

TuffCut®

High Performance End Mills

M.A. Ford® TuffCut® End Mills perform better and last significantly longer than competitive products, minimizing process downtime and maximizing productivity and cost efficiency. Included in our product line are high performance end mills developed for specific applications such as stainless steels and high temperature alloys, hardened steel, titanium, and aluminum and softer alloys.

New to the TuffCut® End Mill family is the TuffCut® XR7 - a 7 flute end mill that provides a 40% productivity increase over 5 flute tools. The XR family of end mills are available as 4, 5 and 7 flute square end, 4, 5 and 7 flute corner radius end and 4 flute ball nose. A variety of available lengths include stub, standard, long and extended reach as well as neck relief styles.

In addition to High Performance products, M.A. Ford® carries 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® End Mills are ideal for tough or abrasive work. On many jobs, they can run faster than HSS or Cobalt because of their high heat resistance.

Benefits of M.A. Ford® End Mill products and support include:

- Thousands of end mills in stock.
- Over 50 different styles of end mills available.
- Aggressive speeds and feeds to maximize metal removal rates.
- Standard, Stub, Long and Extended Reach Lengths are available.
- Solid Carbide Tools are easy to re-sharpened for maximum life.
- ALtima®, ALtima® Blaze, ALtima® 52, TiN and TiCN coatings available.
- U.S. Designed and Manufactured.



Designed and Manufactured in the USA

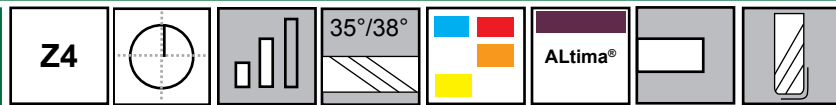
TuffCut® High Performance Series

- TuffCut® XR Series 177
- NEW** TuffCut® XR Series 177L
- TuffCut® XR Series 177S
- TuffCut® XR Series 179
- NEW** TuffCut® XR Series 179L
- TuffCut® XR Series 178
- TuffCut® XR Series 178N
- TuffCut® XR7 Series 180
- TuffCut® XR7 Series 180N
- TuffCut® AL Series 135
- TuffCut® AL Series 135N
- TuffCut® AL Series 135B
- TuffCut® AL Series 135BN
- TuffCut® AL Series 136
- TuffCut® AL Series 134
- TuffCut® X-AL Series 137
- TuffCut® X-AL Series 137N
- TuffCut® X-AL Series 138
- TuffCut® X-AL Series 138N
- TuffCut® X-AL Series 138B
- TuffCut® X-AL Series 138BN
- TuffCut® DM Series 156
- TuffCut® DM Series 198
- TuffCut® DM Series 199
- NEW** TuffCut® DM Series 158
- TuffCut® DM Series 157
- TuffCut® DM Series 192
- TuffCut® SS Series 112
- TuffCut® SS Series 172
- TuffCut® SS Series 174
- TuffCut® SS Series 175
- TuffCut® SS Series 176
- TuffCut® SS Series 113

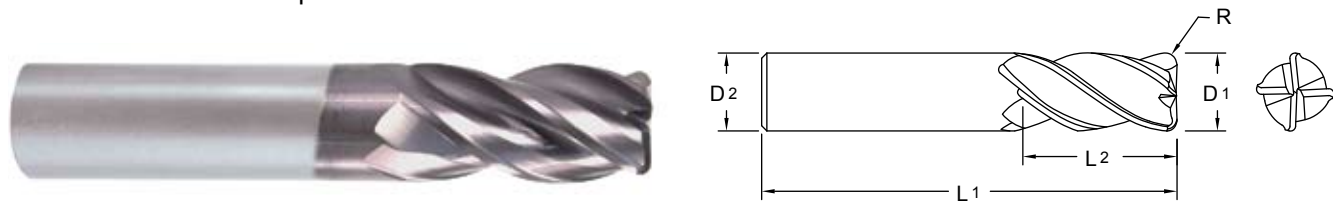


ISO 9001:2000 Certified
An ESOP Company

TuffCut® XR
Series 177



Designed for EXTREME Productivity. Unique flute geometry reduces harmonics at increased feeds and speeds.



ALtima®		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1		L2		R	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
17705900A	17680		1.5	.0591		3.0		38		3.0		
17706250A	17692	1/16		.0625	1/8		1-1/2		1/8			
17707810A	17694	5/64		.0781	1/8		1-1/2		5/32			
17707870A	17682		2.0	.0787		3.0		38		4.0		
17709370A	17696	3/32		.0937	1/8		1-1/2		3/16			
17709840A	17684		2.5	.0984		3.0		38		5.0		
17711800A	17928		3.0	.1181		6.0		57		8.0		
17711801A	17783		3.0	.1181		6.0		57		8.0		0.50
17711803A	17686		3.0	.1181		3.0		38		6.0		
17711808A	17929		3.0	.1181		6.0		57		8.0		0.25
17712500A	17700	1/8		.1250	1/8		1-1/2		1/8			
17712502A	17729	1/8		.1250	1/8		1-1/2		1/8			0.015
17712510A	17701	1/8		.1250	1/8		1-1/2		3/8			
17712512A	17730	1/8		.1250	1/8		1-1/2		3/8			0.015
17713700A	17688		3.5	.1378		6.0		57		7.0		
17715600A	17702	5/32		.1562	3/16		2		3/16			
17715602A	17731	5/32		.1562	3/16		2		3/16			0.015
17715610A	17703	5/32		.1562	3/16		2		7/16			
17715612A	17732	5/32		.1562	3/16		2		7/16			0.015
17715700A	17930		4.0	.1575		6.0		57		11.0		
17715701A	17784		4.0	.1575		6.0		57		11.0		0.50
17715708A	17931		4.0	.1575		6.0		57		11.0		0.25
17717700A	17690		4.5	.1772		6.0		57		9.0		
17718700A	17704	3/16		.1875	3/16		2		3/16			
17718702A	17733	3/16		.1875	3/16		2		3/16			0.015
17718704A	17734	3/16		.1875	3/16		2		3/16			0.030
17718710A	17705	3/16		.1875	3/16		2		7/16			
17718712A	17735	3/16		.1875	3/16		2		7/16			0.015
17718714A	17736	3/16		.1875	3/16		2		7/16			0.030
17719600A	17932		5.0	.1968		6.0		57		13.0		
17719601A	17785		5.0	.1968		6.0		57		13.0		0.50
17719608A	17933		5.0	.1968		6.0		57		13.0		0.25
17721800A	17706	7/32		.2187	1/4		2		1/4			
17721802A	17737	7/32		.2187	1/4		2		1/4			0.015
17721804A	17738	7/32		.2187	1/4		2		1/4			0.030
17721810A	17707	7/32		.2187	1/4		2-1/2		7/16			
17721812A	17739	7/32		.2187	1/4		2-1/2		7/16			0.015
17721814A	17740	7/32		.2187	1/4		2-1/2		7/16			0.030
17723600A	17934		6.0	.2362		6.0		57		13.0		
17723601A	17935		6.0	.2362		6.0		57		13.0		0.50
17723603A	17787		6.0	.2362		6.0		57		13.0		1.00
17723604A	17788		6.0	.2362		6.0		57		13.0		1.50

Inch	
D1	Tolerance
1/16-1/4	+ .000/- .002
> 1/4-1.0	+ .000/- .003

Metric (mm)	
D1	Tolerance h10
1.50-3.00	+ .000/- .040
> 3.00-6.00	+ .000/- .048
> 6.00-10.00	+ .000/- .058
> 10.00-18.00	+ .000/- .070
> 18.00-25.00	+ .000/- .084

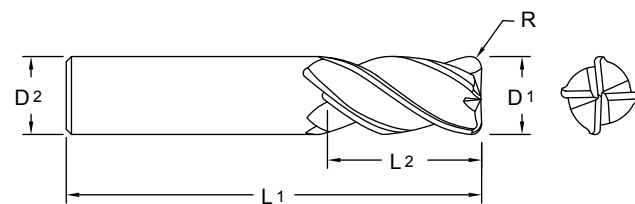
Technical information on page 240.

Series 177 Continued

ALtima®		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1		L2		R	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
17723605A	18070		6.0	.2362		6.0		57		13.0		2.00
17723608A	17786		6.0	.2362		6.0		57		13.0		0.25
17725000A	17708	1/4		.2500	1/4		2		1/4			
17725002A	17741	1/4		.2500	1/4		2		1/4			0.015
17725004A	17742	1/4		.2500	1/4		2		1/4			0.030
17725010A	17709	1/4		.2500	1/4		2-1/2		1/2			
17725012A	17743	1/4		.2500	1/4		2-1/2		1/2			0.015
17725014A	17744	1/4		.2500	1/4		2-1/2		1/2			0.030
17728100A	17710	9/32		.2812	5/16		2-1/2		5/8			
17728102A	17745	9/32		.2812	5/16		2-1/2		5/8			0.015
17728104A	17746	9/32		.2812	5/16		2-1/2		5/8			0.030
17731200A	17711	5/16		.3125	5/16		2		5/16			
17731202A	17747	5/16		.3125	5/16		2		5/16			0.015
17731204A	17748	5/16		.3125	5/16		2		5/16			0.030
17731210A	17712	5/16		.3125	5/16		2-1/2		13/16			
17731212A	17749	5/16		.3125	5/16		2-1/2		13/16			0.015
17731214A	17750	5/16		.3125	5/16		2-1/2		13/16			0.030
17731500A	17937		8.0	.3150		8.0		63		19.0		
17731501A	17938		8.0	.3150		8.0		63		19.0		0.50
17731503A	17789		8.0	.3150		8.0		63		19.0		1.00
17731504A	17790		8.0	.3150		8.0		63		19.0		1.50
17731505A	17791		8.0	.3150		8.0		63		19.0		2.00
17731507A	18072		8.0	.3150		8.0		63		19.0		3.00
17734300A	17713	11/32		.3438	3/8		2-1/2		13/16			
17734302A	17751	11/32		.3438	3/8		2-1/2		13/16			0.015
17734304A	17752	11/32		.3438	3/8		2-1/2		13/16			0.030
17737500A	17714	3/8		.3750	3/8		2		3/8			
17737502A	17753	3/8		.3750	3/8		2		3/8			0.015
17737504A	17754	3/8		.3750	3/8		2		3/8			0.030
17737510A	17715	3/8		.3750	3/8		2-1/2		7/8			
17737512A	17755	3/8		.3750	3/8		2-1/2		7/8			0.015
17737514A	17756	3/8		.3750	3/8		2-1/2		7/8			0.030
17739300A	17940		10.0	.3937		10.0		72		22.0		
17739301A	17941		10.0	.3937		10.0		72		22.0		0.50
17739303A	17792		10.0	.3937		10.0		72		22.0		1.00
17739304A	17793		10.0	.3937		10.0		72		22.0		1.50
17739305A	17794		10.0	.3937		10.0		72		22.0		2.00
17739307A	96603		10.0	.3937		10.0		72		22.0		3.00
17740600A	17716	13/32		.4062	7/16		2-3/4		15/16			
17740602A	17757	13/32		.4062	7/16		2-3/4		15/16			0.015
17740604A	17758	13/32		.4062	7/16		2-3/4		15/16			0.030
17743700A	17717	7/16		.4375	7/16		2-1/2		7/16			
17743702A	17759	7/16		.4375	7/16		2-1/2		7/16			0.015
17743704A	17760	7/16		.4375	7/16		2-1/2		7/16			0.030
17743710A	17718	7/16		.4375	7/16		2-3/4		1			
17743712A	17761	7/16		.4375	7/16		2-3/4		1			0.015
17743714A	17762	7/16		.4375	7/16		2-3/4		1			0.030
17746800A	17719	15/32		.4688	1/2		3		1			
17746802A	17763	15/32		.4688	1/2		3		1			0.015
17746804A	17764	15/32		.4688	1/2		3		1			0.030
17747200A	17943		12.0	.4724		12.0		83		26.0		
17747201A	17795		12.0	.4724		12.0		83		26.0		0.50

Technical information on page 240.

Series 177 Continued



ALtima®		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1		D2		L1		L2		R		
		Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
17747202A	17944		12.0	.4724		12.0		83		26.0		0.75
17747203A	17796		12.0	.4724		12.0		83		26.0		1.00
17747204A	17797		12.0	.4724		12.0		83		26.0		1.50
17747205A	17798		12.0	.4724		12.0		83		26.0		2.00
17747206A	18074		12.0	.4724		12.0		83		26.0		2.50
17747207A	96506		12.0	.4724		12.0		83		26.0		3.00
17747209A	18076		12.0	.4724		12.0		83		26.0		4.00
17750000A	17720	1/2		.5000	1/2		2-1/2		1/2			
17750002A	17765	1/2		.5000	1/2		2-1/2		1/2		0.015	
17750004A	17766	1/2		.5000	1/2		2-1/2		1/2		0.030	
17750010A	17721	1/2		.5000	1/2		3		1			
17750012A	17767	1/2		.5000	1/2		3		1		0.015	
17750014A	17768	1/2		.5000	1/2		3		1		0.030	
17750016A	17901	1/2		.5000	1/2		3		1		0.060	
17750017A	17902	1/2		.5000	1/2		3		1		0.090	
17750018A	17903	1/2		.5000	1/2		3		1		0.125	
17750020A	18094	1/2		.5000	1/2		3		1-1/4			
17750022A	18095	1/2		.5000	1/2		3		1-1/4		.015	
17750024A	18096	1/2		.5000	1/2		3		1-1/4		.030	
17750026A	18097	1/2		.5000	1/2		3		1-1/4		.060	
17750027A	18098	1/2		.5000	1/2		3		1-1/4		.090	
17750028A	18099	1/2		.5000	1/2		3		1-1/4		.125	
17755100A	17946		14.0	.5512		14.0		83		26.0		
17755102A	17947		14.0	.5512		14.0		83		26.0		0.75
17756200A	17722	9/16		.5625	9/16		3-1/2		1-1/8			
17756202A	17769	9/16		.5625	9/16		3-1/2		1-1/8		0.015	
17756204A	17770	9/16		.5625	9/16		3-1/2		1-1/8		0.030	
17762500A	17723	5/8		.6250	5/8		3		5/8			
17762502A	18000	5/8		.6250	5/8		3		5/8		0.015	
17762504A	17771	5/8		.6250	5/8		3		5/8		0.030	
17762505A	17772	5/8		.6250	5/8		3		5/8		0.045	
17762510A	17724	5/8		.6250	5/8		3-1/2		1-1/4			
17762512A	18001	5/8		.6250	5/8		3-1/2		1-1/4		0.015	
17762514A	17773	5/8		.6250	5/8		3-1/2		1-1/4		0.030	
17762515A	17774	5/8		.6250	5/8		3-1/2		1-1/4		0.045	
17762516A	17904	5/8		.6250	5/8		3-1/2		1-1/4		0.060	
17762517A	17905	5/8		.6250	5/8		3-1/2		1-1/4		0.090	
17762518A	17906	5/8		.6250	5/8		3-1/2		1-1/4		0.125	
17762900A	17950		16.0	.6299		16.0		92		32.0		
17762901A	18078		16.0	.6299		16.0		92		32.0		0.50
17762903A	17951		16.0	.6299		16.0		92		32.0		1.00
17762904A	17799		16.0	.6299		16.0		92		32.0		1.50
17762905A	17673		16.0	.6299		16.0		92		32.0		2.00
17762906A	18080		16.0	.6299		16.0		92		32.0		2.50
17762907A	17674		16.0	.6299		16.0		92		32.0		3.00
17762909A	18082		16.0	.6299		16.0		92		32.0		4.00
17770800A	17952		18.0	.7087		18.0		92		32.0		
17770803A	17953		18.0	.7087		18.0		92		32.0		1.00

Technical information on page 240.

Series 177 Continued

ALtima®		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1		D2		L1		L2		R		
		Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
17775000A	17725	3/4		.7500	3/4		3		3/4			
17775002A	18002	3/4		.7500	3/4		3		3/4		0.015	
17775004A	17775	3/4		.7500	3/4		3		3/4		0.030	
17775005A	17776	3/4		.7500	3/4		3		3/4		0.045	
17775010A	17726	3/4		.7500	3/4		4		1-1/2			
17775012A	18003	3/4		.7500	3/4		4		1-1/2		0.015	
17775014A	17777	3/4		.7500	3/4		4		1-1/2		0.030	
17775015A	17778	3/4		.7500	3/4		4		1-1/2		0.045	
17775016A	17907	3/4		.7500	3/4		4		1-1/2		0.060	
17775017A	17908	3/4		.7500	3/4		4		1-1/2		0.090	
17775018A	17909	3/4		.7500	3/4		4		1-1/2		0.125	
17778700A	17955		20.0	.7874		20.0		104		38.0		
177787011A	18090		20.0	.7874		20.0		104		38.0		5.00
177787012A	18092		20.0	.7874		20.0		104		38.0		6.00
17778703A	17956		20.0	.7874		20.0		104		38.0		1.00
17778704A	18091		20.0	.7874		20.0		104		38.0		1.50
17778705A	18084		20.0	.7874		20.0		104		38.0		2.00
17778707A	18086		20.0	.7874		20.0		104		38.0		3.00
17778709A	18088		20.0	.7874		20.0		104		38.0		4.00
17798400A	17957		25.0	.9843		25.0		104		38.0		
17798403A	17958		25.0	.9843		25.0		104		38.0		1.00
17710000A	17727	1		1.0000	1		4		1			
17710002A	18004	1		1.0000	1		4		1		0.015	
17710004A	17779	1		1.0000	1		4		1		0.030	
17710005A	17780	1		1.0000	1		4		1		0.045	
17710010A	17728	1		1.0000	1		4		1-1/2			
17710012A	18005	1		1.0000	1		4		1-1/2		0.015	
17710014A	17781	1		1.0000	1		4		1-1/2		0.030	
17710015A	17782	1		1.0000	1		4		1-1/2		0.045	
17710016A	17910	1		1.0000	1		4		1-1/2		0.060	
17710017A	17911	1		1.0000	1		4		1-1/2		0.090	
17710018A	17912	1		1.0000	1		4		1-1/2		0.125	

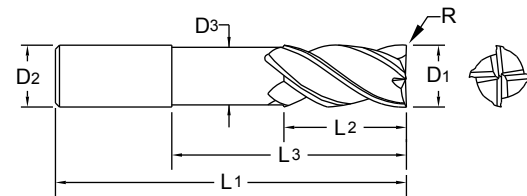
Technical information on page 240.

Safety Note
 Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

NEW

4 Flute

**TuffCut® XR
Series 177L**



ALtima®		Diameter		Shank	Neck Dia.	OAL	Flute Length	Neck Length	Corner Radius
		D1 h10		D2 h6	D3	L1	L2	L3	R
Tool No.	EDP	mm	Decimal	mm	mm	mm	mm	mm	mm
177L2360R010N5A	18186	6	.2362	6	5.8	101	12	31	0.25
177L2360R020N5A	18183	6	.2362	6	5.8	101	12	31	0.5
177L2360R039N5A	18184	6	.2362	6	5.8	101	12	31	1.0
177L3150R020N5A	18187	8	.3150	8	7.6	101	16	41	0.5
177L3150R039N5A	18194	8	.3150	8	7.6	101	16	41	1.0
177L3150R078N5A	18195	8	.3150	8	7.6	101	16	41	2.0
177L3150R118N5A	18196	8	.3150	8	7.6	101	16	41	3.0
177L3930R020N5A	18188	10	.3937	10	9.6	127	20	51	0.5
177L3930R039N5A	18197	10	.3937	10	9.6	127	20	51	1.0
177L3930R078N5A	18198	10	.3937	10	9.6	127	20	51	2.0
177L3930R118N5A	18199	10	.3937	10	9.6	127	20	51	3.0
177L4720R020N5A	18189	12	.4724	12	11.4	152	24	62	0.5
177L4720R039N5A	18176	12	.4724	12	11.4	152	24	62	1.0
177L4720R078N5A	18177	12	.4724	12	11.4	152	24	62	2.0
177L4720R118N5A	18190	12	.4724	12	11.4	152	24	62	3.0
177L4720R157N5A	18178	12	.4724	12	11.4	152	24	62	4.0
177L6290R020N5A	18181	16	.6299	16	15.2	152	32	82	0.5
177L6290R039N5A	18191	16	.6299	16	15.2	152	32	82	1.0
177L6290R078N5A	18179	16	.6299	16	15.2	152	32	82	2.0
177L6290R118N5A	18180	16	.6299	16	15.2	152	32	82	3.0
177L7870R020N5A	18182	20	.7874	20	19.2	152	40	102	0.5
177L7870R039N5A	18192	20	.7874	20	19.2	152	40	102	1.0
177L7870R118N5A	18193	20	.7874	20	19.2	152	40	102	3.0

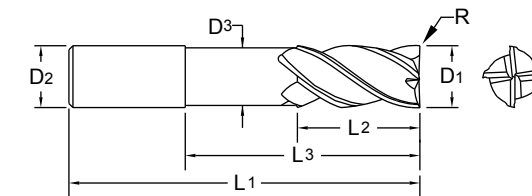
Inch Sizes Available upon request.

Technical information on [page 240](#).

Metric (mm)	
D1	Tolerance h10
6.00	+0.00/-048
>6.00-10.00	+0.00/-058
>10.00-18.00	+0.00/-070
>18.00-20.00	+0.00/-084

4 Flute

**TuffCut® XR
Series 177S**



ALtima®		Diameter		Shank	Neck Diameter	OAL	Flute Length	Neck Length	Corner Radius	Shank
		D1		D2	D3	L1	L2	L3	R	
Tool No.	EDP	mm	Decimal	D2	D3	L1	L2	L3	R	
177S1181A	18218	3	.1181	6	2.9	50	5	11		DIN 6535 HA
177S1181R008A	18200	3	.1181	6	2.9	50	5	11	0.20	DIN 6535 HA
177S1575A	18220	4	.1575	6	3.9	50	6	14		DIN 6535 HA
177S1575R008A	18202	4	.1575	6	3.9	50	6	14	0.20	DIN 6535 HA
177S1969A	18222	5	.1968	6	4.9	57	8	17		DIN 6535 HA
177S1969R008A	18204	5	.1968	6	4.9	57	8	17	0.20	DIN 6535 HA
177S2362A	18224	6	.2362	6	5.8	57	9	20		DIN 6535 HA
177S2362R012A	18206	6	.2362	6	5.8	57	9	20	0.30	DIN 6535 HA
177S3150A	18226	8	.3150	8	7.6	63	12	26		DIN 6535 HA
177S3150R020A	18208	8	.3150	8	7.6	63	12	26	0.50	DIN 6535 HA
177S3937A	18228	10	.3937	10	9.6	72	15	32		DIN 6535 HA
177S3937R020A	18210	10	.3937	10	9.6	72	15	32	0.50	DIN 6535 HA
177S4724A	18230	12	.4724	12	11.4	83	18	38		DIN 6535 HA
177S4724R020A	18212	12	.4724	12	11.4	83	18	38	0.50	DIN 6535 HA
177S6299A	18232	16	.6299	16	15.2	98	24	50		DIN 6535 HA
177S6299R039A	18214	16	.6299	16	15.2	98	24	50	1.00	DIN 6535 HA
177S7874A	18234	20	.7874	20	19.2	112	30	62		DIN 6535 HA
177S7874R039A	18216	20	.7874	20	19.2	112	30	62	1.00	DIN 6535 HA

Metric (mm)	
D1	Tolerance h10
3.00	+0.00/-040
>3.00-6.00	+0.00/-048
>6.00-10.00	+0.00/-058
>10.00-18.00	+0.00/-070
>18.00-20.00	+0.00/-084

Inch Sizes Available upon request.

Technical information on [page 240](#).

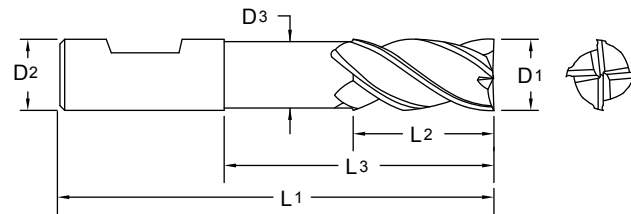
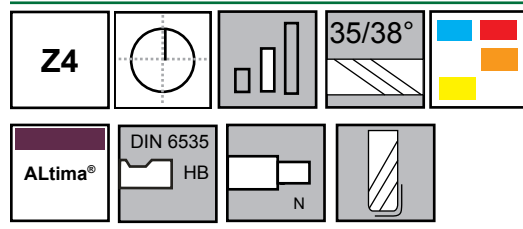
ISO 9001:2000 Certified

An ESOP Company

Series 177S

TuffCut® XR

Series 177S Continued

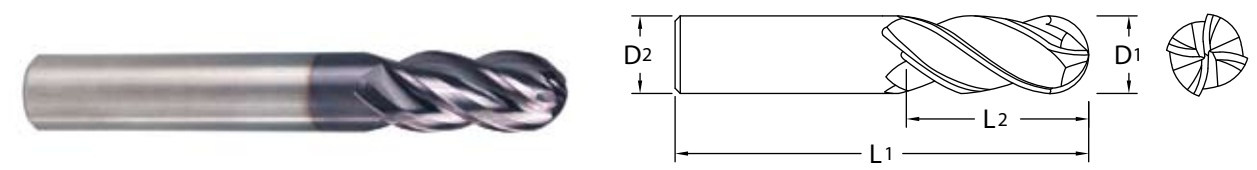
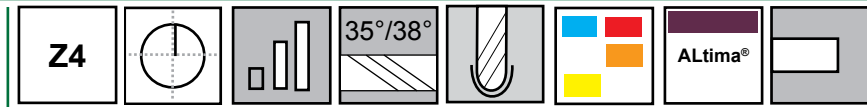


ALtima®		Diameter		Shank	Neck Diameter	OAL	Flute Length	Neck Length	Corner Radius	Shank
Tool No.	EDP	D1	D2							
177S1181AW	18254	3	.1181	6	2.9	50	5	11		DIN 6535 HB
177S1181R008AW	18236	3	.1181	6	2.9	50	5	11	0.20	DIN 6535 HB
177S1575AW	18256	4	.1575	6	3.9	50	6	14		DIN 6535 HB
177S1575R008AW	18238	4	.1575	6	3.9	50	6	14	0.20	DIN 6535 HB
177S1969AW	18258	5	.1968	6	4.9	57	8	17		DIN 6535 HB
177S1969R008AW	18240	5	.1968	6	4.9	57	8	17	0.20	DIN 6535 HB
177S2362AW	18260	6	.2362	6	5.8	57	9	20		DIN 6535 HB
177S2362R012AW	18242	6	.2362	6	5.8	57	9	20	0.30	DIN 6535 HB
177S3150AW	18262	8	.3150	8	7.6	63	12	26		DIN 6535 HB
177S3150R020AW	18244	8	.3150	8	7.6	63	12	26	0.50	DIN 6535 HB
177S3937AW	18264	10	.3937	10	9.6	72	15	32		DIN 6535 HB
177S3937R020AW	18246	10	.3937	10	9.6	72	15	32	0.50	DIN 6535 HB
177S4724AW	18266	12	.4724	12	11.4	83	18	38		DIN 6535 HB
177S4724R020AW	18248	12	.4724	12	11.4	83	18	38	0.50	DIN 6535 HB
177S6299AW	18268	16	.6299	16	15.2	98	24	50		DIN 6535 HB
177S6299R039AW	18250	16	.6299	16	15.2	98	24	50	1.00	DIN 6535 HB
177S7874AW	18270	20	.7874	20	19.2	112	30	62		DIN 6535 HB
177S7874R039AW	18252	20	.7874	20	19.2	112	30	62	1.00	DIN 6535 HB

Inch Sizes Available upon request.

Technical information on [page 240](#).

TuffCut® XR Series 179



ALtima®		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Fraction	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
17905900A	18272		1.5	.0591		3		38		3.0
17906250A	18284	1/16		.0625	1/8		1-1/2		1/8	
17907810A	18286	5/64		.0781	1/8		1-1/2		5/32	
17907870A	18274		2.0	.0787		3		38		4.0
17909370A	18288	3/32		.0937	1/8		1-1/2		3/16	
17909840A	18276		2.5	.0984		3		38		5.0
17911800A	18018		3.0	.1181		6		57		8.0
17911803A	18278		3.0	.1181		3		38		6.0
17912500A	18034	1/8		.1250	1/8		1-1/2		1/4	
17912510A	18035	1/8		.1250	1/8		1-1/2		3/8	
17913700A	18280		3.5	.1378		6		63		7.0
17915700A	18019		4.0	.1575		6		57		11.0
17917700A	18282		4.5	.1772		6		63		9.0
17918700A	18038	3/16		.1875	3/16		2		3/8	
17918710A	18039	3/16		.1875	3/16		2		5/8	
17919600A	18020		5.0	.1968		6		57		13.0
17923600A	18021		6.0	.2362		6		57		13.0
17925000A	18042	1/4		.2500	1/4		2		3/8	
17925010A	18043	1/4		.2500	1/4		2-1/2		3/4	
17925020A	18063	1/4		.2500	1/4		4		1/2	
17931200A	18045	5/16		.3125	5/16		2		1/2	
17931210A	18046	5/16		.3125	5/16		2-1/2		13/16	
17931500A	18022		8.0	.3150		8		63		19.0
17937500A	18048	3/8		.3750	3/8		2		1/2	
17937510A	18049	3/8		.3750	3/8		2-1/2		7/8	
17937520A	18064	3/8		.3750	3/8		4		9/16	
17939300A	18023		10.0	.3937		10		72		22.0
17947200A	18024		12.0	.4724		12		83		26.0
17950000A	18054	1/2		.5000	1/2		2-1/2		5/8	
17950010A	18055	1/2		.5000	1/2		3		1-1/4	
17950020A	18065	1/2		.5000	1/2		5		5/8	
17962510A	18058	5/8		.6250	5/8		3-1/2		1-1/4	
17962520A	18066	5/8		.6250	5/8		6		3/4	
17962900A	18059		16.0	.6299	16			92		32.0
17975010A	18060	3/4		.7500	3/4		4		1-1/2	
17975020A	18067	3/4		.7500	3/4		6		1	
17910010A	18062	1		1.0000	1		4		1-1/2	
17910020A	18068	1		1.0000	1		6		1-1/4	

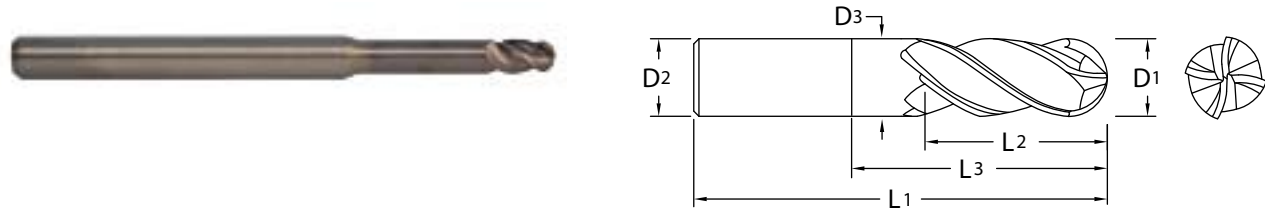
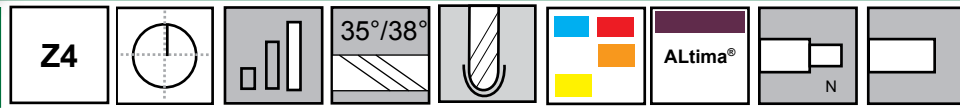
Inch	
D1	Tolerance
1/16-1/4	+ .000/- .002
> 1/4-1.0	+ .000/- .003

Metric (mm)	
D1	Tolerance h10
1.50-3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-16.00	+ .000/- .070

Technical information on [page 240](#).

NEW

**TuffCut® XR
Series 179L**



ALtima®		Diameter		Shank	Neck Dia.	OAL	Flute Length		Neck Length	
		D1 h10		D2 h6	D3	L1	L2	L3		
Tool No.	EDP	mm	Decimal	mm	mm	mm	mm	mm	mm	mm
179L1181N5A	18290	3	.2362	6	2.9	75	4.5	17		
179L1575N5A	18292	4	.1575	6	3.9	75	6.0	22		
179L1968N5A	18294	5	.1968	6	4.9	75	7.5	27		
179L2362N5A	18296	6	.2362	6	5.8	101	9.0	32		
179L3150N5A	18298	8	.3150	8	7.6	101	12.0	42		
179L3937N5A	18302	10	.3937	10	9.6	127	15.0	52		
179L4724N5A	18304	12	.4724	12	11.4	152	18.0	62		
179L6299N5A	18306	16	.6299	16	15.2	152	24.0	82		

Inch Sizes Available upon request.

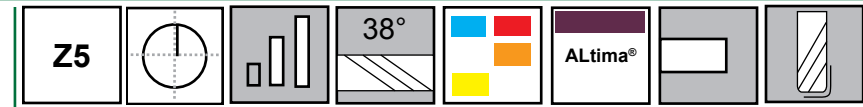
Technical information on [page 240](#).

Metric (mm)	
D1	Tolerance h10
3.00	+.000/-0.040
>3.00-6.00	+.000/-0.048
>6.00-10.00	+.000/-0.058
>10.00-16.00	+.000/-0.070

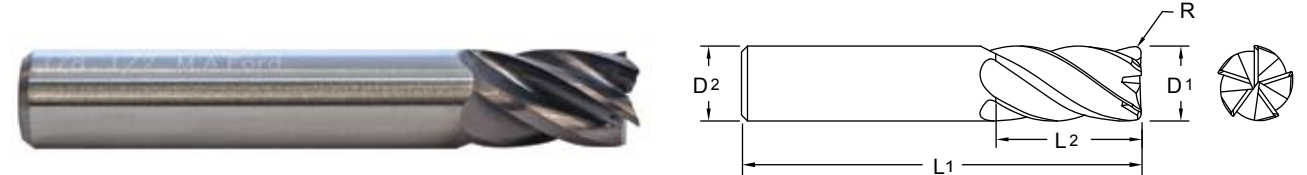


**5
Flute**

**TuffCut® XR
Series 178**



Designed for EXTREME Productivity. Gain 20% or more in productivity over four flute styles. Smooth cutting action to eliminate vibration.



ALtima®		Diameter			Shank		OAL		Flute Length		Corner Radius	
		D1			D2		L1		L2		R	
Tool No.	EDP	Fraction	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
17811800A	17959		3	.1181		6		57		8		
17811810A	17998		3	.1181		3		75		25		
17812500A	17800	1/8		.1250	1/8		1-1/2		1/8			
17812510A	17801	1/8		.1250	1/8		1-1/2		3/8			
17815600A	17802	5/32		.1562	3/16		2		3/16			
17815610A	17803	5/32		.1562	3/16		2		7/16			
17815700A	17961		4	.1575		6		57		11		
17815710A	17999		4	.1575		4		75		25		
17818700A	17804	3/16		.1875	3/16		2		3/16			
17818710A	17805	3/16		.1875	3/16		2		7/16			
17819600A	17963		5	.1968		6		57		13		
17819610A	18026		5	.1968		5		75		25		
17821800A	17806	7/32		.2187	1/4		2		1/4			
17821810A	17807	7/32		.2187	1/4		2-1/2		7/16			
17823600A	17965		6	.2362		6		57		13		
17823601A	17966		6	.2362		6		57		13		0.500
17823610A	18027		6	.2362		6		75		25		
17825000A	17808	1/4		.2500	1/4		2		3/8			
17825002A	17829	1/4		.2500	1/4		2		3/8		0.015	
17825004A	17830	1/4		.2500	1/4		2		3/8		0.030	
17825010A	17809	1/4		.2500	1/4		2-1/2		5/8			
17825012A	17831	1/4		.2500	1/4		2-1/2		5/8		0.015	
17825014A	17832	1/4		.2500	1/4		2-1/2		5/8		0.030	
17828100A	17810	9/32		.2812	5/16		2-1/2		5/8			
17828102A	17835	9/32		.2812	5/16		2-1/2		5/8		0.015	
17828104A	17836	9/32		.2812	5/16		2-1/2		5/8		0.030	
17831200A	17811	5/16		.3125	5/16		2		7/16			
17831202A	17837	5/16		.3125	5/16		2		7/16		0.015	
17831204A	17838	5/16		.3125	5/16		2		7/16		0.030	
17831210A	17812	5/16		.3125	5/16		2-1/2		13/16			
17831212A	17839	5/16		.3125	5/16		2-1/2		13/16		0.015	
17831214A	17840	5/16		.3125	5/16		2-1/2		13/16		0.030	
17831500A	17968		8	.3150		8		63		19		
17831501A	17969		8	.3150		8		63		19		0.500
17831510A	18028		8	.3150		8		75		30		
17834300A	17813	11/32		.3438	3/8		2-1/2		13/16			
17834302A	17843	11/32		.3438	3/8		2-1/2		13/16		0.015	
17834304A	17844	11/32		.3438	3/8		2-1/2		13/16		0.030	
17837500A	17814	3/8		.3750	3/8		2		1/2			
17837502A	17845	3/8		.3750	3/8		2		1/2		0.015	
17837504A	17846	3/8		.3750	3/8		2		1/2		0.030	
17837510A	17815	3/8		.3750	3/8		2-1/2		7/8			
17837512A	17847	3/8		.3750	3/8		2-1/2		7/8		0.015	
17837514A	17848	3/8		.3750	3/8		2-1/2		7/8		0.030	

Inch	
D1	Tolerance
1/8-1/4	+.000/-0.002
> 1/4-1.0	+.000/-0.003

Metric (mm)	
D1	Tolerance h10
3.00	+.000/-0.040
>3.00-6.00	+.000/-0.048
>6.00-10.00	+.000/-0.058
>10.00-18.00	+.000/-0.070
>18.00-25.00	+.000/-0.084

Technical information on [page 242](#).

Series 178

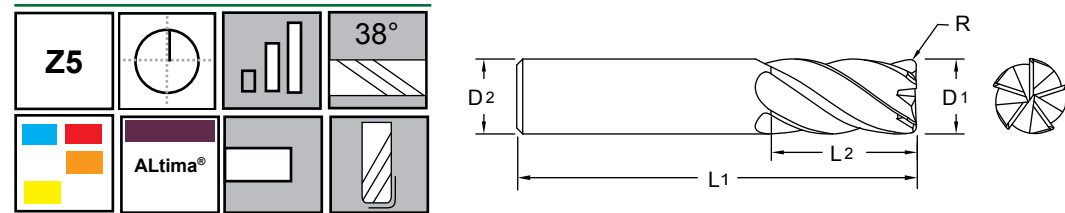
TuffCut® XR

4
Flute
Ball

Series 179L

TuffCut® XR

Series 178 Continued



ALtima®		Diameter			Shank		OAL	Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1	L2		R	
		Fraction	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	
17839300A	17971		10	.3937	10		72		22		
17839301A	17972		10	.3937	10		72		22		0.500
17839310A	18029		10	.3937	10		100		45		
17840600A	17816	13/32		.4062	7/16		2-3/4		7/8		
17840602A	17853	13/32		.4062	7/16		2-3/4		7/8		0.015
17840604A	17854	13/32		.4062	7/16		2-3/4		7/8		0.030
17843700A	17817	7/16		.4375	7/16		2-1/2		9/16		
17843702A	17855	7/16		.4375	7/16		2-1/2		9/16		0.015
17843704A	17856	7/16		.4375	7/16		2-1/2		9/16		0.030
17843710A	17818	7/16		.4375	7/16		2-3/4		1		
17843712A	17857	7/16		.4375	7/16		2-3/4		1		0.015
17843714A	17858	7/16		.4375	7/16		2-3/4		1		0.030
17846800A	17819	15/32		.4688	1/2		3		1		
17846802A	17863	15/32		.4688	1/2		3		1		0.015
17846804A	17864	15/32		.4688	1/2		3		1		0.030
17847200A	17974		12	.4724	12		83		26		
17847202A	17975		12	.4724	12		83		26		0.750
17847210A	18030		12	.4724	12		150		75		
17850000A	17820	1/2		.5000	1/2		2-1/2		5/8		
17850002A	17865	1/2		.5000	1/2		2-1/2		5/8		0.015
17850004A	17866	1/2		.5000	1/2		2-1/2		5/8		0.030
17850010A	17821	1/2		.5000	1/2		3		1		
17850012A	17867	1/2		.5000	1/2		3		1		0.015
17850014A	17868	1/2		.5000	1/2		3		1		0.030
17850015A	17869	1/2		.5000	1/2		3		1		0.045
17850016A	17913	1/2		.5000	1/2		3		1		0.060
17850017A	17914	1/2		.5000	1/2		3		1		0.090
17850018A	17915	1/2		.5000	1/2		3		1		0.125
17855100A	17977		14	.5512	14		83		26		
17855102A	17978		14	.5512	14		83		26		0.750
17856200A	17822	9/16		.5625	9/16		3-1/2		1-1/8		
17856202A	17875	9/16		.5625	9/16		3-1/2		1-1/8		0.015
17856204A	17876	9/16		.5625	9/16		3-1/2		1-1/8		0.030
17862500A	17823	5/8		.6250	5/8		3		3/4		
17862502A	18006	5/8		.6250	5/8		3		3/4		0.015
17862504A	17877	5/8		.6250	5/8		3		3/4		0.030
17862505A	17878	5/8		.6250	5/8		3		3/4		0.045
17862510A	17824	5/8		.6250	5/8		3-1/2		1-1/4		
17862512A	18007	5/8		.6250	5/8		3-1/2		1-1/4		0.015
17862514A	17879	5/8		.6250	5/8		3-1/2		1-1/4		0.030
17862515A	17880	5/8		.6250	5/8		3-1/2		1-1/4		0.045
17862516A	17916	5/8		.6250	5/8		3-1/2		1-1/4		0.060
17862517A	17917	5/8		.6250	5/8		3-1/2		1-1/4		0.090
17862518A	17918	5/8		.6250	5/8		3-1/2		1-1/4		0.125
17862900A	17981		16	.6299	16		92		32		
17862903A	17982		16	.6299	16		92		32		1.000

Technical information on [page 242](#).

Series 178 Continued

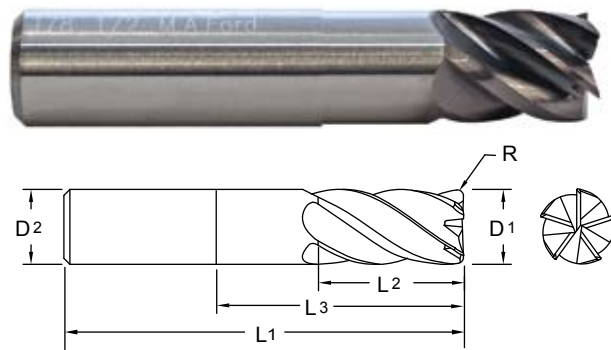
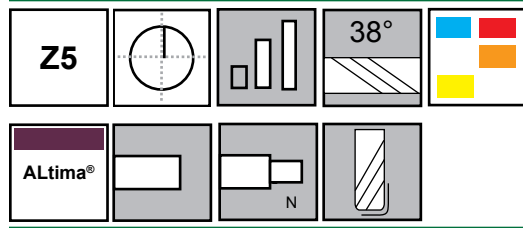
ALtima®		Diameter			Shank		OAL	Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1	L2		R	
		Fraction	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	
17862910A	18031		16	.6299		16		150		75	
17870800A	17983		18	.7087		18		92		32	
17870803A	17984		18	.7087		18		92		32	1.000
17875000A	17825	3/4		.7500	3/4		3		1		
17875002A	18011	3/4		.7500	3/4		3		1		0.015
17875004A	17887	3/4		.7500	3/4		3		1		0.030
17875005A	17888	3/4		.7500	3/4		3		1		0.045
17875010A	17826	3/4		.7500	3/4		4		1-1/2		
17875012A	18012	3/4		.7500	3/4		4		1-1/2		0.015
17875014A	17889	3/4		.7500	3/4		4		1-1/2		0.030
17875015A	17890	3/4		.7500	3/4		4		1-1/2		0.045
17875016A	17919	3/4		.7500	3/4		4		1-1/2		0.060
17875017A	17920	3/4		.7500	3/4		4		1-1/2		0.090
17875018A	17921	3/4		.7500	3/4		4		1-1/2		0.125
17878700A	17986		20	.7874		20		104		38	
17878703A	17987		20	.7874		20		104		38	1.000
17878710A	18032		20	.7874		20		150		75	
17898400A	17988		25	.9843		25		104		38	
17898403A	17989		25	.9843		25		104		38	1.000
17810000A	17827	1		1.0000	1		4		1		
17810010A	17828	1		1.0000	1		4		1-1/2		
17810012A	18015	1		1.0000	1		4		1-1/2		0.015
17810014A	17895	1		1.0000	1		4		1-1/2		0.030
17810015A	17896	1		1.0000	1		4		1-1/2		0.045
17810016A	17922	1		1.0000	1		4		1-1/2		0.060
17810017A	17923	1		1.0000	1		4		1-1/2		0.090
17810018A	17924	1		1.0000	1		4		1-1/2		0.125

Technical information on [page 242](#).



Extend the Life of Your Cutting Tools with M.A.Ford®'s Reconditioning Service

Series 178N



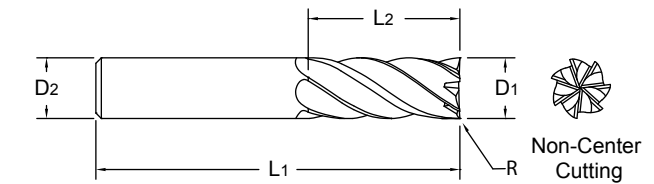
ALtima®		Diameter		Shank	OAL	Flute Length	Neck Length	Corner Radius	
Tool No.	EDP	Fraction	Decimal	D1	D2	L1	L2	L3	R
17825022NA	17833	1/4	.2500	1/4	4	3/4	2-1/8	0.015	
17825024NA	17834	1/4	.2500	1/4	4	3/4	2-1/8	0.030	
17831222NA	17841	5/16	.3125	5/16	4	1	2-1/8	0.015	
17831224NA	17842	5/16	.3125	5/16	4	1	2-1/8	0.030	
17837522NA	17849	3/8	.3750	3/8	4	1	2-1/8	0.015	
17837524NA	17850	3/8	.3750	3/8	4	1	2-1/8	0.030	
17837532NA	17851	3/8	.3750	3/8	6	1-1/4	3-3/8	0.015	
17837534NA	17852	3/8	.3750	3/8	6	1-1/4	3-3/8	0.030	
17843722NA	17859	7/16	.4375	7/16	4	1-1/4	2-1/8	0.015	
17843724NA	17860	7/16	.4375	7/16	4	1-1/4	2-1/8	0.030	
17843732NA	17861	7/16	.4375	7/16	6	1-1/2	3-3/8	0.015	
17843734NA	17862	7/16	.4375	7/16	6	1-1/2	3-3/8	0.030	
17850022NA	17925	1/2	.5000	1/2	4	1-1/4	2-1/8	0.015	
17850024NA	17870	1/2	.5000	1/2	4	1-1/4	2-1/8	0.030	
17850032NA	17871	1/2	.5000	1/2	5	1-3/8	3-1/8	0.015	
17850034NA	17872	1/2	.5000	1/2	5	1-3/8	3-1/8	0.030	
17850042NA	17873	1/2	.5000	1/2	6	1-1/2	4-1/8	0.015	
17850044NA	17874	1/2	.5000	1/2	6	1-1/2	4-1/8	0.030	
17862522NA	18008	5/8	.6250	5/8	4	1-1/2	2-1/8	0.015	
17862524NA	17881	5/8	.6250	5/8	4	1-1/2	2-1/8	0.030	
17862525NA	17882	5/8	.6250	5/8	4	1-1/2	2-1/8	0.045	
17862532NA	18009	5/8	.6250	5/8	5	1-3/4	3-1/8	0.015	
17862534NA	17883	5/8	.6250	5/8	5	1-3/4	3-1/8	0.030	
17862535NA	17884	5/8	.6250	5/8	5	1-3/4	3-1/8	0.045	
17862542NA	18010	5/8	.6250	5/8	6	2	4	0.015	
17862544NA	17885	5/8	.6250	5/8	6	2	4	0.030	
17862545NA	17886	5/8	.6250	5/8	6	2	4	0.045	
17875022NA	18013	3/4	.7500	3/4	5	1-7/8	3	0.015	
17875024NA	17891	3/4	.7500	3/4	5	1-7/8	3	0.030	
17875025NA	17892	3/4	.7500	3/4	5	1-7/8	3	0.045	
17875032NA	18014	3/4	.7500	3/4	6	2-1/4	4	0.015	
17875034NA	17893	3/4	.7500	3/4	6	2-1/4	4	0.030	
17875035NA	17894	3/4	.7500	3/4	6	2-1/4	4	0.045	
17810022NA	18016	1	1.0000	1	5	2-1/4	3	0.015	
17810024NA	17897	1	1.0000	1	5	2-1/4	3	0.030	
17810025NA	17898	1	1.0000	1	5	2-1/4	3	0.045	
17810032NA	18017	1	1.0000	1	6	3	4	0.015	
17810034NA	17899	1	1.0000	1	6	3	4	0.030	
17810035NA	17900	1	1.0000	1	6	3	4	0.045	

Technical information on page 242.

TuffCut® XR7 Series 180



40% increase in productivity over a 5 flute tool.



- Designed specifically for Titanium, Inconel and similar materials.
- ALtima® Blaze coating for increased performance.

ALtima® Blaze		Diameter		Shank	OAL	Flute Length	Corner Radius	
Tool No.	EDP	Inch	Decimal	D1	D2	L1	L2	R
18050000B	18512	1/2	.5000	1/2	3	5/8		
18050002B	18515	1/2	.5000	1/2	3	5/8	.015	
18050004B	18517	1/2	.5000	1/2	3	5/8	.030	
18050006B	18519	1/2	.5000	1/2	3	5/8	.060	
18050007B	18521	1/2	.5000	1/2	3	5/8	.090	
18050008B	18523	1/2	.5000	1/2	3	5/8	.125	
18050010B	18514	1/2	.5000	1/2	3	1-1/4		
18050012B	18516	1/2	.5000	1/2	3	1-1/4	.015	
18050014B	18518	1/2	.5000	1/2	3	1-1/4	.030	
18050016B	18520	1/2	.5000	1/2	3	1-1/4	.060	
18050017B	18522	1/2	.5000	1/2	3	1-1/4	.090	
18050018B	18524	1/2	.5000	1/2	3	1-1/4	.125	
18062500B	18532	5/8	.6250	5/8	3-1/2	3/4		
18062502B	18535	5/8	.6250	5/8	3-1/2	3/4	.015	
18062504B	18537	5/8	.6250	5/8	3-1/2	3/4	.030	
18062506B	18539	5/8	.6250	5/8	3-1/2	3/4	.060	
18062507B	18541	5/8	.6250	5/8	3-1/2	3/4	.090	
18062508B	18543	5/8	.6250	5/8	3-1/2	3/4	.125	
18062510B	18534	5/8	.6250	5/8	3-1/2	1-1/4		
18062512B	18536	5/8	.6250	5/8	3-1/2	1-1/4	.015	
18062514B	18538	5/8	.6250	5/8	3-1/2	1-1/4	.030	
18062516B	18540	5/8	.6250	5/8	3-1/2	1-1/4	.060	
18062517B	18542	5/8	.6250	5/8	3-1/2	1-1/4	.090	
18062518B	18544	5/8	.6250	5/8	3-1/2	1-1/4	.125	
18075000B	18570	3/4	.7500	3/4	4	1		
180750012B	18585	3/4	.7500	3/4	4	1	.250	
18075002B	18573	3/4	.7500	3/4	4	1	.015	
18075004B	18575	3/4	.7500	3/4	4	1	.030	
18075006B	18577	3/4	.7500	3/4	4	1	.060	
18075007B	18579	3/4	.7500	3/4	4	1	.090	
18075008B	18581	3/4	.7500	3/4	4	1	.125	
18075009B	18583	3/4	.7500	3/4	4	1	.190	
18075010B	18572	3/4	.7500	3/4	4	1-1/2		
18075012B	18574	3/4	.7500	3/4	4	1-1/2	.015	
18075014B	18576	3/4	.7500	3/4	4	1-1/2	.030	
18075016B	18578	3/4	.7500	3/4	4	1-1/2	.060	
18075017B	18580	3/4	.7500	3/4	4	1-1/2	.090	
18075018B	18582	3/4	.7500	3/4	4	1-1/2	.125	
18075019B	18584	3/4	.7500	3/4	4	1-1/2	.190	

Technical information on page 244.

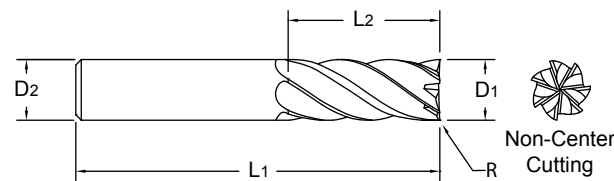
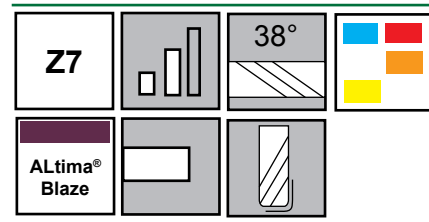
Inch	
D1	Tolerance
1/2-1.0	+0.00/-0.011

ALtima® Blaze features high temperature hardness and oxidation resistance that provides extreme wear resistance under all machining conditions.

Coating Properties

	ALtima® Blaze
Micro Hardness (HV)	3200
Max. Working Temperature	1100°C 2012°F
Friction Coefficient	0.35

Series 180 Continued



ALtima® Blaze	Tool No.	EDP	Diameter		Shank		OAL		Flute Length		Corner Radius
			Inch	Decimal	Inch	Inch	Inch	Inch	Inch	Inch	
	180750112B	18586	3/4	.7500	3/4	4	1-1/2	.250			
	18010000B	18597	1	1.0000	1	4	1				
	180100012B	18611	1	1.0000	1	4	1	.250			
	18010002B	18599	1	1.0000	1	4	1	.015			
	18010004B	18601	1	1.0000	1	4	1	.030			
	18010006B	18603	1	1.0000	1	4	1	.060			
	18010007B	18615	1	1.0000	1	4	1	.090			
	18010008B	18607	1	1.0000	1	4	1	.125			
	18010009B	18609	1	1.0000	1	4	1	.190			
	18010010B	18598	1	1.0000	1	4	1-1/2				
	180100112B	18612	1	1.0000	1	4	1-1/2	.250			
	18010012B	18613	1	1.0000	1	4	1-1/2	.015			
	18010014B	18602	1	1.0000	1	4	1-1/2	.030			
	18010016B	18604	1	1.0000	1	4	1-1/2	.060			
	18010017B	18606	1	1.0000	1	4	1-1/2	.090			
	18010018B	18608	1	1.0000	1	4	1-1/2	.125			
	18010019B	18616	1	1.0000	1	4	1-1/2	.190			

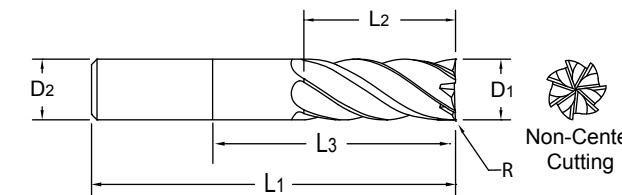
Technical information on [page 244](#).



TuffCut® XR7 Series 180N



40% increase in productivity over a 5 flute tool.



- Designed specifically for Titanium, Inconel and similar materials.
- ALtima® Blaze coating for increased performance.

ALtima® Blaze	Tool No	EDP	Diameter			Shank		OAL		Flute Length		Neck Length		Corner Radius
			Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
	18047203NB	18500	12.0	.4724	12.0	120	30	60	1.0					
	18047205NB	18502	12.0	.4724	12.0	120	30	60	2.0					
	18047207NB	18504	12.0	.4724	12.0	120	30	60	3.0					
	18047209NB	18506	12.0	.4724	12.0	120	30	60	4.0					
	18050024NB	18526	1/2	.5000	1/2	4	1-1/4	2-1/8	.030					
	18062524NB	18546	5/8	.6250	5/8	4	1-1/4	2-1/8	.030					
	18062903NB	18548	16.0	.6299	16.0	150	40	80	1.0					
	18062905NB	18550	16.0	.6299	16.0	150	40	80	2.0					
	18062907NB	18552	16.0	.6299	16.0	150	40	80	3.0					
	18062909NB	18554	16.0	.6299	16.0	150	40	80	4.0					
	18075024NB	18588	3/4	.7500	3/4	5	1-7/8	3	.030					
	18078713NB	18590	20.0	.7874	20.0	150	50	100	1.0					
	18078715NB	18592	20.0	.7874	20.0	150	50	100	2.0					
	18078717NB	18594	20.0	.7874	20.0	150	50	100	3.0					
	18078719NB	18596	20.0	.7874	20.0	150	50	100	4.0					
	180100205NB	18614	1	1.0000	1	6	3	4	.045					

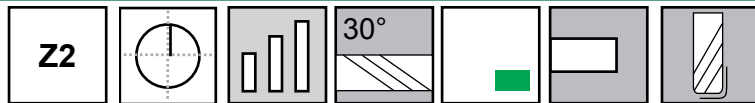
Inch	
D1	Tolerance
1/2-1.0	+0.000/-0.011

Metric (mm)	
D1	Tolerance
12.00-20.00	+0.000/-0.028

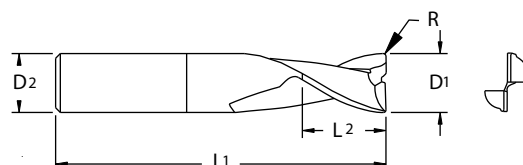
Technical information on [page 244](#).

ISO 9001:2000 Certified
An ESOP Company

TuffCut® AL
Series 135



The geometry of M.A. Ford® 135 Series solid carbide end mill allows it to be run at extremely high chip loads surpassing the current market leaders.



- Extremely high chip loads - .040"/1mm per tooth and above.
- Performs equally well across a broad range of operating speeds.
- Zirconium coating also available.

Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13511810	13523		3.0	.1181		3.0		38		3.5		0.20
13515750	13533		4.0	.1575		4.0		51		4.8		0.20
13518750	13500	3/16		.1875	3/16		2		1/4		0.008	
13518751	13513	3/16		.1875	3/16		3		1/4		0.008	
13519680	13502		5.0	.1968		5.0		51		6.0		0.25
13523620	13504		6.0	.2362		6.0		64		7.0		0.30
13525000	13506	1/4		.2500	1/4		2-1/2		5/16		0.011	
13525001	13514	1/4		.2500	1/4		3-1/2		5/16		0.011	
13531500	13508		8.0	.3150		8.0		64		9.5		0.35
13537500	13510	3/8		.3750	3/8		2-1/2		1/2		0.015	
13537501	13511	3/8		.3750	3/8		3		1/2		0.015	
13537502	13512	3/8		.3750	3/8		4		1/2		0.015	
13539370	13515		10.0	.3937		10.0		70		12.0		0.50
13539371	13516		10.0	.3937		10.0		76		12.0		0.50
13539372	13517		10.0	.3937		10.0		89		12.0		0.50
13547240	13525		12.0	.4724		12.0		76		14.0		0.50
13547241	13526		12.0	.4724		12.0		102		14.0		0.50
13547242	13527		12.0	.4724		12.0		127		14.0		0.50
13550000	13520	1/2		.5000	1/2		3		5/8		0.020	
13550001	13521	1/2		.5000	1/2		4		5/8		0.020	
13550002	13522	1/2		.5000	1/2		5		5/8		0.020	
13555120	13552		14.0	.5512		14.0		89		16.0		0.50
13555121	13554		14.0	.5512		14.0		102		16.0		0.50
13555122	13573		14.0	.5512		14.0		127		16.0		0.50
13562500	13538	5/8		.6250	5/8		3-1/2		3/4		0.025	
13562501	13539	5/8		.6250	5/8		4-5/8		3/4		0.025	
13562502	13543	5/8		.6250	5/8		5-1/4		3/4		0.025	
13562990	13535		16.0	.6299		16.0		89		18.0		0.75
13562991	13536		16.0	.6299		16.0		117		18.0		0.75
13562992	13537		16.0	.6299		16.0		133		18.0		0.75
13570870	13563		18.0	.7087		18.0		102		20.0		0.75
13570871	13568		18.0	.7087		18.0		127		20.0		0.75
13570872	13574		18.0	.7087		18.0		152		20.0		0.75
13575000	13530	3/4		.7500	3/4		4		1		0.030	

Inch	
D1	Tolerance
3/16-1/4	+ .000/- .002
> 1/4-1	+ .000/- .003

Metric (mm)	
D1	Tolerance h10
3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-18.00	+ .000/- .070
>18.00-25.00	+ .000/- .084

Technical information on page 224.

Series 135 Continued

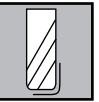
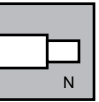
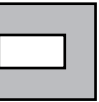
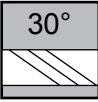
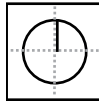
Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13575001	13531	3/4		.7500	3/4		5		1		0.030	
13575002	13532	3/4		.7500	3/4		6		1		0.030	
13578740	13545		20.0	.7874		20.0		102		22.0		0.75
13578741	13546		20.0	.7874		20.0		127		22.0		0.75
13578742	13547		20.0	.7874		20.0		152		22.0		0.75
13598430	13555		25.0	.9843		25.0		102		25.0		0.75
13598431	13556		25.0	.9843		25.0		127		25.0		0.75
13598432	13557		25.0	.9843		25.0		152		25.0		0.75
13510000	13540	1		1.0000	1		4		1-1/4		0.045	
13510001	13541	1		1.0000	1		5		1-1/4		0.045	
13510002	13542	1		1.0000	1		6		1-1/4		0.045	

Technical information on page 224.



TuffCut® AL
Series 135N

Z2



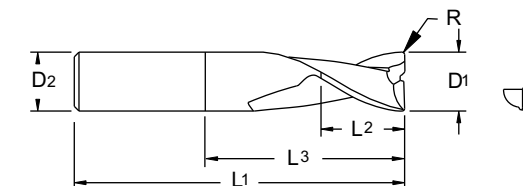
The geometry of M.A. Ford® 135 Series solid carbide end mill allows it to be run at extremely high chip loads surpassing the current market leaders.

Necked		Diameter			Shank		OAL		Flute Length		Neck Length		Corner Radius	
		D1			D2		L1		L2		L3		R	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13511800N3	96620	3.0	.1181		3.0		38		3.5		11			
13511800N5	96623	3.0	.1181		3.0		38		3.5		16			
13511801N3	96621	3.0	.1181		3.0		38		3.5		11		0.50	
13511801N5	96624	3.0	.1181		3.0		38		3.5		16		0.50	
13511803N3	96622	3.0	.1181		3.0		38		3.5		11		1.00	
13511803N5	96625	3.0	.1181		3.0		38		3.5		16		1.00	
13511810N	13524	3.0	.1181		3.0		38		3.5		11		0.20	
13515700N3	96626	4.0	.1575		4.0		51		4.8		14			
13515700N5	96629	4.0	.1575		4.0		51		4.8		22			
13515701N3	96627	4.0	.1575		4.0		51		4.8		14		0.50	
13515701N5	96630	4.0	.1575		4.0		51		4.8		22		0.50	
13515703N3	96628	4.0	.1575		4.0		51		4.8		14		1.00	
13515703N5	96631	4.0	.1575		4.0		51		4.8		22		1.00	
13515750N	13534	4.0	.1575		4.0		51		4.8		22		0.20	
13518750N	13501	3/16	.1875		3/16		2		1/4		9/16		0.008	
13518751N	13518	3/16	.1875		3/16		3		1/4		1-9/16		0.008	
13519600N3	96632	5.0	.1968		6.0		64		6.0		17			
13519600N5	96635	5.0	.1968		6.0		64		6.0		27			
13519601N3	96633	5.0	.1968		6.0		64		6.0		17		0.50	
13519601N5	96636	5.0	.1968		6.0		64		6.0		27		0.50	
13519603N3	96634	5.0	.1968		6.0		64		6.0		17		1.00	
13519603N5	96637	5.0	.1968		6.0		64		6.0		27		1.00	
13519680N	13503	5.0	.1968		5.0		51		6.0		22		0.25	
13523600N3	96638	6.0	.2362		6.0		64		7.0		20			
13523600N5	96643	6.0	.2362		6.0		64		7.0		32			
13523601N3	96639	6.0	.2362		6.0		64		7.0		20		0.50	
13523601N5	96644	6.0	.2362		6.0		64		7.0		32		0.50	
13523603N3	96640	6.0	.2362		6.0		64		7.0		20		1.00	
13523603N5	96645	6.0	.2362		6.0		64		7.0		32		1.00	
13523604N3	96641	6.0	.2362		6.0		64		7.0		20		1.50	
13523604N5	96646	6.0	.2362		6.0		64		7.0		32		1.50	
13523605N3	96642	6.0	.2362		6.0		64		7.0		20		2.00	
13523605N5	96647	6.0	.2362		6.0		64		7.0		32		2.00	
13523620N	13505	6.0	.2362		6.0		64		7.0		26		0.30	
13525000N	13507	1/4	.2500		1/4		2-1/2		5/16		3/4		0.011	
13525001N	13519	1/4	.2500		1/4		3-1/2		5/16		1-3/4		0.011	
13531500N	13509	8.0	.3150		8.0		64		9.5		26		0.35	
13531500N3	96648	8.0	.3150		8.0		64		9.5		26			
13531500N5	96654	8.0	.3150		8.0		75		9.5		42			
13531501N3	96649	8.0	.3150		8.0		64		9.5		26		0.50	
13531501N5	96655	8.0	.3150		8.0		75		9.5		42		0.50	
13531503N3	96650	8.0	.3150		8.0		64		9.5		26		1.00	
13531503N5	96656	8.0	.3150		8.0		75		9.5		42		1.00	
13531504N3	96651	8.0	.3150		8.0		64		9.5		26		1.50	
13531504N5	96657	8.0	.3150		8.0		75		9.5		42		1.50	
13531505N3	96652	8.0	.3150		8.0		64		9.5		26		2.00	
13531505N5	96658	8.0	.3150		8.0		75		9.5		42		2.00	
13531507N3	96653	8.0	.3150		8.0		64		9.5		26		3.00	

Inch	
D1	Tolerance
3/16-1/4	+0.000/-0.002
> 1/4-1	+0.000/-0.003

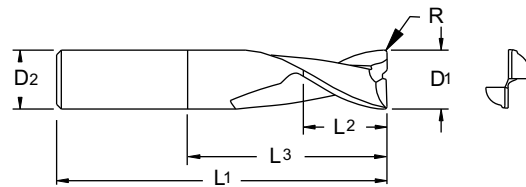
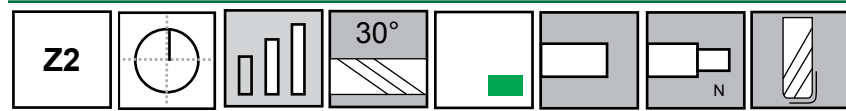
Metric (mm)	
D1	Tolerance h10
3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-25.00	+0.000/-0.084

Series 135N Continued



Necked		Diameter			Shank		OAL		Flute Length		Neck Length		Corner Radius	
		D1			D2		L1		L2		L3		R	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13531507N5	96659		8.0	.3150		8.0		75		9.5		42		3.00
13537500N	13560	3/8		.3750	3/8		2-1/2		1/2		7/8		0.015	
13537501N	13561	3/8		.3750	3/8		3		1/2		1-3/8		0.015	
13537502N	13562	3/8		.3750	3/8		4		1/2		2-3/8		0.015	
13539300N3	96660		10.0	.3937		10.0		76		12.0		34		
13539301N3	96661		10.0	.3937		10.0		76		12.0		34		0.50
13539301N5	96666		10.0	.3937		10.0		89		12.0		52		0.50
13539303N3	96662		10.0	.3937		10.0		76		12.0		34		1.00
13539303N5	96667		10.0	.3937		10.0		89		12.0		52		1.00
13539304N3	96663		10.0	.3937		10.0		76		12.0		34		1.50
13539304N5	96668		10.0	.3937		10.0		89		12.0		52		1.50
13539305N3	96664		10.0	.3937		10.0		76		12.0		34		2.00
13539305N5	96669		10.0	.3937		10.0		89		12.0		52		2.00
13539307N3	96665		10.0	.3937		10.0		76		12.0		34		3.00
13539307N5	96670		10.0	.3937		10.0		89		12.0		52		3.00
13539370N	13565		10.0	.3937		10.0		70		12.0		28		0.50
13539371N	13566		10.0	.3937		10.0		76		12.0		34		0.50
13539372N	13567		10.0	.3937		10.0		89		12.0		47		0.50
13547200N3	96671		12.0	.4724		12.0		76		14.0		38		
135472011N3	96721		12.0	.4724		12.0		76		14.0		38		5.00
135472011N5	96723		12.0	.4724		12.0		110		14.0		62		5.00
13547201N3	96672		12.0	.4724		12.0		76		14.0		38		0.50
13547201N5	96678		12.0	.4724		12.0		110		14.0		62		0.50
13547203N3	96673		12.0	.4724		12.0		76		14.0		38		1.00
13547203N5	96679		12.0	.4724		12.0		110		14.0		62		1.00
13547204N3	96674		12.0	.4724		12.0		76		14.0		38		1.50
13547204N5	96680		12.0	.4724		12.0		110		14.0		62		1.50
13547205N3	96675		12.0	.4724		12.0		76		14.0		38		2.00
13547205N5	96681		12.0	.4724		12.0		110		14.0		62		2.00
13547207N3	96676		12.0	.4724		12.0		76		14.0		38		3.00
13547207N5	96682		12.0	.4724		12.0		110		14.0		62		3.00
13547209N3	96677		12.0	.4724		12.0		76		14.0		38		4.00
13547209N5	96683		12.0	.4724		12.0		110		15.0		62		4.00
13547240N	13575		12.0	.4724		12.0		76		14.0		28		0.50
13547241N	13576		12.0	.4724		12.0		102		14.0		54		0.50
13547242N	13577		12.0	.4724		12.0		127		14.0		79		0.50
13550000N	13570	1/2		.5000	1/2		3		5/8		1-1/8		0.020	
13550001N	13571	1/2		.5000	1/2		4		5/8		2-1/8		0.020	
13550002N	13572	1/2		.5000	1/2		5		5/8		3-1/8		0.020	
13555120N	13553		14.0	.5512		14.0		89		16.0		42		0.50
13555121N	13558		14.0	.5512		14.0		102		16.0		55		0.50
13555122N	13559		14.0	.5512		14.0		127		16.0		80		0.50
13562500N	13544	5/8		.6250	5/8		3-1/2		3/4		1-1/2		0.025	
13562501N	13548	5/8		.6250	5/8		4-5/8		3/4		2-1/2		0.025	
13562502N	13549	5/8		.6250	5/8		5-1/4		3/4		3-1/2		0.025	
13562900N3	96684		16.0	.6299		16.0		117		18.0		53		
13562901N3	96685		16.0	.6299		16.0								

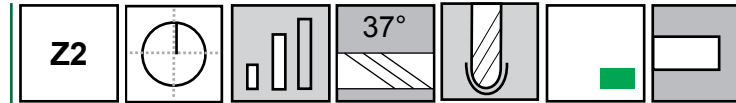
Series 135N Continued



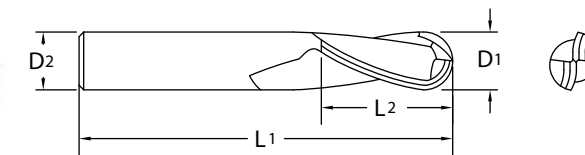
Technical information on page 224.

Necked		Diameter			Shank		OAL	Flute Length		Neck Length	Corner Radius	
		D1			D2		L1	L2	L3	R		
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13562904N5	96693		16.0	.6299		16.0	127		18.0		85	1.50
13562905N3	96688		16.0	.6299		16.0	117		18.0		53	2.00
13562905N5	96694		16.0	.6299		16.0	127		18.0		85	2.00
13562907N3	96689		16.0	.6299		16.0	117		18.0		53	3.00
13562907N5	96695		16.0	.6299		16.0	127		18.0		85	3.00
13562909N3	96690		16.0	.6299		16.0	117		18.0		53	4.00
13562909N5	96696		16.0	.6299		16.0	127		18.0		85	4.00
13562990N	13585		16.0	.6299		16.0	89		18.0		39	0.75
13562991N	13586		16.0	.6299		16.0	117		18.0		83	0.75
13562992N	13587		16.0	.6299		16.0	133		18.0		99	0.75
13570870N	13564		18.0	.7087		18.0	102		20.0		52	0.75
13570871N	13569		18.0	.7087		18.0	127		20.0		77	0.75
13570872N	13578		18.0	.7087		18.0	152		20.0		102	0.75
13575000N	13580	3/4		.7500	3/4		4		1		1-7/8	0.030
13575001N	13581	3/4		.7500	3/4		5		1		2-7/8	0.030
13575002N	13582	3/4		.7500	3/4		6		1		3-7/8	0.030
135787011N3	96722		20.0	.7874		20.0	127		22.0		65	5.00
135787011N5	96724		20.0	.7874		20.0	152		22.0		105	5.00
13578701N3	96697		20.0	.7874		20.0	127		22.0		65	0.50
13578701N5	96703		20.0	.7874		20.0	152		22.0		105	0.50
13578703N3	96698		20.0	.7874		20.0	127		22.0		65	1.00
13578703N5	96704		20.0	.7874		20.0	152		22.0		105	1.00
13578704N3	96699		20.0	.7874		20.0	127		22.0		65	1.50
13578704N5	96705		20.0	.7874		20.0	152		22.0		105	1.50
13578705N3	96700		20.0	.7874		20.0	127		22.0		65	2.00
13578705N5	96706		20.0	.7874		20.0	152		22.0		105	2.00
13578707N3	96701		20.0	.7874		20.0	127		22.0		65	3.00
13578707N5	96707		20.0	.7874		20.0	152		22.0		105	3.00
13578709N3	96702		20.0	.7874		20.0	127		22.0		65	4.00
13578709N5	96708		20.0	.7874		20.0	152		22.0		105	4.00
13578740N	13594		20.0	.7874		20.0	102		22.0		50	0.75
13578741N	13595		20.0	.7874		20.0	127		22.0		75	0.75
13578742N	13596		20.0	.7874		20.0	152		22.0		100	0.75
13598401N3	96709		25.0	.9843		25.0	127		25.0		80	0.50
13598401N5	96715		25.0	.9843		25.0	180		25.0		130	0.50
13598403N3	96710		25.0	.9843		25.0	127		25.0		80	1.00
13598403N5	96716		25.0	.9843		25.0	180		25.0		130	1.00
13598404N3	96711		25.0	.9843		25.0	127		25.0		80	1.50
13598404N5	96717		25.0	.9843		25.0	180		25.0		130	1.50
13598405N3	96712		25.0	.9843		25.0	127		25.0		80	2.00
13598405N5	96718		25.0	.9843		25.0	180		25.0		130	2.00
13598407N3	96713		25.0	.9843		25.0	127		25.0		80	3.00
13598407N5	96719		25.0	.9843		25.0	180		25.0		130	3.00
13598409N3	96714		25.0	.9843		25.0	127		25.0		80	4.00
13598409N5	96720		25.0	.9843		25.0	180		25.0		130	4.00
13598430N	13597		25.0	.9843		25.0	102		25.0		36	0.75
13598431N	13598		25.0	.9843		25.0	127		25.0		61	0.75
13598432N	13599		25.0	.9843		25.0	152		25.0		86	0.75
13510000N	13590	1		1.0000	1		4		1-1/4		1-5/8	0.045
13510001N	13591	1		1.0000	1		5		1-1/4		2-5/8	0.045
13510002N	13592	1		1.0000	1		6		1-1/4		3-5/8	0.045

TuffCut® AL Series 135B



The geometry of M.A. Ford® 135 Series solid carbide end mill allows it to be run at extremely high chip loads surpassing the current market leaders.



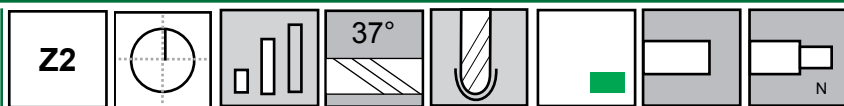
- Performs equally well across a broad range of operating speeds.
- Zirconium coating also available.

Uncoated		Diameter		Shank	OAL	Flute Length	
		D1		D2	L1	L2	
Tool No.	EDP	Inch	Decimal	Inch	Inch	Inch	
135B12500	13440	1/8	.1250	1/8	1-1/2	3/8	
135B12501	13442	1/8	.1250	1/8	2	1/2	
135B18750	13444	3/16	.1875	3/16	2	3/8	
135B18751	13446	3/16	.1875	3/16	2-1/2	5/8	
135B25000	13448	1/4	.2500	1/4	2-1/2	1/2	
135B25001	13450	1/4	.2500	1/4	2-1/2	3/4	
135B31250	13452	5/16	.3125	5/16	2-1/2	1/2	
135B31251	13454	5/16	.3125	5/16	2-1/2	13/16	
135B37500	13456	3/8	.3750	3/8	2-1/2	5/8	
135B37501	13458	3/8	.3750	3/8	2-1/2	1	
135B43750	13460	7/16	.4375	7/16	2-3/4	9/16	
135B43751	13462	7/16	.4375	7/16	2-3/4	1	
135B50000	13464	1/2	.5000	1/2	3	5/8	
135B50001	13466	1/2	.5000	1/2	3	1-1/4	
135B50002	13468	1/2	.5000	1/2	6	1-1/4	
135B62500	13470	5/8	.6250	5/8	3-1/2	1-1/4	
135B62501	13472	5/8	.6250	5/8	4	1-5/8	
135B75000	13474	3/4	.7500	3/4	4	1	
135B75001	13476	3/4	.7500	3/4	4	1-5/8	
135B10000	13478	1	1.0000	1	4	1-1/2	
135B10001	13480	1	1.0000	1	5	2-1/4	

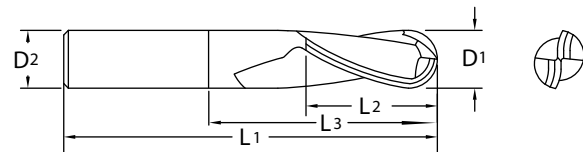
Inch	
D1	Tolerance
1/8-1/4	+.000/-0.002
> 1/4-1	+.000/-0.003

Technical information on page 228.

TuffCut® AL Series 135BN

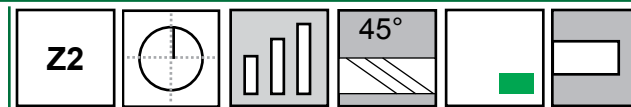


The geometry of M.A. Ford® 135 Series solid carbide end mill allows it to be run at extremely high chip loads surpassing the current market leaders.



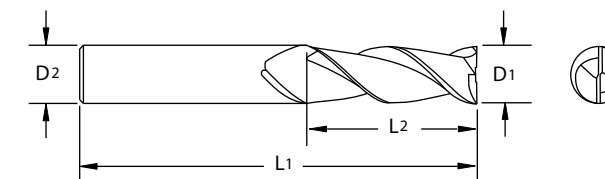
- Performs equally well across a broad range of operating speeds.
- Zirconium coating also available.

TuffCut® AL Series 136



High performance aluminum finisher out performs competitors.

- Available with corner radius upon request. Call customer service for radius pricing.



Uncoated		Diameter			Shank		OAL		Flute Length		Neck Length	
		D1			D2		L1		L2		L3	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
135B0787N5	13252	2.0	.0787		6.0		75.0		4.0		12.0	
135B1181N3	13236	3.0	.1181		3.0		38.0		5.0		11.0	
135B1181N5	13254	3.0	.1181		6.0		75.0		5.0		17.0	
135B1575N3	13238	4.0	.1575		4.0		51.0		6.0		14.0	
135B1575N5	13256	4.0	.1575		6.0		75.0		6.0		22.0	
135B1968N3	13240	5.0	.1968		5.0		64.0		7.0		17.0	
135B1968N5	13258	5.0	.1968		6.0		75.0		7.0		27.0	
135B2362N3	13242	6.0	.2362		6.0		64.0		8.0		20.0	
135B2362N5	13260	6.0	.2362		6.0		110.0		8.0		32.0	
135B25001N	13482	1/4	.2500		1/4		4		3/4		2-1/8	
135B31251N	13484	5/16	.3125		5/16		4		13/16		2-1/8	
135B3150N3	13244	8.0	.3150		8.0		64.0		10.0		26.0	
135B3150N5	13262	8.0	.3150		8.0		110.0		10.0		42.0	
135B37501N	13486	3/8	.3750		3/8		4		1		2-1/8	
135B3937N3	13246	10.0	.3937		10.0		70.0		12.0		32.0	
135B3937N5	13264	10.0	.3937		10.0		110.0		12.0		52.0	
135B4724N3	13248	12.0	.4724		12.0		76.0		16.0		38.0	
135B4724N5	13266	12.0	.4724		12.0		120.0		16.0		62.0	
135B50001N	13488	1/2	.5000		1/2		4		1-1/4		2-1/8	
135B62501N	13490	5/8	.6250		5/8		6		1-5/8		3-3/8	
135B6299N3	13250	16.0	.6299		16.0		89.0		20.0		50.0	
135B6299N5	13268	16.0	.6299		16.0		130.0		20.0		82.0	
135B75001N	13492	3/4	.7500		3/4		6		1-5/8		3-3/8	
135B10000N	13494	1	1.0000		1		6		1-1/2		3-1/4	

Inch	
D1	Tolerance
1/4	+ .000/- .002
> 1/4-1	+ .000/- .003

Metric (mm)	
D1	Tolerance h10
2.00-3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-16.00	+ .000/- .070

Technical information on [page 228](#).

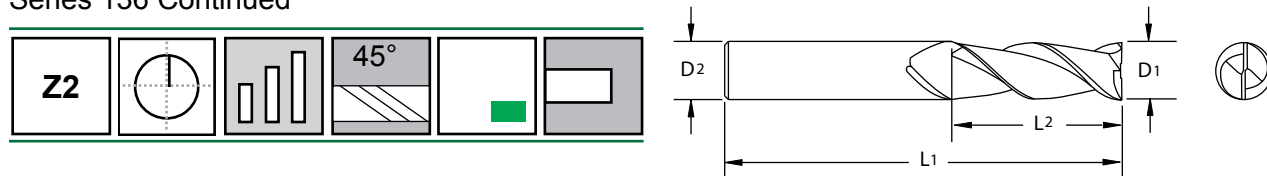
Uncoated		Diameter			Shank		OAL		Flute Length	
		D1			D2		L1		L2	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
13611810	13600		3.0	.1181		6.0		52		8.0
13612500	13641	1/8	.1250		1/8		1-1/2		1/4	
13612501	13642	1/8	.1250		1/8		1-1/2		1/2	
13612502	13643	1/8	.1250		1/8		2-1/2		1	
13612503	13671	1/8	.1250		1/8		1-1/2		3/8	
13612504	13672	1/8	.1250		1/8		2		3/4	
13615620	13673	5/32	.1562		5/32		2		5/16	
13615621	13674	5/32	.1562		5/32		2		9/16	
13615750	13602		4.0	.1575		6.0		55		11.0
13618750	13644	3/16	.1875		3/16		2		5/16	
13618751	13646	3/16	.1875		3/16		2-1/2		5/8	
13618752	13647	3/16	.1875		3/16		2-1/2		1	
13618753	13675	3/16	.1875		3/16		2		3/8	
13618754	13676	3/16	.1875		3/16		2-1/2		3/4	
13619680	13605		5.0	.1968		6.0		58		13.0
13623620	13610		6.0	.2362		6.0		58		13.0
13625000	13640	1/4	.2500		1/4		2-1/2		3/4	
13625001	13648	1/4	.2500		1/4		3-1/16		1-1/4	
13625002	13649	1/4	.2500		1/4		3-9/16		1-3/4	
13625003	13678	1/4	.2500		1/4		2		3/8	
13625004	13679	1/4	.2500		1/4		2		1/2	
13625005	13680	1/4	.2500		1/4		2-1/2		5/8	
13625006	13681	1/4	.2500		1/4		2-1/2		1	
13625007	13682	1/4	.2500		1/4		3		1-1/2	
13625008	13683	1/4	.2500		1/4		4		2	
13631250	13651	5/16	.3125		5/16		2		1/2	
13631251	13652	5/16	.3125		5/16		3-1/8		1-3/8	
13631252	13653	5/16	.3125		5/16		3-1/4		1-3/4	
13631253	13684	5/16	.3125		5/16		2		7/16	
13631254	13685	5/16	.3125		5/16		2-1/2		13/16	
13631500	13615		8.0	.3150		8.0		64		19.0
13637500	13645	3/8	.3750		3/8		2-1/2		3/4	
13637501	13654	3/8	.3750		3/8		3-1/4		1-1/2	
13637502	13660	3/8	.3750		3/8		4-1/4		2-1/2	
13637503	13686	3/8	.3750		3/8		2		1/2	
13637504	13687	3/8	.3750		3/8		2		5/8	
13637505	13688	3/8	.3750		3/8		2-1/2		1	
13637506	13689	3/8	.3750		3/8		3		1-1/4	

Inch	
D1	Tolerance
1/8-1/4	+ .000/- .002
>1/4-1.0	+ .000/- .003

Metric (mm)	
D1	Tolerance h10
3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-18.00	+ .000/- .070
>18.00-20.00	+ .000/- .084

Technical information on [page 226](#).

Series 136 Continued

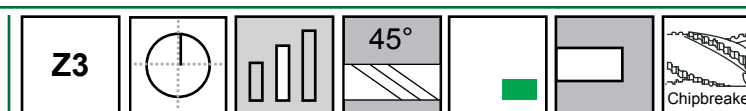


Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
13637507	13690	3/8		.3750	3/8		4		2	
13639370	13620		10.0	.3937		10.0		70		22.0
13647240	13625		12.0	.4724		12.0		84		26.0
13650000	13650	1/2		.5000	1/2		3-1/2		1-1/4	
13650001	13661	1/2		.5000	1/2		4		2	
13650002	13662	1/2		.5000	1/2		5		3	
13650003	13691	1/2		.5000	1/2		3		5/8	
13650004	13692	1/2		.5000	1/2		3		3/4	
13650005	13693	1/2		.5000	1/2		3		1	
13650006	13694	1/2		.5000	1/2		4		1-1/2	
13650007	13695	1/2		.5000	1/2		5		2-1/2	
13655120	13626		14.0	.5512		14.0		84		26.0
13662500	13663	5/8		.6250	5/8		3-1/2		3/4	
13662501	13664	5/8		.6250	5/8		3-3/4		1-5/8	
13662502	13665	5/8		.6250	5/8		4-5/8		2-1/2	
13662503	13696	5/8		.6250	5/8		3-1/2		1-1/4	
13662504	13697	5/8		.6250	5/8		5		2	
13662990	13630		16.0	.6299		16.0		89		32.0
13670870	13631		18.0	.7087		18.0		92		32.0
13675000	13655	3/4		.7500	3/4		4		1-5/8	
13675001	13666	3/4		.7500	3/4		5-1/4		3	
13675002	13667	3/4		.7500	3/4		6-1/4		4	
13675003	13698	3/4		.7500	3/4		4		1	
13675004	13699	3/4		.7500	3/4		5		2	
13675005	13601	3/4		.7500	3/4		5		2-1/2	
13678740	13635		20.0	.7874		20.0		102		38.0
13610000	13668	1		1.0000	1		4		1-1/4	
13610001	13669	1		1.0000	1		4-1/2		2	
13610002	13670	1		1.0000	1		6-1/2		4	
13610003	13603	1		1.0000	1		6		3	
13610004	13604	1		1.0000	1		8		5-1/2	

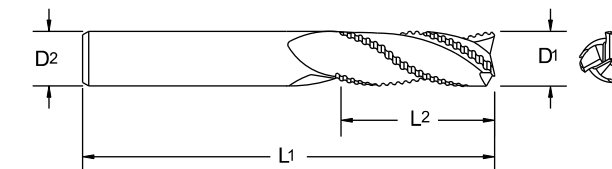
Technical information on [page 226](#).



TuffCut® AL
Series 134



High helix 3 flute design ideal for rapid stock removal in aluminum alloys.



- Unique geometry.
- Improved chip flow and prevents chips from packing in flute.

Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
13423620	13409		6.0	.2362		6.0		64		20.0
13425000	13411	1/4		.2500	1/4		2-1/2		3/4	
13431500	13414		8.0	.3150		8.0		64		20.0
13437500	13417	3/8		.3750	3/8		2-1/2		7/8	
13439370	13419		10.0	.3937		10.0		70		25.0
13447240	13423		12.0	.4724		12.0		76		25.0
13450000	13425	1/2		.5000	1/2		3		1	
13455120	95321		14.0	.5512		14.0		89		30.0
13462990	13429		16.0	.6299		16.0		89		30.0
13470870	13430		18.0	.7087		18.0		102		35.0
13475000	13431	3/4		.7500	3/4		4		1-1/2	
13478740	13433		20.0	.7874		20.0		102		38.0
13498430	13435		25.0	.9843		25.0		102		50.0
13410000	13401	1		1.0000	1		4		2	

Inch	
D1	Tolerance
1/4-1	+0.000/-0.005

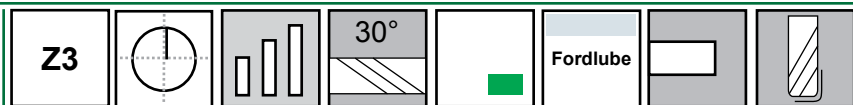
Metric (mm)	
D1	Tolerance
6.00-25.00	+0.000/-0.127

Technical information on [page 224](#).

ISO 9001:2000 Certified

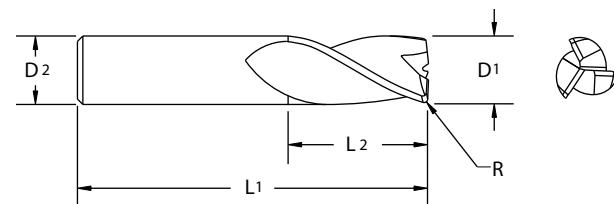
An ESOP Company

TuffCut® X-AL Series 137



High performance aluminum rougher.

- Gem coating available upon request.

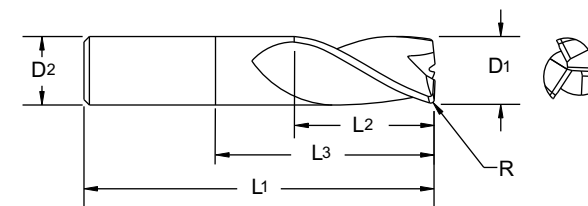


Uncoated		Fordlube*		Diameter			Shank		OAL	Flute Length		Corner Radius		
Tool No.	EDP	Tool No.	EDP	D1			D2		L1	L2		R		
Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm		
13718750	13700	13718750F	14346	3/16		.1875	3/16		2		1/4		0.008	
13718751	14415	13718751F	14347	3/16		.1875	3/16		3		1/4		0.008	
13719680	13701	13719680F	14348		5.0	.1968		5.0		51		6.0		0.25
13723620	13702	13723620F	14349		6.0	.2362		6.0		64		7.0		0.30
13725000	13703	13725000F	14350	1/4		.2500	1/4		2-1/2		5/16		0.011	
13725001	14416	13725001F	14351	1/4		.2500	1/4		3-1/2		5/16		0.011	
13731500	13704	13731500F	14352		8.0	.3150		8.0		64		9.5		0.35
13737500	13705	13737500F	14353	3/8		.3750	3/8		2-1/2		1/2		0.015	
13737501	13706	13737501F	14354	3/8		.3750	3/8		3		1/2		0.015	
13737502	13707	13737502F	14355	3/8		.3750	3/8		4		1/2		0.015	
13739370	13708	13739370F	14356		10.0	.3937		10.0		70		12.0		0.50
13739371	13709	13739371F	14357		10.0	.3937		10.0		76		12.0		0.50
13739372	13710	13739372F	14358		10.0	.3937		10.0		89		12.0		0.50
13747240	13711	13747240F	14414		12.0	.4724		12.0		76		14.0		0.50
13747241	13712	13747241F	14360		12.0	.4724		12.0		102		14.0		0.50
13747242	13713	13747242F	14361		12.0	.4724		12.0		127		14.0		0.50
13750000	13714	13750000F	14362	1/2		.5000	1/2		3		5/8		0.020	
13750001	13715	13750001F	14363	1/2		.5000	1/2		4		5/8		0.020	
13750002	13716	13750002F	14364	1/2		.5000	1/2		5		5/8		0.020	
13762500	14417	13762500F	14429	5/8		.6250	5/8		3-1/2		3/4		0.025	
13762501	14418	13762501F	14430	5/8		.6250	5/8		4-5/8		3/4		0.025	
13762502	14419	13762502F	14431	5/8		.6250	5/8		5-1/4		3/4		0.025	
13762990	13717	13762990F	14365		16.0	.6299		16.0		89		18.0		0.75
13762991	13718	13762991F	14366		16.0	.6299		16.0		117		18.0		0.75
13762992	13719	13762992F	14367		16.0	.6299		16.0		133		18.0		0.75
13775000	13720	13775000F	14368	3/4		.7500	3/4		4		1		0.030	
13775001	13721	13775001F	14369	3/4		.7500	3/4		5		1		0.030	
13775002	13722	13775002F	14370	3/4		.7500	3/4		6		1		0.030	
13778740	13723	13778740F	14371		20.0	.7874		20.0		102		22.0		0.75
13778741	13724	13778741F	14372		20.0	.7874		20.0		127		22.0		0.75
13778742	13725	13778742F	14373		20.0	.7874		20.0		152		22.0		0.75
13798430	13726	13798430F	14374		25.0	.9843		25.0		102		25.0		0.75
13798431	13727	13798431F	14375		25.0	.9843		25.0		127		25.0		0.75
13798432	13728	13798432F	14376		25.0	.9843		25.0		152		25.0		0.75
13710000	13729	13710000F	14377	1		1.0000	1		4		1-1/4		0.045	
13710001	13730	13710001F	14378	1		1.0000	1		5		1-1/4		0.045	
13710002	13731	13710002F	14379	1		1.0000	1		6		1-1/4		0.045	

*Allow 2 weeks to ship non-stock items.

Technical information on page 224.

TuffCut® X-AL Series 137N

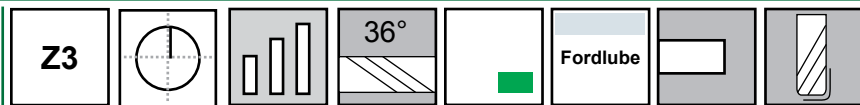


Necked Uncoated		Necked Fordlube*		Diameter			Shank		OAL	Flute Length		Neck Length		Corner Radius		
Tool No.	EDP	Tool No.	EDP	D1			D2		L1	L2		L3		R		
Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm		
13718750N	13732	13718750NF	14380	3/16		.1875	3/16		2		1/4		9/16		0.008	
13718751N	13733	13718751NF	14381	3/16		.1875	3/16		3		1/4		1-9/16		0.008	
13719680N	13734	13719680NF	14382		5.0	.1968		5.0		51		6.0		22		0.25
13723620N	13735	13723620NF	14383		6.0	.2362		6.0		64		7.0		26		0.30
13725000N	13736	13725000NF	14384	1/4		.2500	1/4		2-1/2		5/16		3/4		0.011	
13725001N	13737	13725001NF	14385	1/4		.2500	1/4		3-1/2		5/16		1-3/4		0.011	
13731500N	13738	13731500NF	14386		8.0	.3150		8.0		64		9.5		26		0.35
13737500N	13739	13737500NF	14387	3/8		.3750	3/8		2-1/2		1/2		7/8		0.015	
13737501N	13740	13737501NF	14388	3/8		.3750	3/8		3		1/2		1-3/8		0.015	
13737502N	13741	13737502NF	14389	3/8		.3750	3/8		4		1/2		2-3/8		0.015	
13739370N	13742	13739370NF	14390		10.0	.3937		10.0		70		12.0		28		0.50
13739371N	13743	13739371NF	14391		10.0	.3937		10.0		76		12.0		34		0.50
13739372N	13744	13739372NF	14392		10.0	.3937		10.0		89		12.0		47		0.50
13747240N	13745	13747240NF	14393		12.0	.4724		12.0		76		14.0		28		0.50
13747241N	13746	13747241NF	14394		12.0	.4724		12.0		102		14.0		54		0.50
13747242N	13747	13747242NF	14395		12.0	.4724		12.0		127		14.0		79		0.50
13750000N	13748	13750000NF	14396	1/2		.5000	1/2		3		5/8		1-1/8		0.020	
13750001N	13749	13750001NF	14397	1/2		.5000	1/2		4		5/8		2-1/8		0.020	
13750002N	13750	13750002NF	14398	1/2		.5000	1/2		5		5/8		3-1/8		0.020	
13762500N	14420	13762500NF	14432	5/8		.6250	5/8		3-1/2		3/4		1-1/2		0.025	
13762501N	14421	13762501NF	14433	5/8		.6250	5/8		4-5/8		3/4		2-1/2		0.025	
13762502N	14422	13762502NF	14434	5/8		.6250	5/8		5-1/4		3/4		3-1/2		0.025	
13762990N	13751	13762990NF	14399		16.0	.6299		16.0		89		18.0		39		0.75
13762991N	13752	13762991NF	14400		16.0	.6299		16.0		117		18.0		83		0.75
13762992N	13753	13762992NF	14401		16.0	.6299		16.0		133		18.0		99		0.75
13775000N	13754	13775000NF	14402	3/4		.7500	3/4		4		1		1-7/8		0.030	
13775001N	13755	13775001NF	14403	3/4		.7500	3/4		5		1		2-7/8		0.030	
13775002N	13756	13775002NF	14404	3/4		.7500	3/4		6		1		3-7/8		0.030	
13778740N	13757	13778740NF	14405		20.0	.7874		20.0		102		22.0		50		0.75
13778741N	13758	13778741NF	14406		20.0	.7874		20.0		127		22.0		75		0.75
13778742N	13759	13778742NF	14407		20.0	.7874		20.0		152		22.0		100		0.75
13798430N	13760	13798430NF	14408		25.0	.9843		25.0		102		25.0		36		0.75
13798431N	13761	13798431NF	14409		25.0	.9843		25.0		127		25.0		61		0.75
13798432N	13762	13798432NF	14410		25.0	.9843		25.0		152		25.0		86		0.75
13710000N	13763	13710000NF	14411	1		1.0000	1		4		1-1/4		1-5/8		0.045	
13710001N	13764	13710001NF	14412	1		1.0000	1		5		1-1/4		2-5/8		0.045	
13710002N	13765	13710002NF	14413	1		1.0000	1		6		1-1/4		3-5/8		0.045	

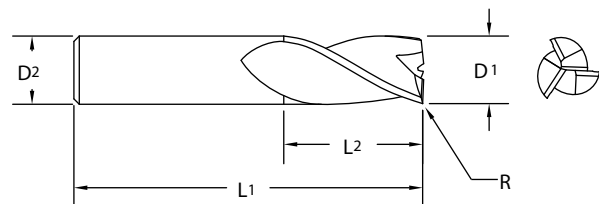
*Allow 2 weeks to ship non-stock items.

Technical information on page 224.

TuffCut® X-AL Series 138



Series 138 takes aluminum milling to the extreme with chip loads and speeds, definitely designed for extreme productivity.



• Gem coating available upon request.

Inch		Metric (mm)	
D1	Tolerance	D1	Tolerance h10
1/8-1-1/4	+0.000/-0.005	3.00-20.00	+0.000/-0.013

Uncoated		Fordlube*		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2		R	
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13811810	13892	13811810F	14295		3.0	.1181		6.0		52.0		8.0		
13811810R.020	13100				3.0	.1181		6.0		52.0		8.0		0.50
13811810R.039	13101				3.0	.1181		6.0		52.0		8.0		1.00
13812500	13800	13812500F	14203	1/8	.1250		1/8		1-1/2		3/16			
13812501	13801	13812501F	14204	1/8	.1250		1/8		1-1/2		1/4			
13812502	13802	13812502F	14205	1/8	.1250		1/8		1-1/2		5/16			
13812503	13803	13812503F	14206	1/8	.1250		1/8		1-1/2		3/8			
13812504	13804	13812504F	14207	1/8	.1250		1/8		1-1/2		1/2			
13812505	13805	13812505F	14208	1/8	.1250		1/8		1-1/2		5/8			
13812506	13806	13812506F	14209	1/8	.1250		1/8		2		3/4			
13812507	13807	13812507F	14210	1/8	.1250		1/8		2		1			
13815750	13893	13815750F	14296		4.0	.1575		6.0		55.0		11.0		
13815750R.020	13102				4.0	.1575		6.0		55.0		11.0		0.50
13815750R.039	13103				4.0	.1575		6.0		55.0		11.0		1.00
13818750	13808	13818750F	14211	3/16	.1875		3/16		2		1/4			
13818751	13809	13818751F	14212	3/16	.1875		3/16		2		3/8			
13818752	13810	13818752F	14213	3/16	.1875		3/16		2		1/2			
13818753	13811	13818753F	14214	3/16	.1875		3/16		2-1/2		5/8			
13818754	13812	13818754F	14215	3/16	.1875		3/16		2-1/2		3/4			
13818755	13813	13818755F	14216	3/16	.1875		3/16		2-1/2		1			
13819680	13894	13819680F	14297		5.0	.1968		6.0		58.0		13.0		
13819680R.020	13104				5.0	.1968		6.0		58.0		13.0		0.50
13819680R.039	13105				5.0	.1968		6.0		58.0		13.0		1.00
13823620	13895	13823620F	14298		6.0	.2362		6.0		58.0		13.0		
13823620R.020	13106				6.0	.2362		6.0		58.0		13.0		0.50
13823620R.039	13107				6.0	.2362		6.0		58.0		13.0		1.00
13823620R.059	13108				6.0	.2362		6.0		58.0		13.0		1.50
13823620R.079	13109				6.0	.2362		6.0		58.0		13.0		2.00
13825000	13814	13825000F	14217	1/4	.2500		1/4		2		3/8			
13825001	13815	13825001F	14218	1/4	.2500		1/4		2		1/2			
13825002	13816	13825002F	14219	1/4	.2500		1/4		4		1/2			
13825003	13817	13825003F	14220	1/4	.2500		1/4		2		5/8			
13825004	13818	13825004F	14221	1/4	.2500		1/4		2-1/2		3/4			
13825005	13819	13825005F	14222	1/4	.2500		1/4		3		1			
13825006	13820	13825006F	14223	1/4	.2500		1/4		3		1-1/8			
13825007	13821	13825007F	14224	1/4	.2500		1/4		3		1-1/4			
13825008	13822	13825008F	14225	1/4	.2500		1/4		3		1-1/2			
13825009	13823	13825009F	14226	1/4	.2500		1/4		4		1-3/4			
13825010	13824	13825010F	14227	1/4	.2500		1/4		4		2			

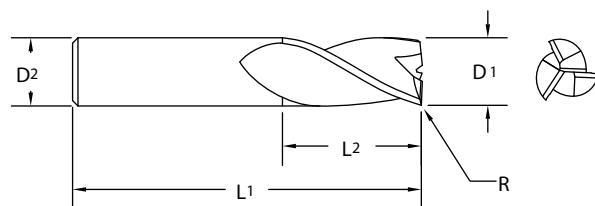
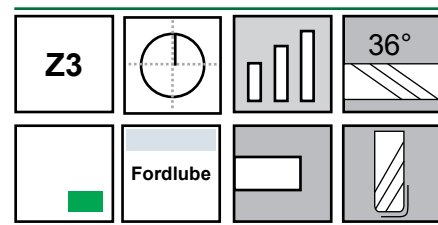
* Allow 2 weeks to ship non-stock items.
Weldon flats available. Please specify when ordering.
When ordering Weldon flats please call customer service for pricing.

Technical information on [page 226](#).

Series 138 Continued

Uncoated		Fordlube*		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2		R	
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13831250	13825	13831250F	14228	5/16		.3125	5/16		4		5/16			
13831251	13826	13831251F	14229	5/16		.3125	5/16		4		3/8			
13831252	13827	13831252F	14230	5/16		.3125	5/16		4		7/16			
13831253	13828	13831253F	14231	5/16		.3125	5/16		4		1/2			
13831254	13829	13831254F	14232	5/16		.3125	5/16		2-1/2		13/16			
13831255	13830	13831255F	14233	5/16		.3125	5/16		2-1/2		1-1/8			
13831256	13831	13831256F	14234	5/16		.3125	5/16		3-1/8		1-3/8			
13831257	13832	13831257F	14235	5/16		.3125	5/16		3		1-1/4			
13831258	13833	13831258F	14236	5/16		.3125	5/16		4		1-1/2			
13831500	13896	13831500F	14299		8.0	.3150		8.0		64.0		19.0		
13831500R.020	13110				8.0	.3150		8.0		64.0		19.0		0.50
13831500R.039	13111				8.0	.3150		8.0		64.0		19.0		1.00
13831500R.059	13112				8.0	.3150		8.0		64.0		19.0		1.50
13831500R.079	13113				8.0	.3150		8.0		64.0		19.0		2.00
13831500R.118	13114				8.0	.3150		8.0		64.0		19.0		3.00
13837500	13834	13837500F	14237	3/8		.3750	3/8		2		1/2			
13837501	13835	13837501F	14238	3/8		.3750	3/8		2-1/2		9/16			
13837502	13836	13837502F	14239	3/8		.3750	3/8		2		5/8			
13837503	13837	13837503F	14240	3/8		.3750	3/8		4		5/8			
13837504	13838	13837504F	14241	3/8		.3750	3/8		2-1/2		3/4			
13837505	13839	13837505F	14242	3/8		.3750	3/8		2-1/2		1			
13837506	13840	13837506F	14243	3/8		.3750	3/8		3		1-1/4			
13837507	13841	13837507F	14244	3/8		.3750	3/8		3-1/2		1-1/2			
13837508	13842	13837508F	14245	3/8		.3750	3/8		4		2			
13837509	13843	13837509F	14246	3/8		.3750	3/8		4-1/2		2-1/2			
13837510	13844	13837510F	14247	3/8		.3750	3/8		3		9/16			
13837511	13845	13837511F	14248	3/8		.3750	3/8		3		1			
13839370	13897	13839370F	14300		10.0	.3937		10.0		70.0		22.0		
13839370R.020	13115				10.0	.3937		10.0		70.0		22.0		0.50
13839370R.039	13116				10.0	.3937		10.0		70.0		22.0		1.00
13839370R.059	13117				10.0	.3937		10.0		70.0		22.0		1.50
13839370R.079	13118				10.0	.3937		10.0		70.0		22.0		2.00
13839370R.118	13119				10.0	.3937		10.0		70.0		22.0		3.00
13843750	13846	13843750F	14249	7/16		.4375	7/16		2-3/4		9/16			
13843751	13847	13843751F	14250	7/16		.4375	7/16		2-3/4		1			
13847240	13898	13847240F	14301		12.0	.4724		12.0		84.0		26.0		
13847240R.020	13120				12.0	.4724		12.0		84.0		26.0		0.50
13847240R.039	13121				12.0	.4724		12.0		84.0		26.0		1.00
13847240R.059	13122				12.0	.4724		12.0		84.0		26.0		1.50
13847240R.079	13123				12.0	.4724		12.0		84.0		26.0		2.00
13847240R.118	13124				12.0	.4724		12.0		84.0		26.0		3.00
13847240R.157	13125				12.0	.4724		12.0		84.0		26.0		4.00
13847240R.196	13126				12.0	.4724		12.0		84.0		26.0		5.00
13850000	13848	13850000F	14251	1/2		.5000	1/2		3		5/8			
13850001	13849	13850001F	14252	1/2		.5000	1/2		3		3/4			
13850002	13850	13850002F	14253	1/2		.5000	1/2		3		1			
13850003	13851	13850003F	14254	1/2		.5000	1/2		3		1-1/4			
13850004	13852	13850004F	14255	1/2		.5000	1/2		4		1-1/2			
13850005	13853	13850005F	14256	1/2		.5000	1/2		4		2			
13850006	13854	13850006F	14257	1/2		.5000	1/2		4		2-1/4			
13850007	13855	13850007F	14258	1/2		.5000	1/2		6		2-1/2			
13850008	13856	13850008F	14259	1/2		.5000	1/2		6		3-1/4			
13850009	13857	13850009F	14260	1/2		.5000	1/2		8		4			
13855120	13899	13855120F	14302		14.0	.5512		14.0		84.0		26.0		
13862500	13858	13862500F	14											

Series 138 Continued

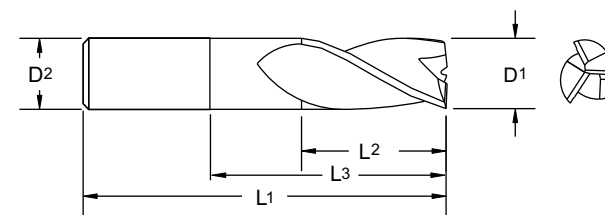
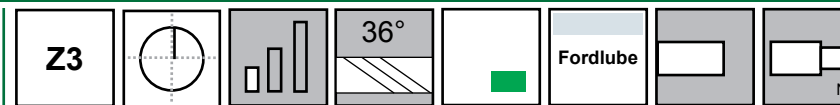


Uncoated		Fordlube*		Diameter		Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Tool No.	EDP	D1		D2		L1		L2		R	
				Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm
13862505	13863	13862505F	14266	5/8	.6250	5/8		5		2			
13862506	13864	13862506F	14267	5/8	.6250	5/8		5		2-1/2			
13862507	13865	13862507F	14268	5/8	.6250	5/8		6		3-1/4			
13862990	13900	13862990F	14303		16.0		16.0		89.0		32.0		
13862990R.020	13127				16.0		16.0		89.0		32.0		0.50
13862990R.039	13128				16.0		16.0		89.0		32.0		1.00
13862990R.059	13129				16.0		16.0		89.0		32.0		1.50
13862990R.079	13130				16.0		16.0		89.0		32.0		2.00
13862990R.118	13131				16.0		16.0		89.0		32.0		3.00
13862990R.157	13132				16.0		16.0		89.0		32.0		4.00
13862990R.196	13133				16.0		16.0		89.0		32.0		5.00
13870870	13901	13870870F	14304		18.0		18.0		92.0		32.0		
13875000	13866	13875000F	14269	3/4	.7500	3/4		4		3/4			
13875001	13867	13875001F	14270	3/4	.7500	3/4		4		1			
13875002	13868	13875002F	14271	3/4	.7500	3/4		6		1			
13875003	13869	13875003F	14272	3/4	.7500	3/4		6		1-1/2			
13875004	13870	13875004F	14273	3/4	.7500	3/4		4		1-5/8			
13875005	13871	13875005F	14274	3/4	.7500	3/4		5		2			
13875006	13872	13875006F	14275	3/4	.7500	3/4		5		2-1/4			
13875007	13873	13875007F	14276	3/4	.7500	3/4		5		2-1/2			
13875008	13874	13875008F	14277	3/4	.7500	3/4		6		3			
13875009	13875	13875009F	14278	3/4	.7500	3/4		6		3-1/4			
13875010	13876	13875010F	14279	3/4	.7500	3/4		6		3-1/2			
13875011	13877	13875011F	14280	3/4	.7500	3/4		6-1/4		4			
13875012	13878	13875012F	14281	3/4	.7500	3/4		8		5			
13878740	13902	13878740F	14305		20.0		20.0		102.0		38.0		
13878740R.020	13134				20.0		20.0		102.0		38.0		0.50
13878740R.039	13135				20.0		20.0		102.0		38.0		1.00
13878740R.059	13136				20.0		20.0		102.0		38.0		1.50
13878740R.079	13137				20.0		20.0		102.0		38.0		2.00
13878740R.118	13138				20.0		20.0		102.0		38.0		3.00
13878740R.157	13139				20.0		20.0		102.0		38.0		4.00
13878740R.196	13140				20.0		20.0		102.0		38.0		5.00
13810000	13879	13810000F	14282	1.00	1.0000	1.00		6		1-1/4			
13810001	13880	13810001F	14283	1.00	1.0000	1.00		8		1-1/4			
13810002	13881	13810002F	14284	1.00	1.0000	1.00		4		1-1/2			
13810003	13882	13810003F	14285	1.00	1.0000	1.00		5		2			
13810004	13883	13810004F	14286	1.00	1.0000	1.00		5		2-1/2			
13810005	13884	13810005F	14287	1.00	1.0000	1.00		6		3			
13810006	13885	13810006F	14288	1.00	1.0000	1.00		6		3-1/2			
13810007	13886	13810007F	14289	1.00	1.0000	1.00		6		4			
13810008	13887	13810008F	14290	1.00	1.0000	1.00		7		4-1/8			
13810009	13888	13810009F	14291	1.00	1.0000	1.00		8		5-1/2			
13812510	13889	13812510F	14292	1-1/4	1.2500	1-1/4		6		2			
13812511	13890	13812511F	14293	1-1/4	1.2500	1-1/4		8		5			
13812512	13891	13812512F	14294	1-1/4	1.2500	1-1/4		12		2			

* Allow 2 weeks to ship non-stock items.
Weldon flats available. Please specify when ordering.
When ordering Weldon flats please call customer service for pricing.

Technical information on [page 226](#).

TuffCut® X-AL Series 138N



Inch	
D1	Tolerance
1/4-1.0	+0.00/-0.0005

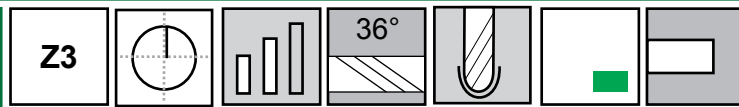
Uncoated		Fordlube*		Diameter		Shank	OAL	Flute Length	Neck Length
Tool No.	EDP	Tool No.	EDP	D1 Inch					
				Size	Decimal	D2 Inch	L1 Inch	L2 Inch	L3 Inch
13825002N	14450	13825002NF	14459	1/4	.2500	1/4	4	1/2	1-1/8
13831252N	14451	13831252NF	14460	5/16	.3125	5/16	4	7/16	2-1/8
13837503N	14452	13837503NF	14461	3/8	.3750	3/8	4	5/8	2-1/8
13850000N	14453	13850000NF	14462	1/2	.5000	1/2	3	5/8	1-3/8
13850010N	14454	13850010NF	14463	1/2	.5000	1/2	4	5/8	2-1/8
13850011N	14455	13850011NF	14464	1/2	.5000	1/2	6	3/4	3-3/8
13862501N	14456	13862501NF	14465	5/8	.6250	5/8	6	3/4	3-3/8
13875002N	14457	13875002NF	14466	3/4	.7500	3/4	6	1	3-3/8
13810000N	14458	13810000NF	14467	1.00	1.0000	1.00	6	1-1/4	3-3/8

* Allow 2 weeks to ship non-stock items.
Weldon flats available. Please specify when ordering.
When ordering Weldon flats please call customer service for pricing.

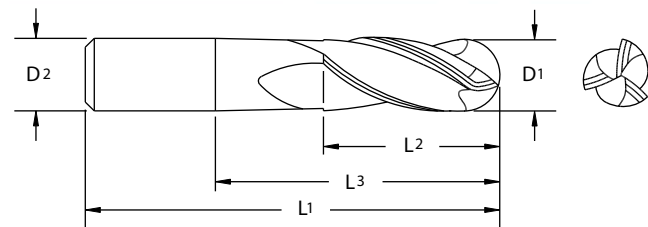
Technical information on [page 226](#).

Safety Note
Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

TuffCut® X-AL Series 138B



Designed for extreme productivity.



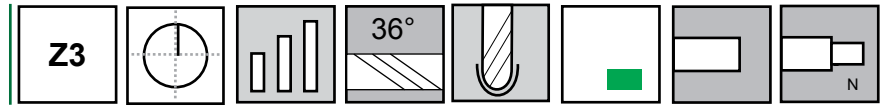
Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
138B11810	13356		3.0	.1181	3.0		38.0		12.0	
138B12500	13300	1/8		.1250	1/8		1-1/2		3/8	
138B12501	13302	1/8		.1250	1/8		2		1/2	
138B15750	13358		4.0	.1575	4.0		51.0		15.0	
138B18750	13304	3/16		.1875	3/16		2		3/8	
138B18751	13306	3/16		.1875	3/16		2-1/2		5/8	
138B19680	13360		5.0	.1968	5.0		64.0		20.0	
138B23620	13362		6.0	.2362	6.0		64.0		20.0	
138B25000	13308	1/4		.2500	1/4		2-1/2		1/2	
138B25001	13310	1/4		.2500	1/4		2-1/2		3/4	
138B31250	13312	5/16		.3125	5/16		2-1/2		1/2	
138B31251	13314	5/16		.3125	5/16		2-1/2		13/16	
138B31500	13364		8.0	.3150	8.0		64.0		20.0	
138B37500	13316	3/8		.3750	3/8		2-1/2		5/8	
138B37501	13318	3/8		.3750	3/8		2-1/2		1	
138B39370	13366		10.0	.3937	10.0		70.0		25.0	
138B43750	13320	7/16		.4375	7/16		2-3/4		9/16	
138B43751	13322	7/16		.4375	7/16		2-3/4		1	
138B47240	13368		12.0	.4724	12.0		76.0		25.0	
138B50000	13324	1/2		.5000	1/2		3		5/8	
138B50001	13326	1/2		.5000	1/2		3		1-1/4	
138B50002	13328	1/2		.5000	1/2		6		1-1/4	
138B62500	13330	5/8		.6250	5/8		3-1/2		1-1/4	
138B62501	13332	5/8		.6250	5/8		4		1-5/8	
138B62990	13370		16.0	.6299	16.0		89.0		35.0	
138B75000	13334	3/4		.7500	3/4		4		1	
138B75001	13336	3/4		.7500	3/4		4		1-5/8	
138B10000	13338	1		1.0000	1		4		1-1/2	
138B10001	13340	1		1.0000	1		5		2-1/4	

Inch	
D1	Tolerance
1/8-1.0	+0.0000/-0.0005

Metric (mm)	
D1	Tolerance
2.00-16.00	+0.000/-0.013

Technical information on page 228.

TuffCut® X-AL Series 138BN

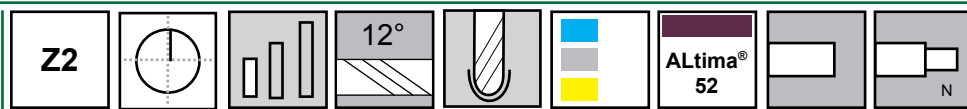


Necked	Tool No.	EDP	Diameter			Shank		OAL	Flute Length		Neck Length	
			D1			D2		L1	L2		L3	
			Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch
138B0787N5	13372		2.0	.0787		6.0		75.0		4.0		12.0
138B1181N5	13374		3.0	.1181		6.0		75.0		5.0		17.0
138B1575N5	13376		4.0	.1575		6.0		75.0		6.0		22.0
138B1968N5	13378		5.0	.1968		6.0		75.0		7.0		27.0
138B2362N5	13380		6.0	.2362		6.0		110.0		8.0		32.0
138B25001N	13342	1/4		.2500	1/4		4		3/4		2-1/8	
138B31251N	13344	5/16		.3125	5/16		4		13/16		2-1/8	
138B3150N5	13382		8.0	.3150		8.0		110.0		10.0		42.0
138B37501N	13346	3/8		.3750	3/8		4		1		2-1/8	
138B3937N5	13384		10.0	.3937		10.0		110.0		12.0		52.0
138B4724N5	13386		12.0	.4724		12.0		120.0		16.0		62.0
138B50001N	13348	1/2		.5000	1/2		4		1-1/4		2-1/8	
138B62501N	13350	5/8		.6250	5/8		6		1-5/8		3-3/8	
138B6299N5	13388		16.0	.6299		16.0		130.0		20.0		82.0
138B75001N	13352	3/4		.7500	3/4		6		1-5/8		3-3/8	
138B10000N	13354	1		1.0000	1		6		1-1/2		3-1/4	

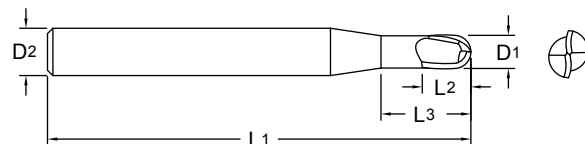
Technical information on page 228.

ISO 9001:2000 Certified
An ESOP Company

TuffCut® DM Series 156



Series 156 is designed for high-productivity milling of hard and difficult to cut materials Rc 45-60. Coated with ALtima® 52 for materials Rc 52 and above.



NEW SIZES

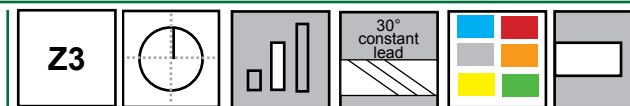
ALtima® 52		Diameter			Shank		OAL		Flute Length		Neck Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
15601560A	15600	1/64		.0156	1/4		2-1/2		1/64		1/64	
15601960A	15602		0.5	.0196		6.0		63		0.5		0.5
15603120A	15604	1/32		.0312	1/4		2-1/2		1/32		1/32	
15603121A	15606	1/32		.0312	1/4		2-1/2		1/32		1/4	
15603122A	15608	1/32		.0312	1/4		2-1/2		1/32		5/16	
15603123A	15610	1/32		.0312	1/4		2-1/2		1/32		3/8	
15603124A	15612	1/32		.0312	1/4		2-1/2		1/32		1/2	
15603125A	15614	1/32		.0312	1/4		2-1/2		1/32		5/8	
15603940A	15616		1.0	.0394		6.0		63		1.0		1.0
15603941A	15618		1.0	.0394		6.0		63		1.0		6.0
15603942A	15620		1.0	.0394		6.0		63		1.0		8.0
15603943A	15622		1.0	.0394		6.0		63		1.0		10.0
15603944A	15624		1.0	.0394		6.0		63		1.0		12.0
15603945A	15626		1.0	.0394		6.0		63		1.0		16.0
15605910A	15628		1.5	.0591		6.0		63		1.5		1.5
15606250A	15630	1/16		.0625	1/4		2-1/2		1/16		1/16	
15607870A	15632		2.0	.0787		6.0		63		2.0		2.0
15607871A	15634		2.0	.0787		6.0		63		2.0		8.0
15607872A	15636		2.0	.0787		6.0		63		2.0		12.0
15607873A	15638		2.0	.0787		6.0		63		2.0		20.0
15609370A	15640	3/32		.0937	1/4		2-1/2		3/32		3/32	
15609371A	15642	3/32		.0937	1/4		2-1/2		3/32		5/16	
15609372A	15644	3/32		.0937	1/4		2-1/2		3/32		1/2	
15609373A	15646	3/32		.0937	1/4		2-1/2		3/32		3/4	
15611810A	15648		3.0	.1181		6.0		75		3.0		3.0
15611811A	15650		3.0	.1181		6.0		75		3.0		20.0
15611812A	15676		3.0	.1181		6.0		75		3.0		12.0
15612500A	15652	1/8		.1250	1/4		3		1/8		1/8	
15612501A	15654	1/8		.1250	1/4		3		1/8		3/4	
15615620A	15656	5/32		.1562	1/4		3		5/32		5/32	
15615750A	15658		4.0	.1575		6.0		75		4.0		4.0
15615751A	15678		4.0	.1575		6.0		75		4.0		12.0
15615752A	15679		4.0	.1575		6.0		75		4.0		20.0
15619680A	15680		5.0	.1968		6.0		75		5.0		5.0
15619681A	15681		5.0	.1968		6.0		75		5.0		12.0
15619682A	15682		5.0	.1968		6.0		75		5.0		25.0
15623620A	15660		6.0	.2362		6.0		75		6.0		6.0
15623621A	15683		6.0	.2362		6.0		75		6.0		12.0
15623622A	15684		6.0	.2362		6.0		75		6.0		25.0
15625000A	15662	1/4		.2500	1/4		3		1/4		1/4	
15631250A	15664	5/16		.3125	5/16		3-1/8		5/16		5/16	
15631500A	15666		8.0	.3150		8.0		80		8.0		8.0
15637500A	15668	3/8		.3750	3/8		3-1/4		3/8		3/8	
15639370A	15670		10.0	.3937		10.0		82		10.0		
15647240A	15672		12.0	.4724		12.0		100		12.0		
15650000A	15674	1/2		.5000	1/2		4		1/2		1/2	

Inch	
D1	Tolerance
1/64-1/4	+0.004/-0.004
≥ 1/4-1/2	+0.004/-0.008

Metric (mm)	
D1	Tolerance
0.50-6.00	+0.0102/-0.0102
>6.00-12.00	+0.0102/-0.0203

Technical information on [page 230](#).

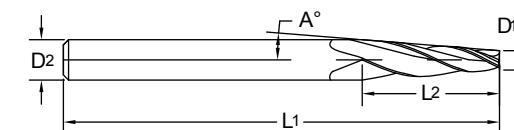
TuffCut® DM Series 198



Designed for cutting ribs and draft forming in molds, these tapered end mills provide maximum productivity.



- Coatings available upon request.
- 7 common taper angles.



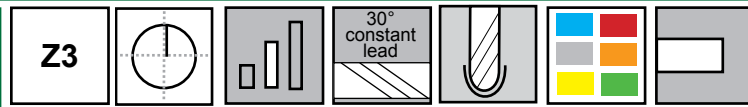
Tool No.	EDP	Diameter		Shank	OAL	Flute Length	Angle
		D1	Decimal				
19825001	95357	1/8	.1250	1/4	3	1-1/2	1°
19825002	95358	1/8	.1250	1/4	3	1-1/2	1-1/2°
19825003	95359	1/8	.1250	1/4	3	1-1/4	2°
19825004	95360	1/8	.1250	1/4	3	1	3°
19825005	95361	1/8	.1250	1/4	3	3/4	5°
19825006	95362	1/8	.1250	1/4	3	1/2	7°
19825007	95363	3/32	.0937	1/4	3	1/2	10°
19837501	95364	3/16	.1875	3/8	3-1/2	1-3/4	1°
19837502	95365	3/16	.1875	3/8	3-1/2	1-3/4	1-1/2°
19837503	95366	3/16	.1875	3/8	3-1/2	1-3/4	2°
19837504	95367	5/32	.1562	3/8	3-1/2	1-3/4	3°
19837505	95368	1/8	.1250	3/8	3-1/2	1-1/2	5°
19837506	95369	1/8	.1250	3/8	3-1/2	1	7°
19837507	95370	1/8	.1250	3/8	3-1/2	3/4	10°
19850001	95371	1/4	.2500	1/2	4	2	1°
19850003	95372	1/4	.2500	1/2	4	2	2°
19850004	95373	1/4	.2500	1/2	4	2	3°
19850005	95374	1/4	.2500	1/2	4	1-1/4	5°
19850006	95375	3/16	.1875	1/2	4	1-1/4	7°
19850007	95376	1/8	.1250	1/2	4	1	10°

Inch	
D1	Tolerance
3/32-1/4	+0.001/-0.002

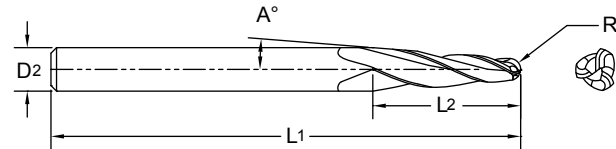
Technical information on [page 248](#).



TuffCut® DM Series 199



Designed for cutting ribs and draft forming in molds, these tapered end mills provide maximum productivity.



- Coatings available upon request.
- 7 common taper angles.

Tool No.	EDP	Radius	Shank D2	OAL L1	Flute Length L2	Angle A
		R				
19925001	95337	.0625	1/4	3	1-1/2	1°
19925002	95338	.0625	1/4	3	1-1/2	1-1/2°
19925003	95339	.0625	1/4	3	1-1/4	2°
19925004	95340	.0625	1/4	3	1	3°
19925005	95341	.0625	1/4	3	3/4	5°
19925006	95342	.0625	1/4	3	1/2	7°
19925007	95343	.0470	1/4	3	1/2	10°
19937501	95344	.0930	3/8	3-1/2	1-3/4	1°
19937502	95345	.0930	3/8	3-1/2	1-3/4	1-1/2°
19937503	95346	.0930	3/8	3-1/2	1-3/4	2°
19937504	95347	.0780	3/8	3-1/2	1-3/4	3°
19937505	95348	.0625	3/8	3-1/2	1-1/2	5°
19937506	95349	.0625	3/8	3-1/2	1	7°
19937507	95350	.0625	3/8	3-1/2	3/4	10°
19950001	95351	.1250	1/2	4	2	1°
19950003	95352	.1250	1/2	4	2	2°
19950004	95353	.1250	1/2	4	2	3°
19950005	95354	.1250	1/2	4	1-1/4	5°
19950006	95355	.0930	1/2	4	1-1/4	7°
19950007	95356	.0625	1/2	4	1	10°

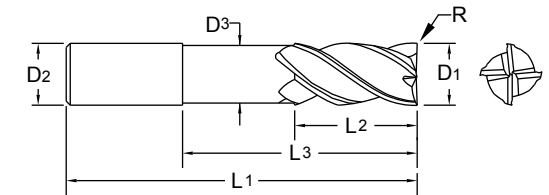
Inch	
R	Tolerance
3/64-1/8	+0.0005/-0.0010

Technical information on page 248.

TuffCut® DM Series 158



Series 158 was designed with similar TuffCut® XR geometry, but incorporates features that make it an excellent tool for die and mold steels and hard to machine materials up to 65 Rc. Coated with ALtima® 52 for materials Rc 52 and above.



ALtima® 52		Diameter D1		Shank D2 h6	Neck Diameter D3	OAL L1	Flute Length L2	Neck Length L3	Radius R
Tool No.	EDP	mm	Decimal						
15811800N3A	15522	3	.1181	6	2.9	50	5	9	
15811800N5A	15524	3	.1181	6	2.9	50	5	15	
15811800R012N3A	15526	3	.1181	6	2.9	50	5	9	0.3
15811800R012N5A	15528	3	.1181	6	2.9	50	5	15	0.3
15811800R031N5A	15530	3	.1181	6	2.9	50	5	15	0.8
15823600N3A	15532	6	.2362	6	5.8	100	9	18	
15823600N5A	15534	6	.2362	6	5.8	100	9	30	
15823600R012N3A	15536	6	.2362	6	5.8	100	9	18	0.3
15823600R012N5A	15538	6	.2362	6	5.8	100	9	30	0.3
15823600R059N5A	15540	6	.2362	6	5.8	100	9	30	1.5
15831500N3A	15542	8	.3150	8	7.6	100	12	24	
15831500N5A	15544	8	.3150	8	7.6	100	12	40	
15831500R012N3A	15546	8	.3150	8	7.6	100	12	24	0.3
15831500R012N5A	15548	8	.3150	8	7.6	100	12	40	0.3
15831500R079N5A	15550	8	.3150	8	7.6	100	12	40	2.0
15839300N3A	15552	10	.3937	10	9.6	100	15	30	
15839300N5A	15554	10	.3937	10	9.6	100	15	50	
15839300R012N3A	15556	10	.3937	10	9.6	100	15	30	0.3
15839300R012N5A	15558	10	.3937	10	9.6	100	15	50	0.3
15839300R079N5A	15560	10	.3937	10	9.6	100	15	50	2.0
15847200N3A	15562	12	.4724	12	11.4	100	18	36	
15847200N5A	15564	12	.4724	12	11.4	130	18	60	
15847200R012N3A	15566	12	.4724	12	11.4	100	18	36	0.3
15847200R012N5A	15568	12	.4724	12	11.4	130	18	60	0.3
15847200R079N5A	15570	12	.4724	12	11.4	130	18	60	2.0
15862900N3A	15572	16	.6299	16	15.2	130	24	48	
15862900N5A	15574	16	.6299	16	15.2	150	24	80	
15862900R012N3A	15576	16	.6299	16	15.2	130	24	48	0.3
15862900R012N5A	15578	16	.6299	16	15.2	150	24	80	0.3
15862900R118N5A	15580	16	.6299	16	15.2	150	24	80	3.0
15878700N5A	15582	20	.7874	20	19.2	150	30	100	
15878700R012N5A	15584	20	.7874	20	19.2	150	30	100	0.3
15878700R118N5A	15586	20	.7874	20	19.2	150	30	100	3.0

Technical information on page 234.

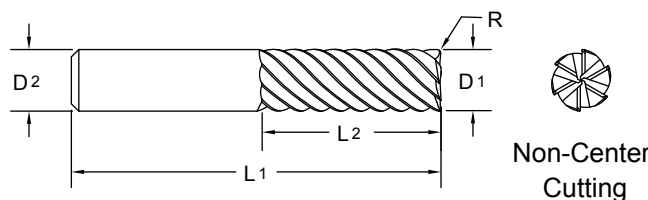
Inch	
D1	Tolerance
.0000 - .7874	+0/-0.0008

Metric (mm)	
D1	Tolerance
0 - 20.0	+0/-0.02

TuffCut® DM
Series 157



Multi-Flute designed for hardened materials Rc 50-65. Available as a Square End and in 7 standard corner radii. Coated with ALtima® 52 for materials Rc 52 and above.



ALtima® 52		Diameter			Shank		OAL		Flute Length		Corner Radius		No. of Flutes
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
15711810A	15700		3	.1181		6		76		9			4
15711811A	15701		3	.1181		6		76		9		0.50	4
15712500A	15702	1/8		.1250	1/4		3		3/8				4
15712501A	15703	1/8		.1250	1/4		3		3/8		0.015		4
15712502A	15704	1/8		.1250	1/4		3		3/8		0.020		4
15715620A	15705	5/32		.1562	1/4		3		15/32				4
15715621A	15706	5/32		.1562	1/4		3		15/32		0.015		4
15715622A	15707	5/32		.1562	1/4		3		15/32		0.020		4
15715750A	15708		4	.1575		6		76		12			4
15715751A	15709		4	.1575		6		76		12		0.50	4
15715752A	15710		4	.1575		6		76		12		0.75	4
15718750A	15711	3/16		.1875	1/4		3		9/16				4
15718751A	15712	3/16		.1875	1/4		3		9/16		0.015		4
15718752A	15713	3/16		.1875	1/4		3		9/16		0.020		4
15718753A	15714	3/16		.1875	1/4		3		9/16		0.030		4
15719680A	15715		5	.1968		6		90		15			4
15719681A	15716		5	.1968		6		90		15		0.50	4
15719682A	15717		5	.1968		6		90		15		0.75	4
15719683A	15718		5	.1968		6		90		15		1.00	4
15723620A	15719		6	.2362		6		90		15			6
15723621A	15720		6	.2362		6		90		15		0.50	6
15723622A	15721		6	.2362		6		90		15		0.75	6
15723623A	15722		6	.2362		6		90		15		1.00	6
15725000A	15723	1/4		.2500	1/4		3-1/2		5/8				6
15725001A	15724	1/4		.2500	1/4		3-1/2		5/8		0.015		6
15725002A	15725	1/4		.2500	1/4		3-1/2		5/8		0.020		6
15725003A	15726	1/4		.2500	1/4		3-1/2		5/8		0.030		6
15725004A	15727	1/4		.2500	1/4		3-1/2		5/8		0.045		6
15731250A	15728	5/16		.3125	5/16		4		3/4				6
15731251A	15729	5/16		.3125	5/16		4		3/4		0.015		6
15731252A	15730	5/16		.3125	5/16		4		3/4		0.020		6
15731253A	15731	5/16		.3125	5/16		4		3/4		0.030		6
15731254A	15732	5/16		.3125	5/16		4		3/4		0.045		6
15731500A	15733		8	.3150		8		100		20			6
15731501A	15734		8	.3150		8		100		20		0.50	6
15731502A	15735		8	.3150		8		100		20		0.75	6
15731503A	15736		8	.3150		8		100		20		1.00	6
15731504A	15737		8	.3150		8		100		20		1.50	6
15737500A	15738	3/8		.3750	3/8		4		1				6
15737501A	15739	3/8		.3750	3/8		4		1		0.015		6
15737502A	15740	3/8		.3750	3/8		4		1		0.020		6

Inch	
D1	Tolerance
1/8-3/16	-.0006/-.0015
1/4-5/8	-.0008/-.0019
3/4-1	-.0008/-.0021

Metric (mm)	
D1	Tolerance
3.0	-.005/-.028
4.0-6.0	-.015/-.038
8.0-16.0	-.020/-.048
20.0-25.0	-.020/-.053

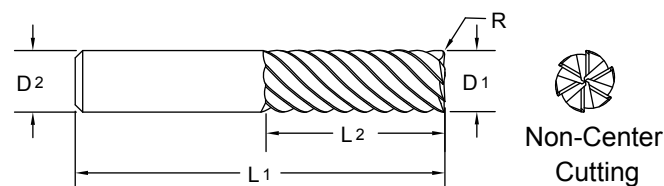
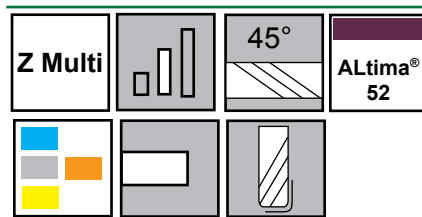
Series 157 Continued

ALtima® 52		Diameter			Shank		OAL		Flute Length		Corner Radius		No. of Flutes
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	L1	L2	L1	L2	R	R	
15737503A	15741	3/8		.3750	3/8		4		1		0.030		6
15737504A	15742	3/8		.3750	3/8		4		1		0.045		6
15739370A	15743		10	.3937		10		100		25			6
15739371A	15744		10	.3937		10		100		25		0.50	6
15739372A	15745		10	.3937		10		100		25		0.75	6
15739373A	15746		10	.3937		10		100		25		1.00	6
15739374A	15747		10	.3937		10		100		25		1.50	6
15747240A	15748		12	.4724		12		100		30			6
15747241A	15749		12	.4724		12		100		30		0.50	6
15747242A	15750		12	.4724		12		100		30		0.75	6
15747243A	15751		12	.4724		12		100		30		1.00	6
15747244A	15752		12	.4724		12		100		30		1.50	6
15747245A	15753		12	.4724		12		100		30		2.00	6
15750000A	15754	1/2		.5000	1/2		4		1-1/4				6
15750001A	15755	1/2		.5000	1/2		4		1-1/4		0.015		6
15750002A	15756	1/2		.5000	1/2		4		1-1/4		0.020		6
15750003A	15757	1/2		.5000	1/2		4		1-1/4		0.030		6
15750004A	15758	1/2		.5000	1/2		4		1-1/4		0.045		6
15750005A	15759	1/2		.5000	1/2		4		1-1/4		0.060		6
15762500A	15760	5/8		.6250	5/8		6		1-9/16				6
15762501A	15761	5/8		.6250	5/8		6		1-9/16		0.015		6
15762502A	15762	5/8		.6250	5/8		6		1-9/16		0.020		6
15762503A	15763	5/8		.6250	5/8		6		1-9/16		0.030		6
15762504A	15764	5/8		.6250	5/8		6		1-9/16		0.045		6
15762505A	15765	5/8		.6250	5/8		6		1-9/16		0.060		6
15762506A	15766	5/8		.6250	5/8		6		1-9/16		0.090		6
15762990A	15767		16	.6299		16		150		40			6
15762991A	15768		16	.6299		16		150		40		0.50	6
15762992A	15769		16	.6299		16		150		40		0.75	6
15762993A	15770		16	.6299		16		150		40		1.00	6
15762994A	15771		16	.6299		16		150		40		1.50	6
15762995A	15772		16	.6299		16		150		40		2.00	6
15762996A	15773		16	.6299		16		150		40		2.50	6
15762997A	15774		16	.6299		16		150		40		3.00	6
15775000A	15775	3/4		.7500	3/4		6		1-7/8				8
15775001A	15776	3/4		.7500	3/4		6		1-7/8		0.015		8
15775002A	15777	3/4		.7500	3/4		6		1-7/8		0.020		8
15775003A	15778	3/4		.7500	3/4		6		1-7/8		0.030		8
15775004A	15779	3/4		.7500	3/4		6		1-7/8		0.045		8
15775005A	15780	3/4		.7500	3/4		6		1-7/8		0.060		8
15775006A	15781	3/4		.7500	3/4		6		1-7/8		0.090		8
15775007A	15782	3/4		.7500	3/4		6		1-7/8		0.125		8
15778740A	15783		20	.7874		20		150		45			8
15778741A	15784		20	.7874		20		150		45		0.50	8
15778742A	15785		20	.7874		20		150		45		0.75	8
15778743A	15786		20	.7874		20		150		45		1.00	8
15778744A	15787		20	.7874		20		150		45		1.50	8
15778745A	15788		20	.7874		20		150		45		2.00	8
15778746A	15789		20	.7874		20		150		45		2.50	8
15778747A	15790		20	.7874		20		150		45		3.00	8
15798430A	15791		25	.9843		25		150		50			10

Technical information on page 232.

Technical information on page 232.

Series 157 Continued



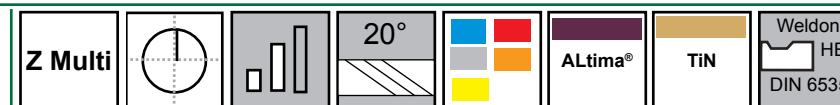
ALtima® 52		Diameter			Shank		OAL		Flute Length		Corner Radius		No. of Flutes
Tool No.	EDP	D1			D2		L1		L2		R		
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
15798431A	15792		25	.9843	25		150		50		0.50		10
15798432A	15793		25	.9843	25		150		50		0.75		10
15798433A	15794		25	.9843	25		150		50		1.00		10
15798434A	15795		25	.9843	25		150		50		1.50		10
15798435A	15796		25	.9843	25		150		50		2.00		10
15798436A	15797		25	.9843	25		150		50		2.50		10
15798437A	15798		25	.9843	25		150		50		3.00		10
15710000A	15799	1		1.0000	1		6		2				10
15710001A	15800	1		1.0000	1		6		2		0.015		10
15710002A	15801	1		1.0000	1		6		2		0.020		10
15710003A	15802	1		1.0000	1		6		2		0.030		10
15710004A	15803	1		1.0000	1		6		2		0.045		10
15710005A	15804	1		1.0000	1		6		2		0.060		10
15710006A	15805	1		1.0000	1		6		2		0.090		10
15710007A	15806	1		1.0000	1		6		2		0.125		10

Technical information on [page 232](#).

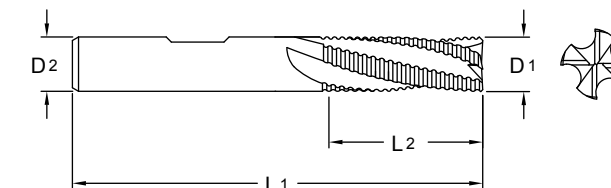


Extend the Life of Your Cutting Tools with M.A.Ford®'s Reconditioning Service

TuffCut® DM Series 192



Designed for high-speed machining of cast iron, mild steels and similar materials.



- High volumetric metal removal rates.
- Achieve 20% higher speed, 50% higher feed than a standard end mill.

ALtima®		TiN		Diameter			Shank		OAL		Flute Length		No. of Flutes
Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2		
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	
19225000A	95730	19225000T	95447	1/4		.2500	1/4		2		1/4		3
19225001A	95737	19225001T	95454	1/4		.2500	1/4		2-1/2		3/4		3
19231500A	95744	19231500T	95461		8	.3150		8		51		8	3
19231501A	95749	19231501T	95466		8	.3150		8		64		16	3
19237500A	95731	19237500T	95448	3/8		.3750	3/8		2		3/8		4
19237501A	95738	19237501T	95455	3/8		.3750	3/8		2-1/2		7/8		4
19239370A	95745	19239370T	95462		10	.3937		10		51		10	4
19239371A	95750	19239371T	95467		10	.3937		10		70		20	4
19247240A	95746	19247240T	95463		12	.4724		12		64		12	4
19247241A	95751	19247241T	95468		12	.4724		12		76		25	4
19250000A	95732	19250000T	95449	1/2		.5000	1/2		2-1/2		1/2		4
19250001A	95739	19250001T	95456	1/2		.5000	1/2		3		1		4
19262500A	95733	19262500T	95450	5/8		.6250	5/8		3		5/8		4
19262501A	95740	19262501T	95457	5/8		.6250	5/8		3-1/2		1-1/4		4
19262990A	95747	19262990T	95464		16	.6299		16		76		16	4
19262991A	95752	19262991T	95469		16	.6299		16		89		32	4
19275000A	95734	19275000T	95451	3/4		.7500	3/4		4		3/4		4
19275001A	95741	19275001T	95458	3/4		.7500	3/4		4		1-1/2		4
19278740A	95748	19278740T	95465		20	.7874		20		76		20	4
19278741A	95753	19278741T	95470		20	.7874		20		102		38	4
19210040A	95735	19210040T	95452	1		1.0000	1		4		1		4
19210041A	95742	19210041T	95459	1		1.0000	1		4		1-1/2		4
19210050A	95736	19210050T	95453	1		1.0000	1		4		1		5*
19210051A	95743	19210051T	95460	1		1.0000	1		4		1-1/2		5*

*Non-Center Cutting.

Inch	
D1	Tolerance
1/4-1	+ .000/- .003

Metric (mm)	
D1	Tolerance
8.00-20.00	+ .000/- .076

Technical information on [page 246](#).

TuffCut® SS Series 112

Designed for milling stainless steel, titanium, inconel and other similar metals, where high cutting forces are generated. Works well as a finishing tool.



Uncoated		TiN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11211810	11203	11211810T	11204		3.0	.1181	3/8	6	1-1/2	38	12.0	
11212500	11205	11212500T	11206	1/8		.1250	1/8		1-1/2		3/8	
11213780	11207	11213780T	11208		3.5	.1378		4.0		51		12.0
11215620	11209	11215620T	11210	5/32		.1562	3/16		2		1/2	
11215750	11211	11215750T	11212		4.0	.1575		4.0		51		14.0
11217720	11213	11217720T	11214		4.5	.1772		5.0		51		14.0
11218750	11215	11218750T	11216	3/16		.1875	3/16		2		9/16	
11219680	11217	11219680T	11218		5.0	.1968		5.0		51		20.0
11221650	11219	11221650T	11220		5.5	.2165		6.0		64		20.0
11221870	11221	11221870T	11222	7/32		.2187	1/4		2-1/2		5/8	
11223620	11223	11223620T	11224		6.0	.2362		6.0		64		20.0
11225000	11225	11225000T	11226	1/4		.2500	1/4		2-1/2		3/4	
11227560	11227	11227560T	11228		7.0	.2756		8.0		64		20.0
11228120	11229	11228120T	11230	9/32		.2812	5/16		2-1/2		3/4	
11231250	11231	11231250T	11232	5/16		.3125	5/16		2-1/2		13/16	
11231500	11233	11231500T	11234		8.0	.3150		8.0		64		20.0
11235430	11235	11235430T	11236		9.0	.3543		9.0		64		20.0
11237500	11237	11237500T	11238	3/8		.3750	3/8		2-1/2		7/8	
11239370	11239	11239370T	11240		10.0	.3937		10.0		70		25.0
11243310	11241	11243310T	11242		11.0	.4331		11.0		70		25.0
11243750	11243	11243750T	11244	7/16		.4375	7/16		2-3/4		1	
11247240	11245	11247240T	11246		12.0	.4724		12.0		76		25.0
11250000	11247	11250000T	11248	1/2		.5000	1/2		3		1	
11255120	11249	11255120T	11250		14.0	.5512		14.0		89		30.0
11256250	11251	11256250T	11252	9/16		.5625	9/16		3-1/2		1-1/8	
11262500	11253	11262500T	11254	5/8		.6250	5/8		3-1/2		1-1/4	
11262990	11255	11262990T	11256		16.0	.6299		16.0		89		30.0
11270870	11257	11270870T	11258		18.0	.7087		18.0		102		35.0
11275000	11259	11275000T	11260	3/4		.7500	3/4		4		1-1/2	
11278740	11261	11278740T	11262		20.0	.7874		20.0		102		38.0
11286620	11263	11286620T	11264		22.0	.8662		22.0		102		40.0
11287500	11265	11287500T	11266	7/8		.8750	7/8		4		1-1/2	
11298430	11267	11298430T	11268		25.0	.9843		25.0		102		40.0
11210000	11201	11210000T	11202	1		1.0000	1		4		1-1/2	

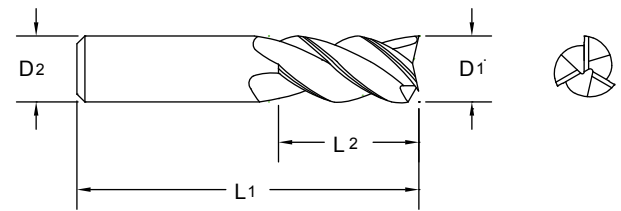
Inch	
D1	Tolerance
1/8-1/4	+0.000/-0.002
> 1/4-1	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-25.00	+0.000/-0.084

- Excellent surface finishes.
- High speed and feed capabilities.
- TiN Coating adds lubricity to prevent edge build up.
- High helix angle increases length of cutting edge engaged in the cut, reducing cutting load variations and prolonging tool life.

Technical information on page 221.

TuffCut® SS Series 172



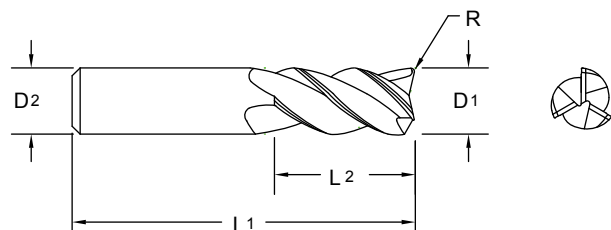
Inch	
D1	Tolerance
1/8-1/4	+0.000/-0.002
>1/4-3/4	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-20.00	+0.000/-0.084

ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
17211811A	17212	17211811C	17211		3.0	.1181		6		51		8
17212500A	17217	17212500C	17215	1/8		.1250	1/8		1-1/2		1/4	
17212501A	17218	17212501C	17216	1/8		.1250	1/8		1-1/2		3/8	
17215751A	17222	17215751C	17221		4.0	.1575		6		51		11
17218750A	17227	17218750C	17225	3/16		.1875	3/16		2		5/16	
17218751A	17228	17218751C	17226	3/16		.1875	3/16		2		9/16	
17219681A	17232	17219681C	17231		5.0	.1968		6		51		14
17223621A	17237	17223621C	17236		6.0	.2362		6		51		15
17225000A	17242	17225000C	17240	1/4		.2500	1/4		2		3/8	
17225001A	17243	17225001C	17241	1/4		.2500	1/4		2-1/2		3/4	
17231250A	17247	17231250C	17245	5/16		.3125	5/16		2		7/16	
17231251A	17248	17231251C	17246	5/16		.3125	5/16		2-1/2		13/16	
17231501A	17252	17231501C	17251		8.0	.3150		8		64		20
17237500A	17257	17237500C	17255	3/8		.3750	3/8		2		1/2	
17237501A	17258	17237501C	17256	3/8		.3750	3/8		2-1/2		1	
17239371A	17262	17239371C	17261		10.0	.3937		10		70		25
17243750A	17267	17243750C	17265	7/16		.4375	7/16		2-1/2		9/16	
17243751A	17268	17243751C	17266	7/16		.4375	7/16		2-3/4		1	
17247241A	17272	17247241C	17271		12.0	.4724		12		76		30
17250000A	17277	17250000C	17275	1/2		.5000	1/2		2-1/2		5/8	
17250001A	17278	17250001C	17276	1/2		.5000	1/2		3		1-1/4	
17262500A	17282	17262500C	17280	5/8		.6250	5/8		3		3/4	
17262501A	17283	17262501C	17281	5/8		.6250	5/8		3-1/2		1-5/8	
17262991A	17287	17262991C	17286		16.0	.6299		16		89		38
17275000A	17292	17275000C	17290	3/4		.7500	3/4		3		1	
17275001A	17293	17275001C	17291	3/4		.7500	3/4		4		1-5/8	
17278741A	17297	17278741C	17296		20.0	.7874		20		102		45

Technical information on page 238.

TuffCut® SS Series 174



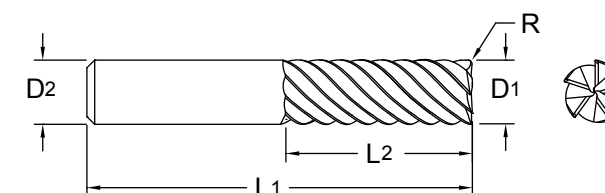
Inch	
D1	Tolerance
1/8-1/4	+0.000/-0.002
> 1/4-3/4	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-20.00	+0.000/-0.084

ALtima®		TiCN		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2		R	
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
17411811A	17410	17411811C	17411		3	.1181		6		51		8		0.2
17412500A	17413	17412500C	17415	1/8		.1250	1/8		1-1/2		1/4			0.008
17412501A	17414	17412501C	17416	1/8		.1250	1/8		1-1/2		3/8			0.008
17415751A	17420	17415751C	17421		4	.1575		6		51		11		0.2
17418750A	17423	17418750C	17425	3/16		.1875	3/16		2		5/16			0.008
17418751A	17424	17418751C	17426	3/16		.1875	3/16		2		9/16			0.008
17419681A	17430	17419681C	17431		5	.1968		6		51		14		0.4
17423621A	17435	17423621C	17436		6	.2362		6		51		15		0.4
17425000A	17438	17425000C	17440	1/4		.2500	1/4		2		3/8			0.015
17425001A	17439	17425001C	17441	1/4		.2500	1/4		2-1/2		3/4			0.015
17431250A	17443	17431250C	17445	5/16		.3125	5/16		2		7/16			0.015
17431251A	17444	17431251C	17446	5/16		.3125	5/16		2-1/2		13/16			0.015
17431501A	17450	17431501C	17451		8	.3150		8		64		20		0.5
17437500A	17453	17437500C	17455	3/8		.3750	3/8		2		1/2			0.020
17437501A	17454	17437501C	17456	3/8		.3750	3/8		2-1/2		1			0.020
17439371A	17460	17439371C	17461		10	.3937		10		70		25		0.5
17443750A	17463	17443750C	17465	7/16		.4375	7/16		2-1/2		9/16			0.020
17443751A	17464	17443751C	17466	7/16		.4375	7/16		2-3/4		1			0.020
17447241A	17470	17447241C	17471		12	.4724		12		76		30		0.5
17450000A	17473	17450000C	17475	1/2		.5000	1/2		2-1/2		5/8			0.030
17450001A	17474	17450001C	17476	1/2		.5000	1/2		3		1-1/4			0.030
17462500A	17478	17462500C	17480	5/8		.6250	5/8		3		3/4			0.030
17462501A	17479	17462501C	17481	5/8		.6250	5/8		3-1/2		1-5/8			0.030
17462991A	17485	17462991C	17486		16	.6299		16		89		38		0.7
17475000A	17488	17475000C	17490	3/4		.7500	3/4		3		1			0.035
17475001A	17489	17475001C	17491	3/4		.7500	3/4		4		1-5/8			0.035
17478741A	17495	17478741C	17496		20	.7874		20		102		45		0.7

Technical information on [page 238](#).

TuffCut® SS Series 175



Inch	
D1	Tolerance
1/4	+0.000/-0.002
>1/4-3/4	+0.000/-0.003

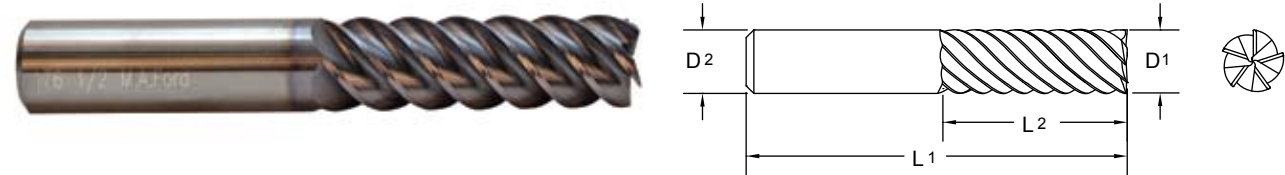
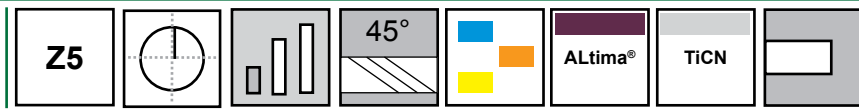
Metric (mm)	
D1	Tolerance h10
6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-20.00	+0.000/-0.084

ALtima®		TiCN		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2		R	
				Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
17523621A	17510	17523621C	17511		6	.2362		6		51		15		0.4
17525000A	17519	17525000C	17520	1/4		.2500	1/4		2		3/8			0.015
17525001A	95777	17525001C	95770	1/4		.2500	1/4		2-1/2		3/4			0.015
17531250A	17524	17531250C	17525	5/16		.3125	5/16		2		7/16			0.015
17531251A	95778	17531251C	95771	5/16		.3125	5/16		2-1/2		13/16			0.015
17531501A	17530	17531501C	17531		8	.3150		8		64		20		0.5
17537500A	17534	17537500C	17535	3/8		.3750	3/8		2		1/2			0.020
17537501A	95779	17537501C	95772	3/8		.3750	3/8		2-1/2		1			0.020
17539371A	17540	17539371C	17541		10	.3937		10		70		25		0.5
17543750A	17544	17543750C	17545	7/16		.4375	7/16		2-1/2		9/16			0.020
17543751A	95780	17543751C	95773	7/16		.4375	7/16		2-3/4		1			0.020
17547241A	17550	17547241C	17551		12	.4724		12		76		30		0.5
17550000A	17559	17550000C	17560	1/2		.5000	1/2		2-1/2		5/8			0.030
17550001A	95781	17550001C	95774	1/2		.5000	1/2		3		1-1/4			0.030
17562500A	17569	17562500C	17570	5/8		.6250	5/8		3		3/4			0.030
17562501A	95782	17562501C	95775	5/8		.6250	5/8		3-1/2		1-5/8			0.030
17562991A	17575	17562991C	17576		16	.6299		16		89		38		0.7
17575000A	17579	17575000C	17580	3/4		.7500	3/4		3		1			0.035
17575001A	95783	17575001C	95776	3/4		.7500	3/4		4		1-5/8			0.035
17578741A	17590	17578741C	17591		20	.7874		20		102		45		0.7

Technical information on [page 238](#).



TuffCut® SS Series 176



ALtima®		TiCN		Diameter D1		Shank D2	OAL L1	Flute Length L2
Tool No.	EDP	Tool No.	EDP	Inch	Decimal			
17625001A	17609	17625001C	17611	1/4	.2500	1/4	2-1/2	3/4
17625002A	17610	17625002C	17612	1/4	.2500	1/4	4	1-1/4
17631251A	17619	17631251C	17621	5/16	.3125	5/16	2-1/2	13/16
17631252A	17620	17631252C	17622	5/16	.3125	5/16	4	1-1/4
17637501A	17629	17637501C	17631	3/8	.3750	3/8	2-1/2	1
17637502A	17630	17637502C	17632	3/8	.3750	3/8	4	1-1/2
17643751A	17639	17643751C	17641	7/16	.4375	7/16	2-3/4	1
17643752A	17640	17643752C	17642	7/16	.4375	7/16	4	2
17650001A	17649	17650001C	17651	1/2	.5000	1/2	3	1-1/4
17650002A	17650	17650002C	17652	1/2	.5000	1/2	4	2
17662501A	17659	17662501C	17661	5/8	.6250	5/8	3-1/2	1-5/8
17662502A	17660	17662502C	17662	5/8	.6250	5/8	5	2-1/2
17675001A	17669	17675001C	17671	3/4	.7500	3/4	4	1-5/8
17675002A	17670	17675002C	17672	3/4	.7500	3/4	6	3-1/4

Inch	
D1	Tolerance
1/4	+0.000/-0.002
>1/4-3/4	+0.000/-0.003

Technical information on page 238.

ISO 9001:2000 Certified
An ESOP Company

TuffCut® SS Series 113



Ideal for machining metals where high cutting forces are generated. Also, the TuffCut® SS works well in most materials as a finishing tool.



Uncoated		TiN		Diameter D1			Shank D2		OAL L1		Flute Length L2	
Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11311810	11303	11311810T	11304	3.0	.1181		3.0	38		12.0		
11312500	11305	11312500T	11306	1/8	.1250		1/8	1-1/2		3/8		
11313780	11307	11313780T	11308	3.5	.1378		4.0	51		12.0		
11315620	11309	11315620T	11310	5/32	.1562		3/16	2		1/2		
11315750	11311	11315750T	11312	4.0	.1575		4.0	51		14.0		
11317720	11313	11317720T	11314	4.5	.1772		5.0	51		14.0		
11318750	11315	11318750T	11316	3/16	.1875		3/16	2		9/16		
11319680	11317	11319680T	11318	5.0	.1968		5.0	51		20.0		
11321650	11319	11321650T	11320	5.5	.2165		6.0	64		20.0		
11321870	11321	11321870T	11322	7/32	.2187		1/4	2-1/2		5/8		
11323620	11323	11323620T	11324	6.0	.2362		6.0	64		20.0		
11325000	11325	11325000T	11326	1/4	.2500		1/4	2-1/2		3/4		
11327560	11327	11327560T	11328	7.0	.2756		8.0	64		20.0		
11328120	11329	11328120T	11330	9/32	.2812		5/16	2-1/2		3/4		
11331250	11331	11331250T	11332	5/16	.3125		5/16	2-1/2		13/16		
11331500	11333	11331500T	11334	8.0	.3150		8.0	64		20.0		
11335430	11335	11335430T	11336	9.0	.3543		9.0	64		20.0		
11337500	11337	11337500T	11338	3/8	.3750		3/8	2-1/2		7/8		
11339370	11339	11339370T	11340	10.0	.3937		10.0	70		25.0		
11343310	11341	11343310T	11342	11.0	.4331		11.0	70		25.0		
11343750	11343	11343750T	11344	7/16	.4375		7/16	2-3/4		1		
11347240	11345	11347240T	11346	12.0	.4724		12.0	76		25.0		
11350000	11347	11350000T	11348	1/2	.5000		1/2	3		1		
11355120	11349	11355120T	11350	14.0	.5512		14.0	89		30.0		
11356250	11351	11356250T	11352	9/16	.5625		9/16	3-1/2		1-1/8		
11362500	11353	11362500T	11354	5/8	.6250		5/8	3-1/2		1-1/4		
11362990	11355	11362990T	11356	16.0	.6299		16.0	89		30.0		
11370870	11357	11370870T	11358	18.0	.7087		18.0	102		35.0		
11375000	11359	11375000T	11360	3/4	.7500		3/4	4		1-1/2		
11378740	11361	11378740T	11362	20.0	.7874		20.0	102		38.0		
11386620	11363	11386620T	11364	22.0	.8662		22.0	102		40.0		
11387500	11365	11387500T	11366	7/8	.8750		7/8	4		1-1/2		
11398430	11367	11398430T	11368	25.0	.9843		25.0	102		40.0		
11310000	11301	11310000T	11302	1	1.0000		1	4		1-1/2		

Inch	
D1	Tolerance
1/8-1/4	+0.000/-0.002
> 1/4-1	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-25.00	+0.000/-0.084

- TiN Coating adds lubricity to prevent edge build up.
- 6 Flute geometry lowers cutting force vibration, permitting higher feeds (at comparable chip loads) and improved tool life.

Technical information on page 221.

TuffCut®

General Purpose End Mills

Square End/Corner Radius

4 Flute

- TuffCut® GP Series 111
- TuffCut® GP Series 114
- TuffCut® GP Series 117
- TuffCut® GP Series 151
- TuffCut® GP Series 163
- TuffCut® GP Series 161
- TuffCut® GP Series 122
- TuffCut® GP Series 132
- TuffCut® GP Series 181

3 Flute

- TuffCut® GP Series 116
- TuffCut® GP Series 169

2 Flute

- TuffCut® GP Series 121
- TuffCut® GP Series 164
- TuffCut® GP Series 162
- TuffCut® GP Series 123
- TuffCut® GP Series 183

Ball Nose

4 Flute

- TuffCut® GP Series 140
- TuffCut® GP Series 165
- TuffCut® GP Series 167
- TuffCut® GP Series 184

3 Flute

- TuffCut® GP Series 145

2 Flute

- TuffCut® GP Series 150
- TuffCut® GP Series 166
- TuffCut® GP Series 168
- TuffCut® GP Series 186

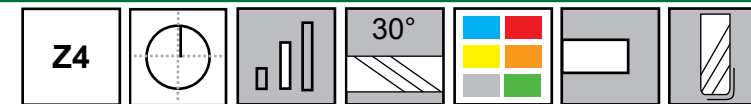


ISO 9001:2000 Certified

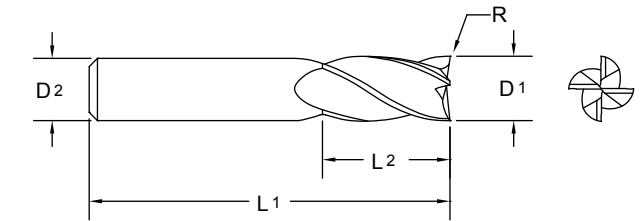
An ESOP Company

For product information, call your local distributor.

TuffCut® GP Series 111



Designed for aggressive milling of most materials.



- Micro sizes available. .005 - .100" and 0.2 - 2.0mm

Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1		L2		R	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
11100500	51001			.0050*	1/8		1-1/2		.015			
11100780	51003		0.2	.0078*		3.0		38		0.6		
11101000	51005			.0100*	1/8		1-1/2		.030			
11101180	51007		0.3	.0118*		3.0		38		0.9		
11101500	51009			.0150*	1/8		1-1/2		.045			
11101560	11011	1/64		.0156	1/8		1-1/2		1/32			
11101570	51013		0.4	.0157		3.0		38		1.2		
11101960	51015		0.5	.0196		3.0		38		1.5		
11102000	51017			.0200	1/8		1-1/2		.060			
11102360	51019		0.6	.0236		3.0		38		1.8		
11102500	51021			.0250	1/8		1-1/2		.075			
11102750	51023		0.7	.0275		3.0		38		2.1		
11103000	51025			.0300	1/8		1-1/2		.090			
11103120	11027	1/32		.0312	1/8		1-1/2		5/64			
11103150	51029		0.8	.0315		3.0		38		2.4		
11103500	51031			.0350	1/8		1-1/2		.105			
11103540	51033		0.9	.0354		3.0		38		2.7		
11103940	11035		1.0	.0394		3.0		38		3.0		
11104000	51039			.0400	1/8		1-1/2		.120			
11104330	51041		1.1	.0433		3.0		38		3.3		
11104500	51043			.0450	1/8		1-1/2		.135			
11104680	11045	3/64		.0468	1/8		1-1/2		7/64			
11104720	51047		1.2	.0472		3.0		38		3.6		
11105000	51049			.0500	1/8		1-1/2		.150			
11105120	51051		1.3	.0512		3.0		38		3.9		
11105500	51053			.0550	1/8		1-1/2		.165			
11105510	51055		1.4	.0551		3.0		38		4.2		
11105910	11057		1.5	.0591		3.0		38		6.0		
11105911	51057		1.5	.0591		3.0		38		4.5		
11106000	51061			.0600	1/8		1-1/2		.180			
11106250	11063	1/16		.0625	1/8		1-1/2		3/16			
11106300	51065		1.6	.0630		3.0		38		4.8		
11106500	51067			.0650	1/8		1-1/2		.195			
11106690	51069		1.7	.0669		3.0		38		5.1		
11107000	51071			.0700	1/8		1-1/2		.210			
11107090	51073		1.8	.0709		3.0		38		5.4		
11107480	51075		1.9	.0748		3.0		38		5.7		
11107500	51077			.0750	1/8		1-1/2		.225			

*End mills 0.015" (0.3mm) and smaller are non-center cutting.

Inch	
D1	Tolerance
1/64	+ .000/- .001
1/32-1/4	+ .000/- .002
>1/4-1 1/4	+ .000/- .003
D1 Micro Sizes*	Tolerance
.005-.100	+ .0005/- .0005

*Inch decimal size range .005 - .100 only.

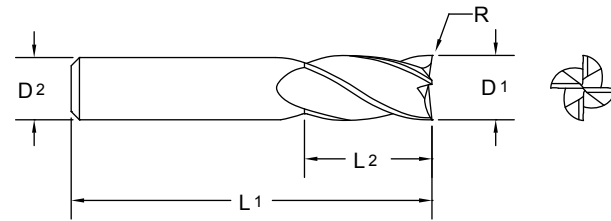
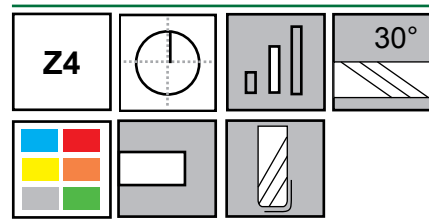
Metric (mm)	
D1	Tolerance h10
0.20-0.50	+ .000/- .025
0.60-3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-18.00	+ .000/- .070
>18.00-30.00	+ .000/- .084
32.00	+ .000/- .100

Coated tools on [page 175](#).

Technical information on [page 250](#).

For product information, call your local distributor.

Series 111 Continued



Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
11107810	11079	5/64		.0781	1/8		1-1/2		3/16			
11107870	11081		2.0	.0787		3.0		38		9.0		
11107871	51081		2.0	.0787		3.0		38		6.0		
11108000	51085			.0800	1/8		1-1/2		.240			
11108500	51087			.0850	1/8		1-1/2		.255			
11109000	51089			.0900	1/8		1-1/2		.270			
11109370	11091	3/32		.0937	1/8		1-1/2		9/32			
11109500	51093			.0950	1/8		1-1/2		.285			
11109840	11095		2.5	.0984		3.0		38		12.0		
11110010	51099			.1000	1/8		1-1/2		.300			
11110930	11101	7/64		.1093	1/8		1-1/2		3/8			
11111810	11103		3.0	.1181		3.0		38		12.0		
11111811	51402		3.0	.1181		3.0		38		12.0		0.50
11112500	11105	1/8		.1250	1/8		1-1/2		3/8			
11112501	11108	1/8		.1250	1/8		1-1/2		1/2			
11112511	51401	1/8		.1250	1/8		1-1/2		3/8		0.015	
11112512	51403	1/8		.1250	1/8		1-1/2		3/8		0.020	
11113780	11111		3.5	.1378		4.0		51		12.0		
11114060	11112	9/64		.1406	3/16		2		1/2			
11115620	11113	5/32		.1562	3/16		2		1/2			
11115750	11115		4.0	.1575		4.0		51		14.0		
11115751	51404		4.0	.1575		4.0		51		14.0		0.50
11115752	51422		4.0	.1575		4.0		51		14.0		0.75
11117190	11116	11/64		.1719	3/16		2		5/8			
11117720	11117		4.5	.1772		5.0		51		14.0		
11118750	11119	3/16		.1875	3/16		2		5/8			
11118751	51405	3/16		.1875	3/16		2		5/8		0.015	
11118752	51407	3/16		.1875	3/16		2		5/8		0.020	
11118753	51409	3/16		.1875	3/16		2		5/8		0.030	
11119680	11121		5.0	.1968		5.0		51		20.0		
11119681	51406		5.0	.1968		5.0		51		20.0		0.50
11119682	51424		5.0	.1968		5.0		51		20.0		0.75
11119683	51440		5.0	.1968		5.0		51		20.0		1.00
11120310	11122	13/64		.2031	1/4		2-1/2		5/8			
11121650	11123		5.5	.2165		6.0		64		20.0		
11121870	11125	7/32		.2187	1/4		2-1/2		5/8			
11123440	11126	15/64		.2344	1/4		2-1/2		3/4			
11123620	11127		6.0	.2362		6.0		64		20.0		
11123621	51408		6.0	.2362		6.0		64		20.0		0.50
11123622	51426		6.0	.2362		6.0		64		20.0		0.75
11123623	51442		6.0	.2362		6.0		64		20.0		1.00
11125000	11129	1/4		.2500	1/4		2-1/2		3/4			
11125001	51411	1/4		.2500	1/4		2-1/2		3/4		0.015	

Coated tools on page 175.

Technical information on page 250.

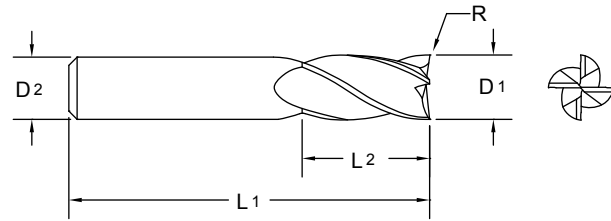
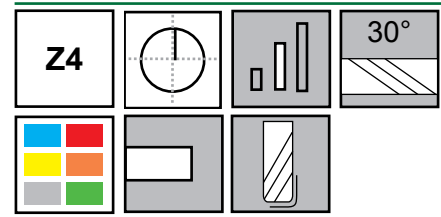
Series 111 Continued

Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
11125002	51413	1/4		.2500	1/4		2-1/2		3/4		0.020	
11125003	51415	1/4		.2500	1/4		2-1/2		3/4		0.030	
11125004	51417	1/4		.2500	1/4		2-1/2		3/4		0.045	
11127560	11131		7.0	.2756		8.0		64		20.0		
11128120	11133	9/32		.2812	5/16		2-1/2		3/4			
11131250	11135	5/16		.3125	5/16		2-1/2		13/16			
11131251	51419	5/16		.3125	5/16		2-1/2		13/16		0.015	
11131252	51421	5/16		.3125	5/16		2-1/2		13/16		0.020	
11131253	51423	5/16		.3125	5/16		2-1/2		13/16		0.030	
11131254	51425	5/16		.3125	5/16		2-1/2		13/16		0.045	
11131500	11137		8.0	.3150		8.0		64		20.0		
11131501	51410		8.0	.3150		8.0		64		20.0		0.50
11131502	51428		8.0	.3150		8.0		64		20.0		0.75
11131503	51444		8.0	.3150		8.0		64		20.0		1.00
11131504	51456		8.0	.3150		8.0		64		20.0		1.50
11135430	11139		9.0	.3543		9.0		64		20.0		
11137500	11141	3/8		.3750	3/8		2-1/2		1			
11137501	51427	3/8		.3750	3/8		2-1/2		1		0.015	
11137502	51429	3/8		.3750	3/8		2-1/2		1		0.020	
11137503	51431	3/8		.3750	3/8		2-1/2		1		0.030	
11137504	51433	3/8		.3750	3/8		2-1/2		1		0.045	
11139370	11143		10.0	.3937		10.0		70		25.0		
11139371	51412		10.0	.3937		10.0		70		25.0		0.50
11139372	51430		10.0	.3937		10.0		70		25.0		0.75
11139373	51446		10.0	.3937		10.0		70		25.0		1.00
11139374	51458		10.0	.3937		10.0		70		25.0		1.50
11143310	11145		11.0	.4331		11.0		70		25.0		
11143750	11147	7/16		.4375	7/16		2-3/4		1			
11147240	11149		12.0	.4724		12.0		76		25.0		
11147241	51414		12.0	.4724		12.0		76		25.0		0.50
11147242	51432		12.0	.4724		12.0		76		25.0		0.75
11147243	51448		12.0	.4724		12.0		76		25.0		1.00
11147244	51460		12.0	.4724		12.0		76		25.0		1.50
11147245	51468		12.0	.4724		12.0		76		25.0		2.00
11150000	11151	1/2		.5000	1/2		3		1			
11150001	51435	1/2		.5000	1/2		3		1		0.015	
11150002	51437	1/2		.5000	1/2		3		1		0.020	
11150003	51439	1/2		.5000	1/2		3		1		0.030	
11150004	51441	1/2		.5000	1/2		3		1		0.045	
11150005	51443	1/2		.5000	1/2		3		1		0.060	
11155120	11153		14.0	.5512		14.0		89		30.0		
11156250	11155	9/16		.5625	9/16		3-1/2		1-1/8			
11162500	11157	5/8		.6250	5/8		3-1/2		1-1/4			
11162501	51445	5/8		.6250	5/8		3-1/2		1-1/4		0.015	
11162502	51447	5/8		.6250	5/8		3-1/2		1-1/4		0.020	
11162503	51449	5/8		.6250	5/8		3-1/2		1-1/4		0.030	
11162504	51451	5/8		.6250	5/8		3-1/2		1-1/4		0.045	
11162505	51453	5/8		.6250	5/8		3-1/2		1-1/4		0.060	
11162506	51455	5/8		.6250	5/8		3-1/2		1-1/4		0.090	
11162990	11159		16.0	.6299		16.0		89		30.0		

Coated tools on page 175.

Technical information on page 250.

Series 111 Continued

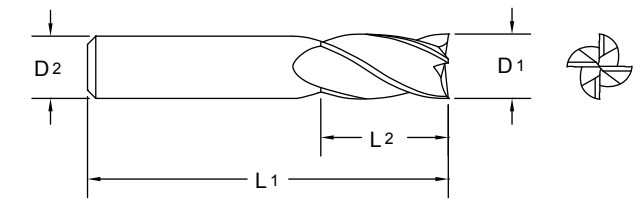


Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
11162991	51416		16.0	.6299	16.0		89		30.0		0.50	
11162992	51434		16.0	.6299	16.0		89		30.0		0.75	
11162993	51450		16.0	.6299	16.0		89		30.0		1.00	
11162994	51462		16.0	.6299	16.0		89		30.0		1.50	
11162995	51470		16.0	.6299	16.0		89		30.0		2.00	
11162996	51476		16.0	.6299	16.0		89		30.0		2.50	
11162997	51482		16.0	.6299	16.0		89		30.0		3.00	
11170870	11161		18.0	.7087	18.0		102		35.0			
11175000	11163	3/4		.7500	3/4		4		1-1/2			
11175001	51457	3/4		.7500	3/4		4		1-1/2		0.015	
11175002	51459	3/4		.7500	3/4		4		1-1/2		0.020	
11175003	51461	3/4		.7500	3/4		4		1-1/2		0.030	
11175004	51463	3/4		.7500	3/4		4		1-1/2		0.045	
11175005	51465	3/4		.7500	3/4		4		1-1/2		0.060	
11175006	51467	3/4		.7500	3/4		4		1-1/2		0.090	
11175007	51469	3/4		.7500	3/4		4		1-1/2		0.125	
11178740	11165		20.0	.7874	20.0		102		38.0			
11178741	51418		20.0	.7874	20.0		102		38.0		0.50	
11178742	51436		20.0	.7874	20.0		102		38.0		0.75	
11178743	51452		20.0	.7874	20.0		102		38.0		1.00	
11178744	51464		20.0	.7874	20.0		102		38.0		1.50	
11178745	51472		20.0	.7874	20.0		102		38.0		2.00	
11178746	51478		20.0	.7874	20.0		102		38.0		2.50	
11178747	51484		20.0	.7874	20.0		102		38.0		3.00	
11186620	11167		22.0	.8662	22.0		102		40.0			
11187500	11169	7/8		.8750	7/8		4		1-1/2			
11198430	11171		25.0	.9843	25.0		102		40.0			
11198431	51420		25.0	.9843	25.0		102		40.0		0.50	
11198432	51438		25.0	.9843	25.0		102		40.0		0.75	
11198433	51454		25.0	.9843	25.0		102		40.0		1.00	
11198434	51466		25.0	.9843	25.0		102		40.0		1.50	
11198435	51474		25.0	.9843	25.0		102		40.0		2.00	
11198436	51480		25.0	.9843	25.0		102		40.0		2.50	
11198437	51486		25.0	.9843	25.0		102		40.0		3.00	
11110000	11097	1.0		1.0000	1		4		1-1/2			
11110001	51471	1.0		1.0000	1		4		1-1/2		0.015	
11110002	51473	1.0		1.0000	1		4		1-1/2		0.020	
11110003	51475	1.0		1.0000	1		4		1-1/2		0.030	
11110004	51477	1.0		1.0000	1		4		1-1/2		0.045	
11110005	51479	1.0		1.0000	1		4		1-1/2		0.060	
11110006	51481	1.0		1.0000	1		4		1-1/2		0.090	
11110007	51483	1.0		1.0000	1		4		1-1/2		0.125	
11112510	11107	1-1/4		1.2500	1-1/4		4-3/8		1-9/16			
11112600	11109		32.0	1.2600	32.0		111		40.0			

Coated tools on page 175.

Technical information on page 250.

TuffCut® GP Series 111 Coated



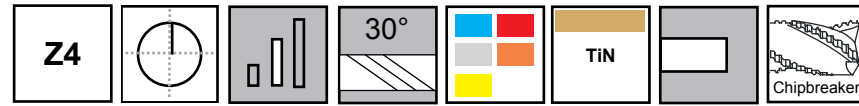
TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	D1			D2		L1		L2	
						Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11111810T	11104	11111810A	11003	11111810C	11004		3.0	.1181		3.0		38		12.0
11112500T	11106	11112500A	11005	11112500C	11006	1/8		.1250	1/8		1-1/2		3/8	
11115750T	11118	11115750A	11007	11115750C	11008		4.0	.1575		4.0		51		14.0
11118750T	11120	11118750A	11009	11118750C	11010	3/16		.1875	3/16		2		5/8	
11119680T	11124	11119680A	11013	11119680C	11014		5.0	.1968		5.0		51		20.0
11123620T	11128	11123620A	11015	11123620C	11016		6.0	.2362		6.0		64		20.0
11125000T	11130	11125000A	11017	11125000C	11018	1/4		.2500	1/4		2-1/2		3/4	
11131250T	11136	11131250A	11019	11131250C	11020	5/16		.3125	5/16		2-1/2		13/16	
11131500T	11138	11131500A	11021	11131500C	11022		8.0	.3150		8.0		64		20.0
11137500T	11142	11137500A	11023	11137500C	11024	3/8		.3750	3/8		2-1/2		1	
11139370T	11144	11139370A	11025	11139370C	11026		10.0	.3937		10.0		70		25.0
11143750T	11148	11143750A	11029	11143750C	11030	7/16		.4375	7/16		2-3/4		1	
11147240T	11150	11147240A	11031	11147240C	11032		12.0	.4724		12.0		76		25.0
11150000T	11152	11150000A	11033	11150000C	11034	1/2		.5000	1/2		3		1	
11162500T	11158	11162500A	11037	11162500C	11038	5/8		.6250	5/8		3-1/2		1-1/4	
11162990T	11160	11162990A	11039	11162990C	11040		16.0	.6299		16.0		89		30.0
11175000T	11164	11175000A	11041	11175000C	11042	3/4		.7500	3/4		4		1-1/2	
11178740T	11166	11178740A	11043	11178740C	11044		20.0	.7874		20.0		102		38.0
11198430T	11172	11198430A	11047	11198430C	11048		25.0	.9843		25.0		102		40.0
11110000T	11098	11110000A	11001	11110000C	11002	1.0		1.0000	1		4		1-1/2	

Uncoated tools on page 171.

Technical information on page 250.

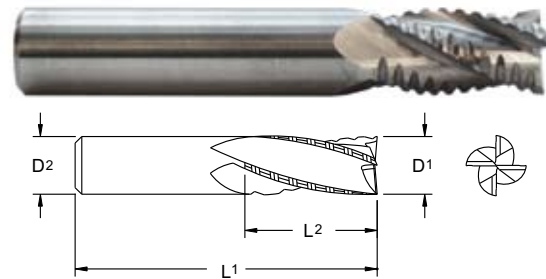
Safety Note
Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

TuffCut® GP Series 114



Chipbreaker end mill designed for aggressive milling of most materials.

- Allows high feed rates when roughing.
- Designed to minimize cutting forces, reduce or eliminate chatter and prolong tool life.
- Designed with tooth overlap to produce smooth part finish.



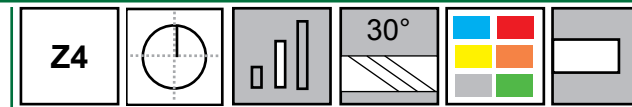
Uncoated		TiN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11411810	11403	11411810T	11404		3.0	.1181	3.0	38		12.0		
11412500	11405	11412500T	11406	1/8		.1250	1/8	1-1/2		3/8		
11413780	11407				3.5	.1378	4.0	51		12.0		
11415620	11409			5/32		.1562	3/16	2		1/2		
11415750	11411				4.0	.1575	4.0	51		14.0		
11417720	11413				4.5	.1772	5.0	51		14.0		
11418750	11415	11418750T	11416	3/16		.1875	3/16	2		5/8		
11419680	11417	11419680T	11418		5.0	.1968	5.0	51		20.0		
11421650	11419				5.5	.2165	6.0	64		20.0		
11421870	11421			7/32		.2187	1/4	2-1/2		5/8		
11423620	11423	11423620T	11424		6.0	.2362	6.0	64		20.0		
11425000	11425	11425000T	11426	1/4		.2500	1/4	2-1/2		3/4		
11427560	11427				7.0	.2756	8.0	64		20.0		
11428120	11429			9/32		.2812	5/16	2-1/2		3/4		
11431250	11431	11431250T	11432	5/16		.3125	5/16	2-1/2		13/16		
11431500	11433	11431500T	11434		8.0	.3150	8.0	64		20.0		
11435430	11435				9.0	.3543	9.0	64		20.0		
11437500	11437	11437500T	11438	3/8		.3750	3/8	2-1/2		1		
11439370	11439	11439370T	11440		10.0	.3937	10.0	70		25.0		
11443310	11441				11.0	.4331	11.0	70		25.0		
11443750	11443	11443750T	11444	7/16		.4375	7/16	2-3/4		1		
11447240	11445	11447240T	11446		12.0	.4724	12.0	76		25.0		
11450000	11447	11450000T	11448	1/2		.5000	1/2	3		1		
11455120	11449				14.0	.5512	14.0	89		30.0		
11456250	11451			9/16		.5625	9/16	3-1/2		1-1/8		
11462500	11453	11462500T	11454	5/8		.6250	5/8	3-1/2		1-1/4		
11462990	11455	11462990T	11456		16.0	.6299	16.0	89		30.0		
11470870	11457	11470870T	11458		18.0	.7087	18.0	102		35.0		
11475000	11459	11475000T	11460	3/4		.7500	3/4	4		1-1/2		
11478740	11461	11478740T	11462		20.0	.7874	20.0	102		38.0		
11486620	11463				22.0	.8662	22.0	102		40.0		
11487500	11465			7/8		.8750	7/8	4		1-1/2		
11498430	11467				25.0	.9843	25.0	102		40.0		
11410000	11401			1		1.0000	1	4		1-1/2		

Inch	
D1	Tolerance
1/8-1/4	+0.000/-0.002
> 1/4-1	+0.000/-0.003

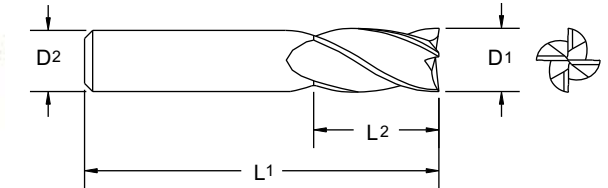
Metric (mm)	
D1	Tolerance h10
3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-25.00	+0.000/-0.084

Technical information on page 222.

TuffCut® GP Series 117



Recommended for use on close tolerance milling.



- NC tolerances on cutting diameter:
Imperial +.001"/-.000"
Metric +.025mm/-0.000mm
- TiN and ALtima® coatings available.

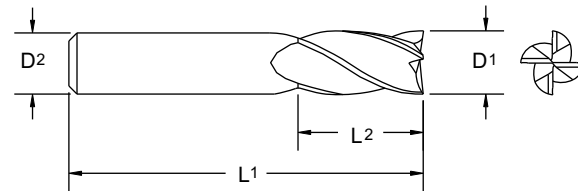
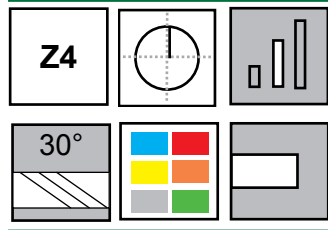
Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11701560	11701	1/64		.0156	1/8		1-1/2		.040	
11703120	11703	1/32		.0312	1/8		1-1/2		5/64	
11703940	11705		1.0	.0394		3.0		38		3.0
11704680	11707	3/64		.0468	1/8		1-1/2		7/64	
11705910	11709		1.5	.0591		3.0		38		6.0
11706250	11711	1/16		.0625	1/8		1-1/2		3/16	
11707810	11713	5/64		.0781	1/8		1-1/2		15/64	
11707870	11715		2.0	.0787		3.0		38		9.0
11709370	11717	3/32		.0937	1/8		1-1/2		9/32	
11709840	11719		2.5	.0984		3.0		38		12.0
11710930	11723	7/64		.1093	1/8		1-1/2		21/64	
11711810	11725		3.0	.1181		3.0		38		12.0
11712500	11727	1/8		.1250	1/8		1-1/2		3/8	
11713780	11729		3.5	.1378		4.0		51		12.0
11715620	11731	5/32		.1562	3/16		2		1/2	
11715750	11733		4.0	.1575		4.0		51		14.0
11717720	11735		4.5	.1772		5.0		51		14.0
11718750	11737	3/16		.1875	3/16		2		9/16	
11719680	11739		5.0	.1968		5.0		51		20.0
11721650	11741		5.5	.2165		6.0		64		20.0
11721870	11743	7/32		.2187	1/4		2-1/2		5/8	
11723620	11745		6.0	.2362		6.0		64		20.0
11725000	11747	1/4		.2500	1/4		2-1/2		3/4	
11727560	11749		7.0	.2756		8.0		64		20.0
11728120	11751	9/32		.2812	5/16		2-1/2		3/4	
11731250	11753	5/16		.3125	5/16		2-1/2		13/16	
11731500	11755		8.0	.3150		8.0		64		20.0
11735430	11757		9.0	.3543		9.0		64		20.0
11737500	11759	3/8		.3750	3/8		2-1/2		7/8	
11739370	11761		10.0	.3937		10.0		70		25.0

Inch	
D1	Tolerance
1/64 - 1	+0.001/-0.000

Metric (mm)	
D1	Tolerance
1.00-25.00	+0.025/-0.000

Technical information on page 250.

Series 117 Continued

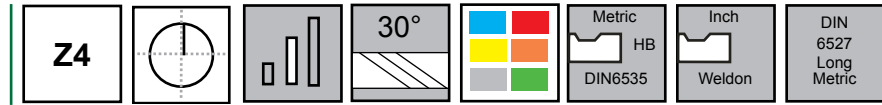


Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11743310	11763		11.0	.4331		11.0		70		25.0
11743750	11765	7/16		.4375	7/16		2-3/4		1	
11747240	11767		12.0	.4724		12.0		76		25.0
11750000	11769	1/2		.5000	1/2		3		1	
11755120	11771		14.0	.5512		14.0		89		30.0
11756250	11773	9/16		.5625	9/16		3-1/2		1-1/8	
11762500	11775	5/8		.6250	5/8		3-1/2		1-1/4	
11762990	11777		16.0	.6299		16.0		89		30.0
11770870	11779		18.0	.7087		18.0		102		35.0
11775000	11781	3/4		.7500	3/4		4		1-1/2	
11778740	11783		20.0	.7874		20.0		102		38.0
11786620	11785		22.0	.8662		22.0		102		40.0
11787500	11787	7/8		.8750	7/8		4		1-1/2	
11798430	11789		25.0	.9843		25.0		102		40.0
11710000	11721	1		1.0000	1		4		1-1/2	

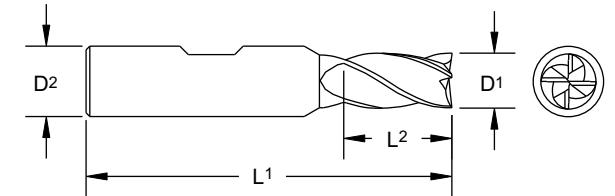
Technical information on [page 250](#).



TuffCut® GP Series 151



Designed for aggressive milling of most materials.
Imperial NC tolerance on body diameter +.001"/-.000".



Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
15111810	15121		3.0	.1181		6.0		57		8.0
15112500	15101	1/8		.1250	3/8		2-1/2		1/2	
15115620	15103	5/32		.1562	3/8		2-1/2		9/16	
15115750	15123		4.0	.1575		6.0		57		11.0
15118750	15105	3/16		.1875	3/8		2-1/2		5/8	
15119680	15125		5.0	.1968		6.0		57		13.0
15121870	15107	7/32		.2187	3/8		2-1/2		5/8	
15123620	15127		6.0	.2362		6.0		57		13.0
15125000	15109	1/4		.2500	3/8		2-1/2		3/4	
15128120	15111	9/32		.2812	3/8		2-1/2		3/4	
15131250	15113	5/16		.3125	3/8		2-1/2		13/16	
15131500	15129		8.0	.3150		8.0		63		19.0
15137500	15115	3/8		.3750	3/8		2-1/2		7/8	
15139370	15131		10.0	.3937		10.0		72		22.0
15143750	15117	7/16		.4375	1/2		3		1	
15147240	15133		12.0	.4724		12.0		83		26.0
15150000	15119	1/2		.5000	1/2		3		1	
15155120	15135		14.0	.5512		14.0		83		26.0
15162990	15137		16.0	.6299		16.0		92		32.0
15170870	15139		18.0	.7087		18.0		92		32.0
15178740	15141		20.0	.7874		20.0		104		38.0

Inch	
D1	Tolerance
1/8-1/2	+0.01/-0.000

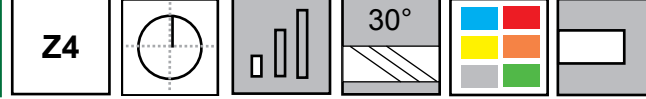
Metric (mm)	
D1	Tolerance h10
3.00	+0.00/-0.040
>3.00-6.00	+0.00/-0.048
>6.00-10.00	+0.00/-0.058
>10.00-18.00	+0.00/-0.070
>18.00-20.00	+0.00/-0.084

Technical information on [page 250](#).

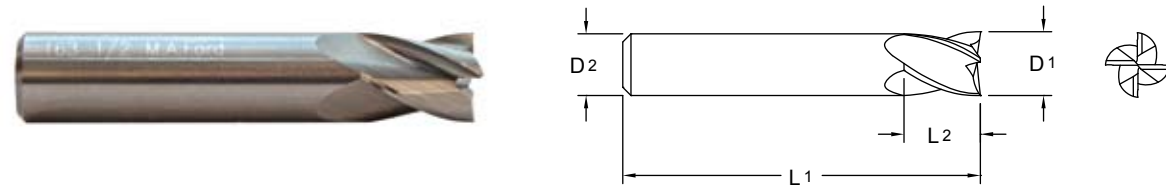
ISO 9001:2000 Certified
An ESOP Company

Series 163 Continued

TuffCut® GP Series 163



Designed for aggressive milling of most materials with reduced deflection, improved tool life and overall economy.



Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16301560	16300	1/64		.0156	1/8		1-1/2		.023	
16303120	16301	1/32		.0312	1/8		1-1/2		1/16	
16303940	16303		1.0	.0394		3.0		38		2.0
16304680	16305	3/64		.0468	1/8		1-1/2		3/32	
16305910	16307		1.5	.0591		3.0		38		3.0
16306250	16309	1/16		.0625	1/8		1-1/2		1/8	
16307810	16310	5/64		.0781	1/8		1-1/2		5/32	
16307870	16311		2.0	.0787		3.0		38		4.0
16309370	16313	3/32		.0937	1/8		1-1/2		3/16	
16309840	16315		2.5	.0984		3.0		38		5.0
16310930	16316	7/64		.1093	1/8		1-1/2		7/32	
16311810	16317		3.0	.1181		3.0		38		6.0
16312500	16319	1/8		.1250	1/8		1-1/2		1/4	
16313780	16321		3.5	.1378		4.0		51		7.0
16314060	16322	9/64		.1406	3/16		2		5/16	
16315620	16323	5/32		.1562	3/16		2		5/16	
16315750	16325		4.0	.1575		4.0		51		8.0
16317180	16326	11/64		.1718	3/16		2		3/8	
16317720	16327		4.5	.1772		5.0		51		9.0
16318750	16329	3/16		.1875	3/16		2		3/8	
16319680	16331		5.0	.1968		5.0		51		11.0
16320310	16332	13/64		.2031	1/4		2		1/2	
16321650	16333		5.5	.2165		6.0		51		12.0
16321870	16335	7/32		.2187	1/4		2		1/2	
16323430	16336	15/64		.2343	1/4		2		1/2	
16323620	16337		6.0	.2362		6.0		51		13.0
16325000	16339	1/4		.2500	1/4		2		1/2	
16327560	16341		7.0	.2756		8.0		51		13.0
16328120	16342	9/32		.2812	5/16		2		1/2	
16331250	16343	5/16		.3125	5/16		2		1/2	
16331500	16345		8.0	.3150		8.0		51		13.0
16335430	16347		9.0	.3543		9.0		51		14.0
16337500	16349	3/8		.3750	3/8		2		5/8	
16339370	16351		10.0	.3937		10.0		51		14.0
16343310	16353		11.0	.4331		11.0		64		16.0

Inch	
D1	Tolerance
1/64	+ .000/- .001
1/32-1/4	+ .000/- .002
>1/4-3/4	+ .000/- .003

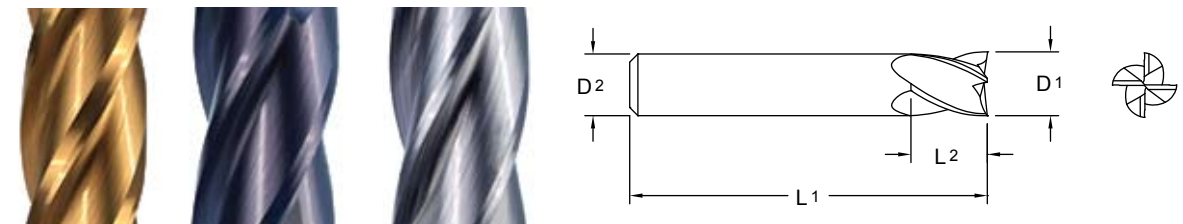
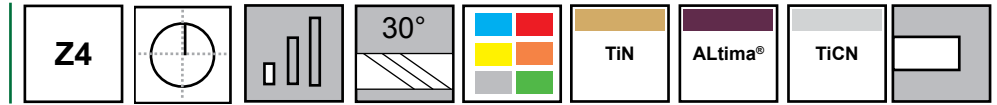
Metric (mm)	
D1	Tolerance h10
1.00-3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-18.00	+ .000/- .070
>18.00-20.00	+ .000/- .084

Coated tools on [page 181](#).

Technical information on [page 250](#).

Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16343750	16355	7/16		.4375	7/16		2-1/2		5/8	
16347240	16357		12.0	.4724		12.0		64		16.0
16350000	16359	1/2		.5000	1/2		2-1/2		5/8	
16355120	16361		14.0	.5512		14.0		70		18.0
16362500	16363	5/8		.6250	5/8		3		3/4	
16362990	16365		16.0	.6299		16.0		76		20.0
16370870	16367		18.0	.7087		18.0		76		25.0
16375000	16369	3/4		.7500	3/4		3		1	
16378740	16371		20.0	.7874		20.0		76		25.0

TuffCut® GP Series 163 Coated

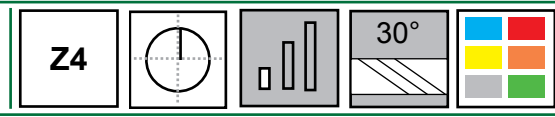


TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16311810T	56300	16311810A	56333	16311810C	56366		3.0	.1181		3.0		38		6.0
16312500T	56301	16312500A	56334	16312500C	56367	1/8		.1250	1/8		1-1/2		1/4	
16315750T	56305	16315750A	56338	16315750C	56371		4.0	.1575		4.0		51		8.0
16318750T	56308	16318750A	56341	16318750C	56374	3/16		.1875	3/16		2		3/8	
16319680T	56309	16319680A	56342	16319680C	56375		5.0	.1968		5.0		51		11.0
16323620T	56314	16323620A	56347	16323620C	56380		6.0	.2362		6.0		51		13.0
16325000T	56315	16325000A	56348	16325000C	56381	1/4		.2500	1/4		2		1/2	
16331250T	56318	16331250A	56351	16331250C	56384	5/16		.3125	5/16		2		1/2	
16331500T	56319	16331500A	56352	16331500C	56385		8.0	.3150		8.0		51		13.0
16337500T	56321	16337500A	56354	16337500C	56387	3/8		.3750	3/8		2		5/8	
16339370T	56322	16339370A	56355	16339370C	56388		10.0	.3937		10.0		51		14.0
16343750T	56324	16343750A	56357	16343750C	56390	7/16		.4375	7/16		2-1/2		5/8	
16347240T	56325	16347240A	56358	16347240C	56391		12.0	.4724		12.0		64		16.0
16350000T	56326	16350000A	56359	16350000C	56392	1/2		.5000	1/2		2-1/2		5/8	
16362500T	56328	16362500A	56361	16362500C	56394	5/8		.6250	5/8		3		3/4	
16362990T	56329	16362990A	56362	16362990C	56395		16.0	.6299		16.0		76		20.0
16375000T	56331	16375000A	56364	16375000C	56397	3/4		.7500	3/4		3		1	
16378740T	56332	16378740A	56365	16378740C	56398		20.0	.7874		20.0		76		25.0

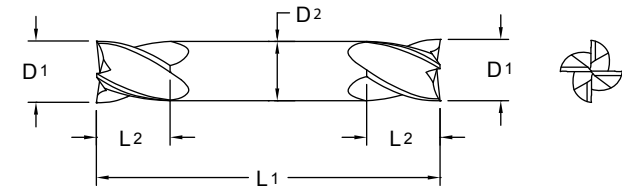
Uncoated tools on [page 180](#).

Technical information on [page 250](#).

TuffCut® GP Series 161



Designed with the same geometry as our standard 4-flute end mills.



- Twice the cutting edge saves you money.
- Good choice for shallow hole milling.

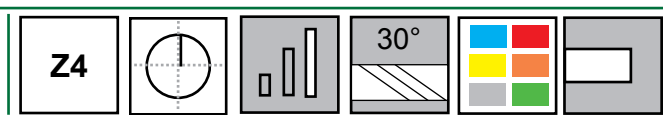
Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16101560	16100	1/64		.0156	1/8		1-1/2		.023	
16103120	16101	1/32		.0312	1/8		1-1/2		1/16	
16103940	16103		1.0	.0394		3.0		38		2.0
16104680	16105	3/64		.0468	1/8		1-1/2		3/32	
16105910	16107		1.5	.0591		3.0		38		3.0
16106250	16109	1/16		.0625	1/8		1-1/2		1/8	
16107810	16111	5/64		.0781	1/8		1-1/2		5/32	
16107870	16113		2.0	.0787		3.0		38		4.0
16109370	16115	3/32		.0937	1/8		1-1/2		3/16	
16109840	16117		2.5	.0984		3.0		38		5.0
16110930	16119	7/64		.1093	1/8		1-1/2		7/32	
16111810	16121		3.0	.1181		3.0		38		6.0
16112500	16123	1/8		.1250	1/8		1-1/2		1/4	
16113780	16125		3.5	.1378		4.0		51		7.0
16114060	16126	9/64		.1406	3/16		2		5/16	
16115620	16127	5/32		.1562	3/16		2		5/16	
16115750	16129		4.0	.1575		4.0		51		8.0
16117720	16131		4.5	.1772		5.0		51		9.0
16118750	16133	3/16		.1875	3/16		2		3/8	
16119680	16135		5.0	.1968		5.0		51		11.0
16121650	16137		5.5	.2165		6.0		64		12.0
16123620	16141		6.0	.2362		6.0		64		13.0
16125000	16143	1/4		.2500	1/4		2-1/2		1/2	
16127560	16145		7.0	.2756		8.0		64		13.0
16131500	16151		8.0	.3150		8.0		64		13.0
16135430	16153		9.0	.3543		9.0		64		14.0
16137500	16155	3/8		.3750	3/8		2-1/2		9/16	
16139370	16157		10.0	.3937		10.0		70		14.0
16147240	16163		12.0	.4724		12.0		76		16.0
16150000	16165	1/2		.5000	1/2		3		5/8	
16162500	16169	5/8		.6250	5/8		3-1/2		3/4	
16175000	16175	3/4		.7500	3/4		4		1	

Inch	
D1	Tolerance
1/64-1/4	+ .000/- .002
> 1/4-3/4	+ .000/- .003

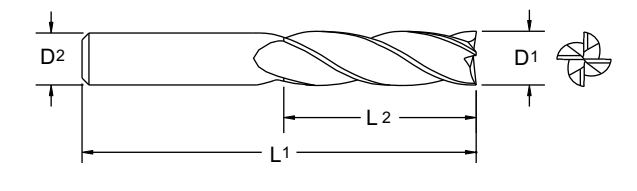
Metric (mm)	
D1	Tolerance h10
1.00- 3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-12.00	+ .000/- .070

Technical information on [page 250](#).

TuffCut® GP Series 122



Designed for deep pocket milling and other applications where standard flute lengths are too short.



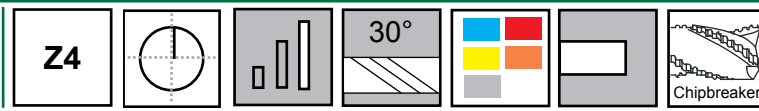
Uncoated	EDP	Diameter			Shank		OAL		Flute Length	
		D1			D2		L1		L2	
Tool No.		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
12211810	12203		3.0	.1181		3.0		64		25.0
12212500	12205	1/8		.1250	1/8		2-1/2		1	
12215750	12206		4.0	.1575		4.0		64		25.0
12218750	12207	3/16		.1875	3/16		3		1-1/8	
12219680	12208		5.0	.1968		5.0		64		25.0
12223620	12209		6.0	.2362		6.0		76		30.0
12225000	12211	1/4		.2500	1/4		3		1-1/4	
12227560	12212		7.0	.2756		8.0		83		30.0
12231250	12213	5/16		.3125	5/16		3-1/4		1-3/8	
12231500	12215		8.0	.3150		8.0		83		35.0
12235430	12216		9.0	.3543		10.0		89		35.0
12237500	12217	3/8		.3750	3/8		3-1/2		1-1/2	
12239370	12219		10.0	.3937		10.0		89		40.0
12243310	12220		11.0	.4331		12.0		102		40.0
12243750	12221	7/16		.4375	7/16		4		1-3/4	
12247240	12223		12.0	.4724		12.0		102		50.0
12250000	12225	1/2		.5000	1/2		4		2	
12262500	12227	5/8		.6250	5/8		4-5/8		2-1/2	
12262990	12229		16.0	.6299		16.0		117		65.0
12275000	12231	3/4		.7500	3/4		5-1/4		3	
12278740	12233		20.0	.7874		20.0		133		80.0
12298430	12235		25.0	.9843		25.0		152		80.0
12210000	12201	1		1.0000	1		6		3	

Inch	
D1	Tolerance
1/8-1/4	+ .000/- .002
> 1/4-1	+ .000/- .003

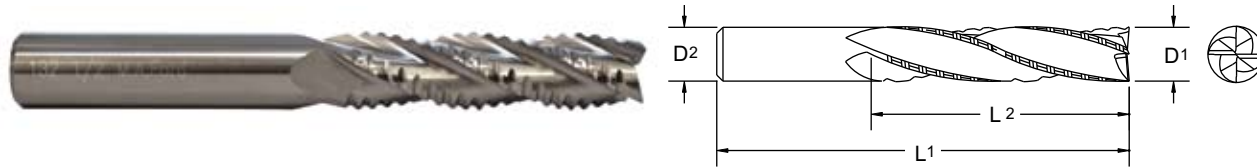
Metric (mm)	
D1	Tolerance
3.00-6.00	+ .000/- .051
7.00-25.00	+ .000/- .076

Technical information on [page 250](#).

TuffCut® GP Series 132



Chipbreakers are designed to minimize cutting forces, reduce or eliminate chatter and prolong tool life.



- Chipbreaker geometry permits extremely high feed rates in roughing operations. Tools designed with tooth overlap to produce fairly smooth part finish.
- Designed for deep pocket milling and other applications where standard flute lengths are too short.
- TiN coating available.

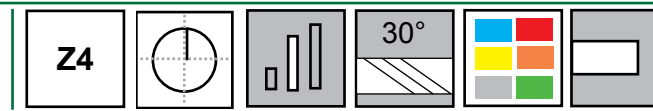
Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
13211810	13203		3.0	.1181	3.0		64		25.0	
13212500	13205	1/8		.1250	1/8		2-1/2		1	
13218750	13207	3/16		.1875	3/16		3		1-1/8	
13223620	13209		6.0	.2362		6.0		76		30.0
13225000	13211	1/4		.2500	1/4		3		1-1/4	
13231250	13213	5/16		.3125	5/16		3-1/4		1-3/8	
13231500	13215		8.0	.3150		8.0		83		35.0
13237500	13217	3/8		.3750	3/8		3-1/2		1-1/2	
13239370	13219		10.0	.3937		10.0		89		40.0
13243750	13221	7/16		.4375	7/16		4		1-3/4	
13247240	13223		12.0	.4724		12.0		102		50.0
13250000	13225	1/2		.5000	1/2		4		2	
13262500	13227	5/8		.6250	5/8		4-5/8		2-1/2	
13262990	13229		16.0	.6299		16.0		117		65.0
13275000	13231	3/4		.7500	3/4		5-1/4		3	
13278740	13233		20.0	.7874		20.0		133		80.0
13298430	13235		25.0	.9843		25.0		152		80.0
13210000	13201	1		1.0000	1		6		3	

Inch	
D1	Tolerance
1/8-1/4	+0.000/-0.002
> 1/4-1	+0.000/-0.003

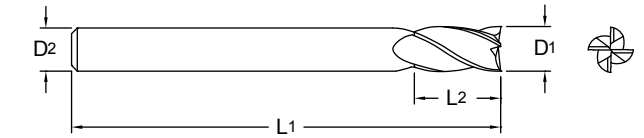
Metric (mm)	
D1	Tolerance
3.00-6.00	+0.000/-0.051
8.00-25.00	+0.000/-0.076

Technical information on [page 222](#).

TuffCut® GP Series 181



Designed for extended reach in die and mold work and other deep pocket applications.



- General purpose milling of most materials.
- 4 flutes for reduced chip loads in tougher materials.
- Available with neck relief upon request.
- Standard flute lengths reduce cutter deflection.

Uncoated		Diameter			Shank		OAL		Flue Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
18125000	18100	1/4		.2500	1/4		4		3/4	
18131250	18110	5/16		.3125	5/16		4		13/16	
18131500	18135		8.0	.3150		8.0		101		20.0
18137500	18120	3/8		.3750	3/8		4		7/8	
18143750	18130	7/16		.4375	7/16		4		1	
18150000	18140	1/2		.5000	1/2		6		1	
18175000	18160	3/4		.7500	3/4		6		1-1/2	

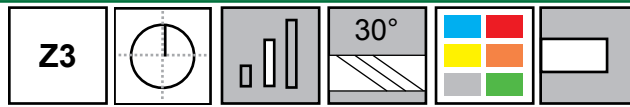
Inch	
D1	Tolerance
1/4	+0.000/-0.002
> 1/4-3/4	+0.000/-0.003

Metric (mm)	
D1	Tolerance
>6.00-8.00	-0.020/-0.048

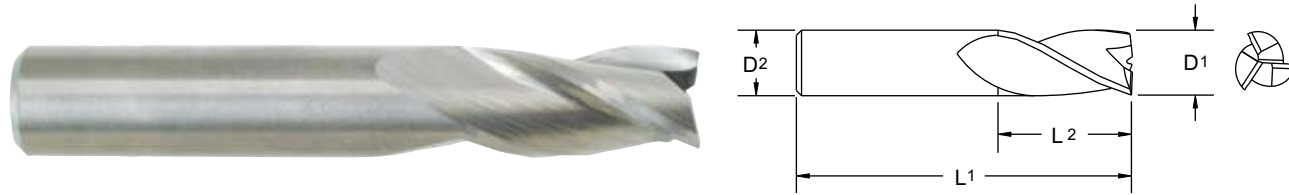
Technical information on [page 250](#).

ISO 9001:2000 Certified
An ESOP Company

TuffCut® GP
Series 116



Designed for aggressive milling of most materials.



Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11601560	11601	1/64		.0156	1/8		1-1/2		1/32	
11603120	11603	1/32		.0312	1/8		1-1/2		5/64	
11603940	11605		1.0	.0394		3.0		38		3.0
11604680	11607	3/64		.0468	1/8		1-1/2		7/64	
11605910	11609		1.5	.0591		3.0		38		6.0
11606250	11611	1/16		.0625	1/8		1-1/2		3/16	
11607810	11613	5/64		.0781	1/8		1-1/2		3/16	
11607870	11615		2.0	.0787		3.0		38		9.0
11609370	11617	3/32		.0937	1/8		1-1/2		9/32	
11609840	11619		2.5	.0984		3.0		38		12.0
11610930	11623	7/64		.1093	1/8		1-1/2		3/8	
11611810	11625		3.0	.1181		3.0		38		12.0
11612500	11627	1/8		.1250	1/8		1-1/2		3/8	
11612501	11630	1/8		.1250	1/8		1-1/2		1/2	
11613780	11633		3.5	.1378		4.0		51		12.0
11614060	11634	9/64		.1406	3/16		2		1/2	
11615620	11635	5/32		.1562	3/16		2		1/2	
11615750	11637		4.0	.1575		4.0		51		14.0
11617190	11638	11/64		.1719	3/16		2		5/8	
11617720	11639		4.5	.1772		5.0		51		14.0
11618750	11641	3/16		.1875	3/16		2		5/8	
11619680	11643		5.0	.1968		5.0		51		20.0
11620310	11644	13/64		.2031	1/4		2-1/2		5/8	
11621650	11645		5.5	.2165		6.0		64		20.0
11621870	11647	7/32		.2187	1/4		2-1/2		5/8	
11623440	11648	15/64		.2344	1/4		2-1/2		3/4	
11623620	11649		6.0	.2362		6.0		64		20.0
11625000	11651	1/4		.2500	1/4		2-1/2		3/4	
11627560	11653		7.0	.2756		8.0		64		20.0
11628120	11655	9/32		.2812	5/16		2-1/2		3/4	
11631250	11657	5/16		.3125	5/16		2-1/2		13/16	
11631500	11659		8.0	.3150		8.0		64		20.0
11635430	11661		9.0	.3543		9.0		64		20.0
11637500	11663	3/8		.3750	3/8		2-1/2		1	
11639370	11665		10.0	.3937		10.0		70		25.0
11643310	11667		11.0	.4331		11.0		70		25.0
11643750	11669	7/16		.4375	7/16		2-3/4		1	

Inch	
D1	Tolerance
1/64	+0.000/-0.001
1/32-1/4	+0.000/-0.002
>1/4-1 1/4	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
1.00-3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-30.00	+0.000/-0.084
32.00	+0.000/-0.100

Coated tools on [page 188](#).

Technical information on [page 250](#).

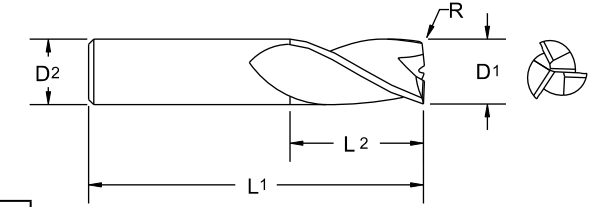
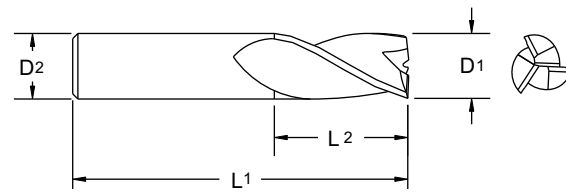
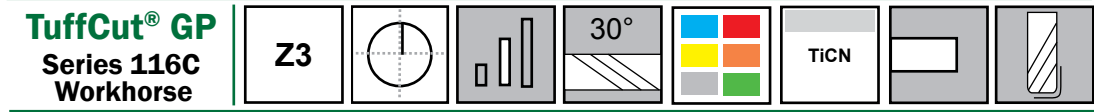
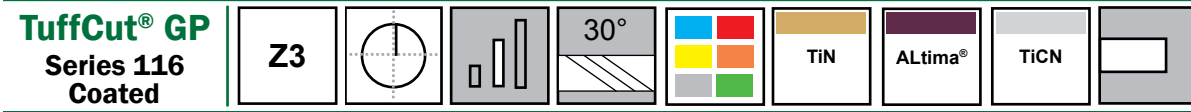
Series 116 Continued

Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
11647240	11671		12.0	.4724		12.0		76		25.0
11650000	11673	1/2		.5000	1/2		3		1	
11655120	11675		14.0	.5512		14.0		89		30.0
11656250	11677	9/16		.5625	9/16		3-1/2		1-1/8	
11662500	11679	5/8		.6250	5/8		3-1/2		1-1/4	
11662990	11681		16.0	.6299		16.0		89		30.0
11670870	11683		18.0	.7087		18.0		102		35.0
11675000	11685	3/4		.7500	3/4		4		1-1/2	
11678740	11687		20.0	.7874		20.0		102		38.0
11686620	11689		22.0	.8662		22.0		102		40.0
11687500	11691	7/8		.8750	7/8		4		1-1/2	
11698430	11693		25.0	.9843		25.0		102		40.0
11610000	11621	1		1.0000	1		4		1-1/2	
11612510	11629	1-1/4		1.2500	1-1/4		4-3/8		1-9/16	
11612600	11631		32.0	1.2600		32.0		111		40.0

Coated tools on [page 188](#).

Technical information on [page 250](#).





TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
Tool No.		EDP		Tool No.		D1		D2		L1		L2		
Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
11611810T	11626	11611810A	51603	11611810C	51604	3.0	.1181	3.0		38		12.0		
11612500T	11628	11612500A	51605	11612500C	51606	1/8	.1250	1/8		1-1/2		3/8		
11615750T	11636	11615750A	51607	11615750C	51608	4.0	.1575	4.0		51		14.0		
11618750T	11642	11618750A	51609	11618750C	51610	3/16	.1875	3/16		2		5/8		
11619680T	11646	11619680A	51611	11619680C	51612	5.0	.1968	5.0		51		20.0		
11623620T	11650	11623620A	51613	11623620C	51614	6.0	.2362	6.0		64		20.0		
11625000T	11652	11625000A	51615	11625000C	51616	1/4	.2500	1/4		2-1/2		3/4		
11631250T	11658	11631250A	51617	11631250C	51618	5/16	.3125	5/16		2-1/2		13/16		
11631500T	11660	11631500A	51619	11631500C	51620	8.0	.3150	8.0		64		20.0		
11637500T	11664	11637500A	51621	11637500C	51622	3/8	.3750	3/8		2-1/2		1		
11639370T	11666	11639370A	51623	11639370C	51624	10.0	.3937	10.0		70		25.0		
11643750T	11670	11643750A	51625	11643750C	51626	7/16	.4375	7/16		2-3/4		1		
11647240T	11672	11647240A	51627	11647240C	51628	12.0	.4724	12.0		76		25.0		
11650000T	11674	11650000A	51629	11650000C	51630	1/2	.5000	1/2		3		1		
11662500T	11680	11662500A	51631	11662500C	51632	5/8	.6250	5/8		3-1/2		1-1/4		
11662990T	11682	11662990A	51633	11662990C	51634	16.0	.6299	16.0		89		30.0		
11675000T	11686	11675000A	51635	11675000C	51636	3/4	.7500	3/4		4		1-1/2		
11678740T	11688	11678740A	51637	11678740C	51638	20.0	.7874	20.0		102		38.0		
11698430T	11694	11698430A	51639	11698430C	51640	25.0	.9843	25.0		102		40.0		
11610000T	11622	11610000A	51601	11610000C	51602	1	1.0000	1		4		1-1/2		

TiCN		Diameter		Shank	OAL	Flute Length		Corner Radius
Tool No.	EDP	D1	Decimal	D2	L1	L2	R	
11612508C	11695	1/8	.1250	1/8	1-1/2	1/2	0.01	
11615628C	11696	5/32	.1562	3/16	2	9/16	0.01	
11618758C	11697	3/16	.1875	3/16	2	5/8	0.01	
11621872C	11698	7/32	.2187	1/4	2-1/2	3/4	0.02	
11625002C	11699	1/4	.2500	1/4	2-1/2	3/4	0.02	
11628122C	11468	9/32	.2812	5/16	2-1/2	3/4	0.02	
11631252C	11469	5/16	.3125	5/16	2-1/2	13/16	0.02	
11634382C	11500	11/32	.3438	3/8	2-1/2	7/8	0.02	
11637502C	11369	3/8	.3750	3/8	2-1/2	1	0.02	
11640622C	11370	13/32	.4062	7/16	2-3/4	1	0.02	
11643752C	11382	7/16	.4375	7/16	2-3/4	1	0.02	
11646882C	11383	15/32	.4688	1/2	3	1-1/4	0.02	
11650002C	11371	1/2	.5000	1/2	3	1-1/4	0.02	
11650003C	11372	1/2	.5000	1/2	3	1-1/4	0.03	
11662502C	11373	5/8	.6250	5/8	3-1/2	1-5/8	0.02	
11662503C	11374	5/8	.6250	5/8	3-1/2	1-5/8	0.03	
11675002C	11375	3/4	.7500	3/4	4	1-1/2	0.02	
11675003C	11376	3/4	.7500	3/4	4	1-1/2	0.03	
11610002C	11379	1	1.0000	1	4	1-1/2	0.02	
11610003C	11380	1	1.0000	1	4	1-1/2	0.03	
11610012C	11377	1	1.0000	1	4	2	0.02	
11610013C	11378	1	1.0000	1	4	2	0.03	

- Performs well in all materials including Stainless Steel, Inconel and Stellite.
- Produces long cuts at reasonable speeds on everyday equipment.
- Exceptional tool life at moderate speeds and feeds.
- Ideal for long cuts requiring accuracy and minimal tool wear deflection.
- Perfect Job Shop Tool.

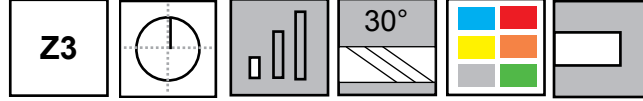
Uncoated tools on [page 186](#).

Technical information on [page 250](#).

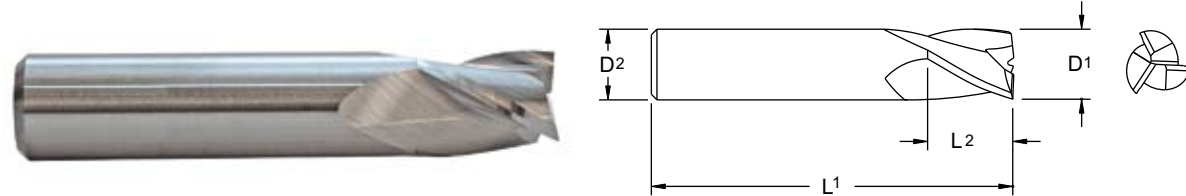
Technical information on [page 250](#).

Inch	
D1	Tolerance
1/8-1/4	+0.000/-0.002
>1/4-1	+0.000/-0.003

TuffCut® GP Series 169



Designed for aggressive milling of most materials. Provides reduced deflection, improved tool life and overall economy.



Uncoated		Diameter D1			Shank D2		OAL L1		Flute Length L2	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16901560	16900	1/64		.0156	1/8		1-1/2		.023	
16903120	16901	1/32		.0312	1/8		1-1/2		1/16	
16903940	16903		1.0	.0394		3.0		38		2.0
16904680	16905	3/64		.0468	1/8		1-1/2		3/32	
16905910	16907		1.5	.0591		3.0		38		3.0
16906250	16909	1/16		.0625	1/8		1-1/2		1/8	
16907810	16911	5/64		.0781	1/8		1-1/2		5/32	
16907870	16913		2.0	.0787		3.0		38		4.0
16909370	16915	3/32		.0937	1/8		1-1/2		3/16	
16909840	16917		2.5	.0984		3.0		38		5.0
16910930	16919	7/64		.1093	1/8		1-1/2		7/32	
16911810	16921		3.0	.1181		3.0		38		6.0
16912500	16923	1/8		.1250	1/8		1-1/2		1/4	
16913780	16925		3.5	.1378		4.0		51		7.0
16914060	16926	9/64		.1406	3/16		2		5/16	
16915620	16927	5/32		.1562	3/16		2		5/16	
16915750	16929		4.0	.1575		4.0		51		8.0
16917180	16930	11/64		.1718	3/16		2		3/8	
16917720	16931		4.5	.1772		5.0		51		9.0
16918750	16933	3/16		.1875	3/16		2		3/8	
16919680	16935		5.0	.1968		5.0		51		11.0
16920310	16936	13/64		.2031	1/4		2		1/2	
16921650	16937		5.5	.2165		6.0		51		12.0
16921870	16939	7/32		.2187	1/4		2		1/2	
16923430	16940	15/64		.2343	1/4		2		1/2	
16923620	16941		6.0	.2362		6.0		51		13.0
16925000	16943	1/4		.2500	1/4		2		1/2	
16927560	16945		7.0	.2756		8.0		51		13.0
16928120	16947	9/32		.2812	5/16		2		1/2	
16931250	16949	5/16		.3125	5/16		2		1/2	
16931500	16951		8.0	.3150		8.0		51		13.0
16935430	16953		9.0	.3543		9.0		51		14.0
16937500	16955	3/8		.3750	3/8		2		5/8	
16939370	16957		10.0	.3937		10.0		51		14.0
16943310	16959		11.0	.4331		11.0		64		16.0
16943750	16961	7/16		.4375	7/16		2-1/2		5/8	

Inch	
D1	Tolerance
1/64	+0.000/-0.001
1/32-1/4	+0.000/-0.002
>1/4-3/4	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
1.00-3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-20.00	+0.000/-0.084

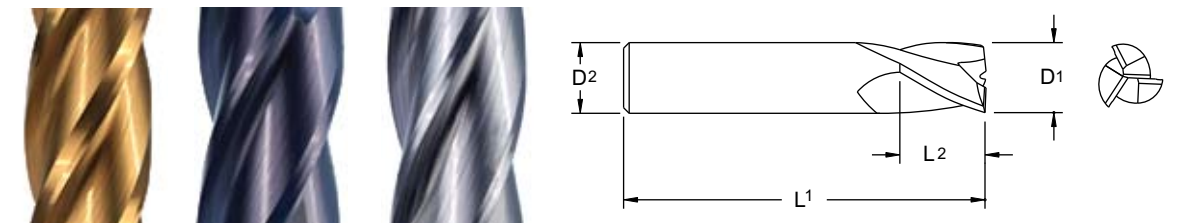
Coated tools on [page 191](#).

Technical information on [page 250](#).

Series 169 Continued

Uncoated		Diameter D1			Shank D2		OAL L1		Flute Length L2	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16947240	16963		12.0	.4724		12.0		64		16.0
16950000	16965	1/2		.5000	1/2		2-1/2		5/8	
16955120	16967		14.0	.5512		14.0		70		18.0
16962500	16969	5/8		.6250	5/8		3		3/4	
16962990	16971		16.0	.6299		16.0		76		20.0
16970870	16973		18.0	.7087		18.0		76		25.0
16975000	16975	3/4		.7500	3/4		3		1	
16978740	16977		20.0	.7874		20.0		76		25.0

TuffCut® GP Series 169 Coated

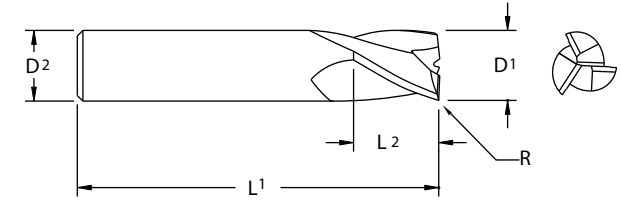
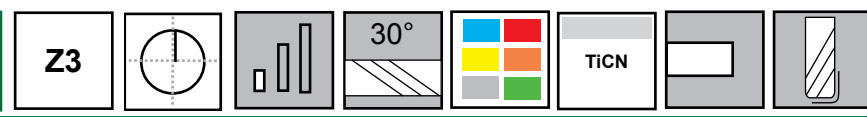


TiN		ALtima®		TiCN		Diameter D1			Shank D2		OAL L1		Flute Length L2	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16911810T	56900	16911810A	56933	16911810C	56966		3.0	.1181		3.0		38		6.0
16912500T	56901	16912500A	56934	16912500C	56967	1/8		.1250	1/8		1-1/2		1/4	
16915750T	56905	16915750A	56938	16915750C	56971		4.0	.1575		4.0		51		8.0
16918750T	56908	16918750A	56941	16918750C	56974	3/16		.1875	3/16		2		3/8	
16919680T	56909	16919680A	56942	16919680C	56975		5.0	.1968		5.0		51		11.0
16923620T	56914	16923620A	56947	16923620C	56980		6.0	.2362		6.0		51		13.0
16925000T	56915	16925000A	56948	16925000C	56981	1/4		.2500	1/4		2		1/2	
16931250T	56918	16931250A	56951	16931250C	56984	5/16		.3125	5/16		2		1/2	
16931500T	56919	16931500A	56952	16931500C	56985		8.0	.3150		8.0		51		13.0
16937500T	56921	16937500A	56954	16937500C	56987	3/8		.3750	3/8		2		5/8	
16939370T	56922	16939370A	56955	16939370C	56988		10.0	.3937		10.0		51		14.0
16943750T	56924	16943750A	56957	16943750C	56990	7/16		.4375	7/16		2-1/2		5/8	
16947240T	56925	16947240A	56958	16947240C	56991		12.0	.4724		12.0		64		16.0
16950000T	56926	16950000A	56959	16950000C	56992	1/2		.5000	1/2		2-1/2		5/8	
16962500T	56928	16962500A	56961	16962500C	56994	5/8		.6250	5/8		3		3/4	
16962990T	56929	16962990A	56962	16962990C	56995		16.0	.6299		16.0		76		20.0
16975000T	56931	16975000A	56964	16975000C	56997	3/4		.7500	3/4		3		1	
16978740T	56932	16978740A	56965	16978740C	56998		20.0	.7874		20.0		76		25.0

Uncoated tools on [page 190](#).

Technical information on [page 250](#).

TuffCut® GP
Series 169C
Workhorse



TiCN		Diameter		Shank	OAL	Flute Length		Corner Radius
Tool No.	EDP	D1	Decimal	D2	L1	L2	R	
16912508C	16978	1/8	.1250	1/8	1-1/2	1/4	0.01	
16915628C	16979	5/32	.1562	3/16	2	5/16	0.01	
16918758C	16980	3/16	.1875	3/16	2	3/8	0.01	
16921872C	16981	7/32	.2187	1/4	2	1/2	0.02	
16925002C	16982	1/4	.2500	1/4	2	1/2	0.02	
16928122C	11381	9/32	.2812	5/16	2	1/2	0.02	
16931252C	16983	5/16	.3125	5/16	2	1/2	0.02	
16934382C	16984	11/32	.3438	3/8	2	1/2	0.02	
16937502C	16985	3/8	.3750	3/8	2	5/8	0.02	
16940622C	16986	13/32	.4062	7/16	2-1/2	9/16	0.02	
16943752C	16987	7/16	.4375	7/16	2-1/2	5/8	0.02	
16946882C	16988	15/32	.4688	1/2	2-1/2	1/2	0.02	
16950002C	16989	1/2	.5000	1/2	2-1/2	5/8	0.02	
16950003C	16990	1/2	.5000	1/2	2-1/2	5/8	0.03	
16962502C	16991	5/8	.6250	5/8	3	3/4	0.02	
16962503C	16992	5/8	.6250	5/8	3	3/4	0.03	
16975002C	16993	3/4	.7500	3/4	3	1	0.02	
16975003C	16994	3/4	.7500	3/4	3	1	0.03	

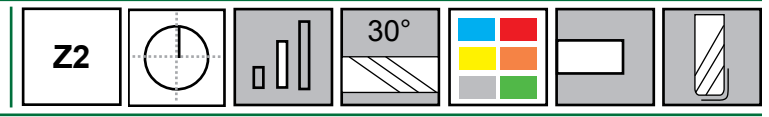
Inch	
D1	Tolerance
1/8-1/4	+ .000/- .002
>1/4-3/4	+ .000/- .003

- Performs well in all materials including Stainless Steel, Inconel and Stellite.
- Produces long cuts at reasonable speeds on everyday equipment.
- Exceptional tool life at moderate speeds and feeds.
- Ideal for long cuts requiring accuracy and minimal tool wear deflection.
- Perfect Job Shop Tool.

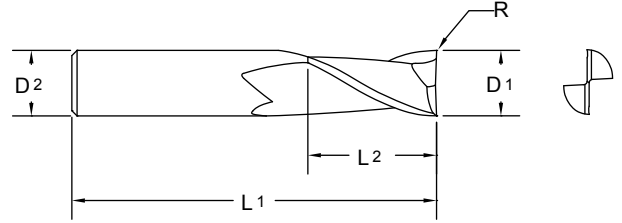
Technical information on [page 250](#).

Safety Note
Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

TuffCut® GP
Series 121



Designed for aggressive milling of most materials.



- Micro sizes available. .005-.100" and 0.2-2.0mm.

Uncoated		Diameter			Shank		OAL	Flute Length		Corner Radius	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	L1	L2	R		
12100500	52101			.0050	1/8		1-1/2	.015			
12100600	52191			.0060	1/8		1-1/2	.018			
12100700	52192			.0070	1/8		1-1/2	.021			
12100780	52102	0.2	.0078			3.0	38	0.6			
12100800	52193			.0080	1/8		1-1/2	.024			
12100900	52194			.0090	1/8		1-1/2	.027			
12101000	52103			.0100	1/8		1-1/2	.030			
12101100	52195			.0110	1/8		1-1/2	.033			
12101180	52104	0.3	.0118			3.0	38	0.9			
12101200	52196			.0120	1/8		1-1/2	.036			
12101300	52197			.0130	1/8		1-1/2	.039			
12101400	52198			.0140	1/8		1-1/2	.042			
12101500	52105			.0150	1/8		1-1/2	.045			
12101560	12106	1/64	.0156		1/8		1-1/2	1/32			
12101570	52107	0.4	.0157			3.0	38	1.2			
12101600	52199			.0160	1/8		1-1/2	.048			
12101700	52250			.0170	1/8		1-1/2	.051			
12101800	52251			.0180	1/8		1-1/2	.054			
12101900	52252			.0190	1/8		1-1/2	.057			
12101960	52108	0.5	.0196			3.0	38	1.5			
12102000	52109			.0200	1/8		1-1/2	.060			
12102100	52253			.0210	1/8		1-1/2	.063			
12102200	52254			.0220	1/8		1-1/2	.066			
12102300	52255			.0230	1/8		1-1/2	.069			
12102360	52110	0.6	.0236			3.0	38	1.8			
12102400	52256			.0240	1/8		1-1/2	.072			
12102500	52111			.0250	1/8		1-1/2	.075			
12102600	52257			.0260	1/8		1-1/2	.078			
12102700	52258			.0270	1/8		1-1/2	.081			
12102750	52112	0.7	.0275			3.0	38	2.1			
12102800	52259			.0280	1/8		1-1/2	.084			
12102900	52260			.0290	1/8		1-1/2	.087			
12103000	52113			.0300	1/8		1-1/2	.090			
12103120	12114	1/32	.0312		1/8		1-1/2	5/64			
12103150	52115	0.8	.0315			3.0	38	2.4			
12103500	52116			.0350	1/8		1-1/2	.105			
12103540	52117	0.9	.0354			3.0	38	2.7			
12103940	12118	1.0	.0394			3.0	38	3.0			
12104000	52120			.0400	1/8		1-1/2	.120			
12104330	52121	1.1	.0433			3.0	38	3.3			
12104500	52122			.0450	1/8		1-1/2	.135			
12104680	12123	3/64	.0468		1/8		1-1/2	7/64			

Inch	
D1	Tolerance
1/64	+ .000/- .001
1/32-1/4	+ .000/- .002
>1/4-1 1/4	+ .000/- .003
D1 Micro Sizes*	Tolerance
.005-.100	+ .0005/- .0005

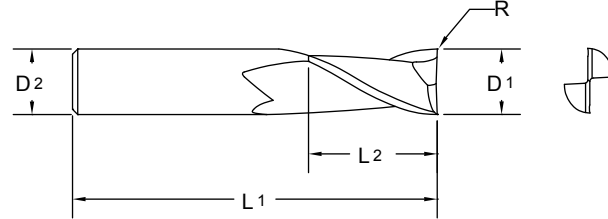
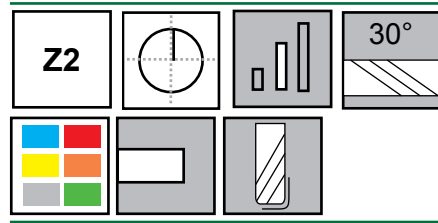
Metric (mm)	
D1	Tolerance h10
0.20-0.50	+ .000/- .025
0.60-3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-18.00	+ .000/- .070
>18.00-30.00	+ .000/- .084
32.00	+ .000/- .100

*Inch decimal size range .005-.100" only.

Coated tools on [page 198](#).

Technical information on [page 250](#).

Series 121 Continued



Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1		L2		R	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
12104720	52124	1.2	.0472		3/8		38		3.6			
12105000	52125		.0500	1/8		1-1/2		.150				
12105120	52126	1.3	.0512		3/8		38		3.9			
12105500	52127		.0550	1/8		1-1/2		.165				
12105510	52128	1.4	.0551		3/8		38		4.2			
12105910	12129	1.5	.0591		3/8		38		6.0			
12105911	52129	1.5	.0591		3/8		38		4.5			
12106000	52131		.0600	1/8		1-1/2		.180				
12106250	12132	1/16	.0625	1/8		1-1/2		3/16				
12106300	52133	1.6	.0630		3/8		38		4.8			
12106500	52134		.0650	1/8		1-1/2		.195				
12106690	52135	1.7	.0669		3/8		38		5.1			
12107000	52136		.0700	1/8		1-1/2		.210				
12107090	52137	1.8	.0709		3/8		38		5.4			
12107480	52138	1.9	.0748		3/8		38		5.7			
12107500	52139		.0750	1/8		1-1/2		.225				
12107810	12140	5/64	.0781	1/8		1-1/2		3/16				
12107870	12141	2.0	.0787		3/8		38		9.0			
12107871	52141	2.0	.0787		3/8		38		6.0			
12108000	52143		.0800	1/8		1-1/2		.240				
12108500	52144		.0850	1/8		1-1/2		.255				
12109000	52145		.0900	1/8		1-1/2		.270				
12109370	12146	3/32	.0937	1/8		1-1/2		9/32				
12109500	52147		.0950	1/8		1-1/2		.285				
12109840	12148	2.5	.0984		3/8		38		12.0			
12110010	52150		.1000	1/8		1-1/2		.300				
12110930	12151	7/64	.1093	1/8		1-1/2		3/8				
12111810	12152	3.0	.1181		3/8		38		12.0			
12111811	52402	3.0	.1181		3/8		38		12.0		0.500	
12112500	12153	1/8	.1250	1/8		1-1/2		3/8				
12112511	52401	1/8	.1250	1/8		1-1/2		3/8			0.015	
12112512	52403	1/8	.1250	1/8		1-1/2		3/8			0.020	
12112501	12150	1/8	.1250	1/8		1-1/2		1/2				
12113780	12156	3.5	.1378		4.0		51		12.0			
12114060	12187	9/64	.1406	3/16		2		1/2				
12115620	12157	5/32	.1562	3/16		2		1/2				
12115750	12158	4.0	.1575		4.0		51		14.0			
12115751	52404	4.0	.1575		4.0		51		14.0		0.500	
12115752	52422	4.0	.1575		4.0		51		14.0		0.750	
12117190	12188	11/64	.1719	3/16		2		5/8				
12117720	12159	4.5	.1772		5.0		51		14.0			
12118750	12160	3/16	.1875	3/16		2		5/8				
12118751	52405	3/16	.1875	3/16		2		5/8			0.015	
12118752	52407	3/16	.1875	3/16		2		5/8			0.020	
12118753	52409	3/16	.1875	3/16		2		5/8			0.030	
12119680	12161	5.0	.1968		5.0		51		20.0			

Coated tools on page 198.

Technical information on page 250.

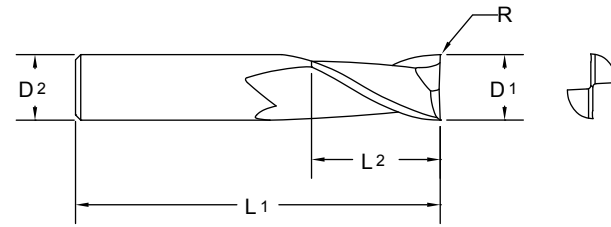
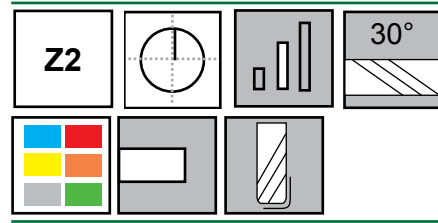
Series 121 Continued

Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1		L2		R	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
12119681	52406		5.0	.1968		5.0		51		20.0		0.500
12119682	52424		5.0	.1968		5.0		51		20.0		0.750
12119683	52440		5.0	.1968		5.0		51		20.0		1.000
12120310	12189	13/64		.2031	1/4		2-1/2		5/8			
12121650	12162		5.5	.2165		6.0		64		20.0		
12121870	12163	7/32		.2187	1/4		2-1/2		5/8			
12123440	12190	15/64		.2344	1/4		2-1/2		3/4			
12123620	12164		6.0	.2362		6.0		64		20.0		
12123621	52408		6.0	.2362		6.0		64		20.0		0.500
12123622	52426		6.0	.2362		6.0		64		20.0		0.750
12123623	52442		6.0	.2362		6.0		64		20.0		1.000
12125000	12165	1/4		.2500	1/4		2-1/2		3/4			
12125001	52411	1/4		.2500	1/4		2-1/2		3/4		0.015	
12125002	52413	1/4		.2500	1/4		2-1/2		3/4		0.020	
12125003	52415	1/4		.2500	1/4		2-1/2		3/4		0.030	
12125004	52417	1/4		.2500	1/4		2-1/2		3/4		0.045	
12127560	12166		7.0	.2756		8.0		64		20.0		
12128120	12167	9/32		.2812	5/16		2-1/2		3/4			
12131250	12168	5/16		.3125	5/16		2-1/2		13/16			
12131251	52419	5/16		.3125	5/16		2-1/2		13/16		0.015	
12131252	52421	5/16		.3125	5/16		2-1/2		13/16		0.020	
12131253	52423	5/16		.3125	5/16		2-1/2		13/16		0.030	
12131254	52425	5/16		.3125	5/16		2-1/2		13/16		0.045	
12131500	12169		8.0	.3150		8.0		64		20.0		
12131501	52410		8.0	.3150		8.0		64		20.0		0.500
12131502	52428		8.0	.3150		8.0		64		20.0		0.750
12131503	52444		8.0	.3150		8.0		64		20.0		1.000
12131504	52456		8.0	.3150		8.0		64		20.0		1.500
12135430	12170		9.0	.3543		9.0		64		20.0		
12137500	12171	3/8		.3750	3/8		2-1/2		1			
12137501	52427	3/8		.3750	3/8		2-1/2		1		0.015	
12137502	52429	3/8		.3750	3/8		2-1/2		1		0.020	
12137503	52431	3/8		.3750	3/8		2-1/2		1		0.030	
12137504	52433	3/8		.3750	3/8		2-1/2		1		0.045	
12139370	12172		10.0	.3937		10.0		70		25.0		
12139371	52412		10.0	.3937		10.0		70		25.0		0.500
12139372	52430		10.0	.3937		10.0		70		25.0		0.750
12139373	52446		10.0	.3937		10.0		70		25.0		1.000
12139374	52458		10.0	.3937		10.0		70		25.0		1.500
12143310	12173		11.0	.4331		11.0		70		25.0		
12143750	12174	7/16		.4375	7/16		2-3/4		1			
12147240	12175		12.0	.4724		12.0		76		25.0		
12147241	52414		12.0	.4724		12.0		76		25.0		0.500
12147242	52432		12.0	.4724		12.0		76		25.0		0.750
12147243	52448		12.0	.4724		12.0		76		25.0		1.000
12147244	52460		12.0	.4724		12.0		76		25.0		1.500
12147245	52468		12.0	.4724		12.0		76		25.0		2.000
12150000	12176	1/2		.5000	1/2		3		1			
12150001	52435	1/2		.5000	1/2		3		1		0.015	
12150002	52437	1/2		.5000	1/2		3		1		0.020	
12150003	52439	1/2		.5000	1/2		3		1		0.030	
12150004	52441	1/2		.5000	1/2		3		1		0.045	

Coated tools on page 198.

Technical information on page 250.

Series 121 Continued



Uncoated		Diameter			Shank		OAL		Flute Length		Corner Radius	
Tool No.	EDP	D1			D2		L1		L2		R	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
12150005	52443	1/2		.5000	1/2		3		1		0.060	
12155120	12177		14.0	.5512		14.0		89		30.0		
12156250	12178	9/16		.5625	9/16		3-1/2		1-1/8			
12162500	12179	5/8		.6250	5/8		3-1/2		1-1/4			
12162501	52445	5/8		.6250	5/8		3-1/2		1-1/4		0.015	
12162502	52447	5/8		.6250	5/8		3-1/2		1-1/4		0.020	
12162503	52449	5/8		.6250	5/8		3-1/2		1-1/4		0.030	
12162504	52451	5/8		.6250	5/8		3-1/2		1-1/4		0.045	
12162505	52453	5/8		.6250	5/8		3-1/2		1-1/4		0.060	
12162506	52455	5/8		.6250	5/8		3-1/2		1-1/4		0.090	
12162990	12180		16.0	.6299		16.0		89		30.0		
12162991	52416		16.0	.6299		16.0		89		30.0		0.500
12162992	52434		16.0	.6299		16.0		89		30.0		0.750
12162993	52450		16.0	.6299		16.0		89		30.0		1.000
12162994	52462		16.0	.6299		16.0		89		30.0		1.500
12162995	52470		16.0	.6299		16.0		89		30.0		2.000
12162996	52476		16.0	.6299		16.0		89		30.0		2.500
12162997	52482		16.0	.6299		16.0		89		30.0		3.000
12170870	12181		18.0	.7087		18.0		102		35.0		
12175000	12182	3/4		.7500	3/4		4		1-1/2			
12175001	52457	3/4		.7500	3/4		4		1-1/2		0.015	
12175002	52459	3/4		.7500	3/4		4		1-1/2		0.020	
12175003	52461	3/4		.7500	3/4		4		1-1/2		0.030	
12175004	52463	3/4		.7500	3/4		4		1-1/2		0.045	
12175005	52465	3/4		.7500	3/4		4		1-1/2		0.060	
12175006	52467	3/4		.7500	3/4		4		1-1/2		0.090	
12175007	52469	3/4		.7500	3/4		4		1-1/2		0.125	
12178740	12183		20.0	.7874		20.0		102		38.0		
12178741	52418		20.0	.7874		20.0		102		38.0		0.500
12178742	52436		20.0	.7874		20.0		102		38.0		0.750
12178743	52452		20.0	.7874		20.0		102		38.0		1.000
12178744	52464		20.0	.7874		20.0		102		38.0		1.500
12178745	52472		20.0	.7874		20.0		102		38.0		2.000
12178746	52478		20.0	.7874		20.0		102		38.0		2.500
12178747	52484		20.0	.7874		20.0		102		38.0		3.000
12186620	12184		22.0	.8662		22.0		102		40.0		
12187500	12185	7/8		.8750	7/8		4		1-1/2			
12198430	12186		25.0	.9843		25.0		102		40.0		
12198431	52420		25.0	.9843		25.0		102		40.0		0.500
12198432	52438		25.0	.9843		25.0		102		40.0		0.750
12198433	52454		25.0	.9843		25.0		102		40.0		1.000
12198434	52466		25.0	.9843		25.0		102		40.0		1.500
12198435	52474		25.0	.9843		25.0		102		40.0		2.000
12198436	52480		25.0	.9843		25.0		102		40.0		2.500

Coated tools on [page 198](#).

Technical information on [page 250](#).

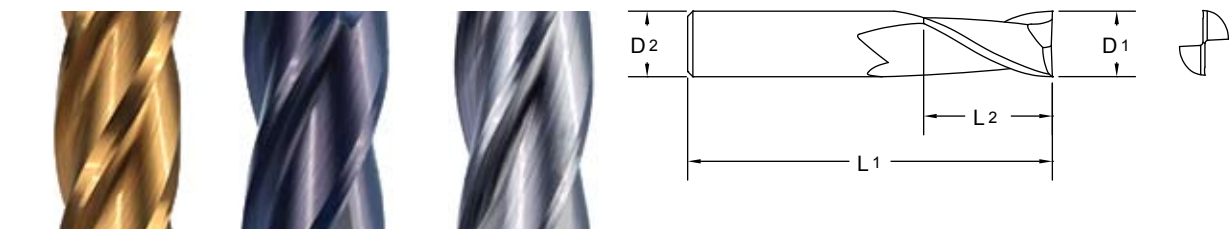
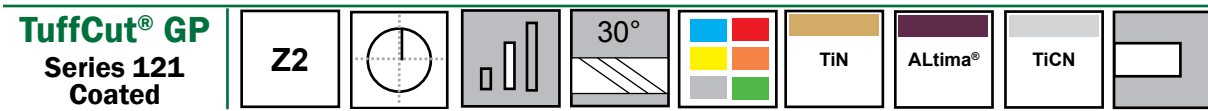
Series 121 Continued

Uncoated		Diameter			Shank		OAL		Flute Length		Radius	
Tool No.	EDP	D1			D2		L1		L2		R	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm
12198437	52486		25.0	.9843		25.0		102		40.0		3.00
12110000	12149	1		1.0000	1		4		1-1/2			
12110001	52471	1		1.0000	1		4		1-1/2		0.015	
12110002	52473	1		1.0000	1		4		1-1/2		0.020	
12110003	52475	1		1.0000	1		4		1-1/2		0.030	
12110004	52477	1		1.0000	1		4		1-1/2		0.045	
12110005	52479	1		1.0000	1		4		1-1/2		0.060	
12110006	52481	1		1.0000	1		4		1-1/2		0.090	
12110007	52483	1		1.0000	1		4		1-1/2		0.125	
12112510	12154	1-1/4		1.2500	1-1/4		4-3/8		1-9/16			
12112600	12155		32.0	1.2600		32.0		111		40.0		

Coated tools on [page 198](#).

Technical information on [page 250](#).

ISO 9001:2000 Certified
An ESOP Company

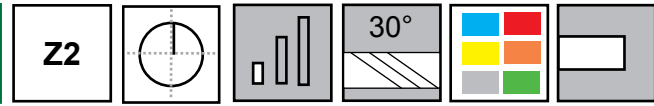


TIN		ALtima®		TICN		Diameter D1			Shank D2		OAL L1		Flute Length L2	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
12111810T	12270	12111810A	52153	12111810C	52154	3.0	3.0	.1181	1/8	3.0	1-1/2	38	3/8	12.0
12112500T	12261	12112500A	52155	12112500C	52156	1/8		.1250	1/8		1-1/2		3/8	
12115750T	12278	12115750A	52157	12115750C	52158		4.0	.1575		4.0		51		14.0
12118750T	12262	12118750A	52159	12118750C	52160	3/16		.1875	3/16		2		5/8	
12119680T	12271	12119680A	52161	12119680C	52162		5.0	.1968		5.0		51		20.0
12123620T	12272	12123620A	52163	12123620C	52164		6.0	.2362		6.0		64		20.0
12125000T	12263	12125000A	52165	12125000C	52166	1/4		.2500	1/4		2-1/2		3/4	
12131250T	12264	12131250A	52167	12131250C	52168	5/16		.3125	5/16		2-1/2		13/16	
12131500T	12273	12131500A	52169	12131500C	52170		8.0	.3150		8.0		64		20.0
12137500T	12265	12137500A	52171	12137500C	52172	3/8		.3750	3/8		2-1/2		1	
12139370T	12274	12139370A	52173	12139370C	52174		10.0	.3937		10.0		70		25.0
12143750T	12266	12143750A	52175	12143750C	52176	7/16		.4375	7/16		2-3/4		1	
12147240T	12275	12147240A	52177	12147240C	52178		12.0	.4724		12.0		76		25.0
12150000T	12267	12150000A	52179	12150000C	52180	1/2		.5000	1/2		3		1	
12162500T	12268	12162500A	52181	12162500C	52182	5/8		.6250	5/8		3-1/2		1-1/4	
12162990T	12276	12162990A	52183	12162990C	52184		16.0	.6299		16.0		89		30.0
12175000T	12269	12175000A	52185	12175000C	52186	3/4		.7500	3/4		4		1-1/2	
12178740T	12277	12178740A	52187	12178740C	52188		20.0	.7874		20.0		102		38.0
12198430T	12280	12198430A	52189	12198430C	52190		25.0	.9843		25.0		102		40.0
12110000T	12279	12110000A	52151	12110000C	52152	1		1.0000	1		4		1-1/2	

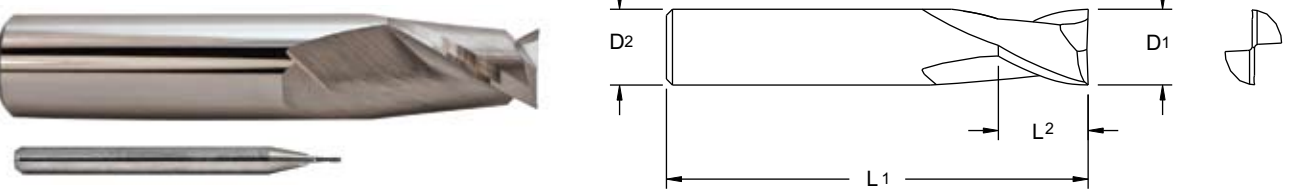
Uncoated tools on page 193.

Technical information on page 250.

TuffCut® GP Series 164



Designed for aggressive milling of most materials with reduced deflection, improved tool life and overall economy.



• Micro sizes available .005-.060" and 0.2-2.0 mm.

Uncoated		Diameter D1			Shank D2		OAL L1		Flute Length L2	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16400500	16468			.0050	1/8		1-1/2		.010	
16400600	16469			.0060	1/8		1-1/2		.012	
16400700	16470			.0070	1/8		1-1/2		.014	
16400780	16402	0.2	.0078		3.0		38		0.4	
16400800	16471			.0080	1/8		1-1/2		.016	
16400900	16472			.0090	1/8		1-1/2		.018	
16401000	16473			.0100	1/8		1-1/2		.020	
16401100	16474			.0110	1/8		1-1/2		.022	
16401180	16404	0.3	.0118		3.0		38		0.6	
16401200	16475			.0120	1/8		1-1/2		.024	
16401300	16476			.0130	1/8		1-1/2		.026	
16401400	16477			.0140	1/8		1-1/2		.028	
16401500	16478			.0150	1/8		1-1/2		.030	
16401560	16400	1/64	.0156		1/8		1-1/2		.023	
16401570	16406	0.4	.0157		3.0		38		0.8	
16401600	16479			.0160	1/8		1-1/2		.032	
16401700	16480			.0170	1/8		1-1/2		.034	
16401800	16481			.0180	1/8		1-1/2		.036	
16401900	16482			.0190	1/8		1-1/2		.038	
16401960	16408	0.5	.0196		3.0		38		1.0	
16402000	16483			.0200	1/8		1-1/2		.040	
16402100	16484			.0210	1/8		1-1/2		.042	
16402200	16485			.0220	1/8		1-1/2		.044	
16402300	16486			.0230	1/8		1-1/2		.046	
16402360	16412	0.6	.0236		3.0		38		1.2	
16402400	16487			.0240	1/8		1-1/2		.048	
16402500	16488			.0250	1/8		1-1/2		.050	
16402600	16489			.0260	1/8		1-1/2		.052	
16402700	16490			.0270	1/8		1-1/2		.054	
16402750	16414	0.7	.0275		3.0		38		1.4	
16402800	16491			.0280	1/8		1-1/2		.056	
16402900	16492			.0290	1/8		1-1/2		.058	
16403000	16493			.0300	1/8		1-1/2		.060	
16403120	16401	1/32	.0312		1/8		1-1/2		1/16	
16403150	16418	0.8	.0315		3.0		38		1.6	
16403500	16494			.0350	1/8		1-1/2		.070	
16403540	16420	0.9	.0354		3.0		38		1.8	

Inch	
D1	Tolerance
1/64	+0.000/-0.001
1/32-1/4	+0.000/-0.002
>1/4-3/4	+0.000/-0.003
D1 Micro Sizes*	
.005-.060	+0.0005/-0.0005

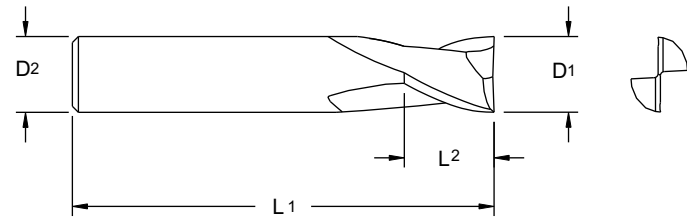
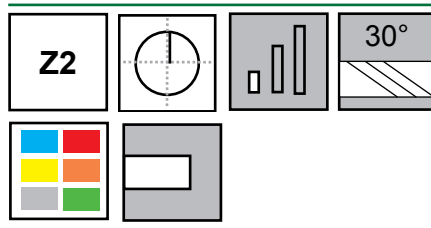
*Inch decimal size range .005-.060" only.

Metric (mm)	
D1	Tolerance h10
0.20-0.50	+0.000/-0.025
0.60-3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-20.00	+0.000/-0.084

Coated tools on page 201.

Technical information on page 250.

Series 164 Continued



Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16403940	16403	1.0	.0394		3.0		38		2.0	
16404000	16495		.0400		1/8		1-1/2		.080	
16404330	16428	1.1	.0433		3.0		38		2.2	
16404500	16496		.0450		1/8		1-1/2		.090	
16404680	16405	3/64	.0468		1/8		1-1/2		3/32	
16404720	16430	1.2	.0472		3.0		38		2.4	
16405000	16497		.0500		1/8		1-1/2		.100	
16405120	16434	1.3	.0512		3.0		38		2.6	
16405500	16498		.0550		1/8		1-1/2		.110	
16405510	16438	1.4	.0551		3.0		38		2.8	
16405910	16407	1.5	.0591		3.0		38		3.0	
16406000	16499		.0600		1/8		1-1/2		.120	
16406250	16409	1/16	.0625		1/8		1-1/2		1/8	
16406300	16444	1.6	.0630		3.0		38		3.2	
16406690	16446	1.7	.0669		3.0		38		3.4	
16407090	16448	1.8	.0709		3.0		38		3.6	
16407480	16450	1.9	.0748		3.0		38		3.8	
16407810	16410	5/64	.0781		1/8		1-1/2		5/32	
16407870	16411	2.0	.0787		3.0		38		4.0	
16409370	16413	3/32	.0937		1/8		1-1/2		3/16	
16409840	16415	2.5	.0984		3.0		38		5.0	
16410930	16416	7/64	.1093		1/8		1-1/2		7/32	
16411810	16417	3.0	.1181		3.0		38		6.0	
16412500	16419	1/8	.1250		1/8		1-1/2		1/4	
16413780	16421	3.5	.1378		4.0		51		7.0	
16414060	16422	9/64	.1406		3/16		2		5/16	
16415620	16423	5/32	.1562		3/16		2		5/16	
16415750	16425	4.0	.1575		4.0		51		8.0	
16417180	16426	11/64	.1718		3/16		2		3/8	
16417720	16427	4.5	.1772		5.0		51		9.0	
16418750	16429	3/16	.1875		3/16		2		3/8	
16419680	16431	5.0	.1968		5.0		51		11.0	
16420310	16432	13/64	.2031		1/4		2		1/2	
16421650	16433	5.5	.2165		6.0		51		12.0	
16421870	16435	7/32	.2187		1/4		2		1/2	
16423430	16436	15/64	.2343		1/4		2		1/2	
16423620	16437	6.0	.2362		6.0		51		13.0	
16425000	16439	1/4	.2500		1/4		2		1/2	
16427560	16441	7.0	.2756		8.0		51		13.0	
16428120	16442	9/32	.2812		5/16		2		1/2	
16431250	16443	5/16	.3125		5/16		2		1/2	
16431500	16445	8.0	.3150		8.0		51		13.0	

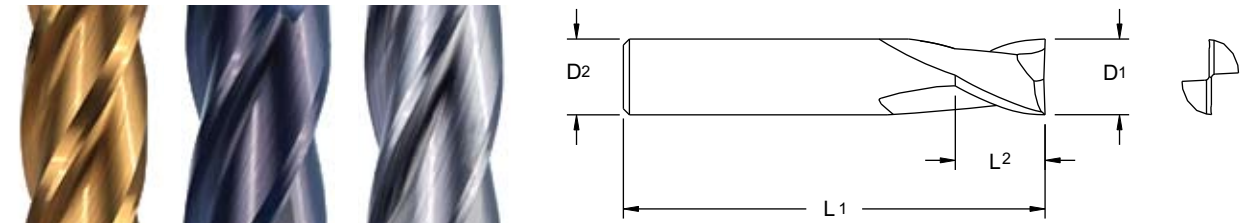
Coated tools on page 201.

Technical information on page 250.

Series 164 Continued

Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16435430	16447		9.0	.3543		9.0		51		14.0
16437500	16449	3/8	.3750		3/8		2		5/8	
16439370	16451		10.0	.3937		10.0		51		14.0
16443310	16453		11.0	.4331		11.0		64		16.0
16443750	16455	7/16	.4375		7/16		2-1/2		5/8	
16447240	16457		12.0	.4724		12.0		64		16.0
16450000	16459	1/2	.5000		1/2		2-1/2		5/8	
16455120	16461		14.0	.5512		14.0		70		18.0
16462500	16463	5/8	.6250		5/8		3		3/4	
16462990	16465		16.0	.6299		16.0		76		20.0
16470870	16466		18.0	.7087		18.0		76		25.0
16475000	16467	3/4	.7500		3/4		3		1	
16478740	16462		20.0	.7874		20.0		76		25.0

TuffCut® GP Series 164 Coated

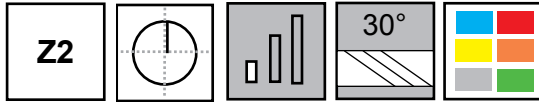


TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16411810T	56400	16411810A	56433	16411810C	56466		3.0	.1181		3.0		38		6.0
16412500T	56401	16412500A	56434	16412500C	56467	1/8		.1250	1/8		1-1/2		1/4	
16415750T	56405	16415750A	56438	16415750C	56471		4.0	.1575		4.0		51		8.0
16418750T	56408	16418750A	56441	16418750C	56474	3/16		.1875	3/16		2		3/8	
16419680T	56409	16419680A	56442	16419680C	56475		5.0	.1968		5.0		51		11.0
16423620T	56414	16423620A	56447	16423620C	56480		6.0	.2362		6.0		51		13.0
16425000T	56415	16425000A	56448	16425000C	56481	1/4		.2500	1/4		2		1/2	
16431250T	56418	16431250A	56451	16431250C	56484	5/16		.3125	5/16		2		1/2	
16431500T	56419	16431500A	56452	16431500C	56485		8.0	.3150		8.0		51		13.0
16437500T	56421	16437500A	56454	16437500C	56487	3/8		.3750	3/8		2		5/8	
16439370T	56422	16439370A	56455	16439370C	56488		10.0	.3937		10.0		51		14.0
16443750T	56424	16443750A	56457	16443750C	56490	7/16		.4375	7/16		2-1/2		5/8	
16447240T	56425	16447240A	56458	16447240C	56491		12.0	.4724		12.0		64		16.0
16450000T	56426	16450000A	56459	16450000C	56492	1/2		.5000	1/2		2-1/2		5/8	
16462500T	56428	16462500A	56461	16462500C	56494	5/8		.6250	5/8		3		3/4	
16462990T	56429	16462990A	56462	16462990C	56495		16.0	.6299		16.0		76		20.0
16475000T	56431	16475000A	56464	16475000C	56497	3/4		.7500	3/4		3		1	
16478740T	56432	16478740A	56465	16478740C	56498		20.0	.7874		20.0		76		25.0

Uncoated tools on page 199.

Technical information on page 250.

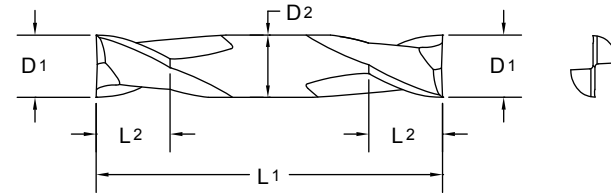
TuffCut® GP
Series 162



Designed with the same geometry as our standard 2 flute end mills.



- Twice the cutting edges saves you money.
- Good choice for shallow hole milling.



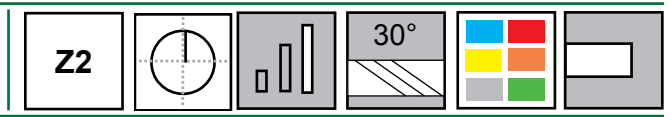
Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16201560	16200	1/64		.0156	1/8		1-1/2		.023	
16203120	16201	1/32		.0312	1/8		1-1/2		1/16	
16203940	16203	1.0		.0394	3.0		38		2.0	
16204680	16205	3/64		.0468	1/8		1-1/2		3/32	
16205910	16207	1.5		.0591	3.0		38		3.0	
16206250	16209	1/16		.0625	1/8		1-1/2		1/8	
16207810	16211	5/64		.0781	1/8		1-1/2		5/32	
16207870	16213	2.0		.0787	3.0		38		4.0	
16209370	16215	3/32		.0937	1/8		1-1/2		3/16	
16209840	16217	2.5		.0984	3.0		38		5.0	
16210930	16219	7/64		.1093	1/8		1-1/2		7/32	
16211810	16221	3.0		.1181	3.0		38		6.0	
16212500	16223	1/8		.1250	1/8		1-1/2		1/4	
16213780	16225	3.5		.1378	4.0		51		7.0	
16214060	16226	9/64		.1406	3/16		2		5/16	
16215620	16227	5/32		.1562	3/16		2		5/16	
16215750	16229	4.0		.1575	4.0		51		8.0	
16217720	16231	4.5		.1772	5.0		51		9.0	
16218750	16233	3/16		.1875	3/16		2		3/8	
16219680	16235	5.0		.1968	5.0		51		11.0	
16223620	16241	6.0		.2362	6.0		64		13.0	
16225000	16243	1/4		.2500	1/4		2-1/2		1/2	
16231500	16251	8.0		.3150	8.0		64		13.0	
16235430	16253	9.0		.3543	9.0		64		14.0	
16237500	16255	3/8		.3750	3/8		2-1/2		9/16	
16239370	16257	10.0		.3937	10.0		70		14.0	
16247240	16263	12.0		.4724	12.0		76		16.0	
16250000	16265	1/2		.5000	1/2		3		5/8	
16262500	16269	5/8		.6250	5/8		3-1/2		3/4	
16275000	16275	3/4		.7500	3/4		4		1	

Inch	
D1	Tolerance
1/64-1/4	+ .000/- .002
>1/4-3/4	+ .000/- .003

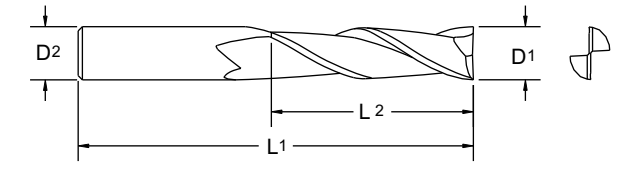
Metric (mm)	
D1	Tolerance h10
1.00- 3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-12.00	+ .000/- .070

Technical information on [page 250](#).

TuffCut® GP
Series 123



Designed for deep pocket milling and other applications where standard flute lengths are too short.

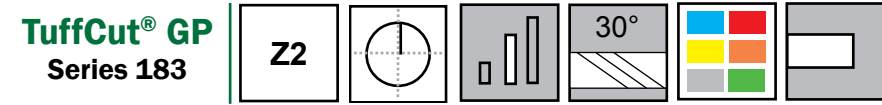


Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
12311810	12303		3.0	.1181		3.0		64		25.0
12312500	12305	1/8		.1250	1/8		2-1/2		1	
12315750	12306		4.0	.1575		4.0		64		25.0
12318750	12307	3/16		.1875	3/16		3		1-1/8	
12319680	12308		5.0	.1968		5.0		64		25.0
12323620	12309		6.0	.2362		6.0		76		30.0
12325000	12311	1/4		.2500	1/4		3		1-1/4	
12327560	12312		7.0	.2756		8.0		83		30.0
12331250	12313	5/16		.3125	5/16		3-1/4		1-3/8	
12331500	12315		8.0	.3150		8.0		83		35.0
12335430	12316		9.0	.3543		10.0		89		35.0
12337500	12317	3/8		.3750	3/8		3-1/2		1-1/2	
12339370	12319		10.0	.3937		10.0		89		40.0
12343310	12320		11.0	.4331		12.0		102		40.0
12343750	12321	7/16		.4375	7/16		4		1-3/4	
12347240	12323		12.0	.4724		12.0		102		50.0
12350000	12325	1/2		.5000	1/2		4		2	
12362500	12327	5/8		.6250	5/8		4-5/8		2-1/2	
12362990	12329		16.0	.6299		16.0		117		65.0
12375000	12331	3/4		.7500	3/4		5-1/4		3	
12378740	12333		20.0	.7874		20.0		133		80.0
12398430	12335		25.0	.9843		25.0		152		80.0
12310000	12301	1		1.0000	1		6		3	

Inch	
D1	Tolerance
1/8-1/4	+ .000/- .002
>1/4-1	+ .000/- .003

Metric (mm)	
D1	Tolerance
3.00-6.00	+ .000/- .051
7.00-25.00	+ .000/- .076

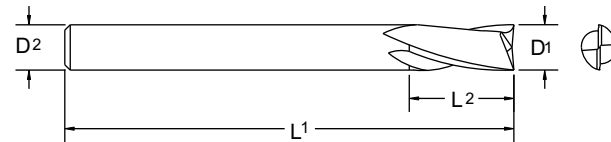
Technical information on [page 250](#).



Designed for extended reach in die and mold work and other deep pocket applications.



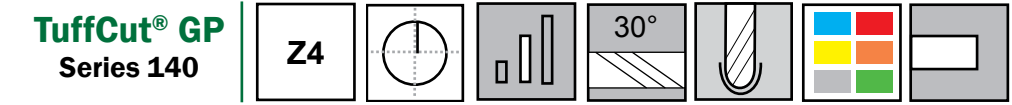
- General purpose milling of most materials.
- Standard flute lengths reduce cutter deflection.
- Available with neck relief upon request.



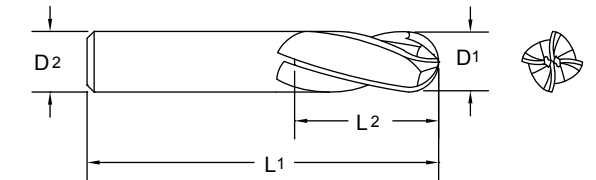
Uncoated		Diameter		Shank	OAL	Flute Length	
Tool No.	EDP	D1		D2	L1	L2	
		Inch	Decimal	Inch	Inch	Inch	Inch
18325000	18300	1/4	.2500	1/4	4	3/4	
18331250	18310	5/16	.3125	5/16	4	13/16	
18337500	18320	3/8	.3750	3/8	4	7/8	
18343750	18330	7/16	.4375	7/16	4	1	
18350000	18340	1/2	.5000	1/2	6	1	
18375000	18360	3/4	.7500	3/4	6	1-1/2	

Inch	
D1	Tolerance
1/4	+ .000/- .002
> 1/4-3/4	+ .000/- .003

Technical information on [page 250](#).



Manufactured with a full ball radius end. Designed for milling fillets or similar rounded corners in the bottom of a cut.



- Ideal for most ferrous metal applications.

Uncoated		Diameter			Shank		OAL	Flute Length		
Tool No.	EDP	D1			D2		L1	L2		
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
14003120	14001	1/32		.0312	1/8		1-1/2		5/64	
14003940	14003		1.0	.0394		3.0		38		3.0
14004680	14005	3/64		.0468	1/8		1-1/2		7/64	
14005910	14007		1.5	.0591		3.0		38		6.0
14006250	14009	1/16		.0625	1/8		1-1/2		3/16	
14007810	14011	5/64		.0781	1/8		1-1/2		3/16	
14007870	14013		2.0	.0787		3.0		38		9.0
14009370	14015	3/32		.0937	1/8		1-1/2		9/32	
14009840	14017		2.5	.0984		3.0		38		12.0
14010930	14021	7/64		.1093	1/8		1-1/2		3/8	
14011810	14023		3.0	.1181		3.0		38		12.0
14012500	14025	1/8		.1250	1/8		1-1/2		3/8	
14013780	14027		3.5	.1378		4.0		51		12.0
14015620	14029	5/32		.1562	3/16		2		1/2	
14015750	14031		4.0	.1575		4.0		51		14.0
14017720	14033		4.5	.1772		5.0		51		14.0
14018750	14035	3/16		.1875	3/16		2		5/8	
14019680	14037		5.0	.1968		5.0		51		20.0
14021650	14039		5.5	.2165		6.0		64		20.0
14021870	14041	7/32		.2187	1/4		2-1/2		5/8	
14023620	14043		6.0	.2362		6.0		64		20.0
14025000	14045	1/4		.2500	1/4		2-1/2		3/4	
14027560	14047		7.0	.2756		8.0		64		20.0
14028120	14049	9/32		.2812	5/16		2-1/2		3/4	
14031250	14051	5/16		.3125	5/16		2-1/2		13/16	
14031500	14053		8.0	.3150		8.0		64		20.0
14035430	14055		9.0	.3543		9.0		64		20.0
14037500	14057	3/8		.3750	3/8		2-1/2		1	
14039370	14059		10.0	.3937		10.0		70		25.0
14043310	14061		11.0	.4331		11.0		70		25.0
14043750	14063	7/16		.4375	7/16		2-3/4		1	
14047240	14065		12.0	.4724		12.0		76		25.0
14050000	14067	1/2		.5000	1/2		3		1	
14055120	14069		14.0	.5512		14.0		89		30.0
14056250	14071	9/16		.5625	9/16		3-1/2		1-1/8	
14062500	14073	5/8		.6250	5/8		3-1/2		1-1/4	

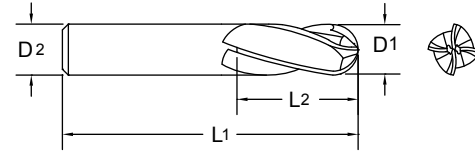
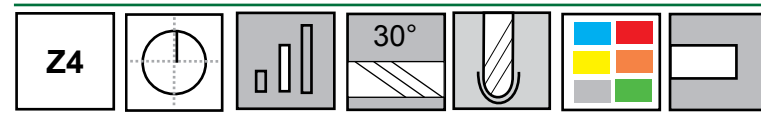
Inch	
D1	Tolerance
1/32-1/4	+ .000/- .002
> 1/4-1	+ .000/- .003

Metric (mm)	
D1	Tolerance h10
1.00-3.00	+ .000/- .040
> 3.00-6.00	+ .000/- .048
> 6.00-10.00	+ .000/- .058
> 10.00-18.00	+ .000/- .070
> 18.00-25.00	+ .000/- .084

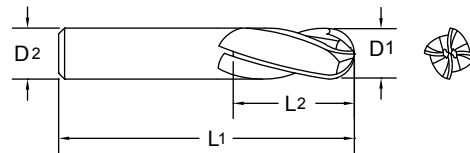
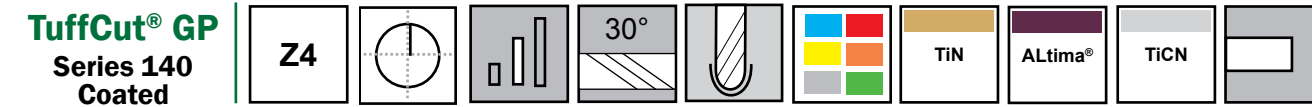
Coated tools on [page 206](#).

Technical information on [page 250](#).

Series 140 Continued



Uncoated		Diameter			Shank		OAL		Flute Length	
		D1			D2		L1		L2	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
14062990	14075		16.0	.6299		16.0		89		30.0
14068750	14077	11/16		.6875	3/4		4		1-3/8	
14070870	14079		18.0	.7087		18.0		102		35.0
14075000	14081	3/4		.7500	3/4		4		1-1/2	
14078740	14083		20.0	.7874		20.0		102		38.0
14086620	14085		22.0	.8662		22.0		102		40.0
14087500	14087	7/8		.8750	7/8		4		1-1/2	
14098430	14089		25.0	.9843		25.0		102		40.0
14010000	14019	1		1.0000	1		4		1-1/2	

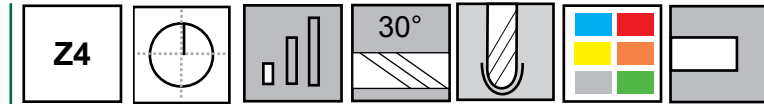


TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
						D1			D2		L1		L2	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
14011810T	14072	14011810A	14000	14011810C	14036		3.0	.1181		3.0		38		12.0
14012500T	14074	14012500A	14002	14012500C	14038	1/8		.1250	1/8		1-1/2		3/8	
14015750T	14076	14015750A	14004	14015750C	14040		4.0	.1575		4.0		51		14.0
14018750T	14078	14018750A	14006	14018750C	14042	3/16		.1875	3/16		2		5/8	
14019680T	14080	14019680A	14008	14019680C	14044		5.0	.1968		5.0		51		20.0
14023620T	14082	14023620A	14010	14023620C	14046		6.0	.2362		6.0		64		20.0
14025000T	14084	14025000A	14012	14025000C	14048	1/4		.2500	1/4		2-1/2		3/4	
14031250T	14086	14031250A	14014	14031250C	14050	5/16		.3125	5/16		2-1/2		13/16	
14031500T	14088	14031500A	14016	14031500C	14052		8.0	.3150		8.0		64		20.0
14037500T	14090	14037500A	14018	14037500C	14054	3/8		.3750	3/8		2-1/2		1	
14039370T	14091	14039370A	14020	14039370C	14056		10.0	.3937		10.0		70		25.0
14043750T	14092	14043750A	14022	14043750C	14058	7/16		.4375	7/16		2-3/4		1	
14047240T	14093	14047240A	14024	14047240C	14060		12.0	.4724		12.0		76		25.0
14050000T	14094	14050000A	14026	14050000C	14062	1/2		.5000	1/2		3		1	
14062500T	14095	14062500A	14028	14062500C	14064	5/8		.6250	5/8		3-1/2		1-1/4	
14062990T	14096	14062990A	14030	14062990C	14066		16.0	.6299		16.0		89		30.0
14075000T	14097	14075000A	14032	14075000C	14068	3/4		.7500	3/4		4		1-1/2	
14078740T	14098	14078740A	14034	14078740C	14070		20.0	.7874		20.0		102		38.0
14098430T	54003	14098430A	54004	14098430C	54005		25.0	.9843		25.0		102		40.0
14010000T	54000	14010000A	54001	14010000C	54002	1		1.0000	1		4		1-1/2	

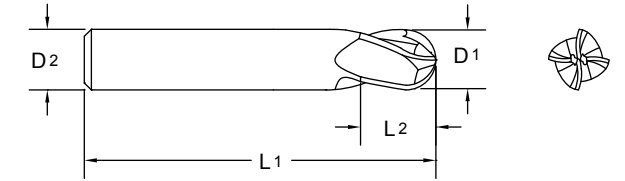
Uncoated tools on page 205.

Technical information on page 250

TuffCut® GP Series 165



Manufactured with full ball radius end.



• Ideal for most ferrous metal applications

Uncoated		Diameter			Shank		OAL		Flute Length	
		D1			D2		L1		L2	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16501560	16500	1/64		.0156	1/8		1-1/2		.023	
16503120	16501	1/32		.0312	1/8		1-1/2		1/16	
16503940	16503		1.0	.0394		3.0		38		2.0
16504680	16505	3/64		.0468	1/8		1-1/2		3/32	
16505910	16507		1.5	.0591		3.0		38		3.0
16506250	16509	1/16		.0625	1/8		1-1/2		1/8	
16507810	16510	5/64		.0781	1/8		1-1/2		5/32	
16507870	16511		2.0	.0787		3.0		38		4.0
16509370	16513	3/32		.0937	1/8		1-1/2		3/16	
16509840	16515		2.5	.0984		3.0		38		5.0
16510930	16516	7/64		.1093	1/8		1-1/2		7/32	
16511810	16517		3.0	.1181		3.0		38		6.0
16512500	16519	1/8		.1250	1/8		1-1/2		1/4	
16513780	16521		3.5	.1378		4.0		51		7.0
16514060	16522	9/64		.1406	3/16		2		5/16	
16515620	16523	5/32		.1562	3/16		2		5/16	
16515750	16525		4.0	.1575		4.0		51		8.0
16517180	16526	11/64		.1718	3/16		2		3/8	
16517720	16527		4.5	.1772		5.0		51		9.0
16518750	16529	3/16		.1875	3/16		2		3/8	
16519680	16531		5.0	.1968		5.0		51		11.0
16520310	16532	13/64		.2031	1/4		2		1/2	
16521650	16533		5.5	.2165		6.0		51		12.0
16521870	16535	7/32		.2187	1/4		2		1/2	
16523430	16536	15/64		.2343	1/4		2		1/2	
16523620	16537		6.0	.2362		6.0		51		13.0
16525000	16539	1/4		.2500	1/4		2		1/2	
16527560	16541		7.0	.2756		8.0		51		13.0
16528120	16542	9/32		.2812	5/16		2		1/2	
16531250	16543	5/16		.3125	5/16		2		1/2	
16531500	16545		8.0	.3150		8.0		51		13.0
16535430	16547		9.0	.3543		9.0		51		14.0
16537500	16549	3/8		.3750	3/8		2		5/8	
16539370	16551		10.0	.3937		10.0		51		14.0
16543310	16553		11.0	.4331		11.0		64		16.0
16543750	16555	7/16		.4375	7/16		2-1/2		5/8	
16547240	16557		12.0	.4724		12.0		64		16.0

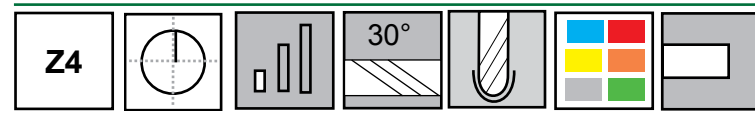
Inch	
D1	Tolerance
1/64	+0.000/-0.001
1/32-1/4	+0.000/-0.002
>1/4-3/4	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
1.00-3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-20.00	+0.000/-0.084

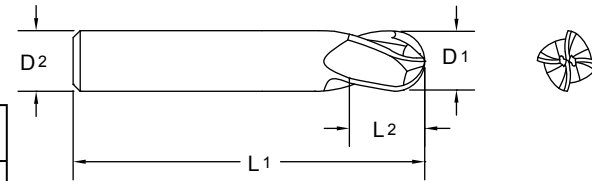
Coated tools on page 208.

Technical information on page 250.

Series 165 Continued

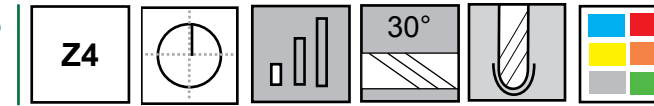


Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16550000	16559	1/2		.5000	1/2		2-1/2		5/8	
16555120	16561		14.0	.5512		14.0		70		18.0
16562500	16563	5/8		.6250	5/8		3		3/4	
16562990	16565		16.0	.6299		16.0		76		20.0
16570870	16567		18.0	.7087		18.0		76		25.0
16575000	16569	3/4		.7500	3/4		3		1	
16578740	16571		20.0	.7874		20.0		76		25.0

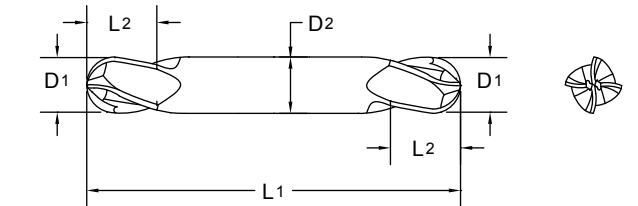


Technical information on [page 250](#).

TuffCut® GP Series 167



Designed with the same geometry as our standard 4-flute ball end mills.

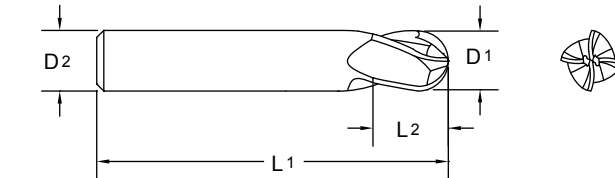


Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16701560	16700	1/64		.0156	1/8		1-1/2		.023	
16703120	16701	1/32		.0312	1/8		1-1/2		1/16	
16703940	16703		1.0	.0394		3.0		38		2.0
16705910	16707		1.5	.0591		3.0		38		3.0
16706250	16709	1/16		.0625	1/8		1-1/2		1/8	
16707870	16711		2.0	.0787		3.0		38		4.0
16709370	16713	3/32		.0937	1/8		1-1/2		3/16	
16709840	16715		2.5	.0984		3.0		38		5.0
16711810	16717		3.0	.1181		3.0		38		6.0
16712500	16719	1/8		.1250	1/8		1-1/2		1/4	
16713780	16721		3.5	.1378		4.0		51		7.0
16715750	16725		4.0	.1575		4.0		51		8.0
16718750	16729	3/16		.1875	3/16		2		3/8	
16719680	16731		5.0	.1968		5.0		51		11.0
16723620	16737		6.0	.2362		6.0		64		13.0
16725000	16739	1/4		.2500	1/4		2-1/2		1/2	
16731500	16745		8.0	.3150		8.0		64		13.0
16737500	16749	3/8		.3750	3/8		2-1/2		9/16	

Inch	
D1	Tolerance
1/64-1/4	+0.000/-0.002
> 1/4-3/8	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
1.00-3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-8.00	+0.000/-0.058

TuffCut® GP Series 165 Coated

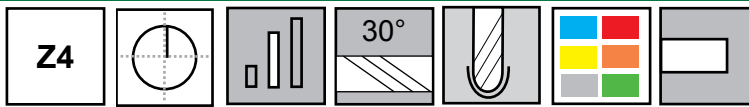


Uncoated tools on [page 207](#).

TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16511810T	56500	16511810A	56533	16511810C	56566		3.0	.1181		3.0		38		6.0
16512500T	56501	16512500A	56534	16512500C	56567	1/8		.1250	1/8		1-1/2		1/4	
16515750T	56505	16515750A	56538	16515750C	56571		4.0	.1575		4.0		51		8.0
16518750T	56508	16518750A	56541	16518750C	56574	3/16		.1875	3/16		2		3/8	
16519680T	56509	16519680A	56542	16519680C	56575		5.0	.1968		5.0		51		11.0
16523620T	56514	16523620A	56547	16523620C	56580		6.0	.2362		6.0		51		13.0
16525000T	56515	16525000A	56548	16525000C	56581	1/4		.2500	1/4		2		1/2	
16531250T	56518	16531250A	56551	16531250C	56584	5/16		.3125	5/16		2		1/2	
16531500T	56519	16531500A	56552	16531500C	56585		8.0	.3150		8.0		51		13.0
16537500T	56521	16537500A	56554	16537500C	56587	3/8		.3750	3/8		2		5/8	
16539370T	56522	16539370A	56555	16539370C	56588		10.0	.3937		10.0		51		14.0
16543750T	56524	16543750A	56557	16543750C	56590	7/16		.4375	7/16		2-1/2		5/8	
16547240T	56525	16547240A	56558	16547240C	56591		12.0	.4724		12.0		64		16.0
16550000T	56526	16550000A	56559	16550000C	56592	1/2		.5000	1/2		2-1/2		5/8	
16562500T	56528	16562500A	56561	16562500C	56594	5/8		.6250	5/8		3		3/4	
16562990T	56529	16562990A	56562	16562990C	56595		16.0	.6299		16.0		76		20.0
16575000T	56531	16575000A	56564	16575000C	56597	3/4		.7500	3/4		3		1	
16578740T	56532	16578740A	56565	16578740C	56598		20.0	.7874		20.0		76		25.0

Technical information on [page 250](#).

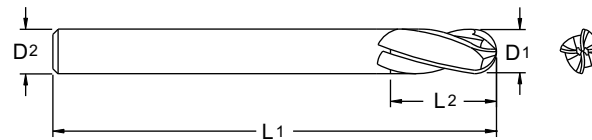
TuffCut® GP Series 184



Designed for extended reach in die and mold work and other deep pocket applications. Ball nose geometry for inside corner radius and CNC contouring.



- General purpose milling of most materials.
- 4 flutes for reduced chip loads in tougher materials.
- Available with neck relief upon request.
- Standard flute lengths reduce cutter deflection.



Uncoated	Diameter		Shank	OAL	Flute Length	
	Tool No.	EDP			D1	D2
18425000	18400	1/4	.2500	1/4	4	3/4
18431250	18410	5/16	.3125	5/16	4	13/16
18437500	18420	3/8	.3750	3/8	4	7/8
18443750	18430	7/16	.4375	7/16	4	1
18450000	18440	1/2	.5000	1/2	6	1
18475000	18460	3/4	.7500	3/4	6	1-1/2

Inch	
D1	Tolerance
1/4	+ .000/- .002
> 1/4-3/4	+ .000/- .003

Technical information on [page 250](#).

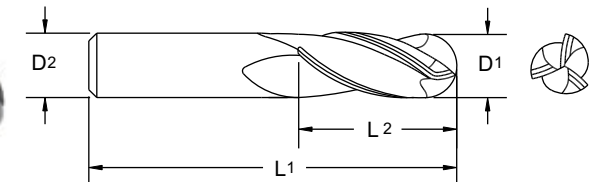
Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

TuffCut® GP Series 145



Manufactured with a full ball radius end. Designed for milling fillets or similar rounded corners in the bottom of a cut. Ideal for most ferrous metal applications. Inch sizes available as a special. Call customer service for pricing.

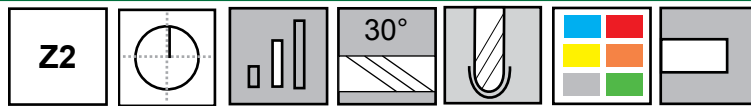


Uncoated		TiN		ALtima®		TiCN		Diameter		Shank	OAL	Flute Length	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	mm	Decimal			D2	L1
14503940	14501							1.0	.0394	3.0	38	3.0	
14505910	14504							1.5	.0591	3.0	38	6.0	
14507870	14507							2.0	.0787	3.0	38	9.0	
14511810	14513	14511810T	14514	14511810A	14515	14511810C	14570	3.0	.1181	3.0	38	12.0	
14515750	14519	14515750T	14520	14515750A	14521	14515750C	14571	4.0	.1575	4.0	51	14.0	
14519680	14525	14519680T	14526	14519680A	14527	14519680C	14572	5.0	.1968	5.0	51	20.0	
14523620	14531	14523620T	14532	14523620A	14533	14523620C	14573	6.0	.2362	6.0	64	20.0	
14531500	14537	14531500T	14538	14531500A	14359	14531500C	14574	8.0	.3150	8.0	64	20.0	
14539370	14543	14539370T	14544	14539370A	14545	14539370C	14575	10.0	.3937	10.0	70	25.0	

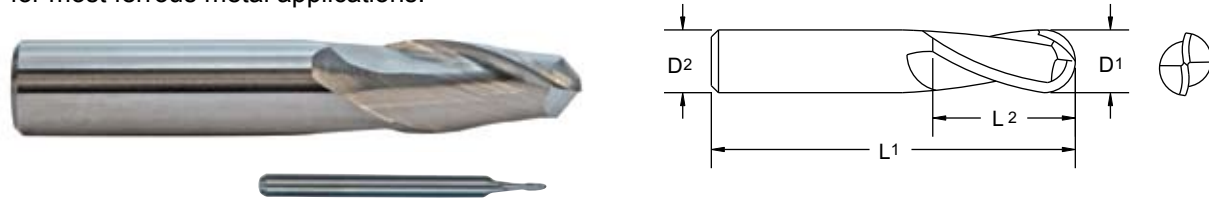
Metric (mm)	
D1	Tolerance h10
1.00-3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058

Technical information on [page 250](#).

**TuffCut® GP
Series 150**



Manufactured with a full ball radius end. Designed for milling fillets or similar rounded corners in the bottom of a cut. Ideal for most ferrous metal applications.



• Micro sizes from .015 - .100" and 0.4-2.0mm

Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
15001500	15002			.0150	1/8		1-1/2		.045	
15001570	15038		0.4	.0157		3		38		1.2
15001960	15040		0.5	.0196		3		38		1.5
15002000	15004			.0200	1/8		1-1/2		.060	
15002360	15042		0.6	.0236		3		38		1.8
15002500	15006			.0250	1/8		1-1/2		.075	
15002750	15044		0.7	.0275		3		38		2.1
15003000	15008			.0300	1/8		1-1/2		.090	
15003120	15001	1/32		.0312	1/8		1-1/2		5/64	
15003150	15046		0.8	.0315		3		38		2.4
15003500	15010			.0350	1/8		1-1/2		.105	
15003540	15048		0.9	.0354		3		38		2.7
15003940	15003		1.0	.0394		3		38		3.0
15004000	15012			.0400	1/8		1-1/2		.120	
15004330	15052		1.1	.0433		3		38		3.3
15004500	15014			.0450	1/8		1-1/2		.135	
15004680	15005	3/64		.0468	1/8		1-1/2		7/64	
15004720	15054		1.2	.0472		3		38		3.6
15005000	15016			.0500	1/8		1-1/2		.150	
15005120	15056		1.3	.0512		3		38		3.9
15005500	15018			.0550	1/8		1-1/2		.165	
15005510	15058		1.4	.0551		3		38		4.2
15005910	15007		1.5	.0591		3		38		6.0
15005911	15060		1.5	.0591		3		38		4.5
15006000	15020			.0600	1/8		1-1/2		.180	
15006250	15009	1/16		.0625	1/8		1-1/2		3/16	
15006300	15062		1.6	.0630		3		38		4.8
15006500	15022			.0650	1/8		1-1/2		.195	
15006690	15064		1.7	.0669		3		38		5.1
15007000	15024			.0700	1/8		1-1/2		.210	
15007090	15066		1.8	.0709		3		38		5.4
15007480	15068		1.9	.0748		3		38		5.7
15007500	15026			.0750	1/8		1-1/2		.225	
15007810	15011	5/64		.0781	1/8		1-1/2		3/16	

Inch	
D1	Tolerance
1/32-1/4	+ .000/- .002
>1/4-1	+ .000/- .003
D1 Micro Sizes*	Tolerance
.015-.100	+ .0005/- .0005

Metric (mm)	
D1	Tolerance h10
0.40-0.50	+ .000/- .025
0.60-3.00	+ .000/- .040
>3.00-6.00	+ .000/- .048
>6.00-10.00	+ .000/- .058
>10.00-18.00	+ .000/- .070
>18.00-25.00	+ .000/- .084

*Inch decimal size range .015-.100" only.

Coated tools on [page 214](#)

Technical information on [page 250](#).

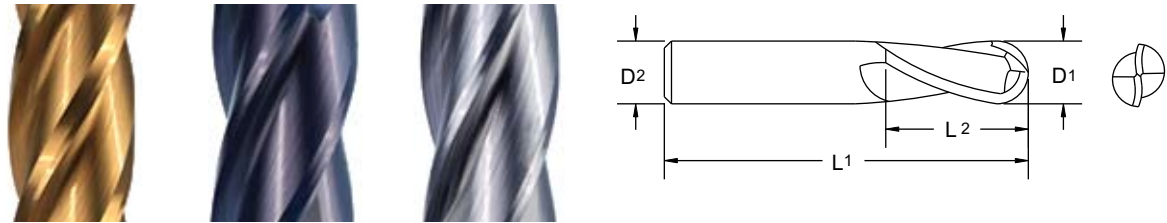
Series 150 Continued

Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
15007870	15013		2.0	.0787		3		38		9.0
15007871	15070		2.0	.0787		3		38		6.0
15008000	15028			.0800	1/8		1-1/2		.240	
15008500	15030			.0850	1/8		1-1/2		.255	
15009000	15032			.0900	1/8		1-1/2		.270	
15009370	15015	3/32		.0937	1/8		1-1/2		9/32	
15009500	15034			.0950	1/8		1-1/2		.285	
15009840	15017		2.5	.0984		3		38		12
15010010	15036			.1000	1/8		1-1/2		.300	
15010930	15021	7/64		.1093	1/8		1-1/2		3/8	
15011810	15023		3.0	.1181		3		38		12
15012500	15025	1/8		.1250	1/8		1-1/2		3/8	
15013780	15027		3.5	.1378		4		51		12
15015620	15029	5/32		.1562	3/16		2		1/2	
15015750	15031		4.0	.1575		4		51		14
15017720	15033		4.5	.1772		5		51		14
15018750	15035	3/16		.1875	3/16		2		5/8	
15019680	15037		5.0	.1968		5		51		20
15021650	15039		5.5	.2165		6		64		20
15021870	15041	7/32		.2187	1/4		2-1/2		5/8	
15023620	15043		6.0	.2362		6		64		20
15025000	15045	1/4		.2500	1/4		2-1/2		3/4	
15027560	15047		7.0	.2756		8		64		20
15028120	15049	9/32		.2812	5/16		2-1/2		3/4	
15031250	15051	5/16		.3125	5/16		2-1/2		13/16	
15031500	15053		8.0	.3150		8		64		20
15035430	15055		9.0	.3543		9		64		20
15037500	15057	3/8		.3750	3/8		2-1/2		1	
15039370	15059		10.0	.3937		10		70		25
15043310	15061		11.0	.4331		11		70		25
15043750	15063	7/16		.4375	7/16		2-3/4		1	
15047240	15065		12.0	.4724		12		76		25
15050000	15067	1/2		.5000	1/2		3		1	
15055120	15069		14.0	.5512		14		89		30
15056250	15071	9/16		.5625	9/16		3-1/2		1-1/8	
15062500	15073	5/8		.6250	5/8		3-1/2		1-1/4	
15062990	15075		16.0	.6299		16		89		30
15068750	15077	11/16		.6875	3/4		4		1-3/8	
15070870	15079		18.0	.7087		18		102		35
15075000	15081	3/4		.7500	3/4		4		1-1/2	
15078740	15083		20.0	.7874		20		102		38
15086620	15085		22.0	.8662		22		102		40
15087500	15087	7/8		.8750	7/8		4		1-1/2	
15098430	15089		25.0	.9843		25		102		40
15010000	15019	1		1.0000	1		4		1-1/2	

Coated tools on [page 214](#).

Technical information on [page 250](#).

TuffCut® GP
Series 150
Coated



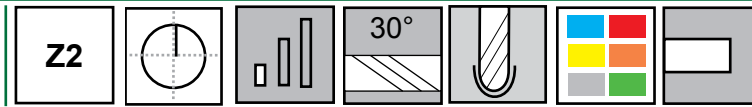
TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length						
Tool No.		EDP		Tool No.		EDP		Tool No.		EDP		D1		D2		L1		L2	
Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	Inch	mm	
15011810T	55076	15011810A	55040	15011810C	55058	3	.1181	3.0		38		12.0							
15012500T	55077	15012500A	55041	15012500C	55059	1/8	.1250	1/8		1-1/2		3/8							
15015750T	55078	15015750A	55042	15015750C	55060	4	.1575	4.0		51		14.0							
15018750T	55079	15018750A	55043	15018750C	55061	3/16	.1875	3/16		2		5/8							
15019680T	55080	15019680A	55044	15019680C	55062	5	.1968	5.0		51		20.0							
15023620T	55081	15023620A	55045	15023620C	55063	6	.2362	6.0		64		20.0							
15025000T	55082	15025000A	55046	15025000C	55064	1/4	.2500	1/4		2-1/2		3/4							
15031250T	55083	15031250A	55047	15031250C	55065	5/16	.3125	5/16		2-1/2		13/16							
15031500T	55084	15031500A	55048	15031500C	55066	8	.3150	8.0		64		20.0							
15037500T	55085	15037500A	55049	15037500C	55067	3/8	.3750	3/8		2-1/2		1							
15039370T	55086	15039370A	55050	15039370C	55068	10	.3937	10.0		70		25.0							
15043750T	55087	15043750A	55051	15043750C	55069	7/16	.4375	7/16		2-3/4		1							
15047240T	55088	15047240A	55052	15047240C	55070	12	.4724	12.0		76		25.0							
15050000T	55089	15050000A	55053	15050000C	55071	1/2	.5000	1/2		3		1							
15062500T	55090	15062500A	55054	15062500C	55072	5/8	.6250	5/8		3-1/2		1-1/4							
15062990T	55091	15062990A	55055	15062990C	55073	16	.6299	16.0		89		30.0							
15075000T	55092	15075000A	55056	15075000C	55074	3/4	.7500	3/4		4		1-1/2							
15078740T	55093	15078740A	55057	15078740C	55075	20	.7874	20.0		102		38.0							
15098430T	55097	15098430A	55098	15098430C	55099	25	.9843	25.0		102		40.0							
15010000T	55094	15010000A	55095	15010000C	55096	1	1.0000	1		4		1-1/2							

Uncoated tools on [page 212](#).

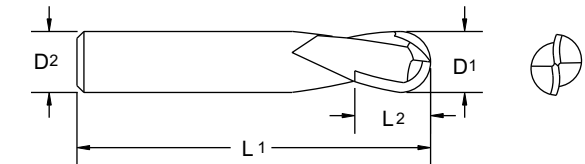
Technical information on [page 250](#).

ISO 9001:2000 Certified
An ESOP Company

TuffCut® GP
Series 166



Manufactured with a full ball radius end. Designed for milling fillets or similar rounded corners in the bottom of a cut. Ideal for most ferrous metal applications.



Uncoated		Diameter			Shank		OAL		Flute Length		
Tool No.		EDP		D1		D2		L1		L2	
Inch	mm	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm	
16601560	16600	1/64		.0156	1/8		1-1/2		.023		
16603120	16601	1/32		.0312	1/8		1-1/2		1/16		
16603940	16603		1.0	.0394	3/8		38		2.0		
16604680	16605	3/64		.0468	1/8		1-1/2		3/32		
16605910	16607		1.5	.0591	3.0		38		3.0		
16606250	16609	1/16		.0625	1/8		1-1/2		1/8		
16607810	16610	5/64		.0781	1/8		1-1/2		5/32		
16607870	16611		2.0	.0787	3.0		38		4.0		
16609370	16613	3/32		.0937	1/8		1-1/2		3/16		
16609840	16615		2.5	.0984	3.0		38		5.0		
16610930	16616	7/64		.1093	1/8		1-1/2		7/32		
16611810	16617		3.0	.1181	3.0		38		6.0		
16612500	16619	1/8		.1250	1/8		1-1/2		1/4		
16613780	16621		3.5	.1378	4.0		51		7.0		
16614060	16622	9/64		.1406	3/16		2		5/16		
16615620	16623	5/32		.1562	3/16		2		5/16		
16615750	16625		4.0	.1575	4.0		51		8.0		
16617180	16626	11/64		.1718	3/16		2		3/8		
16617720	16627		4.5	.1772	5.0		51		9.0		
16618750	16629	3/16		.1875	3/16		2		3/8		
16619680	16631		5.0	.1968	5.0		51		11.0		
16620310	16632	13/64		.2031	1/4		2		1/2		
16621650	16633		5.5	.2165	6.0		51		12.0		
16621870	16635	7/32		.2187	1/4		2		1/2		
16623430	16636	15/64		.2343	1/4		2		1/2		
16623620	16637		6.0	.2362	6.0		51		13.0		
16625000	16639	1/4		.2500	1/4		2		1/2		
16627560	16641		7.0	.2756	8.0		51		13.0		
16628120	16642	9/32		.2812	5/16		2		1/2		
16631250	16643	5/16		.3125	5/16		2		1/2		
16631500	16645		8.0	.3150	8.0		51		13.0		
16635430	16647		9.0	.3543	9.0		51		14.0		
16637500	16649	3/8		.3750	3/8		2		5/8		
16639370	16651		10.0	.3937	10.0		51		14.0		
16643310	16653		11.0	.4331	11.0		64		16.0		
16643750	16655	7/16		.4375	7/16		2-1/2		5/8		
16647240	16657		12.0	.4724	12.0		64		16.0		
16650000	16659	1/2		.5000	1/2		2-1/2		5/8		

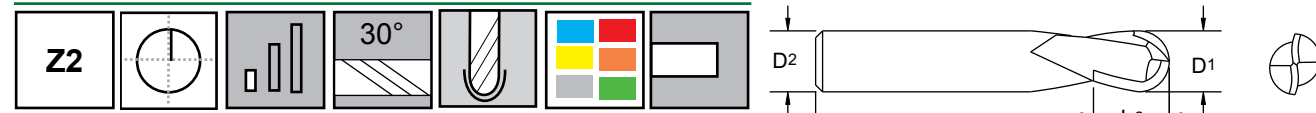
Inch	
D1	Tolerance
1/64	+0.000/-0.001
1/32-1/4	+0.000/-0.002
> 1/4-3/4	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
1.00-3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-10.00	+0.000/-0.058
>10.00-18.00	+0.000/-0.070
>18.00-20.00	+0.000/-0.084

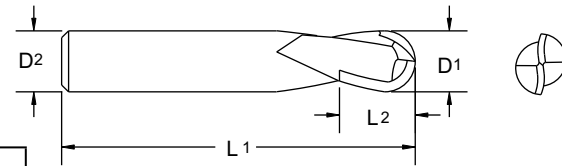
Coated tools on [page 216](#)

Technical information on [page 250](#).

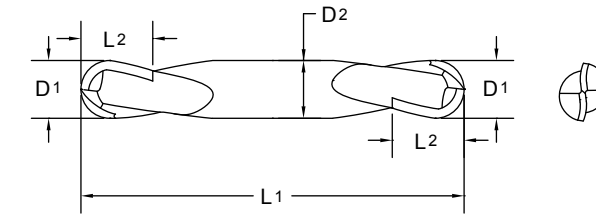
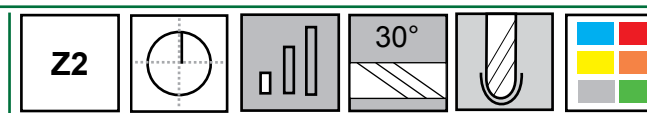
Series 166 Continued



Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16655120	16661		14.0	.5512		14.0		70		18.0
16662500	16663	5/8		.6250	5/8		3		3/4	
16662990	16665		16.0	.6299		16.0		76		20.0
16670870	16667		18.0	.7087		18.0		76		25.0
16675000	16669	3/4		.7500	3/4		3		1	
16678740	16671		20.0	.7874		20.0		76		25.0



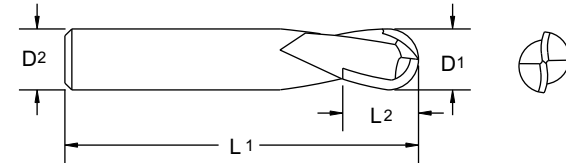
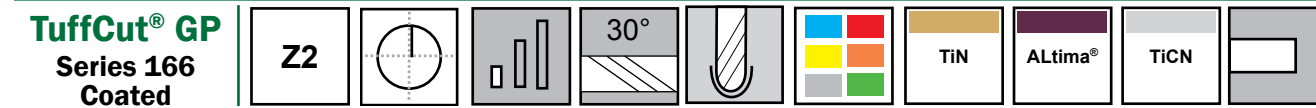
TuffCut® GP Series 168



Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16801560	16800	1/64		.0156	1/8		1-1/2		.023	
16803120	16801	1/32		.0312	1/8		1-1/2		1/16	
16803940	16803		1.0	.0394		3.0		38		2.0
16805910	16807		1.5	.0591		3.0		38		3.0
16806250	16809	1/16		.0625	1/8		1-1/2		1/8	
16807870	16811		2.0	.0787		3.0		38		4.0
16809370	16813	3/32		.0937	1/8		1-1/2		3/16	
16809840	16815		2.5	.0984		3.0		38		5.0
16811810	16817		3.0	.1181		3.0		38		6.0
16812500	16819	1/8		.1250	1/8		1-1/2		1/4	
16813780	16821		3.5	.1378		4.0		51		7.0
16815750	16825		4.0	.1575		4.0		51		8.0
16818750	16829	3/16		.1875	3/16		2		3/8	
16819680	16831		5.0	.1968		5.0		51		11.0
16823620	16837		6.0	.2362		6.0		64		13.0
16825000	16839	1/4		.2500	1/4		2-1/2		1/2	
16831500	16845		8.0	.3150		8.0		64		13.0
16837500	16849	3/8		.3750	3/8		2-1/2		9/16	

Inch	
D1	Tolerance
1/64-1/4	+0.000/-0.002
> 1/4-3/8	+0.000/-0.003

Metric (mm)	
D1	Tolerance h10
1.00-3.00	+0.000/-0.040
>3.00-6.00	+0.000/-0.048
>6.00-8.00	+0.000/-0.058



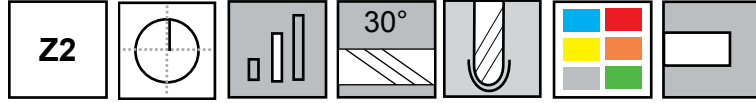
TiN		ALtima®		TiCN		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	Tool No.	EDP	Tool No.	EDP	Inch	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
16611810T	56600	16611810A	56633	16611810C	56666		3.0	.1181		3.0		38		6.0
16612500T	56601	16612500A	56634	16612500C	56667	1/8		.1250	1/8		1-1/2		1/4	
16615750T	56605	16615750A	56638	16615750C	56671		4.0	.1575		4.0		51		8.0
16618750T	56608	16618750A	56641	16618750C	56674	3/16		.1875	3/16		2		3/8	
16619680T	56609	16619680A	56642	16619680C	56675		5.0	.1968		5.0		51		11.0
16623620T	56614	16623620A	56647	16623620C	56680		6.0	.2362		6.0		51		13.0
16625000T	56615	16625000A	56648	16625000C	56681	1/4		.2500	1/4		2		1/2	
16631250T	56618	16631250A	56651	16631250C	56684	5/16		.3125	5/16		2		1/2	
16631500T	56619	16631500A	56652	16631500C	56685		8.0	.3150		8.0		51		13.0
16637500T	56621	16637500A	56654	16637500C	56687	3/8		.3750	3/8		2		5/8	
16639370T	56622	16639370A	56655	16639370C	56688		10.0	.3937		10.0		51		14.0
16643750T	56624	16643750A	56657	16643750C	56690	7/16		.4375	7/16		2-1/2		5/8	
16647240T	56625	16647240A	56658	16647240C	56691		12.0	.4724		12.0		64		16.0
16650000T	56626	16650000A	56659	16650000C	56692	1/2		.5000	1/2		2-1/2		5/8	
16662500T	56628	16662500A	56661	16662500C	56694	5/8		.6250	5/8		3		3/4	
16662990T	56629	16662990A	56662	16662990C	56695		16.0	.6299		16.0		76		20.0
16675000T	56631	16675000A	56664	16675000C	56697	3/4		.7500	3/4		3		1	
16678740T	56632	16678740A	56665	16678740C	56698		20.0	.7874		20.0		76		25.0

Uncoated tools on [page 215](#).

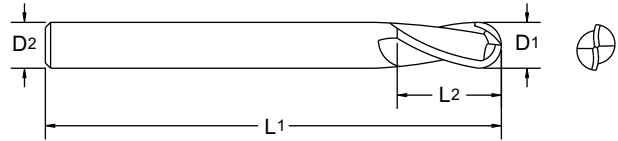
Technical information on [page 250](#).

Technical information on [page 250](#).

TuffCut® GP
Series 186



Designed for extended reach in die and mold work and other deep pocket applications. Ball nose geometry for inside corner radius and CNC contouring.



- General purpose milling of most materials.
- Standard flute lengths reduce cutter deflection.
- Available with neck relief upon request.

Uncoated		Diameter			Shank		OAL		Flute Length	
Tool No.	EDP	D1			D2		L1		L2	
		Fraction	mm	Decimal	Inch	mm	Inch	mm	Inch	mm
18611810	18605		3.0	.1181		6.0		60		6.0
18623620	18625		6.0	.2362		6.0		76		15.0
18625000	18600	1/4		.2500	1/4		4		3/4	
18631500	18635		8.0	.3150		8.0		101		20.0
18637500	18620	3/8		.3750	3/8		4		7/8	
18639370	18645		10.0	.3937		10.0		101		25.0
18647240	18655		12.0	.4724		12.0		152		25.0
18650000	18640	1/2		.5000	1/2		6		1	

Inch	
D1	Tolerance
1/4	+ .000/- .002
> 1/4-1/2	+ .000/- .003

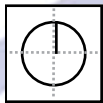
Metric (mm)	
D1	Tolerance
3.00	- .005/- .028
> 3.00-6.00	- .016/- .038
> 6.00-12.00	- .020/- .048

Technical information on [page 250](#).

Icon Glossary



Number of Flutes



Center Cutting



Lengths

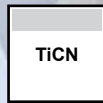
Coatings



ALtima®



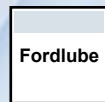
TiAlN



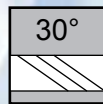
TiCN



TiN

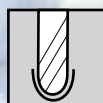


Fordlube

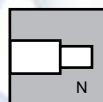


30°

Helix Angle



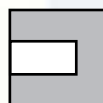
Ball Nose



Neck Relief



Corner Radius

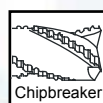


Shank



HB
DIN6535

Shank/DIN

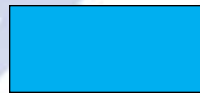


Chipbreaker

Chipbreaker



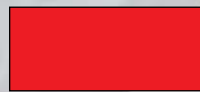
Workpiece
Material Group



Steels



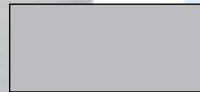
Stainless Steels



Cast Iron



Special Alloys



Hardened Steels
(35-65Rc)



Non-Ferrous

Celebrating

90 Years

1919 - 2009

M.A. Ford®

End Mill Troubleshooting

Problem	Possible Solutions																							
	Rigidity	Increase Inches/tooth	Reduce Inches/tooth	Material	Recutting Chips	Increase Rake Angle	Handling	Runout	Reduce Speed	Increase Speed	Depth of Cut	Fixturing	Coolant	Finish	Dull Tool	Chip Evacuation	Inadequate Number of Flutes	Insufficient Coolant	Plunge Cutting	Reduce Feed	Increase Feed	Tool Holder	Balance Holder & Tool	
Chipping	x		x	x	x		x	x																x
Chatter	x	x							x		x	x												x
Built Up Edge		x				x				x			x	x										
Breakage	x		x								x				x	x								x
Chip Packing																	x	x	x					
Poor Slotting	x	x	x						x		x	x									x			
Premature Wear				x					x	x			x								x	x	x	
Chip Welding			x			x			x				x	x										
Cratering																								x

Formulas

Inch

RPM=SFM x 3.82/Tool Diameter
IPM=RPM x number of teeth x (inches/tooth)

Conversion Inch to Metric

SMM=SFM x .3048
mm/min.= IPM x 25.4

Metric

RPM=SMM x 318.057/Tool Diameter
mm/min.=RPM x number of teeth x (mm/tooth)

Conversion Metric to Inch

SFM=SMM/.3048
IPM= (mm/min.)/25.4

Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded. Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

Series 112/113 Inch

Workpiece Material Group	Examples	SFM	
Stainless Steels	M	Stainless Steel Free Machining	200-400
		Austenitic 304/316	150-175
		Ferritic	175-225
		Martensitic PH Stainless 17-4 PH	80-125

Workpiece Material Group	Examples	SFM	
Special Alloys	S	Titanium 6AL-4V	175-225
		Stellite Inconel 625/718 Incoloy 800-802	80-125

Workpiece Material Group	Examples	Tool Diameter									
		1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
Stainless Steels	M	Inches/Tooth									
		Stainless Steel Free Machining	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Austenitic 304/316	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
		Ferritic	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
Special Alloys	S	Titanium 6AL-4V	.0003-.0004	.0004-.0006	.0006-.0008	.0008-.0012	.0008-.0012	.0012-.0016	.0016-.0018	.0018-.0020	.0020-.0030
		Stellite Inconel 625/718 Incoloy 800-802	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Series 112/113 Metric

Workpiece Material Group	Examples	SMM	
Stainless Steels	M	Stainless Steel Free Machining	60-120
		Austenitic 304/316	45-55
		Ferritic	55-70
		Martensitic PH Stainless 17-4 PH	25-40

Workpiece Material Group	Examples	SMM	
Special Alloys	S	Titanium 6AL-4V	55-70
		Stellite Inconel 625/718 Incoloy 800-802	25-40

Workpiece Material Group	Examples	Tool Diameter (mm)									
		3	5	6	8	10	12	16	20	25	
Stainless Steels	M	mm/Tooth									
		Stainless Steel Free Machining	.013-.030	.025-.030	.038-.051	.038-.064	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Austenitic 304/316	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
		Ferritic	.013-.030	.025-.030	.038-.051	.038-.064	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
Special Alloys	S	Martensitic PH Stainless 17-4 PH	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
		Titanium 6AL-4V	.008-.010	.010-.017	.017-.02	.020-.030	.020-.030	.030-.041	.041-.046	.046-.051	.051-.076
Special Alloys	S	Stellite Inconel 625/718 Incoloy 800-802	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089

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

Series 114/132 Inch

Workpiece Material Group		Examples	SFM
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	450-500
		Steel - Mild (.4-.5 Carbon) 4140	250-300
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	125-250
Cast Irons	K	Iron - Cast (Soft)	450-600
		Iron - Cast (Medium Hard)	300-400
		Iron - Cast (Hard Chilled)	250-300
		Iron (Malleable)	225-300

Workpiece Material Group		Examples	SFM
Stainless Steels	M	Stainless Steel Free Machining	200-300
		Austenitic 304/316	180-225
		Ferritic	200-275
		Martensitic	150-200
Special Alloys	S	PH Stainless 17-4 PH	125-200
		Titanium 6AL-4V	175-375
		Cobalt-Based Alloys Stellite	80-125
		Nickel-Based Alloys Inconel 625/718	80-125
		Iron-Based Alloys Incoloy 800-802	80-125
Hardened Steels	H	Hardened Steels 35-45 Rc	200-250
		Hardened Steels 45-55 Rc	150-200

Series 114/132 Metric

Workpiece Material Group		Examples	SMM
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	135-150
		Steel - Mild (.4-.5 Carbon) 4140	75-90
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	40-75
Cast Irons	K	Iron - Cast (Soft)	135-185
		Iron - Cast (Medium Hard)	90-120
		Iron (Hard Chilled)	75-90
		Iron (Malleable)	70-90
Stainless Steels	M	Stainless Steel Free Machining	60-90
		Austenitic 304/316	55-70

Workpiece Material Group		Examples	SMM
Stainless Steels	M	Ferritic	60-85
		Martensitic	45-60
		PH Stainless 17-4 PH	40-60
Special Alloys	S	Titanium 6AL-4V	55-115
		Cobalt-Based Alloys Stellite	25-40
		Nickel-Based Alloys Inconel 625/718	25-40
		Iron-Based Alloys Incoloy 800-802	25-40
Hardened Steels	H	Hardened Steels 35-45 Rc	60-75
		Hardened Steels 45-55 Rc	45-60

Workpiece Material Group	Examples	Tool Diameter									
		1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Steel - Mild (.4-.5 Carbon) 4140									
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Cast Irons	K	Iron - Cast (Soft)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Iron - Cast (Medium Hard)									
		Iron (Hard Chilled)									
		Iron (Malleable)									
Stainless Steels	M	Stainless Steel Free Machining	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Ferritic									
		Austenitic 304/316	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Special Alloys	S	Martensitic PH Stainless 17-4 PH									
		Titanium 6AL-4V	.0003-.0004	.0004-.0006	.0006-.0008	.0008-.0012	.0008-.0012	.0012-.0016	.0016-.0018	.0018-.0020	.0020-.0030
Special Alloys	S	Stellite	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
		Inconel 625/718 Incoloy 800-802									
Hardened Steels	H	Hardened Steels 35-45 Rc	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
		Hardened Steels 45-55 Rc									

Workpiece Material Group	Examples	Tool Diameter (mm)									
		3	5	6	8	10	14	16	18	25	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Steel - Mild (.4-.5 Carbon) 4140									
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
Cast Irons	K	Iron - Cast (Soft)	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Iron - Cast (Medium Hard)									
		Iron (Hard Chilled)									
		Iron (Malleable)									
Stainless Steels	M	Stainless Steel Free Machining	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Ferritic									
		Austenitic 304/316	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
Special Alloys	S	Martensitic PH Stainless 17-4 PH	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
		Titanium 6AL-4V	.008-.010	.010-.015	.015-.020	.020-.030	.020-.030	.030-.041	.041-.046	.046-.051	.051-.076
Special Alloys	S	Stellite	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
		Inconel 625/718 Incoloy 800-802									
Hardened Steels	H	Hardened Steels 35-45 Rc	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
		Hardened Steels 45-55 Rc									

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

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

Series 134/135/137 Inch

Workpiece Material Group	Examples	Coolant	Slotting					
			Small Radial Depth ==> Large Radial Depth					
			1 x Diameter Axial Depth					
			Profile Milling					
Max.	Type	25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
		SFM						
Non-Ferrous	N	Aluminum < 10% Si	1000-2000			2000	1625	1000
		Aluminum > 10% Si	800-1500			1500	1230	800
		Brass	500-900			900	750	500
		Plastics	800-1200			1200	1050	800

Workpiece Material Group	Examples	Milling Type	Tool Diameter								
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1
			Inches/Tooth								
Non-Ferrous	N	Slotting	.003-.004	.004-.006	.004-.008	.006-.009	.007-.012	.010-.045	.015-.040	.015-.040	.015-.040
		Profile Milling	.0012	.0018	.0025	.0032	.0037	.0050	.0065	.0075	.0100

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Above 20,000 RPM, Tool Balancing Is Required.

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

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

Series 134/135/137 Metric

Workpiece Material Group	Examples	Coolant	Slotting					
			Small Radial Depth ==> Large Radial Depth					
			1 x Diameter Axial Depth					
			Profile Milling					
Max.	Type	25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
		SMM						
Non-Ferrous	N	Aluminum < 10% Si	305-610			610	495	305
		Aluminum > 10% Si	245-460			460	375	245
		Brass	150-275			900	230	155
		Plastics	245-365			365	320	245

Workpiece Material Group	Examples	Milling Type	Tool Diameter(mm)								
			3	5	6	8	10	14	16	18	25
			mm/Tooth								
Non-Ferrous	N	Slotting	.076-.102	.102-.152	.102-.203	.152-.229	.178-.305	.254-1.143	.381-1.016	.381-1.016	.381-1.016
		Profile Milling	.030	.046	.064	.081	.094	.127	.165	.191	.254

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) New Feed per Tooth x Number of Teeth x RPM = mm/min. (mm per Minute)

Above 20,000 RPM, Tool Balancing Is Required.

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

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

Series 136/138 Inch



Workpiece Material Group	Examples	Coolant	Slotting					
			Small Radial Depth ==> Large Radial Depth					
			1 x Diameter Axial Depth					
			Profile Milling					
Max.	Type	25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
		SFM						
		Non-Ferrous	N	Aluminum < 10% Si	•	1400-2000	2000	1775
		Aluminum > 10% Si	•	1000-1500	1500	1310	1000	
		Brass	•	500-900	900	750	500	
		Plastics	•	800-1200	1200	1050	800	

Series 136/138 Metric

Workpiece Material Group	Examples	Coolant	Slotting					
			Small Radial Depth ==> Large Radial Depth					
			1 x Diameter Axial Depth					
			Profile Milling					
Max.	Type	25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
		SMM						
		Non-Ferrous	N	Aluminum < 10% Si	•	425-610	610	540
		Aluminum > 10% Si	•	305-460	460	400	305	
		Brass	•	150-275	275	230	150	
		Plastics	•	245-365	365	320	245	

Workpiece Material Group	Examples	Milling Type	Tool Diameter									
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
			Inches/Tooth									
Non-Ferrous	N	Aluminum / Aluminum Alloys < 10% Si	Slotting	.0024	.0036	.0050	.0064	.0074	.0100	.0120	.0140	.0200
		Aluminum / Aluminum Alloys > 10% Si		Profile Milling	.0012	.0018	.0025	.0032	.0037	.0050	.0065	.0075
		Brass										
		Plastics										

Workpiece Material Group	Examples	Milling Type	Tool Diameter(mm)									
			3	5	6	8	10	14	16	18	25	
			mm/Tooth									
Non-Ferrous	N	Aluminum / Aluminum Alloys < 10% Si	Slotting	.061	.091	.127	.163	.188	.254	.305	.356	.508
		Aluminum / Aluminum Alloys > 10% Si		Profile Milling	.030	.046	.064	.081	.094	.127	.165	.191
		Brass										
		Plastics										

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

- Example: Profile Milling**
- 1) Select Material from chart.
 - 2) Select Tool Size.
 - 3) Select feed per tooth.
 - 4) Figure percentage of cutter Diameter Radial Cut Depth.
 - 5) Select Chip Load Factor for Radial Depth.
 - 6) Multiply Chip Load Factor x Feed per Tooth.
 - 7) Answer: New Feed per Tooth.
 - 8) New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Above 20,000 RPM, Tool Balancing Is Required.

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

- Example: Profile Milling**
- 1) Select Material from chart.
 - 2) Select Tool Size.
 - 3) Select feed per tooth.
 - 4) Figure percentage of cutter Diameter Radial Cut Depth.
 - 5) Select Chip Load Factor for Radial Depth.
 - 6) Multiply Chip Load Factor x Feed per Tooth.
 - 7) Answer: New Feed per Tooth.
 - 8) New Feed per Tooth x Number of Teeth x RPM = mm/min. (mm per Minute)

Above 20,000 RPM, Tool Balancing Is Required.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

Series 135B/138B Inch

Workpiece Material Group	Examples	Coolant	Slotting						Contouring
			Small Radial Depth ==> Large Radial Depth						
			1 x Diameter Axial Depth						
			Profile Milling						
			25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
			SFM						
Non-Ferrous	N		Aluminum < 10% Si						
			Aluminum > 10% Si						
			Brass						
			Plastics						

Workpiece Material Group	Examples	Milling Type	Tool Diameter									
			1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
			Inches/Tooth									
Non-Ferrous	N	Slotting	.0024	.0036	.0050	.0064	.0074	.0100	.0120	.0140	.0200	
		Profile Milling	.0012	.0018	.0025	.0032	.0037	.0050	.0065	.0075	.0100	
		Contouring	.0024	.0036	.0050	.0064	.0074	.0100	.0120	.0140	.0200	

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Above 20,000 RPM, Tool Balancing Is Required.
If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

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

Series 135B/138B Metric

Workpiece Material Group	Examples	Coolant	Slotting						Contouring
			Small Radial Depth ==> Large Radial Depth						
			1 x Diameter Axial Depth						
			Profile Milling						
			25% Axial	50% Axial	100% Axial	10% of Dia.	25% of Dia.	50% of Dia.	
			SMM						
Non-Ferrous	N		Aluminum < 10% Si						
			Aluminum > 10% Si						
			Brass						
			Plastics						

Workpiece Material Group	Examples	Milling Type	Tool Diameter(mm)									
			3	5	6	8	10	14	16	18	25	
			mm/Tooth									
Non-Ferrous	N	Slotting	.061	.091	.127	.163	.188	.254	.305	.356	.508	
		Profile Milling	.030	.046	.064	.081	.094	.127	.165	.191	.254	
		Contouring	.061	.091	.127	.163	.188	.254	.305	.356	.508	

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) New Feed per Tooth x Number of Teeth x RPM = mm/min. (mm per Minute)

Above 20,000 RPM, Tool Balancing Is Required.
If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

Series 156 Inch

Workpiece Material Group	Examples	Tool Diameter	Maximum Cut		Tool Diameter															
					Decimal															
					% of Diameter		1/64	1/32	1/16	3/32	1/8	5/32	1/4	5/16	3/8	1/2				
					Axial Depth	Radial Depth	.0150	.0312	.0625	.0937	.1250	.1562	.2500	.3125	.3750	.5000				
Steels	P Plain Carbon/ Alloy & Tool Steels 30 - 40 Rc 4140/8620/P20	< 1/16	5%	20%	30,000	30,000	30,000													
			> 1/16	10%	20%				25,000	17,500	14,000	8,750	7,000	5,800	4,300					
Stainless Steels	M Ferritic/ Martensitic & PH Stainless < 40 Rc 416/420F/PH Stainless 15-5/ 17-4/17-4 H	< 1/16	5%	20%	30,000	30,000	30,000													
			> 1/16	10%	20%				25,000	17,500	14,000	8,750	7,000	5,800	4,300					
Hardened Steels	H Hardened Steels 40 - 45 Rc H13/D2/P20/ 4140/8620	< 1/16	5%	20%	30,000	30,000	23,500													
			> 1/16	10%	20%				22,000	14,500	11,500	7,250	5,800	4,800	3,625					
Hardened Steels	H Hardened Steels 45 - 55 Rc H13/D2/P20/ 4140/8620	< 1/16	5%	10%	30,000	30,000	23,500													
			> 1/16	5%	10%				20,000	12,000	9,600	6,000	4,800	4,000	3,000					
Hardened Steels	H Hardened Steels 55 - 60 Rc H13/D2/P20/ 4140/8620	< 1/16	5%	10%	30,000	30,000	15,000													
			> 1/16	5%	10%				10,000	7,000	5,600	3,500	2,800	2,300	1,750					

Series 156 Metric

Workpiece Material Group	Examples	Tool Diameter	Maximum Cut		Tool Diameter (mm)															
					Decimal															
					% of Diameter		.5	1	1.5	2	3	4	6	8	10	12				
					Axial Depth	Radial Depth	.0196	.0394	.0591	.0787	.1181	.1575	.2362	.3150	.3937	.4724				
Steels	P Plain Carbon/Alloy & Tool Steels 30 - 40 Rc 4140/8620/P20	< 1mm	5%	20%	30,000															
			> 1mm	10%	20%		30,000	30,000	25,000	17,500	14,000	8,750	7,000	5,800	4,300					
Stainless Steels	M Ferritic/Martensitic & PH Stainless < 40 Rc 416/420F/PH Stainless 15-5/ 17-4/17-4 H	< 1mm	5%	20%	30,000															
			> 1mm	10%	20%		30,000	30,000	25,000	17,500	14,000	8,750	7,000	5,800	4,300					
Hardened Steels	H Hardened Steels 40 - 45 Rc H13/D2 P20/4140/8620	< 1mm	5%	20%	30,000															
			> 1mm	10%	20%		30,000	23,500	22,000	14,500	11,500	7,250	5,800	4,800	3,625					
Hardened Steels	H Hardened Steels 45 - 55 Rc H13/D2 P20/4140/8620	< 1mm	5%	10%	30,000															
			> 1mm	5%	10%		30,000	23,500	20,000	12,000	9,600	6,000	4,800	4,000	3,000					
Hardened Steels	H Hardened Steels 55 - 60 Rc H13/D2 P20/4140/8620	< 1mm	5%	10%	30,000															
			> 1mm	5%	10%		30,000	15,000	10,000	7,000	5,600	3,500	2,800	2,300	1,750					

Workpiece Material Group	Examples	Tool Diameter	Tool Diameter																	
			Decimal																	
			1/64	1/32	1/16	3/32	1/8	5/32	1/4	5/16	3/8	1/2								
			.0150	.0312	.0625	.0937	.1250	.1562	.2500	.3125	.3750	.5000								
Steels	P Plain Carbon/ Alloy & Tool Steels 30 - 40 Rc 4140/8620/P20	< 1/16	20	27	62															
			> 1/16				84	94	120	140	168	125	140							
Stainless Steels	M Ferritic/ Martensitic & PH Stainless < 40 Rc 416/420F/PH Stainless 15-5/ 17-4/17-4 H	< 1/16	20	27	62															
			> 1/16				84	94	120	140	168	125	140							
Hardened Steels	H Hardened Steels 40 - 45 Rc H13/D2/P20/ 4140/8620	< 1/16	20	24	57															
			> 1/16				96	90	88	70	68	51	46							
Hardened Steels	H Hardened Steels 45 - 55 Rc H13/D2/P20/ 4140/8620	< 1/16	12	18	33															
			> 1/16				35	35	37	38	35	30	25							
Hardened Steels	H Hardened Steels 55 - 60 Rc H13/D2/P20/ 4140/8620	< 1/16	10	15	15															
			> 1/16				15	15	20	18	15	15	10							

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

Workpiece Material Group	Examples	Tool Diameter	Tool Diameter (mm)																	
			Decimal																	
			.5	1	1.5	2	3	4	6	8	10	12								
			.0196	.0394	.0591	.0787	.1181	.1575	.2362	.3150	.3937	.4724								
Steels	P Plain Carbon/Alloy & Tool Steels 30 - 40 Rc 4140/8620/P20	< 1mm	508																	
			> 1mm		683	1575	2133	2392	3050	3558	4267	3175	3558							
Stainless Steels	M Ferritic/Martensitic & PH Stainless < 40 Rc 416/420F/PH Stainless 15-5/ 17-4/17-4 H	< 1mm	508																	
			> 1mm		683	1575	2133	2392	3050	3558	4267	3175	3558							
Hardened Steels	H Hardened Steels 40 - 45 Rc H13/D2 P20/4140/8620	< 1mm	508																	
			> 1mm		608	1450	2442	2283	2233	1775	1725	1292	1167							
Hardened Steels	H Hardened Steels 45 - 55 Rc H13/D2 P20/4140/8620	< 1mm	308																	
			> 1mm		458	942	892	892	942	967	892	758	633							
Hardened Steels	H Hardened Steels 55 - 60 Rc H13/D2 P20/4140/8620	< 1mm	250																	
			> 1mm		383	383	383	383	508	458	383	383	250							

If axial depth is less than the ball diameter, the speed is figured using the effective cutting diameter.

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

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

Series 158 Inch

Cutting Conditions - Lower RPM/High Feed

Workpiece Material Group	Examples	Tool Overhang	Tool Diameter															
			.1181 X R .0315 (3.0 x R 0.8mm)				.2362 X R .059 (6.0 x R 1.5mm)				.315 X R .0787 (8.0 x R 2.0mm)				.3937 X R .0787 (10.0 x R 2.0mm)			
			Axial Depth	Radial Depth	RPM	IPM	Axial Depth	Radial Depth	RPM	IPM	Axial Depth	Radial Depth	RPM	IPM	Axial Depth	Radial Depth	RPM	IPM
Steels	P Cast Iron/ Carbon Steels/ Alloy Steels 150-250 HB	5 x D	.0094	.0275	8,000	239	.0170	.0590	4,000	264	.0236	.0787	3,000	264	.0236	.1180	2,400	264
		6 X D	.0085	.0275			.0159	.0590			.0210	.0787			.0212	.1180		
		7 X D	.0078	.0275			.0147	.0590			.0196	.0787			.0196	.1180		
		8 X D	.0072	.0275			.0135	.0590			.0181	.0787			.0181	.1180		
		9 X D	.0059	.0275			.0112	.0590			.0149	.0787			.0149	.1180		
10 X D	.0047	.0275	.0088	.0590	.0118	.0787	.0118	.1180										
Steels	P Tool Steels 25-35 Rc	5 x D	.0094	.0275	7,400	200	.0170	.0590	3,700	224	.0236	.0787	2,800	225	.0236	.1180	2,200	222
		6 X D	.0085	.0275			.0159	.0590			.0210	.0787			.0212	.1180		
		7 X D	.0078	.0275			.0147	.0590			.0196	.0787			.0196	.1180		
		8 X D	.0072	.0275			.0135	.0590			.0181	.0787			.0181	.1180		
		9 X D	.0059	.0275			.0112	.0590			.0149	.0787			.0149	.1180		
10 X D	.0047	.0275	.0088	.0590	.0118	.0787	.0118	.1180										
Hardened Steels	H Hardened Steels 35-45 Rc H13/D2/P20 4140/8620	5 x D	.0094	.0275	6,900	146	.0170	.0590	3,400	160	.0236	.0787	2,600	164	.0236	.1180	2,100	165
		6 X D	.0085	.0275			.0159	.0590			.0210	.0787			.0212	.1180		
		7 X D	.0078	.0275			.0147	.0590			.0196	.0787			.0196	.1180		
		8 X D	.0072	.0275			.0135	.0590			.0181	.0787			.0181	.1180		
		9 X D	.0059	.0275			.0112	.0590			.0149	.0787			.0149	.1180		
10 X D	.0047	.0275	.0088	.0590	.0118	.0787	.0118	.1180										
Hardened Steels	H Hardened Steels 45 - 55 Rc H13/D2/P20 4140/8620	5 x D	.0066	.0275	5,300	112	.0124	.0590	2,700	127	.0165	.0787	2,000	125	.0165	.1180	1,600	125
		6 X D	.0059	.0275			.0111	.0590			.0148	.0787			.0148	.1180		
		7 X D	.0055	.0275			.0103	.0590			.0137	.0787			.0137	.1180		
		8 X D	.0050	.0275			.0095	.0590			.0126	.0787			.0126	.1180		
		9 X D	.0041	.0275			.0078	.0590			.0104	.0787			.0104	.1180		
10 X D	.0033	.0275	.0062	.0590	.0082	.0787	.0082	.1180										
Hardened Steels	H Hardened Steels 55-60 Rc H13/D2/P20 4140/8620	5 x D	.0047	.0275	5,300	45	.0088	.0590	2,700	50	.0118	.0787	2,000	50	.0118	.1180	1,600	50
		6 X D	.0042	.0275			.0079	.0590			.0106	.0787			.0106	.1180		
		7 X D	.0039	.0275			.0073	.0590			.0098	.0787			.0098	.1180		
		8 X D	.0036	.0275			.0067	.0590			.0090	.0787			.0090	.1180		
		9 X D	.0029	.0275			.0056	.0590			.0074	.0787			.0074	.1180		
10 X D	.0023	.0275	.0044	.0590	.0059	.0787	.0059	.1180										



Series 158 Inch Continued

Cutting Conditions - Lower RPM/High Feed

Workpiece Material Group	Examples	Tool Overhang	Tool Diameter											
			.4724 X R .0787 (12.0 x R 2.0mm)				.6299 X R .1181 (16.0 x R 3.0mm)				.7874 X R .1181 (20.0 x R 3.0mm)			
			Axial Depth	Radial Depth	RPM	IPM	Axial Depth	Radial Depth	RPM	IPM	Axial Depth	Radial Depth	RPM	IPM
Steels	P Cast Iron/ Carbon Steels/ Alloy Steels 150-250 HB	5 x D	.0236	.1574	2,000	250	.0354	.1968	1,500	210	.0354	.2755	1,200	172
		6 X D	.0212	.1574			.0318	.1968			.0318	.2755		
		7 X D	.0196	.1574			.0295	.1968			.0295	.2755		
		8 X D	.0181	.1574			.0271	.1968			.0271	.2755		
		9 X D	.0149	.1574			.0224	.1968			.0224	.2755		
10 X D	.0118	.1574	.0177	.1968	.0177	.2755								
Steels	P Tool Steels 25-35 Rc	5 x D	.0236	.1574	1,900	218	.0354	.1968	1,400	180	.0354	.2755	1,100	144
		6 X D	.0212	.1574			.0318	.1968			.0318	.2755		
		7 X D	.0196	.1574			.0295	.1968			.0295	.2755		
		8 X D	.0181	.1574			.0271	.1968			.0271	.2755		
		9 X D	.0149	.1574			.0224	.1968			.0224	.2755		
10 X D	.0118	.1574	.0177	.1968	.0177	.2755								
Hardened Steels	H Hardened Steels 35-45 Rc H13/D2/P20 4140/8620	5 x D	.0236	.1574	1,700	153	.0354	.1968	1,300	131	.0354	.2755	1,000	102
		6 X D	.0212	.1574			.0318	.1968			.0318	.2755		
		7 X D	.0196	.1574			.0295	.1968			.0295	.2755		
		8 X D	.0181	.1574			.0271	.1968			.0271	.2755		
		9 X D	.0149	.1574			.0224	.1968			.0224	.2755		
10 X D	.0118	.1574	.0177	.1968	.0177	.2755								
Hardened Steels	H Hardened Steels 45 - 55 Rc H13/D2/P20 4140/8620	5 x D	.0165	.1574	1,300	116	.0248	.1968	1,000	100	.0248	.2755	800	82
		6 X D	.0148	.1574			.0223	.1968			.0223	.2755		
		7 X D	.0137	.1574			.0206	.1968			.0206	.2755		
		8 X D	.0126	.1574			.0190	.1968			.0190	.2755		
		9 X D	.0104	.1574			.0157	.1968			.0157	.2755		
10 X D	.0082	.1574	.0124	.1968	.0124	.2755								
Hardened Steels	H Hardened Steels 55-60 Rc H13/D2/P20 4140/8620	5 x D	.0118	.1574	1,300	47	.0177	.1968	1,000	40	.0177	.2755	800	32
		6 X D	.0106	.1574			.0159	.1968			.0159	.2755		
		7 X D	.0098	.1574			.0147	.1968			.0147	.2755		
		8 X D	.0090	.1574			.0135	.1968			.0135	.2755		
		9 X D	.0074	.1574			.0112	.1968			.0112	.2755		
10 X D	.0059	.1574	.0088	.1968	.0088	.2755								

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Series 158 Metric

Cutting Conditions - Lower RPM/High Feed

Workpiece Material Group	Examples	Tool Overhang	Tool Diameter(mm)															
			3.0 x R 0.8				6.0 x R 1.5				8.0 x R 2.0				10.0 x R 2.0			
			Axial Depth	Radial Depth	RPM	mm/min.	Axial Depth	Radial Depth	RPM	mm/min.	Axial Depth	Radial Depth	RPM	mm/min.	Axial Depth	Radial Depth	RPM	mm/min.
Steels P	Cast Iron/ Carbon Steels/ Alloy Steels 150-250 HB	5 x D	0.24	0.7	8,000	6,080	0.45	1.5	4,000	6700	0.60	2.0	3,000	6,700	0.60	3.0	2,400	6,700
		6 X D	0.22	0.7			0.41	1.5			0.54	2.0			0.54	3.0		
		7 X D	0.20	0.7			0.38	1.5			0.50	2.0			0.50	3.0		
		8 X D	0.18	0.7			0.35	1.5			0.46	2.0			0.46	3.0		
		9 X D	0.15	0.7			0.29	1.5			0.38	2.0			0.38	3.0		
		10 X D	0.12	0.7			0.23	1.5			0.30	2.0			0.30	3.0		
Steels P	Tool Steels 25-35 Rc	5 x D	0.24	0.7	7,400	5,100	0.45	1.5	3,700	5670	0.60	2.0	2,800	5,725	0.60	3.0	2,200	5,620
		6 X D	0.22	0.7			0.41	1.5			0.54	2.0			0.54	3.0		
		7 X D	0.20	0.7			0.38	1.5			0.50	2.0			0.50	3.0		
		8 X D	0.18	0.7			0.35	1.5			0.46	2.0			0.46	3.0		
		9 X D	0.15	0.7			0.29	1.5			0.38	2.0			0.38	3.0		
		10 X D	0.12	0.7			0.23	1.5			0.30	2.0			0.30	3.0		
Hardened Steels H	Hardened Steels 35-45 Rc H13/D2/P20 4140/8620	5 x D	0.24	0.7	6,900	3,720	0.45	1.5	3,400	4050	0.60	2.0	2,600	4,150	0.60	3.0	2,100	4,200
		6 X D	0.22	0.7			0.41	1.5			0.54	2.0			0.54	3.0		
		7 X D	0.20	0.7			0.38	1.5			0.50	2.0			0.50	3.0		
		8 X D	0.18	0.7			0.35	1.5			0.46	2.0			0.46	3.0		
		9 X D	0.15	0.7			0.29	1.5			0.38	2.0			0.38	3.0		
		10 X D	0.12	0.7			0.23	1.5			0.30	2.0			0.30	3.0		
Hardened Steels H	Hardened Steels 45 - 55 Rc H13/D2/P20 4140/8620	5 x D	0.17	0.7	5,300	2,850	0.32	1.5	2,700	3230	0.42	2.0	2,000	3,190	0.42	3.0	1,600	3,190
		6 X D	0.15	0.7			0.28	1.5			0.38	2.0			0.38	3.0		
		7 X D	0.14	0.7			0.26	1.5			0.35	2.0			0.35	3.0		
		8 X D	0.13	0.7			0.24	1.5			0.32	2.0			0.32	3.0		
		9 X D	0.11	0.7			0.20	1.5			0.27	2.0			0.27	3.0		
		10 X D	0.08	0.7			0.16	1.5			0.21	2.0			0.21	3.0		
Hardened Steels H	Hardened Steels 55-60 Rc H13/D2/P20 4140/8620	5 x D	0.12	0.7	5,300	1,130	0.23	1.5	2,700	1295	0.30	2.0	2,000	1,275	0.30	3.0	1,600	1,275
		6 X D	0.11	0.7			0.20	1.5			0.27	2.0			0.27	3.0		
		7 X D	0.10	0.7			0.19	1.5			0.25	2.0			0.25	3.0		
		8 X D	0.09	0.7			0.17	1.5			0.23	2.0			0.23	3.0		
		9 X D	0.08	0.7			0.14	1.5			0.19	2.0			0.19	3.0		
		10 X D	0.06	0.7			0.11	1.5			0.15	2.0			0.15	3.0		

Series 158 Metric Continued

Cutting Conditions - Lower RPM/High Feed

Workpiece Material Group	Examples	Tool Overhang	Tool Diameter(mm)											
			12.0 x R 2.0				16.0 x R 3.0				20.0 x R 3.0			
			Axial Depth	Radial Depth	RPM	mm/min.	Axial Depth	Radial Depth	RPM	mm/min.	Axial Depth	Radial Depth	RPM	mm/min.
Steels P	Cast Iron/ Carbon Steels/ Alloy Steels 150-250 HB	5 x D	0.60	4.0	2,000	6,350	0.90	5.0	1,500	5,350	0.90	7.0	1,200	4,360
		6 X D	0.54	4.0			0.81	5.0			0.81	7.0		
		7 X D	0.50	4.0			0.75	5.0			0.75	7.0		
		8 X D	0.46	4.0			0.69	5.0			0.69	7.0		
		9 X D	0.38	4.0			0.57	5.0			0.57	7.0		
		10 X D	0.30	4.0			0.45	5.0			0.45	7.0		
Steels P	Tool Steels 25-35 Rc	5 x D	0.60	4.0	1,900	5,530	0.90	5.0	1,400	4,580	0.90	7.0	1,100	3,650
		6 X D	0.54	4.0			0.81	5.0			0.81	7.0		
		7 X D	0.50	4.0			0.75	5.0			0.75	7.0		
		8 X D	0.46	4.0			0.69	5.0			0.69	7.0		
		9 X D	0.38	4.0			0.57	5.0			0.57	7.0		
		10 X D	0.30	4.0			0.45	5.0			0.45	7.0		
Hardened Steels H	Hardened Steels 35-45 Rc H13/D2/P20 4140/8620	5 x D	0.60	4.0	1,700	3,875	0.90	5.0	1,300	3,325	0.90	7.0	1,000	2,595
		6 X D	0.54	4.0			0.81	5.0			0.81	7.0		
		7 X D	0.50	4.0			0.75	5.0			0.75	7.0		
		8 X D	0.46	4.0			0.69	5.0			0.69	7.0		
		9 X D	0.38	4.0			0.57	5.0			0.57	7.0		
		10 X D	0.30	4.0			0.45	5.0			0.45	7.0		
Hardened Steels H	Hardened Steels 45 - 55 Rc H13/D2/P20 4140/8620	5 x D	0.42	4.0	1,300	2,950	0.63	5.0	1,000	2,550	0.63	7.0	800	2,070
		6 X D	0.38	4.0			0.57	5.0			0.57	7.0		
		7 X D	0.35	4.0			0.53	5.0			0.53	7.0		
		8 X D	0.32	4.0			0.48	5.0			0.48	7.0		
		9 X D	0.27	4.0			0.40	5.0			0.40	7.0		
		10 X D	0.21	4.0			0.32	5.0			0.32	7.0		
Hardened Steels H	Hardened Steels 55-60 Rc H13/D2/P20 4140/8620	5 x D	0.30	4.0	1,300	1,185	0.45	5.0	1,000	1,000	0.45	7.0	800	825
		6 X D	0.27	4.0			0.41	5.0			0.41	7.0		
		7 X D	0.25	4.0			0.38	5.0			0.38	7.0		
		8 X D	0.23	4.0			0.35	5.0			0.35	7.0		
		9 X D	0.19	4.0			0.29	5.0			0.29	7.0		
		10 X D	0.15	4.0			0.23	5.0			0.23	7.0		

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Series 172/174/175/176 Inch

Series 172, 174 Recommended for Slotting
Series 175, 176 Recommended for Profile Milling

Workpiece Material Group	Examples	Coolant		Slotting					Profile Milling			
		Air	Max	30% Axial	40% Axial	50% Axial	75% Axial	100% Axial	10% Radial	25% Radial	50% Radial	
				SFM								
Steels	P	Alloy & Tool Steels 4140/P20/H13	•	•	350	335	320	285	250	350	320	250
Stainless Steels	M	Free Machining	•		400	385	370	335	300	400	370	300
		Austenitic 303/304/316	•		300	285	270	235	200	300	270	200
		Ferritic 416F/420F	•		250	235	220	185	150	250	220	150
		Martensitic 403/410/416	•		250	190	185	160	150	250	185	150
		Precipitation Hardened 13-8,15-5	•		200	185	170	135	100	200	170	100
Special Alloys	S	Titanium 6AL-4V	•		260	245	230	195	160	260	230	160
		Inconel 625/718 Stellite/Haynes 25/188 Incoloy 800/Multimet	•		200	185	170	135	100	200	170	100

Workpiece Material Group	Examples	Tool Diameter					
		Decimal					
		1/8	1/4	1/2	3/4	1	
Steels	P	Alloy & Tool Steels 4140/P20/H13	.0005	.0015	.0025	.0035	.0050
Stainless Steels	M	Free Machining	.0005-.0007	.0010	.0030	.0050	.0060
		Austenitic 303/304/316	.0003-.0008	.001-.002	.0010-.0030	.0025-.0050	.0040-.0080
		Ferritic 416F/420F	.0002-.0005	.0005-.0010	.0007-.0015	.0015-.0030	.0030-.0050
		Martensitic 403/410/416	.0003-.0008	.0010-.0020	.0010-.0030	.0025-.0050	.0040-.0080
		Precipitation Hardened 13-8/15-5	.0002-.0005	.0005-.0010	.0007-.0015	.0015-.0030	.0030-.0050
Special Alloys	S	Titanium 6AL-4V	.00015-.0003	.0003-.0005	.0005-.0010	.0010-.0020	.0020-.0040
		Inconel 625/718 Stellite Haynes 25/188 Incoloy 800 Multimet	.0005-.0007	.0005-.0010	.0010-.0020	.0020-.0030	.0030-.0040

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Series 172/174/175/176 Metric

Series 172, 174 Recommended for Slotting
Series 175, 176 Recommended for Profile Milling

Workpiece Material Group	Examples	Coolant		Slotting					Profile Milling			
		Air	Max	30% Axial	40% Axial	50% Axial	75% Axial	100% Axial	10% Radial	25% Radial	50% Radial	
				SMM								
Steels	P	Alloy & Tool Steels 4140/P20/H13	•	•	105	100	95	85	75	105	95	75
Stainless Steels	M	Free Machining	•		120	115	110	100	90	120	110	90
		Austenitic 303/304/316	•		90	85	80	70	60	90	80	60
		Ferritic 416F/420F	•		75	70	65	55	45	75	65	45
		Martensitic 403/410/416	•		75	55	55	50	45	75	55	45
		Precipitation Hardened 13-8/15-5	•		60	55	50	40	30	60	50	30
Special Alloys	S	Titanium 6AL-4V	•		80	75	70	60	50	80	70	50
		Inconel 625/718 Stellite/Haynes 25/188 Incoloy 800/Multimet	•		60	55	50	40	30	60	50	30

Workpiece Material Group	Examples	Tool Diameter (mm)					
		Decimal					
		3	6	12	19	25	
Steels	P	Alloy & Tool Steels 4140/P20/H13	.1181	.2362	.4724	.7480	.9842
Stainless Steels	M	Free Machining	.013-.018	0.025	0.076	0.127	0.152
		Austenitic 303/04/316	.008-.020	.025-.051	.025-.076	.064-.127	.102-.203
		Ferritic 416F/420F	.005-.013	.013-.025	.018-.038	.038-.076	.076-.127
		Martensitic 403/410/416	.008-.020	.025-.051	.025-.076	.064-.127	.102-.203
		Precipitation Hardened 13-8/15-5	.005-.013	.013-.025	.018-.038	.038-.076	.076-.127
Special Alloys	S	Titanium 6AL-4V	.003-.008	.008-.013	.013-.025	.025-.051	.051-.102
		Inconel 625/718 Stellite Haynes 25/188 Incoloy 800 Multimet	.013-.018	.013-.025	.025-.051	.051-.076	.076-.102

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

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Series 178 Inch

Workpiece Material Group	Examples	Coolant		1 x Diameter Axial Depth								
				Profiling								
		Type	Small Radial Depth			Large Radial Depth						
			1% of Dia.	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.	30% of Dia.	50% of Dia.			
Steels	P	Free Machining	•	•	•	2400	2250	2050	1850	1660	1260	500
		Low Carbon	•	•	•	2400	2250	2050	1850	1660	1260	500
		Medium Carbon	•	•	•	1100	1030	950	875	790	620	300
		Alloy Steels	•	•	•	500	480	450	430	400	350	250
		High Strength Alloys	•	•	•	500	480	450	430	400	350	250
		Structural Steels	•	•	•	2400	2250	2050	1850	1660	1260	500
		Die/Tool Steels	•	•	•	400	390	380	370	360	300	200
Stainless Steels	M	Free Machining	•	x	o	500	485	460	450	430	380	300
		Moderate Stainless	•	x	o	500	390	380	370	360	320	250
		Difficult Stainless	•	x	o	350	330	320	300	295	260	200
		PH Stainless	•	x	o	250	245	240	235	230	195	125
		Cobalt Chrome Alloys	•	x	o	250	245	230	225	215	190	150
		Duplex (22%)	•	x	o	250	245	230	225	215	185	125
		Super Duplex (25%)	•	x	o	200	195	180	180	170	140	100
Special Alloys	S	High Temp Alloys	•	x	x	250	240	220	215	200	180	150
		Titanium Alloys	•	x	x	425	400	380	350	325	275	175
Cast Irons	K	Gray Cast Iron	•	o	o	1500	1420	1315	1210	1100	860	400
		SG Iron	•	o	o	1200	1130	1050	980	900	710	350
		Ductile Cast Iron	•	o	o	500	485	460	450	430	380	300
Malleable Iron	•	o	o	400	385	375	360	345	330	300		

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:
Calculated Feed x Spindle Max.
Calculated Speed

• Preferred
o Possible
x Not Possible

Series 178 Metric

Workpiece Material Group	Examples	Coolant		1 x Diameter Axial Depth								
				Profiling								
		Type	Small Radial Depth			Large Radial Depth						
			1% of Dia.	5% of Dia.	10% of Dia.	15% of Dia.	20% of Dia.	30% of Dia.	50% of Dia.			
Steels	P	Free Machining	•	•	•	730	685	620	565	500	380	150
		Low Carbon	•	•	•	730	685	620	565	500	380	150
		Medium Carbon	•	•	•	335	310	290	260	240	180	90
		Alloy Steels	•	•	•	150	140	130	130	120	105	75
		High Strength Alloys	•	•	•	150	140	130	130	120	105	75
		Structural Steels	•	•	•	730	685	620	565	500	380	150
		Die/Tool Steels	•	•	•	120	115	115	110	110	90	60
Stainless Steels	M	Free Machining	•	x	o	150	145	140	135	130	115	90
		Moderate Stainless	•	x	o	150	115	115	110	105	95	75
		Difficult Stainless	•	x	o	105	100	95	90	90	75	60
		PH Stainless	•	x	o	75	75	75	70	70	60	40
		Cobalt Chrome Alloys	•	x	o	75	75	75	70	70	60	45
		Duplex (22%)	•	x	o	75	75	75	70	70	60	40
		Super Duplex (25%)	•	x	o	60	60	55	55	50	45	30
Special Alloys	S	High Temp Alloys	•	x	x	75	75	75	70	60	55	45
		Titanium Alloys	•	x	x	125	120	115	105	100	80	55
Cast Irons	K	Gray Cast Iron	•	o	o	450	430	400	360	335	250	120
		SG Iron	•	o	o	365	345	320	295	275	215	105
		Ductile Cast Iron	•	o	o	150	145	140	130	130	115	90
Malleable Iron	•	o	o	120	115	110	105	105	100	90		

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:
Calculated Feed x Spindle Max.
Calculated Speed

• Preferred
o Possible
x Not Possible

Workpiece Material Group	Examples	Tool Diameter										
		1/16	1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1.0	
Steels	P	Free Machining										
		Low Carbon										
		Medium Carbon										
		Alloy Steels	.0002	.0004	.0007	.0010-.0016	.0013-.0021	.0016-.0026	.0020-.0031	.0026-.0033	.0031-.0035	.0035-.0051
		High Strength Alloys										
		Structural Steels										
Stainless Steels	M	Free Machining										
		Moderate Stainless										
		Difficult Stainless										
		PH Stainless										
		Cobalt Chrome Alloys	.0002	.0004	.0007	.0010-.0016	.0012-.0021	.0012-.0026	.0020-.0031	.0020-.0033	.0022-.0035	.0024-.0039
		Duplex (22%)										
		Super Duplex (25%)										
Special Alloys	S	Titanium Alloys										
		High Temp Alloys	.0001	.0002	.0008	.0005-.0008	.0007-.0011	.0007-.0013	.0010-.0016	.0010-.0017	.0011-.0018	.0012-.0020
Cast Irons	K	Gray Cast Iron										
		SG Iron	.0002	.0004	.0007	.0007-.0016	.0010-.0022	.0015-.0028	.0018-.0033	.0024-.0035	.0028-.0039	.0024-.0050
		Ductile Cast Iron										
Malleable Iron												

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Workpiece Material Group	Examples	Tool Diameter (mm)										
		1	3	4	6	8	10	12	16	18	25	
Steels	P	Free Machining										
		Low Carbon										
		Medium Carbon										
		Alloy Steels	.005	.010	.017	.025-.040	.033-.053	.040	.066	.066-.083	.078-.088	.088-.129
		High Strength Alloys										
		Structural Steels										
Stainless Steels	M	Free Machining										
		Moderate Stainless										
		Difficult Stainless										
		PH Stainless										
		Cobalt Chrome Alloys	.005	.010	.017	.025-.040	.033-.053	.040	.066	.066-.083	.078-.088	.088-.129
		Duplex (22%)										
		Super Duplex (25%)										
Special Alloys	S	Titanium Alloys										
		High Temp Alloys	.002	.005	.020	.012-.020	.017-.027	.017-.033	.025-.040	.025-.043	.027-.045	.030-.050
Cast Irons	K	Gray Cast Iron										
		SG Iron	.005	.010	.017	.017-.040	.025-.055	.038-.071	.045-.083	.060-.088	.071-.099	.060-.127
		Ductile Cast Iron										
Malleable Iron												

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
50%	1.00
30%	1.10
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) RPM x New Feed per Tooth x number of Teeth = mm/min. (mm per Minute)

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

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Series 180 Inch

Workpiece Material Group	Examples	Coolant		1 x Diameter Axial Depth								
				Profiling								
		Air	MMS	Small Radial Depth =====> Large Radial Depth								
1% of Dia.	5% of Dia.			10% of Dia.	15% of Dia.	20% of Dia.						
Steels	P	Free Machining	•	•	•	•	•	2400	2250	2050	1850	1660
		Low Carbon	•	•	•	•	•	2400	2250	2050	1850	1660
		Medium Carbon	•	•	•	•	•	1100	1030	950	875	790
		Alloy Steels	•	•	•	•	•	500	480	450	430	400
		High Strength Alloys	•	•	•	•	•	500	480	450	430	400
		Structural Steels	•	•	•	•	•	2400	2250	2050	1850	1660
		Die/Tool Steels	•	•	•	•	•	400	390	380	370	360
Stainless Steels	M	Free Machining	•	x	o	o	o	500	485	460	450	430
		Moderate Stainless	•	x	o	o	o	500	390	380	370	360
		Difficult Stainless	•	x	o	o	o	350	330	320	300	295
		PH Stainless	•	x	o	o	o	250	245	240	235	230
		Cobalt Chrome Alloys	•	x	o	o	o	250	245	230	225	215
		Duplex (22%)	•	x	o	o	o	250	245	230	225	215
		Super Duplex (25%)	•	x	o	o	o	200	195	180	180	170
Special Alloys	S	High Temp Alloys	•	x	x	o	o	250	240	220	215	200
		Titanium Alloys	•	x	x	o	o	425	400	380	350	325
Cast Irons	K	Gray Cast Iron	•	o	o	o	o	1500	1420	1315	1210	1100
		SG Iron	•	o	o	o	o	1200	1130	1050	980	900
		Ductile Cast Iron	•	o	o	o	o	500	485	460	450	430
		Malleable Iron	•	o	o	o	o	400	385	375	360	345

• Preferred
o Possible
x Not Possible

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

Calculated Speed

Series 180 Metric

Workpiece Material Group	Examples	Coolant		1 x Diameter Axial Depth								
				Profiling								
		Air	MMS	Small Radial Depth =====> Large Radial Depth								
1% of Dia.	5% of Dia.			10% of Dia.	15% of Dia.	20% of Dia.						
Steels	P	Free Machining	•	•	•	•	•	730	685	625	565	505
		Low Carbon	•	•	•	•	•	730	685	625	565	505
		Medium Carbon	•	•	•	•	•	335	310	290	265	240
		Alloy Steels	•	•	•	•	•	150	145	135	130	120
		High Strength Alloys	•	•	•	•	•	150	145	135	130	120
		Structural Steels	•	•	•	•	•	730	685	625	565	505
		Die/Tool Steels	•	•	•	•	•	120	115	115	110	110
Stainless Steels	M	Free Machining	•	x	o	o	o	150	145	140	135	130
		Moderate Stainless	•	x	o	o	o	150	115	115	110	105
		Difficult Stainless	•	x	o	o	o	105	100	95	90	90
		PH Stainless	•	x	o	o	o	75	75	75	70	70
		Cobalt Chrome Alloys	•	x	o	o	o	75	75	70	65	65
		Duplex (22%)	•	x	o	o	o	75	75	70	65	65
		Super Duplex (25%)	•	x	o	o	o	60	60	55	55	50
Special Alloys	S	High Temp Alloys	•	x	x	o	o	75	75	70	65	60
		Titanium Alloys	•	x	x	o	o	130	120	115	105	100
Cast Irons	K	Gray Cast Iron	•	o	o	o	o	455	430	400	365	335
		SG Iron	•	o	o	o	o	365	345	320	295	275
		Ductile Cast Iron	•	o	o	o	o	150	145	140	135	130
		Malleable Iron	•	o	o	o	o	120	115	115	110	105

• Preferred
o Possible
x Not Possible

Spindle Max.
Should the Calculated Spindle Speed be more than your actual Spindle Max., Use Formula Below:

$$\frac{\text{Calculated Feed} \times \text{Spindle Max.}}{\text{Calculated Speed}}$$

Calculated Speed

Workpiece Material Group	Examples	Tool Diameter				
		1/2	5/8	3/4	1.0	
Steels	P	Free Machining	.0020-	.0026-	.0031-	.0035-
		Low Carbon	.0031	.0033	.0035	.0051
		Medium Carbon				
		Alloy Steels				
		High Strength Alloys				
		Structural Steels				
Stainless Steels	M	Free Machining	.0020-	.0020-	.0022-	.0024-
		Moderate Stainless	.0031	.0033	.0035	.0039
		Difficult Stainless				
		PH Stainless				
		Cobalt Chrome Alloys				
		Duplex (22%)				
		Super Duplex (25%)				
Special Alloys	S	Titanium Alloys				
		High Temp Alloys	.0010-	.0010-	.0011-	.0012-
Cast Irons	K	Gray Cast Iron	.0018-	.0024-	.0028-	.0024-
		SG Iron	.0033	.0035	.0039	.0050
		Ductile Cast Iron				
		Malleable Iron				

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) New Feed per Tooth x Number of Teeth x RPM = IPM (Inches per Minute)

Workpiece Material Group	Examples	Tool Diameter (mm)				
		12	16	18	25	
Steels	P	Free Machining	.050-	.066-	.078-	.088-
		Low Carbon	.078	.083	.088	.129
		Medium Carbon				
		Alloy Steels				
		High Strength Alloys				
		Structural Steels				
Stainless Steels	M	Free Machining	.050-	.050-	.055-	.060-
		Moderate Stainless	.078	.083	.088	.099
		Difficult Stainless				
		PH Stainless				
		Cobalt Chrome Alloys				
		Duplex (22%)				
		Super Duplex (25%)				
Special Alloys	S	Titanium Alloys				
		High Temp Alloys	.025-	.025-	.027-	.030-
Cast Irons	K	Gray Cast Iron	.045-	.060-	.071-	.060-
		SG Iron	.083	.088	.099	.127
		Ductile Cast Iron				
		Malleable Iron				

During Profile Milling less than 50% of the cutter diameter radial depth, the actual chipload at the cutting edge is less than the programmed chip load. Below are Chip Load factors depending on Radial Depth Percentage. Multiply your inches per tooth by the factor before figuring your IPM.

Radial Depth in Percentage of Cutter Diameter	Increase Chip Load Factor
20%	1.20
15%	1.40
10%	1.80
5%	2.30
1%	5.00

Example: Profile Milling

- 1) Select Material from chart.
- 2) Select Tool Size.
- 3) Select feed per tooth.
- 4) Figure percentage of cutter Diameter Radial Cut Depth.
- 5) Select Chip Load Factor for Radial Depth.
- 6) Multiply Chip Load Factor x Feed per Tooth.
- 7) Answer: New Feed per Tooth.
- 8) RPM x New Feed per Tooth x number of Teeth = mm/min. (mm per Minute)

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Series 192 Inch

Workpiece Material Group		Examples	SFM
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	450-500
		Steel - Mild (.4-.5 Carbon) 4140	250-300
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	125-250
Cast Irons	K	Iron - Cast (Soft)	450-600
		Iron - Cast (Medium Hard)	300-400
		Iron - Cast (Hard Chilled)	250-300
		Iron (Malleable)	225-300

Workpiece Material Group		Examples	SFM
Stainless Steels	M	Stainless Steel Free Machining	200-300
		Austenitic Stainless 304/316	180-225
		Ferritic	200-275
		Martensitic	150-200
Special Alloys	S	PH Stainless 17-4 PH	125-200
		Titanium 6AL-4V	175-375
		Cobalt-Based Alloys Stellite	80-125
		Nickel-Based Alloys Inconel 625/718	80-125
		Iron-Based Alloys Incoloy 800-802	80-125
Hardened Steels	H	Hardened Steels 35-45 Rc	200-250
		Hardened Steels 45-55 Rc	150-200

Series 192 Metric

Workpiece Material Group		Examples	SMM
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	135-150
		Steel - Mild (.4-.5 Carbon) 4140	75-90
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	40-75
Cast Irons	K	Iron - Cast (Soft)	135-185
		Iron - Cast (Medium Hard)	90-120
		Iron (Hard Chilled)	75-90
		Iron (Malleable)	70-90
Stainless Steels	M	Stainless Steel Free Machining	60-90
		Austenitic Stainless 304/316	55-70

Workpiece Material Group		Examples	SMM
Stainless Steels	M	Ferritic	60-85
		Martensitic	45-60
		PH Stainless 17-4 PH	40-60
Special Alloys	S	Titanium 6AL-4V	55-115
		Cobalt-Based Alloys Stellite	25-40
		Nickel-Based Alloys Inconel 625/718	25-40
		Iron-Based Alloys Incoloy 800-802	25-40
Hardened Steels	H	Hardened Steels 35-45 Rc	60-75
		Hardened Steels 45-55 Rc	45-60

Workpiece Material Group	Examples	Tool Diameter									
		1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Steel - Mild (.4-.5 Carbon) 4140	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Cast Irons	K	Iron - Cast (Soft)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Iron - Cast (Medium Hard)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Iron (Hard Chilled)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Iron (Malleable)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
Stainless Steels	M	Stainless Steel Free Machining Ferritic	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Austenitic Stainless 304/316	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
		Martensitic PH Stainless 17-4 PH	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Special Alloys	S	Titanium 6AL-4V	.0003-.0004	.0004-.0006	.0006-.0008	.0008-.0012	.0008-.0012	.0012-.0016	.0016-.0018	.0018-.0020	.0020-.0030
		Stellite Inconel 625/718 Incoloy 800-802	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
Hardened Steels	H	Hardened Steels 35-45 Rc	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
		Hardened Steels 45-55 Rc	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035

Workpiece Material Group	Examples	Tool Diameter (mm)									
		3	5	6	8	10	12	16	20	25	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Steel - Mild (.4-.5 Carbon) 4140	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
Cast Irons	K	Iron - Cast (Soft)	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Iron - Cast (Medium Hard)	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Iron (Hard Chilled)	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Iron (Malleable)	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
Stainless Steels	M	Stainless Steel Free Machining Ferritic	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.056-.076	.058-.102	.056-.109	.081-.127
		Austenitic Stainless 304/316 Martensitic PH Stainless 17-4 PH	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
Special Alloys	S	Titanium 6AL-4V	.008-.010	.010-.015	.015-.020	.020-.030	.020-.030	.030-.041	.041-.046	.046-.051	.051-.076
		Stellite Inconel 625/718 Incoloy 800-802	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.060-.081	.060-.081
Hardened Steels	H	Hardened Steels 35-45 Rc	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
		Hardened Steels 45-55 Rc	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089

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Series 198/199 Inch

Workpiece Material Group		Examples	SFM
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	100-350
		Steel - Mild (.4-.5 Carbon) 4140	100-160
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	
Cast Irons	K	Iron - Cast (Soft)	100-350
		Iron - Cast (Medium Hard)	100-200
		Iron (Hard Chilled)	100-150
		Iron (Malleable)	150-200
Stainless	M	Stainless Steel Free Machining	100-350
		Austenitic Stainless 304/316	100-150
		Ferritic	150-200
		Martensitic	80-175
		PH Stainless 17-4 PH	80-125

Workpiece Material Group		Examples	SFM
Special Alloys	S	Titanium 6AL-4V	100-175
		Cobalt-Based Alloys Stellite	80-125
		Nickel-Based Alloys Inconel 625/718 Iron-Based Alloys Incoloy 800-802	80-100
Hardened Steels	H	Hardened Steels 35-45 Rc Hardened Steels 45-55 Rc	100-150
		Hardened Steels 55-65 Rc	50-100
Non-Ferrous	N	Aluminum/Aluminum Alloys	500-700
		Brass/Bronze	400-600
		Magnesium/Magnesium Alloys	700-1000
		Plastics/Bakelite	200-500

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

Series 198/199 Metric

Workpiece Material Group		Examples	SMM
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	30-105
		Steel - Mild (.4-.5 Carbon) 4140	30-50
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	
Cast Irons	K	Iron - Cast (Soft)	30-105
		Iron - Cast (Medium Hard)	30-60
		Iron (Hard Chilled)	30-45
		Iron (Malleable)	45-60
Stainless Steels	M	Stainless Steel Free Machining	30-105
		Austenitic Stainless 304/316	30-45

Workpiece Material Group	Examples	SMM
Stainless Steels	Ferritic	45-60
	Martensitic	25-55
	PH Stainless 17-4 PH	25-40
Special Alloys	Titanium 6AL-4V	30-55
	Cobalt-Based Alloys Stellite	25-40
	Nickel-Based Alloys Inconel 625/718	25-30
	Iron-Based Alloys Incoloy 800-802	25-30
Hardened Steels	Hardened Steels 35-45 Rc Hardened Steels 45-55 Rc	30-45
	Hardened Steels 55-65 Rc	15-30
Non-Ferrous	Aluminum/Aluminum Alloys	150-215
	Brass/Bronze	120-185
	Magnesium/Magnesium Alloys	215-305
	Plastics/Bakelite	60-150

Workpiece Material Group	Examples	Tool Diameter									
		1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
		Inches/Tooth									
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.004	.0022-.0043	.0032-.0050
		Steel - Mild (.4-.5 Carbon) 4140									
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Cast Irons	K	Iron - Cast (Soft)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Iron - Cast (Medium Hard)									
		Iron (Hard Chilled) Iron (Malleable)									
Stainless Steels	M	Stainless Steel Free Machining Ferritic	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Austenitic Stainless 304/316									
		Martensitic PH Stainless 17-4 PH	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Special Alloys	S	Titanium 6AL-4V	.0003-.0004	.0004-.0006	.0006-.0008	.0008-.0012	.0008-.0012	.0012-.0016	.0016-.0018	.0018-.0020	.0020-.0030
		Stellite									
		Inconel 625/718 Incoloy 800-802	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
Hardened Steels	H	Hardened Steels 35-45 Rc									
		Hardened Steels 45-55 Rc	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
		Hardened Steels 55-65 Rc									
Non-Ferrous	N	Aluminum/Aluminum Alloys Brass/Bronze	.0008-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0035	.0035-.0050	.0050-.0080	.0075-.0095	.0085-.0100
		Magnesium/Magnesium Alloys Plastics/Bakelite									

Workpiece Material Group	Examples	Tool Diameter (mm)									
		3	5	6	8	10	12	16	20	25	
		mm/Tooth									
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Steel - Mild (.4-.5 Carbon) 4140									
		Tool Steels (1.2 carbon) A2/D2/H13/P20 Forgings	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.061-.081	.061-.081
Cast Irons	K	Iron - Cast (Soft)	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Iron - Cast (Medium Hard)									
		Iron (Hard Chilled) Iron (Malleable)									
Stainless Steels	M	Stainless Steel Free Machining Ferritic	.013-.020	.025-.030	.038-.051	.038-.064	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Austenitic Stainless 304/316									
		Martensitic PH Stainless 17-4 PH	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.061-.081	.061-.081
Special Alloys	S	Titanium 6AL-4V	.008-.010	.010-.015	.015-.020	.020-.030	.020-.030	.030-.041	.041-.046	.046-.051	.051-.076
		Stellite									
		Inconel 625/718 Incoloy 800-802	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
Hardened Steels	H	Hardened Steels 35-45 Rc									
		Hardened Steels 45-55 Rc	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
		Hardened Steels 55-65 Rc									
Non-Ferrous	N	Aluminum/Aluminum Alloys Brass/Bronze	.020-.038	.038-.051	.051-.064	.064-.076	.076-.089	.089-.127	.127-.203	.191-.241	.216-.254
		Magnesium/Magnesium Alloys Plastics/Bakelite									

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

General Purpose Technical Inch

Stub	2 Flute Series			3 Flute Series		4 Flute Series				
	164	166	162/168	169		163	165	117	167	161
Standard	121	150		116	145	111	140	151		
Long Length/Reach	123		183/186			122			181/184	

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

Workpiece Material Group	Examples	SFM	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	350-500
		Steel - Mild (.4-.5 Carbon) 4140	250-350
	K	Tool Steels (1.2 carbon) A2/D2/H13/P20	200-250
		Forgings	125-250
		Iron - Cast (Soft)	450-600
Cast Irons	K	Iron - Cast (Medium Hard)	300-400
		Iron (Hard Chilled)	250-300
	S	Iron (Malleable)	225-300

Workpiece Material Group	Examples	SFM	
Stainless Steels	M	Stainless Steel Free Machining	300-400
		Austenitic Stainless 304/316	180-225
		Ferritic	200-275
	S	Martensitic	150-200
		PH Stainless 17-4 PH	125-200
Special Alloys	S	Titanium 6AL-4V	175-375
		Cobalt-Based Alloys Stellite	100-200
	N	Nickel-Based Alloys Inconel 625/718	100-200
		Iron-Based Alloys Incoloy 800-802	125-200

Workpiece Material Group	Examples	SFM	
Hardened Steels	H	Hardened Steels 35-45 Rc	200-250
		Hardened Steels 45-55 Rc	150-200
		Hardened Steels 55-65 Rc	50-100
Non-Ferrous	N	Aluminum/Aluminum Alloys	500-700
		Brass/Bronze	400-600
	S	Magnesium/Magnesium Alloys	700-1000
		Plastics/Bakelite	800-1200

Bright Tool use low SFM.

ALtima® Coated use high SFM.

General Purpose Technical Metric

Stub	2 Flute Series			3 Flute Series		4 Flute Series				
	164	166	162/168	169		163	165	117	167	161
Standard	121	150		116	145	111	140	151		
Long Length/Reach	123		183/186			122			181/184	

Workpiece Material Group	Examples	SMM	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	105-150
		Steel - Mild (.4-.5 Carbon) 4140	75-105
	K	Tool Steels (1.2 carbon) A2/D2/H13/P20	60-75
		Forgings	40-75
		Iron - Cast (Soft)	140-185
Cast Irons	K	Iron - Cast (Medium Hard)	90-120
		Iron (Hard Chilled)	75-90
	S	Iron (Malleable)	70-90

Workpiece Material Group	Examples	SMM	
Stainless Steels	M	Stainless Steel Free Machining	90-120
		Austenitic Stainless 304/316	55-70
		Ferritic	60-85
	S	Martensitic	45-60
		PH Stainless 17-4 PH	40-60
Special Alloys	S	Titanium 6AL-4V	55-115
		Cobalt-Based Alloys Stellite	30-60
	N	Nickel-Based Alloys Inconel 625/718	30-60
		Iron-Based Alloys Incoloy 800-802	40-60

Workpiece Material Group	Examples	SMM	
Hardened Steels	H	Hardened Steels 35-45 Rc	60-75
		Hardened Steels 45-55 Rc	45-60
		Hardened Steels 55-65 Rc	15-30
Non-Ferrous	N	Aluminum/Aluminum Alloys	150-215
		Brass/Bronze	120-185
	S	Magnesium/Magnesium Alloys	215-305
		Plastics/Bakelite	245-365

Bright Tool use low SMM.

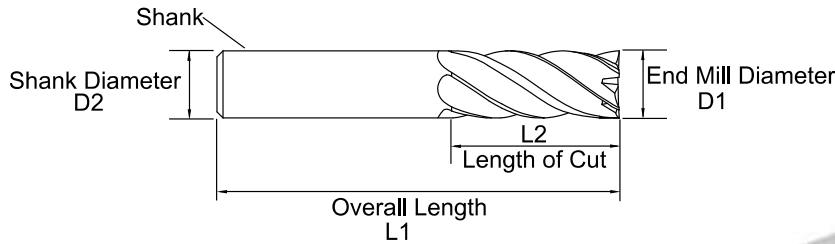
ALtima® Coated use high SMM.

Workpiece Material Group	Examples	Tool Diameter									
		Inches/Tooth									
		1/8	3/16	1/4	5/16	3/8	1/2	5/8	3/4	1	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Steel - Mild (.4-.5 Carbon) 4140	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
	K	Tool Steels (1.2 carbon) A2/D2/H13/P20	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Forgings		.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032	
Cast Irons	K	Iron - Cast (Soft)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Iron - Cast (Medium Hard)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
	S	Iron (Hard Chilled)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Iron (Malleable)	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
Stainless Steels	M	Stainless Steel Free Machining	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
		Ferritic	.0005-.0008	.0010-.0012	.0015-.0020	.0015-.0025	.0021-.0030	.0020-.0035	.0023-.0040	.0022-.0043	.0032-.0050
	S	Austenitic Stainless 304/316	.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032
Martensitic PH Stainless 17-4 PH		.0003-.0005	.0008-.0010	.0012-.0015	.0014-.0018	.0018-.0020	.0020-.0023	.0023-.0030	.0024-.0032	.0024-.0032	
Special Alloys	S	Titanium 6AL-4V	.0003-.0004	.0004-.0006	.0006-.0008	.0008-.0012	.0008-.0012	.0012-.0016	.0016-.0018	.0018-.0020	.0020-.0030
		Stellite Inconel 625/718 Incoloy 800-802	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
Hardened Steels	H	Hardened Steels 35-45 Rc	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
		Hardened Steels 45-55 Rc	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
		Hardened Steels 55-65 Rc	.0003-.0005	.0005-.0015	.0005-.0015	.0010-.0020	.0010-.0020	.0010-.0030	.0020-.0030	.0025-.0035	.0025-.0035
Non-Ferrous	N	Aluminum/Aluminum Alloys	.0008-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0035	.0035-.0050	.0075-.0095	.0085-.0100	
		Brass/Bronze	.0008-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0035	.0035-.0050	.0075-.0095	.0085-.0100	
		Magnesium/Magnesium Alloys	.0008-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0035	.0035-.0050	.0075-.0095	.0085-.0100	
		Plastics/Bakelite	.0008-.0015	.0015-.0020	.0020-.0025	.0025-.0030	.0030-.0035	.0035-.0050	.0075-.0095	.0085-.0100	

Workpiece Material Group	Examples	Tool Diameter (mm)									
		mm/Tooth									
		3	5	6	8	10	12	16	20	25	
Steels	P	Steel - Mild (.2-.3 Carbon) 1018	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Steel - Mild (.4-.5 Carbon) 4140	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
	K	Tool Steels (1.2 carbon) A2/D2/H13/P20	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.061-.081	.061-.081
Forgings		.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.061-.081	.061-.081	
Cast Irons	K	Iron - Cast (Soft)	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Iron - Cast (Medium Hard)	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
	S	Iron (Hard Chilled)	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Iron (Malleable)	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
Stainless Steels	M	Stainless Steel Free Machining	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
		Ferritic	.013-.020	.025-.030	.038-.051	.038-.051	.053-.076	.051-.089	.058-.102	.056-.109	.081-.127
	S	Austenitic Stainless 304/316	.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.061-.081	.061-.081
Martensitic PH Stainless 17-4 PH		.008-.013	.020-.025	.030-.038	.036-.046	.046-.051	.051-.058	.058-.076	.061-.081	.061-.081	
Special Alloys	S	Titanium 6AL-4V	.008-.010	.010-.015	.015-.020	.020-.030	.020-.030	.030-.041	.041-.046	.046-.051	.051-.076
		Stellite Inconel 625/718 Incoloy 800-802	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
Hardened Steels	H	Hardened Steels 35-45 Rc	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
		Hardened Steels 45-55 Rc	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
		Hardened Steels 55-65 Rc	.008-.013	.013-.038	.013-.038	.025-.051	.025-.051	.025-.076	.051-.076	.064-.089	.064-.089
Non-Ferrous	N	Aluminum/Aluminum Alloys	.020-.038	.038-.051	.051-.064	.064-.076	.076-.089	.089-.127	.127-.216	.191-.241	.216-.254
		Brass/Bronze	.020-.038	.038-.051	.051-.064	.064-.076	.076-.089	.089-.127	.127-.216	.191-.241	.216-.254
		Magnesium/Magnesium Alloys	.020-.038	.038-.051	.051-.064	.064-.076	.076-.089	.089-.127	.127-.216	.191-.241	.216-.254
		Plastics/Bakelite	.020-.038	.038-.051	.051-.064	.064-.076	.076-.089	.089-.127	.127-.216	.191-.241	.216-.254

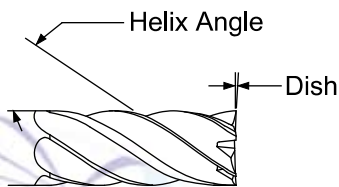
Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

End Mill Terminology

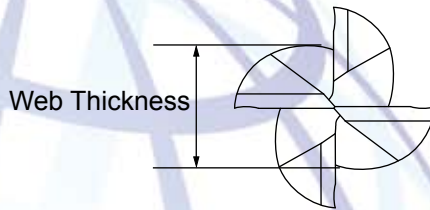


Length of Cut (Flute Length) – Always select the shortest Flute Length possible for your application. By selecting the shortest Flute Length, you can increase rigidity and allow for higher feed rates.

End Mill Diameter – Always select the largest diameter possible for your milling operation. Increasing your diameter by just 10%, can increase your rigidity by 25%.

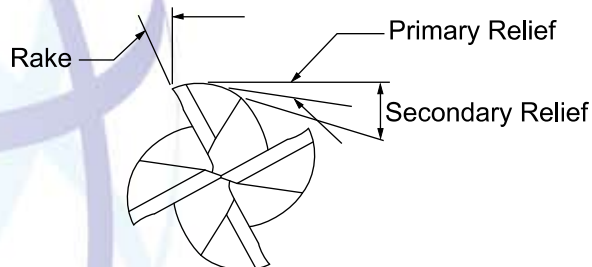


Helix Angle – Varies from 0 to 60 degrees. Higher helix angles can increase the number of teeth in a cut, and help in redirecting cutting forces. This is beneficial in harder to machine materials in particular. Changes in helix angle can also greatly affect the flute form of an end mill, and affect chip evacuation.



Web Thickness – The cross section of the fluting of the end mill. Larger webs allow for more rigidity, while smaller webs allow for better chip evacuation. This feature is highly dependent on the material being machined.

Rake Angle – The measurement of the curvature of the cutting edge in the face of the flute. A high rake angle will cut more aggressively, while a lower rake angle will increase the strength of the cutting edge.



Primary Relief – The clearance directly behind the cutting edge. High primary relief angles will allow for more aggressive milling, while lower relief angles will increase the strength of the cutting edge. The primary relief will also affect the wear on a cutting edge. Lower primary relief angles can tend to develop larger wear lands.