

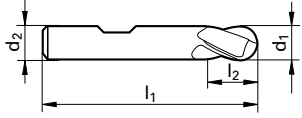





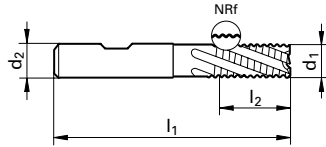

MILLING CUTTERS



4 FLUTE CENTRE CUTTING

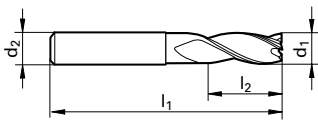

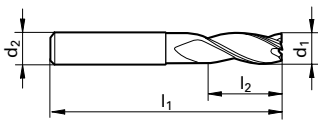
<p>Guhring no. 3466 Standard DIN 327 D Tool material M42 Surface  Type N Helix 30° Tolerance e8/h10</p>  									
									
					d1	d2	l1	l2	z
					mm	mm	mm	mm	
					4.000	6.000	51.00	7.00	2
					6.000	6.000	52.00	8.00	2
					8.000	10.000	61.00	11.00	2
10.000	10.000	63.00	13.00	2					
12.000	12.000	73.00	16.00	2					
16.000	16.000	79.00	19.00	2					
20.000	20.00	88.00	22.00	2					
<p>AVAILABILITY</p> <ul style="list-style-type: none"> • • • • • • • 									

4 FLUTE CENTRE CUTTING
ROUGHING END MILL FINE PROFILE

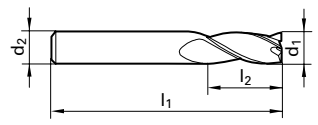

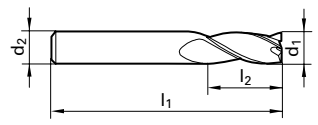
<p>Guhring no. 3660 Standard DIN 844 K Tool material PM HSS-E Surface  Type NRf Helix 30° Tolerance k12</p>  									
									
					d1	d2	l1	l2	z
					mm	mm	mm	mm	
					6.000	6.000	57.00	13.00	4
					8.000	10.000	69.00	19.00	4
					10.000	10.000	72.00	22.00	4
12.000	12.000	83.00	26.00	4					
14.000	12.000	83.00	26.00	4					
16.000	16.000	92.00	32.00	4					
18.000	16.000	92.00	32.00	4					
20.000	20.000	104.00	38.00	4					
25.000	25.000	121.00	45.00	5					
30.000	25.000	121.00	45.00	5					
<p>AVAILABILITY</p> <ul style="list-style-type: none"> • • • • • • • • • • • • 									

METRIC SLOT DRILLS - CARBIDE

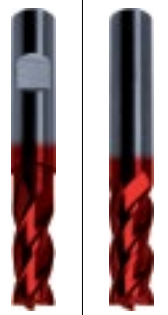
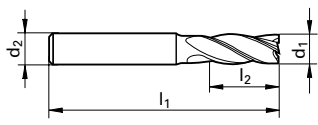
FOR ALUMINUM
3 FLUTED STANDARD LENGTH

<p>Guhring no. Standard Tool material Surface Type Helix angle Tolerance</p> 				3472
				DIN 6527 L
				Solid Carbide
				○
				S
				45°
				h10
				
				
d1	d2	l1	l2	AVAILABILITY
mm	mm	mm	mm	
3.000	3.000	57.00	8.00	•
4.000	4.000	57.00	11.00	•
5.000	5.000	57.00	13.00	•
6.000	6.000	57.00	13.00	•
8.000	8.000	63.00	16.00	•
10.000	10.000	72.00	19.00	•
12.000	12.000	83.00	22.00	•
16.000	16.000	92.00	26.00	•
20.000	20.000	104.00	32.00	•


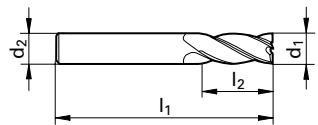
FOR ALUMINUM
3 FLUTED EX LONG

<p>Guhring no. Standard Tool material Surface Type Helix angle Tolerance</p> 				3473
				Guhring std.
				Solid Carbide
				○
				S
				45°
				h10
				
				
d1	d2	l1	l2	AVAILABILITY
mm	mm	mm	mm	
6.000	6.000	65.00	10.00	•
8.000	8.000	80.00	14.00	•
10.000	10.000	80.00	14.00	•
12.000	12.000	93.00	16.00	•
16.000	16.000	108.00	22.00	•
20.000	20.000	126.00	26.00	•

4 FLUTE STANDARD LENGTH

					5535	
					5532	5735
					DIN 6527 L	
					Solid Carbide	
Guhring no.					F	F
Standard					N	N
Tool material					30°	35°/38°
Surface					h10	h10
Type					RATIO	
Helix						
Tolerance						
						
d1	d2	l1	l2	z	AVAILABILITY	
mm	mm	mm	mm			
2.000	6.000	57.00	7.00	4	•	
3.000	6.000	57.00	8.00	4	•	
4.000	6.000	57.00	11.00	4		•
5.000	6.000	57.00	13.00	4		•
6.000	6.000	57.00	13.00	4		•
7.000	8.000	63.00	16.00	4	•	
8.000	8.000	63.00	19.00	4		•
9.000	10.000	72.00	19.00	4	•	
10.000	10.000	72.00	22.00	4		•
12.000	12.000	83.00	26.00	4		•
14.000	14.000	83.00	26.00	4		•
16.000	16.000	92.00	32.00	4		•
18.000	18.000	92.00	32.00	4		•
20.000	20.000	104.00	38.00	4		•
25.000	25.000	121.00	45.00	4		•

4 FLUTE EX LONG

					5556		5735 L	
					Guhring std.		Solid Carbide	
					F	F		
					N	N		
					30°	35°/38°		
					h10	h10		
					RATIO			
								
								
d1	d2	l1	l2	z	AVAILABILITY			
mm	mm	mm	mm					
3.000	3.000	75.00	20.00	4	•			
4.000	4.000	75.00	25.00	4	•			
5.000	5.000	75.00	30.00	4				
6.000	6.000	75.00	30.00	4			•	
8.000	8.000	108.00	40.00	4			•	
10.000	10.000	108.00	40.00	4			•	
12.000	12.000	108.00	45.00	4			•	
16.000	16.000	108.00	65.00	4			•	
20.000	20.000	140.00	65.00	4			•	
25.000	25.000	140.00	65.00	4			•	

METRIC BALL NOSE SLOT DRILLS

2 FLUTED FOR MATERIALS <62 HRC
STANDARD LENGTH

2 FLUTED FOR MATERIALS <62 HRC
EX LONG

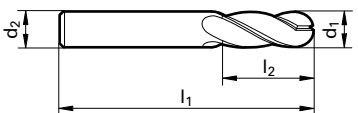

Guhring no.				3359
Standard				Guhring std.
Tool material				Solid carbide
Surface				F
Type				H
Helix				30°
Tolerance				h8

d1	d2	l1	l2	AVAILABILITY
mm	mm	mm	mm	
0.500	3.000	38.00	0.75	•
0.800	3.000	38.00	1.20	•
1.000	3.000	38.00	1.50	•
1.500	3.000	38.00	2.25	•
2.000	6.000	57.00	3.00	•
3.000	6.000	57.00	5.00	•
4.000	6.000	57.00	6.00	•
5.000	6.000	57.00	8.00	•
6.000	6.000	57.00	9.00	•
8.000	8.000	63.00	12.00	•
10.000	10.000	72.00	15.00	•
12.000	12.000	83.00	18.00	•
16.000	16.000	92.00	24.00	•

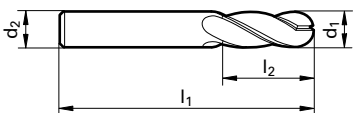

Guhring no.				3360
Standard				Guhring std.
Tool material				Solid carbide
Surface				F
Type				H
Helix				30°
Tolerance				h8

d1	d2	l1	l2	AVAILABILITY
mm	mm	mm	mm	
3.000	6.000	75.00	5.00	•
4.000	6.000	75.00	6.00	•
5.000	6.000	75.00	8.00	•
6.000	6.000	75.00	9.00	•
8.000	8.000	100.00	12.00	•
10.000	10.000	100.00	15.00	•
12.000	12.000	150.00	18.00	•
16.000	16.000	150.00	24.00	•

4 FLUTED STANDARD LENGTH

<p>Guhring no. Standard Tool material Surface Type Helix Tolerance</p> 					3727
					DIN 6528
					Solid carbide
					F
					N
					30°
					h10
					
d1	d2	l1	l2	z	AVAILABILITY
mm	mm	mm	mm		
4.000	4.000	50.00	11.00	4	•
5.000	5.000	50.00	13.00	4	•
6.000	6.000	57.00	13.00	4	•
8.000	8.000	63.00	19.00	4	•
10.000	10.000	72.00	22.00	4	•
12.000	12.000	83.00	26.00	4	•
14.000	14.000	83.00	26.00	4	•
16.000	16.000	92.00	32.00	4	•
18.000	18.000	92.00	32.00	4	•
20.000	20.000	104.00	38.00	4	•
Guhring no. 3505					AVAILABILITY
3.000	6.000	57.00	8.00	4	

4 FLUTED EX LONG

<p>Guhring no. Standard Tool material Surface Type Helix Tolerance</p> 					3043
					Guhring std.
					Solid carbide
					F
					N
					30°
					h10
					
d1	d2	l1	l2	z	AVAILABILITY
mm	mm	mm	mm		
3.000	3.000	75.00	20.00	4	•
4.000	4.000	75.00	25.00	4	•
5.000	5.000	75.00	30.00	4	•
6.000	6.000	75.00	30.00	4	•
8.000	8.000	100.00	40.00	4	•
10.000	10.000	100.00	40.00	4	•
12.000	12.000	150.00	45.00	4	•

4 FLUTE

Guhring no.
Standard
Tool material
Surface
Type
Helix
Tolerance

5005
Guhring std.
Solid carbide
F
N
0°
h7

d1	d2	l1	z
mm	mm	mm	mm
8.000	8.000	63.00	4
10.000	10.000	63.00	4
12.000	12.000	80.00	4
16.000	16.000	80.00	4

AVAILABILITY

-
-
-
-

2 FLUTE

Guhring no.
Standard
Tool material
Surface
Type
Helix
Tolerance

5006
Guhring std.
Solid carbide
C
N
0°
h8

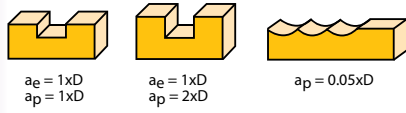
d1	d2	l1	l2	r
mm	mm	mm	mm	mm
3.000	3.000	38.00	0.70	0.30

AVAILABILITY

-

CUTTING SPEED RECOMMENDATION - MILLING CUTTERS

MILLING CORRECTION DATA PAGE 147

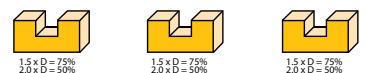


Cutter- mm	Feed Column No.															
	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
	f (mm/tooth)															
2.00	0.001	0.001	0.001	0.002	0.002	0.004	0.005	0.006	0.007	0.008	0.010	0.012	0.014	0.016	0.018	0.020
3.00	0.002	0.002	0.003	0.003	0.004	0.007	0.010	0.010	0.010	0.015	0.016	0.013	0.019	0.022	0.024	0.030
5.00	0.005	0.006	0.007	0.009	0.010	0.014	0.020	0.020	0.022	0.025	0.026	0.026	0.028	0.030	0.032	0.038
6.00	0.006	0.008	0.009	0.011	0.013	0.017	0.024	0.025	0.027	0.031	0.029	0.033	0.039	0.036	0.041	0.047
8.00	0.010	0.012	0.014	0.016	0.019	0.024	0.032	0.032	0.035	0.042	0.042	0.047	0.053	0.052	0.058	0.064
10.00	0.013	0.015	0.018	0.021	0.025	0.030	0.038	0.039	0.044	0.050	0.053	0.059	0.065	0.073	0.080	
12.50	0.016	0.018	0.022	0.026	0.030	0.036	0.046	0.048	0.052	0.059	0.063	0.072	0.079	0.085	0.090	0.100
16.00	0.020	0.023	0.027	0.032	0.038	0.045	0.054	0.058	0.063	0.071	0.079	0.088	0.095	0.100	0.110	0.120
20.00	0.023	0.028	0.033	0.038	0.045	0.057	0.066	0.073	0.080	0.090	0.097	0.100	0.110	0.120	0.130	0.140

Tool Material	M42	M42	M42
Carbide Group	-	-	-
Standard	Guhring	Guhring	Guhring
Type	N	N	N
Surface Finish	○	○	○
Guhring No.	3451 3453	3428 3431	3459 3460
DIN	844	844	844
Guhring Std			
No. Cutting Edges	2-Flute	4-Flute	3-Flute

Coolant
Soluble Oil ●
Oil ●
Air ○

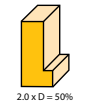
Material Group	Material Examples	Tens. Strength N/mm²	Hard-ness	Cool-ant	Vc m/min	Feed col. no.	Vc m/min	Feed col. no.	Vc m/min	Feed col. no.
Common Structural Steels	Mild steel, Grade 250 plate, Grade 350 plate	≤ 500 > 500 - 850		●	25-31 21-27	42 41	22-28 19-25	40 39	25-31 21-27	42 41
Free-Cutting Steels	1020, S1214, S1213, S12L13, S12L14	≤ 850 850 - 1000		●	21-27 16-25	41 40	19-25 18-22	39 38	21-27 16-25	41 40
Unalloyed Heat-Treatable Steels	1035, 1045, 1055, 1060, 1025	≤ 700 700 - 850 850 - 1000		●	25-31 22-28 19-25	41 41 40	22-28 20-26 18-22	39 39 38	25-31 22-28 19-25	41 41 40
Alloyed Heat-Treatable Steels	3140, 4130, 4140, 4150, 4340, 6150, EN16, EN26	850 - 1000 1000 - 1200		●	19-25 15-19	41 39	18-22 13-17	38 37	19-25 15-19	40 39
Unalloyed Case Hardened Steels	1010, 1015	≤ 750		●	25-31	41	22-28	39	25-31	41
Alloyed Case Hardened Steels	3310, 3415, 5115, 4615, 4620, 5120, 8617, 8620, N33, EN36A	850 - 1000 1000 - 1200		●	19-25 15-19	41 40	18-22 13-17	39 38	19-25 15-19	41 40
Nitriding Steels	1.8504 34CrAl6, 1.8519 31CrMoV9, 1.8550 34CrAlNi7	≥ 850 - 1000 1000 - 1200		●	19-25 15-19	41 39	18-22 13-17	39 37	19-25 15-19	41 39
Tool Steels	H11, H13, P20, D2, D3	≤ 850 850 - 1000		●	25-31 9-13	41 39	22-28 9-11	39 37	25-31 9-13	41 39
High Speed Steels	M2, M3, M35, M45	≥ 650 - 1000		●	9-13	40	9-11	38	9-13	40
Spring Steels	5155, 6150, 9255	≤ 330 HB		●			9-11	37		
Stainless Steels, Sulphured Austenitic Martensitic	410S, 430F, 630 302, 303, 304, 310, 316, 316Ti, 321 410, 410X, 416, 420, 420C, 431, 440C	≤ 850 ≤ 850 ≤ 850		●	16-20 11-15 11-15	40 39 40	14-18 10-14 10-14	38 37 38	16-20 11-15 11-15	40 39 40
Hardened Steels	-	≤ 40 - 48 HRC > 48 - 60 HRC		●						
Special Alloys	Nimonic, Inconel, Monel, Hastelloy, Bisalloy	≤ 1200		●			3-5	37		
Cast Iron	GG10, GG15, GG20, GG25, GG30, GG35, GG40	≤ 240 HB < 300 HB		●	18-22	41	16-20 10-14	39 38	18-22	41
Spheroidal Graphite and Malleable Cast Iron	GGG40, GGG50, GGG60, GGG70, 32510, 50005, Nodular Iron	≤ 240 HB < 300 HB		●	18-22	41	16-20 10-14	39 38	18-22	41
Chilled Cast Iron	-	≤ 350 HB		●	9-13	38	9-11	36	9-13	38
Ti and Ti-alloys	3.7024 Ti99.5, 3.7114 TiAl5Sn2.5, 3.7124 TiCu2 3.7154 TiAl6Zr5, 3.7164 TiAl6V4, 3.7184 TiAl4Mo4Sn2.5, -TiAl8Mo 1V1	≤ 850 850 - 1200		●	9-13	39	5-7 125-153	37 36	9-13	39
Al and Ti-alloys	3.0255 Al99.5, 3.2315 AlMgSi1, 3.3515 AlMg1	≤ 400		●	138-170	44	89-109	42	138-170	44
Al Wrought Alloys	3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 AlMg3Si, 3.4365 AlZnMgCu1.5	≤ 450		●	99-121	43	71-87	41	99-121	43
Al Cast Alloys ≤ 10 % Si	3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9	≤ 600		●	79-97	42	36-44	40	79-97	42
> 10 % Si	3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, -GAlSi12CuNiMg	≤ 600		●	39-49	43	53-65	41	39-49	43
Magnesium Alloys	MgMn2, G-MgAl8Zn1, G-MgAl6Zn3	≤ 450		○	59-73	44	49-61	42	59-73	44
Copper, Low-Alloyed	2.0070 SE-Cu, 2.1020 CuSn6, 2.1020 CuSn6, 2.1096 G-CuSn5ZnPb	≤ 400		●	54-68	43	49-61	41	54-68	43
Brass, Short-Chipping Long-Chipping	2.0380 CuZn39Pb2, 2.0401 CuZn39Pb3, 2.0410 CuZn43Pb2 2.0250 CuZn20, 2.0280 CuZn33, 2.0332 CuZn37Pb0.5	≤ 600 ≤ 600		●	54-68 35-43	42 42	31-39 31-39	40 40	54-68 35-43	42 42
Bronze, Short-Chipping	2.1090 CuSn7ZnPb, 2.1170 CuPb5Sn5, 2.1176 CuPb10Sn 2.0790 CuNi18Zn19Pb	≤ 600 > 600 - 850		●	35-43 29-37	42 41	31-39 27-33	40 39	35-43 29-37	42 41
Bronze, Long-Chipping	2.0916 CuAl5, 2.0960 CuAl9Mn, 2.1050 CuSn10 2.0980 CuAl11Ni, 2.1247 CuBe2	≤ 850 850 - 1000		●	29-37 15-19	41 40	27-33 13-17	39 38	29-37 15-19	41 40
Duroplastics Thermoplastics	Bakelit, Resopal, Pertinax, Moltopren Plexiglas, Hostalen, Novodur, Makralon	-		○						
Kevlar Glass, Carbon Concentr. Plastics	Kevlar GFK/CFK	-		○						



MILLING CUTTERS

PMHSS-E		CARBIDE UF		CARBIDE UF		CARBIDE UF		CARBIDE UF		CARBIDE UF		CARBIDE UF		CARBIDE UF		CARBIDE UF		CARBIDE UF		CARBIDE UF	
-	K/P	K	K	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P	K/P
Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring	Guhring
N	W	Ratio	N	NH	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	NRf
F	○	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
3660	3472	5532	3713	6709	5530	5506	3679	3359	3860	3508											
	3473	5735	5556	3897	5549	5573	3043	3853	3863												
	5743	3736				5574	3727	3866													
DIN 844	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527	DIN 6527
4-Flute	2-Flute	4-Flute	4-Flute	5-Flute	2-Flute	3-Flute	2-4 Flute	2-Flute	4-Flute	4-Flute											

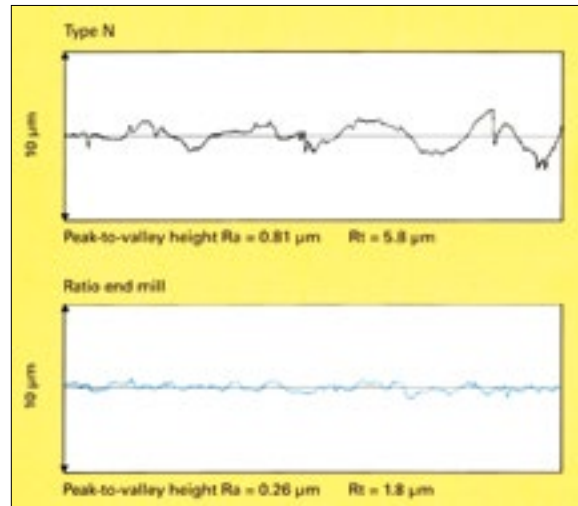
V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.	V_c m/min	Feed col. no.		
82-102	44			170-208	48	110-136	43	171-209	48	85-105	42	94-116	43	97-119	49	97-119	49	97-119	49	97-119	49	97-119	49
74-92	43			157-193	47	102-126	42	157-193	47	81-99	41	89-109	42	90-110	48	90-110	48	90-110	48	90-110	48	90-110	48
74-92	43			170-208	47	110-136	42	171-209	47	85-105	41	94-116	42	97-119	48	97-119	48	97-119	48	97-119	48	97-119	48
67-83	42			126-154	46	81-101	41	126-154	46	63-77	42	69-85	43	72-88	47	72-88	47	72-88	47	72-88	47	72-88	47
82-102	43			170-208	47	110-136	42	171-209	47	85-105	41	94-116	42	97-119	48	97-119	48	97-119	48	97-119	48	97-119	48
74-92	43			151-185	47	98-120	42	153-187	47	76-94	41	84-104	42	86-106	48	86-106	48	86-106	48	86-106	48	86-106	48
67-83	42			126-154	46	81-101	41	126-154	46	63-77	42	69-85	43	72-88	47	72-88	47	72-88	47	72-88	47	72-88	47
67-83	42			151-185	46	98-120	41	153-187	46	76-94	42	84-104	43	86-106	47	86-106	47	86-106	47	86-106	47	86-106	47
53-65	41			126-154	45	81-101	40	126-154	45	63-77	42	69-85	43	72-88	46	72-88	46	72-88	46	72-88	46	72-88	46
82-102	43			189-231	47	123-151	42	189-231	47	91-110	41	99-121	42	108-132	48	108-132	48	108-132	48	108-132	48	108-132	48
67-83	43			151-185	47	98-120	42	153-187	47	76-94	41	84-104	42	86-106	48	86-106	48	86-106	48	86-106	48	86-106	48
53-65	42			113-139	46	73-91	41	117-143	46	54-66	42	59-73	43	64-80	47	64-80	47	64-80	47	64-80	47	64-80	47
67-83	43			170-208	47	110-136	42	171-209	47	85-105	41	94-116	42	97-119	48	97-119	48	97-119	48	97-119	48	97-119	48
53-65	41			151-185	45	98-120	40	153-187	45	76-94	40	84-104	41	86-106	46	86-106	46	86-106	46	86-106	46	86-106	46
82-102	43			151-185	47	98-120	42	153-187	47	76-94	41	84-104	42	86-106	48	86-106	48	86-106	48	86-106	48	86-106	48
37-47	41			126-154	45	81-101	40	126-154	45	63-77	40	69-85	41	72-88	46	72-88	46	72-88	46	72-88	46	72-88	46
37-47	42			94-116	46	61-75	41	94-116	46	45-55	42	49-61	43										
29-37	41			94-116	45			94-116	45	45-55	40	49-61	41										
56-70	42			94-116	46			94-116	46	45-55	42	49-61	43	54-66	47	54-66	47	54-66	47	54-66	47	54-66	47
53-65	41			81-101	45			81-99	45	40-50	40	45-55	41	46-58	46	46-58	46	46-58	46	46-58	46	46-58	46
53-65	42			75-93	46			76-94	46	36-44	41	39-49	42	43-53	47	43-53	47	43-53	47	43-53	47	43-53	47
				44-54	43			49-61	43	45-55	40	49-61	41	25-31	44	25-31	44	25-31	44	25-31	44	25-31	44
														18-22	41	18-22	41	18-22	41	18-22	41	18-22	41
12-16	41			56-70	45			54-66	45	27-33	40	29-37	41	32-40	46	32-40	46	32-40	46	32-40	46	32-40	46
	43			220-270	47	143-175	42	220-270	47	108-132	41	118-146	42	126-154	48	126-154	48	126-154	48	126-154	48	126-154	48
	42			201-247	46	131-161	41	202-248	46	99-121	40	108-134	41	115-141	47	115-141	47	115-141	47	115-141	47	115-141	47
67-83	43			182-224	47	118-146	42	180-220	47	90-110	41	99-121	42	104-128	48	104-128	48	104-128	48	104-128	48	104-128	48
56-70	42			157-193	46	102-126	41	157-193	46	81-99	40	89-109	41	90-110	47	90-110	47	90-110	47	90-110	47	90-110	47
	40			107-131	44	69-85				54-66	40	59-73	41										
32-40	41			94-116	45	61-75	40	94-116	45	45-55	40	49-61	41	54-66	46	54-66	46	54-66	46	54-66	46	54-66	46
15-18	40			75-93	44	49-61	39	76-94	44	36-44	40	39-49	41	43-53	45	43-53	45	43-53	45	43-53	45	43-53	45
		297-363	46	319-1001	50	532-652	45	810-990	50	405-495	43	445-545	44										
		360-440	46	1008-1232	49	655-801	44	720-880	50	495-605	43	544-666	44										
		144-176	45	403-493	48	261-321	43	405-495	48	198-242	42	217-267	43										
		117-143	46	315-385	49	205-251	44	324-396	49	162-198	43	178-218	44										
		171-209	47	466-570	50	303-371	45	450-550	50	225-275	44	247-303	45										
		81-99	46	214-262	49	139-171	44	216-264	49	108-132	43	117-146	44										
		72-88	46	201-247	48	131-161	43	198-242	48	90-110	43	99-121	44										
		67-83	45	163-201	48	106-130	43	162-198	48	81-99	42	89-109	43										
		72-88	46	201-247	48	131-161	43	198-242	48	90-110	42	99-121	43										
		63-77	45	151-185	47	98-120		153-187	47	72-88	41	79-97	42										
		63-77	45	151-185	47			153-187	47	72-88	42	79-97	43										
		54-66	43	126-154	46			126-154	46	63-77	40	69-85	41										
		81-99	43	214-262	46			216-264	46	108-132	40	118-146	41										
		72-88	43	201-247	46			198-242	46	99-121	40	108-134	41										



We have developed the Ratio end mill with uneven spiral angle primarily to prevent chattering and the so-called corkscrew effect (as found when withdrawing tools having a large spiral angle)

However, the uneven spiral angle does not only combat these two unwanted effects but offers the following additional advantages:

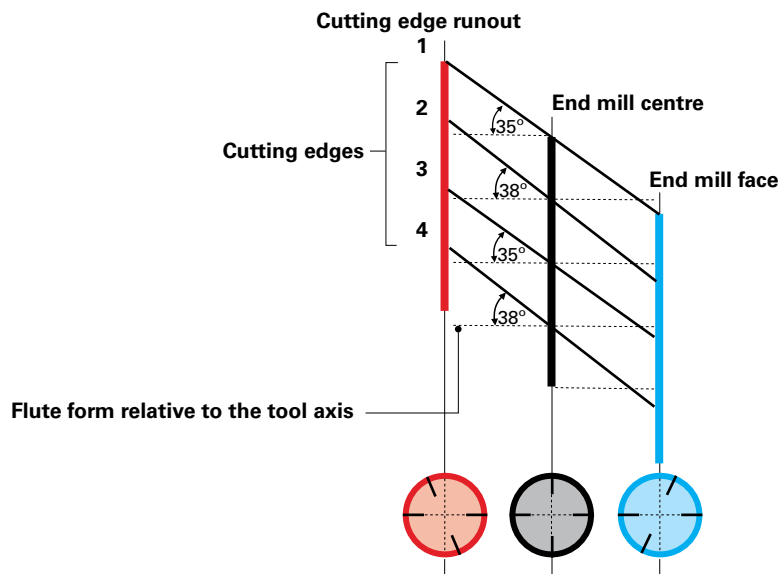
- Up to 60% higher in feed rates
- Longer tool life
- Increased drilling depths
- Vibration-free machining
- Suitable for roughing and finishing
- Increased surface quality
- Reduced wander of cutting



A hole surface quality comparison between a conventional end mill type N and a Ratio end mill clearly shows the Ratio end mill's quieter and more stable machining characteristics.

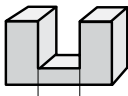



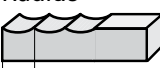

Uneven spiral angle for high rigidity

Guhring's Ratio end mills offer a very simple, but highly efficient solution in order to provide optimal rigidity during the machining process. The cutting edges possess different spiral angles. Subsequently, Ratio end mills have an uneven cutting edge spacing that effectively suppresses the regenerative effect.



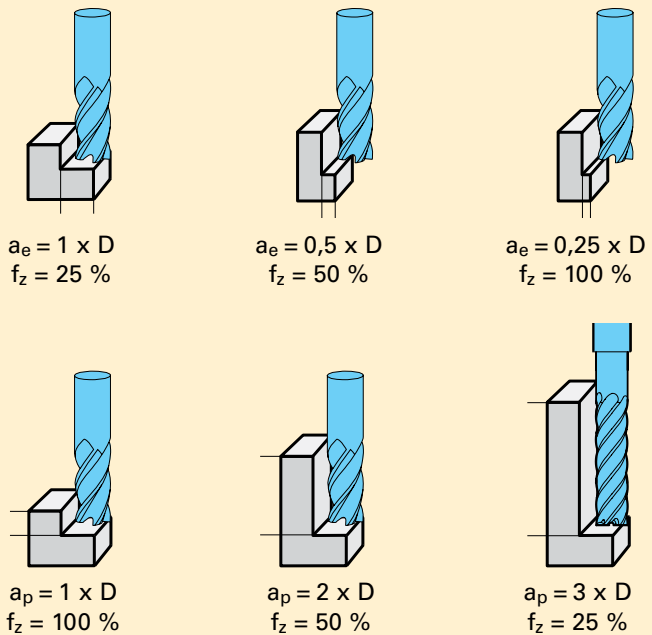
In contrast to the heavy chattering characteristics displayed by a tool with an even cutting edge spacing, the milling process with a Ratio end mill from Guhring is chatter-free resulting in an improved workpiece surface quality as well as an increased profile accuracy and an improved tool life

- Bright
- Steam Tempered
- Nitrided Lands
- S-Coated (TiN)
- A-Coated (TiAlN)
- C-Coated (TiCN)
- F-Coated (FIRE)

Application	Width of cut
Slot Milling Operations Milling of slots or keyways, ramp milling or plunging.	 $1 \times D$
Roughing Operations Removing material in large cuts, pocket milling including ramping.	 $0.5 - 1 \times D$
Finishing Operations Side milling with smaller cutting width but better workpiece surface quality.	 $0.1 - 0.2 \times D$
Fine Finishing Operations Side milling with yet smaller cutting width but yet better workpiece surface quality.	 $0,02 - 0,05 \times D$
Trace Milling Operations Tracing or 3D copying with extremely small cutting width or depth.	Radius  $0.02 - 0.05 \times D$ Torus  $\frac{D-2 \times R}{2}$

Feed rate adjustment: Modifying the cutting depth and width

- ▶ when modifying the cutting depth a_p , the feed rate must be reduced in accordance with the illustration on the right
- ▶ cutting speed or revolutions remain unchanged up to cutting depths of $3 \times D$, must only be adapted over $3 \times D$
- ▶ double reduction applies when also modifying the cutting width a_e !



Plunging strategies for drilling:

- ▶ reduce feed rate v_f (mm/min.)
- Attention: Danger of breakage through abrupt load increase!

Oblique plunging up to 15° (preferred):

- ▶ reduction in feed rate v_f (mm/min.) not required

Oblique plunging between 15° and 30°:

- ▶ reduce feed rate v_f (mm/min.)

Helical plunging:

- ▶ feed 0.1 to 0.2 per cycle
- ▶ reduce feed rate v_f (mm/min.)
- ▶ hole diameter $1.8 \times D$

