STOCK

125 YEARS
R. STOCK & Co
WERKZEUGE SPIRALBOHRER
1887 2012

SuperF-UT

Solid Carbide End Mills
with unequal helix angle

Extended Standard Range
Edition 2013

HPC

Chip – by Chip – to the Top

Solid carbide end mill with unequal helix angle

Overview

Type	Standard	Surface finish	Helix angle	No. of teeth	Shank form		Catalogue no.	Diameter range (mm)
SuperF-UT N	DIN 6527 K	TiAlN	35°/38°	4	HB		**64550**	6.000 - 20.000
	DIN 6527 L	TiAlN	35°/38°	4	HA		**54551**	4.000 - 20.000
	DIN 6527 L	TiAlN	35°/38°	4	HB		**64551**	4.000 - 25.000
	Stock std.	TiAlN	35°/38°	4	HA		**54562**	6.000 - 20.000
	Stock std.	TiAlN	35°/38°	4	HB		**54563**	6.000 - 20.000
	Stock std.	TiAlN	35°/38°	4	HA		**54552**	10.000 - 25.000
SuperF-UT N-F	DIN 6527 L	TiAlN	30°/32°	4	HA		**54566**	6.000 - 25.000
	DIN 6527 L	TiAlN	30°/32°	4	HB		**54567**	6.000 - 25.000
SuperF-UT N-3	DIN 6527 L	TiAlN	41°/43°/45°	3	HA		**54564**	3.000 - 20.000
	DIN 6527 L	TiAlN	41°/43°/45°	3	HB		**54565**	3.000 - 20.000
SuperF-UT N-5	Stock std.	TiAlN	45°	5	HA		**54579**	4.000 - 20.000
	Stock std.	TiAlN	45°	5	HB		**54580**	4.000 - 20.000
SuperF-UT Ti	DIN 6527 L	AlTiN+	35°/38°	4	HA		**54560**	6.000 - 20.000
	DIN 6527 L	AlTiN+	35°/38°	4	HB		**54561**	6.000 - 20.000
SuperF-UT FS	Stock std.	TiAlN	44°/45°/46°	6	HA		**64558**	8.000 - 20.000
	Stock std.	TiAlN	44°/45°/46°	6	HB		**64559**	8.000 - 20.000
SuperF-UT H	DIN 6527 L	AlTiN	40°/42°	4	HA		**54572**	6.000 - 20.000
	DIN 6527 L	AlTiN	40°/42°	4	HB		**54573**	6.000 - 20.000

Solid carbide end mill with unequal helix angle

Overview

Type	Standard	Surface finish	Helix angle	No. of teeth	Shank form		Catalogue no.	Diameter range (mm)
SuperF-UT VA-X	DIN 6527 K	AlTiN nano	36°/38°	4	HB		**54576**	4.000 - 20.000
	DIN 6527 L	AlTiN nano	36°/38°	4	HA		**54558**	3.000 - 25.000
	DIN 6527 L	AlTiN nano	36°/38°	4	HB		**54559**	3.000 - 25.000
SuperF-UT VA-X IK	DIN 6527 L	AlTiN nano	36°/38°	4	HA		**54574**	6.000 - 25.000
	DIN 6527 L	AlTiN nano	36°/38°	4	HB		**54575**	6.000 - 25.000
SuperF-UT VA-XF	DIN 6527 L	AlTiN nano	36°/38°	4	HA		**54568**	6.000 - 25.000
	DIN 6527 L	AlTiN nano	36°/38°	4	HB		**54569**	6.000 - 25.000
SuperF-UT VA	DIN 6527 L	TiAlN	40°/42°	4	HA		**54556**	4.000 - 20.000
	DIN 6527 L	TiAlN	40°/42°	4	HB		**64557**	4.000 - 20.000
	DIN 6527 L	TiAlN	40°/42°	4	HB		**64567**	6.000 - 20.000
SuperF-UT Al-3	~DIN 6527 L	bright	39°/40°/41°	3	HA		**74552**	3.000 - 20.000
	~DIN 6527 L	bright	39°/40°/41°	3	HB		**74553**	3.000 - 20.000
SuperF-UT Al-F	~DIN 6527 L	bright	29°/30°/31°	3	HA		**54570**	6.000 - 25.000
	~DIN 6527 L	bright	29°/30°/31°	3	HB		**54571**	6.000 - 25.000
SuperF-UT Al	DIN 6527 L	bright	40°/42°	4	HA		**74554**	4.000 - 20.000
	DIN 6527 L	bright	40°/42°	4	HB		**74555**	4.000 - 20.000

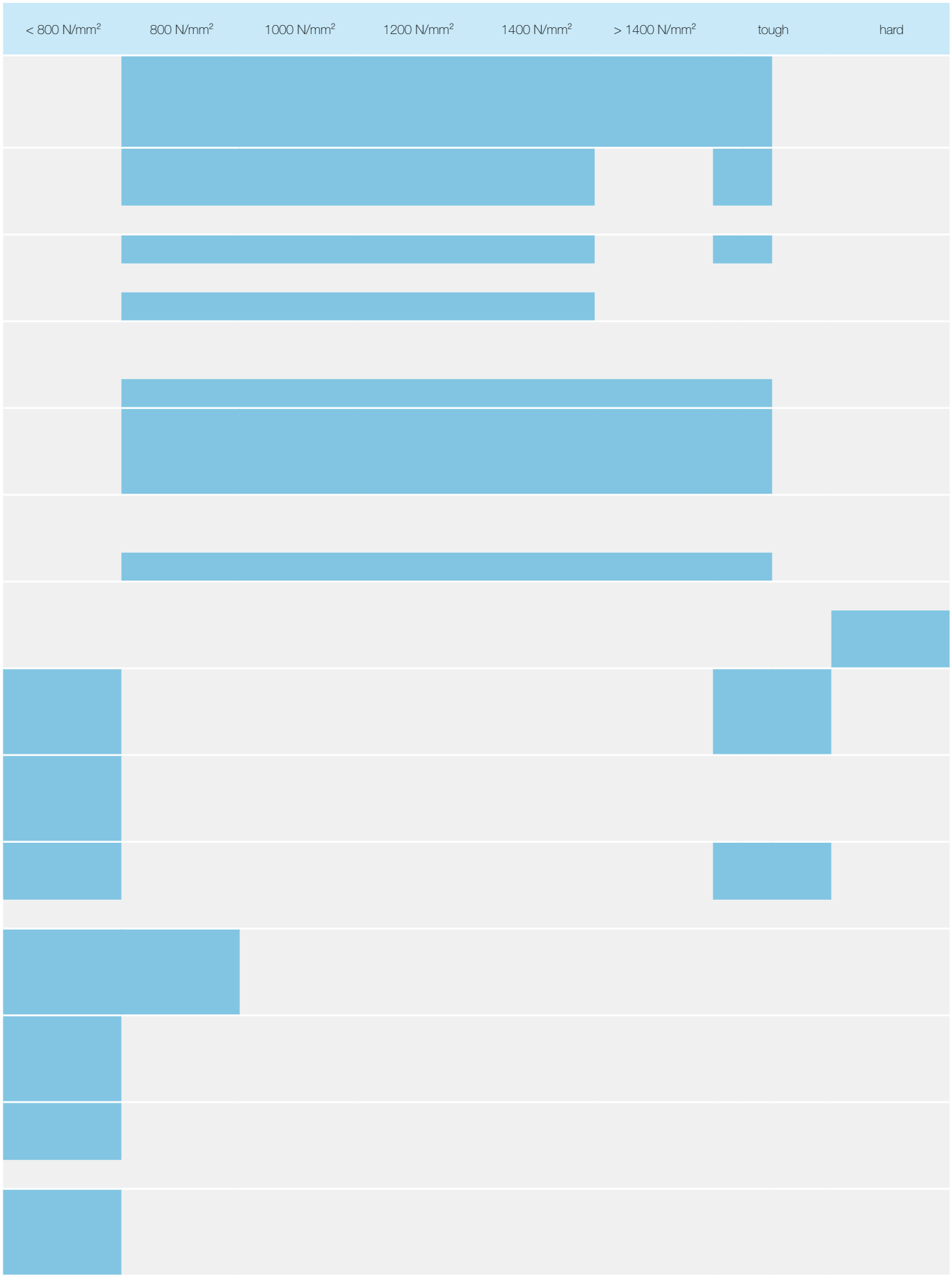
Application

by materials

Type	Catalogue no.	Application	Non-ferrous metals, Aluminium	Steels	Cast iron	Stainless and acid-resistant steels	Nickel, Ti-alloys	Hardened steels
SuperF-UT N	64550 54551 64551 54562 54563 54552	Slot drilling	well suited	optimal	well suited	well suited	well suited	well suited
		Roughing	well suited	optimal	optimal	optimal	well suited	well suited
		Finishing	optimal	optimal	optimal	optimal	well suited	well suited
SuperF-UT N-F	54566 54567	Slot drilling	well suited	optimal	well suited	well suited	optimal	optimal
		Roughing	well suited	optimal	optimal	optimal	well suited	well suited
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT N-3	54564 54565	Slot drilling	optimal	optimal	optimal	optimal	optimal	well suited
		Roughing	well suited	well suited	well suited	well suited	well suited	well suited
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT N-5	54579 54580	Slot drilling	well suited	well suited	well suited	well suited	well suited	well suited
		Roughing	well suited	optimal	optimal	optimal	optimal	well suited
		Finishing	optimal	optimal	optimal	optimal	optimal	optimal
SuperF-UT Ti	54560 54561	Slot drilling	well suited	well suited	well suited	well suited	optimal	well suited
		Roughing	well suited	well suited	well suited	well suited	optimal	well suited
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT FS	64558 64559	Slot drilling	well suited	well suited	well suited	well suited	well suited	well suited
		Roughing	well suited	well suited	well suited	well suited	well suited	well suited
		Finishing	optimal	optimal	optimal	optimal	optimal	optimal
SuperF-UT H	54572 54573	Slot drilling	well suited	well suited	well suited	well suited	well suited	well suited
		Roughing	well suited	well suited	well suited	well suited	well suited	optimal
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT VA-X	54576 54558 54559	Slot drilling	well suited	well suited	well suited	well suited	well suited	well suited
		Roughing	well suited	optimal	well suited	optimal	well suited	well suited
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT VA-X IK	54574 54575	Slot drilling	well suited	well suited	well suited	well suited	well suited	well suited
		Roughing	well suited	optimal	well suited	optimal	well suited	well suited
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT VA-XF	54568 54569	Slot drilling	well suited	optimal	well suited	optimal	well suited	well suited
		Roughing	well suited	optimal	well suited	optimal	well suited	well suited
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT VA	54556 64557 64567	Slot drilling	well suited	well suited	well suited	well suited	well suited	well suited
		Roughing	well suited	well suited	well suited	well suited	well suited	well suited
		Finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT Al-3	74552 74553	Slot drilling	optimal	well suited	well suited	well suited	well suited	well suited
		Roughing	optimal	well suited	well suited	well suited	well suited	well suited
		Finishing	optimal	well suited	well suited	well suited	well suited	well suited
SuperF-UT Al-F	54570 54571	Slot drilling	optimal	well suited	well suited	well suited	well suited	well suited
		Roughing	optimal	well suited	well suited	well suited	well suited	well suited
		Fine finishing	well suited	well suited	well suited	well suited	well suited	well suited
SuperF-UT Al	74554 74555	Slot drilling	well suited	well suited	well suited	well suited	well suited	well suited
		Roughing	well suited	well suited	well suited	well suited	well suited	well suited
		Fine finishing	optimal	well suited	well suited	well suited	well suited	well suited

optimal well suited

by tensile strength



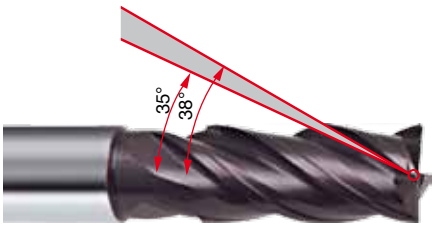
Solid carbide end mill with unequal helix angle

Advantages

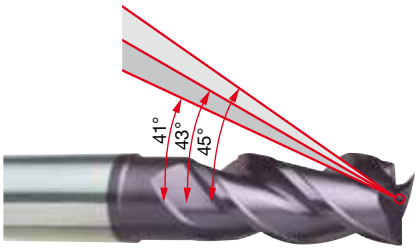
Unequal helix angle for increased performance and quality

The SuperF-UT End Mill with unequal helix angle available from Stock will satisfy even the highest demands in milling operations. The advantages are:

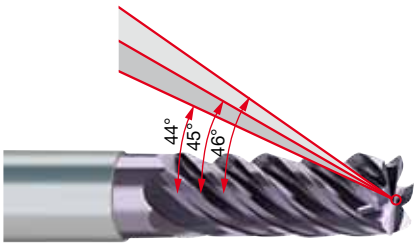
- 60% higher feeds compared to conventional end mills with same helix angle
- no vibrations, chatterfree
- better surface quality
- longer tool life
- greater cutting depths
- much reduced run-out
- much increased application: for roughing and finishing



SuperF-UT N

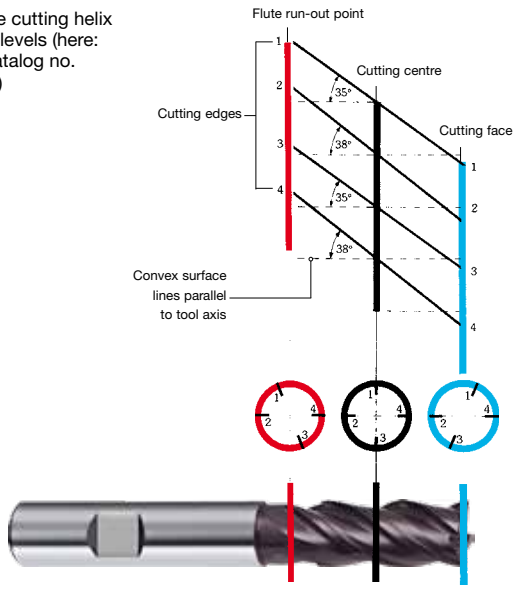


SuperF-UT N-3



SuperF-UT FS

Description of the cutting helix at three different levels (here: F-UT End Mill, catalog no. 64551, Ø 18 mm)



Micro-corner protection for less wear

SuperF-UT solid carbide end mills have a special geometry with micro-corner protection. This design reduces the wear of the cutting edges considerably, allowing higher feed rates and longer tool life.

Reduced neck for increased cutting depths

The reduced neck of SuperF-UT solid carbide end mills increases the cutting depth and optimises the chip flow of large cutting depths. Therefore, SuperF-UT solid carbide end mills offer a wide application range.

Solid carbide end mill with unequal helix angle

Advantages

Defined corner radius

The STOCK SuperF-UT Ti end mill has different sized corner radii per diameter for increased wear protection and high form accuracy

New designed roughing profile

The SuperF-UT end mills type F are suitable for roughing and finishing operations, requiring less power due to less cutting forces by comparison to conventional end mills. They are the perfect solution for unstable conditions and less powerful machines, high feeds and speeds achieving good surface finishing.

Solid carbide end mill with unequal helix angle

Types

SuperF-UT N

- 35°/38° helix angles
- 4-fluted
- slot drilling, roughing and finishing
- steel, high-alloyed steel and hardened steel up to 1600 N/mm^2 (48 HRC)
- 6 variants in different lengths with HA- or HB-shank

SuperF-UT N-F

- 30°/32° helix angles
- 4-fluted
- special roughing geometry
- slot drilling and roughing
- alloyed steel up to 1400 N/mm^2, hardened steel up to 48 HRC, Ni- and Ti-alloys
- especially for large cutting widths and depths under difficult machining conditions
- 2 variants to DIN 6527 long with HA- or HB-shank

SuperF-UT N-3

- 41°/43°/45° helix angles
- 3-fluted
- slot drilling, roughing and finishing
- especially for extrem cutting depths
- steel, high-alloyed steel and hardened steel up to 1400 N/mm^2 (44 HRC)
- 2 variants to DIN 6527 long with HA- or HB-shank

SuperF-UT N-5

- 45° helix angles
- 5-fluted
- semi roughing and finishing
- large cutting depths at moderate widths of cut
- steel up to 1400 N/mm^2, cast, stainless steels, Ni- and Ti-alloys
- 2 variants to DIN 6527 long with HA- or HB-shank

Solid carbide end mill with unequal helix angle

Types

SuperF-UT VA-X

- 36°/38° helix angles
- 4-fluted
- slot drilling, roughing and finishing
- VA-steels and stainless materials
- 2 variants to DIN 6527 long with HA- or HB-shank

SuperF-UT VA-X IK

- with axial coolant ducts

SuperF-UT VA-XF

- 36°/38° helix angles
- 4-fluted
- special roughing geometry
- slot drilling and roughing
- steels up to 1200 N/mm^2, VA-steels and stainless materials, cast materials up to 240 HB 30 and non-ferrous metals
- recommended for difficult machining conditions as well as long reach applications
- 2 variants to DIN 6527 long with HA- or HB-shank

SuperF-UT Al-3

- 39/40/41° helix angles
- 3-fluted
- slot drilling, roughing and finishing
- Aluminium and Al-alloys, long-chipping materials and non-ferrous metals
- 2 variants to Stock standard with HA- or HB-shank

SuperF-UT AL-F

- 29°/30°/31° helix angles
- 3-fluted
- special roughing geometry
- slot drilling and roughing
- Aluminium and Al-alloys
- 2 variants to DIN 6527 long with HA- or HB-shank

SuperF-UT Ti

- 35°/38° helix angles
- 4-fluted
- corner radius
- slot drilling, roughing and finishing
- Ni- and Ti-alloys
- applicable also as a type N with corner radius
- 2 variants to DIN 6527 long with HA- or HB-shank

SuperF-UT H

- 40°/42° helix angles
- 4-fluted
- with core stability
- roughing and finishing
- materials from 44 HRC up to 62 HRC
- 2 variants to DIN 6527 long with HA- or HB-shank

SuperF-UT VA

- 40°/42° helix angles
- 4-fluted
- slot drilling, finishing and roughing
- soft and tough steels, long-chipping materials up to 850 N/mm^2 (25 HRC)
- 3 variants to DIN 6527 long with HA- or HB-shank as well as with/without internal cooling

SuperF-UT FS

- 44°/45°/46° helix angles
- 6-fluted
- TiAlN-coating
- semi-roughing up to 0.3 x D, HPC roughing and HSC fine finishing
- standard steels, cast, non-ferrous metals and high-alloyed materials
- 2 variants to DIN 6527 long with HA- or HB-shank

General recommendations

Stock SuperF-UT end mills are designed for application under optimal machining conditions, i.e.:

- high machine performance
- sufficient coolant supply
- rigid workpiece and tool clamping

If these conditions are not available, we advise the use of SuperF-UT end mills with new designed roughing and finishing profile.

To machine steel materials (typically SuperF-UT type N) with a corner-radius end mill we suggest the SuperF-UT Ti, catalogue no. 54560 or 54561.

We recommend synchronous milling.

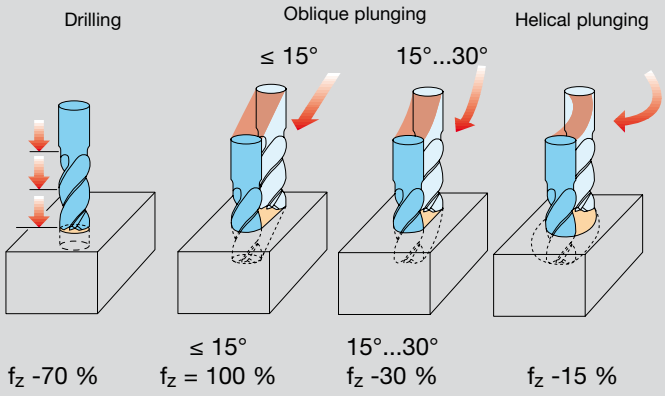
for drilling:
➤ reduce feed rate v_f (mm/min.)
➤ additional pecking for drilling depths > 0.5 x D or transition to radial machining

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.) in accordance with the illustration on the right

Helical plunging:
➤ for helical plunging on a milling cycle, we recommend a feed of 0.1 to 0.2 per cycle
➤ reduce feed rate v_f (mm/min.) in accordance with the illustration on the right
➤ select preferred hole diameter 1.8 x D



Formulae:

Revolution per min. n [min^{-1}]

$$n = \frac{v_c \cdot 1000}{\pi \cdot D}$$

Feed per min. v_f [mm/min]

$$v_f = f_z \cdot n \cdot Z_c$$

f_z = feed per tooth [mm/Z]
Z_c = effective no. of teeth
D = tool diameter [mm]

Chip volume Q [mm^3/min]

$$Q = \frac{a_p \,.\, a_e \,.\, v_f}{1000}$$

Torque M_c [Nm]

$$M_c = \frac{P_c \cdot 30 \cdot 10^3}{\pi \cdot n}$$

P_c = cutting force [kW]
v_c = cutting speed [m/min]
a_p = cutting depth [mm]
a_e = cutting width [mm]
π = Pi

Corner protection chamfer

Size of the corner protection chamfers on SuperF-UT mills					
	SuperF-UT N-3	SuperF-UT N-4	SuperF-UT N-F	SuperF-UT VA-X	SuperF-UT AL-3
	SuperF-UT N-5	SuperF-UT VA	SuperF-UT VA-XF	SuperF-UT H	
	SuperF-UT FS	SuperF-UT AL	SuperF-UT AL-F		
Nom. Ø in mm	**Sizes in mm**				
3	0.05 x 45°				0.06 x 45°
4	0.05 x 45°	0.10 x 45°		0.15 x 45°	0.08 x 45°
5	0.05 x 45°	0.10 x 45°		0.15 x 45°	0.10 x 45°
6	0.05 x 45°	0.15 x 45°	0.30 x 45°	0.20 x 45°	0.12 x 45°
8	0.10 x 45°	0.15 x 45°	0.30 x 45°	0.25 x 45°	0.16 x 45°
10	0.10 x 45°	0.20 x 45°	0.30 x 45°	0.30 x 45°	0.20 x 45°
12	0.15 x 45°	0.20 x 45°	0.50 x 45°	0.35 x 45°	0.24 x 45°
14	0.15 x 45°	0.25 x 45°	0.50 x 45°	0.40 x 45°	0.28 x 45°
16	0.15 x 45°	0.35 x 45°	0.50 x 45°	0.50 x 45°	0.32 x 45°
18	0.15 x 45°	0.40 x 45°	0.50 x 45°	0.60 x 45°	0.36 x 45°
20	0.20 x 45°	0.45 x 45°	0.50 x 45°	0.60 x 45°	0.40 x 45°
25	0.30 x 45°	0.60 x 45°	0.60 x 45°	0.75 x 45°	0.50 x 45°

Strategy of HPC-Milling

High Performance Cutting (HPC) is a milling strategy with increased feed and speed rates and generally larger milling depth, compared to regular milling processes.

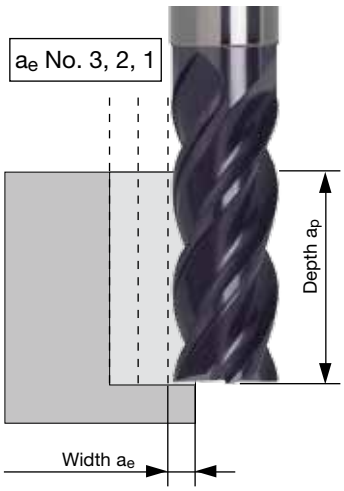
Pros:

- less stress on tool and machine tool due to small cutting width
- less temperatures while milling
- use of entire length of cut possible
- thus, higher tool life

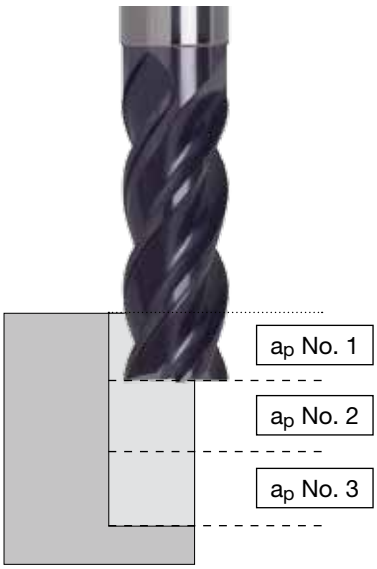
Cons:

- dynamc control on machine tool required when milling complex contours

HPC



conventional



Conversion chart for HPC-Milling

ae	factor fz	factor v_c	Q in %
100%	1.00	1.00	100
50%	1.00	1.20	59
40%	1.08	1.25	54
30%	1.20	1.30	45
20%	1.48	1.35	39
10%	2.00	1.50	27

Remarks:
The basis for all cutting data converted to HPC-Milling are those for slotting with SuperF-UT!

Example:
Tool: SuperF-UT N Ø12, No. 54551
Material: 42CrMo4
Cutting data „HPC Basis":
v_C = 135 m/min
fz = 0.065 mm/Z

Formula for HPC Application:
HPC-Cutting Data calculated on ae 10 % of dia.:
v_C = 135 m/min x 1,5 = 203 m/min
fz = 0.065 mm/Z x 2 = 0.13 mm/Z

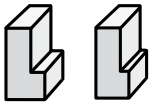
F-UT HPC Milling Basic Cutting Data

Stable conditions:
- good cooling
- sufficient performance
- short-chipping

Unstable conditions:
- standard cooling
- average performance
- medium- to long-chipping

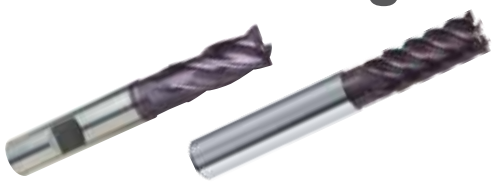
Calculation for HPC-milling			
ae	factor fz	factor Vc	Q in %
100%	1.00	1.00	100
50%	1.00	1.20	59
40%	1.08	1.25	54
30%	1.20	1.30	45
20%	1.48	1.35	39
10%	2.00	1.50	27

Material	Hardness / tensile strength	recom-mended F-UT Type	Type of conditions	v_c [m/min]	Feed fz [mm/z] with nom. Ø							
					3	6	8	10	12	16	20	25
P Struct. + free-cutting steels, unalloyed heat-treat. + case hard. steels 1.0035 S185, 1.0486 P275N, 1.0345 P235GH, 1.0050, 1.0070, 1.8937 1.0718 11SMnPb30, 1.0736 11SMn37 1.0402 C22, 1.1178 C30E, 1.0503 C45, 1.1191 C30E 1.0301 C10, 1.1121 C10E, 1.1750 C75W, 1.2076 102Cr6, 1.2307 29CrMoV9	up to 850 N/mm²	N	stable conditions	180	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
		N-F	unstable conditions	180	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105
P Free-cutting steels, unalloyed case hardened steels, nitriding steels 1.0727 46 S20, 1.0728 60 S20, 1.0757 46SPb20 1.0601 C60, 1.1221 C60E, 1.7043 38Cr4 1.5752 15NiCr13, 1.7131 16MnCr5, 1.7264 20CrMo5 1.8504 34CrAl6, 1.8519 31CrMoV9, 1.8550 34CrAlNi7	850-1.200 N/mm²	N	stable conditions	160	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
		N-F	unstable conditions	160	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105
P Alloyed heat-treatable, tool and high speed steels 1.5131 50MnSi4, 1.7003 38Cr2, 1.7030 28Cr4, 1.5710 36NiCr6, 1.7035 41Cr4, 1.7225 42CrMo4, 1.2080 X210Cr12, 1.2083 X42Cr13, 1.2419 105WCr6, 1.2379 X155CrVMo12-1, 1.3243 S 6-5-2-5, 1.3343 S 6-5-2, 1.3344 S 6-5-3 Federstahl = 1.5026 55Si7, 1.7176 55Cr3, 1.8159 51CrV4	850-1.400 N/mm²	N	stable conditions	135	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		N-F	unstable conditions	135	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
H Hardened steel Tool steel, heat-treatable steel, spring steel, high-speed steel, case hardened steel, etc. e.g.: 1.2344 X40CrMoV5-1; 1.2767 X45NiCrMo4; 1.2379 X155CrVMo12-1 ;1.2080 X210Cr12 1.3343 S 6-5-2	up to 54 HRC	N	stable conditions	70	0.012	0.025	0.030	0.040	0.045	0.060	0.070	0.100
		N-F	unstable conditions	70	0.008	0.018	0.021	0.028	0.032	0.042	0.049	0.070
M Stainless steel 1.4104 X14CrMoS17, 1.4105 X6CrMoS17, 1.4305 X10CrNiS18-9 USA = 303, 410, 420F, 430, 430F	up to 750 N/mm²	VA-X	stable conditions	120	0.015	0.030	0.040	0.050	0.060	0.070	0.090	0.130
		VA-XF	unstable conditions	120	0.011	0.021	0.028	0.035	0.042	0.049	0.063	0.091
M Stainless steel 1.4301X5CrNi18-10, 1.4303 X5CrNi18-12 1.4310 XCrNi18-8 USA = 304, 304L, 420	750-850 N/mm²	VA-X	stable conditions	80	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		VA-XF	unstable conditions	80	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084
M Stainless steel 1.4438 X2CrNiMo18-15-4, 1.4404 X2CrNiMo17-12-2, 1.4571 X6CrNiTi18-10 USA = 310, 316, 316B, 316L, 317	above 850 N/mm²	VA-X	stable conditions	70	0.012	0.025	0.030	0.040	0.045	0.060	0.070	0.100
		VA-XF	unstable conditions	70	0.008	0.018	0.021	0.028	0.032	0.042	0.049	0.070
S Special alloys (nickel based "Ni") Nimonic, Inconel, Monel, Hastelloy	up to 1.300 N/mm²	Ti	stable conditions	30	0.010	0.015	0.020	0.025	0.030	0.040	0.050	0.060
		N-F	unstable conditions	30	0.007	0.011	0.014	0.018	0.021	0.028	0.035	0.042
Ti Titanium alloys ("Ti") 3.7024 Ti99,5, 3.7114 TiAl5Sn2,5, 3.7124 TiCu2 3.7154 TiAl6Zr5, 3.7164 TiAl6V4, 3.7184 TiAl4Mo4Sn2,5	up to 1.300 N/mm²	Ti	stable conditions	60	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		N-F	unstable conditions	60	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6010 EN-GL100 (GG10), 0.6020 EN-GJL-200 (GG20), 0.7050 EN-GJS-500-7 (GGG50), 0.8535 EN-GJMW-350-4 (GTW35)	up to 240 HB 30	N	stable conditions	160	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		N-F	unstable conditions	160	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6025 EN-GL250 (GG25), 0.6035 EN-GJL-350 (GG35), 0.7070 EN-GJS-700-2 (GGG70), 0.8170 EN-GJMB-700-2 (GTS70)	above 240 HB 30	N	stable conditions	140	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		N-F	unstable conditions	140	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
N Aluminium, Al-wrought alloys, Al-alloys 3.0255 Al99,5, 3.2315 AlMgSi1, 3.3515 AlMg1 3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 AlMg3Si, 3.4365 AlZnMgCu1,5	up to 3% Si	AL	stable conditions	500	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		AL-F	unstable conditions	500	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
N Aluminium, Al-wrought alloys, Al-alloys 3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9 3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, - G-AlSi12CuNiMg	above 3% Si	AL	stable conditions	230	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		AL-F	unstable conditions	230	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
N Magnesium-alloys MgMn2, G-MgAl8Zn1, G-MgAl6Zn3	-	AL	stable conditions	180	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		AL-F	unstable conditions	180	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
N Non-ferrous metals (copper, short- or long-chipping brass) 2.0070 SE-Cu, 2.1020 CuSn6, 2.1096 G-CuSn5ZnPb, 2.0380 CuZn39Pb2, 2.0401 CuZn39Pb3, 2.0410 CuZn43Pb2, 2.0250 CuZn20, 2.0280 CuZn33, 2.0332 CuZn37Pb0,5, 2.1090 CuSn7ZnPb, 2.1170 CuPb5Sn5, 2.1176 CuPb10Sn, 2.0916 CuAl5, 2.0960 CuAl9Mn, 2.1050 CuSn10	up to 850 N/mm²	AL	stable conditions	250	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		AL-F	unstable conditions	250	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084



a_p = 1 x D - 3 x D
a_e = 0.1 x D - 0.5 x D

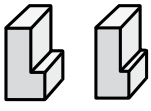
F-UT Finishing / Fine finishing



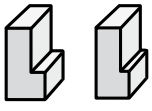
Stable conditions:
- good cooling
- sufficient performance
- short-chipping

* Milling cutters #54207,#54227 for fine finishing in hardened steels > 54 HRC see chapter „Milling Tools“ in the main catalogue

Material	Hardness / tensile strength	recom-mended F-UT Type	Type of conditions	v_c [m/min]	Feed fz [mm/z] with nom. Ø							
					3	6	8	10	12	16	20	25
P Struct. + free-cutting steels, unalloyed heat-treat. + case hard. steels 1.0035 S185, 1.0486 P275N, 1.0345 P235GH, 1.0050, 1.0070, 1.8937 1.0718 11SMnPb30, 1.0736 11SMn37 1.0402 C22, 1.1178 C30E, 1.0503 C45, 1.1191 C30E 1.0301 C10, 1.1121 C10E, 1.1750 C75W, 1.2076 102Cr6, 1.2307 29CrMoV9	up to 850 N/mm²	N / FS	stable conditions	280	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
			unstable conditions	-								
P Free-cutting steels, unalloyed case hardened steels, nitriding steels 1.0727 46 S20, 1.0728 60 S20, 1.0757 46SPb20 1.0601 C60, 1.1221 C60E, 1.7043 38Cr4 1.5752 15NiCr13, 1.7131 16MnCr5, 1.7264 20CrMo5 1.8504 34CrAl6, 1.8519 31CrMoV9, 1.8550 34CrAlNi7	850-1.200 N/mm²	N / FS	stable conditions	220	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
			unstable conditions	-								
P Alloyed heat-treatable, tool and high speed steels 1.5131 50MnSi4, 1.7003 38Cr2, 1.7030 28Cr4, 1.5710 36NiCr6, 1.7035 41Cr4, 1.7225 42CrMo4, 1.2080 X210Cr12, 1.2083 X42Cr13, 1.2419 105WCr6, 1.2379 X155CrVMo12-1, 1.3243 S 6-5-2-5, 1.3343 S 6-5-2, 1.3344 S 6-5-3 Federstahl = 1.5026 55Si7, 1.7176 55Cr3, 1.8159 51CrV4	850-1.400 N/mm²	N / FS	stable conditions	200	0.015	0.030	0.040	0.050	0.060	0.070	0.090	0.130
			unstable conditions	-								
H Hardened steel Tool steel, heat-treatable steel, spring steel, high-speed steel, case hardened steel, etc. e.g.: 1.2344 X40CrMoV5-1; 1.2767 X45NiCrMo4; 1.2379 X155CrVMo12-1 ;1.2080 X210Cr12 1.3343 S 6-5-2	up to 54 HRC	N / FS	stable conditions	150	0.015	0.030	0.040	0.050	0.060	0.070	0.090	0.130
		- / H*	unstable conditions	110	0.007	0.017	0.024	0.030	0.036	0.045	0.057	0.065
M Stainless steel 1.4104 X14CrMoS17, 1.4105 X6CrMoS17, 1.4305 X10CrNiS18-9 USA = 303, 410, 420F, 430, 430F	up to 750 N/mm²	VA-X / FS	stable conditions	180	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
			unstable conditions	-								
M Stainless steel 1.4301X5CrNi18-10, 1.4303 X5CrNi18-12 1.4310 XCrNi18-8 USA = 304, 304L, 420	750-850 N/mm²	VA-X / FS	stable conditions	140	0.015	0.030	0.040	0.050	0.060	0.070	0.090	0.130
			unstable conditions	-								
M Stainless steel 1.4438 X2CrNiMo18-15-4, 1.4404 X2CrNiMo17-12-2, 1.4571 X6CrNiTi18-10 USA = 310, 316, 316B, 316L, 317	above 850 N/mm²	VA-X / FS	stable conditions	120	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
			unstable conditions	-								
S Special alloys (nickel based “Ni“) Nimonic, Inconel, Monel, Hastelloy	up to 1.300 N/mm²	N / FS	stable conditions	45	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
			unstable conditions	-								
Ti Titanium alloys (“Ti“) 3.7024 Ti99,5, 3.7114 TiAl5Sn2,5, 3.7124 TiCu2 3.7154 TiAl6Zr5, 3.7164 TiAl6V4, 3.7184 TiAl4Mo4Sn2,5	up to 1.300 N/mm²	N / FS	stable conditions	130	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
			unstable conditions	-								
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6010 EN-GL100 (GG10), 0.6020 EN-GJL-200 (GG20), 0.7050 EN-GJS-500-7 (GGG50), 0.8535 EN-GJMW-350-4 (GTW35)	up to 240 HB 30	N / FS	stable conditions	220	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
			unstable conditions	-								
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6025 EN-GL250 (GG25), 0.6035 EN-GJL-350 (GG35), 0.7070 EN-GJS-700-2 (GGG70), 0.8170 EN-GJMB-700-2 (GTS70)	above 240 HB 30	N / FS	stable conditions	200	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
			unstable conditions	-								
N Aluminium, Al-wrought alloys, Al-alloys 3.0255 Al99,5, 3.2315 AlMgSi1, 3.3515 AlMg1 3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 AlMg3Si, 3.4365 AlZnMgCu1,5	up to 3% Si	AL / FS	stable conditions	1000	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
			unstable conditions	-								
N Aluminium, Al-wrought alloys, Al-alloys 3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9 3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, - G-AlSi12CuNiMg	above 3% Si	AL / FS	stable conditions	350	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
			unstable conditions	-								
N Magnesium-alloys MgMn2, G-MgAl8Zn1, G-MgAl6Zn3	-	AL / FS	stable conditions	280	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
			unstable conditions	-								
N Non-ferrous metals (copper, short- or long-chipping brass) 2.0070 SE-Cu, 2.1020 CuSn6, 2.1096 G-CuSn5ZnPb, 2.0380 CuZn39Pb2, 2.0401 CuZn39Pb3, 2.0410 CuZn43Pb2, 2.0250 CuZn20, 2.0280 CuZn33, 2.0332 CuZn37Pb0,5, 2.1090 CuSn7ZnPb, 2.1170 CuPb5Sn5, 2.1176 CuPb10Sn, 2.0916 CuAl5, 2.0960 CuAl9Mn, 2.1050 CuSn10	up to 850 N/mm²	N / FS	stable conditions	400	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
			unstable conditions	-								

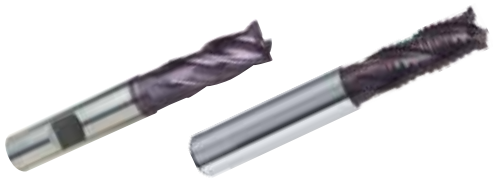


Finishing:
a_p = 1 x D - 2 x D
a_e = 0.1 x D - 0.3 x D



Fine finishing:
a_p = 1 x D - 3 x D
a_e = 0.05 x D - 0.1 x D

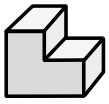
F-UT Roughing



Stable conditions:
- good cooling
- sufficient performance
- short-chipping

Unstable conditions:
- standard cooling
- average performance
- medium- to long-chipping

Material	Hardness / tensile strength	recom-mended F-UT Type	Type of conditions	v_c [m/min]	Feed fz [mm/z] with nom. Ø							
					3	6	8	10	12	16	20	25
P Struct. + free-cutting steels, unalloyed heat-treat. + case hard. steels 1.0035 S185, 1.0486 P275N, 1.0345 P235GH, 1.0050, 1.0070, 1.8937 1.0718 11SMnPb30, 1.0736 11SMn37 1.0402 C22, 1.1178 C30E, 1.0503 C45, 1.1191 C30E 1.0301 C10, 1.1121 C10E, 1.1750 C75W, 1.2076 102Cr6, 1.2307 29CrMoV9	up to 850 N/mm²	N	stable conditions	200	0.020	0.040	0.055	0.070	0.085	0.100	0.120	0.170
		N-F	unstable conditions	200	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119
P Free-cutting steels, unalloyed case hardened steels, nitriding steels 1.0727 46 S20, 1.0728 60 S20, 1.0757 46SPb20 1.0601 C60, 1.1221 C60E, 1.7043 38Cr4 1.5752 15NiCr13, 1.7131 16MnCr5, 1.7264 20CrMo5 1.8504 34CrAl6, 1.8519 31CrMoV9, 1.8550 34CrAlNi7	850-1.200 N/mm²	N	stable conditions	180	0.020	0.040	0.055	0.070	0.085	0.100	0.120	0.170
		N-F	unstable conditions	180	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119
P Alloyed heat-treatable, tool and high speed steels 1.5131 50MnSi4, 1.7003 38Cr2, 1.7030 28Cr4, 1.5710 36NiCr6, 1.7035 41Cr4, 1.7225 42CrMo4, 1.2080 X210Cr12, 1.2083 X42Cr13, 1.2419 105WCr6, 1.2379 X155CrVMo12-1, 1.3243 S 6-5-2-5, 1.3343 S 6-5-2, 1.3344 S 6-5-3 Federstahl = 1.5026 55Si7, 1.7176 55Cr3, 1.8159 51CrV4	850-1.400 N/mm²	N	stable conditions	160	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		N-F	unstable conditions	160	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
H Hardened steel Tool steel, heat-treatable steel, spring steel, high-speed steel, case hardened steel, etc. e.g.: 1.2344 X40CrMoV5-1; 1.2767 X45NiCrMo4; 1.2379 X155CrVMo12-1 ;1.2080 X210Cr12 1.3343 S 6-5-2	up to 54 HRC	N	stable conditions	110	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		N-F	unstable conditions	110	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084
M Stainless steel 1.4104 X14CrMoS17, 1.4105 X6CrMoS17, 1.4305 X10CrNiS18-9 USA = 303, 410, 420F, 430, 430F	up to 750 N/mm²	VA-X	stable conditions	140	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
		VA-XF	unstable conditions	140	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105
M Stainless steel 1.4301X5CrNi18-10, 1.4303 X5CrNi18-12 1.4310 XCrNi18-8 USA = 304, 304L, 420	750-850 N/mm²	VA-X	stable conditions	120	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		VA-XF	unstable conditions	120	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
M Stainless steel 1.4438 X2CrNiMo18-15-4, 1.4404 X2CrNiMo17-12-2, 1.4571 X6CrNiTi18-10 USA = 310, 316, 316B, 316L, 317	above 850 N/mm²	VA-X	stable conditions	100	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		VA-XF	unstable conditions	100	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084
S Special alloys (nickel based "Ni") Nimonic, Inconel, Monel, Hastelloy	up to 1.300 N/mm²	Ti	stable conditions	35	0.010	0.020	0.030	0.035	0.040	0.055	0.065	0.080
		N-F	unstable conditions	35	0.007	0.014	0.021	0.025	0.028	0.039	0.046	0.056
Ti Titanium alloys ("Ti") 3.7024 Ti99,5, 3.7114 TiAl5Sn2,5, 3.7124 TiCu2 3.7154 TiAl6Zr5, 3.7164 TiAl6V4, 3.7184 TiAl4Mo4Sn2,5	up to 1.300 N/mm²	Ti	stable conditions	90	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		N-F	unstable conditions	90	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6010 EN-GL100 (GG10), 0.6020 EN-GJL-200 (GG20), 0.7050 EN-GJS-500-7 (GGG50), 0.8535 EN-GJMW-350-4 (GTW35)	up to 240 HB 30	N	stable conditions	180	0.020	0.040	0.055	0.070	0.085	0.100	0.120	0.170
		N-F	unstable conditions	180	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6025 EN-GL250 (GG25), 0.6035 EN-GJL-350 (GG35), 0.7070 EN-GJS-700-2 (GGG70), 0.8170 EN-GJMB-700-2 (GTS70)	above 240 HB 30	N	stable conditions	160	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		N-F	unstable conditions	160	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
N Aluminium, Al-wrought alloys, Al-alloys 3.0255 Al99,5, 3.2315 AlMgSi1, 3.3515 AlMg1 3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 AlMg3Si, 3.4365 AlZnMgCu1,5	up to 3% Si	AL	stable conditions	600	0.020	0.040	0.055	0.070	0.085	0.100	0.120	0.170
		AL-F	unstable conditions	600	0.014	0.028	0.039	0.049	0.060	0.070	0.084	0.119
N Aluminium, Al-wrought alloys, Al-alloys 3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9 3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, - G-AlSi12CuNiMg	above 3% Si	AL	stable conditions	280	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		AL-F	unstable conditions	280	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
N Magnesium-alloys MgMn2, G-MgAl8Zn1, G-MgAl6Zn3	-	AL	stable conditions	220	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		AL-F	unstable conditions	220	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
N Non-ferrous metals (copper, short- or long-chipping brass) 2.0070 SE-Cu, 2.1020 CuSn6, 2.1096 G-CuSn5ZnPb, 2.0380 CuZn39Pb2, 2.0401 CuZn39Pb3, 2.0410 CuZn43Pb2, 2.0250 CuZn20, 2.0280 CuZn33, 2.0332 CuZn37Pb0,5, 2.1090 CuSn7ZnPb, 2.1170 CuPb5Sn5, 2.1176 CuPb10Sn, 2.0916 CuAl5, 2.0960 CuAl9Mn, 2.1050 CuSn10	up to 850 N/mm²	AL	stable conditions	300	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		AL-F	unstable conditions	300	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098



a_p = ≤ 1 x D
a_e = 0.5 - 0.9 x D

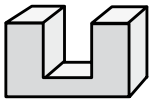
a_p = 1 x D - 2 x D
f_z = 70%

F-UT Slotting

Stable conditions:
- good cooling
- sufficient performance
- short-chipping

Unstable conditions:
- standard cooling
- average performance
- medium- to long-chipping

Material	Hardness / tensile strength	recom-mended F-UT Type	Type of conditions	v_c [m/min]	Feed fz [mm/z] with nom. Ø							
					3	6	8	10	12	16	20	25
P Struct. + free-cutting steels, unalloyed heat-treat. + case hard. steels 1.0035 S185, 1.0486 P275N, 1.0345 P235GH, 1.0050, 1.0070, 1.8937 1.0718 11SMnPb30, 1.0736 11SMn37 1.0402 C22, 1.1178 C30E, 1.0503 C45, 1.1191 C30E 1.0301 C10, 1.1121 C10E, 1.1750 C75W, 1.2076 102Cr6, 1.2307 29CrMoV9	up to 850 N/mm²	N-3	stable conditions	180	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
		N-F	unstable conditions	180	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105
P Free-cutting steels, unalloyed case hardened steels, nitriding steels 1.0727 46 S20, 1.0728 60 S20, 1.0757 46SPb20 1.0601 C60, 1.1221 C60E, 1.7043 38Cr4 1.5752 15NiCr13, 1.7131 16MnCr5, 1.7264 20CrMo5 1.8504 34CrAl6, 1.8519 31CrMoV9, 1.8550 34CrAlNi7	850-1.200 N/mm²	N-3	stable conditions	160	0.018	0.035	0.045	0.060	0.070	0.090	0.100	0.150
		N-F	unstable conditions	160	0.013	0.025	0.032	0.042	0.049	0.063	0.070	0.105
P Alloyed heat-treatable, tool and high speed steels 1.5131 50MnSi4, 1.7003 38Cr2, 1.7030 28Cr4, 1.5710 36NiCr6, 1.7035 41Cr4, 1.7225 42CrMo4, 1.2080 X210Cr12, 1.2083 X42Cr13, 1.2419 105WCr6, 1.2379 X155CrVMo12-1, 1.3243 S 6-5-2-5, 1.3343 S 6-5-2, 1.3344 S 6-5-3 Federstahl = 1.5026 55Si7, 1.7176 55Cr3, 1.8159 51CrV4	850-1.400 N/mm²	N-3	stable conditions	135	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		N-F	unstable conditions	135	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
H Hardened steel Tool steel, heat-treatable steel, spring steel, high-speed steel, case hardened steel, etc. e.g.: 1.2344 X40CrMoV5-1; 1.2767 X45NiCrMo4; 1.2379 X155CrVMo12-1 ;1.2080 X210Cr12 1.3343 S 6-5-2	up to 54 HRC	N-3	stable conditions	70	0.012	0.025	0.030	0.040	0.045	0.060	0.070	0.100
		N-F	unstable conditions	70	0.008	0.018	0.021	0.028	0.032	0.042	0.049	0.070
M Stainless steel 1.4104 X14CrMoS17, 1.4105 X6CrMoS17, 1.4305 X10CrNiS18-9 USA = 303, 410, 420F, 430, 430F	up to 750 N/mm²	VA-X	stable conditions	120	0.015	0.030	0.040	0.050	0.060	0.070	0.090	0.130
		VA-XF	unstable conditions	120	0.011	0.021	0.028	0.035	0.042	0.049	0.063	0.091
M Stainless steel 1.4301X5CrNi18-10, 1.4303 X5CrNi18-12 1.4310 XCrNi18-8 USA = 304, 304L, 420	750-850 N/mm²	VA-X	stable conditions	80	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		VA-XF	unstable conditions	80	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084
M Stainless steel 1.4438 X2CrNiMo18-15-4, 1.4404 X2CrNiMo17-12-2, 1.4571 X6CrNiTi18-10 USA = 310, 316, 316B, 316L, 317	above 850 N/mm²	VA-X	stable conditions	70	0.012	0.025	0.030	0.040	0.045	0.060	0.070	0.100
		VA-XF	unstable conditions	70	0.008	0.018	0.021	0.028	0.032	0.042	0.049	0.070
S Special alloys (nickel based "Ni") Nimonic, Inconel, Monel, Hastelloy	up to 1.300 N/mm²	Ti	stable conditions	30	0.010	0.015	0.020	0.025	0.030	0.040	0.050	0.060
		N-F	unstable conditions	30	0.007	0.011	0.014	0.018	0.021	0.028	0.035	0.042
Ti Titanium alloys ("Ti") 3.7024 Ti99,5, 3.7114 TiAl5Sn2,5, 3.7124 TiCu2 3.7154 TiAl6Zr5, 3.7164 TiAl6V4, 3.7184 TiAl4Mo4Sn2,5	up to 1.300 N/mm²	Ti	stable conditions	60	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		N-F	unstable conditions	60	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6010 EN-GL100 (GG10), 0.6020 EN-GJL-200 (GG20), 0.7050 EN-GJS-500-7 (GGG50), 0.8535 EN-GJMW-350-4 (GTW35)	up to 240 HB 30	N	stable conditions	160	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		N-F	unstable conditions	160	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
K Cast iron, grey cast iron, spheroidal graphite and malleable cast iron 0.6025 EN-GL250 (GG25), 0.6035 EN-GJL-350 (GG35), 0.7070 EN-GJS-700-2 (GGG70), 0.8170 EN-GJMB-700-2 (GTS70)	above 240 HB 30	N	stable conditions	140	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		N-F	unstable conditions	140	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
N Aluminium, Al-wrought alloys, Al-alloys 3.0255 Al99,5, 3.2315 AlMgSi1, 3.3515 AlMg1 3.0615 AlMgSiPb, 3.1325 AlCuMg1, 3.3245 AlMg3Si, 3.4365 AlZnMgCu1,5	up to 3% Si	AL-3	stable conditions	500	0.020	0.040	0.050	0.065	0.080	0.095	0.110	0.160
		AL-F	unstable conditions	500	0.014	0.028	0.035	0.046	0.056	0.067	0.077	0.112
N Aluminium, Al-wrought alloys, Al-alloys 3.2131 G-AlSi5Cu1, 3.2153 G-AlSi7Cu3, 3.2573 G-AlSi9 3.2581 G-AlSi12, 3.2583 G-AlSi12Cu, - G-AlSi12CuNiMg	above 3% Si	AL-3	stable conditions	230	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		AL-F	unstable conditions	230	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
N Magnesium-alloys MgMn2, G-MgAl8Zn1, G-MgAl6Zn3	-	AL-3	stable conditions	180	0.016	0.030	0.040	0.055	0.065	0.080	0.095	0.140
		AL-F	unstable conditions	180	0.011	0.021	0.028	0.039	0.046	0.056	0.067	0.098
N Non-ferrous metals (copper, short- or long-chipping brass) 2.0070 SE-Cu, 2.1020 CuSn6, 2.1096 G-CuSn5ZnPb, 2.0380 CuZn39Pb2, 2.0401 CuZn39Pb3, 2.0410 CuZn43Pb2, 2.0250 CuZn20, 2.0280 CuZn33, 2.0332 CuZn37Pb0,5, 2.1090 CuSn7ZnPb, 2.1170 CuPb5Sn5, 2.1176 CuPb10Sn, 2.0916 CuAl5, 2.0960 CuAl9Mn, 2.1050 CuSn10	up to 850 N/mm²	AL-3	stable conditions	250	0.015	0.025	0.035	0.045	0.050	0.065	0.080	0.120
		AL-F	unstable conditions	250	0.011	0.018	0.025	0.032	0.035	0.046	0.056	0.084



a_p = 0.5 x D - 1 x D a_p = 1 x D - 2 x D
a_e = 1 x D f_z = 70%

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