

GUHRING

RF 100
diver

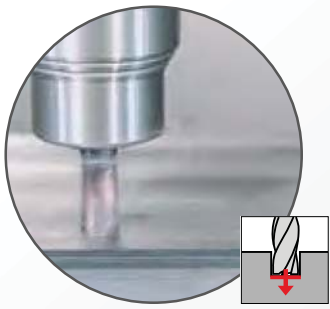


Drilling
Ramping
Roughing
Finishing
Slotting

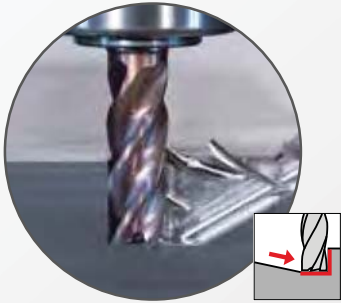
NEW

**EXTENDED PROGRAM
AND INTERNAL COOLING**

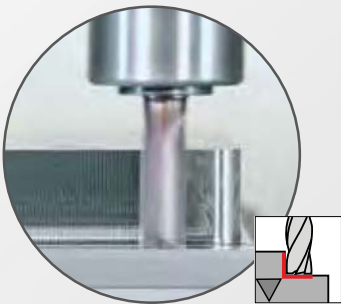




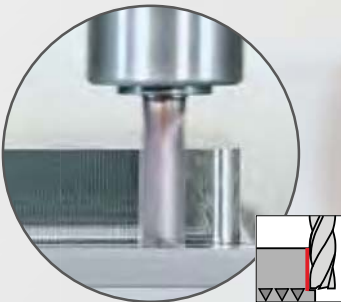
Drilling



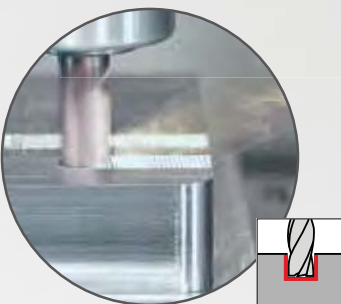
Ramping



Roughing



Finishing



Slotting

Universally applicable for **all materials and milling strategies** for outstanding performance and tool life

- » special face geometry for drilling and ramping
- » optimized flute space
- » cutting edge preparation
- » nano-SiTM coating
- » with neck clearance
- » 4-fluted and 3-fluted option NEW
- » short length, 4-flute series NEW
- » with and without internal cooling NEW



RF100
diver
END MILLS

RF 100
diver
END MILLS

NEW

from

GUHRING

Extended program and coolant through end mills



Drilling and milling optimized coolant ducts

Traditionally, drills have axial coolant ducts and milling cutters have radial coolant ducts. The coolant through RF 100 Diver offers **both** in order to optimize cooling and protection to the face and diameter when plunging. Guhring's decades of expertise in carbide production as well as tooling optimization ensures maximum efficiency of coolant lubrication, chip evacuation and tool stability.

- ▶ up to 40 % longer tool life
- ▶ for sticky materials
- ▶ stainless and heat-resistant materials
- ▶ for process reliability in drilling & plunging
- ▶ HPC machining

Choose the optimal Diver end mill for your application:

3-fluted

- ▶ for less powerful machines & less stable clamping conditions
- ▶ for turning machines & driven tools
- ▶ specially for slotting with smaller milling cutter diameters
- ▶ with and without coolant through

4-fluted

- ▶ for stable machines & clamping
- ▶ high-performance milling with maximum cutting speeds
- ▶ with and without coolant through

4-fluted, short

- ▶ for more stability when slotting
- ▶ up to 25 % higher feed rate
- ▶ reduced deflection
- ▶ without coolant through

4-fluted, corner radii

- ▶ for pocketing and slotting
- ▶ multiple radii per diameter
- ▶ up to 25 % higher feed rate
- ▶ without coolant through

**3-Flute - Inch - Standard Length****center cutting**

Standard



No. Flutes



Helix angle



Chamfer



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



HA



HB

Tool material

Solid Carbide

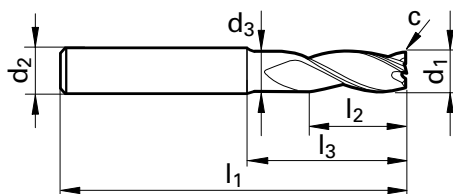
Surface finish

nano-Si®

Series

6872

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	d3	l1	l2	l3	c	No. of Flutes	Code no.	EDP Number
inch	inch	inch	inch	inch	inch	inch x 45°			
1/8	1/8	0.117	2	1/4	3/4	0.002	3	3.170	9068720031700
3/16	3/16	0.180	2	3/8	3/4	0.003	3	4.760	9068720047600
1/4	1/4	0.238	2 1/2	1/2	7/8	0.004	3	6.350	9068720063500
5/16	5/16	0.300	2 1/2	1/2	7/8	0.005	3	7.940	9068720079400
3/8	3/8	0.363	2 1/2	5/8	7/8	0.006	3	9.520	9068720095200
1/2	1/2	0.480	3	5/8	1 1/8	0.007	3	12.700	9068720127000
5/8	5/8	0.605	3 1/2	3/4	1 1/2	0.007	3	15.870	9068720158700
3/4	3/4	0.730	4	1	1 3/4	0.009	3	19.050	9068720190500
1	1	0.960	4	1	1 5/8	0.011	3	25.400	9068720254000



3-Flute - Metric - Standard Length



center cutting



Standard



No. Flutes



Helix angle



Chamfer



Flute Angle



Slotting



Roughing



Ramping



Helix



Plunging



HA



HB

Tool material

Solid Carbide

Surface finish

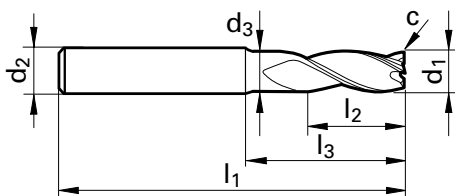
nano-Si®

Series

6797

6798

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	d3	l1	l2	l3	c	No. of Flutes	Code no.	EDP Number	
mm	mm	mm	mm	mm	mm	mm x 45°				
3.00	6.00	2.80	57	8.0	15.0	0.05	3	3.000	9067970030000	9067980030000
3.50	6.00	3.30	57	10.0	15.0	0.05	3	3.500	9067970035000	9067980035000
3.70	6.00	3.50	57	11.0	15.0	0.06	3	3.700	9067970037000	9067980037000
4.00	6.00	3.80	57	11.0	18.0	0.06	3	4.000	9067970040000	9067980040000
4.50	6.00	4.30	57	11.0	18.0	0.07	3	4.500	9067970045000	9067980045000
4.70	6.00	4.50	57	13.0	18.0	0.07	3	4.700	9067970047000	9067980047000
5.00	6.00	4.80	57	13.0	18.0	0.08	3	5.000	9067970050000	9067980050000
5.50	6.00	5.30	57	13.0	19.4	0.08	3	5.500	9067970055000	9067980055000
5.70	6.00	5.50	57	13.0	19.6	0.09	3	5.700	9067970057000	9067980057000
6.00	6.00	5.70	57	13.0	20.0	0.09	3	6.000	9067970060000	9067980060000
6.50	8.00	6.20	63	16.0	24.4	0.10	3	6.500	9067970065000	9067980065000
7.00	8.00	6.70	63	16.0	24.9	0.11	3	7.000	9067970070000	9067980070000
7.50	8.00	7.20	63	19.0	25.3	0.11	3	7.500	9067970075000	9067980075000
8.00	8.00	7.70	63	19.0	26.0	0.12	3	8.000	9067970080000	9067980080000
8.50	10.00	8.20	72	19.0	29.4	0.13	3	8.500	9067970085000	9067980085000
9.00	10.00	8.70	72	19.0	29.9	0.14	3	9.000	9067970090000	9067980090000
9.50	10.00	9.20	72	22.0	30.3	0.14	3	9.500	9067970095000	9067980095000
10.00	10.00	9.50	72	22.0	30.0	0.15	3	10.000	9067970100000	9067980100000
12.00	12.00	11.50	83	26.0	36.0	0.18	3	12.000	9067970120000	9067980120000
16.00	16.00	15.50	92	32.0	42.0	0.19	3	16.000	9067970160000	9067980160000
20.00	20.00	19.50	104	38.0	52.0	0.24	3	20.000	9067970200000	9067980200000

**3-Flute - Inch - Standard Length****center cutting - with coolant through**

Standard



No. Flutes



Helix angle



Chamfer



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



HA



HB

Tool material

Solid Carbide

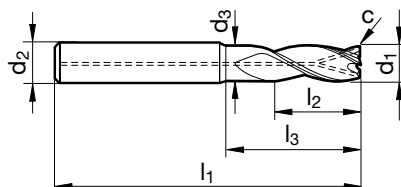
Surface finish

nano-Si®

Series

6873

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	d3	l1	l2	l3	c	No. of Flutes	Code no.	EDP Number
inch	inch	inch	inch	inch	inch	inch x 45°			
1/4	1/4	0.238	2 1/2	1/2	7/8	0.004	3	6.350	9068730063500
5/16	5/16	0.300	2 1/2	1/2	7/8	0.005	3	7.940	9068730079400
3/8	3/8	0.363	2 1/2	5/8	7/8	0.006	3	9.520	9068730095200
1/2	1/2	0.480	3	5/8	1 1/8	0.007	3	12.700	9068730127000
5/8	5/8	0.605	3 1/2	3/4	1 1/2	0.007	3	15.870	9068730158700
3/4	3/4	0.730	4	1	1 3/4	0.009	3	19.050	9068730190500



3-Flute - Metric - Standard Length



center cutting - with coolant through



Standard



No. Flutes



Helix angle



Chamfer



Flake Angle



Slotting



Roughing



Ramping



Helix



Plunging



HA



HB

Tool material

Solid Carbide

Surface finish

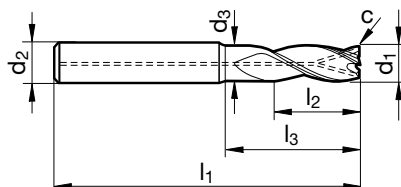
nano-Si®

Series

6799

6800

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	d3	l1	l2	l3	c	No. of Flutes	Code no.	EDP Number	
mm	mm	mm	mm	mm	mm	mm x 45°				
6.00	6.00	5.70	57	13.0	20.0	0.09	3	6.000	9067990060000	9068000060000
8.00	8.00	7.70	63	19.0	26.0	0.12	3	8.000	9067990080000	9068000080000
10.00	10.00	9.50	72	22.0	30.0	0.15	3	10.000	9067990100000	9068000100000
12.00	12.00	11.50	83	26.0	36.0	0.18	3	12.000	9067990120000	9068000120000
16.00	16.00	15.50	92	32.0	42.0	0.19	3	16.000	9067990160000	9068000160000



4-Flute - Inch - Short Length



center cutting



Stub



No. Flutes



Helix Angle



Chamfer



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



Finishing



HA



HB

Tool material

Surface finish

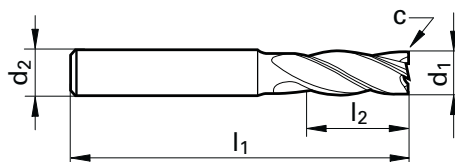
Solid Carbide

nano-Si®

Series

6874

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	l1	l2	c	No. of Flutes	Code no.	EDP Number
inch	inch	inch	inch	inch x 45°			
1/4	1/4	2	1/2	0.002	4	6.350	9068740063500
5/16	5/16	2	1/2	0.003	4	7.940	9068740079400
3/8	3/8	2	5/8	0.004	4	9.520	9068740095200
7/16	7/16	2 1/2	5/8	0.004	4	11.110	9068740111100
1/2	1/2	2 1/2	5/8	0.005	4	12.700	9068740127000
5/8	5/8	3	3/4	0.006	4	15.870	9068740158700
3/4	3/4	3	1	0.007	4	19.050	9068740190500



4-Flute - Metric - Short Length



center cutting



Stub



No. Flutes



Helix Angle



Chamfer



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



Finishing



HA



HB

Tool material

Solid Carbide

Surface finish

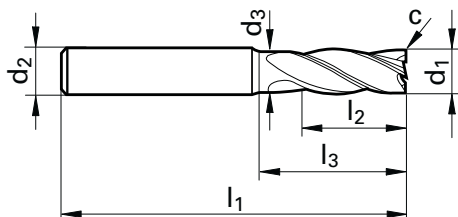
nano-Si®

Series

6803

6804

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	d3	l1	l2	l3	c	No. of Flutes	Code no.	EDP Number	
mm	mm	mm	mm	mm	mm	mm x 45°				
3.00	6.00	2.80	50	5.0	12.0	0.03	4	3.000	9068030030000	9068040030000
3.70	6.00	3.50	54	8.0	12.0	0.04	4	3.700	9068030037000	9068040037000
4.00	6.00	3.80	54	8.0	15.0	0.04	4	4.000	9068030040000	9068040040000
4.70	6.00	4.50	54	9.0	15.0	0.05	4	4.700	9068030047000	9068040047000
5.00	6.00	4.80	54	9.0	15.0	0.05	4	5.000	9068030050000	9068040050000
5.70	6.00	5.50	54	10.0	16.6	0.06	4	5.700	9068030057000	9068040057000
6.00	6.00	5.70	54	10.0	17.0	0.06	4	6.000	9068030060000	9068040060000
7.00	8.00	6.70	58	11.0	19.9	0.07	4	7.000	9068030070000	9068040070000
7.70	8.00	7.40	58	12.0	20.5	0.08	4	7.700	9068030077000	9068040077000
8.00	8.00	7.70	58	12.0	21.0	0.08	4	8.000	9068030080000	9068040080000
9.00	10.00	8.70	66	13.0	23.9	0.09	4	9.000	9068030090000	9068040090000
9.70	10.00	9.40	66	14.0	24.5	0.10	4	9.700	9068030097000	9068040097000
10.00	10.00	9.50	66	14.0	24.0	0.10	4	10.000	9068030100000	9068040100000
11.70	12.00	11.20	73	16.0	25.3	0.12	4	11.700	9068030117000	9068040117000
12.00	12.00	11.50	73	16.0	26.0	0.12	4	12.000	9068030120000	9068040120000
15.60	16.00	15.10	82	22.0	31.2	0.16	4	15.600	9068030156000	9068040156000
16.00	16.00	15.50	82	22.0	32.0	0.16	4	16.000	9068030160000	9068040160000
19.00	20.00	18.50	92	26.0	38.7	0.19	4	19.000	9068030190000	9068040190000
20.00	20.00	19.50	92	26.0	40.0	0.20	4	20.000	9068030200000	9068040200000



4-Flute - Inch - Standard Length



center cutting



Standard



No. Flutes



Helix Angle



Chamfer



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



Finishing



HA



HB

Tool material

Solid Carbide

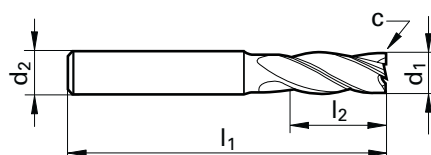
Surface finish

nano-Si®

Series

6757

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	l1	l2	c	No. of Flutes	Code no.	EDP Number
inch	inch	inch	inch	inch x 45°			
1/8	1/8	1 1/2	1/4	0.001	4	3.170	9067570031700
3/16	3/16	2	3/8	0.002	4	4.760	9067570047600
1/4	1/4	2 1/2	1/2	0.002	4	6.350	9067570063500
5/16	5/16	2 1/2	3/4	0.003	4	7.940	9067570079400
3/8	3/8	2 1/2	7/8	0.004	4	9.520	9067570095200
7/16	7/16	2 3/4	7/8	0.004	4	11.110	9067570111100
1/2	1/2	3 1/2	1	0.005	4	12.700	9067570127000
5/8	5/8	3 1/2	1 1/4	0.006	4	15.870	9067570158700
3/4	3/4	4	1 1/2	0.007	4	19.050	9067570190500
1	1	5	1 1/2	0.010	4	25.400	9067570254000



4-Flute - Metric - Standard Length



center cutting



Standard



No. Flutes



Helix Angle



Chamfer



Flute Angle



Slotting



Roughing



Ramping



Helix



Plunging



Finishing



HA



HB

Tool material

Surface finish

Solid Carbide

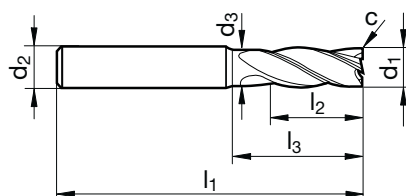
nano-Si®

Series

6737

6736

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	d3	l1	l2	l3	c	No. of Flutes	Code no.	EDP Number	
mm	mm	mm	mm	mm	mm	mm x 45°				
4.000	6.000	3.800	57.00	11.00	18.00	0.04	4	4.000	9067370040000	9067360040000
5.000	6.000	4.800	57.00	13.00	18.00	0.05	4	5.000	9067370050000	9067360050000
5.700	6.000	5.500	57.00	13.00	20.00	0.06	4	5.700	9067370057000	9067360057000
6.000	6.000	5.700	57.00	13.00	20.00	0.06	4	6.000	9067370060000	9067360060000
7.700	8.000	7.400	63.00	19.00	26.00	0.08	4	7.700	9067370077000	9067360077000
8.000	8.000	7.700	63.00	19.00	26.00	0.08	4	8.000	9067370080000	9067360080000
9.700	10.000	9.400	72.00	22.00	30.00	0.10	4	9.700	9067370097000	9067360097000
10.000	10.000	9.500	72.00	22.00	30.00	0.10	4	10.000	9067370100000	9067360100000
11.700	12.000	11.200	83.00	26.00	36.00	0.12	4	11.700	9067370117000	9067360117000
12.000	12.000	11.500	83.00	26.00	36.00	0.12	4	12.000	9067370120000	9067360120000
13.700	14.000	13.200	83.00	26.00	36.00	0.14	4	13.700	9067370137000	9067360137000
14.000	14.000	13.500	83.00	26.00	36.00	0.14	4	14.000	9067370140000	9067360140000
15.600	16.000	15.100	92.00	32.00	42.00	0.16	4	15.600	9067370156000	9067360156000
16.000	16.000	15.500	92.00	32.00	42.00	0.16	4	16.000	9067370160000	9067360160000
19.500	20.000	19.000	104.00	38.00	52.00	0.20	4	19.500	9067370195000	9067360195000
20.000	20.000	19.500	104.00	38.00	52.00	0.20	4	20.000	9067370200000	9067360200000



4-Flute - Inch - Standard Length



center cutting - with corner radius options



Standard



No. Flutes



Helix Angle



Radius



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



Finishing



HA



HB

Tool material

Solid Carbide

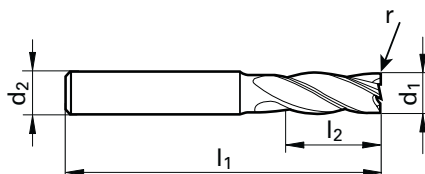
Surface finish

nano-Si®

Series

6759

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	l1	l2	corner	No. of Flutes	Code no.	EDP Number
inch	inch	inch	inch	radius			
1/8	1/8	1 1/2	1/4	0.015	4	3.172	9067590031720
1/8	1/8	1 1/2	1/4	0.031	4	3.174	9067590031740
3/16	3/16	2	3/8	0.015	4	4.762	9067590047620
3/16	3/16	2	3/8	0.031	4	4.764	9067590047640
1/4	1/4	2 1/2	1/2	0.015	4	6.352	9067590063520
1/4	1/4	2 1/2	1/2	0.031	4	6.354	9067590063540
1/4	1/4	2 1/2	1/2	0.062	4	6.356	9067590063560
5/16	5/16	2 1/2	3/4	0.015	4	7.942	9067590079420
5/16	5/16	2 1/2	3/4	0.031	4	7.944	9067590079440
5/16	5/16	2 1/2	3/4	0.062	4	7.946	9067590079460
3/8	3/8	2 1/2	7/8	0.015	4	9.522	9067590095220
3/8	3/8	2 1/2	7/8	0.031	4	9.524	9067590095240
3/8	3/8	2 1/2	7/8	0.062	4	9.526	9067590095260
3/8	3/8	2 1/2	7/8	0.090	4	9.527	9067590095270
1/2	1/2	3 1/2	1	0.015	4	12.702	9067590127020
1/2	1/2	3 1/2	1	0.031	4	12.704	9067590127040
1/2	1/2	3 1/2	1	0.062	4	12.706	9067590127060
1/2	1/2	3 1/2	1	0.090	4	12.707	9067590127070
1/2	1/2	3 1/2	1	0.125	4	12.709	9067590127090
5/8	5/8	3 1/2	1 1/4	0.031	4	15.874	9067590158740
5/8	5/8	3 1/2	1 1/4	0.062	4	15.876	9067590158760
5/8	5/8	3 1/2	1 1/4	0.090	4	15.877	9067590158770
5/8	5/8	3 1/2	1 1/4	0.125	4	15.879	9067590158790
3/4	3/4	4	1 1/2	0.031	4	19.054	9067590190540
3/4	3/4	4	1 1/2	0.062	4	19.056	9067590190560
3/4	3/4	4	1 1/2	0.090	4	19.057	9067590190570
3/4	3/4	4	1 1/2	0.125	4	19.059	9067590190590
3/4	3/4	4	1 1/2	0.190	4	19.050	9067590190500
3/4	3/4	4	1 1/2	0.250	4	19.051	9067590190510
1	1	5	1 1/2	0.031	4	25.404	9067590254040
1	1	5	1 1/2	0.062	4	25.406	9067590254060
1	1	5	1 1/2	0.090	4	25.407	9067590254070
1	1	5	1 1/2	0.125	4	25.409	9067590254090
1	1	5	1 1/2	0.190	4	25.400	9067590254000
1	1	5	1 1/2	0.250	4	25.401	9067590254010



4-Flute - Inch - Standard Length



center cutting - with coolant through



Standard



No. Flutes



Helix Angle



Chamfer



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



Finishing



HA



HB

Tool material

Solid Carbide

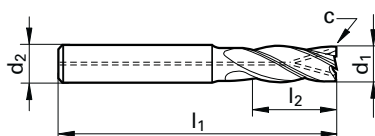
Surface finish

nano-Si®

Series

6875

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		



d1 h10	d2 h6	l1	l2	c	No. of Flutes	Code no.	EDP Number
inch	inch	inch	inch	inch x 45°			
1/4	1/4	2 1/2	1/2	0.002	4	6.350	9068750063500
5/16	5/16	2 1/2	3/4	0.003	4	7.940	9068750079400
3/8	3/8	2 1/2	7/8	0.004	4	9.520	9068750095200
1/2	1/2	3 1/2	1	0.005	4	12.700	9068750127000
5/8	5/8	3 1/2	1 1/4	0.006	4	15.870	9068750158700
3/4	3/4	4	1 1/2	0.007	4	19.050	9068750190500

**4-Flute - Metric - Standard Length****center cutting - with coolant through**

Standard



No. Flutes



Helix Angle



Chamfer



Rake Angle



Slotting



Roughing



Ramping



Helix



Plunging



Finishing



HA



HB

Tool material

Surface finish

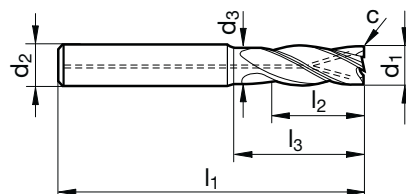
Solid Carbide

nano-Si®

Series

6801**6802**

Application group	Material examples	Ideal for
P	Steel	●
M	Stainless steel	●
K	Cast iron	●
N	Aluminum	○
S	Ni / Ti alloys	●
H	Hardened steel	—
●=Optimal ○=Secondary		

**NEW****NEW**

d1 h10	d2 h6	d3	l1	l2	l3	c	No. of Flutes	Code no.	EDP Number	
mm	mm	mm	mm	mm	mm	mm x 45°				
6.00	6.00	5.70	57	13.0	20.0	0.06	4	6.000	9068010060000	9068020060000
8.00	8.00	7.70	63	19.0	26.0	0.08	4	8.000	9068010080000	9068020080000
10.00	10.00	9.50	72	22.0	30.0	0.10	4	10.000	9068010100000	9068020100000
12.00	12.00	11.50	83	26.0	36.0	0.12	4	12.000	9068010120000	9068020120000
16.00	16.00	15.50	92	32.0	42.0	0.16	4	16.000	9068010160000	9068020160000
20.00	20.00	19.50	104	38.0	52.0	0.20	4	20.000	9068010200000	9068020200000
25.00	25.00	24.00	121	45.0	63.0	0.25	4	25.000	9068010250000	9068020250000



Plunging Strategies - Milling cutters with special Diver face geometry

Simple Ramp



Ramp angle = $15^\circ - 45^\circ$ with max depth $1 \times D$

Pendulum



Ramp angle = $10^\circ - 20^\circ$ with max depth $1 \times D$

Helical



Feed = $0.10 - 0.30 \times D$ per revolution
Diameter of interpolation should be at least $= 1.7 \times D$

Plunge milling

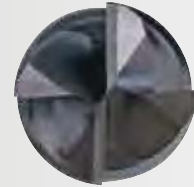


Max radial engagement = $0.25 \times D$
Alternative for problems caused by excessive radial forces

Drilling/Piloting



Pecking cycles required for drilling depths over $1 \times D$



Tool Cooling

Steel



Cast



Machine Dry, Air Blast:

Hard



- Avoid Thermal Shock
- Heat is transferred to the chip
- Air blast to assist in chip evacuation

Stainless



Ti/HTA



Emulsion, Oil:

- Provide cooling to the cutting edge
- Prevention of built up edge
- Aid in chip evacuation

Non-Ferrous



Emulsion, MMS:

- Prevention of built up edge
- Aid in chip evacuation

Exceptions for material ranges



As a general Rule

If it is not possible to avoid the use of coolant, the cutting speed and radial engagement should be reduced compared with dry machining. This will result in lower cutting temperatures and the risk of thermal shock will be decreased.

Chip evacuation: Coolant should be used in applications where chip evacuation is not possible. Recutting chips will lead to accelerated tool wear and breakage

Finishing: The application of coolant is principally an advantage as a better surface finish can be achieved.

Very long tools: Coolant can result in a smoother process, as the lubricant has a vibration-reducing effect.

Alignment of coolant

- as accurate as possible in the cutting area from at least three directions
- no flushing back of small chips to the cutting area

Peripheral cooling / Guhrojet

Best external option: Optimal tool cooling and chip evacuation thanks to the direct route from coolant exit to cutting area



**SLOTING**

	Material	Hardness	Cutting depth (a_p)	Cutting width (a_e)	SFM	Feed Rate Inch per Tooth - IPT d1 End Mill Diameter						
						1/8	1/4	5/16	3/8	1/2	5/8	3/4
P	Struct./free-cutting steels, unall. heat-treat./case hard. steels	up to 28 HRc	1 x D	1xd	890	.0005	.0010	.0013	.0019	.0025	.0031	.0038
	Free-cutting steels, unalloyed case hard. steels, nitr. steels	28 - 38 HRc	1 x D	1xd	750	.0005	.0010	.0013	.0019	.0025	.0031	.0038
	Alloyed heat-treatable, tool and high speed steels	28 - 44 HRc	1 x D	1xd	590	.0004	.0009	.0011	.0017	.0023	.0028	.0034
M	Stainless steel - easy to machine / sulphured	up to 20 HRc	1 x D	1xd	390	.0004	.0009	.0011	.0017	.0023	.0028	.0034
	Stainless steel - moderately difficult to machine	20 - 30 HRc	1 x D	1xd	260	.0004	.0008	.0010	.0015	.0020	.0025	.0030
S	Titanium, Titanium alloys	up to 44 HRc	1 x D	1xd	200	.0004	.0008	.0010	.0015	.0020	.0025	.0030
K	Cast iron, grey cast iron, spher. graphite/malleable cast iron	over 240 HB 30	1 x D	1xd	490	.0005	.0010	.0013	.0019	.0025	.0031	.0038
N	Aluminum, Al-wrought alloys, Al-alloys	up to 7% Si	1 x D	1xd	1640	.0007	.0014	.0017	.0024	.0033	.0041	.0049
	Aluminum-cast alloys	over 7% Si	1 x D	1xd	1120	.0006	.0011	.0014	.0021	.0028	.0034	.0041

HIGH-VOLUME ROUGHING

	Material	Hardness	Cutting depth (a_p)	Cutting width (a_e)	SFM	Feed Rate Inch per Tooth - IPT d1 End Mill Diameter						
						1/8	1/4	5/16	3/8	1/2	5/8	3/4
P	Struct./free-cutting steels, unall. heat-treat./case hard. steels	up to 28 HRc	1.5 x D	0.40 x D	1150	.0007	.0013	.0016	.0024	.0031	.0039	.0047
	Free-cutting steels, unalloyed case hard. steels, nitr. steels	28 - 38 HRc	1.5 x D	0.40 x D	950	.0007	.0013	.0016	.0024	.0031	.0039	.0047
	Alloyed heat-treatable, tool and high speed steels	28 - 44 HRc	1.5 x D	0.33 x D	850	.0006	.0011	.0014	.0022	.0029	.0037	.0044
M	Stainless steel - easy to machine / sulphured	up to 20 HRc	1.5 x D	0.33 x D	525	.0006	.0011	.0014	.0022	.0029	.0037	.0044
	Stainless steel - moderately difficult to machine	20 - 30 HRc	1.5 x D	0.25 x D	390	.0006	.0012	.0015	.0023	.0030	.0038	.0045
S	Titanium, Titanium alloys	up to 44 HRc	1.5 x D	0.33 x D	360	.0005	.0010	.0013	.0020	.0026	.0032	.0039
K	Cast iron, grey cast iron, spher. graphite/malleable cast iron	over 240 HB 30	1.5 x D	0.40 x D	620	.0007	.0013	.0016	.0024	.0031	.0039	.0047
N	Aluminum, Al-wrought alloys, Al-alloys	up to 7% Si	1.5 x D	0.40 x D	1976	.0009	.0017	.0021	.0030	.0041	.0051	.0061
	Aluminum-cast alloys	over 7% Si	1.5 x D	0.40 x D	1440	.0007	.0014	.0018	.0026	.0035	.0043	.0052

HIGH-SPEED FINISHING

	Material	Hardness	Cutting depth (a_p)	Cutting width (a_e)	SFM	Feed Rate Inch per Tooth - IPT d1 End Mill Diameter						
						1/8	1/4	5/16	3/8	1/2	5/8	3/4
P	Struct./free-cutting steels, unall. heat-treat./case hard. steels	up to 28 HRc	2 x D	0.02 x D	1776	.0006	.0012	.0014	.0021	.0028	.0034	.0041
	Free-cutting steels, unalloyed case hard. steels, nitr. steels	28 - 38 HRc	2 x D	0.02 x D	1500	.0006	.0012	.0014	.0021	.0028	.0034	.0041
	Alloyed heat-treatable, tool and high speed steels	28 - 44 HRc	2 x D	0.02 x D	1150	.0005	.0010	.0012	.0019	.0025	.0031	.0037
M	Stainless steel - easy to machine / sulphured	up to 20 HRc	2 x D	0.02 x D	720	.0005	.0010	.0012	.0019	.0025	.0031	.0037
	Stainless steel - moderately difficult to machine	20 - 30 HRc	2 x D	0.02 x D	525	.0005	.0009	.0011	.0017	.0022	.0027	.0033
S	Titanium, Titanium alloys	up to 44 HRc	2 x D	0.02 x D	430	.0005	.0009	.0011	.0017	.0022	.0027	.0033
K	Cast iron, grey cast iron, spher. graphite/malleable cast iron	over 240 HB 30	2 x D	0.02 x D	980	.0006	.0012	.0014	.0021	.0028	.0034	.0041
N	Aluminum, Al-wrought alloys, Al-alloys	up to 7% Si	2 x D	0.02 x D	3280	.0008	.0015	.0019	.0027	.0036	.0045	.0054
	Aluminum-cast alloys	over 7% Si	2 x D	0.02 x D	2230	.0006	.0013	.0016	.0023	.0030	.0038	.0045

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RAMPING - HELICAL INTERPOLATION

	Material	Hardness	Ramping depth* (DOC max.)	Ramping* max. angle in °	SFM	Feed Rate Inch per Tooth - IPT d1 End Mill Diameter						
						1/8	1/4	5/16	3/8	1/2	5/8	3/4
P	Struct./free-cutting steels, unall. heat-treat./case hard. steels	up to 28 HRc	1 x D	45°	890	.0005	.0010	.0012	.0017	.0023	.0028	.0034
	Free-cutting steels, unalloyed case hard. steels, nitr. steels	28 - 38 HRc	1 x D	45°	762	.0004	.0008	.0010	.0015	.0020	.0025	.0030
	Alloyed heat-treatable, tool and high speed steels	28 - 44 HRc	1 x D	30°	590	.0003	.0007	.0009	.0011	.0015	.0019	.0023
M	Stainless steel - easy to machine / sulphured	up to 20 HRc	1 x D	10°	390	.0003	.0006	.0007	.0011	.0015	.0019	.0023
	Stainless steel - moderately difficult to machine	20 - 30 HRc	0.5 x D	5°	260	.0002	.0005	.0005	.0009	.0013	.0016	.0019
S	Titanium, Titanium alloys	up to 44 HRc	0.5 x D	10°	200	.0002	.0005	.0005	.0009	.0013	.0016	.0019
K	Cast iron, grey cast iron, spher. graphite/malleable cast iron	over 240 HB 30	1 x D	45°	490	.0005	.0010	.0012	.0017	.0023	.0028	.0034
N	Aluminum, Al-wrought alloys, Al-alloys	up to 7% Si	1 x D	30°	1640	.0004	.0008	.0010	.0015	.0020	.0025	.0030
	Aluminum-cast alloys	over 7% Si	1 x D	45°	1120	.0005	.0010	.0012	.0017	.0023	.0028	.0034

DRILLING

	Material	Hardness	Drilling depth** (a _p max.)	SFM	Feed Rate Inch per Tooth - IPT d1 End Mill Diameter						
					1/8	1/4	5/16	3/8	1/2	5/8	3/4
P	Struct./free-cutting steels, unall. heat-treat./case hard. steels	up to 28 HRc	2 x D	890	.0005	.0009	.0011	.0015	.0020	.0025	.0030
	Free-cutting steels, unalloyed case hard. steels, nitr. steels	28 - 38 HRc	2 x D	790	.0004	.0008	.0009	.0013	.0018	.0022	.0026
	Alloyed heat-treatable, tool and high speed steels	28 - 44 HRc	1 x D	660	.0003	.0005	.0006	.0009	.0013	.0016	.0019
K	Cast iron, grey cast iron, spher. graphite/malleable cast iron	over 240 HB 30	2 x D	490	.0005	.0009	.0011	.0015	.0020	.0025	.0030
N	Aluminum, Al-wrought alloys, Al-alloys	up to 7% Si	1 x D	590	.0004	.0008	.0009	.0013	.0018	.0022	.0026
	Aluminum-cast alloys	over 7% Si	1 x D	460	.0005	.0009	.0011	.0015	.0020	.0025	.0030



SLOTING

Material/ISO material	Hardness	a_p max	a_e max	v_c	fz (mm/z) with nom. Ø							
					4	5	6	8	10	12	16	20
Struct./free-cutting steels, unall. heat-treat./case hard. steels	$\leq 850 \text{ N/mm}^2$	1xD	1xD	270	0.017	0.021	0.025	0.034	0.050	0.060	0.080	0.100
P Free-cutting steels, unalloyed case hard. steels, nitr. steels	850 - 1200 N/mm ²	1xD	1xD	230	0.017	0.021	0.025	0.034	0.050	0.060	0.080	0.100
Alloyed heat-treatable, tool and high speed steels	850 - 1400 N/mm ²	1xD	1xD	180	0.014	0.018	0.021	0.028	0.045	0.054	0.072	0.090
M Stainless steel - easy to machine / sulphured	$\leq 750 \text{ N/mm}^2$	1xD	1xD	120	0.014	0.018	0.021	0.028	0.045	0.054	0.072	0.090
Stainless steel - moderately difficult to machine	750 - 950 N/mm ²	1xD	1xD	80	0.013	0.016	0.019	0.026	0.040	0.048	0.064	0.080
K Cast iron, grey cast iron, spher. graphite/malleable cast iron	$\geq 240 \text{ HB}$	1xD	1xD	150	0.017	0.021	0.025	0.034	0.050	0.060	0.080	0.100
N Aluminium, Al-wrought alloys, Al-alloys	$\leq 7\% \text{ Si}$	1xD	1xD	500	0.022	0.028	0.033	0.044	0.065	0.078	0.104	0.130
Aluminium-cast alloys	$\geq 7\% \text{ Si}$	1xD	1xD	340	0.018	0.023	0.027	0.036	0.055	0.066	0.088	0.110
S Titanium, Titanium alloys	$\leq 1300 \text{ N/mm}^2$	1xD	1xD	60	0.013	0.016	0.019	0.026	0.040	0.048	0.064	0.080

HPC-ROUGHING

Material/ISO material	Hardness	a_p max	a_e max	v_c	fz (mm/z) with nom. Ø							
					4	5	6	8	10	12	16	20
Struct./free-cutting steels, unall. heat-treat./case hard. steels	$\leq 850 \text{ N/mm}^2$	1.5xD	0.40xD	350	0.021	0.026	0.032	0.042	0.063	0.075	0.100	0.125
P Free-cutting steels, unalloyed case hard. steels, nitr. steels	850 - 1200 N/mm ²	1.5xD	0.40xD	290	0.021	0.026	0.032	0.042	0.063	0.075	0.100	0.125
Alloyed heat-treatable, tool and high speed steels	850 - 1400 N/mm ²	1.5xD	0.33xD	260	0.018	0.023	0.027	0.036	0.059	0.070	0.094	0.117
M Stainless steel - easy to machine / sulphured	$\leq 750 \text{ N/mm}^2$	1.5xD	0.33xD	160	0.018	0.023	0.027	0.036	0.059	0.070	0.094	0.117
Stainless steel - moderately difficult to machine	750 - 950 N/mm ²	1.5xD	0.25xD	120	0.019	0.024	0.029	0.038	0.060	0.072	0.096	0.120
K Cast iron, grey cast iron, spher. graphite/malleable cast iron	$\geq 240 \text{ HB}$	1.5xD	0.40xD	190	0.021	0.026	0.032	0.042	0.063	0.075	0.100	0.125
N Aluminium, Al-wrought alloys, Al-alloys	$\leq 7\% \text{ Si}$	1.5xD	0.40xD	600	0.028	0.034	0.041	0.055	0.081	0.098	0.130	0.163
Aluminium-cast alloys	$\geq 7\% \text{ Si}$	1.5xD	0.40xD	440	0.023	0.028	0.034	0.045	0.069	0.083	0.110	0.138
S Titanium, Titanium alloys	$\leq 1300 \text{ N/mm}^2$	1.5xD	0.33xD	110	0.017	0.021	0.025	0.033	0.052	0.062	0.083	0.104

HSC-FINISHING

Material/ISO material	Hardness	a_p max	a_e max	v_c	fz (mm/z) with nom. Ø							
					4	5	6	8	10	12	16	20
Struct./free-cutting steels, unall. heat-treat./case hard. steels	$\leq 850 \text{ N/mm}^2$	2xD	0.02xD	540	0.018	0.023	0.028	0.037	0.055	0.066	0.088	0.110
P Free-cutting steels, unalloyed case hard. steels, nitr. steels	850 - 1200 N/mm ²	2xD	0.02xD	460	0.018	0.023	0.028	0.037	0.055	0.066	0.088	0.110
Alloyed heat-treatable, tool and high speed steels	850 - 1400 N/mm ²	2xD	0.02xD	350	0.015	0.019	0.023	0.031	0.050	0.059	0.079	0.099
M Stainless steel - easy to machine / sulphured	$\leq 750 \text{ N/mm}^2$	2xD	0.02xD	220	0.015	0.019	0.023	0.031	0.050	0.059	0.079	0.099
Stainless steel - moderately difficult to machine	750 - 950 N/mm ²	2xD	0.02xD	160	0.014	0.018	0.021	0.028	0.044	0.053	0.070	0.088
K Cast iron, grey cast iron, spher. graphite/malleable cast iron	$\geq 240 \text{ HB}$	2xD	0.02xD	300	0.018	0.023	0.028	0.037	0.055	0.066	0.088	0.110
N Aluminium, Al-wrought alloys, Al-alloys	$\leq 7\% \text{ Si}$	2xD	0.02xD	1000	0.024	0.030	0.036	0.048	0.072	0.086	0.114	0.143
Aluminium-cast alloys	$\geq 7\% \text{ Si}$	2xD	0.02xD	680	0.020	0.025	0.030	0.040	0.061	0.073	0.097	0.121
S Titanium, Titanium alloys	$\leq 1300 \text{ N/mm}^2$	2xD	0.02xD	130	0.014	0.018	0.021	0.028	0.044	0.053	0.070	0.088

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RAMPING, HELIX, GROOVING

Material/ISO material	Hardness	a_p	Ramping max. angle	v_c	fz (mm/z) with nom. $\emptyset$							
					4	5	6	8	10	12	16	20
Struct./free-cutting steels, unall. heat-treat./case hard. steels	$\leq 850 \text{ N/mm}^2$	1 x D	45°	270	0.015	0.019	0.023	0.030	0.045	0.054	0.072	0.090
P Free-cutting steels, unalloyed case hard. steels, nitr. steels	850 - 1200 N/mm ²	1 x D	45°	230	0.013	0.017	0.020	0.026	0.040	0.048	0.064	0.080
Alloyed heat-treatable, tool and high speed steels	850 - 1400 N/mm ²	1 x D	30°	180	0.011	0.014	0.017	0.022	0.030	0.036	0.048	0.060
M Stainless steel - easy to machine / sulphured	$\leq 750 \text{ N/mm}^2$	1 x D	10°	120	0.009	0.012	0.014	0.018	0.030	0.036	0.048	0.060
Stainless steel - moderately difficult to machine	750 - 950 N/mm ²	1 x D	5°	80	0.007	0.009	0.011	0.014	0.025	0.030	0.040	0.050
K Cast iron, grey cast iron, spher. graphite/malleable cast iron	$\geq 240 \text{ HB}$	1 x D	45°	150	0.015	0.019	0.023	0.030	0.045	0.054	0.072	0.090
N Aluminium, Al-wrought alloys, Al-alloys	$\leq 7\% \text{ Si}$	1 x D	30°	500	0.013	0.017	0.020	0.026	0.040	0.048	0.064	0.080
Aluminium-cast alloys	$\geq 7\% \text{ Si}$	1 x D	45°	340	0.015	0.019	0.023	0.030	0.045	0.054	0.072	0.090
S Titanium, Titanium alloys	$\leq 1300 \text{ N/mm}^2$	1 x D	10°	60	0.007	0.009	0.011	0.014	0.025	0.030	0.040	0.050

DRILLING

Material/ISO material	Hardness	Drilling depth (a_p max.)	v_c	fz (mm/z) with nom. $\emptyset$							
				4	5	6	8	10	12	16	20
Struct./free-cutting steels, unall. heat-treat./case hard. steels	$\leq 850 \text{ N/mm}^2$	1.5 x D	270	0.014	0.018	0.021	0.028	0.040	0.048	0.064	0.080
P Free-cutting steels, unalloyed case hard. steels, nitr. steels	850 - 1200 N/mm ²	1.5 x D	230	0.012	0.015	0.018	0.024	0.035	0.042	0.056	0.070
Alloyed heat-treatable, tool and high speed steels	850 - 1400 N/mm ²	1.0 x D	180	0.008	0.010	0.012	0.016	0.025	0.030	0.040	0.050
K Cast iron, grey cast iron, spher. graphite/malleable cast iron	$\geq 240 \text{ HB}$	1.5 x D	150	0.014	0.018	0.021	0.028	0.040	0.048	0.064	0.080
N Aluminium, Al-wrought alloys, Al-alloys	$\leq 7\% \text{ Si}$	1.0 x D	500	0.012	0.015	0.018	0.024	0.035	0.042	0.056	0.070
Aluminium-cast alloys	$\geq 7\% \text{ Si}$	1.0 x D	340	0.014	0.018	0.021	0.028	0.040	0.048	0.064	0.080

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