109	0,127	0,159	0,184	
	120	0,014	0,024	0,035	0,045	0,054	0,063	0,079	0,092	180	0,022	0,039	0,055	0,071	0,086	0,1	0,125	0,145	
	485	0,046	0,082	0,116	0,149	0,181	0,211	0,264	0,306	715	0,073	0,129	0,184	0,236	0,286	0,334	0,418	0,484	
	445	0,039	0,069	0,099	0,127	0,154	0,179	0,224	0,26	655	0,062	0,11	0,156	0,201	0,243	0,284	0,355	0,411	
	365	0,032	0,057	0,081	0,105	0,127	0,148	0,185	0,214	535	0,051	0,09	0,128	0,165	0,2	0,234	0,292	0,339	
	200	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	295	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194	
	325	0,032	0,057	0,081	0,105	0,127	0,148	0,185	0,214	475	0,051	0,09	0,128	0,165	0,2	0,234	0,292	0,339	
	305	0,028	0,049	0,07	0,09	0,109	0,127	0,158	0,184	445	0,044	0,077	0,11	0,142	0,172	0,2	0,251	0,29	
	405	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	595	0,035	0,062	0,088	0,113	0,137	0,16	0,2	0,232	
	330	0,021	0,037	0,052	0,067	0,081	0,095	0,118	0,137	485	0,033	0,058	0,082	0,106	0,128	0,149	0,187	0,217	
	370	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	540	0,035	0,062	0,088	0,113	0,137	0,16	0,2	0,232	
	260	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	380	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194	
	240	0,021	0,037	0,053	0,068	0,083	0,096	0,12	0,14	350	0,033	0,059	0,084	0,108	0,131	0,152	0,19	0,221	
	200	0,019	0,034	0,048	0,062	0,075	0,088	0,11	0,127	295	0,03	0,054	0,076	0,098	0,119	0,139	0,174	0,201	
	165	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	245	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	
	245	0,021	0,038	0,054	0,069	0,084	0,098	0,123	0,142	360	0,034	0,06	0,085	0,11	0,133	0,155	0,194	0,225	
	165	0,01	0,018	0,026	0,033	0,041	0,047	0,059	0,069	245	0,016	0,029	0,041	0,053	0,064	0,075	0,094	0,108	
	110	0,013	0,023	0,033	0,042	0,051	0,059	0,074	0,086	160	0,02	0,036	0,051	0,066	0,08	0,093	0,117	0,135	
	105	0,011	0,019	0,027	0,035	0,042	0,049	0,061	0,071	150	0,017	0,03	0,043	0,055	0,066	0,077	0,097	0,112	
	120	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,093	180	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	
	110	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	160	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116	
	440	0,037	0,065	0,093	0,119	0,145	0,169	0,211	0,245	650	0,058	0,103	0,147	0,189	0,229	0,267	0,334	0,387	
	405	0,031	0,055	0,079	0,102	0,123	0,144	0,18	0,208	595	0,05	0,088	0,125	0,161	0,195	0,227	0,284	0,329	
	330	0,026	0,046	0,065	0,084	0,101	0,118	0,148	0,171	485	0,041	0,072	0,103	0,132	0,16	0,187	0,234	0,271	
	185	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	270	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	
	295	0,026	0,046	0,065	0,084	0,101	0,118	0,148	0,171	430	0,041	0,072	0,103	0,132	0,16	0,187	0,234	0,271	
	275	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	405	0,035	0,062	0,088	0,113	0,137	0,16	0,2	0,232	

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Tool length/ Correction factor:	
Length	f_z & v_c
Short	1
Long	0,9
Overlong	0,8
Extra long	0,6

Groove milling –
partial slot



$$a_p = 1 \times D$$

$$a_e = 0,6 \times D$$

OptiMill-Uni-HPC | M3090, M3091, M3094

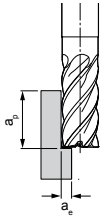
MMG*		Material	Strength/ hardness [N/mm ²] [HRC]	Cooling			v_c [m/min]	f_z [mm/tooth]									
				MQL/air	Dry	Wet		Milling cutter diameter [mm]									
								2	4	6	8	10	12	16	20	25	
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	200	0,013	0,023	0,033	0,042	0,051	0,060	0,075	0,087	0,096
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	160	0,012	0,022	0,031	0,039	0,048	0,056	0,070	0,081	0,090
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	180	0,013	0,023	0,033	0,042	0,051	0,060	0,075	0,087	0,096
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓		✓	125	0,011	0,019	0,027	0,035	0,043	0,050	0,062	0,072	0,080
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	115	0,012	0,022	0,031	0,040	0,049	0,057	0,071	0,082	0,091
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓		✓	100	0,011	0,020	0,028	0,037	0,044	0,052	0,065	0,075	0,083
P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	80	0,009	0,015	0,022	0,028	0,034	0,040	0,050	0,058	0,064	
P5	P5.1	Cast steel					120	0,013	0,022	0,032	0,041	0,050	0,058	0,072	0,084	0,093	
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	80	0,006	0,011	0,015	0,020	0,024	0,028	0,035	0,040	0,045	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	55	0,008	0,013	0,019	0,025	0,030	0,035	0,044	0,051	0,056
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	50	0,006	0,011	0,016	0,020	0,025	0,029	0,036	0,042	0,046
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	60	0,008	0,015	0,021	0,027	0,032	0,038	0,047	0,055	0,061
M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	55	0,007	0,012	0,016	0,021	0,026	0,030	0,037	0,043	0,048	
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	215	0,022	0,038	0,055	0,070	0,085	0,100	0,125	0,144	0,160
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	200	0,018	0,033	0,047	0,060	0,073	0,085	0,106	0,123	0,136
		K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	160	0,015	0,027	0,038	0,049	0,060	0,070	0,087	0,101	0,112
	K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	90	0,009	0,015	0,022	0,028	0,034	0,040	0,050	0,058	0,064	
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	145	0,015	0,027	0,038	0,049	0,060	0,070	0,087	0,101	0,112
K3.2		Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	135	0,013	0,023	0,033	0,042	0,051	0,060	0,075	0,087	0,096	

OptiMill-Uni-HPC-Silent | M3095

P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	230	-	-	0,042	0,055	0,066	0,077	0,096	0,112	0,124
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	190	-	-	0,04	0,051	0,062	0,072	0,09	0,104	0,116
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	210	-	-	0,042	0,055	0,066	0,077	0,096	0,112	0,124
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓		✓	145	-	-	0,035	0,045	0,055	0,064	0,08	0,093	0,103
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	135	-	-	0,04	0,052	0,063	0,073	0,092	0,106	0,118
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓		✓	115	-	-	0,037	0,047	0,057	0,067	0,084	0,097	0,107
P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	95	-	-	0,028	0,036	0,044	0,051	0,064	0,075	0,083	
P5	P5.1	Cast steel					140	-	-	0,041	0,053	0,064	0,075	0,093	0,108	0,12	
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	95	-	-	0,02	0,025	0,031	0,036	0,045	0,052	0,058	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	65	-	-	0,025	0,032	0,039	0,045	0,056	0,065	0,072
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	60	-	-	0,02	0,026	0,032	0,037	0,047	0,054	0,06
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	70	-	-	0,027	0,035	0,042	0,049	0,061	0,071	0,078
M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	65	-	-	0,021	0,027	0,033	0,039	0,048	0,056	0,062	
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	250	-	-	0,071	0,091	0,11	0,128	0,161	0,186	0,206
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	230	-	-	0,06	0,077	0,094	0,109	0,137	0,158	0,175
		K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	190	-	-	0,049	0,064	0,077	0,09	0,113	0,13	0,144
	K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	105	-	-	0,028	0,036	0,044	0,051	0,064	0,075	0,083	
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	170	-	-	0,049	0,064	0,077	0,09	0,113	0,13	0,144
K3.2		Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	160	-	-	0,042	0,055	0,066	0,077	0,096	0,112	0,124	

* MILLER machining groups

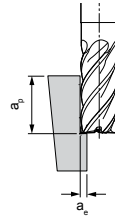
Roughing



$$a_p = 1,5 \times D$$

$$a_e = 0,25 \times D$$

Finishing



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

	v_c [m/min]	f_z [mm/tooth]										v_c [m/min]	f_z [mm/tooth]									
		Milling cutter diameter [mm]											Milling cutter diameter [mm]									
		2	4	6	8	10	12	16	20	25	2		4	6	8	10	12	16	20	25		
	405	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	0,163	595	0,035	0,062	0,088	0,113	0,137	0,160	0,200	0,232	0,257		
	330	0,021	0,037	0,052	0,067	0,081	0,095	0,118	0,137	0,152	485	0,033	0,058	0,082	0,106	0,128	0,149	0,187	0,217	0,240		
	370	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	0,163	540	0,035	0,062	0,088	0,113	0,137	0,160	0,200	0,232	0,257		
	260	0,018	0,033	0,046	0,060	0,072	0,084	0,106	0,122	0,136	380	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194	0,214		
	240	0,021	0,037	0,053	0,068	0,083	0,096	0,120	0,140	0,155	350	0,033	0,059	0,084	0,108	0,131	0,152	0,190	0,221	0,244		
	200	0,019	0,034	0,048	0,062	0,075	0,088	0,110	0,127	0,141	295	0,030	0,054	0,076	0,098	0,119	0,139	0,174	0,201	0,223		
	165	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	0,108	245	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	0,172		
	245	0,021	0,038	0,054	0,069	0,084	0,098	0,123	0,142	0,157	360	0,034	0,060	0,085	0,110	0,133	0,155	0,194	0,225	0,249		
	165	0,010	0,018	0,026	0,033	0,041	0,047	0,059	0,069	0,076	245	0,016	0,029	0,041	0,053	0,064	0,075	0,094	0,108	0,120		
	110	0,013	0,023	0,033	0,042	0,051	0,059	0,074	0,086	0,095	160	0,020	0,036	0,051	0,066	0,080	0,093	0,117	0,135	0,150		
	105	0,011	0,019	0,027	0,035	0,042	0,049	0,061	0,071	0,079	150	0,017	0,030	0,043	0,055	0,066	0,077	0,097	0,112	0,124		
	120	0,014	0,025	0,035	0,045	0,055	0,064	0,080	0,093	0,103	180	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	0,163		
	110	0,011	0,020	0,028	0,036	0,043	0,051	0,063	0,073	0,081	160	0,017	0,031	0,044	0,057	0,069	0,080	0,100	0,116	0,129		
	440	0,037	0,065	0,093	0,119	0,145	0,169	0,211	0,245	0,271	650	0,058	0,103	0,147	0,189	0,229	0,267	0,334	0,387	0,429		
	405	0,031	0,055	0,079	0,102	0,123	0,144	0,180	0,208	0,231	595	0,050	0,088	0,125	0,161	0,195	0,227	0,284	0,329	0,365		
	330	0,026	0,046	0,065	0,084	0,101	0,118	0,148	0,171	0,190	485	0,041	0,072	0,103	0,132	0,160	0,187	0,234	0,271	0,300		
	185	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	0,108	270	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	0,172		
	295	0,026	0,046	0,065	0,084	0,101	0,118	0,148	0,171	0,190	430	0,041	0,072	0,103	0,132	0,160	0,187	0,234	0,271	0,300		
	275	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	0,163	405	0,035	0,062	0,088	0,113	0,137	0,160	0,200	0,232	0,257		

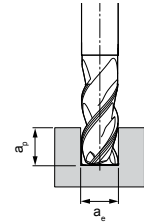
	405	-	-	0,056	0,072	0,087	0,101	0,127	0,147	0,163	595	-	-	0,088	0,113	0,137	0,16	0,2	0,232	0,257
	330	-	-	0,052	0,067	0,081	0,095	0,118	0,137	0,152	485	-	-	0,082	0,106	0,128	0,149	0,187	0,217	0,24
	370	-	-	0,056	0,072	0,087	0,101	0,127	0,147	0,163	540	-	-	0,088	0,113	0,137	0,16	0,2	0,232	0,257
	260	-	-	0,046	0,06	0,072	0,084	0,106	0,122	0,136	380	-	-	0,073	0,094	0,115	0,133	0,167	0,194	0,214
	240	-	-	0,053	0,068	0,083	0,096	0,12	0,14	0,155	350	-	-	0,084	0,108	0,131	0,152	0,19	0,221	0,244
	200	-	-	0,048	0,062	0,075	0,088	0,11	0,127	0,141	295	-	-	0,076	0,098	0,119	0,139	0,174	0,201	0,223
	165	-	-	0,037	0,048	0,058	0,068	0,085	0,098	0,108	245	-	-	0,059	0,076	0,092	0,107	0,134	0,155	0,172
	245	-	-	0,054	0,069	0,084	0,098	0,123	0,142	0,157	360	-	-	0,085	0,11	0,133	0,155	0,194	0,225	0,249
	165	-	-	0,026	0,033	0,041	0,047	0,059	0,069	0,076	245	-	-	0,041	0,053	0,064	0,075	0,094	0,108	0,12
	110	-	-	0,033	0,042	0,051	0,059	0,074	0,086	0,095	160	-	-	0,051	0,066	0,08	0,093	0,117	0,135	0,15
	105	-	-	0,027	0,035	0,042	0,049	0,061	0,071	0,079	150	-	-	0,043	0,055	0,066	0,077	0,097	0,112	0,124
	120	-	-	0,035	0,045	0,055	0,064	0,08	0,093	0,103	180	-	-	0,056	0,072	0,087	0,101	0,127	0,147	0,163
	110	-	-	0,028	0,036	0,043	0,051	0,063	0,073	0,081	160	-	-	0,044	0,057	0,069	0,08	0,1	0,116	0,129
	440	-	-	0,093	0,119	0,145	0,169	0,211	0,245	0,271	650	-	-	0,147	0,189	0,229	0,267	0,334	0,387	0,429
	405	-	-	0,079	0,102	0,123	0,144	0,18	0,208	0,231	595	-	-	0,125	0,161	0,195	0,227	0,284	0,329	0,365
	330	-	-	0,065	0,084	0,101	0,118	0,148	0,171	0,19	485	-	-	0,103	0,132	0,16	0,187	0,234	0,271	0,3
	185	-	-	0,037	0,048	0,058	0,068	0,085	0,098	0,108	270	-	-	0,059	0,076	0,092	0,107	0,134	0,155	0,172
	295	-	-	0,065	0,084	0,101	0,118	0,148	0,171	0,19	430	-	-	0,103	0,132	0,16	0,187	0,234	0,271	0,3
	275	-	-	0,056	0,072	0,087	0,101	0,127	0,147	0,163	405	-	-	0,088	0,113	0,137	0,16	0,2	0,232	0,257

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Tool length/ Correction factor:	
Length	f_z & v_c
Short	1
Long	0,9
Overlong	0,8
Extra long	0,6

Groove milling



$$a_p = 1 \times D$$

$$a_e = 1 \times D$$

OptiMill-Titan-HPC | M3694, M3794

MMG*		Material	Strength/ hardness [N/mm ²] [HRC]	Cooling			v_c [m/min]	f_z [mm/tooth]								
				MQL/air	Dry	Wet		Milling cutter diameter [mm]								
								2	4	6	8	10	12	16	20	
S	S1	S1.1	Titanium, titanium alloy	< 400			✓	90	0,012	0,021	0,03	0,039	0,047	0,055	0,068	0,079
	S2	S2.1	Titanium, titanium alloy	< 1200			✓	80	0,01	0,017	0,025	0,032	0,038	0,045	0,056	0,065
		S2.2	Titanium, titanium alloy	> 1200			✓	55	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	S3	S3.1	Nickel, non-alloyed and alloyed	< 900			✓	35	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
		S3.2	Nickel, non-alloyed and alloyed	> 900			✓	27	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
	S4	S4.1	Heat resistant super alloys, Ni, Co, and Fe based				✓	27	0,005	0,01	0,014	0,018	0,021	0,025	0,031	0,036
S5	S5.1	Tungsten and molybdenum alloys				✓	27	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058	

OptiMill-Alu-HPC | M3493

N1	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	755	0,022	0,038	0,055	0,07	0,085	0,1	0,125	0,144
	N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	500	0,023	0,04	0,057	0,074	0,09	0,105	0,131	0,152
	N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	400	0,024	0,042	0,06	0,077	0,094	0,109	0,137	0,159
	N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	290	0,026	0,046	0,066	0,085	0,103	0,119	0,149	0,173
N2	N2.1	Copper, non-alloyed and low alloyed	< 300	✓	✓	✓	290	0,017	0,031	0,044	0,056	0,068	0,08	0,1	0,115
	N2.2	Copper, alloyed	> 300	✓	✓	✓	215	0,017	0,031	0,044	0,056	0,068	0,08	0,1	0,115
	N2.3	Brass, bronze, gun metal	< 1200	✓	✓	✓	360	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
N4	N4.1	Plastic, thermoplastic		✓	✓	✓	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
	N4.2	Plastic, thermosetting plastic (duroplast)		✓	✓	✓	150	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
	N4.3	Plastic, foam		✓	✓		1200	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043

OptiMill-Composite-Speed | M7218, M7228, M7238

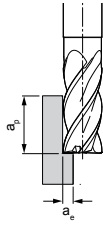
N	N4	N4.1	Plastic, thermoplastic		✓	✓	✓	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
		N4.2	Plastic, thermosetting plastic (duroplast)		✓	✓	✓	150	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
		N4.3	Plastic, foam		✓	✓		1200	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
C	C1	C1.1	Plastic matrix, aramid fibre reinforced plastic (AFK)		✓	✓	✓	110	0,015	0,027	0,038	0,049	0,06	0,07	0,087	0,101
		C1.2	Plastic matrix (thermosetting), CFRP/GFRP		✓	✓	✓	150	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
		C1.3	Plastic matrix (thermoplastic), CFRP/GFRP		✓	✓	✓	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
	C4	C4.1	Sandwich construction, honeycomb core of paper		✓	✓		1000	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
		C4.2	Sandwich construction, honeycomb core of aluminium		✓	✓		800	0,006	0,011	0,015	0,02	0,024	0,028	0,035	0,04
		C4.3	Sandwich construction, honeycomb core of plastic and fibre composite materials		✓	✓		600	0,005	0,01	0,014	0,018	0,021	0,025	0,031	0,036
		C4.4	Sandwich construction, core of rigid foam		✓	✓		150	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043

MICRO-Router | M7901

								1	2	3							
N	N4	N4.1	Plastic, thermoplastic		✓	✓	✓	70	0,005	0,008	0,011						
		N4.2	Plastic, thermosetting plastic (duroplast)		✓	✓	✓	105	0,005	0,008	0,011						
		N4.3	Plastic, foam		✓	✓		840	0,003	0,005	0,006						
C	C1	C1.1	Plastic matrix, aramid fibre reinforced plastic (AFK)		✓	✓	✓	75	0,007	0,011	0,015						
		C1.2	Plastic matrix (thermosetting), CFRP/GFRP		✓	✓	✓	105	0,005	0,008	0,011						
		C1.3	Plastic matrix (thermoplastic), CFRP/GFRP		✓	✓	✓	70	0,005	0,008	0,011						

* MILLER machining groups

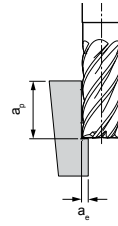
Roughing



$$a_p = 1,5 \times D$$

$$a_e = 0,25 \times D$$

Finishing



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

v_c [m/min]	f_z [mm/tooth]									v_c [m/min]	f_z [mm/tooth]								
	Milling cutter diameter [mm]										Milling cutter diameter [mm]								
	2	4	6	8	10	12	16	20	2		4	6	8	10	12	16	20		
185	0,02	0,036	0,051	0,066	0,08	0,093	0,116	0,135	270	0,032	0,057	0,081	0,104	0,126	0,147	0,184	0,213		
165	0,017	0,029	0,042	0,054	0,065	0,076	0,095	0,11	245	0,026	0,046	0,066	0,085	0,103	0,12	0,15	0,174		
110	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	160	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155		
75	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	110	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194		
55	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	80	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116		
55	0,009	0,016	0,023	0,03	0,036	0,042	0,053	0,061	80	0,015	0,026	0,037	0,047	0,057	0,067	0,084	0,097		
55	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	80	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155		

1540	0,037	0,065	0,093	0,119	0,145	0,169	0,211	0,245	2255	0,058	0,103	0,147	0,189	0,229	0,267	0,334	0,387
1025	0,039	0,069	0,098	0,125	0,152	0,177	0,222	0,257	1500	0,061	0,108	0,154	0,198	0,241	0,28	0,351	0,406
815	0,041	0,072	0,102	0,131	0,159	0,186	0,232	0,269	1200	0,064	0,113	0,162	0,208	0,252	0,294	0,367	0,426
590	0,044	0,078	0,111	0,143	0,174	0,203	0,254	0,294	865	0,07	0,124	0,176	0,227	0,275	0,32	0,401	0,464
590	0,03	0,052	0,074	0,096	0,116	0,135	0,169	0,196	865	0,047	0,083	0,117	0,151	0,183	0,214	0,267	0,31
440	0,03	0,052	0,074	0,096	0,116	0,135	0,169	0,196	650	0,047	0,083	0,117	0,151	0,183	0,214	0,267	0,31
735	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	1080	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194
200	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	295	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194
300	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	445	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194
2450	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	3595	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116

200	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	295	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194
300	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	445	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194
2450	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	3595	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116
220	0,026	0,046	0,065	0,084	0,101	0,118	0,148	0,171	325	0,041	0,072	0,103	0,132	0,16	0,187	0,234	0,271
300	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	445	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194
200	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	295	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194
2045	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	2995	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116
1635	0,01	0,018	0,026	0,033	0,041	0,047	0,059	0,069	2400	0,016	0,029	0,041	0,053	0,064	0,075	0,094	0,108
1225	0,009	0,016	0,023	0,03	0,036	0,042	0,053	0,061	1800	0,015	0,026	0,037	0,047	0,057	0,067	0,084	0,097
300	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	445	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116

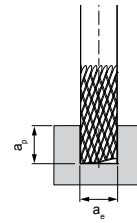
	1	2	3							1	2	3					
140	0,008	0,013	0,018							210	0,012	0,02	0,028				
210	0,008	0,013	0,018							310	0,012	0,02	0,028				
1715	0,005	0,008	0,011							2520	0,007	0,012	0,017				
155	0,011	0,018	0,025							225	0,017	0,029	0,04				
210	0,008	0,013	0,018							310	0,012	0,02	0,028				
140	0,008	0,013	0,018							210	0,012	0,02	0,028				

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

OptiMill-Composite-MT | M7001-M7004, M7011-M7014
OptiMill-Composite-MT-Radius | M7801

Groove milling



$$a_p = 1 \times D$$

$$a_e = 1 \times D$$

MMG*	Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]							
			MQL/air	Dry	Wet		Milling cutter diameter [mm]							
							2	4	6	8	10	12	16	20
N N4	N4.1	Plastic, thermoplastic	✓	✓	✓	80	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	N4.2	Plastic, thermosetting plastic (duroplast)	✓	✓	✓	120	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	N4.3	Plastic, foam	✓	✓		960	0,005	0,009	0,013	0,017	0,021	0,024	0,03	0,035
C C1	C1.1	Plastic matrix, aramid fibre reinforced plastic (AFK)	✓	✓	✓	85	0,012	0,022	0,031	0,039	0,048	0,056	0,07	0,081
	C1.2	Plastic matrix (thermosetting), CFRP/GFRP	✓	✓	✓	120	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	C1.3	Plastic matrix (thermoplastic), CFRP/GFRP	✓	✓	✓	80	0,009	0,015	0,022	0,028	0,034	0,04	0,05	0,058

OptiMill-Composite-UD | M7212, M7242

N N4	N4.2	Plastic, thermosetting plastic (duroplast)	✓	✓	✓	150	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
C C1	C1.2	Plastic matrix (thermosetting), CFRP/GFRP				150	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072

OptiMill-Composite-Duo | M7222

C C1	C1.1	Plastic matrix, aramid fibre reinforced plastic (AFK)	✓	✓	✓	75	0,011	0,019	0,027	0,035	0,042	0,049	0,061	0,071
	C1.2	Plastic matrix (thermosetting), CFRP/GFRP	✓	✓	✓	105	0,008	0,013	0,019	0,025	0,03	0,035	0,044	0,051
	C1.3	Plastic matrix (thermoplastic), CFRP/GFRP	✓	✓	✓	70	0,008	0,013	0,019	0,025	0,03	0,035	0,044	0,051

OptiMill-Composite-TwinCut | M7402

C C1	C1.1	Plastic matrix, aramid fibre reinforced plastic (AFK)	✓	✓	✓	110	0,015	0,027	0,038	0,049	0,06	0,07	0,087	0,101
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OptiMill-Thermoplastic | M7614

N N4	N4.1	Plastic, thermoplastic	✓	✓	✓	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
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OptiMill-Thermoplastic-FR | M7644

N N4	N4.1	Plastic, thermoplastic	✓	✓	✓	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072
C C1	C1.3	Plastic matrix (thermoplastic), CFRP/GFRP	✓	✓	✓	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072

OptiMill-Honeycomb | M7526, M7528

C C4	C4.1	Sandwich construction, honeycomb core of paper	✓	✓		1000	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
	C4.2	Sandwich construction, honeycomb core of aluminium	✓	✓		800	0,006	0,011	0,015	0,02	0,024	0,028	0,035	0,04
	C4.3	Sandwich construction, honeycomb core of plastic and fibre composite materials	✓	✓		600	0,005	0,01	0,014	0,018	0,021	0,025	0,031	0,036
	C4.4	Sandwich construction, core of rigid foam	✓	✓		150	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043

OptiMill-Softfoam | M7624

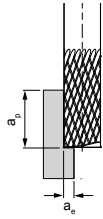
N N4	N4.3	Plastic, foam	✓	✓		1200	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
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OptiMill-Hardfoam | M7718

N N4	N4.3	Plastic, foam	✓	✓		1200	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
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* MILLER machining groups

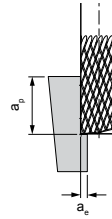
Roughing



$$a_p = 1,5 \times D$$

$$a_e = 0,25 \times D$$

Finishing



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

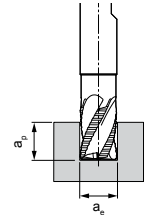
	v_c [m/min]	f_z [mm/tooth]								v_c [m/min]	f_z [mm/tooth]								
		Milling cutter diameter [mm]									Milling cutter diameter [mm]								
		2	4	6	8	10	12	16	20		2	4	6	8	10	12	16	20	
	160	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	240	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	
	240	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	355	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	
	1960	0,009	0,016	0,022	0,029	0,035	0,041	0,051	0,059	2875	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,093	
	175	0,021	0,037	0,052	0,067	0,081	0,095	0,118	0,137	260	0,033	0,058	0,082	0,106	0,128	0,149	0,187	0,217	
	240	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	355	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	
	160	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,098	240	0,023	0,041	0,059	0,076	0,092	0,107	0,134	0,155	
	300	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	445	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194	
	300	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	445	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194	
	155	0,018	0,032	0,046	0,059	0,071	0,083	0,104	0,12	225	0,029	0,051	0,072	0,093	0,112	0,131	0,164	0,19	
	210	0,013	0,023	0,033	0,042	0,051	0,059	0,074	0,086	310	0,02	0,036	0,051	0,066	0,08	0,093	0,117	0,135	
	140	0,013	0,023	0,033	0,042	0,051	0,059	0,074	0,086	210	0,02	0,036	0,051	0,066	0,08	0,093	0,117	0,135	
	220	0,026	0,046	0,065	0,084	0,101	0,118	0,148	0,171	325	0,041	0,072	0,103	0,132	0,16	0,187	0,234	0,271	
	200	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	295	0,029	0,052	0,073	0,094	0,115	0,133	0,167	0,194	
	200	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072	
	200	0,018	0,033	0,046	0,06	0,072	0,084	0,106	0,122	100	0,011	0,019	0,027	0,035	0,043	0,05	0,062	0,072	
	2045	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	2995	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116	
	1635	0,01	0,018	0,026	0,033	0,041	0,047	0,059	0,069	2400	0,016	0,029	0,041	0,053	0,064	0,075	0,094	0,108	
	1225	0,009	0,016	0,023	0,03	0,036	0,042	0,053	0,061	1800	0,015	0,026	0,037	0,047	0,057	0,067	0,084	0,097	
	300	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	445	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116	
	2450	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	3595	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116	
	2450	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	3595	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116	

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Tool length/ Correction factor:	
Length	f_z & v_c
Short	1
Long	0,9
Overlong	0,8
Extra long	0,6

Groove milling



$$a_p = 1 \times D$$

$$a_e = 1 \times D$$

OptiMill-Uni-Rough & Finish | M3060

MMG*		Material	Strength/ hardness [N/mm ²] [HRC]	Cooling			v_c [m/min]	f_z [mm/tooth]							
				MQL/Air	Dry	Wet		Milling cutter diameter [mm]							
								6	8	10	12	16	20	25	
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	140	0,026	0,034	0,041	0,048	0,06	0,069	0,077
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	115	0,025	0,032	0,038	0,045	0,056	0,065	0,072
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	125	0,026	0,034	0,041	0,048	0,06	0,069	0,077
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓		✓	90	0,022	0,028	0,034	0,04	0,05	0,058	0,064
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	80	0,025	0,032	0,039	0,045	0,057	0,066	0,073
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓		✓	70	0,023	0,029	0,036	0,041	0,052	0,06	0,067
P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	55	0,018	0,023	0,027	0,032	0,04	0,046	0,051	
P5	P5.1	Cast steel					85	0,025	0,033	0,04	0,046	0,058	0,067	0,074	
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	55	0,012	0,016	0,019	0,022	0,028	0,032	0,036	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	40	0,015	0,02	0,024	0,028	0,035	0,04	0,045
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	35	0,013	0,016	0,02	0,023	0,029	0,033	0,037
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	40	0,017	0,021	0,026	0,03	0,038	0,044	0,049
M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	40	0,013	0,017	0,021	0,024	0,03	0,035	0,038	
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	150	0,044	0,056	0,068	0,08	0,1	0,115	0,128
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	140	0,037	0,048	0,058	0,068	0,085	0,098	0,109
		K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	115	0,031	0,039	0,048	0,056	0,07	0,081	0,09
	K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	65	0,018	0,023	0,027	0,032	0,04	0,046	0,051	
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	100	0,031	0,039	0,048	0,056	0,07	0,081	0,09
K3.2		Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	95	0,026	0,034	0,041	0,048	0,06	0,069	0,077	
N	N1	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	525	0,044	0,056	0,068	0,08	0,1	0,115	0,128
		N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	350	0,046	0,059	0,072	0,084	0,105	0,121	0,134
		N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	280	0,048	0,062	0,075	0,088	0,11	0,127	0,141
		N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	200	0,053	0,068	0,082	0,096	0,12	0,139	0,153
	N2	N2.1	Copper, non-alloyed and low alloyed	< 300	✓	✓	✓	200	0,035	0,045	0,055	0,064	0,08	0,092	0,102
		N2.2	Copper, alloyed	> 300	✓	✓	✓	150	0,035	0,045	0,055	0,064	0,08	0,092	0,102
N2.3	Brass, bronze, gun metal	< 1200	✓	✓	✓	250	0,022	0,028	0,034	0,04	0,05	0,058	0,064		

OptiMill-Uni-HPC-Rough | M3081, M3181

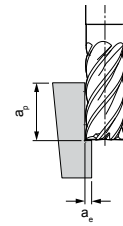
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	200	0,033	0,042	0,051	0,06	0,075	0,087	0,096
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	160	0,031	0,039	0,048	0,056	0,07	0,081	0,09
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	180	0,033	0,042	0,051	0,06	0,075	0,087	0,096
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓		✓	125	0,027	0,035	0,043	0,05	0,062	0,072	0,08
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	115	0,031	0,04	0,049	0,057	0,071	0,082	0,091
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓		✓	100	0,028	0,037	0,044	0,052	0,065	0,075	0,083
P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	80	0,022	0,028	0,034	0,04	0,05	0,058	0,064	
P5	P5.1	Cast steel					120	0,032	0,041	0,05	0,058	0,072	0,084	0,093	
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	80	0,015	0,02	0,024	0,028	0,035	0,04	0,045	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	55	0,019	0,025	0,03	0,035	0,044	0,051	0,056
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	50	0,016	0,02	0,025	0,029	0,036	0,042	0,046
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	60	0,021	0,027	0,032	0,038	0,047	0,055	0,061
M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	55	0,016	0,021	0,026	0,03	0,037	0,043	0,048	
M	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	215	0,055	0,07	0,085	0,1	0,125	0,144	0,16
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	200	0,047	0,06	0,073	0,085	0,106	0,123	0,136
		K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	160	0,038	0,049	0,06	0,07	0,087	0,101	0,112
	K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	90	0,022	0,028	0,034	0,04	0,05	0,058	0,064	
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	145	0,038	0,049	0,06	0,07	0,087	0,101	0,112
K3.2		Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	135	0,033	0,042	0,051	0,06	0,075	0,087	0,096	

* MILLER machining groups

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Finishing



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

OptiMill-Uni-Finish | M3046, M3048, M3049

MMG*		Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]								
				MQL/air	Dry	Wet		Milling cutter diameter [mm]								
								4	6	8	10	12	16	20	25	
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	415	0,05	0,07	0,091	0,11	0,128	0,16	0,186	0,206
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	340	0,046	0,066	0,085	0,103	0,12	0,15	0,173	0,192
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	380	0,05	0,07	0,091	0,11	0,128	0,16	0,186	0,206
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓	✓	✓	265	0,041	0,059	0,076	0,092	0,107	0,134	0,155	0,172
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	245	0,047	0,067	0,086	0,104	0,122	0,152	0,177	0,196
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓	✓	✓	210	0,043	0,061	0,079	0,095	0,111	0,139	0,161	0,178
	P4	P4.1	Stainless steel, ferritic and martensitic		✓	✓	✓	170	0,033	0,047	0,06	0,073	0,085	0,107	0,124	0,137
	P5	P5.1	Cast steel					255	0,048	0,068	0,088	0,106	0,124	0,155	0,18	0,199
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	170	0,023	0,033	0,042	0,051	0,06	0,075	0,087	0,096	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓	✓	✓	115	0,029	0,041	0,053	0,064	0,075	0,094	0,108	0,12
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	105	0,024	0,034	0,044	0,053	0,062	0,077	0,09	0,099
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓	✓	✓	125	0,031	0,045	0,057	0,07	0,081	0,102	0,118	0,13
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	115	0,025	0,035	0,045	0,055	0,064	0,08	0,093	0,103
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	455	0,083	0,117	0,151	0,183	0,214	0,267	0,31	0,343
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	415	0,07	0,1	0,128	0,156	0,182	0,227	0,263	0,292
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	340	0,058	0,082	0,106	0,128	0,149	0,187	0,217	0,24
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	190	0,033	0,047	0,06	0,073	0,085	0,107	0,124	0,137
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	300	0,058	0,082	0,106	0,128	0,149	0,187	0,217	0,24
		K3.2	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	285	0,05	0,07	0,091	0,11	0,128	0,16	0,186	0,206

OptiMill-Hardened | M3076, M3078, M3071

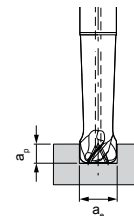
H	H1	H1.1	Hardened steel/cast steel	45-55	✓	✓	✓	115	0,021	0,029	0,038	0,046	0,053	0,067	0,077
		H1.2	Hardened steel/cast steel	55-64	✓	✓	✓	55	0,015	0,022	0,028	0,034	0,04	0,05	0,058
	H2	H2.1	Wear resistant castings/chilled cast iron, GJN		✓	✓	✓	55	0,015	0,022	0,028	0,034	0,04	0,05	0,058

Cutting data recommendation for shoulder milling cutters

Feed and cutting speed

Tool length/ Correction factor:	
Length	f _z & v _c
Short	1
Long	0,9
Overlong	0,8
Extra long	0,6

Groove milling



$$a_p = 0,5 \times D$$

$$a_e = 1 \times D$$

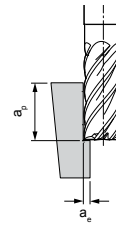
OptiMill-Volume-N | M3591, M3593

MMG*		Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]								
				MQL/air	Dry	Wet		Milling cutter diameter [mm]								
								6	8	10	12	16	20	25	32	
N	N1	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	1955	0,103	0,133	0,161	0,188	0,235	0,273	0,302	0,303
		N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	1300	0,109	0,140	0,169	0,197	0,247	0,286	0,317	0,318
		N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	1040	0,114	0,146	0,178	0,207	0,259	0,300	0,332	0,334
		N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	750	0,124	0,160	0,194	0,226	0,282	0,327	0,362	0,364

* MILLER machining groups

OptiMill-Uni-HPC-Finish I M3096

Finishing



$$a_p = 1,5 \times D$$

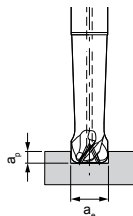
$$a_e = 0,1 \times D$$

MMG*	Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]**									
			MQL/air	Dry	Wet		Milling cutter diameter [mm]									
							4	6	8	10	12	16	20	25		
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	595	0,062	0,035	0,062	0,088	0,113	0,137	0,16	0,257
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	485	0,058	0,033	0,058	0,082	0,106	0,128	0,149	0,24
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	540	0,062	0,035	0,062	0,088	0,113	0,137	0,16	0,257
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓	✓	✓	380	0,052	0,029	0,052	0,073	0,094	0,115	0,133	0,214
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	350	0,059	0,033	0,059	0,084	0,108	0,131	0,152	0,244
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓	✓	✓	295	0,054	0,03	0,054	0,076	0,098	0,119	0,139	0,223
	P4	P4.1	Stainless steel, ferritic and martensitic		✓	✓	✓	245	0,041	0,023	0,041	0,059	0,076	0,092	0,107	0,172
	P5	P5.1	Cast steel					360	0,06	0,034	0,06	0,085	0,11	0,133	0,155	0,249
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	245	0,029	0,016	0,029	0,041	0,053	0,064	0,075	0,12	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓	✓	✓	160	0,036	0,02	0,036	0,051	0,066	0,08	0,093	0,15
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	150	0,03	0,017	0,03	0,043	0,055	0,066	0,077	0,124
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓	✓	✓	180	0,039	0,022	0,039	0,056	0,072	0,087	0,101	0,163
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	160	0,031	0,017	0,031	0,044	0,057	0,069	0,08	0,129
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	650	0,103	0,058	0,103	0,147	0,189	0,229	0,267	0,429
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	595	0,088	0,05	0,088	0,125	0,161	0,195	0,227	0,365
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	485	0,072	0,041	0,072	0,103	0,132	0,16	0,187	0,3
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	270	0,041	0,023	0,041	0,059	0,076	0,092	0,107	0,172
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	430	0,072	0,041	0,072	0,103	0,132	0,16	0,187	0,3
		K3.2	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	405	0,062	0,035	0,062	0,088	0,113	0,137	0,16	0,257

** To achieve better surface finishes, the feed rates must be appropriately reduced.
 E.g.: finishing with SCM37, ø 20 mm of 42CrMo4, a_p = 0.2 mm (synchronous milling)

Standard values: 42CrMo4 v_c = 200 m/min. f_z = 0,1 mm R_a = 1,00 R_z = 5
 Modified values: 42CrMo4 v_c = 200 m/min. f_z = 0,03 mm R_a = 0,30 R_z = 1

Groove milling



$$a_p = 0,3 \times D$$

$$a_e = 1 \times D$$

v _c [m/min]	f _z [mm/tooth]							
	Milling cutter diameter [mm]							
	6	8	10	12	16	20	25	32
1955	0,119	0,153	0,186	0,217	0,271	0,314	0,348	0,349
1300	0,125	0,161	0,195	0,227	0,285	0,330	0,365	0,367
1040	0,131	0,169	0,204	0,238	0,298	0,345	0,383	0,384
750	0,143	0,184	0,223	0,260	0,325	0,377	0,418	0,419

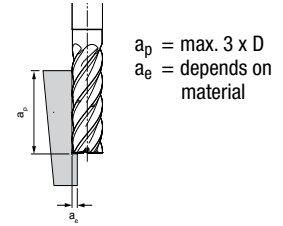
* MILLER machining groups

Cutting data recommendation for trochoidal milling cutters

Feed and cutting speed

OptiMill-Tro-Uni | M3099
OptiMill-Tro-PM | M3299

Trochoidal milling



MMG*	Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth] in % from D	a _e [mm] in % from D	h _m [mm] in % from D		
			MQL/air	Dry	Wet						
P	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	380-520	2,0-2,6	14-18	0,66-0,8	
	P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	320-460	1,8-2,4	12-16	0,62-0,76	
	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	340-480	1,8-2,4	10-14	0,58-0,71	
	P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓	✓	✓	280-380	1,4-2,0	8-12	0,56-0,68	
	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	240-350	1,5-2,2	8-14	0,54-0,65	
	P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓	✓	✓	210-320	1,2-1,9	6-12	0,52-0,62	
	P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	180-260	1,0-1,8	6-12	0,5-0,6
	P5	P5.1	Cast steel					220-300	1,4-2,0	8-12	0,54-0,62
P6	P6.1	Stainless cast steel, ferritic and martensitic			✓		160-240	0,8-1,6	6-12	0,5-0,6	
M	M1.1	Stainless steel, austenitic	< 700	✓		✓	140-220	0,6-1,0	5-10	0,48-0,6	
	M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	110-180	0,6-1,0	5-10	0,46-0,58	
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	130-200	0,8-1,2	6-12	0,52-0,6
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	120-180	0,8-1,2	5-10	0,46-0,56
K	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	400-500	2,0-2,6	15-20	0,64-0,78	
	K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	340-500	1,8-2,4	12-16	0,62-0,7	
	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	300-440	1,6-2,2	10-14	0,58-0,68	
	K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	180-260	1,4-2,0	8-12	0,56-0,68	
	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	280-360	1,6-2,2	10-16	0,6-0,68	
	K3.2	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	210-340	1,4-2,0	10-16	0,58-0,66	

OptiMill-Tro-S | M3699, OptiMill-Tro-Titan | M3799

M	M1.1	Stainless steel, austenitic	< 700	✓		✓	140-220	0,6-1,0	5-10	0,48-0,6	
	M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	110-180	0,6-1,0	5-10	0,46-0,58	
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	130-200	0,8-1,2	6-12	0,52-0,6
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	120-180	0,8-1,2	5-10	0,46-0,56
S	S1.1	Titanium, titanium alloy	< 400			✓	110-170	0,65-1,3	6-12	0,52-0,6	
	S2.1	Titanium, titanium alloy	< 1200			✓	90-150	0,6-1,2	5-10	0,46-0,56	
	S2.2	Titanium, titanium alloy	> 1200			✓	70-130	0,4-1,0	5-10	0,42-0,54	
	S3.1	Nickel, non-alloyed and alloyed	< 900			✓	60-120	0,4-1,0	5-10	0,4-0,52	
	S3.2	Nickel, non-alloyed and alloyed	> 900			✓	50-100	0,3-0,9	5-10	0,4-0,52	
	S4	S4.1	Heat resistant super alloys, Ni, Co, and Fe based			✓	35-90	0,3-0,8	4-8	0,38-0,46	
	S5	S5.1	Tungsten and molybdenum alloys			✓	35-90	0,3-0,8	4-8	0,38-0,46	

OptiMill-Tro-H | M3079

H	H1.1	Hardened steel/cast steel	45-55	✓	✓	✓	80-140	0,45-0,65	7-12	0,42-0,52
	H1.2	Hardened steel/cast steel	55-64	✓	✓	✓	60-120	0,4-0,52	6-12	0,4-0,5
	H1.3	Hardened steel/cast steel	64-70	✓	✓		50-100	0,3-0,5	5-10	0,38-0,46
	H2	H2.1	Wear resistant castings/chilled cast iron, GJN		✓		✓	60-120	0,35-0,55	6-12

Note:

With trochoidal milling, the cutting conditions indicated change during the machining process. This is also dependent on the CAM software used and the machining position of the tool in the work-piece. Feed rate and contact width or contact angle change constantly during the machining process in order to achieve the most constant average chip thickness possible, depending on the contour.

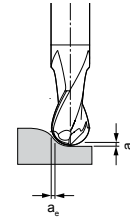
* MILLER machining groups

Machining example		
16MnCr5	$\emptyset = 12 \text{ mm}$ $v_c = 500 \text{ m/min}$ $f_z = 0,28 \text{ mm}$ $a_e = 1,8 \text{ mm}$ $a_p = 32 \text{ mm}$	
42CrMo4	$\emptyset = 12 \text{ mm}$ $v_c = 375 \text{ m/min}$ $f_z = 0,17 \text{ mm}$ $a_e = 1,2 \text{ mm}$ $a_p = 32 \text{ mm}$	
X5CrNi18-8	$\emptyset = 12 \text{ mm}$ $v_c = 180 \text{ m/min}$ $f_z = 0,09 \text{ mm}$ $a_e = 1,2 \text{ mm}$ $a_p = 32 \text{ mm}$	
X5CrNi18-8	$\emptyset = 12 \text{ mm}$ $v_c = 180 \text{ m/min}$ $f_z = 0,09 \text{ mm}$ $a_e = 1,2 \text{ mm}$ $a_p = 32 \text{ mm}$	
TiAl6V4	$\emptyset = 12 \text{ mm}$ $v_c = 140 \text{ m/min}$ $f_z = 0,09 \text{ mm}$ $a_e = 1,2 \text{ mm}$ $a_p = 30 \text{ mm}$	
90MnCrV8	$\emptyset = 12 \text{ mm}$ $v_c = 110 \text{ m/min}$ $f_z = 0,052 \text{ mm}$ $h_m = 0,04 \text{ mm}$ $a_e = 1 \text{ mm}$	

Cutting data recommendation for radius and chamfering milling cutters

Feed and cutting speed

Finishing



$$a_p = 0,1 \times D$$

$$a_e = 0,1 \times D$$

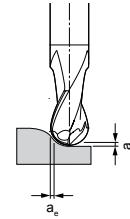
OptiMill-Uni-Radius | M3832

MMG*	Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]									
			MQL/air	Dry	Wet		Milling cutter diameter [mm]									
							2	4	6	8	10	12	16	20		
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	295	0,015	0,027	0,039	0,05	0,06	0,07	0,088	0,102
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	245	0,014	0,025	0,036	0,046	0,056	0,066	0,082	0,095
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	270	0,015	0,027	0,039	0,05	0,06	0,07	0,088	0,102
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓	✓	✓	190	0,013	0,023	0,032	0,041	0,05	0,059	0,073	0,085
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	175	0,015	0,026	0,037	0,047	0,057	0,067	0,084	0,097
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓	✓	✓	150	0,013	0,024	0,034	0,043	0,052	0,061	0,076	0,088
	P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	120	0,01	0,018	0,026	0,033	0,04	0,047	0,059	0,068
	P5	P5.1	Cast steel					180	0,015	0,026	0,037	0,048	0,058	0,068	0,085	0,099
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	120	0,007	0,013	0,018	0,023	0,028	0,033	0,041	0,048	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	80	0,009	0,016	0,023	0,029	0,035	0,041	0,051	0,059
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	75	0,007	0,013	0,019	0,024	0,029	0,034	0,043	0,049
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	90	0,01	0,017	0,024	0,032	0,038	0,045	0,056	0,065
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	80	0,008	0,014	0,019	0,025	0,03	0,035	0,044	0,051
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	325	0,026	0,045	0,064	0,083	0,101	0,117	0,147	0,17
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	295	0,022	0,038	0,055	0,071	0,086	0,1	0,125	0,144
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	245	0,018	0,032	0,045	0,058	0,07	0,082	0,103	0,119
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	135	0,01	0,018	0,026	0,033	0,04	0,047	0,059	0,068
	K3	K3.1	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500	✓	✓	✓	215	0,018	0,032	0,045	0,058	0,07	0,082	0,103	0,119
		K3.2	Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	> 500	✓	✓	✓	205	0,015	0,027	0,039	0,05	0,06	0,07	0,088	0,102

OptiMill-Composite-MT-Radius | M7801

see on Page 130

Finishing



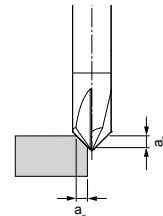
$$a_p = 0,05 \times D$$

$$a_e = 0,05 \times D$$

OptiMill-Hardened-Radius | M3872

MMG*	Material		Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]								
				MQL/air	Dry	Wet		Milling cutter diameter [mm]								
								2	4	6	8	10	12	16	20	
H	H1	H1.1	Hardened steel/cast steel	45-55	✓	✓	✓	130	0,012	0,022	0,031	0,04	0,049	0,057	0,071	0,082
		H1.2	Hardened steel/cast steel	55-64	✓	✓	✓	65	0,009	0,016	0,023	0,03	0,036	0,042	0,053	0,062
	H2	H2.1	Wear resistant castings/chilled cast iron, GJN		✓		✓	65	0,009	0,016	0,023	0,03	0,036	0,042	0,053	0,062

Finishing



$$a_p = 0,1 \times D$$

$$a_e = 0,1 \times D$$

OptiMill-Chamfer | M5390

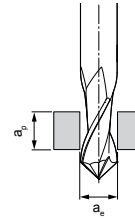
MMG*	Material		Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]							
				MQL/air	Dry	Wet		Milling cutter diameter [mm]							
								4	6	8	10	12	16	20	
P	P1	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	265	0,041	0,058	0,075	0,091	0,105	0,132	0,153
		P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	220	0,038	0,054	0,07	0,085	0,098	0,123	0,143
	P2	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	245	0,041	0,058	0,075	0,091	0,105	0,132	0,153
		P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓		✓	170	0,034	0,048	0,062	0,075	0,088	0,11	0,127
	P3	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	160	0,039	0,055	0,071	0,086	0,1	0,125	0,145
		P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓		✓	135	0,035	0,05	0,065	0,078	0,091	0,114	0,133
	P4	P4.1	Stainless steel, ferritic and martensitic		✓		✓	110	0,027	0,039	0,05	0,06	0,07	0,088	0,102
	P5	P5.1	Cast steel					165	0,039	0,056	0,072	0,088	0,102	0,128	0,148
P6	P6.1	Stainless cast steel, ferritic and martensitic				✓	110	0,019	0,027	0,035	0,042	0,049	0,062	0,071	
M	M1	M1.1	Stainless steel, austenitic	< 700	✓		✓	75	0,024	0,034	0,044	0,053	0,062	0,077	0,089
		M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	70	0,02	0,028	0,036	0,044	0,051	0,064	0,074
	M2	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	80	0,026	0,037	0,047	0,057	0,067	0,084	0,097
	M3	M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	75	0,02	0,029	0,037	0,045	0,053	0,066	0,076
K	K1	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	290	0,068	0,097	0,124	0,151	0,176	0,22	0,255
		K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	265	0,058	0,082	0,106	0,128	0,149	0,187	0,217
	K2	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	220	0,048	0,068	0,087	0,106	0,123	0,154	0,178
		K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	120	0,027	0,039	0,05	0,06	0,07	0,088	0,102
N	N1	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	1015	0,068	0,097	0,124	0,151	0,176	0,22	0,255
		N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	675	0,071	0,102	0,131	0,158	0,185	0,231	0,268
		N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	540	0,075	0,106	0,137	0,166	0,193	0,242	0,28
		N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	390	0,082	0,116	0,149	0,181	0,211	0,264	0,306
	N2	N2.1	Copper, non-alloyed and low alloyed	< 300	✓	✓	✓	390	0,054	0,077	0,1	0,121	0,141	0,176	0,204
		N2.2	Copper, alloyed	> 300	✓	✓	✓	290	0,054	0,077	0,1	0,121	0,141	0,176	0,204
		N2.3	Brass, bronze, gun metal	< 1200	✓	✓	✓	485	0,034	0,048	0,062	0,075	0,088	0,11	0,127

* MILLER machining groups

Cutting data recommendation for drill milling cutters

Feed and cutting speed

Groove milling



$$a_p = 1 \times D$$

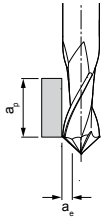
$$a_e = 1 \times D$$

OptiMill-DrillMill | M5490

MMG*	Material	Strength/hardness [N/mm ²] [HRC]	Cooling			v _c [m/min]	f _z [mm/tooth]								
			MQL/air	Dry	Wet		Milling cutter diameter [mm]								
							2	4	6	8	10	12	16	20	
P	P1.1	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700	✓	✓	✓	120	0,008	0,014	0,02	0,025	0,031	0,036	0,045	0,052
	P1.2	Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200	✓	✓	✓	95	0,007	0,013	0,018	0,024	0,029	0,033	0,042	0,048
	P2.1	Nitrated, case hardened and heat-treated steel, alloyed	< 900	✓	✓	✓	110	0,008	0,014	0,02	0,025	0,031	0,036	0,045	0,052
	P2.2	Nitrated, case hardened and heat-treated steel, alloyed	< 1400	✓	✓	✓	75	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043
	P3.1	Tool, roller bearing, spring and high speed steel	< 900	✓	✓	✓	70	0,007	0,013	0,019	0,024	0,029	0,034	0,043	0,049
	P3.2	Tool, roller bearing, spring and high speed steel	< 1500	✓	✓	✓	60	0,007	0,012	0,017	0,022	0,027	0,031	0,039	0,045
	P4.1	Stainless steel, ferritic and martensitic		✓	✓	✓	50	0,005	0,009	0,013	0,017	0,021	0,024	0,03	0,035
	P5.1	Cast steel					70	0,008	0,013	0,019	0,025	0,03	0,035	0,043	0,05
P6.1	Stainless cast steel, ferritic and martensitic				✓	50	0,004	0,006	0,009	0,012	0,014	0,017	0,021	0,024	
M	M1.1	Stainless steel, austenitic	< 700	✓		✓	30	0,005	0,008	0,011	0,015	0,018	0,021	0,026	0,03
	M1.2	Stainless steel, ferritic/austenitic (Duplex)	< 1000			✓	30	0,004	0,007	0,01	0,012	0,015	0,017	0,022	0,025
	M2.1	Stainless cast steel, austenitic	< 700	✓		✓	35	0,005	0,009	0,012	0,016	0,019	0,023	0,028	0,033
M3.1	Stainless cast steel, ferritic/austenitic (Duplex)	< 1000			✓	30	0,004	0,007	0,01	0,013	0,015	0,018	0,022	0,026	
K	K1.1	Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300	✓	✓	✓	130	0,013	0,023	0,033	0,042	0,051	0,06	0,075	0,087
	K2.1	Cast iron with spheroidal graphite, EN-GJS	< 500	✓	✓	✓	120	0,011	0,02	0,028	0,036	0,044	0,051	0,064	0,074
	K2.2	Cast iron with spheroidal graphite, EN-GJS	500-800	✓	✓	✓	95	0,009	0,016	0,023	0,03	0,036	0,042	0,052	0,061
K2.3	Cast iron with spheroidal graphite, EN-GJS	> 800	✓	✓	✓	55	0,005	0,009	0,013	0,017	0,021	0,024	0,03	0,035	
N	N1.1	Aluminium, non-alloyed and alloyed <3% Si		✓	✓	✓	450	0,013	0,023	0,033	0,042	0,051	0,06	0,075	0,087
	N1.2	Aluminium, alloyed <=7% Si		✓	✓	✓	300	0,014	0,024	0,034	0,044	0,054	0,063	0,078	0,091
	N1.3	Aluminium, alloyed > 7-12% Si		✓	✓	✓	240	0,014	0,025	0,036	0,046	0,056	0,066	0,082	0,095
	N1.4	Aluminium, alloyed > 12% Si		✓	✓	✓	175	0,016	0,028	0,039	0,051	0,062	0,072	0,09	0,104
	N2.1	Copper, non-alloyed and low alloyed	< 300	✓	✓	✓	175	0,01	0,018	0,026	0,034	0,041	0,048	0,06	0,069
	N2.2	Copper, alloyed	> 300	✓	✓	✓	130	0,01	0,018	0,026	0,034	0,041	0,048	0,06	0,069
	N2.3	Brass, bronze, gun metal	< 1200	✓	✓	✓	215	0,007	0,012	0,016	0,021	0,026	0,03	0,037	0,043

* MILLER machining groups

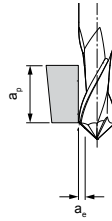
Trimming



$$a_p = 1,5 \times D$$

$$a_e = 0,25 \times D$$

Trimming



$$a_p = 1,5 \times D$$

$$a_e = 0,1 \times D$$

	v_c [m/min]	f_z [mm/tooth]								v_c [m/min]	f_z [mm/tooth]								
		Milling cutter diameter [mm]									Milling cutter diameter [mm]								
		2	4	6	8	10	12	16	20		2	4	6	8	10	12	16	20	
	245	0,013	0,023	0,033	0,043	0,052	0,061	0,076	0,088	355	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139	
	200	0,012	0,022	0,031	0,04	0,049	0,057	0,071	0,082	290	0,02	0,035	0,049	0,063	0,077	0,09	0,112	0,13	
	220	0,013	0,023	0,033	0,043	0,052	0,061	0,076	0,088	325	0,021	0,037	0,053	0,068	0,082	0,096	0,12	0,139	
	155	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	225	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116	
	145	0,013	0,022	0,032	0,041	0,05	0,058	0,072	0,084	210	0,02	0,035	0,05	0,065	0,078	0,091	0,114	0,132	
	120	0,012	0,02	0,029	0,037	0,045	0,053	0,066	0,076	180	0,018	0,032	0,046	0,059	0,071	0,083	0,104	0,121	
	100	0,009	0,016	0,022	0,029	0,035	0,041	0,051	0,059	145	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,093	
	150	0,013	0,023	0,032	0,042	0,05	0,059	0,074	0,085	215	0,02	0,036	0,051	0,066	0,08	0,093	0,116	0,135	
	100	0,006	0,011	0,016	0,02	0,024	0,028	0,035	0,041	145	0,01	0,017	0,025	0,032	0,038	0,045	0,056	0,065	
	65	0,008	0,014	0,02	0,025	0,03	0,035	0,044	0,051	95	0,012	0,022	0,031	0,04	0,048	0,056	0,07	0,081	
	60	0,006	0,011	0,016	0,021	0,025	0,029	0,037	0,043	90	0,01	0,018	0,026	0,033	0,04	0,046	0,058	0,067	
	75	0,008	0,015	0,021	0,027	0,033	0,038	0,048	0,056	105	0,013	0,024	0,033	0,043	0,052	0,061	0,076	0,088	
	65	0,007	0,012	0,017	0,022	0,026	0,03	0,038	0,044	95	0,01	0,019	0,026	0,034	0,041	0,048	0,06	0,07	
	265	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	390	0,035	0,062	0,088	0,113	0,137	0,16	0,2	0,232	
	245	0,019	0,033	0,047	0,061	0,074	0,086	0,108	0,125	355	0,03	0,053	0,075	0,096	0,117	0,136	0,17	0,197	
	200	0,015	0,027	0,039	0,05	0,061	0,071	0,089	0,103	290	0,024	0,043	0,062	0,079	0,096	0,112	0,14	0,163	
	110	0,009	0,016	0,022	0,029	0,035	0,041	0,051	0,059	160	0,014	0,025	0,035	0,045	0,055	0,064	0,08	0,093	
	925	0,022	0,039	0,056	0,072	0,087	0,101	0,127	0,147	1355	0,035	0,062	0,088	0,113	0,137	0,16	0,2	0,232	
	615	0,023	0,041	0,059	0,075	0,091	0,106	0,133	0,154	900	0,037	0,065	0,092	0,119	0,144	0,168	0,21	0,244	
	490	0,024	0,043	0,061	0,079	0,096	0,111	0,139	0,162	720	0,038	0,068	0,097	0,125	0,151	0,176	0,22	0,255	
	355	0,027	0,047	0,067	0,086	0,104	0,122	0,152	0,176	520	0,042	0,074	0,106	0,136	0,165	0,192	0,241	0,279	
	355	0,018	0,031	0,045	0,057	0,07	0,081	0,101	0,118	520	0,028	0,05	0,07	0,091	0,11	0,128	0,16	0,186	
	265	0,018	0,031	0,045	0,057	0,07	0,081	0,101	0,118	390	0,028	0,05	0,07	0,091	0,11	0,128	0,16	0,186	
	440	0,011	0,02	0,028	0,036	0,043	0,051	0,063	0,073	650	0,017	0,031	0,044	0,057	0,069	0,08	0,1	0,116	

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Pictograms

1 End-mills with fixed cutting edges

- Groove milling
- Profile milling
- Roughing
- Chamfering
- Finishing
- Trimming
- Trochoidal milling (hm opt.)

2 Design

- Monolithic

3 Product class

- Basic Line:** Universal tools, broad application area, low procurement costs
- Expert Line:** Specialist tools for selected applications, maximum precision and productivity
- Performance Line:** High-performance tools, broad application area, high productivity in series production manufacturing

4 Material suitability

Highly suitable
 Suitable in some situations

Example standard material suitability table

P	1	2	3	4	5	6	M	1	2	3	K	1	2	3	N	1	2	3	4	S	1	2	3	4	5	H	1	2	
	■	■	■	■			■				■	■			■						■								

Example material suitability table for non-ferrous metals and lightweight materials

N	1.1	1.2	1.3	1.4	2.1	2.2	2.3	3.1	4.1	4.2	4.3	C	1.1	1.2	1.3	2.1	3.1	4.1	4.2	4.3	4.4	5.1	5.2
												■	■	■	■	■	■	■	■	■	■	■	■

5 Design

- 45° chamfer
- 90° Sharp edged
- CR Corner radius
- FR Full radius
- D Drill tip
- HA Cylindrical shank in accordance with DIN 6535
- HB Cylindrical shank in accordance with DIN 6535
- Internal cooling
- Short
- Long
- Overlong
- Extra long
- For lateral material removal rates
- For lateral material removal rates and for inclined entry
- For lateral material removal rates, for inclined entry and recessing
- In accordance with works standard (MILLER NORM)
- DIN 6527 Design DIN 6527
- DIN 6535 Design DIN 6535

NOTE:

On request we would be pleased to provide you with information on prices and availability for the products in this catalogue.

Miller GmbH & Co. KG, Präzisionswerkzeuge

Im Tal 12, 89281 Altenstadt, Germany

Telephone +49 8337 727-0

Telefax +49 8337 727-4027

info@miller-tools.de

MILLER machining groups

The MILLER machining groups make it possible to provide precise information on the suitability of a tool for certain workpiece materials. Crucial for the categorisation of the groups is the machinability in relation to the cutting data (cutting speed and feed) for a material. It is necessary to sub-divide certain workpiece material groups based on the strength/hardness of the related workpiece material.

Machining group		Material	Strength - Hardness [N/mm ² - HRC]	Frequently machined workpiece materials	
P	P1	P1.1 Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 700 N/mm ²	1.0122 (S235/St 37), 1.0401 (C15), 1.0503 (C45), 1.0570 (S355/St 52), 1.1213 (C153)	
		P1.2 Structural, free-cutting, case hardened and heat-treated steel, non-alloyed	< 1200 N/mm ²	1.1249 (C70)	
	P2	P2.1 Nitratated, case hardened and heat-treated steel, alloyed	< 900 N/mm ²	1.7131 (16MnCr5)	
		P2.2 Nitratated, case hardened and heat-treated steel, alloyed	< 1400 N/mm ²	1.7227 (42CrMoS4)	
	P3	P3.1 Tool, roller bearing, spring and high speed steel	< 900 N/mm ²	1.2343 (X38CrMoV5-1)	
		P3.2 Tool, roller bearing, spring and high speed steel	< 1500 N/mm ²	1.3505 (100Cr6)	
	P4	P4.1 Stainless steel, ferritic and martensitic		1.4510 (X3CrTi17), 1.4589 (X5CrNiMoTi15-2)	
P5	P5.1 Cast steel		1.7231 (G42CrMo4)		
M	M1	M1.1 Stainless steel, austenitic	< 700 N/mm ²	1.4301 (V2A), 1.4571 (V4A)	
		M1.2 Stainless steel, ferritic/austenitic (Duplex)	< 1000 N/mm ²	1.4362 (Alloy 2304), 1.4501, 1.4662 (LDX 2404)	
	M2	M2.1 Stainless cast steel, austenitic	< 700 N/mm ²		
	M3	M3.1 Stainless cast steel, ferritic/austenitic (Duplex)	< 1000 N/mm ²		
K	K1	K1.1 Cast iron with lamellar graphite (grey cast iron), EN-GJL	< 300 N/mm ²	GJL-250 (GG-25), GJL-260 (GG-26 Cr)	
		K2.1 Cast iron with spheroidal graphite, EN-GJS	< 500 N/mm ²	GJS-400 (GGG-40), GJS-450 (GGG-45)	
	K2	K2.2 Cast iron with spheroidal graphite, EN-GJS	500-800 N/mm ²	GJS-600 (GGG-60), GJS-800-2 (GGG-80), GJS-800-8 (ADI 800)	
		K2.3 Cast iron with spheroidal graphite, EN-GJS	> 800 N/mm ²	GJS-900-2 (GGG-90), GJS-1000-5 (ADI 1000), GJS-1200-2 (ADI 1200), GJS-1400-1 (ADI 1400)	
	K3	K3.1 Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM	< 500 N/mm ²	GJV-300, GJV-400, GJMW-400-5 (GTW-40)	
K3.2 Cast iron with vermicular graphite, EN-GJV; Malleable cast iron, GJM		> 500 N/mm ²	GJV-500, GJV-700		
N	N1	N1.1 Aluminium, non-alloyed and alloyed <3% Si		Alloy 2024, Alloy 7075, Al99	
		N1.2 Aluminium, alloyed ≤ 7% Si		AlSi7	
		N1.3 Aluminium, alloyed > 7-12% Si		AlSi9, AlSi9Cu	
		N1.4 Aluminium, alloyed > 12% Si		AlSi12, AlSi17	
	N2	N2.1 Copper, non-alloyed and low alloyed	< 300 N/mm ²	SE-Cu	
		N2.2 Copper, alloyed	> 300 N/mm ²	CuSn6	
		N2.3 Brass, bronze, gun metal	< 1200 N/mm ²	CuZn33, CuAl9Mn3	
	N3	N3.1 Graphite			
		N4	N4.1 Plastic, thermoplastic		PA, PE, PC, PS, PVC, PP, PTFE, POM, PMMA
			N4.2 Plastic, thermosetting plastic (duroplast)		PU, PF, EP, UP, VE, CR
N4.3 Plastic, foam			EPS, PUR, PVC-E, PS-E, PP-E		
C	C1	C1.1 Plastic matrix, aramid fibre reinforced plastic (AFK)		Nomex, Kevlar, Twaron, KOREX	
		C1.2 Plastic matrix (thermosetting), CFRP/GFRP		IMS, HTA	
		C1.3 Plastic matrix (thermoplastic), CFRP/GFRP		GMT-PP, PEEK	
	C2	C2.1 Carbon matrix, carbon fibre reinforced (CFC)		CF222, CF225, CF226, CF227, CF260	
	C3	C3.1 Metal matrix (MMC)		CeramTec AO-403 (AlSi9MgMn-Al2O3), Al/Cu/Mg-SiO2/Al2O3/AlN/TiC/SiC/BN/TiB2	
	C4	C4.1 Sandwich construction, honeycomb core of paper			
		C4.2 Sandwich construction, honeycomb core of aluminium		PLASCORE PAMG-XR1 5052, PCGA-XR1 3003, PAMG-XR1 5056, Micro-Cell (core = alloy 5052/5056)	
		C4.3 Sandwich construction, honeycomb core of plastic and fibre composite materials		CORMASTER, TUBUS, KOREX, HFT-G, TPU, HFT, HRH (HRH-10, HRH-310, HRH-78, HRH-49, HRH-327), HDC-F	
		C4.4 Sandwich construction, core of rigid foam		AIREX R63, AIREX C70, ROHACELL IG-F	
	C5	C5.1 Stack (hybrid structure) CFRP-aluminium		IMS/HTA + Alloy 2024/6061/7075	
C5.2 Stack (hybrid structure) CFRP-titanium/stainless steel			IMS/HTA + TiAl6V4/AMS4905		
S	S1	S1.1 Titanium, titanium alloy	< 400 N/mm ²		
		S2.1 Titanium, titanium alloy	< 1200 N/mm ²	TiAl6V4	
	S2	S2.2 Titanium, titanium alloy	> 1200 N/mm ²		
		S3.1 Nickel, non-alloyed and alloyed	< 900 N/mm ²	1.3912 (Invar, Ni36)	
	S3	S3.2 Nickel, non-alloyed and alloyed	> 900 N/mm ²		
		S4.1 Heat resistant super alloys, Ni, Co, and Fe based		Hardox, Hastelloy, Incoloy, Inconel, NIMONIC, Stellite, Waspaloy	
S5	S5.1 Tungsten and molybdenum alloys				
H	H1	H1.1 Hardened steel/cast steel	45-55 HRC		
		H1.2 Hardened steel/cast steel	55-64 HRC		
		H1.3 Hardened steel/cast steel	64-70 HRC		
	H2	H2.1 Wear resistant castings/chilled cast iron, GJN			