

# EMUGE

## TOP-Cut VAR



### UNIVERSAL HIGH PERFORMANCE END MILLS

# You Know **EMUGE** Now Know their *End Mills*

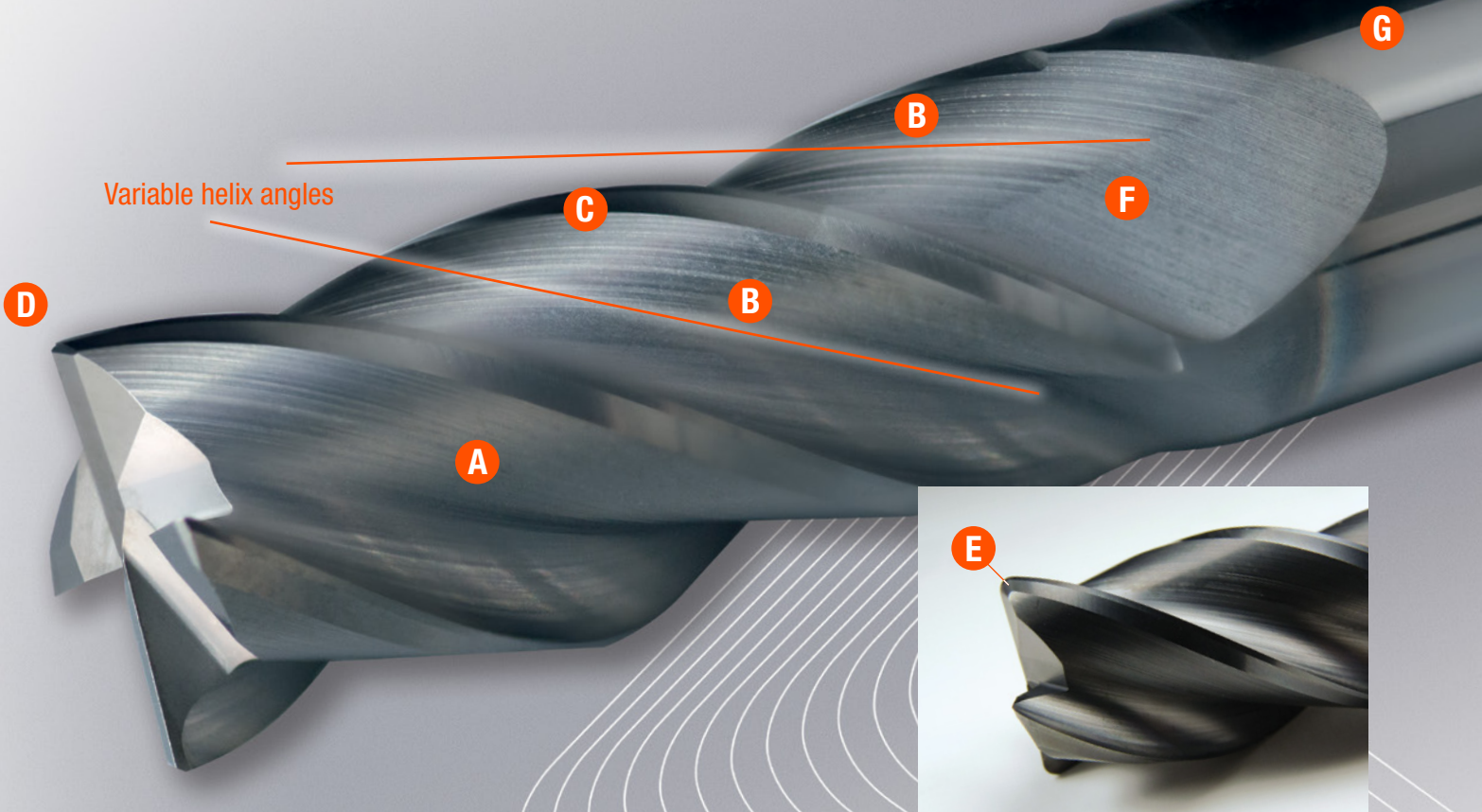


## **INTRODUCING *EMUGE High Performance End Mills!***

**D**id you know that Emuge also manufactures an exhaustive range of high quality, high performance **Emuge-Franken End Mills**? Emuge-Franken End Mills are the result of extensive development, incorporating the latest in end milling technology and coatings and will outperform any other end mills, *guaranteed*. You trust Emuge Taps and Thread Mills. Now you can rely on Emuge-Franken End Mills for your machining needs.

# New Emuge TOP-Cut VAR End Mills for universal milling applications.

TOP-Cut VAR is the most versatile variable helix carbide tool in the industry. Featuring unique geometry and coating, it can be used in virtually all materials and applications. TOP-Cut VAR is the best choice for manufacturers who need flexibility and high performance.

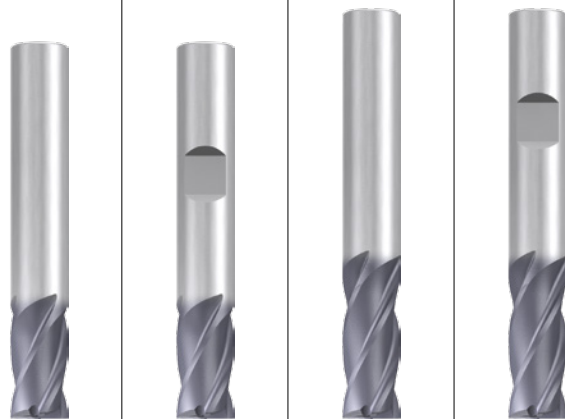
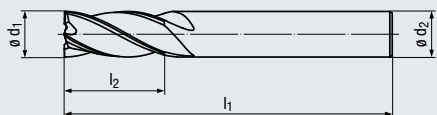
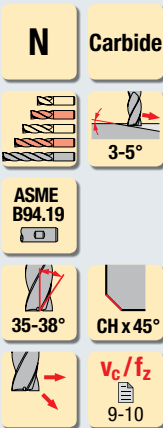


TOP-Cut VAR / Corner Radius

- A Unique flute and profile geometries** optimized for extended tool life, provide superior performance in both roughing and finishing applications.
- B Variable helix angle flutes** provide vibration dampening milling.
- C Precision ground flutes and advanced edge preparation** provide maximum chip evacuation. Tapered core promotes added tool stability to further enhance material removal.
- D Chamfer feature** protects cutting edges to prevent tool chipping.
- E Fully blended corner radius** extends tool life and delivers improved surface finishes.
- F Advanced ALCR PVD coating** enables outstanding performance in higher operating temperatures.
- G Proprietary sub-micro grain carbide grade** for maximum abrasion resistance and durability, providing consistent, high performance levels.

***German engineered and made,  
with unsurpassed Emuge quality***

- Variable helix angle flutes
- Vibration dampening
- Chamfer to stabilize the cutting edge
- ALCR PVD coating
- Sub-micro grain carbide
- Center cutting



### Coating

Applications – materials (see page 9)

- Ideal for most materials
- Suitable for roughing and finishing operations

### ALCR

P	1.1-5.1
M	1.1-4.1
K	1.1-4.2
N	1.2-1.4
N	2.1-4.1, 5.2
S	1.1-2.6
H	1.1 1.2-1.3

### ALCR

P	1.1-5.1
M	1.1-4.1
K	1.1-4.2
N	1.2-1.4
N	2.1-4.1, 5.2
S	1.1-2.6
H	1.1 1.2-1.3

### Stub length

$\varnothing d_1$ h10	$l_2$	$l_1$	$\varnothing d_2$ h6	Chamfer	Flutes	Tool no.	Tool no.
1/16	1/8	1 1/2	1/8	0.002	4	2992L.00625	
3/32	3/16	1 1/2	1/8	0.003	4	2992L.009375	
1/8	1/4	1 1/2	1/8	0.003	4	2992L.0125	
5/32	5/16	2	3/16	0.003	4	2992L.015625	
3/16	3/8	2	3/16	0.003	4	2992L.01875	
7/32	7/16	2	1/4	0.003	4	2992L.021875	2993L.021875*
1/4	1/2	2	1/4	0.005	4	2992L.0250	2993L.0250*
5/16	1/2	2	5/16	0.005	4	2992L.03125	2993L.03125*
3/8	5/8	2	3/8	0.008	4	2992L.0375	2993L.0375*
7/16	5/8	2 1/2	7/16	0.008	4	2992L.04375	
1/2	5/8	2 1/2	1/2	0.008	4	2992L.0500	2993L.0500*
5/8	3/4	3	5/8	0.008	4	2992L.0625	2993L.0625*
3/4	1	3	3/4	0.012	4	2992L.0750	2993L.0750*


### Standard length

$\varnothing d_1$ h10	$l_2$	$l_1$	$\varnothing d_2$ h6	Chamfer	Flutes	Tool no.	Tool no.
1/8	3/8	1 1/2	1/8	0.003	4	2994L.0125	
3/16	7/16	2	3/16	0.003	4	2994L.01875	
1/4	1/2	2 1/2	1/4	0.005	4	2994L.0250	2995L.0250*
1/4	3/8	2 1/2	1/4	0.005	4	2994L.A250	2995L.A250*
5/16	13/16	2 1/2	5/16	0.005	4	2994L.03125	2995L.03125*
3/8	7/8	2 1/2	3/8	0.008	4	2994L.0375	2995L.0375*
7/16	1	2 3/4	7/16	0.008	4	2994L.04375	
1/2	1	3	1/2	0.008	4	2994L.0500	2995L.0500*
1/2	1 1/4	3 1/4	1/2	0.008	4	2994L.A500	2995L.A500*
5/8	1 1/4	3 1/2	5/8	0.008	4	2994L.0625	2995L.0625*
3/4	1 1/2	4	3/4	0.012	4	2994L.0750	2995L.0750*
1	1 1/2	4	1	0.012	4	2994L.1000	2995L.1000*

\* Series available upon request.

- Variable helix angle flutes
- Vibration dampening
- Chamfer to stabilize the cutting edge
- ALCR PVD coating
- Sub-micro grain carbide
- Center cutting

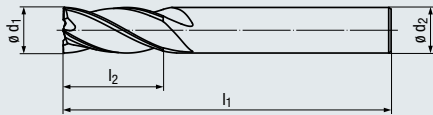
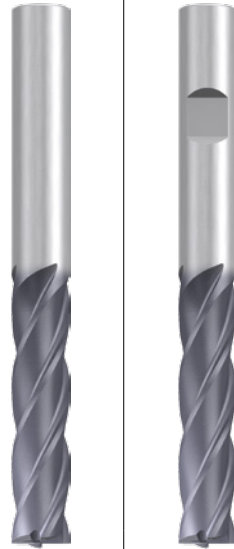
**N Carbide**



ASME B94.19

38-42° CH x 45°

$V_c / f_z$   
11



### Coating

Applications – materials (see page 9)

- Ideal for most materials
- Suitable for roughing and finishing operations

### ALCR

P	1.1-5.1	
M	1.1-4.1	
K	1.1-4.2	
N	1.1-1.4	1.5-1.6
N	2.1-2.8, 5.2	
S	1.1-1.3	2.1-2.6

### Long length

$\varnothing d_1$ h10	$l_2$	$l_1$	$\varnothing d_2$ h6	Chamfer	Flutes	Tool no.	Tool no.
1/8	3/4	2 1/4	1/8	0.003	4	2996L.0125	
3/16	3/4	2 1/2	3/16	0.003	4	2996L.01875	
1/4	1 1/8	3	1/4	0.005	4	2996L.0250	2997L.0250*
5/16	1 1/8	3	5/16	0.005	4	2996L.03125	2997L.03125*
3/8	1 1/8	3	3/8	0.008	4	2996L.0375	2997L.0375*
7/16	2	4 1/2	7/16	0.008	4	2996L.04375	
1/2	2	4 1/2	1/2	0.008	4	2996L.0500	2997L.0500*
5/8	2 1/4	5	5/8	0.008	4	2996L.0625	2997L.0625*
3/4	2 1/4	5	3/4	0.012	4	2996L.0750	2997L.0750*
1	2 1/4	5	1	0.012	4	2996L.1000	2997L.1000*

\* Series available upon request.

- Variable helix angle flutes
- Vibration dampening
- Corner radius options
- ALCR PVD coating
- Sub-micro grain carbide
- Center cutting

**N**

**Carbide**

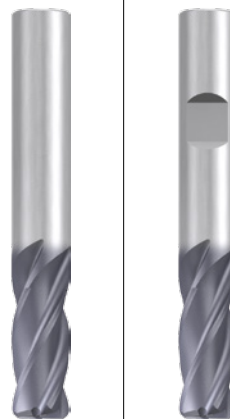
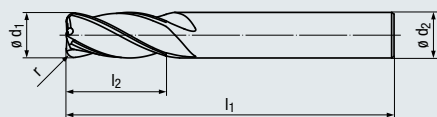
**ASME B94.19**

**3-5°**

**35-38°**

**CR**

**Vc/fz**  
10



### Coating

Applications – materials (see page 9)

- Ideal for most materials including high tensile strength applications
- Suitable for roughing and finishing operations

### ALCR

P	1.1-5.1
M	1.1-4.1
K	1.1-4.2
N	1.2-1.4
N	2.1-4.1, 5.2
S	1.1-2.6
H	1.1 1.2-1.3

### Standard length

### Corner radius

$\phi d_1$ h10	r $\pm .0008$	$l_2$	$l_1$	$\phi d_2$ h6	Flutes	Tool no.	Tool no.
1/8	0.010	3/8	1 1/2	1/8	4	2998L.012010	
1/8	0.015	3/8	1 1/2	1/8	4	2998L.012015	
3/16	0.010	7/16	2	3/16	4	2998L.018010	
3/16	0.015	7/16	2	3/16	4	2998L.018015	
3/16	0.030	7/16	2	3/16	4	2998L.018030	
1/4	0.010	1/2	2 1/2	1/4	4	2998L.025010	2999L.025010*
1/4	0.010	3/4	2 1/2	1/4	4	2998L.A25010	2999L.A25010*
1/4	0.015	1/2	2 1/2	1/4	4	2998L.025015	2999L.025015*
1/4	0.015	3/4	2 1/2	1/4	4	2998L.A25015	2999L.A25015*
1/4	0.020	1/2	2 1/2	1/4	4	2998L.025020	2999L.025020*
1/4	0.020	3/4	2 1/2	1/4	4	2998L.A25020	2999L.A25020*
1/4	0.030	1/2	2 1/2	1/4	4	2998L.025030	2999L.025030*
1/4	0.030	3/4	2 1/2	1/4	4	2998L.A25030	2999L.A25030*
5/16	0.015	13/16	2 1/2	5/16	4	2998L.031015	2999L.031015*
5/16	0.020	13/16	2 1/2	5/16	4	2998L.031020	2999L.031020*
5/16	0.030	13/16	2 1/2	5/16	4	2998L.031030	2999L.031030*
3/8	0.010	7/8	2 1/2	3/8	4	2998L.037010	2999L.037010*
3/8	0.015	7/8	2 1/2	3/8	4	2998L.037015	2999L.037015*
3/8	0.020	7/8	2 1/2	3/8	4	2998L.037020	2999L.037020*
3/8	0.030	7/8	2 1/2	3/8	4	2998L.037030	2999L.037030*
3/8	0.060	7/8	2 1/2	3/8	4	2998L.037060	2999L.037060*
7/16	0.010	1	2 3/4	7/16	4	2998L.043010	
7/16	0.015	1	2 3/4	7/16	4	2998L.043015	
1/2	0.010	1	3	1/2	4	2998L.050010	2999L.050010*
1/2	0.010	1 1/4	3 1/4	1/2	4	2998L.A50010	2999L.A50010*
1/2	0.015	1	3	1/2	4	2998L.050015	2999L.050015*
1/2	0.015	1 1/4	3 1/4	1/2	4	2998L.A50015	2999L.A50015*
1/2	0.030	1	3	1/2	4	2998L.050030	2999L.050030*
1/2	0.030	1 1/4	3 1/4	1/2	4	2998L.A50030	2999L.A50030*
1/2	0.060	1	3	1/2	4	2998L.050060	2999L.050060*
1/2	0.060	1 1/4	3 1/4	1/2	4	2998L.A50060	2999L.A50060*
5/8	0.030	1 1/4	3 1/2	5/8	4	2998L.062030	2999L.062030*
5/8	0.040	1 1/4	3 1/2	5/8	4	2998L.062040	2999L.062040*
5/8	0.060	1 1/4	3 1/2	5/8	4	2998L.062060	2999L.062060*
3/4	0.030	1 1/2	4	3/4	4	2998L.075030	2999L.075030*
3/4	0.040	1 1/2	4	3/4	4	2998L.075040	2999L.075040*
3/4	0.060	1 1/2	4	3/4	4	2998L.075060	2999L.075060*
1	0.030	1 1/2	4	1	4	2998L.100030	2999L.100030*
1	0.040	1 1/2	4	1	4	2998L.100040	2999L.100040*
1	0.060	1 1/2	4	1	4	2998L.100060	2999L.100060*

Other corner radii available on request.

\* Series available upon request.

- Variable helix flutes
- Vibration dampening
- ALCR PVD coating
- Sub-micro grain carbide
- 2 center cutting edges

**N**

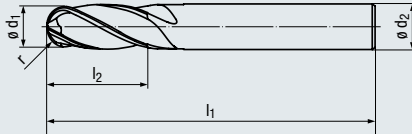
**Carbide**

ASME B94.19

35-38° **Ball**

3-5°

$v_c / f_z$   
12



### Coating

Applications – materials (see page 9)

- Ideal for most materials
- Suitable for HSC finishing

**ALCR**

<b>P</b>	1.1-5.1	3.1-4.1
<b>M</b>	1.1-2.1	3.1-4.1
<b>K</b>	1.1-2.2	3.1-4.2
<b>N</b>	2.1-2.8, 4.1-4.2	
<b>N</b>	5.2-5.3	
<b>S</b>	1.1-2.6	

### Standard length

$\varnothing d_1$ h10	r	$l_2$	$l_1$	$\varnothing d_2$ h6	Flutes	Tool no.			
1/8	1/16	3/8	1 1/2	1/8	4	2974L.0125			
3/16	3/32	7/16	2	3/16	4	2974L.01875			
1/4	1/8	1/2	2 1/2	1/4	4	2974L.0250			
1/4	1/8	3/4	2 1/2	1/4	4	2974L.A250			
5/16	5/32	13/16	2 1/2	5/16	4	2974L.03125			
3/8	3/16	7/8	2 1/2	3/8	4	2974L.0375			
7/16	7/32	1	2 3/4	7/16	4	2974L.04375			
1/2	1/4	1	3	1/2	4	2974L.0500			
1/2	1/4	1 1/4	3 1/4	1/2	4	2974L.A500			
5/8	5/16	1 1/4	3 1/2	5/8	4	2974L.0625			

**Helpful Formulas:**

- SFM = (RPM x D in) / 3.82
- RPM = (SFM x 3.82) / D in
- f<sub>z</sub> feed/tooth = IPM / (#teeth x RPM)
- IPM = RPM x #teeth x f<sub>z</sub>

Applications – Materials		HRC	Hardness Range	N/mm <sup>2</sup>	Material Examples	
			BHN			
<b>Steel materials</b>						
<b>P</b>	1.1	Cold-extrusion steels, Construction steels, Free-cutting steels, etc.		≤ 180	≤ 600	1010 / 1018 / 1020 / 12L14 / 12L15 / A36 / T1
	2.1	Construction steels, Cementation steels, Steel castings, etc.	≤ 22	≤ 235	≤ 800	A36 / T1 / 1030-1095 / 4140 / 4340 / 8620
	3.1	Cementation steels, Heat-treatable steels, Cold work steels, etc.	≤ 31	≤ 295	≤ 1000	4140 / 4340 / 8620 / P20 / H13 / D2 / A2 / S7 / H1150
	4.1	Heat-treatable steels, Cold work steels, Nitriding steels, etc.	≤ 38	≤ 355	≤ 1200	4140 / 4340 / 8620 / P20 / H13 / D2 / 300M / 52100 / M1-M42
	5.1	High-alloyed steels, Cold work steels, Hot work steels, etc.	≤ 44	≤ 415	≤ 1400	4140 / 4340 / 8620 / P20 / H13 / D2 / 300M / 52100
<b>Stainless steel materials</b>						
<b>M</b>	1.1	Ferritic, martensitic	≤ 29	≤ 280	≤ 950	410 / 440 / 440C / 17-4 PH
	2.1	Austenitic	≤ 29	≤ 280	≤ 950	303 / 304 / 316 / 316L / 321
	3.1	Austenitic-ferritic (Duplex)	≤ 35	≤ 325	≤ 1100	
	4.1	Austenitic-ferritic heat-resistant (Super Duplex)	≤ 39	≤ 370	≤ 1250	
<b>Cast materials</b>						
<b>K</b>	1.1	Cast iron with lamellar graphite (GJL)		30 - 75	100 - 250	Grey cast irons G10-GG40
	1.2			75 - 135	250 - 450	
	2.1	Cast iron with nodular graphite (GJS)		105 - 150	350 - 500	Nodular GGG40-GGG70
	2.2			150 - 265	500 - 900	
	3.1	Cast iron with vermicular graphite (GJV)		90 - 120	300 - 400	
	3.2			120 - 150	400 - 500	Compact graphite iron (CGI)
	4.1	Malleable cast iron (GTMW, GTMB)		70 - 145	250 - 500	
4.2			150 - 235	500 - 800	White iron	
<b>Non ferrous materials</b>						
<b>Aluminium alloys</b>						
<b>N</b>	1.1	Aluminium wrought alloys		≤ 60	≤ 200	7075
	1.2			≤ 105	≤ 350	6061-T6 / 2024-T4
	1.3			≤ 165	≤ 550	
	1.4	Aluminium cast alloys Si ≤ 7%				
	1.5	Aluminium cast alloys 7% < Si ≤ 12%				
	1.6	Aluminium cast alloys 12% < Si ≤ 17%				
<b>Copper alloys</b>						
<b>N</b>	2.1	Pure copper, low-alloyed copper		≤ 120	≤ 400	
	2.2	Copper-zinc alloys (brass, long-chipping)		≤ 165	≤ 550	
	2.3	Copper-zinc alloys (brass, short-chipping)		≤ 165	≤ 550	
	2.4	Copper-aluminium alloys (alu bronze, long-chipping)		≤ 235	≤ 800	
	2.5	Copper-tin alloys (tin bronze, long-chipping)		≤ 205	≤ 700	
	2.6	Copper-tin alloys (tin bronze, short-chipping)		≤ 120	≤ 400	
	2.7	Special copper alloys		≤ 180	≤ 600	
	2.8		≤ 44	≤ 415	≤ 1400	
<b>Magnesium alloys</b>						
<b>N</b>	3.1	Magnesium wrought alloys		≤ 150	≤ 500	
	3.2	Magnesium cast alloys		≤ 150	≤ 500	
<b>Synthetics</b>						
<b>N</b>	4.1	Duroplastics (short-chipping)				
	4.2	Thermoplastics (long-chipping)				
	4.3	Fibre-reinforced synthetics (fibre content ≤ 30%)				
	4.4	Fibre-reinforced synthetics (fibre content > 30%)				
<b>Special materials</b>						
<b>N</b>	5.1	Graphite				
	5.2	Tungsten-copper alloys				
5.3	Composite materials					
<b>Special materials</b>						
<b>Titanium alloys</b>						
<b>S</b>	1.1	Pure titanium		≤ 135	≤ 450	CP1 / CP2
	1.2	Titanium alloys	≤ 27	≤ 265	≤ 900	6AL4V
	1.3		≤ 39	≤ 370	≤ 1250	
<b>Nickel alloys, cobalt alloys and iron alloys</b>						
<b>S</b>	2.1	Pure nickel		≤ 180	≤ 600	
	2.2	Nickel-base alloys	≤ 31	≤ 295	≤ 1000	Monel 500
	2.3		≤ 49	≤ 475	≤ 1600	718 Inconel
	2.4	Cobalt-base alloys	≤ 31	≤ 295	≤ 1000	
	2.5		≤ 49	≤ 475	≤ 1600	Haynes 25
	2.6	Iron-base alloys	≤ 46	≤ 445	≤ 1500	Incoloy 925
<b>Hard materials</b>						
<b>H</b>	1.1		44 - 50			
	1.2		50 - 55			
	1.3	High strength steels, hardened steels, hard castings	55 - 60			
	1.4		60 - 63			
	1.5		63 - 66			

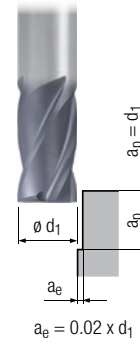
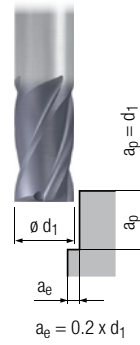
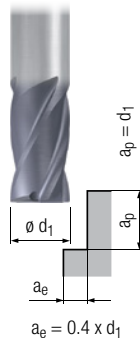
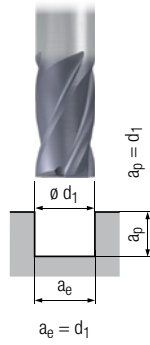


## Stub Length

**N**

Valid for

2992L  
2993L

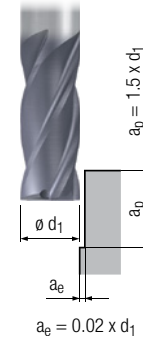
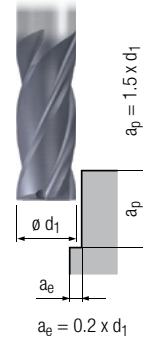
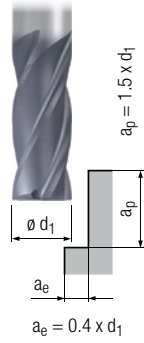
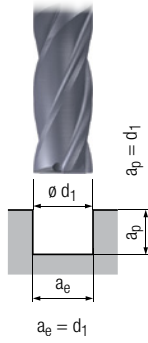


	V <sub>c</sub> [SFM]	f <sub>z</sub> [inch]	V <sub>c</sub> [SFM]	f <sub>z</sub> [inch]	V <sub>c</sub> [SFM]	f <sub>z</sub> [inch]	V <sub>c</sub> [SFM]	f <sub>z</sub> [inch]	MMS MQL				
<b>P</b>	1.1	615	0.005 x d <sub>1</sub>	685	0.006 x d <sub>1</sub>	720	0.007 x d <sub>1</sub>	865	0.008 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	540	0.004 x d <sub>1</sub>	615	0.005 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	760	0.007 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	470	0.004 x d <sub>1</sub>	505	0.005 x d <sub>1</sub>	575	0.005 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	4.1	435	0.003 x d <sub>1</sub>	470	0.004 x d <sub>1</sub>	505	0.004 x d <sub>1</sub>	615	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	5.1	360	0.003 x d <sub>1</sub>	395	0.003 x d <sub>1</sub>	435	0.004 x d <sub>1</sub>	505	0.004 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>M</b>	1.1	290	0.003 x d <sub>1</sub>	325	0.004 x d <sub>1</sub>	360	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	255	0.003 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>	360	0.005 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	180	0.002 x d <sub>1</sub>	215	0.003 x d <sub>1</sub>	215	0.003 x d <sub>1</sub>	255	0.004 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	4.1	110	0.002 x d <sub>1</sub>	110	0.003 x d <sub>1</sub>	145	0.003 x d <sub>1</sub>	145	0.004 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>K</b>	1.1	615	0.005 x d <sub>1</sub>	685	0.006 x d <sub>1</sub>	720	0.007 x d <sub>1</sub>	865	0.008 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	1.2	615	0.005 x d <sub>1</sub>	685	0.006 x d <sub>1</sub>	720	0.007 x d <sub>1</sub>	865	0.008 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	2.1	540	0.004 x d <sub>1</sub>	615	0.005 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	760	0.007 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	2.2	540	0.004 x d <sub>1</sub>	615	0.005 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	760	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	3.1	470	0.004 x d <sub>1</sub>	505	0.005 x d <sub>1</sub>	575	0.006 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	3.2	470	0.004 x d <sub>1</sub>	505	0.005 x d <sub>1</sub>	575	0.006 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	4.1	360	0.003 x d <sub>1</sub>	395	0.004 x d <sub>1</sub>	435	0.004 x d <sub>1</sub>	505	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	4.2	290	0.003 x d <sub>1</sub>	325	0.004 x d <sub>1</sub>	360	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>N</b>	1.1	795	0.009 x d <sub>1</sub>	900	0.010 x d <sub>1</sub>	1010	0.011 x d <sub>1</sub>	1085	0.013 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.2	795	0.008 x d <sub>1</sub>	900	0.009 x d <sub>1</sub>	1010	0.010 x d <sub>1</sub>	1085	0.011 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.3	795	0.007 x d <sub>1</sub>	900	0.008 x d <sub>1</sub>	1010	0.009 x d <sub>1</sub>	1085	0.010 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.4	720	0.008 x d <sub>1</sub>	900	0.009 x d <sub>1</sub>	1010	0.010 x d <sub>1</sub>	1085	0.011 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.5	720											
	1.6	720											
	2.1	540	0.005 x d <sub>1</sub>	615	0.006 x d <sub>1</sub>	650	0.007 x d <sub>1</sub>	760	0.008 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.2	540	0.005 x d <sub>1</sub>	615	0.006 x d <sub>1</sub>	650	0.007 x d <sub>1</sub>	760	0.008 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.3	540	0.005 x d <sub>1</sub>	615	0.006 x d <sub>1</sub>	650	0.007 x d <sub>1</sub>	760	0.008 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.4	470	0.004 x d <sub>1</sub>	505	0.005 x d <sub>1</sub>	575	0.006 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.5	470	0.004 x d <sub>1</sub>	505	0.005 x d <sub>1</sub>	575	0.006 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.6	470	0.004 x d <sub>1</sub>	505	0.005 x d <sub>1</sub>	575	0.006 x d <sub>1</sub>	650	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.7	290	0.003 x d <sub>1</sub>	325	0.004 x d <sub>1</sub>	360	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.8	290	0.003 x d <sub>1</sub>	325	0.004 x d <sub>1</sub>	360	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	1225	0.009 x d <sub>1</sub>	1335	0.011 x d <sub>1</sub>	1480	0.013 x d <sub>1</sub>	1730	0.014 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.2	1225	0.007 x d <sub>1</sub>	1335	0.008 x d <sub>1</sub>	1480	0.010 x d <sub>1</sub>	1730	0.011 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.1	1225	0.008 x d <sub>1</sub>	1335	0.009 x d <sub>1</sub>	1480	0.011 x d <sub>1</sub>	1730	0.012 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.2	1805	0.008 x d <sub>1</sub>	1985	0.009 x d <sub>1</sub>	2165	0.011 x d <sub>1</sub>	2525	0.012 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.3													
4.4													
5.1													
5.2	290	0.003 x d <sub>1</sub>	325	0.004 x d <sub>1</sub>	360	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>				<input checked="" type="checkbox"/>	
5.3													
<b>S</b>	1.1	290	0.004 x d <sub>1</sub>	325	0.004 x d <sub>1</sub>	360	0.005 x d <sub>1</sub>	395	0.006 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	1.2	255	0.003 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>	360	0.005 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	1.3	145	0.003 x d <sub>1</sub>	145	0.003 x d <sub>1</sub>	180	0.004 x d <sub>1</sub>	215	0.004 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.1	255	0.002 x d <sub>1</sub>	290	0.002 x d <sub>1</sub>	290	0.003 x d <sub>1</sub>	360	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.2	110	0.002 x d <sub>1</sub>	110	0.002 x d <sub>1</sub>	125	0.003 x d <sub>1</sub>	145	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.3	70	0.002 x d <sub>1</sub>	90	0.002 x d <sub>1</sub>	90	0.003 x d <sub>1</sub>	110	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.4	70	0.002 x d <sub>1</sub>	90	0.002 x d <sub>1</sub>	90	0.003 x d <sub>1</sub>	110	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>
2.5	70	0.002 x d <sub>1</sub>	70	0.002 x d <sub>1</sub>	70	0.003 x d <sub>1</sub>	110	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>	
2.6	70	0.002 x d <sub>1</sub>	70	0.002 x d <sub>1</sub>	70	0.003 x d <sub>1</sub>	110	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>	
<b>H</b>	1.1	360	0.003 x d <sub>1</sub>	395	0.003 x d <sub>1</sub>	435	0.004 x d <sub>1</sub>	505	0.004 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	1.2	290	0.003 x d <sub>1</sub>	325	0.003 x d <sub>1</sub>	360	0.004 x d <sub>1</sub>	395	0.004 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	1.3			325	0.003 x d <sub>1</sub>	360	0.003 x d <sub>1</sub>	395	0.004 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	1.4												
	1.5												



## Standard Length

N



Valid for

- 2994L
- 2995L
- 2998L
- 2999L

		Standard Length		N		N		N					
		$V_c$ [SFM]	$f_z$ [inch]	$V_c$ [SFM]	$f_z$ [inch]	$V_c$ [SFM]	$f_z$ [inch]	$V_c$ [SFM]	$f_z$ [inch]				
<b>P</b>	1.1	505	$0.005 \times d_1$	540	$0.005 \times d_1$	615	$0.006 \times d_1$	720	$0.007 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	470	$0.004 \times d_1$	505	$0.005 \times d_1$	575	$0.005 \times d_1$	650	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	395	$0.004 \times d_1$	435	$0.004 \times d_1$	470	$0.005 \times d_1$	540	$0.005 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	4.1	360	$0.003 \times d_1$	395	$0.003 \times d_1$	435	$0.004 \times d_1$	505	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5.1	325	$0.003 \times d_1$	360	$0.003 \times d_1$	395	$0.003 \times d_1$	470	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>M</b>	1.1	255	$0.003 \times d_1$	290	$0.003 \times d_1$	290	$0.004 \times d_1$	360	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	215	$0.003 \times d_1$	255	$0.003 \times d_1$	255	$0.004 \times d_1$	290	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	145	$0.002 \times d_1$	145	$0.003 \times d_1$	180	$0.003 \times d_1$	215	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	4.1	110	$0.002 \times d_1$	110	$0.003 \times d_1$	145	$0.003 \times d_1$	145	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>K</b>	1.1	505	$0.005 \times d_1$	540	$0.006 \times d_1$	615	$0.006 \times d_1$	720	$0.007 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1.2	505	$0.005 \times d_1$	540	$0.006 \times d_1$	615	$0.006 \times d_1$	720	$0.007 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2.1	470	$0.004 \times d_1$	505	$0.005 \times d_1$	575	$0.005 \times d_1$	650	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2.2	470	$0.004 \times d_1$	505	$0.005 \times d_1$	575	$0.005 \times d_1$	650	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	3.1	395	$0.004 \times d_1$	435	$0.005 \times d_1$	470	$0.005 \times d_1$	540	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	3.2	395	$0.004 \times d_1$	435	$0.005 \times d_1$	470	$0.005 \times d_1$	540	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.1	325	$0.003 \times d_1$	360	$0.003 \times d_1$	395	$0.004 \times d_1$	470	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.2	255	$0.003 \times d_1$	290	$0.003 \times d_1$	290	$0.004 \times d_1$	360	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>N</b>	1.1	795	$0.009 \times d_1$	900	$0.010 \times d_1$	1010	$0.011 \times d_1$	1085	$0.013 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.2	795	$0.008 \times d_1$	900	$0.009 \times d_1$	1010	$0.010 \times d_1$	1085	$0.011 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.3	795	$0.007 \times d_1$	900	$0.008 \times d_1$	1010	$0.009 \times d_1$	1085	$0.010 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.4	720	$0.008 \times d_1$	900	$0.009 \times d_1$	1010	$0.010 \times d_1$	1085	$0.011 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.5									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.6									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	470	$0.005 \times d_1$	505	$0.006 \times d_1$	575	$0.006 \times d_1$	650	$0.007 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.2	470	$0.005 \times d_1$	505	$0.006 \times d_1$	575	$0.006 \times d_1$	650	$0.007 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.3	470	$0.005 \times d_1$	505	$0.006 \times d_1$	575	$0.006 \times d_1$	650	$0.007 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.4	435	$0.004 \times d_1$	470	$0.005 \times d_1$	505	$0.005 \times d_1$	615	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.5	435	$0.004 \times d_1$	470	$0.005 \times d_1$	505	$0.005 \times d_1$	615	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.6	435	$0.004 \times d_1$	470	$0.005 \times d_1$	505	$0.005 \times d_1$	615	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.7	255	$0.003 \times d_1$	290	$0.003 \times d_1$	290	$0.004 \times d_1$	360	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.8	255	$0.003 \times d_1$	290	$0.003 \times d_1$	290	$0.004 \times d_1$	360	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	1045	$0.009 \times d_1$	1155	$0.010 \times d_1$	1265	$0.011 \times d_1$	1480	$0.013 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.2	1045	$0.007 \times d_1$	1155	$0.008 \times d_1$	1265	$0.009 \times d_1$	1480	$0.010 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.1	1045	$0.008 \times d_1$	1155	$0.009 \times d_1$	1265	$0.009 \times d_1$	1480	$0.011 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.2	1550	$0.008 \times d_1$	1695	$0.009 \times d_1$	1875	$0.009 \times d_1$	2165	$0.011 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.3									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.4									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
5.1									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
5.2	255	$0.003 \times d_1$	290	$0.003 \times d_1$	290	$0.004 \times d_1$	360	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
5.3									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>S</b>	1.1	255	$0.004 \times d_1$	290	$0.004 \times d_1$	290	$0.004 \times d_1$	360	$0.005 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.2	215	$0.003 \times d_1$	255	$0.003 \times d_1$	255	$0.004 \times d_1$	290	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.3	145	$0.003 \times d_1$	145	$0.003 \times d_1$	180	$0.003 \times d_1$	215	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	215	$0.002 \times d_1$	255	$0.002 \times d_1$	255	$0.003 \times d_1$	290	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.2	70	$0.002 \times d_1$	70	$0.002 \times d_1$	55	$0.003 \times d_1$	110	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.3	70	$0.002 \times d_1$	90	$0.002 \times d_1$	90	$0.003 \times d_1$	110	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.4	70	$0.002 \times d_1$	90	$0.002 \times d_1$	90	$0.003 \times d_1$	110	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.5	70	$0.002 \times d_1$	70	$0.002 \times d_1$	70	$0.003 \times d_1$	110	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.6	70	$0.002 \times d_1$	70	$0.002 \times d_1$	70	$0.003 \times d_1$	110	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>H</b>	1.1	325	$0.003 \times d_1$	360	$0.003 \times d_1$	395	$0.003 \times d_1$	470	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.2	255	$0.003 \times d_1$	290	$0.003 \times d_1$	290	$0.003 \times d_1$	360	$0.004 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.3			255	$0.003 \times d_1$	255	$0.003 \times d_1$	290	$0.003 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.4									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.5									<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

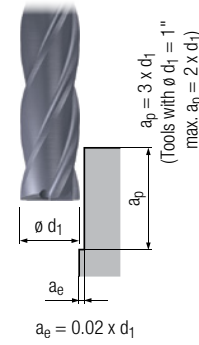
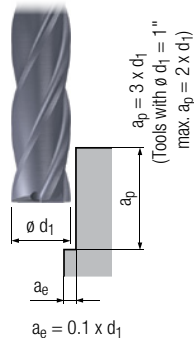


## Long Length

**N**

Valid for

2996L  
2997L



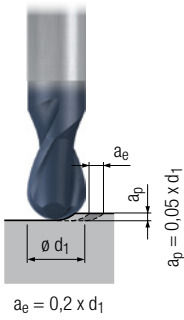
	V <sub>C</sub> [SFM]	f <sub>z</sub> [inch]	V <sub>C</sub> [SFM]	V <sub>C</sub> [SFM]					
							MMS MQL		
<b>P</b>	1.1	435	0.005 x d <sub>1</sub>	505	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	395	0.004 x d <sub>1</sub>	470	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	325	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	4.1	255	0.003 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	5.1	215	0.003 x d <sub>1</sub>	255	0.003 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>M</b>	1.1	435	0.003 x d <sub>1</sub>	505	0.004 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	360	0.003 x d <sub>1</sub>	435	0.004 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	255	0.003 x d <sub>1</sub>	290	0.003 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	4.1	180	0.003 x d <sub>1</sub>	215	0.003 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>K</b>	1.1	435	0.005 x d <sub>1</sub>	505	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	1.2	435	0.005 x d <sub>1</sub>	505	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	2.1	395	0.004 x d <sub>1</sub>	470	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	2.2	395	0.004 x d <sub>1</sub>	470	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	3.1	325	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	3.2	325	0.004 x d <sub>1</sub>	395	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	4.1	255	0.003 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
	4.2	215	0.003 x d <sub>1</sub>	255	0.004 x d <sub>1</sub>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		
<b>N</b>	1.1	1300	0.009 x d <sub>1</sub>	1550	0.011 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.2	1300	0.008 x d <sub>1</sub>	1550	0.010 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.3	1300	0.007 x d <sub>1</sub>	1550	0.008 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.4	865	0.008 x d <sub>1</sub>	1045	0.010 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.5	830	0.007 x d <sub>1</sub>	1010	0.008 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.6	575	0.006 x d <sub>1</sub>	685	0.007 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	395	0.005 x d <sub>1</sub>	470	0.006 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.2	395	0.005 x d <sub>1</sub>	470	0.006 x d <sub>1</sub>			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.3	395	0.005 x d <sub>1</sub>	470	0.006 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>
	2.4	360	0.004 x d <sub>1</sub>	435	0.005 x d <sub>1</sub>		<input type="checkbox"/>		<input checked="" type="checkbox"/>
	2.5	360	0.004 x d <sub>1</sub>	435	0.005 x d <sub>1</sub>		<input type="checkbox"/>		<input checked="" type="checkbox"/>
	2.6	360	0.004 x d <sub>1</sub>	435	0.005 x d <sub>1</sub>	<input type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>
	2.7	215	0.003 x d <sub>1</sub>	255	0.004 x d <sub>1</sub>		<input type="checkbox"/>		<input checked="" type="checkbox"/>
	2.8	215	0.003 x d <sub>1</sub>	255	0.004 x d <sub>1</sub>		<input type="checkbox"/>		<input checked="" type="checkbox"/>
	3.1								
	3.2								
4.1									
4.2									
4.3									
4.4									
5.1									
5.2	215	0.003 x d <sub>1</sub>	255	0.004 x d <sub>1</sub>				<input checked="" type="checkbox"/>	
5.3									
<b>S</b>	1.1	325	0.004 x d <sub>1</sub>	360	0.005 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	1.2	255	0.003 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	1.3	255	0.003 x d <sub>1</sub>	290	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.1	255	0.004 x d <sub>1</sub>	290	0.004 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.2	110	0.003 x d <sub>1</sub>	145	0.004 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.3	70	0.002 x d <sub>1</sub>	90	0.002 x d <sub>1</sub>				<input checked="" type="checkbox"/>
	2.4	110	0.003 x d <sub>1</sub>	160	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>
2.5	70	0.002 x d <sub>1</sub>	70	0.002 x d <sub>1</sub>				<input checked="" type="checkbox"/>	
2.6	70	0.003 x d <sub>1</sub>	70	0.003 x d <sub>1</sub>				<input checked="" type="checkbox"/>	
<b>H</b>	1.1								
	1.2								
	1.3								
	1.4								
	1.5								

v<sub>C</sub> = Cutting speed     = very suitable  
f<sub>z</sub> = Feed per tooth     = suitable



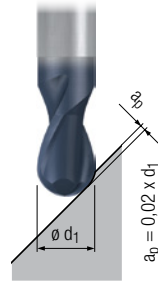
### Standard Length

Roughing



**N**

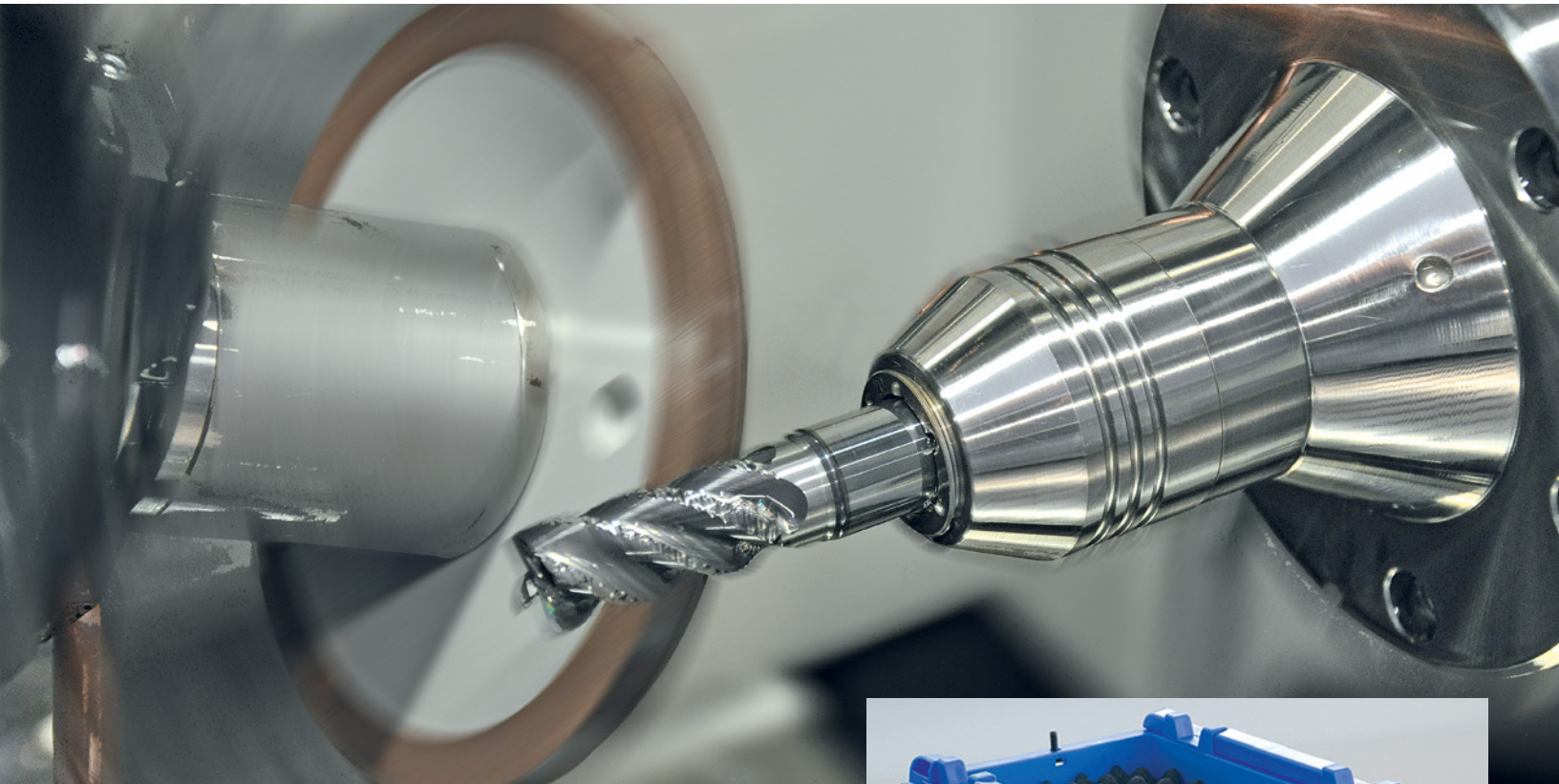
Finishing



Valid for  
2974L

	$V_c$ [SFM]	$f_z$ [inch]	$V_c$ [SFM]	$V_c$ [SFM]			MMS MQL		
<b>P</b>	1.1	655	$0.014 \times d_1$	885	$0.010 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	555	$0.013 \times d_1$	755	$0.009 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	460	$0.011 \times d_1$	655	$0.008 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.1	360	$0.010 \times d_1$	525	$0.007 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	5.1	325	$0.008 \times d_1$	425	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>M</b>	1.1	325	$0.008 \times d_1$	425	$0.006 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	260	$0.008 \times d_1$	360	$0.006 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	195	$0.006 \times d_1$	260	$0.005 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	4.1	130	$0.006 \times d_1$	195	$0.005 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
<b>K</b>	1.1	655	$0.014 \times d_1$	855	$0.010 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	1.2	655	$0.014 \times d_1$	855	$0.010 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2.1	590	$0.011 \times d_1$	755	$0.008 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	2.2	590	$0.011 \times d_1$	755	$0.008 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	3.1	460	$0.011 \times d_1$	655	$0.008 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	3.2	460	$0.011 \times d_1$	655	$0.008 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.1	360	$0.008 \times d_1$	525	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	4.2	325	$0.008 \times d_1$	425	$0.006 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>N</b>	1.1								
	1.2								
	1.3								
	1.4								
	1.5								
	1.6								
	2.1	590	$0.014 \times d_1$	755	$0.010 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.2	590	$0.014 \times d_1$	755	$0.010 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.3	590	$0.014 \times d_1$	755	$0.010 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.4	460	$0.011 \times d_1$	655	$0.008 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.5	460	$0.011 \times d_1$	655	$0.008 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.6	460	$0.011 \times d_1$	655	$0.008 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.7	295	$0.008 \times d_1$	395	$0.006 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.8	295	$0.008 \times d_1$	395	$0.006 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.1	1310	$0.025 \times d_1$	1640	$0.018 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
	3.2	1310	$0.020 \times d_1$	1640	$0.014 \times d_1$	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
4.1	950	$0.020 \times d_1$	1310	$0.015 \times d_1$		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.2	1410	$0.020 \times d_1$	1900	$0.015 \times d_1$		<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
4.3									
4.4									
5.1									
5.2	325	$0.008 \times d_1$	425	$0.006 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>	
5.3	590	$0.017 \times d_1$	885	$0.012 \times d_1$	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>S</b>	1.1	325	$0.010 \times d_1$	425	$0.007 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.2	260	$0.008 \times d_1$	360	$0.006 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	1.3	130	$0.007 \times d_1$	195	$0.005 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.1	230	$0.008 \times d_1$	325	$0.006 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.2	80	$0.006 \times d_1$	130	$0.004 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.3	80	$0.006 \times d_1$	100	$0.004 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
	2.4	80	$0.006 \times d_1$	100	$0.004 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>
2.5	50	$0.006 \times d_1$	80	$0.004 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>	
2.6	80	$0.006 \times d_1$	100	$0.004 \times d_1$			<input type="checkbox"/>	<input checked="" type="checkbox"/>	
<b>H</b>	1.1								
	1.2								
	1.3								
	1.4								
	1.5								

$v_c$  = Cutting speed  = very suitable  
 $f_z$  = Feed per tooth  = suitable



***Emuge offers tool grinding/reconditioning for all end mill products. Also, beginning Q4 2015, Emuge will offer USA reconditioning services at our West Boylston, MA USA facility.***

Reconditioning your Emuge tools through Emuge makes sense. Emuge has the knowledge and manufacturing expertise to refurbish an Emuge tool to its original condition and specification, providing maximum performance levels, predictable operation and longer life than any other method, all at a modest investment for the utmost value.

**Emuge reconditioning offers:**

- Complete regrinding to the original geometry of the tool.
- Coating via state-of-the-art coating system.
- Prompt delivery of reground tools.



Rugged protective containers for shipping tools and individual or bulk packaging provided as needed.

**Reconditioning examples – End Mills**



# EMUGE HIGH PERFORMANCE TOOLS

## EMUGE Corp. Technology Center

West Boylston, MA, USA



**EMUGE Corp.** is a wholly owned subsidiary of EMUGE-Werk Richard Glimpel GmbH & Co. KG (Lauf, Germany) that has been the product technology and performance leader in their field for nearly 100 years. Emuge manufactures an extensive line of taps, thread mills, end mills, drills, toolholders, clamping devices and other rotary cutting tools, over 100,000 items sold through distributors worldwide. Emuge also offers end-user technical support through a network of in-the-field engineers and in-house product specialists, all with extensive tooling and application experience.

## Emuge-Franken

Rückersdorf, Germany



## Almost 100 years of precision milling and innovation.

Ever since its foundation, Franken, as part of the Emuge-Franken Company, has been developing and manufacturing milling tools — a wide range of solid carbide and HSS end mills, PCD and CBN inserts and milling cutters with indexable inserts, characterized by precision and innovation.

The Franken production facility is located in Rückersdorf, Germany and is dedicated to the manufacturing of high precision end mills and indexable cutters as well as special design form and profile milling tools. With an extensive variety of tool types in a variety of materials, Emuge-Franken manufactures only the highest quality cutting tools for discerning customers.

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