

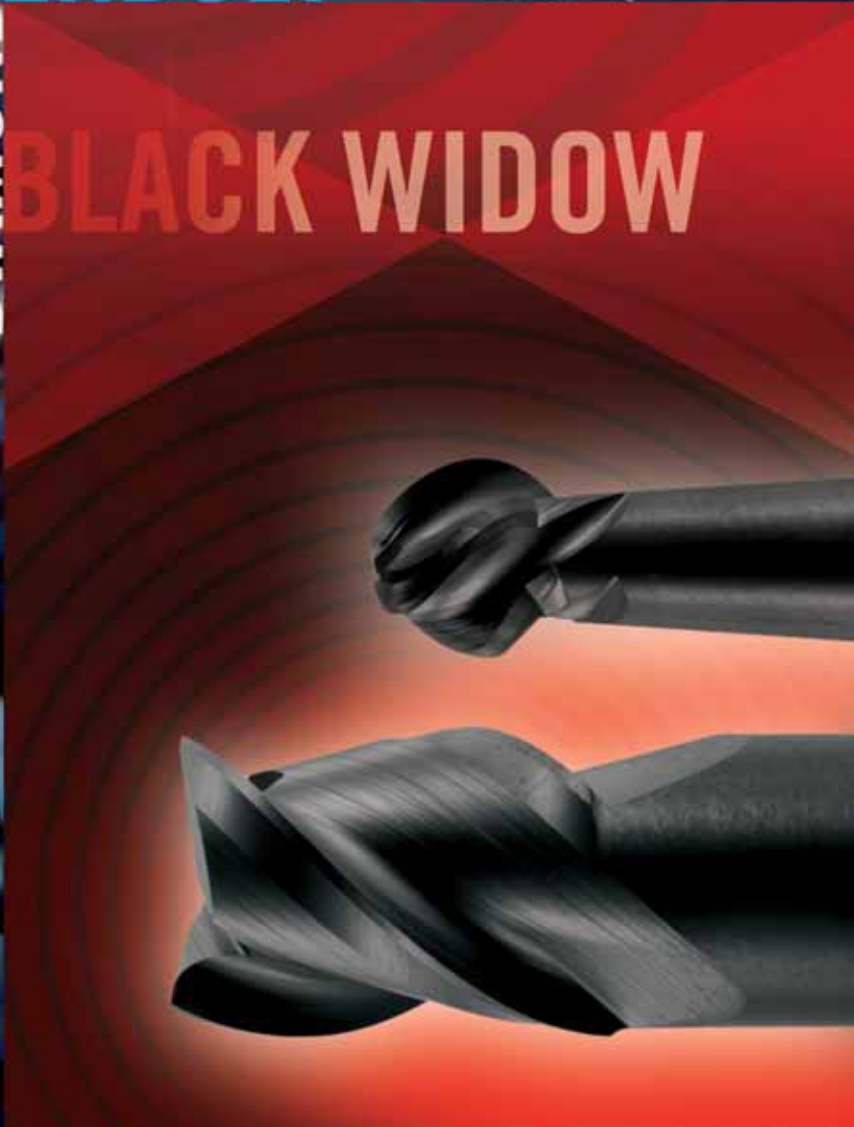
ENGINEERED TOOLS & APPLICATIONS



THUNDERBOLT



DIAMOND



BLACK WIDOW


Crystallume

A Division of RobbJack Corporation

Solving Customer Problems

with

CVD

Diamond Technology

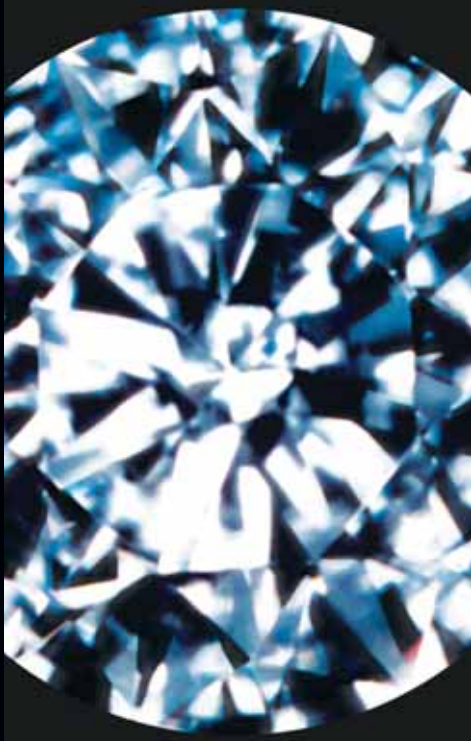


Table of Contents

About CVD Diamond Technology	2
Graphite Electrode Machining	4
Extended Shank End Mills	5
Mold Maker End Mills	6
Deep Cavity Mold Maker End Mills.....	9
Big Shank Tools	9
ThunderBolt Tools	10
General Purpose Tools	12
Standard End Mills.....	13
Drills.....	14
Inserts.....	16
Machining Guidelines.....	17
Black Widow Tools	18
Aircraft Tools	20
Coating Services	22
Terms and Conditions.....	24

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.

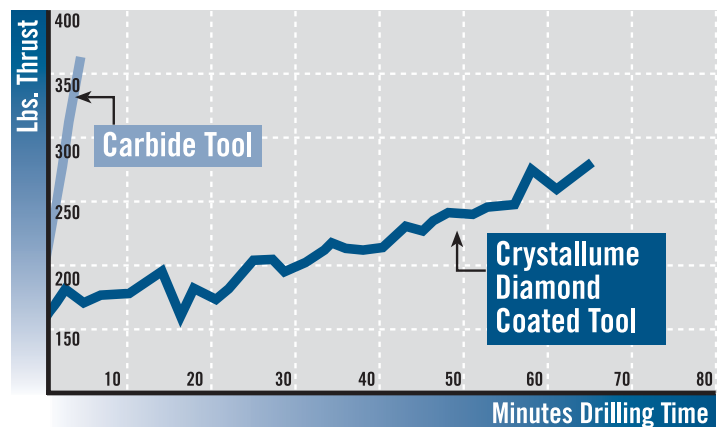
Coating Properties of Black Widow HCC-C

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

