

***sutton*tools**
world class cutting tools

MICRO SERIES & HI-FEED ENDMILLS



New for 2018

- More sizes
- New solutions
- Higher productivity

Sutton Tools New Hi-Feed series of endmills is designed to bring you premium features with much higher wear resistance and feed rates, due to the 4 & 6 flutes construction that enables the wear to be distributed across more cutting edges. Together with the TiSiN PVD coating, which is renowned for extremely good wear resistance due to the silicon base, it prolongs tool life, enables higher cutting speeds with increased heat resistance making ideal for dry machining.

Tool Design



4 & 6 flutes – enable 2x & 3x the feedrate in comparison with conventional 2 flute tools. Differential pitch design for chatter-free machining and excellent surface finishes.



Edge rounding geometry provide greater improvement to productivity with higher speed & feedrates.



E598 series has neck reduction to avoid heeling, improving performance in off-centre contour milling applications.



Reinforced neck design for stability



E598 series has multiple neck lengths per diameter.

Coating

TiSiN is an extremely wear-resistant, multi-layer coating for high speed and high efficiency machining in minimum or zero lubrication. This tough PVD coating increases wear resistance and performance up to 62HRC.

Profile Ranges

4 Flute CR



6 Flute CR



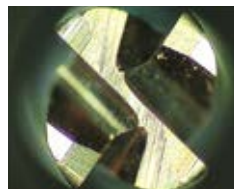
Page No.	Catalogue Code	Tool	Application	Geometry	Tool Material	Coating
4	E650		Hi-Feed	R25-HF Torus	VHM ULTRA	TiSiN
5-7	E598		Hi-Feed Micro	R25-HF Torus	VHM ULTRA	TiSiN

Case Study - Side Milling comparison – Sutton Tools Vs Competitors

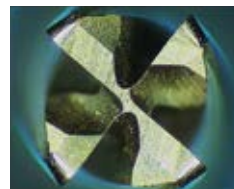
Comparison of Wear Rate

Tool	Sutton Tools E598 Vs Competitor A & B
Machine	Jing Diao
Coolant Size	
Material	SKD 58 HRC
V _c	62.8 m/min
n	20000 RPM
F _z	0.07 mm/tooth
V _f	600 mm/min
Z	4 flutes
Ae	0.02mm
Ap	3mm

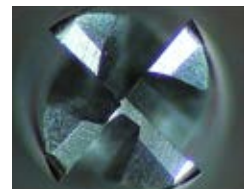
Sutton Tools



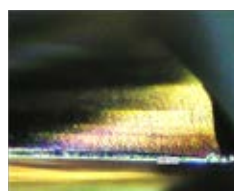
Competitor A



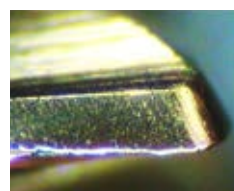
Competitor B



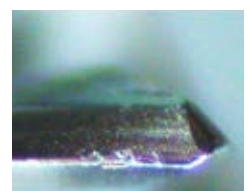
Tool Condition & Average Wear after 38.4 metres of machining



Wear = 0.019mm



Wear = 0.033mm



Wear = 0.021mm

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Sutton Tools range of micro endmills represents world's latest technologies to provide increases in both performance and tool life. The key to successful long-reach or depth machining is to minimise or eliminate the vibration produced in the cutting action. Vibration can be detrimental to the tool life of the endmill and lead to poor surface finish. This problem is typically solved by adjusting the cutting conditions to suit the material group, or by improving the machining conditions such as tool holding or clamping.

Sutton Tools micro endmill range overcomes vibration, through careful tool design, micro geometry & coating, without the need to sacrifice productivity & tool life.

Tool Design



Positive rake angle (10-12°) removes material by slicing through the material rather than by scraping, which in turn reduces the power needed to penetrate the workpiece.



Micro geometry – unique edge geometry for superior surface finish. Hairline margin creates a wiper edge effect, which produces 60-70% better surface smoothness than standard tools.



Neck reduction – to avoid heeling. Improves performance in off-centre contour milling applications.



Reinforced neck design for stability.



Multiple neck length per diameter

Coating

TiSiN is an extremely wear-resistant, multi-layer coating for high speed and high efficiency machining in minimum or zero lubrication. This tough PVD coating increases wear resistance and performance up to 62HRC.

Profile Ranges

Square End (SE)



Corner Radius (CR)



Ball Nose (BN)

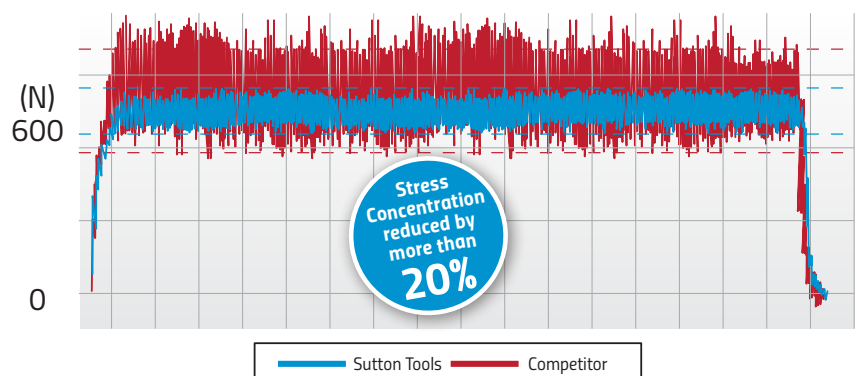


Page No.	Catalogue Code	Tool	Application	Geometry	Tool Material	Coating
8-10	E580		Micro	R40-SE	VHM ULTRA	TiSiN
11	E581		Micro	R40-CR Torus	VHM ULTRA	TiSiN
12	E582		Micro	R40-BN	VHM ULTRA	TiSiN

Case Study - Tool Load comparison – Sutton Tools Vs Competitor

Comparison of Stress Concentration

Tool	Sutton Tools E580 VS. Competitor
Machine	Makino S33 external flood
Coolant Size	2mm
Material	S55C Carbon Steel
V _c	18 m/min
n	3000 RPM (18m/min)
F _z	0.05 mm/tooth
V _f	300 mm/min (0.05mm/z)
Z	2 flutes
Ae	0.15mm
Ap	3mm



Endmills Carbide, 4 Flute, Corner Rad

suttontools

- Increased feedrates
- Tough coating for long tool life
- Variable helix design for chatter-free machining
- Machine Material 35 to 68HRC



Catalogue Code **E650**
Discount Group **B0218**
Material **VHM**
Surface Finish **TISIN**
Application **N**
Geometry R40
Shank Form (DIN 6535) HA
Shank Tolerance h6



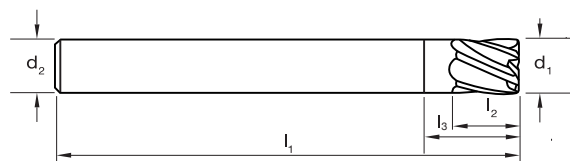
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0202	2	60	2	20	6	4	0.5	E650 0202
0301	3	60	3	21	6	4	0.3	E650 0301
0302	3	60	3	21	6	4	0.5	E650 0302
0401	4	60	4	12	6	4	0.3	E650 0401
0402	4	60	4	12	6	4	0.5	E650 0402
0601	6	60	6	20	6	4	0.3	E650 0601
0602	6	60	6	20	6	4	0.5	E650 0602
0603	6	60	6	20	6	4	1.0	E650 0603

Endmills Carbide, 6 Flute, Corner Rad

- Increased feedrates
- Tough coating for long tool life
- Variable helix design for chatter-free machining
- Machine Material 35 to 68HRC



Catalogue Code **E650**
Discount Group **B0218**
Material **VHM**
Surface Finish **TISIN**
Application **N**
Geometry R40
Shank Form (DIN 6535) HA
Shank Tolerance h6



Size Ref.	d ₁ *	l ₁	l ₂	l ₃	d ₂	z	rad	Item #
0801	8	64	8	24	8	6	0.3	E650 0801
0802	8	64	8	24	8	6	0.5	E650 0802
0803	8	64	8	24	8	6	1.0	E650 0803
0804	8	64	8	24	8	6	2.0	E650 0804
1001	10	75	10	30	10	6	0.3	E650 1001
1002	10	75	10	30	10	6	0.5	E650 1002
1003	10	75	10	30	10	6	1.0	E650 1003
1004	10	75	10	30	10	6	2.0	E650 1004
1201	12	75	12	30	12	6	0.3	E650 1201
1202	12	75	12	30	12	6	0.5	E650 1202
1203	12	75	12	30	12	6	1.0	E650 1203
1204	12	75	12	30	12	6	2.0	E650 1204

ISO	P													M	K								N										S										H						
VDI 3323	1	2	3	4	5	6	7	8	9	10	11	12	13	14.1	14.2	14.3	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37.1	37.2	37.3	37.4	37.5	38.1	38.2	39.1	39.2	40	41
E650				○	●			●	●	●	●	○	○																					○	○	○	●	●						●	●	●	○		
P	Steel	M Stainless Steel													K Cast Iron	N Non-Ferrous Metals								S Titanium & Super Alloys										H Hard Materials	● Optimal ○ Effective														

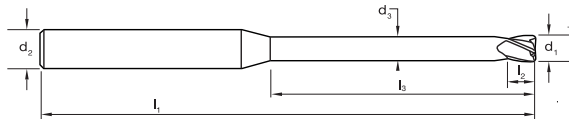
P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials

● Optimal ○ Effective

*Cutting Ø tolerance: d₁ < 0.7 = 0 / -0.012 d₁ > 0.7 = 0 / -0.020

suttontools

- Increased feedrates
- Tough coating for long tool life
- Variable helix design for chatter-free machining
- Machine Material 35 to 68HRC



Catalogue Code **E598**
 Discount Group **B0218**
 Material **VHM**
 Surface Finish **TiSiN**
 Application **N**
 Geometry **R40**
 Shank Form (DIN 6535) **HA**
 Shank Tolerance **h6**

Size Ref.	d ₁ *	l ₁	l ₂	l ₃	d ₂	z	rad	Item #
0102	1	50	1	4	4	4	0.1	E598 0102
0103	1	50	1	6	4	4	0.1	E598 0103
0104	1	50	1	8	4	4	0.1	E598 0104
0105	1	50	1	10	4	4	0.1	E598 0105
0106	1	50	1	12	4	4	0.1	E598 0106
0107	1	50	1	14	4	4	0.1	E598 0107
0108	1	50	1	16	4	4	0.1	E598 0108
0110	1	75	1	20	4	4	0.1	E598 0110
0112	1	50	1	4	4	4	0.2	E598 0112
0113	1	50	1	6	4	4	0.2	E598 0113
0114	1	50	1	8	4	4	0.2	E598 0114
0115	1	50	1	10	4	4	0.2	E598 0115
0116	1	50	1	12	4	4	0.2	E598 0116
0117	1	50	1	14	4	4	0.2	E598 0117
0118	1	50	1	16	4	4	0.2	E598 0118
0120	1	60	1	20	4	4	0.2	E598 0120
0122	1	50	1	6	4	4	0.3	E598 0122
0123	1	50	1	10	4	4	0.3	E598 0123
0124	1	50	1	16	4	4	0.3	E598 0124
0126	1	60	1	20	4	4	0.3	E598 0126
0152	1.5	50	1.5	6	4	4	0.1	E598 0152
0153	1.5	50	1.5	8	4	4	0.1	E598 0153
0154	1.5	50	1.5	12	4	4	0.1	E598 0154
0155	1.5	50	1.5	16	4	4	0.1	E598 0155
0157	1.5	60	1.5	20	4	4	0.1	E598 0157
0159	1.5	50	1.5	6	4	4	0.2	E598 0159
0160	1.5	50	1.5	8	4	4	0.2	E598 0160
0161	1.5	50	1.5	10	4	4	0.2	E598 0161
0162	1.5	50	1.5	12	4	4	0.2	E598 0162
0163	1.5	50	1.5	14	4	4	0.2	E598 0163
0164	1.5	50	1.5	16	4	4	0.2	E598 0164
0166	1.5	60	1.5	18	4	4	0.2	E598 0166
0167	1.5	60	1.5	20	4	4	0.2	E598 0167
0169	1.5	50	1.5	8	4	4	0.3	E598 0169
0170	1.5	50	1.5	16	4	4	0.3	E598 0170
0172	1.5	60	1.5	20	4	4	0.3	E598 0172
0202	2	50	2	6	4	4	0.2	E598 0202
0203	2	50	2	8	4	4	0.2	E598 0203
0204	2	50	2	10	4	4	0.2	E598 0204
0205	2	50	2	12	4	4	0.2	E598 0205

ISO	P													M	K										N										S										H				
VDI 3323	1	2	3	4	5	6	7	8	9	10	11	12	13	14.1	14.2	14.3	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37.1	37.2	37.3	37.4	37.5	38.1	38.2	39.1	39.2	40	41
E598				○	●			●	●	●	●	○	○		●	●																		○	○	○	○	●			●		●	●	○	○	○		

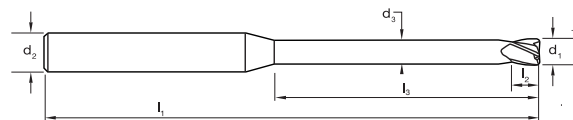
P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials

● Optimal ○ Effective

*Cutting Ø tolerance: d₁ < 0.7 = 0 / -0.012 d₁ > 0.7 = 0 / -0.020

suttontools

- Increased feedrates
- Tough coating for long tool life
- Variable helix design for chatter-free machining
- Machine Material 35 to 68HRC



Catalogue Code **E598**
Discount Group **B0218**
Material **VHM**
Surface Finish **TiSiN**
Application **N**
Geometry **R40**
Shank Form (DIN 6535) **HA**
Shank Tolerance **h6**

Size Ref.	d ₁ *	l ₁	l ₂	l ₃	d ₂	z	rad	Item #
0315	3	60	3	10	6	4	0.3	E598 0315
0316	3	50	3	12	6	4	0.3	E598 0316
0317	3	50	3	14	6	4	0.3	E598 0317
0319	3	60	3	16	6	4	0.3	E598 0319
0320	3	60	3	18	6	4	0.3	E598 0320
0321	3	60	3	20	6	4	0.3	E598 0321
0323	3	75	3	30	6	4	0.3	E598 0323
0325	3	50	3	8	6	4	0.5	E598 0325
0326	3	50	3	10	6	4	0.5	E598 0326
0327	3	50	3	12	6	4	0.5	E598 0327
0328	3	50	3	14	6	4	0.5	E598 0328
0330	3	60	3	16	6	4	0.5	E598 0330
0331	3	60	3	18	6	4	0.5	E598 0331
0332	3	60	3	20	6	4	0.5	E598 0332
0334	3	75	3	30	6	4	0.5	E598 0334
0402	4	60	4	10	6	4	0.3	E598 0402
0403	4	60	4	15	6	4	0.3	E598 0403
0404	4	60	4	20	6	4	0.3	E598 0404
0406	4	75	4	25	6	4	0.3	E598 0406
0407	4	75	4	32	6	4	0.3	E598 0407
0408	4	75	4	40	6	4	0.3	E598 0408
0410	4	60	4	10	6	4	0.5	E598 0410
0411	4	60	4	15	6	4	0.5	E598 0411
0412	4	60	4	20	6	4	0.5	E598 0412
0414	4	75	4	25	6	4	0.5	E598 0414
0415	4	75	4	32	6	4	0.5	E598 0415
0416	4	75	4	40	6	4	0.5	E598 0416

ISO	P													M	K								N												S												H											
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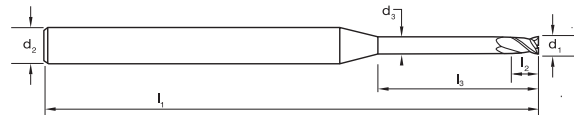
P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials

● Optimal ○ Effective

*Cutting Ø tolerance: d₁ < 0.7 = 0 / -0.012 d₁ > 0.7 = 0 / -0.020

suttontools

- For precision milling of cavities
- Suitable for materials up to 35-62 HRC
- TiSiN for longer tool life
- Positive rake angle (10° - 12°)



Catalogue Code	E580
Discount Group	B0218
Material	VHM
Surface Finish	TiSiN
Application	N
Geometry	R40
Shank Form (DIN 6535)	HA
Shank Tolerance	h6

Size Ref.	d ₁ *	l ₁	l ₂	l ₃	d ₂	d ₃	z	Item #
0122		50	1.8	10	4	1.15	2	E580 0122
0123		50	1.8	12	4	1.15	2	E580 0123
0124		50	1.8	8	4	1.15	2	E580 0124
0141	1.4	50	2.1	6	4	1.35	2	E580 0141
0142		50	2.1	8	4	1.35	2	E580 0142
0143		50	2.1	10	4	1.35	2	E580 0143
0144		50	2.1	12	4	1.35	2	E580 0144
0145		50	2.1	14	4	1.35	2	E580 0145
0146		50	2.1	16	4	1.35	2	E580 0146
0151	1.5	50	2.3	6	4	1.45	2	E580 0151
0152		50	2.3	8	4	1.45	2	E580 0152
0153		50	2.3	12	4	1.45	2	E580 0153
0154		50	2.3	16	4	1.45	2	E580 0154
0155		60	2.3	20	4	1.45	2	E580 0155
0156		50	2.3	10	4	1.45	2	E580 0156
0157		50	2.3	14	4	1.45	2	E580 0157
0158		60	2.3	18	4	1.45	2	E580 0158
0161	1.6	50	2.4	6	4	1.55	2	E580 0161
0162		50	2.4	8	4	1.55	2	E580 0162
0163		50	2.4	10	4	1.55	2	E580 0163
0164		50	2.4	12	4	1.55	2	E580 0164
0165		50	2.4	14	4	1.55	2	E580 0165
0166		50	2.4	16	4	1.55	2	E580 0166
0167		60	2.4	18	4	1.55	2	E580 0167
0168		60	2.4	20	4	1.55	2	E580 0168
0181	1.8	50	2.7	6	4	1.75	2	E580 0181
0182		50	2.7	8	4	1.75	2	E580 0182
0183		50	2.7	10	4	1.75	2	E580 0183
0184		50	2.7	12	4	1.75	2	E580 0184
0185		50	2.7	14	4	1.75	2	E580 0185
0186		50	2.7	16	4	1.75	2	E580 0186
0187		60	2.7	18	4	1.75	2	E580 0187
0188		60	2.7	20	4	1.75	2	E580 0188
0201	2	50	3.0	6	4	1.95	2	E580 0201
0202		50	3.0	8	4	1.95	2	E580 0202
0203		50	3.0	10	4	1.95	2	E580 0203
0204		50	3.0	12	4	1.95	2	E580 0204
0205		50	3.0	16	4	1.95	2	E580 0205
0206		60	3.0	20	4	1.95	2	E580 0206
0207		75	3.0	25	4	1.95	2	E580 0207

ISO	P													M			K					N										S										H							
VDI 3323	1	2	3	4	5	6	7	8	9	10	11	12	13	14.1	14.2	14.3	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37.1	37.2	37.3	37.4	37.5	38.1	38.2	39.1	39.2	40	41
E580				○	●			●	●	●	●	○	○		●	●																		○	○	○	○	●			●		●	●	○	○	○		

P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials

● Optimal ○ Effective

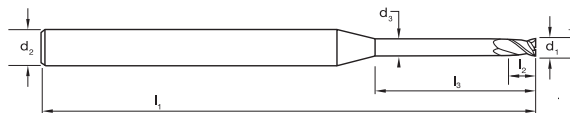
*Cutting Ø tolerance: d₁ < 0.7 = 0 / -0.012 d₁ > 0.7 = 0 / -0.020

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- For precision milling of cavities
- Suitable for materials up to 35-62 HRC
- TiSiN for longer tool life
- Positive rake angle (10° - 12°)



Catalogue Code	E580
Discount Group	B0218
Material	VHM
Surface Finish	TiSiN
Application	N
Geometry	R40
Shank Form (DIN 6535)	HA
Shank Tolerance	h6

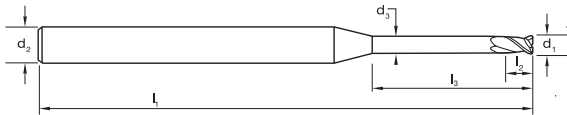


Size Ref.	d1 *	l1	l2	l3	d2	d3	z	Item #
0208	2	50	3	14	4	1.95	2	E580 0208
0209		60	3	18	4	1.95	2	E580 0209
0210		75	3	30	4	1.95	2	E580 0210
0251	2.5	50	3.7	8	4	2.40	2	E580 0251
0252		50	3.7	12	4	2.40	2	E580 0252
0253		50	3.7	10	4	2.40	2	E580 0253
0254		50	3.7	14	4	2.40	2	E580 0254
0255		50	3.7	16	4	2.40	2	E580 0255
0256		60	3.7	18	4	2.40	2	E580 0256
0257		60	3.7	20	4	2.40	2	E580 0257
0258		60	3.7	25	4	2.40	2	E580 0258
0259		75	3.7	30	4	2.40	2	E580 0259
0301	3	60	4.5	16	6	2.85	2	E580 0301
0302		60	4.5	20	6	2.85	2	E580 0302
0303		75	4.5	25	6	2.85	2	E580 0303
0304		50	4.5	8	6	2.85	2	E580 0304
0305		50	4.5	10	6	2.85	2	E580 0305
0306		50	4.5	12	6	2.85	2	E580 0306
0307		50	4.5	14	6	2.85	2	E580 0307
0308		60	4.5	18	6	2.85	2	E580 0308
0401	4	60	4.5	10	6	3.85	2	E580 0401
0401		60	4.5	15	6	3.85	2	E580 0401
0401		60	4.5	20	6	3.85	2	E580 0401
0401		75	4.5	25	6	3.85	2	E580 0401
0401		75	4.5	30	6	3.85	2	E580 0401
0401		75	4.5	40	6	3.85	2	E580 0401

ISO	P													M	K								N										S										H			
VDI 3323	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41					
E580				○	●			●	●	●	●	○	○	●	●																○	○	○	●	●			●	●	○	○	○				
P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials																																														
● Optimal ○ Effective																																														

suttontools

- For precision milling of cavities
- Suitable for materials up to 35-62 HRC
- TiSiN for longer tool life
- Positive rake angle (10° - 12°)



Catalogue Code
Discount Group
Material
Surface Finish
Application
Geometry
Shank Form (DIN 6535)
Shank Tolerance

E581
B0218
VHM
TiSiN
N
R40
HA
h6

Size Ref.	d ₁ *	l ₁	l ₂	l ₃	d ₂	d ₃	z	rad	Item #
0021	0.2	50	0.3	0.5	4	0.16	2	0.02	E581 0021
0022		50	0.3	1	4	0.16	2	0.02	E581 0022
0023		50	0.3	1.5	4	0.16	2	0.02	E581 0023
0041	0.4	50	0.6	2	4	0.37	2	0.03	E581 0041
0042		50	0.6	4	4	0.37	2	0.03	E581 0042
0051	0.5	50	0.7	2	4	0.45	2	0.05	E581 0051
0052		50	0.7	4	4	0.45	2	0.05	E581 0052
0053		50	0.7	6	4	0.45	2	0.05	E581 0053
0061	0.6	50	0.9	4	4	0.55	2	0.05	E581 0061
0062		50	0.9	8	4	0.55	2	0.05	E581 0062
0081	0.8	50	1.2	6	4	0.75	2	0.08	E581 0081
0082		50	1.2	6	4	0.75	2	0.08	E581 0082
0083		50	1.2	8	4	0.75	2	0.08	E581 0083
0101	1	50	1.5	6	4	0.95	2	0.1	E581 0101
0102		50	1.5	8	4	0.95	2	0.1	E581 0102
0103		50	1.5	10	4	0.95	2	0.1	E581 0103
0104		50	1.5	12	4	0.95	2	0.1	E581 0104
0105		50	1.5	16	4	0.95	2	0.1	E581 0105
0121	1.2	50	1.8	6	4	1.15	2	0.1	E581 0121
0122		50	1.8	10	4	1.15	2	0.1	E581 0122
0123		50	1.8	12	4	1.15	2	0.1	E581 0123
0151	1.5	50	2.3	6	4	1.45	2	0.15	E581 0151
0152		50	2.3	8	4	1.45	2	0.15	E581 0152
0153		50	2.3	12	4	1.45	2	0.15	E581 0153
0154		50	2.3	16	4	1.45	2	0.15	E581 0154
0155		60	2.3	20	4	1.45	2	0.15	E581 0155
0201	2	50	3.0	6	4	1.95	2	0.2	E581 0201
0202		50	3.0	8	4	1.95	2	0.2	E581 0202
0203		50	3.0	10	4	1.95	2	0.2	E581 0203
0204		50	3.0	12	4	1.95	2	0.2	E581 0204
0205		50	3.0	16	4	1.95	2	0.2	E581 0205
0206		60	3.0	20	4	1.95	2	0.2	E581 0206
0207		75	3.0	25	4	1.95	2	0.2	E581 0207
0251	2.5	50	3.7	8	4	2.40	2	0.3	E581 0251
0252		50	3.7	12	4	2.40	2	0.3	E581 0252
0301	3	60	4.5	16	6	2.95	2	0.3	E581 0301
0302		60	4.5	20	6	2.95	2	0.3	E581 0302
0303		75	4.5	25	6	2.95	2	0.3	E581 0303

ISO	P													M	K					N											S											H							
VDI 3323	1	2	3	4	5	6	7	8	9	10	11	12	13	14.1	14.2	14.3	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37.1	37.2	37.3	37.4	37.5	38.1	38.2	39.1	39.2	40	41
E581				○	●			●	●	●	●	○	○		●	●																		○	○	○	○	●			●	●	●	○	○	○			

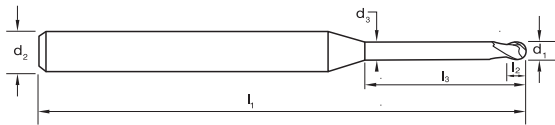
P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials

● Optimal ○ Effective

*Cutting Ø tolerance: d₁ < 0.7 = 0 / -0.012 d₁ > 0.7 = 0 / -0.020

suttontools

- For profile & contour milling in long reach applications
- Suitable for materials up to 35-62 HRC
- TiSiN for longer tool life
- Positive rake angle (10° - 12°)



Catalogue Code	E582
Discount Group	B0218
Material	VHM
Surface Finish	TiSiN
Application	N
Geometry	R30
Shank Form (DIN 6535)	HA
Shank Tolerance	h6

Size Ref.	d ₁ *	l ₁	l ₂	l ₃	d ₂	d ₃	z	rad [†]	Item #
0201	2	50	1.6	6	4	1.95	2	1.0	E582 0201
0202		50	1.6	8	4	1.95	2	1.0	E582 0202
0203		50	1.6	12	4	1.95	2	1.0	E582 0203
0204		50	1.6	16	4	1.95	2	1.0	E582 0204
0205		60	1.6	20	4	1.95	2	1.0	E582 0205
0206		75	1.6	30	4	1.95	2	1.0	E582 0206
0301	3	50	2.4	10	6	2.85	2	1.5	E582 0301
0302		60	2.4	16	6	2.85	2	1.5	E582 0302
0303		75	2.4	25	6	2.85	2	1.5	E582 0303
0304		75	2.4	30	6	2.85	2	1.5	E582 0304

ISO	P													M			K						N										S										H						
VDI 3323	1	2	3	4	5	6	7	8	9	10	11	12	13	14.1	14.2	14.3	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37.1	37.2	37.3	37.4	37.5	38.1	38.2	39.1	39.2	40	41
E582				○	●			●	●	●	●	○	○		●	●																		○	○	○	○	●			●		●	●	○	○			

P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials

● Optimal ○ Effective

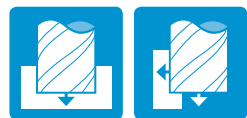
*Cutting Ø tolerance: d₁ < 0.7 = 0 / -0.012 d₁ > 0.7 = 0 / -0.020 †Radius tolerance: Rad = ±0.01



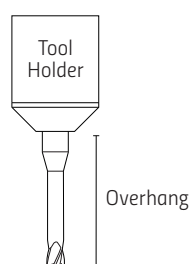
E650 Carbide, 4 Flute, Corner Rad



E650 Carbide, 6 Flute, Corner Rad



ISO			P				S				H				H			
VDI			35 ≤ HRC ≤ 45				-				45 ≤ HRC ≤ 52				≥ 52 - 68 HRC			
Material			Pre-hardened Steel				Nickel Alloy				Hardened Steel				Hardened Steel			
Ø	ae x Ø	ap x Ø	Vc	Fz	n	Vf	Vc	Fz	n	Vf	Vc	Fz	n	Vf	Vc	Fz	n	Vf
2	0.31	0.05	90	0.075	14300	4290	40	0.075	6400	1910	80	0.075	12700	3820	70	0.075	11100	3340
3	0.31	0.05	90	0.120	9500	4560	40	0.120	4200	2030	80	0.120	8500	4070	70	0.120	7400	3560
4	0.31	0.05	90	0.200	7200	5760	40	0.200	3200	2550	80	0.199	6400	5090	70	0.199	5600	4460
6	0.31	0.05	90	0.231	4800	4440	40	0.231	2100	1960	80	0.233	4200	3920	70	0.232	3700	3430
8	0.31	0.05	90	0.375	3600	5400	40	0.375	1600	2390	80	0.373	3200	4770	70	0.373	2800	4180
10	0.31	0.05	90	0.405	2900	4700	40	0.405	1300	2060	80	0.412	2500	4120	70	0.410	2200	3610
12	0.31	0.05	90	0.435	2400	4180	40	0.435	1100	1850	80	0.439	2100	3690	70	0.425	1900	3230

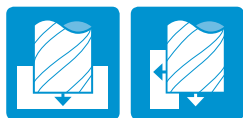


Application Notes:

- Above conditions based on 5xØ overhang
- For 6xØ overhang, reduce ap by 10%
- For 8xØ overhang, reduce ap by 25%
- For 10xØ overhang, reduce ap by 50%
- For plunge in Z-Axis direction or ramping at 1° incline, reduce feed rate between 60% to 70%



E598 Carbide, Micro, 4 Flute, Long Reach, Corner Rad



LEGEND

Ø	= nominal tool diameter (mm)
n	= Spindle speed (RPM ⁻¹)
v _c	= Cutting speed (m/min)
F _z	= Feed rate per tooth (mm/tooth)
v _f	= Feed rate (mm/min)
a _p	= Cutting depth (mm)
a _e	= Cutting width (mm)

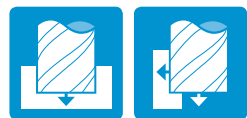
ISO	P					H					H				
VDI	35 ≤ HRC ≤ 45					45 ≤ HRC ≤ 52					≥ 52 - 68 HRC				
Material	Pre-hardened Steel					Hardened Steel					Hardened Steel				
Ø	a _p	v _c	F _z	n	v _f	a _p	v _c	F _z	n	v _f	a _p	v _c	F _z	n	v _f
1	0.030	96	0.020	30600	2480	0.025	85	0.018	27000	1940	0.023	79	0.016	25200	1590
1	0.019	78	0.020	24800	2000	0.016	69	0.018	21900	1570	0.014	64	0.016	20400	1280
1	0.019	69	0.020	22000	1780	0.016	61	0.018	19400	1400	0.014	57	0.016	18100	1140
1	0.012	61	0.020	19300	1560	0.010	53	0.018	17000	1220	0.009	50	0.016	15900	1000
1	0.012	54	0.016	17100	1080	0.010	47	0.016	15100	950	0.009	44	0.013	14100	760
1	0.010	54	0.015	17100	1040	0.008	47	0.015	15100	880	0.007	44	0.012	14100	700
1	0.007	54	0.015	17100	1000	0.006	47	0.013	15100	810	0.005	44	0.011	14100	630
1	0.005	41	0.015	12900	750	0.004	36	0.013	11300	610	0.004	33	0.011	10600	480
1.5	0.052	106	0.022	22500	2000	0.042	94	0.019	20000	1550	0.039	87	0.017	18500	1270
1.5	0.048	101	0.022	21400	1900	0.039	89	0.019	18900	1470	0.036	83	0.017	17600	1210
1.5	0.048	81	0.022	17100	1520	0.039	71	0.019	15100	1170	0.036	66	0.017	14100	970
1.5	0.036	72	0.020	15200	1220	0.029	63	0.018	13400	990	0.027	59	0.016	12500	810
1.5	0.024	63	0.017	13300	920	0.020	56	0.017	11800	810	0.018	52	0.015	11000	640
2	0.064	123	0.042	19600	3310	0.052	109	0.034	17300	2340	0.048	102	0.029	16200	1910
2	0.056	112	0.042	17900	3010	0.046	99	0.034	15800	2120	0.042	92	0.029	14700	1730
2	0.044	102	0.040	16200	2600	0.036	90	0.034	14300	1920	0.033	84	0.03	13300	1570
2	0.032	91	0.038	14500	2190	0.026	80	0.034	12800	1720	0.024	75	0.029	11900	1400
2	0.032	86	0.038	13700	2070	0.026	75	0.034	12000	1620	0.024	70	0.03	11200	1330
2	0.032	81	0.038	12900	1950	0.026	71	0.034	11300	1530	0.024	67	0.029	10600	1250
2	0.030	75	0.038	12000	1830	0.025	67	0.032	10600	1370	0.023	62	0.028	9900	1110
2	0.028	70	0.038	11200	1710	0.023	62	0.030	9900	1200	0.021	58	0.026	9300	980
2	0.020	70	0.038	11200	1710	0.016	62	0.030	9900	1200	0.015	58	0.026	9300	980
2	0.014	67	0.038	10700	1620	0.011	59	0.030	9400	1140	0.010	55	0.026	8800	930
2.5	0.077	119	0.038	15100	2290	0.062	104	0.034	13300	1820	0.058	97	0.03	12400	1490
2.5	0.072	114	0.038	14500	2190	0.059	101	0.034	12800	1720	0.054	93	0.029	11900	1400
2.5	0.067	108	0.038	13800	2100	0.055	96	0.033	12200	1620	0.050	90	0.029	11400	1320
2.5	0.062	104	0.038	13200	2000	0.051	91	0.033	11600	1510	0.047	85	0.028	10800	1230
2.5	0.058	98	0.038	12500	1900	0.047	87	0.032	11100	1410	0.043	81	0.028	10300	1150
2.5	0.053	93	0.038	11900	1800	0.043	82	0.031	10500	1310	0.040	77	0.027	9800	1070
2.5	0.048	88	0.038	11200	1710	0.039	78	0.030	9900	1200	0.036	73	0.026	9300	980
2.5	0.036	86	0.038	11000	1660	0.029	76	0.030	9700	1170	0.027	71	0.027	9000	960
2.5	0.024	84	0.038	10700	1620	0.020	74	0.030	9400	1140	0.018	69	0.026	8800	930
3	0.072	128	0.053	13600	2860	0.059	113	0.042	12000	2020	0.054	106	0.037	11200	1650
3	0.064	128	0.053	13600	2860	0.052	113	0.042	12000	2020	0.048	106	0.037	11200	1650
3	0.056	128	0.053	13600	2860	0.046	113	0.042	12000	2020	0.042	106	0.037	11200	1650
3	0.048	128	0.053	13600	2860	0.039	113	0.042	12000	2020	0.036	106	0.037	11200	1650
3	0.040	128	0.053	13600	2860	0.033	113	0.042	12000	2020	0.030	106	0.037	11200	1650
3	0.040	115	0.053	12200	2570	0.033	100	0.042	10600	1790	0.030	95	0.037	10100	1490
3	0.040	104	0.053	11000	2320	0.033	91	0.042	9700	1640	0.030	86	0.037	9100	1340
3	0.036	92	0.050	9800	1970	0.029	81	0.041	8600	1400	0.027	76	0.035	8100	1140
3	0.032	81	0.047	8600	1620	0.026	72	0.038	7600	1160	0.024	67	0.033	7100	930
4	0.184	147	0.065	11700	3060	0.150	131	0.052	10400	2160	0.138	122	0.045	9700	1760
4	0.164	134	0.065	10700	2780	0.133	117	0.052	9300	1940	0.123	109	0.046	8700	1590
4	0.144	121	0.065	9600	2510	0.117	103	0.052	8200	1720	0.108	98	0.046	7800	1420
4	0.136	109	0.062	8700	2170	0.111	96	0.049	7600	1500	0.102	89	0.044	7100	1240
4	0.120	99	0.058	7900	1830	0.098	87	0.046	6900	1280	0.090	80	0.041	6400	1050
4	0.104	88	0.054	7000	1500	0.085	78	0.043	6200	1060	0.078	73	0.037	5800	860



E580 Carbide, Micro, 2 Flute, Long Reach, **Sq End**



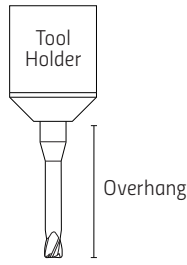
E581 Carbide, Micro, 2 Flute, **Corner Rad**



ISO			P					M				
VDI			5, 8, 9, 10, 11					14.2, 14.3				
Material			Steel - Low alloy & cast Steel - High alloy, cast & tool					Stainless Steel				
Ø	l _s	ae x Ø	ap	Vc	Fz	n	Vf	ap	Vc	Fz	n	Vf
0.2	0.5	1.0	0.028	25	0.003	40000	240	0.028	25	0.003	40000	240
0.2	1	1.0	0.011	23	0.003	37400	210	0.011	23	0.003	37400	210
0.2	1.5	1.0	0.008	22	0.003	34800	182	0.008	22	0.003	34800	182
0.4	2	1.0	0.022	47	0.004	37400	280	0.022	47	0.004	37400	280
0.4	4	1.0	0.011	37	0.003	29600	175	0.011	37	0.003	29600	175
0.5	2	1.0	0.035	62	0.007	39099	513	0.035	62	0.007	39099	513
0.5	4	1.0	0.018	50	0.005	31474	332	0.018	50	0.005	31474	332
0.5	6	1.0	0.012	42	0.004	26391	234	0.012	42	0.004	26391	234
0.6	4	1.0	0.028	59	0.007	31246	423	0.028	59	0.007	31246	423
0.6	6	1.0	0.017	50	0.006	26577	306	0.017	50	0.006	26577	306
0.8	4	1.0	0.045	65	0.007	26042	410	0.045	65	0.007	26042	410
0.8	6	1.0	0.032	61	0.007	24231	355	0.032	61	0.007	24231	355
0.8	8	1.0	0.022	52	0.006	20610	257	0.022	52	0.006	20610	257
1.0	6	1.0	0.047	61	0.008	19385	337	0.047	61	0.008	19385	337
1.0	8	1.0	0.035	56	0.008	17937	289	0.035	56	0.008	17937	289
1.0	10	1.0	0.028	52	0.007	16489	244	0.028	52	0.007	16489	244
1.0	12	1.0	0.023	47	0.006	15040	203	0.023	47	0.006	15040	203
1.0	16	1.0	0.018	38	0.005	12144	132	0.018	38	0.005	12144	132
1.2	6	1.0	0.067	65	0.010	17361	357	0.067	65	0.010	17361	357
1.2	10	1.0	0.042	56	0.008	14947	265	0.042	56	0.008	14947	265
1.2	12	1.0	0.034	52	0.008	13740	224	0.034	52	0.008	13740	224
1.5	6	1.0	0.105	70	0.013	14855	391	0.105	70	0.013	14855	391
1.5	8	1.0	0.084	65	0.012	13889	341	0.084	65	0.012	13889	341
1.5	12	1.0	0.053	56	0.010	11958	253	0.053	56	0.010	11958	253
1.5	16	1.0	0.042	52	0.009	10992	214	0.042	52	0.009	10992	214
1.5	20	1.0	0.032	47	0.008	10027	178	0.032	47	0.008	10027	178
2.0	6	1.0	0.187	70	0.015	11141	350	0.187	70	0.015	11141	350
2.0	8	1.0	0.140	70	0.015	11141	350	0.140	70	0.015	11141	350
2.0	10	1.0	0.112	65	0.014	10416	306	0.112	65	0.014	10416	306
2.0	12	1.0	0.093	61	0.013	9692	265	0.093	61	0.013	9692	265
2.0	16	1.0	0.070	56	0.012	8968	227	0.070	56	0.012	8968	227
2.0	20	1.0	0.056	52	0.011	8244	192	0.056	52	0.011	8244	192
2.0	25	1.0	0.047	47	0.010	7520	159	0.047	47	0.010	7520	159
2.5	8	1.0	0.233	70	0.018	8913	336	0.233	70	0.018	8913	336
2.5	12	1.0	0.175	70	0.018	8913	336	0.175	70	0.018	8913	336
3.0	16	1.0	0.168	65	0.020	6944	285	0.168	65	0.020	6944	285
3.0	20	1.0	0.140	61	0.018	6461	247	0.140	61	0.018	6461	247
3.0	25	1.0	0.105	56	0.017	5979	212	0.105	56	0.017	5979	212

LEGEND

ϕ	= nominal tool diameter (mm)
n	= Spindel speed (RPM ⁻¹)
v_c	= Cutting speed (m/min)
F_z	= Feed rate per tooth (mm/tooth)
v_f	= Feed rate (mm/min)
a_p	= Cutting depth (mm)
a_e	= Cutting width (mm)



Application Notes:

- Above conditions based on 5x ϕ overhang
- For 6x ϕ overhang, reduce ap by 10%
- For 8x ϕ overhang, reduce ap by 25%
- For 10x ϕ overhang, reduce ap by 50%
- For plunge in Z-Axis direction or ramping at 1°incline, reduce feed rate between 60% to 70%

ISO			S					H				
VDI			34, 35, 37.3, 37.5					38.1				
Material			High temp. alloys Titanium & Ti alloys					Hardened Steel				
ϕ	l_3	$a_e \times \phi$	a_p	V_c	F_z	n	V_f	a_p	V_c	F_z	n	V_f
0.2	0.5	1.0	0.028	25	0.003	40000	240	0.040	25	0.003	40000	240
0.2	1	1.0	0.011	23	0.003	37400	210	0.016	23	0.003	37400	210
0.2	1.5	1.0	0.008	22	0.003	34800	182	0.011	22	0.003	34800	182
0.4	2	1.0	0.022	47	0.004	37400	280	0.032	47	0.004	37400	280
0.4	4	1.0	0.011	37	0.003	29600	175	0.016	37	0.003	29600	175
0.5	2	1.0	0.035	62	0.007	39099	513	0.050	63	0.004	40000	320
0.5	4	1.0	0.018	50	0.005	31474	332	0.025	51	0.003	32200	207
0.5	6	1.0	0.012	42	0.004	26391	234	0.017	43	0.003	27000	146
0.6	4	1.0	0.028	59	0.007	31246	423	0.040	63	0.007	33554	443
0.6	6	1.0	0.017	50	0.006	26577	306	0.024	54	0.006	28540	321
0.8	4	1.0	0.045	65	0.007	26042	410	0.064	75	0.007	29762	466
0.8	6	1.0	0.032	61	0.007	24231	355	0.046	70	0.007	27693	404
0.8	8	1.0	0.022	52	0.006	20610	257	0.032	59	0.006	23555	292
1.0	6	1.0	0.047	61	0.008	19385	337	0.067	70	0.008	22155	383
1.0	8	1.0	0.035	56	0.008	17937	289	0.050	64	0.008	20499	328
1.0	10	1.0	0.028	52	0.007	16489	244	0.040	59	0.007	18844	277
1.0	12	1.0	0.023	47	0.006	15040	203	0.033	54	0.006	17189	231
1.0	16	1.0	0.018	38	0.005	12144	132	0.025	44	0.005	13878	150
1.2	6	1.0	0.067	65	0.010	17361	357	0.096	75	0.010	19841	406
1.2	10	1.0	0.042	56	0.008	14947	265	0.060	64	0.008	17083	301
1.2	12	1.0	0.034	52	0.008	13740	224	0.048	59	0.008	15703	254
1.5	6	1.0	0.105	70	0.013	14855	391	0.150	80	0.013	16977	444
1.5	8	1.0	0.084	65	0.012	13889	341	0.120	75	0.012	15873	388
1.5	12	1.0	0.053	56	0.010	11958	253	0.075	64	0.010	13666	287
1.5	16	1.0	0.042	52	0.009	10992	214	0.060	59	0.009	12563	243
1.5	20	1.0	0.032	47	0.008	10027	178	0.046	54	0.008	11459	202
2.0	6	1.0	0.187	70	0.015	11141	350	0.267	80	0.015	12733	398
2.0	8	1.0	0.140	70	0.015	11141	350	0.200	80	0.015	12733	398
2.0	10	1.0	0.112	65	0.014	10416	306	0.160	75	0.014	11905	348
2.0	12	1.0	0.093	61	0.013	9692	265	0.133	70	0.013	11077	301
2.0	16	1.0	0.070	56	0.012	8968	227	0.100	64	0.012	10250	258
2.0	20	1.0	0.056	52	0.011	8244	192	0.080	59	0.011	9422	218
2.0	25	1.0	0.047	47	0.010	7520	159	0.067	54	0.010	8594	181
2.5	8	1.0	0.233	70	0.018	8913	336	0.333	80	0.018	10186	382
2.5	12	1.0	0.175	70	0.018	8913	336	0.250	80	0.018	10186	382
3.0	16	1.0	0.168	65	0.020	6944	285	0.240	75	0.020	7936	325
3.0	20	1.0	0.140	61	0.018	6461	247	0.200	70	0.018	7385	281
3.0	25	1.0	0.105	56	0.017	5979	212	0.150	64	0.017	6833	241

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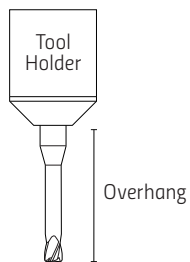


E582 Carbide, Micro, 2 Flute, Long Reach, **Ballnose**



ISO				P				M			
VDI				5, 8, 9, 10, 11				14.2, 14.3			
Material				Steel - Low alloy & cast Steel - High alloy, cast & tool				Stainless Steel			
ϕ	l_s	$a_e \times \phi$	$a_p \times \phi$	Vc	Fz	n	Vf	Vc	Fz	n	Vf
0.2	0.5	0.05	0.20	25	0.003	40000	240	25	0.003	40000	240
0.2	1	0.05	0.20	25	0.003	40000	240	25	0.003	40000	240
0.2	1.5	0.05	0.15	21	0.002	34000	144	21	0.002	34000	144
0.4	2	0.05	0.20	50	0.004	40000	320	50	0.004	40000	320
0.4	4	0.02	0.10	35	0.003	28000	160	35	0.003	28000	160
0.5	2	0.05	0.20	62	0.006	39099	433	62	0.006	39099	433
0.5	6	0.02	0.10	43	0.004	27369	217	43	0.004	27369	217
0.6	2	0.05	0.20	68	0.006	35916	448	68	0.006	35916	448
0.6	4	0.05	0.15	57	0.004	30528	269	57	0.004	30528	269
0.6	6	0.02	0.10	47	0.004	25141	224	47	0.004	25141	224
0.6	8	0.02	0.10	47	0.004	25141	224	47	0.004	25141	224
0.8	4	0.05	0.20	70	0.007	27852	406	70	0.007	27852	406
0.8	6	0.05	0.15	60	0.005	23674	244	60	0.005	23674	244
0.8	8	0.02	0.10	49	0.005	19496	203	49	0.005	19496	203
1.0	4	0.05	0.20	70	0.009	22282	395	70	0.009	22282	395
1.0	6	0.05	0.15	60	0.006	18940	237	60	0.006	18940	237
1.0	8	0.05	0.15	60	0.006	18940	237	60	0.006	18940	237
1.0	10	0.02	0.10	49	0.006	15597	197	49	0.006	15597	197
1.0	12	0.02	0.10	49	0.006	15597	197	49	0.006	15597	197
1.0	14	0.02	0.10	49	0.006	15597	197	49	0.006	15597	197
1.0	20	0.02	0.10	42	0.006	13369	158	42	0.006	13369	158
1.2	8	0.05	0.15	60	0.006	15783	210	60	0.006	15783	210
1.2	10	0.05	0.15	60	0.006	15783	210	60	0.006	15783	210
1.2	12	0.02	0.10	49	0.006	12998	175	49	0.006	12998	175
2.0	6	0.05	0.20	70	0.014	11141	315	70	0.014	11141	315
2.0	8	0.05	0.20	70	0.014	11141	315	70	0.014	11141	315
2.0	12	0.05	0.15	60	0.010	9469	189	60	0.010	9469	189
2.0	16	0.05	0.15	60	0.010	9469	189	60	0.010	9469	189
2.0	20	0.02	0.10	49	0.010	7798	158	49	0.010	7798	158
2.0	30	0.02	0.10	49	0.010	7798	158	49	0.010	7798	158
3.0	10	0.05	0.20	70	0.019	7427	289	70	0.019	7427	289
3.0	16	0.05	0.20	70	0.019	7427	289	70	0.019	7427	289
3.0	25	0.05	0.15	60	0.013	6313	173	60	0.013	6313	173
3.0	30	0.02	0.10	49	0.013	5199	144	49	0.013	5199	144

LEGEND	
Ø	= nominal tool diameter (mm)
n	= Spindel speed (RPM ⁻¹)
V _c	= Cutting speed (m/min)
F _z	= Feed rate per tooth (mm/tooth)
V _f	= Feed rate (mm/min)
a _p	= Cutting depth (mm)
a _e	= Cutting width (mm)

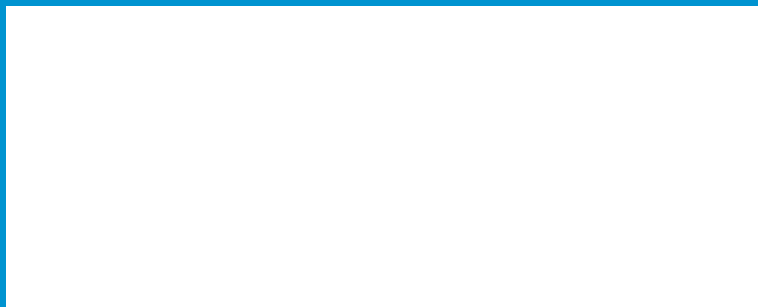


Application Notes:

- Above conditions based on 5xØ overhang
- For 6xØ overhang, reduce ap by 10%
- For 8xØ overhang, reduce ap by 25%
- For 10xØ overhang, reduce ap by 50%
- For plunge in Z-Axis direction or ramping at 1°incline, reduce feed rate between 60% to 70%

ISO				S				H			
VDI				34, 35, 37.3, 37.5				38.1			
Material				High temp. alloys Titanium & Ti alloys				Hardened Steel			
Ø	l ₃	ae x Ø	ap x Ø	V _c	F _z	n	V _f	V _c	F _z	n	V _f
0.2	0.5	0.05	0.20	25	0.003	40000	240	25	0.003	40000	240
0.2	1	0.05	0.20	25	0.003	40000	240	25	0.003	40000	240
0.2	1.5	0.05	0.15	21	0.002	34000	144	21	0.002	34000	144
0.4	2	0.05	0.20	50	0.004	40000	320	50	0.004	40000	320
0.4	4	0.02	0.10	35	0.003	28000	160	35	0.003	28000	160
0.5	2	0.05	0.20	62	0.006	39099	433	63	0.004	40000	320
0.5	6	0.02	0.10	43	0.004	27369	217	44	0.003	28000	160
0.6	2	0.05	0.20	68	0.006	35916	448	73	0.006	38568	469
0.6	4	0.05	0.15	57	0.004	30528	269	62	0.004	32783	281
0.6	6	0.02	0.10	47	0.004	25141	224	51	0.004	26998	234
0.6	8	0.02	0.10	47	0.004	25141	224	51	0.004	26998	234
0.8	4	0.05	0.20	70	0.007	27852	406	80	0.007	31831	462
0.8	6	0.05	0.15	60	0.005	23674	244	68	0.005	27056	277
0.8	8	0.02	0.10	49	0.005	19496	203	56	0.005	22282	231
1.0	4	0.05	0.20	70	0.009	22282	395	80	0.009	25465	449
1.0	6	0.05	0.15	60	0.006	18940	237	68	0.006	21645	269
1.0	8	0.05	0.15	60	0.006	18940	237	68	0.006	21645	269
1.0	10	0.02	0.10	49	0.006	15597	197	56	0.006	17826	224
1.0	12	0.02	0.10	49	0.006	15597	197	56	0.006	17826	224
1.0	14	0.02	0.10	49	0.006	15597	197	56	0.006	17826	224
1.0	20	0.02	0.10	42	0.006	13369	158	48	0.006	15279	179
1.2	8	0.05	0.15	60	0.006	15783	210	68	0.006	18037	239
1.2	10	0.05	0.15	60	0.006	15783	210	68	0.006	18037	239
1.2	12	0.02	0.10	49	0.006	12998	175	56	0.006	14854	199
2.0	6	0.05	0.20	70	0.014	11141	315	80	0.014	12733	359
2.0	8	0.05	0.20	70	0.014	11141	315	80	0.014	12733	359
2.0	12	0.05	0.15	60	0.010	9469	189	68	0.010	10823	215
2.0	16	0.05	0.15	60	0.010	9469	189	68	0.010	10823	215
2.0	20	0.02	0.10	49	0.010	7798	158	56	0.010	8913	179
2.0	30	0.02	0.10	49	0.010	7798	158	56	0.010	8913	179
3.0	10	0.05	0.20	70	0.019	7427	289	80	0.019	8488	328
3.0	16	0.05	0.20	70	0.019	7427	289	80	0.019	8488	328
3.0	25	0.05	0.15	60	0.013	6313	173	68	0.013	7215	197
3.0	30	0.02	0.10	49	0.013	5199	144	56	0.013	5942	164

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Australia (Head Office) 378 Settlement Road, Thomastown 3074, Victoria Australia
T +61 3 9280 0800 **F** +61 3 9464 0015 **E** cservice@sutton.com.au

The Netherlands (Europe Head Office) Postbus 2092, 5001 CA Tilburg, Jellinghausstraat 28, 5048 AZ Tilburg, The Netherlands
T +31 13 220 1480 **E** suttontools.eu@sutton.com.au

France **T** +33 788 557 404 **E** suttontools.fr@sutton.com.au

UK and Ireland **T** +44 (0) 7725 846 432 **E** suttontools.uk@sutton.com.au

Central and Eastern Europe **T** +421 948 520 246 **E** suttontools.eeu@sutton.com.au

Spain **T** +34 648 020 098 **E** suttontools.es@sutton.com.au

www.suttontools.com