

CNC Diamond Drag Engraving Bit 1/4" Shank



Your CNC Diamond Drag Engraving Bit fits in any 1/4" collet, just like a regular end mill. Instead of cutting away chips like a standard rotary tool, it allows your CNC machine to engrave plastic, metal, glass, and stone with precise score lines. Engraving pressure is adjustable to match the hardness of the material you are working on. The spring-loaded, "floating head" design controls the engraving pressure at the diamond tip, automatically compensating for warped material, material that varies in thickness, and machine tables that are not perfectly flat.

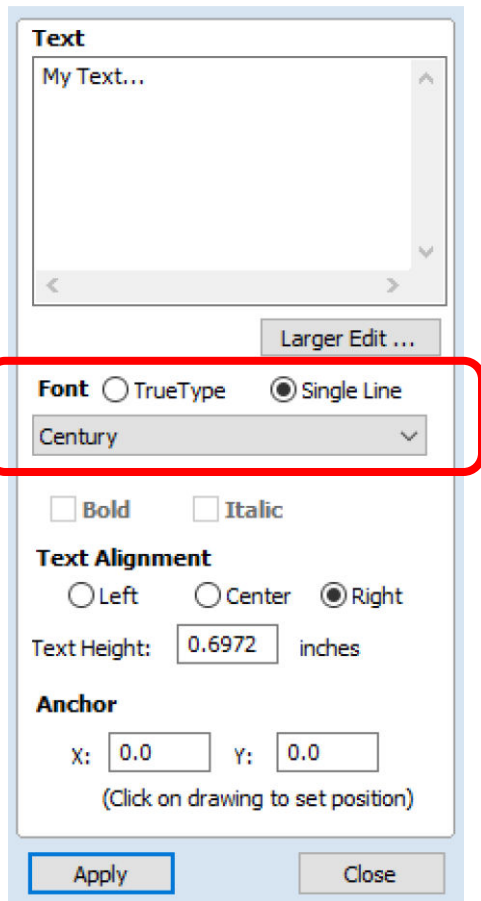
Creating Your Engraving Artwork File:

Your CNC Diamond Drag Engraving Bit can engrave text, graphics, precise measurement scales, guide marks for assembling parts, and more. Create your artwork file for engraving with the same CAD or graphic design software you would use to create any other cut file.

If your project includes engraved text, you may want to use a "single line" type font. Modern computers are preloaded with TrueType fonts, but other font types are available. When TrueType fonts are shown on a screen or printed on paper, they look like solid filled letters. But, when you add TrueType font text in your design software, you will see empty *outlines* of letters.

For projects that call for large lettering, TrueType fonts are often a good choice. You can engrave text as empty outlines of letters, or you can fill in the outlines with crosshatching for a bold look.

For projects that call for small lettering, single line fonts are often a better choice. Engraved TrueType fonts can be hard to read at very small sizes and machining a crosshatch fill pattern in small letters requires a lot of machine time. Single line fonts define the shape of each letter with a simple line – much like hand-written text. For bold lettering, single line type fonts will use two or more lines drawn in parallel.



TrueType
Single Line

Many software design programs include single line fonts for engraving. The popular VCarve Pro and Aspire software programs made by Vectric include a Draw Text tool that allows you to pick the type of font you want to use, then select from a list of available fonts to find a style that matches your project.

Engraved graphics are similar to engraved text. Some projects will look best with simple, clean line art graphics. Other projects will call for duotone artwork or “black and white” graphics that include areas with crosshatch fill or an etched/frosted look. Suggestions for creating crosshatching follow in the *Creating Your Engraving Cut File* and *Optimizing Cut File Settings* sections.

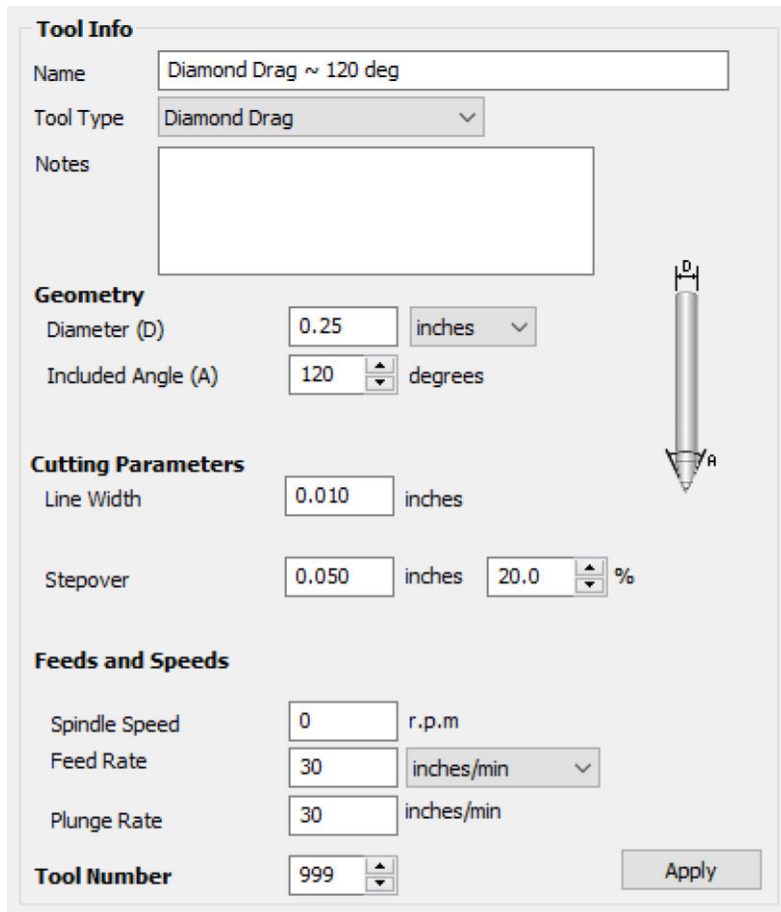
Problems To Avoid When CNC Engraving:

Engraving lines should not cross into open holes or pockets in your part – the spring-loaded diamond tip will plunge into the hole and could be damaged. Similarly, engraving lines should not run off the edge of your part – the diamond tip could plunge into your table or clamping fixture.

Diamond drag engraving works on smooth surfaced materials: plastic, clean metal, glass, and polished stone. It even works on smooth, curved surfaces like wine glasses and round metal parts. Materials with a rough surface texture, (rusty metal, textured stained glass, unpolished stone,) will quickly wear out and possibly break the diamond tip.

Creating Your Engraving Cut File:

The following settings are *recommended starting values* for engraving plastic, metal, glass, and stone. Every CNC project has unique challenges that require hands-on experimenting to solve. We always recommend testing your cut file on a piece of scrap material before attempting to engrave valuable material. Suggestions for increasing/decreasing these settings from the recommended starting values follow in the *Optimizing Cut File Settings* and the *Engraving Glass and Stone* sections.



The screenshot shows a tool configuration window with the following sections and values:

- Tool Info:**
 - Name: Diamond Drag ~ 120 deg
 - Tool Type: Diamond Drag
 - Notes: (empty)
- Geometry:**
 - Diameter (D): 0.25 inches
 - Included Angle (A): 120 degrees
- Cutting Parameters:**
 - Line Width: 0.010 inches
 - Stepover: 0.050 inches, 20.0 %
- Feeds and Speeds:**
 - Spindle Speed: 0 r.p.m
 - Feed Rate: 30 inches/min
 - Plunge Rate: 30 inches/min
- Tool Number:** 999
- Buttons: Apply

A diagram of a diamond drag tool is shown to the right of the Geometry section, with labels 'D' for diameter and 'A' for included angle.

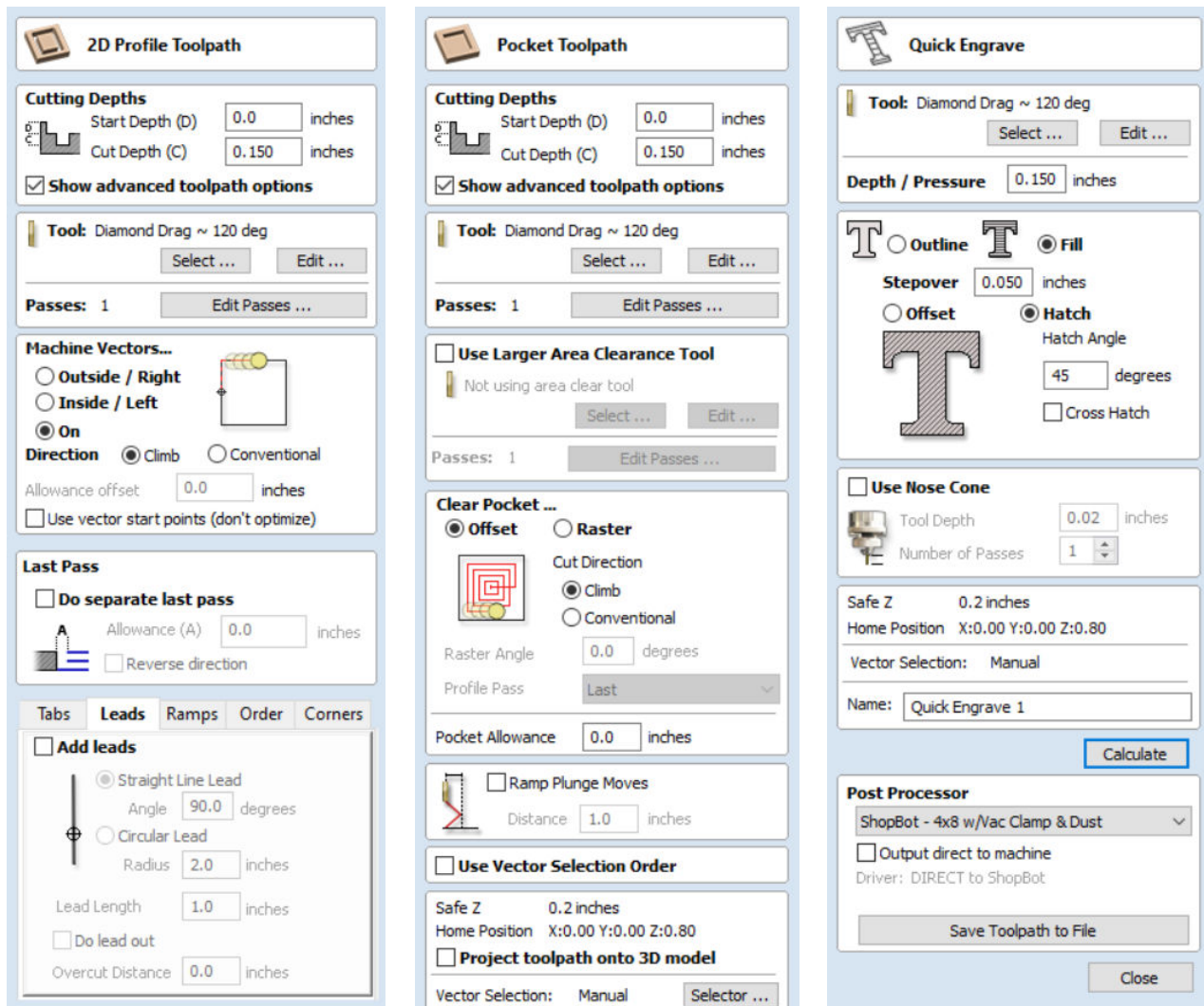
Most CAM programs store tool parameters in a Tool Library/Database. The VCarve Pro and Aspire software programs made by Vectric include a “Diamond Drag” Tool Type. If your program does not offer something similar, you can set your engraving bit up as a rotary “V” shaped tool or a tiny 0.010” diameter endmill.

The Diameter and Line Width parameters are used for visually simulating your cut file. The actual width of the line engraved on your part is controlled by the Cut Depth setting, which is typically found on the Toolpath screen, not the Tool Library screen.

MAKE SURE YOUR SPINDLE SPEED = 0 RPM AND YOUR SPINDLE IS TURNED OFF!

Your spindle must remain OFF while the CNC Diamond Drag Engraving Bit is loaded in your machine. Rotating the CNC Diamond Drag Engraving Bit at high speeds could damage the tool, potentially causing an accident or serious injury.

Some CNC machines use a physical switch to turn the spindle on during cut files. Other CNC machines control the spindle electronically. If your CAM software controls your spindle by outputting standard M3 or M4 G-Codes, you may be able to manually delete these lines from your cut file. You may also be able to create a separate post processor that does not add the M3 or M4 commands to engraving cut files. Contact your machine’s manufacturer for guidance.



Your CNC Diamond Drag Engraving Bit works with any CAM software that creates profile and pocketing toolpaths. Some CAM programs, such as the VCarve Pro and Aspire programs made by Vectric include special engraving toolpaths that provide additional features.

Your toolpath settings will include a Cut Depth parameter. Increasing the Cut Depth parameter will increase the pressure applied to the diamond tip of your tool. This will create a deeper, wider score mark on your part. The Cut Depth parameter can be set anywhere between 0 and 0.500 inches, 0.150 inches is the suggested starting value. The actual depth of the engraved mark will vary depending on the hardness of the material you are engraving. It will also depend on the diamond tip and spring you choose, as described in the *Setting Up Your Engraving Tool* section.

Engraving is typically done in a single pass, but multiple passes are possible for deep score marks.

Enter and exit your engraving cuts vertically – do not use straight or circular lead-ins and do not use ramped plunge moves. Movement between cuts should be done at a safe Z height at least 0.200” above the part, higher if you need to avoid clamps or fixtures.

Profile toolpaths are a quick and easy way to engrave single line fonts and line art graphics. For duotone artwork or “black and white” graphics, you can use a pocketing toolpath to create a spiral fill pattern. Engraving toolpaths can create a fill pattern with parallel diagonal lines, or a crosshatch pattern of diamonds. The suggested starting value for the Stepover parameter used in fill patterns is 0.050 inches. See the *Optimizing Cut File Settings* section for more information if you want to reduce this value.

Setting Up Your Engraving Tool:

Your CNC Diamond Drag Engraving Bit comes preassembled with the standard-pressure spring installed. For most projects, the standard pressure spring is recommended. A low-pressure spring is also included with the bit. This spring is the best choice for engraving soft materials, thin plastic films, and delicate metal foils. It provides the most control over engraving pressure when making very light score marks.

Your CNC Diamond Drag Engraving Bit comes preassembled with a 120° engraving tip installed. The 120° tip is recommended for general purpose engraving on plastic, uncoated metal, glass, and stone. A 90° tip is also available and may be more appropriate for specific types of projects.

120° Diamond Tip

90° Diamond Tip

Engraves a bolder, wider line, with a relatively shallow score depth. For small lettering and graphics these lines may be easier to see at a distance.	Engraves a narrower, finer line, with a deeper score depth. The best choice for cutting through surface coatings on anodized aluminum and lacquered brass name plates for award trophies.
Accepts higher engraving pressures that are required for working on hard materials.	Accepts lower engraving pressures that are helpful when working on soft, delicate, or thin materials.
Is more robust, can run faster, and is less susceptible to wear when engraving hard/abrasive materials like glass or granite.	Creates engraved lines in acrylic edge lit signs that refract more light, producing a brighter effect.

Changing the Spring or Tip in Your Engraving Tool:

The outer housing of the 1/4" shank bit is made up of two pieces that thread together. To disassemble the housing, orient the bit with the diamond point facing up. Hold the larger diameter (5/8" / 16mm) section of the housing in one hand. Rotate the smaller diameter (1/2" / 13mm) section of the housing counterclockwise. As the housing separates into two pieces, be careful – you do not want to lose the diamond tip and spring that are inside the bit.

The diamond tip will slide freely out of the bore in the smaller diameter (1/2" / 13 mm) section of the housing. Replace the diamond tip as needed. The spring is loosely held in the bore of the larger diameter (5/8" / 16mm) section of the housing. Swap the high-pressure spring for the low-pressure spring as needed.

To reassemble the bit, hold the larger diameter (5/8" / 16mm) section of the housing in one hand with the 1/4" shank oriented down. Place the spring inside the center bore of the larger diameter section of the housing.

Place the diamond tip on top of the spring, pointed end up. Orient the smaller diameter (1/2" / 13mm) section of the housing with the threads facing down. Slide the smaller diameter section of the housing over the diamond tip. Thread the housing together by rotating the smaller diameter section of the housing clockwise.

Setting Up Your Machine and Running Your Cut File:

Place your material/part on the CNC machine. Locate the material and clamp it in place as you would for a normal cutting operation. Remove the cap from the bit's diamond tip and tighten the bit's shank in your CNC machine's spindle.

Electrical sensors/touch plates used for setting Z = 0 offset values will not work with your diamond drag bit. To set your Z = 0 position, slowly lower your Z axis until the diamond tip just barely touches the top of your part or your machine's table, (depending on which you've selected as Z = 0 in your CAM software.) Set Z = 0 in your machine's control, remembering to raise the bit to a safe Z level when you're finished.

Before you hit the Cycle Start/Run button on your machine, verify that your spindle will remain OFF while you run your engraving cut file - the power to the spindle is turned off, or your cut file does not contain the G-Codes that turn your spindle on.

Run your engraving cut file. When you are done, put the cap back on the diamond tip to protect the tool while in storage.

Obtaining Replacement Diamond Tips:

Your CNC Diamond Drag Engraving Bit uses replaceable diamond tips. A 120° tip is included with the bit. A 90° tip is also available separately. See the previous section, *Setting Up Your Engraving Tool*, for information on which tip is most suitable for your project.

Replacement tips for your CNC Diamond Drag Engraver Bit are available in the Replacement Blades, Tips, Pens, etc. section of our website: www.WidgetWorksUnlimited.com

Optimizing Cut File Settings:

Depending on the requirements of your project, it is often safe to set cut file parameters well beyond the starting values recommended in the *Creating Your Engraving Cut File* section. As with any new CNC tool, it is best to experiment on scrap material and to work your way up or down in small increments until you have found the optimal settings for your machine, material, and artwork.

Feed Rate - Your CNC Diamond Drag Engraving Tool can be run at Feed Rates much higher than the recommended starting value of 30 inches/minute. The maximum Feed Rate will depend on the artwork you are trying to engrave and the rigidity of your machine. At high Feed Rates, engraving small lettering and graphics with sharp bends can cause rapid acceleration of your X and Y axis. This can cause a machine to flex, leading to a loss in engraving precision. If you are engraving a graphic with large, sweeping curves that do not require high precision, raising your Feed Rate is less likely to cause a problem.

Increasing the Feed Rate often requires an increase in the Cut Depth parameter, which increases the pressure on the diamond engraving tip. If you increase the Feed Rate without increasing the engraving pressure, the diamond tip may slide across the surface of your material instead of digging in and producing a clean, consistent score mark.

Plunge Rate - On soft plastics and soft metals, the Plunge Rate (Z Axis Feed Rate) can be increased from the recommended starting value of 30 inches/minute. Plunging too quickly into hard metals or stone can shock the diamond tip, causing it to fracture. The 120° diamond tips are more robust and will withstand higher plunge rates than the more delicate 90° tips.

Cut Depth - The Cut Depth can be set between 0 and 0.500", controlling the engraving pressure on the diamond tip. Changing the Cut Depth parameter, selecting a different tip angle, and swapping between standard-pressure/low-pressure springs can cause a dramatic difference in the final engraving. To quickly dial in the best combination for your project, it can be helpful to create a test panel with side-by-side comparisons of several Cut Depth settings. Higher engraving pressure does not necessarily improve the final product. On brittle materials, such as glass and granite, high engraving pressure will produce a "fuzzy" score line with lateral fractures/chips.

Stepover – The lines that make up engraved fill patterns, (spirals, diagonals, crosshatching,) are spaced apart based on the Stepover setting. Large Stepover values often look nice – from a distance, your brain will see the pattern as a shade of gray instead of seeing the individual lines. Large Stepover values can also reduce machining time and wear on the diamond tip. Depending on the material you are engraving and the rigidity of your machine, it is possible to reduce the Stepover value as low as 0.010", which produces a frosted or etched look. When making tight fill patterns, you want to make sure the Stepover is large enough that each pass of the machine creates a completely separate line. If your Stepover is too small, the diamond tip can end up "regrinding" the edge of the previous line. This will put side pressure on the mounting that holds the diamond in place, possibly causing the diamond to break off the tip of the tool.

Engraving Glass and Stone

Compared to engraving plastics and metals, engraving glass and stone can be challenging. There are lots of different types of glass and stone, providing a wide range of material properties. Finding the optimal cut file settings for your glass or stone project may require a fair amount of experimentation.

The 120° diamond tip is recommended for engraving all types of glass and stone. Glass and stone are the hardest materials that are commonly engraved and tend to be much more abrasive than plastics and metals. Engraving glass and stone tends to wear out diamond tips much faster than engraving plastics or metals. The broad 120° diamond tip is more robust and less susceptible to wear than the 90° diamond tip. Reducing your Cut Depth setting will prolong the life of the diamond tip. If your project requires engraved fill patterns, (spirals, diagonal lines, crosshatching,) consider the use of a large Steptover setting to reduce the overall amount of engraving.

Glass and many types of stone are brittle materials. High engraving pressures can lead to a “fuzzy” engraved line with lateral fractures/chips. For some projects this may not be as appealing as a clean, smooth score mark.

Glass “Cutting” With the “Score and Snap” Method

Your CNC Diamond Drag Engraving Bit can be used to score glass for glass “cutting”. If you softly bend or tap the glass perpendicular to the score line, the glass should snap/break in a shape that follows the engraved mark.

Learning to score and snap glass takes practice and patience. The techniques involved vary in difficulty depending on the final shape you are trying to achieve. An in-depth discussion of glass cutting is beyond the scope of this document, but there are lots of resources available on the internet and you may be able to find local experts for guidance.

The 120° diamond tip is recommended for scoring all types of glass, (see the *Engraving Glass and Stone* section for an in-depth explanation of why this is important.) You want the score mark to be as deep as possible, but it also needs to be a “clean” score mark. If you apply too much engraving pressure, the score line will get “fuzzy” with hairline fractures radiating out from the line. When you go to snap your glass, sometimes the glass will crack along the hairline fractures instead of the intended score line. To achieve a “clean” score mark, you should make sure your diamond tip is in good condition. A dull tip will require increased engraving pressure.

Some sources recommend the use of cutting oil when scoring glass. In our testing on standard, clear plate glass, cutting oil has not made a significant difference in the quality of the engraving and has not prolonged the life of the diamond tip. If you are working with other types of glass, it may be worth trying.