CORE DRILLING CROSSVILLE PORCELAIN TILES

Drilling:

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Old fashioned *Spear Point* carbide bits no longer work on the new type of super-hard floor, counter and wall tiles. Diamond Drill Bits are the solution.

Typically, a diamond tipped drill bit is used when drilling, one that is specifically designed for cutting through ceramic tile, marble, granite, stone or other dense materials.

It is also recommended to keep the drill bit wet, to cool the bit down and keep dust to a minimum. This can be done with a sponge, a small diameter hose and water source, or a spray bottle. Additional methods and details are included in the attached article.

For large diameter holes, a segmented diamond tipped Core Boring bit and appropriate drilling equipment is required. These sizes can range from about 1 inch up to over 6 inches.

Diamond Drill & Tool Omaha, Nebraska
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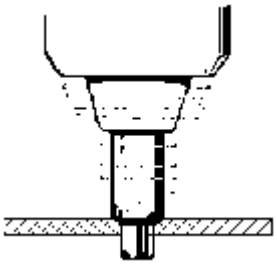
The following article from www.Diamond-Drill-Bit-And-Tool.com will provide additional facts and information about coring with diamond drill bits:

How To Use Diamond Drill Bits

Drill glass, ceramic, marble, granite, stone, tile & fiberglass!



Diamond drills are used on glass, stained glass, ceramics, ceramic tile, porcelain, porcelain tile, limestone, marble, granite, slate, stone or fiberglass. Drills used on wood or metal have a sharp metal tip or teeth which cut into the material. These types of drills do not work on glass, marble, etc. as the tips do not "bite" into the hard material and they create heat build-up which burns up the bit and causes "heat fractures" in the material. Carbide tipped *Spear Point* steel drills are sometimes used on glass, marble, etc. While they do work, they tend to chip the hard surface very badly, leaving a rough hole and causing breakage due to fractures from the chipping and heat. Diamond drill bits are designed differently - they have diamond coated tips which "grind" into the extremely hard materials.

Carbide Tipped
Spear Point Drill Bit

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Types and Styles of Diamond Drill Bits

Diamond drill bits come in many different sizes and shapes but are primarily of two basic styles, *blunt nose bits* and *core drill bits.* There are also two basic types of diamond drill bits relating to the application of the diamonds; *bonded and sintered*.

Top - Core Drill Bit
Bottom - Blunt Nose Bit

Blunt nose bits are solid at the tip and have diamonds on the tip and on the sides of the tip. This style of bit drills a complete hole by grinding a full hole the size of the tip. Core drill bits however, are hollow at the tip. They have diamonds along the edge of the tip and slightly up the sides of the tip - similar to a margarita glass which has been "rimmed" with salt. Core drill bits grind or saw a circle at the edge of the tip rather than the full diameter of the tip. A core drill results in a hole the size of the tip and a smaller "core" or "plug" which comes from the middle of the hole. Core drills are often called *hole saws*, since they grind or saw a circle to create a hole.

Since Blunt Nose bits drill out the complete hole, they are only effective for smaller holes. This style of bits are only available in

sizes up to 3/8" and are used primarily for glass, stained glass, ceramic or porcelain dishes or water fixtures and fiberglass. Blunt Nose bits are not designed for extremely hard materials such as stone or ceramic and porcelain tile. Core drills only drill out a portion of the resulting hole, so they tend to drill slightly faster than blunt nose drills. Core drills can be used to drill large holes and can be used on glass, stained glass, ceramic, porcelain and fiberglass, in addition to ceramic or porcelain tile, floor tile, limestone, slate, marble, granite and other stone materials.


Core Drill Bits

Bonded diamond drill bits have the diamonds bonded to the edges of the drill bit tip, generally using an electroplate bonding process. These drill bits are generally slow-speed bits and are fairly inexpensive. During use, the diamonds eventually wear off of the bit due to the hardness and abrasiveness of the material being drilled. Sintered bits have the diamonds mixed directly into or embedded in the steel tip. As the bit wears down and diamonds wear off, new diamonds come to the surface. Sintered diamond drills are generally high-speed bits and are somewhat long-lasting; however, they are also extremely expensive.

The life of any type of diamond drill bit depends upon the hardness, abrasiveness and thickness of the material being drilled and the specific drilling techniques used (drill speed, pressure and lubrication), however, the diamonds of a drill bit don't actually *wear out* as much as they *wear off* due to heat and friction caused by the extreme hardness and abrasiveness of the material drilled.

Drilling in glass, ceramic, or marble, etc. is a slow process compared to wood. A hole can be drilled in wood in several seconds, while for standard 1/8" thick glass, it can take several minutes, and in some very hard stones, the drilling rate for large diameter holes may be only a few inches of depth per hour. Using diamond drills to drill in hard materials is not difficult, however, it takes time. A person should consider that they aren't 'drilling' a hole, as much as 'grinding' a hole.

General

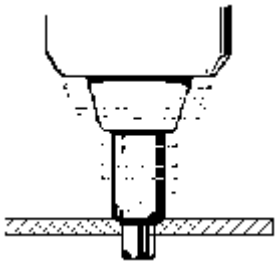
The sections below discuss the characteristics of various materials and the special techniques for using diamond drill bits on those materials. The most important factors are to use a slow to very slow drill speed (see speed table below), low drill pressure and plenty of water for lubrication. Variable speed drills work best since the proper speed can be selected, however, some variable

speed drills have a minimum speed of 600 or 800 rpm, which is too fast for many diamond drill applications (see speed chart). Also, impact type "hammer drills" should never be used with diamond drills.

Material Hardness & Abrasiveness

Materials have varying degrees of hardness and abrasiveness. Additionally, specific man-made and natural materials can differ greatly depending upon the exact physical composition. For example, glass varies in hardness depending upon color and type, since various metals and minerals are added to achieve the different types and colors. Ceramics, ceramic tile, porcelain and porcelain tile are various forms of glass. They also have differing hardness and abrasiveness depending upon the type, composition, manufacturer and manufacturing methods used.

The hardness and abrasiveness of natural materials, such as stone, vary by type, but they also vary significantly within a specific type. Most stones are not pure - they are mixtures of various types of rock. Granite, for example is a name for various combinations of primarily quartz, feldspar, black mica and hornblende. Therefore, a specific stone type such as granite, marble or limestone will vary significantly in hardness and abrasiveness depending upon the exact mineral composition which varies by quarry location.



Below is a table of the hardness of various materials. The table uses the standard Knoop Hardness Scale (kg/mm2). The hardest known material is Diamond, with a measurement of 7,000. Tungsten Carbide, used in carbide drill bits, is the hardest natural material next to Diamond. However, with a measurement of 2,100, Tungsten Carbide is only 30% as hard as Diamond.

Material	Knoop Hardness Scale
Wood - Pine	10
Copper	120
Limestone	125 - 150
Marble	140 - 180
Slate	140 - 250
Porcelain Fixtures & China	400 - 500
Glass & Ceramic	450 - 600
Ceramic/Porcelain Wall Tile	450 - 650
Marble Style Floor Tile	500 - 650
Granite Style Floor Tile	500 - 650
Granite	550 - 650
Quartz	820
Tungsten Carbide	2,100
Diamond	7,000

Drill Speed

Core Drill Bits

Diamond drill speeds vary depending upon the manufacturer and type of diamond drill. Glastar Blunt Nose Diamond Drills are designed to be used at high speeds up to 10,000. HK Diamond Core Drill Bits should be used at slow to very slow speeds, with the speed decreasing as the hardness and abrasiveness of the material increases. Also, since the circumference of a bit increases as the bit diameter becomes larger, the drill rpm speed must be reduced on larger bits to offset the increased speed at which the outside cutting edge is moving.

The following table shows recommended drill speeds for HK Diamond Core Drill Bits. Drill speeds considerably in excess of these speeds will quickly burn up the diamond bits. Reduced drill speeds, low drill pressure and use of water for lubrication will extend drill bit life.

HK Diamond Core Drills	Recommended Drill Speed (rpm)				
Material Bit Size -->	To 1/2"	To 1"	To 2"	To 3"	To 4"
Fiberglass	250	500	250	180	125
Limestone & Marble Stone	180	375	180	125	90
Glass, Ceramic & Porcelain	150	300	150	100	75
Ceramic/Porcelain Wall Tile	100	225	100	75	50
Stone Style Porcelain Floor Tile	75	150	75	50	35
Granite Stone	50	100	50	35	25

(Not for use on Concrete)

SPEED KILLS: Reduced drill speeds, low drill pressure and increased use of water lubrication will extend drill bit life considerably.

Since all materials vary in hardness and abrasiveness, it is impossible to determine exact drill speeds. Additionally, as discussed below, lubrication and drill pressure must also be considered when determining the proper drill speed. A faster drill speed may reduce the cutting time slightly, but it will also increase the friction significantly and heat up the bit, reducing the bit life considerably and increasing the risk of heat fractures and material breakage. If a drill bit develops yellow, brown, blue or black 'burn marks' around the tip, it is generally an indication that the drill speed being used is too fast or the amount of pressure on the drill is too great.

Lubrication

Water or coolant should always be used to cool and lubricate the tip. The lubrication reduces heat build-up and heat fractures in the material. Water is most often used as the lubricant, since it works very well and has no cost. The amount of lubrication used should increase with the hardness of the material being drilled. When drilling in fiberglass, a diamond drill bit can be used dry or with a very small amount of water. When drilling in glass or ceramic, soft ceramic tile and porcelain, if properly lubricated, the dust from the cut should be at least the consistency of a very wet paste and the drill bit contact with the surface should always be wet.

When drilling in hard, abrasive materials such as limestone, sandstone, hard ceramic tiles, marble or granite, it is very important to have lots of lubrication. With these hard materials, it is common to have a small amount of water constantly running over the drill bit and bore hole. This discussion is presented only as a guide. It is almost impossible to have 'too much' lubrication and the only down side is the mess from water being thrown off by the bit. However, 'too little' lubrication will cause many problems.

Lubrication Tips & Tricks

Various kinds of very specialized industrial *water feed* equipment are available for production type work, however, when drilling with diamond bits, the primary concern is merely getting enough water lubrication on the cutting edge of the bit, no mater what method is used. The most basic method is to use a small hose which runs water onto the surface near the bore hole. To provide lubrication on a horizontal surface, one trick is to place a plastic jug or bottle with a small hole near the bottom of it, next to the drill hole. The water leaks out of the bottle and provides continuous lubrication as you drill. Another trick is to build a "dam" around the drill hole using a small amount of modeling clay or a similar material.

For low volume repetitive work, it is also possible to place the material into a short 'jelly-roll' or 'cake' style pan (place a thin board underneath so you don't drill into the pan) and fill the pan with water so that it slightly covers the surface of the material being drilled. When drilling on vertical surfaces, about the only way to apply water is to use some type of hose. If that is not possible, a reasonably effective solution is to have someone constantly "squirting" water into the bore hole using a squirt bottle. In any case, the amount of lubrication should always be in relation to the hardness and abrasiveness of the material.

Drill Pressure

When using normal drill bits on soft materials such as wood, increasing the pressure causes the bit to drill faster and has little affect upon friction or heat build-up on the bit. When drilling in harder materials such as hardwoods, it is more important to reduce the pressure and let the bit "drill at its own speed". Otherwise, friction will quickly burn up the bit. When using diamond drill bits, the affect is similar to hardwood drilling, but it is magnified many times due to the extreme hardness and abrasiveness of the material.

When using diamond drills on glass, ceramic or porcelain tile, limestone, marble and granite, etc, it is very important to have only light to medium pressure on the drill and to let the bit "drill at its own speed". Increasing pressure will not speed up the cutting noticeably, but it will increase the friction considerably and quickly cause the bit to overheat. This not only burns up the bit, but it also heats up the surrounding surface and can cause heat fractures or breakage to occur.

If a drill bit develops yellow, brown, blue or black 'burn marks' around the tip, it is generally an indication of extreme heat caused by the excessive drill speed or by too much pressure on the drill. Impact type "hammer drills" should never be used with diamond drills as they have no benefit and will cause the tip of the bit to mushroom or split.

If a hole is being drilled completely through a piece of material, it is also important to "lighten up" considerably on the pressure when the drill bit is near the back of the material. This reduces chipping or fracturing on the back of the material when the bit emerges from the back.

Balancing Cutting Speed, Drill Speed, Pressure and Lubrication

The cutting speed and life of a diamond drill bit are affected by the hardness and abrasiveness of the material plus the drill speed, pressure and lubrication. Experience with a specific material quickly allows a person to determine the optimum drill speed, pressure and lubrication to obtain the fastest cutting speed with the least affect upon bit life and risk of heat fractures or breakage. However, when experience is lacking, it is best to start out with a very slow drill speed, very low pressure and lots of lubrication. This starting point reduces risks to a minimum and extends bit life considerably.

Starting a Drill Bit By Using a Template

Drill bits above 1/2" work best when used in a drill press rather than in a hand drill. Starting a drill hole using a drill press is simple, since the drill press keeps the drill bit from moving about. To reduce slippage when starting a hole using a hand drill, a template can be made to help start the drill bit. A pilot hole can be made in a piece of soft wood or plastic using the diamond drill. 1/8" pressed wood, 1/8" plexiglass or even heavy cardboard works well. The template is then placed on the surface of the material being drilled, with the pilot hole above the target hole. This keeps the diamond drill bit in place as it starts.

Depth of Bore

When drilling with core drills in material over 1/2" thick (such as slab marble or stone), it is generally best to drill to a depth of about 1/2", then carefully chip out the center 'plug' with a chisel or screwdriver before continuing to drill. If a very thick material is being drilled, this process may need to be repeated several times. This process reduces friction and heat build-up caused by the 'plug' and will actually reduce the cutting time and increase the life of the bit. When drilling large diameter holes (say 2" and above) in some very hard materials such as marble or granite, it is sometimes difficult to break-out the plug without drilling several smaller holes into the plug so that it can be removed in sections.

Extending Bore Depth

Diamond drill bits generally have a total length of about 2" to 2-1/2", with the shaft being 1" long and the lower cutting portion being 1" to 1-1/2" long. When drilling to extreme depths beyond the length of the bit, the drill chuck may come into contact with the surface of the material being drilled. A common *shaft extension* can be used to lengthen the potential drilling depth. Various sized shaft extensions are readily available at most local hardware stores or building centers and therefore, we do not carry them.

Bit Life

The life span of all types of drill bits is affected by the hardness and abrasiveness of the material being drilled, plus the speed of the power drill, the amount of pressure used and the use of adequate lubrication. The hardness and abrasiveness of materials vary significantly. Even materials which appear similar have varying degrees of hardness and abrasiveness. Each individual's drill speed, pressure and amount of lubrication also varies significantly. As a result it is nearly impossible to estimate the life of a diamond bit. On some thin, soft materials a bit may last for 100, 150 or even 200 holes or more, while on some thick, very hard and very abrasive materials the life many be only 5 holes or less.

See also: **Diamond Core Drill Bits & Hole Saws**

Blunt Nose Diamond Drill Bits