

High Performance Tools

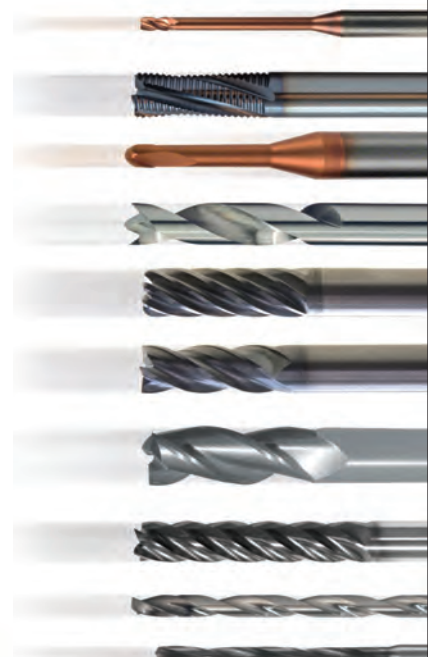
Metric Catalogue

TuffCut® X-AL

TuffCut® DM

TuffCut® XR-XT

Twister Drills



Innovation for Today's Industries

 **M.A.FORD**
High Performance Cutting Tools

ISO 9001:2008 Certified



At M.A.Ford®, we pride ourselves on being one of the world's premier manufacturers of high performance cutting tools. That's as true today as it was back in 1919 when Matthew A. Ford produced the first hand cut HSS rotary files made in America.

Whether it's engineering the exacting tolerances of the first circuit board drills, or developing the intricate geometries for application specific high performance cutting tools, such as Aero engine casings in Inconel 718, or Aluminium wing spars at 40 M/Min feed, our commitment to innovation, quality and professional service put us a cut above.

M.A.Ford has two modern solid carbide and HSS cutting tool manufacturing facilities located in Davenport, Iowa and Vero Beach, Florida, USA. Both plants employ a team concept that strives for improved response times, the highest quality tools, innovative ideas and cost reduction & control.

European markets are covered from our stock and distribution headquarters located in Derby, England, supported by factory trained technical field sales personnel.

M.A.Ford strives to keep ahead of market requirements for unique tooling technology and speciality coatings, by creating partnerships and joint ventures with worldwide market leaders.

M.A.Ford's ALtima® coating is produced by Miracle Tools America, an M.A.Ford subsidiary established with Mitsubishi Carbide and MMC Kobelco Tool. MMC Kobelco Tool licences the PVD technology to Miracle Tools America.

Nous sommes fiers chez M.A.Ford® d'être parmi les meilleurs fabricants d'outils coupants à haute performance sur le plan mondial. Ceci est aussi vrai aujourd'hui que ce l'était en 1919 quand Matthew A. Ford a fabriqué les premières limes rotatives en HSS taillées à la main en Amérique.

Que ce soit les tolérances exigeantes dans l'ingénierie de forets pour les premiers circuits imprimés, ou le développement de géométries très élaborées pour des outils coupants à haute performance dans des applications particulières telles que carters de réacteurs dans de l'Inconel, ou des envergures d'aile en Aluminium avec des avances de 40M/Min, notre engagement en matière d'innovation, de qualité et d'un service professionnel nous place dans une catégorie supérieure.

M.A.Ford possède deux installations modernes de fabrication d'outils de coupe en carbure et en HSS situées à Davenport, Iowa et Vero Beach, Floride, aux E-U. Les deux usines sont encadrées dans un concept d'équipe s'efforçant d'améliorer continuellement les temps de réponses, la meilleure qualité possible, des idées innovatrices, ainsi que la diminution et la maîtrise des coûts.

Les marchés européens, pour le stock et la distribution, sont gérés à partir de notre quartier général situé à Derby en Angleterre, avec l'appui d'un personnel technico-commercial formé en usine et sur le terrain.

M.A.Ford's effort de rester à l'avant-garde des exigences du marché en matière de technologie d'outillage unique et de revêtements spécialisés en créant des partenariats et des coentreprises avec des leaders du marché mondial.

Le revêtement ALtima® de M.A.Ford est fabriqué par Miracle Tools America, une succursale d' M.A.Ford établie conjointement avec Mitsubishi Carbide et MMC Kobelco Tool. La technologie PVD de Miracle Tools America provient sous licence de MMC Kobelco Tool.

Tool application guide

High Performance milling tools

Series	Page	No. of Flutes	Square End	Ball Nose	Corner Radius	Neck Relief	Rough / Finish	HSC	Available Coating	Steel (L)	Steel (S)	Harden	Austen	Predip	High Te	Titanium	Gray Cast	Ductile	Aluminum	Kevlar	Glass (C
113A	13	6	X				F	X	Altima®	■	■		■	■	■	■	■	■	■		
177	4	4	X				R/F	X	Altima®	■	■		■	■	■	■	■	■	■		
177LR	7	4			X	X	R/F	X	Altima®	■	■		■	■	■	■	■	■	■		
177R	5	4			X		R/F	X	Altima®	■	■		■	■	■	■	■	■	■		
177S	6	4	X		X	X	R/F	X	Altima®	■	■		■	■	■	■	■	■	■		
178	9	5	X				R/F	X	Altima®	■	■		■	■	■	■	■	■	■		
178R	10	5			X		R/F	X	Altima®	■	■		■	■	■	■	■	■	■		
178-1	10	5	X				R/F	X	Altima®	■	■		■	■	■	■	■	■	■		
179	11	4		X			R/F		Altima®	■	■		■	■	■	■	■	■	■		
179L	11	4		X		X	R/F		Altima®	■	■		■	■	■	■	■	■	■		
180NR	12	7			X	X	R/F	X	Altima® Blaze	■	■		■	■	■	■	■	■			
180R	12	7			X		R/F	X	Altima® Blaze	■	■		■	■	■	■	■	■			
192	13	Multi	X				R		Altima®	■	■		■	■	■	■	■	■			
277	8	4	X				R/F	X	Altima® Blaze	■	■		■	■	■	■	■	■	■		
277R	8	4			X		R/F	X	Altima® Blaze	■	■		■	■	■	■	■	■	■		
134	16	3	X				R		FordLube*										■		
135	17	2			X		R		FordLube*										■	■	
135B-N3	23	2		X		X	R		FordLube*										■	■	
135B-N5	23	2		X		X	R		FordLube*										■	■	
135N	18	2			X	X	R		FordLube*										■	■	
135N3	19	2	X		X	X	R		FordLube*										■	■	
135N5	21	2	X		X	X	R		FordLube*										■	■	
136	24	2	X				F		FordLube*										■	■	
138	25	3	X				R/F	X	FordLube*										■	■	
138B	27	3		X			R/F		FordLube*										■	■	
138B-N5	27	3		X		X	R/F		FordLube*										■	■	
138R	26	3			X		R/F	X	FordLube*										■	■	
156	30	2		X		X	F		ALtima® 52	■	■	■	■	■							
157	33	Multi	X		X		F		ALtima® 52		■	■									
158	34	4			X	X	R/F	X	ALtima® 52	■	■	■									

FordLube* Available to order - delivery 3-4 weeks

High performance drilling tools

Series	Page	Drill Length	Coolant Fed	Diameter range-mm	Available Coating	Steel (up to 35 Rc)	Steel (36-50Rc)	Hardened Materials	Austenitic Stainless 48HRC+	Precipitation Hardened Stainless	High Temp Alloys	Titanium	Gray Cast Iron	Ductile Cast Iron	Aluminium-Non-Ferrous	Kevlar-Composites-Plastics	Glass/Ceramic
2MDCLM	38	10X Micro	Y	2.0 - 2.95	Altima®	■	■		■	■	■	■	■	■			
2XDCM	54	12X-25X	Y	3.0 - 12.7	Altima®	■	■		■	■	■	■	■	■	■		
2XDCLM	51	7-8X	Y	3.0 - 12	Altima®	■	■		■	■	■	■	■	■	■		
2XDCRM	48	5X	Y	3.0 - 20	Altima®	■	■		■	■	■	■	■	■	■		
2XDSCM	42	3X	Y	3.0 - 16	Altima®	■	■		■	■	■	■	■	■	■		
2XDSCM	45	5X	N	0.5 - 16	Altima®	■	■		■	■	■	■	■	■	■		
2XDSSM	39	3X	N	2.5 - 20	Altima®	■	■		■	■	■	■	■	■	■		
200A	57	3X	N	3.0 - 20	Altima®			■	■	■	■	■	■	■	■		■
200S	56	Spot Drill	N	3.0 - 16	Altima®	■	■	■	■	■	■	■	■	■	■		
205B	60	5X	N	0.3 - 20	Altima® Blaze	■	■	■	■	■	■	■	■	■	■		■
207	64	3X	N	2.4 - 16	None												■
229	66	5X-3 Flute	N	2.0 - 16	None											■	
Technical Information section	69																

■ 1st Choice
 ■ 2nd Choice
 ■ For chip removal in deep slotting

TuffCut® XR-XT

Series 113A ,177, 178, 179, 180 & 277

XTREME ROUGHING End Mills

Ebauche Xtrême Fraises pour Ebauche

Features

- Unique M.A. Ford® Heli-Pitch Geometry.
- Proprietary Carbide Substrate.
- Eccentric Primary Relief Angle.
- ALtima® Coating.

Caractéristique

- Géométrie Héll Décalée de M.A. Ford®.
- Substrat Carbure sous licence.
- Angle de dépouille primaire excentrique.
- Revêtement ALtima®

Benefits

- Higher Feeds and Speeds for Increased Productivity. Reduced Vibration Harmonics
- Maintains Cutting Edge Strength & Sharpness for Improved Tool Life.
- Strong Cutting Edges Allowing for Increased Depths of Cut at Elevated Cutting Data.
- State-of-the-Art ALtima® (AlTiN) PVD Coating for Superior Tool Life in Virtually All Materials.

Avantage

- Avances et Vitesses supérieures pour un Meilleur Rendement. Diminution des Vibrations.
- Maintient la Résistance et l'Acuité de l'arête de coupe pour une meilleure Durée de Vie.
- Fortes Arêtes permettant des Profondeurs de Coupe Accrues avec des paramètres de coupe élevés.
- Revêtement PVD de pointe ALtima® (AlTiN) pour Une Durée de vie supérieure pour presque toutes matières.

**Use Roughing Speeds
and
Achieve Your
Finishing Needs!**

**Utilisez des Vitesses
pour l'Ebauche
Et
Obtenez vos Besoins
en Finition !**

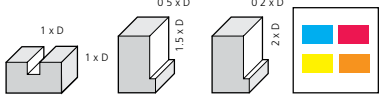
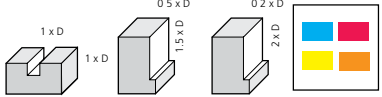
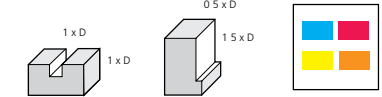
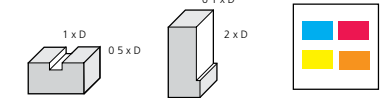
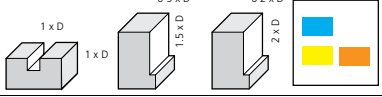
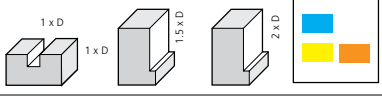
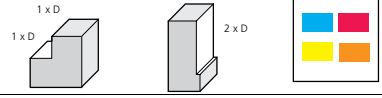
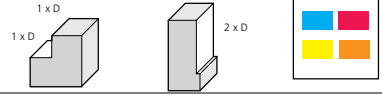
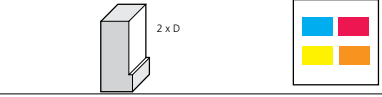
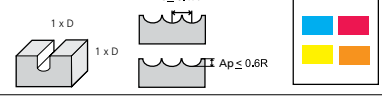
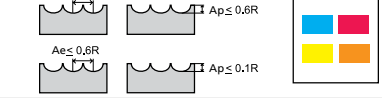
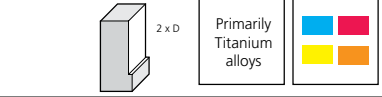
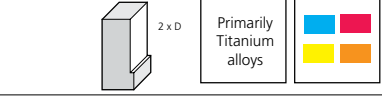
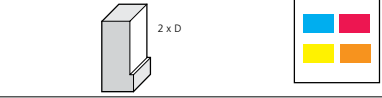
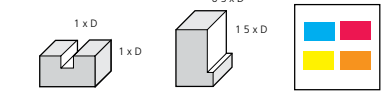


Celebrating

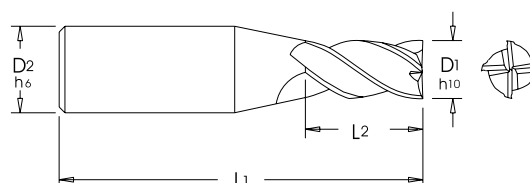
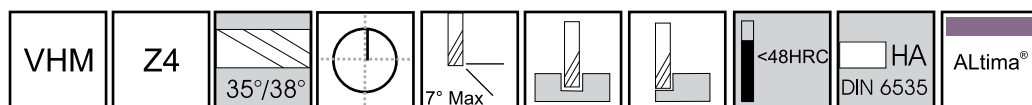


M.A. Ford®

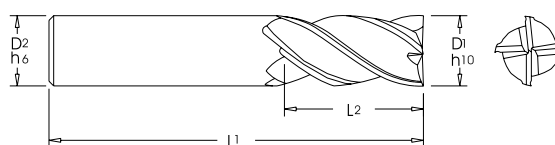
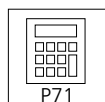
Contents Vue d'Ensemble

	Series Séries	Form Forme	No. of Teeth Nbre.Dents	Lengths Longueurs	Corner Prep Prép.Bec	Application Area Secteur d'Application	Page
	177		Z=4		Sharp corner		4
	177R		Z=4		0.25 - 6.0mm radius		5
	177S		Z=4		0.2 - 1.0mm radius		6
	177LR		Z=4		0.3 - 3.0mm radius		7
	277		Z=4		Sharp corner		8
	277R		Z=4		0.25 - 0.8mm radius		8
	178		Z=5		Sharp corner		9
	178R		Z=5		0.5 - 1.0mm radius		10
	178-1		Z=5		Sharp corner		10
	179		Z=4		N/A		11
	179L		Z=4		N/A		11
	180R		Z=7		0.5 - 4.0mm radius		12
	180NR		Z=7		1.0 - 4.0mm radius		12
	113A		Z=6		Sharp corner		13
	192		Z=4		Sharp corner		13
Technical Section							69

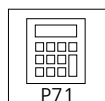
TuffCut® XR Series 177



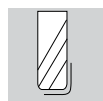
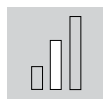
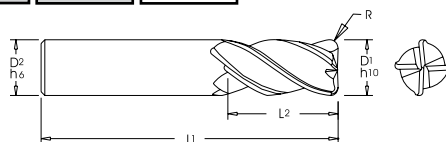
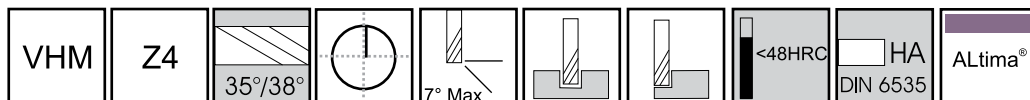
Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2
177 0150A	17680	1.5	3	38	3
177 0200A	17682	2	3	38	4
177 0250A	17684	2.5	3	38	5
177 0303A	17686	3	3	38	6



Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2
177 0300A	17928	3	6	57	8
177 0350A	17688	3.5	6	63	7
177 0400A	17930	4	6	57	11
177 0450A	17690	4.5	6	63	9
177 0500A	17932	5	6	57	13
177 0600A	17934	6	6	57	13
177 0800A	17937	8	8	63	19
177 1000A	17940	10	10	72	22
177 1200A	17943	12	12	83	26
177 1400A	17946	14	14	83	26
177 1600A	17950	16	16	92	32
177 1800A	17952	18	18	92	32
177 2000A	17955	20	20	104	38
177 2500A	17957	25	25	104	38

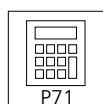


TuffCut® XR Series 177R



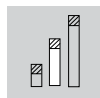
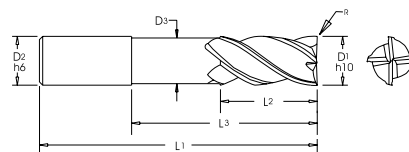
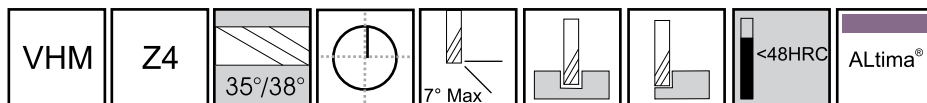
Corner Radius
Eckenradius
Rayon

Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2	R
177 0300-0.25RA	17929	3	6	57	8	0.25
177 0300-0.50RA	17783	3	6	57	8	0.50
177 0400-0.25RA	17931	4	6	57	11	0.25
177 0400-0.50RA	17784	4	6	57	11	0.50
177 0500-0.25RA	17933	5	6	57	13	0.25
177 0500-0.50RA	17785	5	6	57	13	0.50
177 0600-0.25RA	17786	6	6	57	13	0.25
177 0600-0.50RA	17935	6	6	57	13	0.50
177 0600-1.0RA	17787	6	6	57	13	1.00
177 0600-1.5RA	17788	6	6	57	13	1.50
177 0600-2.0RA	18070	6	6	57	13	2.00
177 0800-0.50RA	17938	8	8	63	19	0.50
177 0800-1.0RA	17789	8	8	63	19	1.00
177 0800-1.5RA	17790	8	8	63	19	1.50
177 0800-2.0RA	17791	8	8	63	19	2.00
177 0800-3.0RA	18072	8	8	63	19	3.00
177 1000-0.50RA	17941	10	10	72	22	0.50
177 1000-1.0RA	17792	10	10	72	22	1.00
177 1000-1.5RA	17793	10	10	72	22	1.50
177 1000-2.0RA	17794	10	10	72	22	2.00
177 1000-3.0RA	96603	10	10	72	22	3.00
177 1200-0.50RA	17795	12	12	83	26	0.50
177 1200-0.75RA	17944	12	12	83	26	0.75
177 1200-1.0RA	17796	12	12	83	26	1.00
177 1200-1.5RA	17797	12	12	83	26	1.50
177 1200-2.0RA	17798	12	12	83	26	2.00
177 1200-2.5RA	18074	12	12	83	26	2.50
177 1200-3.0RA	96506	12	12	83	26	3.00
177 1200-4.0RA	18076	12	12	83	26	4.00
177 1400-0.75RA	17947	14	14	83	26	0.75
177 1600-0.50RA	18078	16	16	92	32	0.50
177 1600-1.0RA	17951	16	16	92	32	1.00
177 1600-1.5RA	17799	16	16	92	32	1.50
177 1600-2.0RA	17673	16	16	92	32	2.00
177 1600-2.5RA	18080	16	16	92	32	2.50
177 1600-3.0RA	17674	16	16	92	32	3.00
177 1600-4.0RA	18082	16	16	92	32	4.00
177 1800-1.0RA	17953	18	18	92	32	1.00
177 2000-1.0RA	17956	20	20	104	38	1.00
177 2000-1.5RA	18091	20	20	104	38	1.50
177 2000-2.0RA	18084	20	20	104	38	2.00
177 2000-3.0RA	18086	20	20	104	38	3.00
177 2000-4.0RA	18088	20	20	104	38	4.00
177 2000-5.0RA	18090	20	20	104	38	5.00
177 2000-6.0RA	18092	20	20	104	38	6.00
177 2500-1.0RA	17958	25	25	104	38	1.00



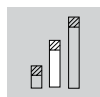
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TuffCut® XR Series 177S



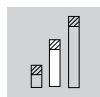
HA
DIN 6535

Tool No.	EDP	D1 (Tol h10)	D2 (h6)	D3	L1	L2	L3	Shank
177S 0300A	18218	3	6	2.9	50	5	11	DIN 6535 HA
177S 0400A	18220	4	6	3.9	50	6	14	DIN 6535 HA
177S 0500A	18222	5	6	4.9	57	8	17	DIN 6535 HA
177S 0600A	18224	6	6	5.8	57	9	20	DIN 6535 HA
177S 0800A	18226	8	8	7.6	63	12	26	DIN 6535 HA
177S 1000A	18228	10	10	9.6	72	15	32	DIN 6535 HA
177S 1200A	18230	12	12	11.4	83	18	38	DIN 6535 HA
177S 1600A	18232	16	16	15.2	98	24	50	DIN 6535 HA
177S 2000A	18234	20	20	19.2	112	30	62	DIN 6535 HA

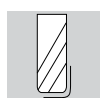


HB
DIN 6535

Tool No.	EDP	D1 (Tol h10)	D2 (h6)	D3	L1	L2	L3	Shank
177S 0300AW	18254	3	6	2.9	50	5	11	DIN 6535 HB
177S 0400AW	18256	4	6	3.9	50	6	14	DIN 6535 HB
177S 0500AW	18258	5	6	4.9	57	8	17	DIN 6535 HB
177S 0600AW	18260	6	6	5.8	57	9	20	DIN 6535 HB
177S 0800AW	18262	8	8	7.6	63	12	26	DIN 6535 HB
177S 1000AW	18264	10	10	9.6	72	15	32	DIN 6535 HB
177S 1200AW	18266	12	12	11.4	83	18	38	DIN 6535 HB
177S 1600AW	18268	16	16	15.2	98	24	50	DIN 6535 HB
177S 2000AW	18270	20	20	19.2	112	30	62	DIN 6535 HB

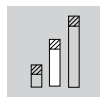


HA
DIN 6535

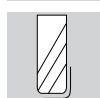


Corner Radius
Eckenradius
Rayon

Tool No.	EDP	D1 (Tol h10)	D2 (h6)	D3	L1	L2	L3	R	Shank
177S 03-0.2RA	18200	3	6	2.9	50	5	11	0.2	DIN 6535 HA
177S 04-0.2RA	18202	4	6	3.9	50	6	14	0.2	DIN 6535 HA
177S 05-0.2RA	18204	5	6	4.9	57	8	17	0.2	DIN 6535 HA
177S 06-0.3RA	18206	6	6	5.8	57	9	20	0.3	DIN 6535 HA
177S 08-0.5RA	18208	8	8	7.6	63	12	26	0.5	DIN 6535 HA
177S 10-0.5RA	18210	10	10	9.6	72	15	32	0.5	DIN 6535 HA
177S 12-0.5RA	18212	12	12	11.4	83	18	38	0.5	DIN 6535 HA
177S 16-1.0RA	18214	16	16	15.2	98	24	50	1.0	DIN 6535 HA
177S 20-1.0RA	18216	20	20	19.2	112	30	62	1.0	DIN 6535 HA



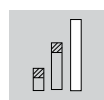
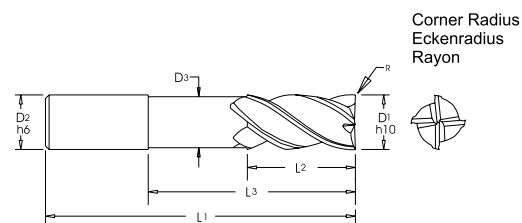
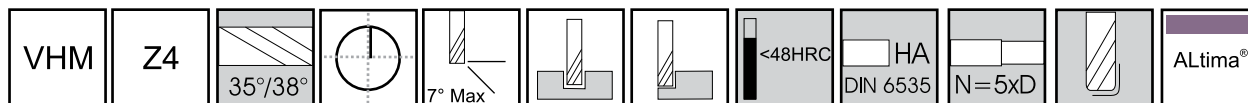
HB
DIN 6535



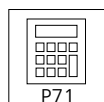
Corner Radius
Eckenradius
Rayon

Tool No.	EDP	D1 (Tol h10)	D2 (h6)	D3	L1	L2	L3	R	Shank
177S 03-0.2RAW	18236	3	6	2.9	50	5	11	0.2	DIN 6535 HB
177S 04-0.2RAW	18238	4	6	3.9	50	6	14	0.2	DIN 6535 HB
177S 05-0.2RAW	18240	5	6	4.9	57	8	17	0.2	DIN 6535 HB
177S 06-0.3RAW	18242	6	6	5.8	57	9	20	0.3	DIN 6535 HB
177S 08-0.5RAW	18244	8	8	7.6	63	12	26	0.5	DIN 6535 HB
177S 10-0.5RAW	18246	10	10	9.6	72	15	32	0.5	DIN 6535 HB
177S 12-0.5RAW	18248	12	12	11.4	83	18	38	0.5	DIN 6535 HB
177S 16-1.0RAW	18250	16	16	15.2	98	24	50	1.0	DIN 6535 HB
177S 20-1.0RAW	18252	20	20	19.2	112	30	62	1.0	DIN 6535 HB

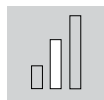
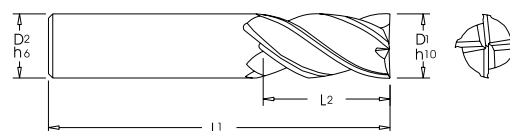
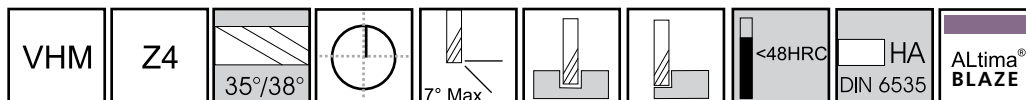
TuffCut® XR Series 177LR



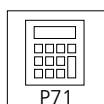
Tool No.	EDP	D1 (Tol h10)	D2 (h6)	D3	L1	L2	L3	R
177L 06N5-0.25RA	18186	6	6	5.8	101	12	30	0.25
177L 06N5-0.5RA	18183	6	6	5.8	101	12	30	0.50
177L 06N5-1.0RA	18184	6	6	5.8	101	12	30	1.00
177L 08N5-0.5RA	18187	8	8	7.6	101	16	40	0.50
177L 08N5-1.0RA	18194	8	8	7.6	101	16	40	1.00
177L 08N5-2.0RA	18195	8	8	7.6	101	16	40	2.00
177L 08N5-3.0RA	18196	8	8	7.6	101	16	40	3.00
177L 10N5-0.5RA	18188	10	10	9.6	127	20	50	0.50
177L 10N5-1.0RA	18197	10	10	9.6	127	20	50	1.00
177L 10N5-2.0RA	18198	10	10	9.6	127	20	50	2.00
177L 10N5-3.0RA	18199	10	10	9.6	127	20	50	3.00
177L 12N5-0.5RA	18189	12	12	11.4	152	24	60	0.50
177L 12N5-1.0RA	18176	12	12	11.4	152	24	60	1.00
177L 12N5-2.0RA	18177	12	12	11.4	152	24	60	2.00
177L 12N5-3.0RA	18190	12	12	11.4	152	24	60	3.00
177L 12N5-4.0RA	18178	12	12	11.4	152	24	60	4.00
177L 16N5-0.5RA	18181	16	16	15.2	152	32	80	0.50
177L 16N5-1.0RA	18191	16	16	15.2	152	32	80	1.00
177L 16N5-2.0RA	18179	16	16	15.2	152	32	80	2.00
177L 16N5-3.0RA	18180	16	16	15.2	152	32	80	3.00
177L 20N5-0.5RA	18182	20	20	19.2	152	40	100	0.50
177L 20N5-1.0RA	18192	20	20	19.2	152	40	100	1.00
177L 20N5-3.0RA	18193	20	20	19.2	152	40	100	3.00



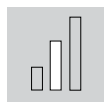
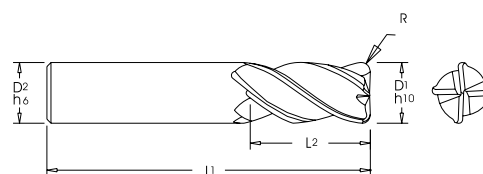
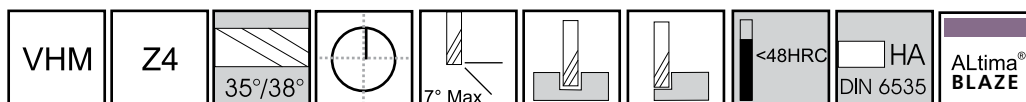
TuffCut® XT Series 277



Tool No.	D1 (Tol h10)	D2 (h6)	L1	L2
277 0300B	3	6	57	8
277 0400B	4	6	57	11
277 0500B	5	6	57	13
277 0600B	6	6	57	13
277 0800B	8	8	63	19
277 1000B	10	10	72	22
277 1200B	12	12	83	26
277 1600B	16	16	92	32
277 2000B	20	20	104	38

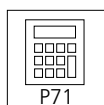


Series 277R



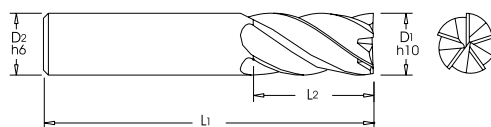
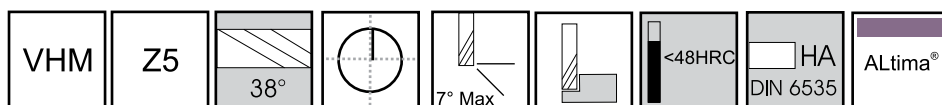
Tool No.	D1 (Tol h10)	D2 (h6)	L1	L2	R
277 0300-0.25RB	3	6	57	8	0.25
277 0400-0.25RB	4	6	57	11	0.25
277 0500-0.25RB	5	6	57	13	0.25
277 0600-0.25RB	6	6	57	13	0.25
277 0800-0.8RB	8	8	63	19	0.80
277 1000-0.8RB	10	10	72	22	0.80
277 1200-0.8RB	12	12	83	26	0.80
277 1200-3.0RB	12	12	83	26	3.00
277 1600-0.8RB	16	16	92	32	0.80
277 2000-0.8RB	20	20	104	38	0.80

Corner Radius
Eckenradius
Rayon

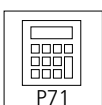


TuffCut XT - For enhanced performance in stainless steel type materials

TuffCut® XR Series 178

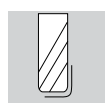
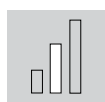
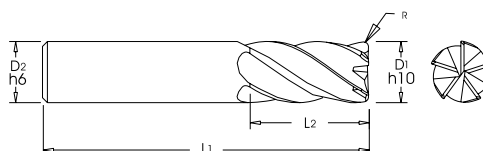
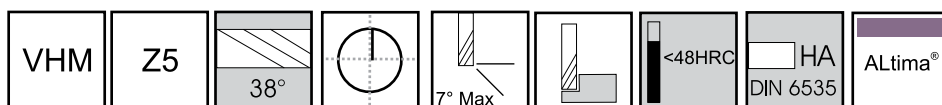


Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2
178 0300A	17959	3	6	57	8
178 0400A	17961	4	6	57	11
178 0500A	17963	5	6	57	13
178 0600A	17965	6	6	57	13
178 0800A	17968	8	8	63	19
178 1000A	17971	10	10	72	22
178 1200A	17974	12	12	83	26
178 1400A	17977	14	14	83	26
178 1600A	17981	16	16	92	32
178 1800A	17983	18	18	92	32
178 2000A	17986	20	20	104	38
178 2500A	17988	25	25	104	38

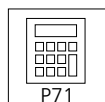


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TuffCut® XR Series 178R



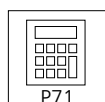
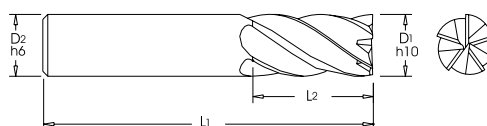
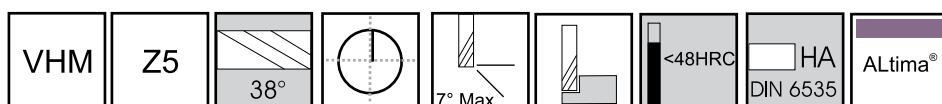
Corner Radius
Eckenradius
Rayon



P71

Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2	R
178 0600-0.50RA	17966	6	6	57	13	0.50
178 0800-0.50RA	17969	8	8	63	19	0.50
178 1000-0.50RA	17972	10	10	72	22	0.50
178 1200-0.75RA	17975	12	12	83	26	0.75
178 1400-0.75RA	17978	14	14	83	26	0.75
178 1600-1.0RA	17982	16	16	92	32	1.00
178 1800-1.0RA	17984	18	18	92	32	1.00
178 2000-1.0RA	17987	20	20	104	38	1.00
178 2500-1.0RA	17989	25	25	104	38	1.00

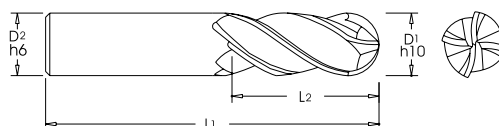
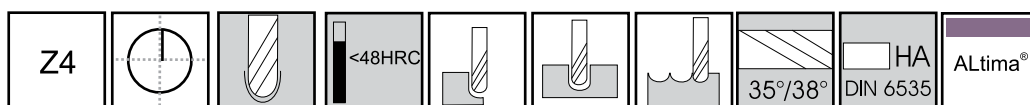
Series 178-1



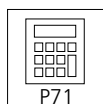
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Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2
178 0300-1A	17998	3	3	75	25
178 0400-1A	17999	4	4	75	25
178 0500-1A	18026	5	5	75	25
178 0600-1A	18027	6	6	75	25
178 0800-1A	18028	8	8	75	30
178 1000-1A	18029	10	10	100	45
178 1200-1A	18030	12	12	150	75
178 1600-1A	18031	16	16	150	75
178 2000-1A	18032	20	20	150	75

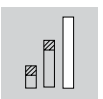
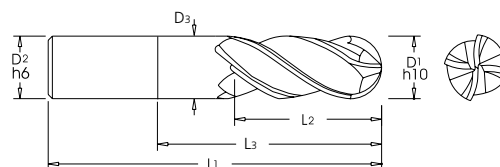
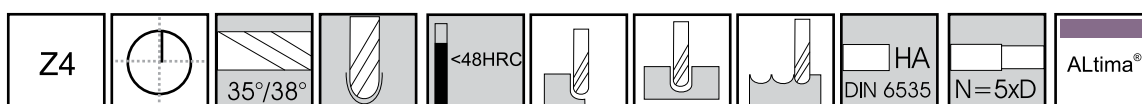
TuffCut® XR Series 179



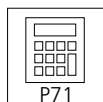
Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2
179 0150A	18272	1.5	3	38	3
179 0200A	18274	2	3	38	4
179 0250A	18276	2.5	3	38	5
179 0300A	18018	3	6	57	8
179 0303A	18278	3	3	38	6
179 0350A	18280	3.5	6	63	7
179 0400A	18019	4	6	57	11
179 0450A	18282	4.5	6	63	9
179 0500A	18020	5	6	57	13
179 0600A	18021	6	6	57	13
179 0800A	18022	8	8	63	19
179 1000A	18023	10	10	72	22
179 1200A	18024	12	12	83	26
179 1600A	18059	16	16	92	32



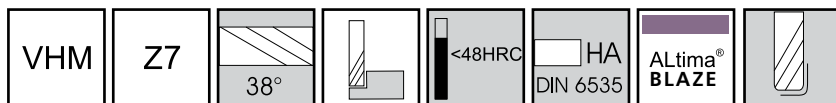
Series 179L



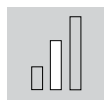
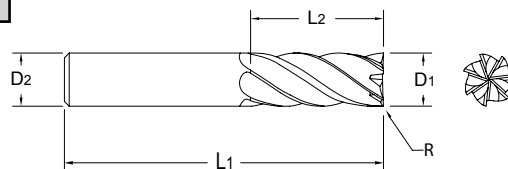
Tool No.	EDP	D1 (Tol h10)	D2 (h6)	D3	L1	L2	L3
179L 03N5A	18290	3	6	2.9	75	4.5	17
179L 04N5A	18292	4	6	3.9	75	6.0	22
179L 05N5A	18294	5	6	4.9	75	7.5	27
179L 06N5A	19296	6	6	5.8	101	9.0	32
179L 08N5A	19298	8	8	7.6	101	12.0	42
179L 10N5A	18302	10	10	9.6	127	15.0	52
179L 12N5A	18304	12	12	11.4	152	18.0	62
179L 16N5A	18306	16	16	15.2	152	24.0	82



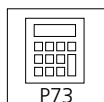
TuffCut® XR Series 180R



Corner Radius
Eckenradius
Rayon



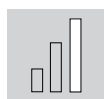
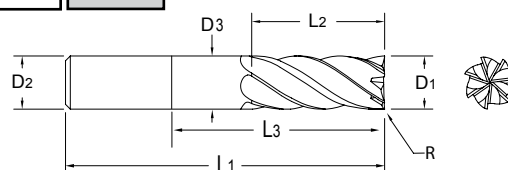
Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2	R
180 1200-0.5RB	18501	12	12	84	32	0.5
180 1200-1.0RB	18503	12	12	84	32	1.0
180 1200-2.0RB	18505	12	12	84	32	2.0
180 1200-3.0RB	18507	12	12	84	32	3.0
180 1200-4.0RB	18508	12	12	84	32	4.0
180 1600-0.5RB	18509	16	16	92	42	0.5
180 1600-1.0RB	18510	16	16	92	42	1.0
180 1600-2.0RB	18511	16	16	92	42	2.0
180 1600-3.0RB	18513	16	16	92	42	3.0
180 1600-4.0RB	18527	16	16	92	42	4.0
180 2000-0.5RB	18528	20	20	102	52	0.5
180 2000-1.0RB	18529	20	20	102	52	1.0
180 2000-2.0RB	18530	20	20	102	52	2.0
180 2000-3.0RB	18531	20	20	102	52	3.0
180 2000-4.0RB	18533	20	20	102	52	4.0



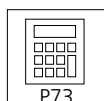
TuffCut® XR Series 180NR



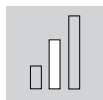
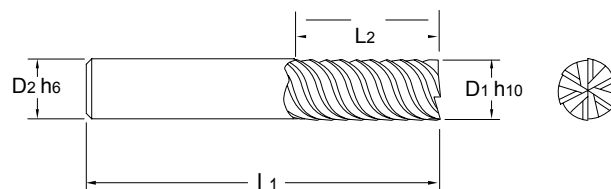
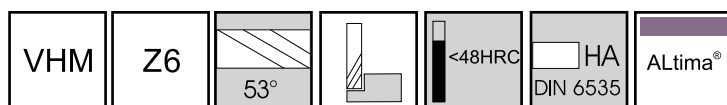
Corner Radius
Eckenradius
Rayon



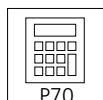
Tool No.	EDP	D1 (Tol h10)	D2 (h6)	D3	L1	L2	L3	R
180 1200N5-1.0RB	18500	12	12	11.4	120	30	60	1
180 1200N5-2.0RB	18502	12	12	11.4	120	30	60	2
180 1200N5-3.0RB	18504	12	12	11.4	120	30	60	3
180 1200N5-4.0RB	18506	12	12	11.4	120	30	60	4
180 1600N5-1.0RB	18548	16	16	15.2	150	40	80	1
180 1600N5-2.0RB	18550	16	16	15.2	150	40	80	2
180 1600N5-3.0RB	18552	16	16	15.2	150	40	80	3
180 1600N5-4.0RB	18554	16	16	15.2	150	40	80	4
180 2000N5-1.0RB	18590	20	20	19.2	150	50	100	1
180 2000N5-2.0RB	18592	20	20	19.2	150	50	100	2
180 2000N5-3.0RB	18594	20	20	19.2	150	50	100	3
180 2000N5-4.0RB	18596	20	20	19.2	150	50	100	4



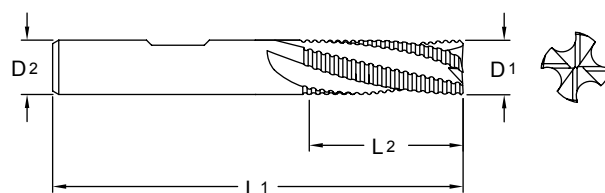
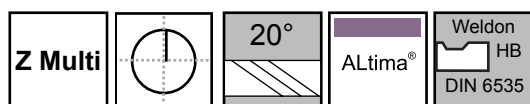
TuffCut® XR Series 113A



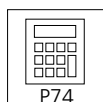
Tool No.	EDP	D1 (Tol h10)	D2 (h6)	L1	L2
113 0300A	11384	3	3	38	12
113 0400A	11385	4	4	51	14
113 0500A	11386	5	5	51	20
113 0600A	11387	6	6	64	20
113 0800A	11388	8	8	64	20
113 1000A	11389	10	10	70	25
113 1200A	11390	12	12	76	25
113 1600A	11391	16	16	89	30
113 2000A	11392	20	20	102	38



TuffCut® XR Series 192



Tool No.	EDP	D1 Tol h10	D2	L1	L2	Z
192 0800A	95744	8	8	51	8	3
192 0801A	95749	8	8	64	16	3
192 1000A	95745	10	10	51	10	4
192 1001A	95750	10	10	70	20	4
192 1200A	95746	12	12	64	12	4
192 1201A	95751	12	12	76	25	4
192 1600A	95747	16	16	76	16	4
192 1601A	95752	16	16	89	32	4
192 2000A	95748	20	20	76	20	4
192 2001A	95753	20	20	102	38	4



TuffCut® X-AL

Designed for Extreme Productivity

Features / Caractéristique

Benefit / Avantage

134 Series / Série 134

- Chipbreaker design
- Sinusoidal Flute Form
- Conception brise-copeaux
- Goujure à forme sinusoïdale

Reduced power consumption on low power/torque machines
 Produces small manageable chips for ease of evacuation.
 Chips not thrown clear on unguarded machines.

Diminution de la puissance absorbée sur les machines à faible puissance/couple.
 Produit des petits copeaux facilitant leur évacuation
 Les copeaux ne sont pas rejetés de machines non protégées.

135 series / Série 135

- Unique double grind geometry
- Variety of lengths from stock with neck relief as standard.
- Industry standard radii from stock.
- Géométrie unique à double rectification.
- Choix de longueurs en stock avec fraises détalonnées en standard.
- Rayons industriels stockés en standard

Controlled chip form for easy evacuation.
 Highest tooth loading capability (1 mm/tooth/rev during 1 x D slotting)
 Enabling the use of best practice tool length.
 3 x D and 5 x D neck relieved shanks available.

Tool availability reduces forward planning required for short lead time components.
 Forme du copeau maîtrisée pour en faciliter l'évacuation
 Capacité de charge à la dent la plus élevée (1 mm/dent/tour lors de rainurage 1 x D).
 Permettant l'utilisation d'une longueur d'outil optimale.
 3 x D et 5 x D disponibles avec queues détalonnée.
 Moins de planification nécessaire, diminuant le délai d'approvisionnement.

138 series / Série 138

- 3 Flute geometry
- Circular land
- Wiper flats
- Géométrie à 3 Dents
- Face de dépouille circulaire
- Arêtes de Raclage

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

Fraise finition HV pour coupes plus douces et avances plus élevées.
 Etats de surface améliorées et broutage diminué sur les parois.
 Meilleures états de surface possibles pour les parois/fonds.

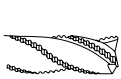
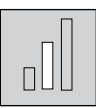
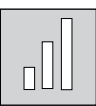
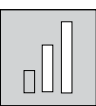
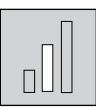
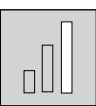
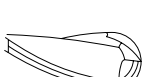
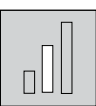
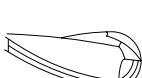
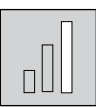
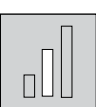
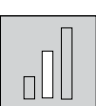
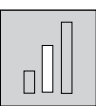
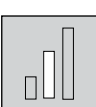
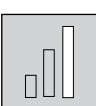
General Features / Caractéristiques Générales

- Unique carbide substrates
- Fordlube coating
- Substrats en carbure exceptionnels
- Revêtement Fordlube

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

Nuances pour applications particulières afin d'assurer une performance optimale.
 Pour éviter l'adhérence de copeaux et prolonger la durée de vie lors d'usinages à très hautes vitesses ou pour des applications utilisant un minimum d'arrosage.

Contents Vue d'Ensemble

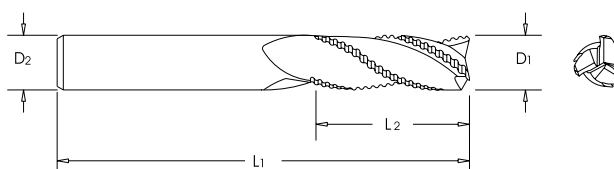
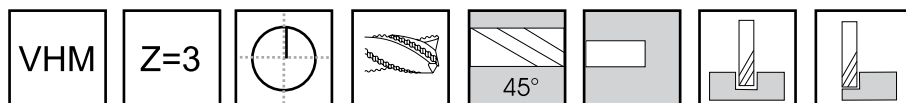
	Series Séries	Form Forme	No. of Teeth Nbre.Dents	Lengths Longueurs	Corner Prep Prép.Bec	Application Area Secteur d'Application	Page
	134		Z=3		Chamfer 45 deg Chanfrein 45°	Older-Lower KW machine, long DOC (Ae) M/c anciennes, < KW, long DOC (Ae)	16
	135		Z=2		0.2 - 0.75mm Radius Rayon	High feed machine -1> mm tooth loading possible Fortes avances -1> mm à la dent	17
	135N		Z=2		0.2 - 0.75mm Radius Rayon	High feed machine -1> mm tooth loading possible Fortes avances -1> mm à la dent	18
	135N3		Z=2		0 - 5.0mm Radius Rayon	High feed machine -1> mm tooth loading possible Fortes avances -1> mm à la dent	19
	135N5		Z=2		0 - 5.0mm Radius Rayon	Rough & finish profile milling Ebauche & Fraisage finition profil	21
	135B-N3		Z=2		N/A	Rough & finish profile milling Ebauche & Fraisage finition profil	23
	135B-N5		Z=2		N/A	Rough & finish profile milling Ebauche & Fraisage finition profil	23
	136		Z=2		Sharp corner radius to order Coin carré Rayon à la cde.	Finishing Al alloys Wiper flats for surface finish Finition Aciers Alliés Al Arêtes de raclage	24
	138		Z=3		Sharp corner Coin carré	High performance finish machining. Wiper flats for surface finish Finition HP Arêtes de raclage	25
	138R		Z=3		0.5 - 5.0mm Radius Rayon	High performance finish machining. Wiper flats for surface finish Finition HP Arêtes de raclage	26
	138B		Z=3		N/A	Finish profile milling Finition profil	27
	138B-N5		Z=3		N/A	Finish profile milling Finition profil	27

Technical Section

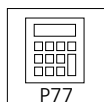
69

Available Coatings - Delivery 3 - 4 weeks			Revêtements Disponibles - Livraison 3 - 4 semaines		
	Micro Hardness (HV)	Max Work Temp. °C	Colour	Coef. of Friction	Application Area
	Dureté Micro (HV)	Max. Fonctionnement °C	Couleur	Coef. friction	
F - Fordlube	4000	850	Light Grey Gris clair	<0.45	Al-Si Alloys / Ti Alloys / Mg Alloys / Copper Alloys Alliages Al-Si/Alliages Ti / Alliages Mg/Alliages Cuivre

TuffCut® X-AL Series 134

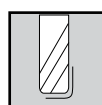
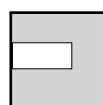
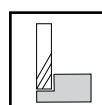
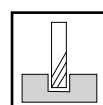
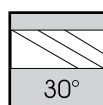
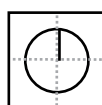
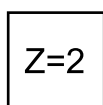


Tool No.	EDP	D1	D2	L1	L2
134 0600	13409	6	6	64	20
134 0800	13414	8	8	64	20
134 1000	13419	10	10	70	25
134 1200	13423	12	12	76	25
134 1400	95321	14	14	89	30
134 1600	13429	16	16	89	30
134 1800	13430	18	18	102	35
134 2000	13433	20	20	102	38
134 2500	13435	25	25	102	50

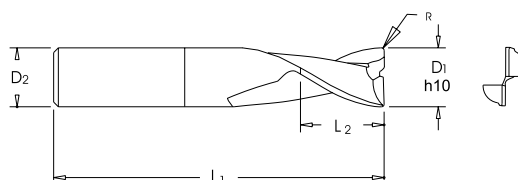


Available with Fordlube upon request.

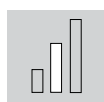
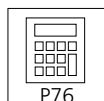
TuffCut® X-AL Series 135



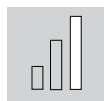
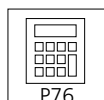
Corner Radius
Eckenradius
Avec Rayons



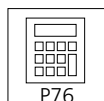
Tool No.	EDP	D1 Tol h10	D2	L1	L2	R
135 0300	13523	3	3	38	3.5	0.20
135 0400	13533	4	4	51	4.8	0.20
135 0500	13502	5	5	51	6.0	0.25
135 0600	13504	6	6	64	7.0	0.30
135 0800	13508	8	8	64	9.5	0.35
135 1000	13515	10	10	70	12.0	0.50
135 1200	13525	12	12	76	14.0	0.50
135 1400	13552	14	14	89	16.0	0.50
135 1600	13535	16	16	89	18.0	0.75
135 1800	13563	18	18	102	20.0	0.75
135 2000	13545	20	20	102	22.0	0.75
135 2500	13555	25	25	102	25.0	0.75



Tool No.	EDP	D1 Tol h10	D2	L1	L2	R
135 1001	13516	10	10	76	12	0.50
135 1201	13526	12	12	102	14	0.50
135 1401	13554	14	14	102	16	0.50
135 1601	13536	16	16	117	18	0.75
135 1801	13568	18	18	127	20	0.75
135 2001	13546	20	20	127	22	0.75
135 2501	13556	25	25	127	25	0.75

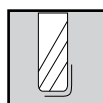
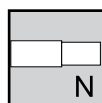
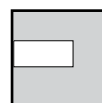
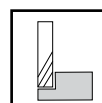
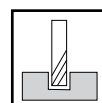
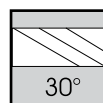
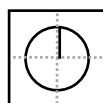
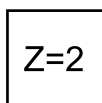


Tool No.	EDP	D1 Tol h10	D2	L1	L2	R
135 1002	13517	10	10	89	12	0.50
135 1202	13527	12	12	127	14	0.50
135 1402	13573	14	14	127	16	0.50
135 1602	13537	16	16	133	18	0.75
135 1802	13574	18	18	152	20	0.75
135 2002	13547	20	20	152	22	0.75
135 2502	13557	25	25	152	25	0.75

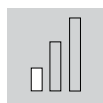
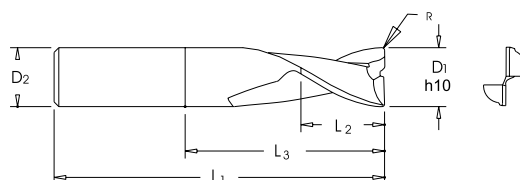


Available with Fordlube upon request.

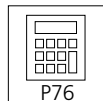
TuffCut® X-AL Series 135N



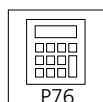
Corner Radius
Eckenradius
Avec Rayons



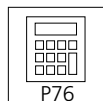
Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3	R
135 0300N	13524	3	3	38	3.5	11	0.20
135 0400N	13534	4	4	51	4.8	22	0.20
135 0500N	13503	5	5	51	6.0	22	0.25
135 0600N	13505	6	6	64	7.0	26	0.30
135 0800N	13509	8	8	64	9.5	26	0.35
135 1000N	13565	10	10	70	12.0	28	0.50
135 1200N	13575	12	12	76	14.0	28	0.50
135 1400N	13553	14	14	89	16.0	42	0.50
135 1600N	13585	16	16	89	18.0	39	0.75
135 1800N	13564	18	18	102	20.0	52	0.75
135 2000N	13594	20	20	102	22.0	50	0.75
135 2500N	13597	25	25	102	25.0	36	0.75



Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3	R
135 1001N	13566	10	10	76	12	34	0.50
135 1201N	13576	12	12	102	14	54	0.50
135 1401N	13558	14	14	102	16	55	0.50
135 1601N	13586	16	16	117	18	83	0.75
135 1801N	13569	18	18	127	20	77	0.75
135 2001N	13595	20	20	127	22	75	0.75
135 2501N	13598	25	25	127	25	61	0.75

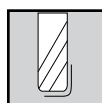
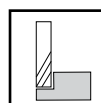
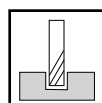
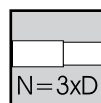
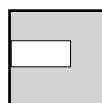
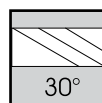
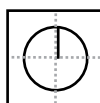
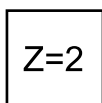


Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3	R
135 1002N	13567	10	10	89	12	47	0.50
135 1202N	13577	12	12	127	14	79	0.50
135 1402N	13559	14	14	127	16	80	0.50
135 1602N	13587	16	16	133	18	99	0.75
135 1802N	13578	18	18	152	20	102	0.75
135 2002N	13596	20	20	152	22	100	0.75
135 2502N	13599	25	25	152	25	86	0.75

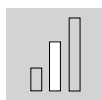
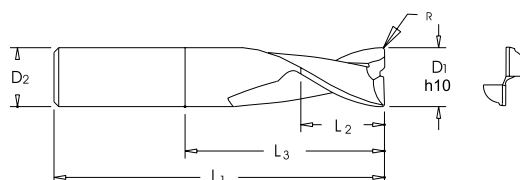


Available with Fordlube upon request.

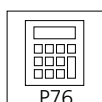
TuffCut® X-AL Series 135N3



Corner Radius
Eckenradius
Avec Rayons

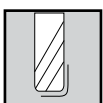
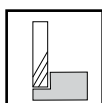
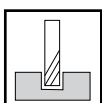
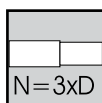
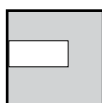
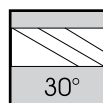
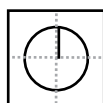
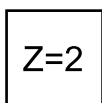


Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3	R
135 03N3	96620	3	3	38	3.5	11	-
135 03N3-0.5R	96621	3	3	38	3.5	11	0.5
135 03N3-1.0R	96622	3	3	38	3.5	11	1.0
135 04N3	96626	4	4	51	4.8	14	-
135 04N3-0.5R	96627	4	4	51	4.8	14	0.5
135 04N3-1.0R	96628	4	4	51	4.8	14	1.0
135 05N3	96632	5	6	64	6.0	17	-
135 05N3-0.5R	96633	5	6	64	6.0	17	0.5
135 05N3-1.0R	96634	5	6	64	6.0	17	1.0
135 06N3	96638	6	6	64	7.0	20	-
135 06N3-0.5R	96639	6	6	64	7.0	20	0.5
135 06N3-1.0R	96640	6	6	64	7.0	20	1.0
135 06N3-1.5R	96641	6	6	64	7.0	20	1.5
135 06N3-2.0R	96642	6	6	64	7.0	20	2.0
135 08N3	96648	8	8	64	9.5	26	-
135 08N3-0.5R	96649	8	8	64	9.5	26	0.5
135 08N3-1.0R	96650	8	8	64	9.5	26	1.0
135 08N3-1.5R	96651	8	8	64	9.5	26	1.5
135 08N3-2.0R	96652	8	8	64	9.5	26	2.0
135 08N3-3.0R	96653	8	8	64	9.5	26	3.0
135 10N3	96660	10	10	76	12.0	34	-
135 10N3-1.0R	96662	10	10	76	12.0	34	1.0
135 10N3-1.5R	96663	10	10	76	12.0	34	1.5
135 10N3-2.0R	96664	10	10	76	12.0	34	2.0
135 10N3-3.0R	96665	10	10	76	12.0	34	3.0
135 12N3	96671	12	12	76	14.0	38	-

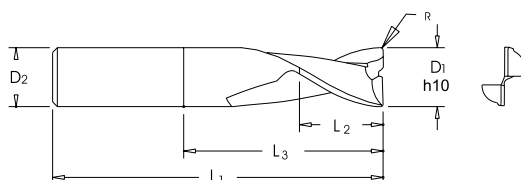


Available with Fordlube upon request.

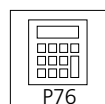
TuffCut® X-AL Series 135N3



Corner Radius
Eckenradius
Avec Rayons

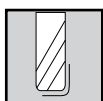
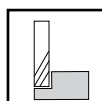
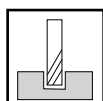
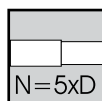
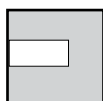
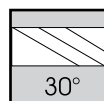
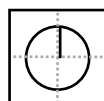
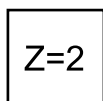


Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3	R
135 12N3-0.5R	96672	12	12	76	14	38	0.5
135 12N3-1.0R	96673	12	12	76	14	38	1.0
135 12N3-1.5R	96674	12	12	76	14	38	1.5
135 12N3-2.0R	96675	12	12	76	14	38	2.0
135 12N3-3.0R	96676	12	12	76	14	38	3.0
135 12N3-4.0R	96677	12	12	76	14	38	4.0
135 16N3	96684	16	16	117	18	53	-
135 16N3-0.5R	96685	16	16	117	18	53	0.5
135 16N3-1.0R	96686	16	16	117	18	53	1.0
135 16N3-1.5R	96687	16	16	117	18	53	1.5
135 16N3-2.0R	96688	16	16	117	18	53	2.0
135 16N3-3.0R	96689	16	16	117	18	53	3.0
135 16N3-4.0R	96690	16	16	117	18	53	4.0
135 20N3-0.5R	96697	20	20	127	22	65	0.5
135 20N3-1.0R	96698	20	20	127	22	65	1.0
135 20N3-1.5R	96699	20	20	127	22	65	1.5
135 20N3-2.0R	96700	20	20	127	22	65	2.0
135 20N3-3.0R	96701	20	20	127	22	65	3.0
135 20N3-4.0R	96702	20	20	127	22	65	4.0
135 25N3-0.5R	96709	25	25	127	25	80	0.5
135 25N3-1.0R	96710	25	25	127	25	80	1.0
135 25N3-1.5R	96711	25	25	127	25	80	1.5
135 25N3-2.0R	96712	25	25	127	25	80	2.0
135 25N3-3.0R	96713	25	25	127	25	80	3.0
135 25N3-4.0R	96714	25	25	127	25	80	4.0

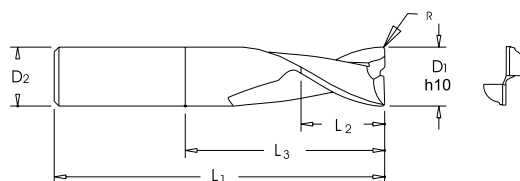


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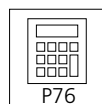
TuffCut® X-AL Series 135N5



Corner Radius
Eckenradius
Avec Rayons



Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3	R
135 03N5	96623	3	3	38	3.5	16	-
135 03N5-0.5R	96624	3	3	38	3.5	16	0.5
135 03N5-1.0R	96625	3	3	38	3.5	16	1.0
135 04N5	96629	4	4	51	4.8	22	-
135 04N5-0.5R	96630	4	4	51	4.8	22	0.5
135 04N5-1.0R	96631	4	4	51	4.8	22	1.0
135 05N5	96635	5	6	64	6.0	27	-
135 05N5-0.5R	96636	5	6	64	6.0	27	0.5
135 05N5-1.0R	96637	5	6	64	6.0	27	1.0
135 06N5	96643	6	6	64	7.0	32	-
135 06N5-0.5R	96644	6	6	64	7.0	32	0.5
135 06N5-1.0R	96645	6	6	64	7.0	32	1.0
135 06N5-1.5R	96646	6	6	64	7.0	32	1.5
135 06N5-2.0R	96647	6	6	64	7.0	32	2.0
135 08N5	96654	8	8	75	9.5	42	-
135 08N5-0.5R	96655	8	8	75	9.5	42	0.5
135 08N5-1.0R	96656	8	8	75	9.5	42	1.0
135 08N5-1.5R	96657	8	8	75	9.5	42	1.5
135 08N5-2.0R	96658	8	8	75	9.5	42	2.0
135 10N5-0.5R	96666	10	10	89	12.0	52	0.5
135 10N5-1.0R	96667	10	10	89	12.0	52	1.0
135 10N5-1.5R	96668	10	10	89	12.0	52	1.5
135 10N5-2.0R	96669	10	10	89	12.0	52	2.0
135 10N5-3.0R	96670	10	10	89	12.0	52	3.0
135 12N5-0.5R	96678	12	12	110	14.0	62	0.5



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TuffCut XR - XT

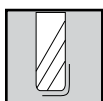
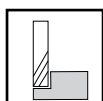
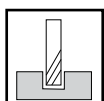
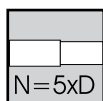
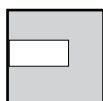
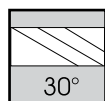
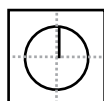
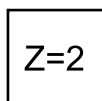
TuffCut X-AL

TuffCut Die & Mould

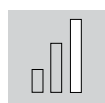
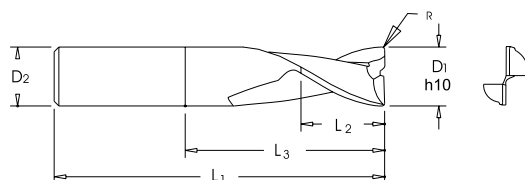
Twister Drills

Technical Section

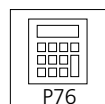
TuffCut® X-AL Series 135N5



Corner Radius
Eckenradius
Avec Rayons

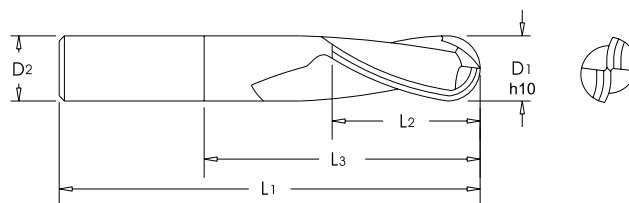
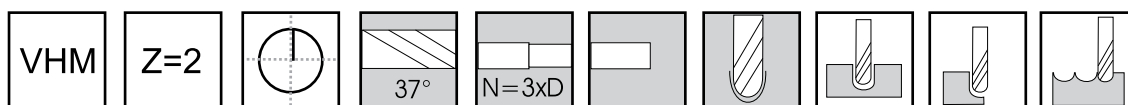


Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3	R
135 12N5-1.0R	96679	12	12	110	14	62	1.0
135 12N5-1.5R	96680	12	12	110	14	62	1.5
135 12N5-2.0R	96681	12	12	110	14	62	2.0
135 12N5-3.0R	96682	12	12	110	14	62	3.0
135 12N5-4.0R	96683	12	12	110	14	62	4.0
135 12N5-5.0R	96723	12	12	110	14	62	5.0
135 16N5-0.5R	96691	16	16	127	18	85	0.5
135 16N5-1.0R	96692	16	16	127	18	85	1.0
135 16N5-1.5R	96693	16	16	127	18	85	1.5
135 16N5-2.0R	96694	16	16	127	18	85	2.0
135 16N5-3.0R	96695	16	16	127	18	85	3.0
135 16N5-4.0R	96696	16	16	127	18	85	4.0
135 20N5-0.5R	96703	20	20	152	22	105	0.5
135 20N5-1.0R	96704	20	20	152	22	105	1.0
135 20N5-1.5R	96705	20	20	152	22	105	1.5
135 20N5-2.0R	96706	20	20	152	22	105	2.0
135 20N5-3.0R	96707	20	20	152	22	105	3.0
135 20N5-4.0R	96708	20	20	152	22	105	4.0
135 20N5-5.0R	96724	20	20	152	22	105	5.0
135 25N5-0.5R	96715	25	25	180	25	130	0.5
135 25N5-1.0R	96716	25	25	180	25	130	1.0
135 25N5-1.5R	96717	25	25	180	25	130	1.5
135 25N5-2.0R	96718	25	25	180	25	130	2.0
135 25N5-3.0R	96719	25	25	180	25	130	3.0
135 25N5-4.0R	96720	25	25	180	25	130	4.0

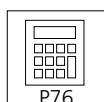


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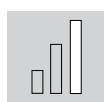
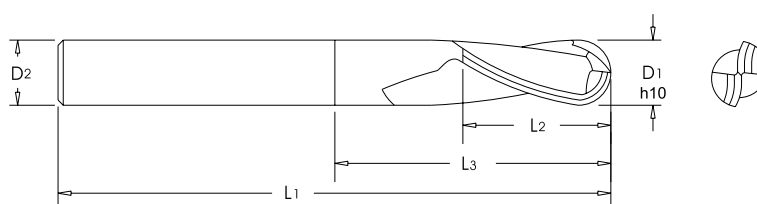
TuffCut® X-AL Series 135B-N3



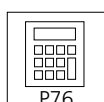
Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3
135B 0300N3	13236	3	3	38	5	11
135B 0400N3	13238	4	4	51	6	14
135B 0500N3	13240	5	5	64	7	17
135B 0600N3	13242	6	6	64	8	20
135B 0800N3	13244	8	8	64	10	26
135B 1000N3	13246	10	10	70	12	32
135B 1200N3	13248	12	12	76	16	38
135B 1600N3	13250	16	16	89	20	50



TuffCut® X-AL Series 135B-N5

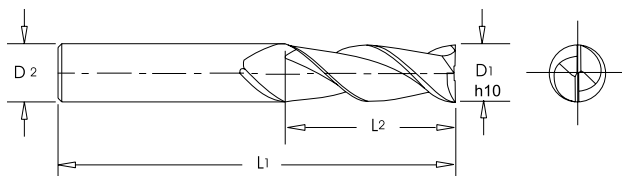
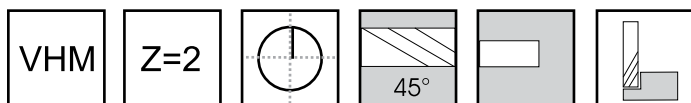


Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3
135B 0200N5	13252	2.0	6.0	75.0	4.0	12.0
135B 0300N5	13254	3.0	6.0	75.0	5.0	17.0
135B 0400N5	13256	4.0	6.0	75.0	6.0	22.0
135B 0500N5	13258	5.0	6.0	75.0	7.0	27.0
135B 0600N5	13260	6.0	6.0	110.0	8.0	32.0
135B 0800N5	13262	8.0	8.0	110.0	10.0	42.0
135B 1000N5	13264	10.0	10.0	110.0	12.0	52.0
135B 1200N5	13266	12.0	12.0	120.0	16.0	62.0
135B 1600N5	13268	16.0	16.0	130.0	20.0	82.0

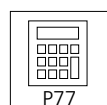


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TuffCut® X-AL Series 136

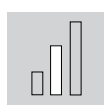
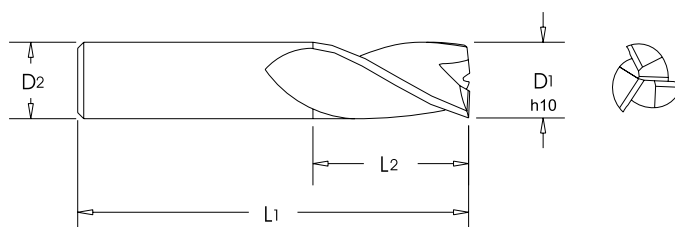
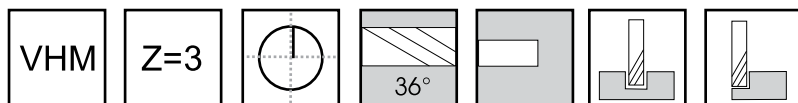


Tool No.	EDP	D1 Tol h10	D2	L1	L2
136 0300	13600	3	6	52	8.0
136 0400	13602	4	6	55	11.0
136 0500	13605	5	6	58	13.0
136 0600	13610	6	6	58	13.0
136 0800	13615	8	8	64	19.0
136 1000	13620	10	10	70	22.0
136 1200	13625	12	12	84	26.0
136 1400	13626	14	14	83	26.0
136 1600	13630	16	16	89	32.0
136 1800	13631	18	18	92	32.0
136 2000	13635	20	20	102	38.0

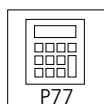


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TuffCut® X-AL Series 138



Uncoated		Fordlube		D1 Tol. h10	D2	L1	L2
Tool No.	EDP	Tool No.	EDP				
138 0300	13892	138 0300F	14295	3	6	52	8
138 0400	13893	138 0400F	14296	4	6	55	11
138 0500	13894	138 0500F	14297	5	6	58	13
138 0600	13895	138 0600F	14298	6	6	58	13
138 0800	13896	138 0800F	14299	8	8	64	19
138 1000	13897	138 1000F	14300	10	10	70	22
138 1200	13898	138 1200F	14301	12	12	84	26
138 1400	13899	138 1400F	14302	14	14	84	26
138 1600	13900	138 1600F	14303	16	16	89	32
138 1800	13901	138 1800F	14304	18	18	92	32
138 2000	13902	138 2000F	14305	20	20	102	38

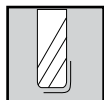
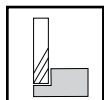
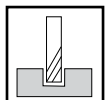
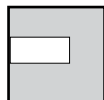
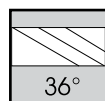
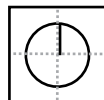


Available with Fordlube upon request.

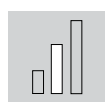
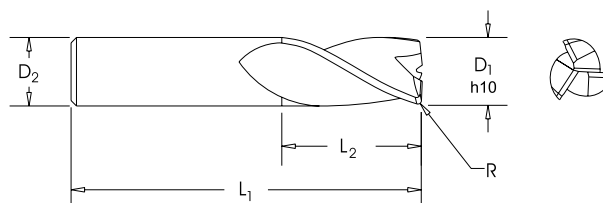
TuffCut® X-AL Series 138R

VHM

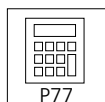
Z=3



Corner Radius
Eckenradius
Avec Rayons

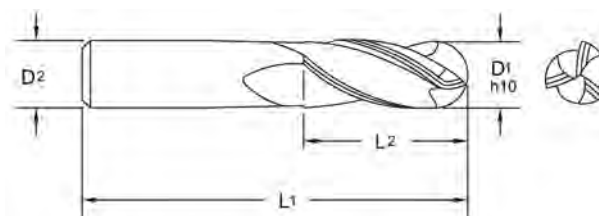
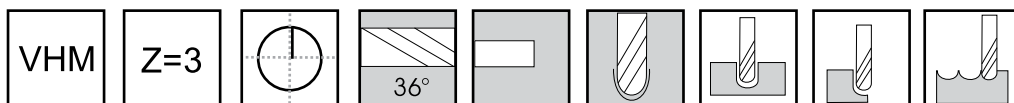


Tool No.	EDP	D1 Tol h10	D2	L1	L2	R
138 0300-0.5R	13100	3	6	52	8	0.50
138 0300-1.0R	13101	3	6	52	8	1.00
138 0400-0.5R	13102	4	6	55	11	0.50
138 0400-1.0R	13103	4	6	55	11	1.00
138 0500-0.5R	13104	5	6	58	13	0.50
138 0500-1.0R	13105	5	6	58	13	1.00
138 0600-0.5R	13106	6	6	58	13	0.50
138 0600-1.0R	13107	6	6	58	13	1.00
138 0600-1.5R	13108	6	6	58	13	1.50
138 0600-2.0R	13109	6	6	58	13	2.00
138 0800-0.5R	13110	8	8	64	19	0.50
138 0800-1.0R	13111	8	8	64	19	1.00
138 0800-1.5R	13112	8	8	64	19	1.50
138 0800-2.0R	13113	8	8	64	19	2.00
138 0800-3.0R	13114	8	8	64	19	3.00
138 1000-0.5R	13115	10	10	70	22	0.50
138 1000-1.0R	13116	10	10	70	22	1.00
138 1000-1.5R	13117	10	10	70	22	1.50
138 1000-2.0R	13118	10	10	70	22	2.00
138 1000-3.0R	13119	10	10	70	22	3.00
138 1200-0.5R	13120	12	12	84	26	0.50
138 1200-1.0R	13121	12	12	84	26	1.00
138 1200-1.5R	13122	12	12	84	26	1.50
138 1200-2.0R	13123	12	12	84	26	2.00
138 1200-3.0R	13124	12	12	84	26	3.00
138 1200-4.0R	13125	12	12	84	26	4.00
138 1200-5.0R	13126	12	12	84	26	5.00
138 1600-0.5R	13127	16	16	89	32	0.50
138 1600-1.0R	13128	16	16	89	32	1.00
138 1600-1.5R	13129	16	16	89	32	1.50
138 1600-2.0R	13130	16	16	89	32	2.00
138 1600-3.0R	13131	16	16	89	32	3.00
138 1600-4.0R	13132	16	16	89	32	4.00
138 1600-5.0R	13133	16	16	89	32	5.00
138 2000-0.5R	13134	20	20	102	38	0.50
138 2000-1.0R	13135	20	20	102	38	1.00
138 2000-1.5R	13136	20	20	102	38	1.50
138 2000-2.0R	13137	20	20	102	38	2.00
138 2000-3.0R	13138	20	20	102	38	3.00
138 2000-4.0R	13139	20	20	102	38	4.00
138 2000-5.0R	13140	20	20	102	38	5.00

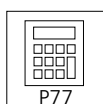


Available with Fordlube upon request.

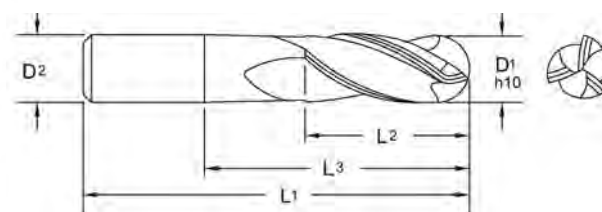
TuffCut® X-AL Series 138B



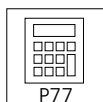
Tool No.	EDP	D1 Tol h10	D2	L1	L2
138B 0300	13356	3	3	38	12
138B 0400	13358	4	4	51	15
138B 0500	13360	5	5	64	20
138B 0600	13362	6	6	64	20
138B 0800	13364	8	8	64	20
138B 1000	13366	10	10	70	25
138B 1200	13368	12	12	76	25
138B 1600	13370	16	16	89	35



TuffCut® X-AL Series 138B-N5



Tool No.	EDP	D1 Tol h10	D2	L1	L2	L3
138B 0200N5	13372	2	6	75	4	12
138B 0300N5	13374	3	6	75	5	17
138B 0400N5	13376	4	6	75	6	22
138B 0500N5	13378	5	6	75	7	27
138B 0600N5	13380	6	6	110	8	32
138B 0800N5	13382	8	8	110	10	42
138B 1000N5	13384	10	10	110	12	52
138B 1200N5	13386	12	12	120	16	62
138B 1600N5	13388	16	16	130	20	82



Available with Fordlube upon request.

TuffCut[®] DM

Features & Benefits

Features

- Series 156 - New additions to our ballnose endmill range.
- Improved ballnose radius tolerance (± 0.005)
- New & Improved Series 157 Multi Flute Endmills
- Series 158 - Brand new range of four flute necked endmill with corner radius.
- New coating technology with ALtima[®] 52

Benefits

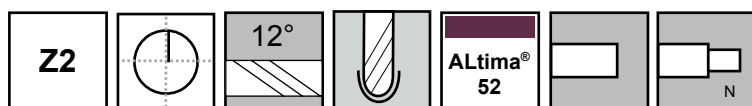
- Offering greater application solutions for the Die/Mould industry.
- For precision finishing applications.
- Allows for high feed machining of hardened steels.
- Extended range offering for high feed milling of pre-hardened and hardened tool steels.
- Allows for machining pre-hardened and hardened steels up to 65HRc

Contents Vue d'Ensemble

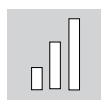
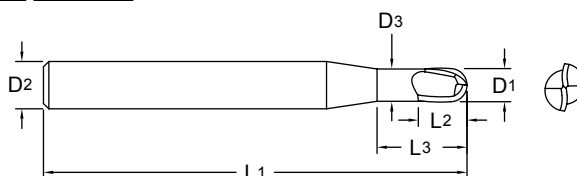
	Series	Lengths	Diameter Range	Application Area	Page
	156		0.5 - 12mm		30
	157		3.0 - 16mm		33
	158		3.0 - 20mm		34
Technical Information					69



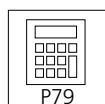
TuffCut® DM Series 156



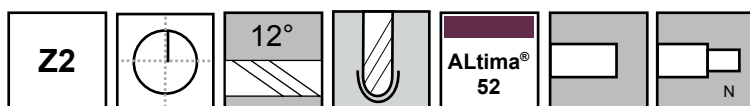
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2011



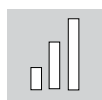
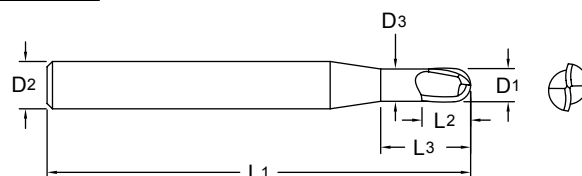
Tool No.	EDP	D1 +0.0/-0.015	R +0.005/- .005	D2 (h5)	D3	L1	L2	L3
156 0050N1A	15400	0.5	0.25	4	0.47	50	0.35	1
156 0050N2A	15401	0.5	0.25	4	0.47	50	0.35	2
156 0050N3A	15402	0.5	0.25	4	0.47	50	0.35	3
156 0050N4A	15403	0.5	0.25	4	0.47	50	0.35	4
156 0050N5A	15404	0.5	0.25	4	0.47	50	0.35	5
156 0050N6A	15406	0.5	0.25	4	0.47	50	0.35	6
156 0060N2A	15409	0.6	0.3	4	0.57	50	0.4	2
156 0060N4A	15411	0.6	0.3	4	0.57	50	0.4	4
156 0060N6A	15413	0.6	0.3	4	0.57	50	0.4	6
156 0060N8A	15415	0.6	0.3	4	0.57	50	0.4	8
156 0060N10A	15417	0.6	0.3	4	0.57	50	0.4	10
156 0080N2A	15419	0.8	0.4	4	0.77	50	0.5	2
156 0080N4A	15420	0.8	0.4	4	0.77	50	0.5	4
156 0080N6A	15422	0.8	0.4	4	0.77	50	0.5	6
156 0080N8A	15423	0.8	0.4	4	0.77	50	0.5	8
156 0080N10A	15424	0.8	0.4	4	0.77	50	0.5	10
156 0100N2A	15425	1.0	0.5	4	0.96	50	0.8	2
156 0100N3A	15426	1.0	0.5	4	0.96	50	0.8	3
156 0100N4A	15427	1.0	0.5	4	0.96	50	0.8	4
156 0100N6A	15429	1.0	0.5	4	0.96	50	0.8	6
156 0100N10A	15431	1.0	0.5	4	0.96	50	0.8	10
156 0100N12A	15432	1.0	0.5	4	0.96	63	0.8	12
156 0100N14A	15433	1.0	0.5	4	0.96	63	0.8	14
156 0100N16A	15434	1.0	0.5	4	0.96	63	0.8	16
156 0100N18A	15435	1.0	0.5	4	0.96	63	0.8	18
156 0100N20A	15436	1.0	0.5	4	0.96	63	0.8	20
156 0120N8A	15437	1.2	0.6	4	1.15	50	1.1	8
156 0120N12A	15438	1.2	0.6	4	1.15	63	1.1	12
156 0140N8A	15439	1.4	0.7	4	1.34	50	1.3	8
156 0140N12A	15440	1.4	0.7	4	1.34	63	1.3	12
156 0140N16A	15441	1.4	0.7	4	1.34	63	1.3	16
156 0150N4A	15442	1.5	0.75	4	1.44	50	1.35	4
156 0150N8A	15444	1.5	0.75	4	1.44	50	1.35	8
156 0150N16A	15446	1.5	0.75	4	1.44	63	1.35	16



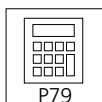
TuffCut® DM Series 156



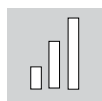
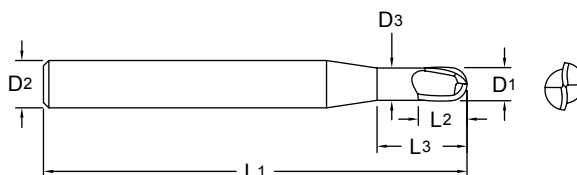
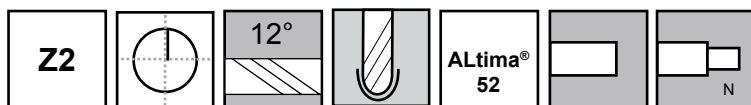
March 2011



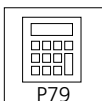
Tool No.	EDP	D1 +0.0/-0.015	R +0.005/- .005	D2 (h5)	D3	L1	L2	L3
156 0150N20A	15447	1.5	0.75	4	1.44	63	1.35	20
156 0160N8A	15448	1.6	0.8	4	1.54	50	1.4	8
156 0160N12A	15449	1.6	0.8	4	1.54	63	1.4	12
156 0160N16A	15450	1.6	0.8	4	1.54	63	1.4	16
156 0160N20A	15451	1.6	0.8	4	1.54	63	1.4	20
156 0180N8A	15452	1.8	0.9	4	1.73	50	1.6	8
156 0180N12A	15453	1.8	0.9	4	1.73	63	1.6	12
156 0180N16A	15454	1.8	0.9	4	1.73	63	1.6	16
156 0180N20A	15455	1.8	0.9	4	1.73	63	1.6	20
156 0200N3A	15456	2.0	1.0	4	1.92	50	1.7	3
156 0200N4A	15457	2.0	1.0	4	1.92	50	1.7	4
156 0200N6A	15458	2.0	1.0	4	1.92	50	1.7	6
156 0200N8A	15459	2.0	1.0	4	1.92	50	1.7	8
156 0200N10A	15460	2.0	1.0	4	1.92	50	1.7	10
156 0200N12A	15461	2.0	1.0	4	1.92	63	1.7	12
156 0200N16A	15463	2.0	1.0	4	1.92	63	1.7	16
156 0200N20A	15465	2.0	1.0	4	1.92	63	1.7	20
156 0200N25A	15467	2.0	1.0	4	1.92	80	1.7	25
156 0200N30A	15468	2.0	1.0	4	1.92	80	1.7	30
156 0200N35A	15469	2.0	1.0	4	1.92	80	1.7	35
156 0200N40A	15470	2.0	1.0	4	1.92	80	1.7	40
156 0300N8A	15471	3.0	1.5	6	2.88	75	2.5	8
156 0300N10A	15472	3.0	1.5	6	2.88	75	2.5	10
156 0300N16A	15474	3.0	1.5	6	2.88	75	2.5	16
156 0300N25A	15476	3.0	1.5	6	2.88	75	2.5	25
156 0300N30A	15477	3.0	1.5	6	2.88	75	2.5	30
156 0300N35A	15478	3.0	1.5	6	2.88	75	2.5	35
156 0400N10A	15480	4.0	2.0	6	3.9	75	3	10
156 0400N16A	15482	4.0	2.0	6	3.9	75	3	16
156 0400N25A	15484	4.0	2.0	6	3.9	75	3	25
156 0400N35A	15486	4.0	2.0	6	3.9	75	3	35
156 0400N40A	15487	4.0	2.0	6	3.9	75	3	40
156 0400N50A	15489	4.0	2.0	6	3.9	100	3	50
156 0500N25A	15490	5.0	2.5	6	4.9	75	3.5	25



TuffCut® DM Series 156



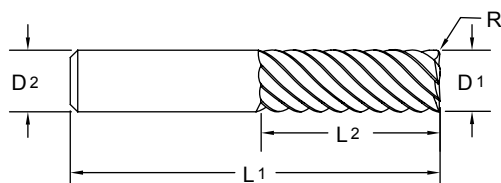
Tool No.	EDP	D1 +0.0/-0.015	R +0.005/- .005	D2 (h5)	D3	L1	L2	L3
156 0500N40A	15493	5.0	2.5	6	4.9	75	3.5	40
156 0600N30A	15494	6.0	3.0	6	5.9	75	4.5	30
156 0600N50A	15495	6.0	3.0	6	5.9	100	4.5	50
156 0800N30A	15666	8.0	4.0	8	7.9	102	5.5	30
156 0800N50A	15667	8.0	4.0	8	7.9	102	5.5	50
156 0100N30A	15670	10.0	5.0	10	9.9	102	6.5	30
156 0100N50A	15671	10.0	5.0	10	9.9	102	6.5	50
156 0120N30A	15672	12.0	6.0	12	11.9	102	7.5	30
156 0120N50A	15673	12.0	6.0	12	11.9	102	7.5	50



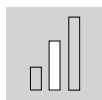
TuffCut® DM Series 157



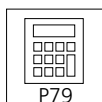
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Non-Center
Cutting



Tool No.	EDP	D1	D2	L1	L2	Z	R
157 0300A	15700	3	6	76	9	4	-
157 0300-0.50RA	15701	3	6	76	9	4	0.50
157 0400A	15708	4	6	76	12	4	-
157 0400-0.50RA	15709	4	6	76	12	4	0.50
157 0500A	15715	5	6	90	15	4	-
157 0500-0.50RA	15716	5	6	90	15	4	0.50
157 0600A	15719	6	6	90	15	6	-
157 0600-0.50RA	15720	6	6	90	15	6	0.50
157 0600-1.00RA	15722	6	6	90	15	6	1.00
157 0800A	15733	8	8	100	20	6	-
157 0800-0.50RA	15734	8	8	100	20	6	0.50
157 0800-1.00RA	15736	8	8	100	20	6	1.00
157 0800-2.00RA	-	8	8	100	20	6	2.00
157 1000A	15743	10	10	100	25	6	-
157 1000-0.50RA	15744	10	10	100	25	6	0.50
157 1000-1.00RA	15746	10	10	100	25	6	1.00
157 1000-1.50RA	15747	10	10	100	25	6	1.50
157 1000-2.00RA	-	10	10	100	25	6	2.00
157 1200A	15748	12	12	100	30	6	-
157 1200-0.50RA	15749	12	12	100	30	6	0.50
157 1200-1.00RA	15751	12	12	100	30	6	1.00
157 1200-1.50RA	15752	12	12	100	30	6	1.50
157 1200-2.00RA	15753	12	12	100	30	6	2.00
157 1200-3.00RA	-	12	12	100	30	6	3.00
157 1600A	15767	16	16	150	40	6	-
157 1600-0.50RA	15768	16	16	150	40	6	0.50
157 1600-1.00RA	15770	16	16	150	40	6	1.00
157 1600-1.50RA	15771	16	16	150	40	6	1.50
157 1600-2.00RA	15772	16	16	150	40	6	2.00
157 1600-3.00RA	15774	16	16	150	40	6	3.00



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TuffCut XR - XT

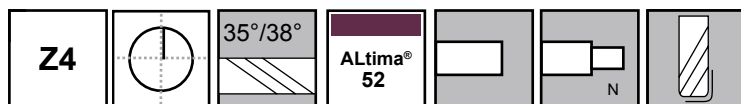
TuffCut X-AL

TuffCut Die & Mould

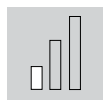
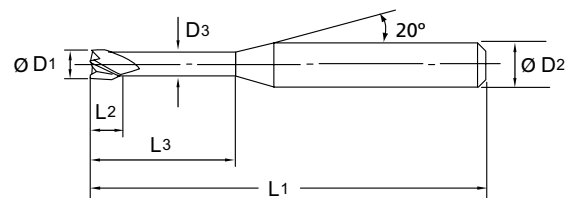
Twister Drills

Technical Section

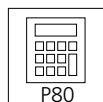
TuffCut® DM Series 158



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2011



Metric No.	EDP	D1 (+0/-0.02)	D2 (h6)	D3	L1	L2	L3	L3/D1	R (+0.02/-0.02)
158 03N3-0.3RB	15526	3	6	2.9	50	5	9	3 x D	0.3
158 03N4-0.3RB	-	3	6	2.9	50	5	12	4 x D	0.3
158 03N5-0.3RB	15528	3	6	2.9	50	5	15	5 x D	0.3
158 03N4-0.8RB	-	3	6	2.9	50	5	12	4 x D	0.8
158 03N5-0.8RB	15530	3	6	2.9	50	5	15	5 x D	0.8
158 06N3-0.3RB	15536	6	6	5.8	100	9	18	3 x D	0.3
158 06N4-0.3RB	-	6	6	5.8	100	9	24	4 x D	0.3
158 06N5-0.3RB	15538	6	6	5.8	100	9	30	5 x D	0.3
158 06N4-1.5RB	-	6	6	5.8	100	9	24	4 x D	1.5
158 06N5-1.5RB	15540	6	6	5.8	100	9	30	5 x D	1.5
158 08N3-0.3RB	15546	8	8	7.6	100	12	24	3 x D	0.3
158 08N4-0.3RB	-	8	8	7.6	100	12	32	4 x D	0.3
158 08N5-0.3RB	15548	8	8	7.6	100	12	40	5 x D	0.3
158 08N4-2.0RB	-	8	8	7.6	100	12	32	4 x D	2.0
158 08N5-2.0RB	15550	8	38	7.6	100	12	40	5 x D	2.0
158 10N3-0.3RB	15556	10	10	9.6	100	15	30	3 x D	0.3
158 10N4-0.3RB	-	10	10	9.6	100	15	40	4 x D	0.3
158 10N5-0.3RB	15558	10	10	9.6	100	15	50	5 x D	0.3
158 10N4-2.0RB	-	10	10	9.6	100	15	40	4 x D	2.0
158 10N5-2.0RB	15560	10	10	9.6	100	15	50	5 x D	2.0
158 12N3-0.3RB	15566	12	12	11.4	100	18	36	3 x D	0.3
158 12N4-0.3RB	-	12	12	11.4	100	18	48	4 x D	0.3
158 12N5-0.3RB	15568	12	12	11.4	130	18	60	5 x D	0.3
158 12N4-2.0RB	-	12	12	11.4	100	18	48	4 x D	2.0
158 12N5-2.0RB	15570	12	12	11.4	130	18	60	5 x D	2.0
158 16N3-0.3RB	15576	16	16	15.2	130	24	48	3 x D	0.3
158 16N4-0.3RB	-	16	16	15.2	130	24	64	4 x D	0.3
158 16N5-0.3RB	15578	16	16	15.2	150	24	80	5 x D	0.3
158 16N4-3.0RB	-	16	16	15.2	130	24	64	4 x D	3.0
158 16N5-3.0RB	15580	16	16	15.2	150	24	80	5 x D	3.0
158 20N4-0.3RB	-	20	20	19.2	150	30	80	4 x D	0.3
158 20N5-0.3RB	15584	20	20	19.2	150	30	100	5 x D	0.3
158 20N4-3.0RB	-	20	20	19.2	150	30	80	4 x D	3.0
158 20N5-3.0RB	15586	20	20	19.2	150	30	100	5 x D	3.0



Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
TOOL STEELS		1.1525	C80W1	Y190;Y180		W108
		1.1545	C105W1	Y1105		W110
	BW1B	1.1625	C80W2		F.1507 C80	W1
		1.1663	C125W	Y2120	F.5123 C120	W112
	BW1A	1.175	C75W			W1
	BL3	1.2067	100Cr6	Y100C6	F.5230 100 Cr6	L3
		1.221	115CrV3			L2
	BO1	1.251	100MnCrW4		F.5220 95 MnCrW5	O1
	BS1	1.2542	45WCrV7	2140	F.5241 45 WCrSi 8	S1
	BW2	1.2833	100V1	Y1105V		W210
	BO2	1.2842	90MnCrV8	90MV8		2
	534A99	1.3505	100Cr6	100C6	F.1310 - 100 Cr 6	S2100
		1.2713	55NiCrMoV6	55NCDV7	F.528	L6
	Grade2A	0.962	G-X260NiCr42			A532IBNiCr-LC
	Grade2B	0.9625	G-X330NiCr42			A532IANiCr-HC
	Grade2C;D;E	0.963	G-X300CrNiSi952			A532IDNi-HiCr
	Grade3A;B	0.964	G-X300CrMoNi1521			
	Grade3C	0.9645	G-X260CrMoNi2021			A532IID20%CrMo-LC
	Grade3D	0.965	G-X260Cr27			A532IIIA25%Cr
	Grade3E	0.9655	G-X300CrMo271			A532IIIA25%Cr
	BD3	1.208	X210Cr12	Z200C12	F.5212 X210 Cr12	D3
	BH11	1.2343	X38CrMoV51	Z38CDV5	F.5317 X37 CrMoV5	H11
	BH13	1.2344	X40CrMoV51	Z40CDV5	F.5318 X40 CrMoV5	H13
	BA2	1.2363	X100CrMoV51	Z100CDV5	F.5227 X100 CrMoV5	A2
	BH10	1.2365	X32CrMoV33	32DCV28	F.5313 CrMoV 12	H10
	BD2	1.2379	X155CrVMo121	Z160CDV12		D2
		1.2436	X210CrW12		F.5213 X210 CrW12	
		1.2567	X30WCrV53	Z32WCV5		
	BH21	1.2581	X30WCrV93	Z30WCV9	F.5323 X30 WCrV9	H21
		1.2601	X165CrMoV12		F.5211 X160 CrMoV12	
	BH12	1.2606	X37CrMoV51	Z35CWDV5		H12
	BT15	1.3202	S12-1-4-5		F.5563 12-1-5-5	T15
		1.3207	S10-4-3-10	Z130WKCDV10-10-04-03	F.553 10-4-3-10	
		1.3243	S6-5-2-5	Z85WDCV06-05-04-02	F.5613 6-5-2-5	
		1.3246	S7-4-2-5	Z110WKCDV07-05-04-04-02	F.5613 6-5-2-5	M41
	BT42	1.3247	S2-10-1-8	Z110DKCWW09-08-04-02-01	F.5615 7-4-2-5	M42
	BM34	1.3249	S2-9-2-8		F.5611 2-9-2-8	M33/M34
	BT4	1.3255	S18-1-2-5	Z80WKCV18-05-04-01	F.5530 18-1-1-5	T4
	BT5	1.3265	S18-1-2-10		F.5540 18-0-2-10	T5
		1.3342	SC6-5-2	Z90WDCV06-05-04-03		M3
	BM2	1.3343	S6-5-2	Z85WDCV06-05-04-02	F.5603 6-5-2	M2
		1.3344	S6-5-3	Z130WDCV06-05-04-04	F.5605 6-5-3	M3Class2
	BM1	1.3346	S2-9-1	Z85DCVW08-04-02-01		H41/M1
		1.3348	S2-9-2	Z100DCVW09-04-02-02	F.5607 2-9-2	M7
	BT1	1.3355	S18-0-1	Z80WCV18-04-01	F.5520 18-0-1	T1
		1.3401	X120Mn12	Z120M12 / Z120Mn12	F.82551-AM-X 120 Mn 12	A128(A)

TuffCut XR - XT

TuffCut X-AL

TuffCut Die & Mould

Twister Drills

Technical Section



Twister Drills

*Xtreme High Performance Drilling
with
Xtended tool life in a broad range of materials*

Features

- Advanced "Active Cut" Geometric Design
- Refined Critical Cut Zone Characteristics
- High-Efficiency Flute Profile
- "State-of-the-Art" Proprietary Coating
- Stable Low-Thrust Point Form
- Coolant-Fed or Solid
- Diameter Range - .5mm to 20.0mm
- Stub (3x), Regular (5x), Long Flute Lengths (7x+) (12x-25x) and Micro (10x)
- Engineered & Produced in the USA

Benefits

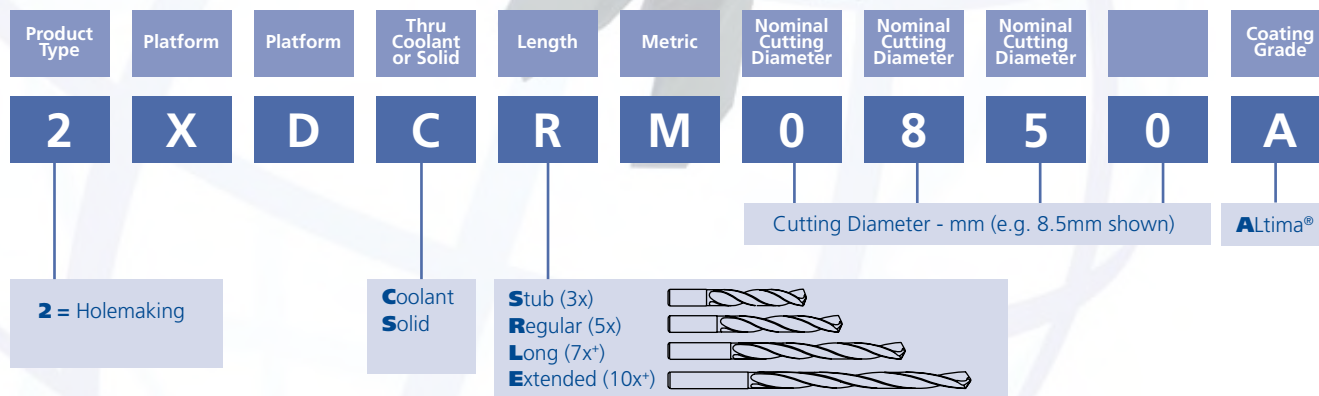
- Extended Tool Life
- Elevated Metal Removal Rates (MRR)
- Lower Cost Per Hole
- Improved Hole/Part Quality
- Increased Tool Reliability
- Factory Trained Network of Application & Technical Specialists
- Factory Reconditioning Service
- Ideal Platform for Modification or an Engineered "Special" Tool
- Compatibility to a Wide Range of Standard Toolholder Systems

Tolerances

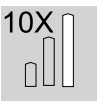
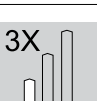
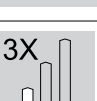
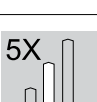
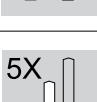
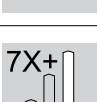
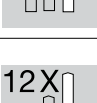
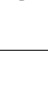
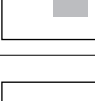
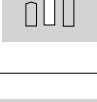
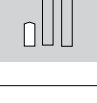
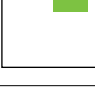
Drill Dia. (h7)	Tolerance
0 - 3.0	+0/-.010
3.01 - 6.0	+0/-.012
6.01 - 10.0	+0/-.015
10.01 - 18.0	+0/-.018
18.01 - 30.0	+0/-.021

Shank Dia. (h6)	Tolerance
0 - 3.0	+0/-.006
3.01 - 6.0	+0/-.008
6.01 - 10.0	+0/-.009
10.01 - 18.0	+0/-.011
18.01 - 30.0	+0/-.013

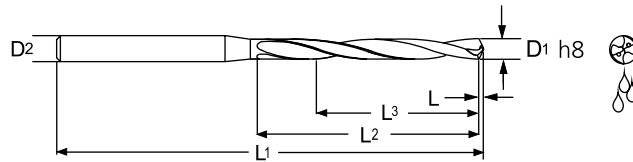
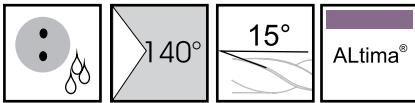
New easy read numbering system



Contents Vue d'Ensemble

	Series	Lengths	Diameter Range	Application Area	Page
 	2MDCLM		2.0 - 2.95		38
 	2XDSSM		2.5 - 20.0		39
 	2MDCSM		3.0 - 16.0		42
 	2XD SRM		0.5 - 16.0		45
 	2XD CRM		3.0 - 20.0		48
 	2XDCLM		3.0 - 12.0		51
 	2XDCEM		3.0 - 12.7		54
 	200S		3.0 - 16.0		56
 	200A		3.0 - 20.0		57
 	205B		0.3 - 20.0		60
 	207		2.4 - 12.0		64
 	229		2.0 - 16.0		66
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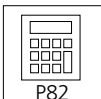
Twister® MD 2MDCLM



10X



Metric No.	EDP	D1 (Tol h8)	D2	L1	L2	L3	L4
2MDCLM0200A	04198	2.00	3	68	24	18	0.31
2MDCLM0205A	04200	2.05	3	74	28	21	0.32
2MDCLM0210A	04202	2.10	3	74	28	21	0.33
2MDCLM0215A	04204	2.15	3	74	28	21	0.33
2MDCLM0220A	04206	2.20	3	74	28	21	0.34
2MDCLM0225A	04208	2.25	3	74	28	21	0.35
2MDCLM0230A	04210	2.30	3	74	28	21	0.36
2MDCLM0235A	04212	2.35	3	74	28	21	0.36
2MDCLM0240A	04214	2.40	3	74	28	21	0.37
2MDCLM0245A	04216	2.45	3	74	28	21	0.38
2MDCLM0250A	04218	2.50	3	74	28	21	0.39
2MDCLM0255A	04220	2.55	3	81	34	25.5	0.4
2MDCLM0260A	04222	2.60	3	81	34	25.5	0.4
2MDCLM0265A	04224	2.65	3	81	34	25.5	0.41
2MDCLM0270A	04226	2.70	3	81	34	25.5	0.42
2MDCLM0275A	04228	2.75	3	81	34	25.5	0.43
2MDCLM0280A	04230	2.80	3	81	34	25.5	0.43
2MDCLM0285A	04232	2.85	3	81	34	25.5	0.44
2MDCLM0290A	04234	2.90	3	81	34	25.5	0.45
2MDCLM0295A	04236	2.95	3	81	34	25.5	0.46



Tolerances

Drill Dia. (h8)	Tolerance
2.0 - 2.95	+0/-0.014

Shank Dia. (h6)	Tolerance
3.0	+0/-0.006

Machine Requirements

High Pressure Pump System (1000 psi)
Coolant filtration of 10 microns or better
Machine runout of .0004" (.01mm) Max.

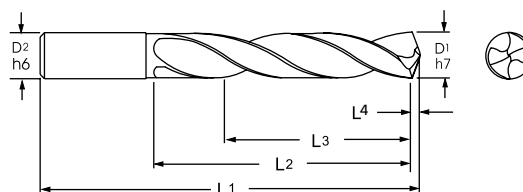
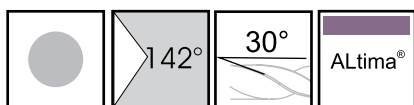
Estimated Peck Depths

For hole depths up to 6x diameter No pecks
For hole depths up to 10x diameter 0-2 pecks
For hole depths up to 15x diameter 2-4 pecks

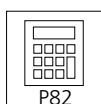
M.A. Ford® recommends full retraction of the body of the drill from the hole during the peck cycle. It is recommended to leave the drill point within the hole.

For hole depths deeper than 4x the diameter, M.A. Ford® recommends using a "soft start" program that drills to .5x diameter deep at 2/3 of the speed and feed.

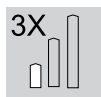
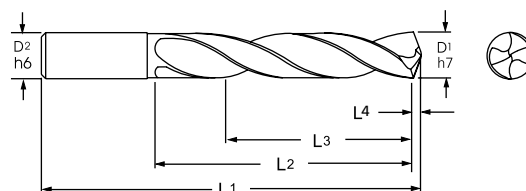
Twister Xtreme Drilling® 2XDSSM



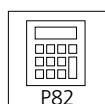
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDSSM0250A	22601	2.5	2.5	43	14	11	0.39
2XDSSM0290A	22602	2.9	2.9	46	16	12	0.45
2XDSSM0300A	02100	3.0	3.0	57	16	13	0.46
2XDSSM0310A	02103	3.1	4.0	63	22	18	0.48
2XDSSM0320A	02106	3.2	4.0	63	22	18	0.50
2XDSSM0330A	02110	3.3	4.0	63	22	18	0.51
2XDSSM0340A	02112	3.4	4.0	63	22	18	0.53
2XDSSM0350A	02116	3.5	4.0	63	22	18	0.54
2XDSSM0360A	02119	3.6	4.0	63	22	18	0.56
2XDSSM0370A	02120	3.7	4.0	63	22	18	0.57
2XDSSM0380A	02122	3.8	4.0	63	22	18	0.59
2XDSSM0390A	02123	3.9	4.0	63	22	18	0.60
2XDSSM0400A	02126	4.0	4.0	63	22	18	0.62
2XDSSM0410A	04000	4.1	5.0	63	26	21	0.64
2XDSSM0420A	02128	4.2	5.0	63	26	21	0.65
2XDSSM0430A	02129	4.3	5.0	63	26	21	0.67
2XDSSM0440A	02131	4.4	5.0	63	26	21	0.68
2XDSSM0450A	02132	4.5	5.0	63	26	21	0.70
2XDSSM0460A	02134	4.6	5.0	63	26	21	0.71
2XDSSM0470A	02135	4.7	5.0	63	26	21	0.73
2XDSSM0480A	02138	4.8	5.0	63	26	21	0.74
2XDSSM0490A	02140	4.9	5.0	63	26	21	0.76
2XDSSM0500A	02142	5.0	5.0	63	26	21	0.77
2XDSSM0510A	02144	5.1	6.0	76	30	24	0.79
2XDSSM0520A	02148	5.2	6.0	76	30	24	0.81
2XDSSM0530A	02150	5.3	6.0	76	30	24	0.82
2XDSSM0540A	02152	5.4	6.0	76	30	24	0.84
2XDSSM0550A	02154	5.5	6.0	76	30	24	0.85
2XDSSM0570A	02160	5.7	6.0	76	30	24	0.88
2XDSSM0580A	02162	5.8	6.0	76	30	24	0.90
2XDSSM0590A	02164	5.9	6.0	76	30	24	0.91
2XDSSM0600A	02168	6.0	6.0	76	30	24	0.93
2XDSSM0610A	02170	6.1	8.0	82	35	28	0.95
2XDSSM0620A	02174	6.2	8.0	82	35	28	0.96
2XDSSM0630A	02178	6.3	8.0	82	35	28	0.98
2XDSSM0640A	02182	6.4	8.0	82	35	28	0.99
2XDSSM0650A	02184	6.5	8.0	82	35	28	1.01
2XDSSM0660A	02185	6.6	8.0	82	35	28	1.03
2XDSSM0670A	02189	6.7	8.0	82	35	28	1.04
2XDSSM0680A	02192	6.8	8.0	82	35	28	1.05
2XDSSM0690A	02194	6.9	8.0	82	35	28	1.07



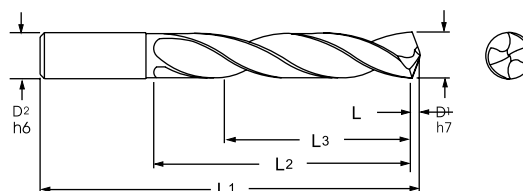
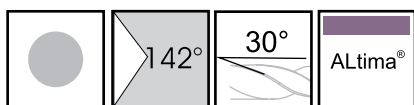
Twister ^{XTreme Drilling} 2XDSSM



Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDSSM0700A	02196	7.0	8	82	35	28	1.08
2XDSSM0710A	02197	7.1	8	82	38	31	1.10
2XDSSM0720A	02200	7.2	8	82	38	31	1.12
2XDSSM0730A	02201	7.3	8	82	38	31	1.13
2XDSSM0740A	02202	7.4	8	82	38	31	1.15
2XDSSM0750A	02204	7.5	8	82	38	31	1.16
2XDSSM0760A	02208	7.6	8	82	38	31	1.18
2XDSSM0770A	02210	7.7	8	82	38	31	1.19
2XDSSM0780A	02212	7.8	8	82	38	31	1.21
2XDSSM0790A	02213	7.9	8	82	38	31	1.22
2XDSSM0800A	02216	8.0	8	82	38	31	1.24
2XDSSM0810A	02218	8.1	10	89	43	35	1.26
2XDSSM0820A	02220	8.2	10	89	43	35	1.27
2XDSSM0830A	02222	8.3	10	89	43	35	1.29
2XDSSM0840A	02223	8.4	10	89	43	35	1.31
2XDSSM0850A	02226	8.5	10	89	43	35	1.32
2XDSSM0860A	02227	8.6	10	89	43	35	1.33
2XDSSM0870A	04001	8.7	10	89	43	35	1.35
2XDSSM0880A	02230	8.8	10	89	43	35	1.36
2XDSSM0890A	02232	8.9	10	89	43	35	1.38
2XDSSM0900A	02234	9.0	10	89	43	35	1.39
2XDSSM0910A	02235	9.1	10	89	43	35	1.41
2XDSSM0920A	02238	9.2	10	89	43	35	1.43
2XDSSM0925A	02240	9.25	10	89	43	35	1.43
2XDSSM0930A	02242	9.3	10	89	43	35	1.44
2XDSSM0940A	02243	9.4	10	89	43	35	1.46
2XDSSM0950A	02244	9.5	10	89	43	35	1.47
2XDSSM0960A	02247	9.6	10	89	43	35	1.49
2XDSSM0970A	02248	9.7	10	89	43	35	1.50
2XDSSM0980A	02250	9.8	10	89	43	35	1.52
2XDSSM0990A	02251	9.9	10	89	43	35	1.53
2XDSSM1000A	02254	10.0	10	89	43	35	1.55
2XDSSM1010A	02255	10.1	10	101	51	41	1.56
2XDSSM1020A	02256	10.2	10	101	51	41	1.58
2XDSSM1030A	02257	10.3	10	101	51	41	1.60
2XDSSM1040A	02259	10.4	10	101	51	41	1.61
2XDSSM1050A	02260	10.5	10	101	51	41	1.63
2XDSSM1060A	02261	10.6	10	101	51	41	1.64
2XDSSM1070A	04002	10.7	10	101	51	41	1.66
2XDSSM1080A	02263	10.8	10	101	51	41	1.67
2XDSSM1090A	04003	10.9	10	101	51	41	1.69



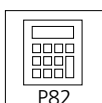
Twister ^{Xtreme Drilling} 2XDSSM



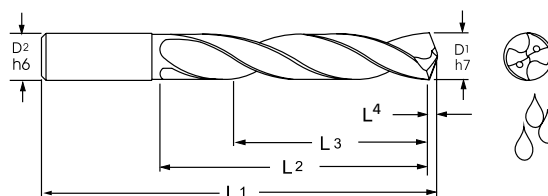
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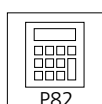
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDSSM1100A	02264	11.0	12	101	51	41	1.70
2XDSSM1110A	02265	11.1	12	101	51	41	1.72
2XDSSM1120A	02268	11.2	12	101	51	41	1.74
2XDSSM1130A	02269	11.3	12	101	51	41	1.75
2XDSSM1140A	04004	11.4	12	101	51	41	1.77
2XDSSM1150A	02270	11.5	12	101	51	41	1.78
2XDSSM1160A	02271	11.6	12	101	51	41	1.80
2XDSSM1170A	02272	11.7	12	101	51	41	1.81
2XDSSM1180A	02273	11.8	12	101	51	41	1.83
2XDSSM1190A	04005	11.9	12	101	51	41	1.84
2XDSSM1200A	02276	12.0	12	101	51	41	1.86
2XDSSM1210A	02278	12.1	14	107	54	43	1.87
2XDSSM1250A	02282	12.5	14	107	54	43	1.94
2XDSSM1280A	02286	12.8	14	107	54	43	1.98
2XDSSM1290A	02287	12.9	14	107	54	43	2.00
2XDSSM1300A	02288	13.0	14	107	54	43	2.01
2XDSSM1350A	02292	13.5	14	107	54	43	2.09
2XDSSM1370A	02294	13.7	14	107	54	43	2.12
2XDSSM1400A	02298	14.0	14	107	54	43	2.17
2XDSSM1450A	02302	14.5	16	117	60	48	2.25
2XDSSM1470A	02304	14.7	16	117	60	48	2.28
2XDSSM1500A	02306	15.0	16	117	60	48	2.32
2XDSSM1530A	02309	15.3	16	117	60	48	2.37
2XDSSM1550A	02310	15.5	16	117	60	48	2.40
2XDSSM1570A	02312	15.7	16	117	60	48	2.43
2XDSSM1600A	02316	16.0	16	117	60	48	2.48
2XDSSM1608A	02318	16.08	18	122	63	51	2.49
2XDSSM1630A	02319	16.3	18	122	63	51	2.53
2XDSSM1650A	02320	16.5	18	122	63	51	2.56
2XDSSM1700A	02324	17.0	18	122	63	51	2.63
2XDSSM1750A	02328	17.5	18	122	63	51	2.71
2XDSSM1800A	02330	18.0	18	122	63	51	2.79
2XDSSM1850A	02332	18.5	20	133	70	56	2.87
2XDSSM1916A	02336	19.16	20	133	70	56	2.97
2XDSSM1925A	02338	19.25	20	133	70	56	2.98
2XDSSM1930A	02340	19.3	20	133	70	56	2.99
2XDSSM1950A	02342	19.5	20	133	70	56	3.02
2XDSSM2000A	02344	20.0	20	133	70	56	3.10



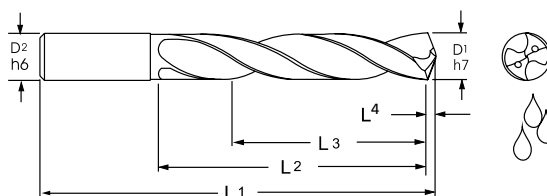
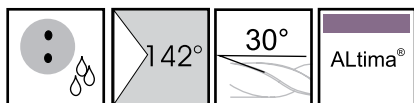
Twister ^{XTreme Drilling} 2XDCSM



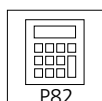
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCSM0300A	04400	3.0	3	57	16	13	0.46
2XDCSM0310A	04404	3.1	4	63	22	18	0.48
2XDCSM0320A	04408	3.2	4	63	22	18	0.50
2XDCSM0330A	04412	3.3	4	63	22	18	0.51
2XDCSM0340A	04414	3.4	4	63	22	18	0.53
2XDCSM0350A	04418	3.5	4	63	22	18	0.54
2XDCSM0360A	04422	3.6	4	63	22	18	0.56
2XDCSM0370A	04424	3.7	4	63	22	18	0.57
2XDCSM0380A	04426	3.8	4	63	22	18	0.59
2XDCSM0390A	04430	3.9	4	63	22	18	0.60
2XDCSM0400A	04434	4.0	4	63	22	18	0.62
2XDCSM0410A	04438	4.1	5	63	26	21	0.64
2XDCSM0420A	04440	4.2	5	63	26	21	0.65
2XDCSM0430A	04442	4.3	5	63	26	21	0.67
2XDCSM0440A	04446	4.4	5	63	26	21	0.68
2XDCSM0450A	04448	4.5	5	63	26	21	0.70
2XDCSM0460A	04450	4.6	5	63	26	21	0.71
2XDCSM0470A	04452	4.7	5	63	26	21	0.73
2XDCSM0480A	04456	4.8	5	63	26	21	0.74
2XDCSM0490A	04458	4.9	5	63	26	21	0.76
2XDCSM0500A	04460	5.0	5	63	26	21	0.77
2XDCSM0510A	04462	5.1	6	66	28	20	0.79
2XDCSM0520A	04466	5.2	6	66	28	20	0.81
2XDCSM0530A	04468	5.3	6	66	28	20	0.82
2XDCSM0540A	04470	5.4	6	66	28	20	0.84
2XDCSM0550A	04472	5.5	6	66	28	20	0.85
2XDCSM0570A	04478	5.7	6	66	28	20	0.88
2XDCSM0580A	04480	5.8	6	66	28	20	0.90
2XDCSM0590A	04482	5.9	6	66	28	20	0.91
2XDCSM0600A	04486	6.0	6	66	28	20	0.93
2XDCSM0610A	04488	6.1	8	79	34	24	0.95
2XDCSM0620A	04492	6.2	8	79	34	24	0.96
2XDCSM0630A	04496	6.3	8	79	34	24	0.98
2XDCSM0640A	04500	6.4	8	79	34	24	0.99
2XDCSM0650A	04502	6.5	8	79	34	24	1.01
2XDCSM0660A	04506	6.6	8	79	34	24	1.03
2XDCSM0670A	04510	6.7	8	79	34	24	1.04
2XDCSM0680A	04514	6.8	8	79	34	24	1.05
2XDCSM0690A	04516	6.9	8	79	34	24	1.07
2XDCSM0700A	04518	7.0	8	79	34	24	1.08
2XDCSM0710A	04520	7.1	8	79	41	29	1.10



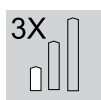
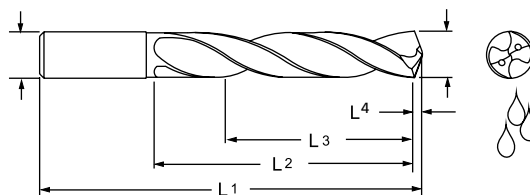
Twister X[®]D Xtreme Drilling 2XDCSM



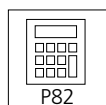
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCSM0720A	04524	7.2	8	79	41	29	1.12
2XDCSM0730A	04526	7.3	8	79	41	29	1.13
2XDCSM0740A	04528	7.4	8	79	41	29	1.15
2XDCSM0750A	04530	7.5	8	79	41	29	1.16
2XDCSM0760A	04534	7.6	8	79	41	29	1.18
2XDCSM0770A	04536	7.7	8	79	41	29	1.19
2XDCSM0780A	04538	7.8	8	79	41	29	1.21
2XDCSM0790A	04540	7.9	8	79	41	29	1.22
2XDCSM0800A	04544	8.0	8	79	41	29	1.24
2XDCSM0810A	04546	8.1	10	89	47	35	1.26
2XDCSM0820A	04548	8.2	10	89	47	35	1.27
2XDCSM0830A	04550	8.3	10	89	47	35	1.29
2XDCSM0840A	04554	8.4	10	89	47	35	1.31
2XDCSM0850A	04558	8.5	10	89	47	35	1.32
2XDCSM0860A	04560	8.6	10	89	47	35	1.33
2XDCSM0870A	04562	8.7	10	89	47	35	1.35
2XDCSM0880A	04566	8.8	10	89	47	35	1.36
2XDCSM0890A	04568	8.9	10	89	47	35	1.38
2XDCSM0900A	04570	9.0	10	89	47	35	1.39
2XDCSM0910A	04572	9.1	10	89	47	35	1.41
2XDCSM0920A	04576	9.2	10	89	47	35	1.43
2XDCSM0925A	04578	9.25	10	89	47	35	1.43
2XDCSM0930A	04580	9.3	10	89	47	35	1.44
2XDCSM0940A	04582	9.4	10	89	47	35	1.46
2XDCSM0950A	04584	9.5	10	89	47	35	1.47
2XDCSM0960A	04588	9.6	10	89	47	35	1.49
2XDCSM0970A	04590	9.7	10	89	47	35	1.50
2XDCSM0980A	04592	9.8	10	89	47	35	1.52
2XDCSM0990A	04594	9.9	10	89	47	35	1.53
2XDCSM1000A	04598	10.0	10	89	47	35	1.55
2XDCSM1010A	04600	10.1	12	102	55	40	1.56
2XDCSM1020A	04602	10.2	12	102	55	40	1.58
2XDCSM1030A	04604	10.3	12	102	55	40	1.60
2XDCSM1040A	04608	10.4	12	102	55	40	1.61
2XDCSM1050A	04610	10.5	12	102	55	40	1.63
2XDCSM1060A	04612	10.6	12	102	55	40	1.64
2XDCSM1070A	04614	10.7	12	102	55	40	1.66
2XDCSM1080A	04618	10.8	12	102	55	40	1.67
2XDCSM1090A	04620	10.9	12	102	55	40	1.69
2XDCSM1100A	04622	11.0	12	102	55	40	1.70
2XDCSM1110A	04624	11.1	12	102	55	40	1.72



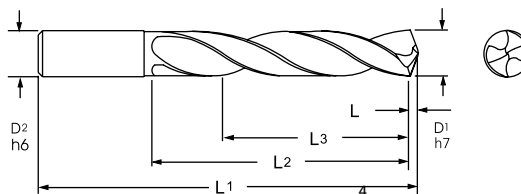
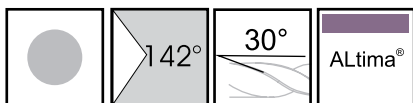
Twister [®] Xtreme Drilling 2XDCSM



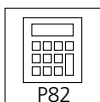
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCSM1120A	04628	11.2	12	102	55	40	1.74
2XDCSM1130A	04630	11.3	12	102	55	40	1.75
2XDCSM1140A	04632	11.4	12	102	55	40	1.77
2XDCSM1150A	04634	11.5	12	102	55	40	1.78
2XDCSM1160A	04636	11.6	12	102	55	40	1.80
2XDCSM1170A	04638	11.7	12	102	55	40	1.81
2XDCSM1180A	04640	11.8	12	102	55	40	1.83
2XDCSM1190A	04642	11.9	12	102	55	40	1.84
2XDCSM1200A	04646	12.0	12	102	55	40	1.86
2XDCSM1210A	04648	12.1	14	107	60	43	1.87
2XDCSM1250A	04652	12.5	14	107	60	43	1.94
2XDCSM1280A	04656	12.8	14	107	60	43	1.98
2XDCSM1283A	04658	12.83	14	107	60	43	1.99
2XDCSM1290A	04660	12.9	14	107	60	43	2.00
2XDCSM1300A	04662	13.0	14	107	60	43	2.01
2XDCSM1350A	04666	13.5	14	107	60	43	2.09
2XDCSM1370A	04668	13.7	14	107	60	43	2.12
2XDCSM1400A	04672	14.0	14	107	60	43	2.17
2XDCSM1450A	04676	14.5	16	115	65	45	2.25
2XDCSM1470A	04678	14.7	16	115	65	45	2.28
2XDCSM1500A	04680	15.0	16	115	65	45	2.32
2XDCSM1530A	04684	15.3	16	115	65	45	2.37
2XDCSM1550A	04686	15.5	16	115	65	45	2.40
2XDCSM1570A	04688	15.7	16	115	65	45	2.43
2XDCSM1600A	04692	16.0	16	115	65	45	2.48



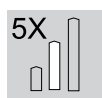
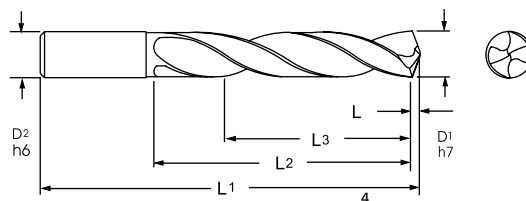
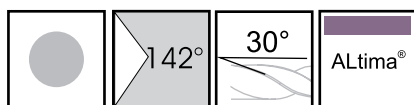
Twister ^{XTreme Drilling} 2XDSRM



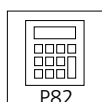
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDSRM0050A	28001	0.5	0.5	26	6	5	0.08
2XDSRM0060A	28006	0.6	0.6	26	7	5	0.09
2XDSRM0065A	28011	0.65	0.65	26	8	6	0.10
2XDSRM0095A	28016	0.95	0.95	32	11	8	0.15
2XDSRM0100A	28021	1.0	1.0	34	12	9	0.16
2XDSRM0105A	28026	1.05	1.05	34	12	9	0.16
2XDSRM0125A	28031	1.25	1.25	38	16	12	0.19
2XDSRM0150A	28036	1.5	1.5	40	18	14	0.23
2XDSRM0160A	28041	1.6	1.6	43	20	15	0.25
2XDSRM0180A	28046	1.8	1.8	46	22	17	0.28
2XDSRM0190A	28051	1.9	1.9	46	22	17	0.29
2XDSRM0200A	28056	2.0	2.0	49	24	18	0.31
2XDSRM0205A	28058	2.05	2.05	49	24	18	0.32
2XDSRM0230A	28061	2.3	2.3	53	27	20	0.36
2XDSRM0240A	28066	2.4	2.4	57	30	23	0.37
2XDSRM0250A	28071	2.5	2.5	57	30	23	0.39
2XDSRM0290A	28073	2.9	2.9	61	33	25	0.45
2XDSRM0300A	02346	3.0	3.0	63	24	19	0.46
2XDSRM0310A	02349	3.1	4.0	69	32	26	0.48
2XDSRM0320A	02352	3.2	4.0	69	32	26	0.50
2XDSRM0330A	02356	3.3	4.0	69	32	26	0.51
2XDSRM0340A	02358	3.4	4.0	69	32	26	0.53
2XDSRM0350A	02362	3.5	4.0	69	32	26	0.54
2XDSRM0360A	02365	3.6	4.0	69	32	26	0.56
2XDSRM0370A	02366	3.7	4.0	69	32	26	0.57
2XDSRM0380A	02368	3.8	4.0	69	32	26	0.59
2XDSRM0390A	02369	3.9	4.0	69	32	26	0.60
2XDSRM0400A	02372	4.0	4.0	69	32	26	0.62
2XDSRM0410A	04006	4.1	5.0	80	38	30	0.64
2XDSRM0420A	02374	4.2	5.0	80	38	30	0.65
2XDSRM0430A	02375	4.3	5.0	80	38	30	0.67
2XDSRM0440A	02377	4.4	5.0	80	38	30	0.68
2XDSRM0450A	02378	4.5	5.0	80	38	30	0.70
2XDSRM0460A	02380	4.6	5.0	80	38	30	0.71
2XDSRM0470A	02381	4.7	5.0	80	38	30	0.73
2XDSRM0480A	02384	4.8	5.0	80	38	30	0.74
2XDSRM0490A	02386	4.9	5.0	80	38	30	0.76
2XDSRM0500A	02388	5.0	5.0	80	38	30	0.77
2XDSRM0510A	02390	5.1	6.0	82	40	32	0.79
2XDSRM0520A	02394	5.2	6.0	82	40	32	0.81
2XDSRM0530A	02396	5.3	6.0	82	40	32	0.82



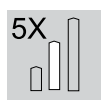
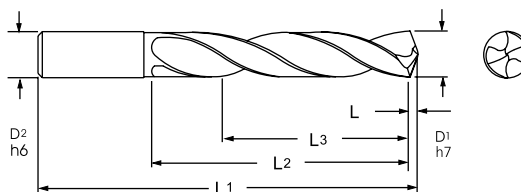
Twister ^{XTreme Drilling} 2XDSRM



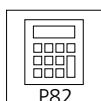
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDSRM0540A	02398	5.4	6	82	40	32	0.84
2XDSRM0550A	02400	5.5	6	82	40	32	0.85
2XDSRM0570A	02406	5.7	6	82	40	32	0.88
2XDSRM0580A	02408	5.8	6	82	40	32	0.90
2XDSRM0590A	02410	5.9	6	82	40	32	0.91
2XDSRM0600A	02414	6.0	6	82	40	32	0.93
2XDSRM0610A	02416	6.1	8	91	48	38	0.95
2XDSRM0620A	02420	6.2	8	91	48	38	0.96
2XDSRM0630A	02424	6.3	8	91	48	38	0.98
2XDSRM0640A	02428	6.4	8	91	48	38	0.99
2XDSRM0650A	02430	6.5	8	91	48	38	1.01
2XDSRM0660A	02433	6.6	8	91	48	38	1.03
2XDSRM0670A	02435	6.7	8	91	48	38	1.04
2XDSRM0680A	02438	6.8	8	91	48	38	1.05
2XDSRM0690A	02440	6.9	8	91	48	38	1.07
2XDSRM0700A	02442	7.0	8	91	48	38	1.08
2XDSRM0710A	02443	7.1	8	91	48	38	1.10
2XDSRM0720A	02446	7.2	8	91	48	38	1.12
2XDSRM0730A	02447	7.3	8	91	48	38	1.13
2XDSRM0740A	02448	7.4	8	91	48	38	1.15
2XDSRM0750A	02450	7.5	8	91	48	38	1.16
2XDSRM0760A	02454	7.6	8	91	48	38	1.18
2XDSRM0770A	02456	7.7	8	91	48	38	1.19
2XDSRM0780A	02458	7.8	8	91	48	38	1.21
2XDSRM0790A	02459	7.9	8	91	48	38	1.22
2XDSRM0800A	02480	8.0	8	91	48	38	1.24
2XDSRM0810A	02482	8.1	10	103	55	44	1.26
2XDSRM0820A	02484	8.2	10	103	55	44	1.27
2XDSRM0830A	02486	8.3	10	103	55	44	1.29
2XDSRM0840A	02487	8.4	10	103	55	44	1.31
2XDSRM0850A	02490	8.5	10	103	55	44	1.32
2XDSRM0860A	02491	8.6	10	103	55	44	1.33
2XDSRM0870A	04007	8.7	10	103	55	44	1.35
2XDSRM0880A	02494	8.8	10	103	55	44	1.36
2XDSRM0890A	02496	8.9	10	103	55	44	1.38
2XDSRM0900A	02498	9.0	10	103	55	44	1.39
2XDSRM0910A	02499	9.1	10	103	55	44	1.41
2XDSRM0920A	02502	9.2	10	103	55	44	1.43
2XDSRM0925A	02504	9.25	10	103	55	44	1.43
2XDSRM0930A	02506	9.3	10	103	55	44	1.44
2XDSRM0940A	02507	9.4	10	103	55	44	1.46



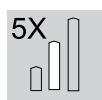
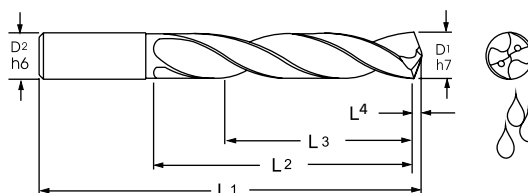
Twister X[®] 2XDSRM



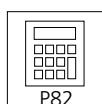
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDSRM0950A	02508	9.5	10	103	55	44	1.47
2XDSRM0960A	02511	9.6	10	103	55	44	1.49
2XDSRM0970A	02512	9.7	10	103	55	44	1.50
2XDSRM0980A	02514	9.8	10	103	55	44	1.52
2XDSRM0990A	02515	9.9	10	103	55	44	1.53
2XDSRM1000A	02518	10.0	10	103	55	44	1.55
2XDSRM1010A	02519	10.1	12	120	60	48	1.56
2XDSRM1020A	02520	10.2	12	120	60	48	1.58
2XDSRM1030A	02521	10.3	12	120	60	48	1.60
2XDSRM1040A	02523	10.4	12	120	60	48	1.61
2XDSRM1050A	02524	10.5	12	120	60	48	1.63
2XDSRM1060A	02525	10.6	12	120	60	48	1.64
2XDSRM1070A	04008	10.7	12	120	60	48	1.66
2XDSRM1080A	02527	10.8	12	120	60	48	1.67
2XDSRM1090A	04009	10.9	12	120	60	48	1.69
2XDSRM1100A	02528	11.0	12	120	60	48	1.70
2XDSRM1110A	02529	11.1	12	120	66	53	1.72
2XDSRM1120A	02532	11.2	12	120	66	53	1.74
2XDSRM1130A	02533	11.3	12	120	66	53	1.75
2XDSRM1140A	04010	11.4	12	120	66	53	1.77
2XDSRM1150A	02534	11.5	12	120	66	53	1.78
2XDSRM1160A	02535	11.6	12	120	66	53	1.80
2XDSRM1170A	02536	11.7	12	120	66	53	1.81
2XDSRM1180A	02537	11.8	12	120	66	53	1.83
2XDSRM1190A	04011	11.9	12	120	66	53	1.84
2XDSRM1200A	02540	12.0	12	120	66	53	1.86
2XDSRM1210A	02542	12.1	14	126	72	58	1.87
2XDSRM1250A	02546	12.5	14	126	72	58	1.94
2XDSRM1280A	02550	12.8	14	126	72	58	1.98
2XDSRM1290A	02551	12.9	14	126	72	58	2.00
2XDSRM1300A	02552	13.0	14	126	72	58	2.01
2XDSRM1350A	02556	13.5	14	134	77	62	2.09
2XDSRM1370A	02558	13.7	14	134	77	62	2.12
2XDSRM1400A	02562	14.0	14	134	77	62	2.17
2XDSRM1450A	02566	14.5	16	140	80	64	2.25
2XDSRM1470A	02568	14.7	16	140	80	64	2.28
2XDSRM1500A	02570	15.0	16	140	80	64	2.32
2XDSRM1530A	02573	15.3	16	146	82	66	2.37
2XDSRM1550A	02574	15.5	16	146	82	66	2.40
2XDSRM1570A	02576	15.7	16	146	82	66	2.43
2XDSRM1600A	02580	16.0	16	146	82	66	2.48



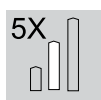
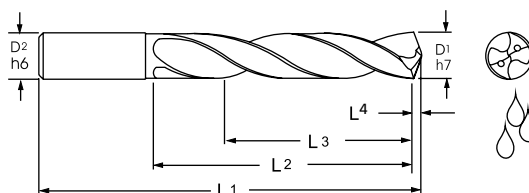
Twister ^{XD} Xtreme Drilling 2XDCRM



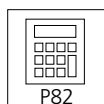
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCRM0300A	02582	3.0	3	75	24	19	0.46
2XDCRM0310A	02585	3.1	4	80	32	26	0.48
2XDCRM0320A	02590	3.2	4	80	32	26	0.50
2XDCRM0330A	02594	3.3	4	80	32	26	0.51
2XDCRM0340A	02596	3.4	4	80	32	26	0.53
2XDCRM0350A	02600	3.5	4	80	32	26	0.54
2XDCRM0360A	02603	3.6	4	80	32	26	0.56
2XDCRM0370A	02604	3.7	4	80	32	26	0.57
2XDCRM0380A	02606	3.8	4	80	32	26	0.59
2XDCRM0390A	02607	3.9	4	80	32	26	0.60
2XDCRM0400A	02610	4.0	4	80	32	26	0.62
2XDCRM0410A	04012	4.1	5	82	38	30	0.64
2XDCRM0420A	02612	4.2	5	82	38	30	0.65
2XDCRM0430A	02613	4.3	5	82	38	30	0.67
2XDCRM0440A	02615	4.4	5	82	38	30	0.68
2XDCRM0450A	02616	4.5	5	82	38	30	0.70
2XDCRM0460A	02618	4.6	5	82	38	30	0.71
2XDCRM0470A	02619	4.7	5	82	38	30	0.73
2XDCRM0480A	02622	4.8	5	82	38	30	0.74
2XDCRM0490A	02624	4.9	5	82	38	30	0.76
2XDCRM0500A	02626	5.0	5	82	38	30	0.77
2XDCRM0510A	02628	5.1	6	82	40	32	0.79
2XDCRM0520A	02632	5.2	6	82	40	32	0.81
2XDCRM0530A	02634	5.3	6	82	40	32	0.82
2XDCRM0540A	02636	5.4	6	82	40	32	0.84
2XDCRM0550A	02638	5.5	6	82	40	32	0.85
2XDCRM0570A	02644	5.7	6	82	40	32	0.88
2XDCRM0580A	02646	5.8	6	82	40	32	0.90
2XDCRM0590A	02648	5.9	6	82	40	32	0.91
2XDCRM0600A	02652	6.0	6	82	40	32	0.93
2XDCRM0610A	02654	6.1	8	91	48	38	0.95
2XDCRM0620A	02658	6.2	8	91	48	38	0.96
2XDCRM0630A	02662	6.3	8	91	48	38	0.98
2XDCRM0640A	02666	6.4	8	91	48	38	0.99
2XDCRM0650A	02668	6.5	8	91	48	38	1.01
2XDCRM0660A	02671	6.6	8	91	48	38	1.03
2XDCRM0670A	02673	6.7	8	91	48	38	1.04
2XDCRM0680A	02676	6.8	8	91	48	38	1.05
2XDCRM0690A	02678	6.9	8	91	48	38	1.07
2XDCRM0700A	02680	7.0	8	91	48	38	1.08
2XDCRM0710A	02681	7.1	8	91	48	38	1.10



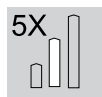
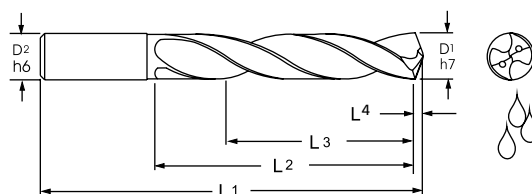
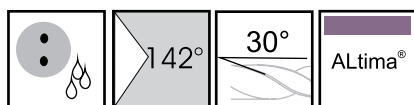
Twister Xtreme Drilling® 2XDCRM



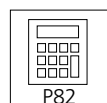
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCRM0720A	02684	7.2	8	91	48	38	1.12
2XDCRM0730A	02685	7.3	8	91	48	38	1.13
2XDCRM0740A	02686	7.4	8	91	48	38	1.15
2XDCRM0750A	02688	7.5	8	91	48	38	1.16
2XDCRM0760A	02692	7.6	8	91	48	38	1.18
2XDCRM0770A	02694	7.7	8	91	48	38	1.19
2XDCRM0780A	02696	7.8	8	91	48	38	1.21
2XDCRM0790A	02697	7.9	8	91	48	38	1.22
2XDCRM0800A	02700	8.0	8	91	48	38	1.24
2XDCRM0810A	02702	8.1	10	103	55	44	1.26
2XDCRM0820A	02704	8.2	10	103	55	44	1.27
2XDCRM0830A	02706	8.3	10	103	55	44	1.29
2XDCRM0840A	02707	8.4	10	103	55	44	1.31
2XDCRM0850A	02710	8.5	10	103	55	44	1.32
2XDCRM0860A	02711	8.6	10	103	55	44	1.33
2XDCRM0870A	04013	8.7	10	103	55	44	1.35
2XDCRM0880A	02714	8.8	10	103	55	44	1.36
2XDCRM0890A	02716	8.9	10	103	55	44	1.38
2XDCRM0900A	02718	9.0	10	103	55	44	1.39
2XDCRM0910A	02719	9.1	10	103	55	44	1.41
2XDCRM0920A	02722	9.2	10	103	55	44	1.43
2XDCRM0925A	02724	9.25	10	103	55	44	1.43
2XDCRM0930A	02726	9.3	10	103	55	44	1.44
2XDCRM0940A	02727	9.4	10	103	55	44	1.46
2XDCRM0950A	02728	9.5	10	103	55	44	1.47
2XDCRM0960A	02731	9.6	10	103	55	44	1.49
2XDCRM0970A	02732	9.7	10	103	55	44	1.50
2XDCRM0980A	02734	9.8	10	103	55	44	1.52
2XDCRM0990A	02735	9.9	10	103	55	44	1.53
2XDCRM1000A	02738	10.0	10	103	55	44	1.55
2XDCRM1010A	02739	10.1	12	120	60	48	1.56
2XDCRM1020A	02740	10.2	12	120	60	48	1.58
2XDCRM1030A	02741	10.3	12	120	60	48	1.60
2XDCRM1040A	02743	10.4	12	120	60	48	1.61
2XDCRM1050A	02744	10.5	12	120	60	48	1.63
2XDCRM1060A	02745	10.6	12	120	60	48	1.64
2XDCRM1070A	04014	10.7	12	120	60	48	1.66
2XDCRM1080A	02747	10.8	12	120	60	48	1.67
2XDCRM1090A	04015	10.9	12	120	60	48	1.69
2XDCRM1100A	02748	11.0	12	120	60	48	1.70
2XDCRM1110A	02749	11.1	12	120	66	53	1.72



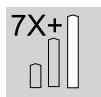
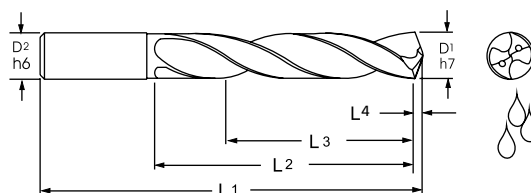
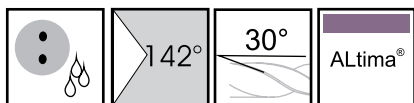
Twister [®] Xtreme Drilling 2XDCRM



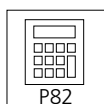
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCRM1120A	02752	11.2	12	120	66	53	1.74
2XDCRM1130A	02753	11.3	12	120	66	53	1.75
2XDCRM1140A	04016	11.4	12	120	66	53	1.77
2XDCRM1150A	02754	11.5	12	120	66	53	1.78
2XDCRM1160A	02755	11.6	12	120	66	53	1.80
2XDCRM1170A	02756	11.7	12	120	66	53	1.81
2XDCRM1180A	02757	11.8	12	120	66	53	1.83
2XDCRM1190A	04017	11.9	12	120	66	53	1.84
2XDCRM1200A	02760	12.0	12	120	66	53	1.86
2XDCRM1210A	02762	12.1	14	126	72	58	1.87
2XDCRM1250A	02766	12.5	14	126	72	58	1.94
2XDCRM1280A	02770	12.8	14	126	72	58	1.98
2XDCRM1290A	02771	12.9	14	126	72	58	2.00
2XDCRM1300A	02772	13.0	14	126	72	58	2.01
2XDCRM1350A	02776	13.5	14	134	77	62	2.09
2XDCRM1370A	02778	13.7	14	134	77	62	2.12
2XDCRM1400A	02782	14.0	14	134	77	62	2.17
2XDCRM1450A	02786	14.5	16	140	80	64	2.25
2XDCRM1470A	02788	14.7	16	140	80	64	2.28
2XDCRM1500A	02790	15.0	16	140	80	64	2.32
2XDCRM1530A	02793	15.3	16	146	82	66	2.37
2XDCRM1550A	02794	15.5	16	146	82	66	2.40
2XDCRM1570A	02796	15.7	16	146	82	66	2.43
2XDCRM1600A	02800	16.0	16	146	82	66	2.48
2XDCRM1608A	02802	16.08	18	158	90	72	2.49
2XDCRM1630A	02803	16.3	18	158	90	72	2.53
2XDCRM1650A	02804	16.5	18	158	90	72	2.56
2XDCRM1700A	02808	17.0	18	158	90	72	2.63
2XDCRM1750A	02812	17.5	18	158	95	76	2.71
2XDCRM1800A	02814	18.0	18	158	95	76	2.79
2XDCRM1850A	02816	18.5	20	160	100	80	2.87
2XDCRM1916A	02820	19.16	20	160	100	80	2.97
2XDCRM1925A	02822	19.25	20	160	100	80	2.98
2XDCRM1930A	02824	19.3	20	160	100	80	2.99
2XDCRM1950A	02826	19.5	20	160	100	80	3.02
2XDCRM2000A	02828	20.0	20	160	100	80	3.10



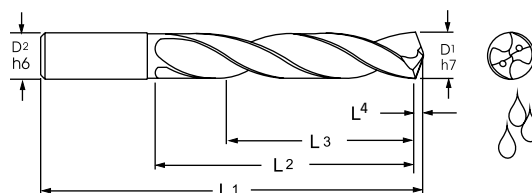
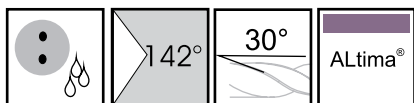
Twister X[®]D Xtreme Drilling 2XDCLM



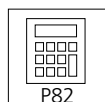
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCLM0300A	02830	3.0	3	81	33	26	0.46
2XDCLM0310A	02833	3.1	4	92	44	35	0.48
2XDCLM0320A	02836	3.2	4	92	44	35	0.50
2XDCLM0330A	02840	3.3	4	92	44	35	0.51
2XDCLM0340A	02842	3.4	4	92	44	35	0.53
2XDCLM0350A	02846	3.5	4	92	44	35	0.54
2XDCLM0360A	02849	3.6	4	92	44	35	0.56
2XDCLM0370A	02850	3.7	4	92	44	35	0.57
2XDCLM0380A	02852	3.8	4	92	44	35	0.59
2XDCLM0390A	02853	3.9	4	92	44	35	0.60
2XDCLM0400A	02856	4.0	4	92	44	35	0.62
2XDCLM0410A	04018	4.1	5	100	45	36	0.64
2XDCLM0420A	02858	4.2	5	100	45	36	0.65
2XDCLM0430A	02859	4.3	5	100	45	36	0.67
2XDCLM0440A	02861	4.4	5	100	45	36	0.68
2XDCLM0450A	02862	4.5	5	100	45	36	0.70
2XDCLM0460A	02864	4.6	5	100	45	36	0.71
2XDCLM0470A	02865	4.7	5	100	45	36	0.73
2XDCLM0480A	02868	4.8	5	100	45	36	0.74
2XDCLM0490A	02870	4.9	5	100	45	36	0.76
2XDCLM0500A	02872	5.0	5	100	45	36	0.77
2XDCLM0510A	02874	5.1	6	100	51	41	0.79
2XDCLM0520A	02878	5.2	6	100	51	41	0.81
2XDCLM0530A	02880	5.3	6	100	51	41	0.82
2XDCLM0540A	02882	5.4	6	100	51	41	0.84
2XDCLM0550A	02884	5.5	6	100	51	41	0.85
2XDCLM0570A	02890	5.7	6	100	51	41	0.88
2XDCLM0580A	02892	5.8	6	100	51	41	0.90
2XDCLM0590A	02894	5.9	6	100	51	41	0.91
2XDCLM0600A	02898	6.0	6	100	51	41	0.93
2XDCLM0610A	02900	6.1	8	109	60	48	0.95
2XDCLM0620A	02904	6.2	8	109	60	48	0.96
2XDCLM0630A	02908	6.3	8	109	60	48	0.98
2XDCLM0640A	02912	6.4	8	109	60	48	0.99
2XDCLM0650A	02914	6.5	8	109	60	48	1.01
2XDCLM0660A	02917	6.6	8	109	60	48	1.03
2XDCLM0670A	02919	6.7	8	109	60	48	1.04
2XDCLM0680A	02922	6.8	8	109	60	48	1.05
2XDCLM0690A	02924	6.9	8	109	60	48	1.07



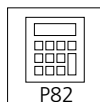
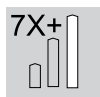
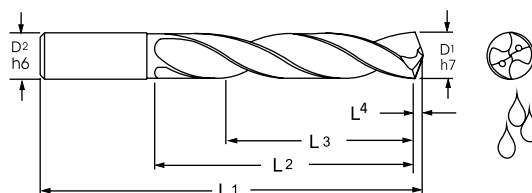
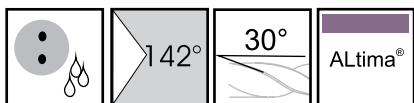
Twister [®] Xtreme Drilling 2XDCLM



Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCLM0700A	02926	7.0	8	109	60	48	1.08
2XDCLM0710A	02927	7.1	8	118	70	56	1.10
2XDCLM0720A	02930	7.2	8	118	70	56	1.12
2XDCLM0730A	02931	7.3	8	118	70	56	1.13
2XDCLM0740A	02932	7.4	8	118	70	56	1.15
2XDCLM0750A	02934	7.5	8	118	70	56	1.16
2XDCLM0760A	02938	7.6	8	118	70	56	1.18
2XDCLM0770A	02940	7.7	8	118	70	56	1.19
2XDCLM0780A	02942	7.8	8	118	70	56	1.21
2XDCLM0790A	02943	7.9	8	118	70	56	1.22
2XDCLM0800A	02946	8.0	8	118	70	56	1.24
2XDCLM0810A	02948	8.1	10	127	80	64	1.26
2XDCLM0820A	02950	8.2	10	127	80	64	1.27
2XDCLM0830A	02952	8.3	10	127	80	64	1.29
2XDCLM0840A	02953	8.4	10	127	80	64	1.31
2XDCLM0850A	02956	8.5	10	127	80	64	1.32
2XDCLM0860A	02957	8.6	10	127	80	64	1.33
2XDCLM0870A	04019	8.7	10	127	80	64	1.35
2XDCLM0880A	02960	8.8	10	127	80	64	1.36
2XDCLM0890A	02962	8.9	10	127	80	64	1.38
2XDCLM0900A	02964	9.0	10	127	80	64	1.39
2XDCLM0910A	02965	9.1	10	136	85	68	1.41
2XDCLM0920A	02968	9.2	10	136	85	68	1.43
2XDCLM0925A	02970	9.25	10	136	85	68	1.43
2XDCLM0930A	02972	9.3	10	136	85	68	1.44
2XDCLM0940A	02973	9.4	10	136	85	68	1.46
2XDCLM0950A	02974	9.5	10	136	85	68	1.47
2XDCLM0960A	02977	9.6	10	136	85	68	1.49
2XDCLM0970A	02978	9.7	10	136	85	68	1.50
2XDCLM0980A	02980	9.8	10	136	85	68	1.52
2XDCLM0990A	04024	9.9	10	136	85	68	1.53
2XDCLM1000A	02982	10.0	10	136	85	68	1.55
2XDCLM1010A	04025	10.1	12	149	93	74	1.56
2XDCLM1020A	02983	10.2	12	149	93	74	1.58
2XDCLM1030A	04026	10.3	12	149	93	74	1.60
2XDCLM1040A	02979	10.4	12	149	93	74	1.61
2XDCLM1050A	02986	10.5	12	149	93	74	1.63
2XDCLM1060A	02985	10.6	12	149	93	74	1.64
2XDCLM1070A	04020	10.7	12	149	93	74	1.66

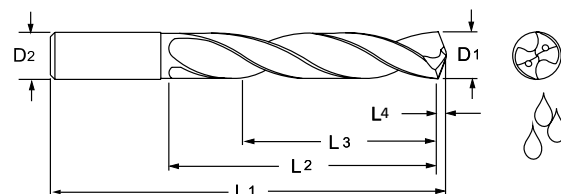
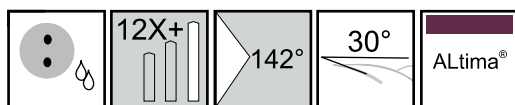


Twister ^{XTreme Drilling} 2XDCLM



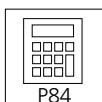
Metric No.	EDP	D1 (Tol h7)	D2 (h6)	L1	L2	L3	L4
2XDCLM1080A	96600	10.8	12	149	93	74	1.67
2XDCLM1090A	04021	10.9	12	149	93	74	1.69
2XDCLM1100A	02988	11.0	12	149	93	74	1.70
2XDCLM1110A	04027	11.1	12	155	102	82	1.72
2XDCLM1120A	02990	11.2	12	155	102	82	1.74
2XDCLM1130A	04028	11.3	12	155	102	82	1.75
2XDCLM1140A	04022	11.4	12	155	102	82	1.77
2XDCLM1150A	02991	11.5	12	155	102	82	1.78
2XDCLM1160A	04029	11.6	12	155	102	82	1.80
2XDCLM1170A	02992	11.7	12	155	102	82	1.81
2XDCLM1180A	96602	11.8	12	155	102	82	1.83
2XDCLM1190A	04023	11.9	12	155	102	82	1.84
2XDCLM1200A	02994	12.0	12	155	102	82	1.86

Twister [®] Xtreme Drilling 2XDCEM

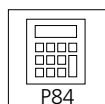
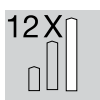
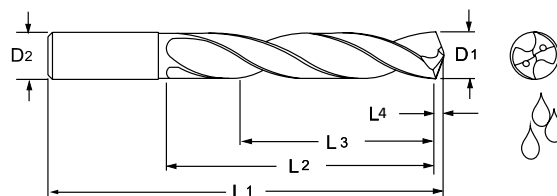
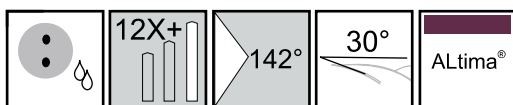


12X+

Metric No.	EDP	D1 h7	D2 h6	L1	L2	L3 Ref.	L4	L2/D1	L3/D1
2XDCEM 0300A	04300	3.00	3	125	75	60	0.46	25	20
2XDCEM 0318A	04302	3.18	4	163	100	80	0.49	31	25
2XDCEM 0320A	04304	3.20	4	163	100	80	0.50	31	25
2XDCEM 0330A	04306	3.30	4	163	100	80	0.51	30	24
2XDCEM 0340A	04308	3.40	4	163	100	80	0.53	29	24
2XDCEM 0360A	04310	3.60	4	163	100	80	0.56	28	22
2XDCEM 0380A	04312	3.80	4	163	100	80	0.59	26	21
2XDCEM 0390A	04314	3.90	4	163	100	80	0.60	26	21
2XDCEM 0400A	04316	4.00	4	163	100	80	0.62	25	20
2XDCEM 0420A	04318	4.20	5	163	105	84	0.65	25	20
2XDCEM 0430A	04320	4.30	5	163	105	84	0.67	24	20
2XDCEM 0440A	04322	4.40	5	163	105	84	0.68	24	19
2XDCEM 0460A	04324	4.60	5	163	105	84	0.71	23	18
2XDCEM 0476A	04326	4.76	5	163	105	84	0.74	22	18
2XDCEM 0480A	04328	4.80	5	163	105	84	0.74	22	18
2XDCEM 0490A	04330	4.90	5	163	105	84	0.76	21	17
2XDCEM 0500A	04332	5.00	5	163	105	84	0.77	21	17
2XDCEM 0520A	04334	5.20	6	163	110	88	0.81	21	17
2XDCEM 0540A	04336	5.40	6	163	110	88	0.84	20	16
2XDCEM 0560A	04338	5.60	6	163	110	88	0.87	20	16
2XDCEM 0580A	04340	5.80	6	163	110	88	0.90	19	15
2XDCEM 0600A	04342	6.00	6	163	110	88	0.93	18	15
2XDCEM 0620A	04344	6.20	8	163	110	88	0.96	18	14
2XDCEM 0630A	04346	6.30	8	163	110	88	0.98	17	14
2XDCEM 0635A	04348	6.35	8	163	110	88	0.98	17	14
2XDCEM 0680A	04350	6.80	8	163	110	88	1.05	16	13
2XDCEM 0700A	04352	7.00	8	163	110	88	1.08	16	13
2XDCEM 0760A	04354	7.60	8	163	120	96	1.18	16	13
2XDCEM 0780A	04356	7.80	8	163	120	96	1.21	15	12
2XDCEM 0794A	04358	7.94	8	163	120	96	1.23	15	12
2XDCEM 0800A	04360	8.00	8	163	120	96	1.24	15	12
2XDCEM 0820A	04362	8.20	10	180	135	108	1.27	16	13
2XDCEM 0850A	04364	8.50	10	180	135	108	1.32	16	13
2XDCEM 0870A	04366	8.70	10	180	135	108	1.35	16	12
2XDCEM 0900A	04368	9.00	10	180	135	108	1.39	15	12
2XDCEM 0940A	04370	9.40	10	195	150	120	1.46	16	13
2XDCEM 0953A	04372	9.53	10	195	150	120	1.48	16	13
2XDCEM 0980A	04374	9.80	10	195	150	120	1.52	15	12
2XDCEM 1000A	04376	10.00	10	195	150	120	1.55	15	12

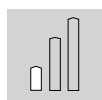
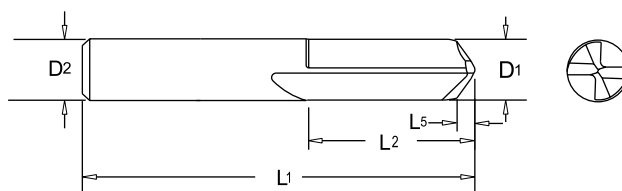
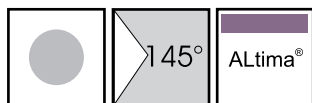


Twister ^{Xtreme Drilling} XD 2XDCEM

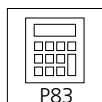


Metric No.	EDP	D1 h7	D2 h6	L1	L2	L3 Ref.	L4	L2/D1	L3/D1
2XDCEM 1030A	04378	10.30	12	210	160	128	1.60	16	12
2XDCEM 1050A	04380	10.50	12	210	160	128	1.63	15	12
2XDCEM 1080A	04382	10.80	12	210	160	128	1.67	15	12
2XDCEM 1100A	04384	11.00	12	210	160	128	1.70	15	12
2XDCEM 1111A	04386	11.11	12	210	160	128	1.72	14	12
2XDCEM 1150A	04388	11.50	12	210	160	128	1.78	14	11
2XDCEM 1180A	04390	11.80	12	210	160	128	1.83	14	11
2XDCEM 1200A	04392	12.00	12	210	160	128	1.86	13	11
2XDCEM 1270A	04394	12.70	14	230	180	144	1.97	14	11

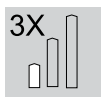
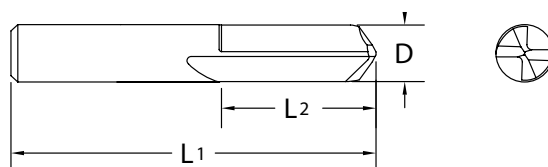
Twister 200S Spot Drill



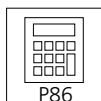
Metric No.	EDP	D1	D2	L1	L2	L5
200S 0300A	20221	3	3	38	16	0.41
200S 0600A	20431	6	6	51	19	0.83
200S 0800A	20545	8	8	64	19	1.10
200S 1000A	20647	10	10	70	25	1.38
200S 1200A	20731	12	12	76	25	1.65
200S 1600A	20785	16	16	89	32	2.20



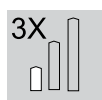
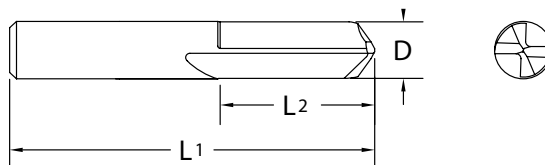
Twister 200A



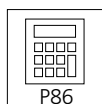
Tool No.	EDP	D	L1	L2
200 0100A	-	1.0	38	6.5
200 0150A	-	1.5	38	8.0
200 0200A	-	2.00	38	9.5
200 0250A	-	2.50	38	12.5
200 0300A	96400	3.00	38	16.0
200 0310A	96401	3.10	38	16.0
200 0320A	96402	3.20	38	16.0
200 0330A	96403	3.30	38	16.0
200 0340A	96404	3.40	51	16.0
200 0350A	96405	3.50	51	16.0
200 0360A	96406	3.60	51	16.0
200 0370A	96407	3.70	51	16.0
200 0380A	96408	3.80	51	16.0
200 0390A	96409	3.90	51	16.0
200 0400A	96410	4.00	51	16.0
200 0410A	96411	4.10	51	16.0
200 0420A	96412	4.20	51	16.0
200 0430A	96413	4.30	51	16.0
200 0440A	96414	4.40	51	16.0
200 0450A	96415	4.50	51	16.0
200 0460A	96416	4.60	51	16.0
200 0470A	96417	4.70	51	16.0
200 0480A	96418	4.80	51	16.0
200 0490A	96419	4.90	51	16.0
200 0500A	96420	5.00	51	19.0
200 0510A	96421	5.10	51	19.0
200 0520A	96422	5.20	51	19.0
200 0530A	96423	5.30	51	19.0
200 0540A	96424	5.40	51	19.0
200 0550A	96425	5.50	51	19.0
200 0560A	96426	5.60	51	19.0
200 0570A	96427	5.70	51	19.0
200 0580A	96428	5.80	51	19.0
200 0590A	96429	5.90	51	19.0
200 0600A	96430	6.00	51	19.0
200 0610A	96431	6.10	51	19.0



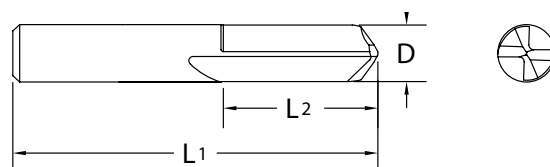
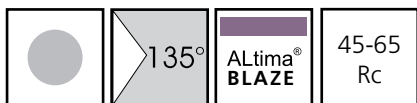
Twister 200A



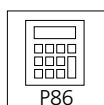
Tool No.	EDP	D	L1	L2
200 0620A	96432	6.20	51	19.0
200 0630A	96433	6.30	51	19.0
200 0640A	96434	6.40	51	19.0
200 0650A	96435	6.50	51	19.0
200 0660A	96436	6.60	64	19.0
200 0670A	96437	6.70	64	19.0
200 0680A	96438	6.80	64	19.0
200 0690A	96439	6.90	64	19.0
200 0700A	96440	7.00	64	19.0
200 0710A	96441	7.10	64	19.0
200 0720A	96442	7.20	64	19.0
200 0730A	96443	7.30	64	19.0
200 0740A	96444	7.40	64	19.0
200 0750A	96445	7.50	64	19.0
200 0760A	96446	7.60	64	19.0
200 0770A	96447	7.70	64	19.0
200 0780A	96448	7.80	64	19.0
200 0790A	96449	7.90	64	19.0
200 0800A	96450	8.00	64	19.0
200 0810A	96451	8.10	64	19.0
200 0820A	96452	8.20	64	25.5
200 0830A	96453	8.30	64	25.5
200 0840A	96454	8.40	64	25.5
200 0850A	96455	8.50	64	25.5
200 0860A	96456	8.60	64	25.5
200 0870A	96457	8.70	64	25.5
200 0880A	96458	8.80	64	25.5
200 0890A	96459	8.90	64	25.5
200 0900A	96460	9.00	64	25.5
200 0910A	96461	9.10	64	25.5
200 0920A	96462	9.20	64	25.5
200 0930A	96463	9.30	64	25.5
200 0940A	96464	9.40	64	25.5
200 0950A	96465	9.50	64	25.5
200 0960A	96466	9.60	64	25.5
200 0970A	96467	9.70	70	25.5



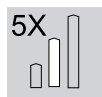
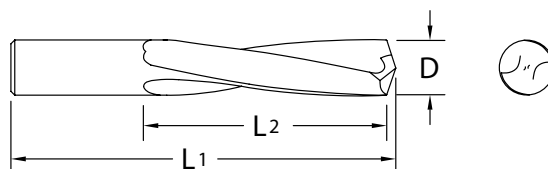
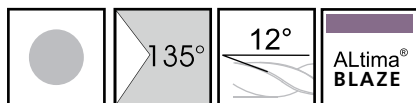
Twister 200A



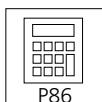
Tool No.	EDP	D	L1	L2
200 0980A	96468	9.80	70	25.5
200 0990A	96469	9.90	70	25.5
200 1000A	96470	10.00	70	25.5
200 1010A	96471	10.10	70	25.5
200 1020A	96472	10.20	70	25.5
200 1030A	96473	10.30	70	25.5
200 1040A	96474	10.40	70	25.5
200 1050A	96475	10.50	70	25.5
200 1060A	96476	10.60	70	25.5
200 1070A	96477	10.70	70	25.5
200 1080A	96478	10.80	70	25.5
200 1090A	96479	10.90	70	25.5
200 1100A	96480	11.00	70	25.5
200 1110A	96481	11.10	70	25.5
200 1120A	96482	11.20	70	25.5
200 1130A	96483	11.30	76	25.5
200 1140A	96484	11.40	76	25.5
200 1150A	96485	11.50	76	25.5
200 1160A	96486	11.60	76	25.5
200 1170A	96487	11.70	76	25.5
200 1180A	96488	11.80	76	25.5
200 1190A	96489	11.90	76	25.5
200 1200A	96490	12.00	76	25.5
200 1250A	96491	12.50	76	25.5
200 1300A	96492	13.00	89	28.5
200 1350A	96493	13.50	89	28.5
200 1400A	96494	14.00	89	28.5
200 1450A	96495	14.50	89	32.0
200 1500A	96496	15.00	89	32.0
200 1550A	96497	15.50	89	32.0
200 1600A	96498	16.00	89	32.0



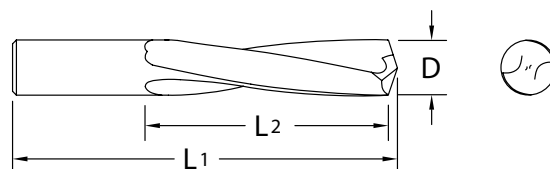
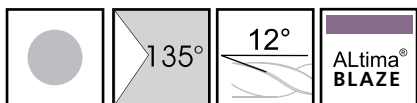
Twister 205B



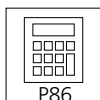
Tool No.	EDP	D	L1	L2
205 0030B	21686	0.30	38	5.0
205 0035B	21687	0.35	38	5.0
205 0040B	21688	0.40	38	5.0
205 0045B	21689	0.45	38	5.0
205 0050B	21690	0.50	38	6.5
205 0055B	21691	0.55	38	6.5
205 0060B	21692	0.60	38	6.5
205 0065B	21693	0.65	38	8.0
205 0070B	21694	0.70	38	8.0
205 0075B	21695	0.75	38	8.0
205 0080B	21696	0.80	38	9.5
205 0085B	21697	0.85	38	9.5
205 0090B	21698	0.90	38	11.0
205 0095B	21699	0.95	38	11.0
205 0100B	21701	1.00	38	12.5
205 0105B	21702	1.05	38	12.5
205 0110B	21703	1.10	38	12.5
205 0115B	21704	1.15	38	12.5
205 0120B	21706	1.20	38	12.5
205 0125B	21707	1.25	41	16.0
205 0130B	21708	1.30	41	16.0
205 0135B	21709	1.35	41	16.0
205 0140B	21710	1.40	41	16.0
205 0145B	21711	1.45	41	16.0
205 0150B	21712	1.50	41	16.0
205 0160B	21714	1.60	41	16.0
205 0170B	21715	1.70	43	17.5
205 0180B	21717	1.80	43	17.5
205 0190B	21718	1.90	43	17.5
205 0200B	21720	2.00	44	19.0
205 0210B	21721	2.10	44	19.0
205 0220B	21722	2.20	44	19.0
205 0230B	21724	2.30	44	19.0
205 0240B	21726	2.40	44	19.0



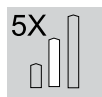
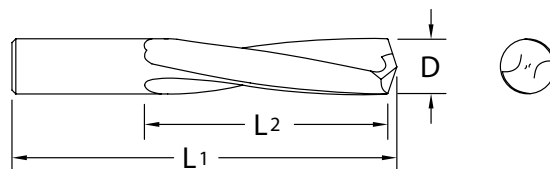
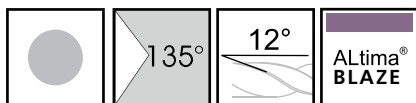
Twister 205B



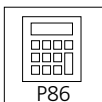
Tool No.	EDP	D	L1	L2
205 0250B	21727	2.50	46	21.0
205 0260B	21729	2.60	46	20.5
205 0270B	21730	2.70	46	20.5
205 0280B	21731	2.80	48	22.0
205 0290B	21732	2.90	48	22.0
205 0300B	21733	3.00	48	22.0
205 0310B	21734	3.10	48	22.0
205 0320B	21736	3.20	48	22.0
205 0320B	21737	3.30	49	24.0
205 0330B	21738	3.40	49	24.0
205 0350B	21739	3.50	49	24.0
205 0360B	21740	3.60	49	24.0
205 0370B	21742	3.70	52	25.5
205 0380B	21743	3.80	52	25.5
205 0390B	21744	3.90	52	25.5
205 0400B	21746	4.00	54	27.0
205 0410B	21747	4.10	54	27.0
205 0420B	21748	4.20	54	27.0
205 0430B	21749	4.30	54	27.0
205 0450B	21751	4.50	56	28.5
205 0460B	21752	4.60	56	28.5
205 0470B	21753	4.70	57	30.0
205 0480B	21755	4.80	57	30.0
205 0490B	21756	4.90	57	30.0
205 0500B	21757	5.00	57	30.0
205 0510B	21758	5.10	57	30.0
205 0520B	21760	5.20	60	32.0
205 0530B	21761	5.30	60	32.0
205 0540B	21762	5.40	60	32.0
205 0550B	21763	5.50	60	32.0
205 0560B	21765	5.60	62	33.4
205 0570B	21766	5.70	62	33.4
205 0580B	21767	5.80	62	33.4
205 0590B	21768	5.90	62	33.4



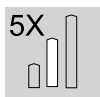
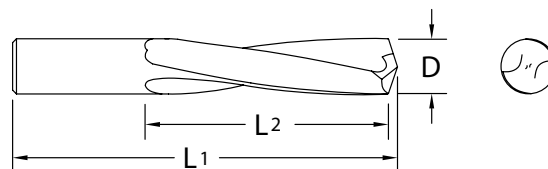
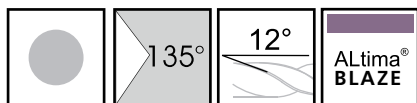
Twister 205B



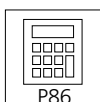
Tool No.	EDP	D	L1	L2
205 0600B	21770	6.0	64	35.0
205 0610B	21771	6.1	64	35.0
205 0620B	21772	6.2	64	35.0
205 0630B	21773	6.3	64	35.0
205 0640B	21775	6.4	64	35.0
205 0650B	21776	6.5	67	36.5
205 0660B	21777	6.6	67	36.5
205 0670B	21778	6.7	67	36.5
205 0680B	21780	6.8	68	38.0
205 0690B	21781	6.9	68	38.0
205 0700B	21782	7.0	68	38.0
205 0710B	21783	7.10	68	38.0
205 0720B	21785	7.20	68	38.0
205 0730B	21786	7.30	68	38.0
205 0740B	21787	7.40	70	39.5
205 0750B	21788	7.5	70	40.0
205 0760B	21790	7.6	70	39.5
205 0770B	21791	7.7	71	41.5
205 0780B	21792	7.8	71	41.5
205 0790B	21793	7.9	71	41.5
205 0800B	21795	8.0	71	41.5
205 0810B	21796	8.10	75	43.0
205 0820B	21797	8.20	75	43.0
205 0830B	21798	8.30	75	43.0
205 0840B	21800	8.40	75	43.0
205 0850B	21801	8.5	75	43.0
205 0860B	21802	8.6	75	43.0
205 0870B	21803	8.7	75	43.0
205 0880B	21805	8.8	75	43.0
205 0890B	21806	8.9	78	44.5
205 0900B	21807	9.0	78	44.5
205 0910B	21808	9.1	78	44.5
205 0920B	21810	9.2	78	44.5
205 0930B	21811	9.3	79	46.0



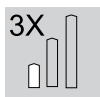
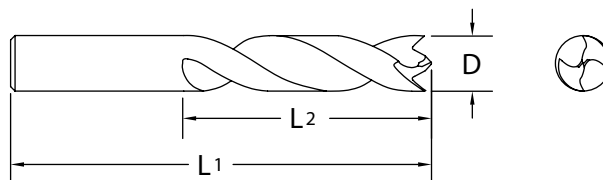
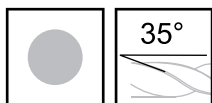
Twister 205B



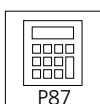
Tool No.	EDP	D	L1	L2
205 0940B	21812	9.4	79	46.0
205 0950B	21813	9.5	79	46.0
205 0960B	21815	9.6	83	47.5
205 0970B	21816	9.7	83	47.5
205 0980B	21817	9.8	83	47.5
205 0990B	21819	9.9	83	47.5
205 1000B	21820	10.0	84	49.0
205 1010B	21821	10.1	84	49.0
205 1020B	21822	10.2	84	49.0
205 1030B	21823	10.3	84	49.0
205 1040B	21825	10.4	84	49.0
205 1050B	21826	10.5	86	51.0
205 1060B	21828	10.6	86	51.0
205 1070B	21829	10.7	86	51.0
205 1080B	21830	10.8	86	51.0
205 1090B	21831	10.9	87	52.5
205 1100B	21832	11.0	87	52.5
205 1110B	21833	11.1	87	52.5
205 1120B	21835	11.2	92	54.0
205 1130B	21836	11.3	92	54.0
205 1140B	21837	11.4	92	54.0
205 1150B	21838	11.5	92	54.0
205 1160B	21840	11.6	92	54.0
205 1170B	21841	11.7	92	54.0
205 1180B	21842	11.8	92	54.0
205 1190B	21843	11.9	92	54.0
205 1200B	21845	12.0	94	56.0
205 1300B	21848	13.0	98	60.5
205 1400B	21849	14.0	102	63.5
205 1500B	21851	15.0	105	66.5
205 1600B	21853	16.0	108	70.0
205 1700B	21854	17.0	117	73.0
205 1800B	21856	18.0	121	76.0
205 1900B	21857	19.0	127	79.5
205 2000B	21859	20.0	133	83.0



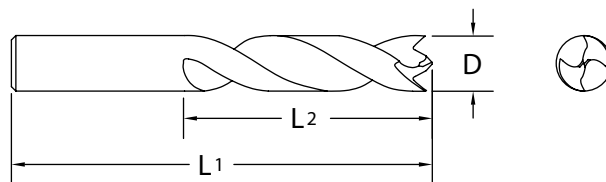
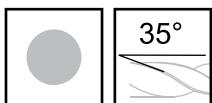
Twister 207



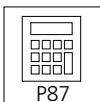
Tool No.	EDP	D	L1	L2
207 0240	27007	2.40	44	12.5
207 0250	27016	2.50	46	12.5
207 0260	27025	2.60	46	12.5
207 0270	27031	2.70	46	12.5
207 0280	27043	2.80	48	16.0
207 0290	27052	2.90	48	16.0
207 0300	27058	3.00	48	16.0
207 0310	27064	3.10	48	16.0
207 0320	27070	3.20	48	16.0
207 0330	27076	3.30	49	17.5
207 0340	27079	3.40	49	17.5
207 0350	27085	3.50	49	17.5
207 0360	27094	3.60	49	17.5
207 0370	27100	3.70	52	19.0
207 0380	27109	3.80	52	19.0
207 0390	27115	3.90	52	19.0
207 0400	27127	4.00	54	22.0
207 0410	27136	4.10	54	22.0
207 0420	27139	4.20	54	22.0
207 0430	27145	4.30	54	22.0
207 0440	27157	4.40	56	24.0
207 0450	27163	4.50	56	24.0
207 0460	27169	4.60	56	24.0
207 0480	27181	4.80	57	25.5
207 0490	27190	4.90	57	25.5
207 0500	27199	5.00	57	25.5
207 0510	27205	5.10	57	25.5
207 0520	27217	5.20	60	27.0
207 0530	27223	5.30	60	27.0
207 0540	27229	5.40	60	27.0
207 0550	27235	5.50	60	27.0
207 0560	27241	5.60	62	28.5
207 0570	27247	5.70	62	28.5
207 0580	27253	5.80	62	28.5
207 0590	27256	5.90	62	28.5
207 0600	27265	6.00	64	32.0



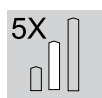
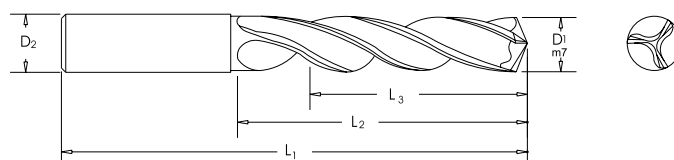
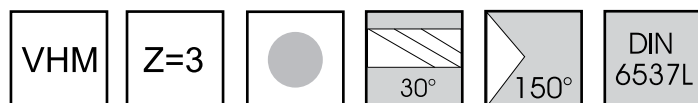
Twister 207



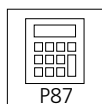
Tool No.	EDP	D	L1	L2
207 0610	27271	6.10	64	32.0
207 0620	27277	6.20	64	32.0
207 0630	27283	6.30	64	32.0
207 0640	27289	6.40	64	32.0
207 0650	27292	6.50	67	33.5
207 0700	27310	7.00	68	35.0
207 0750	27328	7.50	70	35.0
207 0800	27340	8.00	71	38.0
207 0850	27355	8.50	75	39.5
207 0900	27367	9.00	78	39.5
207 0950	27379	9.50	79	41.5
207 1000	27394	10.00	84	44.5
207 1050	27409	10.50	86	46.0
207 1100	27415	11.00	87	47.5
207 1150	27421	11.50	92	51.0
207 1200	27430	12.00	94	54.0



Twister® X-AL Series 229

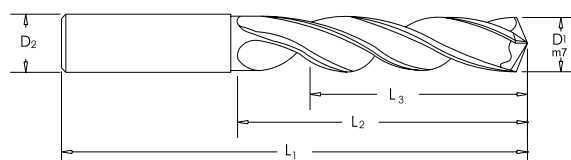
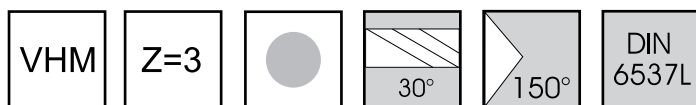


Tool No.	EDP	D1 Tol m7	D2	L1	L2	L3
229 0200	22950	2.0	2	38	16	12
229 0230	23058	2.3	2.3	43	20.5	15
229 0250	22951	2.5	2.5	43	20.5	15
229 0290	22952	2.9	2.9	46	25	19
229 0300	22953	3.0	6	66	28	23
229 0310	23063	3.1	6	66	28	23
229 0320	22945	3.2	6	66	28	23
229 0330	22954	3.3	6	66	28	23
229 0340	22949	3.4	6	66	28	23
229 0350	22955	3.5	6	66	28	23
229 0360	22992	3.6	6	66	28	23
229 0370	22994	3.7	6	66	28	23
229 0380	22996	3.8	6	74	36	29
229 0390	22997	3.9	6	74	36	29
229 0400	22956	4.0	6	74	36	29
229 0410	22998	4.1	6	74	36	29
229 0420	22957	4.2	6	74	36	29
229 0440	22999	4.4	6	74	36	29
229 0450	22958	4.5	6	74	36	29
229 0460	23000	4.6	6	74	36	29
229 0480	23001	4.8	6	82	44	35
229 0490	23002	4.9	6	82	44	35
229 0500	22959	5.0	6	82	44	35
229 0520	23003	5.2	6	82	44	35
229 0550	22960	5.5	6	82	44	35
229 0560	23004	5.6	6	82	44	35
229 0600	22961	6.0	6	82	44	35
229 0620	22980	6.2	8	91	53	43
229 0650	22962	6.5	8	91	53	43
229 0670	22979	6.7	8	91	53	43
229 0680	22963	6.8	8	91	53	43
229 0700	22964	7.0	8	91	53	43
229 0720	23005	7.2	8	91	53	43
229 0730	22940	7.3	8	91	53	43

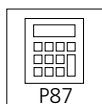


Available with Fordlube upon request.

Twister® X-AL Series 229



Tool No.	EDP	D1 Tol m7	D2	L1	L2	L3
229 0740	22965	7.4	8	91	53	43
229 0750	22966	7.5	8	91	53	43
229 0780	23006	7.8	8	91	53	43
229 0800	22967	8.0	8	91	53	43
229 0810	23008	8.1	10	103	61	49
229 0840	22985	8.4	10	103	61	49
229 0850	22968	8.5	10	103	61	49
229 0900	22989	9.0	10	103	61	49
229 0950	23009	9.5	10	103	61	49
229 0970	23011	9.7	10	103	61	49
229 1000	22969	10.0	10	103	61	49
229 1020	22970	10.2	12	118	71	56
229 1040	23012	10.4	12	118	71	56
229 1050	22986	10.5	12	118	71	56
229 1060	23013	10.6	12	118	71	56
229 1100	22993	11.0	12	118	71	56
229 1150	23014	11.5	12	118	71	56
229 1200	22971	12.0	12	118	71	56
229 1250	22988	12.5	14	124	77	60
229 1300	23015	13.0	14	124	77	60
229 1350	23017	13.5	14	124	77	60
229 1400	23018	14.0	14	124	77	60
229 1450	23020	14.5	16	133	83	63
229 1500	23021	15.0	16	133	83	63
229 1550	23022	15.5	16	133	83	63
229 1580	23023	15.8	16	133	83	63
229 1600	23024	16.0	16	133	83	63



Available with Fordlube upon request.

Icon Glossary

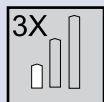
Drill Icons



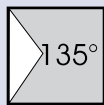
Solid Carbide



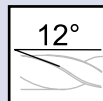
Coolant Fed



Drill Length



Drill Point Angle



Helix Angle



Coatings



DIN Specs

Workpiece Material Group



Steels



Hardened Steels (45-65Rc)



Stainless Steels



Cast Iron

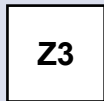


Special Alloys

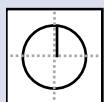


Non-Ferrous

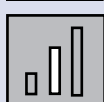
End Mill Icons



Number of Flutes



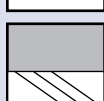
Center Cutting



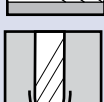
Lengths



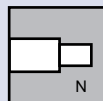
Coatings



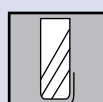
Helix Angle



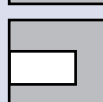
Ball Nose



Neck Relief



Corner Radius



Shank



Shank/DIN



Chipbreaker

Workpiece Material Group



Steels



Hardened Steels (45-65Rc)



Stainless Steels



Cast Iron



Special Alloys



Non-Ferrous

Celebrating
90 Years
1919 - 2009
M.A. Ford®

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TuffCut® XR Series 113A Recommended cutting data

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

● Preferred ○ Possible X Not Possible

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

Please Note- Peripheral Milling only.

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

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

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

Workpiece Material Group		Material Type	Coolant			1 x D	1 x D	0.05 x D	0.1 x D	0.2 x D	0.3 x D	0.5 x D
			Max	Air	MMS							
						Vc-M/Min						
Steels	P	Low Carbon	●	●	●	210	200	450	350	300	250	200
		Medium Carbon	●	●	●	180	170	270	250	230	200	170
		Alloy Steels	●	●	●	160	150	250	230	210	180	150
		Die/Tool Steels	●	●	●	130	120	225	200	170	130	120
Stainless Steels	M	Free Machining	●	X	○	110	100	150	150	120	105	100
		Austenitic	●	X	○	100	90	130	120	110	100	90
		Difficult Stainless	●	X	○	70	60	100	90	80	70	60
		PH Stainless	●	X	○	100	90	130	120	110	100	90
		Cobalt Chrome Alloys	●	X	○	70	60	100	90	80	70	60
		Duplex (22%)	●	X	○	70	60	100	90	80	70	60
		Super Duplex (25%)	●	X	○	50	40	60	55	50	45	40
Special Alloys	S	High Temp Alloys	●	X	X	30	25	50	40	35	30	25
		Titanium Alloys	●	X	X	70	60	120	120	90	75	60
Cast Irons	K	Gray Cast Iron	●	○	○	180	160	360	360	240	190	160
		Ductile Cast Iron	●	○	○	170	150	270	270	190	170	150
		Malleable Iron	●	○	○	130	120	160	150	140	130	120
Hardened Steels	H	Hardened Steels 45 - 50 Rc	●	○	○	50	45	135	135	90	50	45
		Hardened Steels 50 - 55 Rc	●	○	○	45	40	115	115	75	45	40

● Preferred ○ Possible X Not Possible

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

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

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

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

For 177L tools please use the following conditions

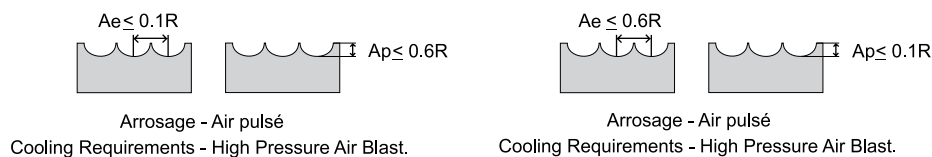
Ap	1 x D1	0.25 x D1
Ae	0.1 x D1	1.0 x D1

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

TuffCut® XR Series 179 Profiling

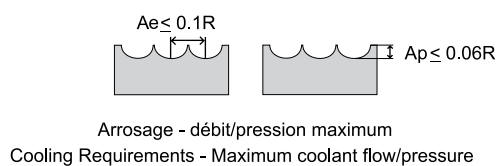
Découpage au profil Série 179

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



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

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



TuffCut® XR Series 180 Recommended cutting data

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

● Preferred ○ Possible X Not Possible

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

Please Note - Peripheral Milling only.

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

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

TuffCut® XR Series 192 Recommended cutting data

Workpiece Material Group		Material Type	Coolant									
			Max	Air	MMS	Vc-M/Min						
Steels	P	Low Carbon	●	●	●	210	210	450	450	350	300	250
		Medium Carbon	●	●	●	180	180	270	270	250	230	200
		Alloy Steels	●	●	●	160	160	250	250	230	210	180
		Die/Tool Steels	●	●	●	130	130	225	225	200	170	130
Stainless Steels	M	Free Machining	●	X	○	110	110	150	150	130	120	105
		Austenitic	●	X	○	100	100	130	130	120	110	100
		Difficult Stainless	●	X	○	70	70	100	100	90	80	70
		PH Stainless	●	X	○	100	100	130	130	120	110	100
		Cobalt Chrome Alloys	●	X	○	70	70	100	100	90	80	70
		Duplex (22%)	●	X	○	70	70	100	100	90	80	70
		Super Duplex (25%)	●	X	○	50	50	60	60	55	50	45
Special Alloys	S	High Temp Alloys	●	X	X	30	30	50	50	40	35	30
		Inconel	●	X	X	30	30	50	50	40	35	30
		Titanium Alloys	●	X	X	70	70	120	120	110	90	75
Cast Irons	K	Gray Cast Iron	●	○	○	180	180	360	360	340	240	190
		Ductile Cast Iron	●	○	○	170	170	270	270	240	190	170
		Malleable Iron	●	○	○	130	130	160	160	150	140	130
Hardened Steels	H	Hardened Steels 35 - 45 Rc	●	○	○	55	55	135	135	125	90	50
		Hardened Steels 45 - 55 Rc	●	○	○	45	45	115	115	105	75	45

● Preferred ○ Possible X Not Possible

Workpiece Material Group		Material Type	Type of machining	Tool Diameter						
				6mm	8mm	10mm	12mm	16mm	20mm	25mm
				fz-mm/tooth						
Steels	P	Low Carbon	Profiling	0.085	0.100	0.120	0.170	0.200	0.230	0.330
		Medium Carbon								
		Alloy Steels	Slotting	0.043	0.050	0.060	0.085	0.100	0.125	0.165
		Die/Tool Steels								
Stainless Steels	M	Free Machining	Profiling	0.085	0.100	0.120	0.170	0.200	0.230	0.330
		Austenitic								
		Difficult Stainless	Slotting	0.043	0.050	0.060	0.085	0.100	0.125	0.165
		PH Stainless	Profiling	0.064	0.076	0.086	0.125	0.150	0.175	0.250
		Cobalt Chrome Alloys								
		Duplex (22%)	Slotting	0.032	0.038	0.045	0.060	0.075	0.085	0.125
		Super Duplex (25%)								
Special Alloys	S	High Temp Alloys	Profiling	0.043	0.050	0.060	0.085	0.100	0.120	0.165
			Slotting	0.022	0.025	0.030	0.045	0.050	0.060	0.080
		Titanium Alloys	Profiling	0.085	0.100	0.120	0.170	0.200	0.230	0.330
			Slotting	0.022	0.025	0.030	0.045	0.050	0.060	0.080
Cast Irons	K	Gray Cast Iron	Profiling	0.085	0.100	0.120	0.170	0.200	0.230	0.208
		Ductile Cast Iron								
		Malleable Iron	Slotting	0.043	0.050	0.060	0.085	0.100	0.125	0.165
Hardened Steels	H	Hardened Steels 35 - 45 Rc	Profiling	0.076	0.090	0.100	0.150	0.180	0.200	0.300
			Slotting	0.035	0.045	0.050	0.075	0.090	0.100	0.150
		Hardened Steels 45 - 55 Rc	Profiling	0.053	0.066	0.076	0.100	0.132	0.155	0.220
			Slotting	0.025	0.033	0.036	0.050	0.065	0.080	0.110

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

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

TuffCut® XT Series 277 Recommended cutting data

Workpiece Material Group		Material Type	Coolant			1 x D	1 x D	0.05 x D	0.1 x D	0.2 x D	0.3 x D	0.5 x D
			Max	Air	MMS							
Vc-M/Min												
Steels	P	Low Carbon	●	●	●	230	220	480	385	330	275	220
		Medium Carbon	●	●	●	200	185	345	275	255	220	185
		Alloy Steels	●	●	●	175	165	315	255	230	200	165
		Die/Tool Steels	●	●	●	145	130	275	220	187	145	130
Stainless Steels	M	Free Machining	●	X	○	120	110	205	165	130	115	110
		Austenitic	●	X	○	110	100	160	130	120	110	100
		Difficult Stainless	●	X	○	75	65	125	100	90	75	65
		PH Stainless	●	X	○	110	100	160	130	120	110	100
		Cobalt Chrome Alloys	●	X	○	75	65	125	100	90	75	65
		Duplex (22%)	●	X	○	75	65	125	100	90	75	65
		Super Duplex (25%)	●	X	○	55	45	75	60	55	50	45
Special Alloys	S	High Temp Alloys	●	X	X	35	28	55	45	40	35	28
			●	X	X	35	28	55	45	40	35	28
		Titanium Alloys	●	X	X	75	66	160	130	100	85	65
Cast Irons	K	Gray Cast Iron	●	○	○	200	175	495	395	265	210	175
		Ductile Cast Iron	●	○	○	185	165	370	300	210	185	165
		Malleable Iron	●	○	○	145	132	205	165	155	145	130
Hardened Steels	H	Hardened Steels 35 - 45 Rc	●	○	○	60	50	185	150	100	55	50
		Hardened Steels 45 - 55 Rc	●	○	○	50	45	155	125	85	50	45

● Preferred ○ Possible X Not Possible

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

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

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

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

Série 135 Paramètres de Coupe. Outils Corps Passant

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

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

Feed rate allowance for length

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

Surcote sur avance pour la longueur

Article no. exemple	longueur	Fz	Ae	Ap
135 12N3	Court	1	1 x D	1 X D
135 12N5	Moyen	x 0.7	1 x D	0.25 X D
135 1202N	Long	x 0.6	0.1 x D	1 X D

Feed rate for un-necked tools

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

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

Avance pour outils décolletés

Veuillez calculer l'avance en fonction de la longueur indiquée dans le tableau ci-dessus - puis appliquer la formule suivante:

Coefficient diamètre
3 - 8mm Avance mm/min x 2.0
10 - 25 mm Avance mm/min x 1.35

TuffCut® X-AL Recommended cutting data - Al / Al-Si Alloys

Series		Type of cut		Vc	Diameter - mm		Diamètre - mm		
					2 - 3	4	5	6	8
		Ae	Ap		M/Min	fz	fz	fz	fz
134		1 x D	0.5 x D	250-300	-	-	0.063	0.063	0.094
		1 x D	1 x D	250-300	-	-	0.052	0.052	0.084
		0.2 x D	1 x D	250-300	-	-	0.075	0.075	0.125
		0.5 x D	1 x D	250-300	-	-	0.063	0.063	0.094
135		1 x D	0.5 x D	300-425	0.035	0.035	0.075-0.1	0.1-0.23	0.175-0.3
		1 x D	1 x D	250-365	0.030	0.030	0.025-0.05	0.1-0.15	0.1-0.15
		0.2 x D	1 x D	300-425	0.030	0.030	0.05-0.1	0.1-0.23	0.1-0.23
		0.5 x D	1 x D	300-425	0.030	0.030	0.05-0.1	0.1-0.23	0.1-0.23
		1 x D	1 x D	250-365	0.025	0.025	0.025-0.05	0.1-0.15	0.1-0.15
136		0.05 x D	1 x D	215-300	0.030	0.030	0.025-0.08	0.05-0.10	0.08-0.13
		0.1 x D	1 x D	215-300	0.030	0.030	0.025-0.05	0.05-0.10	0.08-0.13
		0.2 x D	1 x D	215-300	0.025	0.025	0.025-0.04	0.05-0.08	0.05-0.10
138									
		0.3 X D	1x D	425-610	0.03	0.04	0.05	0.06	0.08
		1 x D	1 X D	425-610	0.06	0.08	0.09	0.13	0.16
135B		1 x D	0.5 x D	150	0.050	0.080	0.12	0.16	0.20
138B		0.1 x D	1 x D	300	0.050	0.080	0.12	0.16	0.20

TuffCut XR - XT

TuffCut X-AL

TuffCut Die & Mould

Twister Drills

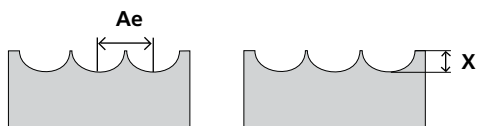
Technical Section

TuffCut® X-AL Recommended cutting data - Al / Al-Si Alloys

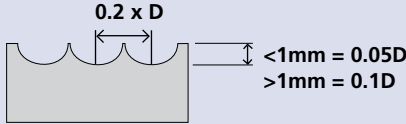
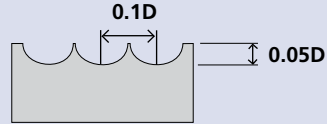
Series		Type of cut		Vc	Diameter - mm		Diamètre - mm		
					10	12	16	20	25
		Ae	Ap	M/Min	fz	fz	fz	fz	fz
134		1 x D	0.5 x D	250-300	0.094	0.127	0.19	0.19	0.25
		1 x D	1 x D	250-300	0.084	0.1	0.14	0.14	0.21
		0.2 x D	1 x D	250-300	0.125	0.135	0.225	0.225	0.275
		0.5 x D	1 x D	250-300	0.094	0.127	0.19	0.19	0.25
135		1 x D	0.5 x D	300-425	0.175-0.3	0.25-1.15	0.38-1.02	0.38-1.02	0.38-1.02
		1 x D	1 x D	250-365	0.1-0.15	0.25-0.75	0.38-0.75	0.38-0.75	0.38-0.75
		0.2 x D	1 x D	300-425	0.1-0.23	0.25-1.15	0.38-1.02	0.38-1.02	0.38-1.02
		0.5 x D	1 x D	300-425	0.1-0.23	0.25-0.89	0.38-0.89	0.38-0.89	0.38-0.89
		1 x D	1 x D	250-365	0.1-0.15	0.25-0.75	0.38-0.75	0.38-0.75	0.38-0.75
136		0.05 x D	1 x D	215-300	0.08-0.13	0.1-0.15	0.15-0.2	0.15-0.2	0.2-0.25
		0.1 x D	1 x D	215-300	0.08-0.13	0.1-0.15	0.15-0.2	0.15-0.2	0.2-0.25
		0.2 x D	1 x D	215-300	0.05-0.10	0.08-0.13	0.10-0.15	0.10-0.15	0.15-0.20
138		0.3 X D	1x D	425-610	0.1	0.13	0.17	0.2	0.25
		1 x D	1 X D	425-610	0.19	0.25	0.3	0.36	0.5
135B		1 x D	0.5 x D	150	0.25	0.50	0.50	-	-
138B		0.1 x D	1 x D	300	0.25	0.50	0.50	-	-

Profile Height-X (µm) / Surface finish

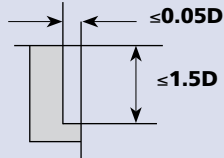
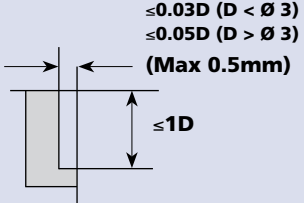
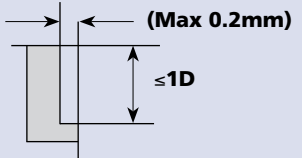
Ae mm	Diameter - mm				Diamètre - mm			
	1	2	4	6	8	10	12	16
0.06	0.9	0.45	0.23	0.15	0.11	0.09	0.08	0.06
0.08	1.6	0.8	0.4	0.27	0.2	0.16	0.13	0.1
0.11	3	1.5	0.76	0.5	0.38	0.3	0.25	0.19
0.15	5.7	2.8	1.4	0.94	0.7	0.56	0.47	0.35
0.2	10	5	2.5	1.7	1.3	1	0.83	0.63
0.3	23	11	5.6	3.8	2.8	2.3	1.9	1.41
0.45	53	26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



TuffCut® DM Series 156 Recommended cutting data

Material Group		Carbon/Alloy/ Tool steels		Ferritic/martensitic/ PH stainless steel		Hardened tool steel		Hardened tool steel		Hardened tool steel	
Hardness HRC		30-40 HRC		<40 HRC		40-45 HRC		45-55 HRC		55-60 HRC	
Dia. mm	Radius mm	Vc RPM	Vf mm/min	Vc RPM	Vf mm/min	Vc RPM	Vf mm/min	Vc RPM	Vf mm/min	Vc RPM	Vf mm/min
0.5	0.25	30,000	508	30,000	508	30,000	508	30,000	308	30,000	250
1	0.5	30,000	683	30,000	683	30,000	608	30,000	458	30,000	383
1.5	0.75	30,000	1575	30,000	1575	23,500	1450	23,500	942	15,000	383
2	1	25,000	2133	25,000	2133	22,000	2442	20,000	892	10,000	383
3	1.5	17,500	2392	17,500	2392	14,500	2283	12,000	892	7,000	383
4	2	14,000	3050	14,000	3050	11,500	2233	9,600	942	5,600	508
6	3	8,750	3558	8,750	3558	7,250	1775	6,000	967	3,500	458
8	4	7,000	4267	7,000	4267	5,800	1725	4,800	892	2,800	383
10	5	5,800	3175	5,800	3175	4,800	1292	4,000	758	2,300	383
12	6	4,300	3558	4,300	3558	3,625	1167	3,000	633	1,750	250
Application conditions											

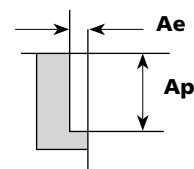
TuffCut® DM Series 157 Recommended cutting data

Material Group	Hardened tool steel		Hardened tool steel		Hardened tool steel	
Hardness HRC	40-45 HRC		45-55 HRC		55-60 HRC	
Diameter mm	Vc RPM	Vf mm/min	Vc RPM	Vf mm/min	Vc RPM	Vf mm/min
3	14,500	2283	12,000	892	7,000	383
4	11,500	2233	9,600	942	5,600	508
6	7,250	1775	6,000	967	3,500	458
8	5,800	1725	4,800	892	2,800	383
10	4,800	1292	4,000	758	2,300	383
12	3,625	1167	3,000	633	1,750	250
16	3,625	1167	3,000	633	1,750	250
Application conditions						

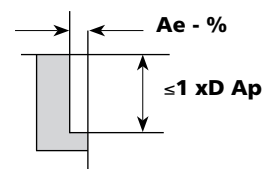
TuffCut® DM Series 158 Recommended cutting data

Material	HRC	Machining type	Diameter (mm)		corner radius		Diameter (mm)		corner radius		Diameter (mm)		corner radius	
			3		0.8		6		1.5		8		2	
			Ae	Ap	n (rpm)	Vf (mm/min)	Ae	Ap	n (rpm)	Vf (mm/min)	Ae	Ap	n (rpm)	Vf (mm/min)
Cast Iron Carbon Steel Alloy Steel	15-25	1	0.7	0.24	8000	6000	1.5	0.45	4000	6700	2	0.6	3000	6700
		2	0.7	0.192	13500	10000	1.5	0.36	6600	11000	2	0.48	5000	11200
		3	0.7	0.48	8000	2800	1.5	0.9	4000	3050	2	1.2	3000	3050
		4	0.7	0.24	10100	5900	1.5	0.45	5000	6500	2	0.6	3800	6600
		5	0.05-0.1	0.08	19100	2050	0.05-0.1	0.15	9500	2300	0.05-0.1	0.2	7200	230
Tool steels PH Stainless steel	25-35	1	0.7	0.24	7400	5100	1.5	0.45	3700	5700	2	0.6	2800	5700
		2	0.7	0.192	11700	8100	1.5	0.36	5800	8900	2	0.48	4400	9000
		3	0.7	0.432	7400	2400	1.5	0.81	3700	2650	2	1.08	2800	2700
		4	0.7	0.24	9500	4950	1.5	0.45	4800	5550	2	0.6	3600	5550
		5	0.05-0.1	0.08	16000	1370	0.05-0.1	0.15	8000	1600	0.05-0.1	0.2	6000	1550
Hardened steel PH Stainless steel	35-45	1	0.7	0.24	6900	3700	1.5	0.45	3400	4100	2	0.6	2600	4200
		2	0.7	0.168	10600	5700	1.5	0.315	5300	6350	2	0.42	4000	6400
		3	0.7	0.384	6900	1860	1.5	0.72	3400	2050	2	0.96	2600	2080
		4	0.7	0.24	9000	3700	1.5	0.45	4500	4100	2	0.6	3400	4150
		5	0.05-0.1	0.08	12700	820	0.05-0.1	0.15	6400	920	0.05-0.1	0.2	4800	920
Hardened steel	45-55	1	0.7	0.168	5300	2900	1.5	0.315	2700	3250	2	0.42	2000	3200
		2	0.7	0.144	8500	4600	1.5	0.27	4200	5050	2	0.36	3200	5150
		3	0.7	0.288	5300	1440	1.5	0.54	2700	1630	2	0.72	2000	1600
		4	0.7	0.168	6900	2600	1.5	0.315	3400	2900	2	0.42	2600	2900
		5	0.05-0.1	0.08	9500	510	0.05-0.1	0.15	4800	580	0.05-0.1	0.2	3600	580
Hardened steel	55-60	1	0.7	0.12	5300	1150	1.5	0.225	2700	1300	2	0.3	2000	1300
		2	0.7	0.096	7400	1600	1.5	0.18	3700	1790	2	0.24	2800	1800
		3	0.7	0.168	5300	690	1.5	0.315	2700	780	2	0.42	2000	770
		4	0.7	0.12	6400	1050	1.5	0.225	3200	1150	2	0.3	2400	1150
		5	0.05-0.1	0.08	7400	320	0.05-0.1	0.15	3700	360	0.05-0.1	0.2	2800	360

1	Standard cutting conditions. First choice starting conditions. High efficiency-longest life.
2	High Speed condition. Machine stable, capable of high feeds, high spindle speeds. Ultra high efficiency.
3	High depth of cut. Rigid machines without high speed spindles.
4	Low Load conditions. Low rigidity machines, hence lower speed / feed.
5	Finishing conditions



Material Groups	TuffCut® DM Endmill Diameter (mm)							
	3.0		4.0		5.0		6.0	
	Radial Cut		Radial Cut		Radial Cut		Radial Cut	
	Ae 10%	Ae 20%	Ae 10%	Ae 20%	Ae 10%	Ae 20%	Ae 10%	Ae 20%
Structural-Alloy-Low carbon steel	37100		27825		22260		18550	
	7791	5565	7791	5565	7791	5565	7791	5565
Die-Mould / Tool Steels	26500		19875		15900		13250	
	2783	2783	5565	5565	5565	5565	5565	5565
Austenitic Stainless Steels and Precipitation Hardened & Martensitic Stainless Steels 32 HRC+	15900		11925		9540		7950	
	1113	795	1002	716	1068	763	1169	835



TuffCut® DM Series 158 Recommended cutting data

Diameter (mm)		corner radius		Diameter (mm)		corner radius		Diameter (mm)		corner radius		Diameter (mm)		corner radius	
10		2		12		2		16		3		20		3	
Ae	Ap	n (rpm)	Vf (mm/min)	Ae	Ap	n (rpm)	Vf (mm/min)	Ae	Ap	n (rpm)	Vf (mm/min)	Ae	Ap	n (rpm)	Vf (mm/min)
3	0.6	2400	6700	4	0.6	2000	6400	5	0.9	1500	5400	7	0.9	1200	4400
3	0.48	4000	11200	4	0.48	3300	10550	5	0.72	2500	9000	7	0.72	2000	7300
3	1.2	2400	3050	4	1.2	2000	2950	5	1.8	1500	2500	7	1.8	1200	2000
3	0.6	3000	6500	4	0.6	2500	6200	5	0.9	1900	5250	7	0.9	1500	4200
0.05-0.1	0.2	5700	2300	0.05-0.1	0.2	4800	2200	0.05-0.1	0.3	3600	1850	0.05-0.1	0.3	2900	1510
3	0.6	2200	5600	4	0.6	1900	5550	5	0.9	1400	4600	7	0.9	1100	3700
3	0.48	3500	9000	4	0.48	2900	8450	5	0.72	2200	7200	7	0.72	1800	6000
3	1.08	2200	2650	4	1.08	1900	2600	5	1.62	1400	2150	7	1.62	1100	1730
3	0.6	2900	5570	4	0.6	2400	5300	5	0.9	1800	4420	7	0.9	1400	3500
0.05-0.1	0.2	4800	1550	0.05-0.1	0.2	4000	1470	0.05-0.1	0.3	3000	1250	0.05-0.1	0.3	2400	1000
3	0.6	2100	4200	4	0.6	1700	3900	5	0.9	1300	3300	7	0.9	1000	2600
3	0.42	3200	6400	4	0.42	2700	6200	5	0.63	2000	5100	7	0.63	1600	4200
3	0.96	2100	2100	4	0.96	1700	1950	5	1.44	1300	1700	7	1.44	1000	1300
3	0.6	2700	4100	4	0.6	2300	4000	5	0.9	1700	3300	7	0.9	1400	2800
0.05-0.1	0.2	3800	910	0.05-0.1	0.2	3200	900	0.05-0.1	0.3	2400	740	0.05-0.1	0.3	1900	600
3	0.42	1600	3200	4	0.42	1300	3000	5	0.63	1000	2600	7	0.63	800	2100
3	0.36	2500	5000	4	0.36	2100	4800	5	0.54	1600	4100	7	0.54	1300	3400
3	0.72	1600	1600	4	0.72	1300	1500	5	1.08	1000	1280	7	1.08	800	1050
3	0.42	2100	2950	4	0.42	1700	2700	5	0.63	1300	2350	7	0.63	1000	1830
0.05-0.1	0.2	2900	580	0.05-0.1	0.2	2400	550	0.05-0.1	0.3	1800	460	0.05-0.1	0.3	1400	360
3	0.3	1600	1300	4	0.3	1300	1200	5	0.45	1000	1000	7	0.45	800	830
3	0.24	2200	1750	4	0.24	1900	1750	5	0.36	1400	1450	7	0.36	1100	1140
3	0.42	1600	770	4	0.42	1300	710	5	0.63	1000	610	7	0.63	800	500
3	0.3	1900	1150	4	0.3	1600	1100	5	0.45	1200	920	7	0.45	1000	780
0.05-0.1	0.2	2200	350	0.05-0.1	0.2	1900	350	0.05-0.1	0.3	1400	290	0.05-0.1	0.3	1100	230

TuffCut® DM Endmill Diameter (mm)									
8.0		10.0		12.0		16.0		20.0	
Radial Cut		Radial Cut		Radial Cut		Radial Cut		Radial Cut	
Ae 10%	Ae 20%	Ae 10%	Ae 20%	Ae 10%	Ae 20%	Ae 10%	Ae 20%	Ae 10%	Ae 20%
13913		11130		9275		6956		5565	
7791	5565	7791	5565	7791	5565	7791	5565	7791	5565
9938		7950		6625		4969		3975	
5565	5565	5565	5565	5565	5565	5565	5565	5565	5565
5963		4770		3975		2981		2385	
1043	745	1670	1193	2226	1590	1878	1342	1503	1073
									RPM (n)
									FEED (mm/min)
									RPM (n)
									FEED (mm/min)
									RPM (n)
									FEED (mm/min)

Recommended speed - all drills

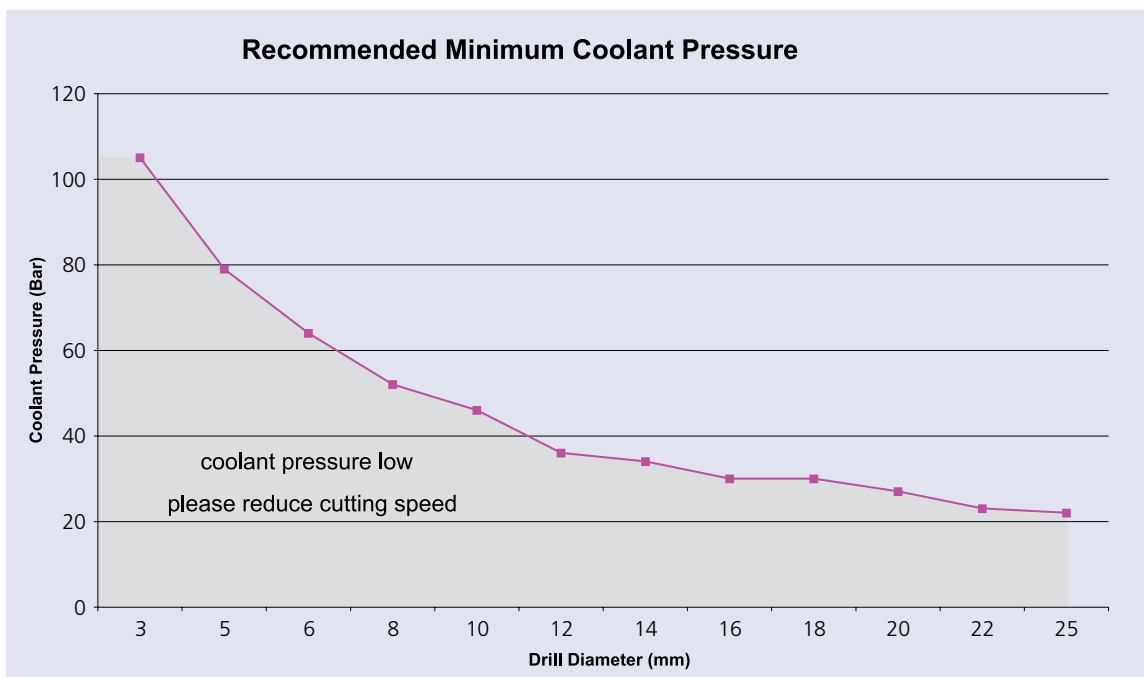
Materials	SPEED - M/MIN					
	2XDSSM 3 X D SOLID	2XD SRM 5 X D SOLID	2XD CSM 3 X D COOLANT	2XD CRM 5 X D COOLANT	2XD CLM 7 X D COOLANT	2MD CLM 10 X D COOLANT
Low Carbon Steel <0.3%C	80-120	75-100	150-200	150-200	130-145	80-90
Medium Carbon Steel	75-100	65-90	125-175	125-175	100-130	80-90
Alloy Steel ≤ 35hrc	60-75	50-70	75-105	75-105	70-90	80-90
Alloy Steel 36- 45hrc	45-60	40-55	45-70	45-70	40-55	60-80
Alloy Steel 45-50hrc	30-35	25-30	35-50	35-50	35-45	40-60
Grey Cast Iron	100-120	80-100	150-200	150-200	110-140	80-90
Ductile Cast Iron	75-90	65-80	135-150	135-150	130-145	60-80
Austenitic Stainless	30-45	25-40	80-150	80-150	45-65	60-70
Ph Stainless	20-35	15-30	50-80	50-80	30-45	40-50
High Temp Alloys	15-30	10-25	15-35	15-35	20-30	20-25
Titanium Alloys	35-45	30-40	55-70	55-70	50-65	40-50

Series 2XD drill - Recommended feed 0.5 - 6mm diameter

Materials	FEED MM/REV					
	0.5	1.5	3	4	5	6
Low Carbon Steel <0.3%C	0.025-0.05	0.05-0.075	0.075-0.12	0.1-0.15	0.12-0.18	0.14-0.2
Medium Carbon Steel	0.025-0.05	0.05-0.075	0.075-0.12	0.1-0.15	0.12-0.18	0.14-0.2
Alloy Steel ≤ 35hrc	0.025-0.05	0.05-0.075	0.075-0.12	0.1-0.15	0.12-0.18	0.14-0.2
Alloy Steel 36- 45hrc	0.01-0.025	0.025-0.04	0.05-0.11	0.08-0.13	0.12-0.18	0.14-0.2
Alloy Steel 45-50hrc	0.01-0.02	0.02-0.03	0.035-0.075	0.06-0.1	0.08-0.12	0.09-0.15
Grey Cast Iron	0.025-0.05	0.05-0.075	0.075-0.12	0.1-0.15	0.12-0.18	0.14-0.2
Ductile CaSt Iron	0.025-0.05	0.05-0.075	0.075-0.12	0.1-0.15	0.12-0.18	0.14-0.2
Austenitic Stainless	0.025-0.05	0.05-0.075	0.075-0.12	0.1-0.15	0.12-0.18	0.14-0.2
Ph Stainless	0.01-0.03	0.025-0.05	0.05-0.085	0.06-0.09	0.07-0.11	0.08-0.12
High Temp Alloys	0.01-0.03	0.025-0.05	0.035-0.085	0.04-0.09	0.05-0.10	0.06-0.11
Titanium Alloys	0.01-0.03	0.025-0.05	0.075-0.12	0.1-0.15	0.12-0.18	0.14-0.2

Series 2MDCL micro coolant drills - Recommended feed

Materials	FEED MM/REV		
	Diameter		
	2	2.5	2.9
Low Carbon Steel <0.3%C	0.046	0.051	0.056
Medium Carbon Steel	0.046	0.051	0.056
Alloy Steel ≤ 35hrc	0.046	0.051	0.056
Alloy Steel 36- 45hrc	0.046	0.046	0.051
Alloy Steel 45-50hrc	0.025	0.033	0.046
Grey Cast Iron	0.046	0.051	0.056
Ductile Cast Iron	0.046	0.051	0.056
Austenitic Stainless	0.033	0.038	0.043
Ph Stainless	0.025	0.027	0.038
High Temp Alloys	0.025	0.027	0.036
Titanium Alloys	0.025	0.027	0.036



Series 2XD drill - Recommended feed 8 - 20mm diameter

Materials	FEED MM/REV						
	8	10	12	14	16	18	20
Low Carbon Steel <0.3%C	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4
Medium Carbon Steel	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4
Alloy Steel ≤ 35hrc	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4
Alloy Steel 36- 45hrc	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4
Alloy Steel 45-50hrc	0.12-0.2	0.13-0.23	0.13-0.23	0.15-0.26	0.16-0.26	0.18-0.28	0.2-0.3
Grey Cast Iron	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4
Ductile Cast Iron	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4
Austenitic Stainless	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4
Ph Stainless	0.1-0.15	0.13-0.23	0.18-0.25	0.2-0.27	0.22-0.3	0.25-0.33	0.28-0.35
High Temp Alloys	0.08-0.13	0.1-0.15	0.12-0.17	0.14-0.19	0.16-0.21	0.18-0.25	0.23-0.28
Titanium Alloys	0.16-0.24	0.18-0.27	0.2-0.3	0.22-0.35	0.25-0.36	0.28-0.38	0.3-0.4

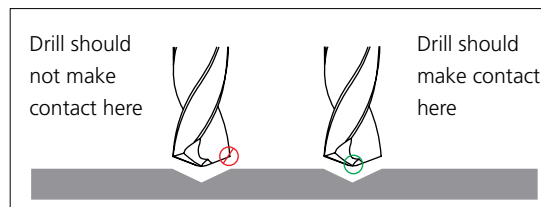
Series 200S Spot drill - Recommended Cutting Data

Materials	Speed-Vc M/min	Diameter				
		6	8	10	12	16
		FEED MM/REV				
Low Carbon Steel <0.3%C	100	0.076	0.1	0.13	0.16	0.16
Medium Carbon Steel	80	0.076	0.1	0.13	0.16	0.16
Alloy Steel ≤ 35hrc	70	0.076	0.1	0.13	0.16	0.16
Alloy Steel 36- 45hrc	45	0.076	0.1	0.13	0.16	0.16
Alloy Steel 45-50hrc	40	0.076	0.1	0.13	0.16	0.16
Grey Cast Iron	110	0.076	0.1	0.13	0.16	0.16
Ductile Cast Iron	80	0.076	0.1	0.13	0.16	0.16
Austenitic Stainless	45	0.076	0.1	0.13	0.16	0.16
Ph Stainless	30	0.076	0.1	0.13	0.16	0.16
High Temp Alloys	20	0.076	0.1	0.13	0.16	0.16
Titanium Alloys	55	0.076	0.1	0.13	0.16	0.16

Twister Drills Series 2XDCE Technical Information

Process For Successful Deep Hole Drilling:

1. Start by producing a 1.5 x diameter to 3 x diameter pilot hole using a coolant or non-coolant pilot drill. Typically this tool will have a point angle the same as or greater than the deep hole drill. Run this drill at 100% of the final drill speed and 1/2 the normal IPM.
2. Retract and tool change to the final deep hole (2XDCE MA Ford® Series) drill.
3. Rapid to clearance plane and enter the pilot hole at 25% (don't exceed 400 to 500 RPM) of the final speed and 25 - 50 mm/min. This will help with true position by eliminating drill whip. Once into the hole, turn on the coolant and advance to the material start. At this point, you can add a dwell to clear any chips that have been left from the previous drill and let the spindle get to full speed. Increase the speed and feed to final drilling parameters.
4. Drill one shot to the final hole depth or through.
5. Should you experience any squeaking you may need to retract the drill and increase your feed. Chip packing is occurring and will need to be addressed.
6. Once through the material, it may be necessary to reduce the RPM to eliminate breakage of the drill due to drill whip. Then retract to the clearance plane.



Machine Requirements

High Pressure Pump System (70 Bar)
Machine runout of 0.008mm Max.



Due to the conditions of equipment, tool holders, and conditions beyond MA Ford®'s control, your results may vary.

Should your application require more in depth discussion or a special tool, please contact M.A. Ford®'s Application Engineering Department at +44(0) 1332 267960.

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.

Twister Drills Series 2XDCE Recommended cutting data

Workpiece material	SPEED Vc-M/Min	Diameter								
		3	4	5	6	7	8	9	10	12
		FEED MM/REV								
Low Carbon Steel <0.3%C	105	0.05	0.075	0.088	0.106	0.127	0.193	0.215	0.238	0.254
Structural Steel	120	0.05	0.075	0.088	0.106	0.127	0.193	0.215	0.238	0.254
Medium Carbon Steel	80	0.05	0.075	0.088	0.106	0.127	0.193	0.215	0.238	0.254
Tool & Die Steel	80	0.05	0.075	0.088	0.106	0.127	0.193	0.215	0.238	0.254
Alloy Steel	80	0.05	0.075	0.088	0.106	0.127	0.193	0.215	0.238	0.254
Grey Cast Iron	120	0.06	0.078	0.1	0.12	0.14	0.2	0.215	0.24	0.254
Ductile Cast Iron	80	0.06	0.078	0.1	0.12	0.14	0.2	0.215	0.24	0.254
Austenitic Stainless	55	0.05	0.071	0.09	0.105	0.127	0.193	0.215	0.238	0.254
Ph Stainless	40	0.05	0.071	0.09	0.105	0.127	0.193	0.215	0.238	0.254
Martensitic Stainless	40	0.05	0.071	0.09	0.105	0.127	0.193	0.215	0.238	0.254
Ferritic Stainless	75	0.05	0.071	0.09	0.105	0.127	0.193	0.215	0.238	0.254
High Temp Alloys	20-25	0.017	0.022	0.03	0.035	0.048	0.063	0.071	0.078	0.085
Titanium Alloys	45	0.03	0.04	0.05	0.06	0.071	0.12	0.127	0.14	0.152
Hardened Steel (35-45 Hrc)	35	0.012	0.015	0.02	0.022	0.027	0.048	0.053	0.06	0.066
Hardened Steel (46-55 Hrc)	25	0.012	0.015	0.02	0.022	0.027	0.048	0.053	0.06	0.066
Non Ferrous-Al<14%Si	150	0.083	0.11	0.14	0.17	0.195	0.28	0.314	0.35	0.378
Non Ferrous-Al>14%Si	105	0.083	0.11	0.14	0.17	0.195	0.28	0.314	0.35	0.378
Non Ferrous-Brass	120	0.053	0.071	0.088	0.106	0.127	0.279	0.314	0.35	0.378
Cu/Cu Alloys/Magnesium	90	0.053	0.071	0.088	0.106	0.127	0.279	0.314	0.35	0.378

TuffCut XR - XT

TuffCut X-AL

TuffCut Die & Mould

Twister Drills

Technical Section

Twister Drills Series 200A Recommended cutting data

Workpiece Material Group		Material Type	Speed Vc-M/min	Diameter							
				1	1.5	3	6	10	12	16	20
				FEED MM/REV							
Steels	P	Low Carbon	70	0.006	0.013	0.051	0.1	0.127	0.152	0.175	0.2
		Alloy Steels < 35 HRC	60	0.006	0.013	0.051	0.1	0.127	0.152	0.175	0.2
		Alloy Steels 35-45 HRC	50	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
Stainless Steels	M	Austenetic	50	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
		PH Stainless	35	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
		Duplex / Super duplex	30	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
Special Alloys	S	High Temp Alloys	30	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
		Titanium Alloys	40	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
Cast Irons	K	Gray /Ductile Cast Iron	85	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
Hardened Steels	H	Hardened Steels 45-55 HRC	45	0.013	0.025	0.025	0.025	0.05	0.05	0.05	0.076
		Hardened Steels 55-65 HRC	35	0.013	0.025	0.025	0.025	0.05	0.05	0.05	0.076
Non- Ferrous	H	Plastic	90	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
		Kevlar/Graphite/Composite	115	0.006	0.0127	0.005	0.076	0.1	0.152	0.2	0.225
		Glass/Ceramic	25	0.013	0.025	0.025	0.025	0.05	0.05	0.05	0.076

Twister Drills Series 205B Recommended cutting data

Workpiece Material Group		Material Type	Speed- M/min	Diameter							
				1	1.5	3	6	10	12	16	20
				FEED MM/REV							
Steels	P	Low Carbon	70	0.025	0.05	0.076	0.152	0.203	0.254	0.275	0.3
		Alloy Steels < 35 HRC	60	0.025	0.05	0.076	0.152	0.203	0.254	0.275	0.3
		Alloy Steels 35-45 HRC	50	0.025	0.05	0.076	0.152	0.203	0.254	0.275	0.3
Stainless Steels	M	Austenetic	50	0.025	0.05	0.076	0.152	0.203	0.254	0.275	0.3
		PH Stainless	35	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
		Duplex / Super duplex	30	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
Special Alloys	S	High Temp Alloys	30	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
		Titanium Alloys	40	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
Cast Irons	K	Gray /Ductile Cast Iron	85	0.025	0.05	0.076	0.152	0.203	0.254	0.275	0.3
Hardened Steels	H	Hardened Steels 45-55 HRC	45	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
Non- Ferrous	H	Plastic	120	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
		Kevlar/Graphite/Composite	120	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
		Glass/Ceramic	25	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225

Twister Drills Series 207 Recommended cutting data

Workpiece Material Group		Material Type	Speed- M/min	Diameter							
				1	1.5	3	6	10	12	16	20
				FEED MM/REV							
Non-Ferrous	K	Plastic	90	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225
		Kevlar/Graphite/Composite	115	0.06	0.0127	0.05	0.076	0.1	0.152	0.2	0.225

Twister Drills Series 229 Recommended cutting data

Material group	Example	Vc m/min	Diameter					
			1.5	3	6	12	20	25
			FEED MM/REV					
Titanium Alloys	Ti6Al4V	30	0.013	0.05	0.11	0.15	0.2	0.25
Aluminium < 10% Si	6061/7075	215	0.08	0.20	0.31	0.45	0.61	0.76
Aluminium > 10% Si		155	0.05	0.08	0.15	0.25	0.31	0.35
Brass/Copper		120	0.05	0.08	0.15	0.25	0.31	0.35
Plastics		90	0.05	0.08	0.15	0.25	0.31	0.35

Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
FREE MACHINING STEEL	1.0718	9SMnPb28	S250Pb	1914	F.2112 - 11SMnPb28	12L13
	210M15	1.0721	10S20	10F1	F.2121 - 10 S 20	1108
	210A15	1.0723	15S20	1922	F.210F	
	240M07	1.0736	9SMn36	S300	F.2113- 12 SMn 35	1215
		1.0737	9MnPb36	S300Pb	F.2114 - 12 SMnPb 35	12L14
		1.7022	10SPb20	10PbF2	F.2122 - 10 SPb 20	11L08
LOW CARBON STEEL	045M10	1.0301	C10	AF34C10/XC10		1010
	080M15;040A15	1.0401	C15	AF37C12/XC18	F.111	1015
	050A20/055M15	1.0402	C22	AF42C20/XC25	F.112	1020
	070M26	1.0406	C25	AF50C30	F.221	1025
	220M07	1.0711	9S20			1212
	230M07	1.0715	9SMn28	S250	F.2111 - 11SMn28	1213
	040A10	1.1121	CK10	XC10	F.1510 - C 10 k	1010
	120M19	1.1133	20Mn5	20M5	F.1515 - 20 Mn 6	1022/1518
	080M15	1.1141	CK15	XC15 / C15E	F.1511 - C 16 k	1015
	050A20	1.1151	CK22	XC25 / C22E	F.1120 - C 25 k	1020/1023
	070M26	1.1158	CK25	XC25 / C25E	F.1120 - C 25 k	1025
		1.5419	22Mo4			4419
		1.5622	14Ni6	15N6 / 15Ni6	F.2641 - 15 Ni 6	A350-LF5
	655M13/A12	1.5752	14NiCr14	12NC15		3310/9314
	523M15	1.7015	15Cr3	12C3		5015
STRUCTURAL STEEL	4360-40C	1.0038	RSt37-2	E24-2NE / S235JRG2	1312	A570 (36)
	4360-43B	1.0044	St44-2	E28-2 / S275JR	1412	A570 (40)
	4360-50B	1.005	St50-2	A50-2 / E295	2172	A570 (50)
	4360-55E	1.006	St60-2	A60-2 / E335		
	4360-40C/D-1449-37C	1.0116	St37-3	E24-3;-4 / S235J2G3	1313	A360 C;D
	1449 -2/3/4CR	1.033	St12	DC01	AP 00	A366/1012/A619
	1449 2CR; 3CR	1.0333	St13		AP 02	1008
	1449 1CR; 2CR	1.0338	St14	DC04	AP 04	A620
	1501Gr.161-360/400	1.0345	H I	A37CP;AP / P235GH	1330	A516Gr.65;-55;
	3CR	1.0347	RRSt13	DC03		A619
	161-400;	1.0425	H II	A42CP;AP / P265GH	1430	
		1.0473	19Mn6	A52CP;AP / P335GH	2101/2102	A42 RC I
		1.0481	17Mn4	A48CP;AP / P295GH		A 47 RB II
		1.0562	StE355	E355R/FP / S355N	2132	A 47 RC I; RA II
	4360-50B;50C;50D	1.057	St52-3	E36-3;E36-4 / S355J2G3	2132	AE 355 KG; DD
	1501-240	1.5415	15Mo3	15D3 / 15Mo3	2912	A 510 C;D
	1503-245-420	1.5423	16Mo5			F.2601 - 16 Mo 3
	1501-503-690	1.5637	10Ni14	12N14 / 12Ni14		F.2602 - 16 Mo 5
		1.5713	13NiCr6	10NC6		F.152
		1.5732	14NiCr10	14NC11		A204 (A)
	620Gr.27;31	1.7335	13CrMo44	15CD3.05	2216	F.2601 - 16 Mo 3
	4360-55E	1.8902	StE420	E420RIFP / S420N		F.2602 - 16 Mo 5
		1.8905	StE460	E460RIFP / S460N		F.152
		1.007	St70-2	A70-2 / E360		A350-LF3
	620Gr.27	1.7337	16CrMo44	15CD4.5	2216	3115
	622Gr.31;45	1.738	10CrMo910	12CD9.10 / 10CrMo9-10	2218	F.1540 - 15 NiCr 11
	660/440	1.7715	14MoV63			F.2631 - 14 CrMo 4 5
MEDIUM CARBON STEEL	060A35	1.0501	C35	AF55C35 /XC38	1550	AE 420 KG
	212M36	1.0726	35S20	35MF6	1957	AE 460 KG
	120M36/150M28	1.1165	30Mn5	35M5 / 30Mn5		
		1.1166	34Mn5	35M5 / 34Mn5		
	150M36	1.1167	36Mn5	40M5 / 36Mn5	2120	
	150M28	1.117	28Mn6	20M5 / 28Mn6		
	080M36	1.118	Cm35	XC32 / C35R	1572	
	080M36	1.1181	CK35	XC38H1 / C35E	1572	
	060A35	1.1183	CF35	XC38H1TS	1572	
	080M46	1.0503	C45	AF65C45 /C45	1650	
	070M55	1.0535	C55	C55	1655	
	080A62	1.0601	C60	AF70C55 / C60		
	070A72	1.0605	C75	C75		
	212M44	1.0727	45S20	45MF4	1973	
	250A53	1.0903	51Si7	51S7	2090	
	250A53	1.0904	55Si7	55S7	2085	
	150M36	1.1157	40Mn4	35M5		
	060A40/080A40	1.1186	CK40	XC42H1 / C40E		
	080M46/060A47	1.1191	CK45	XC42H1 / C45/XC45	1672	
	060A47	1.1193	CF45	XC42H1TS	1672	
	080M46	1.1201	Cm45	XC42H1 /C45R	1660	
	060A57/070M55	1.1203	CK55	XC55H1 / C55E		
	080M50	1.1206	CK50	XC48H1 / C50E		
	070M55	1.1209	Cm55	XC55H1 / C55R / 3C55		
	060A52	1.1213	CF53	XC48H1TS	1674	
	060A62	1.1221	CK60	XC60 / C60E/2C60	1665/1678	
	060A67	1.1231	CK67	XC68	1770	
	250A58	1.0909	60Si7	60S7		
	250A61	1.0961	60SiCr7	60SC7		

Material cross reference chart

							
	UK	German	DIN	French	Swedish	Spanish	USA
ALLOY STEEL	805M20	1.6523	21NiCrMo2	20NCD2	2506	F.1522 - 20 NiCrMo 2	8620
	805A20	1.6543	21NiCrMo22			F.1534 - 20 NiCrMo 3	8720
	060A78	1.1248	Ck75	XC75 / C75E	1774/1778	F.513/514/515	1080/1078
	640A35	1.571	36NiCr6	35NC6			3135
	640M40	1.5711	40NiCr6				3140
	311-Type7	1.6546	40NiCrMo22	40NCD2		F.1204 - 40 NiCrMo2	8740
	820A16	1.6587	17CrNiMo8	18NCD6		F.1560 - 14 NiCrMo13	
	832M13	1.6657	14NiCrMo134	16NCD13		F.1569 - 14 NiCrMo 131	
		1.7006	46Cr2	42C2 / 46Cr2			5045/5046
	530A32	1.7033	34Cr4	32C4 / 34Cr4		F.8221 - 35 Cr 4/F.224	5132
	530A36	1.7034	37Cr4	38C4 / 37Cr4		F.1201 - 38 Cr 4	5135
	527M17	1.7131	16MnCr5	16MC5	2511	F.1515 - 16 MnCr 5	5115
		1.7147	20MnCr5	20MC5		F.150.D	5120
	1717CDS110	1.7218	25CrMo4	25CD4 / 25CrMo4	2225	F.8330 - AM 25 CrMo4	4130
	905M31	1.8507	34CrAlMo5	30CAD6.12		F.1741 - 34 CrAlMo5	A355Cl.D
	905M39	1.8509	41CrAlMo7	40CAD6.12	2940	F.1740 - 41 CrAlMo7	A355Cl.A
	708A37	1.233	35CrMo4	34CD4 / 35CrMo4	2234		4135
	708M40	1.2332	47CrMo4	42CD4	2244		4142
	530M40/530A40	1.7035	41Cr4	42C4 / 41Cr4		F.1202 -42 Cr4	5140
	530A40	1.7045	42Cr4	42C4TS	2245	F.1202 - 42 Cr 4	5140
	527A60	1.7176	55Cr3	55C3	2253	F.1431 - 55 Cr3	5155
	708A37	1.722	34CrMo4	35CD4 / 34CrMo4	2234	F.8231 - AM 34 CrMo4	4135/4137
	708M40	1.7223	41CrMo4	42CD4TS	2244	F.8232 - 42 CrMo4	4142/4140
	708M40	1.7225	42CrMo4	42CD4 / 42CrMo4	2244	F.8232 - 42 CrMo4	4140
	708A47	1.7228	50CrMo4	50CrMo4			4150
	735A50	1.8159	50CrV4	50CV4 / 51CrV4	2230	F.1430 - 51 CrV4	6150
	060A96	1.1274	Ck101	XC100	1870		1095
HIGH STRENGTH ALLOY STEEL	816M40	1.6511	36CrNiMo4	40NCD3 / 36CrNiMo4		F.1280 - 35 NiCrMo4	9840
	817M40	1.6562	40NiCrMo73				4340
	311-Type6	1.6565	40NiCrMo6			F.1272 - 40 NiCrMo 7	4340
	823M30	1.658	30CrNiMo8	30CND8 / 30CrNiMo8			
	817M40	1.6582	34CrNiMo8	35NCD6 / 34CrNiMo6	2541	F.1272 - 40 NiCrMo 7	4340
	830M31	1.6746	32NiCrMo145	35NCD14		F.1262 - 32 NiCrMo 12	
	835M30	1.6747	30NiCrMo166	35NCD16		F.1260 - 32 NiCrMo16	
	722M24	1.8515	31CrMoV139	30CD12	2240	F.1712 - 31 CrMo 12	
722M24	1.7361	32CrMo12	30CD12	2240	F.124.A		
TOOL STEELS		1.1525	C80W1	Y190;Y180			W108
		1.1545	C105W1	Y1105	1880		W110
	BW1B	1.1625	C80W2			F.1507 C80	W1
		1.1663	C125W	Y2120		F.5123 C120	W112
	BW1A	1.175	C75W				W1
	BL3	1.2067	100Cr6	Y100C6		F.5230 100 Cr6	L3
		1.221	115CrV3				L2
	BO1	1.251	100MnCrW4		2140	F.5220 95 MnCrW5	O1
	BS1	1.2542	45WCrV7		2710	F.5241 45 WCrSi 8	S1
	BW2	1.2833	100V1	Y1105V			W210
	BO2	1.2842	90MnCrV8	90MV8			2
	534A99	1.3505	100Cr6	100C6	2258	F.1310 - 100 Cr 6	52100
		1.2713	55NiCrMoV6	55NCDV7		F.528	L6
	Grade2A	0.962	G-X260NiCr42				A532IBNiCr-LC
	Grade2B	0.9625	G-X330NiCr42				A532IANiCr-HC
	Grade2C;D;E	0.963	G-X300CrNiSi952				A532IDNi-HiCr
	Grade3A;B	0.964	G-X300CrMoNi1521				
	Grade3C	0.9645	G-X260CrMoNi2021				A532IID20%CrMo-LC
	Grade3D	0.965	G-X260Cr27				A532IIIA25%Cr
	Grade3E	0.9655	G-X300CrMo271				A532IIIA25%Cr
	BD3	1.208	X210Cr12	Z200C12		F.5212 X210 Cr12	D3
	BH11	1.2343	X38CrMoV51	Z38CDV5		F.5317 X37 CrMoV5	H11
	BH13	1.2344	X40CrMoV51	Z40CDV5	2242	F.5318 X40 CrMoV5	H13
	BA2	1.2363	X100CrMoV51	Z100CDV5	2260	F.5227 X100 CrMoV5	A2
	BH10	1.2365	X32CrMoV33	32DCV28		F.5313 CrMoV 12	H10
	BD2	1.2379	X155CrVMo121	Z160CDV12			D2
		1.2436	X210CrW12		2312	F.5213 X210 CrW12	
		1.2567	X30WCrV53	Z32WCV5			
	BH21	1.2581	X30WCrV93	Z30WCV9		F.5323 X30 WCrV9	H21
		1.2601	X165CrMoV12		2310	F.5211 X160 CrMoV12	
	BH12	1.2606	X37CrMoW51	Z35CWDV5			H12
	BT15	1.3202	S12-1-4-5			F.5563 12-1-5-5	T15
	1.3207	S10-4-3-10	Z130WKCDV10-10-04-03		F.553 10-4-3-10		
	1.3243	S6-5-2-5	Z85WDKCV06-05-05-04-02	2723	F.5613 6-5-2-5		
	1.3246	S7-4-2-5	Z110WKCDV07-05-04-04-02		F.5613 6-5-2-5	M41	
BT42	1.3247	S2-10-1-8	Z110DKCWW09-08-04-02-01		F.5615 7-4-2-5	M42	
BM34	1.3249	S2-9-2-8			F.5611 2-9-2-8	M33/M34	
BT4	1.3255	S18-1-2-5	Z80WKCV18-05-04-01		F.5530 18-1-1-5	T4	
BT5	1.3265	S18-1-2-10			F.5540 18-0-2-10	T5	
	1.3342	SC6-5-2	Z90WDCV06-05-04-03			M3	
BM2	1.3343	S6-5-2	Z85WDCV06-05-04-02	2722	F.5603 6-5-2	M2	

Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
TOOL STEELS		1.3344	S6-5-3		F.5605 6-5-3	M3Class2
	BM1	1.3346	S2-9-1			H41/M1
		1.3348	S2-9-2		F.5607 2-9-2	M7
	BT1	1.3355	S18-0-1	2782	F.5520 18-0-1	T1
STAINLESS STEEL		1.3401	X120Mn12		F.82551-AM-X 120 Mn 12	A128(A)
	443S65	1.4747	X80CrNiSi20		F.3222-X 80CrSiNi20-02	HNv6
	403S17	1.4	X6Cr13	2301	F.3110-X6 Cr 13	403
	403S17	1.4001	X7Cr14	2301	F.8401-AM-X12 Cr 13	410S
	405S17	1.4002	X6CrAl13	2302	F.3111-X6 CrAl13	405
	416S21	1.4005	X12CrS13	2380	F.3411-X12 CrS13	416
	410S21	1.4006	X10Cr13	2302	F.3401-X12 Cr 13	410/CA-15
	410C21	1.4008	G-X8Cr14			410
	430S15	1.4016	X6Cr17	2320	F.3113-X8 Cr17	430
	420S37	1.4021	X20Cr13	2303	F.3402-X20 Cr 13	420
	420S45	1.4028	X30Cr13	2304	F.3403-X30 Cr 13	420
		1.4031	X38Cr13	2304	F.3404-X40 Cr 13	
	420S45	1.4034	X46Cr13		F.3405-X46 Cr 13	420
	431S29	1.4057	X20CrNi172	2321	F.3427-X15 CrNi16	431
		1.4104	X12CrMoS17	2383	F.3117-X10 CrS17	430F
	434S17	1.4113	X6CrMo17	2325		434
		1.4125	X105CrMo17			440C
		1.451	X6CrTi17		F.3114-X8CrTi17	XM8/430Ti
	409S19	1.4512	X5CrTi12			409
		1.4534				13-8 PH Mo
		1.4545				15-5 PH
						15-7 PH Mo
		1.4504				17-4 PH
		1.4548	Z7CNU17-04			17-4 PH ,CH900
	401S45	1.4718	X45CrSi93		F.3220-X 4 CrSi 09-03	HNv3
	403S17	1.4724	X10CrAl13		F.13152-X 10 CrAl13	
		1.4731	X40CrSiMo102		F.3221-X 40 CrSiMo 10-02	
	430S15	1.4742	X10CrAl18		F.3153-X 10 CrAl 18	430
		1.4762	X10CrAl24		F.3154-X 10 CrAl24	446
	303S21	1.4305	X10CrNiS189	2346	F.3508-X10CrNiS18-09	303
	304S15	1.4301	X5CrNi1810	2332	F.3451-X5 CrNi18-10	304/304H
	305S19	1.4303	X5CrNi1812		F.3513-X8CrNi18-12	308; 305
	304S12/S11/C12	1.4306	G-X2CrNi189/1911	2333/52	F.3503-X 2CrNi19-10	304L
	304C15	1.4308	G-X6CrNi189	2333		CF-8
	301S21	1.431	X12CrNi177		F.3517-X12CrNi17 07	301
	304S62	1.4311	X2CrNi1810	2371		304LN
	425C11	1.4313	G-X5CrNi134	2385		CA6-NM
	316S16/S31	1.4401	X5CrNiMo17122	2347	F.3543-X5CrNiMo17-12/03	316/316L
	316S11/S12	1.4404	X2CrNiMo17132	2348	F.3533-X 2CrNiMo17 12-03	316L
	316S61	1.4406	2CrNiMoN17122			316LN
	316C16	1.4408	G-X6CrNiMo1810	2343	F.8414-AM-X7 CrNiMo20 10	CF-8M
	316S62	1.4429	X2CrNiMo17133	2375		316LN
	316S11/S12	1.4435	X2CrNiMo18143	2353	F.3533-X 2 CrNiMo 17-12-03	316L
	316S16	1.4436	X5CrNiMo17133	2343	F.3534-X 6 CrNiMo 17-12-03	316
	317S12	1.4438	X2CrNiMo18164	2367		317L
	317S16	1.4449	X5CrNiMo1713			317
	347C17	1.4452	G-X5CrNiNb189			
		1.446	X8CrNiMo275	2324	F.3309-X 8CrNiMo27-05	329
	321S12S31	1.4541	X6CrNiTi1810	2337	F.3553-X 7 CrNiTi 18-11	321
		1.4542	X5CrNiCuNb1714			630
	347S17/S18	1.4546	X5CrNiNb1810			348
	347S17/S31	1.455	X6CrNiNb1810	2338	F.3552-X 7 CrNiNb 18-11	347
	320S31/S17	1.4571	X6CrNiMoTi17122	2350	F.3552-X 6 CrNiMoTi17-12-03	316Ti
	318S17	1.458	X6CrNiMoNb17122			316Cb
	318C17	1.4581	G-X5CrNiMiNb1810			
	309S24	1.4828	X15CrNiSi2012			309
	309S24	1.4833	X7CrNi2314			309S
	309C30	1.4837	G-X40CrNiSi2520			
		1.4841	X15CrNiSi2520		F.3310-X15 CrNiSi 25-20	314/310
	310S24	1.4845	X12CrNi2521	2361	F.331	310S
	310C40	1.4848	G-X40CrNiSi2520		F.8452-AM-X 40 CrNi25 20	HK
	349S54	1.4871	X53CrMnNiN219		F.3217-X 53 CrMnNiN 21-09	EV8
	331S40	1.4873	X45CrNiW189		F.3211-X45 CrNiSiW 28-09	
	321S20	1.4878	X12CrNiTi189	2337	F.3523-X 6CrNiTi 18 11	321
	1501-509;510	1.5662	X8Ni9		F.2645 - X 8 Ni 09	A353
		1.568	12Ni19			2515
HIGH TEMPERATURE ALLOYS	NA 18	2.4375	NiCu30 Al			Monel k-500
		2.4685	G-NiMo28			Hastelloy B
		2.481	G-NiMo30			Hastelloy C
		2.461	NiMo16Cr16Ti			Hastelloy C-4
	NA 16/3072-76	2.4858	NiCr21Mo			Incoloy 825
		2.4694	NiCr16Fe7TiAl			Inconel
	NA 21	2.4856	NiCr22Mo9Nb			Inconel 625

Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
HIGH TEMPERATURE ALLOYS		2.4856				Inconel 625
		2.4642	NiCr29Fe			Inconel 690
		2.4668	NiCr19FeNbMo			Inconel 718
		2.4669	NiCr15Fe7TiAl			Inconel X-750
						Invar 36-36 Alloy
						Invar Super 32-5
						Invar Super 32-5
						Monel 400
	NA 13	2.436	NiCu30Fe			A286
	X5NiCrTi26 15			HR650		Co Chrome ASTM F-75
			Co28Cr6Mo			330
	NA17	1.4864	X12NiCrSi3616		F.3313-X 12 CrNi 36-16	B163
	NA15(H)	1.4876	X10NiCrAlTi3320		F.3545-X 9NiCr 33-21	4544/SB127/164
	3072-76/NA13	2.436	NiCu30Fe			4676
	3072-76/NA18/3146	2.4375	NiCu30Al			5388 C
		2.4602	NiCr17Mo17FeW			Nimonic 75
	HR5/203-4/703-B	2.463	Ni-Cr20Ti			
	HR 10	2.465	NiCr20Co19MoTi	MH-05		
		2.4662	NiCr15MoTi			5660C
	HR 6/204	2.4665	NiCr22Fe18Mo	MH-16		5536E
	HC 203	2.467	G-NiCr13Al6MoNb	MH-03		5391A
	HC 204	2.4674	NiCo15Cr10MoAlTi	MH-31		
	3072-76	2.4816	NiCr15Fe			5540
		2.4856	NiCr22Mo9Nb			5581
	3072-76	2.4858	NiCr21Mo			
	HR 207/5047		NiFe33Cr17Mo			
			NiCo32Cr26Mo			
			NiCo28Cr15MoAlTi			
	HR 3/5007	2.4634	NiCo20Cr15MoAlTi	MH-14		
		2.4654	NiCr20Co14MoTi			
	HR 505	2.4669	NiCr16FeTi			5542G
		2.4676	NiCo10W10Cr9AlTi			
			NiCr20Co16MoTi			
			NiW13Co10Cr9AlTi			
			NiCr16Co10WAlTi			
	HR 401HR601/736B	2.4631	NiCr20TiAl	MH-07		
		2.4636	NiCo15Cr15MoAlTi			687
		2.4662	NiFe35Cr14MoTi			
	HR 8	2.4668	NiCr19Fe19NbMo	MH-06		
		2.4916	NiCr19Co11MoTi			
		2.4983	NiCr18Co18MoAlTi			684
			NiCo22Cr16WAlTi			
TITANIUM	TA.1	3.7024/25	Ti 99,8	T-35	Ti-P01	
	TA.2/3/4/5	3.7034/35	Ti 99,7	T-40	Ti-P02	4941/42/51/4902
	TA.6/7/8/9	3.7064/65	Ti99,5	T-60	Ti-P04	4901/21
	TA.21-24/52-55/58	3.7124	TiCu2	T-U2	Ti-P11	
	DTD 5023/5273/5283			T-50		4900
		3.7114	TiAl5Sn2			Ti-5Al-2.5Sn
			5553			Ti-5Al-5V-5Mo-3Cr
	TA.43/44	3.7154	TiAl6Zr5Mo0,5Si0,2	T-A6ZD	Ti-P67	
NODULAR CAST IRON	TA.10-13/28/56	3.7164/65	TiAl6V4	T-A6V	Ti-P63	491128/35/54/65/67
	TA.45-51/57	3.7184	TiAl4Mo4Sn2Si0,5	T-A4DE	Ti-P68	
	420/12	0.704	GGG-40	FGS-400-12		60-40-18
	370/17	0.7043	GGG-40.3	FGS370-17	0717-02	
	500/7	0.705	GGG-50	FGS500-7	0717-15	
	600/3	0.706	GGG-60	FGS600-3	0727-02	65-45-12
	700/2	0.707	GGG-70	FGS 700-2	0732-03	80-55-06
	800/2	0.708	GGG-80	FGS 800-2	0737-01	100-70-03
GREY CAST IRON	W 340/3	0.8035	GTW-35-04	MB 35-7		120-90-02
	W 410/4	0.804	GTW-40-05	MB 40-10		
	B 340/12	0.8135	GTS-35-10	MN 35-10	SIS 08 15-00	32 510
	P 440/7	0.8145	GTS-45-06	MP 50-5	SIS 08 54-00	
	P 540/5	0.8155	GTS-55-04	MP 60-3	SIS 08 56-00	
	P 690/2	0.817	GTS 70-02	MP 70-2	SIS 08 62-03	70 003
	B 290/6			MN 32-8/38-18	SIS 08 14-00	
ALUMINIUM ALLOYS	LM4/LM22	3.2151	G-AlSi6Cu4	A-S5U	FG 10	A48-20B
	2L99/LM25	3.2371	G-AlSi7Mg	A-S7G0,3	FG 15	A48-25B
	LM24	3.2161	G-AlSi8Cu3	A-S9U3	FG20	A48-30B
	LM9	3.2381	G-AlSi10Mg	A-S10G	FG 25	A48-40B
	LM20	3.2583	G-AlSi12Cu	A-S12U	FG 30	A48-45B
	LM6	3.3581	G-AlSi12	A-S13	FG35	A48-50B
						A48-60B
					L-2660	319,2
Twister Drills					L-2630	A356.2
					L-2560	380,1
					L-2530	A360
					L-2520	413,1
						A413

Material cross reference chart

						
	UK	German DIN	French	Swedish	Spanish	USA
ALUMINIUM ALLOYS	LM28/LM29		AlSi18-25CuNiMg			393
	1C	3.0205	Al99	144010	L-3001	1200
	1B	3.0255	Al99,5	144007	L-3051	1050A
	1E	3.0257	E-Al	144008	L-3052	1350A
	1A	3.0285	Al99,8	144004	L-3081	1080A
	1	3.0385	Al99,98R			1199
	N31	3.0505	AlMn0,5Mg0,5			3105
	N3	3.0515	AlMn	144054	L-3810	3103
		3.0525	AlMn1Mg0,5			3005
	N4	3.0526	AlMnMg1		L-3820	3004
		3.0915	AlFeSi			8011A
	H15	3.1255	AlCuSiMn	144338	L-3130	2014
		3.1303	AlCu2Mg0,5			2036
	3L86/HR13	3.1305	AlCu2,5Mg0,5		L-3180	2117
	H14	3.1325	AlCuMg1		L-3120	2017A
	2L98	3.1355	AlCuMg2		L3140	2024
		3.1645	AlCuMgPb	144335	L-3121	2003
	FC1	3.1655	AlCuBiPb	144355	L-3182	2011
	2L91/92	3.1841	G-AlCu4Ti			295.1/2
	91E	3.2305	E-AlMgSi		L-3431	6101B
	BTR6	3.2307	Al99,85MgSi			6463
	H30	3.2315	Al-Si1 Mg	144212	L-3451	6181
	H9	3.3206	AlMgSi0,5	144103	L-3441	6060
	BTR6	3.3207	E-AlMgSi0,5	144102		6101C
		3.3241	G-AlMg3Si			F/8514.0
	N41	3.3315	AlMg1	144106	L-3350	5005A
	3L44	3.3316	AlMg1,5		L-3380	5050B
	BTR2	3.3317	Al99,85Mg1			
		3.3326	AlMg1,8			5051A
		3.3345	AlMg4,5			5082
	N5Mg3,5	3.3523	AlMg2,5	144120	L-3360	5052
	N4	3.3525	AlMg2Mn0,3			5251
		3.3527	AlMg2Mn0,8			5049
		3.3535	AlMg3	144133	L-3390	5754
	N51	3.3537	AlMg2,7Mn			5454
		3.3541	G-AlMg3		L-2341	514
		3.3545	AlMg4Mn		L-3322	5086
	N8	3.3547	AlMg4,5Mn	144140	L-3321	5083
	N6	3.3555	AlMg5	144146	L-3320	5056A
	LM5	3.3561	G-AlMg5			514.1
	LM10	3.3591	G-AlMg10		L-2310	520
	H17	3.4335	AlZn4,5Mg1	144425	L-3741	7020
		3.4345	AlZnMgCu0,5			7022
	2L95	3.4365	AlZnMgCu1,5		L-3710	7075
		3.4415	AlZn1		L-3721	7072
COPPER ALLOYS	Pb2	2.1052	G-CuSn12			C 90800
	CT2	2.106	G-CuSn12Ni			C 91700
	CT1	2.1086	G-CuSn10			C 90250
		2.109	G-CuSn7ZnPb	CuSn7Pb6Zn4		C 93200
	LG4	2.1093	G-CuSn6ZnNi			C 92410
	LG2	2.1096	G-CuSn5ZnPb/RG5	CuPb5Sn5Zn5		C 83600
	LG1	2.1098	G-CuSn2ZnPb			C 83810
	LB2	2.1176	G-CuPb10Sn	CuPb10Sn10		C 93700
	LB1	2.1182	G-CuPb15Sn			C 93800
	LB5	2.1188	G-CuPb20Sn	CuPb20Sn5		C 94100
		2.0918	CuAl5As	CuAl6		C 60 800
		2.092	CuAl8	CuAl8		C 61 000
	CA 106	2.0932	CuAl8Fe3	CuAl7Fe2		C 61 400
	CA 105	2.0936	CuAl10Fe3Mn2	CuAl9Fe3Mn2		C 62 300
	AB 1	2.094	CuAl10Fe	CuAl9Fe3		C 95 200
	CA 104	2.0966	CuAl10Ni5Fe4	CuAl9Ni5Fe3Mn		C 63 200
	AB 2	2.097	G-NiAlBzF50	CuAl9Ni5Fe		C 95 800
	CC 102	2.1293	CuCrZr			C 18100
	C 112	2.1285	CuCo2Be			C 17500
	CB 101	2.1245	CuBe1,7	CuBe1,7		C 17000

Custom Tool Division

Engineering and Manufacturing Excellence

The true value of a tool is measured by its ability to increase productivity through superior craftsmanship, performance and tool life.

The M.A. Ford® Custom Tool Division focuses on meeting the growing need for unique and increasingly complex special cutting tools. By partnering with select machine tool users the Custom Tool Division develops and supplies custom engineered carbide tools of unmatched quality which meet or exceed their productivity, delivery and utilized cost expectations. Custom tools are proven to increase speeds and feeds, save setup and handling time which in turn leads to faster run times, more efficient manufacturing and most importantly, INCREASED PROFITS.

Meeting the growing need for unique and increasingly complex high performance custom cutting tools in today's industry

To support your productivity improvement efforts, we offer the following services:

- Technical assistance in prototype custom tool design.
- Re-engineering of existing custom tooling to optimize tool performance.
- Tool manufacturing lead times which meet or exceed your delivery requirements.
- Immediate response to quotation request.
- Readily available technical phone support.
- Field representative support service.
- Emergency tool service.
- Custom tools of the highest quality.

We offer application development, design and manufacturing expertise in the following product classifications:

- High Performance Drills
- G-Drills
- Step Drill Reamers
- Coolant Thru Specials
- Step Reamers
- Coolant Thru Reamers
- Custom End Mills
- Custom Form Tools

Optimised Cutting-High Performance Cutting (HPC)

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

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

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

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

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

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

M.A.Ford has partnered with OneCNC Cad/Cam software company to provide this service to its customers. In conjunction with their XR3/XR4 software with its HSM function the radial engagement of the tool during the milling process can be guaranteed never to exceed the set percentage.

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

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

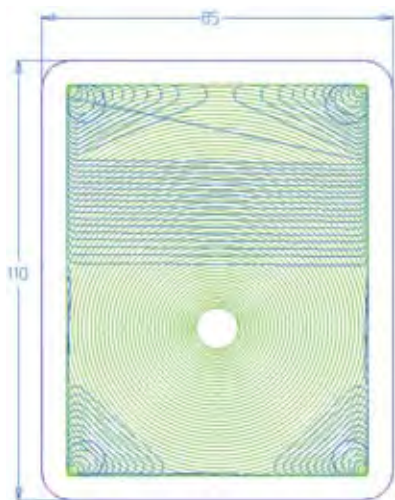
Benefits of HPC using OneCNC software-

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



Benefits of Enhanced cutting parameters with HSM toolpaths

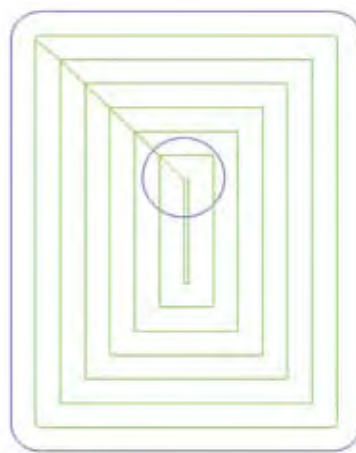
HSM tool path



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

177 1200-0.5RA

Conventional tool path



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

177 1200-0.5RA

Cutting data and cycle time by material

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

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

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

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

M.A. FORD Quality Policy

Ultimately we are judged by our customer. The product that we supply must satisfy our customers needs and meet their requirements, or they will find an alternate source. The customer will define quality. It therefore becomes everyone's quality mission to know their customer, to fully understand their requirements, and to commit to continued improvement in satisfying those needs and requirements.



Certificate of Registration



Certificate Number
96-12471

Initial Certification Date
October 30, 1998

Certificate Issue Date
December 26, 2009

Certificate Expiry Date
December 26, 2012



The following organization's quality management system has been assessed and registered by Intertek Testing Services NA, Inc. as conforming to the requirements of:

ISO 9001:2008

Organization:

M.A. Ford Manufacturing Company, Inc.

Main Site: 7737 N.W. Boulevard, Davenport, Iowa, 52808, USA

The Quality Management System is applicable to:

The design and manufacture of precision rotary cutting tools.

In the issuance of this certificate, Intertek assumes no liability to any party other than to the Client, and then only in accordance with the agreed upon Certification Agreement.



Intertek Testing Services NA, Inc. – Kentwood, MI, USA

GF106-US-QMS-4-2008 – Issue Date 15/11/2008 Project No. 4633

The M.A. Ford Quality Policy is:

*Know our customers.
Know their requirements.
Make continual improvements in satisfying those requirements.*

These are the responsibilities of every individual who works at M.A. Ford.



Steve Morency, President



M.A.FORD
High Performance Cutting Tools

Coatings

ALtima®

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

ALtima® 52

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

ALtima® Blaze

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

Fordlube

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

Special Coatings

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

Coating Properties

MA Ford® Coating	MA Ford® Tool Number Designation	Microhardness (HV)	Maximum Service Temp.	Friction Coefficient
ALtima®	A	3100	1100° C / 2012° F	0.42
ALtima® 52	A	3600	1200° C / 2192° F	0.40
ALtima® Blaze	B	3200	1100° C / 2012° F	0.35
Fordlube	F	4000	700° C / 1292° F	0.30

ISO 9001:2008 Certified



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