suttontools
world class cutting tools

ALUMINIUM MACHINING

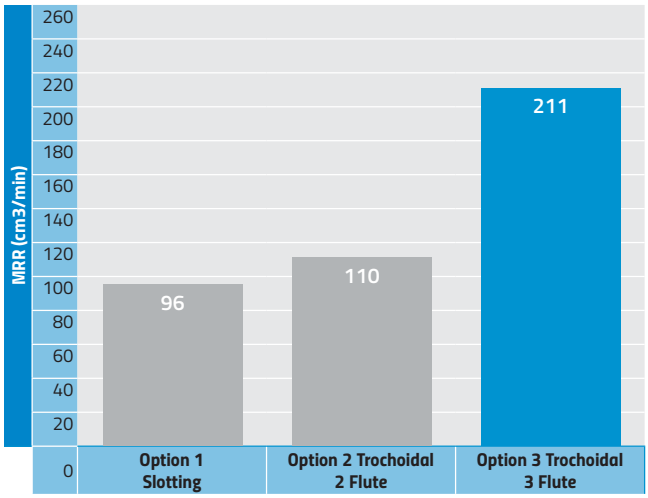
HARMONY

suttontools

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=24mm). 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.

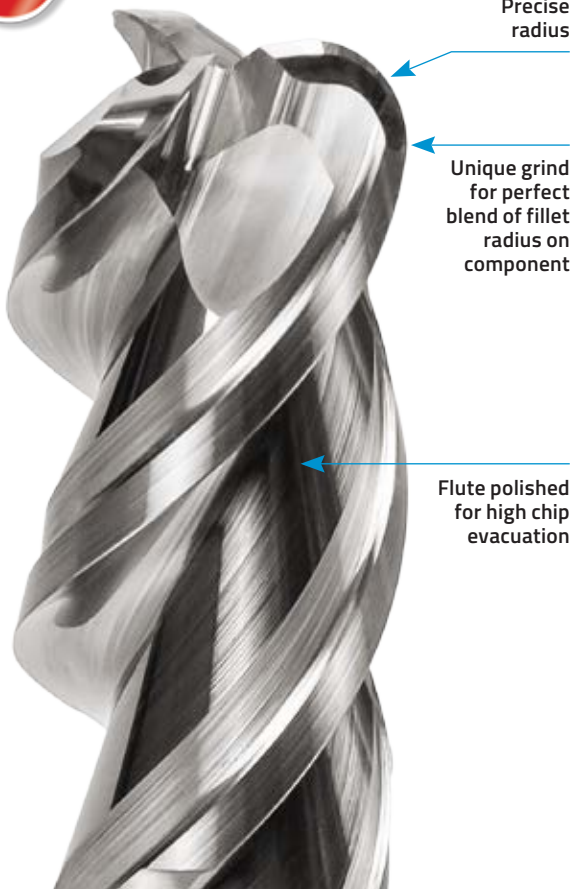
Test Data	Option 1 Slotting	Option 2 Trochoidal 2 Flute	Option 3 Trochoidal 3 Flute
Tool	R40 Al	R40 Al	R42/43/44 HARMONY Al
Part No. / Reference	E3102000	E3101200	E4001200
Tool Diameter (mm)	20	12	12
Z (teeth number)	2	2	3
ae (mm)	20	2	2
ap (mm) / depth	12 + 12 (2 passes)	24 (single pass)	24 (single 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.

NEW

E478 Corner Radius Series

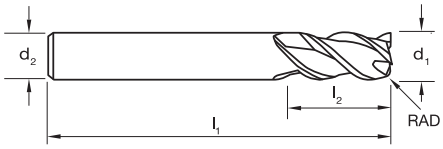


Endmills Carbide, 3 Flute, *Harmony Al*

suttontools HARMONY

- VHM-ULTRA grade of carbide for high performance
- 45/46/44° variable flute helix for chatter free milling
- Optimised geometry for soft materials
- CrN for copper and non-ferrous materials

DIN 6527L | MICRO | 15°



	E400	E401	E478
Catalogue Code	E400	E401	E478
Discount Group	B0210	B0210	B0210
Material	VHM-ULTRA	VHM-ULTRA	VHM-ULTRA
Surface Finish	*CrN*	*CrN*	*Brt*
Sutton Designation	**Al**	**Al**	**Al**
Geometry	R45/46/44	R45/46/44	R45/46/44
Shank Form (DIN 6535)	HA	HB	HA
Shank Tolerance	h5	h5	h5

Size Ref.	d_1 (e8)	l_1	l_2	d_2	z	rad	Item #	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	
1210	**12.0**	83	26	12		1			E478 1210
1225	**12.0**	83	26	12		2.5			E478 1225
1230	**12.0**	83	26	12		3			E478 1230
1240	**12.0**	83	26	12		4			E478 1240
1610	**16.0**	92	32	16		1			E478 1610
1625	**16.0**	92	32	16		2.5			E478 1625
1630	**16.0**	92	32	16		3			E478 1630
1640	**16.0**	92	32	16		4			E478 1640
2010	**20.0**	104	38	20		1			E478 2010
2025	**20.0**	104	38	20		2.5			E478 2025
2030	**20.0**	104	38	20		3			E478 2030
2040	**20.0**	104	38	20		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	14.1	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
E400																							●	●	●	●	●	●	●	●																						
E401																							●	●	●	●	●	●	●	●																						
E478																							●	●	●	●	●	●	●	●																						

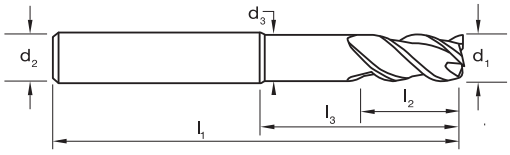
P Steel | M Stainless Steel | K Cast Iron | N Non-Ferrous Metals | S Titanium & Super Alloys | H Hard Materials

● Optimal ○ Effective

Endmills Carbide, 3 Flute, Long Reach, *Harmony Al*

suttontools HARMONY

- VHM-ULTRA grade of carbide for high performance
- 45/46/44° variable flute helix for chatter free milling
- Optimised geometry for soft materials
- CrN for copper and non-ferrous materials



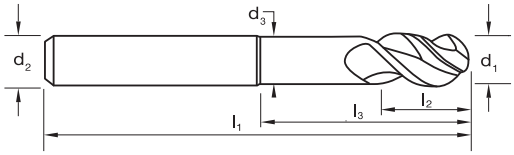
Catalogue Code	E402	E403
Discount Group	B0210	B0210
Material	VHM-ULTRA	VHM-ULTRA
Surface Finish	*CrN*	*CrN*
Sutton Designation	**Al**	**Al**
Geometry	R45/46/44	R45/46/44
Shank Form (DIN 6535)	HA	HB
Shank Tolerance	h5	h5

Size Ref.	d_1 (k10)	l_1	l_2	l_3	d_2	d_3	z	rad	Item #	Item #
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

Endmills Carbide, Ballnose, 3 Flute, Long Reach, *Harmony Al*

suttontools HARMONY

- VHM-ULTRA grade of carbide for high performance
- 45/46/44° variable flute helix for chatter free milling
- Optimised geometry for soft materials
- CrN for copper and non-ferrous materials



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

Size Ref.	d_1 (e8)	l_1	l_2	l_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

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
E402																							●	●	●	●	●	●	●	●																			
E403																							●	●	●	●	●	●	●	●																			
E408																							●	●	●	●	●	●	●	●																			
E409																							●	●	●	●	●	●	●	●																			

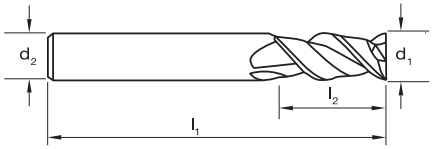
P Steel M Stainless Steel K Cast Iron N Non-Ferrous Metals S Titanium & Super Alloys H Hard Materials

● Optimal ○ Effective

Slot Drills Carbide, 2 Flute, *AlCarb*

suttontools

- 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



Catalogue Code	E310
Discount Group	B0208
Material	VHM
Surface Finish	*Brt*
Sutton Designation	Al
Geometry	R40
Shank Form (DIN 6535)	HA
Shank Tolerance	h6

Size Ref.	d_1 (h10)	l_1	l_2	l_3	d_2	z	Item #
0200	**2.0**	57	7	10	6	2	E310 0200
0300	**3.0**	57	8	10	6	2	E310 0300
0400	**4.0**	57	11	10	6	2	E310 0400
0500	**5.0**	57	13	8	6	2	E310 0500
0600	**6.0**	57	13		6	2	E310 0600
0800	**8.0**	63	19		8	2	E310 0800
1000	**10.0**	72	22		10	2	E310 1000
1200	**12.0**	83	26		12	2	E310 1200
1600	**16.0**	92	32		16	2	E310 1600
2000	**20.0**	104	38		20	2	E310 2000

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
E310																							●	●	●	●	●	●	●	●																						

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

● Optimal ○ Effective

• Available on request as special manufacture. Subject to lead time.

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ISO	VDI	Material Group	Sutton		
P	A	Steel	N		UNI
M	R	Stainless Steel	VA		
K	F	Cast Iron	GG		
N	N	Non-Ferrous Metals, Aluminiums & Coppers	Al	W	
S	S	Titaniums & Super Alloys	Ti		Ni
H	H	Hard Materials (≥ 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

Catalogue Code	E400 / E401				E478				E402 / E403				E408 / E409				E310			
Material	VHM-ULTRA				VHM-ULTRA				VHM-ULTRA				VHM-ULTRA				VHM			
Surface Finish	*CrN*				*Brt*				*CrN*				*CrN*				*Brt*			
Sutton Designation	Al				Al				Al				Al				Al			
Type of Cut: *Slotting*		●				●				●								●		
Finishing																				
Universal			●				●				●								●	
Roughing				●				●				●		●						●
Profiling															●					
ap × Ø		1.5	1.5	1.5		0.25	0.5	0.5		0.25	0.5	0.5		0.1	0.1			1.0	1.5	1.5
ae × Ø		1.0	0.25	0.4		1.0	0.2	0.3		1.0	0.2	0.3		0.1	0.05			1.0	0.25	0.4

ISO	VDI^ 3323	Material		Condition	HB	N/mm²	Vc	Feed #			Vc	Feed #			Vc	Feed #			Vc	Feed #			Vc	Feed #		
N	21	Aluminum & Magnesium - wrought alloy	Non Heat Treatable		60	210	200	8	17	13	200	9	18	13	200	9	18	13	200	18	15	220	8	18	14
	22		Heat Treatable	AH	100	360	200	8	17	13	200	9	18	13	200	9	18	13	200	18	15	220	8	18	14
	23	Aluminum & Magnesium - cast alloy ≤12% Si	Non Heat Treatable		75	270	200	8	17	13	200	9	18	13	200	9	18	13	200	18	15	220	8	18	14
	24		Heat Treatable	AH	90	320	200	8	17	13	200	9	18	13	200	9	18	13	200	18	15	220	8	18	14
	25	Al & Mg - cast alloy >12% Si	Non Heat Treatable		130	460	200	8	17	13	200	9	18	13	200	9	18	13	200	18	15	220	8	18	14
	26	Copper & Cu alloys (Brass/Bronze)	Free cutting, Pb > 1%		110	390	350	8	17	13	350	9	18	13	350	9	18	13	350	18	15	160	8	18	14
	27		Brass (CuZn, CuSnZn)		90	320	350	8	17	13	350	9	18	13	350	9	18	13	350	18	15	160	8	18	14
	28		Bronze (CuSn)		100	360	350	8	17	13	350	9	18	13	350	9	18	13	350	18	15	160	8	18	14
	29	Non-metallic - Thermosetting & fiber-reinforced plastics					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	30	Non-metallic - Hard rubber, wood etc.					-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Condition: **A** (Annealed), **AH** (Age Hardened), **C** (Cast), **HT** (Hardened & Tempered), **QT** (Quenched & Tempered)
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 = Spindel speed (RPM)
v_c = Cutting speed (m/min)
f_z = Feed rate per tooth (mm/tooth)
v_f = Feed rate (mm/min)
z = No. cutting edges
Q = Metal removal rate (cm^3/min)
a_p = Cutting depth (mm)
a_e = Cutting width (mm)

$$n = \frac{v_c \times 1000}{Ø \times \pi} \simeq \frac{v_c}{Ø} \times 318$$

$$v_c = \frac{n \times Ø \times \pi}{1000} \simeq \frac{n \times Ø}{318}$$

$$f_z = \frac{V_f}{z \times n} \qquad v_f = f_z \times z \times n$$

$$Q = \frac{a_p \times a_e \times v_f}{1000}$$

Feed Table (fz) (mm/tooth)																				
Ø	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

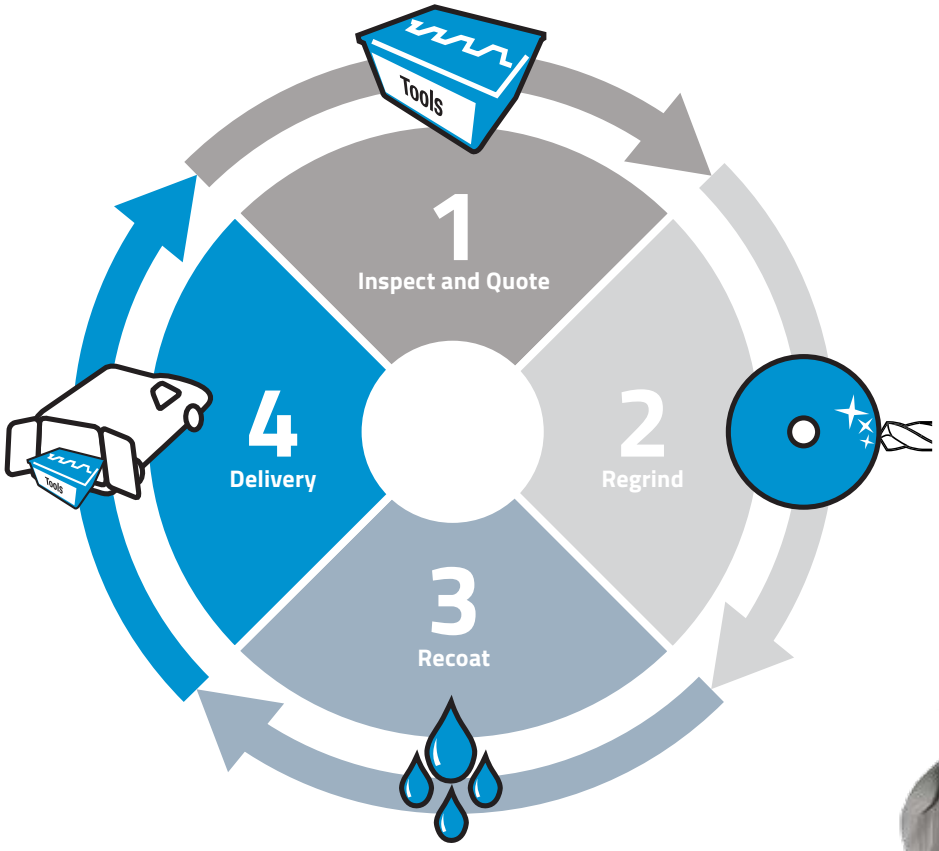
Recoating

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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