



M.A.FORD Advanced
Product Groups



Where **high performance** is the **standard**



TuffCut® XR-XT



TuffCut® X-AL

www.mafordeurope.com



Where **high performance** is the **standard**



For more than 90 years, M.A.FORD has been at the cutting edge of tooling design and manufacture and has developed an enviable global reputation for performance and precision in advanced solid carbide tooling, serving over 60 countries worldwide.

Our innovative cutting geometries, materials and coating technologies are providing effective manufacturing solutions to an expanding and increasingly diverse range of industries from agriculture and construction to aerospace, power generation and automotive, to name but a few.

From our European HQ and custom tooling production facilities here in the UK, we ensure that our customers not only obtain the latest cutting tool technologies direct from our extensive stocks, but also have access to specialist tool design and manufacturing solutions to meet unique applications.

M.A.FORD – Where high performance is the standard.





M.A.FORD Advanced
Product Groups



Where **high performance** is the **standard**

Contents

Product Contents	2 - 3
------------------	-------

TuffCut® XR - XT	4 - 19
------------------	--------

Technical Information	40 - 44
-----------------------	---------

TuffCut® X-AL	21 - 38
---------------	---------

Technical Information	45 - 48
-----------------------	---------

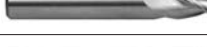
Technical Information	39 - 53
-----------------------	---------



Product contents

TuffCut® XR - XT							
Series	Tool Illustration	Z	Length	Corner Prep	Application Area	Matrial Group	Page
177		4		Sharp corner			6
177R		4		0.25 - 6.0mm radius			7
177S		4		0.2 - 1.0mm radius			8
177LR N5		4		0.3 - 3.0mm radius			9
277		4		Sharp corner			10
277R		4		0.25 - 0.8mm radius			10
277NR		4		0.25 - 6.0mm radius			11
277NR-W		4		0.25 - 6.0mm radius			12
178		5		Sharp corner			13
178R		5		0.5 - 1.0mm radius			14
178-1		5		Sharp corner			14
278R N3		5		0.5 - 4.0mm radius			15
278R N4		5		0.5 - 3.0mm radius			16
278R N5		5		1.0 - 3.0mm radius			16
278R N5 (With Central Coolant)		5		0.5 - 4.0mm radius			17
113A		6		Sharp corner			17
179		4		N/A			18
179L N5		4		N/A			18
180R		7		0.5 - 4.0mm radius		Primarily Titanium alloys	19
180R N5		7		1.0 - 4.0mm radius		Primarily Titanium alloys	19
Technical Information							40 - 44

Product contents

TuffCut® X-AL						
Series	Tool Illustration	Z	Length	Corner Prep	Application Area	Page
135		2		0.2 - 0.75mm Radius	High feed machine -1> mm tooth loading possible	22
135 N		2		0.2 - 0.75mm Radius	High feed machine -1> mm tooth loading possible	23
135 N3		2		0 - 5.0mm Radius	High feed machine -1> mm tooth loading possible	24
135 N5		2		0 - 5.0mm Radius	Rough profile milling	26
135B N3		2		N/A	Rough & finish profile milling	28
135B N5		2		N/A	Rough & finish profile milling	28
137V N3		3		0 - 4.0mm Radius	Rough & finish profile milling	29
137V N4		3		0 - 4.0mm Radius	Rough & finish profile milling	31
137V N5		3		0 - 4.0mm Radius	Rough & finish profile milling	33
138B		3		N/A	Finish profile milling	35
138B N5		3		N/A	Finish profile milling	35
137VR N5		3		1.0mm Radius	Rough milling	36
137VF		3		0 - 2.0mm Radius	Finishing	36
Technical Information						45 - 48

TuffCut® XR-XT

XTREME ROUGHING End Mills



Features

- Unique M.A.FORD Heli-Pitch Geometry
- Proprietary Carbide Substrate
- Eccentric Primary Relief Angle
- ALtima® Coatings & ALtima® BLAZE

Benefits

- Higher feeds and speeds for increased productivity. Reduced vibration harmonics
- Maintains cutting edge strength & sharpness for improved tool life
- Strong cutting edges allowing for increased depths of cut at elevated cutting data
- State-of-the-art ALtima® (Altin) PVD coating for superior tool life in virtually all materials
- ALtima® BLAZE for long life in Stainless Steel, Titanium and Steel (dry machining)

TuffCut® XR-XT

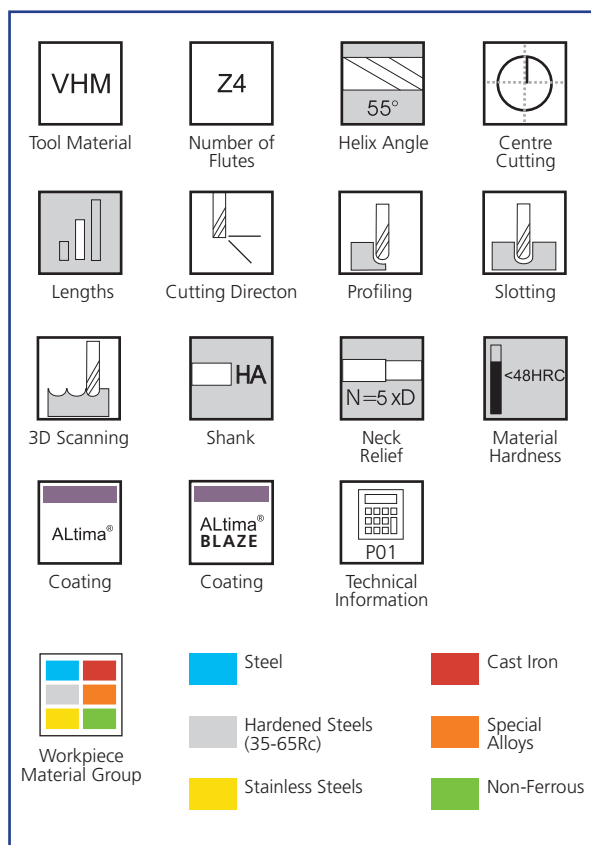
Carbide End mills



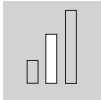
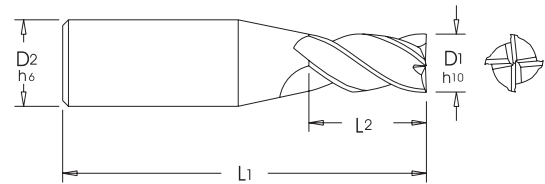
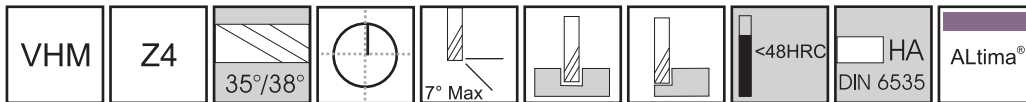
TuffCut® end mills are designed to provide the outstanding performance and results to minimise process downtime while maximising productivity and cost efficiency. Included in the range are high performance end mills developed for specific applications such as stainless steels and high temperature alloys, hardened steel and aluminium and softer alloys.

We also carry a complete family of standard carbide end mills designed for efficient general purpose milling of all steels, cast irons and most other materials.

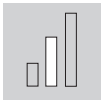
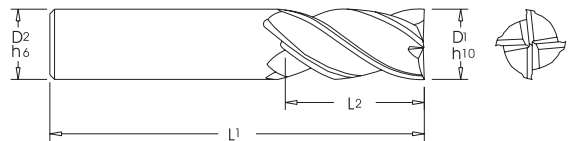
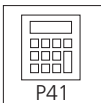
M.A.FORD solid carbide end mills are ideal for tough or abrasive work. On many jobs they can run faster than HSS or Cobalt due to their high heat resistance, resulting in higher production rates. With more than fifty different styles available, we can deliver the correct combination of size, flute length, numbers of flutes, geometry and coating to meet your precise needs.



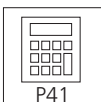
	Page
TuffCut® XR Series 177	6
TuffCut® XR Series 177R	7
TuffCut® XR Series 177S	8
TuffCut® XR Series 177LR N5	9
TuffCut® XT Series 277, 277R	10
TuffCut® XT Series 277NR	11 - 12
TuffCut® XT Series 277NR-W	12 - 13
TuffCut® XT Series 178	13
TuffCut® XR Series 178R	14
TuffCut® XR Series 178-1	14
TuffCut® XT Series 278R N3	15
TuffCut® XT Series 278R N4, 278R N5, 278R N5 (with central coolant)	16 - 17
TuffCut® XR Series 113A	17
TuffCut® XR Series 179, 179L N5	18
TuffCut® XR Series 180R, 180R N5	19
Technical Section	40 - 44



Tool No.	EDP	D1	D2	L1	L2
177 0150A	17680	1.5	3	38	3
177 0200A	17682	2	3	38	4
177 0250A	17684	2.5	3	38	5
177 0303A	17686	3	3	38	6

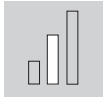
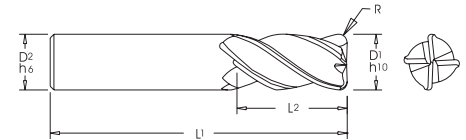
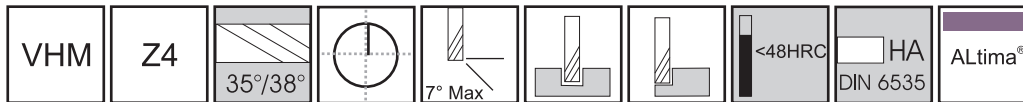


Tool No.	EDP	D1	D2	L1	L2
177 0300A	17928	3	6	57	8
177 0350A	17688	3.5	6	57	7
177 0400A	17930	4	6	57	11
177 0450A	17690	4.5	6	57	9
177 0500A	17932	5	6	57	13
177 0600A	17934	6	6	57	13
177 0800A	17937	8	8	63	19
177 1000A	17940	10	10	72	22
177 1200A	17943	12	12	83	26
177 1400A	17946	14	14	83	26
177 1600A	17950	16	16	92	32
177 1800A	17952	18	18	92	32
177 2000A	17955	20	20	104	38
177 2500A	17957	25	25	104	38



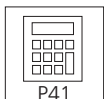


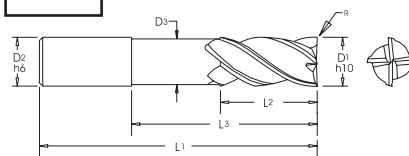
TuffCut® XR Series 177R



Corner Radius

Tool No.	EDP	D1	D2	L1	L2	R
177 0300-0.25RA	17929	3	6	57	8	0.25
177 0300-0.50RA	17783	3	6	57	8	0.5
177 0400-0.25RA	17931	4	6	57	11	0.25
177 0400-0.50RA	17784	4	6	57	11	0.5
177 0500-0.25RA	17933	5	6	57	13	0.25
177 0500-0.50RA	17785	5	6	57	13	0.5
177 0600-0.25RA	17786	6	6	57	13	0.25
177 0600-0.50RA	17935	6	6	57	13	0.5
177 0600-1.0RA	17787	6	6	57	13	1
177 0600-1.5RA	17788	6	6	57	13	1.5
177 0600-2.0RA	18070	6	6	57	13	2
177 0800-0.50RA	17938	8	8	63	19	0.5
177 0800-1.0RA	17789	8	8	63	19	1
177 0800-1.5RA	17790	8	8	63	19	1.5
177 0800-2.0RA	17791	8	8	63	19	2
177 0800-3.0RA	18072	8	8	63	19	3
177 1000-0.50RA	17941	10	10	72	22	0.5
177 1000-1.0RA	17792	10	10	72	22	1
177 1000-1.5RA	17793	10	10	72	22	1.5
177 1000-2.0RA	17794	10	10	72	22	2
177 1000-3.0RA	96603	10	10	72	22	3
177 1200-0.50RA	17795	12	12	83	26	0.5
177 1200-0.75RA	17944	12	12	83	26	0.75
177 1200-1.0RA	17796	12	12	83	26	1
177 1200-1.5RA	17797	12	12	83	26	1.5
177 1200-2.0RA	17798	12	12	83	26	2
177 1200-2.5RA	18074	12	12	83	26	2.5
177 1200-3.0RA	96506	12	12	83	26	3
177 1200-4.0RA	18076	12	12	83	26	4
177 1400-0.75RA	17947	14	14	83	26	0.75
177 1600-0.50RA	18078	16	16	92	32	0.5
177 1600-1.0RA	17951	16	16	92	32	1
177 1600-1.5RA	17799	16	16	92	32	1.5
177 1600-2.0RA	17673	16	16	92	32	2
177 1600-2.5RA	18080	16	16	92	32	2.5
177 1600-3.0RA	17674	16	16	92	32	3
177 1600-4.0RA	18082	16	16	92	32	4
177 1800-1.0RA	17953	18	18	92	32	1
177 2000-1.0RA	17956	20	20	104	38	1
177 2000-1.5RA	18091	20	20	104	38	1.5
177 2000-2.0RA	18084	20	20	104	38	2
177 2000-3.0RA	18086	20	20	104	38	3
177 2000-4.0RA	18088	20	20	104	38	4
177 2000-5.0RA	18090	20	20	104	38	5
177 2000-6.0RA	18092	20	20	104	38	6
177 2500-1.0RA	17958	25	25	104	38	1





Tool No.	EDP	D1	D2	D3	L1	L2	L3	Shank
177S 0300A	18218	3	6	2.9	50	5	11	DIN 6535 HA
177S 0400A	18220	4	6	3.9	50	6	14	DIN 6535 HA
177S 0500A	18222	5	6	4.9	57	8	17	DIN 6535 HA
177S 0600A	18224	6	6	5.8	57	9	20	DIN 6535 HA
177S 0800A	18226	8	8	7.6	63	12	26	DIN 6535 HA
177S 1000A	18228	10	10	9.6	72	15	32	DIN 6535 HA
177S 1200A	18230	12	12	11.4	83	18	38	DIN 6535 HA
177S 1600A	18232	16	16	15.2	98	24	50	DIN 6535 HA
177S 2000A	18234	20	20	19.2	112	30	62	DIN 6535 HA



Tool No.	EDP	D1	D2	D3	L1	L2	L3	Shank
177S 0300AW	18254	3	6	2.9	50	5	11	DIN 6535 HB
177S 0400AW	18256	4	6	3.9	50	6	14	DIN 6535 HB
177S 0500AW	18258	5	6	4.9	57	8	17	DIN 6535 HB
177S 0600AW	18260	6	6	5.8	57	9	20	DIN 6535 HB
177S 0800AW	18262	8	8	7.6	63	12	26	DIN 6535 HB
177S 1000AW	18264	10	10	9.6	72	15	32	DIN 6535 HB
177S 1200AW	18266	12	12	11.4	83	18	38	DIN 6535 HB
177S 1600AW	18268	16	16	15.2	98	24	50	DIN 6535 HB
177S 2000AW	18270	20	20	19.2	112	30	62	DIN 6535 HB



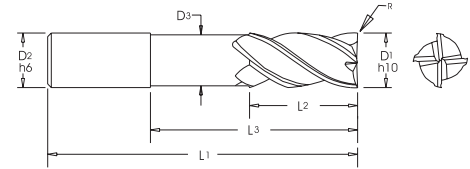
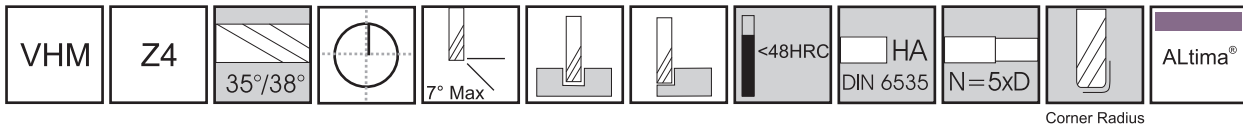
Tool No.	EDP	D1	D2	D3	L1	L2	L3	R	Shank
177S 03-0.2RA	18200	3	6	2.9	50	5	11	0.2	DIN 6535 HA
177S 04-0.2RA	18202	4	6	3.9	50	6	14	0.2	DIN 6535 HA
177S 05-0.2RA	18204	5	6	4.9	57	8	17	0.2	DIN 6535 HA
177S 06-0.3RA	18206	6	6	5.8	57	9	20	0.3	DIN 6535 HA
177S 08-0.5RA	18208	8	8	7.6	63	12	26	0.5	DIN 6535 HA
177S 10-0.5RA	18210	10	10	9.6	72	15	32	0.5	DIN 6535 HA
177S 12-0.5RA	18212	12	12	11.4	83	18	38	0.5	DIN 6535 HA
177S 16-1.0RA	18214	16	16	15.2	98	24	50	1	DIN 6535 HA
177S 20-1.0RA	18216	20	20	19.2	112	30	62	1	DIN 6535 HA



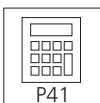
Tool No.	EDP	D1	D2	D3	L1	L2	L3	R	Shank
177S 03-0.2RAW	18236	3	6	2.9	50	5	11	0.2	DIN 6535 HB
177S 04-0.2RAW	18238	4	6	3.9	50	6	14	0.2	DIN 6535 HB
177S 05-0.2RAW	18240	5	6	4.9	57	8	17	0.2	DIN 6535 HB
177S 06-0.3RAW	18242	6	6	5.8	57	9	20	0.3	DIN 6535 HB
177S 08-0.5RAW	18244	8	8	7.6	63	12	26	0.5	DIN 6535 HB
177S 10-0.5RAW	18246	10	10	9.6	72	15	32	0.5	DIN 6535 HB
177S 12-0.5RAW	18248	12	12	11.4	83	18	38	0.5	DIN 6535 HB
177S 16-1.0RAW	18250	16	16	15.2	98	24	50	1	DIN 6535 HB
177S 20-1.0RAW	18252	20	20	19.2	112	30	62	1	DIN 6535 HB

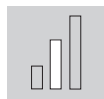
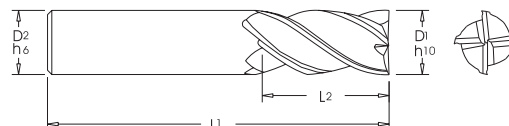
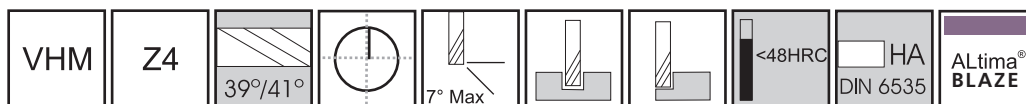


TuffCut® XR Series 177LR N5

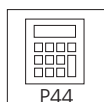


Tool No.	EDP	D1	D2	D3	L1	L2	L3	R
177L 06N5-0.25RA	18186	6	6	5.8	101	12	30	0.25
177L 06N5-0.5RA	18183	6	6	5.8	101	12	30	0.5
177L 06N5-1.0RA	18184	6	6	5.8	101	12	30	1
177L 08N5-0.5RA	18187	8	8	7.6	101	16	40	0.5
177L 08N5-1.0RA	18194	8	8	7.6	101	16	40	1
177L 08N5-2.0RA	18195	8	8	7.6	101	16	40	2
177L 08N5-3.0RA	18196	8	8	7.6	101	16	40	3
177L 10N5-0.5RA	18188	10	10	9.6	127	20	50	0.5
177L 10N5-1.0RA	18197	10	10	9.6	127	20	50	1
177L 10N5-2.0RA	18198	10	10	9.6	127	20	50	2
177L 10N5-3.0RA	18199	10	10	9.6	127	20	50	3
177L 12N5-0.5RA	18189	12	12	11.4	152	24	60	0.5
177L 12N5-1.0RA	18176	12	12	11.4	152	24	60	1
177L 12N5-2.0RA	18177	12	12	11.4	152	24	60	2
177L 12N5-3.0RA	18190	12	12	11.4	152	24	60	3
177L 12N5-4.0RA	18178	12	12	11.4	152	24	60	4
177L 16N5-0.5RA	18181	16	16	15.2	152	32	80	0.5
177L 16N5-1.0RA	18191	16	16	15.2	152	32	80	1
177L 16N5-2.0RA	18179	16	16	15.2	152	32	80	2
177L 16N5-3.0RA	18180	16	16	15.2	152	32	80	3
177L 20N5-0.5RA	18182	20	20	19.2	152	40	100	0.5
177L 20N5-1.0RA	18192	20	20	19.2	152	40	100	1
177L 20N5-3.0RA	18193	20	20	19.2	152	40	100	3

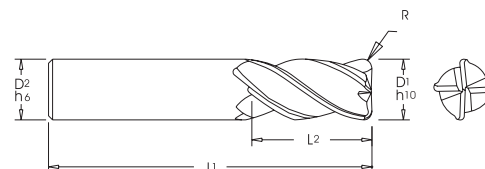
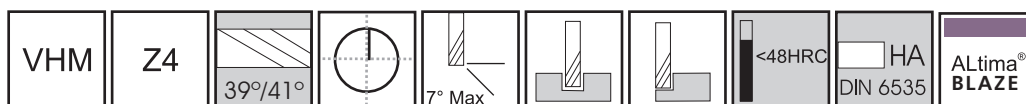




Tool No.	D1	D2	L1	L2
277 0300B	3	6	57	8
277 0400B	4	6	57	11
277 0500B	5	6	57	13
277 0600B	6	6	57	13
277 0800B	8	8	63	19
277 1000B	10	10	72	22
277 1200B	12	12	83	26
277 1600B	16	16	92	32
277 2000B	20	20	104	38



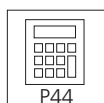
Series 277R



Tool No.	D1	D2	L1	L2	R
277 0300-0.25RB	3	6	57	8	0.25
277 0400-0.25RB	4	6	57	11	0.25
277 0500-0.25RB	5	6	57	13	0.25
277 0600-0.25RB	6	6	57	13	0.25
277 0800-0.80RB	8	8	63	19	0.8
277 1000-0.80RB	10	10	72	22	0.8
277 1200-0.80RB	12	12	83	26	0.8
277 1200-3.0RB	12	12	83	26	3
277 1600-0.80RB	16	16	92	32	0.8
277 2000-0.80RB	20	20	104	38	0.8



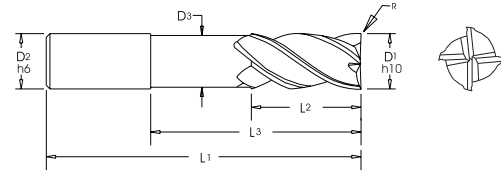
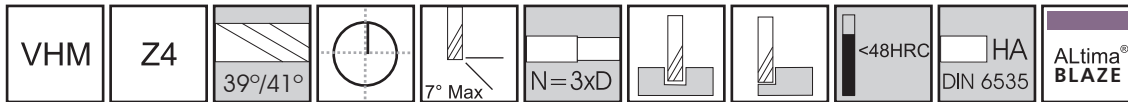
Corner Radius



TuffCut® XT - For enhanced performance in stainless steel type materials

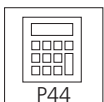


TuffCut® XT Series 277NR



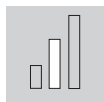
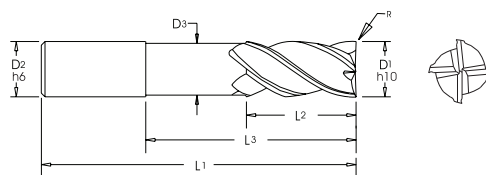
Corner Radius

Tool No.	D1	D2	D3	L1	L2	L3	R	Stock
277 03N3-0.25RB	3	6	2.9	64	8	11	0.25	●
277 03N3-0.3RB	3	6	2.9	64	8	11	0.3	●
277 03N3-0.5RB	3	6	2.9	64	8	11	0.5	●
277 04N3-0.25RB	4	6	3.9	64	11	14	0.25	●
277 04N3-0.3RB	4	6	3.9	64	11	14	0.3	●
277 04N3-0.5RB	4	6	3.9	64	11	14	0.5	●
277 05N3-0.25RB	5	6	4.9	64	13	17	0.25	●
277 05N3-0.3RB	5	6	4.9	64	13	17	0.3	●
277 05N3-0.5RB	5	6	4.9	64	13	17	0.5	●
277 06N3-0.25RB	6	6	5.9	64	13	20	0.25	●
277 06N3-0.3RB	6	6	5.9	64	13	20	0.3	●
277 06N3-0.5RB	6	6	5.9	64	13	20	0.5	●
277 06N3-1.0RB	6	6	5.9	64	13	20	1.0	●
277 06N3-1.5RB	6	6	5.9	64	13	20	1.5	○
277 06N3-2.0RB	6	6	5.9	64	13	20	2.0	○
277 08N3-0.5RB	8	8	7.8	64	19	26	0.5	●
277 08N3-1.0RB	8	8	7.8	64	19	26	1.0	●
277 08N3-1.5RB	8	8	7.8	64	19	26	1.5	●
277 08N3-2.0RB	8	8	7.8	64	19	26	2.0	●
277 08N3-3.0RB	8	8	7.8	64	19	26	3.0	●
277 10N3-0.5RB	10	10	9.8	73	22	32	0.5	●
277 10N3-1.0RB	10	10	9.8	73	22	32	1.0	●
277 10N3-1.5RB	10	10	9.8	73	22	32	1.5	●
277 10N3-2.0RB	10	10	9.8	73	22	32	2.0	●
277 10N3-3.0RB	10	10	9.8	73	22	32	3.0	●
277 12N3-0.5RB	12	12	11.4	84	26	38	0.5	●
277 12N3-1.0RB	12	12	11.4	84	26	38	1.0	●
277 12N3-1.5RB	12	12	11.4	84	26	38	1.5	●
277 12N3-2.0RB	12	12	11.4	84	26	38	2.0	●
277 12N3-2.5RB	12	12	11.4	84	26	38	2.5	○
277 12N3-3.0RB	12	12	11.4	84	26	38	3.0	●
277 12N3-4.0RB	12	12	11.4	84	26	38	4.0	○
277 16N3-0.5RB	16	16	15.2	100	32	50	0.5	●
277 16N3-1.0RB	16	16	15.2	100	32	50	1.0	●
277 16N3-1.5RB	16	16	15.2	100	32	50	1.5	●
277 16N3-2.0RB	16	16	15.2	100	32	50	2.0	●
277 16N3-3.0RB	16	16	15.2	100	32	50	3.0	○



● Stock Item. ○ Please call for availability.



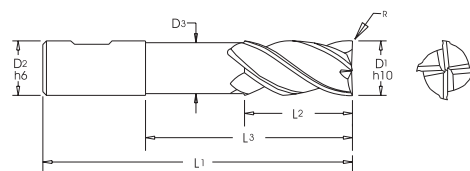
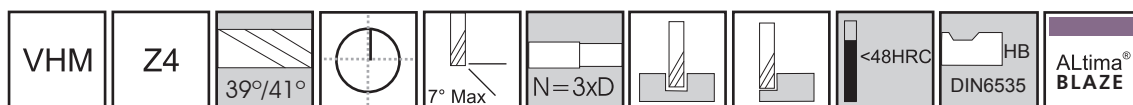


Corner Radius

Tool No.	D1	D2	D3	L1	L2	L3	R	Stock
277 16N3-4.0RB	16	16	15.2	100	32	50	4.0	○
277 20N3-1.0RB	20	20	19.2	112	50	62	1.0	●
277 20N3-1.5RB	20	20	19.2	112	50	62	1.5	●
277 20N3-2.0RB	20	20	19.2	112	50	62	2.0	●
277 20N3-3.0RB	20	20	19.2	112	40	62	3.0	●
277 20N3-4.0RB	20	20	19.2	112	40	62	4.0	●
277 20N3-5.0RB	20	20	19.2	112	40	62	5.0	●
277 20N3-6.0RB	20	20	19.2	112	40	62	6.0	○

● Stock Item. ○ Please call for availability.

Series 277NR-W



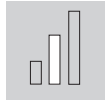
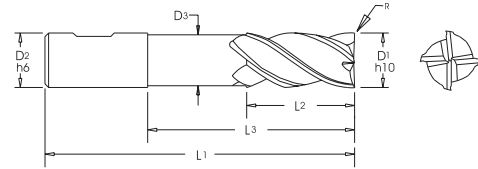
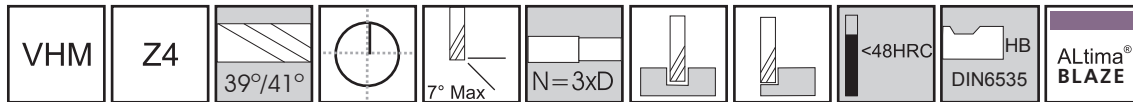
Corner Radius

Tool No.	D1	D2	D3	L1	L2	L3	R	Stock
277 08N3-0.5RBW	8	8	7.8	64	19	26	0.5	●
277 08N3-1.0RBW	8	8	7.8	64	19	26	1.0	●
277 08N3-1.5RBW	8	8	7.8	64	19	26	1.5	○
277 08N3-2.0RBW	8	8	7.8	64	19	26	2.0	●
277 08N3-3.0RBW	8	8	7.8	64	19	26	3.0	●
277 10N3-0.5RBW	10	10	9.8	73	22	32	0.5	●
277 10N3-1.0RBW	10	10	9.8	73	22	32	1.0	●
277 10N3-1.5RBW	10	10	9.8	73	22	32	1.5	●
277 10N3-2.0RBW	10	10	9.8	73	22	32	2.0	●
277 10N3-3.0RBW	10	10	9.8	73	22	32	3.0	●
277 12N3-0.5RBW	12	12	11.4	84	26	38	0.5	●
277 12N3-1.0RBW	12	12	11.4	84	26	38	1.0	●
277 12N3-1.5RBW	12	12	11.4	84	26	38	1.5	●
277 12N3-2.0RBW	12	12	11.4	84	26	38	2.0	●
277 12N3-2.5RBW	12	12	11.4	84	26	38	2.5	○
277 12N3-3.0RBW	12	12	11.4	84	26	38	3.0	●

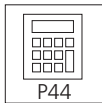
● Stock Item. ○ Please call for availability.



TuffCut® XT Series 277NR-W



Corner Radius

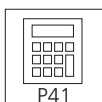
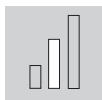
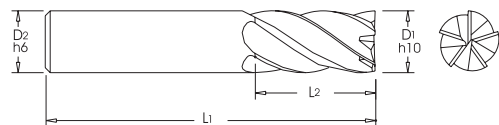
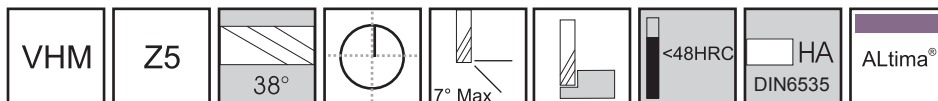


P44

Tool No.	D1	D2	D3	L1	L2	L3	R	Stock
277 12N3-4.0RBW	12	12	11.4	84	26	38	4.0	○
277 16N3-0.5RBW	16	16	15.2	100	32	50	0.5	●
277 16N3-1.0RBW	16	16	15.2	100	32	50	1.0	●
277 16N3-1.5RBW	16	16	15.2	100	32	50	1.5	●
277 16N3-2.0RBW	16	16	15.2	100	32	50	2.0	●
277 16N3-3.0RBW	16	16	15.2	100	32	50	3.0	○
277 16N3-4.0RBW	16	16	15.2	100	32	50	4.0	○
277 20N3-1.0RBW	20	20	19.2	112	40	62	1.0	●
277 20N3-1.5RBW	20	20	19.2	112	40	62	1.5	○
277 20N3-2.0RBW	20	20	19.2	112	40	62	2.0	○
277 20N3-3.0RBW	20	20	19.2	112	40	62	3.0	●
277 20N3-4.0RBW	20	20	19.2	112	40	62	4.0	●
277 20N3-5.0RBW	20	20	19.2	112	40	62	5.0	●
277 20N3-6.0RBW	20	20	19.2	112	40	62	6.0	○

● Stock item. ○ Please call for availability.

Series 178



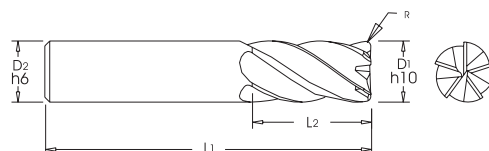
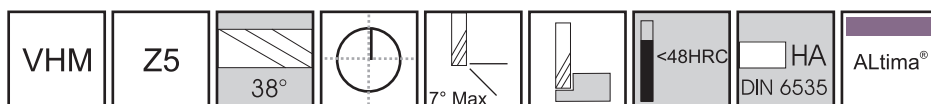
P41

Tool No.	EDP	D1	D2	L1	L2
178 0300A	17959	3	6	57	8
178 0400A	17961	4	6	57	11
178 0500A	17963	5	6	57	13
178 0600A	17965	6	6	57	13
178 0800A	17968	8	8	63	19
178 1000A	17971	10	10	72	22
178 1200A	17974	12	12	83	26
178 1400A	17977	14	14	83	26
178 1600A	17981	16	16	92	32
178 1800A	17983	18	18	92	32
178 2000A	17986	20	20	104	38
178 2500A	17988	25	25	104	38

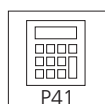




TuffCut® XR Series 178R

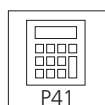
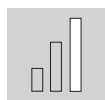
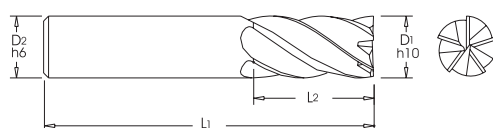
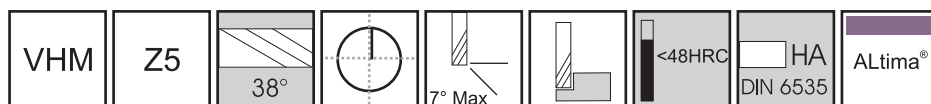


Corner Radius



Tool No.	EDP	D1	D2	L1	L2	R
178 0600-0.50RA	17966	6	6	57	13	0.5
178 0800-0.50RA	17969	8	8	63	19	0.5
178 1000-0.50RA	17972	10	10	72	22	0.5
178 1200-0.75RA	17975	12	12	83	26	0.75
178 1400-0.75RA	17978	14	14	83	26	0.75
178 1600-1.0RA	17982	16	16	92	32	1
178 1800-1.0RA	17984	18	18	92	32	1
178 2000-1.0RA	17987	20	20	104	38	1
178 2500-1.0RA	17989	25	25	104	38	1

Series 178-1

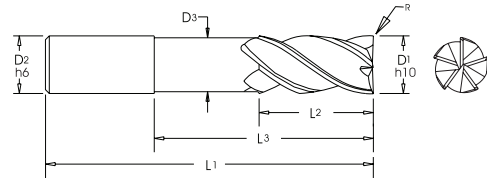
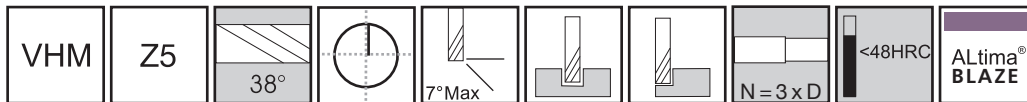


Tool No.	EDP	D1	D2	L1	L2
178 0300-1A	17998	3	3	75	25
178 0400-1A	17999	4	4	75	25
178 0500-1A	18026	5	5	75	25
178 0600-1A	18027	6	6	75	25
178 0800-1A	18028	8	8	75	30
178 1000-1A	18029	10	10	100	45
178 1200-1A	18030	12	12	150	75
178 1600-1A	18031	16	16	150	75
178 2000-1A	18032	20	20	150	75

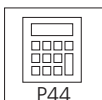




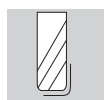
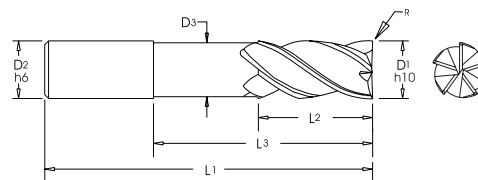
TuffCut® XT Series 278R N3



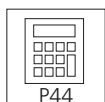
Tool No.	D1	D2	D3	L1	L2	L3	R
278 0300N3-0.25RB	3	6	2.9	57	8	10	0.25
278 0300N3-0.5RB	3	6	2.9	57	8	10	0.5
278 0400N3-0.25RB	4	6	3.9	57	11	13	0.25
278 0400N3-0.5RB	4	6	3.9	57	11	13	0.5
278 0500N3-0.25RB	5	6	4.9	57	13	16	0.25
278 0500N3-0.5RB	5	6	4.9	57	13	16	0.5
278 0600N3-0.25RB	6	6	5.9	57	13	19	0.25
278 0600N3-0.5RB	6	6	5.9	57	13	19	0.5
278 0600N3-1.0RB	6	6	5.9	57	13	19	1
278 0800N3-0.25RB	8	8	7.8	63	19	25	0.25
278 0800N3-0.5RB	8	8	7.8	63	19	25	0.5
278 0800N3-1.0RB	8	8	7.8	63	19	25	1
278 0800N3-1.5RB	8	8	7.8	63	19	25	1.5
278 0800N3-2.0RB	8	8	7.8	63	19	25	2
278 1000N3-0.5RB	10	10	9.8	72	22	31	0.5
278 1000N3-1.0RB	10	10	9.8	72	22	31	1
278 1000N3-2.0RB	10	10	9.8	72	22	31	2
278 1200N3-0.5RB	12	12	11.4	84	26	38	0.5
278 1200N3-1.0RB	12	12	11.4	84	26	38	1
278 1200N3-1.0RBW	12	12	11.4	84	26	38	1
278 1200N3-1.5RB	12	12	11.4	84	26	38	1.5
278 1200N3-2.5RB	12	12	11.4	84	26	38	2.5
278 1200N3-3.0RB	12	12	11.4	84	26	38	3
278 1200N3-4.0RB	12	12	11.4	84	26	38	4
278 1600N3-0.5RB	16	16	15.2	100	35	50	0.5
278 1600N3-1.0RB	16	16	15.2	100	35	50	1
278 1600N3-1.0RBW	16	16	15.2	100	35	50	1
278 1600N3-1.5RB	16	16	15.2	100	35	50	1.5
278 1600N3-2.5RB	16	16	15.2	100	35	50	2.5
278 1600N3-3.0RB	16	16	15.2	100	35	50	3
278 1600N3-4.0RB	16	16	15.2	100	35	50	4
278 2000N3-1.0RB	20	20	19.2	112	40	62	1
278 2000N3-2.0RB	20	20	19.2	112	40	62	2
278 2000N3-3.0RB	20	20	19.2	112	40	62	3
278 2000N3-4.0RB	20	20	19.2	112	40	62	4
278 2500N3-1.0RB	25	25	24.6	127	40	77	1
278 2500N3-3.0RB	25	25	24.6	127	40	77	3
278 2500N3-4.0RB	25	25	24.6	127	40	77	4



TuffCut® XT Series 278R N4



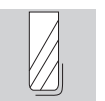
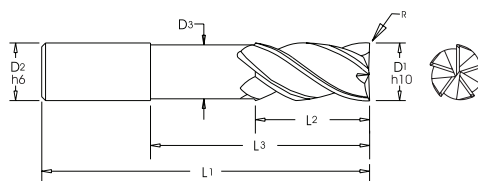
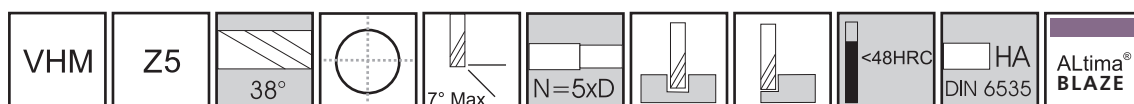
Corner Radius



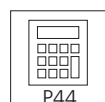
P44

Tool No.	D1	D2	D3	L1	L2	L3	R
278 1200N4-0.5RB	12	12	11.4	100	18	50	0.5
278 1200N4-1.0RB	12	12	11.4	100	18	50	1
278 1200N4-1.5RB	12	12	11.4	100	18	50	1.5
278 1200N4-2.0RB	12	12	11.4	100	18	50	2
278 1200N4-3.0RB	12	12	11.4	100	18	50	3
278 1200N4-4.0RB	12	12	11.4	100	18	50	4
278 1600N4-1.0RB	16	16	15.6	120	35	65	1
278 1600N4-3.0RB	16	16	15.6	120	35	65	3
278 2000N4-1.0RB	20	20	19.6	133	40	82	1
278 2000N4-3.0RB	20	20	19.6	133	40	82	3
278 2500N4-1.0RB	25	25	24.6	152	40	102	1
278 2500N4-3.0RB	25	25	24.6	152	40	102	3

Series 278R N5



Corner Radius

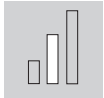
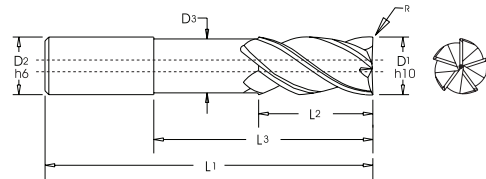
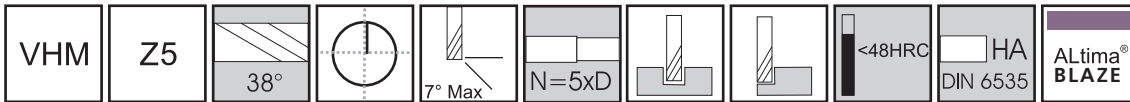


P44

Tool No.	D1	D2	D3	L1	L2	L3	R
278 1600N5-1.0RB	16.0	16.0	15.6	133.0	40.0	82.0	1
278 1600N5-3.0RB	16.0	16.0	15.6	133.0	40.0	82.0	3
278 2000N5-1.0RB	20.0	20.0	19.6	152.0	40.0	102.0	1
278 2000N5-3.0RB	20.0	20.0	19.6	152.0	40.0	102.0	3
278 2500N5-1.0RB	25.0	25.0	24.6	180.0	40.0	125.0	1
278 2500N5-3.0RB	25.0	25.0	24.6	180.0	40.0	125.0	3



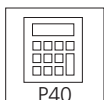
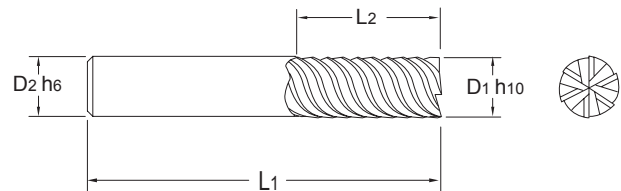
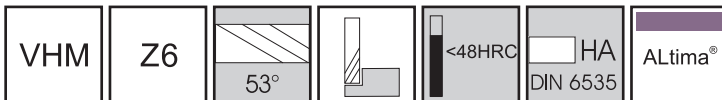
TuffCut® XT Series 278R N5CT (With Central Coolant)



Corner Radius

Tool No.	D1	D2	D3	L1	L2	L3	R
278 1200N5-0.5RBCT	12.0	12.0	11.4	110.0	18.0	62.0	0.5
278 1200N5-1.0RBCT	12.0	12.0	11.4	110.0	18.0	62.0	1
278 1200N5-1.5RBCT	12.0	12.0	11.4	110.0	18.0	62.0	1.5
278 1200N5-2.0RBCT	12.0	12.0	11.4	110.0	18.0	62.0	2
278 1200N5-3.0RBCT	12.0	12.0	11.4	110.0	18.0	62.0	3
278 1200N5-4.0RBCT	12.0	12.0	11.4	110.0	18.0	62.0	4

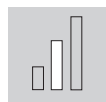
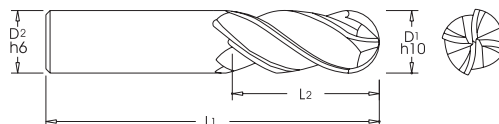
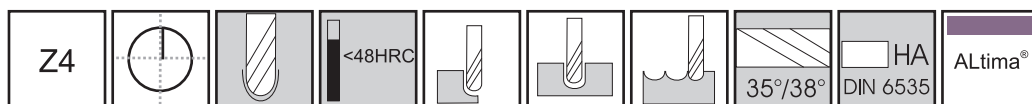
TuffCut® XR Series 113A



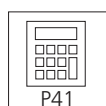
Tool No.	EDP	D1	D2	L1	L2
113 0300A	11384	3	3	38	12
113 0400A	11385	4	4	51	14
113 0500A	11386	5	5	51	20
113 0600A	11387	6	6	64	20
113 0800A	11388	8	8	64	20
113 1000A	11389	10	10	70	25
113 1200A	11390	12	12	76	25
113 1600A	11391	16	16	89	30
113 2000A	11392	20	20	102	38



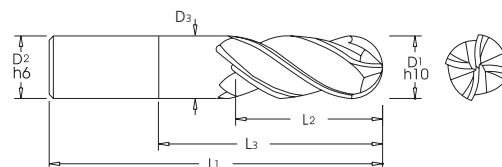
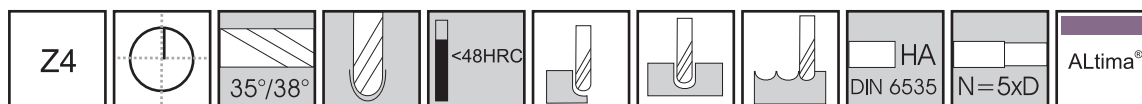
TuffCut® XR Series 179



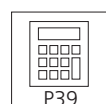
Tool No.	EDP	D1	D2	L1	L2
179 0150A	18272	1.5	3	38	3
179 0200A	18274	2	3	38	4
179 0250A	18276	2.5	3	38	5
179 0300A	18018	3	6	57	8
179 0303A	18278	3	3	38	6
179 0350A	18280	3.5	6	57	7
179 0400A	18019	4	6	57	11
179 0450A	18282	4.5	6	57	9
179 0500A	18020	5	6	57	13
179 0600A	18021	6	6	57	13
179 0800A	18022	8	8	63	19
179 1000A	18023	10	10	72	22
179 1200A	18024	12	12	83	26
179 1600A	18059	16	16	92	32



Series 179L N5

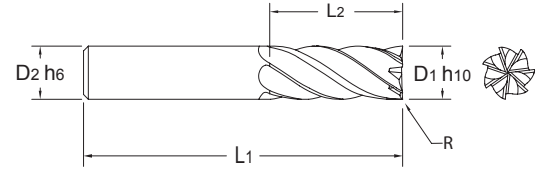
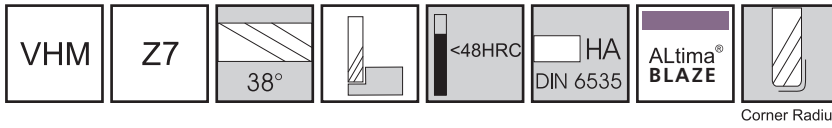


Tool No.	EDP	D1	D2	D3	L1	L2	L3
179L 03N5A	18290	3	6	2.9	75	4.5	17
179L 04N5A	18292	4	6	3.9	75	6	22
179L 05N5A	18294	5	6	4.9	75	7.5	27
179L 06N5A	18296	6	6	5.8	101	9	32
179L 08N5A	18298	8	8	7.6	101	12	42
179L 10N5A	18302	10	10	9.6	127	15	52
179L 12N5A	18304	12	12	11.4	152	18	62
179L 16N5A	18306	16	16	15.2	152	24	82

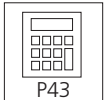




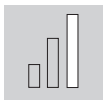
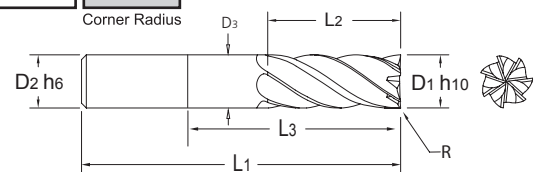
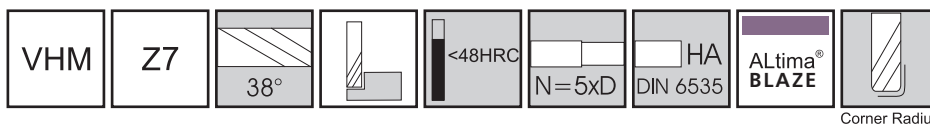
TuffCut® XR Series 180R



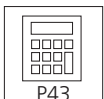
Tool No.	EDP	D1	D2	L1	L2	R
180 1200-0.5RB	18501	12	12	84	32	0.5
180 1200-1.0RB	18503	12	12	84	32	1
180 1200-2.0RB	18505	12	12	84	32	2
180 1200-3.0RB	18507	12	12	84	32	3
180 1200-4.0RB	18508	12	12	84	32	4
180 1600-0.5RB	18509	16	16	92	42	0.5
180 1600-1.0RB	18510	16	16	92	42	1
180 1600-2.0RB	18511	16	16	92	42	2
180 1600-3.0RB	18513	16	16	92	42	3
180 1600-4.0RB	18527	16	16	92	42	4
180 2000-0.5RB	18528	20	20	102	52	0.5
180 2000-1.0RB	18529	20	20	102	52	1
180 2000-2.0RB	18530	20	20	102	52	2
180 2000-3.0RB	18531	20	20	102	52	3
180 2000-4.0RB	18533	20	20	102	52	4



Series 180R N5



Tool No.	EDP	D1	D2	D3	L1	L2	L3	R
180 1200N5-1.0RB	18500	12	12	11.4	120	30	60	1
180 1200N5-2.0RB	18502	12	12	11.4	120	30	60	2
180 1200N5-3.0RB	18504	12	12	11.4	120	30	60	3
180 1200N5-4.0RB	18506	12	12	11.4	120	30	60	4
180 1600N5-1.0RB	18548	16	16	15.2	150	40	80	1
180 1600N5-2.0RB	18550	16	16	15.2	150	40	80	2
180 1600N5-3.0RB	18552	16	16	15.2	150	40	80	3
180 1600N5-4.0RB	18554	16	16	15.2	150	40	80	4
180 2000N5-1.0RB	18590	20	20	19.2	150	50	100	1
180 2000N5-2.0RB	18592	20	20	19.2	150	50	100	2
180 2000N5-3.0RB	18594	20	20	19.2	150	50	100	3
180 2000N5-4.0RB	18596	20	20	19.2	150	50	100	4



TuffCut® X-AL

Features

135 series

- Unique double grind geometry
- Variety of lengths from stock with neck relief as standard.
- Industry standard radii from stock

Benefits

135 series

Controlled chip form for easy evacuation.
Highest tooth loading capability (1 mm/tooth/rev during 1 x D slotting) on sizes ≥ 12 mm
Enabling the use of best practice tool length.
3 x D and 5 x D neck relieved shanks available.
Tool availability reduces forward planning required for short lead time components.

137V series

- 3 Flute geometry
- Circular land
- Wiper flats

137V series

Roughing and finishing endmill for smoother cutting and higher feed rates.
Improved surface finishes and reduced chatter on walls/ribs.
Best possible web/rib surface finishes.

General Features

- Unique carbide substrates
- Fordlube coating

General Features

Application specific grades for optimum tool performance.
To prevent chip adhesion and extend tool life during Ultra high speed machining or applications involving the use of minimal coolant.



TuffCut® X-AL

Carbide End mills



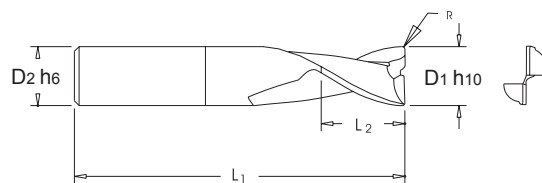
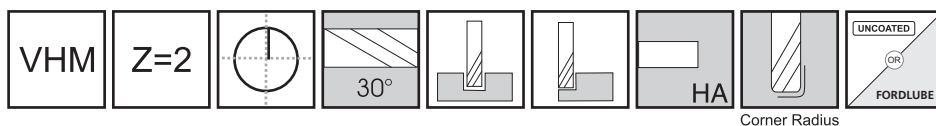
As an integral part of our innovative TuffCut® range of solid carbide end mills, the X-AL Series of products are designed to provide outstanding performance when cutting aluminium, aluminium alloys and non-ferrous materials.

Across the range, the use of high performance coatings, multiple flutes and innovative tooling geometries ensures that TuffCut® X-AL end mills deliver class leading productivity without compromising on finish quality or tool life.

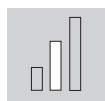
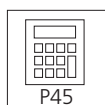
TuffCut® X-AL is continually evolving to meet new manufacturing, productivity and performance challenges to ensure that its position at the forefront of cutting tool design and technology is maintained.

 VHM Tool Material	 Z4 Number of Flutes	 55° Helix Angle	 Centre Cutting
 Lengths	 Cutting Direction	 Profiling	 Slotting
 3D Scanning	 Shank	 Neck Relief	 Material Hardness
 Coating	 Coating	 Uncoated or Fordlube	 Technical Information
 Steel Cast Iron Hardened Steels (35-65Rc) Special Alloys Stainless Steels Non-Ferrous			

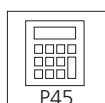
	Page
TuffCut® X-AL Series 135	22
TuffCut® X-AL Series 135 N	23
TuffCut® X-AL Series 135 N3	24 - 25
TuffCut® X-AL Series 135 N5	26 - 27
TuffCut® X-AL Series 135B N3, 135B N5	28
TuffCut® X-AL Series 137V N3	29 - 30
TuffCut® X-AL Series 137V N4	31 - 32
TuffCut® X-AL Series 137V N5	33 - 34
TuffCut® X-AL Series 138B, 138B N5	35
TuffCut® X-AL Series 137VRN, 137VF	36
Technical Section	45 - 48



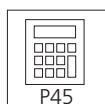
Tool No.	EDP	D1	D2	L1	L2	R
135 0300	13523	3	3	38	3.5	0.2
135 0400	13533	4	4	51	4.8	0.2
135 0500	13502	5	5	51	6	0.25
135 0600	13504	6	6	64	7	0.3
135 0800	13508	8	8	64	9.5	0.35
135 1000	13515	10	10	70	12	0.5
135 1200	13525	12	12	76	14	0.5
135 1400	13552	14	14	89	16	0.5
135 1600	13535	16	16	89	18	0.75
135 1800	13563	18	18	102	20	0.75
135 2000	13545	20	20	102	22	0.75
135 2500	13555	25	25	102	25	0.75



Tool No.	EDP	D1	D2	L1	L2	R
135 1001	13516	10	10	76	12	0.5
135 1201	13526	12	12	102	14	0.5
135 1401	13554	14	14	102	16	0.5
135 1601	13536	16	16	117	18	0.75
135 1801	13568	18	18	127	20	0.75
135 2001	13546	20	20	127	22	0.75
135 2501	13556	25	25	127	25	0.75



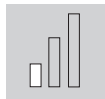
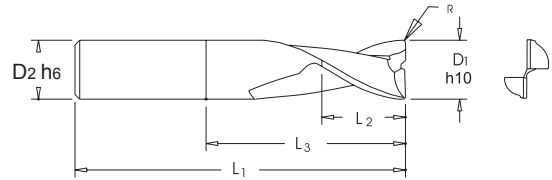
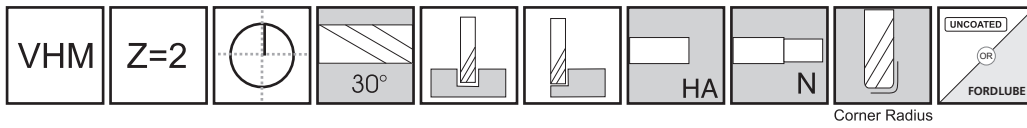
Tool No.	EDP	D1	D2	L1	L2	R
135 1002	13517	10	10	89	12	0.5
135 1202	13527	12	12	127	14	0.5
135 1402	13573	14	14	127	16	0.5
135 1602	13537	16	16	133	18	0.75
135 1802	13574	18	18	152	20	0.75
135 2002	13547	20	20	152	22	0.75
135 2502	13557	25	25	152	25	0.75



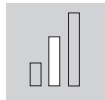
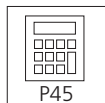
Available with Fordlube upon request.



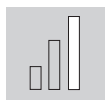
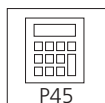
TuffCut® X-AL Series 135 N



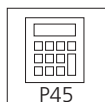
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 0300N	13524	3	3	38	3.5	11	0.2
135 0400N	13534	4	4	51	4.8	22	0.2
135 0500N	13503	5	5	51	6	22	0.25
135 0600N	13505	6	6	64	7	26	0.3
135 0800N	13509	8	8	64	9.5	26	0.35
135 1000N	13565	10	10	70	12	28	0.5
135 1200N	13575	12	12	76	14	28	0.5
135 1400N	13553	14	14	89	16	42	0.5
135 1600N	13585	16	16	89	18	39	0.75
135 1800N	13564	18	18	102	20	52	0.75
135 2000N	13594	20	20	102	22	50	0.75
135 2500N	13597	25	25	102	25	36	0.75



Tool No.	EDP	D1	D2	L1	L2	L3	R
135 1001N	13566	10	10	76	12	34	0.5
135 1201N	13576	12	12	102	14	54	0.5
135 1401N	13558	14	14	102	16	55	0.5
135 1601N	13586	16	16	117	18	83	0.75
135 1801N	13569	18	18	127	20	77	0.75
135 2001N	13595	20	20	127	22	75	0.75
135 2501N	13598	25	25	127	25	61	0.75

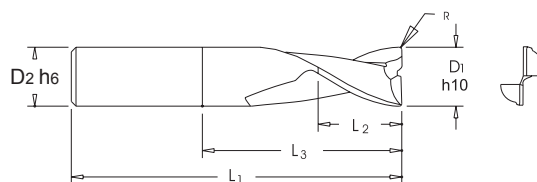
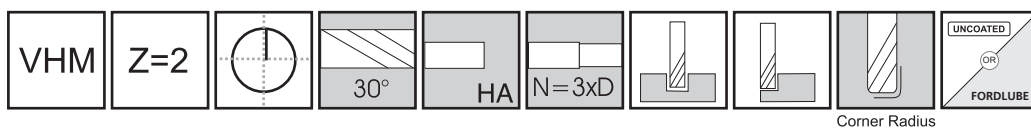


Tool No.	EDP	D1	D2	L1	L2	L3	R
135 1002N	13567	10	10	89	12	47	0.5
135 1202N	13577	12	12	127	14	79	0.5
135 1402N	13559	14	14	127	16	80	0.5
135 1602N	13587	16	16	133	18	99	0.75
135 1802N	13578	18	18	152	20	102	0.75
135 2002N	13596	20	20	152	22	100	0.75
135 2502N	13599	25	25	152	25	86	0.75

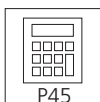


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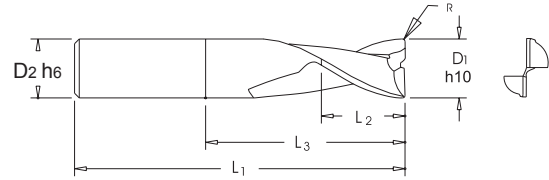
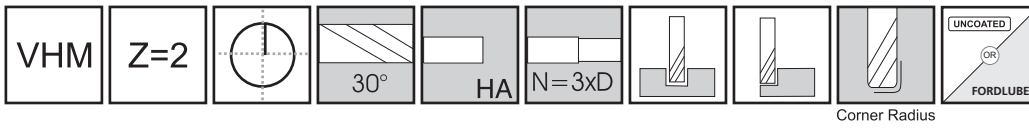
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 03N3	96620	3	3	38	3.5	11	-
135 03N3-0.5R	96621	3	3	38	3.5	11	0.5
135 03N3-1.0R	96622	3	3	38	3.5	11	1
135 04N3	96626	4	4	51	4.8	14	-
135 04N3-0.5R	96627	4	4	51	4.8	14	0.5
135 04N3-1.0R	96628	4	4	51	4.8	14	1
135 05N3	96632	5	6	64	6	17	-
135 05N3-0.5R	96633	5	6	64	6	17	0.5
135 05N3-1.0R	96634	5	6	64	6	17	1
135 06N3	96638	6	6	64	7	20	-
135 06N3-0.5R	96639	6	6	64	7	20	0.5
135 06N3-1.0R	96640	6	6	64	7	20	1
135 06N3-1.5R	96641	6	6	64	7	20	1.5
135 06N3-2.0R	96642	6	6	64	7	20	2
135 08N3	96648	8	8	64	9.5	26	-
135 08N3-0.5R	96649	8	8	64	9.5	26	0.5
135 08N3-1.0R	96650	8	8	64	9.5	26	1
135 08N3-1.5R	96651	8	8	64	9.5	26	1.5
135 08N3-2.0R	96652	8	8	64	9.5	26	2
135 08N3-3.0R	96653	8	8	64	9.5	26	3
135 10N3	96660	10	10	76	12	34	-
135 1001N	13566	10	10	76	12	34	0.5
135 10N3-1.0R	96662	10	10	76	12	34	1
135 10N3-1.5R	96663	10	10	76	12	34	1.5
135 10N3-2.0R	96664	10	10	76	12	34	2
135 10N3-3.0R	96665	10	10	76	12	34	3
135 12N3	96671	12	12	76	14	38	-



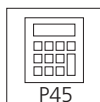
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TuffCut® X-AL Series 135 N3

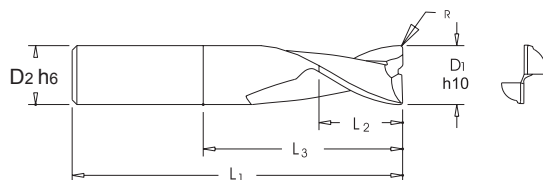
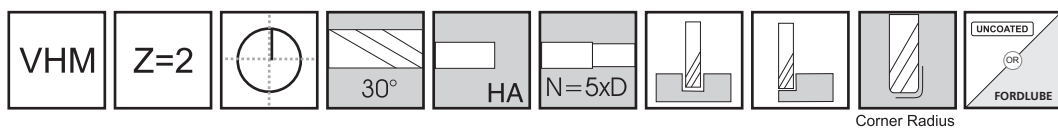


Tool No.	EDP	D1	D2	L1	L2	L3	R
135 12N3-0.5R	96672	12	12	76	14	38	0.5
135 12N3-1.0R	96673	12	12	76	14	38	1
135 12N3-1.5R	96674	12	12	76	14	38	1.5
135 12N3-2.0R	96675	12	12	76	14	38	2
135 12N3-3.0R	96676	12	12	76	14	38	3
135 12N3-4.0R	96677	12	12	76	14	38	4
135 16N3	96684	16	16	117	18	53	-
135 16N3-0.5R	96685	16	16	117	18	53	0.5
135 16N3-1.0R	96686	16	16	117	18	53	1
135 16N3-1.5R	96687	16	16	117	18	53	1.5
135 16N3-2.0R	96688	16	16	117	18	53	2
135 16N3-3.0R	96689	16	16	117	18	53	3
135 16N3-4.0R	96690	16	16	117	18	53	4
135 20N3-0.5R	96697	20	20	127	22	65	0.5
135 20N3-1.0R	96698	20	20	127	22	65	1
135 20N3-1.5R	96699	20	20	127	22	65	1.5
135 20N3-2.0R	96700	20	20	127	22	65	2
135 20N3-3.0R	96701	20	20	127	22	65	3
135 20N3-4.0R	96702	20	20	127	22	65	4
135 25N3-0.5R	96709	25	25	127	25	80	0.5
135 25N3-1.0R	96710	25	25	127	25	80	1
135 25N3-1.5R	96711	25	25	127	25	80	1.5
135 25N3-2.0R	96712	25	25	127	25	80	2
135 25N3-3.0R	96713	25	25	127	25	80	3
135 25N3-4.0R	96714	25	25	127	25	80	4

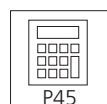


Available with Fordlube upon request.





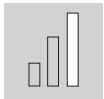
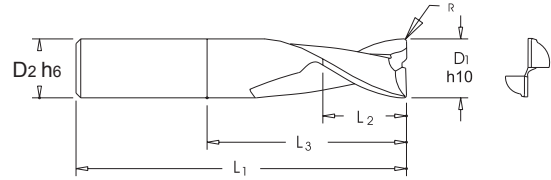
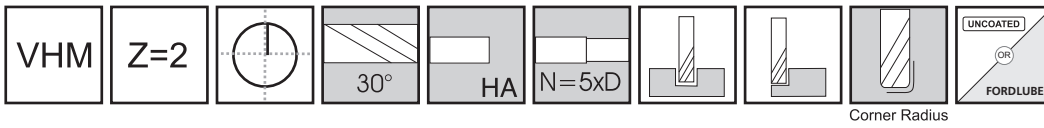
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 03N5	96623	3	3	38	3.5	16	-
135 03N5-0.5R	96624	3	3	38	3.5	16	0.5
135 03N5-1.0R	96625	3	3	38	3.5	16	1
135 04N5	96629	4	4	51	4.8	22	-
135 04N5-0.5R	96630	4	4	51	4.8	22	0.5
135 04N5-1.0R	96631	4	4	51	4.8	22	1
135 05N5	96635	5	6	64	6	27	-
135 05N5-0.5R	96636	5	6	64	6	27	0.5
135 05N5-1.0R	96637	5	6	64	6	27	1
135 06N5	96643	6	6	64	7	32	-
135 06N5-0.5R	96644	6	6	64	7	32	0.5
135 06N5-1.0R	96645	6	6	64	7	32	1
135 06N5-1.5R	96646	6	6	64	7	32	1.5
135 06N5-2.0R	96647	6	6	64	7	32	2
135 08N5	96654	8	8	75	9.5	42	-
135 08N5-0.5R	96655	8	8	75	9.5	42	0.5
135 08N5-1.0R	96656	8	8	75	9.5	42	1
135 08N5-1.5R	96657	8	8	75	9.5	42	1.5
135 08N5-2.0R	96658	8	8	75	9.5	42	2
135 08N5-3.0R	96659	8	8	75	9.5	42	3
135 10N5-0.5R	96666	10	10	89	12	52	0.5
135 10N5-1.0R	96667	10	10	89	12	52	1
135 10N5-1.5R	96668	10	10	89	12	52	1.5
135 10N5-2.0R	96669	10	10	89	12	52	2
135 10N5-3.0R	96670	10	10	89	12	52	3
135 12N5-0.5R	96678	12	12	110	14	62	0.5



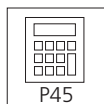
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TuffCut® X-AL Series 135 N5



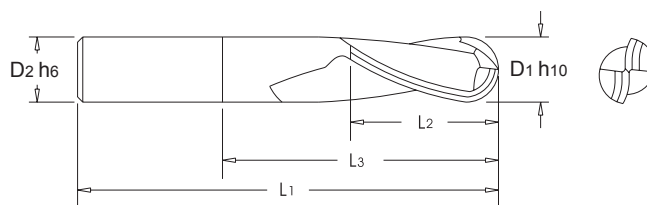
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 12N5-1.0R	96679	12	12	110	14	62	1
135 12N5-1.5R	96680	12	12	110	14	62	1.5
135 12N5-2.0R	96681	12	12	110	14	62	2
135 12N5-3.0R	96682	12	12	110	14	62	3
135 12N5-4.0R	96683	12	12	110	14	62	4
135 12N5-5.0R	96723	12	12	110	14	62	5
135 16N5-0.5R	96691	16	16	127	18	85	0.5
135 16N5-1.0R	96692	16	16	127	18	85	1
135 16N5-1.5R	96693	16	16	127	18	85	1.5
135 16N5-2.0R	96694	16	16	127	18	85	2
135 16N5-3.0R	96695	16	16	127	18	85	3
135 16N5-4.0R	96696	16	16	127	18	85	4
135 20N5-0.5R	96703	20	20	152	22	105	0.5
135 20N5-1.0R	96704	20	20	152	22	105	1
135 20N5-1.5R	96705	20	20	152	22	105	1.5
135 20N5-2.0R	96706	20	20	152	22	105	2
135 20N5-3.0R	96707	20	20	152	22	105	3
135 20N5-4.0R	96708	20	20	152	22	105	4
135 20N5-5.0R	96724	20	20	152	22	105	5
135 25N5-0.5R	96715	25	25	180	25	130	0.5
135 25N5-1.0R	96716	25	25	180	25	130	1
135 25N5-1.5R	96717	25	25	180	25	130	1.5
135 25N5-2.0R	96718	25	25	180	25	130	2
135 25N5-3.0R	96719	25	25	180	25	130	3
135 25N5-4.0R	96720	25	25	180	25	130	4



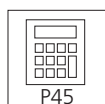
Available with Fordlube upon request.



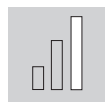
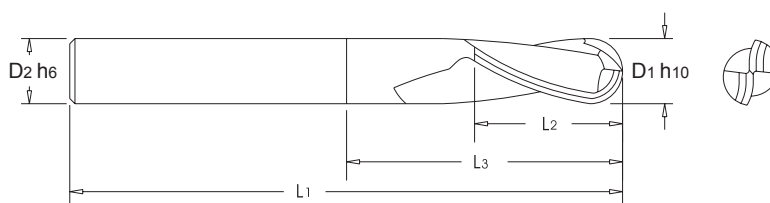
TuffCut® X-AL Series 135B N3



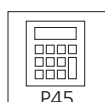
Tool No.	EDP	D1	D2	L1	L2	L3
135B 0300N3	13236	3	3	38	5	11
135B 0400N3	13238	4	4	51	6	14
135B 0500N3	13240	5	5	64	7	17
135B 0600N3	13242	6	6	64	8	20
135B 0800N3	13244	8	8	64	10	26
135B 1000N3	13246	10	10	70	12	32
135B 1200N3	13248	12	12	76	16	38
135B 1600N3	13250	16	16	89	20	50



TuffCut® X-AL Series 135B N5

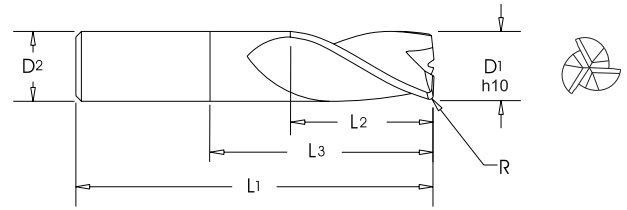
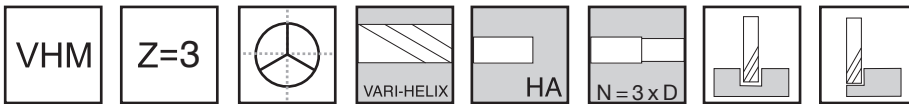


Tool No.	EDP	D1	D2	L1	L2	L3
135B 0200N5	13252	2	6	75	4	12
135B 0300N5	13254	3	6	75	5	17
135B 0400N5	13256	4	6	75	6	22
135B 0500N5	13258	5	6	75	7	27
135B 0600N5	13260	6	6	110	8	32
135B 0800N5	13262	8	8	110	10	42
135B 1000N5	13264	10	10	110	12	52
135B 1200N5	13266	12	12	120	16	62
135B 1600N5	13268	16	16	130	20	82



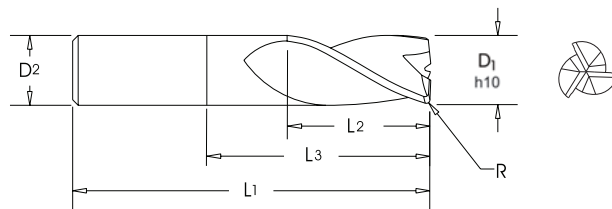
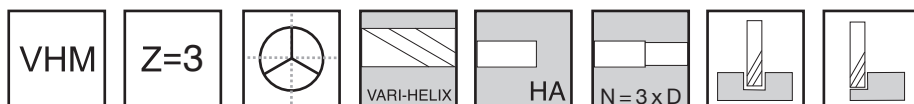


TuffCut® X-AL Series 137V N3

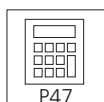


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 03N3	3	3	2.8	51	8	11	-
137V 03N3-0.2R	3	3	2.8	51	8	11	0.2
137V 03N3-0.5R	3	3	2.8	51	8	11	0.5
137V 03N3-1.0R	3	3	2.8	51	8	11	1
137V 04N3	4	4	3.8	51	11	14	-
137V 04N3-0.2R	4	4	3.8	51	11	14	0.2
137V 04N3-0.5R	4	4	3.8	51	11	14	0.5
137V 04N3-1.0R	4	4	3.8	51	11	14	1
137V 05N3	5	5	4.8	57	13	17	-
137V 05N3-0.2R	5	5	4.8	57	13	17	0.2
137V 05N3-0.5R	5	5	4.8	57	13	17	0.5
137V 05N3-1.0R	5	5	4.8	57	13	17	1
137V 06N3	6	6	5.8	64	13	20	-
137V 06N3-0.2R	6	6	5.8	64	13	20	0.2
137V 06N3-0.5R	6	6	5.8	64	13	20	0.5
137V 06N3-1.0R	6	6	5.8	64	13	20	1
137V 06N3-1.5R	6	6	5.8	64	13	20	1.5
137V 06N3-2.0R	6	6	5.8	64	13	20	2
137V 08N3	8	8	7.8	64	19	26	-
137V 08N3-0.2R	8	8	7.8	64	19	26	0.2
137V 08N3-0.5R	8	8	7.8	64	19	26	0.5
137V 08N3-1.0R	8	8	7.8	64	19	26	1
137V 08N3-1.5R	8	8	7.8	64	19	26	1.5
137V 08N3-2.0R	8	8	7.8	64	19	26	2
137V 08N3-3.0R	8	8	7.8	64	19	26	3
137V 10N3	10	10	9.8	73	22	32	-
137V 10N3-0.2R	10	10	9.8	73	22	32	0.2
137V 10N3-0.5R	10	10	9.8	73	22	32	0.5
137V 10N3-1.0R	10	10	9.8	73	22	32	1
137V 10N3-1.5R	10	10	9.8	73	22	32	1.5
137V 10N3-2.0R	10	10	9.8	73	22	32	2
137V 10N3-3.0R	10	10	9.8	73	22	32	3
137V 10N3-4.0R	10	10	9.8	73	22	32	4
137V 12N3	12	12	11.8	84	26	38	-
137V 12N3-0.2R	12	12	11.8	84	26	38	0.2



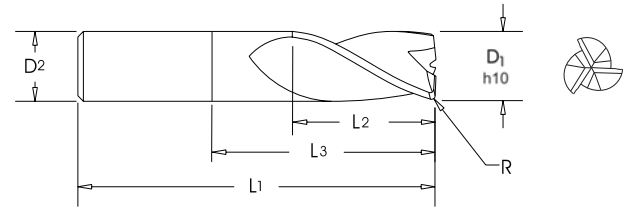
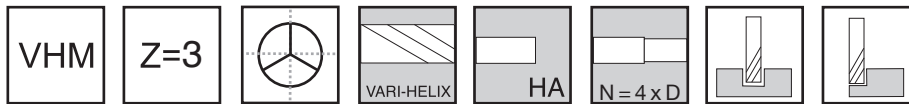


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 12N3-0.5R	12	12	11.8	84	26	38	0.5
137V 12N3-1.0R	12	12	11.8	84	26	38	1
137V 12N3-1.5R	12	12	11.8	84	26	38	1.5
137V 12N3-2.0R	12	12	11.8	84	26	38	2
137V 12N3-3.0R	12	12	11.8	84	26	38	3
137V 12N3-4.0R	12	12	11.8	84	26	38	4
137V 16N3	16	16	15.8	93	32	50	-
137V 16N3-0.2R	16	16	15.8	93	32	50	0.2
137V 16N3-0.5R	16	16	15.8	93	32	50	0.5
137V 16N3-1.0R	16	16	15.8	93	32	50	1
137V 16N3-1.5R	16	16	15.8	93	32	50	1.5
137V 16N3-2.0R	16	16	15.8	93	32	50	2
137V 16N3-3.0R	16	16	15.8	93	32	50	3
137V 16N3-4.0R	16	16	15.8	93	32	50	4
137V 20N3	20	20	19.8	105	38	62	-
137V 20N3-0.2R	20	20	19.8	105	38	62	0.2
137V 20N3-0.5R	20	20	19.8	105	38	62	0.5
137V 20N3-1.0R	20	20	19.8	105	38	62	1
137V 20N3-1.5R	20	20	19.8	105	38	62	1.5
137V 20N3-2.0R	20	20	19.8	105	38	62	2
137V 20N3-3.0R	20	20	19.8	105	38	62	3
137V 20N3-4.0R	20	20	19.8	105	38	62	4

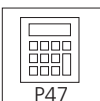


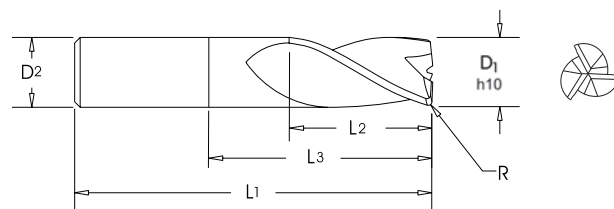
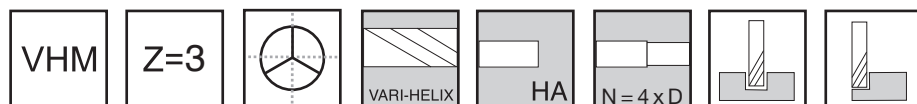


TuffCut® X-AL Series 137V N4

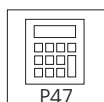


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 03N4	3	3	2.8	51	4.5	14	-
137V 03N4-0.2R	3	3	2.8	51	4.5	14	0.2
137V 03N4-0.5R	3	3	2.8	51	4.5	14	0.5
137V 03N4-1.0R	3	3	2.8	51	4.5	14	1
137V 04N4	4	4	3.8	51	6	18	-
137V 04N4-0.2R	4	4	3.8	51	6	18	0.2
137V 04N4-0.5R	4	4	3.8	51	6	18	0.5
137V 04N4-1.0R	4	4	3.8	51	6	18	1
137V 05N4	5	5	4.8	57	7.5	22	-
137V 05N4-0.2R	5	5	4.8	57	7.5	22	0.2
137V 05N4-0.5R	5	5	4.8	57	7.5	22	0.5
137V 05N4-1.0R	5	5	4.8	57	7.5	22	1
137V 06N4	6	6	5.8	64	9	26	-
137V 06N4-0.2R	6	6	5.8	64	9	26	0.2
137V 06N4-0.5R	6	6	5.8	64	9	26	0.5
137V 06N4-1.0R	6	6	5.8	64	9	26	1
137V 06N4-1.5R	6	6	5.8	64	9	26	1.5
137V 06N4-2.0R	6	6	5.8	64	9	26	2
137V 08N4	8	8	7.8	70	12	34	-
137V 08N4-0.2R	8	8	7.8	70	12	34	0.2
137V 08N4-0.5R	8	8	7.8	70	12	34	0.5
137V 08N4-1.0R	8	8	7.8	70	12	34	1
137V 08N4-1.5R	8	8	7.8	70	12	34	1.5
137V 08N4-2.0R	8	8	7.8	70	12	34	2
137V 08N4-3.0R	8	8	7.8	70	12	34	3
137V 10N4	10	10	9.8	90	15	42	-
137V 10N4-0.2R	10	10	9.8	90	15	42	0.2
137V 10N4-0.5R	10	10	9.8	90	15	42	0.5
137V 10N4-1.0R	10	10	9.8	90	15	42	1
137V 10N4-1.5R	10	10	9.8	90	15	42	1.5
137V 10N4-2.0R	10	10	9.8	90	15	42	2
137V 10N4-3.0R	10	10	9.8	90	15	42	3
137V 10N4-4.0R	10	10	9.8	90	15	42	4
137V 12N4	12	12	11.8	100	18	50	-
137V 12N4-0.2R	12	12	11.8	100	18	50	0.2



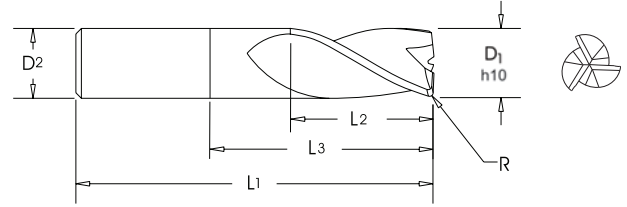
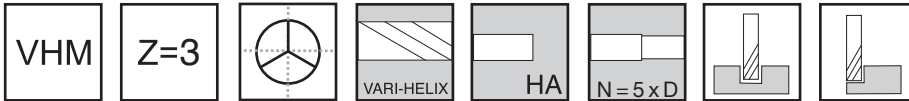


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 12N4-0.5R	12	12	11.8	100	18	50	0.5
137V 12N4-1.0R	12	12	11.8	100	18	50	1
137V 12N4-1.5R	12	12	11.8	100	18	50	1.5
137V 12N4-2.0R	12	12	11.8	100	18	50	2
137V 12N4-3.0R	12	12	11.8	100	18	50	3
137V 12N4-4.0R	12	12	11.8	100	18	50	4
137V 16N4	16	16	15.8	120	24	66	-
137V 16N4-0.2R	16	16	15.8	120	24	66	0.2
137V 16N4-0.5R	16	16	15.8	120	24	66	0.5
137V 16N4-1.0R	16	16	15.8	120	24	66	1
137V 16N4-1.5R	16	16	15.8	120	24	66	1.5
137V 16N4-2.0R	16	16	15.8	120	24	66	2
137V 16N4-3.0R	16	16	15.8	120	24	66	3
137V 16N4-4.0R	16	16	15.8	120	24	66	4
137V 20N4	20	20	19.8	135	30	82	-
137V 20N4-0.2R	20	20	19.8	135	30	82	0.2
137V 20N4-0.5R	20	20	19.8	135	30	82	0.5
137V 20N4-1.0R	20	20	19.8	135	30	82	1
137V 20N4-1.5R	20	20	19.8	135	30	82	1.5
137V 20N4-2.0R	20	20	19.8	135	30	82	2
137V 20N4-3.0R	20	20	19.8	135	30	82	3
137V 20N4-4.0R	20	20	19.8	135	30	82	4



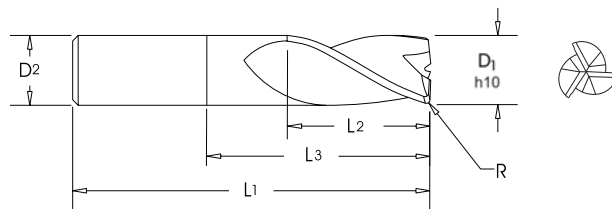
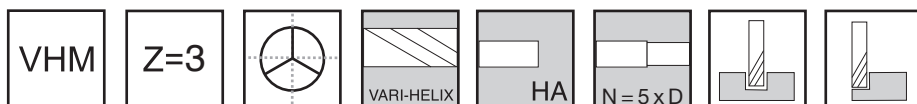


TuffCut® X-AL Series 137V N5

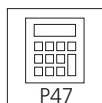


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 03N5	3	3	2.8	51	4.5	17	-
137V 03N5-0.2R	3	3	2.8	51	4.5	17	0.2
137V 03N5-0.5R	3	3	2.8	51	4.5	17	0.5
137V 03N5-1.0R	3	3	2.8	51	4.5	17	1
137V 04N5	4	4	3.8	51	6	22	-
137V 04N5-0.2R	4	4	3.8	51	6	22	0.2
137V 04N5-0.5R	4	4	3.8	51	6	22	0.5
137V 04N5-1.0R	4	4	3.8	51	6	22	1
137V 05N5	5	5	4.8	57	7.5	27	-
137V 05N5-0.2R	5	5	4.8	57	7.5	27	0.2
137V 05N5-0.5R	5	5	4.8	57	7.5	27	0.5
137V 05N5-1.0R	5	5	4.8	57	7.5	27	1
137V 06N5	6	6	5.8	64	9	32	-
137V 06N5-0.2R	6	6	5.8	64	9	32	0.2
137V 06N5-0.5R	6	6	5.8	64	9	32	0.5
137V 06N5-1.0R	6	6	5.8	64	9	32	1
137V 06N5-1.5R	6	6	5.8	64	9	32	1.5
137V 06N5-2.0R	6	6	5.8	64	9	32	2
137V 08N5	8	8	7.8	75	12	42	-
137V 08N5-0.2R	8	8	7.8	75	12	42	0.2
137V 08N5-0.5R	8	8	7.8	75	12	42	0.5
137V 08N5-1.0R	8	8	7.8	75	12	42	1
137V 08N5-1.5R	8	8	7.8	75	12	42	1.5
137V 08N5-2.0R	8	8	7.8	75	12	42	2
137V 08N5-3.0R	8	8	7.8	75	12	42	3
137V 10N5	10	10	9.8	90	15	52	-
137V 10N5-0.2R	10	10	9.8	90	15	52	0.2
137V 10N5-0.5R	10	10	9.8	90	15	52	0.5
137V 10N5-1.0R	10	10	9.8	90	15	52	1
137V 10N5-1.5R	10	10	9.8	90	15	52	1.5
137V 10N5-2.0R	10	10	9.8	90	15	52	2
137V 10N5-3.0R	10	10	9.8	90	15	52	3
137V 10N5-4.0R	10	10	9.8	90	15	52	4
137V 12N5	12	12	11.8	110	18	62	-
137V 12N5-0.2R	12	12	11.8	110	18	62	0.2



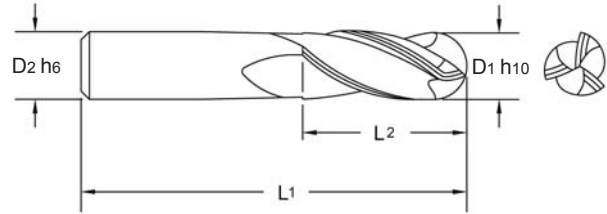


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 12N5-0.5R	12	12	11.8	110	18	62	0.5
137V 12N5-1.0R	12	12	11.8	110	18	62	1
137V 12N5-1.5R	12	12	11.8	110	18	62	1.5
137V 12N5-2.0R	12	12	11.8	110	18	62	2
137V 12N5-3.0R	12	12	11.8	110	18	62	3
137V 12N5-4.0R	12	12	11.8	110	18	62	4
137V 16N5	16	16	15.8	130	24	82	-
137V 16N5-0.2R	16	16	15.8	130	24	82	0.2
137V 16N5-0.5R	16	16	15.8	130	24	82	0.5
137V 16N5-1.0R	16	16	15.8	130	24	82	1
137V 16N5-1.5R	16	16	15.8	130	24	82	1.5
137V 16N5-2.0R	16	16	15.8	130	24	82	2
137V 16N5-3.0R	16	16	15.8	130	24	82	3
137V 16N5-4.0R	16	16	15.8	130	24	82	4
137V 20N5	20	20	19.8	150	30	102	-
137V 20N5-0.2R	20	20	19.8	150	30	102	0.2
137V 20N5-0.5R	20	20	19.8	150	30	102	0.5
137V 20N5-1.0R	20	20	19.8	150	30	102	1
137V 20N5-1.5R	20	20	19.8	150	30	102	1.5
137V 20N5-2.0R	20	20	19.8	150	30	102	2
137V 20N5-3.0R	20	20	19.8	150	30	102	3
137V 20N5-4.0R	20	20	19.8	150	30	102	4

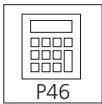




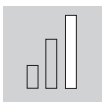
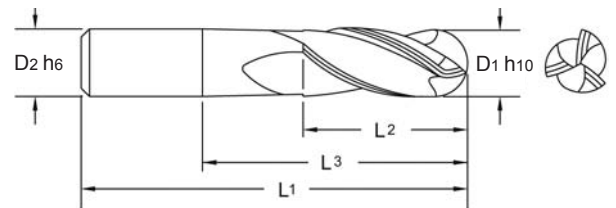
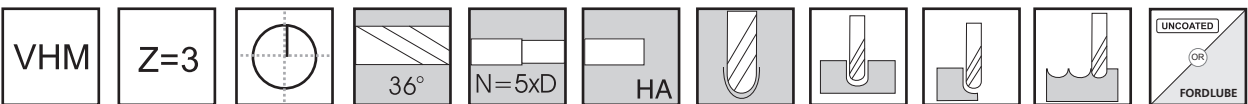
TuffCut® X-AL Series 138B



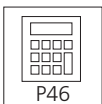
Tool No.	EDP	D1	D2	L1	L2
138B 0300	13356	3	3	38	12
138B 0400	13358	4	4	51	15
138B 0500	13360	5	5	64	20
138B 0600	13362	6	6	64	20
138B 0800	13364	8	8	64	20
138B 1000	13366	10	10	70	25
138B 1200	13368	12	12	76	25
138B 1600	13370	16	16	89	35



Series 138B N5



Tool No.	EDP	D1	D2	L1	L2	L3
138B 0200N5	13372	2	6	75	4	12
138B 0300N5	13374	3	6	75	5	17
138B 0400N5	13376	4	6	75	6	22
138B 0500N5	13378	5	6	75	7	27
138B 0600N5	13380	6	6	110	8	32
138B 0800N5	13382	8	8	110	10	42
138B 1000N5	13384	10	10	110	12	52
138B 1200N5	13386	12	12	120	16	62
138B 1600N5	13388	16	16	130	20	82

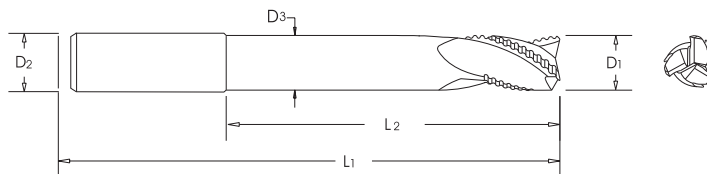
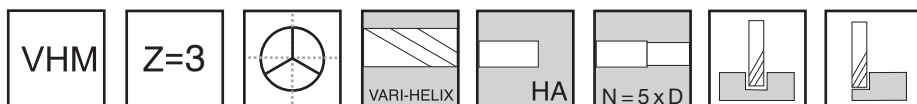


Available with Fordlube upon request.

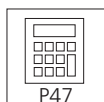




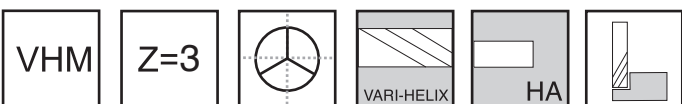
TuffCut® X-AL Series 137VR N5



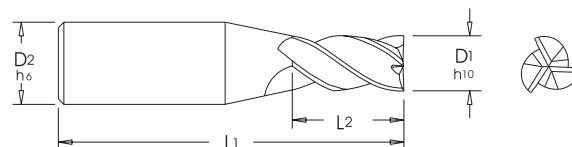
Tool No.	D1	D2	D3	L1	L2	L3	R	Shank
137VR 12N5-1.0R	12	12	11.8	110	18	62	1	HA
137VR 12N5-1.0RW	12	12	11.8	110	18	62	1	HB
137VR 16N5-1.0R	16	16	15.8	130	24	82	1	HA
137VR 16N5-1.0RW	16	16	15.8	130	24	82	1	HB
137VR 20N5-1.0R	20	20	19.8	150	30	102	1	HA
137VR 20N5-1.0RW	20	20	19.8	150	30	102	1	HB



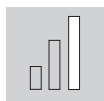
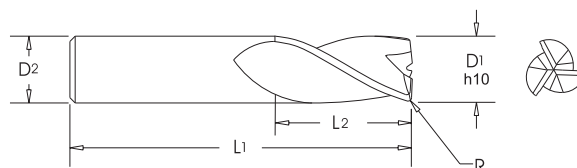
TuffCut® X-AL Series 137VF



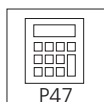
Type 1

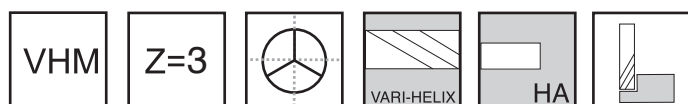


Type 2

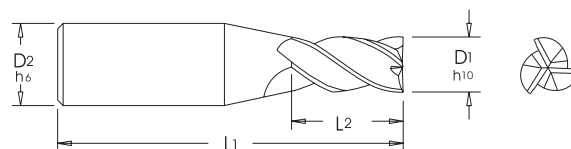


Tool No.	D1	D2	L1	L2	R	Type
137VF 0303	3	6	64	11	-	1
137VF 0303-0.2R	3	6	64	11	0.2	1
137VF 0305	3	6	64	17	-	1
137VF 0305-0.2R	3	6	64	17	0.2	1
137VF 0403	4	6	64	14	-	1
137VF 0403-0.2R	4	6	64	14	0.2	1
137VF 0403-0.5R	4	6	64	14	0.5	1
137VF 0405	4	6	64	22	-	1

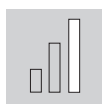
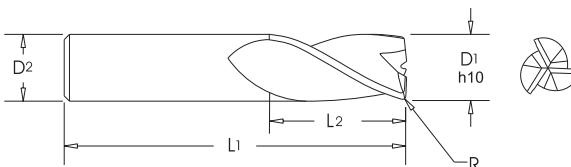




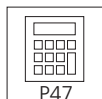
Type 1

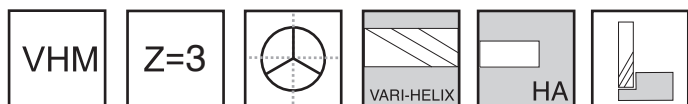


Type 2

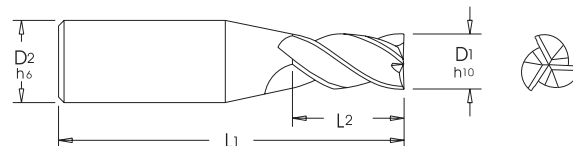


Tool No.	D1	D2	L1	L2	R	Type
137VF 0405-0.2R	4	6	64	22	0.2	1
137VF 0405-0.5R	4	6	64	22	0.5	1
137VF 0503	5	6	64	17	-	1
137VF 0503-0.2R	5	6	64	17	0.2	1
137VF 0503-0.5R	5	6	64	17	0.5	1
137VF 0505	5	6	64	27	-	1
137VF 0505-0.2R	5	6	64	27	0.2	1
137VF 0505-0.5R	5	6	64	27	0.5	1
137VF 0603	6	6	64	20	-	2
137VF 0603-0.2R	6	6	64	20	0.2	2
137VF 0603-0.5R	6	6	64	20	0.5	2
137VF 0605	6	6	64	32	-	2
137VF 0605-0.2R	6	6	64	32	0.2	2
137VF 0605-0.5R	6	6	64	32	0.5	2
137VF 0605-1.0R	6	6	64	32	1.0	2
137VF 0803	8	8	64	26	-	2
137VF 0803-0.2R	8	8	64	26	0.2	2
137VF 0803-0.5R	8	8	64	26	0.5	2
137VF 0803-1.0R	8	8	64	26	1.0	2
137VF 0805	8	8	75	42	-	2
137VF 0805-0.2R	8	8	75	42	0.2	2
137VF 0805-0.5R	8	8	75	42	0.5	2
137VF 0805-1.0R	8	8	75	42	1.0	2
137VF 1003	10	10	73	32	-	2
137VF 1003-0.2R	10	10	73	32	0.2	2
137VF 1003-0.5R	10	10	73	32	0.5	2
137VF 1003-1.0R	10	10	73	32	1.0	2
137VF 1003-2.0R	10	10	73	32	2.0	2
137VF 1005	10	10	90	52	-	2
137VF 1005-0.2R	10	10	90	52	0.2	2
137VF 1005-0.5R	10	10	90	52	0.5	2

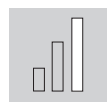
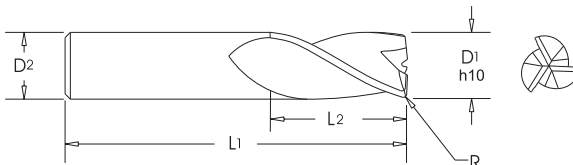




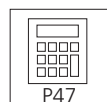
Type 1



Type 2



Tool No.	D1	D2	L1	L2	R	Type
137VF 1005-1.0R	10	10	90	52	1.0	2
137VF 1005-2.0R	10	10	90	52	2.0	2
137VF 1203	12	12	84	38	-	2
137VF 1203-0.2R	12	12	84	38	0.2	2
137VF 1203-0.5R	12	12	84	38	0.5	2
137VF 1203-1.0R	12	12	84	38	1.0	2
137VF 1203-2.0R	12	12	84	38	2.0	2
137VF 1205	12	12	110	62	-	2
137VF 1205-0.2R	12	12	110	62	0.2	2
137VF 1205-0.5R	12	12	110	62	0.5	2
137VF 1205-1.0R	12	12	110	62	1.0	2
137VF 1205-2.0R	12	12	110	62	2.0	2
137VF 1603	16	16	93	50	-	2
137VF 1603-0.2R	16	16	93	50	0.2	2
137VF 1603-0.5R	16	16	93	50	0.5	2
137VF 1603-1.0R	16	16	93	50	1.0	2
137VF 1603-2.0R	16	16	93	50	2.0	2
137VF 1605	16	16	130	82	-	2
137VF 1605-0.2R	16	16	130	82	0.2	2
137VF 1605-0.5R	16	16	130	82	0.5	2
137VF 1605-1.0R	16	16	130	82	1.0	2
137VF 1605-2.0R	16	16	130	82	2.0	2
137VF 2003	20	20	105	62	-	2
137VF 2003-0.2R	20	20	105	62	0.2	2
137VF 2003-0.5R	20	20	105	62	0.5	2
137VF 2003-1.0R	20	20	105	62	1.0	2
137VF 2003-2.0R	20	20	105	62	2.0	2
137VF 2005	20	20	150	102	-	2
137VF 2005-0.2R	20	20	150	102	0.2	2
137VF 2005-0.5R	20	20	150	102	0.5	2
137VF 2005-1.0R	20	20	150	102	1.0	2
137VF 2005-2.0R	20	20	150	102	2.0	2



Technical Section	Page
TuffCut® XR Series 113A Recommended cutting data	40
TuffCut® XR Series 177, 178 & 179 Recommended cutting data	41
TuffCut® XR Series 179 Profiling	42
TuffCut® XR Series 180 Recommended cutting data	43
TuffCut® XT Series 277/NR/NR W, 278R N3/N4/N5 Recommended cutting data	44
TuffCut® X-AL Series 135 Feed capability - Necked Tools	45
TuffCut® X-AL Series 135,135B,138B Recommended cutting data	46
TuffCut® X-AL Series 137V, 137VR N5, 137VF Recommended cutting data	47



TuffCut® XR Series 113A Recommended cutting data

Workpiece Material Group		Material Type	Coolant						
			Max	Air	MMS	Vc-M/Min			
Steels	P	Low Carbon	●	●	●	280	240	200	160
		Medium Carbon	●	●	●	200	185	160	135
		Alloy Steels	●	●	●	185	170	145	120
		Die/Tool Steels	●	●	●	160	135	105	100
Stainless Steels	M	Free Machining	●	X	○	120	100	85	80
		Austenitic	●	X	○	95	90	80	70
		Difficult Stainless	●	X	○	75	65	55	50
		PH Stainless	●	X	○	95	90	80	70
		Cobalt Chrome Alloys	●	X	○	70	65	55	50
		Duplex (22%)	●	X	○	70	65	55	50
		Super Duplex (25%)	●	X	○	45	40	35	30
Special Alloys	S	High Temp Alloys	●	X	X	35	30	25	20
		Inconel 625/718	●	X	X	35	30	25	20
		Titanium Alloys	●	X	X	95	70	60	50
Cast Irons	K	Gray Cast Iron	●	○	○	290	190	150	130
		Ductile Cast Iron	●	○	○	215	150	135	120
		Malleable Iron	●	○	○	120	110	105	95
Hardened Steels	H	Hardened Steels 45 - 50 Rc	●	○	○	110	70	40	35
		Hardened Steels 50 - 55 Rc	●	○	○	90	60	35	30

● Preferred ○ Possible X Not Possible

Workpiece Material Group		Material Type	Tool Diameter								
			3mm	5mm	6mm	8mm	10mm	12mm	16mm	20mm	25mm
			Peripheral Milling-fz mm / Tooth								
Steels	P	Low Carbon	0.020	0.027	0.067	0.080	0.093	0.133	0.160	0.187	0.267
		Medium Carbon									
		Alloy Steels									
		Die/Tool Steels									
Stainless Steels	M	Free Machining	0.020	0.027	0.067	0.080	0.093	0.133	0.160	0.187	0.267
		Austenitic									
		Difficult Stainless									
		PH Stainless									
		Cobalt Chrome Alloys	0.014	0.020	0.050	0.060	0.070	0.100	0.120	0.140	0.200
		Duplex (22%)									
Super Duplex (25%)											
Special Alloys	S	High Temp Alloys	0.009	0.013	0.033	0.040	0.047	0.067	0.080	0.093	0.133
		Inconel									
		Titanium Alloys									
Cast Irons	K	Gray Cast Iron	0.019	0.027	0.067	0.080	0.093	0.133	0.160	0.187	0.267
		Ductile Cast Iron									
		Malleable Iron									
Hardened Steels	H	Hardened Steels 45 - 50 Rc	0.017	0.024	0.060	0.072	0.084	0.120	0.144	0.168	0.240
		Hardened Steels 50 - 55 Rc	0.010	0.018	0.043	0.053	0.061	0.089	0.107	0.124	0.178

Please Note- Peripheral Milling only.

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

Radial Cut (Ae)	Chip thickness Compensation factor
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

TuffCut® XR Series 177, 178 & 179 Recommended cutting data

Workpiece Material Group		Material Type	Coolant									
			Max	Air	MMS	Vc-M/Min						
Steels	P	Low Carbon	●	●	●	210	200	450	350	300	250	200
		Medium Carbon	●	●	●	180	170	270	250	230	200	170
		Alloy Steels	●	●	●	160	150	250	230	210	180	150
		Die/Tool Steels	●	●	●	130	120	225	200	170	130	120
Stainless Steels	M	Free Machining	●	X	○	110	100	150	150	120	105	100
		Austenitic	●	X	○	100	90	130	120	110	100	90
		Difficult Stainless	●	X	○	70	60	100	90	80	70	60
		PH Stainless	●	X	○	100	90	130	120	110	100	90
		Cobalt Chrome Alloys	●	X	○	70	60	100	90	80	70	60
		Duplex (22%)	●	X	○	70	60	100	90	80	70	60
		Super Duplex (25%)	●	X	○	50	40	60	55	50	45	40
Special Alloys	S	High Temp Alloys	●	X	X	30	25	50	40	35	30	25
		Titanium Alloys	●	X	X	70	60	120	120	90	75	60
Cast Irons	K	Gray Cast Iron	●	○	○	180	160	360	360	240	190	160
		Ductile Cast Iron	●	○	○	170	150	270	270	190	170	150
		Malleable Iron	●	○	○	130	120	160	150	140	130	120
Hardened Steels	H	Hardened Steels 45 - 50 Rc	●	○	○	50	45	135	135	90	50	45
		Hardened Steels 50 - 55 Rc	●	○	○	45	40	115	115	75	45	40

● Preferred ○ Possible X Not Possible

Workpiece Material Group		Machining type by series	Tool Diameter									
			1.5mm	3mm	5mm	6mm	8mm	10mm	12mm	16mm	20mm	25mm
			fz-mm/tooth									
Steels	P	Profiling-177-178-179	0.005	0.018	0.025	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting-177/179	0.003	0.009	0.012	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Stainless Steels	M	Profiling-177-178-179	0.005	0.018	0.025	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting-177/179	0.003	0.009	0.012	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Special Alloys	S	Profiling-177-178-179	0.003	0.009	0.013	0.032	0.038	0.044	0.064	0.076	0.089	0.127
		Slotting-177/179	0.0015	0.0045	0.007	0.016	0.019	0.022	0.032	0.038	0.045	0.065
Profiling-177-178-179		0.005	0.018	0.025	0.060	0.080	0.100	0.120	0.160	0.200	0.250	
Slotting-177/179		0.003	0.009	0.013	0.030	0.040	0.050	0.060	0.080	0.100	0.125	
Titanium	S	Profiling-177-178-179	0.005	0.018	0.025	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting-177/179	0.003	0.009	0.013	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Cast Irons	K	Profiling-177-178-179	0.005	0.018	0.025	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting-177/179	0.003	0.009	0.013	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Hardened Steels	H	Profiling-177-178-179<50HRC	0.005	0.016	0.023	0.057	0.069	0.080	0.114	0.137	0.160	0.229
		Slotting-177/179 <50HRC	0.003	0.008	0.013	0.028	0.035	0.040	0.065	0.070	0.080	0.115
		Profiling-177-178-179>55HRC	0.003	0.010	0.015	0.041	0.051	0.058	0.084	0.102	0.119	0.170
		Slotting-177/179 >55HRC	0.002	0.005	0.008	0.020	0.025	0.028	0.042	0.050	0.060	0.080

Please Note- 178 series-5 flute to be used for Peripheral milling only.

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

Radial Cut (Ae)	Chip thickness Compensation factor
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

For 177L tools please use the following conditions

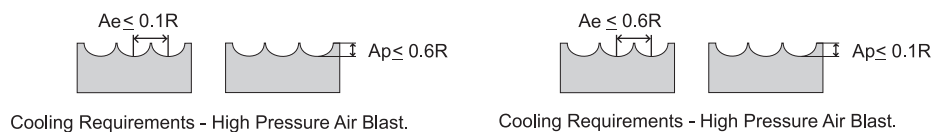
Ap 1 x D1
Ae 0.1 x D1

0.25 x D1
1.0 x D1

When using Long Series 178 - 1 Reduce speed by 20%

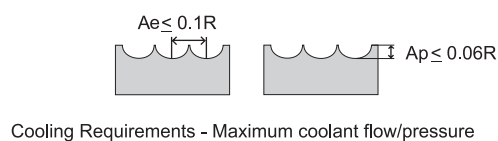
TuffCut® XR Series 179 Profiling

			Semi Roughing / Roughing Steel (25-48 HRC)				Semi Finishing / Finishing Steel (25-48 HRC)			
Diameter	R	RPM	f	fz	Ae Max.	Ap Max.	f	fz	Ae Max.	Ap Max.
mm	mm	trs	mm/min	mm/z	mm	mm	mm/min	mm/z	mm	mm
1.5	R 0.75	35,000	1,950 - 3,300	0.0139 - 0.0235	0.075	0.450	1,950 - 3,300	0.0139 - 0.0235	0.450	0.075
2.0	R 1.0	30,000	2,100 - 3,600	0.0175 - 0.0300	0.100	0.600	2,100 - 3,600	0.0175 - 0.0300	0.600	0.100
2.5	R 1.25	28,000	2,100 - 3,600	0.0185 - 0.0320	0.125	0.750	2,100 - 3,600	0.0185 - 0.0320	0.750	0.125
3.0	R 1.5	26,500	2,100 - 3,600	0.0198 - 0.0330	0.150	0.900	2,100 - 3,600	0.0198 - 0.0330	0.900	0.150
3.5	R 1.75	24,000	2,250 - 3,900	0.0230 - 0.0400	0.175	1.000	2,250 - 3,900	0.0230 - 0.0400	1.000	0.175
4.0	R 2.0	23,000	2,250 - 3,900	0.0240 - 0.0420	0.200	1.200	2,250 - 3,900	0.0240 - 0.0420	1.200	0.200
4.5	R 2.25	22,000	2,250 - 3,900	0.0250 - 0.0440	0.220	1.350	2,250 - 3,900	0.0250 - 0.0440	1.350	0.220
5.0	R 2.5	20,000	1,800 - 5,500	0.0225 - 0.0687	0.250	1.500	1,800 - 5,500	0.0225 - 0.0687	1.500	0.250
6.0	R 3.0	20,000	1,800 - 5,500	0.0225 - 0.0687	0.300	1.800	1,800 - 5,500	0.0225 - 0.0687	1.800	0.300
8.0	R 4.0	15,000	2,200 - 5,000	0.0366 - 0.0833	0.400	2.400	2,200 - 5,000	0.0366 - 0.0833	2.400	0.400
10.0	R 5.0	12,000	2,300 - 4,600	0.0479 - 0.0958	0.500	3.000	2,300 - 4,600	0.0479 - 0.0958	3.000	0.500
12.0	R 6.0	10,000	1,900 - 4,100	0.0475 - 0.1025	0.600	3.600	1,900 - 4,100	0.0475 - 0.1025	3.600	0.600
16.0	R 8.0	7,500	1,600 - 3,200	0.0533 - 0.1066	0.800	4.800	1,600 - 3,200	0.0533 - 0.1066	4.800	0.800



Titanium				
Diameter	R	RPM	f	fz
mm	mm	trs	mm/min	mm/z
1.5	R 0.75	32,000	2,700	0.020
2.0	R 1.0	24,000	2,400	0.025
2.5	R 1.25	24,000	2,400	0.025
3.0	R 1.5	16,000	1,950	0.030
3.5	R 1.75	16,000	1,950	0.030
4.0	R 2.0	12,000	1,950	0.040
4.5	R 2.25	12,000	1,950	0.040
5.0	R 2.5	10,000	1,650	0.040
6.0	R 3.0	8,000	1,500	0.046
8.0	R 4.0	6,000	1,650	0.068
10.0	R 5.0	5,000	1,650	0.080
12.0	R 6.0	4,000	1,500	0.093
16.0	R 8.0	3,000	1,200	0.100

High Temperature Alloys						
Diameter	R	RPM	f	fz	Ae Max.	Ap Max.
mm	mm	trs	mm/min	mm/z	mm	mm
1.5	R 0.75	10,000	825	0.020	0.075	0.05
2.0	R 1.0	7,300	750	0.025	0.100	0.06
2.5	R 1.25	6,000	700	0.029	0.125	0.08
3.0	R 1.5	5,000	630	0.030	0.150	0.09
3.5	R 1.75	4,100	575	0.035	0.175	0.11
4.0	R 2.0	3,600	555	0.040	0.200	0.12
4.5	R 2.25	3,200	510	0.040	0.220	0.14
5.0	R 2.5	3,000	510	0.040	0.250	0.15
6.0	R 3.0	2,500	495	0.046	0.300	0.18
8.0	R 4.0	1,900	510	0.068	0.400	0.24
10.0	R 5.0	1,500	510	0.080	0.500	0.30
12.0	R 6.0	1,200	450	0.093	0.600	0.36
16.0	R 8.0	900	360	0.100	0.800	0.48



TuffCut® XR Series 180 Recommended cutting data

Workpiece Material Group		Material Type	Coolant			 0.05 x D 2 x D	 0.1 x D 2 x D	 0.2 x D 2 x D
			Max	Air	MMS	Vc-M/Min		
Steels	P	Low Carbon	●	●	●	480	385	330
		Medium Carbon	●	●	●	345	275	255
		Alloy Steels	●	●	●	315	255	230
		Die/Tool Steels	●	●	●	275	220	187
Stainless Steels	M	Free Machining	●	X	○	205	165	130
		Austenitic	●	X	○	160	130	120
		Difficult Stainless	●	X	○	125	100	90
		PH Stainless	●	X	○	160	130	120
		Cobalt Chrome Alloys	●	X	○	125	100	90
		Duplex (22%)	●	X	○	125	100	90
		Super Duplex (25%)	●	X	○	75	60	55
Special Alloys	S	High Temp Alloys	●	X	X	55	45	40
		Inconel	●	X	X	55	45	40
		Titanium Alloys	●	X	X	160	130	100
Cast Irons	K	Gray Cast Iron	●	○	○	495	395	265
		Ductile Cast Iron	●	○	○	370	300	210
		Malleable Iron	●	○	○	205	165	155
Hardened Steels	H	Hardened Steels 45 - 50 Rc	●	○	○	185	150	100
		Hardened Steels 50 - 55 Rc	●	○	○	155	125	85

● Preferred ○ Possible X Not Possible

Workpiece Material Group		Material Type	Tool Diameter			
			12mm	16mm	20mm	25mm
			Peripheral Milling Fz-mm/Tooth			
Steels	P	Low Carbon	0.120	0.160	0.200	0.250
		Medium Carbon				
		Alloy Steels				
		Die/Tool Steels				
Stainless Steels	M	Free Machining	0.120	0.160	0.200	0.250
		Austenitic				
		Difficult Stainless				
		PH Stainless	0.095	0.114	0.133	0.191
		Cobalt Chrome Alloys				
		Duplex (22%)				
		Super Duplex (25%)				
Special Alloys	S	High Temp Alloys	0.064	0.076	0.089	0.127
		Inconel				
		Titanium Alloys				
Cast Irons	K	Gray Cast Iron	0.120	0.160	0.200	0.250
		Ductile Cast Iron				
		Malleable Iron				
Hardened Steels	H	Hardened Steels 45 - 50 Rc	0.114	0.137	0.160	0.229
		Hardened Steels 50 - 55 Rc	0.084	0.102	0.119	0.170

Please Note - Peripheral Milling only.

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

Radial Cut (Ae)	Chip thickness Compensation factor
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

TuffCut® XT Series 277/NR/NR-W, 278R /N3/N4/N5 Recommended cutting data

Workpiece Material Group		Material Type	Coolant									
			Max	Air	MMS	Vc-M/Min						
Steels	P	Low Carbon	●	●	●	230	220	480	385	330	275	220
		Medium Carbon	●	●	●	200	185	345	275	255	220	185
		Alloy Steels	●	●	●	175	165	315	255	230	200	165
		Die/Tool Steels	●	●	●	145	130	275	220	187	145	130
Stainless Steels	M	Free Machining	●	X	○	120	110	205	165	130	115	110
		Austenitic	●	X	○	110	100	160	130	120	110	100
		Difficult Stainless	●	X	○	75	65	125	100	90	75	65
		PH Stainless	●	X	○	110	100	160	130	120	110	100
		Cobalt Chrome Alloys	●	X	○	75	65	125	100	90	75	65
		Duplex (22%)	●	X	○	75	65	125	100	90	75	65
		Super Duplex (25%)	●	X	○	55	45	75	60	55	50	45
Special Alloys	S	High Temp Alloys	●	X	X	35	28	55	45	40	35	28
			●	X	X	35	28	55	45	40	35	28
		Titanium Alloys	●	X	X	75	66	160	130	100	85	65
Cast Irons	K	Gray Cast Iron	●	○	○	200	175	495	395	265	210	175
		Ductile Cast Iron	●	○	○	185	165	370	300	210	185	165
		Malleable Iron	●	○	○	145	132	205	165	155	145	130
Hardened Steels	H	Hardened Steels 35 - 45 Rc	●	○	○	60	50	185	150	100	55	50
		Hardened Steels 45 - 55 Rc	●	○	○	50	45	155	125	85	50	45

● Preferred ○ Possible X Not Possible

Workpiece Material Group	Machining type	Tool Diameter									
		3mm	5mm	6mm	8mm	10mm	12mm	16mm	20mm	25mm	
		fz-mm/tooth									
Steels	P	Profiling	0.030	0.050	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting	0.015	0.025	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Stainless Steels	M	Profiling	0.030	0.050	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting	0.015	0.025	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Special Alloys	S	Profiling	0.009	0.013	0.032	0.038	0.044	0.064	0.076	0.089	0.127
		Slotting	0.005	0.007	0.016	0.019	0.022	0.032	0.038	0.045	0.065
Titanium		Profiling	0.030	0.050	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting	0.015	0.025	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Cast Irons	K	Profiling	0.030	0.050	0.060	0.080	0.100	0.120	0.160	0.200	0.250
		Slotting	0.015	0.025	0.030	0.040	0.050	0.060	0.080	0.100	0.125
Hardened Steels	H	Profiling 35 - 45 Rc	0.016	0.023	0.057	0.069	0.080	0.114	0.137	0.160	0.229
		Slotting 35 - 45 Rc	0.010	0.015	0.025	0.035	0.045	0.065	0.070	0.075	0.100
		Profiling 45 - 55 Rc	0.010	0.015	0.041	0.051	0.058	0.084	0.102	0.119	0.170
		Slotting 45 - 55 Rc	0.008	0.011	0.020	0.030	0.040	0.050	0.055	0.080	0.090

During profile milling less than 50% of the cutter diameter radial width, the actual chip thickness at the cutting edge is less than the programmed chipload. The accompanying table shows the increase in tooth load by given radial percentage engagement. Multiply your feed per tooth by the factor before finalising your table feed.

Note:

For N4 tools reduce above data by 10%

For N5 tools reduce above data by 30%

Radial Cut (Ae)	Chip thickness Compensation factor
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

For N4 & N5 tools profile machining only!



TuffCut® X-AL Series 135 Feed capability - Necked Tools

RPM	Diameter - mm									
	3	4	5	6	8	10	12	16	20	25
	fz 0.035	fz 0.035	fz 0.084	fz 0.12	fz 0.26	fz 0.61	fz 0.77	fz 0.79	fz 0.762	fz 0.76
4000	280	280	672	960	2080	4880	6160	6304	6096	6096
5000	350	350	840	1200	2600	6100	7700	7880	7620	7620
6000	420	420	1008	1440	3120	7320	9240	9456	9144	9144
7000	490	490	1176	1680	3640	8540	10780	11032	10668	10668
8000	560	560	1344	1920	4160	9760	12320	12608	12192	12192
9000	630	630	1512	2160	4680	10980	13860	14184	13716	13716
10000	700	700	1680	2400	5200	12200	15400	15760	15240	15240
11000	770	770	1848	2640	5720	13420	16940	17336	16764	16764
12000	840	840	2016	2880	6240	14640	18480	18912	18288	18288
13000	910	910	2184	3120	6760	15860	20020	20488	19812	19812
14000	980	980	2352	3360	7280	17080	21560	22064	21336	21336
15000	1050	1050	2520	3600	7800	18300	23100	23640	22860	22860
16000	1120	1120	2688	3840	8320	19520	24640	25216	24384	24384
17000	1190	1190	2856	4080	8840	20740	26180	26792	25908	25908
18000	1260	1260	3024	4320	9360	21960	27720	28368	27432	27432
19000	1330	1330	3192	4560	9880	23180	29260	29944	28956	28956
20000	1400	1400	3360	4800	10400	24400	30800	31520	30480	30480
21000	1470	1470	3528	5040	10920	25620	32340	33096	32004	32004
22000	1540	1540	3696	5280	11440	26840	33880	34672	33528	33528
23000	1610	1610	3864	5520	11960	28060	35420	36248	35052	35052
24000	1680	1680	4032	5760	12480	29280	36960	37824	36576	36576
25000	1750	1750	4200	6000	13000	30500	38500	39400	38100	38100
30000	2100	2100	5040	7200	15600	36600	46200	47280	45720	45720

FEED Shown in mm/min AVANCE indiquée en mm/min

Feed rate allowance for length (Slotting)

Part no. example	length	Fz	Ae	Ap
135 12N3	Short	1	1 x D	1 X D
135 12N5	Medium	x 0.7	1 x D	0.25 X D
135 1202N	Long	x 0.6	0.1 x D	1 X D

Feed rate for un-necked tools

Please calculate feed rate based upon length from table above - then apply the following factors:

Diameter	Factor
3 - 8mm	Feed mm/min x 2.0
10 - 25mm	Feed mm/min x 1.35

TuffCut® X-AL Series 135, 135B, 138B Recommended cutting data - Al / Al-Si Alloys

Series		Type of cut		Vc	Diameter - mm				
					2 - 3	4	5	6	8
		Ae	Ap		M/Min	fz	fz	fz	fz
135		1 x D	0.5 x D	300-425	0.035	0.035	0.075-0.1	0.1-0.23	0.175-0.3
		1 x D	1 x D	250-365	0.030	0.030	0.025-0.05	0.1-0.15	0.1-0.15
		0.2 x D	1 x D	300-425	0.030	0.030	0.05-0.1	0.1-0.23	0.1-0.23
		0.5 x D	1 x D	300-425	0.030	0.030	0.05-0.1	0.1-0.23	0.1-0.23
		1 x D	1 x D	250-365	0.025	0.025	0.025-0.05	0.1-0.15	0.1-0.15
135B		1 x D	0.5 x D	150	0.050	0.080	0.12	0.16	0.20
138B		0.1 x D	1 x D	300	0.050	0.080	0.12	0.16	0.20

Series		Type of cut		Vc	Diameter - mm				
					10	12	16	20	25
		Ae	Ap		M/Min	fz	fz	fz	fz
135		1 x D	0.5 x D	300-425	0.175-0.3	0.25-1.15	0.38-1.02	0.38-1.02	0.38-1.02
		1 x D	1 x D	250-365	0.1-0.15	0.25-0.75	0.38-0.75	0.38-0.75	0.38-0.75
		0.2 x D	1 x D	300-425	0.1-0.23	0.25-1.15	0.38-1.02	0.38-1.02	0.38-1.02
		0.5 x D	1 x D	300-425	0.1-0.23	0.25-0.89	0.38-0.89	0.38-0.89	0.38-0.89
		1 x D	1 x D	250-365	0.1-0.15	0.25-0.75	0.38-0.75	0.38-0.75	0.38-0.75
135B									
		1 x D	0.5 x D	150	0.25	0.50	0.50	-	-
138B									
		0.1 x D	1 x D	300	0.25	0.50	0.50	-	-

TuffCut X-AL Series 137V, 137VR N5, 137VF

Series		Type of cut		Vc	Diameter - mm				
					Ø 3.0	Ø 4.0	Ø 5.0	Ø 6.0	Ø 8.0
		Ae	Ap	M/Min	fz	fz	fz	fz	fz
137V N3		1 x D	0.25 x D	400-600	0.03	0.04	0.05	0.06	0.08
		1 x D	0.5 x D	400-600	0.03	0.04	0.05	0.06	0.08
		1 x D	1 x D	400-600	0.02	0.03	0.04	0.05	0.07
		0.75 x D	0.5 x D	500-700	0.045	0.06	0.075	0.09	0.12
		0.5 x D	1 x D	500-700	0.03	0.04	0.05	0.06	0.08
		0.5 x D	1.5 x D	500-700	0.03	0.04	0.05	0.06	0.08
		≤ 0.1 x D	≤ 0.9 x L ²	800-1000	0.036	0.054	0.072	0.09	0.126

Series		Type of cut		Vc	Diameter - mm			
					Ø 10.0	Ø 12.0	Ø 16.0	Ø 20.0
		Ae	Ap	M/Min	fz	fz	fz	fz
137V N3		1 x D	0.25 x D	400-600	0.10	0.12	0.16	0.20
		1 x D	0.5 x D	400-600	0.10	0.12	0.16	0.20
		1 x D	1 x D	400-600	0.09	0.11	0.15	0.19
		0.75 x D	0.5 x D	500-700	0.15	0.18	0.24	0.30
		0.5 x D	1 x D	500-700	0.10	0.12	0.16	0.20
		0.5 x D	1.5 x D	500-700	0.10	0.12	0.16	0.20
		≤ 0.1 x D	≤ 0.9 x L ²	800-1000	0.162	0.20	0.27	0.342

Series		Type of cut		Vc	Diameter - mm				
					Ø 3.0	Ø 4.0	Ø 5.0	Ø 6.0	Ø 8.0
		Ae	Ap	M/Min	fz	fz	fz	fz	fz
137V N4		1 x D	0.25 x D	400-600	0.03	0.04	0.05	0.06	0.08
		1 x D	0.5 x D	400-600	0.03	0.04	0.05	0.06	0.08
		1 x D	1 x D	400-600	0.02	0.03	0.04	0.05	0.07
		0.75 x D	0.5 x D	500-700	0.045	0.06	0.075	0.09	0.12
		0.5 x D	1 x D	500-700	0.03	0.04	0.05	0.06	0.08
		0.5 x D	0.9 x L ²	500-700	0.03	0.04	0.05	0.06	0.08
		≤ 0.1 x D	≤ 0.9 x L ²	800-1000	0.036	0.054	0.072	0.09	0.126

TuffCut X-AL Series 137V, 137VR N5, 137VF

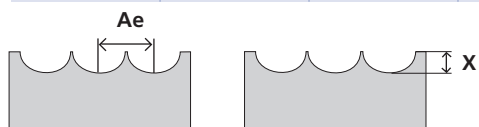
Series		Type of cut		Vc	Diameter - mm			
					Ø 10.0	Ø 12.0	Ø 16.0	Ø 20.0
		Ae	Ap	M/Min	fz	fz	fz	fz
137V N4		1 x D	0.25 x D	400-600	0.10	0.12	0.16	0.20
		1 x D	0.5 x D	400-600	0.10	0.12	0.16	0.20
		1 x D	1 x D	400-600	0.09	0.11	0.15	0.19
		0.75 x D	0.5 x D	500-700	0.15	0.18	0.24	0.30
		0.5 x D	1 x D	500-700	0.10	0.12	0.16	0.20
		0.5 x D	0.9 x L ²	500-700	0.10	0.12	0.16	0.20
		≤ 0.1 x D	≤ 0.9 x L ²	800-1000	0.162	0.20	0.27	0.342

Series		Type of cut		Vc	Diameter - mm				
					Ø 3.0	Ø 4.0	Ø 5.0	Ø 6.0	Ø 8.0
		Ae	Ap	M/Min	fz	fz	fz	fz	fz
137V N5		≤ 1 x D Max	≤ 0.2 x D	300-500	0.02	0.03	0.04	0.05	0.07
		0.1 - 0.2 x D	≤ 1 x D Max	300-500	0.03	0.06	0.08	0.10	0.14

Series		Type of cut		Vc	Diameter - mm			
					Ø 10.0	Ø 12.0	Ø 16.0	Ø 20.0
		Ae	Ap	M/Min	fz	fz	fz	fz
137V N5		≤ 1 x D Max	≤ 0.2 x D	300-500	0.09	0.11	0.13	0.15
		0.1 - 0.2 x D	≤ 1 x D Max	300-500	0.16	0.18	0.20	0.23

Profile Height-X (µm) / Surface finish

Ae mm	Diameter - mm							
	1	2	4	6	8	10	12	16
0.06	0.9	0.45	0.23	0.15	0.11	0.09	0.08	0.06
0.08	1.6	0.8	0.4	0.27	0.2	0.16	0.13	0.1
0.11	3	1.5	0.76	0.5	0.38	0.3	0.25	0.19
0.15	5.7	2.8	1.4	0.94	0.7	0.56	0.47	0.35
0.2	10	5	2.5	1.7	1.3	1	0.83	0.63
0.3	23	11	5.6	3.8	2.8	2.3	1.9	1.41
0.45	53	26	13	8.4	6.3	5.1	4.2	3.16



Material cross reference chart

							
	UK	German	DIN	French	Swedish	Spanish	USA
FREE MACHINING STEEL	1.0718	9SMnPb28	S250Pb	1914	F.2112 - 11SMnPb28	12L13	
	210M15	1.0721	10S20	10F1		F.2121 - 10 S 20	1108
	210A15	1.0723	15S20		1922	F.210F	
	240M07	1.0736	9SMn36	S300		F.2113- 12 SMn 35	1215
		1.0737	9MnPb36	S300Pb	1926	F.2114 - 12 SMnPb 35	12L14
		1.7022	10SPb20	10PbF2		F.2122 - 10 SPb 20	11L08
LOW CARBON STEEL	045M10	1.0301	C10	AF34C10/XC10			1010
	080M15;040A15	1.0401	C15	AF37C12/XC18	1350	F.111	1015
	050A20/055M15	1.0402	C22	AF42C20/XC25	1450	F.112	1020
	070M26	1.0406	C25	AF50C30		F.221	1025
	220M07	1.0711	9S20				1212
	230M07	1.0715	9SMn28	S250	1912	F.2111 - 11SMn28	1213
	040A10	1.1121	Ck10	XC10	1265	F.1510 - C 10 k	1010
	120M19	1.1133	20Mn5	20M5		F.1515 - 20 Mn 6	1022/1518
	080M15	1.1141	Ck15	XC15 / C15E	1370	F.1511 - C 16 k	1015
	050A20	1.1151	Ck22	XC25 / C22E		F.1120 - C 25 k	10201023
	070M26	1.1158	Ck25	XC25 / C25E		F.1120 - C 25 k	1025
		1.5419	22Mo4				4419
		1.5622	14Ni6	15N6 / 15Ni6		F.2641 - 15 Ni 6	A350-LF5
	655M13/A12	1.5752	14NiCr14	12NC15			3310/9314
	523M15	1.7015	15Cr3	12C3			5015
STRUCTURAL STEEL	4360-40C	1.0038	RSt37-2	E24-2NE / S235JRG2	1312		A570 (36)
	4360-43B	1.0044	St44-2	E28-2 / S275JR	1412	A 430B	A570 (40)
	4360-50B	1.005	St50-2	A50-2 / E295	2172		A570 (50)
	4360-55E	1.006	St60-2	A60-2 / E335			
	4360-40C/D-1449-37C	1.0116	St37-3	E24-3;-4 / S235J2G3	1313	A360 C;D	A284/A573/A611
	1449 -2/3/4CR	1.033	St12	DC01		AP 00	A366/1012/A619
	1449 2CR; 3CR	1.0333	St13			AP 02	1008
	1449 1CR; 2CR	1.0338	St14	DC04		AP 04	A620
	1501Gr.161-360/400	1.0345	H I	A37CP;AP / P235GH	1330	A 37 RC I;RA II	A516Gr.65;-55;
	3CR	1.0347	RRSt13	DC03			A619
	161-400;	1.0425	H II	A42CP;AP / P265GH	1430	A42 RC I	
		1.0473	19Mn6	A52CP;AP / P335GH	2101/2102	A 47 RB II	A537
		1.0481	17Mn4	A48CP;AP / P295GH		A 47 RC I; RA II	A516 (70)
		1.0562	StE355	E355R/FP / S355N	2132	AE 355 KG; DD	A633 (C)
	4360-50B;50C;50D	1.057	St52-3	E36-3;E36-4 / S355J2G3	2132	A 510 C;D	
	1501-240	1.5415	15Mo3	15D3 / 15Mo3	2912	F.2601 - 16 Mo 3	A204 (A)
	1503-245-420	1.5423	16Mo5			F.2602 - 16 Mo 5	4520
	1501-503-690	1.5637	10Ni14	12N14 / 12Ni14		F.152	A350-LF3
		1.5713	13NiCr6	10NC6			3115
		1.5732	14NiCr10	14NC11		F.1540 - 15 NiCr 11	3415
	620Gr.27;31	1.7335	13CrMo44	15CD3.05	2216	F.2631 - 14 CrMo 4 5	A182-F11;F12
	4360-55E	1.8902	StE420	E420RIFP / S420N		AE 420 KG	A633Gr.E
		1.8905	StE460	E460RIFP / S460N		AE 460 KG	A633Gr.E
		1.007	St70-2	A70-2 / E360			
	620Gr.27	1.7337	16CrMo44	15CD4.5	2216		A387 (12)
	622Gr.31;45	1.738	10CrMo910	12CD9.10 / 10CrMo9-10	2218	TU.H	A182F22
	660/440	1.7715	14MoV63			F.2621 - 13 MoCrV6	
	MEDIUM CARBON STEEL	060A35	1.0501	C35	AF55C35 /XC38	1550	F.113
212M36		1.0726	35S20	35MF6	1957	F.210G	1140
120M36/150M28		1.1165	30Mn5	35M5 / 30Mn5		F.1203 - 36 Mn5	1330
		1.1166	34Mn5	35M5 / 34Mn5		F.8211 - 30 Mn5	1536
150M36		1.1167	36Mn5	40M5 / 36Mn5	2120	F.1203 - 36 Mn5	1335
150M28		1.117	28Mn6	20M5 / 28Mn6			1330
080M36		1.118	Cm35	XC32 / C35R	1572	F.1135 - C 35 k-1	1035
080M36		1.1181	Ck35	XC38H1 / C35E	1572	F.1130 - C 35 k	1035
060A35		1.1183	Cf35	XC38H1TS	1572		1035
080M46		1.0503	C45	AF65C45 /C45	1650	F.114	1045
070M55		1.0535	C55	C55	1655		1055
080A62		1.0601	C60	AF70C55 / C60		F.115	1060
070A72		1.0605	C75	C75			
212M44		1.0727	45S20	45MF4	1973		1146
250A53		1.0903	51Si7	51S7	2090	F.1450 - 50 Si 7	9255
250A53		1.0904	55Si7	55S7	2085	F.1440- 56 Si 7	9255
150M36		1.1157	40Mn4	35M5			1039
060A40/080A40		1.1186	Ck40	XC42H1 / C40E			1040
080M46/060A47		1.1191	Ck45	XC42H1 / C45/XC45	1672	F.1140 - C 45 k	1045
060A47		1.1193	Cf45	XC42H1TS	1672		1045
080M46		1.1201	Cm45	XC42H1 /C45R	1660	F.1145 - C 45 k	1045
060A57/070M55		1.1203	Ck55	XC55H1 / C55E		F.1150 - C 55 k	1055
080M50		1.1206	Ck50	XC48H1 / C50E			1050
070M55		1.1209	Cm55	XC55H1 / C55R / 3C55		F.1150 - C 55 k	1055
060A52		1.1213	Cf53	XC48H1TS	1674		1050
060A62		1.1221	Ck60	XC60 / C60E/2C60	1665/1678	F.511/F.512	1060
060A67		1.1231	Ck67	XC68	1770		1070
250A58		1.0909	60Si7	60S7		F.1441 - 60 Si 7	9260
250A61		1.0961	60SiCr7	60SC7		F.1442 - 60 SiCr 8	9262



Material cross reference chart

								
	UK	German	DIN	French	Swedish	Spanish	USA	
ALLOY STEEL	805M20	1.6523	21NiCrMo2	20NCD2	2506	F.1522 - 20 NiCrMo 2	8620	
	805A20	1.6543	21NiCrMo22			F.1534 - 20 NiCrMo 3	8720	
	060A78	1.1248	Ck75	XC75 / C75E	1774/1778	F.513/514/515	1080/1078	
	640A35	1.571	36NiCr6	35NC6			3135	
	640M40	1.5711	40NiCr6				3140	
	311-Type7	1.6546	40NiCrMo22	40NCD2		F.1204 - 40 NiCrMo2	8740	
	820A16	1.6587	17CrNiMo8	18NCD6		F.1560 - 14 NiCrMo13		
	832M13	1.6657	14NiCrMo134	16NCD13		F.1569 - 14 NiCrMo 131		
		1.7006	46Cr2	42C2 / 46Cr2			5045/5046	
	530A32	1.7033	34Cr4	32C4 / 34Cr4		F.8221 - 35 Cr 4/F.224	5132	
	530A36	1.7034	37Cr4	38C4 / 37Cr4		F.1201 - 38 Cr 4	5135	
	527M17	1.7131	16MnCr5	16MC5	2511	F.1515 - 16 MnCr 5	5115	
		1.7147	20MnCr5	20MC5		F.150.D	5120	
	1717CDS110	1.7218	25CrMo4	25CD4 / 25CrMo4	2225	F.8330 - AM 25 CrMo4	4130	
	905M31	1.8507	34CrAlMo5	30CAD6.12		F.1741 - 34 CrAlMo5	A355CI.D	
	905M39	1.8509	41CrAlMo7	40CAD6.12	2940	F.1740 - 41 CrAlMo7	A355CI.A	
	708A37	1.233	35CrMo4	34CD4 / 35CrMo4	2234		4135	
	708M40	1.2332	47CrMo4	42CD4	2244		4142	
	530M40/530A40	1.7035	41Cr4	42C4 / 41Cr4		F.1202 - 42 Cr4	5140	
	530A40	1.7045	42Cr4	42C4TS	2245	F.1202 - 42 Cr 4	5140	
	527A60	1.7176	55Cr3	55C3	2253	F.1431 - 55 Cr3	5155	
	708A37	1.722	34CrMo4	35CD4 / 34CrMo4	2234	F.8231 - AM 34 CrMo4	4135/4137	
	708M40	1.7223	41CrMo4	42CD4TS	2244	F.8232 - 42 CrMo4	4142/4140	
	708M40	1.7225	42CrMo4	42CD4 / 42CrMo4	2244	F.8232 - 42 CrMo4	4140	
	708A47	1.7228	50CrMo4	50CrMo4			4150	
	735A50	1.8159	50CrV4	50CV4 / 51CrV4	2230	F.1430 - 51 CrV4	6150	
	060A96	1.1274	Ck101	XC100	1870		1095	
	HIGH STRENGTH ALLOY STEEL	816M40	1.6511	36CrNiMo4	40NCD3 / 36CrNiMo4		F.1280 - 35 NiCrMo4	9840
		817M40	1.6562	40NiCrMo73				4340
		311-Type6	1.6565	40NiCrMo6			F.1272 - 40 NiCrMo 7	4340
823M30		1.658	30CrNiMo8	30CND8 / 30CrNiMo8				
817M40		1.6582	34CrNiMo8	35NCD6 / 34CrNiMo6	2541	F.1272 - 40 NiCrMo 7	4340	
830M31		1.6746	32NiCrMo145	35NCD14		F.1262 - 32 NiCrMo 12		
835M30		1.6747	30NiCrMo166	35NCD16		F.1260 - 32 NiCrMo16		
722M24		1.8515	31CrMoV139	30CD12	2240	F.1712 - 31 CrMo 12		
722M24	1.7361	32CrMo12	30CD12	2240	F.124.A			
TOOL STEELS		1.1525	C80W1	Y190;Y180			W108	
		1.1545	C105W1	Y1105	1880		W110	
	BW1B	1.1625	C80W2			F.1507 C80	W1	
		1.1663	C125W	Y2120		F.5123 C120	W112	
	BW1A	1.175	C75W				W1	
	BL3	1.2067	100Cr6	Y100C6		F.5230 100 Cr6	L3	
		1.221	115CrV3				L2	
	BO1	1.251	100MnCrW4		2140	F.5220 95 MnCrW5	O1	
	BS1	1.2542	45WCrV7		2710	F.5241 45 WCrSi 8	S1	
	BW2	1.2833	100V1	Y1105V			W210	
	BO2	1.2842	90MnCrV8	90MV8			2	
	534A99	1.3505	100Cr6	100C6	2258	F.1310 - 100 Cr 6	52100	
		1.2713	55NiCrMoV6	55NCDV7		F.528	L6	
	Grade2A	0.962	G-X260NiCr42				A532IBNiCr-LC	
	Grade2B	0.9625	G-X330NiCr42				A532IANiCr-HC	
	Grade2C;D;E	0.963	G-X300CrNiSi952				A532IDNi-HiCr	
	Grade3A;B	0.964	G-X300CrMoNi1521					
	Grade3C	0.9645	G-X260CrMoNi2021				A532IID20%CrMo-LC	
	Grade3D	0.965	G-X260Cr27				A532IIIA25%Cr	
	Grade3E	0.9655	G-X300CrMo271				A532IIIA25%Cr	
	BD3	1.208	X210Cr12	Z200C12		F.5212 X210 Cr12	D3	
	BH11	1.2343	X38CrMoV51	Z38CDV5		F.5317 X37 CrMoV5	H11	
	BH13	1.2344	X40CrMoV51	Z40CDV5	2242	F.5318 X40 CrMoV5	H13	
	BA2	1.2363	X100CrMoV51	Z100CDV5	2260	F.5227 X100 CrMoV5	A2	
	BH10	1.2365	X32CrMoV33	Z32DCV28		F.5313 CrMoV 12	H10	
	BD2	1.2379	X155CrVMo121	Z160CDV12			D2	
		1.2436	X210CrW12		2312	F.5213 X210 CrW12		
		1.2567	X30WCrV53	Z32WCV5				
	BH21	1.2581	X30WCrV93	Z30WCV9		F.5323 X30 WCrV9	H21	
		1.2601	X165CrMoV12		2310	F.5211 X160 CrMoV12		
BH12	1.2606	X37CrMoW51	Z35CWDV5			H12		
BT15	1.3202	S12-1-4-5			F.5563 12-1-5-5	T15		
	1.3207	S10-4-3-10	Z130WKCDV10-10-04-03		F.553 10-4-3-10			
	1.3243	S6-5-2-5	Z85WDKCV06-05-05-04-02	2723	F.5613 6-5-2-5			
	1.3246	S7-4-2-5	Z110WKCDV07-05-04-04-02		F.5613 6-5-2-5	M41		
BT42	1.3247	S2-10-1-8	Z110DKCWW09-08-04-02-01		F.5615 7-4-2-5	M42		
BM34	1.3249	S2-9-2-8			F.5611 2-9-2-8	M33/M34		
BT4	1.3255	S18-1-2-5	Z80WKCV18-05-04-01		F.5530 18-1-1-5	T4		
BT5	1.3265	S18-1-2-10			F.5540 18-0-2-10	T5		
	1.3342	SC6-5-2	Z90WDCV06-05-04-03			M3		
BM2	1.3343	S6-5-2	Z85WDCV06-05-04-02	2722	F.5603 6-5-2	M2		



Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
TOOL STEELS		1.3344	S6-5-3	Z130WDCV06-05-04-04		F.5605 6-5-3
	BM1	1.3346	S2-9-1	Z85DCWV08-04-02-01		M3Class2
		1.3348	S2-9-2	Z100DCWV09-04-02-02	2782	H41/M1
	BT1	1.3355	S18-0-1	Z80WCV18-04-01		M7
		1.3401	X120Mn12	Z120M12 / Z120Mn12		T1
					F.82551-AM-X 120 Mn 12	A128(A)
	443S65	1.4747	X80CrNiSi20	Z80CSN20.02		HNv6
	403S17	1.4	X6Cr13	Z6013 / Z6Cr13	2301	403
	403S17	1.4001	X7Cr14	Z3014	2301	F.8401-AM-X12 Cr 13
	405S17	1.4002	X6CrAl13	Z6CA13 / Z6CrAl13	2302	F.3111-X6 CrAl13
	416S21	1.4005	X12CrS13	Z12CF13 / Z12CrS13	2380	F.3411-X12 CrS13
	410S21	1.4006	X10Cr13	Z12C13 / Z12Cr13	2302	F.3401-X12 Cr 13
	410C21	1.4008	G-X8Cr14	Z12CN13M		410
	430S15	1.4016	X6Cr17	Z8C17 / Z6Cr17	2320	F.3113-X8 Cr17
	420S37	1.4021	X20Cr13	Z20C13 / Z20Cr13	2303	F.3402-X20 Cr 13
	420S45	1.4028	X30Cr13	Z20C13 / Z20Cr13	2304	F.3403-X30 Cr 13
		1.4031	X38Cr13	Z40C14 / Z40Cr14	2304	F.3404-X40 Cr 13
	420S45	1.4034	X46Cr13	Z40C14 / Z40Cr14		F.3405-X46 Cr 13
	431S29	1.4057	X20CrNi172	Z15CN16.02	2321	F.3427-X15 CrNi16
		1.4104	X12CrMoS17	Z10CF17	2383	F.3117-X10 CrS17
	434S17	1.4113	X6CrMo17	Z8CD17.01	2325	
		1.4125	X105CrMo17	Z100CD17		434
		1.451	X6CrTi17	Z8CT17		440C
	409S19	1.4512	X5CrTi12	Z6CT12		F.3114-X8CrTi17
		1.4534				XM8/430Ti
		1.4545				409
						13-8 PH Mo
						15-5 PH
						15-7 PH Mo
		1.4504				17-4 PH
		1.4548				17-4 PH ,CH900
	401S45	1.4718	X45CrSi93	Z7CNU17-04		
	403S17	1.4724	X10CrAl13	Z45CS9		HNv3
		1.4731	X40CrSiMo102	Z10C13		F.3220-X 4 CrSi 09-03
	430S15	1.4742	X10CrAl18	Z40CSD10		F.13152-X 10 CrAl13
		1.4762	X10CrAl24	Z10CAS18		F.3221-X 40 CrSiMo 10-02
	303S21	1.4305	X10CrNiS189	Z10CAS24		F.3153-X 10 CrAl 18
	304S15	1.4301	X5CrNi1810	Z10CNF18.09	2346	F.3154-X 10 CrAl24
	305S19	1.4303	X5CrNi1812	Z6CN18.09	2332	F.3508-X10CrNiS18-09
	304S12/S11/C12	1.4306	G-X2CrNi189/1911	Z2CN18.10/Z3CN19.10M	2333/52	F.3451-X5 CrNi18-10
	304C15	1.4308	G-X6CrNi189	Z6CN18.10M	2333	F.3513-X8CrNi18-12
	301S21	1.431	X12CrNi177	Z12CN17.07		F.3503-X 2CrNi19-10
	304S62	1.4311	X2CrNiN1810	Z2CN18.10Az	2371	F.3517-X12CrNi17 07
	425C11	1.4313	G-X5CrNi134	Z4CND13.4M	2385	
	316S16/S31	1.4401	X5CrNiMo17122	Z6CND17.11	2347	F.3543-X5CrNiMo17-12-03
	316S11/S12	1.4404	X2CrNiMo17132	Z2CND 18.13	2348	F.3533-X 2CrNiMo17 12-03
	316S61	1.4406	2CrNiMoN17122	Z2CND 17.12Az		F.8414-AM-X7 CrNiMo20 10
	316C16	1.4408	G-X6CrNiMo1810		2343	
	316S62	1.4429	X2CrNiMo17133	Z2CND17.13Az	2375	F.8414-AM-X7 CrNiMo20 10
	316S11/S12	1.4435	X2CrNiMo18143	Z2CND17.13	2375	
	316S16	1.4436	X5CrNiMo17133	Z6CND17.12	2353	F.3533-X 2 CrNiMo 17-12-03
	317S12	1.4438	X2CrNiMo18164	Z2CND19.15	2343	F.3534-X 6 CrNiMo 17-12-03
	317S16	1.4449	X5CrNiMo1713		2367	
	347C17	1.4452	G-X5CrNiNb189	Z6NNb18.10M		317L
		1.446	X8CrNiMo275			317
	321S12S31	1.4541	X6CrNiTi1810	Z6CNT18.10	2324	F.3309-X 8CrNiMo27-05
		1.4542	X5CrNiCuNb1714	Z6CNU17.04	2337	F.3553-X 7 CrNiTi 18-11
	347S17/S18	1.4546	X5CrNiNb1810			321
	347S17/S31	1.455	X6CrNiNb1810	Z6CNCNb18.10		630
	320S31/S17	1.4571	X6CrNiMoTi17122	Z6CNDT17.12	2338	348
	318S17	1.458	X6CrNiMoNb17122	Z6CNDNb17.12/19.13	2350	F.3552-X 7 CrNiNb 18-11
	318C17	1.4581	G-X5CrNiMiNb1810	Z4CNDNb18.12M		F.3552-X 6 CrNiMoTi17-12-03
	309S24	1.4828	X15CrNiSi2012	Z15CNS20.12		316Ti
	309S24	1.4833	X7CrNi2314	Z15CN24.13		316Cb
	309C30	1.4837	G-X40CrNiSi2520			
		1.4841	X15CrNiSi2520	Z15CNS25.20		309
	310S24	1.4845	X12CrNi2521	Z12CN25.20	2361	F.3310-X15 CrNiSi 25-20
	310C40	1.4848	G-X40CrNiSi2520			F.331
	349S54	1.4871	X53CrMnNiN219	Z52CMN21.09		F.8452-AM-X 40 CrNi25 20
	331S40	1.4873	X45CrNiW189	Z35CNWS14.14		F.3217-X 53 CrMnNiN 21-09
	321S20	1.4878	X12CrNiTi189	T6CNT18.12(B)	2337	F.3211-X45 CrNiSiW 28-09
	1501-509;510	1.5662	X8Ni9	Z8N9		F.3523-X 6CrNiTi 18 11
		1.568	12Ni19	Z18N5		F.2645 - X 8 Ni 09
HIGH TEMPERATURE ALLOYS	NA 18	2.4375	NiCu30 Al	NU 30 AT		Monel k-500
		2.4685	G-NiMo28			Hastelloy B
		2.481	G-NiMo30			Hastelloy C
		2.461	NiMo16Cr16Ti			Hastelloy C-4
	NA 16/3072-76	2.4858	NiCr21Mo	NC 21 Fe DU		Incoloy 825
		2.4694	NiCr16Fe7TiAl			Inconel
	NA 21	2.4856	NiCr22Mo9Nb	NC 22 FeDnb		Inconel 625



Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
HIGH TEMPERATURE ALLOYS		2.4856	NiC29Fe	Nnc 30 Fe		Inconel 625
		2.4642	NiCr19FeNbMo	NC 19 Fe Nb		Inconel 690
		2.4668	NiCr15Fe7TiAl	NC 15 TNb A		Inconel 718
		2.4669				Inconel X-750
						Invar 36-36 Alloy
						Invar Super 32-5
						Invar Super 32-5
	NA 13	2.436	NiCu30Fe	NU 30		Monel 400
	X5NiCrTi26 15			HR650		A286
			Co28Cr6Mo	Z6CNU15-5		Co Chrome ASTM F-75
	NA17	1.4864	X12NiCrSi3616	Z12NCS37.18	F.3313-X 12 CrNi 36-16	330
	NA15(H)	1.4876	X10NiCrAlTi3320	Z8NC3221	F.3545-X 9NiCr 33-21	B163
	3072-76/NA13	2.436	NiCu30Fe	NU30		4544/SB127/164
	3072-76/NA18/3146	2.4375	NiCu30Al			4676
		2.4602	NiCr17Mo17FeW	NC 17 DWY		5388 C
	HR5/203-4/703-B	2.463	Ni-Cr20Ti	NC 20 T	MH-05	Nimonic 75
	HR 10	2.465	NiCr20Co19MoTi	NCK 20 D		
		2.4662	NiCr15MoTi	Z8 NCDT 42	MH-16	5660C
	HR 6/204	2.4665	NiCr22Fe18Mo	Nc 22 FeD	MH-03	5536E
	HC 203	2.467	G-NiCr13Al6MoNb	NC 13 AD	MH-31	5391A
	HC 204	2.4674	NiCo15Cr10MoAlTi	NK 15 CAT		
	3072-76	2.4816	NiCr15Fe	NC 15 Fe		5540
		2.4856	NiCr22Mo9Nb	NC 22 FeDNB		5581
	3072-76	2.4858	NiCr21Mo	NC 21 FeDU		
	HR 207/5047		NiFe33Cr17Mo	NW 11 AC		
			NiCo32Cr26Mo	KC 20 WN		
			NiCo28Cr15MoAlTi	NK 27 CADT		
	HR 3/5007	2.4634	NiCo20Cr15MoAlTi	NCKD 20 ATV	MH-14	
		2.4654	NiCr20Co14MoTi	NC 20 K 14		
	HR 505	2.4669	NiCr16FeTi	NC 15 Fe TNb		5542G
		2.4676	NiCo10W10Cr9AlTi			
			NiCr20Co16MoTi	NC 19 KDU/V		
			NiW13Co10Cr9AlTi	NKW 10 CAT aHf		
			NiCr16Co10WAlTi			
	HR 401HR601/736B	2.4631	NiCr20TiAl	NC 20 TA	MH-07	
		2.4636	NiCo15Cr15MoAlTi	NCKD 20 AT		687
		2.4662	NiFe35Cr14MoTi	Z8 NCDT 42		
	HR 8	2.4668	NiCr19Fe19NbMo	NC 19 FeNb	MH-06	
		2.4916	NiCr19Co11MoTi			
		2.4983	NiCr18Co18MoAlTi	NCK 19 DAT		684
			NiCo22Cr16WAlTi	NC 14 K8		
TITANIUM	TA.1	3.7024/25	Ti 99,8	T-35	Ti-PO1	
	TA.2/3/4/5	3.7034/35	Ti 99,7	T-40	Ti-PO2	4941/42/51/4902
	TA.6/7/8/9	3.7064/65	Ti99,5	T-60	Ti-PO4	4901/21
	TA.21-24/52-55/58	3.7124	TiCu2	T-U2	Ti-P11	
	DTD 5023/5273/5283			T-50		4900
		3.7114	TiAl5Sn2			Ti-5Al-2.5Sn
			5553			Ti-5Al-5V-5Mo-3Cr
	TA.43/44	3.7154	TiAl6Zr5Mo0,5Si0,2	T-A6ZD	Ti-P67	
NODULAR CAST IRON	TA.10-13/28/56	3.7164/65	TiAl6V4	T-A6V	Ti-P63	491128/35/54/65/67
	TA.45-51/57	3.7184	TiAl4Mo4Sn2Si0,5	T-A4DE	Ti-P68	
	420/12	0.704	GGG-40	FGS-400-12		60-40-18
	370/17	0.7043	GGG-40.3	FGS370-17	0717-02	
	500/7	0.705	GGG-50	FGS500-7	0717-15	
	600/3	0.706	GGG-60	FGS 600-3	0727-02	65-45-12
	700/2	0.707	GGG-70	FGS 700-2	0732-03	80-55-06
	800/2	0.708	GGG-80	FGS 800-2	0737-01	100-70-03
GREY CAST IRON	W 340/3	0.8035	GTW-35-04	MB 35-7		120-90-02
	W 410/4	0.804	GTW-40-05	MB 40-10		
	B 340/12	0.8135	GTS-35-10	MN 35-10	SIS 08 15-00	32 510
	P 440/7	0.8145	GTS-45-06	MP 50-5	SIS 08 54-00	
	P 540/5	0.8155	GTS-55-04	MP 60-3	SIS 08 56-00	
	P 690/2	0.817	GTS 70-02	MP 70-2	SIS 08 62-03	70 003
	B 290/6			MN 32-8/38-18	SIS 08 14-00	
		0.601	GG10	Ft10D / FGL100	0110-00	A48-20B
ALUMINIUM ALLOYS	Grade 150	0.6015	GG15	Ft15D / FGL150	0115-00	A48-25B
	Grade 220	0.602	GG20	Ft20D / FGL200	0120-00	A48-30B
	Grade 260	0.0625	GG25	Ft25D / FGL250	0125-00	A48-40B
	Grade 300	0.603	GG30	Ft30D / FGL300	0130-00	A48-45B
	Grade 350	0.6035	GG35	Ft35D / FGL350	0135-00	A48-50B
	Grade 400	0.604	GG40	Ft40D / FGL400	0140-00	A48-60B
ALUMINIUM ALLOYS	LM4/LM22	3.2151	G-AlSi6Cu4	A-55U	4230	319,2
	2L99/LM25	3.2371	G-AlSi7Mg	A-S7G0,3	4244	A356.2
	LM24	3.2161	G-AlSi8Cu3	A-S9U3	4252	380,1
	LM9	3.2381	G-AlSi10Mg	A-S10G	4253	A360
	LM20	3.2583	G-AlSi12Cu	A-S12U	4260	413,1
	LM6	3.3581	G-AlSi12	A-S13	4261	A413



Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
ALUMINIUM ALLOYS	LM28/LM29		AlSi18-25CuNiMg			393
	1C	3.0205	Al99			1200
	1B	3.0255	Al99,5		L-3001	1050A
	1E	3.0257	E-Al		L-3051	1350A
	1A	3.0285	Al99,8		L-3052	1080A
	1	3.0385	Al99,98R		L-3081	1199
	N31	3.0505	AlMn0,5Mg0,5			3105
	N3	3.0515	AlMn	144054	L-3810	3103
		3.0525	AlMn1Mg0,5			3005
	N4	3.0526	AlMnMg1	A-M1G0,5	L-3820	3004
		3.0915	AlFeSi	A-FeS		8011A
	H15	3.1255	AlCuSiMn	A-U4SG	L-3130	2014
		3.1303	AlCu2Mg0,5			2036
	3L86/HR13	3.1305	AlCu2,5Mg0,5		L-3180	2117
	H14	3.1325	AlCuMg1	A-U2G	L-3120	2017A
	2L98	3.1355	AlCuMg2	A-U4G1	L3140	2024
		3.1645	AlCuMgPb	A-U4Pb	L-3121	2003
	FC1	3.1655	AlCuBiPb	A-U5PbBi	L-3182	2011
	2L91/92	3.1841	G-AlCu4Ti			295.1/.2
	91E	3.2305	E-AlMgSi		L-3431	6101B
	BTR6	3.2307	Al99,85MgSi	A85-GS		6463
	H30	3.2315	Al-Si1 Mg	A-SGMO,7	L-3451	6181
	H9	3.3206	AlMGSi0,5	144103	L-3441	6060
	BTRE6	3.3207	E-AlMGSi0,5	A-GS/L		6101C
		3.3241	G-AlMg3Si	A-G3T		F/B514.0
	N41	3.3315	AlMg1	A-G0,6	L-3350	5005A
	3L44	3.3316	AlMg1,5	A-G1,5	L-3380	5050B
	BTR2	3.3317	Al99,85Mg1	A85-G1		
		3.3326	AlMg1,8			5051A
		3.3345	AlMg4,5			5082
	N5Mg3,5	3.3523	AlMg2,5	A-G2,5C	L-3360	5052
	N4	3.3525	AlMg2Mn0,3	A-G2M		5251
		3.3527	AlMg2Mn0,8			5049
		3.3535	AlMg3	A-G3M	L-3390	5754
	N51	3.3537	AlMg2,7Mn	A-G2,5MC		5454
		3.3541	G-AlMg3	A-G3T	L-2341	514
		3.3545	AlMg4Mn	A-G4MC	L-3322	5086
	N8	3.3547	AlMg4,5Mn	5083	L-3321	5083
	N6	3.3555	AlMg5	144146	L-3320	5056A
	LM5	3.3561	G-AlMg5	A-G6		514.1
	LM10	3.3591	G-AlMg10	A-G10-Y4	L-2310	520
	H17	3.4335	AlZn4,5Mg1	A-Z5G	L-3741	7020
		3.4345	AlZnMgCu0,5	A-Z5GU0,6		7022
	2L95	3.4365	AlZnMgCu1,5	A-Z5GU	L-3710	7075
		3.4415	AlZn1		L-3721	7072
COPPER ALLOYS	Pb2	2.1052	G-CuSn12	CuSn12		C 90800
	CT2	2.106	G-CuSn12Ni			C 91700
	CT1	2.1086	G-CuSn10			C 90250
		2.109	G-CuSn7ZnPb	CuSn7Pb6Zn4		C 93200
	LG4	2.1093	G-CuSn6ZnNi			C 92410
	LG2	2.1096	G-CuSn5ZnPb/RG5	CuPb5Sn5Zn5		C 83600
	LG1	2.1098	G-CuSn2ZnPb			C 83810
	LB2	2.1176	G-CuPb10Sn	CuPb10Sn10		C 93700
	LB1	2.1182	G-CuPb15Sn			C 93800
	LB5	2.1188	G-CuPb20Sn	CuPb20Sn5		C 94100
		2.0918	CuAl5As	CuAl6		C 60 800
		2.092	CuAl8	CuAl8		C 61 000
	CA 106	2.0932	CuAl8Fe3	CuAl7Fe2		C 61 400
	CA 105	2.0936	CuAl10Fe3Mn2	CuAl9Fe3Mn2		C 62 300
	AB 1	2.094	CuAl10Fe	CuAl9Fe3		C 95 200
	CA 104	2.0966	CuAl10Ni5Fe4	CuAl9Ni5Fe3Mn		C 63 200
	AB 2	2.097	G-NiAlBzF50	CuAl9Ni5Fe		C 95 800
	CC 102	2.1293	CuCrZr			C 18100
	C 112	2.1285	CuCo2Be			C 17500
	CB 101	2.1245	CuBe1,7	CuBe1,7		C 17000



Optimised Cutting-High Performance Cutting (HPC)

Since producing its first cutting tools in 1919, M.A.FORD has always strived to improve its customers productivity and hence lower costs.

The TuffCut® XR-XT range of end mills is the latest step in this process, offering unique Heli-pitch geometry, proprietary substrates and state of the art AlTiN coatings.

High Speed Machining or HSM has long been characterised by cutting conditions that are 4 to 10 times higher than conventional machining. The machine tools widely available today to 95% of customers are not capable of these cutting speeds nor do they have the rigidity required.

High Performance Cutting techniques (HPC) use cutting speeds that are 2 times+ that of standard or conventional techniques. In conjunction with the increase in surface speed, by controlling the engagement angle of the cutting tool during the milling process and the use of chip thickness compensation-vastly increased cutting data can be achieved.

Before using these techniques there are several required pre-requisites:-

- Rigid machine tools with modern control systems with a HSM function..
- High performance, high technology cutting tools.
- High gripping strength, rigid tool holders.
- Air or powerful coolant delivery system-according to material being machined.
- Cad Cam software to control the engagement angle of the tool.

M.A.FORD has partnered with OneCNC Cad/Cam software company to provide this service to its customers. In conjunction with their XR5 software with its HSM function the radial engagement of the tool during the milling process can be guaranteed never to exceed the set percentage.

A step over of 10% of the cutter diameter requires a chip thickness compensation factor of 1.8 to be applied. 20% radial engagement requires a compensation of 1.2 times. However, care must be taken when using these rates for tight corner internal machining.

Due to the small radial cuts, large axial cuts – typically 2 times the tool diameter can be used. The combination of these factors enables most steels up to 40HRC to be machined at feeds of up to 13 metres/min. An example of this HPC cutting data can be seen on the next page in a direct comparison with conventional programming techniques.

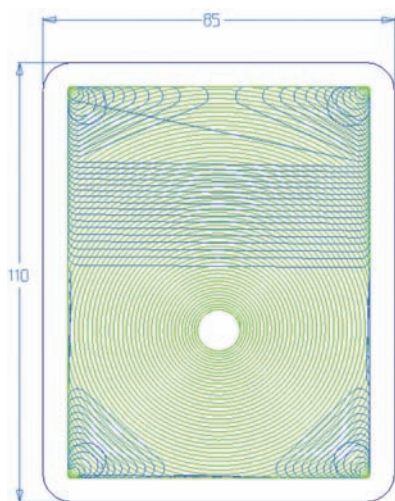
Benefits of HPC using OneCNC software-

- Decreased cycle time
- Reduced costs
- Potentially reduced cutting tool diameter and hence cost
- Improved process reliability
- Improved cutting tool life
- Reduced coolant consumption



Benefits of Enhanced cutting parameters with HSM toolpaths

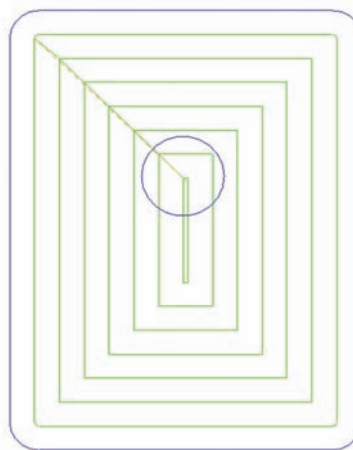
HSM tool path



Tool diameter-12 mm
Entry-Helical ramp-2 degrees
Axial depth Ap-24 mm-1cut
Radial step over Ae-10%-1.2 mm

177 1200-0.5RA

Conventional tool path



Tool diameter-12 mm
Entry-Via drilled hole.
Axial depth Ap-24 mm-2 cuts of 12 mm
Radial step over Ae-50%-6 mm

177 1200-0.5RA

Cutting data and cycle time by material

Steel		
RPM	8000	3200
Feed mm/min	6700	765
Cycle time	1 min-40 secs	4 mins
Metal removal rate	193 Cm-3	55 Cm-3
Expected tool life	2-3hrs	1-2hrs

Stainless steel		
RPM	4000	1855
Feed mm/min	3400	450
Cycle time	3 min-20 secs	7 mins
Metal removal rate	98 Cm-3	32 Cm-3
Expected tool life	2-3hrs	1-2hrs

Titanium		
RPM	2600	1600
Feed mm/min	2100	380
Cycle time	5 min-15 secs	8 mins
Metal removal rate	61 Cm-3	27 Cm-3
Expected tool life	2-3hrs	1-2hrs

Inconel 625		
RPM	930	660
Feed mm/min	470	80
Cycle time	21 mins	37 mins
Metal removal rate	14 Cm-3	6 Cm-3
Expected tool life	30 mins-1 hr	15-30 mins

CERAedge®

A.P.G.
M.A.FORD Advanced
Product Groups

Ceramic coating with Extreme properties

- Perfect for machining Titanium Clad Composites
- Hardness that makes it the 3rd hardest material when compared to industrial diamonds
- Lubricity that approaches Teflon
- Titanium tough
- Extreme heat tolerance
- Non-reactive to Titanium



Coating Properties

M.A. FORD Coating	Microhardness (HV)	Maximum Service Temp.	Friction Coefficient	Coating Thickness	Colour
CERAedge®	3400	1100° C / 2012° F	.25	2-3 Microns	Light Gray

CERAedge® Applications

Titanium-clad composite material:

- Hardness and lubricity ideal for composites
- Toughness that allows excellent machining of Titanium
- CERAedge® is perfect for machining of Titanium-clad composites!

Aluminum and high silicon aluminum materials:

- Hardness and lubricity extend tool life by increasing wear and resistance.

	Competitor's Lubricious Coating	M.A. FORD CERAedge® Coated
Parts Produced/Tool	5	42
Linear Inches/Tool (Linear m/tool)	10,690 (272)	92,976 (2,360)

For further information please contact:

Tel: +44 (0)1332 267 960



Where **high performance** is the **standard**

NEW

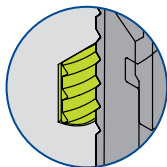
TuffCut® XT

277NR 277NRW

Guaranteed Non Pull-Out

With modern high performance machining and demanding production specifications, the risk of cutting tool 'pull-out' has become a very real concern for many companies. There are various tool holding solutions available, each provide varying degrees of success.

NOW, with the TuffCut® XT 277 NR and NRW range of tooling, M.A.FORD has arguably the highest performing and most cost effective system, incorporating a unique 'Non-pull out' feature - secuRgrip® that is ideal for use with our recommended tool holding solution from REGO-FIX®.

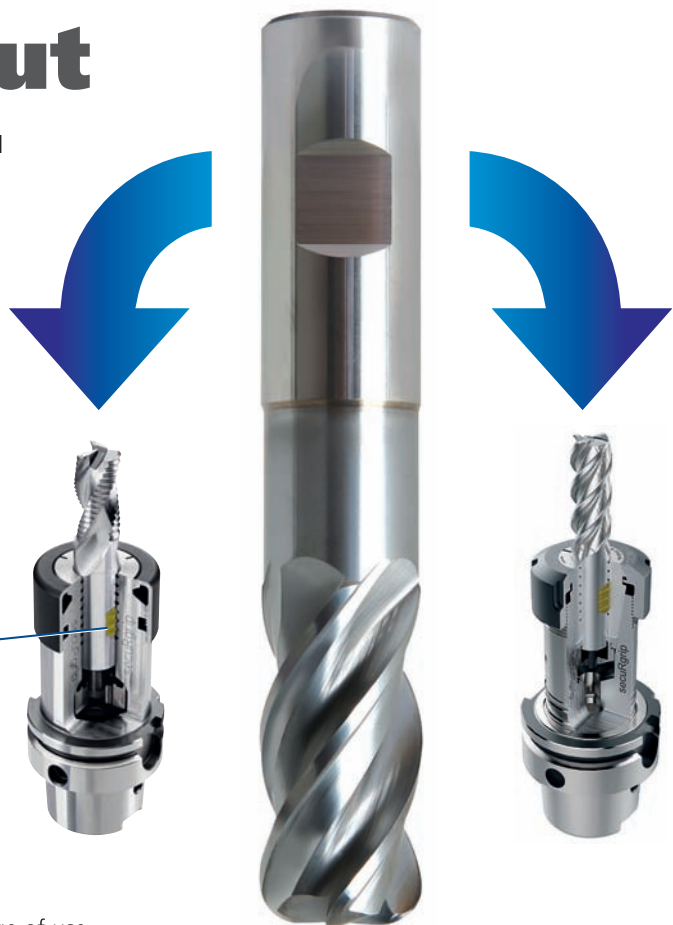


277 NR/NRW

- 'Non-pull out' shank form
- Innovative ALtima® Blaze coating
- Full radius range from stock
- Ideal for stainless steel and titanium
- M.A.Ford's unique Heli-Pitch geometry
- Necked, 3 x Diameter as standard to increase range of use

REGO-FIX® powRgrip® Clamping System

- More than 50% increase in transmitted torque over shrink-fit as standard (without Weldon feature)
- Holders capable of 20,000 insertion / extraction of collet without deterioration in clamping force
- Concentricity $\leq 3\mu\text{m}$
- Designed for roughing and finishing operations
- Eliminates the requirement to have expensive grooves ground in the shank of tool
- Anti vibration effect over standard shrink-fit allowing increased tool life and cutting parameters



Where **high performance** is the **standard**

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Stop Guessing. Start Knowing

The BlueSwarf Dashboard™ is a revolutionary new product that dramatically improves the performance of milling using the science of machining dynamics. Dashboards™ control the dynamic frequencies and vibrations that limit milling operations and generate chatter.



EXPERT ANALYSIS - BlueSwarf Dashboards™ are a system of patented and proven services that begin with onsite measurements of your milling tools by M.A.FORD and analysis by our staff of Ph.D.-level engineers. Interactive Dashboards™ are delivered for first time right and fully optimized machining.

- Eliminate Chatter
- Increase Metal Removal Rates
- Increase Tool Life
- Improve surface finishes
- Faster Set-Ups
- Reduce Energy Consumption

Contact M.A.FORD to book your process optimisation appointment today!

For further information please contact:

Tel: +44 (0)1332 267 960

Fully interactive BlueSwarf Dashboards™ allow users, without extensive knowledge of chatter theory or mechanical vibrations, to take full advantage of the available improvements in process efficiency.

BlueSwarf Dashboards™ allow process planners and programmers to select high-efficiency milling parameters for maximized material removal rates in a science-based pre-process manner, rather than relying on trial and error testing.



Where **high performance** is the **standard**



Special designs with a special service

Sometimes, even our extraordinarily advanced tooling range can't meet every need 'off-the-shelf', which is where M.A.FORD Europe Custom Tools Division, our specialist custom tool design, production, regrind and remanufacture facility can provide the perfect solution for your needs.

Whether you have a specialised requirement for a custom tool form, length or material, our team can help you design, develop and create dedicated, application specific tooling that not only does the job, but is also manufactured to the excellent quality and precision standards expected from M.A.FORD.

From precision drills, taps, milling tools and cutters for high performance composites, through to special punches, press tool dies and rotary broaches, we have the expertise, facilities and experience to produce advanced special purpose tools, which are used in a diverse range of manufacturing environments. From agriculture to aerospace and motorsport to medical, we've got it covered.

In addition, for more than 30 years, we have provided a precision tool regrind, remanufacture and modification service to businesses in the UK and Europe, which allows worn tools to be revitalised and ensure that their productive working life can be increased at a fraction of the cost of making a new tool.

Like all our precision solutions, our regrinding service is managed and carried out by highly skilled manufacturing professionals to ensure that every customer receives the same high quality support and service that has been a key factor in why M.A.FORD Europe Custom Tools Division's customers keep returning.

For further information please contact:

Tel: +44 (0)1332 267 960



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Coatings

ALtima®

Aluminum Titanium Nitride (AlTiN). ALtima® is the original high performance coating. This coating allows tools to be run at higher speeds and feeds in a wide array of materials. Also, it allows the option of running tools dry due to the high oxidation temperature of the coating.

ALtima® Plus

This Aluminum Titanium Nitride (AlTiN) multi-layer coating has optimized coating structure, with pre and post treatment of the coating for optimized high performance drilling in any ferrous material.

ALtima® 52

Aluminum Titanium Nitride (AlTiN). ALtima® 52 is specially designed for milling hardened steels 52 Rc and above. It has very high hardness and the oxidation temperature of the coating makes this the absolute best choice for hardened steel milling. ALtima® 52 is designed to allow for dry machining.

ALtima® Blaze

ALtima® Blaze is designed to allow higher material removal rates. This coating has a higher oxidation temperature than a typical TiAlN coating. It has shown very good results in nickel alloys, titanium, and other difficult to machine materials. Tools coated with ALtima® Blaze can be used in dry machining.

Special Coatings

Upon request, M.A.Ford® can provide any commercially available coating. Any standard M.A.Ford® cutting tool can be provided with coating if requested.

CERAedge® combines the heat resistance of conventional AlTiN coatings with the hardness and smoothness of amorphous diamond coatings.

- Hardness that makes it the 3rd hardest material when compared to industrial diamonds
- Toughness that is comparable to Titanium
- Lubricity that approaches Teflon

Applications-

- Only CERAedge® has properties allowing for ideal drilling and milling of Titanium clad composites
- Ideal for machining Titanium, Aluminium Alloys and High Silicon Aluminium materials.

Fordlube

Titanium DiBoride (TiB₂) is a unique coating with low Aluminum affinity, smooth surface finish and high hardness. It is ideal for Aluminum and Magnesium alloys as it prevents build-up on cutting edge, provides superior chip flow along with extended wear resistance.

Gem Coat

Amorphous Diamond. Gem is M.A. Ford®'s answer to diamond coated tooling. It has the hardness of diamond, the smoothness of typical PVD coatings, and excellent thermal stability. It is excellent for milling graphite and aluminum.

TiN

Titanium Nitride (TiN). TiN coating has shown good results in low carbon steels and many iron-based applications. It is a very popular coating used in the industry today.

TiCN

Titanium Carbonitride (TiCN). TiCN is a multi-layer coating. Because of the multi-layer composition, TiCN is tougher than TiN, even though TiCN is harder. The added toughness of the TiCN coating makes it a good choice for mechanically stressed edges like in end mill applications. The higher hardness makes TiCN a good choice for abrasive applications where higher wear resistance is required.

Coating Properties

M.A. FORD Coating	M.A. FORD Tool Number Designation	Microhardness (HV)	Maximum Service Temp.	Friction Coefficient
ALtima®	A	3100	1100 C / 2012 F	0.42
ALtima® Plus	AP	3200	1100 C / 2012 F	0.25
ALtima® 52	A	3600	1200 C / 2192 F	0.4
ALtima® Blaze	B	3200	1100 C / 2012 F	0.35
TiN	T	2300	600 C / 1112 F	0.4
TiCN	C	3000	400 C / 752 F	0.4
Fordlube	F	4000	700 C / 1292 F	0.3
Gem	G	8000	700 C / 1292 F	0.1
CERAedge®	CE	3400	1100 C / 2012 F	0.25





Where **high performance** is the **standard**

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