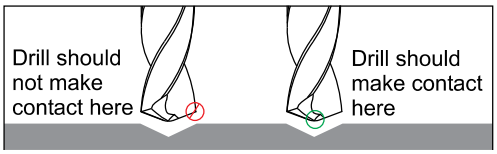
Series CXDCE Technical Information

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 (mm/min).



2. Retract and tool change to the final deep hole (CXDCE M.A. Ford® Series) drill.
3. Rapid to clearance plane and enter the pilot hole at 25% (don't exceed 400 to 500 RPM (n)) of the final speed and 1 to 2 IPM (25.4 to 50.8 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 (n) to eliminate breakage of the drill due to drill whip. Then retract to the clearance plane.

Recommended Machine Requirements

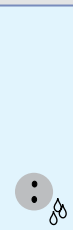
500-1,000 PSI through-spindle coolant pressure
Machine runout of .0003" (.008mm) Max.

Due to the conditions of equipment, tool holders, and conditions beyond M.A. 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 563-391-6220 / 800-553-8024.

Made in USA

Recommended Cutting Data CXDCE - Inch

Workpiece Material Group	ISO	Hardness	TYPE	DEPTH	vc - SFM	Drill Diameter				
						3/16	1/4	5/16	3/8	15/32
						f - IPR				
Free Machining & Low Carbon Steels 1006, 1008, 1015, 1018, 1020, 1022, 1025, 1117, 1140, 1141, 11L08, 11L14, 1213, 12L13, 12L14, 1215, 1330	P	up to 28 Rc		15X	345	.0030	.0040	.0080	.0090	.0100
Medium Carbon & High Carbon Steels, Alloy Steels & Easy to Machine Tool Steels 1030, 1035, 1040, 1045, 1050, 1052, 1055, 1060, 1085, 1095, 1541, 1551, 9255, 2515, 3135, 3415, 4130, 4137, 4140, 4150, 4320, 4340, 4520, 5015, 5115, 5120, 5132, 5140, 5155, 6150, 8620, 9262, 9840, 52100, O1, O2, O6, S2, W1 to W310	P	28 to 35 Rc		15X	265	.0030	.0040	.0080	.0090	.0100
Tool Steels & Die Steels O7, M1, M2, M3, M4, M7, T1, T2, T4, T5, T8, T15, A2, A3, A6, A7, H10, H11, H12, H13, H19, H21, L3, L6, L7, P2, P20, S1, S5, S7, 52100, A128, D2, D3, D4, D5, D7	P	28 to 35 Rc		15X	265	.0030	.0040	.0080	.0090	.0100
Hardened Steels	H	35-45 Rc		15X	115	.0006	.0009	.0020	.0024	.0030
Hardened Steels	H	45-55 Rc		15X	80	.0006	.0009	.0020	.0024	.0030
Stainless Steel - Easy to Machine 430F, 301, 303, 410, 416 Annealed, 420F, 430	M	up to 28 Rc		15X	300	.0030	.0040	.0080	.0090	.0100
Stainless Steel - Moderately Difficult 301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH	M	up to 28 Rc		15X	180	.0030	.0040	.0080	.0090	.0100
Stainless Steel - Difficult to Machine 302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321, PH13-8Mo, Nitronics	M	over 28 Rc		15X	130	.0020	.0030	.0060	.0080	.0100
High Temp Alloys Nimonics, Inconel, Monel, Hastelloy	S	up to 42 Rc		15X	65-80	.0009	.0014	.0025	.0030	.0033
Titanium Alloys 6Al-4V, 5Al-2.5 Sn, 6Al-2 Sn-4Zr-6Mo, 3Al-8V-6Cr4Mo-4Zr, 10V-2Fe-3Al, 13V-11Cr-3Al	S	up to 42 Rc		15X	150	.0016	.0024	.0050	.0060	.0060
Cast Iron - Gray CG, ASTM A48, CLASS 20, 25, 30, 35, SAE J431C, GRADES G1800, G3000, G3500, GG 10, 15, 20, 25, 30, 35, 40	K	up to 240 HB		15X	400	.0030	.0050	.0080	.0090	.0100
Cast Iron - Ductile & Malleable CGI 60-40-18, 65-45-12, D4018, D4512, D5506, 32510, 35108, M3210, M4504, M5503, 250, 300, 350, 400, 450	K	over 240 HB		15X	265	.0030	.0050	.0080	.0090	.0100
Non-Ferrous - Al < 14% Si	N			15X	500	.0043	.0070	.0110	.0138	.0149
Non-Ferrous - Al > 14% Si	N			15X	350	.0043	.0070	.0110	.0138	.0149
Non-Ferrous - Brass	N			15X	400	.0030	.0040	.0110	.0130	.0140
Non-Ferrous - Cu/Cu Alloys/Magnesium	N			15X	300	.0030	.0040	.0110	.0130	.0140

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.

Recommended Cutting Data CXDCE - Metric

Workpiece Material Group	ISO	Hardness	TYPE	DEPTH	vc - m/min	Drill Diameter (mm)						
						5	6	7	8	9	10	12
						f - mm/Rev						
Free Machining & Low Carbon Steels 1006, 1008, 1015, 1018, 1020, 1022, 1025, 1117, 1140,1141, 11L08, 11L14, 1213, 12L13, 12L14, 1215, 1330	P	up to 28 Rc		15X	105	.088	.106	.127	.193	.215	.238	.254
Medium Carbon & High Carbon Steels, Alloy Steels & Easy to Machine Tool Steels 1030, 1035, 1040, 1045, 1050, 1052, 1055, 1060, 1085, 1095, 1541, 1551, 9255, 2515, 3135, 3415, 4130, 4137, 4140, 4150, 4320, 4340, 4520, 5015, 5115, 5120, 5132, 5140, 5155, 6150, 8620, 9262, 9840, 52100, O1, O2, O6, S2, W1 to W310	P	28 to 35 Rc		15X	80	.088	.106	.127	.193	.215	.238	.254
Tool Steels & Die Steels O7, M1, M2, M3, M4, M7, T1, T2, T4, T5, T8, T15, A2, A3, A6, A7, H10, H11, H12, H13, H19, H21, L3, L6, L7, P2, P20, S1, S5, S7, 52100, A128, D2, D3, D4, D5, D7	P	28 to 35 Rc		15X	80	.088	.106	.127	.193	.215	.238	.254
Hardened Steels	H	35-45 Rc		15X	35	.020	.022	.027	.046	.053	.060	.066
Hardened Steels		45-55 Rc			25							
Stainless Steel - Easy to Machine 430F, 301, 303, 410, 416 Annealed, 420F, 430	M	up to 28 Rc		15X	90	.090	.105	.127	.193	.215	.238	.254
Stainless Steel - Moderately Difficult 301, 302, 303 High Tensile, 304, 304L, 305, 420, 15-5PH, 17-4PH, 17-7PH	M	up to 28 Rc		15X	55	.090	.105	.127	.193	.215	.238	.254
Stainless Steel - Difficult to Machine 302B, 304B, 309, 310, 316, 316B, 316L, 316Ti, 317, 317L, 321, PH13-8Mo, Nitronics	M	over 28 Rc		15X	40	.090	.105	.127	.193	.215	.238	.254
High Temp Alloys Nimonics, Inconel, Monel, Hastelloy	S	up to 42 Rc		15X	20-25	.030	.035	.048	.051	.071	.078	.085
Titanium Alloys 6Al-4V, 5Al-2.5 Sn, 6Al-2 Sn-4Zr-6Mo, 3Al-8V-6Cr4Mo-4Zr, 10V-2Fe-3Al, 13V-11Cr-3Al	S	up to 42 Rc		15X	45	.050	.060	.071	.098	.127	.140	.152
Cast Iron - Gray CG, ASTM A48, CLASS 20, 25, 30, 35, SAE J431C, GRADES G1800, G3000, G3500, GG 10, 15, 20, 25, 30, 35, 40	K	up to 240 HB		15X	120	.100	.120	.140	.200	.215	.240	.254
Cast Iron - Ductile & Malleable CGI 60-40-18, 65-45-12, D4018, D4512, D5506, 32510, 35108, M3210, M4504, M5503, 250, 300, 350, 400, 450	K	over 240 HB		15X	80	.100	.120	.140	.200	.215	.240	.254
Non-Ferrous - Al < 14% Si	N			15X	150	.140	.170	.195	.280	.314	.350	.378
Non-Ferrous - Al > 14% Si	N				105	.140	.170	.195	.280	.314	.350	.378
Non-Ferrous - Brass	N				120	.088	.106	.127	.279	.314	.350	.378
Non- Ferrous - Cu/Cu Alloys/Magnesium	N				90	.088	.106	.127	.279	.314	.350	.378

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

High Performance Drill Selection Chart

Our industry leading high performance drill with the same high quality that helped set the standard.

Multipurpose high quality drill for most drilling applications adding stability, hole quality, tool life, and finish (excludes some work hardening materials).

An economical choice perfect for job shop and batch production work requiring a high performance drill option.

Series	Drill Lgth	Size Range Inch	Size Range mm	Margin	D1 Tol.	D2 Tol.	Helix	Point Angle	Coolant Fed	DIN	Coating	Application Recommendations							
												TEMA* Sizes	Steel	Hardened Steel	Stainless Steel	PH Stainless Steel	Cast Iron	Titanium	High Temp Alloys
CXDSS	3X	#31-3/4	3.0-20.0	Double	m7	h6	30°	140°	N	6537K	ALtima® Plus	X	1st	2nd	2nd	2nd	1st	2nd	2nd
CXDSR	5X	#31-5/8	3.0-16.0	Double	m7	h6	30°	140°	N	6537L	ALtima® Plus	X	1st	2nd	2nd	2nd	1st	2nd	2nd
CXDCS	3X	#31-5/8	3.0-16.0	Double	m7	h6	30°	140°	Y	6537K	ALtima® Plus	X	1st	2nd	1st	2nd	1st	1st	2nd
CXDCR	5X	#31-3/4	3.0-20.0	Double	m7	h6	30°	140°	Y	6537L	ALtima® Plus	X	1st	2nd	1st	2nd	1st	1st	2nd
CXDCL	8X	#31-5/8	3.0-16.0	Double	m7	h6	30°	140°	Y		ALtima® Plus	X	1st	2nd	1st	2nd	1st	1st	2nd
CXDCE	15X	#31-15/32	3.0-12.0	Double	h7	h6	30°	140°	Y		ALtima® Plus		1st	2nd	1st	2nd	1st	1st	2nd
2XDSS	3X	#31-3/4	2.5-20.0	Single	h7	h6	30°	142°	N		ALtima®	X	2nd	1st	1st	1st	2nd	1st	1st
2XDSR	5X	1/64-5/8	0.5-16.0	Single	h7	h6	30°	142°	N		ALtima®	X	2nd	1st	1st	1st	2nd	1st	1st
2XDCS	3X	#31-5/8	3.0-16.0	Single	h7	h6	30°	142°	Y	6537K	ALtima®	X	2nd	1st	1st	1st	2nd	2nd	1st
2XDCR	5X	#31-3/4	3.0-20.0	Single	h7	h6	30°	142°	Y		ALtima®	X	2nd	1st	1st	1st	2nd	2nd	1st
2XDCL	7X+	#31-1/2	3.0-12.0	Single	h7	h6	30°	142°	Y		ALtima®	X	2nd	1st	1st	1st	2nd	2nd	1st
2XDCE	12X-25X**	1/4 - 1/2	5.0-12.0	Double	h7	h6	30°	142°	Y		ALtima®		2nd	1st	1st	1st	2nd	2nd	1st
HPDSR	5X	#31-5/8	3.0-16.0	Single	h7	h6	30°	140°	N	6537L	ALtima®		3rd	3rd	3rd	3rd	3rd	3rd	3rd
HPDCR	5X	#31-5/8	3.0-16.0	Single	h7	h6	30°	140°	Y	6537L	ALtima®		3rd	3rd	3rd	3rd	3rd	3rd	3rd

Note: For drilling applications involving cross holes and/or optimal hole finishes, use the CXD style drill.
*TEMA - Tubular Exchange Manufacturer's Association
**Length varies depending on size.

Inch	
D1	Tolerance (m7)
.0000 - .1181	+.00008/+.00047
.1182 - .2362	+.00016/+.00063
.2363 - .3937	+.00024/+.00083
.3938 - .7087	+.00027/+.00098
.7088 - .7500	+.00031/+.00114

Inch	
D1	Tolerance (h7)
.0000 - .1181	+0/-.00039
.1182 - .2362	+0/-.00047
.2363 - .3937	+0/-.00059
.3938 - .7087	+0/-.00071
.7088 - .7500	+0/-.00083

Inch	
D2	Tolerance (h6)
.0000 - .1181	+0/-.00024
.1182 - .2362	+0/-.00031
.2363 - .3937	+0/-.00035
.3938 - .7087	+0/-.00043
.7088 - .7500	+0/-.00051

Metric (mm)	
D1	Tolerance (m7)
0 - 3.0	+.002/+.012
3.01 - 6.0	+.004/+.016
6.01 - 10.0	+.006/+.021
10.01 - 18.0	+.007/+.025
18.01 - 20.0	+.008/+.029

Metric (mm)	
D1	Tolerance (h7)
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 - 20.0	+0/-.021

Metric (mm)	
D2	Tolerance (h6)
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 - 20.0	+0/-.013

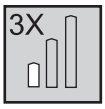
M.A. Ford® Coating	Microhardness (HV)	Maximum Service Temp.	Friction Coefficient
ALtima®	3100	1100° C / 2012° F	0.42
ALtima® Plus	3200	1100° C / 2012° F	0.25

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

Twister® Drill Icon Glossary


Solid


Coolant Fed



Drill Length

Drill Point Angle

Helix Angle

Coatings

DIN Specs

Workpiece Material Group

Steels

Stainless Steels

Cast Iron

Special Alloys

Hardened Steels (35-65Rc)

Non-Ferrous

Cutting Calculations and Definitions			Metric	U.S.
ae	=	Width of cut, radial depth of cut	(mm)	(inch)
ap	=	Depth of cut, axial depth of cut	(mm)	(inch)
Dc	=	Cutter diameter	(mm)	(inch)
f	=	Feed per revolution	(mm/rev)	(IPR)
fz	=	Feed per tooth	(mm/tooth)	(IPT)
zn	=	Number of teeth	Number	
n	=	RPM	(rev/min)	(rev/min)
Q	=	Metal removal rate	(cm^3/min)	(in^3/min)
vc	=	Cutting speed	(m/min)	(SFM)
vf	=	Feed speed	(mm/min)	(IPM)
Dw	=	Working diameter	(mm)	(inch)

Formulas

Inch
RPM (n) = SFM (vc) x 3.82/Tool Diam.
IPM (vf) = RPM (n) x IPR (f)

Conversion Inch to Metric
SFM (vc) to m/min (vc) = SFM (vc) x .3048
IPM (vf) to mm/min (vf) = IPM (vf) x 25.4

Metric
RPM (n) = m/min (vc) x 318.057/Tool Diam.
mm/min (vf) = RPM (n) x mm/Revolution (f).

Conversion Metric to Inch
m/min (vc) to SFM (vc) = (m/min)/.3048
mm/min (vf) to IPM (vf) = (mm/min)/25.4

Safety Note

Always wear the appropriate personal protective equipment such as safety glasses and protective clothing when using solid carbide or HSS cutting tools. Machines should be fully guarded.

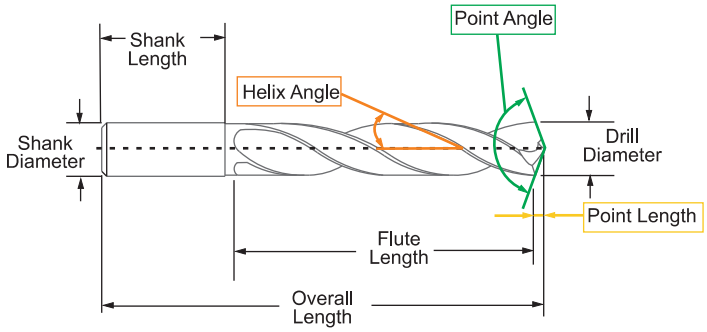
Drill Troubleshooting

		Problem																												
		Tool Deterioration													Chip Formation			Tool Life	Workpiece								Process					
	Possible Solutions	Flank wear	Margin wear	Breakage	Flaking	Creater wear	Chisel edge wear	Corner chipping	Flute chipping	Cutting edge chipping	Cutting edge wear	Point center chipping	Rake face	Scoring on tool body	Long stringy	Varied chip form	Blue/brown chips	Tool Life	Undersized hole	Oversized hole	Poor alignment	Poor surface finish	Heavy burr breakout	Retract marks	Hole location	Hole straightness	Deflection	Point Deflection	Galling	Vibration	Abnormal noise	Chip packing	No drill penetration
Speed & Feed	Reduce feed or reduce at exit	x		x			x	x	x	x		x	x	x				x	x	x		x	x			x					x	
	Reduce feed at entrance			x															x			x			x		x					x	
	Consistent feed rate			x											x	x														x		x	
	Increase feed	x					x				x				x				x	x													
	Reduce speed	x	x			x		x			x							x	x										x		x	x	
	Increase speed																					x											
Coolant	Coolant mix		x	x	x					x				x				x	x			x	x								x	
	Coolant increase flow	x		x			x	x		x							x	x	x			x	x								x	
	Coolant filter	x		x	x					x								x	x			x	x								x	
Setup	Workpiece clamp rigid		x	x			x	x		x				x				x		x	x	x	x	x	x	x							x
	Collet accuracy			x						x										x					x	x				x			
	Tool holder fit .0008			x						x										x					x	x				x			
	Alignment			x						x										x													x
	Peck drill			x																													
	Concentricity		x	x	x			x	x					x							x	x		x	x	x		x		x			
	Do not extract tool during peck							x																									

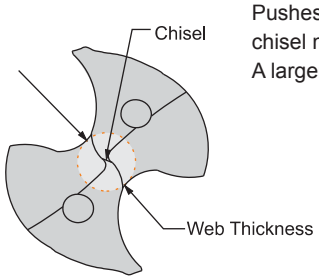
Technical data provided should be considered advisory only as variations may be necessary depending on the particular application.

M.A. Ford® Phone: 800-553-8024 or 563-391-6220 • email: sales@maford.com • www.maford.com

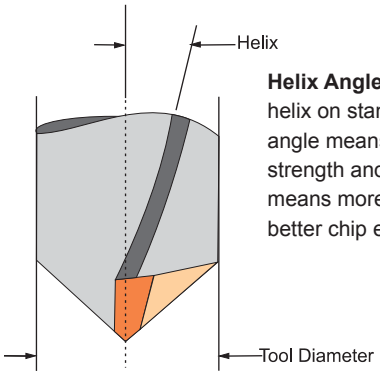
Drill Terminology



Chisel Edge – The non-cutting tip of the drill. Pushes, rather than cuts material. Having a smaller chisel means that a tool will cut more aggressively. A larger chisel means that a tool will be stronger.

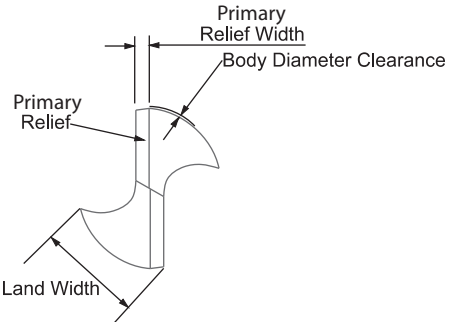


Web – The core of the drill that is left from the fluting operation. A thicker web means added rigidity, while a smaller web means more chip evacuation. On two flute drills, typically varies from 16% - 30% of the tool diameter.

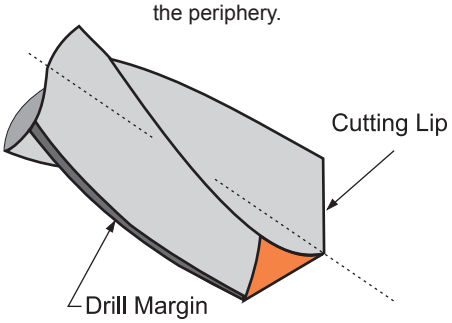


Helix Angle - Varies from 0° to 35° helix on standard tools. Lower helix angle means more rigidity and strength and a higher helix angle means more aggressive drilling and better chip evacuation.

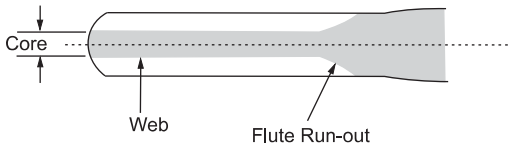
Margin Width – Provides a surface to support the drill inside the hole during the drilling operation. M.A. Ford® offers both single margin and double margin geometries. Margin widths are a balancing act between friction build-up vs. tool support in the drilling operation.



Cutting Lip - The cutting edges of a two flute drill extending from the chisel edge to the periphery.



Land Width – The amount of material left on the drill per side, from the fluting operation. Larger land widths mean more rigidity, while smaller land widths allow for better chip evacuation.



Having a problem with drill geometries? Circle the area where the problem exists.
Include a detailed explanation of the issue and fax to Attn: Technical Application Support 800-892-9522 / 563-386-7660
or email: maftech@maford.com

Coatings

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

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

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

ALtima® Blaze
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.

ALtima® Micro
An ultra thin, nano structured, TiAlN coating developed specifically for micro tool applications.

ALtima® Xtreme
Designed for high speed and dry machining.

Fordlube
Titanium DiBoride (TiB_2) is a unique coating with low Aluminum affinity, smooth surface finish and high hardness. It is ideal for Aluminum and Magnesium alloys as it prevents build-up on cutting edge, provides superior chip flow along with extended wear resistance.

Gem+
Recommended for aluminium and aluminium alloys up to 12% Si, non-ferrous metals and composites. Gem+ provides excellent wear resistance and maintains sharp cutting edges.

GemX
A CVD diamond coating for composites and aluminum that offers the maximum hardness and wear resistance of any of our coatings.

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

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

CERAedge®
CERAedge® is a unique coating that provides excellent performance in titanium, aluminium, and composites.

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

Coating Properties

M.A. Ford® Coating	M.A. Ford® Tool Number Designation	Microhardness (HV)	Maximum Service Temp.	Friction Coefficient
ALtima®	A	3100	1100° C / 2012° F	0.42
ALtima® Plus	AP	3200	1100° C / 2012° F	0.25
ALtima® 52	A or AH	3600	1200° C / 2192° F	0.40
ALtima® Blaze	B	3200	1100° C / 2012° F	0.35
ALtima® Micro	AM	3300	900° C / 1652° F	0.30-0.35
ALtima® Xtreme	AX	3800	1100° C / 2012° F	0.30-0.50
Fordlube	F	4000	700° C / 1292° F	0.30
Gem+	GP	4710	500° C / 932° F	0.30
GemX	GX	10000	600° C / 1100° F	0.10
TiN	T	2300	600° C / 1112° F	0.40
TiCN	C	3000	400° C / 752° F	0.40
CERAedge®	CE	3400	1100° C / 2012° F	0.25