

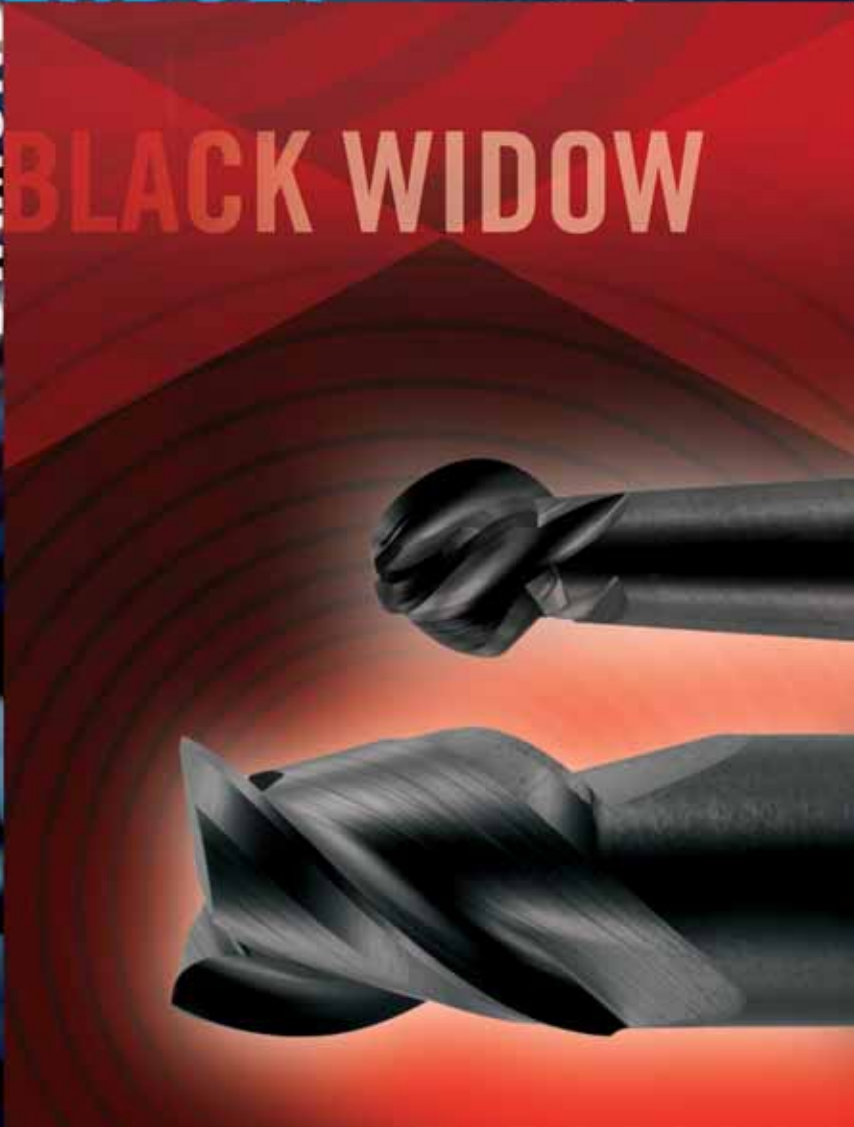
ENGINEERED TOOLS & APPLICATIONS



THUNDERBOLT



DIAMOND



BLACK WIDOW


Crystallume

A Division of RobbJack Corporation

Solving Customer Problems

with

CVD

Diamond Technology

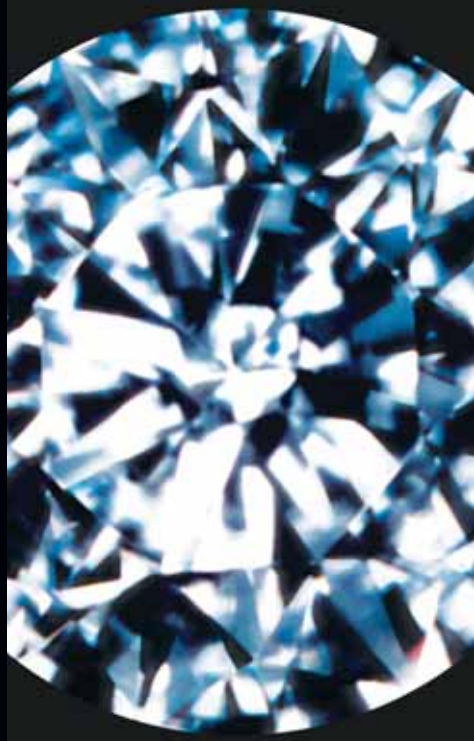


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Founded in 1984, Crystallume pioneered the development and application of **Chemical Vapor Deposition (CVD) diamond technology**. Crystallume has been shipping diamond products since 1988 and diamond is one of the carbon-based technologies that are Crystallume's specialty. The company's strength is its ability to apply its technology, coating and application experience to solve customer challenges.

Diamond technology isn't new. In the late 1950s, Russian scientist first suggested the idea that diamond could be synthesized by CVD techniques under low pressure. Product designers were interested but, initially, it was viewed as an exotic and expensive solution. Today, with advancements in technology, customers consider CVD diamond to be a viable and important solution for many cutting tool and hard coating applications. In defense, manufacturing, medicine, computing, and many other areas – from components to systems – diamond helps improve product performance.



Benefits of Diamond

Highest degree of hardness of any material – Lowest coefficient of friction

Highest thermal conductivity – Lowest chemical reactivity

Highest tensile and compressive strength – Broadest range of optical transmissivity

As a manufacturer you place higher demands on the performance of materials. Diamond is available on tools to make your product and as a material for your product. *By contacting our engineering staff we can work together for a successful implementation of diamond into your future today.*

A new Crystallume was born in 2002 as

CrystallumePVD, offering Physical Vapor Deposition (PVD) coatings for the market. CrystallumePVD offers Tin, TiCN, AlTiN, CrN, and ZrN coatings for a broad spectrum of applications and is supported by the Crystallume application and engineering staff.

In 2003 a completely new type of coating system was developed for the Hard Carbon Coatings (HCC).

Through HCC technology Crystallume developed the Black Widow coating. This coating approaches diamond hardness and has a very slippery surface. Most important is the low temperature that this coating can be applied at creating applications from coated plastics to high-performance engine parts to coated-carbide tools.

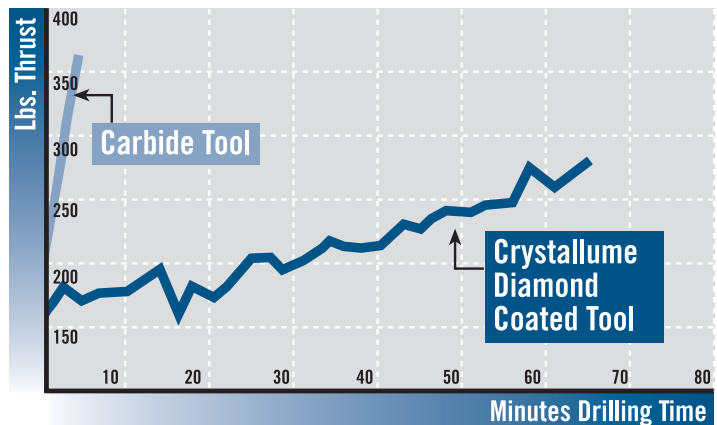
Coating Properties of Black Widow HCC-C

Microhardness (HV)	4000
Coefficient of Friction*	0.05-0.2
Thickness (um)	1-2
Oxidation temperature (°C)	450
Color 10^{15} (< 10^{-3} doped)	black/gray

Crystallume is proud to introduce the new Black Widow coating and tool line in this catalog along with an expanded ThunderBolt line of tools.

Comparison of Crystallume CVD Diamond with Current Alternative Materials

Property	Crystallume CVD Diamond	Alternative
Thermal Conductivity (w/cm-°C)@25°C	10-18	Copper 4.0
Hardness (kg/mm ²)	9000	CBN 4500
Optical Transmissivity	225 nm to far IR	Sapphire
Band Gap (eV)	5.4	GaAs 1.43
Coefficient of Friction	0.05-0.7	Teflon®0.05
Thermal Expansion (ppm)	2.0	Si 2.6
Electrical Resistivity (ohm-cm)	10^{15} (< 10^{-3} doped)	Al ₂ O ₃ 10^{15}



Drilling test results 390 aluminum



Graphite Electrode Machining

Crystallume DCC® tools are finding rapid acceptance among manufacturers of graphite electrodes for use in EDM operations because they last 10 to 30 times as long as carbide tools currently used. Increased tool life results in longer periods of unmanned machining. The machining speeds for Crystallume DCC tools can be increased 2 to 3 times over the speeds used with carbide tools to increase your productivity. These features combine to increase the utilization of your machine tools.

Machining Example 1

Mold company using POCO 200 to build graphite electrodes.

They machined the trode at 1400 sfm and 315 ipm. This was 2 times faster than the carbide tool. The Crystallume DCC end mill lasted 15 times as long as the TiN coated carbide tool used previously. The company was amazed at the tolerance control without having to recut.

Machining Example 2

Metal casting mold company using POCO 3 to build molds.

The machine was run at 940 sfm and 200 ipm. The Crystallume DCC end mill lasted 21 times as long as the TiN coated carbide tool used previously. Due to the extended tool life this customer now runs unmanned overnight operations.

Machining Example 3

Tool and die company using POCO 200 to build electrodes.

They finish machine the trode with a 1/4 ball end mill. The TiN coated carbide end mill lasted 7 hours (7 trodes) and the Crystallume DCC end mill lasted 97 hours (97 trodes). They now use the Crystallume DCC end mill as a roughing tool after this for an unkown amount of time.

Deep Cavity *Page 9*

P820-200930-1

P820-200929-1



Mold Maker End Mills *Page 6*

Crystallume's Mold Maker tools offer features specifically for electrode and mold manufacturing. The Mold Maker tools have a 5 times diameter flute length with an extended shank. The big difference is the tolerance of the tools. With a cutting diameter up to 1/8 and 3mm the tolerance is +0.0000/-0.0005 and for tools larger than this the tolerance is +0.0000/-0.0010. All shanks are held to a tolerance of -0.0001/-0.0003 to assure consistent and concentric gripping in shrink fit holders. Mold Maker tools are available in sizes from 1/64 to 1/2 inch and from .5mm to 6mm in diameter with tools below 1/4 and 6mm available with and without extended reach. Crystallume Mold Maker tools are the most precise diamond coated tools available.

Cutting Speeds and Feeds for Graphite

Tool Diameter	Soft Graphite		Chip Load Per Tooth		Hard Graphite	
	Roughing	Finishing	Medium Graphite Roughing	Medium Graphite Finishing	Roughing	Finishing
1/32	.0006-.0008	.0005-.0006	.0005-.0006	.0004-.0005	.0004-.0005	.0003-.0004
1/16	.0013-.0015	.0010-.0013	.0010-.0013	.0008-.0010	.0008-.0010	.0005-.0008
3/32	.0019-.0023	.0015-.0019	.0015-.0019	.0011-.0015	.0011-.0015	.0008-.0011
1/8	.0025-.0030	.0020-.0025	.0020-.0025	.0015-.0020	.0015-.0020	.0010-.0015
3/16	.0038-.0045	.0030-.0038	.0030-.0038	.0023-.0030	.0023-.0030	.0015-.0023
1/4	.0050-.0060	.0040-.0050	.0040-.0050	.0030-.0040	.0030-.0040	.0020-.0030
5/16	.0063-.0075	.0050-.0063	.0050-.0063	.0038-.0050	.0038-.0050	.0025-.0038
3/8	.0075-.0090	.0060-.0075	.0060-.0075	.0045-.0060	.0045-.0060	.0030-.0045
7/16	.0088-.0105	.0070-.0088	.0070-.0088	.0053-.0070	.0053-.0070	.0035-.0053
1/2	.0100-.0120	.0080-.0100	.0080-.0100	.0060-.0080	.0060-.0080	.0040-.0060

(Speeds and Feeds are only general starting points and may vary depending on specific applications)

Cutting Speed

Soft Graphite	1000-2000sfm
Medium Graphite	750-1500sfm
Hard Graphite	500-1250sfm

(Use maximum RPM if suggested RPM is higher than the machines capabilities)

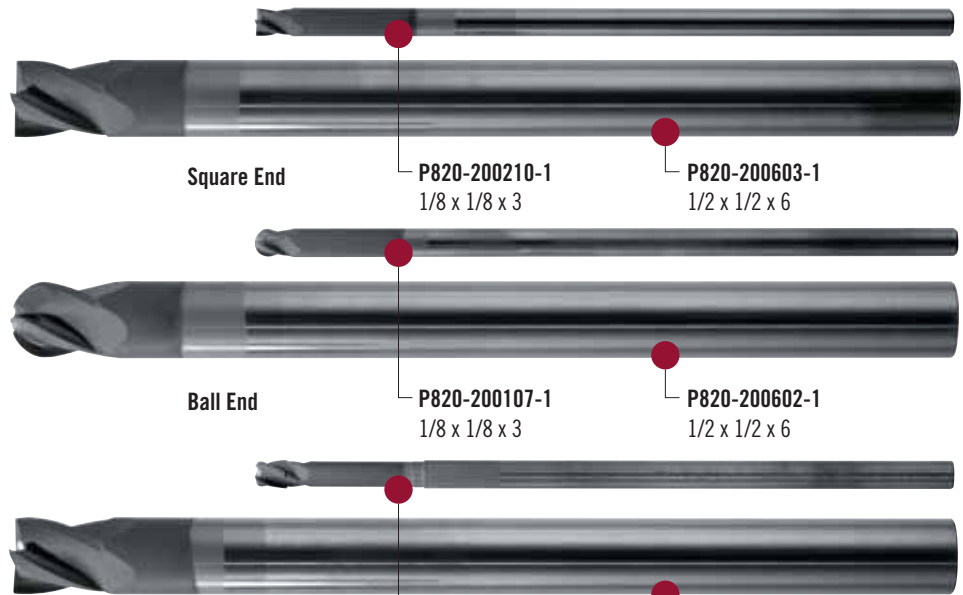


Extended Shank End Mills Page 6

The Extended Shank tools combine a short flute length for maximum rigidity with a long shank for extended reach into deep cavities. When the extended reach is not required, you can choke up on the tool to make it extremely rigid as a stub tool. This is a great all around tool that will become the workhorse for your shop.

Standard Tolerance

Cutting Diameter: +0.001"/-0.001"
 Shank Tolerance: -0.0001"/-0.0003"
 Flute Length: ±0.060"
 Overall Length: ±0.060"



Square End

P820-200210-1
1/8 x 1/8 x 3

P820-200603-1
1/2 x 1/2 x 6

Ball End

P820-200107-1
1/8 x 1/8 x 3

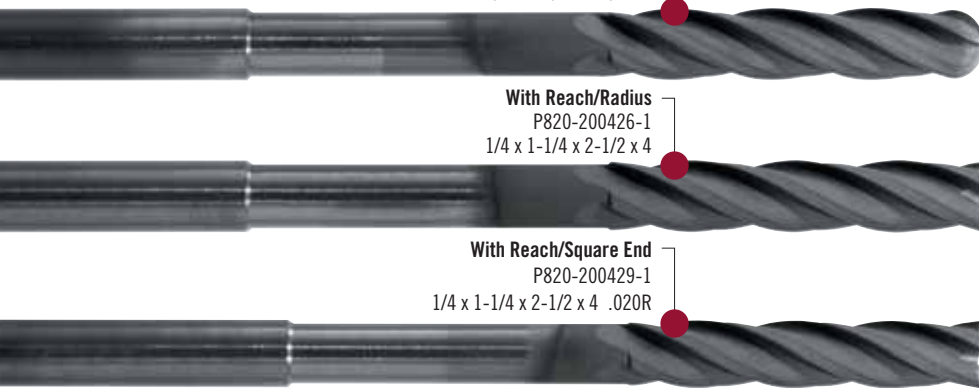
P820-200602-1
1/2 x 1/2 x 6

Radius

P820-200628-1
1/8 x 1/8 x 3 .031R

P820-200310-1
1/2 x 1/2 x 6 .015R

Mold Maker End Mills in US and Metric Sizes Page 6



With Reach/Ball End
P820-200427-1
1/4 x 1-1/4 x 2-1/2 x 4

With Reach/Radius
P820-200426-1
1/4 x 1-1/4 x 2-1/2 x 4

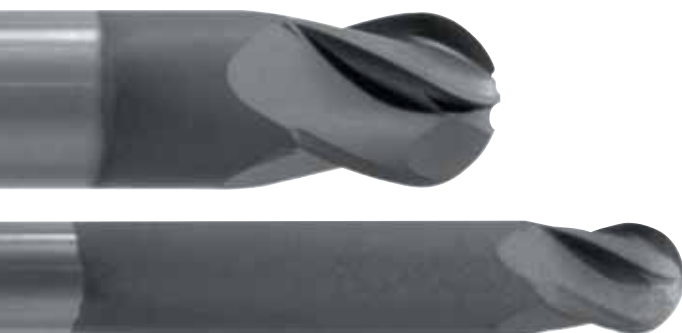
With Reach/Square End
P820-200429-1
1/4 x 1-1/4 x 2-1/2 x 4 .020R

Standard Tolerance

Cutting Diameter:
 +0.0000/-0.0005 up to 0.1250
 +0.0000/-0.0010 from 0.2500 to 0.5000
 Shank Tolerance: -0.0001"/-0.0003"
 Flute Length: ±0.060"
 Overall Length: ±0.060"

ThunderBolt Tools Page 10

The new ThunderBolt Ultra Thin Nano Diamond Tools have a real diamond coating that is the thickness of most PVD coatings.



Big Shank Tools Page 9

These tools have been designed for customers using automated machining cells where graphite electrodes are machined. These cells use heat shrink tooling and have multiple high speed ultra accurate machining centers from Rödgers or Mikron doing unmanned graphite machining. The large shank size helps to stabilize the smaller diameter cutting tools.



P820-200749-1

P820-200745-1



Extended Shank End Mills

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
0.0625	1/16		1/16	5/16	3	1/16	4	BN	+0.001/-0.001	P820-200105-1
0.0625	1/16		1/16	5/16	3	1/16	4	SE	+0.001/-0.001	P820-200209-1
0.0938	3/32		3/32	11/32	3	3/32	4	BN	+0.001/-0.001	P820-200106-1
0.0938	3/32		3/32	11/32	3	3/32	4	SE	+0.001/-0.001	P820-200582-1
0.1250	1/8		1/8	5/8	3	1/8	4	BN	+0.001/-0.001	P820-200107-1
0.1250	1/8		1/8	5/8	3	1/8	4	SE	+0.001/-0.001	P820-200210-1
0.1250	1/8		1/8	5/8	3	1/8	4	SE-.015CR	+0.001/-0.001	P820-200241-1
0.1250	1/8		1/8	5/8	3	1/8	4	SE-.031CR	+0.001/-0.001	P820-200628-1
0.1875	3/16		3/16	11/16	3	3/16	4	BN	+0.001/-0.001	P820-200108-1
0.1875	3/16		3/16	11/16	3	3/16	4	SE	+0.001/-0.001	P820-200237-1
0.1875	3/16		3/16	11/16	3	3/16	4	SE-.062CR	+0.001/-0.001	P820-200627-1
0.2500	1/4		1/4	3/4	4	1/4	4	BN	+0.001/-0.001	P820-200109-1
0.2500	1/4		1/4	3/4	4	1/4	4	SE	+0.001/-0.001	P820-200211-1
0.2500	1/4		1/4	3/4	4	1/4	4	SE-.015CR	+0.001/-0.001	P820-200242-1
0.2500	1/4		1/4	3/4	4	1/4	4	SE-.030CR	+0.001/-0.001	P820-200279-1
0.2500	1/4		1/4	3/4	4	1/4	4	SE-.062CR	+0.001/-0.001	P820-200626-1
0.3125	5/16		5/16	13/16	4	5/16	4	BN	+0.001/-0.001	P820-200110-1
0.3125	5/16		5/16	13/16	4	5/16	4	SE	+0.001/-0.001	P820-200581-1
0.3750	3/8		3/8	1-1/8	4	3/8	4	BN	+0.001/-0.001	P820-200111-1
0.3750	3/8		3/8	1-1/8	4	3/8	4	SE	+0.001/-0.001	P820-200512-1
0.3750	3/8		3/8	1-1/8	4	3/8	4	SE-.015CR	+0.001/-0.001	P820-200309-1
0.5000	1/2		1/2	1-1/4	6	1/2	4	BN	+0.001/-0.001	P820-200602-1
0.5000	1/2		1/2	1-1/4	6	1/2	4	SE	+0.001/-0.001	P820-200603-1
0.5000	1/2		1/2	1-1/4	6	1/2	4	SE-.015CR	+0.001/-0.001	P820-200310-1

Mold Maker End Mills US Sizes

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
Mold Makers With Reach										
0.0156	1/64	0.075		1/8	2-1/2	1/8	2	BN	+0.000/-0.0005	P820-200404-1
0.0156	1/64	0.075		1/8	2-1/2	1/8	2	SE	+0.000/-0.0005	P820-200403-1
0.0313	1/32	5/32		1/4	2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200406-1
0.0313	1/32	5/32		1/4	2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200405-1
0.0313	1/32	5/32		1/4	2-1/2	1/8	4	SE-.005CR	+0.000/-0.0005	P820-200407-1
0.0469	3/64	15/64		1/2	2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200409-1
0.0469	3/64	15/64		1/2	2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200408-1
0.0469	3/64	15/64		1/2	2-1/2	1/8	4	SE-.010CR	+0.000/-0.0005	P820-200410-1
0.0625	1/16	5/16		1	2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200412-1
0.0625	1/16	5/16		1	2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200411-1
0.0625	1/16	5/16		1	2-1/2	1/8	4	SE-.010CR	+0.000/-0.0005	P820-200413-1
0.0938	3/32	15/32		1	2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200415-1
0.0938	3/32	15/32		1	2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200414-1
0.0938	3/32	15/32		1	2-1/2	1/8	4	SE-.015CR	+0.000/-0.0005	P820-200416-1
0.0938	3/32	15/32		1	2-1/2	1/8	4	SE-.020CR	+0.000/-0.0005	P820-200417-1
0.1250	1/8	5/8		1-1/4	3	1/8	4	BN	+0.000/-0.0005	P820-200419-1
0.1250	1/8	5/8		1-1/4	3	1/8	4	SE	+0.000/-0.0005	P820-200418-1
0.1250	1/8	5/8		1-1/4	3	1/8	4	SE-.015CR	+0.000/-0.0005	P820-200420-1
0.1250	1/8	5/8		1-1/4	3	1/8	4	SE-.020CR	+0.000/-0.0005	P820-200421-1
0.1250	1/8	5/8		1-1/4	3	1/8	4	SE-.030CR	+0.000/-0.0005	P820-200422-1

Mold Maker End Mills US Sizes

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
0.1875	3/16		15/16	1-1/2	3	3/16	4	BN	+0.000/-0.001	P820-200424-1
0.1875	3/16		15/16	1-1/2	3	3/16	4	SE	+0.000/-0.001	P820-200423-1
0.1875	3/16		15/16	1-1/2	3	3/16	4	SE-.030CR	+0.000/-0.001	P820-200425-1
0.2500	1/4		1-1/4	2-1/2	4	1/4	4	BN	+0.000/-0.001	P820-200427-1
0.2500	1/4		1-1/4	2-1/2	4	1/4	4	SE	+0.000/-0.001	P820-200426-1
0.2500	1/4		1-1/4	2-1/2	4	1/4	4	SE-.015CR	+0.000/-0.001	P820-200428-1
0.2500	1/4		1-1/4	2-1/2	4	1/4	4	SE-.020CR	+0.000/-0.001	P820-200429-1
0.2500	1/4		1-1/4	2-1/2	4	1/4	4	SE-.030CR	+0.000/-0.001	P820-200430-1
0.2500	1/4		1-1/4	2-1/2	4	1/4	4	SE-.060CR	+0.000/-0.001	P820-200431-1
Mold Makers Without Reach										
0.0156	1/64		0.075		2-1/2	1/8	2	BN	+0.000/-0.0005	P820-200684-1
0.0156	1/64		0.075		2-1/2	1/8	2	SE	+0.000/-0.0005	P820-200683-1
0.0313	1/32		5/32		2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200686-1
0.0313	1/32		5/32		2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200685-1
0.0313	1/32		5/32		2-1/2	1/8	4	SE-.005CR	+0.000/-0.0005	P820-200687-1
0.0469	3/64		15/64		2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200689-1
0.0469	3/64		15/64		2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200688-1
0.0469	3/64		15/64		2-1/2	1/8	4	SE-.010CR	+0.000/-0.0005	P820-200690-1
0.0625	1/16		5/16		2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200692-1
0.0625	1/16		5/16		2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200691-1
0.0625	1/16		5/16		2-1/2	1/8	4	SE-.010CR	+0.000/-0.0005	P820-200693-1
0.0938	3/32		15/32		2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200695-1
0.0938	3/32		15/32		2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200694-1
0.0938	3/32		15/32		2-1/2	1/8	4	SE-.015CR	+0.000/-0.0005	P820-200696-1
0.0938	3/32		15/32		2-1/2	1/8	4	SE-.020CR	+0.000/-0.0005	P820-200697-1
0.1250	1/8		5/8		3	1/8	4	BN	+0.000/-0.0005	P820-200699-1
0.1250	1/8		5/8		3	1/8	4	SE	+0.000/-0.0005	P820-200698-1
0.1250	1/8		5/8		3	1/8	4	SE-.015CR	+0.000/-0.0005	P820-200700-1
0.1250	1/8		5/8		3	1/8	4	SE-.020CR	+0.000/-0.0005	P820-200701-1
0.1250	1/8		5/8		3	1/8	4	SE-.030CR	+0.000/-0.0005	P820-200702-1
0.1875	3/16		15/16		3	3/16	4	BN	+0.000/-0.001	P820-200704-1
0.1875	3/16		15/16		3	3/16	4	SE	+0.000/-0.001	P820-200703-1
0.1875	3/16		15/16		3	3/16	4	SE-.030CR	+0.000/-0.001	P820-200705-1
0.2500	1/4		1-1/4		4	1/4	4	BN	+0.000/-0.001	P820-200707-1
0.2500	1/4		1-1/4		4	1/4	4	SE	+0.000/-0.001	P820-200706-1
0.2500	1/4		1-1/4		4	1/4	4	SE-.015CR	+0.000/-0.001	P820-200708-1
0.2500	1/4		1-1/4		4	1/4	4	SE-.020CR	+0.000/-0.001	P820-200709-1
0.2500	1/4		1-1/4		4	1/4	4	SE-.030CR	+0.000/-0.001	P820-200710-1
0.2500	1/4		1-1/4		4	1/4	4	SE-.060CR	+0.000/-0.001	P820-200711-1
0.3750	3/8		1-1/2		6	3/8	4	BN	+0.000/-0.001	P820-200713-1
0.3750	3/8		1-1/2		6	3/8	4	SE	+0.000/-0.001	P820-200712-1
0.3750	3/8		1-1/2		6	3/8	4	SE-.015CR	+0.000/-0.001	P820-200714-1
0.3750	3/8		1-1/2		6	3/8	4	SE-.030CR	+0.000/-0.001	P820-200715-1
0.3750	3/8		1-1/2		6	3/8	4	SE-.060CR	+0.000/-0.001	P820-200716-1
0.5000	1/2		1-1/2		6	1/2	4	BN	+0.000/-0.001	P820-200718-1
0.5000	1/2		1-1/2		6	1/2	4	SE	+0.000/-0.001	P820-200717-1
0.5000	1/2		1-1/2		6	1/2	4	SE-.015CR	+0.000/-0.001	P820-200719-1
0.5000	1/2		1-1/2		6	1/2	4	SE-.030CR	+0.000/-0.001	P820-200720-1
0.5000	1/2		1-1/2		6	1/2	4	SE-.060CR	+0.000/-0.001	P820-200721-1



Mold Maker End Mills Metric Sizes

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
Metric Mold Makers With Reach										
0.0197		0.5mm	2.5mm	3mm	62mm	3mm	2	BN	+0.000mm/-0.013mm	P820-200338-1
0.0197		0.5mm	2.5mm	3mm	62mm	3mm	2	SE	+0.000mm/-0.013mm	P820-200337-1
0.0394		1mm	5mm	12mm	62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200340-1
0.0394		1mm	5mm	12mm	62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200339-1
0.0591		1.5mm	7.5mm	25mm	62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200342-1
0.0591		1.5mm	7.5mm	25mm	62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200341-1
0.0787		2mm	10mm	25mm	62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200344-1
0.0787		2mm	10mm	25mm	62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200343-1
0.1181		3mm	15mm	30mm	62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200346-1
0.1181		3mm	15mm	30mm	62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200345-1
0.1575		4mm	20mm	40mm	75mm	4mm	4	BN	+0.000mm/-0.025mm	P820-200348-1
0.1575		4mm	20mm	40mm	75mm	4mm	4	SE	+0.000mm/-0.025mm	P820-200347-1
0.2362		6mm	24mm	50mm	75mm	6mm	4	BN	+0.000mm/-0.025mm	P820-200350-1
0.2362		6mm	24mm	50mm	75mm	6mm	4	SE	+0.000mm/-0.025mm	P820-200349-1
Metric Mold Makers Without Reach										
0.0197		0.5mm	2.5mm		62mm	3mm	2	BN	+0.000mm/-0.013mm	P820-200670-1
0.0197		0.5mm	2.5mm		62mm	3mm	2	SE	+0.000mm/-0.013mm	P820-200669-1
0.0394		1mm	5mm		62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200672-1
0.0394		1mm	5mm		62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200671-1
0.0591		1.5mm	7.5mm		62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200674-1
0.0591		1.5mm	7.5mm		62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200673-1
0.0787		2mm	10mm		62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200676-1
0.0787		2mm	10mm		62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200675-1
0.1181		3mm	15mm		62mm	3mm	4	BN	+0.000mm/-0.013mm	P820-200678-1
0.1181		3mm	15mm		62mm	3mm	4	SE	+0.000mm/-0.013mm	P820-200677-1
0.1575		4mm	20mm		75mm	4mm	4	BN	+0.000mm/-0.025mm	P820-200680-1
0.1575		4mm	20mm		75mm	4mm	4	SE	+0.000mm/-0.025mm	P820-200679-1
0.2362		6mm	24mm		75mm	6mm	4	BN	+0.000mm/-0.025mm	P820-200682-1
0.2362		6mm	24mm		75mm	6mm	4	SE	+0.000mm/-0.025mm	P820-200681-1

Deep Cavity Mold Maker End Mills

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
0.0197		0.5mm	2.5mm	15mm	2-1/2	1/8	2	SE	+0.000mm/-0.013mm	P820-200921-1
0.0197		0.5mm	2.5mm	15mm	2-1/2	1/8	2	BN	+0.000mm/-0.013mm	P820-200922-1
0.0394		1mm	6.3mm	19mm	2-1/2	1/8	4	SE	+0.000mm/-0.013mm	P820-200927-1
0.0394		1mm	6.3mm	19mm	2-1/2	1/8	4	BN	+0.000mm/-0.013mm	P820-200928-1
0.0156	1/64		0.075	0.575	2-1/2	1/8	2	SE	+0.000/-0.0005	P820-200919-1
0.0156	1/64		0.075	0.575	2-1/2	1/8	2	BN	+0.000/-0.0005	P820-200920-1
0.0313	1/32		0.150	0.650	2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200923-1
0.0313	1/32		0.150	0.650	2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200924-1
0.0313	1/32		0.250	0.750	2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200925-1
0.0313	1/32		0.250	0.750	2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200926-1
0.0469	3/64		0.250	0.750	2-1/2	1/8	4	SE	+0.000/-0.0005	P820-200929-1
0.0469	3/64		0.250	0.750	2-1/2	1/8	4	BN	+0.000/-0.0005	P820-200930-1

Big Shank Tools

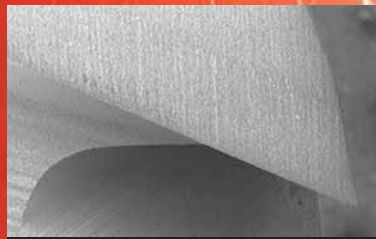
Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
0.0157		0.4mm	2mm		62mm	6mm	2	BN	+0.010mm/-0.000mm	P820-200745-1
0.0157		0.4mm	2mm		62mm	6mm	2	SE	+0.010mm/-0.000mm	P820-200744-1
0.0197		0.5mm	2.5mm		62mm	6mm	2	BN	+0.010mm/-0.000mm	P820-200733-1
0.0197		0.5mm	2.5mm		62mm	6mm	2	SE	+0.010mm/-0.000mm	P820-200746-1
0.0236		0.6mm	3mm		63mm	6mm	2	BN	+0.010mm/-0.000mm	P820-200784-1
0.0236		0.6mm	3mm		63mm	6mm	2	SE	+0.010mm/-0.000mm	P820-200785-1
0.0315		0.8mm	5mm	7mm	50mm	6mm	4	BN	+0.010mm/-0.000mm	P820-200734-1
0.0315		0.8mm	5mm	7mm	50mm	6mm	4	SE	+0.010mm/-0.000mm	P820-200783-1
0.0394		1mm	5mm	7mm	50mm	6mm	4	BN	+0.010mm/-0.000mm	P820-200768-1
0.0394		1mm	5mm	7mm	50mm	6mm	4	SE	+0.010mm/-0.000mm	P820-200747-1
0.0787		2mm	8mm		50mm	6mm	4	BN	+0.010mm/-0.000mm	P820-200749-1
0.0787		2mm	8mm		50mm	6mm	4	SE	+0.010mm/-0.000mm	P820-200748-1
0.1181		3mm	12mm		50mm	6mm	4	BN	+0.010mm/-0.000mm	P820-200769-1
0.1181		3mm	12mm		50mm	6mm	4	SE	+0.010mm/-0.000mm	P820-200770-1
0.1575		4mm	14mm		50mm	6mm	4	BN	+0.010mm/-0.000mm	P820-200737-1
0.1575		4mm	14mm		50mm	6mm	4	SE	+0.010mm/-0.000mm	P820-200771-1
0.2362		6mm	14mm		57mm	6mm	4	BN	+0.010mm/-0.010mm	P820-200772-1
0.2362		6mm	14mm		57mm	6mm	4	SE	+0.010mm/-0.010mm	P820-200773-1
0.3150		8mm	18mm		63mm	8mm	4	BN	+0.025mm/-0.050mm	P820-200574-1
0.3150		8mm	18mm		63mm	8mm	4	SE	+0.025mm/-0.050mm	P820-200573-1
0.3937		10mm	10mm	25mm	63mm	10mm	4	BN	+0.025mm/-0.050mm	P820-200786-1
0.3937		10mm	10mm	25mm	63mm	10mm	4	SE	+0.025mm/-0.050mm	P820-200575-1

ThunderBolt



REAL CRYSTALLINE DIAMOND

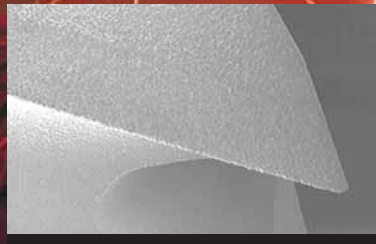
ULTRA THIN NANO DIAMOND



Standard uncoated carbide tool



ThunderBolt coated carbide tool



Standard diamond coated carbide tool



Real Crystalline Diamond Coating The Thickness of PVD!

The new ThunderBolt Ultra Thin Nano Diamond Tools have a real diamond coating that is the thickness of most PVD coatings. You can now use real diamond where once you thought you could only afford the imitations. The performance of real diamond, along with the edge sharpness of a thin coating, gives unheard of performance in the finishing of graphite. It is also the perfect tool for those short run jobs requiring a diamond tool.



Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Cutting DIA Tolerance +0.XXXX/-0.XXXX	Part Number
0.0625	1/16		1/16	5/16	3	1/16	4	BN	+ .001/- .001	P47-100001-1
0.0625	1/16		1/16	5/16	3	1/16	4	SE	+ .001/- .001	P47-100006-1
0.0935	3/32		3/32	11/32	3	3/32	4	BN	+ .001/- .001	P47-100002-1
0.0935	3/32		3/32	11/32	3	3/32	4	SE	+ .001/- .001	P47-100007-1
0.1250	1/8		1/8	5/8	3	1/8	4	BN	+ .001/- .001	P47-100003-1
0.1250	1/8		1/8	5/8	3	1/8	4	SE	+ .001/- .001	P47-100008-1
0.1250	1/8		1/8	5/8	3	1/8	4	SE, .015CR	+ .001/- .001	P47-100009-1
0.1250	1/8		1/8	5/8	3	1/8	4	SE, .031CR	+ .001/- .001	P47-100010-1
0.1875	3/16		3/16	11/16	3	3/16	4	BN	+ .001/- .001	P47-100004-1
0.1875	3/16		3/16	11/16	3	3/16	4	SE	+ .001/- .001	P47-100011-1
0.1875	3/16		3/16	11/16	3	3/16	4	SE, .062CR	+ .001/- .001	P47-100012-1
0.2500	1/4		1/4	3/4	3	1/4	4	BN	+ .001/- .001	P47-100005-1
0.2500	1/4		1/4	3/4	3	1/4	4	SE	+ .001/- .001	P47-100013-1
0.2500	1/4		1/4	3/4	3	1/4	4	SE, .015CR	+ .001/- .001	P47-100014-1
0.2500	1/4		1/4	3/4	3	1/4	4	SE, .031CR	+ .001/- .001	P47-100015-1
0.2500	1/4		1/4	3/4	3	1/4	4	SE, .062CR	+ .001/- .001	P47-100016-1
0.0313	1/32		3/32		1-1/2	1/8	4	SE	+ .001/- .001	P47-100017-1
0.0313	1/32		3/32		1-1/2	1/8	4	BN	+ .001/- .001	P47-100018-1
0.0625	1/16		1/4	*	1-1/2	1/8	4	SE	+ .001/- .001	P47-100019-1
0.0625	1/16		1/4	*	1-1/2	1/8	4	BN	+ .001/- .001	P47-100020-1
0.0935	3/32		3/8	*	1-1/2	1/8	4	SE	+ .001/- .001	P47-100021-1
0.0935	3/32		3/8	*	1-1/2	1/8	4	BN	+ .001/- .001	P47-100022-1
0.1250	1/8		1/2	*	1-1/2	1/8	4	SE	+ .001/- .001	P47-100023-1
0.1250	1/8		1/2	*	1-1/2	1/8	4	BN	+ .001/- .001	P47-100024-1
0.1875	3/16		5/8	*	2	3/16	4	SE	+ .001/- .001	P47-100025-1
0.1875	3/16		5/8	*	2	3/16	4	BN	+ .001/- .001	P47-100026-1
0.2500	1/4		3/4	*	2-1/2	1/4	4	SE	+ .001/- .001	P47-100027-1
0.2500	1/4		3/4	*	2-1/2	1/4	4	BN	+ .001/- .001	P47-100028-1

*Tools coated 1X Diameter

General Purpose Tools

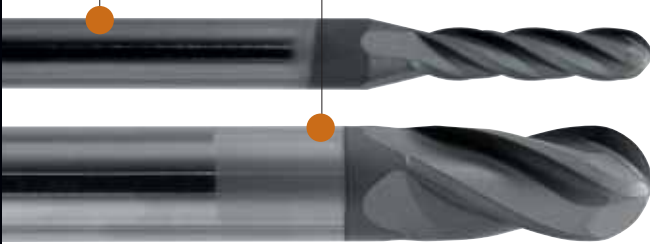
Standard End Mills

Standard Tolerance

Cutting Diameter: +0.0005"/-0.0010"
 Shank Tolerance: -0.0001"/-0.0003"
 Flute Length: ±0.060"
 Overall Length: ±0.060"

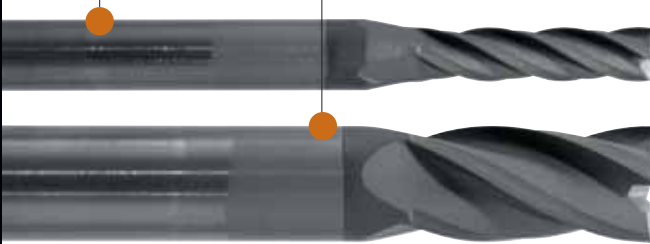
P820-200004-1
 3/32 x 3/8 x 1-1/2

P820-200056-1
 1/2 x 1 x 3



P820-200002-1
 3/32 x 3/8 x 1-1/2

P820-200054-1
 1/2 x 1 x 3



Drills

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P810-100074-1
 #3 Center Drill

P810-100002-1
 1/4 Jobbers Drill



DCC Drills are available in sizes from 0.028" to 0.75". Metric sizes are available. Standard DCC Drills are 2 flute with a 118°, 4 facet drill point and come in jobbers lengths. The diamond coating extends a minimum of one diameter from the drill tip.

Long Standard and Extra Long Standard End Mills

Standard Tolerance

Cutting Diameter: +0.0005"/-0.0010"
 Shank Diameter: -0.0001"/-0.0003"
 Flute Length: ±0.060"
 Overall Length: ±0.060"

P820-200012-1
 1/8 x 1 x 3

P820-200205-1
 1/2 x 3 x 6

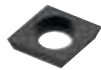
P820-200010-1
 1/8 x 1 x 3

P820-200195-1
 1/2 x 3 x 6



Inserts

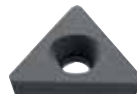
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P830-100006-1
 CDCD-500



P830-100501-1
 6FN-2J



P830-100078-1
 TD-6p



P830-100201-1
 CCMT-32.52-um



P830-100032-1
 NPGR-51L



P830-100584-1
 SPG-1242

Standard End Mills

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
Standard Length										
0.0313	1/32		3/32		1-1/2	1/8	4	SE	+0.0005/-0.0010	P820-200219-1
0.0313	1/32		3/32		1-1/2	1/8	4	BN	+0.0005/-0.0010	P820-200202-1
0.0625	1/16		1/4		1-1/2	1/8	4	SE	+0.0005/-0.0010	P820-200492-1
0.0625	1/16		1/4		1-1/2	1/8	4	BN	+0.0005/-0.0010	P820-200646-1
0.0938	3/32		3/8		1-1/2	1/8	4	SE	+0.0005/-0.0010	P820-200002-1
0.0938	3/32		3/8		1-1/2	1/8	4	BN	+0.0005/-0.0010	P820-200004-1
0.1250	1/8		1/2		1-1/2	1/8	4	SE	+0.0005/-0.0010	P820-200006-1
0.1250	1/8		1/2		1-1/2	1/8	4	BN	+0.0005/-0.0010	P820-200008-1
0.1875	3/16		5/8		2	3/16	4	SE	+0.0005/-0.0010	P820-200014-1
0.1875	3/16		5/8		2	3/16	4	BN	+0.0005/-0.0010	P820-200016-1
0.2500	1/4		3/4		2-1/2	1/4	4	SE	+0.0005/-0.0010	P820-200022-1
0.2500	1/4		3/4		2-1/2	1/4	4	BN	+0.0005/-0.0010	P820-200024-1
0.3125	5/16		13/16		2-1/2	5/16	4	SE	+0.0005/-0.0010	P820-200030-1
0.3125	5/16		13/16		2-1/2	5/16	4	BN	+0.0005/-0.0010	P820-200032-1
0.3750	3/8		7/8		2-1/2	3/8	4	SE	+0.0005/-0.0010	P820-200038-1
0.3750	3/8		7/8		2-1/2	3/8	4	BN	+0.0005/-0.0010	P820-200040-1
0.4375	7/16		1		2-3/4	7/16	4	SE	+0.0005/-0.0010	P820-200046-1
0.4375	7/16		1		2-3/4	7/16	4	BN	+0.0005/-0.0010	P820-200048-1
0.5000	1/2		1		3	1/2	4	SE	+0.0005/-0.0010	P820-200054-1
0.5000	1/2		1		3	1/2	4	BN	+0.0005/-0.0010	P820-200056-1
Long Standard										
0.1250	1/8		1		3	1/8	4	SE	+0.0005/-0.0010	P820-200010-1
0.1250	1/8		1		3	1/8	4	BN	+0.0005/-0.0010	P820-200012-1
0.1875	3/16		1-1/8		3	3/16	4	SE	+0.0005/-0.0010	P820-200018-1
0.1875	3/16		1-1/8		3	3/16	4	BN	+0.0005/-0.0010	P820-200020-1
0.2500	1/4		1-1/4		3	1/4	4	SE	+0.0005/-0.0010	P820-200026-1
0.2500	1/4		1-1/4		3	1/4	4	BN	+0.0005/-0.0010	P820-200028-1
0.3125	5/16		1-3/8		3-1/8	5/16	4	SE	+0.0005/-0.0010	P820-200034-1
0.3125	5/16		1-3/8		3-1/8	5/16	4	BN	+0.0005/-0.0010	P820-200036-1
0.3750	3/8		1-1/2		4	3/8	4	SE	+0.0005/-0.0010	P820-200722-1
0.3750	3/8		1-1/2		4	3/8	4	BN	+0.0005/-0.0010	P820-200094-1
0.5000	1/2		2		4	1/2	4	SE	+0.0005/-0.0010	P820-200058-1
0.5000	1/2		2		4	1/2	4	BN	+0.0005/-0.0010	P820-200060-1
Extra Long Standard										
0.2500	1/4		2		4	1/4	4	BN	+0.0005/-0.0010	P820-200539-1
0.2500	1/4		2		4	1/4	4	SE	+0.0005/-0.0010	P820-200277-1
0.5000	1/2		3		6	1/2	4	BN	+0.0005/-0.0010	P820-200205-1
0.5000	1/2		3		6	1/2	4	SE	+0.0005/-0.0010	P820-200195-1

Standard End Mills Metric Sizes

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Tolerance +0.XXXX/-0.XXXX	Part Number
0.0787		2mm	8mm		38mm	3mm	2	BN	+0.013mm/-0.025mm	P820-200659-1
0.0787		2mm	8mm		38mm	3mm	2	SE	+0.013mm/-0.025mm	P820-200723-1
0.1181		3mm	12mm		38mm	3mm	2	BN	+0.013mm/-0.025mm	P820-200661-1
0.1181		3mm	12mm		38mm	3mm	2	SE	+0.013mm/-0.025mm	P820-200660-1
0.1575		4mm	12mm		50mm	4mm	2	BN	+0.013mm/-0.025mm	P820-200663-1
0.1575		4mm	12mm		50mm	4mm	2	SE	+0.013mm/-0.025mm	P820-200662-1
0.1968		5mm	14mm		50mm	5mm	2	BN	+0.013mm/-0.025mm	P820-200665-1
0.1968		5mm	14mm		50mm	5mm	2	SE	+0.013mm/-0.025mm	P820-200664-1
0.2362		6mm	14mm		57mm	6mm	2	BN	+0.013mm/-0.025mm	P820-200239-1
0.2362		6mm	14mm		57mm	6mm	2	SE	+0.013mm/-0.025mm	P820-200666-1
0.3150		8mm	16mm		63mm	8mm	2	BN	+0.013mm/-0.025mm	P820-200667-1
0.3150		8mm	16mm		63mm	8mm	2	SE	+0.013mm/-0.025mm	P820-200522-1
0.3937		10mm	20mm		72mm	10mm	2	BN	+0.013mm/-0.025mm	P820-200526-1
0.3937		10mm	20mm		72mm	10mm	2	SE	+0.013mm/-0.025mm	P820-200668-1
0.4724		12mm	25mm		83mm	12mm	2	BN	+0.013mm/-0.025mm	P820-200525-1
0.4724		12mm	25mm		83mm	12mm	2	SE	+0.013mm/-0.025mm	P820-200523-1



Center Drills *(Only one end coated)*

Tool Number	Drill Size	Body Size	Angle	OAL	Part Number
#00	0.025	1/8	60°	1-1/2	P810-100200-1
#0	1/32	1/8	60°	1-1/2	P810-100071-1
#1	3/64	1/8	60°	1-1/2	P810-100072-1
#2	5/64	3/16	60°	2	P810-100073-1
#3	7/64	1/4	60°	2	P810-100074-1
#4	1/8	5/16	60°	2-1/8	P810-100075-1
#5	3/16	7/16	60°	2.75	P810-100240-1

Drills

Decimal Equivalent	Tolerance from Nominal		Fractional	Wire & Letter	Metric	Flute Length	OAL	Type or Point	Part Number
	Minimum	Maximum							
0.0280	-0.0003	0.0005		70		5/16	1-1/4	4FCT	P810-100070-1
0.0292	-0.0003	0.0005		69		5/16	1-1/4	4FCT	P810-100069-1
0.0310	-0.0003	0.0005		68		5/16	1-1/4	4FCT	P810-100068-1
0.0312	-0.0003	0.0005	1/32			5/16	1-1/4	4FCT	P810-100180-1
0.0320	-0.0003	0.0005		67		5/16	1-1/4	4FCT	P810-100067-1
0.0330	-0.0003	0.0005		66		5/16	1-1/4	4FCT	P810-100066-1
0.0350	-0.0003	0.0005		65		5/8	1-1/2	4FCT	P810-100065-1
0.0360	-0.0003	0.0005		64		5/8	1-1/2	4FCT	P810-100064-1
0.0370	-0.0003	0.0005		63		5/8	1-1/2	4FCT	P810-100063-1
0.0380	-0.0003	0.0005		62		5/8	1-1/2	4FCT	P810-100062-1
0.0390	-0.0003	0.0005		61		5/8	1-1/2	4FCT	P810-100061-1
0.0394	-0.0003	0.0005			1.00	5/8	1-1/2	4FCT	P810-100037-1
0.0400	-0.0003	0.0005		60		3/4	1-1/2	4FCT	P810-100060-1
0.0410	-0.0001	0.0006		59		3/4	1-1/2	4FCT	P810-100059-1
0.0420	-0.0001	0.0006		58		3/4	1-1/2	4FCT	P810-100058-1
0.0430	-0.0001	0.0006		57		3/4	1-1/2	4FCT	P810-100057-1
0.0465	-0.0001	0.0006		56		3/4	1-1/2	4FCT	P810-100056-1
0.0469	-0.0001	0.0006	3/64			3/4	1-1/2	4FCT	P810-100181-1
0.0520	-0.0001	0.0006		55		3/4	1-1/2	4FCT	P810-100055-1
0.0550	-0.0001	0.0006		54		3/4	1-1/2	4FCT	P810-100054-1
0.0591	-0.0001	0.0006			1.50	3/4	1-1/2	4FCT	P810-100038-1
0.0595	-0.0001	0.0006		53		3/4	1-1/2	4FCT	P810-100053-1
0.0625	-0.0001	0.0006	1/16			3/4	1-1/2	4FCT	P810-100023-1
0.0635	-0.0001	0.0006		52		3/4	1-1/2	4FCT	P810-100052-1
0.0670	-0.0001	0.0006		51		3/4	1-1/2	4FCT	P810-100051-1
0.0700	-0.0001	0.0006		50		7/8	1-3/4	4FCT	P810-100050-1
0.0730	-0.0001	0.0006		49		7/8	1-3/4	4FCT	P810-100049-1
0.0760	-0.0001	0.0006		48		7/8	1-3/4	4FCT	P810-100048-1
0.0781	-0.0001	0.0006	5/64			7/8	1-3/4	4FCT	P810-100182-1
0.0785	-0.0001	0.0006		47		7/8	1-3/4	4FCT	P810-100039-1
0.0787	-0.0001	0.0006			2.00	7/8	1-3/4	4FCT	P810-100040-1
0.0810	-0.0001	0.0006		46		7/8	1-3/4	4FCT	P810-100041-1
0.0820	-0.0001	0.0006		45		7/8	1-3/4	4FCT	P810-100042-1
0.0860	-0.0001	0.0006		44		1	2	4FCT	P810-100043-1
0.0890	-0.0001	0.0006		43		1	2	4FCT	P810-100044-1
0.0935	-0.0001	0.0006		42		1	2	4FCT	P810-100045-1
0.0938	-0.0001	0.0006	3/32			1	2	4FCT	P810-100016-1
0.0960	-0.0001	0.0006		41		1	2	4FCT	P810-100046-1
0.0980	-0.0001	0.0006		40		1	2	4FCT	P810-100076-1
0.0984	-0.0001	0.0006			2.50	1	2	4FCT	P810-100077-1
0.0995	-0.0001	0.0006		39		1-1/4	2-1/4	4FCT	P810-100078-1
0.1015	0.0001	0.0010		38		1-1/4	2-1/4	4FCT	P810-100079-1
0.1040	0.0001	0.0010		37		1-1/4	2-1/4	4FCT	P810-100081-1
0.1065	0.0001	0.0010		36		1-1/4	2-1/4	4FCT	P810-100082-1
0.1094	0.0001	0.0010	7/64			1-1/4	2-1/4	4FCT	P810-100083-1
0.1100	0.0001	0.0010		35		1-1/4	2-1/4	4FCT	P810-100084-1
0.1110	0.0001	0.0010		34		1-1/4	2-1/4	4FCT	P810-100085-1
0.1130	0.0001	0.0010		33		1-1/4	2-1/4	4FCT	P810-100086-1
0.1160	0.0001	0.0010		32		1-1/4	2-1/4	4FCT	P810-100087-1
0.1181	0.0001	0.0010			3.00	1-1/4	2-1/4	4FCT	P810-100088-1

Drills

Decimal Equivalent	Tolerance from Nominal		Fractional	Wire & Letter	Metric	Flute Length	OAL	Type or Point	Part Number
	Minimum	Maximum							
0.1200	0.0001	0.0010		31		1-1/4	2-1/4	4FCT	P810-100089-1
0.1250	0.0001	0.0010	1/8			1-1/4	2-1/4	4FCT	P810-100024-1
0.1285	0.0001	0.0010		30		1-3/8	2-1/2	4FCT	P810-100015-1
0.1360	0.0001	0.0010		29		1-3/8	2-1/2	4FCT	P810-100090-1
0.1378	0.0001	0.0010			3.50	1-3/8	2-1/2	4FCT	P810-100091-1
0.1405	0.0001	0.0010		28		1-3/8	2-1/2	4FCT	P810-100092-1
0.1406	0.0001	0.0010	9/64			1-3/8	2-1/2	4FCT	P810-100006-1
0.1440	0.0001	0.0010		27		1-3/8	2-1/2	4FCT	P810-100093-1
0.1470	0.0001	0.0010		26		1-3/8	2-1/2	4FCT	P810-100094-1
0.1495	0.0001	0.0010		25		1-3/8	2-1/2	4FCT	P810-100095-1
0.1520	0.0001	0.0010		24		1-3/8	2-1/2	4FCT	P810-100096-1
0.1540	0.0001	0.0010		23		1-3/8	2-1/2	4FCT	P810-100097-1
0.1562	0.0001	0.0010	5/32			1-3/8	2-1/2	4FCT	P810-100018-1
0.1570	0.0003	0.0011		22		1-3/8	2-1/2	4FCT	P810-100098-1
0.1575	0.0003	0.0011			4.00	1-3/8	2-1/2	4FCT	P810-100099-1
0.1590	0.0003	0.0011		21		1-3/8	2-1/2	4FCT	P810-100100-1
0.1610	0.0003	0.0011		20		1-3/8	2-1/2	4FCT	P810-100101-1
0.1655	0.0003	0.0011				1	3	4FCT	P810-100020-1
0.1660	0.0003	0.0011		19		1-5/8	2-3/4	4FCT	P810-100102-1
0.1695	0.0003	0.0011		18		1-5/8	2-3/4	4FCT	P810-100103-1
0.1719	0.0003	0.0011	11/64			1-5/8	2-3/4	4FCT	P810-100007-1
0.1730	0.0003	0.0011		17		1-5/8	2-3/4	4FCT	P810-100104-1
0.1770	0.0003	0.0011		16		1-5/8	2-3/4	4FCT	P810-100008-1
0.1772	0.0003	0.0011			4.50	1-5/8	2-3/4	4FCT	P810-100105-1
0.1800	0.0003	0.0011		15		1-5/8	2-3/4	4FCT	P810-100106-1
0.1820	0.0003	0.0011		14		1-5/8	2-3/4	4FCT	P810-100107-1
0.1850	0.0003	0.0011		13		1-5/8	2-3/4	4FCT	P810-100108-1
0.1875	0.0003	0.0011	3/16			1-5/8	2-3/4	4FCT	P810-100027-1
0.1890	0.0003	0.0011		12		1-5/8	2-3/4	4FCT	P810-100109-1
0.1910	0.0003	0.0011		11		1-5/8	2-3/4	4FCT	P810-100110-1
0.1915	0.0003	0.0011				1	3	4FCT	P810-100021-1
0.1935	0.0003	0.0011		10		15/8	2-3/4	4FCT	P810-100111-1
0.1960	0.0003	0.0011		9		1-3/4	3	4FCT	P810-100112-1
0.1968	0.0003	0.0011			5.00	1-3/4	3	4FCT	P810-100113-1
0.1990	0.0003	0.0011		8		1-3/4	3	4FCT	P810-100114-1
0.2010	0.0003	0.0011		7		1-3/4	3	4FCT	P810-100009-1
0.2031	0.0003	0.0011	13/64			1-3/4	3	4FCT	P810-100019-1
0.2040	0.0003	0.0011		6		1-3/4	3	4FCT	P810-100115-1
0.2055	0.0003	0.0011		5		1-3/4	3	4FCT	P810-100116-1
0.2090	0.0003	0.0011		4		1-3/4	3	4FCT	P810-100117-1
0.2130	0.0003	0.0011		3		1-3/4	3	4FCT	P810-100118-1
0.2165	0.0003	0.0011			5.50	1-3/4	3	4FCT	P810-100119-1
0.2188	0.0003	0.0011	7/32			1-3/4	3	4FCT	P810-100026-1
0.2210	0.0006	0.0016		2		1-3/4	3	4FCT	P810-100120-1
0.2280	0.0006	0.0016		1		1-3/4	3	4FCT	P810-100121-1
0.2340	0.0006	0.0016		A		2	3-1/4	4FCT	P810-100122-1
0.2344	0.0006	0.0016	15/64			2	3-1/4	4FCT	P810-100010-1
0.2362	0.0006	0.0016			6.00	2	3-1/4	4FCT	P810-100123-1
0.2380	0.0006	0.0016		B		2	3-1/4	4FCT	P810-100124-1
0.2420	0.0006	0.0016		C		2	3-1/4	4FCT	P810-100125-1
0.2460	0.0006	0.0016		D		2	3-1/4	4FCT	P810-100126-1
0.2484	0.0006	0.0016				2-1/4	3-1/4	4FCT	P810-100030-1
0.2500	0.0006	0.0016	1/4	E		2	3-1/4	4FCT	P810-100002-1
0.3125	0.0006	0.0016	5/16			2-3/8	4	4FCT	P810-100142-1
0.3150	0.0006	0.0016			8.00	2-3/8	4	4FCT	P810-100143-1
0.3543	0.0006	0.0016			9.00	2-3/4	4-1/4	4FCT	P810-100151-1
0.3750	0.0006	0.0016	3/8			2-3/4	4-1/4	4FCT	P810-100047-1
0.3937	0.0006	0.0016			10.00	2-7/8	4-1/2	4FCT	P810-100159-1
0.4375	0.0006	0.0016	7/16			2-7/8	4-1/2	4FCT	P810-100017-1
0.4724	0.0006	0.0016			12.00	3	4-3/4	4FCT	P810-100034-1
0.5000	0.0006	0.0016	1/2			3	4-3/4	4FCT	P810-100004-1

Inserts

ANSI Code	ISO Code	Part Number	ANSI Code	ISO Code	Part Number
ADKT-1505 PDR	ADKT1505 PDR	P830-100551-1	SPG-322	SPGN090308	P830-100063-1
BDR-0500-N-F1-R1-R1/32		P830-100690-1	SPG-420	SPGN120302	P830-100240-1
BDR-1000-N-F1-R1/32		P830-100699-1	SPG-422	SPGN120308	P830-100064-1
CCGT-32.50HP	CCGT09T302HP	P830-100547-1	SPG-424	SPGN120316	P830-100065-1
CCGT-32.51HP	CCGT09T304HP	P830-100558-1	SPG-428	SPGN120332	P830-100162-1
CCGX-431 AL	CCGX120404 AL	P830-100523-1	SPG-632	SPGN190408	P830-100343-1
CCMT-21.50	CCMT060202	P830-100309-1	SPG-633	SPGN190412	P830-100386-1
CCMT-21.51	CCMT060204	P830-100310-1	SPG-634	SPGN190416	P830-100175-1
CCMT-32.50	CCMT09T302	P830-100163-1	SPG-842	SPGN250608	P830-100583-1
CCMT-32.52UM	CCMT09T308	P830-100201-1	SPGB-432	SPGB120408	P830-100385-1
CDCD-500		P830-100006-1	SPMR-322	SPMR090308	P830-100620-1
CDCD-505		P830-100007-1	SPMT-432-WH	SPMT120408WH	P830-100244-1
CDCD-51		P830-100500-1	TCGW-32.52	TCGW16T308	P830-100072-1
CNGA-430	CNGA120402	P830-100009-1	TCGX-1.8(1.5)1AL	TCGX090204-AL	P830-100564-1
CNMG-431	CNMG120404	P830-100491-1	TCGX-21.51-AL	TCGX110204-AL	P830-100327-1
CNMG-432	CNMG120408	P830-100012-1	TCGX-3(2.5)1-AL	TCGX16T304	P830-100602-1
CNMP-431	CNMP120404	P830-100013-1	TCMT-32.52	TCMT16T308	P830-100269-1
CNMP-432	CNMP120408	P830-100014-1	TCMW-21.51	TCMW110204	P830-100076-1
CPG-421	CPGN120304	P830-100017-1	TCMW-32.51	TCMW16T304	P830-100372-1
CPG-422	CPGN120308	P830-100018-1	TD-6P		P830-100078-1
CPGT-32.52	CPGT09T308	P830-100091-1	TD-6P1		P830-100080-1
CPGW-21.51	CPGW060204	P830-100253-1	TD-8P		P830-100081-1
CPGW-32.51	CPGW09T304	P830-100420-1	TDAB-500	TDAB070102	P830-100082-1
DCGT-32.51HP	DCGT11T304HP	P830-100559-1	TDAB-51	TDAB070104	P830-100083-1
DCMT-32.51	DCMT11T304	P830-100170-1	TDAB-52	TDAB070108	P830-100084-1
DDGB-522	DDGB190308	P830-100722-1	TEGA-321	TEGA160304	P830-100300-1
DNMG-431	DNMG150404	P830-100211-1	TEGA-322	TEGA160308	P830-100301-1
DNMG-432	DNMG150408	P830-100374-1	TEGA-323	TEGA160312	P830-100302-1
DNMP-431	DNMP150402	P830-100027-1	TEGA-324	TEGA160316	P830-100303-1
DPG-432	DPG150408	P830-100279-1	TEGA-326	TEGA160324	P830-100304-1
DPG-532	DPG190408	P830-100495-1	TEGA-328	TEGA160332	P830-100305-1
DPGT-21.51	DPGT070204	P830-100429-1	TNMA-432	TNMA220408	P830-100454-1
FLGD 3062R		P830-100628-1	TPCB-221	TPCB110304	P830-100360-1
DPGT-32.52	DPGT11T308	P830-100347-1	TPG-221	TPGN110304	P830-100101-1
FLGD-3125L		P830-100400-1	TPG-222	TPGN110308	P830-100102-1
FLGD-3125R		P830-100401-1	TPG-320	TPGN160301	P830-100252-1
FLRD-3031L		P830-100599-1	TPG-321	TPGN160304	P830-100104-1
FLRD-3031R		P830-100600-1	TPG-322	TPGN160308	P830-100105-1
GFN-2J (.079 wide, .006 CR)		P830-100501-1	TPG-324	TPGN160316	P830-100107-1
GFN-3		P830-100605-1	TPG-431	TPGN220404	P830-100109-1
N151.2-300-30-4P		P830-100597-1	TPG-432	TPGN220408	P830-100110-1
N151.2-400-40-4P		P830-100596-1	TPG-433	TPGN220412	P830-100111-1
N151.4-600-40-AL		P830-100595-1	TPMA-322	TPMA160308	P830-100227-1
NG-2062L		P830-100436-1	TPMM-321	TPMM160304	P830-100373-1
NG-2062R		P830-100031-1	TPMM-322	TPMM160308	P830-100023-1
NG-2062RK		P830-100254-1	TPMM-431	TPMM220404	P830-100026-1
NG-3094R		P830-100236-1	TPMM-432	TPMM220408	P830-100397-1
NPGR-51L		P830-100032-1	VBGT-331HP	VBGT160404HP	P830-100525-1
NPL-51		P830-100438-1	VBMT-221	VBMT110304	P830-100127-1
NT-3R		P830-100521-1	VBMT-331	VBMT160404	P830-100217-1
R290.90-150420M-WM		P830-100103-1	VBMT-332	VBMT160408	P830-100165-1
RCGX-10T3MO-AL	RCGX-10T3MO-AL	P830-100505-1	VCGT-220HP	VCGT110302HP	P830-100548-1
RCHT-130400KL	RCHT130400KL	P830-100588-1	VCGT-221HP	VCGT110304HP	P830-100524-1
RCHT-190600-KL	RCHT190600-KL	P830-100598-1	VCGT-330HP	VCGT160402HP	P830-100530-1
RCMT-0803MO-100	RCMT0803MO-100	P830-100607-1	VCGT-331HP	VCGT160404HP	P830-100531-1
RD-10P	RXGB150300	P830-100153-1	VCGX-21.50-AL	VCGX110202-AL	P830-100351-1
RD-12P	RXGB190400	P830-100396-1	VCGX-331-AL	VCGX160404-AL	P830-100395-1
RD-16P	RXGB250600	P830-100196-1	VCGX-332-AL	VCGX160408-AL	P830-100498-1
RD-6P	RXGB090300	P830-100224-1	VNGP-330	VNGP160402	P830-100615-1
RD-8P	RXGB120300	P830-100040-1	VNGP-330.5	VNGP160403	P830-100575-1
RFG-21F (1/4IC)		P830-100650-1	VNMP-331	VNMP160404	P830-100483-1
RFG-21F (5/16IC)		P830-100399-1	VNMP-332	VNMP160408	P830-100131-1
RNG-42	RNGN120300	P830-100042-1	VPGR-331	VPGR160404	P830-100485-1
RNMG-43	RNMG120400	P830-100044-1	VPGR-332	VPGR160408	P830-100136-1
SD-421P		P830-100652-1	WNMG-431	WNMG080404	P830-100314-1
SD-531P		P830-100576-1	WNMG-432	WNMG080408	P830-100209-1
PG-1242	SPGN370608	P830-100584-1			

General Machining Guidelines

Milling

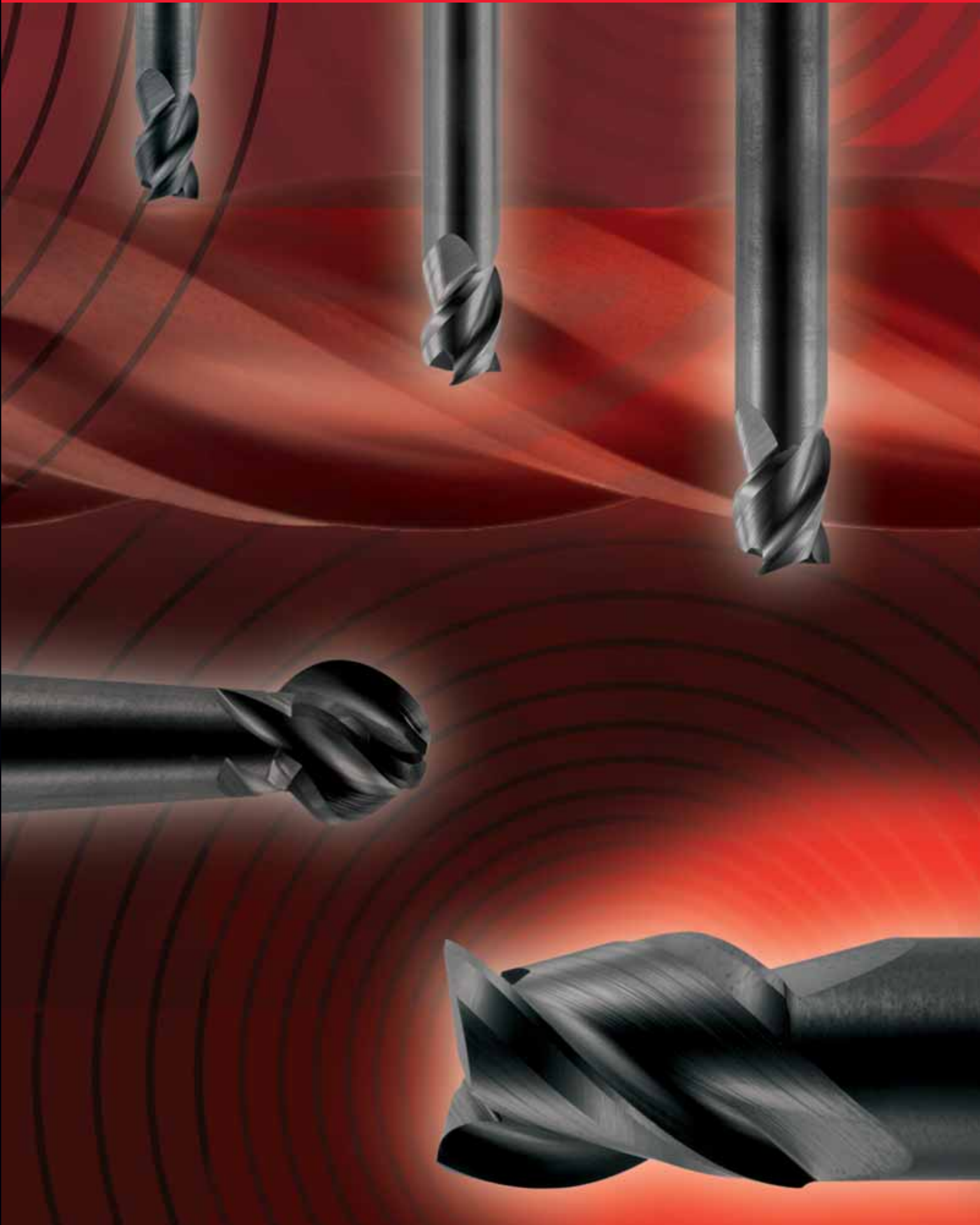
Workpiece Material	Application	Cutting Speed fpm(m/min)	Chip Load (ipt)
Aluminum (5-8% Si) (356, 308, 242, 208)	Rough Milling	2000-5000 (610-1525)	0.010-0.020 (.254-.508)
Aluminum (5-8% Si) (356, 308, 242, 208)	Finish Milling	2000-6000 (610-1830)	0.005-0.010 (.127-.254)
Aluminum Cast (8-12% Si) (354, 357, 380)	Rough Milling	1500-4000 (460-1220)	0.007-0.015 (.178-.381)
Aluminum Cast (8-12% Si) (354, 357, 380)	Finish Milling	1500-5000 (460-1525)	0.004-0.008 (.102-.204)
Aluminum Cast (12-18% Si) (390)	Rough Milling	1000-2000 (305-610)	0.005-0.010 (.127-.254)
Aluminum Cast (12-18% Si) (390)	Finish Milling	1000-3000 (305-915)	0.002-0.006 (.050-.150)
Copper	Milling	750-1500 (230-460)	0.001-0.008 (.025-.200)
Bronze	Milling	900-1350 (275-410)	0.003-0.008 (.076-.200)
Brass	Milling	2000-4000 (610-1220)	0.001-0.008 (.025-.200)
Babbitt	Milling	700-1100 (210-335)	0.003-0.010 (.076-.254)
Carbon	Milling	500-2000 (150-610)	0.0003-0.012 (.008-.305)
Unfilled Plastic	Milling	1000-4000 (305-1220)	0.003-0.020 (.076-.508)
Glass Fiber Material	Milling	750-1500 (230-460)	0.001-0.010 (.025-.254)
Carbon Fiber Materials	Milling	500-2000 (150-610)	0.003-0.015 (.076-.381)
Green Ceramic Materials	Milling	500-1500 (150-460)	0.002-0.010 (.050-.254)
Wood	Milling	3300-9800 (1000-3000)	0.004-0.030 (.102-.762)

Turning

Workpiece Material	Application	Cutting Speed fpm(m/min)	Chip Load (ipt)
Aluminum (5-8% Si) (356, 308, 242, 208)	Rough Turning	2000-5000 (610-1525)	0.010-0.025 (.254-.635)
Aluminum (5-8% Si) (356, 308, 242, 208)	Finish Turning	2000-6000 (610-1830)	0.005-0.010 (.127-.254)
Aluminum Cast (8-12% Si) (354, 357, 380)	Rough Turning	1500-4000 (460-1220)	0.007-0.020 (.178-.508)
Aluminum Cast (8-12% Si) (354, 357, 380)	Finish Turning	1500-5000 (460-1525)	0.004-0.008 (.102-.204)
Aluminum Cast (12-18% Si) (390)	Rough Turning	1000-2000 (305-610)	0.005-0.010 (.127-.254)
Aluminum Cast (12-18% Si) (390)	Finish Turning	1000-3000 (305-915)	0.002-0.006 (.050-.150)
Copper	Turning	750-1500 (230-460)	0.003-0.010 (.076-.254)
Bronze	Turning	900-1350 (275-410)	0.003-0.010 (.076-.254)
Brass	Turning	2000-4000 (610-1220)	0.003-0.015 (.076-.381)
Babbitt	Turning	700-1100 (210-335)	0.003-0.010 (.076-.254)
Carbon	Turning	500-2000 (150-610)	0.005-0.015 (.127-.381)
Unfilled Plastic	Turning	1000-4000 (305-1220)	0.003-0.020 (.076-.508)
Glass Fiber Material	Turning	750-1500 (230-460)	0.001-0.015 (.025-.381)
Carbon Fiber Materials	Turning	500-2000 (150-610)	0.003-0.020 (.076-.508)
Green Ceramic Materials	Turning	500-1500 (150-460)	0.002-0.020 (.050-.508)
Wood	Turning	3300-9800 (1000-3000)	0.004-0.030 (.102-.762)

Drilling

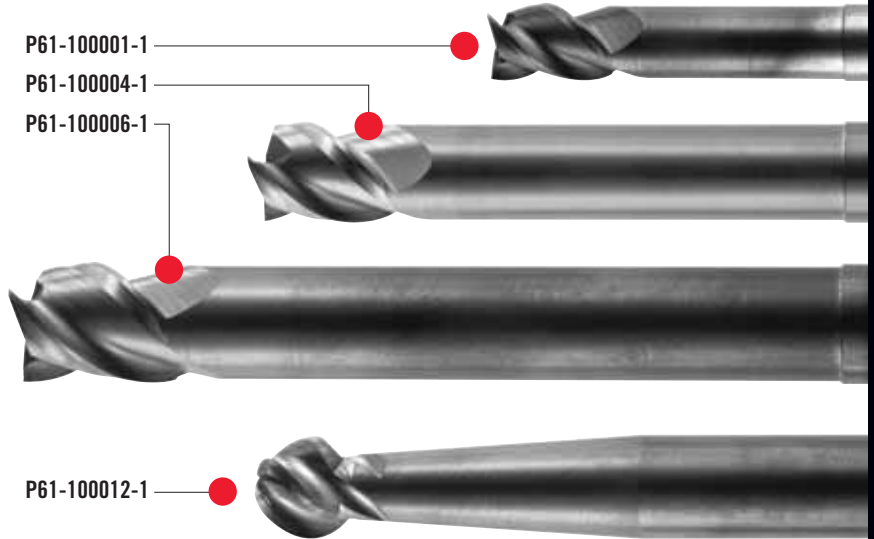
Workpiece Material	Application	Cutting Speed fpm(m/min)	Chip Load (ipt)
Aluminum (5-8% Si) (356, 308, 242, 208)	Drilling	2000-6000 (610-1830)	0.001-0.010 (.025-.254)
Aluminum Cast (8-12% Si) (354, 357, 380)	Drilling	1500-5000 (460-1525)	0.001-0.010 (.025-.254)
Aluminum Cast (12-18% Si) (390)	Drilling	1000-3000 (305-915)	0.001-0.010 (.025-.254)
Copper	Drilling	750-1500 (230-460)	0.001-0.010 (.025-.254)
Bronze	Drilling	900-1350 (275-410)	0.001-0.010 (.025-.254)
Brass	Drilling	2000-4000 (610-1220)	0.001-0.010 (.025-.254)
Babbitt	Drilling	700-1100 (210-335)	0.001-0.010 (.025-.254)
Carbon	Drilling	500-2000 (150-610)	0.001-0.010 (.025-.254)
Unfilled Plastic	Drilling	1000-4000 (305-1220)	0.001-0.010 (.025-.254)
Glass Fiber Material	Drilling	750-1500 (230-460)	0.001-0.010 (.025-.254)
Carbon Fiber Materials	Drilling	500-2000 (150-610)	0.001-0.010 (.025-.254)
Green Ceramic Materials	Drilling	500-1500 (150-460)	0.001-0.010 (.025-.254)
Wood	Drilling	3300-9800 (1000-3000)	0.003-0.025 (.076-.635)



New!

Black Widow

Crystallume is proud to introduce the Black Widow line of cutting tools for high performance machining of aluminum and other nonferrous material. These specially designed tools have been optimized to be coated with the Black Widow HCC-C-100 coating. HCC-C-100 is a coating containing a mixture of diamond and graphite. Diamond is the hardest material known to man, while Graphite is much softer. These two materials are mixed together on the nanomolecular scale and therefore form a type of nano-phase amorphous material that offers high hardness and very low friction. This decreases built up edge (BUE) and extends tool life 2-3 times that of an uncoated tool.



Black Widow Tools

Diameter	Fractional	Metric	LOC	Reach	OAL	Shank Diameter	Flute Number	Style	Cutting DIA Tolerance +0.XXXX/-0.XXXX	Part Number
High Velocity Cutters										
0.2500	1/4	3/8	1-1/8	2-1/2	1/4	3	SE-45°Helix	+0.0000/-0.0010	P61-100001-1	
0.2500	1/4	3/8	2-1/8	4	1/4	3	SE-45°Helix	+0.0000/-0.0010	P61-100002-1	
0.3750	3/8	1/2	1-1/8	2-1/2	3/8	3	SE-45°Helix	+0.0000/-0.0010	P61-100003-1	
0.3750	3/8	1/2	2-1/8	4	3/8	3	SE-45°Helix	+0.0000/-0.0010	P61-100004-1	
0.5000	1/2	5/8	1-3/8	3	1/2	3	SE-45°Helix	+0.0000/-0.0010	P61-100005-1	
0.5000	1/2	5/8	3-3/8	6	1/2	3	SE-45°Helix	+0.0000/-0.0010	P61-100006-1	
High Performance End Mills										
0.1250	1/8	1/2	1-1/2	1/8	2	SE-45°Helix	+0.0000/-0.0010	P61-100007-1		
0.1875	3/16	5/8	2	3/16	2	SE-45°Helix	+0.0000/-0.0010	P61-100008-1		
0.2500	1/4	1	2-1/2	1/4	2	SE-45°Helix	+0.0000/-0.0010	P61-100009-1		
0.3750	3/8	1	2-1/2	3/8	2	SE-45°Helix	+0.0000/-0.0010	P61-100010-1		
0.5000	1/2	1	3	1/2	2	SE-45°Helix	+0.0000/-0.0010	P61-100011-1		
Automotive Contour Profilers										
0.5000	1/2	1/2	6	1/2	4	LollyPop Cutter	+0.0000/-0.0010	P61-100012-1		

Notes: The Shank Tolerance is held to $-.0001/-0.0003$ and the OAL Tolerance is held to $-.000/+0.030$

General Machining Guidelines

Workpiece Material	Application	Cutting Speed fpm (m/min)	Chip Load ipt (mm/tooth)
Aluminum Wrought (2024, 6061, 7075)	Roughing	1000 (305)	0.002-0.008 (.050-.200)
Aluminum Wrought (2024, 6061, 7075)	Finishing	3000 (915)	0.002-0.006 (.050-.150)
Aluminum Cast (308, 356, 380)	Roughing	1000 (305)	0.002-0.008 (.050-.200)
Aluminum Cast (308, 356, 380)	Finishing	3000 (915)	0.002-0.006 (.050-.150)
Aluminum Cast (390)	Roughing	500 (150)	0.002-0.008 (.050-.200)
Aluminum Cast (390)	Finishing	1500 (450)	0.002-0.006 (.050-.150)
Copper (OFHC)	Roughing	350 (105)	0.002-0.008 (.050-.200)
Copper (OFHC)	Finishing	600 (180)	0.002-0.006 (.050-.150)
Brass	Roughing	450 (135)	0.002-0.008 (.050-.200)
Brass	Finishing	750 (225)	0.002-0.006 (.050-.150)

Aircraft Tools

Non-stocked Specials that have been custom manufactured

Drill Reamer



Drill Reamer



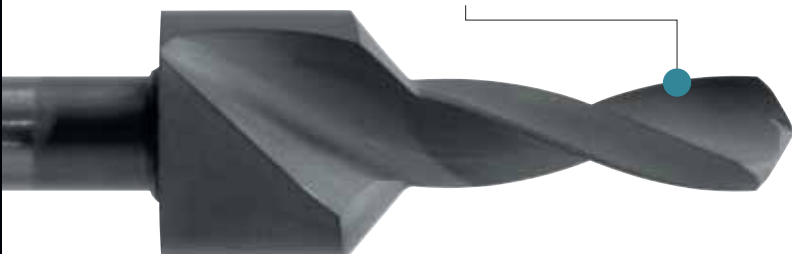
8-Facet Drill



Drill Router



Drill Countersink



Crystallume DCC rotating tools were developed in a NIST (National Institute of Science and Technology) program that involved a research partnership with Boeing Aircraft and three other large manufacturing companies. Some of the information gained in that program is presented here.

The material was 8-276 carbon fiber laminate 0.30" thick. Test tools were .191 and .251 diameter drill countersinks. The graph compares the number of holes drilled vs. the thrust required. The test was concluded at 50 lbs. of thrust when breakout and haloing became unacceptable. Carbide lasted about 200 holes, PCD lasted 1,500 holes and Crystallume DCC lasted 2,700 holes. Also, note that the sharper carbide tool started with the lowest thrust while the PCD and Crystallume DCC started with about the same thrust (even though the PCD is a ground edge and the Crystallume DCC is a coated, faceted edge). These test lab results were repeated on the production floor.

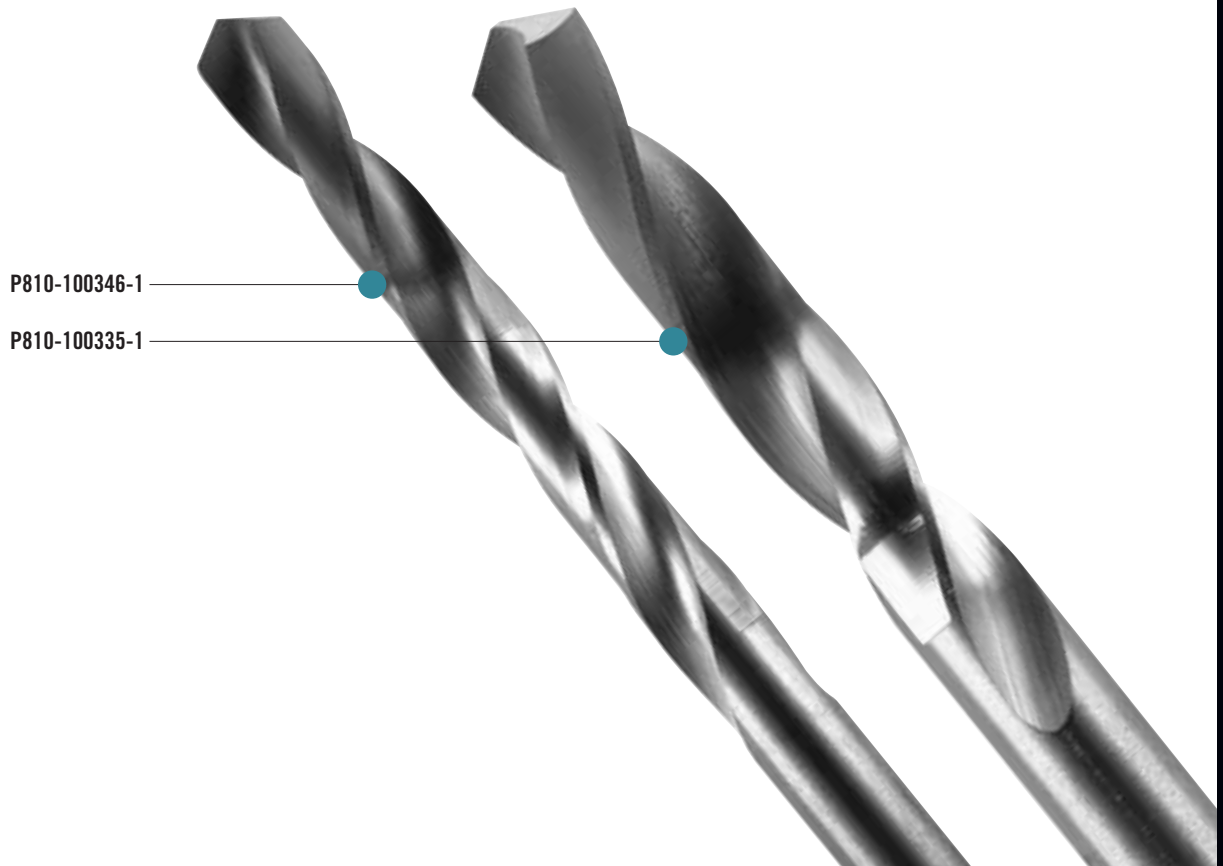
Since the conclusion of this program Crystallume has coated various tools (as pictured here) to use in aircraft applications. Contact one of our engineers to discuss your application and possible solutions using Crystallume DCC.

DCC Drill Test Results in Carbon Fiber Reinforced Composites



Aircraft Tools

Decimal Equivalent	Tolerance from Nominal Minimum	Tolerance from Nominal Maximum	Flute Length	OAL	Type or Point	Part Number
0.0980	+0.0000	-0.0005	1.400	2.700	4FCT	P810-100345-1
0.1285	+0.0000	-0.0005	1.400	2.700	4FCT	P810-100334-1
0.1655	+0.0000	-0.0005	1.400	2.700	4FCT	P810-100335-1
0.1915	+0.0000	-0.0005	1.400	2.700	4FCT	P810-100336-1
0.2210	+0.0000	-0.0005	1.400	2.700	4FCT	P810-100346-1
0.2510	+0.0000	-0.0005	1.400	2.700	4FCT	P810-100337-1
0.3125	+0.0000	-0.0005	1.500	2.700	4FCT	P810-100338-1
0.3765	+0.0000	-0.0005	1.500	2.700	4FCT	P810-100341-1



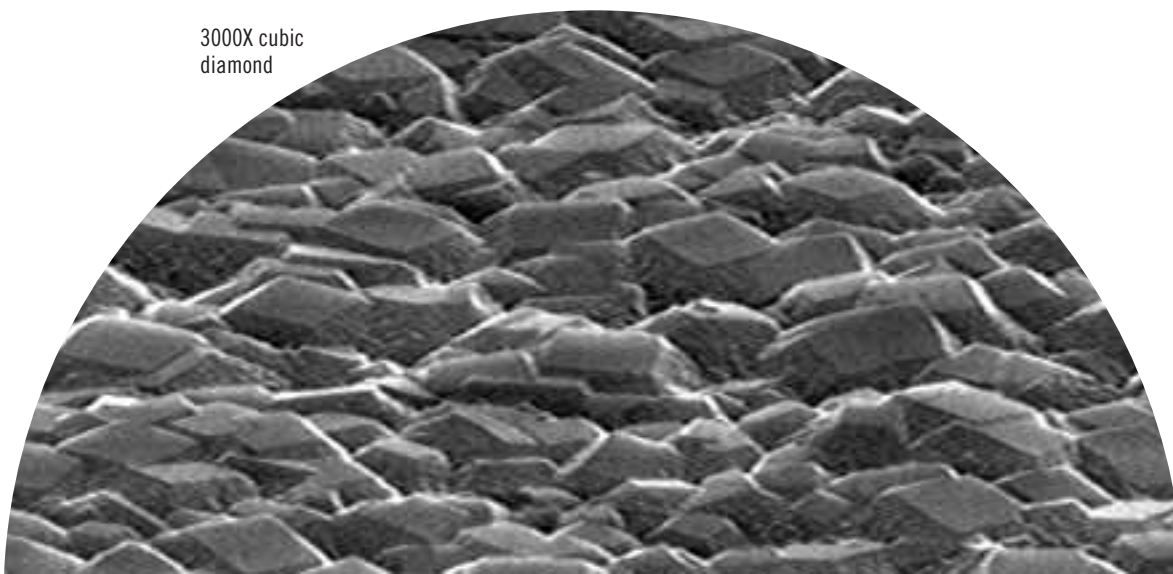
Coating Services

Crystallume DCC coatings can be applied to customer supplied cutting tools and wear parts.

Some of the common carbide grades that are approved for coating are listed in the chart below. The specific requirements are 6% Cobalt and 94% Tungsten Carbide with a 1 to 3 micron grain size. For more information contact one of our engineers regarding your application needs.

Company	Grade	Company	Grade
ag&I Cutting Tools	AG22	Stellram (Teledyne)	H21
Allied CarbiTech	E6	Superbee	NT33
ANC	AN-6	Sumitomo	G10E
Carbology	HX, 883	Tool-Flo	C25
Carbex	CH01, CH1	Toshiba	TH10
Carbide	CD-30	Teledyne	HA,H21
Carmet	CA4	Tungaloy	H10T
Cerametal	HC05	Toshiba Tungaloy	TH10
Circle	C2,C3,C25	Ultramet	Z20, Z22, Z86
Duramet	DU2,DU22	Valenite-Widia	VC-2, VC-21, VC-28
Dijet	KT9	Valenite-Widia	THM
Dapra	F1	Vardex	VK2
Emuge Franken	K10	Waukesha	WK10
Fansteel/Hydro Carbide	HCUS10,HC290	Walter	WKM
Firth Stirling	H21	Widia	THM
Hertel	KMF	VNE – Versa-Turn	V12K
Guhring	DK120		
Iscar	IC20	Company	Grade
Ingersoll	ICT111	Fansteel	HC290
Kaisar	D5	Newcommer	H21P
Kennametal	K68, K10	RTW	CQ2
Komet	K10	Sandvik	H6N
Lovejoy	LTC-21	Valenite	WA2
Mitsubishi	HTi10	Extramet	EMT806
Cera Tizit	H216T,H10T	Kennametal	K96
Pro-Cut	PC2	Carmet	CA4
Rouse Arno	AK10	Tungaloy	G1F
RTW	CQ2, CQ23		
Sandvik	H13A		

3000X cubic diamond



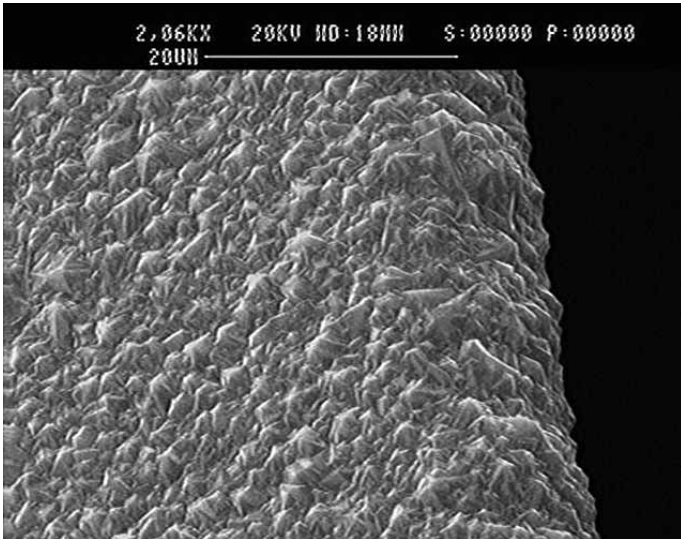
Smooth Diamond – What is It? Where is it Used?

Crystallume has been coating tools with smooth diamond since the beginning of 2003. Field tests have shown that the smooth diamond has performed most successfully in the turning and boring of low silicon aluminum alloys.

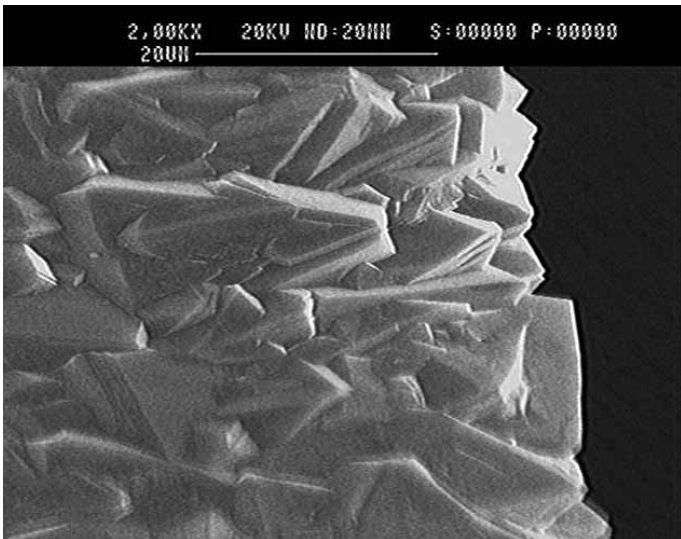
The new smooth coating is about half the thickness of our standard coating which helps to give the tool a sharper edge. The grain size of the new coating is less than 1 micron, compared to our standard coating with an average grain size of 10-12 microns. This gives the new smooth coating an improved surface for resisting BUE (Built Up Edge) a key in machining low silicon aluminums.

The smooth diamond tools work best where finish and edge sharpness is an issue. The tool life will still be equivalent to PCD tools in the same application.

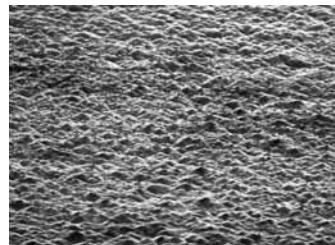
Smooth diamond tools are available by special order only. Please remember to specify Smooth Diamond for those applications where surface finish is an issue.



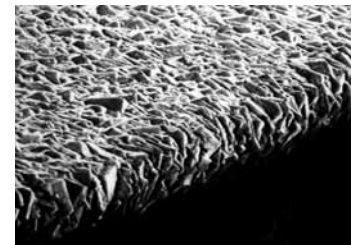
2000X smooth diamond cutting edge



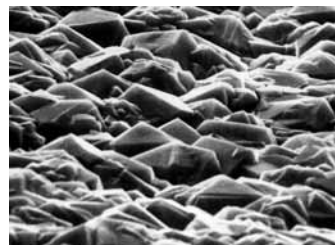
2000X faceted diamond cutting edge



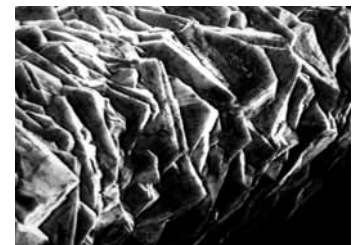
3000X smooth diamond



1000X continuous uniform coatings over the entire surface



3000X faceted diamond



4000X faceted edge lowers cutting forces

Terms and Conditions, General Information

Terms:

1% 10 Day. Net 30 Days. Minimum Invoice \$75.00

Shipping:

F.O.B. Santa Clara, California. All shipments via UPS Orange unless otherwise specified. Actual shipping rates will be invoiced.

Claims:

Although goods are considered sold and our responsibility ceases when delivery is made to the transportation company, in the event of goods being lost in transit, we will make every effort on behalf of customers to have lost goods found or to have the transportation company make proper restitution for loss.

Damage claims must be made against carrier.

Specials:

Orders for special tools, non-catalog or modified tools are accepted on a no-cancellation basis and tools are not returnable. A confirming purchase order is required before any work begins on special tools.

A 10% over and under shipment on a special is acceptable based on industry practices unless no overshipment is stated on the order when placed.

Return Policy:

No merchandise may be returned without prior authorization from the factory. Credit will not be issued for merchandise returned without a return authorization number.

All merchandise returned for credit will be subject to a 15% restocking fee.

Errors:

Crystallume Corporation can not be held responsible for incorrect parts made with our products due to mislabeling or defects. We assume all tools used by our customers are inspected before use and that a first part inspection in customer's plant is the rule. We will replace or credit tools in those situations.

Prices:

Prices subject to change without notice.

For more information contact:



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