

Basic concept **TuffCut®XV** Series XV5CB



- A stable & reliable solution for deep, dynamic milling applications
- 5-flute chipbreaker design
- Proven 278 features with some major enhancements for increased axial cutting up to 4xD



Portfolio overview **TuffCut®XV** Series XV5CB



		Size F	Range
LOC	End Type	Inch	Metric
	R.030	3/8" – 3/4"	-

Workpiece material focus

TuffCut®XV Series XV5CB



ISO	Material	Suitability						
Р	Steel	•						
М	Stainless Steel	•						
К	Cast Iron							
N	Aluminum							
S	High-Temp Alloys							
S	Titanium Alloys	0						
н	Hardened Steel							
	Non-ISO							
	= Primary o= Second	dary						

Deep, dynamic milling applications



Basic concept **TuffCut® XV** Series XV7 / XV7CB



- 7-flute design for dynamic milling & finishing strategies optimized for difficult-to-machine materials
- Proven 180 geometry with some enhancements for more efficient ramping & enhanced floor finishes



Portfolio overview

TuffCut® XV Series XV7 / XV7CB



Sorios		End Type	Size Range				
Series	LUC	спа туре	Inch	Metric			
XV7		Square R.015 - R.120	3/8" - 3/4"	-			
XV7CB		R.030 - R.060	3/8" - 3/4"	-			

Workpiece material focus

TuffCut® XV Series XV7 / XV7CB



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Finishing

ISO	Material	Suitability					
Р	Steel	0					
М	Stainless Steel	•					
К	Cast Iron						
N	Aluminum						
S	High-Temp Alloys	0					
S	Titanium Alloys	•					
н	Hardened Steel						
	Non-ISO						
	•= Primary o= Second	dary					

Multitude of flute length options

• Ranging from 1xD up to 4xD



Center-cutting end geometry



- Helical ramp angles up to 3°-5°
- R&D testing found:
 - 3° in 316 SS
 - 5° in Ti6Al-4V
 - 2xD ap
- In comparison to 180 series
 - .5°-1.5° range
- Improved floor finishes
 - < 20 Ra @ 70% ae

ALtima[®] Q coating

Base: Proprietary Designation: AQ Microhardness (HV): 4500 Service Temperature: 900° C Friction Coefficient: 0.4



Basic concept **TuffCut® 3D** Series XFO / XFO-AL



- Xtreme Finisher, Oval form
- Optimized cycle times in 3D surfacing applications utilizing 5-axis machine tools
- 2 different designs to suit multiple material groups

Ballnose vs. Oval form

 Oval form cutters' large effective radius allows for **better** finishes with **shorter** cycle times



Portfolio overview **TuffCut® 3D**



Series	# of Elutor	Size Range				
	# OF FILLES	Inch	Metric			
XFO	4-6	-	6mm - 12mm			
XFO-AL	3-4	-	6mm - 12mm			

Features & benefits **TuffCut® 3D** Series XFO

Multiple flute configurations —

allows for finishing & semi-finishing applications



ALtima® Q coating

optimal heat & wear resistance allowing for increased tool life

Progressive helix & rake angles
 for smooth, vibration free finishing

Edge preparation

strengthens & stabilizes cutting edge

Cutting data **TuffCut® 3D** Series XFO

Recommended Speeds by Material Group						Finishing	Semi-Finishng
Workpiece		Material Ture	Stock Allow	ance		.0103 x D	.0507 x D
Material Grou	р	wateriai Type		Coolant		Ma	CENA
			Emulsion	Air	MQL	vc-	SFIVI
		Low Carbon	•	•	•	1480	1150
Stools	Р	Medium Carbon	•	•	•	1130	900
Steels	P	Alloy Steels	•	•	•	1030	840
		Die / Tool Steels (≤ 45 HRC)	•	•	•	900	720
		Free Machining	•	Х	0	670	540
		Austenitic	•	Х	0	520	430
Chainlana		Difficult Stainless	•	Х	0	410	330
Stainless	М	PH Stainless (≤ 45 HRC)	•	Х	0	520	430
Steels		Cobalt Chrome Alloys	•	Х	0	410	330
		Duplex (22%)	•	Х	0	250	200
		Super Duplex (25%)	•	Х	0	200	160
		High Temp Alloys	•	Х	Х	150	100
Special Alloys	5	Titanium Alloys	•	Х	Х	360	300

Recomme	Recommended Feeds by Material Group					Tool Di	ameter			
Workpiece Material			.23	62	.3150		.3937		.4724	
		Material Type	Semi Finish	Finish	Semi Finish	Finish	Semi Finish	Finish	Semi Finish	Finish
Group						Fz - in	/tooth			
		Low Carbon	.0019	.0012	.0025	.0016	.0031	.0020	.0038	.0024
Stools	р	Medium Carbon	.0019	.0012	.0025	.0016	.0031	.0020	.0038	.0024
Steels	٢	Alloy Steels	.0019	.0012	.0025	.0016	.0031	.0020	.0038	.0024
		Die / Tool Steels (≤ 45 HRC)	.0014	.0009	.0019	.0013	.0024	.0016	.0028	.0019
		Free Machining	.0019	.0012	.0025	.0016	.0031	.0020	.0038	.0024
		Austenitic	.0019	.0012	.0025	.0016	.0031	.0020	.0038	.0024
Chainlana		Difficult Stainless	.0019	.0012	.0025	.0016	.0031	.0020	.0038	.0024
Stainless	М	PH Stainless (≤ 45 HRC)	.0014	.0009	.0019	.0013	.0024	.0016	.0028	.0019
Steels		Cobalt Chrome Alloys	.0014	.0009	.0019	.0013	.0024	.0016	.0028	.0019
		Duplex (22%)	.0014	.0009	.0019	.0013	.0024	.0016	.0028	.0019
		Super Duplex (25%)	.0014	.0009	.0019	.0013	.0024	.0016	.0028	.0019
Special	c	High Temp Alloys	.0014	.0009	.0019	.0013	.0024	.0016	.0028	.0019
Alloys	3	Titanium Alloys	.0017	.0012	.0022	.0016	.0028	.0020	.0033	.0024

Product range & materials **TuffCut® 3D** Series XFO





D1	R1	R2	L1	L2	D2	Flutes
6	1	95	64	20.8	6	4
8	1	90	64	24.5	8	4
10	2	85	72	24.7	10	4
10	2	85	72	24.7	10	6
12	2	80	84	27.3	12	4
12	2	80	84	27.3	12	6

	Р			M S H			S						
Carbon Steels	Alloy Steels	Die/Tool Steels	Ferritic & Martensitic	Austenitic	Precipitation Hardened	Duplex	Fe-based Co- based Ni-based Ti-based			I	Hardened Steels	5	
≤ 28 HRC	≤ 38 HRC	≤ 45 HRC	≤ 28	HRC	≤ 48 HRC	≤ 32 HRC	≤ 42 HRC			45-50 HRC	51-55 HRC	56-68 HRC	
0	0	0	0	•	•	0	0	0	0	•	0		



Enhanced notch design

allows for milling capabilities with full cutting edge, including nose radius



Fordlube coating

increased wear resistance & lubricity

High shear action

for optimal performance in aluminum alloys

Progressive helix & rake angles
 for smooth, vibration free finishing

Product range & materials **TuffCut® 3D** Series XFO-AL





D1	R1	R2	L1	L2	D2	Flutes
6	1	95	64	20.8	6	3
8	1	90	64	24.5	8	3
10	2	85	72	24.7	10	4
12	2	80	84	27.3	12	4

	N								
Aluminum (<12% Si)	Aluminum (>12% Si)	Brass / Copper	Plastics						
•	0	0							

Cutting data **TuffCut® 3D** Series XFO-AL



Recommended Speeds by Material Group						Finishing	Semi-Finishng
Workpiece Material Group		Matorial Tuno	Stock Allowance			.0103 x D	.0507 x D
		wateria Type	Coolant			Vc. SEM	
			Emulsion	Air	MQL	vc-	36141
Aluminum	N	Wrought (≤10% Si)	•	Х	0	2000	1900
		Cast (> 10% Si)	•	Х	0	1710	1610

Recomme	ndec	l Feeds by Material Group	Tool Diameter							
Workpiece Material Group			.2362		.3150		.3937		.4724	
		Material Type	Semi Finish	Finish	Semi Finish	Finish	Semi Finish	Finish	Semi Finish	Finish
			Fz - in/tooth							
Aluminum	N	Wrought (≤ 10% Si)	.0024	.0015	.0032	.0020	.0039	.0026	.0047	.0031
		Cast (> 10% Si)	.0024	.0015	.0032	.0020	.0039	.0026	.0047	.0031

Applications

- Finishing & semi-finishing with high accuracy & efficiency
- Allows for the machining of drafted / radiused surfaces & blended fillets with one tool







Aerospace components TuffCut® 3D

Series XFO













Impellers

Medical components TuffCut® 3D

Series XFO







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Aerospace components TuffCut® 3D

Series XFO-AL







Motorsport components **TuffCut® 3D**

Series XFO-AL







Throttle body components

Component features

• Avoid complex surfaces with small intersections – focus on large / simple surfaces



CAM software

• Robust CAM software capable of driving circle segment tooling is required





Machine tool

5-axis machines most often required to effectively utilize tool •



5-axis machine

- Utilize machine to tilt tool to effective angle
- Finish steep faces with major
- Gradual faces & blend fillets with nose radius



Tool axis control

- Toolpath generation can be quite complex & difficult
- Controlling the tilt of the tool is one of the most important parameters
- Side tilt controls how the tool contacts the part
- Several ways to control



Effective angles



Tool Ø	Nose Radius		Major Radius		
D1	R1	Effective Angle (Max.)	R2	Effective Angle (Max.)	
6	1	78.2°	95	11.8°	
8	1	75.1°	90	14.9°	
10	2	74.6°	85	15.4°	
12	2	71.6°	80	18.4°	

* Numbers above represent maximum angle values

Tool guidance & cut direction

• Climb milling is advised for best tool performance & surface finish









Tool guidance & cut direction Freeform features Correct use Major radius is doing majority of work Long & consistent tool life • Higher feed = higher productivity •

Lab test – 3-flute Ballnose vs...



Material: 6061 Condition: T651

Parameters			
Tool Series:	138B (3-flt)		
Footprint:	12mm ballnose		
Toolpath:	Unified Parallel		
N:	15000 RPM		
Fz:	.0031 IPT		
Vf:	140 IPM		
Stock:	.010"		
Stepover:	.059″		





Lab test – XFO-AL



Material: 6061 Condition: T651

Parameters					
Tool Series:	138B (3-flt)	XFO-AL (4-flt)			
Footprint:	12mm ballnose 12mm x R80mm				
Toolpath:	Parallel 5 axis toolpath				
N:	15000 RPM				
Fz:	.0031 IPT				
Vf:	140 IPM	186 IPM			
Stock:	.010″				
Stepover:	.059″				



Scallop height ≈ .0001"

Oval form a_e = .059"

Ballnose

 $a_e = .059''$ $a_e = .014''$ cut time $\approx 1m$ 16scut time $\approx 7m$ 3s

Lab test – Titanium blisk



Material: Ti6Al-4V *Condition:* Annealed





Lab test – Titanium blisk

2nd level finishing









Lab test – Femoral trial



Resources

- M.A. Ford is available to offer assistance in CAM programming & programming theory (Mastercam & hyperMILL)
- Tool profiles (.dxf & .stp) as well as Mastercam tool libraries available for download via maford.com







TrueSize[®] Reamer

TrueSize[®] Reamer Series TrueSize[®] Series 270 TrueSize[®] S TrueSize[®] Series 270P TrueSize[®] S

TrueSize[®] Series 270L TrueSize[®] Series 272

ISO 9001:2015 Certified

Where high performance is the standard



- No Centers OD .0433" (1.09mm) and below
- Male Centers OD .0434" (1.10mm) .1280" (3.25mm)
- · Female Centers OD .1281" (3.26mm) and larger
- All Diameters with Male Centers Chamfer Angle: 42 44
 Degrees per side
- All Diameters without Male Centers Chamfer Angle: 44 46 Degrees per side

Solid Carbide TrueSize[®] Reamers Deliver High-Precision Hole Finishes

In applications that require high-precision hole finishes, or tighter diameter control, M.A. Ford[®] True Size[®] Reamers can be used with confidence. Solid Carbide Reamers are available in a wide range of sizes for virtually all materials, including cast iron, aluminum, stainless steel, exotic alloys, plastics and other non-ferrous materials.

Complete Family of Standard and Metric Sizes

M.A. Ford[®] stocks over 900 inch and metric size reamers in its product line, ranging from .013 inch to 16mm diameter. These products are available for immediate shipment. M.A. Ford[®] also maintains an inventory of pre-finished blanks, which can be finished to your precise specifications and shipped within 72 hours upon request. **See our Rapid Turn Around Program for details.**

Material Removal Parameters

For proper finishing with a reamer, the correct amount of material must be left in the hole. If the hole is too close to the finish size, the reamer will tend to burnish the hole, and excessive tool wear will occur. If too much material is left, chips can clog the flutes of the reamer, resulting in a poor finish, poor size control, and possible tool breakage.

