

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



TuffCut® XR-XT



NEW Products



TuffCut® X-AL



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.



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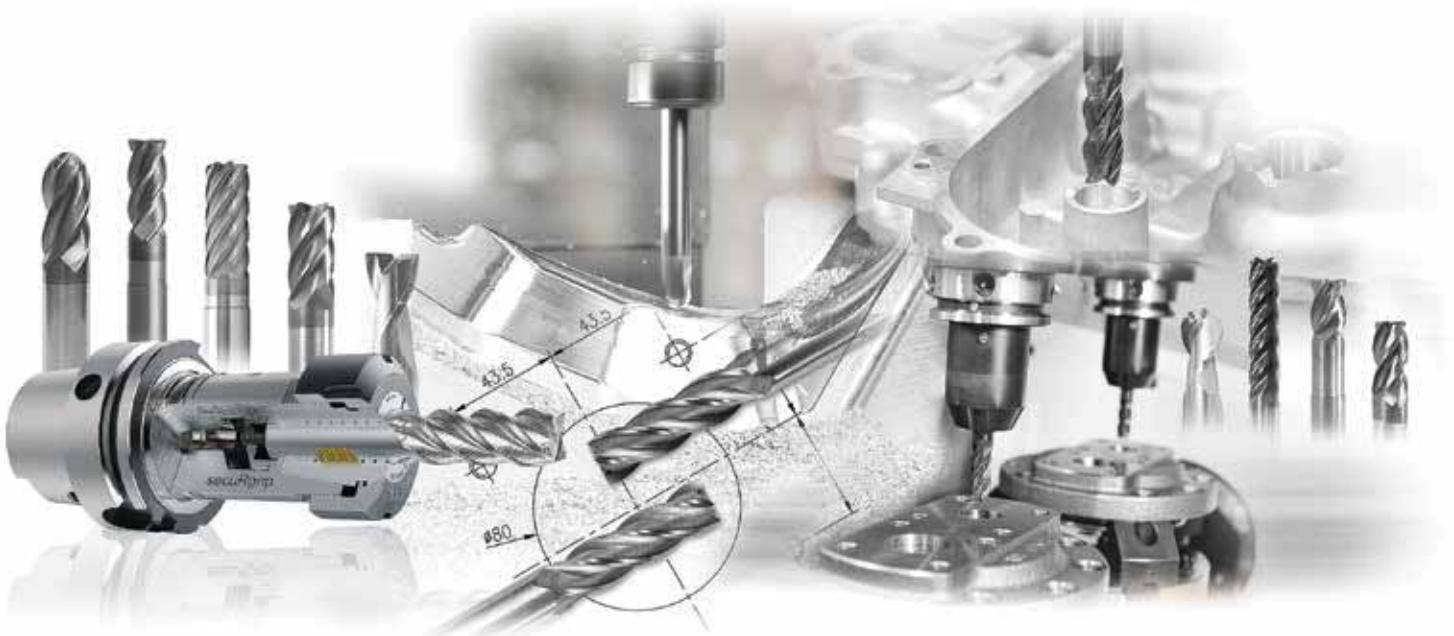
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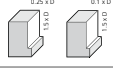



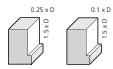







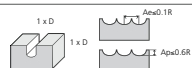



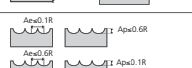





































Product contents

X-AL, XT, XR, V5LCB, Diamond Grind Routers							
Series	Tool Illustration	Z	Length	Corner Prep	Application Area	Material Group	Page
137VR N3		3		1.0mm radius			6
279		4		N/A			7
180 & 180R		7		Sharp corner & 0.5mm radius			7
V5LCB		5		0.5mm radius			9
230		Multi		N/A			11
231		Multi		N/A			11
239		Multi		N/A			12

TuffCut® XR - XT							
Series	Tool Illustration	Z	Length	Corner Prep	Application Area	Material Group	Page
177		4		Sharp corner			16
177R		4		0.25 - 6.0mm radius			17
177S		4		0.2 - 1.0mm radius			18
177LR N5		4		0.3 - 3.0mm radius			19
277		4		Sharp corner			20
277R		4		0.25 - 0.8mm radius			20
277NR		4		0.25 - 6.0mm radius			21
277NR-W		4		0.25 - 6.0mm radius			22
178		5		Sharp corner			23
178R		5		0.5 - 1.0mm radius			24
178-1		5		Sharp corner			24
278R N3		5		0.5 - 4.0mm radius			25
278R N4		5		0.5 - 3.0mm radius			26
Technical Information							50-54

Product contents

TuffCut® XR - XT							
Series	Tool Illustration	Z	Length	Corner Prep	Application Area	Material Group	Page
278R N5	 NEW	5		1.0 - 3.0mm radius			26
278R N5 (With Central Coolant)	 NEW	5		0.5 - 4.0mm radius			27
113A		6		Sharp corner			27
179		4		N/A			28
179L N5		4		N/A			28
180R	 NEW SIZES NOW AVAILABLE	7		0.5 - 4.0mm radius		Primarily Titanium alloys 	29
180R N5		7		1.0 - 4.0mm radius		Primarily Titanium alloys 	29
Technical Information							50-54

TuffCut® X-AL							
Series	Tool Illustration	Z	Length	Corner Prep	Application Area	Material Group	Page
135		2		0.2 - 0.75mm Radius	High feed machine - 1 > mm tooth loading possible		32
135 N		2		0.2 - 0.75mm Radius	High feed machine - 1 > mm tooth loading possible		33
135 N3		2		0 - 5.0mm Radius	High feed machine - 1 > mm tooth loading possible		34
135 N5		2		0 - 5.0mm Radius	Rough profile milling		36
135B N3		2		N/A	Rough & finish profile milling		38
135B N5		2		N/A	Rough & finish profile milling		38
137V N3		3		0 - 4.0mm Radius	Rough & finish profile milling		39
137V N4		3		0 - 4.0mm Radius	Rough & finish profile milling		41
137V N5		3		0 - 4.0mm Radius	Rough & finish profile milling		43
138B		3		N/A	Finish profile milling		45
138B N5		3		N/A	Finish profile milling		45
137VR N5	 NEW	3		1.0mm Radius	Rough milling		46
137VF	 NEW	3		0 - 2.0mm Radius	Finishing 3 x D and 5 x D Flute Lengths		46
Technical Information							55-58

NEW

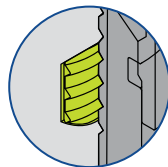
TuffCut® XT

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**

For further information please contact:
Tel: +44 (0)1332 267 960



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



MACH 2016 saw the launch of several new product lines to enhance our already impressive portfolio of high performance cutting tools.

These additions enhance our highly successful XR, XT and X-AL programmes and bring even more manufacturing solutions to both new and existing customers.

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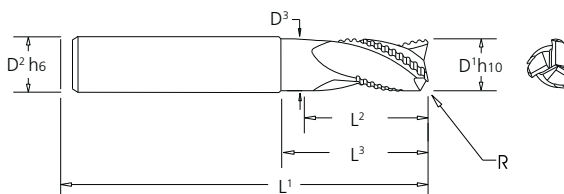
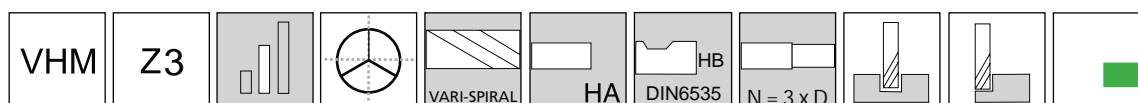
VHM Tool Material	Z2 Z3 Number of Flutes	55° Helix Angle	Centre Cutting
Lengths	Cutting Direction	Profiling	Slotting
3D Scanning	HA Shank	<48HRC Material Hardness	ALtima® Coating
UNCOATED OR ALtima® PROTECTOR Uncoated or Coated			
Workpiece Material Group	Steel	Cast Iron	
	Hardened Steels (35-65Rc)	Special Alloys	
	Stainless Steels	Non-Ferrous	



TuffCut® X-AL Series 137VR N3

Based on our highly successful 137V Vari-Spiral end mills, 137VR has been developed to bring an even more aggressive roughing platform when machining Aluminium and other non-ferrous materials. The unique flute form and chip breaker design provides exceptional metal removal rates and chip evacuation.

- Due to the reduction in chip size, 137VR provides effective swarf management when machining large Aluminium components.
- The versatility of 137VR allows for slotting, pocketing and external profiling applications up to $3 \times D^1$ depths due to its neck relieved shank.
- Suitable for both high and lower powered machines alike, 137VR provides a highly efficient Aluminium machining solution.



Tool No.	D1	D2	D3	L1	L2	L3	R	Shank
137VR 12N3-1.0R	12	12	11.8	84	26	38	1	HA
137VR 12N3-1.0RW	12	12	11.8	84	26	38	1	HB
137VR 16N3-1.0R	16	16	15.8	93	32	50	1	HA
137VR 16N3-1.0RW	16	16	15.8	93	32	50	1	HB
137VR 20N3-1.0R	20	20	19.8	105	38	62	1	HA
137VR 20N3-1.0RW	20	20	19.8	105	38	62	1	HB

Series	Type of cut	Vc		Ø 12.0			Ø 16.0			Ø 20.0		
		Ae	Ap	M/Min	fz		fz		fz			
137VR N3		1 x D	0.25 x D	400-600	0.12		0.16		0.2			
		1 x D	0.5 x D	400-600	0.12		0.16		0.2			
		1 x D	1 x D	400-600	0.11		0.15		0.19			
		0.75 x D	0.5 x D	500-700	0.18		0.24		0.3			
		0.5 x D	1 x D	500-700	0.12		0.16		0.2			
		0.5 x D	1.5 x D	500-700	0.12		0.16		0.2			
		≤ 0.1 x D	≤ 0.9 x L ²	800-1000	0.2		0.27		0.342			

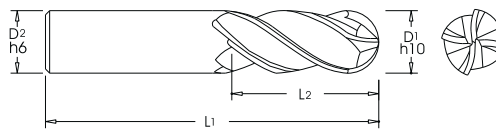
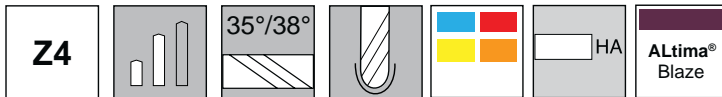


TuffCut® XT Series 279

Following the highly successful launch of our series 179 ballnose end mill, M.A.FORD is introducing the 2nd generation series 279 programme.

A new substrate, geometry and advanced coating allows series 279 to enhance your machining of Steels, Stainless Steels and Titanium alloys.

- Designed for specific applications in steels, stainless steels, special alloys, and cast irons.
- Variable helix and flute spacing for improved machining harmonics.
- Advanced ALtima® Blaze coating for extended tool life.



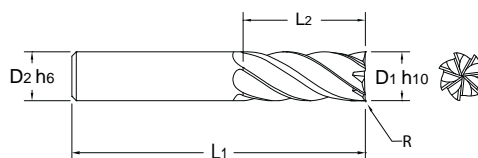
Tool Number	D1	D2	L1	L2
279 0300B	3	6	57	8
279 0400B	4	6	57	11
279 0500B	5	6	57	13
279 0600B	6	6	57	13
279 0800B	8	8	63	19
279 1000B	10	10	72	22
279 1200B	12	12	83	26
279 1600B	16	16	92	32



TuffCut® XR Series 180 & 180R

By popular demand, our Series 180 range of 7 flute end mills sees the addition of new diameters below the current 12.0mm – 20.0mm programme.

The new additions are 6.0mm, 8.0mm and 10.0mm and are available with or without corner radius.



Tool Number	D1	D2	L1	L2	R
180 0600B	6	6	57	13	-
180 0600-0.5RB	6	6	57	13	0.5
180 0800B	8	8	63	19	-
180 0800-0.5RB	8	8	63	19	0.5
180 1000B	10	10	72	22	-
180 1000-0.5RB	10	10	72	22	0.5



Workpiece Material Group	Material Type	Coolant			1 x D	1 x D	0.05 x D	0.1 x D	0.2 x D	0.3 x D	0.5 x D	
		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	S	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.

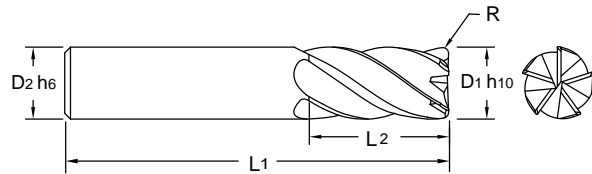
Radial Cut (Ae)	Chip thickness Compensation factor
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00



V5LCB End Mill

M.A.FORD's unique chip breaker and flute design technology ensures V5LCB provides exceptional metal removal rates and effective swarf control at increased axial depths. V5LCB's 5 flute variable pitch design with an enhanced core strength profile and advanced flute geometry for vibration free machining at extended axial depths of cut.

- State-of-the-art surface coating for extended tool life.
- Axial depths of up to 4 times the tool's diameter!
- Designed for high speed profiling in Steels, Stainless Steels and Titanium Alloys.
- HA and HB shank options available.
- Available in diameters 6, 8, 10, 12 and 16mm – all with 4 x D cutting lengths.



Cylindrical Shank (HA)

Tool Number	D1	D2	L1	L2	R
V5LCB 0604-0.5RB	6	6	75	24	0.5
V5LCB 0804-0.5RB	8	8	75	32	0.5
V5LCB 1004-0.5RB	10	10	90	40	0.5
V5LCB 1204-0.5RB	12	12	100	48	0.5
V5LCB 1604-0.5RB	16	16	120	64	0.5

Weldon Shank (HB)

Tool Number	D1	D2	L1	L2	R
V5LCB 0804-0.5RBW	8	8	75	32	0.5
V5LCB 1004-0.5RBW	10	10	90	40	0.5
V5LCB 1204-0.5RBW	12	12	100	48	0.5
V5LCB 1604-0.5RBW	16	16	120	64	0.5



V5LCB End Mill Recommended Cutting Data

V5LCB Cutting Parameters Axial Depth of Cut (ap) ≤ 4 x D

Material Groups	Vc		Ø6.0	Ø8.0	Ø10.0	Ø12.0	Ø16.0
			ae 10%	ae 10%	ae 10%	ae 10%	ae 10%
			0.1 x Ø	0.1 x Ø	0.1 x Ø	0.1 x Ø	0.1 x Ø
			Radial Depth of Cut (ae)	Radial Depth of Cut (ae)	Radial Depth of Cut (ae)	Radial Depth of Cut (ae)	Radial Depth of Cut (ae)
			0.6mm	0.8mm	1.0mm	1.2mm	1.6mm
Low Carbon, Free Machining Steels	300	RPM	15,900	11,925	9,540	7,950	5,963
		Feed (Vf)	4,770	4,770	4,770	4,770	4,770
Alloy Steels, Tool Steels & Nitriding Steels	200	RPM	10,600	7,950	6,360	5,300	3,975
		Feed (Vf)	3,180	3,180	3,180	3,180	3,180
Free Machining & Austenitic Stainless Steels ≤ 32 HRC	150	RPM	7,950	5,963	4,770	3,975	2,981
		Feed (Vf)	2,385	2,385	2,385	2,385	2,385
Moderate Machining & PH Stainless Steels	130	RPM	6,890	5,168	4,134	3,445	2,584
		Feed (Vf)	2,067	2,067	2,067	2,067	2,067
Duplex & Super Duplex Stainless Steels	80	RPM	4,240	3,180	2,544	2,120	1,590
		Feed (Vf)	1,272	1,272	1,272	1,272	1,272
Titanium Alloys	80	RPM	4,240	3,180	2,544	2,120	1,590
		Feed (Vf)	1,272	1,272	1,272	1,272	1,272

Please note - the cutting data shown in the table above is advisory and should be considered as the maximum. Adjustments should be made to the cutting data depending on the application, work piece rigidity, machine tool etc. V5LCB should only be used in accurate tool holders with high gripping power. ER collet type tool holders are not recommended.



Diamond Grind Routers

Series 230, 231 & 239

With the ever increasing need for components manufactured from composite materials, M.A.FORD is introducing a new range of diamond grind routers to complement its existing range of PCD end mills, drills and countersinks.

This new programme brings composite routers with our exclusive CERAedge™ ceramic and GEM-X amorphous diamond coatings for extended tool life when machining advanced composites.



Standard Uncoated



Series 230 Down Cut Safe End



Series 231 Down Cut End Mill



Series 231B Down Cut Burr End



Series 231D Down Cut Drill Point



Series 231F Down Cut Fishtail

CERAedge™ Coating



Series 230CE CERAedge® Down Cut Safe End



Series 231CE CERAedge® Down Cut End Mill



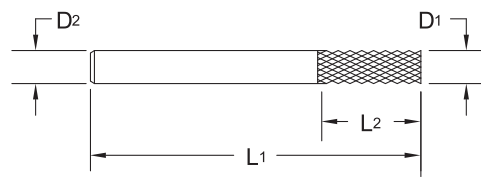
Series 231BCE CERAedge® Down Cut Burr End



Series 231DCE CERAedge® Down Cut Drill Point

CERAedge® Coating

- Diamond grind designed for routing glass-reinforced printed circuit boards, phenolic-epoxy, composites and other highly abrasive materials.
- Available with a non-cutting safe end, or in three popular end-cutting styles with down cut geometries.



Diameter mm	Series 230	Series 230CE	Series 231	Series 231CE	Series 231B	Series 231BCE	Series 231D	Series 231DCE	Series 231F
0.8	230 0080	-	231 0080	-	231 0080B	-	231 0080D	-	231 0080F
1	230 0100	-	231 0100	-	231 0100B	-	231 0100D	-	231 0100F
1.2	230 0120	-	231 0120	-	231 0120B	-	231 0120D	-	231 0120F
1.5	230 0150	-	231 0150	-	231 0150B	-	231 0150D	-	231 0150F
1.6	230 0160	-	231 0160	-	231 0160BC	-	-	-	231 0160F
2	230 0200	-	231 0200	-	231 0200B	-	231 0200D	-	231 0200F
2.4	230 0240	-	231 0240	-	231 0240B	-	231 0240D	-	231 0240F
3	230 0300	230 0300CE	231 0300	231 0300CE	231 0300B	231 0300BCE	231 0300D	231 0300DCE	231 0300F
5	230 0500	-	231 0500	231 0500CE	231 0500B	231 0500BCE	231 0500D	231 0500DCE	231 0500F
6	230 0600	230 0600CE	231 0600	231 0600CE	231 0600B	231 0600BCE	231 0600D	231 0600DCE	231 0600F
8	230 0800	-	231 0800	-	231 0800B	-	231 0800D	-	231 0800F



Diamond Grind Routers

Series 239 'The "Black" Diamond'

GemX Coating

- Microhardness (HV) – 10,000
- Maximum Service Temp. 600° C / 1100° F
- Friction Coefficient 0.10

Features

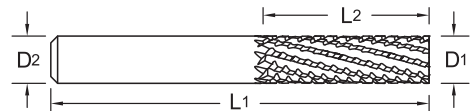
- GemX coating
- Unique carbide substrate
- Specially treated cutting edges

Benefits

- Longer tool life
- Faster cycle times
- No delamination or flaking
- Great edge quality
- Excellent for composite materials and fiberglass

Applications

- Trimming
- Routing
- Pocketing
- Interpolation of holes
- Low plastic content CFRP



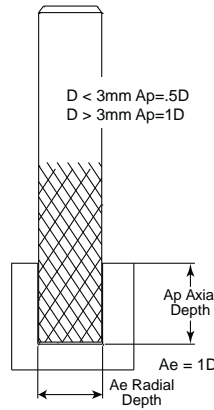
Tool No.	D1	D2	L2	L1	# Flutes (RHC)	End cut
239M0300B	3.0	3.0	12.0	38	6	Burr
239M0300E	3.0	3.0	12.0	38	6	End Mill
239M0300F	3.0	3.0	12.0	38	6	Fishtail
239M0400B	4.0	4.0	15.0	50	6	Burr
239M0400E	4.0	4.0	15.0	50	6	End Mill
239M0400F	4.0	4.0	15.0	50	6	Fishtail
239M0500B	5.0	5.0	20.0	50	6	Burr
239M0500E	5.0	5.0	20.0	50	6	End Mill
239M0500F	5.0	5.0	20.0	50	6	Fishtail
239M0600B	6.0	6.0	20.0	63	10	Burr
239M0600E	6.0	6.0	20.0	63	10	End Mill
239M0600F	6.0	6.0	20.0	63	10	Fishtail
239M0601B	6.0	6.0	25.0	75	10	Burr
239M0601E	6.0	6.0	25.0	75	10	End Mill
239M0601F	6.0	6.0	25.0	75	10	Fishtail
239M0800B	8.0	8.0	25.0	75	10	Burr
239M0800E	8.0	8.0	25.0	75	10	End Mill
239M0800F	8.0	8.0	25.0	75	10	Fishtail
239M1000B	10.0	10.0	30.0	90	12	Burr
239M1000E	10.0	10.0	30.0	90	12	End Mill
239M1000F	10.0	10.0	30.0	90	12	Fishtail
239M1200B	12.0	12.0	40.0	100	14	Burr
239M1200E	12.0	12.0	40.0	100	14	End Mill
239M1200F	12.0	12.0	40.0	100	14	Fishtail

Tool No.	D1	D2	L2	L1	# Flutes (RHC)	End cut
239M0300BGX	3.0	3.0	12.0	38	6	Burr
239M0300EGX	3.0	3.0	12.0	38	6	End Mill
239M0300FGX	3.0	3.0	12.0	38	6	Fishtail
239M0400BGX	4.0	4.0	15.0	50	6	Burr
239M0400EGX	4.0	4.0	15.0	50	6	End Mill
239M0400FGX	4.0	4.0	15.0	50	6	Fishtail
239M0500BGX	5.0	5.0	20.0	50	6	Burr
239M0500EGX	5.0	5.0	20.0	50	6	End Mill
239M0500FGX	5.0	5.0	20.0	50	6	Fishtail
239M0600BGX	6.0	6.0	20.0	63	10	Burr
239M0600EGX	6.0	6.0	20.0	63	10	End Mill
239M0600FGX	6.0	6.0	20.0	63	10	Fishtail
239M0601BGX	6.0	6.0	25.0	75	10	Burr
239M0601EGX	6.0	6.0	25.0	75	10	End Mill
239M0601FGX	6.0	6.0	25.0	75	10	Fishtail
239M0800BGX	8.0	8.0	25.0	75	10	Burr
239M0800EGX	8.0	8.0	25.0	75	10	End Mill
239M0800FGX	8.0	8.0	25.0	75	10	Fishtail
239M1000BGX	10.0	10.0	30.0	90	12	Burr
239M1000EGX	10.0	10.0	30.0	90	12	End Mill
239M1000FGX	10.0	10.0	30.0	90	12	Fishtail
239M1200BGX	12.0	12.0	40.0	100	14	Burr
239M1200EGX	12.0	12.0	40.0	100	14	End Mill
239M1200FGX	12.0	12.0	40.0	100	14	Fishtail

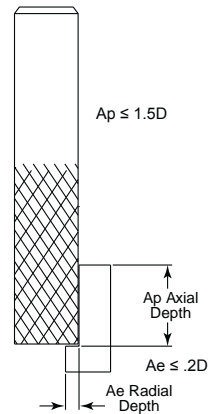


Diamond Grind Routers Series 230, 231 Recommended Cutting Data

Slotting 90 (m/min)			Slotting 182 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
0.8	35000	141	0.8	72000	289
1	28000	226	1	57000	463
1.2	23000	306	1.2	48000	627
1.5	18000	376	1.5	38000	771
1.6	17000	388	1.6	36000	795
2	14000	423	2	28000	868
2.4	11000	447	2.4	24000	916
3	9400	480	3	19000	984
5	5600	395	5	11000	810
6	4700	423	6	9600	868
8	3500	353	8	7200	723



Side Milling 120(m/min)			Side Milling 240 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
0.8	47000	190	0.8	95000	381
1	38000	305	1	76000	610
1.2	31000	413	1.2	63000	826
1.5	25000	508	1.5	50000	1017
1.6	23000	524	1.6	47000	1049
2	19000	572	2	38000	1145
2.4	15000	604	2.4	31000	1208
3	12000	648	3	25000	1297
5	7600	534	5	15000	1068
6	6300	572	6	12000	1145
8	4700	477	8	9500	954

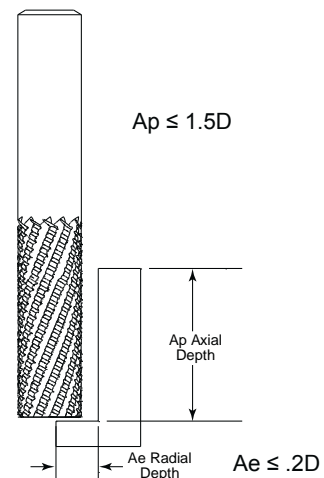
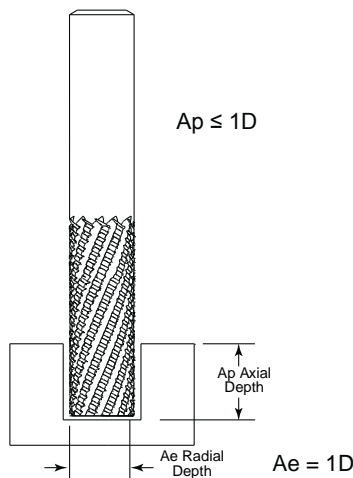


** Tool must have end grind in order to slot.

Note: The parameters in this table are for common material thickness of 6mm. You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.



Diamond Grind Routers Series 239 'The "Black" Diamond' Recommended Cutting Data



Slotting 90 (m/min)			Slotting 182 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
3	9000	254	3	18000	508
5	6000	304	5	12000	635
6	5000	381	6	9000	762
8	4000	457	8	7000	889
10	3000	508	10	6000	1016
12	2000	635	12	5000	1270

Feed adjustment to part thickness	
≤ 0.5D	x 150%
0.5D - 1D	x 120%
1D - 2D	x 80%
3D-4D	x 50%

Side Milling 120(m/min)			Side Milling 240 (m/min)		
Tool Diameter	RPM	mm/min	Tool Diameter	RPM	mm/min
3	12000	508	3	24000	1016
5	8000	635	5	16000	1270
6	6000	762	6	12000	1524
8	5000	889	8	10000	1778
10	4000	1016	10	8000	2032
12	3000	1270	12	6000	2540

** Tool must have end grind to slot.

Note: The parameters in this table are for common material thickness of 6mm. You must use the Radial Depth (Ae) of 20% or less for Side Milling. For best surface finish conventional mill is recommended. Higher feed rates are possible but surface finish may change.

Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

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.

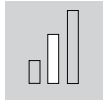
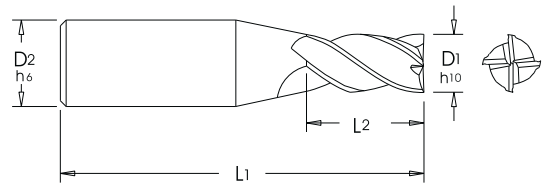
VHM Tool Material	Z4 Number of Flutes	55° Helix Angle	Centre Cutting
Lengths	Cutting Direction	Profiling	Slotting
3D Scanning	HA Shank	N=5xD Neck Relief	<48HRC Material Hardness
ALtima® Coating	ALtima® BLAZE Coating	P01 Technical Information	
Workpiece Material Group	Steel	Cast Iron	
	Hardened Steels (35-65Rc)	Special Alloys	
	Stainless Steels	Non-Ferrous	

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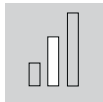
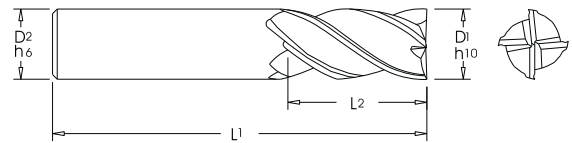
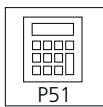


TuffCut® XR Series 177

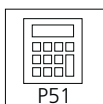
VHM	Z4	35°/38°	7° Max			<48HRC	HA DIN 6535	ALtima®	
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Tool No.	EDP	D1	D2	L1	L2
177 0150A	17680	1.5	3	38	3
177 0200A	17682	2	3	38	4
177 0250A	17684	2.5	3	38	5
177 0303A	17686	3	3	38	6

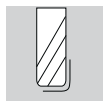
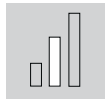
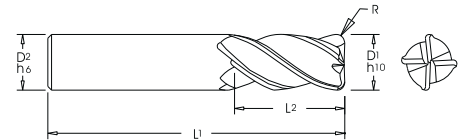
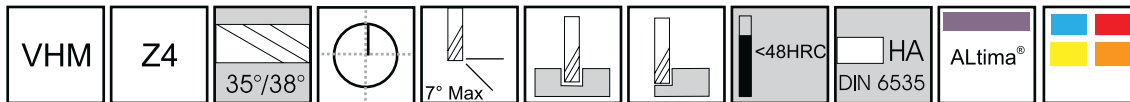


Tool No.	EDP	D1	D2	L1	L2
177 0300A	17928	3	6	57	8
177 0350A	17688	3.5	6	57	7
177 0400A	17930	4	6	57	11
177 0450A	17690	4.5	6	57	9
177 0500A	17932	5	6	57	13
177 0600A	17934	6	6	57	13
177 0800A	17937	8	8	63	19
177 1000A	17940	10	10	72	22
177 1200A	17943	12	12	83	26
177 1400A	17946	14	14	83	26
177 1600A	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



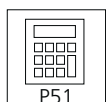


TuffCut® XR Series 177R



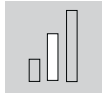
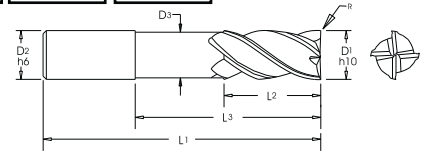
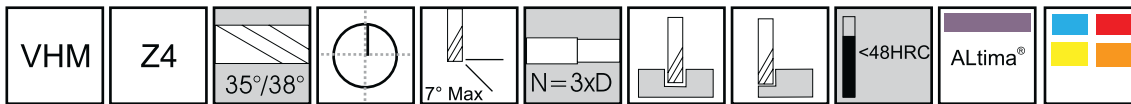
Corner Radius

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



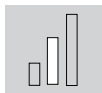


TuffCut® XR Series 177S



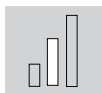
HA
DIN 6535

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



HB
DIN 6535

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

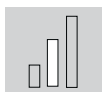


HA
DIN 6535



Corner Radius

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



HB
DIN 6535

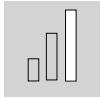
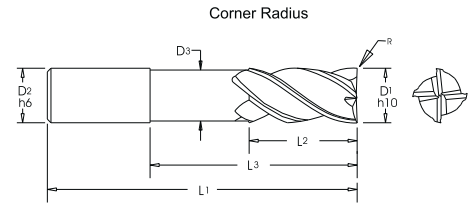
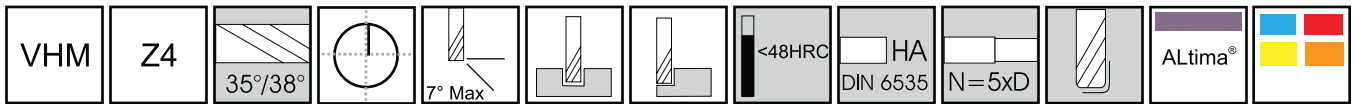


Corner Radius

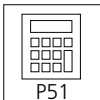
Tool No.	EDP	D1	D2	D3	L1	L2	L3	R	Shank
177S 03-0.2RAW	18236	3	6	2.9	50	5	11	0.2	DIN 6535 HB
177S 04-0.2RAW	18238	4	6	3.9	50	6	14	0.2	DIN 6535 HB
177S 05-0.2RAW	18240	5	6	4.9	57	8	17	0.2	DIN 6535 HB
177S 06-0.3RAW	18242	6	6	5.8	57	9	20	0.3	DIN 6535 HB
177S 08-0.5RAW	18244	8	8	7.6	63	12	26	0.5	DIN 6535 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



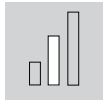
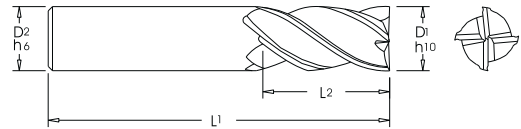
Tool No.	EDP	D1	D2	D3	L1	L2	L3	R
177L 06N5-0.25RA	18186	6	6	5.8	101	12	30	0.25
177L 06N5-0.5RA	18183	6	6	5.8	101	12	30	0.5
177L 06N5-1.0RA	18184	6	6	5.8	101	12	30	1
177L 08N5-0.5RA	18187	8	8	7.6	101	16	40	0.5
177L 08N5-1.0RA	18194	8	8	7.6	101	16	40	1
177L 08N5-2.0RA	18195	8	8	7.6	101	16	40	2
177L 08N5-3.0RA	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



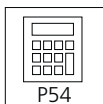


TuffCut® XT Series 277

VHM	Z4	39°/41°	7° Max	<48HRC	HA DIN 6535	ALtima® BLAZE
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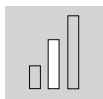
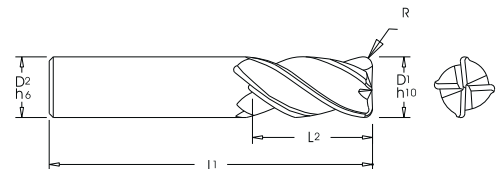


Tool No.	D1	D2	L1	L2
277 0300B	3	6	57	8
277 0400B	4	6	57	11
277 0500B	5	6	57	13
277 0600B	6	6	57	13
277 0800B	8	8	63	19
277 1000B	10	10	72	22
277 1200B	12	12	83	26
277 1600B	16	16	92	32
277 2000B	20	20	104	38

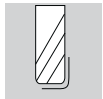


Series 277R

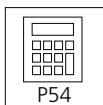
VHM	Z4	39°/41°	7° Max	<48HRC	HA DIN 6535	ALtima® BLAZE
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Tool No.	D1	D2	L1	L2	R
277 0300-0.25RB	3	6	57	8	0.25
277 0400-0.25RB	4	6	57	11	0.25
277 0500-0.25RB	5	6	57	13	0.25
277 0600-0.25RB	6	6	57	13	0.25
277 0800-0.80RB	8	8	63	19	0.8
277 1000-0.80RB	10	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

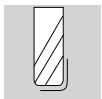
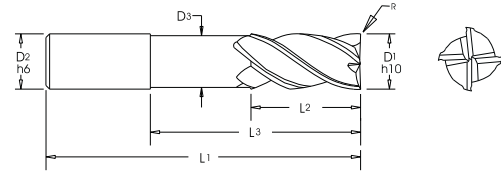
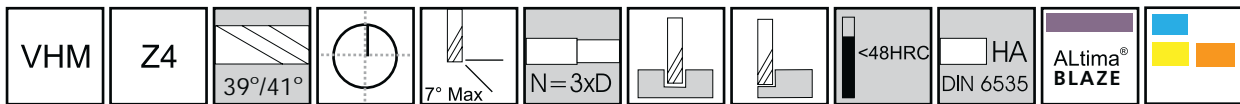


TuffCut® XT - For enhanced performance in stainless steel type materials





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.



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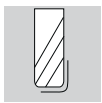
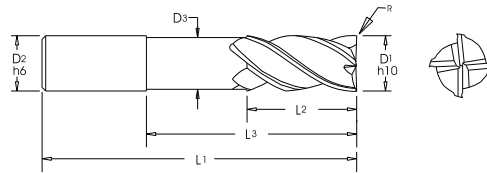


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TuffCut® XT Series 277NR

VHM	Z4	39°/41°		7° Max	N=3xD			<48HRC	HA DIN6535	ALtima® BLAZE	
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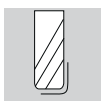
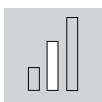
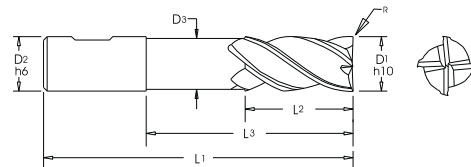
Corner Radius

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	40	62	1.0	●
277 20N3-1.5RB	20	20	19.2	112	40	62	1.5	●
277 20N3-2.0RB	20	20	19.2	112	40	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

VHM	Z4	39°/41°		7° Max	N=3xD			<48HRC	HB DIN6535	ALtima® BLAZE	
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Corner Radius

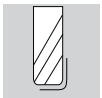
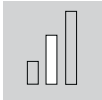
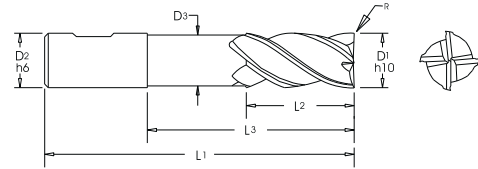
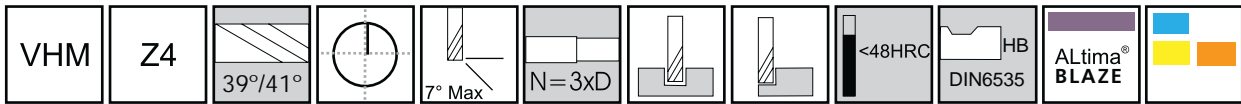
Tool No.	D1	D2	D3	L1	L2	L3	R	Stock
277 08N3-0.5RBW	8	8	7.8	64	19	26	0.5	●
277 08N3-1.0RBW	8	8	7.8	64	19	26	1.0	●
277 08N3-1.5RBW	8	8	7.8	64	19	26	1.5	○
277 08N3-2.0RBW	8	8	7.8	64	19	26	2.0	●
277 08N3-3.0RBW	8	8	7.8	64	19	26	3.0	●
277 10N3-0.5RBW	10	10	9.8	73	22	32	0.5	●
277 10N3-1.0RBW	10	10	9.8	73	22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

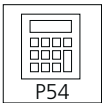




TuffCut® XT Series 277NR-W



Corner Radius

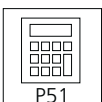
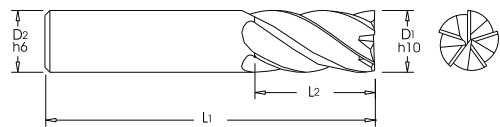
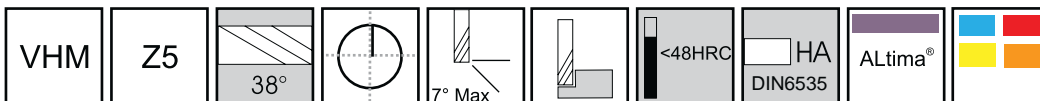


P54

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



P51

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



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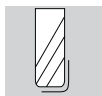
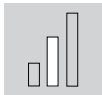
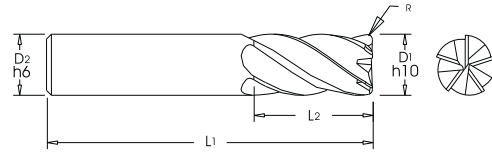


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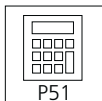


TuffCut® XR Series 178R

VHM	Z5	38°	7° Max	<48HRC	HA DIN 6535	ALtima®	
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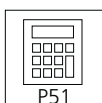
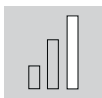
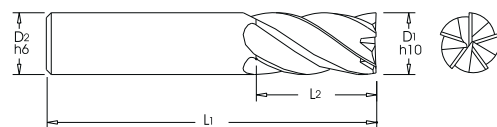
Corner Radius



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

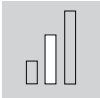
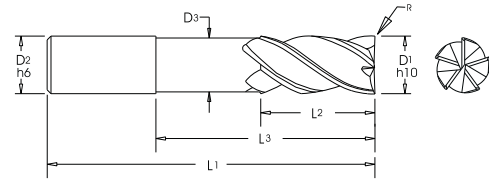
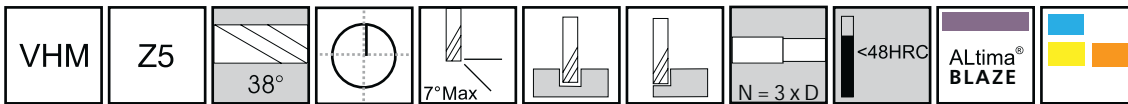
VHM	Z5	38°	7° Max	<48HRC	HA DIN 6535	ALtima®	
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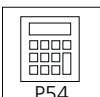
Tool No.	EDP	D1	D2	L1	L2
178 0300-1A	17998	3	3	75	25
178 0400-1A	17999	4	4	75	25
178 0500-1A	18026	5	5	75	25
178 0600-1A	18027	6	6	75	25
178 0800-1A	18028	8	8	75	30
178 1000-1A	18029	10	10	100	45
178 1200-1A	18030	12	12	150	75
178 1600-1A	18031	16	16	150	75
178 2000-1A	18032	20	20	150	75



TuffCut® XT Series 278R N3



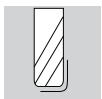
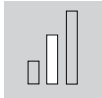
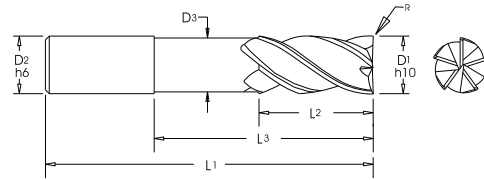
Tool No.	D1	D2	D3	L1	L2	L3	R
278 0300N3-0.25RB	3	6	2.9	57	8	10	0.25
278 0300N3-0.5RB	3	6	2.9	57	8	10	0.5
278 0400N3-0.25RB	4	6	3.9	57	11	13	0.25
278 0400N3-0.5RB	4	6	3.9	57	11	13	0.5
278 0500N3-0.25RB	5	6	4.9	57	13	16	0.25
278 0500N3-0.5RB	5	6	4.9	57	13	16	0.5
278 0600N3-0.25RB	6	6	5.9	57	13	19	0.25
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



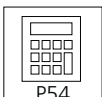


TuffCut® XT Series 278R N4

VHM	Z5	38°	7° Max	N=4xD			<48HRC	HA DIN 6535	ALtima® BLAZE	
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Corner Radius

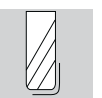
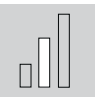
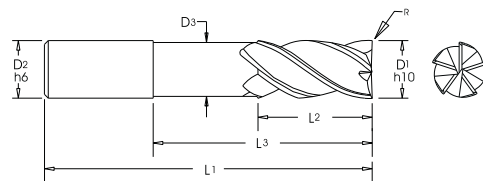


P54

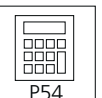
Tool No.	D1	D2	D3	L1	L2	L3	R
278 1200N4-0.5RB	12	12	11.4	100	18	50	0.5
278 1200N4-1.0RB	12	12	11.4	100	18	50	1
278 1200N4-1.5RB	12	12	11.4	100	18	50	1.5
278 1200N4-2.0RB	12	12	11.4	100	18	50	2
278 1200N4-3.0RB	12	12	11.4	100	18	50	3
278 1200N4-4.0RB	12	12	11.4	100	18	50	4
278 1600N4-1.0RB	16	16	15.6	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

VHM	Z5	38°	7° Max	N=5xD			<48HRC	HA DIN 6535	ALtima® BLAZE	
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Corner Radius



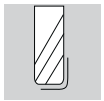
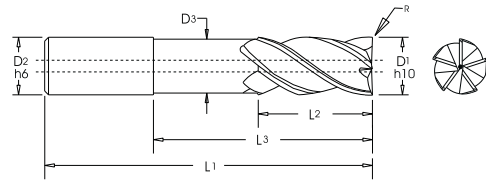
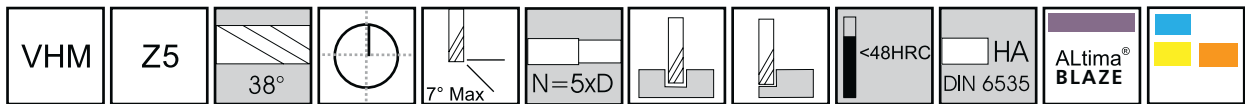
P54

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





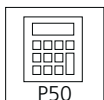
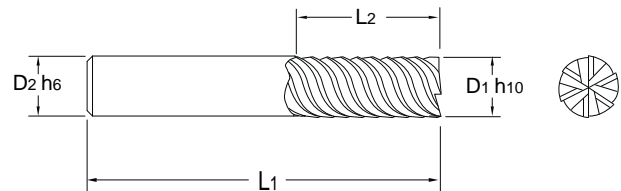
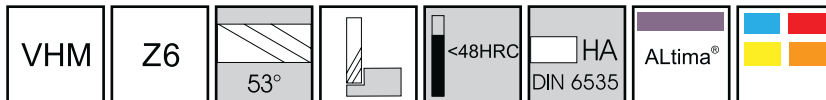
TuffCut® XT Series 278R N5CT (With Central Coolant)



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

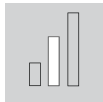
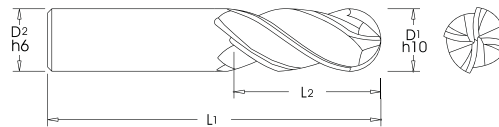
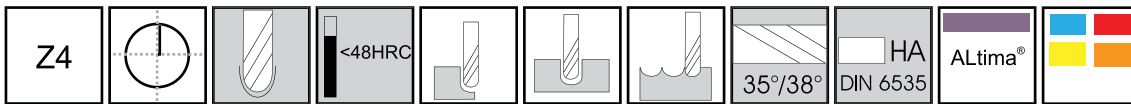


Tool No.	EDP	D1	D2	L1	L2
113 0300A	11384	3	3	38	12
113 0400A	11385	4	4	51	14
113 0500A	11386	5	5	51	20
113 0600A	11387	6	6	64	20
113 0800A	11388	8	8	64	20
113 1000A	11389	10	10	70	25
113 1200A	11390	12	12	76	25
113 1600A	11391	16	16	89	30
113 2000A	11392	20	20	102	38

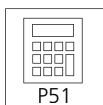


TuffCut® XR Series 179

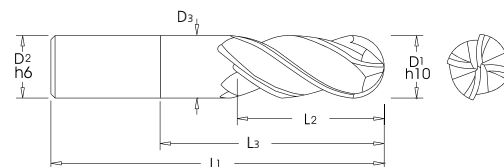
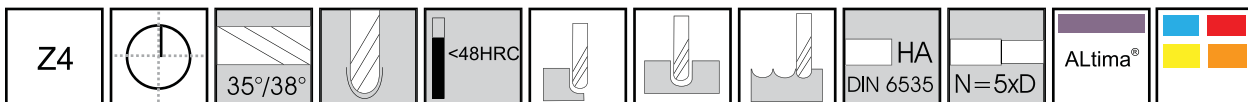
NEW
SERIES 279
also available,
see page 7



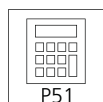
Tool No.	EDP	D1	D2	L1	L2
179 0150A	18272	1.5	3	38	3
179 0200A	18274	2	3	38	4
179 0250A	18276	2.5	3	38	5
179 0300A	18018	3	6	57	8
179 0303A	18278	3	3	38	6
179 0350A	18280	3.5	6	57	7
179 0400A	18019	4	6	57	11
179 0450A	18282	4.5	6	57	9
179 0500A	18020	5	6	57	13
179 0600A	18021	6	6	57	13
179 0800A	18022	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

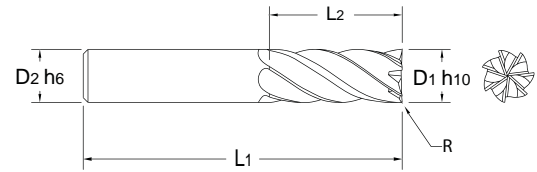




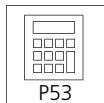
TuffCut® XR Series 180R

Diameters
6, 8 and 10mm
now available,
see page 7

VHM Z7 38° <48HRC HA DIN 6535 ALtima® BLAZE Corner Radius

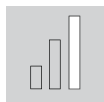
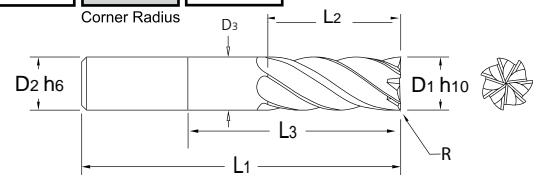


Tool No.	EDP	D1	D2	L1	L2	R
180 1200-0.5RB	18501	12	12	84	32	0.5
180 1200-1.0RB	18503	12	12	84	32	1
180 1200-2.0RB	18505	12	12	84	32	2
180 1200-3.0RB	18507	12	12	84	32	3
180 1200-4.0RB	18508	12	12	84	32	4
180 1600-0.5RB	18509	16	16	92	42	0.5
180 1600-1.0RB	18510	16	16	92	42	1
180 1600-2.0RB	18511	16	16	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

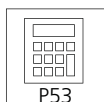


Series 180R N5

VHM Z7 38° <48HRC N=5xD HA DIN 6535 ALtima® BLAZE Corner Radius



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.

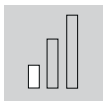
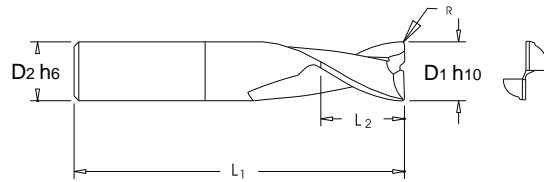
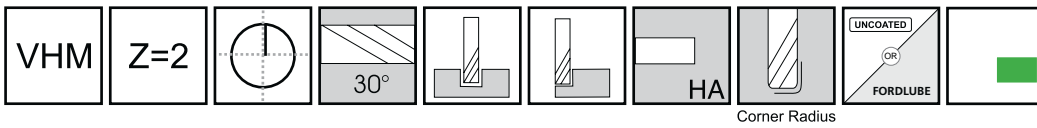
TuffCut® X-AL is continually evolving to meet new manufacturing, productivity and performance challenges to ensure that its position at the forefront of cutting tool design and technology is maintained.

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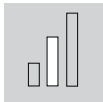
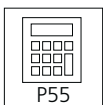
VHM Tool Material	Z4 Number of Flutes	55° Helix Angle	Centre Cutting
Lengths	Cutting Direction	Profiling	Slotting
3D Scanning	HA Shank	N=5 xD Neck Relief	<48HRC Material Hardness
ALtima® Coating	ALtima® BLAZE Coating	UNCOATED / FORDLUBE Uncoated or Fordlube	PO1 Technical Information
Workpiece Material Group	Steel	Cast Iron	
	Hardened Steels (35-65Rc)	Special Alloys	
	Stainless Steels	Non-Ferrous	



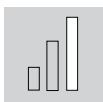
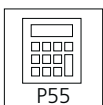
TuffCut® X-AL Series 135



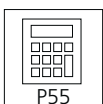
Tool No.	EDP	D1	D2	L1	L2	R
135 0300	13523	3	3	38	3.5	0.2
135 0400	13533	4	4	51	4.8	0.2
135 0500	13502	5	5	51	6	0.25
135 0600	13504	6	6	64	7	0.3
135 0800	13508	8	8	64	9.5	0.35
135 1000	13515	10	10	70	12	0.5
135 1200	13525	12	12	76	14	0.5
135 1400	13552	14	14	89	16	0.5
135 1600	13535	16	16	89	18	0.75
135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



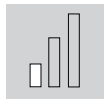
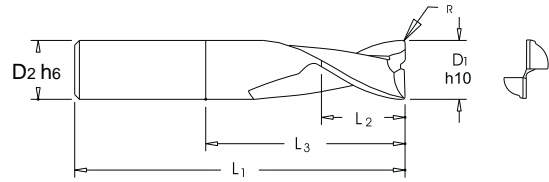
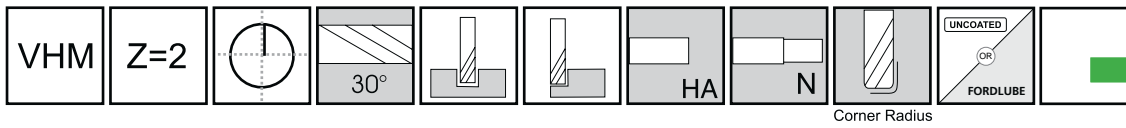
Tool No.	EDP	D1	D2	L1	L2	R
135 1002	13517	10	10	89	12	0.5
135 1202	13527	12	12	127	14	0.5
135 1402	13573	14	14	127	16	0.5
135 1602	13537	16	16	133	18	0.75
135 1802	13574	18	18	152	20	0.75
135 2002	13547	20	20	152	22	0.75
135 2502	13557	25	25	152	25	0.75



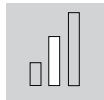
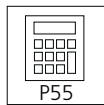
Available with Fordlube upon request.



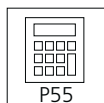
TuffCut® X-AL Series 135 N



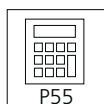
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 0300N	13524	3	3	38	3.5	11	0.2
135 0400N	13534	4	4	51	4.8	22	0.2
135 0500N	13503	5	5	51	6	22	0.25
135 0600N	13505	6	6	64	7	26	0.3
135 0800N	13509	8	8	64	9.5	26	0.35
135 1000N	13565	10	10	70	12	28	0.5
135 1200N	13575	12	12	76	14	28	0.5
135 1400N	13553	14	14	89	16	42	0.5
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

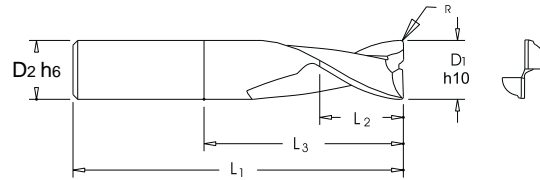
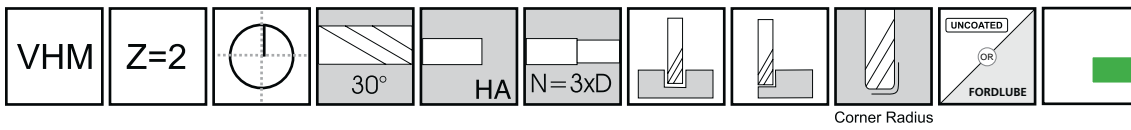


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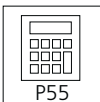




TuffCut® X-AL Series 135 N3



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	-

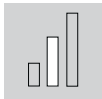
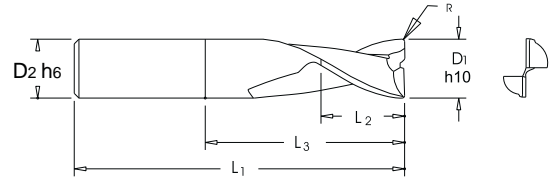
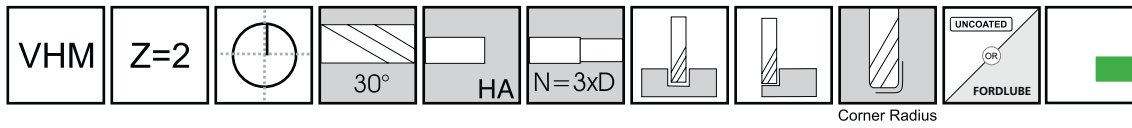


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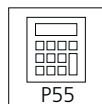




TuffCut® X-AL Series 135 N3



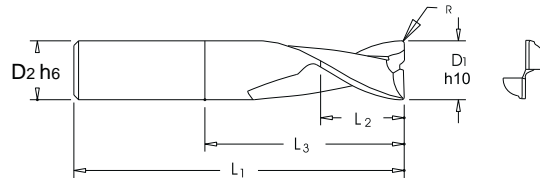
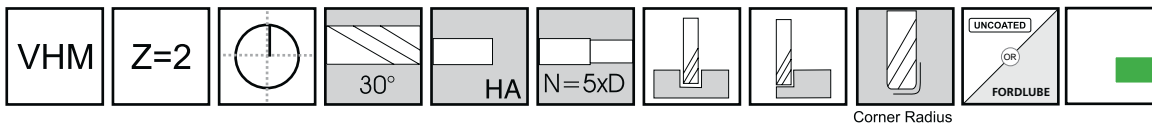
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 12N3-0.5R	96672	12	12	76	14	38	0.5
135 12N3-1.0R	96673	12	12	76	14	38	1
135 12N3-1.5R	96674	12	12	76	14	38	1.5
135 12N3-2.0R	96675	12	12	76	14	38	2
135 12N3-3.0R	96676	12	12	76	14	38	3
135 12N3-4.0R	96677	12	12	76	14	38	4
135 16N3	96684	16	16	117	18	53	-
135 16N3-0.5R	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



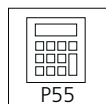
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TuffCut® X-AL Series 135 N5



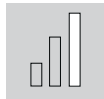
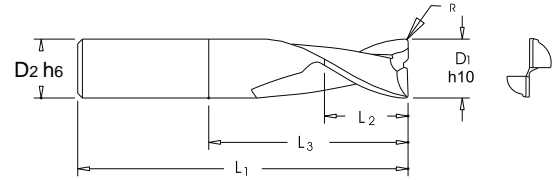
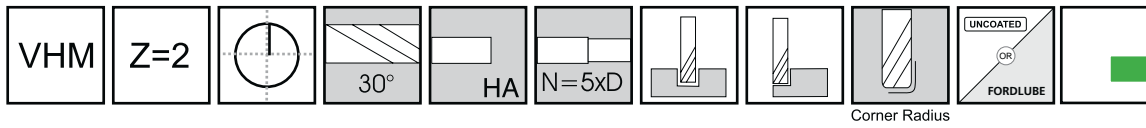
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 03N5	96623	3	3	38	3.5	16	-
135 03N5-0.5R	96624	3	3	38	3.5	16	0.5
135 03N5-1.0R	96625	3	3	38	3.5	16	1
135 04N5	96629	4	4	51	4.8	22	-
135 04N5-0.5R	96630	4	4	51	4.8	22	0.5
135 04N5-1.0R	96631	4	4	51	4.8	22	1
135 05N5	96635	5	6	64	6	27	-
135 05N5-0.5R	96636	5	6	64	6	27	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



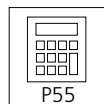
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TuffCut® X-AL Series 135 N5



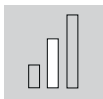
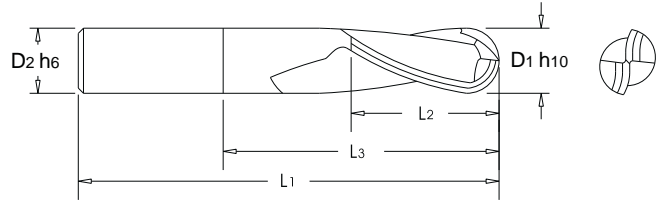
Tool No.	EDP	D1	D2	L1	L2	L3	R
135 12N5-1.0R	96679	12	12	110	14	62	1
135 12N5-1.5R	96680	12	12	110	14	62	1.5
135 12N5-2.0R	96681	12	12	110	14	62	2
135 12N5-3.0R	96682	12	12	110	14	62	3
135 12N5-4.0R	96683	12	12	110	14	62	4
135 12N5-5.0R	96723	12	12	110	14	62	5
135 16N5-0.5R	96691	16	16	127	18	85	0.5
135 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



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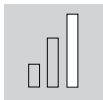
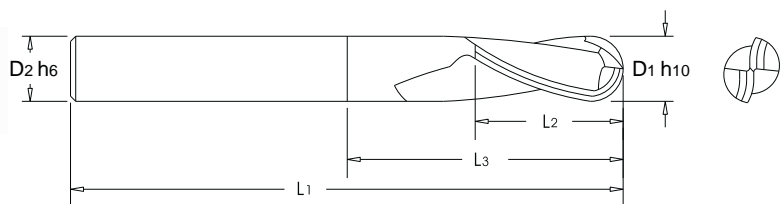
TuffCut® X-AL Series 135B N3



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

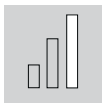
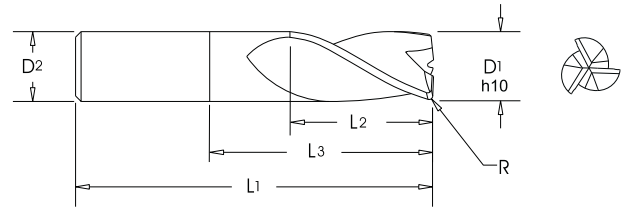
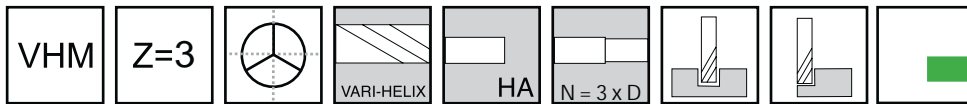


Tool No.	EDP	D1	D2	L1	L2	L3
135B 0200N5	13252	2	6	75	4	12
135B 0300N5	13254	3	6	75	5	17
135B 0400N5	13256	4	6	75	6	22
135B 0500N5	13258	5	6	75	7	27
135B 0600N5	13260	6	6	110	8	32
135B 0800N5	13262	8	8	110	10	42
135B 1000N5	13264	10	10	110	12	52
135B 1200N5	13266	12	12	120	16	62
135B 1600N5	13268	16	16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

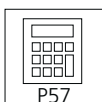




TuffCut® X-AL Series 137V N3

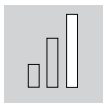
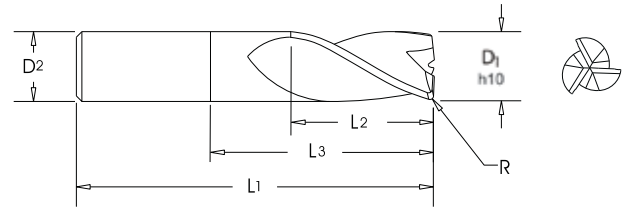


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 03N3	3	3	2.8	51	8	11	-
137V 03N3-0.2R	3	3	2.8	51	8	11	0.2
137V 03N3-0.5R	3	3	2.8	51	8	11	0.5
137V 03N3-1.0R	3	3	2.8	51	8	11	1
137V 04N3	4	4	3.8	51	11	14	-
137V 04N3-0.2R	4	4	3.8	51	11	14	0.2
137V 04N3-0.5R	4	4	3.8	51	11	14	0.5
137V 04N3-1.0R	4	4	3.8	51	11	14	1
137V 05N3	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

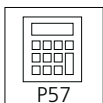




TuffCut® X-AL Series 137V N3

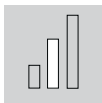
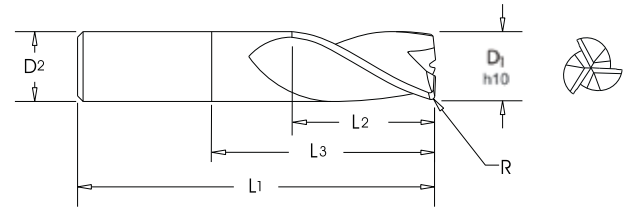
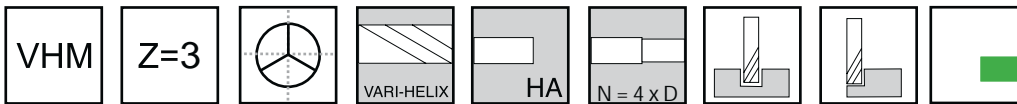


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 12N3-0.5R	12	12	11.8	84	26	38	0.5
137V 12N3-1.0R	12	12	11.8	84	26	38	1
137V 12N3-1.5R	12	12	11.8	84	26	38	1.5
137V 12N3-2.0R	12	12	11.8	84	26	38	2
137V 12N3-3.0R	12	12	11.8	84	26	38	3
137V 12N3-4.0R	12	12	11.8	84	26	38	4
137V 16N3	16	16	15.8	93	32	50	-
137V 16N3-0.2R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

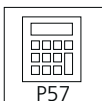




TuffCut® X-AL Series 137V N4

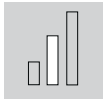
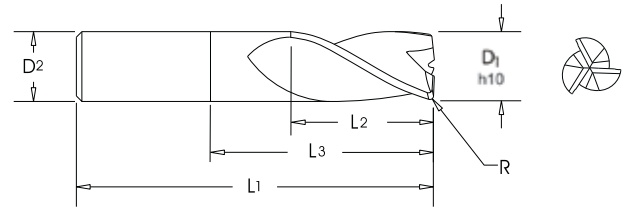
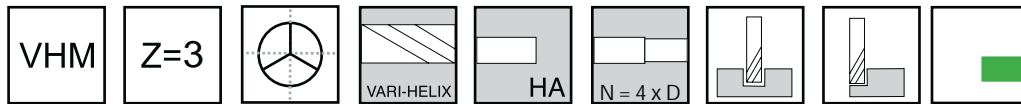


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 03N4	3	3	2.8	51	4.5	14	-
137V 03N4-0.2R	3	3	2.8	51	4.5	14	0.2
137V 03N4-0.5R	3	3	2.8	51	4.5	14	0.5
137V 03N4-1.0R	3	3	2.8	51	4.5	14	1
137V 04N4	4	4	3.8	51	6	18	-
137V 04N4-0.2R	4	4	3.8	51	6	18	0.2
137V 04N4-0.5R	4	4	3.8	51	6	18	0.5
137V 04N4-1.0R	4	4	3.8	51	6	18	1
137V 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

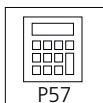




TuffCut® X-AL Series 137V N4

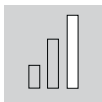
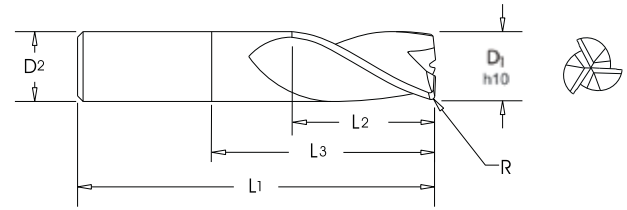
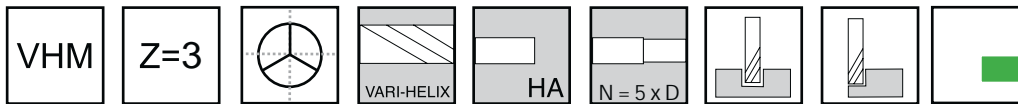


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 12N4-0.5R	12	12	11.8	100	18	50	0.5
137V 12N4-1.0R	12	12	11.8	100	18	50	1
137V 12N4-1.5R	12	12	11.8	100	18	50	1.5
137V 12N4-2.0R	12	12	11.8	100	18	50	2
137V 12N4-3.0R	12	12	11.8	100	18	50	3
137V 12N4-4.0R	12	12	11.8	100	18	50	4
137V 16N4	16	16	15.8	120	24	66	-
137V 16N4-0.2R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

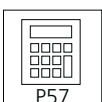




TuffCut® X-AL Series 137V N5

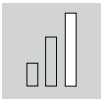
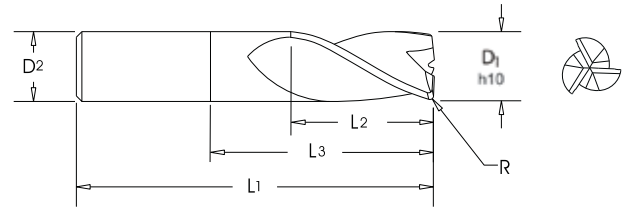
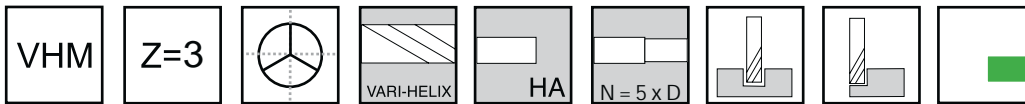


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 03N5	3	3	2.8	51	4.5	17	-
137V 03N5-0.2R	3	3	2.8	51	4.5	17	0.2
137V 03N5-0.5R	3	3	2.8	51	4.5	17	0.5
137V 03N5-1.0R	3	3	2.8	51	4.5	17	1
137V 04N5	4	4	3.8	51	6	22	-
137V 04N5-0.2R	4	4	3.8	51	6	22	0.2
137V 04N5-0.5R	4	4	3.8	51	6	22	0.5
137V 04N5-1.0R	4	4	3.8	51	6	22	1
137V 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

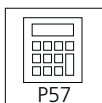




TuffCut® X-AL Series 137V N5

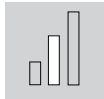
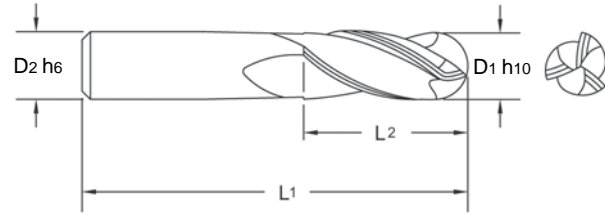
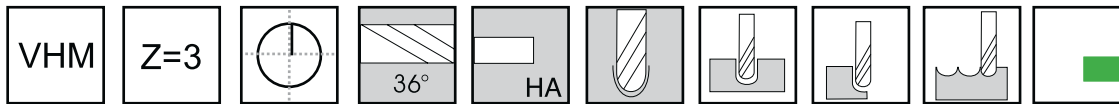


Tool No.	D1	D2	D3	L1	L2	L3	R
137V 12N5-0.5R	12	12	11.8	110	18	62	0.5
137V 12N5-1.0R	12	12	11.8	110	18	62	1
137V 12N5-1.5R	12	12	11.8	110	18	62	1.5
137V 12N5-2.0R	12	12	11.8	110	18	62	2
137V 12N5-3.0R	12	12	11.8	110	18	62	3
137V 12N5-4.0R	12	12	11.8	110	18	62	4
137V 16N5	16	16	15.8	130	24	82	-
137V 16N5-0.2R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

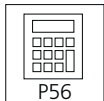




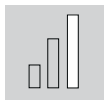
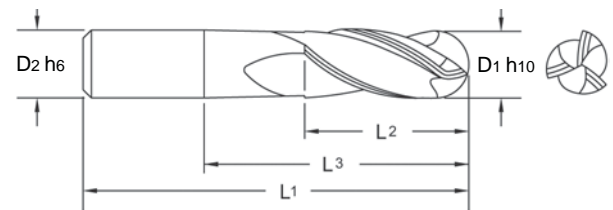
TuffCut® X-AL Series 138B



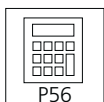
Tool No.	EDP	D1	D2	L1	L2
138B 0300	13356	3	3	38	12
138B 0400	13358	4	4	51	15
138B 0500	13360	5	5	64	20
138B 0600	13362	6	6	64	20
138B 0800	13364	8	8	64	20
138B 1000	13366	10	10	70	25
138B 1200	13368	12	12	76	25
138B 1600	13370	16	16	89	35



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



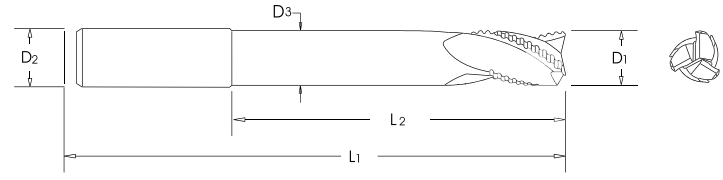
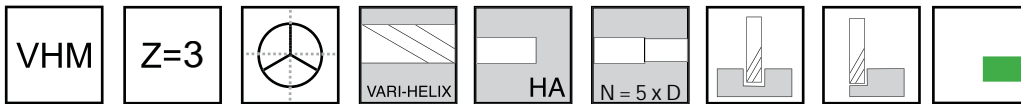
Available with Fordlube upon request.



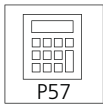


TuffCut® X-AL Series 137VR N5

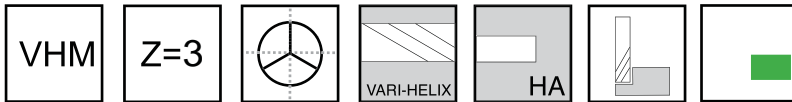
137VR N3 sizes now available, see page 6



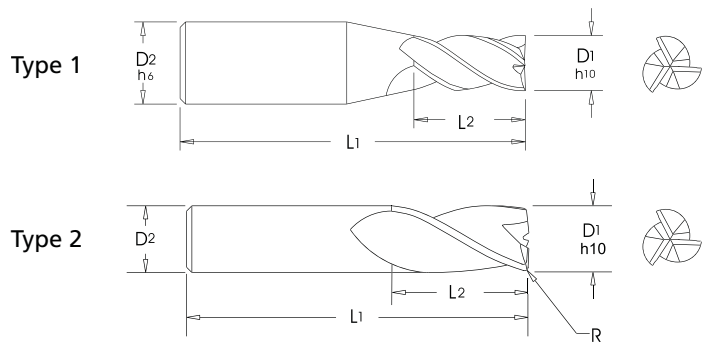
Tool No.	D1	D2	D3	L1	L2	L3	R	Shank
137VR 12N5-1.0R	12	12	11.8	110	18	62	1	HA
137VR 12N5-1.0RW	12	12	11.8	110	18	62	1	HB
137VR 16N5-1.0R	16	16	15.8	130	24	82	1	HA
137VR 16N5-1.0RW	16	16	15.8	130	24	82	1	HB
137VR 20N5-1.0R	20	20	19.8	150	30	102	1	HA
137VR 20N5-1.0RW	20	20	19.8	150	30	102	1	HB



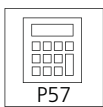
TuffCut® X-AL Series 137VF Finishing



3 x D1 and 5 x D1 Flute Lengths

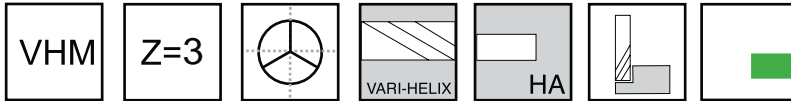


Tool No.	D1	D2	L1	L2	R	Type
137VF 0303	3	6	75	11	-	1
137VF 0303-0.2R	3	6	75	11	0.2	1
137VF 0305	3	6	75	17	-	1
137VF 0305-0.2R	3	6	75	17	0.2	1
137VF 0403	4	6	75	14	-	1
137VF 0403-0.2R	4	6	75	14	0.2	1
137VF 0403-0.5R	4	6	75	14	0.5	1
137VF 0405	4	6	75	22	-	1

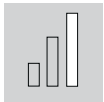
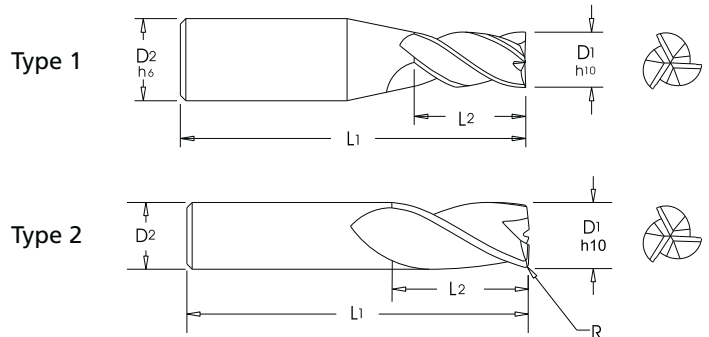




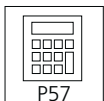
TuffCut® X-AL Series 137VF Finishing



3 x D1 and 5 x D1 Flute Lengths

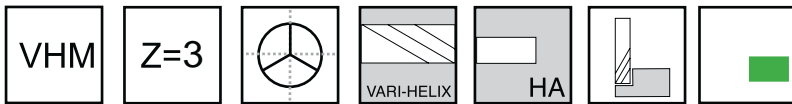


Tool No.	D1	D2	L1	L2	R	Type
137VF 0405-0.2R	4	6	75	22	0.2	1
137VF 0405-0.5R	4	6	75	22	0.5	1
137VF 0503	5	6	75	17	-	1
137VF 0503-0.2R	5	6	75	17	0.2	1
137VF 0503-0.5R	5	6	75	17	0.5	1
137VF 0505	5	6	75	27	-	1
137VF 0505-0.2R	5	6	75	27	0.2	1
137VF 0505-0.5R	5	6	75	27	0.5	1
137VF 0603	6	6	75	20	-	2
137VF 0603-0.2R	6	6	75	20	0.2	2
137VF 0603-0.5R	6	6	75	20	0.5	2
137VF 0605	6	6	75	32	-	2
137VF 0605-0.2R	6	6	75	32	0.2	2
137VF 0605-0.5R	6	6	75	32	0.5	2
137VF 0605-1.0R	6	6	75	32	1.0	2
137VF 0803	8	8	75	26	-	2
137VF 0803-0.2R	8	8	75	26	0.2	2
137VF 0803-0.5R	8	8	75	26	0.5	2
137VF 0803-1.0R	8	8	75	26	1.0	2
137VF 0805	8	8	90	42	-	2
137VF 0805-0.2R	8	8	90	42	0.2	2
137VF 0805-0.5R	8	8	90	42	0.5	2
137VF 0805-1.0R	8	8	90	42	1.0	2
137VF 1003	10	10	90	32	-	2
137VF 1003-0.2R	10	10	90	32	0.2	2
137VF 1003-0.5R	10	10	90	32	0.5	2
137VF 1003-1.0R	10	10	90	32	1.0	2
137VF 1003-2.0R	10	10	90	32	2.0	2
137VF 1005	10	10	100	52	-	2
137VF 1005-0.2R	10	10	100	52	0.2	2
137VF 1005-0.5R	10	10	100	52	0.5	2

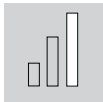
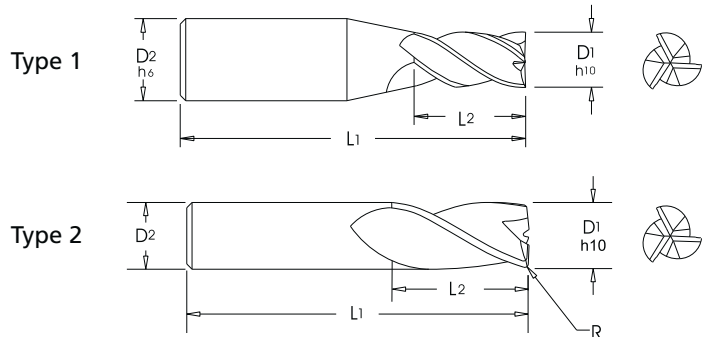




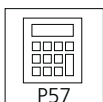
TuffCut® X-AL Series 137VF Finishing



3 x D1 and 5 x D1 Flute Lengths







Tool No.	D1	D2	L1	L2	R	Type
137VF 1005-1.0R	10	10	100	52	1.0	2
137VF 1005-2.0R	10	10	100	52	2.0	2
137VF 1203	12	12	100	38	-	2
137VF 1203-0.2R	12	12	100	38	0.2	2
137VF 1203-0.5R	12	12	100	38	0.5	2
137VF 1203-1.0R	12	12	100	38	1.0	2
137VF 1203-2.0R	12	12	100	38	2.0	2
137VF 1205	12	12	120	62	-	2
137VF 1205-0.2R	12	12	120	62	0.2	2
137VF 1205-0.5R	12	12	120	62	0.5	2
137VF 1205-1.0R	12	12	120	62	1.0	2
137VF 1205-2.0R	12	12	120	62	2.0	2
137VF 1603	16	16	120	50	-	2
137VF 1603-0.2R	16	16	120	50	0.2	2
137VF 1603-0.5R	16	16	120	50	0.5	2
137VF 1603-1.0R	16	16	120	50	1.0	2
137VF 1603-2.0R	16	16	120	50	2.0	2
137VF 1605	16	16	150	82	-	2
137VF 1605-0.2R	16	16	150	82	0.2	2
137VF 1605-0.5R	16	16	150	82	0.5	2
137VF 1605-1.0R	16	16	150	82	1.0	2
137VF 1605-2.0R	16	16	150	82	2.0	2
137VF 2003	20	20	135	62	-	2
137VF 2003-0.2R	20	20	135	62	0.2	2
137VF 2003-0.5R	20	20	135	62	0.5	2
137VF 2003-1.0R	20	20	135	62	1.0	2
137VF 2003-2.0R	20	20	135	62	2.0	2
137VF 2005	20	20	164	102	-	2
137VF 2005-0.2R	20	20	164	102	0.2	2
137VF 2005-0.5R	20	20	164	102	0.5	2
137VF 2005-1.0R	20	20	164	102	1.0	2
137VF 2005-2.0R	20	20	164	102	2.0	2



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TuffCut® XR Series 113A Recommended cutting data

Workpiece Material Group	Material Type	Coolant			0.05 x D	0.1 x D	0.25 x D	0.5 x D	
		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									
		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									

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			1 x D	1 x D	0.05 x D	0.1 x D	0.2 x D	0.3 x D	0.5 x D	
		Max	Air	MMS	0.5 x D	1 x D	2 x D	2 x D	2 x D	1.5 x D	1.5 x D	
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
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 ute 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

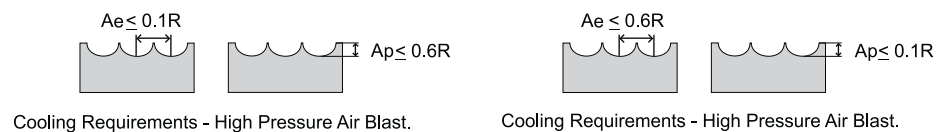
For 177L tools please use the following conditions

Ap 1 x D1
Ae 0.1 x D1

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

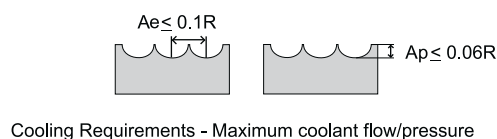
TuffCut® XR Series 179 Profiling

			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								
		Cobalt Chrome Alloys					0.095	0.114	0.133	0.191
		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			1 x D	1 x D	0.05 x D	0.1 x D	0.2 x D	0.3 x D	0.5 x D	
		Max	Air	MMS	0.5 x D	1 x D	2 x D	2 x D	2 x D	1.5 x D	1.5 x D	
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
		High Temp Alloys	●	X	X	35	28	55	45	40	35	28
Special Alloys	S	Titanium Alloys	●	X	X	75	66	160	130	100	85	65
		Gray Cast Iron	●	○	○	200	175	495	395	265	210	175
Cast Irons	K	Ductile Cast Iron	●	○	○	185	165	370	300	210	185	165
		Malleable Iron	●	○	○	145	132	205	165	155	145	130
		Hardened Steels 35 - 45 Rc	●	○	○	60	50	185	150	100	55	50
Hardened Steels	H	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	S	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.

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

Note:

For N4 tools reduce above data by 10%

For N5 tools reduce above data by 30%

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					
		Ae	Ap	M/Min	2 - 3	4	5	6	8
					fz	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					
		Ae	Ap	M/Min	10	12	16	20	25
					fz	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					
		Ae	Ap	M/Min	∅ 3.0	∅ 4.0	∅ 5.0	∅ 6.0	∅ 8.0
					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				
		Ae	Ap	M/Min	∅ 10.0	∅ 12.0	∅ 16.0	∅ 20.0
					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					
		Ae	Ap	M/Min	∅ 3.0	∅ 4.0	∅ 5.0	∅ 6.0	∅ 8.0
					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

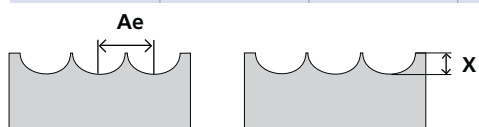
Series	Type of cut	Vc	Diameter - mm						
			Ae	Ap	M/Min	∅ 10.0	∅ 12.0	∅ 16.0	∅ 20.0
						fz	fz	fz	fz
137V N4		1 x D	0.25 x D	400-600	0.10	0.12	0.16	0.20	
		1 x D	0.5 x D	400-600	0.10	0.12	0.16	0.20	
		1 x D	1 x D	400-600	0.09	0.11	0.15	0.19	
		0.75 x D	0.5 x D	500-700	0.15	0.18	0.24	0.30	
		0.5 x D	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							
			Ae	Ap	M/Min	∅ 3.0	∅ 4.0	∅ 5.0	∅ 6.0	∅ 8.0
						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						
			Ae	Ap	M/Min	∅ 10.0	∅ 12.0	∅ 16.0	∅ 20.0
						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	1020/1023
	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	1035
	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	A355Cl.D
	905M39	1.8509	41CrAlMo7	40CAD6.12	2940	F.1740 - 41 CrAlMo7	A355Cl.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		
		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				A532ID20%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	
BT42		1.3247	S2-10-1-8	Z110DKCWW09-08-04-02-01		F.5615 7-4-2-5	M41
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	BM1	1.3344 1.3346 1.3348	S6-5-3 S2-9-1 S2-9-2	Z130WDCV06-05-04-04 Z85DCWV08-04-02-01 Z100DCWV09-04-02-02		F.5605 6-5-3 F.5607 2-9-2	M3Class2 H41/M1 M7
	BT1	1.3355	S18-0-1	Z80WCV18-04-01	2782	F.5520 18-0-1	T1
		1.3401	X120Mn12	Z120M12 / Z120Mn12		F.82551-AM-X 120 Mn 12	A128(A)
	STAINLESS STEEL	443S65	1.4747	X80CrNiSi20	Z80CSN20.02		F.3222-X 80CrSiNi20-02
403S17		1.4	X6Cr13	Z6013 / Z6Cr13	2301	F.3110-X6 Cr 13	403
403S17		1.4001	X7Cr14	Z3014	2301	F.8401-AM-X12 Cr 13	410S
405S17		1.4002	X6CrAl13	Z6CA13 / Z6CrAl13	2302	F.3111-X6 CrAl13	405
416S21		1.4005	X12CrS13	Z12CF13 / Z12CrS13	2380	F.3411-X12 CrS13	416
410S21		1.4006	X10Cr13	Z12C13 / Z12Cr13	2302	F.3401-X12 Cr 13	410/CA-15
410C21		1.4008	G-X8Cr14	Z12CN13M			410
430S15		1.4016	X6Cr17	Z8C17 / Z6Cr17	2320	F.3113-X8 Cr17	430
420S37		1.4021	X20Cr13	Z20C13 / Z20Cr13	2303	F.3402-X20 Cr 13	420
420S45		1.4028	X30Cr13	Z20C13 / Z20Cr13	2304	F.3403-X30 Cr 13	420
		1.4031	X38Cr13	Z40C14 / Z40Cr14	2304	F.3404-X40 Cr 13	
420S45		1.4034	X46Cr13	Z40C14 / Z40Cr14		F.3405-X46 Cr 13	420
431S29		1.4057	X20CrNi172	Z15CN16.02	2321	F.3427-X15 CrNi16	431
		1.4104	X12CrMoS17	Z10CF17	2383	F.3117-X10 CrS17	430F
434S17		1.4113	X6CrMo17	Z8CD17.01	2325		434
		1.4125	X105CrMo17	Z100CD17			440C
		1.451	X6CrTi17	Z8CT17		F.3114-X8CrTi17	XM8/430Ti
409S19		1.4512	X5CrTi12	Z6CT12			409
		1.4534					13-8 PH Mo
		1.4545					15-5 PH
		1.4504					15-7 PH Mo
		1.4548		Z7CNU17-04			17-4 PH
		1.4718	X45CrSi93	Z45CS9		F.3220-X 4 CrSi 09-03	17-4 PH ,CH900
401S45		1.4718	X10CrAl13	Z10C13		F.13152-X 10 CrAl13	HNV3
403S17		1.4724	X40CrSiMo102	Z40CSD10		F.3221-X 40 CrSiMo 10-02	
430S15		1.4742	X10CrAl18	Z10CAS18		F.3153-X 10 CrAl 18	430
		1.4762	X10CrAl24	Z10CAS24		F.3154-X 10 CrAl24	446
303S21		1.4305	X10CrNiS189	Z10CNF18.09	2346	F.3508-X10CrNiS18-09	303
304S15		1.4301	X5CrNi1810	Z6CN18.09	2332	F.3451-X5 CrNi18-10	304/304H
305S19		1.4303	X5CrNi1812	Z8CN18.12		F.3513-X8CrNi18-12	308; 305
304S12/S11/C12		1.4306	G-X2CrNi189/1911	Z2CN18.10/Z3CN19.10M	2333/52	F.3503-X 2CrNi19-10	304L
304C15		1.4308	G-X6CrNi189	Z6CN18.10M	2333		CF-8
301S21		1.431	X12CrNi177	Z12CN17.07		F.3517-X12CrNi17 07	301
304S62		1.4311	X2CrNiN1810	Z2CN18.10Az	2371		304LN
425C11		1.4313	G-X5CrNi134	Z4CND13.4M	2385		CA6-NM
316S16/S31		1.4401	X5CrNiMo17122	Z6CND17.11	2347	F.3543-X5CrNiMo17-12/03	316/316L
316S11/S12		1.4404	X2CrNiMo17132	Z2CND 18.13	2348	F.3533-X 2CrNiMo17 12-03	316L
316S61		1.4406	2CrNiMoN17122	Z2CND 17.12Az			316LN
316C16		1.4408	G-X6CrNiMo1810		2343	F.8414-AM-X7 CrNiMo20 10	CF-8M
316S62		1.4429	X2CrNiMo17133	Z2CND17.13Az	2375		316LN
316S11/S12		1.4435	X2CrNiMo18143	Z2CND17.13	2353	F.3533-X 2 CrNiMo 17-12-03	316L
316S16		1.4436	X5CrNiMo17133	Z6CND17.12	2343	F.3534-X 6 CrNiMo 17-12-03	316
317S12		1.4438	X2CrNiMo18164	Z2CND19.15	2367		317L
317S16		1.4449	X5CrNiMo1713				317
347C17		1.4452	G-X5CrNiNb189	Z6NNb18.10M			
		1.446	X8CrNiMo275		2324	F.3309-X 8CrNiMo27-05	329
321S12S31		1.4541	X6CrNiTi1810	Z6CNT18.10	2337	F.3553-X 7 CrNiTi 18-11	321
		1.4542	X5CrNiCuNb1714	Z6CNU17.04			630
347S17/S18		1.4546	X5CrNiNb1810				348
347S17/S31		1.455	X6CrNiNb1810	Z6CNNb 18.10	2338	F.3552-X 7 CrNiNb 18-11	347
320S31/S17	1.4571	X6CrNiMoTi17122	Z6CNDT17.12	2350	F.3552-X 6 CrNiMoTi17-12-03	316Ti	
318S17	1.458	X6CrNiMoNb17122	Z6CNDNb17.12/19.13			316Cb	
318C17	1.4581	G-X5CrNiMiNb1810	Z4CNDNb18.12M				
309S24	1.4828	X15CrNiSi2012	Z15CNS20.12			309	
309S24	1.4833	X7CrNi2314	Z15CN24.13			309S	
309C30	1.4837	G-X40CrNiSi2520					
	1.4841	X15CrNiSi2520	Z15CNS25.20		F.3310-X15 CrNiSi 25-20	314/310	
310S24	1.4845	X12CrNi2521	Z12CN25.20	2361	F.331	310S	
310C40	1.4848	G-X40CrNiSi2520			F.8452-AM-X 40 CrNi25 20	HK	
349S54	1.4871	X53CrMnNiN219	Z52CMN21.09		F.3217-X 53 CrMnNiN 21-09	EV8	
331S40	1.4873	X45CrNiW189	Z35CNWS14.14		F.3211-X45 CrNiSiW 28-09		
321S20	1.4878	X12CrNiTi189	T6CNT18.12(B)	2337	F.3523-X 6CrNiTi 18 11	321	
1501-509;510	1.5662	X8Ni9	Z8N9		F.2645 - X 8 Ni 09	A353	
	1.568	12Ni19	Z18N5			2515	
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	NiCr29Fe	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		330
	NA15(H)	1.4876	X10NiCrAlTi3320	Z8NC3221		F.3313-X 12 CrNi 36-16
	3072-76/NA13	2.436	NiCu30Fe	NU30		F.3545-X 9NiCr 33-21
	3072-76/NA18/3146	2.4375	NiCu30Al			B163
		2.4602	NiCr17Mo17FeW	NC 17 DWY		4544/SB127/164
	HR5/203-4/703-B	2.463	Ni-Cr20Ti	NC 20 T	MH-05	4676
	HR 10	2.465	NiCr20Co19MoTi	NCK 20 D		5388 C
		2.4662	NiCr15MoTi	Z8 NCDT 42	MH-16	Nimonic 75
	HR 6/204	2.4665	NiCr22Fe18Mo	Nc 22 FeD	MH-03	5660C
	HC 203	2.467	G-NiCr13Al6MoNb	NC 13 AD	MH-31	5536E
	HC 204	2.4674	NiCo15Cr10MoAlTi	NK 15 CAT		5391A
	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
	TA.6/7/8/9	3.7064/65	Ti99,5	T-60		4941/42/51/4902
	TA.21-24/52-55/58	3.7124	TiCu2	T-U2		Ti-PO4
	DTD 5023/5273/5283			T-50		Ti-P11
		3.7114	TiAl5Sn2			4900
			5553			Ti-5Al-2.5Sn
						Ti-5Al-5V-5Mo-3Cr
	TA.43/44	3.7154	TiAl6Zr5Mo0,5Si0,2	T-A6ZD		Ti-P67
	TA.10-13/28/56	3.7164/65	TiAl6V4	T-A6V		Ti-P63
TA.45-51/57	3.7184	TiAl4Mo4Sn2Si0,5	T-A4DE		Ti-P68	
NODULAR CAST IRON	420/12	0.704	GGG-40	FGS-400-12	0717-02	60-40-18
	370/17	0.7043	GGG-40.3	FGS370-17	0717-15	
	500/7	0.705	GGG-50	FGS500-7	0727-02	65-45-12
	600/3	0.706	GGG-60	FGS 600-3	0732-03	80-55-06
	700/2	0.707	GGG-70	FGS 700-2	0737-01	100-70-03
	800/2	0.708	GGG-80	FGS 800-2		120-90-02
	W 340/3	0.8035	GTW-35-04	MB 35-7		
	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	
	P 440/7	0.8145	GTS-45-06	MP 50-5	SIS 08 54-00	32 510
	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		
GREY CAST IRON	Grade 150	0.601	GG10	Ft10D / FGL100	0110-00	FG 10
	Grade 220	0.6015	GG15	Ft15D / FGL150	0115-00	FG 15
	Grade 260	0.602	GG20	Ft20D / FGL200	0120-00	FG20
	Grade 300	0.0625	GG25	Ft25D / FGL250	0125-00	FG 25
	Grade 350	0.603	GG30	Ft30D / FGL300	0130-00	FG 30
	Grade 400	0.6035	GG35	Ft35D / FGL350	0135-00	FG35
	Grade 450	0.604	GG40	Ft40D / FGL400	0140-00	FG35
ALUMINIUM ALLOYS	LM4/LM22	3.2151	G-ALSi6Cu4	A-55U	4230	L-2660
	2L99/LM25	3.2371	G-ALSi7Mg	A-S7G0,3	4244	319,2
	LM24	3.2161	G-ALSi8Cu3	A-S9U3	4252	A356.2
	LM9	3.2381	G-ALSi10Mg	A-S10G	4253	380,1
	LM20	3.2583	G-ALSi12Cu	A-S12U	4260	L-2630
	LM6	3.3581	G-ALSi12	A-S13	4261	L-2530
					L-2520	A413



Material cross reference chart

							
	UK	German DIN	French	Swedish	Spanish	USA	
ALUMINIUM ALLOYS	LM28/LM29		AlSi18-25CuNiMg			393	
	1C	3.0205	Al99	A4	144010	L-3001 1200	
	1B	3.0255	Al99,5	A5	144007	L-3051 1050A	
	1E	3.0257	E-Al	A5/L	144008	L-3052 1350A	
	1A	3.0285	Al99,8	A8	144004	L-3081 1080A	
	1	3.0385	Al99,98R	A99			1199
	N31	3.0505	AlMn0,5Mg0,5				3105
	N3	3.0515	AlMn		144054	L-3810	3103
		3.0525	AlMn1Mg0,5	A-M1G0,5			3005
	N4	3.0526	AlMnMg1	A-M1G		L-3820	3004
		3.0915	AlFeSi	A-FeS			8011A
	H15	3.1255	AlCuSiMn	A-U4SG	144338	L-3130	2014
		3.1303	AlCu2Mg0,5				2036
	3L86/HR13	3.1305	AlCu2,5Mg0,5	A-U2G		L-3180	2117
	H14	3.1325	AlCuMg1	A-U4G		L-3120	2017A
	2L98	3.1355	AlCuMg2	A-U4G1		L3140	2024
		3.1645	AlCuMgPb	A-U4Pb	144335	L-3121	2003
	FC1	3.1655	AlCuBiPb	A-U5PbBi	144355	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	144212	L-3451	6181
	H9	3.3206	AlMGSi0,5		144103	L-3441	6060
	BTRE6	3.3207	E-AlMgSi0,5	A-GS/L	144102		6101C
		3.3241	G-AlMg3Si	A-G3T			F/B514.0
	N41	3.3315	AlMg1	A-G0,6	144106	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	144120	L-3360	5052
	N4	3.3525	AlMg2Mn0,3	A-G2M			5251
		3.3527	AlMg2Mn0,8				5049
		3.3535	AlMg3	A-G3M	144133	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	144140	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	144425	L-3741	7020	
	3.4345	AlZnMgCu0,5	A-Z5GU0,6			7022	
	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 Speed Machining (HSM)

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 ALTima® coatings.

HSM uses 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 requirements to consider:-

- 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.

We can show you how!

M.A.FORD utilises class leading CAD/CAM software which allows for exact control of the radial depth engagement which is crucial to the high speed machining process.

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 HSM cutting data can be seen on the next page in a direct comparison with conventional programming techniques.

Benefits of HSM:

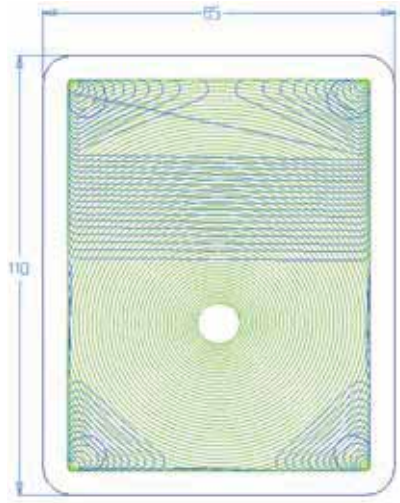
- Increased cycle time
- Reduced costs
- Potentially reduced cutting tool diameter and hence cost
- Improved process reliability
- Improved cutting tool life
- Reduced coolant consumption



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

Benefits of Enhanced cutting parameters with HSM toolpaths

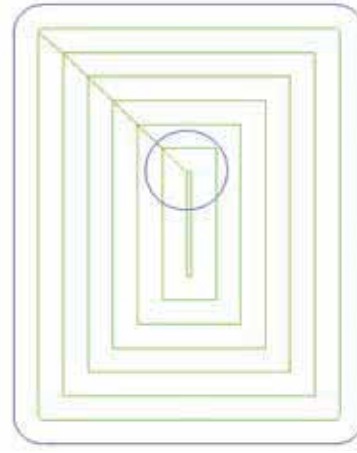
HSM tool path



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

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

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**



BLUESWARF DASHBOARDS™

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

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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**



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

Also available:



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