

HARMONY AI

ALUMINIUM MACHINING



sutton tools

VS

Traditional

Trochoidal

Dynamic & Trochoidal Milling

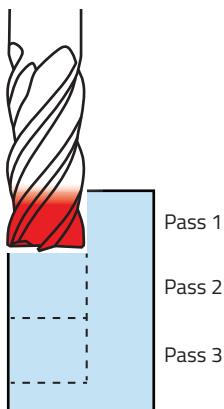
Dynamic/Trochoidal Milling strategies provide a tool engagement angle with the workpiece that utilises more of the cutting edge of the tool, ensuring a stable process, shorter machining times & longer tool life.

Dynamic & Trochoidal method - Applies a lower radial step-over (ae) & a higher depth of cut (ap), spreading the wear, loads & heat across the entire cutting edge.

Dynamic & Trochoidal milling, adjusts the parameters to maintain a constant load on the tool, providing more aggressive metal material rates (MRR).

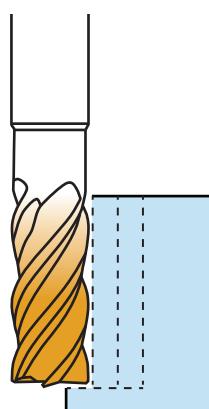
Dynamic & Trochoidal milling, requires a CAM package to generate the tool path & virtually any CNC machine.

Traditional



Traditional methods are typically higher step-over & lower depth of cut.

Trochoidal



Dynamic & Trochoidal is mostly based on the theory of radial chip thinning that occurs with varying ae which relates to chip thickness and feed per tooth.

Advantages of Dynamic & Trochoidal Milling

- Decreased cutting forces
- Reduced heat
- Reduced tool wear
- Suitable for lower power machines
- Greater machining accuracy
- Spindle & machine friendly
- Improved tool life
- Faster cycle time
- One tool for multiple slot sizes (trochoidal)
- Thin wall applications

Page	Item Code	Tool	Diameter range	Type	DIN6535	No. of Flutes	Geometry	Surface Finish	Standard	Non-Ferrous Metals			
4	E400		6mm to 25mm	Square End	HA	HB	3	R45/46/44	CrN	DIN6527 L			
	E401												
5	E402		6mm to 25mm	Square End	HA	HB	3	R45/46/44	CrN	Sutton Std			
	E403												
6	E408		2mm to 20mm	Corner Radius	HA	HB	3	R40	Vn Coated (Polished)	DIN6527 L			
	E409												
7	E310		12mm to 20mm	Square End	HA	2	R40	CrN	DIN6527 L	DIN6527 L			
8	E480		3mm to 20mm	Corner Radius	HA	3	R45/46/44						
9	E478		3mm to 20mm	Square/Corner Radius	HA	3							

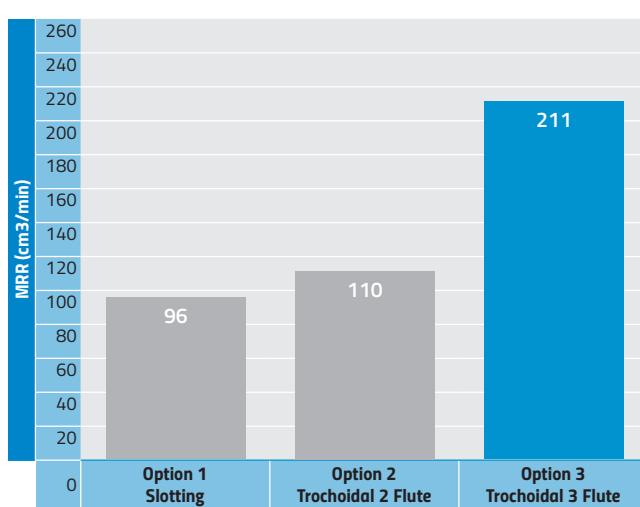
Producing 20mm Slots in Aluminium

Option 1 Using a **20mm 2-flute endmill** results in high vibration with an under-utilised cutting edge with two passes to get to the full depth. It is a more expensive option due to the larger tool size.

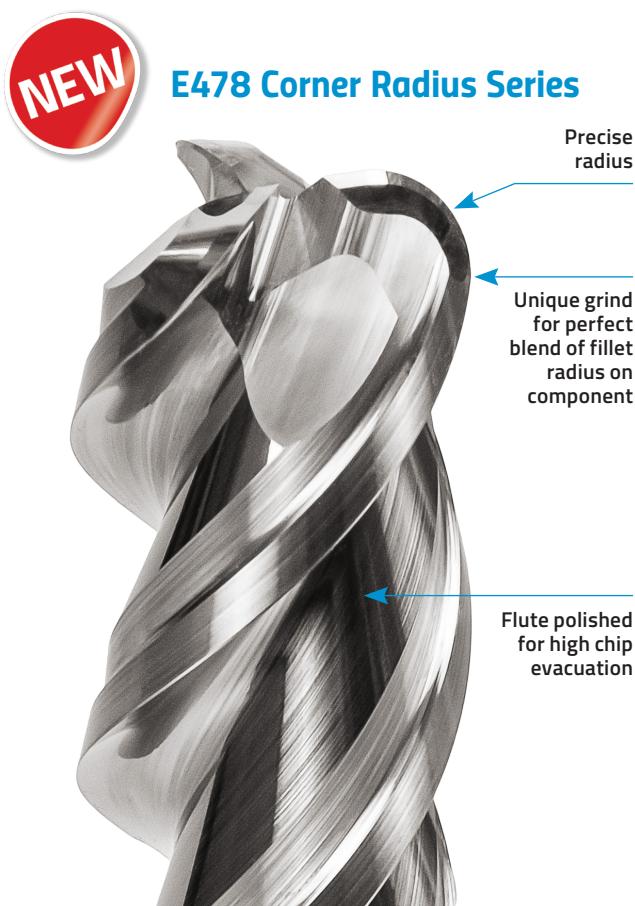
Option 2 Using a **12mm 2-flute endmill in trochoidal milling** provides a much higher metal removal rate with smoother cut, resulting an all-round stable cutting environment as well as a lower tool cost.

Option 3 Using a **12mm 3-flute endmill in trochoidal milling** similar to Option 2. The design of this tool has a variable helix and when used with trochoidal methods, at least two of the cutting edges are always engaged in the depth of cut (in this case $ap=24\text{mm}$). The variable helix design also suppresses the vibration caused from the interrupted cutting action of milling. This means that greater speeds are possible, increasing the volume of material removed (MRR) dramatically.

Test Data	Option 1 Slitting	Option 2 Trochoidal 2 Flute	Option 3 Trochoidal 3 Flute
Tool	R40 Al	R40 Al	R42/43/44 HARMONY Al
Part No. / Reference	E3102000	E3101200	E4001200
Tool Diameter (mm)	20	12	12
Z (teeth number)	2	2	3
ae (mm)	20	2	2
ap (mm) / depth	12 + 12 (2 passes)	24 (single pass)	24 (single pass)
RPM	1600	5300	6600
Feed Rate (mm/min)	200	2300	4400



At Sutton Tools, we often talk about 'Good, Better, Best' when diagnosing the right cutting tool for an application. The above example illustrates this concept well. Our R&D Team are continuously running similar tests to determine the Good, Better or Best tooling solution for our customers' unique requirements.





- VHM-ULTRA grade of carbide for high performance
 - Variable flute helix for chatter free milling
 - Optimised geometry for soft materials
 - CrN for copper and non-ferrous materials



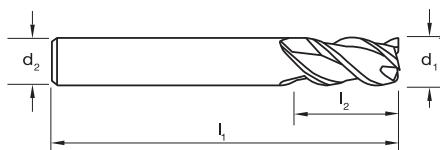
Fraise 3 dents carbure, R45/46/44 Al,
DIN6527L Harmony

- Carbure VHM Ultra pour une meilleure performance
 - Hélice variable pour la suppression des vibrations
 - Géométrie optimisée pour les matériaux légers
 - Revêtement CrN pour les cuivres et non-ferreux



**Frese metallo duro, 3 Taglienti, R45/46/44 Al,
DIN6527L, Harmony**

- VHM-ULTRA, grado di metallo duro per alte prestazione
 - Elica tagliente variabile per lavorazioni senza vibrazioni
 - Geometria ottimizzata per materiali morbidi
 - CrN specifico per le lavorazioni di rame e materiali non ferrosi



Fresas de MD, 3 ranuras, R45/46/44 Al, DIN6527L, Harmony

- Grado de MD, VHM-ULTRA para alto rendimiento
 - Hélice de ranura variable para fresado sin vibraciones
 - Geometría optimizada para materiales blandos
 - CrN para cobres y materiales no ferrosos



Catalogue Code	E400	E401
Discount Group	B0210	B0210
Material	VHM-ULTRA	VHM-ULTRA
Surface Finish	CrN	CrN
Sutton Designation	AI	AI
Geometry	R45/46/44	R45/46/44
Shank Form (DIN 6535)	HA	HB
Shank Tolerance	h5	h5

Size Ref.	d ₁ (e8)	I ₁	I ₂	d ₂	z	rad	Item #	Item #
0600	6.0	57	13	6	3	0.2	E400 0600	E401 0600
0800	8.0	63	19	8	3	0.2	E400 0800	E401 0800
1000	10.0	72	24	10	3	0.3	E400 1000	E401 1000
1200	12.0	83	28	12	3	0.4	E400 1200	E401 1200
1400	14.0	83	30	14	3	0.4	E400 1400	E401 1400
1600	16.0	92	35	16	3	0.5	E400 1600	E401 1600
1800	18.0	92	38	18	3	0.5	E400 1800	E401 1800
2000	20.0	104	42	20	3	0.6	E400 2000	E401 2000
2500	25.0	120	50	25	3	0.6	E400 2500	E401 2500

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

● Optimal ○ Effective



- VHM-ULTRA grade of carbide for high performance
 - Variable flute helix for chatter free milling
 - Optimised geometry for soft materials
 - CrN for copper and non-ferrous materials



Fraise 3 dents carbure, R45/46/44 Al, Longue Harmony

- Carbure VHM-ULTRA pour une meilleure performance
 - Hélice variable pour la suppression des vibrations
 - Géométrie optimisée et revêtement CrN pour les non-ferreux et cuivres



**Frese metallo duro, 3 Taglienti, R45/46/44 Al,
Lunga Portata. Harmony**

- VHM-ULTRA, grado di metallo duro per alte prestazioni
 - Elica tagliente variabile per lavorazioni senza vibrazioni
 - Geometria ottimizzata per materiali morbidi
 - CrN specifico per le lavorazioni di rame e materiali non ferrosi

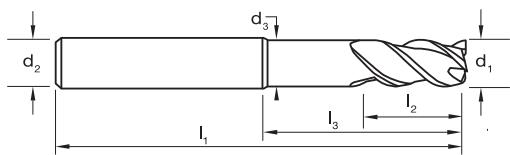


Fresas de MD, 3 ranuras, R45/46/44 Al, Larga, Harmony

- Grado de MD, VHM-ULTRA para alto rendimiento
 - Hélice de ranura variable para fresado sin vibraciones
 - Geometría optimizada para materiales blandos
 - CrN para cobres y materiales no ferrosos



Catalogue Code	E402	E403
Discount Group	B0210	B0210
Material	VHM-ULTRA	VHM-ULTRA
Surface Finish	CrN	CrN
Sutton Designation	AI	AI
Geometry	R45/46/44	R45/46/44
Shank Form (DIN 6535)	HA	HB
Shank Tolerance	h5	h5



Shaft Features										Item #	Item #
Size Ref.	d ₁ (k10)	I ₁	I ₂	I ₃	d ₂	d ₃	z	rad			
0600	6.0	62	7	24	6	5.0	3	0.2		E402 0600	
0800	8.0	68	9	30	8	7.0	3	0.2		E402 0800	
1000	10.0	80	12	38	10	9.0	3	0.3		E402 1000	E403 1000
1200	12.0	93	14	46	12	11.0	3	0.4		E402 1200	E403 1200
1400	14.0	93	16	46	14	13.0	3	0.4		E402 1400	E403 1400
1600	16.0	108	18	58	16	15.0	3	0.5		E402 1600	E403 1600
1800	18.0	108	20	58	18	17.0	3	0.5		E402 1800	E403 1800
2000	20.0	126	22	74	20	19.0	3	0.6		E402 2000	E403 2000
2500	25.0	150	27	92	25	24.0	3	0.6		E402 2500	E403 2500

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

- Optimal ○ Effective



- VHM-ULTRA grade of carbide for high performance
 - Variable flute helix for chatter free milling
 - Optimised geometry for soft materials
 - CrN for copper and non-ferrous materials



Fraise 3 dents carbure, Hémisphérique, R45/46/44

Longue, Harmony

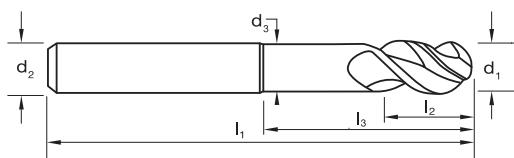
- Carbure VHM-ULTRA pour une meilleure performance
 - Pour le fraisage de formes et de poches profondes
 - Hélice variable pour la suppression des vibrations
 - Géométrie optimisée et revêtement CrN pour les non-ferreux et cuivres



Frese metallo duro, Sferiche, 3 Taglienti, R45/46/44 Al,

Lunga Portata, Harmony

- VHM-ULTRA, grado di metallo duro per alte prestazioni
 - Elica tagliente variabile per lavorazioni senza vibrazioni
 - Geometria ottimizzata per materiali morbidi
 - CrN specifico per le lavorazioni di rame e materiali non ferrosi



Catalogue Code	E408	E409
Discount Group	B0210	B0210
Material	VHM-ULTRA	VHM-ULTRA
Surface Finish	<i>CrN</i>	<i>CrN</i>
Sutton Designation	AI	AI
Geometry	R45/46/44	R45/46/44
Shank Form (DIN 6535)	HA	HB
Shank Tolerance	h5	h5

Size Ref.	d ₁ (e8)	I ₁	I ₂	I ₃	d ₂	z	Item #	Item #
0600	6.0	62	9	24	6	3	E408 0600	E409 0600
0800	8.0	68	12	30	8	3	E408 0800	E409 0800
1000	10.0	80	15	38	10	3	E408 1000	E409 1000
1200	12.0	93	18	46	12	3	E408 1200	E409 1200
1400	14.0	93	21	46	14	3	E408 1400	E409 1400
1600	16.0	108	24	58	16	3	E408 1600	E409 1600
1800	18.0	108	27	58	18	3	E408 1800	E409 1800
2000	20.0	126	30	74	20	3	E408 2000	E409 2000
2500	25.0	150	38	92	25	3	E408 2500	E409 2500

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

● Optimal ○ Effective



- For precision milling of slots & cavities
 - Optimised geometry for aluminiums & non-ferrous materials
 - High speed & high feed rates can be achieved
 - Highly efficient chip disposal



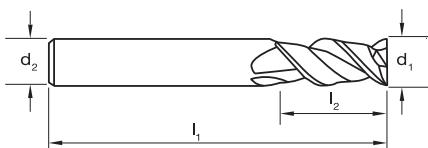
Fraise 2 dents carbure, R40 Al, courte

- Pour le fraisage de rainures, de poches dans les aluminiums et non-ferreux
 - Utilisable en haute vitesse
 - Evacuation copeaux optimale



Frese metallo duro, 2 Taglienti, R40 AlCarb, DIN6527L

- Fresa universale per cave e lavorazioni di finitura
 - Geometria tagliente ottimizzata per materiali non ferrosi & alluminio
 - Supporta alti avanzamenti e alte velocità di taglio
 - Elevata evaquazione truciolo



Size Ref.	d ₁ (h10)	I ₁	I ₂	I ₃	d ₂	z	chamf	Shank tolerance	Item #
0200	2.0	57	7	10	6	2	0.05		E310 0200
0300	3.0	57	8	10	6	2	0.05		E310 0300
0350	3.5	57	10	10	6	2	0.05	•	
0400	4.0	57	11	10	6	2	0.05		E310 0400
0450	4.5	57	11	10	6	2	0.05	•	
0500	5.0	57	13	8	6	2	0.05		E310 0500
0600	6.0	57	13		6	2	0.06		E310 0600
0700	7.0	63	16		8	2	0.07	•	
0800	8.0	63	19		8	2	0.08		E310 0800
0900	9.0	72	19		10	2	0.09	•	
1000	10.0	72	22		10	2	0.10		E310 1000
1200	12.0	83	26		12	2	0.12		E310 1200
1400	14.0	83	26		14	2	0.14	•	
1600	16.0	92	32		16	2	0.16		E310 1600
1800	18.0	92	32		18	2	0.18	•	
2000	20.0	104	38		20	2	0.20		E310 2000

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

- Optimal ○ Effective



- VHM-ULTRA grade of carbide for high performance
 - Variable flute helix for chatter free milling
 - Optimised geometry for soft materials



Fraise 3 dents carbure, R45/46/44 Al, Longue Harmony

- Carbure VHM-ULTRA pour une meilleure performance
 - Hélice variable pour la suppression des vibrations
 - Géométrie optimisée les non-ferreux et cuivres



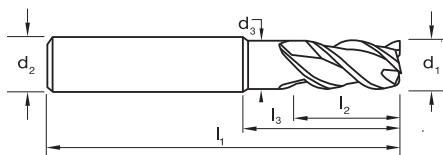
Frese metallo duro, 3 Taglienti, R45/46/44 Al, Lunga Portata, Harmony

- VHM-ULTRA, grado di metallo duro per alte prestazioni
 - Elica tagliente variabile per lavorazioni senza vibrazioni
 - Geometria ottimizzata per materiali morbidi



Fresas de MD, 3 ranuras, R45/46/44 Al, Larga, Harmony

- Grado de MD, VHM-ULTRA para alto rendimiento
 - Hélice de ranura variable para fresado sin vibraciones
 - Geometría optimizada para materiales blandos



Catalogue Code	E480
Discount Group	B0210
Material	VHM-ULTRA
Surface Finish	Brt
Sutton Designation	AI
Geometry	R45/46/44
Shank Form (DIN 6535)	HA
Shank Tolerance	h5

Size Ref.	d ₁ (e8)	I ₁	I ₂	I ₃	d ₂	d ₃	Chamfer	Item #
0300	3.0	57	8	19	6	2.8	0.08/0.12 x 45°	E480 0300
0400	4.0	57	11	19	6	3.7	0.08/0.12 x 45°	E480 0400
0500	5.0	57	13	20	6	4.6	0.08/0.12 x 45°	E480 0500
0600	6.0	57	13	21	6	5.1	0.08/0.12 x 45°	E480 0600
0800	8.0	63	19	27	8	7.1	0.08/0.12 x 45°	E480 0800
1000	10.0	72	22	32	10	9.1	0.15/0.25 x 45°	E480 1000
1200	12.0	83	26	40	12	11.1	0.15/0.25 x 45°	E480 1200
1600	16.0	92	32	50	16	14.8	0.25/0.35 x 45°	E480 1600
2000	20.0	104	38	60	20	18.5	0.25/0.35 x 45°	E480 2000

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

● Optimal ○ Effective



- VHM-ULTRA grade of carbide for high performance
- Variable flute helix for chatter free milling
- Optimised geometry for soft materials


Fraise 3 dents carbure, R45/46/44 Al, Longue Harmony

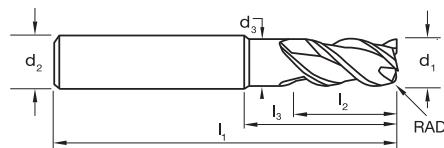
- Carbure VHM-ULTRA pour une meilleure performance
- Hélice variable pour la suppression des vibrations
- Géométrie optimisée les non-ferreux et cuivres


Frese metallo duro, 3 Taglienti, R45/46/44 Al, Lunga Portata, Harmony

- VHM-ULTRA, grado di metallo duro per alte prestazione
- Elica tagliente variabile per lavorazioni senza vibrazioni
- Geometria ottimizzata per materiali morbidi


Fresas de MD, 3 ranuras, R45/46/44 Al, Larga, Harmony

- Grado de MD, VHM-ULTRA para alto rendimiento
- Hélice de ranura variable para fresado sin vibraciones
- Geometría optimizada para materiales blandos



Catalogue Code

E478

Discount Group

B0210

Material

VHM-ULTRA

Surface Finish

BrT

Sutton Designation

Al

Geometry

R45/46/44

Shank Form (DIN 6535)

HA

Shank Tolerance

h5

Size Ref.	d ₁ (e8)	l ₁	l ₂	l ₃	d ₂	d ₃	rad	Item #
1210	12.0	83	26	40	12	11.1	1	E478 1210
1225	12.0	83	26	40	12	11.1	2.5	E478 1225
1230	12.0	83	26	40	12	11.1	3	E478 1230
1240	12.0	83	26	40	12	11.1	4	E478 1240
1610	16.0	92	32	50	16	14.8	1	E478 1610
1625	16.0	92	32	50	16	14.8	2.5	E478 1625
1630	16.0	92	32	50	16	14.8	3	E478 1630
1640	16.0	92	32	50	16	14.8	4	E478 1640
2010	20.0	104	38	60	20	18.5	1	E478 2010
2025	20.0	104	38	60	20	18.5	2.5	E478 2025
2030	20.0	104	38	60	20	18.5	3	E478 2030
2040	20.0	104	38	60	20	18.5	4	E478 2040

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					
E478						

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

● Optimal ○ Effective

ISO	VDI	Material Group	Sutton
P	A	Steel	N
M	R	Stainless Steel	VA
K	F	Cast Iron	GG
N	N	Non-Ferrous Metals, Aluminiums & Coppers	AI W
S	S	Titaniums & Super Alloys	TI Ni
H	H	Hard Materials (\geq 45 HRC)	H

[^] VDI 3323 material groups can also be determined by referring to the workpiece material cross reference listing. Refer to main index of this section.

For expert tooling recommendations, go to:
www.suttontools.com/expert-tool-selector

Sutton					
N					
VA					
GG					
AI					
W					
Ti					
Ni					
H					
ed					
Catalogue Code	E400 / E401	E402 / E403	E408 / E409	E310	E478 / 480
Material	VHM-ULTRA	VHM-ULTRA	VHM-ULTRA	VHM	VHM-ULTRA
Surface Finish	CrN	CrN	CrN	Brt	Brt
Sutton Designation	AI	AI	AI	AI	AI
Type of Cut: <i>Slotting</i>	•			•	
<i>Finishing</i>		•			
<i>Universal</i>			•		
<i>Roughing</i>		•			
<i>Profiling</i>			•		
↑ ap < Ø	1.5	1.5	1.5	0.25	0.25
↔ ce > Ø	1.0	0.25	0.4	0.2	0.25

Condition: A (Annealed), AH (Age Hardened), C (Cast),
HT (Hardened & Tempered), QT (Quenched & Tempered)
Bold = Optimal | Regular = Effective

BOLD = Optimal | Regular = Effective

Notes on Milling

1. Above values are guidelines for the size and type of cut nominated.
 2. For long series tools, reduce speed by 40% and feed by 20%.

METRIC ENDMILLS (mm size)		
Ø	= nominal tool diameter (mm)	$n = \frac{V_c \times 1000}{\emptyset \times \pi} \simeq \frac{V_c}{\emptyset} \times 318$
n	= Spindel speed (RPM)	
V_c	= Cutting speed (m/min)	
f_z	= Feed rate per tooth (mm/tooth)	$V_c = \frac{n \times \emptyset \times \pi}{1000} \simeq \frac{n \times \emptyset}{318}$
V_f	= Feed rate (mm/min)	
z	= No. cutting edges	$f_z = \frac{V_f}{z \times n}$
Q	= Metal removal rate (cm ³ /min)	$V_f = f_z \times z \times n$
a_p	= Cutting depth (mm)	
a_w	= Cutting width (mm)	$Q = \frac{a_p \times a_w \times V_f}{1000}$

Feed Table (fz) (mm/tooth)

Ø	Feed Table (1/2" (mm/tooth))																			
	Feed #																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
2	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.010	0.011	0.013	0.014	0.016	0.018	0.020	0.022	0.024	0.026	0.030
3	0.002	0.003	0.004	0.005	0.006	0.008	0.009	0.010	0.012	0.014	0.016	0.018	0.020	0.023	0.025	0.028	0.032	0.034	0.038	0.042
4	0.004	0.005	0.006	0.007	0.009	0.010	0.012	0.014	0.016	0.018	0.021	0.023	0.026	0.030	0.032	0.036	0.040	0.044	0.045	0.050
5	0.005	0.006	0.008	0.009	0.011	0.013	0.015	0.017	0.020	0.023	0.025	0.030	0.032	0.036	0.040	0.044	0.050	0.055	0.060	0.065
6	0.006	0.008	0.009	0.011	0.013	0.016	0.018	0.021	0.024	0.028	0.030	0.034	0.038	0.042	0.045	0.050	0.055	0.060	0.070	0.075
8	0.010	0.012	0.014	0.017	0.019	0.022	0.025	0.028	0.032	0.036	0.040	0.045	0.050	0.055	0.060	0.065	0.075	0.080	0.085	0.095
10	0.013	0.015	0.018	0.021	0.024	0.028	0.032	0.036	0.040	0.045	0.050	0.055	0.060	0.070	0.075	0.085	0.090	0.100	0.11	0.12
12	0.016	0.019	0.022	0.026	0.030	0.034	0.038	0.044	0.050	0.055	0.060	0.065	0.075	0.080	0.090	0.100	0.11	0.12	0.13	0.14
16	0.020	0.024	0.028	0.034	0.038	0.044	0.050	0.055	0.060	0.070	0.080	0.085	0.095	0.11	0.12	0.13	0.14	0.16	0.17	0.18
20	0.022	0.028	0.032	0.038	0.044	0.050	0.060	0.065	0.075	0.085	0.095	0.11	0.12	0.13	0.15	0.16	0.18	0.19	0.21	0.23
25	0.025	0.032	0.038	0.045	0.055	0.060	0.070	0.080	0.090	0.10	0.12	0.13	0.15	0.16	0.18	0.20	0.22	0.24	0.26	0.29

Regrinding and Recoating Services

Regrinding

The relationship with you does not end after the delivery of our products. Sutton Tools supports you by reducing your production costs through our regrinding service of carbide tools available at our state-of-the-art facility.

Using our regrinding service means:

- ✓ Reground with original geometry
- ✓ Quality assured
- ✓ Handled by highly experienced personnel
- ✓ Lower tooling cost

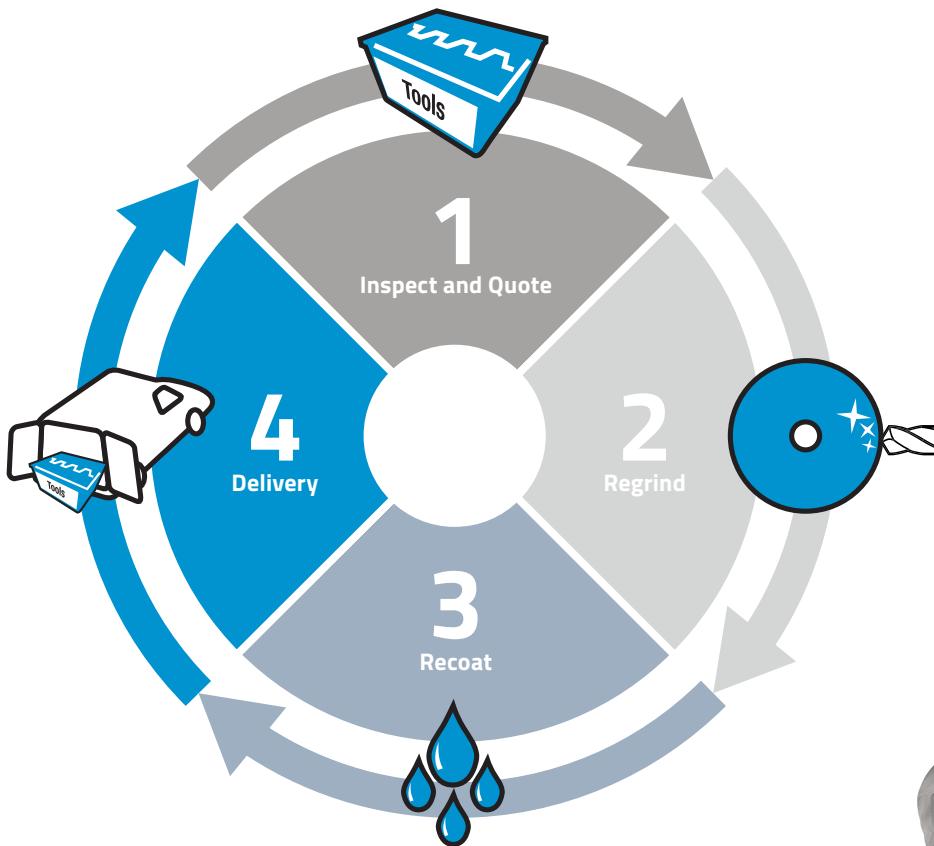
Recoating

As a total solution provider, Sutton Tools uses world leading heat treatment PVD coating (Physical Vapour Deposition) based on Oerlikon Balzers technology on their latest INNOVA coating machine to add life to our products.

The benefits of PVD coatings include:

- ✓ 300%–1000% increase in tool life
- ✓ Increased productivity
- ✓ Uniform thickness
- ✓ Corrosion resistant
- ✓ Less tool changes due to less wear
- ✓ Better wear condition for regrinds

Tool Regrinding and Recoating Process



Custom Tools and Modifications

With the synergy of facility and services, Sutton Tools are able to manufacture custom tools to your exact requirements. Simply provide your details via our enquiry form and our team of engineers will be able to design a custom solution for your tooling needs in no time.



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