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SUBSEA MACHINING SOLUTIONS
OFFSHORE

DIAMOND WIRE GUIDANCE

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AN OVERVIEW OF WIRE TYPES AND APPLICATIONS

There are many different types of diamond wire, each with advantages and best use applications depending on the scope of work and variables of the wires assembly and properties. Mactech Offshore has the expertise and offers our experience to our customers to find the best fit for your project. Contact us today at 1-337-839-2793 or info@mactechoffshore.com

- Bead Shapes – Cylindrical, Conical & Bi-Conical
- Bonding Methods – Electroplating, Vacuum Brazing, Sintered
- Diamond size & grade
- Injection molding types, plastics & rubbers
- Connector Types
- Bead Densities (BPM)
- Application guide, the best wire for the cut

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CYLINDRICAL BEAD SHAPES

Cylindrical beads are produced on a concentric cylindrical steel carrier. For offshore applications they are typically 10.2mm diameter. Specialty beads can range from 8mm to 13mm diameter.

- Great general purpose bead shape
- Best for pipe in pipe cutting
- Usually bi-directional operation
- Available in Electroplated, Sintered & Vacuum Brazed
- Works well with saws of all power levels

CONICAL (TAPERED) BEAD SHAPES

Conical beads are produced on a tapered steel carrier. For offshore applications they are typically 10.2mm to 11mm diameter. Specialty beads can range from 10mm to 13mm diameter. Tapers can vary from very mild to aggressive.

- Best for heavy single wall pipe or single wall cuts
- Can be very aggressive cutting with high wire tension
- Can offer good wire life, only part of the bead contacts the workpiece
- Can tend to get stuck on pipe in pipe cuts
- Only cuts in one direction (Directional Wire)
- Only available in electroplated bonds

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BI-CONICAL BEAD SHAPES

Bi-Conical beads are produced on a bi-conical or double tapered steel carrier. For offshore applications they are typically 10.2mm diameter.

- Great general purpose bead shape
- Usually a very mild bi-conical shape (nearly cylindrical)
- Best for pipe in pipe cutting
- Usually bi-directional operation
- Available in Electroplated bonds
- Best properties of both cylindrical & conical beads

ELECTROPLATED BEADS

Electroplated beads use an electrolytic process in a cathodic bath to apply diamond grains and nickel to the exterior surface of the steel carrier. Diamond is deposited on the carrier by agitation and nickel bonds the diamond to the carrier. More than 50% of the diamond grain must be covered in nickel for diamond retention. Typically 55-65% coverage is ideal.

- Most common type of bonding
- Typically fastest cutting & most aggressive
- All diamond is deposited in a single layer with 35-45% of the grain exposed
- Not as long of life as Vacuum Brazed or Sintered

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VACUUM BRAZED BEADS

Vacuum brazed beads are manufactured in a brazing oven under vacuum to increase the quality of the braze bond. The braze, often called ‘paste’ is a mixture of different metal alloys. Active brazing uses some titanium alloys and forms carbides when cured.

- Longer life due to multiple layers of diamond and better diamond retention due to 100% coverage of the grains
- Can be difficult to wear away the braze from the beads and expose new diamond when cutting only steel. Best with abrasive materials such as grout or concrete
- Best combination of speed and life, in the right conditions
- Only commercially available in cylindrical bead shapes

SINTERED BEADS

Sintered beads are a composite of diamond grains and mixed metals which are heated and compressed to form a solid bead. Sintering can damage and weaken the diamond grains due to heat. Sintered beads are almost exclusively used in stone and concrete cutting. No commercially available sintered wires are available for steel cutting.

- Most commonly used for stone and concrete
- Cost effective and long lasting
- Typically smaller diamond grains
- Typically slower cutting than electroplated or vacuum brazed beads.
- Cylindrical bead shape only

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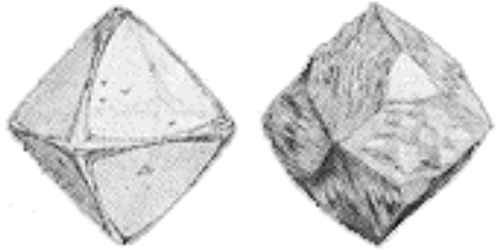
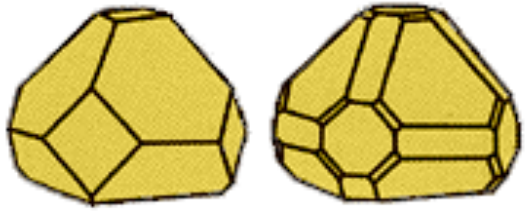
DIAMOND SHAPES, GRADES & SIZES

Diamond Wires, and other diamond cutting tools use synthetic, lab manufactured diamonds as the super hard abrasive material which cuts the intended object through abrasion. The shape, size and quality of the diamond are all factors in the performance and which is best for an application.

- The shape can range from jagged & sharp to angular & crystalline
- The grade is in regards to the diamonds friability, or its ability to fracture off small pieces to maintain a sharp cutting edge
- The size is measured in mesh size, which is equivalent to a micron range. The smaller the number, the larger the diamond size



Natural crystal shape



Synthetic crystal shape

DIAMOND TYPES

All Diamond Wires, whether Electroplated, Vacuum Brazed, or Sintered are made using Synthetic Diamonds. Synthetic Diamonds were first created by General Electric in the 1950's. Synthetic Diamonds are considered a super hard material which is primarily used for abrasive cutting, grinding or milling on non-ferrous materials outside of the diamond wire cutting industry. Diamonds, when exposed to high temperatures, above 800° Celsius will react with ferrous materials and oxidize, weakening the diamond. It is important to use adequate water cooling when cutting ferrous materials with diamond abrasives.

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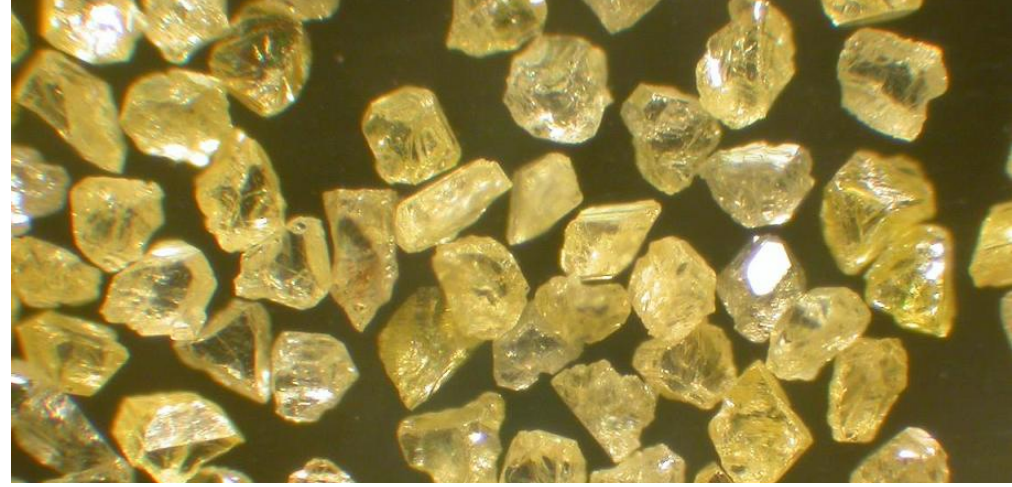
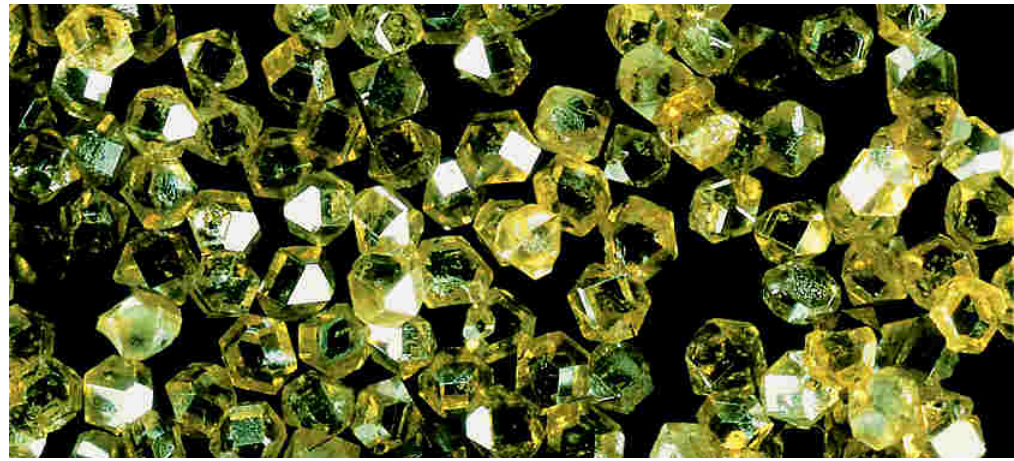
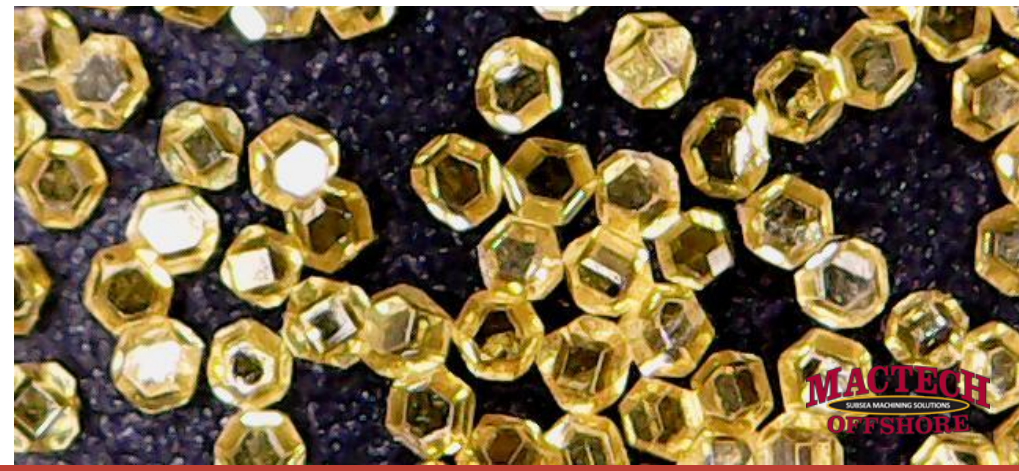
DIAMOND GRADES

Synthetic Diamonds are graded according to their manufacturer's standards rather than an industry standard. Higher grade diamonds generally more uniform in shape and are less friable, meaning they do not fracture easily. Lower grade diamonds are generally irregular in shape and fracture more easily. It would be easy to assume that a higher grade diamond is better in this application, but that isn't necessarily correct. Too high grade of a diamond with 'polish over' and wont cut effectively. Too low a grade will too quickly fracture and crumble. Diamonds of a medium / high grade are generally best for wire sawing. Examples would be Sandvik Hyperion MBS940 to 955 grades, or Element 6, SDB1065 – 1085.







DIAMOND SIZES

Diamond sizes are most commonly referred to as mesh size or by the FEPA designation. The mesh size is a range, based on the grain sizes in microns. Larger meshes require higher diamond grades than smaller meshes to maintain the level of friability.

- 20/25 mesh, D851 FEPA is a very coarse and aggressive grain used for steel cutting applications
- 20/30 mesh, D852 FEPA is a blend of coarse & medium grains giving a good combination of fast cutting & diamond life in steel cutting applications
- 25/30 mesh, D711 FEPA is a minimum grain size recommended for steel cutting applications
- 30/35 & 35/40 mesh, D601 & D501 FEPA are generally used for concrete & stone cutting applications

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INJECTION MOLDING, RUBBER & PLASTIC

Diamond Wires rely on injection molded materials to stabilize and maintain spacing of the beads on the wire rope. Rubber is generally a synthetic material using HNBR, SBR, or a blend of these materials. Plastic is generally a polymer based thermoplastic type such as Desmopan 192. Chemical primers or bonding agents are used to increase the bond with the wire, beads and springs.

- **Rubber** is more flexible and has a higher heat resistance
- **Rubber** has a higher materials cost & longer cure time which generally makes it more expensive
- **Plastic** has an adequate temperature rating in most any application with some water cooling
- **Plastic** is more compression, tear & abrasion resistant than rubber and can offer longer wire life with sufficient cooling

CONNECTOR TYPES

There are various types of connections available from pre-made continuous loops, to crimped connections that can be made on-site with specialized crimping tools.

- Continuous Loops – Woven connections of the wire rope held in place by the beads and injected rubber or plastic. These are the strongest connection in loops of 150” or more
- Straight Crimp Connections – Strong and inexpensive. Best for saws with large diameter pulleys or rigidity & cable fatigue can be an issue
- Swivel Connectors – Best for tight bend radius or small diameter pulleys. Allows more flexibility & less wire rope fatigue
- Quick Disconnect – Also a type of swivel connector that allows a loop to be opened & closed after crimping. These have the least strength, but allow a wire to be removed from a closed cut without cutting the wire. Good for cutting vertical pipes that close upon cut completion, or require wedges. Allows the wire to be reused

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BEAD DENSITIES (BEADS PER METER)

Diamond wires are often spec'd by the number of beads per meter. Commercially available wire varies from 40 bpm to 54 bpm with some specialty wires outside of this range. 44 bpm to 48 bpm are most common.

- Diamond wire relies on pressure to regulate the friction between the wire and the workpiece
- More beads require higher wire tension to produce the same amount of pressure and friction
- Wires with less than 44 bpm generally require less tension to cut at similar speeds, but with decreased wire life
- Wires with more than 48 bpm generally require high power saws capable of high wire tension to realize any gains in cutting speed
- Higher bead densities decrease the spacing between beads and can decrease wear on the wires structure
- Pulleys less than 7" in diameter require lower bead densities to aid wire flexibility

APPLICATION GUIDE

Material	Electroplated	Vacuum Brazed	Sintered
Stone	Better	Better	Best
Concrete	Better	Better	Best
Reinforced Concrete	Best	Best	Better
Steel	Best	Better	N/A

Material Shape	Cylindrical	Bi-Conical	Conical
Solid	Good	Better	Best
Heavy Wall	Better	Better	Best
Standard Wall	Better	Better	Better
Pipe in Pipe	Best	Better	Good

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