Why Buy Diamond Drills/Bits from UKAM Industrial Superhard Tools

- Huge Diamond Drill/Bit Variety
- Immediate Worldwide Delivery
- Superior Quality & Consistency
- Manufacturer Direct Prices
- Best Value & Performance
- Superior Technology & Innovation
- Unmatched Technical Support
- Purchase the Right Diamond Drill/Bit for your Needs the First Time

INDUSTRIES USED IN:

- Advanced Ceramics
- Composites
- Concrete
- Glass
- Quartz
- Stone
- Lapidary (Gemstone)
- Precision Optics (Photonics)
- MANY OTHERS

UKAM Industrial Superhard Tools is a Leading Manufacturer a full range of Precision Diamond Core drills from .001” to 48” Diameter, drilling just about any type of material/application. Our products are used worldwide in Industry, Research & Development, Contractor, & Hobby applications. Customers include some of the leading Fortune 500 companies, Military, Science & Space Organizations, Universities, R & D Organizations as well as Small Machine Shops.

Diamond Drills are available from inventory in many different specifications, outside & inside diameters, drilling depths, bond types, diamond mesh sizes, mountings, & tolerances. We will work with you to determine your needs, and recommend the right solution for your specific material/application. You can count on us to improve your drilling operation to its ultimate efficiency.

LEADING U.S. Diamond Drill Manufacturer. (most items & raw materials in this catalog are produced in USA)
DIAMOND DRILL TECHNICAL ADVICE, RECOMMENDATIONS, & SUPPORT

What you should KNOW before you BUY your next diamond drill? Successful diamond drilling is both an art & science. Requiring Proper Use & Understanding of selecting the Right Diamond Drill for your material/application. UKAM Industrial Superhard Tools is constantly engaged in Manufacturing, R & D, and Client Diamond Drill Process Optimization. We regularly publish technical articles & give lectures for many leading industry publications (magazines) and trade associations. On our web site you can Find & Download articles that can help you optimize your diamond drilling operation to ultimate point of efficiency.

EASY ORDERING

Ordering is Fast, Easy, & Secure. Most of our standard stock diamond drills/bits can be ordered online. Place your order right here at our web site - 24 hours a day, 7 days a week (any time, day or night!) You can also order by Phone, fax, email, & Regular mail. We are happy to accept Visa, Master Card, American Express, Wire Transfers, & checks that have cleared our bank.

IMMEDIATE WORLD WIDE DELIVERY

Same day shipping on in-stock Items via UPS if ordered before 4:00 pm PST. We ship worldwide & have representatives in most industrialized countries. Other Shipping Methods such as Fed Ex, DHL, US mail, & Cargo are available upon request.

Not all Diamond Drills / Bits are created equal. UKAM Industrial Superhard Tools uses only the highest quality diamonds and raw materials in Diamond Drill / Bit manufacturing process. The highest quality standards and product consistency is maintained, using sophisticated inspection and measurement equipment. Our Diamond Drills/Bits are regularly used in demanding & mission critical applications. First company to develop SMART CUT™ technology, allows for even diamond distribution & orientation inside Diamond Drill / Bit Bond matrix so that every diamond is better able to participate drilling action.

UKAM Industrial Superhard Tools experience, precision manufacturing, modern quality control methods, allow us to control and regulate dozens of variables that affect diamond drill life, quality of cut, surface finish. We will work with you to determine your needs, and recommend the Right Diamond Drill & Solution for your specific material / application. Let us help you improve your diamond drilling operation to ultimate level of efficiency. Turn to UKAM Industrial Superhard Tools for help, and see the difference in working with the LEADER can make.
# TABLE OF CONTENTS

- **Multi-Layered Electroplated Diamond Core Drills with 5/8-11" female thread 1/8" to 3"**  
  Page - 5

- **Multi-Layered Electroplated Diamond Core Drills with straight shank 1/8" to 3"**  
  Page - 6

- **UNIVERSAL APPLICATION**  
  Sintered (metal bond) Diamond Core drills with 5/8-11" female thread & optional shank adapters 1/8" to 6"  
  Page - 7

- **THIN WALL Sintered (metal bond) diamond core drills with 5/8-11" female thread 1/8" to 3"**  
  Page - 10

- **STANDARD WALL**  
  Sintered (metal bond) diamond core drills made to customer specifications .020" to 20"  
  Page - 12

- **NON-CORING TYPE**  
  Sintered (metal bond) diamond drills 6mm to 12mm  
  Page - 14

- **Multi Layered Electroplated Diamond Solid Thin Drills 0.75mm to 2.5mm**  
  Page - 15

- **SINTERED (metal bond) Diamond Solid Thin Drills 0.8mm to 6mm**  
  Page - 15

- **DIAMOND & CBN MICRO DRILLS .001" to .040" (25 microns & up)**  
  Page - 16

- **DIAMOND CARVING POINTS Sintered (metal bond) – over 80 shapes**  
  Page - 19

- **DIAMOND CORE BITS**  
  For construction & allied industries. 1" to 12" diameter, 14.5" drill depth  
  Page - 23

- **DIAMOND COUNTER SINK**  
  for sink holes  
  Page - 25

- **WATER SWIVEL ADAPTERS & drilling accessories**  
  Page - 26

- **CUSTOM DIAMOND DRILL**  
  – Application Data Sheet (let us make the right drill for your application)  
  Page - 28

- **SMART CUT synthetic water soluble coolant (and mineral oil)**  
  Page - 29

- **DRESSING STICKS**  
  Small to large diameter  
  Page - 30
DRILLING RECOMMENDATIONS & SUGGESTIONS
- Properly use diamond drills
- Increase diamond drill life
- Improve Surface Finish
- Obtain overall all better drilling results  Page - 31

DIAMOND DRILLING IN NEW MATERIAL AGE
Selecting the right diamond drill for your application will save you time, money, and improve the overall outcome of your project.  Page - 39

DIAMOND DRILL GUIDE
What you should know before you buy your next diamond drill. This article will help you better understand the difference between diamond drills and which one to chose for each application.  Page - 47

DIAMOND DRILL TROUBLE SHOOTING / PROBLEM SOLVING GUIDE
Guide of most common diamond drill problems and recommendations & solutions on how to resolve them and prevent them from happening in the first place.  Page - 51

GETTING THE MOST OUT OF YOUR DIAMOND TOOLS
instruction manual has been written tool help you get the most out of your sintered (metal bond) diamond tool investment. Learn how to optimize your operation to ultimate level of efficiency.  Page - 56

SMART CUT technology
Advanced technology that redefines the standard in drilling. Diamonds are oriented inside matrix so that every diamond is better able to participate in cutting, drilling, or diamond machining action. Learn what this exiting technology can do for you.  Page - 62

CUSTOMER APPLICATION FEEDBACK
We want to hear from you. After you have used your diamond drill/tool, Please complete the feedback form below and fax or send by mail to address above. Your feedback is very important to us. Your input and suggestions will help us better understand product performance in various environments, applications, and usage patterns.  Page - 69

HOW TO ORDER
Lists ways of ordering & payment accepted  Page - 71

CUSTOMER ORDER BLANK
Form for customer easy ordering  Page - 72

TERMS & CONDITIONS OF SALE
Lists company policies, Merchandising Policies, Return Policies and etc.  Page - 73
UKAM Industrial Superhard Tools Division of LEL Diamond Tools International, Inc.
28231 Avenue Crocker, Unit 80 Valencia, CA 91355 USA
Phone: (661) 257-2288 Fax: (661) 257-3833 www.ukam.com

THIN WALL MULTI-LAYERED ELECTROPLATED DIAMOND CORE DRILLS

- less loss of material
- minimum material deformation
- less heat generation
- faster drilling speed
- less chipping
- better surface finish quality
- preserves material microstructure

Thin Wall Multi-Layered Electroplated Diamond Core Drills, Manufactured by UKAM Industrial are Multi Layered. They have 3 layers of diamonds, not just 1 layer of diamonds like conventional electroplated drills. This provides longer drilling life, smoother surface finish, faster and freer drilling action, & more consistent performance. Recommended for drilling full range of glass, quartz, optical materials, composites, soft to medium hard natural and semi-precious stone, as well as softer Advanced Materials. It is highly recommended that these diamond drills be used with water swivel adapter Model 5811, 5811S or 58MF to run high pressure of coolant through center of drill.

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Tolerances:

- Outside Diameter (D): + / - 0.060mm
- Inside Diameter (D1): + / - 0.060mm
- Drill Run out: 0.04mm (.00157")

HEIGHTS:

- H = Total Drill Length: 3.375" (85.72mm) accept for 1/8" (3.2mm) & 3/16" (4.76mm)
- H1 = Diamond Depth (diamond height): .20" (.50mm)
- H2 = Drilling Depth (how deep you can drill): 2.15" (54.61mm) accept for 1/8", 3/16"
- TH = Drill Tube Wall Thickness: 0.55-0.65mm (.021" to .0255") accept 1/8", 3/16"
Manufactured by UKAM Industrial are Multi Layered. They have 3 layers of diamonds, not just 1 layer of diamonds like conventional electroplated drills. This provides longer drilling life, faster and freer drilling action, & more consistent performance. Unlike cheap imitations, diamond will not peel or pull out.

- High Diamond Concentration
- Smooth Surface Finish Quality
- Fast Drilling & Consistent Performance
- Superior Quality & Consistency
- Maximum Diamond Particle (Grit) Exposure
- Preserves True Material Micro Structure
- Long Life when used correctly
- Superior Design that is Easier to Use (Easier Core Removal)

### Specifications:

- **(L) - Drill Length:** 2-5/8”
- **(I) - Shank Length:** 7/8”
- **(S) - Rim Depth:** .20”
- **Drilling Depth:** 1.56”

### Application:

- Glass / Quartz
- Stone
- Optics
- Marble / Granite
- Lapidary
- Tile / Porcelain
- Advanced Ceramics
- Composites

### Used On:

- Drill Press
- Hand Held Drills
- Cordless Drills
- Other Equipment

### APPROXIMATE DIAMOND DRILL LIFE:

Up to 350+ holes on many materials. Diamond Drill Life will vary with Material Hardness, Drilling Depth, Coolant Used & Operator Experience.
STANDARD WALL SINTERED (METAL BOND) DIAMOND CORE DRILLS
UNIVERSAL APPLICATION

All diamond drills have:
- 5/8-11" female thread
- Drilling Depth: 3.0" (75mm) (for 1/4" to 3.5 Diameters)
- Total Diamond Drill Length with adopter: 5.5" (139.7mm)
- Diamond Drill length without adopter: 4.0" (101.6mm)
- Adopters shank length: 1.0" (25.4mm)
- Tolerance on Outside Diameter: .0035" (0.1mm)
- Coolant Recommendations: must be used with coolant. Such as water, mineral oil & water soluble coolant

EQUIPMENT USED ON:
- Low Speed Drill Press
- Mounted Hand Piece Drills
- Angle Grinders/Hand Held Grinders
- Electric Hand Held Drills
- CNC Machines
- Other equipment with applicable speed RPM

INDUSTRIES USED IN:
- Ultra Hard & Brittle Materials
- Advanced Ceramics & Materials
- Natural & Synthetic Stone
- Precious & Semi Precious Stone
- Glass & Quartz
- MANY OTHER APPLICATIONS

SMART CUT™ series Universal Application sintered (metal bond) diamond core drills provide unmatched performance on ultra hard materials, where most diamond drills do not perform. Designed for Professionals & Users who Understand & Appreciate Quality.

APPLICATION:
Designed for drilling materials from 9.5 to 4.5 on mohe's scale from Sapphire down to Glass. You can't beat their Universal Application. Examples of materials listed in order of hardness:

Sapphire, Agate, Opal, Porcelain, Granite, Marble, Quartz, Glass, Al203, PZT

7/8" diameter Diamond Drills & below are continuous rim with 2 slots in diamond section. Diamond Mesh/Grit Size: 70/80. 1" diameter Diamond Drills & above are segmented. Diamond Mesh/Grit Size: 40/60.
### Price List

#### 1/8” to 7/8” diameter continuous rim with 2 slots

<table>
<thead>
<tr>
<th>Item #</th>
<th>Outside Diameter</th>
<th>Inside Diameter</th>
<th>Rim Depth</th>
<th>Rim Thickness</th>
<th>Drilling Depth</th>
<th>Recommended RPM</th>
<th>Price</th>
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<td>1/8&quot; (3.18mm)</td>
<td>1.60mm (.63&quot;)</td>
<td>.276&quot; (7mm)</td>
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### SHANK ADAPTORS

Drills have 5/8"-11" female thread colet and come with one FREE 3/8", 1/2", or 1/2" gas male shank adapter (placed in chuck) to fit all popular drilling equipment and accessories. **$22.46 value (when sold separately).** Shank adapter can be threaded into 5/8-11" thread & fits chuck of any drilling machine. These drills can also be used with water swivel adapter Model 5811, 5811S, & 5811MF to run high pressure of coolant through center of drill.

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#### Shank Adapters

- **3/8" Shank Adopter**
  - if Purchased Separately: **$22.46**

- **1/2" Shank Adopter**
  - if Purchased Separately: **$22.46**

- **1/2" Gas Male Shank Adopter**
  - if Purchased Separately: **$26.72**

All **SMART CUT™**, Metal Bond Diamond Drills, Universal Application come already mounted with adapter 5/8"-11" female thread and additional adapter (your choice) that is included in the price of drill. This is **FREE** of charge. Drills can be used with water swivel adapter **Model 5811** or placed into chuck. Shank Adapters can be ordered individually (without diamond drills). Shank Adapters fit into chuck of any drilling equipment. Shank adapter threads into 5/8"-11" female thread of drill. Drills may be used with or without shank adapter or water swivel.

Best performance will be achieved when used with water swivel adapter used to run high pressure of coolant through center of drill. Available to fit any drilling equipment. Improve overall performance by as much as 75% more >>>
THIN WALL SINTERED (METAL BOND) DIAMOND CORE DRILLS

ADVANTAGES:

- less loss of material
- minimum material deformation
- less heat generation
- faster drilling speed
- less chipping
- better finish quality

Wall Thickness: 0.5mm (.0196") provide, long lasting, faster drilling (RPM), and minimum heat generation performance. All drills are available with either 5/8-11" female thread to fit water swivel adapter Model 5811 or 1/2" gas male thread (belgium mount) to fit water swivel adapter Model 12GF.

Water Swivel Adapter is used to run high pressure of coolant through center of drill. Drills can also be used with screw in shank adapter. Diamond Core Drills can be manufactured in many different specifications, outside & inside diameters, drilling depths, bond types, diamond mesh sizes, mountings, and tolerances.

TOLERANCES:

Tolerance on OD: +/- .03mm (.001")
Tolerance on ID: +/- .03mm (.001")

SPECIFICATIONS

DIAMETERS:

D = Outside Diameter
D1 = Inside Diameter
D2 = Shank Diameter - all drills have 5/8-11" female thread
D3 = Shank Inside Diameter - no shank

HEIGHTS:

H = Total Drill Length
H1 = Diamond Depth (diamond height): 10mm
H2 = Drilling Depth (how deep you can drill): 1.5" (38.10mm)
H3 = Shank Length

THICKNESS:

TH = Drill Tube Wall Thickness: 0.5mm (.0196")
TH1 = Outside Diameter Diamond Section Relief: 0.25mm (.0098")
TH2 = Inside Diameter Diamond Section Relief: 0.27mm (.010")
Diamond Mesh Size: 100/120

QUANTITY DISCOUNTS:

1-2 pcs net
3-5 pcs 5%
6-10 pcs 8%
11-20 pcs 13%
21+ pcs 18%
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<thead>
<tr>
<th>Item #</th>
<th>Outside Diameter (D)</th>
<th>Inside Diameter (D1)</th>
<th>Diamond Depth (H1)</th>
<th>Wall Thickness (TH)</th>
<th>Drilling Depth (H2)</th>
<th>Recommended RPM</th>
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### STANDARD WALL DIAMOND CORE DRILLS

**Standard Wall Metal Bond Diamond Core Drills** provide long lasting, faster drilling (RPM), and minimum heat generation performance. Diamond Core Drills can be manufactured in many different specifications, outside & inside diameters, drilling depths, bond types, diamond mesh sizes, mountings, and tolerances. We will work with you to determine your needs, and recommend the right solution for your specific material/application. **Made to order (not a stock item)**

#### DIAMETERS:
- **D** = Outside Diameter
- **D1** = Inside Diameter
- **D2** = Shank Diameter
- **D3** = Shank Inside Diameter

#### HEIGHTS:
- **H** = Total Drill Length
- **H1** = Diamond Depth (diamond height)
- **H2** = Drilling Depth (how deep you can drill)
- **H3** = Shank Length

#### THICKNESS:
- **TH** = Drill Tube Wall Thickness
- **TH1** = Outside Diameter Diamond Section Relief
- **TH2** = Inside Diameter Diamond Section Relief

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<th>Inside Diameter (Decimal)</th>
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**HOW TO OBTAIN ACCURATE PRICE QUOTATION**

Prices are without collet or shank (tube only with diamond tip). Prices are for budgetary purpose only and are will vary with customer technical requirements and tolerances. Other OD and ID Sizes are available, in various drilling depths, tolerances, & mountings. Please contact our Sales or Engineering Department for accurate quote & lead time.
NONE-CORING SINTERED (METAL BOND) DRILLS & BOTTOMING TOOLS

Diamond Bottoming Drills/Tools, sintered (metal bond) are used for making Blind Holes in all types of material ranging in hardness from sapphire, to quartz and slate. A bottoming tool does not have a core, and essentially works as both a diamond drill and grinding disc. The bottoming tools works by grinding the bottom and inside of the hole to a flat surface. This tool is just about the only way you can drill larger than 3/8” OD (outside diameter) blind holes.

Sintered (metal bond) diamond drills (non-coring) type 6mm (.236”) to 12mm (.472”) OD are available from stock. All drills have 5/8-11” female thread and recommended for use with Water Swivel Adapter Model 5811 or Model 5811S to run high pressure of coolant through center of drill.

- Designed for Drilling without Core Formation
- Grinds Hole to Flat Surface
- Grinds out material core in hole
- Available in all sizes for .062” to 5” diameter
- Used for almost any application from Ultra Hard to Soft Material

LARGER DIAMETER DIAMOND BOTTOMING TOOLS

1” (25.4mm) and up are individually produced per customer application

* other sizes & drill depths can be produced

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<tr>
<th>Item No.</th>
<th>Outside Diameter</th>
<th>Diamond Height</th>
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Diamond Section of the bottoming drill/tool shown, threaded apart from the custom water swivel adapter specially made for this application.

Diamond Bottoming Tool unthreaded from the water swivel adapter.

Bottoming Tool profile (side) view.
Electroplated Diamond Solid Thin Drills manufactured by UKAM Industrial have Multiple Layers of Diamond (3 Layers), not just 1 layer of diamonds like conventional electroplated drills. This provides longer drilling life, faster and freer drilling action, & more consistent performance.

Unlike conventional plated diamond solid drills which are made using music wire or straight gage pin. These drills are machined from solid piece of steel on CNC lathe machine. Each drill has a recess between head diameter and shank diameter, increasing drill rigidity and accuracy while drilling.

Sold in Pack of 6 units
Head Length: 15.00mm (.591") Drill Length: 45.00mm (1.772") Shank Diameter: 2.35mm (.0925")

Drilling Depth: 14mm (.55")
Recommended Operating Speed: 7,000-10,000
Maximum Operating Speed: 30,000.

$24.99 for package of 6 pcs

USED ON: High Speed Drill Press, Mounted Hand Piece Drill (such as: Foredom & Dremel), High Speed Air Spindles.

APPLICATION: drilling smooth and clean holes in a wide variety of:
- ceramic, tile & related materials
- advanced ceramics
- glass & quartz
- optical materials
- composites
- natural & synthetic stone
- semi-precious & precious stone
- many other materials

Will last significantly longer than electroplated diamond solid drills. Recommended for drilling Ultra Hard Materials (harder than 8 on mohes scale or 60 on Rockwell Scale).

$48.97 each

Other sizes and drilling depths are available upon request
OD diameters from 0.75mm (.029") to 12.7mm (.500") in .001" (.0254mm) increments. Lead time: 4 weeks
MICRO DIAMOND DRILLS .001" to .035" Diameter

THE WORLD'S SMALLEST DIAMOND MICRO DRILLS!!!

SMCDU Series - .125” shank

MCDU Series - .040” shank

Micro Diamond Drills are available from .001” to .035" (.0254mm to .889mm) in diameter

25 microns & up. We also Manufacture Diamond & CBN Micro Tools & Points to your Specifications & Drawings

Diamond Micro Drills are Manufactured in clean room environment under the Highest Quality Standards to Mil Specs. Only the highest quality raw materials are used in manufacturing process. Utilizing world class quality control, inspection, and measurement equipment. Highly Experienced Engineers and chemists constantly monitor and control all material input & output at all stages of manufacturing process. Insuring product consistency for use in demanding & sensitive applications such Nano Technology, MEMS, Materials Research, and etc. Customers include some of the Leading Fortune 500 companies, Universities, Military, Space Flight Organizations, Laboratories, Advanced Material Fabricating Facilities to small machine shops. Diamond & CBN (cubic boron nitride) is the hardest material known to man and is well suited for drilling all types of materials harder than 35 Rockwell scale C.

USED ON:

- High Speed Air Spindles
- Other Equipment with applicable speed

APPLICATION: (materials used on)

SMART CUT™ series Micro Diamond Drills provide the most precision performance on Alumina, Glass, Quartz, Ruby, Sapphire, Yag, Silicon, Fused Quartz, Bk7, and Many Other Materials.
MCDU Series - Diamond Micro Drills Recommended Drilling Speed (RPM's): MCDU series, 150,000 and up. (may be used at lower RPM's such as 35,000. Longer Life and optimum performance will be obtained at recommended RPM's)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Diameter (D)</th>
<th>Diamond Height (DL)</th>
<th>Head Length (HL)</th>
<th>Total Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCDU6</td>
<td>0.006&quot; (.152mm)</td>
<td>Entire Head</td>
<td>0.040&quot; (1.016mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU7</td>
<td>0.007&quot; (.117mm)</td>
<td>Entire Head</td>
<td>0.050&quot; (1.27mm)</td>
<td>3/4&quot; (19.05mm)</td>
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<tr>
<td>MCDU8</td>
<td>0.008&quot; (.203mm)</td>
<td>Entire Head</td>
<td>0.050&quot; (1.27mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU9</td>
<td>0.009&quot; (.228mm)</td>
<td>Entire Head</td>
<td>0.060&quot; (1.524mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU10</td>
<td>0.010&quot; (.254mm)</td>
<td>Entire Head</td>
<td>0.070&quot; (1.778mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU11</td>
<td>0.011&quot; (.279mm)</td>
<td>Entire Head</td>
<td>0.080&quot; (2.032mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU12</td>
<td>0.012&quot; (.304mm)</td>
<td>Entire Head</td>
<td>0.080&quot; (2.032mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU13</td>
<td>0.013&quot; (.330mm)</td>
<td>Entire Head</td>
<td>0.090&quot; (2.286mm)</td>
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<tr>
<td>MCDU14</td>
<td>0.014&quot; (.335mm)</td>
<td>Entire Head</td>
<td>3/32&quot; (2.381mm)</td>
<td>3/4&quot; (19.05mm)</td>
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<tr>
<td>MCDU15</td>
<td>0.015&quot; (.381mm)</td>
<td>Entire Head</td>
<td>3/32&quot; (2.381mm)</td>
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<tr>
<td>MCDU16</td>
<td>0.016&quot; (.406mm)</td>
<td>Entire Head</td>
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<td>3/4&quot; (19.05mm)</td>
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<tr>
<td>MCDU17</td>
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<td>MCDU18</td>
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<td>3/4&quot; (19.05mm)</td>
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<tr>
<td>MCDU20</td>
<td>0.020&quot; (.508mm)</td>
<td>Entire Head</td>
<td>1/8&quot; (3.175mm)</td>
<td>3/4&quot; (19.05mm)</td>
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<tr>
<td>MCDU25</td>
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<td>1/16&quot;</td>
<td>1/8&quot; (3.175mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU30</td>
<td>0.030&quot; (.762mm)</td>
<td>1/16&quot;</td>
<td>1/8&quot; (3.175mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
<tr>
<td>MCDU35</td>
<td>0.035&quot; (.889mm)</td>
<td>1/15&quot;</td>
<td>1/8&quot; (3.175mm)</td>
<td>3/4&quot; (19.05mm)</td>
</tr>
</tbody>
</table>

*Other Sizes & Drilling Depths are available upon request

**Recommended Feed Rate:** down or side feed: .010" per minute.

*Lead time 4 to 7 working days / Faster Lead times are available upon request (many sizes available from stock / inventory changes daily)

**Recommended Coolants:** water soluble coolant such as SMART CUT™ Coolant or glycerols.

*No minimum order
**SMCDU Series - .125” Shank**

**Recommended Drilling Speed (RPM's):** SMCDU series 60,000 minimum. (may be used at lower RPM's such as 35,000. Longer Life and optimum performance will be obtained at recommended RPM's)

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Diameter (D)</th>
<th>Diamond Height (DL)</th>
<th>Head Length (HL)</th>
<th>Total Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMCDU16</td>
<td>0.016” (.406mm)</td>
<td>1/8” (3.175mm)</td>
<td>1/4” (6.35mm)</td>
<td>1” (25.4mm)</td>
</tr>
<tr>
<td>SMCDU20</td>
<td>0.020” (.508mm)</td>
<td>1/8” (3.175mm)</td>
<td>1/4” (6.35mm)</td>
<td>1” (25.4mm)</td>
</tr>
<tr>
<td>SMCDU25</td>
<td>0.025” (.635mm)</td>
<td>1/8” (3.175mm)</td>
<td>1/4” (6.35mm)</td>
<td>1” (25.4mm)</td>
</tr>
<tr>
<td>SMCDU30</td>
<td>0.030” (.762mm)</td>
<td>1/8” (3.175mm)</td>
<td>1/4” (6.35mm)</td>
<td>1” (25.4mm)</td>
</tr>
<tr>
<td>SMCDU35</td>
<td>0.035” (.889mm)</td>
<td>1/8” (3.175mm)</td>
<td>1/4” (6.35mm)</td>
<td>1” (25.4mm)</td>
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<tr>
<td>SMCDU40</td>
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<td>1/8” (3.175mm)</td>
<td>1/4” (6.35mm)</td>
<td>1” (25.4mm)</td>
</tr>
</tbody>
</table>

*Lead Time 5 to 8 working days (many sizes available from stock / inventory changes daily)  
Recommended Feed Rate: down or side feed: .010” per minute.  
*No minimum order  
Recommended Coolants: water soluble coolant such as SMART CUT™ coolant or glycerols.
SINTERED (METAL BOND) DIAMOND CARVING POINTS

Sintered (metal bond) diamond carving points will last 50 times longer than conventional electroplated diamond carving points.

Designed for carving a wide range of ultra hard to soft material into intricate shapes. The diamond is all the way through cutting tip for maximum efficiency and superior long life. Unlike electroplated diamond carving points, metal bond carving points will continue to work as long as portion of the head still remains. Designed for use with all popular hand held machines & must be used with coolant.

True SINTERED diamond carving points are produced with a process that uses extreme heat and pressure to bring about the cohesion of diamond particles and a metallic binder material. Each sintered (metal bond) diamond carving point is processed under tons of pressure and thousands of degree temperatures, for several hours, in metal molds. This completely eliminates the loss of diamond particles through pull-out which is often a problem with electroplated bonded tools. In addition, the diamond section will never strip off or peel. Diamond head will hold critical shapes for the life of the diamond crystal. Cutting action is fast and easy.

APPLICATION:
- Glass / Quartz
- Natural Stone & Gem Stone
- Ultra Hard & Brittle Materials
- Composites

D (mm) – Outside Diameter  L (mm) – Diamond Height  Shank Diameter: 3/32” (2.35mm)
Shank Length: 38mm  Other Shank Sizes can be produced: 1/8” and 1/4” (others upon request)
Diamond Sizes Available: 40 microns (500 mesh) to 230 microns (65 grit)
Typically in Stock: 70 microns (240 mesh), 80 microns (210 mesh), 110 microns (150 mesh), 160 microns (90 mesh), 230 microns (65 mesh)

SHAPES SHOWN CLOSE TO ACTUAL SIZE

Minimum Order: $100.00 USD

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |   |   |   |   |   |
| d-2.1 | d-3.5 | d-1.6 | d-1.8 | d-2.7 | d-3.7 | d-4.7 | d-8.0 | d-1.8 | d-2.7 | d-3.7 | d-4.7 | d-8.0 | d-1.6 | d-1.8 | L-2.1 | L-3.5 | L-1.6 | L-1.6 | $25.0 | $25.0 | $25.0 | $25.0 | $25.0 | $35.0 | $45.0 | $25.0 | $30.0 | $35.0 | $45.0 | $35.0 | $45.0 | $37.00 | $37.00 |
RESIN BOND DIAMOND CARVING POINTS

ADVANTAGES:

- Maximum efficiency, no vibrations, low heat build up
- Ideal for critical work on delicate ceramic parts, ultra hard & brittle materials
- Very good diamond retention, long life length
- Significantly lowers cracking and chipping risks in critical ceramics zones.
- High comfort of utilization. The resin bond acts as a vibration and shock absorber.
- Preserves Material Micro Structure & No material deformation
- No Contamination

APPLICATION:

- Glass / Quartz
- Optics
- Ultra Hard & Brittle Materials
- Advanced Materials

Diamond Mesh Sizes Typically Available from stock: 80, 120, 160 microns (other mesh size can be made upon request)

Shapes shown above are in stock.

Almost any other shape resin bond diamond carving point can be produced, 3mm diameter and above. Per customer request

USAGE RECOMMENDATIONS:

- Speed: 12,000 to 15,000 RPM, maximum 20,000 RPM
- Light pressure, to avoid premature wear out
- Dress with 5,000 RPM on wet abrasive green stone

Shank Diameter: 2.35mm
UKAM Industrial Superhard Tools  
Division of LEL Diamond Tools International, Inc.  
28231 Avenue Crocker, Unit 80  
Valencia, CA 91355 USA  
Phone: (661) 257-2288  Fax: (661) 257-3833  www.ukam.com

Diamond Core Bits for Construction & Allied Materials - wet drilling

Available from inventory and Manufactured to better fit your specific requirements / specifications.

Select the Right Diamond Core Bit for your Application. From Several hundred diamond bond specifications, with right combination of diamonds, metal powders, and diamond distribution to better fit your material and operating conditions. We can make any drill length & custom sizes. Let us know how we can help.

- Will Not Lose Segments
- Different Design (Proven & Tested)
- Rebuildable
- Almost Indestructible (when used with coolant)
- Fast Drilling
- Super Long Life / Consistent Performance
- Works on concrete, allied, & ultra hard materials

USED ON:
- Core Rings
- Hand Held Core Drill Machines
- Hydraulic Drilling Machines
- Pneumatic Core Drilling
- Other Drilling Equipment

APPLICATION:
Designed for drilling most types of ultra hard to soft materials. Examples of materials listed in order of hardness: Artificial Stone, Rebar, Reinforced Concrete, Masonry Material, Bricks

SUPER PREMIUM QUALITY
Unlike some companies who offer several grades or qualities of core bits such is economy, standard, premium, premium plus. We produce only the highest quality tools, using highest quality materials. We believer you deserve only the best.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Outside Diameter</th>
<th>Drilling Depth</th>
<th>Thread Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>40CA12SG</td>
<td>1/2&quot;</td>
<td>14&quot;</td>
<td>5/8-11&quot;</td>
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<td>5/8-11&quot;</td>
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<td>5/8-11&quot;</td>
<td>$109.32</td>
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<td>5/8-11&quot;</td>
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<td>Core Bit Size</td>
<td>Diameter</td>
<td>Thread</td>
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<td>1-1/4-7&quot;</td>
<td>$1,281.00</td>
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</tbody>
</table>

**SPECIFICATIONS:**

- 360 degree segment, 8mm (.314") high
- 5/8"-11" female thread for drills up to 1.5" OD. 1-1/4-7" for larger sizes
- Drills are made to fit your application. Standard Lead Time: 1 work day

- Other Core Bit Sizes & Drilling Depths are available upon request
- Different Drilling Depths are available upon request
- Custom Core Bits can be made to your specifications to better fit your specific material, application, and operating conditions.

**Extensions: (used to increase core bit length)**
Available in with either 5/8-11” or 1-1/4-7” male thread

- **Extension A** – 6” long, .980” Diameter, with 5/8-11” male and female thread - $72.81
- **Extension B** – 12” long, .980” Diameter, with 5/8-11” male and female thread - $78.97
- **Extension C** – 6” long, 2” Diameter, with 1-1/4-7” male and female thread - $76.75
- **Extension D** – 12” long, 2” Diameter, with 1-1/4-7” male and female thread - $104.81

**ADAPTERS**

- **A** - Adapter from 1-1/4-7” Female Thread to 5/8-11” Female Thread (longer version for drilling rigs) - $75.00
- **B** - Adapter from 1-1/4-7” Female Thread to 5/8-11” Female Thread (shorter version for angle grinders/hand held drills) - $85.00
- **C** - Adapter from 5/8-11” Female Thread to 1-1/4-7” Female Thread
UKAM Industrial Superhard Tools
Division of LEL Diamond Tools International, Inc.
28231 Avenue Crocker, Unit 80 Valencia, CA 91355 USA
Phone: (661) 257-2288 Fax: (661) 257-3833 www.ukam.com

DIAMOND COUNTERSINK

Multi-Layered Electroplated Diamond Countersinks are designed for countersinking operation in materials such as Glass, Quartz, Composites, Graphite Epoxy, Carbon, Boron, Fiberglass, Marble, and many other materials. Designed for use on hole diameters from 1.5" (38.1mm) to 2.5"

Price: $198.00 each

Dimensions

A = 1.5"  B = 2.490"  C = 0.526"  D = .375"  E = 45 degrees  L = 4.5"

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/26&quot;</td>
<td>47/64&quot;</td>
<td>5/16&quot;</td>
<td>1/4&quot;</td>
<td>42 degrees</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1/4&quot;</td>
<td>51/64&quot;</td>
<td>5/16&quot;</td>
<td>1/4&quot;</td>
<td>42 degrees</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1/2&quot;</td>
<td>59/64&quot;</td>
<td>1/4&quot;</td>
<td>1/4&quot;</td>
<td>42 degrees</td>
<td>2&quot;</td>
</tr>
<tr>
<td>3/4&quot;</td>
<td>1-3/16&quot;</td>
<td>1/4&quot;</td>
<td>3/8&quot;</td>
<td>42 degrees</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1</td>
<td>1-5/8&quot;</td>
<td>3/8&quot;</td>
<td>3/8&quot;</td>
<td>42 degrees</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1-1/8&quot;</td>
<td>2</td>
<td>12&quot;</td>
<td>3/8&quot;</td>
<td>42 degrees</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>2.490&quot;</td>
<td>0.526&quot;</td>
<td>3/8&quot;</td>
<td>42 degrees</td>
<td>4.5&quot;</td>
</tr>
</tbody>
</table>

HOW TO PROPERLY USE YOUR DIAMOND COUNTER SINK

Make sure your diamond countersink will run true

Take a scrap piece of material. Make sure it is firmly held together in place and does not move. Take the counter sink and lower it to piece of material until its sharp point barely touches material surface. Using your drilling machine slowly rotate counter sink (very slowly). If the counter sink produces a straight point (dot) than you countersinking operation will not have any problems. If its starts to wobble even just slightly produce scratches of slightly eclipse circle (not perfect dot). This means the diamond counter sink is not properly centered (installed) in your drilling machine chuck. Adjust and center your counter sink until you are able to produce perfect dot.

Another very important concept in using your diamond counter sink is finding a perfect center in your hole. Make sure that your counter sink is perfectly centered in your drilling machine chuck. Bring up your material until the counter sink sharp point touches the center of your hole. Make sure their are no gaps in hole between material and countersink (that countersink) absorbs in entire diameter of your hole. Make sure the material will not wobble while the countersink is in use.
WATER SWIVEL ADAPTERS (Drill Head Assemblies)
used to run high pressure of coolant through center of drill

INCREASE THE LIFE OF YOUR DRILLS UP TO 75%

Water Swivel Adapters (also known as drill head assemblies) are to supply high water, coolant, or air through the center of your diamond drill. Water Swivel Adapters/Drill Head Assemblies cool both diamond drills and material in zone of drilling. 

Water swivel adapters fit just about any type of drilling equipment and available with different threads and mountings. On average, Diamond Drills used with Water Swivel Adapters will last 40% to 75% longer. Using a water swivel adapter is highly recommended for most diamond drilling applications. SAVE TIME & MONEY!

FEATURES:
- Heavy Duty
- Stainless Steel
- 2 Bearings
- Adjustable Water Flow
- Precision Crafted

USED ON:
- Low Speed Drill Press
- Mounted Hand Piece Drills
- Angle/Hand Held Grinders
- Electric Hand Held Drills
- CNC Machines
- Other Equipment

ADVANTAGES:
- Increase Drill Life
- Minimize Material
- Stress & Deformation
- Consistent Performance
- Improve Drill
- Concentricity (run out)
- Save Time
- Save Money
Model 5811

Item # AF4412GW $149.87
Thread: 5/8-11" male Shank Diameter: 1/2"
USED ON: Drill Press, CNC Machine

Model 5811S

Item # ASWSCB5811S $149.87
USED ON: Drill Press, Cordless Drills

Model 58MF

Item # AWSCB5811TF $145.87
Thread: 5/8"-11" Male/Female x Shank diameter: 1/2"
USED ON: Angle Grinders/Hand Held Grinders

Model 3416

Item # AF44GW316 $174.00
Thread: 3/4-16" x Shank diameter: 1/2"

Model 12GF

Item # AF4412GW $174.00
Thread: 1/2" gas female. Shank: 1/2"
USED ON: Drill Press, CNC machine

Model 5818

Item # AF445818GW $174.00
Thread: 5/8"-18" x Shank diameter: 1/2"
USED ON: Drill Press, CNC machine
CUSTOM DIAMOND CORE DRILL – APPLICATION DATA SHEET

ATTENTION!
Applicable box cross or mark

1. Material to be drill:

1.1. Quantity: _____________
1.2. Lead Time: ____________
1.3. Price each: ____________

2. Type of drill: Continuous rim; Segmented; Slotted Continuous rim - Number slots - ; Solid rim ;

3. Kind of drill: Thin wall; Standard wall; Heavy-duty wall; Others specify:

4. Drill configuration: Collet; Strait shank; Others specify: 4.1 Collet thread:

5. Drill will use to obtain: Hole (OD drill); Core (ID drill); Others specify:

6. Surface finish: _________________________________________________________________

7. Drilling condition: Dry drilling; Wet drilling; Others specify:

8. Coolant recommendation: ______________________________________________________

9. Speed (RPM’S) use now: ________________ 10. Speed (RPM’S) recommendation: ________________

11. Drilling feed rate down use now: ________________ 12. Drilling feed rate down recommendation: ________________

<table>
<thead>
<tr>
<th>DIAMETERS</th>
<th>HEIGHTS</th>
<th>THICKNESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>H</td>
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<tr>
<td>D1</td>
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<td>TH1</td>
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<tr>
<td>D2</td>
<td>H2</td>
<td>TH2</td>
</tr>
<tr>
<td>D3</td>
<td>H3</td>
<td></td>
</tr>
</tbody>
</table>
When added to cooled water SMART CUT™ synthetic water soluble coolant or Mineral Oil will improve your overall diamond drilling and diamond machining operation by as much as 30%. Plain water evaporates at 212°F. Often temperature in your drilling zone reaches as much as 500 degrees F. Often water evaporates, before it has a chance of effectively cooling the diamond drill and material being drilled. Resulting in shorter Diamond Drill Life, Material Damage or micro cracks associated with overheating. Water may cool your diamond drill, yet provide poor lubrication properties needed for optimum drilling results.

Using synthetic water soluble coolant or mineral oil with your Diamond Drill will:

- Improve Drilling Speed
- Increase Diamond Drill Life
- Improve Material Surface Finish
- Reduce Chipping
- Reduce Material Cracking
- Preserve Material True Micro Structure

Available in:

- 1 (one) Quart Bottles
- 1 (one) Gallon Bottles
- 5 (five) Gallon Pails
- 55 Gallon Drums

SMART CUT™ Synthetic Water Soluble Coolant recommended for drilling:

- Advanced/Technical Ceramics
- Advanced Materials
- Glass
- Quartz
- Optical Materials
- Composites
- Many Types of Natural Stone
- Precious & Semi-Precious Stone
- And Many Other Materials

SMART CUT™ Mineral Oil is recommended for drilling:

- Materials with High Metallic Content
- Advanced Ceramics
- Precious & Semi Precious Stones
- Many Other Ultra Hard Materials

**MIX RATION: 1:20**

1 part coolant, & 20 parts water

For use with Diamond Drills

For Example: 1 quart of coolant will give you 5.7 gallons of coolant. When mixed with water.
Diamond Tools must be used with diamonds exposed properly through frequent dressing. Otherwise, the diamond tool will glaze over. They will begin to tear rather than grind which is very destructive. Tearing caused from unexposed diamonds creates friction. This causes uneven wear and heat cracks in the diamond tool as well as material being machined. Resulting in premature diamond tool wear, blade tensioning problems, and will eventually destroy the diamond tool. The more a diamond tool is dress the cooler it will drill or cut.

Different types of dressing sticks break down differently under a variety of conditions. The dressing stick used must be compatible with the bond and size (grit) of the diamond tool, in addition to the RPM's of the machine. Silicon carbide crystals are less friable and are sharper than alumina oxide crystals which are more friable and break down easier. If the diamond wheels running at RPM's that are too high and/or SFPM is too fast and/or the diamond wheel bond is too hard in relationship to the dressing stick, the diamond tool may not cut freely through the dressing stick causing the operator to believe the dressing stick may be too hard.

### RECOMMENDED DRESSING STICKS

<table>
<thead>
<tr>
<th>Code</th>
<th>Size</th>
<th>Color</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>UKAMDRST10</td>
<td>1/2&quot; x 1/2&quot; x 6.0&quot;</td>
<td>White</td>
<td>Recommended for coarser grits found in segment wheels, core drills, or Blanchard grinding. Excellent performance on 120 grit tools.</td>
<td>$8.65</td>
</tr>
<tr>
<td><strong>A-100 Soft</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UKAMDRST10</td>
<td>1/2&quot; x 1/2&quot; x 6.0&quot;</td>
<td>White</td>
<td>Recommended for coarser grits found in segment wheels, core drills, or Blanchard grinding. Excellent performance on 120 grit tools.</td>
<td>$8.65</td>
</tr>
<tr>
<td><strong>A-220 Soft</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UKAMDRST7</td>
<td>1.0&quot; x 1.0&quot; x 6.0&quot;</td>
<td>Black</td>
<td>Recommended for coarser grits found in segment wheels, core drills, or Blanchard grinding. Excellent performance on 120 grit tools.</td>
<td>$15.99</td>
</tr>
<tr>
<td><strong>C-100 Soft</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UKAMDRST8</td>
<td>2.0&quot; x 2.0&quot; x 6.0&quot;</td>
<td>Black</td>
<td>Recommended for coarser grits found in segment wheels, core drills, or Blanchard grinding. Excellent performance on 120 grit tools.</td>
<td>$39.47</td>
</tr>
<tr>
<td><strong>C-100 Soft</strong></td>
<td></td>
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</table>
How to Properly Use DIAMOND DRILLS - DRILLING RECOMMENDATIONS

In order for you to get the most out of your new diamond drill / diamond drill bit, we strongly urge you to read and follow these instructions and suggestions. Doing so will help you save money and time. These suggestions and recommendations have come from years of experience in research, development and manufacturing of precision diamond drills/bits & diamond tools. As well as years of personal experience and observations of diamond drill/bit users like you. The **diamond drill/bit itself is only a small factor in your drilling operation.** Successful diamond drilling is both an art & science. Requiring proper use and understanding of selecting the right diamond drill for your material / application. Maintaining and using proper:

- **MATERIAL TO BE DRILLED**
- **OPERATOR**
- **DRESSING**
- **COOLANT**
- **RPM’S (speed)**
- **PROPER ACCESSORIES**

Selecting the right diamond drill/diamond drill bit parameters, often involves a **trial and error process.** Many which can be avoided through experience and understanding of how to use these parameter for your specific application. What works for one application, may not work for another. While there is no real substitute for experience, even new diamond drill/bit users can quickly become proficient by learning and applying some basic principles of diamond drilling.

Before Drilling

Visually examine diamond drill for cracks or any other damage. Do not use if damage is suspected. Damaged, incorrectly mounted, or misused drills can be very **dangerous** to use. Always wear proper safety equipment: Safety footwear, snug fitting clothing, safety goggles, hearing and head protection, and proper respiratory equipment. **Make sure to check the diamond drill for run out.**

Checking Diamond Drill/Bit Run Out

Run out will cause excess vibration when you are drilling and effect the circumference (roundness) of your hole. Instead of your hole being perfectly round, it will become ellipse and uneven. Diamond Drill/Bit run out will also affect tolerances you are able to achieve. Every diamond drill is made to hold a specific tolerance and run-out. When ordering diamond drills, make sure to indicate the run-out and tolerance you need. To check for run out, use an indicator specifically designed for this purpose.
Bring the indicator close to the drill, until its spring just touches the surface of the drill. The dial of the indicator should indicate 0. Turn on your drilling machine, holding the indicator firmly in place. The dial of your indicator should remain at 0 while your drill is running (rotating). This means you have no drill run out. If your indicator is greater than zero, your drill is running out. Turn off your drilling machine, and remount the drill. A black marker, is an alternative if you do not have an indicator available.

Take a piece of paper or any thin piece of material, measuring its thickness using a caliper or micrometer. Place the material firmly against the drill. Holding the marker firmly in place, remove material between drill and marker. Turn on your drilling machine and observe drill rotation. If the marker touches surface of the drill, there is too much drill run out. Turn off drilling machine, and try again.

Another effective way of checking drill run out, is rotate the drill head assembly (including the water swivel adapter, if your drill has this feature) by hand. The run out of the drill diamond section (the cutting/drilling edge) will be indicated by the stem. A strong correlation exists between the run out on the water swivel adapter and on the diamond drill—the larger the run out on the water swivel adapter, the larger the run out will be on the drill. If the run out is not properly indicated, the drilling operation will not be successful.

You should also ensure that your drilling accessories are properly held in the chuck. If the drill or drilling device is not running true, loosen the chuck of your drilling machine, turn it 90 degrees and run your drill again. If this does not work, examine condition of your equipment. Mount the drill on another drilling machine. Make sure your drilling equipment is in proper condition to accomplish your objectives. No matter how well the diamond drill is made, it will not give you close tolerances if the shaft, or chuck of your drilling equipment is misaligned or vibrates.

If for some reason you feel there is a manufacturing defect, please return the drill where it was purchased with a note explaining the difficulty. Defective drills will be repaired or replaced. Drills improperly used will be repaired or replaced at users expense.

**Starting to Drill a hole**

Line up the drill to the material being drilled. Clearly mark the insertion point where you will start drilling. Drill by quickly pressing and lifting the drill head. Moving the drill up and down frequently during the drilling operation will allow the coolant to cool the drill and flush out the material debris formed while drilling. The color of the water in the drilling zone should be milky white. For some hobby applications, you can consider using a pilot, which can easily be made from a piece of wood. A pilot can reduce your drill slippage when starting the hole. Place the pilot on the surface of the material being drilled, with the pilot hole above the insertion point. Doing so will help you maintain the drill in place as you start drilling. When making contact with the material, tip the drill at a 45 degree angle. When you have made a slight indentation, slowly bring the drill to a 15 degree angle, gradually straightening the drill as you penetrate deeper into material. Drill by pressing and lifting the drilling head, down and up frequently to allow water to flush out the material debris formed while drilling and cool the drill at the same time. Do not use extensive pressure. If you find a piece of material debris is stuck inside the drill, take it out before continuing to use.
Securing your material while drilling

It is extremely important that the part you are drilling is clamped down and held securely in place. So material does not move, if material does move while drilling it may break the diamond section of your drill. A clamp should be used for this purpose. **Do not hold the part (material) with your hands.** Doing so is dangerous, and your material will chip. For drilling thinner materials and substrates consider using heavy duty double sided tape to firmly hold your material in place.

**Drilling Speeds**

To maximize the life of your drill and minimize material damage, it is important to run your drills at the proper drill speed and pressure. Drilling speeds vary with diameter of diamond drill, diamond mesh size, coolant being used, diamond bond type and hardness, as well as material hardness. Micro Diamond Drills from .001” required drilling speeds as high as 150,000+ RPM. Whereas very large diamond drills 48” diameter require drilling speeds as low as 3 RPM's.

Below is a chart of Recommended RPM's (speeds) in correlation to diamond drill/bit diameter. **Please note this chart is for reference purpose only to be used as starting point only.** RPM's will vary with material being drilled, material hardness, density, geometry, drilling depth, environment, and operator objectives.

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>RECOMMENDED RPM'S</th>
</tr>
</thead>
<tbody>
<tr>
<td>.001” to .004”</td>
<td>300,000 to 450,000</td>
</tr>
<tr>
<td>.005” to .015”</td>
<td>65,000 to 150,000</td>
</tr>
<tr>
<td>.016” to .030”</td>
<td>30,000 to 65,000</td>
</tr>
<tr>
<td>.031” to .090”</td>
<td>9,000 to 30,000</td>
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<tr>
<td>1/8” (3.18mm)</td>
<td>2,500</td>
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<tr>
<td>3/16” (4.76mm)</td>
<td>2,250</td>
</tr>
<tr>
<td>1/4” (6.35mm)</td>
<td>2,000</td>
</tr>
<tr>
<td>5/16” (7.94mm)</td>
<td>1,500</td>
</tr>
<tr>
<td>3/8” (5.52mm)</td>
<td>1,250</td>
</tr>
<tr>
<td>7/16” (11.1mm)</td>
<td>1,000</td>
</tr>
<tr>
<td>½” (12.7mm)</td>
<td>950</td>
</tr>
<tr>
<td>9/16” (14.28mm)</td>
<td>925</td>
</tr>
<tr>
<td>5/8” (15.87mm)</td>
<td>875</td>
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<td>2/3” (16.93mm)</td>
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<tr>
<td>11/16” (17.46mm)</td>
<td>825</td>
</tr>
<tr>
<td>3/4” (19.05mm)</td>
<td>775</td>
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<td>7/8” (22.22mm)</td>
<td>700</td>
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<tr>
<td>1.0” (25.4mm)</td>
<td>675</td>
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<tr>
<td>1-1/8” (28.57mm)</td>
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<tr>
<td>1-1/4” (1-1/4mm)</td>
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<tr>
<td>1-3/8” (34.92mm)</td>
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<tr>
<td>1-1/2” (38.10mm)</td>
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<tr>
<td>1-5/8” (41.27mm)</td>
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<tr>
<td>1-3/4” (44.45mm)</td>
<td>550</td>
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<tr>
<td>2.00” (50.80mm)</td>
<td>525</td>
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<tr>
<td>2-1/4” (57.15mm)</td>
<td>500</td>
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<td>2-1/2” (63.50mm)</td>
<td>475</td>
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<td>3.00” (76.20mm)</td>
<td>450</td>
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<td>3-1/2” (88.90mm)</td>
<td>425</td>
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<tr>
<td>4.00” (101.60mm)</td>
<td>400</td>
</tr>
<tr>
<td>6.00” (152.40mm)</td>
<td>300</td>
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</table>

Soft, abrasive materials can typically handle higher drilling speeds, while hard, dense materials require much slower speeds. Faster drilling might appear to increase your production efficiency, but the tradeoff is a significant increase in friction and heat, which considerably reduces the drill life and increases the risk of heat fractures and breakage in the material being drilled.

Meaning if a diamond core drill develops dark “burn” marks at the diamond section, the drill is being used is too fast or the amount of pressure is too great. Reduce drilling speed or adjust pressure accordingly. It is generally recommended that you use a slightly faster “drill” speed.
Drilling with Coolant

Coolant should always be used to cool and lubricate the drill. The most frequent cause of diamond drill damage is drilling without enough coolant. Never run a diamond drill dry—coolant should always be used to cool and lubricate the drill and to flush out abrasive particles formed while drilling. When used without coolant diamonds turn into carbon under high temperature. This is known as the reverse osmosis process. Water is the most frequently used coolant because it typically provides excellent performance at a minimal cost. Water is a true organic coolant, which does not leave the material being machined oily, greasy, or contaminated. City water with 90 psi or running water is usually used for drilling.

Other types of coolant include: synthetic water soluble coolants, mineral oils, other oils, and on some applications cold or compressed air. If you are planning to use water as a coolant, check with the drill manufacturer to find out what water pressure is required and if any additives are recommended. (Note that using additives will require a circulating system to ensure that the right ratio is maintained between your additive and coolant.)

The coolant must also be applied in the right place to ensure that it properly cools the drill and the material being drilled. The coolant should be directed so that the full flow is at the point of contact between the drill and the material, facing the same direction as the rotation of the drill. When drilling on a vertical surface (not recommended for advanced ceramic materials), use a squirt bottle or small cup of water to continuously pour water onto the drilling zone. Make sure enough coolant is reaching the drill. Alternatively, you can submerge the material into a shallow tub of coolant so that the coolant just barely covers the material surface. If coolants cannot be used, consider using air to cool your diamond drills. If air cannot be used, a resin bond or electroplated (nickel bonded) diamond drill may be a solution.

Never run a diamond drill dry. Severe damage will result. Coolants do 3 things:

- a.) cool drill and material being drilled
- b.) clean out abrasive particles formed while drilling
- c.) provide lubrication to keep drilling edge clean

When drilling in harder materials such as granite, agate, quartz, porcelain, or very hard materials like sapphire and alumina, it is important to have lots of coolant. Running water through the center of your drills, is the best way for drilling these materials. This can best be accomplished by using a water swivel adapter. Doing so, you will have constant water pressure following through the center of your drill. Which you will be able to regulate. All diamond drills with female collet (thread) can can be used with a water swivel adapter. Such as sintered (metal bond) diamond drills or Electroplated Thin Wall diamond drills . If you are using electroplated (nickel bond) core drills, you will need to drill with a small amount of water constantly running over the diamond core drill and bore hole by using something like a garden hose.

For some applications, you may want to use an additive with your coolant. If you decide to go this route, you will need a circulating system and the right ratio between your additive and coolant.

Coolant Usage Suggestions & Recommendations:

Drilling on a horizontal surface
• drilling zone. Observe hole to make sure enough lubrication is reaching the drill.
• submerge the material into a tub of water. So water just touches material surface.

Drilling on a vertical surface

• consider using a water swivel adapter to provide coolant through the center of your drills. Water swivel adapters provide the most efficient and effective method of coolant.
• should you find yourself in a situation where a water swivel adapter cannot be used, use a garden type of hose which can be easily obtained from any hardware store.
• if this is not possible, use a squirt bottle to provide coolant to your drilling zone.

Water Swivel Adapters

Provide coolant through the center of the diamond core drill. Water Swivel adapter cools both diamond core drill and material in zone of drilling. Water swivel adapters come with a valve for adjustable water flow. On Average, diamond drills used with water swivel adapters will last 40% to 75% longer.

Diamond Core Drills used with water swivel adapter will not overheat material and prevent cracks that occasionally arise from drilling. UKAM Industrial Superhard Tools manufactures water swivel adapters to fit just about any drilling equipment.

When considering using a water swivel adapter, make sure it is designed to be used with RPM's you are planning to run your drills. Water swivel adapters that are made from stainless steel, ball bearings, and with adjustable water flow, are preferable over water swivel adapters made from brass and no bearings.

Water Swivel Adapters are generally used with diamond drills that are mounted on a collet with female thread. Water swivel adapters are designed to fit all standard thread sizes such as 5/8-18", ¾-16", 5/8-11", ½" gas and many others. Diamond solid drills and most Electroplated (nickel bond) Diamond Drills are usually made with a straight shank and not designed for coolant to run through center of drill, should be used submerged with coolant.

**Why use Water Swivel Adapter to run high pressure of coolant through center of your diamond drill?**

• Best and most efficient way of drilling ultra hard materials
• Best & most efficient way to obtain (extract) core samples
• Improve surface finish quality and reduce material chipping
• Increase Diamond Drill Life 40% to 75%
• Increase Drilling Speed & Feed Rate
• Prevent micro cracks that occasionally arise from heat generated while drillings
• Preserve material true micro structure
• Obtain More Consistent overall performance
• Optimize your Diamond Drilling Operation to ultimate point of efficiency

**Coolant pressure**

You will find the more pressure you have on your coolant, usually the better your drilling results will be. Strong coolant pressure will wash out material debris (center plugs) stuck in center of your drill. Center plugs restrict coolant flow to center of drill and prevent coolant from reaching the diamond section. Your drill will start to drill dry, significantly reducing your drill life, material surface finish, and deteriorating overall performance. Contact your equipment supplier for advice.
diamond section, are behind 90% of all drill wreckage.

Using Coolant through center of your drills

When drilling with diamond drills, the *proper use of coolant* is important for two reasons.

**Minimize Drill & Material Overheating**

Frictional heat produced at the working face of diamond tip must be disposed immediately. Otherwise the diamond become rapidly damaged by oxidation and graphitization. Excessive heat generated while drilling will also damage the metal matrix holding the diamonds in place.

**Insure Drilling Consistency**

Debris generated while drilling should be removed as soon as they are produced. When this drilling debris is not removed rapidly, diamond wear increases through abrasion caused by the presence of excessive coarse stone fragments.

Water is the most common coolant used for many drilling applications. It is always a good idea to pump an adequate supply of water or coolant through the center of the drill. So that an uninterrupted flow is maintained flushing across the working surface of the drill diamond section. In this way diamonds and the metal matrix are both kept sufficiently cool. And material debris is removed as soon as it is produced. This is the *most optimum condition* for your drill.

**Reduce Friction between material and drill**

Water/coolant also penetrates the micro-cracks which are generated upon impact of material and diamond drill. Under ideal conditions, the material will absorb water/coolant, hence becoming completely saturated with water/coolant. In this state the material is weaker and more easily drillable.

The coolant surface tension also plays an important part in the drilling operation. Usually the lower the surface tension, the easier it is for the coolant with a lower surface tension also wets the diamonds more easily. Most users find that by lowering the surface tension of their coolant, resulted in better cooling (wetting) of their diamond, and more effective overall cooling. Lower surface tension also improves material debris lubrication, promoting efficient removal.

**Applying Pressure to Drill**

It is also very important to apply the right amount of pressure during drilling. Use light to medium pressure, gradually feeding the drill into the material, until the drilling begins to progress at its own speed. Increasing pressure on the drill will do little to reduce the time it takes you to complete a hole, but it will cause your drill to overload and overheat, which will lead to excessive wear on the drill and defects in the material being drilled.

When you are drilling completely through a piece of material and the hole is near completion, reduce the drill pressure considerably to minimize chipping of the material. *Never force a diamond drill.* Apply even pressure until the drill and material just touch. Since the drill and material surface are not perfectly even (symmetric) to each other, this lets the drill surface become sharper and adjust to the surface of material. If a diamond core drill develops dark “burn” marks at the diamond section, the drill speed is probably too high or the amount of pressure is too great. Reduce the drilling speed or pressure accordingly.

**Using Submerged Pressure**

Using frequent up and down motion when drilling will help propel coolant deeper into the hole being drilled. It is highly recommended that drilling should be done in even intervals. Drilling for about 30 seconds, lift diamond drill up from drilling zone to let it cool in air and diamond and coolant reach further into the drilling zone. Following this technique will reduce pre-mature and uneven diamond drill wear and avoid diamond drill/bit wreckage.
Balancing Drilling Speed, Pressure and Coolant

Drilling speeds are affected by the hardness and abrasiveness of the material, age and condition of equipment, pressure and coolant. Experience with a specific material and applications allows the operator to develop the right drilling process for their particular application, and taking into account all of the factors discussed above. **New users, who are just beginning to drill with diamond drills, are better off starting to drill at low speeds, low pressure and with a large amount of coolant.** Until they are able to build their experience using a specific diamond drill, set up, and application. Doing so will minimize the risk of diamond drill and material damage.

Drilling Depth

When drilling with core drills in material over 1/2" thick, it is recommended to drill to a depth of about 1/2", then remove material debris with a chisel or screwdriver before continuing to drill. If you are using a water swivel adapter, increase the water pressure until, the debris stuck inside is flushed out. If you are drilling a thick piece of material, repeat this process several times. Continuing to drill without removing material debris stuck in the center will cause the drill to burn up, since enough coolant is unable to reach the drill.

Applications require drilling depth of not more than 1”. Applications requiring you to drill over 1” should be tread in a different way. We recommend running coolants from multiple directions. Through drill center, from side of drill, as well as drilling submerged in coolant. This will insure maximum amount of coolant and lubrication reaching your drilling zone. Running high pressure of coolant through center of your diamond drill/bit by using a **water swivel adapter** is highly recommended for drilling material over 1” (25.4mm) Thick. Longer Drilling depths may require drilling in several steps and using more than one diamond core drill / diamond drill bit.

Small Diameter Drills

Small diameter diamond drills must be used at significantly higher speeds than larger size drills. It has been found that **higher Revolutions Per Minute (RPM’s) improve surface finish and overall drilling performance.** RPM’s for diamond solid drills .001” to 2.5mm (without center hole for coolant flow capabilities) range from 9,000 to 450,000. Drilling equipment that can accommodate these speeds include: high speed air spindles, hand held drills, and other specialty micro drilling equipment. High speed air spindles can run up to 450,000 RPM, hand held drilling machines to 35,000 RPM, and specialty micro drilling equipment up to 25,000 RPM. All diamond solid drills and diamond micro drills must be used with coolant. We recommend either drilling submerged in coolant, or applying air as coolant (in some cases), if other liquid coolant types cannot be used. Smaller size diamond core drills 1.6mm to ½” (mounted on a collet with thread and designed to run coolant through center of drill) must run with high pressure of coolant 45 PSI through center of drill.

Extending Drilling Depth

Diamond Drills can deliver drilling depths of about 2” to 8” (with long and the diamond depth (diamond section) being about 8mm. When drilling deep holes, beyond the diamond drill depth, the drill chuck may come into contact with the surface of the material being drilled. A drill tube extension can be used to lengthen the the drilling depth. Various sized tubes (core drill) extensions can be purchased at most hardware stores, building, contractor, and do-it-yourself supply centers.
This is the key successful drilling very hard materials. Drilling submerged in coolant is not recommend. Once the core (material debris) becomes stuck inside the drill, coolant is blocked off from the drilling zone, and the drill can no longer be used.

It is very important that you periodically check the inside of the drill for material clog up. If you spot the material core becoming clogged up, flush out this debris using coolant pressure from a water swivel adapter or other coolant source. Continue drilling only after the debris has been removed. We recommend that you use diamond core drills 1/2" and above on a drill press.

Dressing Diamond Drills

Most Diamond Drills can be dressed (retrued) several times. Usually the wear on the diamond drill depth takes place on the drill core and diamond section, as well as wall thickness. A diamond drill can be retrued by facing off the drill depth with a SiC wheel to the point where the wall thickness is standard. Retrueing (dressing) causes diamonds to be pulled out from the drill diamond section (diamond tip). For this reason, great care should be taken to reduce this effect. We suggest reexposing the diamond section with a Al203 stick after retrueing. This is a very simple operation: just drill into the dressing stick a few times.

Diamond Drill Maintenance

Proper diamond drill care and maintenance is very important for optimum drilling performance. Maintaining the diamond section shape and rigidity is important to prevent the drill from losing its sharpness and roundness. Make sure to repeatedly dress and retrue the drills diamond section to reexpose new diamonds. If you see the diamond drill has lost its shape or rigidity, send it back to the manufacturer to be retrued.

Importance of following proper mounting, dressing, and coolant techniques

Sintered (metal bond) Diamond core drill, 5/16" in diameter was used to drill 0.070" thick alumina substrate mounted on double sided tape.

Hole # 1: Diamond Drill was not dressed before use and also shows signs of significant run out. Hole is out of round and shows signs of diamond drill hitting (hammering) surface of material, before making indentation.

Hole # 2: Diamond Drill was properly mounted and checked for concentricity. However, diamond drill was still not dressed before use.

Hole # 3: All proper diamond drilling procedures were followed. Diamond Drill was properly dressed and is running concentric.
Today’s growing variety and ever changing materials, Manufacturers, R & D facilities, hobbyists and everyone else involved in diamond drilling encounter wide variety of applications and challenges. The ever increasing variety of advanced, new generation, ultra hard, composite, micro, and exotic materials transform the way we look at diamond drilling. And set many age old diamond drills and drilling methods obsolete. New materials require different technology and methods. And although, today’s market place offers the Production Engineer, R & D Scientist, Hobby Enthusiast, and Home Owner hundreds of choices of diamond drills, accessories, and equipment. It offers little advice on how the user can implement these tools to accomplish their specific objectives.

Many users still spend days and even weeks, trying different drills, and experimenting with different types of drilling equipment. An expensive and time consuming trial and error process, which can be avoided with proper understanding of your material and objectives you need to accomplish. Proper preparation, attention to detail, and following basic drilling technique can make the difference in the success of your drilling operation. The following are some factors and criteria to consider when selecting the right diamond drill for your application.

Selecting the right diamond drill for your application will save you time, money, and improve the overall outcome of your project.

by BRIAN FARBEROV, VP President UKAM Industrial Superhard Tools, Valencia, Calif.

MATERIAL TO BE DRILLED

Materials you are planning to drill will have a large impact in the types of diamond drills, equipment, and accessories you will be able to use. If you are drilling ultra hard materials such as sapphire, alumina, other types of advanced ceramics, high metallic content materials, precious and natural stone. It is generally recommended that you use a sintered (metal bonded) diamond drill. However, if you are drilling softer and less expensive materials such as glass, composites, soft stone and tile, an electroplated (nickel bonded) diamond drill may be a better and more cost effective solution. As a rule of thumb harder materials require softer bond, to drill faster and freer. While softer and abrasive materials require a harder bond, to last longer.

If the material you are planning to drill is precious, valuable, or expensive. The diamond drill cost will play a minor role in your drilling operation. It is suggested that you obtain a thin wall diamond core drill to minimize material loss and deformation. It’s always a good idea to have some type of an estimate of target cost and quality per hole.
Material Thickness

Material thickness will also play a critical role in your diamond drilling operation. Usually thicker materials require larger amount of coolant and water pressure. Drilling Depth of most applications require drilling depth of not more than 1”. Applications requiring you to drill over 1” should be treated in a different way. We recommend running coolants from multiple directions. Through drill center, from side of drill, as well as drilling submerged in coolant. This will insure maximum amount of coolant and lubrication reaching your drilling zone. Apply more pressure and reduce speed the deeper you penetrate into your material. Lift drill up, after every inch drilling into your material, letting the drill cool and coolant reach deeper into your hole. Carefully examine the diamond tip condition, making sure it's round, and not overheated.

Your maximum drilling depth will also be limited by spindle travel. The distance your drilling equipment can move in an upward and downward motion before touching the surface of your material. Make sure to take this into consideration when ordering diamond drills.

EQUIPMENT TO BE USED

The equipment you will be using and its physical condition, will dictate the speeds (RPM's) and coolants you can use along with your drills. Hence, somewhat limiting your diamond drill selection. No matter what diamond drill you use or how well its made, it will not provide the performance you are looking for, if you don't use the right drilling equipment for your application. Diamond drills are usually used on a drill press, angle grinders, hand held drills, milling machines and CNC equipment. A drill press, milling machine, or CNC machine is used in most production applications. R & D facilities also tend to utilize the same equipment. Hobby Enthusiasts, Contractors, and Home Owners most often use hand held drills, followed by drill presses, drilling rigs, and angle grinders.

Drill Press

For most drilling applications we recommend you use diamond drills on a drill press. The drill press provides uniform drilling consistency, tighter tolerances, and better overall performance. Although it may cost more than an angle grinder, hand held grinder, or hand held drill. It will pay off in the long run. Although there are hundreds of different types of drill presses on the market. For the most part, drill presses can be classified as four different types:

Bench Drill Press is the most frequently used drill presses. Designed for smaller jobs and usually bolted or clamped to table or bench top or stand. This is the smallest and least expensive type of drill press. Perfect for the hobbyist and beginner. Floor Drill Press are larger drill presses. Usually has a base that stands directly on the floor of your shop. This drill press can be extended and adjusted for optimum use and movement. An operator may use this drill press in either sitting or standing position.

This type of drill press can be found used in most manufacturing and R & D facilities. Industrial / Production Drill Press on the other hand is a more heavier duty drill press, similar to a milling machine. Usually come with adjusted RPM (variable speed), larger drilling table (area) for holding larger parts (material), more powerful motor, capability to use chuck or collet, move drilling head up and down, move table horizontally and vertically. This type of equipment is used in more high production scenarios.

A few high production and manufacturing facilities have Specialty / Custom Drill Presses built specifically for their material / application. For example, when machining very
brittle or fragile materials the drill press will be made from special type of metal to minimize dust and corrosion.

Many come with X, Y, Z axis and have ultra precise chucks, collets, water pumps and devices. With these types of drill press you are usually able to regulate drilling depth either electronically or by computer, maintain consistent speed and feed rate. More advanced drill presses today may have feed back mechanism that provides information on all of these variables.

When buying a Diamond Drill to fit your current Drill Press or buying a Drill Press to fit a Diamond Drill, we recommend you carefully examine both drill and drilling equipment specifications to make sure they are compatible. Some variables you should consider:

Drill presses run on electric motors rated in horsepower. Make sure the motor for the drill press you choose is powerful enough for the material you are planning to drill and the diamond drill you are planning to use. Most Bench Drill Presses have motors rated between .3 hp and .5 hp. Floor Drill Presses on the other hand have motors that run between .75 hp and 1.5 hp. We recommend you choose the highest power motor you can afford. Doing so will place less strain on your job and will allow you to be more flexible, if you decide to use another drill or drill a different type of material in the future.

Depending on the material you are planning to drill, you will need to adjust the speed (RPM) at which you diamond drills run. A drill press will usually allow you to run your diamond drills between 500 RPM (Revolutions Per Minute) to 3,500 RPM. Some Drill Presses only provide specific speed settings, such as 500, 1,000, 1,500, 2,00, 2,500, and 3,000 RPM. This may be acceptable to you, again depending on the diameter of the diamond drill and material you are planning to use it on.

Before buying a drill press, make sure it will run at the RPM required RPM of your diamond drill.

Another important factor to consider when buying a drill press, is its throat depth. Drill Press design usually limits the distance between the center of the spindle (where the diamond drill is placed) and front edge of the vertical post that is used to support the drill head. This is called the throat depth. When drilling a hole in the center of a round work piece such as a tabletop, the radius of your work piece will need to be less than the throat depth itself.

Drill Press Variables:

Spindle Travel - The spindle of a drill press moves up and down only a certain distance. The distance the spindle can move is called spindle travel. This determines the maximum depth of the holes you will be able to drill. The drilling depth of your diamond drill will need to reflect and consider the spindle travel of your drill press.

Table Adjustments - Most Drill Presses have a tilting worktable. Some have the capability to tilt 45 degrees left and 45 degrees right. Others can tilt a full 90 degrees in each direction. Before buying a drill press, make sure the model you are considering, can work with the angles you need to make for your application. It is also recommended that the table swing in the horizontal pane as well. An excellent type of drill press is the one that can spin completely around the post.

Head Adjustments - A number of Drill Presses supplement a tilting table with a tilting drill head. Tilting heads typically move 45 degrees left and right, and ease the mind-bending work of compound angles. We recommend you are comfortable with both the adjustment mechanism and the angle gauge before using or buying this type of drill press.
Drill Press Accessories - There are a number of accessories on the market that will make your drilling experience faster, easier, and provide better performance as well as lower cost per hole. A few important ones include:

Water Swivel Adapters - used to supply water through the center of your drills. Increase drill life 40% to 75%, improve quality of hole, and surface finish.

Shank Adapters - thread into your diamond drill collet, and allow the diamond drill to be placed in the drill press chuck.

Vises and Clamps - Designed for your drill press worktable. Hold you material firmly in place while drilling

Angle Grinders / Hand Held Grinders

Angle / Hand Held Grinder offer your diamond drilling operation the advantage of low cost, and increasing

With this one piece equipment you can drill, cut, grind, and polish. An angle grinder is excellent choice for small jobs, outside jobs, drilling hard to reach places, or when drilling a very large piece of material. An excellent alternate, where use of a conventional drill press is not feasible. Angle grinders can run up to 10,000 rpm. Water swivel adapters specially designed to fit all popular angle / hand held grinders can extend the capability of your angle grinder by supply coolant through center of your diamond drills or many other diamond tools. Giving your angle grinder and diamond drills to accomplish improved efficiency, drilling speed, and surface quality finish.

Hand Held Drills

Nothing beats the versatility and ease of use of a Hand Held Drill. Hand held drills are lightweight and portable, and can be taken with you anywhere you go.

Perfect for use on horizontal surfaces, and outside jobs. There are over a dozen of different types of hand held drills available on the market. Hand held drills are designed for use in many different applications. Some are made to use with low RPM’s and there are some that can run over 35,000 RPM. A hand held drill is an excellent tool for the contractor, hobby enthusiast, and home owner.

Hand Held Drills are available in a wide selection of both corded electric and battery-powered cordless models. The drill type you choose will effect your drilling capability in terms of material and diameter of the hole. The first step in selecting the right hand held drill for your application is determining the size of holes you need to drill and in what materials will you are planning to drill.

Make sure you select the hand held drill that actually has the capacity to do the work you need. Doing so will make your jobs faster and easier. As well as avoid problems such as ruining the diamond drill or material, caused by drilling with the wrong hand held drill or hand held rill without enough capacity.

The following are some of the features you should consider when choosing the right hand held drill for your application:

Capacity

A hand held drill's capacity indicates the largest hole size you can drill. Most hand held drills are ranked according to the maximum diamond drill shank the chuck can hold. Most popular drill shank sizes are 3/8" and 1/2". For smaller Foredom™ and Dremel™ machines, shanks size is usually 1/8" or 1/16".

Power

Make sure your hand held drill has enough power to use the diamond drill at the recommend RPM. Hand held drills are ranked according to maximum horsepower the motor can give. If your hand held drill does not have enough
And you will not be able to drill the size of hole and material you need. Before buying a hand held drill, we recommend you compare the horsepower of the drill. By the same token, if you will be working only with small, or soft material, and need to drill only a few holes an inexpensive drill will probably be sufficient for your application. However, if you are planning to drill a large amount of holes, drill hard materials, or make deep holes and need to use your drill often, a more heavy duty and higher powered drill will be required.

When drilling, **never force your hand held drills**, doing causes a more wear and tear on your drill, than associated with normal usage. Hence, decreasing your machines life and deteriorating future performance.

### CNC / Milling Machines

The best drilling results, precision tolerances, surface finish, and consistency will be obtained on a CNC / Milling Machine. An ideal choice for **high production drilling operations**

This equipment is fully automatic and controlled by a computer. And costs more than other types of drilling equipment.

### Number of Holes to be Drilled

Your diamond drill requirements will greatly vary with your frequency of use and the number of holes you need to drill. High production diamond drilling requirements greatly differ from R & D, contractor, hobby, and home owner requirements. Diamond Drills in production setting are used every day or several times a day, drilling several thousand holes until the drill is warn out and replaced. Metal Bond (Sintered) diamond drills are usually recommended for this type of heavy duty use. However, if you have a very fine or specific finish requirement and do not polish material after drilling. **HYBRID Bond diamond drill** may be the best solution for your application.

If you are planning to use Diamond Drill occasionally for a specific job and than stored for later use, or make less than a 100 holes, we recommend you use an **electroplated** (nickel bond) diamond drills are recommended. However, if you are planning to use the drill a number of times through the year. **Sintered (metal bonded) diamond drill** is a better overall solution and investment.

### Technical Requirements/Specifications

#### Chipping/Finish Requirements

If you have an application where surface finish and chipping is a critical factor, a sintered **(metal bond) diamond drill** with a very fine diamond grit may be the best solution. **HYBRID Bond diamond drill** is another alternative.

#### Tolerances

If you are using diamond drills to drill holes in a product that requires on specific tolerances, you will need a **custom diamond drill** specifically designed for your application. Its important to have some kind of an idea on what accuracy and tolerance you need to obtain. Diamond Drills, accessories, and drilling equipment should be selected to achieve these requirements. Each material has different density, hardness, composition. For this reason a diamond drill and technique that may work on one material, may not work on another material. To obtain optimum drilling results, each diamond drill should be ideally made to factor in the unique differences and properties of each material.

#### Material Cost

If the material you are drilling drill precious, valuable, or expensive. The diamond drill cost will play a minor role in your drilling operation. It is suggested that you obtain a **thin wall diamond core drill** to minimize material loss and deformation. Thin wall diamond core drills are capable of being used at much higher rpm’s than thicker wall drills. And will minimize material loose, and provide closer tolerances. Thin wall core drills are not recommended for use on angle grinders. It’s always a good idea to have some type of an estimate of target cost and quality per hole.
Coolant to be used

Your capability to use coolant while drill, will seriously effect your diamond drill selection. Most diamond core drills must be used with coolant. When drilling with diamond drills, the proper use of coolant is important for two reasons.

Minimize Drill & Material Overheating

Frictional heat produced at the working face of diamond tip must be disposed immediately. Otherwise the diamond become rapidly damaged by oxidation and graphitization. Excessive heat generated while drilling will also damage the metal matrix holding the diamonds in place.

Insure Drilling Consistency

Debris generated while drilling should be removed as soon as they are produced. When this drilling debris is not removed rapidly, diamond wear increases through abrasion caused by the presence of excessive coarse stone fragments.

Water is the most common coolant used for most drilling application. It is always a good idea to pump an adequate supply of water through the center of the drill. So that an uninterrupted flow is maintained flushing across the working surface of the drill diamond section. In this way diamonds and the metal matrix are both kept sufficiently cool. And rock debris is removed as soon as it is produced. This is the most optimum condition for your drill.

Reduce Friction between material and drill

Water also penetrates the micro-cracks witch are generated upon impact of material and diamond drill. Under ideal conditions, the material will absorb water, hence becoming completely saturated with water. In this state the material is weaker and more easily drillable. The coolant surface tension also plays an important part in the drilling operation. Usually the lower the surface tension, the easier it is for the coolant to enter the micro cracks. Coolant with a lower surface tension also wets the diamonds more easily. Most users find that by lowering the surface tension of their coolant, resulted in better cooling (wetting) of their diamond, and more effective overall cooling.

Lower surface tension also improves material debris lubrication, promoting efficient removal.

Shorter drill life, material and drill deformation will result when using drills dry. Electroplated (nickel bonded) diamond core drills may be used dry (without water) depending on the application (material being drilled). UKAM Industrial Superhard Tools does have the capability to manufactured diamond drills to be used without coolant. However, using diamond drills dry is not recommended on most applications. When chance prevails, use all diamond drills with coolant.

Diamond Drill Variables

The Bond Hardness of your diamond drill will determine the type of materials you will be able to drill with your diamond drill. Harder materials such as advanced ceramics and ultra hard stone generally require a softer bond. However, a diamond drill made for this application will not last a long time on softer and more brittle materials such as silicon and flagstone, witch require a harder bond. Another important factor to consider when selecting the right diamond drill for your application is Grit Size. Generally selected depending on the speed you wish to operate the drill and surface finish of your material. Courser (larger) size diamonds will drill faster than finer (smaller) diamonds. However, the trade off is smoother surface finish. Different materials and equipment require the use of diamond drills with various wall thickness. Many production facilities are equipment...
Diamond core drills. Thin wall diamond core drills provide less loss of material, minimum material deformation, less heat generation, faster drilling, speed, less chipping, better finish quality. Usually the thinner the wall thickness of your diamond drill, faster the speed (RPM) your drill may run, less chipping and heat your drill generates, and smoother and higher quality of the finish. Thin wall diamond core drills. One major drawback is shorter diamond drill life.

**Diamond Bond Types**

High production applications that require hundreds of holes, involve use of Sintered (Metal Bond) Diamond Drills. As a general rule of thumb, Metal Bond (sintered) diamond drills last longer than other diamond drills available. Although Drilling life will vary with manufacturer, and hardness of material being drilled. With most conventional sintered (metal bonded) diamond drills, you should be able to obtain 450 to 1200 holes. Metal bonded diamond core drills have diamonds sintered and multiple layers of diamonds impregnated inside the metal matrix. They wear evenly, and are known for their consistency. Sintered (metal bonded) diamond core drills are the latest technology available in diamond drills. And represent the best value and performance per hole.

**Electroplated Diamond Core Drills** are perfect for smaller jobs, softer materials and beginning diamond drill users. Electroplated diamond drill is just about the only type of diamond drill that may be used dry (without coolant) in a few applications, excellent for drilling very abrasive materials and have a high diamond concentration and give a freer, faster drilling action with minimum heat generation. Diamonds stay on the surface of the drill allowing for fast material removal. Electroplated Diamond Drills last less than metal bond, drills and are the least expensive diamond drills available. And are more forgiving than, metal bonded drills, in most cases capable of withstanding to greater amount of operator error.

**Metal Bond Drills vs. Electroplated Drills**

- Multiple layers of diamond  - Single layer of diamond
- Stands under aggressive conditions  - Cannot be dressed
- Super smooth finish  - Least Expensive
- Longest lasting drill  - Shortest Drill Life
- Very Universal  - Cannot be used on
- Most cost effective  - some materials
Varying with application and material, an average electroplated diamond core drill will last you 80 to 120 holes.

Electroplated drills cost less, and at first glance may seem like the most cost effective alternative. However depending on you application, they will cost you more in the long run. Varying with material and application, metal bond diamond core drills will last significantly more than 20 electroplated diamond drills put together. You can't get more life out of any other drill. Instead of constantly putting diamond core drills on and off the drill press, you will save time and money by using one drill. This means cost per hole, metal bond diamond core drills are the best choice.

Electroplated drills have only one layer of diamond coated on metal body. Diamonds sit only on the surface. When this diamond portion is peeled off, the diamond drill will slow down, drill on the side (not drill straight) or stop working (drilling) altogether. Metal bond diamond core drills have diamonds sintered and multiple layers of diamonds impregnated inside the metal matrix. Unlike electroplated drills, metal bond diamond core drills wear evenly, and are known for their consistency. You will get consistent

Diamond Bottoming Tool / Drill

Designed for drilling without core formation, Diamond Bottoming Drills/Tools are used for making Blind Holes in all types of material ranging in hardness. A bottoming tool does not have a core, and essentially works as both a diamond drill and grinding disc. The bottoming tools works by grinding the bottom and inside of the hole to a flat surface. This tool is just about the only way you can drill larger than 3/8" OD (outside diameter) blind holes. Careful attention to detail will make the whole difference in quality of your diamond drilling operation.
DIAMOND DRILL GUIDE – What you should know before you buy your next diamond drill

Not all Diamond Drills/Bits are created equal. Diamond Drills are found in hundreds of different varieties, types, bond types, and manufacturing methods. It's important for the user to understand the subtle differences between diamond drill & diamond drill bit types, their intended application and their affect on performance. The Guide below was designed to aid diamond drill/bit users of all experience levels from novice to experienced manufacturing engineer, researcher and professional craftsmen. Better understand the numerous variables that play a vital role in the success of your diamond drilling operation. Each diamond drill/bit is designed specific application, and hence may react differently under different conditions. What worked for one application, may not work for another. After reading this guide, the user will be equipped with the knowledge to make a more intelligent diamond drill selection. And Select the Right Diamond Drill/Bit for their material/application the First Time.

Why use Diamond Drills?

Diamond is the hardest material known to man kind. When used on diamond drills/tools, diamond grinds away material on micro (nano) level. Due to its hardness Diamond will work all types of materials from hardness of 40 on Rockwell scale and up. Diamond (diamond drills/bts) will machine hardest material, including those materials that other conventional types of abrasives, carbide and high speed steel will not. Diamond Drills/Bits will drill materials faster, produce smoother surface finish quality, provide consistent performance, & yield (cost per part) possible. Diamond drills are an excellent alternative to carbide, and other types of drills Unlike carbide, high speed steel, & other types of drills. Diamond drill works by grinding away material on micro (nano) level. Carbide and other types drills on the other hand cut material with a sharp cutting edge.
Sintered (Metal Bonded) Diamond Core Drills vs. Electroplated (nickel bonded) Diamond Core Drills

- Multiple layers of diamond
- Stands up well under aggressive conditions
- Super smooth finish
- Longest lasting blade
- Very Universal
- Most cost effective

Metal bonded diamond core drills have diamonds sintered and multiple layers of diamonds impregnated inside the metal matrix. Diamonds are furnaces sintered in a matrix made of iron, cobalt, nickel, bronze, copper, tungsten, alloys of these powders or other metals in various combinations. Metal Bonded Diamond Tools are “impregnated” with diamonds. The compacted materials are then hot pressed or sintered to full density. Heating rate, applied pressure, sintering temperature and holding time, are all controlled according to the matrix composition. This means that selected diamonds are mixed and sintered with specific metal alloys to achieve the best cutting performance possible on any materials such as sapphire, advanced ceramics, optics, glass, granite, tile and etc. The metal bond surrounding the diamonds must wear away to continuously keep re-exposing the diamonds for the diamond tool to continue cutting. **Sintered (metal bonded) diamond tools are recommended for machining hard materials from 45 to 75 on Rockwell Scale (5 to 9.5 on mohs scale of hardness)**. As a general rule of thumb, **Metal Bond (sintered) diamond drills last longer than other diamond drills available**.

They can be used in almost all diamond drilling application ranging from very soft & abrasive materials to ultra hard materials. Typical applications include in order from hardness: Composites, Glass, Concrete, Sandstone/flagstone, Natural Stone, Optical Materials, Precious & Semiprecious stone, Advanced/Technical Ceramics, Advanced Materials, & Many Others. Sintered (metal bonded) diamond drills/bits are used & preferred in most **Industrial/Manufacturing, R & D, Professional Contractor, & Serious Hobby Enthusiast / Craftsmen** users. Sintered (metal bond) diamond core drills/bits are most widely used diamond drills across almost all industries & applications. They wear evenly, and are known for their long life & consistency. **Precision & Accurate tolerances either on OD, ID, Run Out & Concentricity can only be obtained with sintered (metal bond) diamond drills.**

**Sintered (metal bond) diamond core drills/bits Require PROPER USE & SOLID UNDERSTANDING of Proper Diamond Drill/Diamond Tool Principals.** Experience well help as well. Careless handling or use in imprecise machinery will result in diamond drill wrecking/breaking, bending or cracking the bond and will prevent future use. Drilling life will vary with manufacturer & application/material factors described in this guide below. While there is no way to accurately predicting diamond drill life, with most conventional sintered (metal bonded) diamond drills, you can expect 350 to 1200 holes, parts machined, or cores. In laboratory tests, Diamond Drills with **SMART CUT™ technology** have shown to last **2,000+ holes** on many applications/materials. Sintered (metal bonded) diamond core drills/bits with **SMART CUT™ technology** are the latest technology available in diamond drills. And represent the best value and performance per hole or part.
HYBRID BOND™ Diamond Drills

Between METAL BOND and RESIN BOND. Designed to produce smoothest surface finish possible. You will find all the advantages of drilling speed and fine finish that you have come to expect in a resin bond, and long life, consistency, aggressiveness, durability, and excellent performance on you look for in a metal bond. Hybrid Bond Diamond Drills are used on finish critical applications, that require a minimum amount of chipping and where no further polishing, lapping, or processing of material is planned. Best performance will be achieved on following applications: Glass/Quartz Tubing, Bk7, Fused Silica, Other ultra brittle materials. Advantages include: Less Chipping, Additional Universality in Application - 1 drill will work in both metal bond and resin bond applications, and Greater Consistency in Performance.

Electroplated Diamond Core Drills & Electroplated Thin Wall Diamond Core Drills have a high diamond concentration and maximum diamond particle (grit) exposure/protrusion ratio. This provides freer, faster drilling action with minimum heat generation. Electroplated Diamond Drills provide excellent performance on softer materials ranging from 6 to 1 on mohs scale of hardness. While electroplated diamond drills, specifically manufactured by UKAM Industrial, will still work on harder materials (up to 9 on mohs scale). Diamond drill life will be (very short) significantly reduced. Diamonds stay on the surface of the drill allowing for fast material removal. Perfect for softer, more ductile, and gummable materials. Electroplated Diamond Drills are frequently used in glass and composite industries (as well as some photonics / optics) applications. Electroplated Diamond Drills are designed for small & occasional use. They are widely used by beginning diamond drill users (novices) in numerous hobby/craft applications. As well as home owners and contractors requiring to drill a few holes when installing tile, marble, shower doors, glass mirrors, and etc. (not recommended for professional or serious industrial use). They are also usually more forgiving to operator/user drilling mistakes than most other types of diamond drills/bits. Electroplated core drills are just about the only type of diamond drill that may be used dry (without coolant) in a few applications if needed. Best performance and results will be achieved when drilling less than 1/4" (6.35") into material. Performance in many applications will decline when drilling thicker materials.

Most Electroplated diamond drills/bits have only one layer of diamond coated on a steel body. Diamonds stay only on the surface. When this diamond portion is worn out or peeled off, the diamond drill will slow down, drill on the side (not drill straight) or stop working (drilling) altogether. Electroplated diamond core drills Manufactured by UKAM Industrial are Multi Layered. They have 3 layers of diamonds, not just 1 layer of diamonds like conventional electroplated drills. This provides longer drilling life, faster and freer drilling action, & more consistent performance.

When using Carbide, and Other types of diamond drills

Diamond drills are an excellent alternative to carbide, and other types of drills Unlike carbide, high speed steel, & other types of drills. Diamond drill works by orinds away material on micro (nano) level. Carbide and other types drills on the other hand cut material with a sharo cuttina edge. Diamond Drill/Bit Advantages over other drills:

- Cross application capabilities
- Superior Long Life
- More Consistency in Performance
- More Durability

Many users have found that ONE diamond drills can last up to 50+ carbide drills put together. Is a Diamond Core Drill the right tool for your application? To find out, give our Engineering Department a call at Phone: (661) 257-2288.
**UKAM Industrial Superhard Tools** manufactures & stocks Diamond Drills/Bits to customer desired specifications, outside & inside diameters, drilling depths, bond types, diamond grit sizes, mountings, & tolerances. Below is a diagram (technical drawing) that will help you better understand different diamond drill/bit specifications that can be altered based on your requirements.

**DIAMETERS:**

- \(D\) = Outside Diameter
- \(D_1\) = Inside Diameter
- \(D_3\) = Shank Diameter
- \(D_4\) = Shank Inside Diameter

**HEIGHTS:**

- \(H\) = Total Drill Length
- \(H_1\) = Diamond Depth (diamond height)
- \(H_2\) = Drilling Depth (how deep you can drill)
- \(H_3\) = Shank Length

**THICKNESS:**

- \(TH\) = Drill Tube Wall Thickness
- \(TH_1\) = Outside Diameter Diamond Section Relief
- \(TH_2\) = Inside Diameter Diamond Section Relief

**Offcentric Diamond Drill:** Designed with what is commonly called Half Moon shaped ID, allowing the core drill to move material and coolant at the same time as it drills the hole. ID (Inside Diameter) of the Diamond Drills/Bit is made larger (off center). OD (outside diameter) is made smaller to accomplish this purpose.

**Non Coring / DISINTEGRATING ID Diamond Drill:** Inside diameter of this diamond drill is offset. It is still considered a diamond core drill because it has a slot on side for coolant to pass through center of the diamond drill. This type of diamond drill leaves no core behind (destroys core when drilling), because its ID (inside diameter) is Offset.

**Slotted Diamond Drill Design** - Making slots in diamond drill tip will usually make them drill faster and freer in hard materials. Slots help reduce diamond drill heat generation, and better propel coolant through the drilling zone. The width of slot depends on hardness of material. Diamond Drills manufactured for drilling harder materials require more slots than diamond drills made for softer materials. Slots are recommended for thick wall diamond drills, helping increase drilling speed and efficiency.

**Diamond Core Drill/Bit Mounting Methods:** Diamond Drills/Bits must be either mounted on a collet or made with straight shank. Diamond Drills mounted on a collet can be used with water swivel adapter to run high pressure of coolant through center of drill. Diamond drills with straight shank are meant to be placed in drilling machine chuck and cannot be used with water swivel adapter. We recommend using diamond drills/bits that are mounted on a collet. You can always purchase a shank adapter that will thread into the collet, that will convert your diamond drill into a straight shank mounting. Various industries used different collets (mounting methods). **Most often used collets are** 5/8-11", 5/8-18, 1-14, 3/4-16, 7/8-14, 1-1/4-7", **BRANSON (Ultrasonic) and Others. Standard shank sizes are usually** 1/4", 3/8", and 1/2" diameter.
Successful diamond drilling is both an art & science. Requiring the proper understanding of how to use drilling speed and pressure, coolants, and drilling accessories to maximize production efficiency, drill life and product quality. While this understanding is best gained through experience, even new diamond drill users can quickly become proficient by learning and applying some basic principles of diamond drilling. We are here to help you get the most out of your diamond drilling operation. **Below is a guide of most common diamond drilling problems & solutions on how to resolve them.** If you have a problem than is not addressed by this guide, have a question, need further guidance or assistance please contact us by email, phone, or fax. For urgent support, you can contact us at: Phone: (661) 257-2288. Our experienced engineers will provide valuable suggestions on how to improve you diamond drilling operation. We encourage you to provide as much information as possible on your application problem occurred, and periodically update us on your diamond drilling progress. We also highly encourage you to check the **SUPPORT** part of our web site. This will answer most questions you may have.

Diamond Drill Life & Overall Performance will vary with material hardness, density, Drilling Depth. Few other factors that play a role in diamond drill life include: RPM's (drilling speed), Feed Rate, Geometry (shape) of Material, Coolant being Used, Coolant feed rate and Direction. Drilling Equipment, Material Clamping Method & experience of operator. While there is now way of accurately predicting Life of your diamond drill. It can be optimized by following **Principals of Proper Diamond Drill / Tool Usage**

There may also be some experimenting, as well as trial & error involved in the part of the end user. Highly experienced diamond drill users may find some variations in diamond drill life or performance even when working on same material & application.
MOST COMMON PROBLEMS ENCOUNTERED WHEN USING DIAMOND DRILLS

If you find your material is:

a.) Broken while drilling  b.) Chipped while drilling  c.) Drilling Process is too slow

We recommend following the steps below in consecutive order:

1. Dress and Clean the drill by drilling several times into a dressing stick
2. Check for drill runout. We recommend the drill concentricity within 0.005". If you find the drill run out not close to this figure, take the drill off the machine, clean tapers and threads of drill and any drilling accessories. Mount the drill again and recheck its runout using an indicator.
3. Increase the amount of coolant (PSI) Pressure per square inch flowing through the center of your drills. Look inside the drill to make sure no material debris is stuck inside.
4. Check if you are using the appropriate (recommended) drilling speed.
5. Decrease the drilling pressure placed on the drill. Try drilling with only minimal contact pressure. Make sure you are using submerged pressure. Meaning drilling in up and down cycles (movements). Drill down for 30 seconds, than lift diamond drill up for 30 seconds, letting coolant penetrate deeper into material being drilled and diamond drill cool in air. Continue this process until drilling is completed. Attempting to drill without properly applying SUBMERGED PRESSURE technique is the most common cause for diamond drilling trouble or failure.
6. Repeat all steps carefully. If the problem persists, you may have to check your drilling machine. Make sure your drilling equipment is in proper condition and you have enough horse power for your drilling operation. Larger diameter diamond drills or thicker material requires greater than 1HP motor power.
7. Try mounting the drill on another drilling machine. See if this resolves the issue.

Diamond Core Drill/Bit Tip #1 - FREQUENT CAUSE OF DIAMOND DRILL DAMAGE:

What happens when material core (center plug) becomes stuck inside the diamond drill

Once the center core (plug), material debris stick inside the tube of the drill. Coolant is no longer able to penetrate the drilling zone. The bond structure surrounding the diamonds either on sintered (metal bond) or electroplated (nickel bond) diamond drill must wear away to continuously keep re-exposing the diamonds for the diamond drill to continue drilling.

If the tool becomes overheated, the metal bond does not wear away, instead it “glazes over” the diamond. Hence coating or covering the diamond. The metal bond then becomes the cutting agent rather than the diamond. Generating more heat. The diamond tool will eventually chip the material or break it, due to excessive heat build up in material. Same heat may damage the diamond tool itself, by causing heat cracks in the diamond section.

Diamonds in the center of the drill start turning into carbon (phenomena known as reverse osmosis process) and slowly stop working (drilling the material), while diamonds on the side of drill (diamond layer section) continue working at full speed. There is uneven wear on the diamond section, and the drill appears to be drilling very slow, or almost stops drilling. The operator than applies greater force (pressure on the drill). Usually what ends up happening is the operator breaks the steel tube with the diamond section from the steel collet or shank.
<table>
<thead>
<tr>
<th>Common Problems / Cause</th>
<th>Solution / Preventions</th>
</tr>
</thead>
</table>
| Material Overheating         | • Not enough coolant is reaching drilling zone.  
• Run high pressure of coolant through center of drill.  
• Run high pressure of coolant through jets from both sides of diamond drill into drilling zone.  
• Consider Using synthetic water soluble coolant (such as SMART CUT™ coolant) or mineral oil. |
| Material/Drill Vibration (uneven holes) | • Check your diamond drill for run out  
• check your drilling machine chuck for run out  
• Make sure your diamond drill is properly placed into drilling machine chuck  
• Check condition of your drilling machine & replace worn/out of order parts as needed.  
• Make sure your material is firmly held in place and does not move while drilling  
• Make sure your table does not vibrate  
• Dress your diamond drill using a dressing stick to reexpose and sharpen diamonds as needed. |
| Excessive Chipping           | • Use Finer Diamond Mesh (grit size) diamond core drill  
• Reduce Speed, RPM & Feed Rate  
• Consider using appropriate coolant for the material / application such as synthetic water soluble coolant or mineral oil.  
• Make sure that your material is securely held in place and does not move while being cut.  
• Check condition of your drilling machine to make sure it is not out of order or parts need replacement  
• Check to see if sufficient amount of coolant is reaching the cutting zone. |
| Excessive Burrs on Material Edges | • Use Finer Diamond Mesh (grit size) diamond drill  
• Reduce RPM and Feed rate as needed  
• Use higher Diamond Concentration diamond drill  
• Check to see if sufficient amount of coolant is reaching the drilling zone.  
• Consider Using appropriate coolant for the material / application such as synthetic water soluble coolant or mineral oil. (not just plain water) |
<table>
<thead>
<tr>
<th>Diamond Drill is Drilling Very Slow</th>
<th>Diamond Drill is Not Drilling / Working</th>
<th>Short Diamond Drill Life</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use a <strong>dressing stick</strong> made from alumina oxide or silicon carbide to dress the diamond drill (sharpen diamonds / rexpose diamond layer)</td>
<td>• Make sure the RPM's recommended for the specific diamond drill you are using</td>
<td>• Improper diamond drill specification selection. Diamond Concentration, Mesh Size, and Bond Hardness is inappropriate for material being drilled. Use different diamond drill with right bond type, hardness, concentration and grit size for material being drilled. Contact us for recommendation.</td>
</tr>
<tr>
<td>• drill into <strong>dressing stick</strong> 10 to 20 times. Or as much as necessary, until diamond drill starts near same speed as when it was new.</td>
<td>• Use a <strong>dressing stick</strong> made from alumina oxide or silicon carbide to dress the diamond drill (sharpen diamonds / rexpose diamond layer)</td>
<td>• Check to see if sufficient amount of coolant is reaching the drilling zone.</td>
</tr>
<tr>
<td>• Make sure material core (plug) is not stuck inside the core drill.</td>
<td>• Cut into <strong>dressing stick</strong> 10 to 20 times. Or as much as necessary, until diamond drill starts near same speed as when it was new.</td>
<td>• Make sure material core (plug) is not stuck inside the core drill.</td>
</tr>
<tr>
<td>• Increase the RPM and Feed Rate as needed</td>
<td>• Increase RPM (speed)</td>
<td>• Consider Using <strong>water swivel adapter</strong> to run high pressure of coolant through center of drill. On Average, depending on material / application Diamond Drills used with <strong>Water Swivel Adapters</strong> will last 40% to 75% longer.</td>
</tr>
</tbody>
</table>

**NOTE ABOUT DIAMOND DRILL LIFE:**

Diamond Drill Life will vary with material hardness, density, Drilling Depth. Few other factors that play a role in diamond drill life include: RPM's (drilling speed), Feed Rate, Geometry (shape) of Material, Coolant being Used, Coolant feed rate and Direction. Drilling Equipment, Material Clamping Method & experience of operator. While there is now way of accurately predicting Life of your diamond drill. It can be optimized by following Principals of Proper Diamond Drill Usage. There may also be some experimenting, as well as trial & error involved in the part of the end user. Even high experienced diamond drill users may find some variations in diamond drill life on same material & application.
Diamond Tip Fractures Off (for sintered metal bond drills)

**Possible Causes:**
- Material Core (plug) stuck inside
- Material Being Drilled in not held firmly & securely in place
- Drilling Material at an angle
- Excessive run out or wobbling of drilling machine chuck

Possible Cause: Material Core (plug) stuck inside diamond drill. This occurs when user does not remove this core generated while drilling. Failing to remove this core periodically will generate excessive heat on diamond drill and material. Coolant cannot effectively cool & lubricate diamond drill. Diamonds start turning into carbon under high temperature in phenomena known as reverse osmosis process. Diamond Drill will slowly stop drilling, while user is applying same feed rate level. **Solution / Prevention:** Periodically check the inside of your diamond core drill to make sure material core does not bind up the drill. Remove when necessary. Consider using this drill with Water Swivel Adapter to run high pressure of coolant through center of drill (about 45 PSI). You can automatically remove material core inside drill by increasing coolant pressure.

Possible Cause: Material Being Drilled in not held firmly & securely in place. Failing to properly secure material while drilling will cause material to suddenly jolt creating enough pressure to while diamond drill is rotating to deform the diamond section (tip) or break off completely. **Solution / Prevention:** Firmly secure material before drilling using proper clamping mechanisms for material size, type and geometry being drilled. Such as vice, vee-block, clay dam, double sided tape, rotary table, vacuum chuck, and etc.

Possible Cause: Drilling Material at an angle will cause the diamond drill section (tip) to unevenly wear. One side of the diamond tip may wear faster than the other or wear excessively in proportion to the rest of the diamond tip. Eventually pressure may cause the diamond section to collapse on itself, hence fracturing the diamond section (diamond tip). This often occurs when drilling horizontal surface or using hand held drilling machine or chuck of users drilling machine wobbles excessively and is out of tolerance. **Solution / Prevention:** When drilling horizontal surfaces use a template or guide. One can be made using a block of wood or crap piece of material. Drill the hole size in the template that you need to drill. And use it to start your hole and keep your drill from drilling at an angle or wobbling all over the place. use the **SUBMERGED PRESSURE TECHNIQUE** discussed above.

Diamond Tube separated from collet (female thread) Possible Causes:
- Drilling at an angle
- Drilling machine chuck run out
- Excessive Vibration while drilling
- Drilling at maximum drill depth at angle or not enough coolant reaching drilling zone

Possible Cause: Material Core (plug) stuck inside diamond drill. This occurs when user does not remove this core generated while drilling. Failing to remove this core periodically will generate excessive heat on diamond drill and material. Coolant cannot effectively cool & lubricate diamond drill. Diamonds start turning into carbon under high temperature in phenomena known as reverse osmosis process. Diamond Drill will slowly stop drilling, while user is applying same feed rate level. **Solution / Prevention:** Periodically check the inside of your diamond core drill to make sure material core does not bind up the drill. Remove when necessary. Consider using this drill with Water Swivel Adapter to run high pressure of coolant through center of drill (about 45 PSI). You can automatically remove material core inside drill by increasing coolant pressure.

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Possible Cause: Excessive run out or wobbling of drilling machine chuck. This occurs when user does not remove this core generated while drilling. Failing to remove this core periodically will generate excessive heat on diamond drill and material. Coolant cannot effectively cool & lubricate diamond drill. Diamonds start turning into carbon under high temperature in phenomena known as reverse osmosis process. Diamond Drill will slowly stop drilling, while user is applying same feed rate level. **Solution / Prevention:** Consider using this drill with Water Swivel Adapter to run high pressure of coolant through center of drill (about 45 PSI). You can automatically remove material core inside drill by increasing coolant pressure.

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Possible Cause: material core (plug), material debris stick inside the tube of the drill. Coolant is no longer able to penetrate the drilling zone. Diamonds in the center of the drill start turning into carbon (phenomena known as reverse osmosis process) and slowly stop working (drilling the material), while diamonds on the side of drill (diamond layer section) continue working at full speed. There is uneven wear on the diamond section, and the drill appears to be drilling very slow, or almost stops drilling. The operator than applies greater force (pressure on the drill). Usually what ends up happening is the operator breaks the steel tube with the diamond section from the steel collet or shank. These drills are produced from one piece of solid steel. We do not braise or weld the drill tube to the female collet. Its all one solid piece. **Solution / Prevention:** Periodically check diamond drill to make sure material core is not stuck inside. In order to cool the drill to optimum conditions. we very highly recommend that the customer use a Water Swivel Adapter (drill head assembly) to run high pressure of coolant through center of drill. This will increase life of drill up to 75% and improve surface finish.
HOW DIAMOND TOOLS WORK

UKAM Industrial Superhard Tools manufactures precision diamond tools for a large variety of applications, materials, and industries.

Metal Bonded Diamond Tools are “impregnated” with diamonds. This means that selected diamonds are mixed and sintered with specific metal alloys to achieve the best cutting performance possible on any materials such as sapphire, glass, granite, tile and etc. The metal bond surrounding the diamonds must wear away to continuously keep re-exposing the diamonds for the diamond tool to continue cutting.

If the tool becomes overheated, the metal bond does not wear away, instead it “glazes over” the diamond. Hence coating or covering the diamond. The metal bond then becomes the cutting agent rather than the diamond. Generating more heat. The diamond tool will eventually chip the material or break it, due to excessive heat build up in material. Same heat may damage the diamond tool itself, by causing heat cracks in the diamond section.

This has been a frequent problem with most conventional diamond tools. Much of this has been resolved with the introduction of SMART CUT™ technology. Advanced technology, that redefines the standard in cutting and drilling. Diamonds are oriented and evenly distributed inside the metal matrix, so that every diamond is better able to participate in the cutting action.

Optimum diamond tool performance can be achieved through the proper use and basic care of your diamond tool, before and during its use.

This instruction manual has been written tool help you get the most out of your diamond tool investment.

In order to help you select the right diamond tool for your application, our staff may ask you many questions about the material you wish to machine. These questions will specifically focus on:

a.) material being machined
b.) how you plan to machine it
c.) equipment you will be using
d.) RPM of that machine
e.) Coolants used
f.) Flange size

You may wonder why we need to know this information? Each diamond tool is designed specifically for each application, and hence may react differently under different conditions. What worked for one application, may not work for another. Yet, there is one thing all diamond tools have in common:
They are metal based products being used to cut either metals or hard materials. There use generates friction, which in turn can generate heat. Doing so, may damage your diamond tools.

In order to prevent this from occurring, there a number of basic procedures you can follow that will allow each diamond tool to operate successfully no matter what material you are machining.

**BASIC PROCEDURES YOU SHOULD FOLLOW WHEN USING DIAMOND TOOLS**

Although we realize than in many circumstances, there are a variety of factors that may prevent you from following all the suggested procedures. And not all jobs or operations can be done in a controlled environment such as a shop or lab. Nor all equipment on the market can be adjusted to suitably accommodate a diamond tool needs.

Frequently, you will find the best performance will be achieved by following these guidelines as closely as possible.

**Use the right diamond tool for your application**

Provide as much information possible about your application and material being machined. We can help you better define your needs, so you can obtain the right tool for the job. Saving money and time.

**Use the right RPM’S**

If the RPM on your equipment runs either too fast or too slow, excessive heat will be generated. Hence damaging your diamond tool. Charts provided in this manual will help you identify and select the right RPM’s for your diamond tools. As well as provide suggestions on ways you can achieve it.

**Use the right coolant at point of contact**

Depending on your application, there is a large variety of coolants you can select. Ranging from plain water, to water soluble coolants, to minerals and oils. Your specific application will be a determining factor in selecting a coolant. Not matter what coolant you decide to use, make sure it is used at the point of contact where material and tool intersect.

**Keep diamonds thoroughly exposed at all times**

Dress your new diamond tools before usage. Make sure to frequently redress your diamond tool while using it. Always use a recommended dressing stick.
Use the right diamond tool accessories

When cutting, use the right size flanges or wheel stiffener sets with all thin diamond blades to firmly hold it in place. This will help prevent the blade from “walking”. Use Drill Head Assemblies (water swivel adapters) with core drills to provide coolant (water) through the center of the drill and on to drilling zone.

THE RIGHT RPM’S

One of the most critical factors in successful diamond tool usage is the right RPM’s. If the diamond tool rotates to slow, it drags and creates heat. If it spins too fast, it causes friction and again generates heat. Heat is the worst enemy for a diamond tool. Selecting the right RPM becomes a critical factor of success. Unfortunately, this can also be the most difficult aspect of cutting or drilling to correct. Unless you have a machine with variable speed capability, most machines will only run at 1,725 to 3,450 RPM. Diamond tools frequently require RPM’s from 100 to 23,000.

If you use diamond tools on a regular basis, you may want to consider altering your machinery to accommodate variable speed capability. Using diamond tools at incorrect RPM’S will effect their performance. Causing excessive heat generation, warping, walking, and breakage. Frequent dressing, using right coolants, and using right flange sizes or wheel stiffeners can help. But will not completely substitute for correct RPM’s.

To determine the correct RPM’s for the optimum performance of your diamond tool, you must know the Surface Feet per Minute (SFPM) required to machine your material. The following “Guide to Operating Speeds for Diamond Tools” calculator includes a broad range of materials and the Surface Feet per Minute (SFPM) required to cut them. Input the SFPM needed, input the size of the blade or drill and calculate the SFPM or RPM you need to use with that tool.

Guide to Operating Speeds for Diamond Tools

<table>
<thead>
<tr>
<th>Material</th>
<th>Recommended Surface Feet per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jaspers</td>
<td>1900-3100</td>
</tr>
<tr>
<td>Other Lapidary Rocks</td>
<td>1900-3100</td>
</tr>
<tr>
<td>Carbide</td>
<td>1900-3100</td>
</tr>
<tr>
<td>Agates</td>
<td>2000-3250</td>
</tr>
<tr>
<td>Silicon Nitride</td>
<td>3050-4100</td>
</tr>
</tbody>
</table>
Hard Ceramics 4000-5650
Ruby-Germanium 4100-6500
Natural Quartz 4200-6000
Hard Glass 4300-6300
Fused Quartz 4500-6500
Sapphire 4500-5900
Medium Hard Glass 4250-7250
Hard Granite 5050-6250
Wall Tile 5250-6500
Hard Marble 5650-6750
Silicon 5750-7200
Ferrite 5750-7200
Medium Hard Marble 6050-8000
Light Weight Refractory 8800-11900

Unlike most diamond tool manufacturers, we recommend that you use water or water soluble coolants for most application. Oil is not a proper coolant, as most other diamond tool manufacturers would suggest. Water is a true organic coolant, which does not leave the material being machined oily, greasy, or contaminated.

Water does turn to steam at temperatures exceeding 212 degrees Fahrenheit. So, adding a non-sudsing detergent will help water provide more lubricity and serve longer as a coolant. Occasionally, it may be necessary to move from water to water soluble coolants. Such as when machining harder and more dense materials.

If coolants cannot be used, a resin bond or electroplated (nickel bonded) diamond product may be a solution. It is also important to remember that coolant must be delivered at the point of contact where the diamond tool and material intersect. When a diamond tool is turning at the right RPM's, momentum will throw the coolant out and away from the point of contact. When the diamond tool begins to rotate, and coolant is not delivered as close as possible to the point of contact, Heat will begin to generate, and the diamond tool will “glaze over”
with the bond no longer allowing diamonds to perform the cutting action.

**DRESSING DIAMOND TOOLS**

Diamond tools must be both trued to and dressed on the machine on which it will be used. This will guarantee two things:

a.) diamonds will be thoroughly exposed
b.) diamond tool will be “true in running (T.I.R.)” on your machine

Remember that every machine runs differently. And even if the diamond tool is trued at the factory, it can still “run-out” of tolerance when you place it on your machine. Blades must be trued and drills must be indicated in. Truing a tool is the operation of squaring a tool so it runs within your tolerances. This may be done with a hard stone that will knock diamonds out. This operation differs from dressing. It is still necessary to dress the tool after truing as the diamonds will no longer be sticking-up.

After truing the diamond tool, it is important to dress it to make sure the diamonds are exposed. The diamonds must be sticking up “exposed” from the bond matrix. If this is not accomplished, you will experience difficulty with your new diamond tool. A diamond tool that is thoroughly dressed will have diamond “tails” extending from the back of the diamond. Your diamond tool is now “directional”.

This means it should always run in the direction the leading edge of the diamond, away from the tail. So the sharper, leading edge of the diamond can achieve desired cutting action.

When your diamond tool is new, it should be dressed thoroughly by the operator. Never assume because the tool is new, that it does not require this operation. Dressing diamond tools is similar to dressing a knife with a stone. You want your knife as sharp as possible when you begin cutting as you do your diamond tool. In much the same way you make passes across the stone with the knife, you make several cuts into the dressing stick with the diamond tool. Using the correct, soft dressing stick, it is recommended that the tool is passed through the tick five to ten passes to expose the diamonds for optimum cutting performance.

If the dressing stick is too hard, it will “knock the diamonds out”. UKAM Industrial Superhard Tools can provide the proper dressing stick to avoid this problem. The more diamonds are exposed, the better the performance of the diamond tool. We recommend you give your new diamond tool the “Thumb Nail Test”. After thoroughly dressing the blade, you should be able to snag your thumb nail on the diamonds. This will let you know they are sticking up in order to cut properly.
After using your diamond tool for a while, it may seem to cut more slowly or begin to chip your material. This is because the diamonds are not longer exposed.

Never force your diamond tool. If you feel

a.) “resistance” in cutting
b.) diamond tool is not cutting as easily
c.) diamond tool is lowing down

it is important to stop and dress the wheel again. Following the same procedure as before. This will restore the blade to it’s original condition. Depending on the material to be cut, this procedure will be need to be repeated. Without proper dressing, your blade will stop cutting. Hence breaking or shipping your material or tool. This is because you are no longer cutting with diamonds, but instead using metal bond to do the cutting.

USE THE RIGHT DIAMOND TOOL

ACCESSORIES

With some materials, you may find yourself using a very thin diamond blade to cut into the material. You may wish to avoid the “resistance” of a thicker blade, need to hold tight tolerances or you are cutting an expensive piece of material, where minimum loss is critical. Even though your cut may not be very deep, your machine may only accommodate a specific blade diameter. When your blade cuts into your material, it may not have the rigidity to maintain the tolerance. The blade may begin to walk.

Although we use special alloy steel cores to minimize this problem. We suggest you insure maximum performance from your new diamond blade by using wheel stiffener sets to provide an extra degree of rigidity to the blade. Helping it run true. Wheel stiffener sets should be used at 2/3 rd’s the outside diameter of the Diamond blade and can be manufactured in all sizes needed.

To achieve optimum performance when using diamond core drills, water should be used down the center of the drill. We recommend that sealed bearing Drill Head Assembly (water swivel adapter) be used. Using a water swivel adapter helps your drills last up to 75% longer and minimizes material deformation and cracks associated with overheating.

We manufacture a large variety of water swivel adapter Models to accommodate different collets, chuck sizes, and thread sizes on the market. Water down the center of the drill also insures that the diamond section has a constant flow of coolant to keep maximum amount of diamonds exposed.

Wheel Stiffeners
Advanced Diamond Machining Solutions

Diamond Tools Play a major role in our everyday life.

Our life as we know today would not be made possible without the use of diamonds to machine the materials around us. Diamond Tools are used to machine the concrete roads we walk and drive on, granites in our kitchen countertops, electronic chips found in our cellular phones and other electronic devices. Many Industries and Products we take for granted today, could not feasibly exist without the use of diamond tools.

In 1996 over 5 billion dollars worth of diamond tools were consumed worldwide. Since the inception of the first industrial diamond, the material industry and diamond tools employed have evolved over the last 50 years from infancy to steady maturity. Despite the tremendous improvements which Synthetic Diamond and CBN (cubic boron nitride) have provided for precision cutting, drilling, and grinding tools, which are used to shape and fabricate the world around us. There are still many problems and disadvantages in both manufacturing and using these tools. Which when resolved, would greatly improve performance of these tools and reduce their costs.

One of the main problems faced by diamond tool manufacturers worldwide involves properly orienting and positioning diamonds inside bond matrix. Over the decades there have been numerous attempts to solve the diamond and CBN distribution problem. Unfortunately, none of the attempts have been proven effective.

Today 99.8% diamond tool manufacturers still have no way or technology to evenly control and distribute Diamond or CBN particles inside bond matrix, nor properly position them to maximize their machining efficiency.
Current technologies are also inadequate to provide effective control of diamond mesh size (grit size) and concentration of variations on different parts of the same tool. Current technologies also do not allow diamond distribution to be factored in when manufacture a wheel specifically designed for individual material property and structure.

In 1998 UKAM Industrial Superhard Tools, Division of LEL Diamond Tools International, Inc. Developed a solution to this problem. A new breakthrough called “SMART CUT technology” in manufacturing precision diamond tools. SMART CUT will greatly improve your diamond tool cutting, drilling, grinding, and lapping efficiency. SMART CUT™ is an ADVANCED technology that redefines the standard in manufacturing diamond tools. Utilizing this technology a diamond tool manufacturer is capable of orienting diamonds inside matrix so that every diamond is better able to participate in cutting or drilling action. SMART CUT™ open bond design makes sure every diamond is in the right place and at the right time, working where you need it most. You get maximum use of diamond and bond.

This technology makes diamond concentration almost irrelevant. What most diamond tool manufacturers used to do, and still do today is place diamonds inside the metal matrix, with no control over diamond distribution. The problem with this approach is inconsistent diamond tool performance. Only about 40% of these diamonds are able to participate in diamond machining action. The rest fall out, become dull, or disintegrate before they have a chance of being used. This factor causes the following problems:
Problems with Conventional Diamond Tools

The distance between each Diamond or CBN particles determines the work load each diamond will perform. Improper spacing of diamond or CBN particles typically leads to premature failure of abrasive surfaces or structure. If diamond or CBN particles are too close to one another, some of these particles are redundant and provide little or no assistance in cutting, drilling, grinding, or lapping. Excess diamonds particles increase the cost of manufacturing diamond tools, due to high cost diamond and CBN powder.

Yet have no effect in increasing performance. In fact excess and non performing diamond or CBN particles reduce the diamond tools overall performance and efficiency by blocking up the passage of debris from material being machined. In many cases these excessive diamond particles play a major rule in decreasing the useful life of your diamond tool. Conventional diamond tools have been suffering from these type of problems and inefficiencies for over 50 years.

Diamond Inefficiency / Ineffective Tool Performance

The performance of a diamond tool depends on how diamonds are distributed and adhered in matrix. Diamond distribution can be random or regular, and its adherence strong or weak. Conventional diamond tools contain randomly distributed diamond particles, and their adherence is intrinsically weak. Random diamond distribution combined with weak diamond bonding in conventional diamond tools design may slow down the cutting, drilling, grinding, and machining speed and shorten the tool life.

Diamond particles in conventional diamond tools are separated too far (the impact exerted by each diamond particle on material becomes excessive). The sparsely distributed diamond or CBN particles may be crushed or even dislodged from the matrix into which they are disposed. The damaged or missing diamond particles are unable to fully assist in the work load. Hence the
The failure of each diamond particle causes a chain reaction, which soon results in tool ineffective performance or complete failure of the diamond tool.

Inconsistent Machining Speed & Excessive Tool Dressing

After a few dozen uses a conventional diamond tool, and its speed gradually begins to slow down. You will notice excessively longer machining speeds, and equipment motor bug downs. And since only a few diamonds participate in the machining action, you may find yourself applying an increasing amount pressure just to machine the same amount of material. Without properly orienting the diamonds, conventional diamond tools quickly become dull, out of round. With further machining requiring constant tool dressing, in order to expose new diamonds.

SMART CUT™ technology

SMART CUT™ technology allows the diamond tool manufacturer to control diamond spacing. Hence improving performance of every diamond particle. This reduces the need for high diamond concentration used today in conventional diamond tools. Every Diamond in a SMART CUT™ diamond bond works like a small horse. Unlike many other bond designs, the SMART CUT™ begins to work from the first cut, and remains to work at the same level of consistent performance until you take your last cut. This unique open bond design insures you get the maximum usage of diamond and bond every time you use a SMART CUT™ product.

INDUSTRIES USED IN:

- Advanced Ceramics
- Composites
- Glass
- Medical Industry
- Metallography
- Material Science
- Natural Stone
- Precision Optics
- Precious Stone
- Semiconductor
Maximum Diamond Exposure / Diamonds Working for you

**SMART CUT™** open bond is designed to keep diamonds working at their maximum potential. **SMART CUT** diamond bond undergoes regular renewal, making sure all diamonds are constantly under maximum exposure to materials being worked on.

Some of the advantages include:

- More Consistent & Uniform Overall Performance
- Minimal Chipping
- Faster Machining Action
- Minimal Machining Noise
- Minimal Loss of Material
- Minimal Tool Dressing / Diamond Rexposure
- Easier to Use

**HOW SMART CUT WORKS?**

**Figure # 1**
The sharpest and finest quality Synthetic DeBeers diamonds that go into a **SMART CUT™** Diamond Bond. Immediately penetrate into the material, grinding and polishing as they cut.

**Figure # 2**
Diamonds are activated only at the exposed layer. As diamond layer begins to wear out, diamonds in the new layer are immediately activated, substituting the already used up diamond layer. The **SMART CUT™** Diamond Bond makes sure every diamond is in the right place and at the right time, working where you need it most.

**Figure # 3**
The newly exposed diamonds don’t effect diamonds working already inside the material. Unlike many other diamond bonds, diamond in a **SMART CUT™** remain sharp and grow sharper with each cut. Prolonging product life and consistent performance.

**Figure # 4**
This advanced formulated open bond design insures minimal chipping, fast cut, constant speed of cut, minimal cutting noise, and most important of all, minimal loss of material.
What is the difference between conventional diamond tools, and a diamond tools with SMART CUT™ technology?

**Advanced Coolant System**

Precision diamond tools manufactured utilizing SMART CUT™ technology, are built with a special open bond design that promotes a better coolant system. Air and water flows freely through the diamond bond, providing extra coolant, greater conductor of heat and thus increased product longevity. Instead of heat generated in a few places, it is evenly distributed and hence minimized.

**Easy to Use**

We made a science out of making your work easier. SMART CUT™ technology are easier to use than most conventional diamond products. Thousands of sharp and high quality diamond particles metallurgically bonded to alloy steel allow diamond tools with SMART CUT™ technology to complete a job by applying little or no pressure. Freeing the user from constantly having to dress and renew the diamond layer. SMART CUT™ technology makes any sophisticated job a simple one.

**no glazing**

Diamond Tools with SMART CUT™ technology require minimal dressing, the bond renews itself.

**faster machining action**

Diamond Tools manufactured utilizing this technology are much more aggressive than your conventional blades. They machine material faster, still leaving behind a smooth finish.

**longer lasting**

In most cases diamond tools manufactured utilizing SMART CUT™ technology, will outlast other conventional metal (sintered), resin, and nickel bonded diamond tools. SMART CUT™ diamond tools are more sturdy than tools manufactured with conventional technologies. Unlike many other resin or metal bonded diamond tools, these will not dull and maintain its firm shape and bond configuration all the way through the diamond tools life.

**Controlled Diamond Concentration at different parts of diamond tool**

Many times a metal bond diamond tool requires different sizes of diamonds and different diamond concentrations to be disposed at different parts on the same tool. Most diamond tools wear faster on the edge or in front of the tool
Higher diamond concentrations are preferred in these locations to prevent uneven wear and thus premature tools failure.

By making the distribution of Diamond or CBN particles uniform and in a predetermined pattern, tailored to individual customer application. The work load can be evenly distributed to each diamond particle. As a result a diamond tool with SMART CUT technology will machine material faster and its working life will be extended a considerable amount of time.

SMART CUT technology promotes not only even diamond distribution. But strong diamond retention as well. Allowing the diamond tool manufacturer to use of smaller diamond particles. Small diamond particles will improve surface finish, and optimized performance of each diamond particle.

There are other advantages of utilizing diamond tools manufactured with the SMART CUT™ technology. The company feels, you will find it a significant breakthrough in your industry.

When you see the SMART CUT™ symbol on a product, you know there is more to the diamond tool than it looks. Because what you don’t see is what makes all the difference. Whatever your goal requires you will find an advanced, high quality, and cost effective SMART CUT™ solution, specially designed for your needs. Just how superior is a SMART CUT™ product?

That’s for you to decide. Because you can’t really see the difference or get a sense of it from words. You must feel it, and you will from the first time you pick up a SMART CUT™ diamond product to the time you first use it, and all the way to the tools life.
Satisfied with your diamond drill/tool performance? We want to hear from you. After you have used your diamond drill/tool, Please complete the feedback form below and fax or send by mail to address above. Your feedback is very important to us. Your input and suggestions will help us better understand product performance in various environments, applications, and usage patterns. Hence, allowing us to make product improvements, provide improved usage recommendations, and serve you better now and near future. We value your input and appreciate

CUSTOMER DETAILS

Your Name: ____________________________ Company Name: ____________________________

Phone Number: ____________________________ Fax: ____________________________

Email: ____________________________ web site: ____________________________

Application Type: please select description that best applies to you (I am using this product for):

Industry _____ R & D _____ Hobby _____ Contractor Work _____ Other _____

PRODUCT INFORMATION

Purchase Date: ___________ Purchased from: ____________________________________________________________

Product Item Number: ______________________ Drill OD or ID: ____________________________

Product Description: ____________________________________________________________________________________

APPLICATION ENVIRONMENT

Materials working with: ____________________________________________________________

Typical Drill depth: ___________ Material Holding Method (how is your material held in place): ____________________________________________________________

Equipment used on: ______________________ RPM’s (speed) used: ___________ Coolant type used: ______________________

How coolant is supplied into drilling zone: ______________________ Is this a new application for you: Yes ___ No ___

THANK YOU FOR YOUR SUPPORT!
UKAM Industrial Superhard Tools Division of LEL Diamond Tools International, Inc.
28231 Avenue Crocker, Unit 80 Valencia, CA 91355 USA
Phone: (661) 257-2288 Fax: (661) 257-3833 www.ukam.com

CUSTOMER APPLICATION FEEDBACK

Feed rate (how long did it take you to drill through the material): ___________________________________________

Approximate Drill / Tool Life: _______________ Surface finish achieved: ________________________________

How did the drill / tool perform to what you have used before for same application:
__________________________________________________________________________________________________
__________________________________________________________________________________________________

What improvements you would like seen in product design, features or performance:
__________________________________________________________________________________________________
__________________________________________________________________________________________________

General Application Drill Feedback / Suggestions:
__________________________________________________________________________________________________
__________________________________________________________________________________________________

Would you like to review your application and provide suggestions on how you may optimize or improve your drilling operation to ultimate level of efficiency?  Yes ___  No ___

What would you like to improve about your current drilling operation (please circle all that apply):
Increase Drill/Tool Life  Reduce Chipping on top or bottom side  Increase Production Rate  Improve Part
Geometry, Straightness, Tolerances  Improve Surface Finish  Improve Process Consistency  Improve
Productivity: throughput, Feed Rate  Improve Total cost per hole/core

GENERAL CUSTOMER FEEDBACK

How did you hear about our company? ________________________________

Did you utilize our articles on how to properly use diamond drills, select the right diamond drill for your application, principals of proper diamond tool usage?  Yes _____  No _____

Would you purchase this product again?  Yes ____  No _____

Would you recommend this product to your friends or colleagues  Yes ____  No _____

General Suggestions on how we can improve our product, service, or support to better serve you:
_____________________________________________________________________________
HOW TO ORDER

Minimum Order: $25.00 USD (minimum order amount may vary depending on product type)

Order by Phone:

Call: (661) 257-2288  Monday through Friday 8:30 a.m. to 5:30 p.m.

Order by Fax:

Fax: (661) 257-3833, available 24 hours a day.

Order by Mail:

send your orders to: 28231 Avenue Crocker, Unit 80 Valencia, CA 91355 U.S.A.

please include product item number, description, and payment.

Accepted forms of payment

We accept Visa, MasterCard, and American Express. Organizations located in State of California add 8.25% sales tax. Net 30 terms on approved credit. Credit terms are only available to eligible organizations in USA and Canada. Pre Payment is requested from all customers outside North America. Payment by wire transfer is preferred. If paying by wire transfer, please add $25.00 USD to total. This is how much our bank charges us for each incoming wire transfer.
CUSTOMER ORDER FORM

Customer No. ____________ Date: ____________

Name: ____________________________________________

Company: __________________________________________

Billing Address: _____________________________________

Phone: __________________ Fax: __________________ e-mail: __________________

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Number</th>
<th>Description of Item</th>
<th>Unit Price</th>
<th>Total</th>
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Please indicate manner of payment below:

- Visa [ ]
- Master Card [ ]
- AMEX [ ]
- Check [ ]

Credit Card No. __________________________
Expiration Date: __________________________
Name on Card: ____________________________

CA residents add 8.25% sales tax
Shipping: ____________________________
Total Amount Enclosed: __________________
MERCHANDISING POLICIES:

Prices: Prices are F.O.B. Valencia, CA. Prices, discounts, terms, and conditions are subject to change without notice.

Discounts on Special Products: Products not listed on published price list may be subject to different discounts.

Quotations: On quantities larger than listed on Discount Schedule. Contact your UKAM Industrial sales representative.

Special Order: Special orders or standard products modified to a customers specifications cannot be returned, without our approval. Pre-payment with 50% non-refundable deposit is required.

Sales Tax: UKAM Industrial is required to charge applicable state and local tax on every item for which sales tax exemption certification has not been provided. When ordering please indicate clearly which items are tax exempt. Sales tax is only charged for customers located in state of California.

Payment Terms: Pre-payment by credit card. We are happy to accept Visa, Master Card, & American Express. We also accept money orders, wire transfers and checks in US dollars that have cleared our bank. For purchasers with established credit, terms are Net 30 days from date of shipment. If credit is not established, please include payment with order or pay by credit card or wire transfer. Cash or anticipation discounts are not allowed. All payments must be in U.S. Dollars.

FREIGHT POLICY:

Equipment, Parts and accessories: F.O.B. Shipping point (Valencia, CA). Diamond tools: F.O.B. Shipping point with freight allowed on orders of six or more tools if shipped by carrier of our choice. Unless routing is specified on each order, our shipping department will rout all shipment via one of the following carriers:

UPS & FEDERAL EXPRESS . shipments via air freight or other higher cost transportation will be invoiced.

EXPRESS SERVICE . when you want an order delivered as quickly as possible, ask for Express Service. We will help you select the fastest means to deliver your order.

DEFECTS:

The billing department must be notified of any defects and price or quantity errors within 5 days after receipt of shipment. Defective merchandise may be returned no later than 30 days after receipt.

CLAIMS:

All claims for merchandise damaged in transit must be with the freight company.

Any claims regarding or relating to any aspect of products purchased, services rendered must be made within first thirty (30) days of invoice date.
SHORTAGES:

Open and inspect all cartons upon receipt. Shortage claims will only be honored when reported promptly (within 24 hours of merchandise receipt).

RETURNED MERCHANDISE:

Should you wish to return any product you have purchased from us please observe the following:

- Our customer service department must be contacted for approval to return merchandise.
- Merchandise will not be accepted without a Return Goods Authorization number.
- All returned merchandise must be shipped prepaid to destination.
- **All returned merchandise must have been purchased within the previous 30 days** and be in resalable condition (not used).
- A restocking and handling charge of 25% will be billed, unless approved by a representative.
- Custom made products are not returnable.

*Before any product can be returned to us, you must request an RMA number online from Customer Service.* Requests for an RMA number must be made within 30 days from the date you received your order. Additional information including the return address will be provided to you once your request has been approved. By issuing you an RMA number, we assume that your return meets our guidelines. If possible, please include a copy of the original packing slip with your return. All products must be returned to us at your own expense. We recommend that you use a service such as UPS that provides a tracking number and includes insurance. In addition, we must receive your return within 30 days from the date the RMA number was issued.

Once we have received and approved your return, we will issue a credit back to the original payment method. The credit will be for the amount of the purchases, promotional discounts and/or coupon codes, kept/used toys and original shipping charges.

If you return a product and you used a free shipping coupon code when you placed your order, the full original shipping charge will be deducted from the refund amount.

CREDITS:

Credit for returned goods not accompanied by the original invoice number will be issued at the current price from which shall be deducted.

- 25% of the net credit value, for handling and restocking
- Inbound credit charges for merchandise received collect
Credit for freight charges shall be issued on defective materials and in-house errors only. Credit not taken within a 6 month period will be forfeited. Refund check shall not be issued unless the account is to be closed permanently.

CHANGING OR CANCELING AN ORDER

Order changes or cancellations may be made if the order has not shipped. There are no fees for altering/changing an order. For order cancellations a 0.5% processing fee may apply for some products. For Custom manufactured products, you must check with customer service if order change/alteration or cancellation can be made (depending where your order is in the manufacturing process).

GENERAL TERMS:

- All prices are quoted in U.S. Dollars.
- Prices are subject to change without notice.
- All prices, terms and quotes are binding when approved in writing.
- Written quotes expire sixty (30) calendar days from date of issuance.
- All orders constitute a binding contract between the seller (UKAM Industrial Superhard Tools) and the buyer when seller releases shipment.
- Title to all goods transfers to the buyer at the FOB point.
- If no invoice is found with the shipment, buyer should notify UKAM Industrial Superhard Tools immediately and a second copy will be issued.
- Unless otherwise expressly agreed, UKAM Industrial Superhard Tools may make delivery in one or more installments with each installment being treated as a separate agreement.
- An order shall not constitute a binding contract between Seller and Buyer until (a) Buyer shall have received Seller’s written acknowledgment of its acceptance of the order or (b) Seller shall have made shipment.
- Seller’s Terms and Conditions of Sale shall prevail over Buyer’s Terms and Conditions of Purchase. Our standard terms and conditions are accepted by buyer when ordering. We don not accept any deviations from those terms. If any additional or different terms or conditions are included in your order, we may choose to fulfill your order, but the additional or different terms and conditions will not apply or be deemed accepted by us.
- The prices and terms in this Agreement are not subject to verbal changes or other agreements unless approved in writing by the corporate headquarters of Seller.
- Prices are based upon costs and conditions existing on date of quotation and are subject to change by Seller before final acceptance.
- When quotation specifies material to be furnished by Buyer, ample allowance must be made for reasonable spoilage and material must be of suitable quality to facilitate efficient production.
- When material is to be furnished by Buyer, goods are to be delivered to Seller’s factory dock freight and applicable duties paid.
- Delivery dates mentioned in any Agreement are approximate only and not of any contractual effect and Seller shall not be under any liability to Buyer in respect of any failure to deliver on any particular date or dates.
• Delivery shall be at Seller's premises unless otherwise stipulated or agreed by Seller. Seller will charge for delivery other
than at its premises at its standard delivery rates.
• All non standard products, machines equipment, process development, and / or services. Written price quotation must be
obtained from an authorized representative.
• Export freight terms are quoted in accordance with INCOTERMS 1990, or when they become available, INCOTERMS
2000, except as otherwise provided herein. All shipping and related charges will be paid by Buyer.
• All drawings, designs, specifications and other information submitted by Seller are the property of Seller, are confidential
and shall not be disclosed to any third party without Seller's prior written consent.

Clerical Errors & Waiver

• UKAM Industrial Superhard Tools is not liable for clerical errors which may be corrected at any time.
• UKAM Industrial Superhard Tools is not liable to buyer for loss, damage, detention or delay resulting from causes beyond
its reasonable control.
• UKAM Industrial Superhard Tools has no liability in the case of orders arising from typographical errors and reserves the
right to cancel any orders. Every effort has been made to ensure accuracy of information listed and UKAM Industrial
Superhard Tools is not responsible for any errors contained therein.

WARRANTY:

UKAM Industrial Superhard Tools, warrants all products manufactured or distributed by us against defects in workmanship and
materials. The responsibility of UKAM Industrial Superhard Tools, under this warranty, is limited to replacement or repair of
defective parts at UKAM Industrial in Valencia, CA. In no event shall UKAM Industrial Superhard Tools be liable for consequential
damages arising out of failure of any product if operated improperly.

This warranty DOES NOT cover normal wear or damages resulting from operator abuse. Nor does this warranty cover FITNESS
FOR A PARTICULAR USE. This warranty is in lieu of all other warranties expressed or implied.

Diamond Tools perform and react differently with each individual application /material. Meaning EACH MATERIAL/APPLICATION
REQUIRES A DIFFERENT SOLUTION/TECHNOLOGICAL PROCESS. Based on our experience & input from other customers.
UKAM Industrial Superhard Tools makes its best effort to provide information & recommendations on selecting the right proper
diamond tool usage for your application. However, please note: The diamond tool itself is only a small factor in your overall
machining operation. Successful Results will depend on a large variety of factors such as:

a.) Selecting the right tool for your material/application
b.) RPM's
c.) Coolants
d.) Equipment
e.) Dressing Devices
f.) Accessories
Selecting these parameters, often involves a trial and error process. UKAM Industrial Superhard Tools has no way of controlling the environment & conditions under which its tools will be used by the "end user". What works for one application, may not work for another. Hence, in no event shall UKAM Industrial Superhard Tools be liable to any party direct or indirect, for special or other consequential damage due to use of its information, recommendations, or tools.

IN NO EVENT SHALL ANY LIABILITY UNDER THIS WARRANTY EXCEED THE REPLACEMENT COST OF ANY DEFECTIVE PRODUCT OR COMPONENT THEREOF, AND UKAM Industrial Superhard Tools SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES OR FOR ANY OTHER DAMAGE OR LOSS NOT EXPRESSLY ASSUMED AS SET FORTH HEREIN.

CONTINUOUS Rim Blade Warranty

If the bond between the diamond rim and the core fails during normal use, the blade will be replaced free of charge.

CROSS REFERENCE INFORMATION:

Product cross reference comparisons do not imply that all products compared are available, or in the case of functional equivalency, the performance and other characteristics are perfectly comparable. For critical applications, review specifications prior to purchase.

International Orders

UKAM Industrial requires pre-payment in full by either US bank money order, MasterCard, or Visa prior to shipment unless other terms have been approved UKAM Industrial Superhard Tools. Payment by credit card is accepted only few countries such as: Mexico, Canada, Australia, New Zeland, European Union, Singapore, and Malaysia. For most other countries, payment in full by wire transfer is required.

All prices are quoted Valencia, CA U.S.A. Unless otherwise stated. All expenses such as freight, duties, taxes, and brokerage fees will be the responsibility of the consignee. You may either choose your own freight forwarder or we will provide one for you based upon the best service for the particular destination. Please note that if we select the forwarder on your behalf, the associated charges will be added to your invoice.

All losses or damages incurred in transit are the responsibility of the consignee, but we will be happy to assist in the claims process by providing supporting documentation.

C.O.D. shipments are not available for non-U.S. deliveries. Unpaid Collect freight bills that are reversed and charged back to the shipper will be rebilled with an additional fee from UKAM Industrial Superhard Tools. If this occurs, no further shipments will be allowed until the account has been paid in full. Frequent abuse of collect shipments will result in prepayment only status. Customer Service will contact you for additional information upon receipt of order.
If you have an established Customs Broker, we would be happy to identify them on the export documents. Please have their contact information ready when Customer Service contacts you. Also, recording your import license on these documents can often expedite Customs clearance. Again, please advise Customer Service.

If your country requires any additional documentation, please notify Customer Service of the appropriate details.

- Pro Forma Invoice
- Letter of Credit
- Country Specific Commercial Invoice
- Consular Legalization
- Chamber of Commerce Certification
- Pre-shipment or SGS Inspections
- Certificate of Conformance
- Specialized Certificate of Origin
- Quarantine Certificate
- Special Labeling, Packaging, or Marking

Some of the above items may require a nominal fee to be added to the invoice.

Please be advised that export deliveries require additional processing time and may necessitate minimal delays.

Due to extensive screening and possible licensing requirements, an additional fee will be charged for any international shipments to locations other than the customer's primary address.

**Force Majeure**

Seller shall not be liable to Buyer for loss, damage, detention or delay resulting from causes beyond its reasonable control including, but not limited to, fire, strike, or other concerted action of workmen, act or omission of any governmental authority or of Buyer, insurrection or riot, embargo, car shortage, wreck or delay in transportation, or inability to obtain necessary labor, materials, or manufacturing facilities from unusual sources. In the event of delay due to any such cause, the date of delivery will be postponed by such length of time as may be reasonably necessary to compensate for the delay. In no event shall seller be liable for consequential damages or claims for labor resulting from failure or delay in delivery.