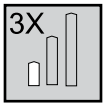
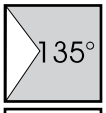
Twister® Drill Icon Glossary


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

Formulas

Inch

RPM = SFM x 3.82/Tool Diam.
IPM = RPM x IPR

Conversion Inch to Metric

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

Metric

RPM = SMM x 318.057/Tool Diam.
mm/min. = RPM x mm/rev.

Conversion Metric to Inch

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

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
	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.

2XDSS/2XDSR Inch

Workpiece Material Group		Examples	SFM	Tool Diameter					
				1/8	1/4	3/8	1/2	5/8	3/4
				IPR					
Steels	P	Low Carbon Steels 1018/12L14	345-405	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
		Alloy Steels (up to 35 Rc) 4140/A2/D2/400	280-350						
		Alloy Steels (36-45 Rc) 4140/A2/D2	170-210	.0019-.0031	.0038-.0063	.0050-.0088	.0063-.0100	.0088-.0120	.0100-.0140
Cast Irons	K	Gray Cast Iron A48, Class 20/G4000	405-500	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
		Ductile Cast Iron 60-40-18	315-375						
Austenitic	M	304/316	125-190	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	95-155	.0019-.0031	.0038-.0063	.0050-.0088	.0063-.0100	.0088-.0120	.0100-.0140
Special Alloys	S	Titanium 6AL-4V	150	.0010	.0025	.0040	.0050	.0060	.0075
		Cobalt-Based Alloys Stellite, Haynes 25/188	40						
		Nickel-Based Alloys Inconel 625/718 Iron-Based Alloys Incoloy 800-802/Multimet	80						
		High Nickel Alloys Monel	100						

2XDSS/2XDSR Metric

Workpiece Material Group		Examples	SMM	Tool Diameter(mm)					
				3	6	10	12	16	19
				mm/rev.					
Steels	P	Low Carbon Steels 1018/12L14	105-125	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
		Alloy Steels (up to 35 Rc) 4140/A2/D2/400	85-105						
		Alloy Steels (36-45 Rc) 4140/A2/D2	50-65	.051-.076	.102-.152	.127-.229	.152-.254	.229-.305	.254-.356
Cast Irons	K	Gray Cast Iron A48, Class 20/G4000	125-150	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
		Ductile Cast Iron 60-40-18	95-115						
Austenitic	M	304/316	40-60	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	30-50	.051-.076	.102-.152	.127-.229	.152-.254	.229-.305	.254-.356
Special Alloys	S	Titanium 6AL-4V	45	.025	.064	.102	.127	.152	.191
		Cobalt-Based Alloys Stellite, Haynes 25/188	15						
		Nickel-Based Alloys Inconel 625/718 Iron-Based Alloys Incoloy 800-802/Multimet	25						
		High Nickel Alloys Monel	30						

2XDCR Inch

Workpiece Material Group		Examples	SFM	Tool Diameter					
				1/8	1/4	3/8	1/2	5/8	3/4
				IPR					
Steels	P	Low Carbon Steels 1018/12L14	500-625	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
		Alloy Steels (up to 35 Rc) 4140/A2/D2/400	315-435						
		Alloy Steels (36-45 Rc) 4140/A2/D2	190-250	.0019-.0031	.0038-.0063	.0050-.0088	.0063-.0100	.0088-.0120	.0100-.0140
Cast Irons	K	Gray Cast Iron A48, Class 20/G4000	500-625	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
		Ductile Cast Iron 60-40-18	350-425						
Austenitic	M	304/316	220-315	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	155-220	.0019-.0031	.0038-.0063	.0050-.0088	.0063-.0100	.0088-.0120	.0100-.0140
Special Alloys	S	Titanium 6AL-4V	180	.0010	.0025	.0040	.0050	.0060	.0075
		Cobalt-Based Alloys Stellite, Haynes 25/188	50						
		Nickel-Based Alloys Inconel 625/718 Iron-Based Alloys Incoloy 800-802/Multimet	95						
		High Nickel Alloys Monel	120						

2XDCR Metric

Workpiece Material Group		Examples	SMM	Tool Diameter(mm)					
				3	6	10	12	16	19
				mm/rev.					
Steels	P	Low Carbon Steels 1018/12L14	150-190	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
		Alloy Steels (up to 35 Rc) 4140/A2/D2/400	95-130						
		Alloy Steels (36-45 Rc) 4140/A2/D2	60-75	.051-.076	.102-.152	.127-.229	.152-.254	.229-.305	.254-.356
Cast Irons	K	Gray Cast Iron A48, Class 20/G4000	150-190	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
		Ductile Cast Iron 60-40-18	106-129						
Austenitic	M	304/316	220-315	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	155-220	.051-.076	.102-.152	.127-.229	.152-.254	.229-.305	.254-.356
Special Alloys	S	Titanium 6AL-4V	55	.025	.064	.102	.127	.152	.191
		Cobalt-Based Alloys Stellite, Haynes 25/188	15						
		Nickel-Based Alloys Inconel 625/718 Iron-Based Alloys Incoloy 800-802/Multimet	30						
		High Nickel Alloys Monel	35						

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

For product information, call your local distributor.

2XDCL Inch

Workpiece Material Group		Examples	SFM	Tool Diameter					
				1/8	1/4	3/8	1/2	5/8	3/4
				IPR					
Steels	P	Low Carbon Steels 1018/12L14	530-595	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
		Alloy Steels (up to 35 Rc) 4140/A2/D2/400	280-375						
		Alloy Steels (36-45 Rc) 4140/A2/D2	170-225	.0019-.0031	.0038-.0063	.0050-.0088	.0063-.0100	.0088-.0120	.0100-.0140
Cast Irons	K	Gray Cast Iron A48, Class 20/G4000	530-590	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
		Ductile Cast Iron 60-40-18	350-425						
Austenitic	M	304/316	185-280	.0038-.0063	.0063-.0088	.0088-.0110	.0100-.0125	.0110-.0150	.0120-.0170
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	125-190	.0019-.0031	.0038-.0063	.0050-.0088	.0063-.0100	.0088-.0120	.0100-.0140
Special Alloys	S	Titanium 6AL-4V	180	.0010	.0025	.0040	.0050	.0060	.0075
		Cobalt-Based Alloys Stellite, Haynes 25/188	50						
		Nickel-Based Alloys Inconel 625/718 Iron-Based Alloys Incoloy 800-802/Multimet	95						
		High Nickel Alloys Monel	120						

2XDCL Metric

Workpiece Material Group		Examples	SMM	Tool Diameter(mm)					
				3	6	10	12	16	19
				mm/rev.					
Steels	P	Low Carbon Steels 1018/12L14	160-180	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
		Alloy Steels (up to 35 Rc) 4140/A2/D2/400	85-115						
		Alloy Steels (36-45 Rc) 4140/A2/D2	50-70	.051-.076	.102-.152	.127-.229	.152-.254	.229-.305	.254-.356
Cast Irons	K	Gray Cast Iron A48, Class 20/G4000	160-180	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
		Ductile Cast Iron 60-40-18	106-129						
Austenitic	M	304/316	55-85	.102-.152	.152-.229	.229-.279	.254-.330	.279-.381	.305-.432
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	40-60	.051-.076	.102-.152	.127-.229	.152-.254	.229-.305	.254-.356
Special Alloys	S	Titanium 6AL-4V	55	.025	.064	.102	.127	.152	.191
		Cobalt-Based Alloys Stellite, Haynes 25/188	15						
		Nickel-Based Alloys Inconel 625/718 Iron-Based Alloys Incoloy 800-802/Multimet	30						
		High Nickel Alloys Monel	35						

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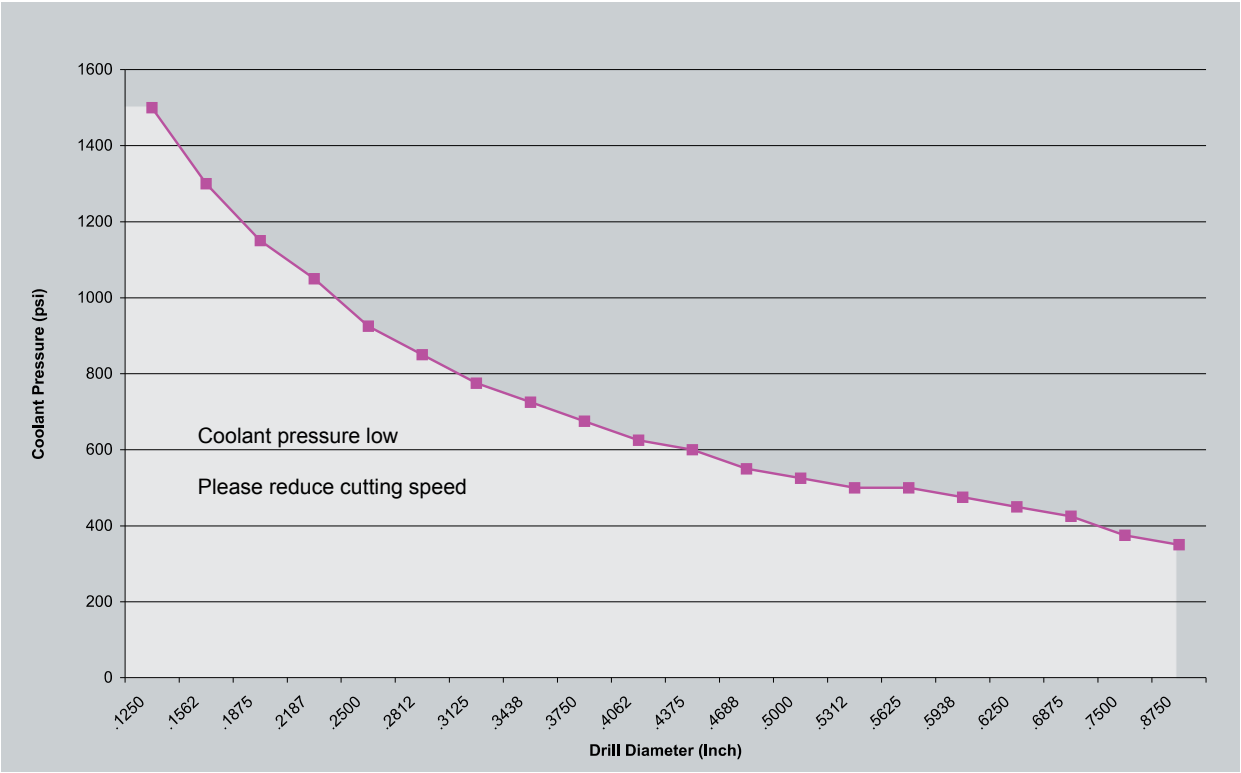
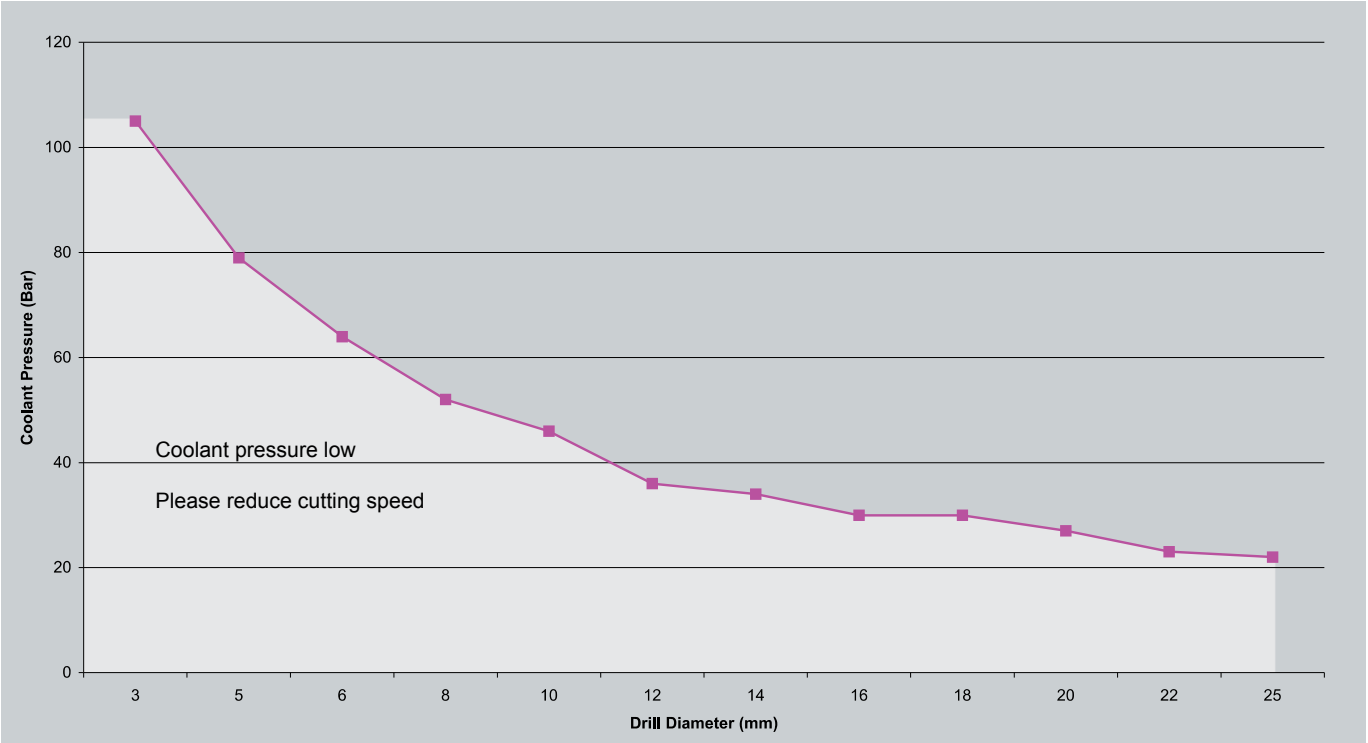
Coolant Pressure - Inch

Recommended Minimum Coolant Pressure



Coolant Pressure - Metric

Recommended Minimum Coolant Pressure



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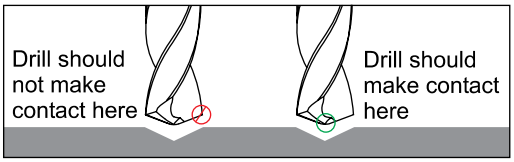
2XDCE

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 1 to 2 IPM. 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 (1,000 psi)
Machine runout of .0003" (.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 563-391-6220/800-553-8024.

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.

2XDCE Inch

Workpiece Material Group		Examples	SFM	Tool Diameter								
				.1181	.1575	.1968	.2362	.2756	.3150	.3543	.3937	.4724
				IPR								
Steels	P	Low Carbon Steels 1018/12L14	350	.0020	.0028	.0035	.0042	.0050	.0076	.0085	.0094	.0100
		Medium Carbon Steels 4140	260									
		Tool & Die Steels A2/D2/P20/H13										
		Alloy Steels 4140/8620										
		Structural Steels	400									
		Steel Forgings	175	.0024	.0031	.0039	.0047	.0055	.0076	.0085	.0094	.0100
Cast Irons	K	Gray Cast Iron Class 20	400									
		Ductile Cast Iron 60-40-18	260									
		Malleable Iron Ferritic	260									
Austenitic	M	304/316	180	.0020	.0028	.0035	.0042	.0050	.0076	.0085	.0094	.0100
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	125									
Martensitic	M	410/440	125									
Stainless	M	Ferritic	250									
Special Alloys	S	Titanium 6AL-4V	160	.0012	.0016	.0020	.0024	.0028	.0040	.0050	.0055	.0060
		Cobalt-Based Alloys Stellite, Haynes 25/188	80	.0007	.0009	.0012	.0014	.0019	.0025	.0028	.0031	.0034
		Nickel-Based Alloys Inconel 625/718	80									
		Iron-Based Alloys Incoloy 800-802/Multimet	60									
		High Nickel Alloys Monel	80									
Hardened Materials	H	Alloy Steels (36-45 Rc) A2/D2/P20/H13	260	.0005	.0006	.0008	.0009	.0011	.0019	.0021	.0024	.0026
		Alloy Steels (46-50 Rc) A2/D2/P20/H13	120									
Non-Ferrous	N	Aluminum < 14% Si 6061-T6	500	.0033	.0044	.0055	.0066	.0077	.0110	.0120	.0130	.0140
		Aluminum > 14% Si	350									
		Brass	400	.0021	.0028	.0035	.0042	.0050	.0110	.0125	.0135	.0150
		Copper/Copper Alloys Magnesium	300									

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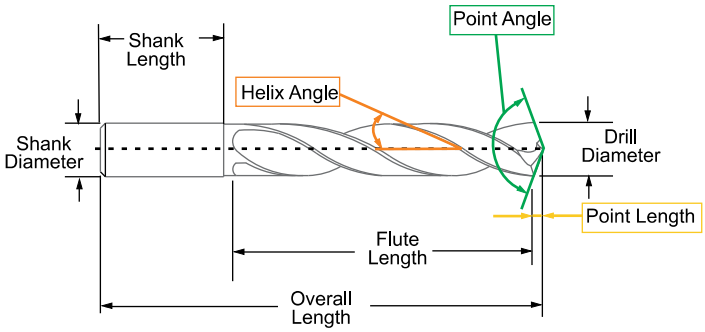
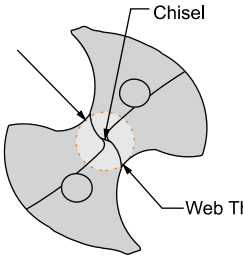
2XDCE Metric

Workpiece Material Group		Examples	SMM	Tool Diameter(mm)								
				3	4	5	6	7	8	9	10	12
				mm/rev.								
Steels	P	Low Carbon Steels 1018/12L14	105	.050	.071	.088	.106	.127	.193	.215	.238	.254
		Medium Carbon Steels 4140	80									
		Tool & Die Steels A2/D2/P20/H13										
		Alloy Steels 4140/8620										
		Structural Steels	120									
		Steel Forgings	55	.060	.078	.099	.119	.139	.193	.215	.238	.254
Cast Irons	K	Gray Cast Iron Class 20	120									
		Ductile Cast Iron 60-40-18	80									
		Malleable Iron Ferritic	80									
Austenitic	M	304/316	55	.050	.071	.088	.106	.127	.193	.215	.238	.254
Precipitation Hardened Stainless Steels	M	17-4 PH 13-8 PH	40									
Martensitic	M	410/440	40									
Stainless	M	Ferritic	75									
Special Alloys	S	Titanium 6AL-4V	45	.030	.040	.050	.060	.071	.120	.127	.139	.152
		Cobalt-Based Alloys Stellite, Haynes 25/188	25	.017	.022	.030	.035	.048	.063	.071	.078	.085
		Nickel-Based Alloys Inconel 625/718	25									
		Iron-Based Alloys Incoloy 800-802/Multimet	20									
		High Nickel Alloys Monel	25									
Hardened Materials	H	Alloy Steels (36-45 Rc) A2/D2/P20/H13	35	.012	.015	.020	.022	.027	.048	.053	.060	.066
		Alloy Steels (46-50 Rc) A2/D2/P20/H13	25									
Non-Ferrous	N	Aluminum < 14% Si 6061-T6	150	.083	.110	.139	.167	.195	.279	.314	.350	.378
		Aluminum > 14% Si	105									
		Brass	120	.053	.071	.088	.106	.127	.279	.314	.350	.378
		Copper/Copper Alloys Magnesium	90									

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

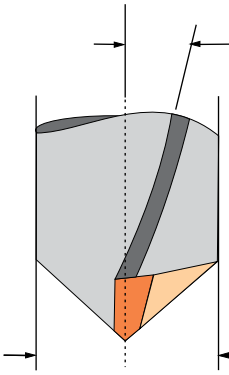
Drill Terminology





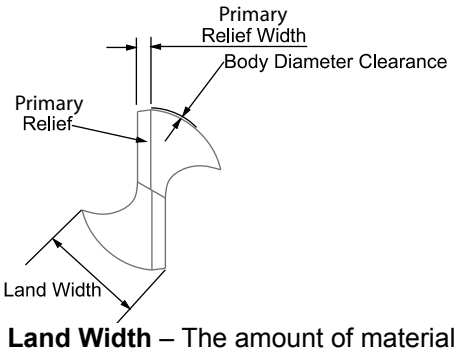
Chisel Edge – The non-cutting tip of the drill. Pushes, rather than cuts material. Having a smaller chisel means that a tool will cut more aggressively. A larger chisel means that a tool will be stronger.

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.

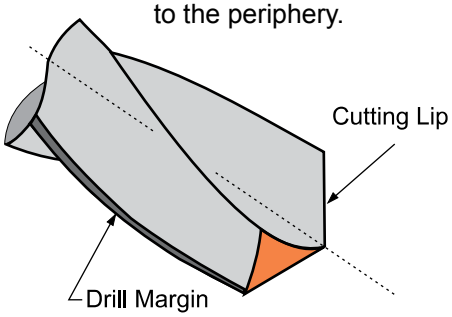


Helix Angle - Varies from 0° to 35° helix on standard tools. Lower helix angle means more rigidity and strength and a higher helix angle means more aggressive drilling and better chip evacuation.

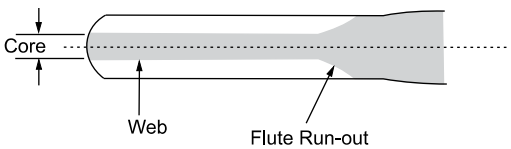
Margin Width – Provides a surface to support the drill inside the hole during the drilling operation. M.A. Ford® offers both single margin and double margin geometries. Margin widths are a balancing act between friction build-up vs. tool support in the drilling operation.



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

For product information, call your local distributor.