Making Your Own Tools …

…Working with Epoxy and Super Glues

Text and Photos by
William Johnston

I like to make woodworking tools. The materials I use include exotic wood, carbon steel, drill rod, cold rolled steel, and brass flat stock and rods. I glue brass or steel to wood using either two part epoxy or super glue.

You may think of glues as tools to use to mend broken items. But just like the woodworkers standby, yellow aliphatic resin glue, epoxy and super glue (cyanoacrylate) can be used in the construction of new projects as well.

The hand router pictured above uses epoxy in a number of ways … to glue the brass base to the padauk body, the brass posts to the padauk knobs to form the handles, even the vertical center post holding the cutter makes use of epoxy to connect to the base and body.

Familiar to many woodworkers is the current popularity of pen making. In its simplest form, a brass tube is super glued into a hole drilled into a wood body. The wood is turned and a pen is formed.

Many of my tool projects use this simple pen making technology. The only difference is that solid brass rods or carbon steel drill rod replace the brass tube.

The marking awl, above right, and the miniature lathe tool, above left, use this pen making technology to surround a solid brass rod with padauk to form the handle. The wood is epoxy glued to the brass. In both cases the brass is drilled to accept the blade. In the awl, the drill rod (hardened tip), is secured with a small set screw so that it can be easily removed and sharpened or replaced. The square metal lathe tooling used to form the blade in the miniature lathe tool is forced into a round hole, the hardened square edges hold it extremely secure without glue, a 'square peg in a round hole'.

When do you use epoxy? …Super glue? Or should you use glue at all? …Answers to these questions are of importance to a person making tools.

- What characteristics of these glues make them appropriate?
- What problems will these glues cause?
- What do you need to know about these products in making woodworking tools.

Shortly we will begin just that discussion.

Epoxy is that two part product … the resin and the hardener … that you mix with a stick. Often the resin is one color and the hardener another. Mixing the two produces a color change that tells you when they are mixed and will set properly. Epoxy is purchased in two plastic bottles, two tubes like toothpaste, or even in a two cylinder hypo with plungers to push out equal amounts. These products come under many names but regardless of the names and claims, these two part products are epoxy. A common name in epoxy products is Loctite, another is JB Weld.

Super glue comes in a small tube or a much larger bottle. Get the larger (about .7 oz.) bottle for less trouble, ease, and cost savings. The tubes will be messy or useless after their first use as super glue will polymerize due to the contact with the moisture in the air.

Epoxy is Gap Filling

Unlike super glues, epoxy is gap filling. If the fit is not just right, epoxy will fill in the gap and set, not only gluing two parts together but taking up any extra space.

When might this happen?

Say that you have used your Forstner bit to drill a nice, accurately sized hole into the end-grain of a piece of wood, perhaps to insert a brass rod, such as in the case of metal scraper pictured above. You would like to think that the ½ inch drilled hole is the same diameter as the brass rod. But is this so?

Unlike metal drills that come in 135 sizes up to ½ inch, your Forstner bits won't have this fine graduation. Even so, wood will change diameter as you walk around the shop … move into an elliptical shape almost before your eyes, and more pronounced as the moisture in the wood changes. Even moving the bit out of the wood to clear chips will widen the drilled hole.

The brass rod, very close to the specified size, will expand, contract, and change shape much less … metal change being more dependent on temperature.

If there is a small gap, the gap filling characteristic of epoxy works in our favor. If there is, however, a nearly force fit, the excess epoxy will press out as the brass is pressed into the hole or out of the hole at the other end. Neither is good, but there are several possible solutions for you to try.

- Use less epoxy in a tight fitting situation. I prefer to apply the epoxy to the wood, not the metal, with a small dowel, making sure that I'm "wetting" the wood but not leaving excess epoxy behind.
- In a blind hole you could make the hole deeper then needed. However, since we are making tools, this gap weakens the wood and could cause a handle, for example, to break at the void. Epoxy will immediately seal the hole and often the brass rod will not push all of the way in anyway when air can not escape. Grooved metal dowels to accommodate excess glue, like in woodworking, is not usually an option.
- If otherwise appropriate, use super glue. This is especially true if you have a tight fit, as in the drill rod blade in the marking awl at the left that is super glued into a exact same size hold in the brass. The solid brass rod extends into cocobolo handle. But note that super glue has its own problems and advantages… read on.

Clean off unset epoxy with vinegar, mineral spirits, acetone, or rubbing alcohol.

Epoxy Does Not Need to Be Clamped

In fact, Epoxy needs a small gap between, for example, a piece of flat brass stock and the wood to which it is glued. Press (or clamp) too tightly and the epoxy probably will not bind very well. So while epoxy does not need to be clamped you can't clamp it very tight. And there is the rub! This stuff is slippery. Holding it in place until it sets can be a challenge.

Epoxy Sets Fast … or slow!

You will want to consider whether quick setting or slow setting epoxy is the most appropriate for your project. Epoxy may set up in as little as 5 minutes, be at useable strength in 8 hours, and fully cured in 24 hours. You can purchase epoxy that sets <u>much slower</u>.

But why would you want a slower setting epoxy?

If you are working on small items that can be secured quickly, the quick setting 5 minute epoxy may be your choice. Spreading glue over larger items may require the slower setting product. Five minutes goes by fast! Also, slower setting epoxy (20 minutes or more, see the label) is much stronger. Also, important to note is that the slower setting epoxy will release (break) after setting and curing <u>at a much higher temperature</u>. This high release temperature is very important in making a tool that may experience heat in the making and will be discussed later.

Epoxy Will Release on Impact

You can't pull it apart, you probably can't slide it apart (exception noted later) but if you strike it just right or drop it on a hard surface, the epoxy bond will sometimes separate.

A good example is a small hammer that I made to (tap) set plane blades. It is designed as a small mallet with a wood handle and maple head. Each end of the square maple head is face with ¼ inch brass secured to the maple with epoxy. I gave this mallet a good hard tap on a hard surface and the brass face flew across the room and disappeared in the saw dust under a bench.

You will want to consider when you use epoxy as to whether the tool that you are making will be subject to impact. There is a simple solution to the brass facing on the mallet discussed above. It's simple ...it works … it's a mystery.

After the epoxy is set and cured, drill four 1/8th inch holes in the face of the brass near each corner, all the way through the brass and ½ to 1 inch into the maple wood. Inexpensive 1/8 X 36 inch brass rod is readily available in any hardware store in the welding section (stay away from the expensive 12 inch rod in the hobby metals section). Epoxy coat the rod (cut to size) and tap it into the 1/8 inch holes. This technique will effectively eliminate the separation due to impact (shock).

Epoxy Will Release When Heated

Like many things this can be good or bad, depending on your use and intent. **Super glue** will release (separate) at a very low temperature. You can release a super glue bond at about 180 degrees. Poor boiling water on a super glue bond or touch it with your torch flame and it will immediately release. In the case of a brass tube glued to wood to make a pen, there is little risk coming into contact with heat (too hot to touch) and releasing the bond.

But if you use super glue to bond brass to brass or to wood and than mill or sand it under power, as would be common in making a tool, the super glue bond will immediately break.

When the bond will be subject to heat, epoxy is a better choice. Quick setting epoxy should be avoided when later milling and sanding will generate enough heat to be much to hot to touch. Brass or steel will be too hot to touch very quickly using a disk or belt sander or grinder. Hand filing, sanding, or buffing will not generate sufficient heat to affect the bond.

If the tool that you are making is bonded with epoxy and will experience heat in use or in the making, use the slower setting product (20 min or 1 hour setting label). My impression is that the slowest setting epoxy can experience up to several hundred degrees before releasing.

Sometime you may want to release the bond. I super glued a pointed and hardened 3/16 inch drill rod blade into a brass rod of the brad awl at the right on the next page. The brass rod was epoxy glued into a cocobolo handle and turned on the lathe. Now you just know that I am going to break off the hardened blade point and will want to remove it from the brass to re-file the point or replace it if it is too short. I need only to run a torch over the blade to just heat it and the super glue bond will break but the epoxy bond will not. The super glue was not only chosen

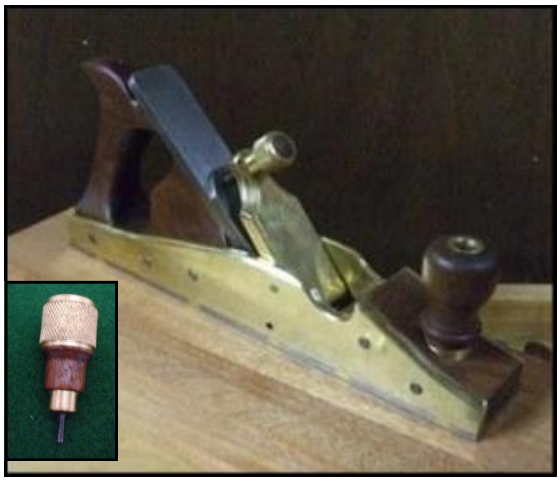
for gluing the blade to the brass for it's easy release properties but also because of the tight fit that would make epoxy a poorer choice. Unlike epoxy, super glue is only momentarily slick. Lightly super glue the drill rod blade and quickly place it into the hole. As soon as exposure to air is removed the super glue bonds and the rod will not move. Of course, you can always heat, remove, and start over. Be sure not to heat the hardened and tempered blade tip.

Two brass pieces on the left-handed center finder on the right were glued with epoxy and the padauk was attached the same way. The outside angles were accurately ground with a stationary disk sander and the inside angles on a mill. Both generate heat. Slow setting epoxy was chosen. Sometime you may want to temporarily create a bond such as when connecting your work to a faceplate or for turning two parts together that will be separated after turning. Being able to break the joint (with heat) would be desirable. Either super glue or epoxy may be used. Five Minute Epoxy would make a stronger joint but requires 8 – 24 hours for curing and breaks under moderate heat suitable for brass or steel. If wood is involved also, heat only the metal directly until the bond brakes. Super glue will set very quickly upon pressing the parts to be glued together but will not be as strong and may break unexpectedly if any heat is generated during turning. Super glue bonds also can be broken by freezing as low temperatures make the glue brittle. I would tend not to use superglue where the tool would be exposed to cold temperatures for any length of time. Super glue joints shear easily making it good for gluing pieces to be turned on a lathe and later separated by impact.

When Gluing Is <u>Not</u> Needed

As in woodworking, sometimes the joint itself will suffice and little or no gluing is needed. I have found a number of times in working wood when a nice fitting dovetail joint is all that is necessary. If I don't use glue I can take the joint apart, when necessary. Draw pegging a mortise & tenon is another example where glue is not needed in woodworking.

I recently make a British Style infill plane. These planes were originally made with sides dovetailed to a steel sole. At the end of the 19th century the sides would likely be made of steel.



Today brass sides are often chosen. This provides an attractive contrasting joint. Metal dovetails are similar to through dovetails in wood in their construction. But unlike wood, brass is malleable. The sole viewed from the bottom is not square where the pen comes through the tail, but is slightly splayed. The brass is peened to fill this splayed area and into any gaps in the tail. This makes a very strong joint that will not pull apart. There is no need for soldering or, heaven forbid, gluing with epoxy or any other product.

Planes of this type have a wood infill. Due to movement, the wood is not glued to the sole or the sides. The wood infill is carefully sized to fit between the plane sides. The sides can be ever so slightly tighter at the top. Holes for brass dowels (or less likely drill rod dowels as in the plane above) are drilled through the brass sides and the wood infill. If the fit is excellent no peening of the dowels is necessary and they can be removed to disassemble. The holes in the brass sides can be very lightly countersunk. The brass dowels would be peened to fill the extremely shallow countersink. Peening also fattens the dowels along their length and makes them snug in the wood infill as long as there was a press fit originally. It is harder to peen soft steel without damaging the brass sides, so I don't do that. The drill rod dowels in the infill plane above are not peened and the entire plane (except for the dovetails) can be disassembled.

The blade on the marking knife at the left needs no glue as the press fit into the wood serves to hold it in place and can be later removed if necessary.

And this brings me to the unproven observation that **epoxies creep**. As I said earlier, you probably won't be able to slide an epoxy joint apart. But I believe under constant pressure the two items bonded will slide across each other. Suppose you have a plane wedge constantly pushing on an epoxy joint . My observation is that the joint will move, or at least stretch, but not break.

Final thoughts …Super glue leaves no line. Some epoxies have a color, some are clear, others are translucent yellow. Consider appearance in your selection of epoxy..

After setting, epoxy is tough. It is somewhat resistant to removal should you leave a residue. I've found no trouble power sanding or filing steel, brass, and wood joined by epoxy as it sands nice along the glue line (note the heat discussion). It will also come off with a sharp chisel. However, spillover on the brass or steel is undesirable when you can not polish the tool metal such as where it meets a shoulder. In removing the excess epoxy you will likely scratch soft

brass and unhardened steel. An example of this would be in gluing a blade endwise in wood. A square's blade is joined this way. You can not easily polish the blade in the long direction near the shoulder if you happen to scratch the blade while removing glue. Clean off excess epoxy with mineral spirits, acetone, or rubbing alcohol before it sets (you might need more time that the 5 minutes epoxy allows for cleanup).

For more information on epoxy & super glue go to:

http://en.wikipedia.org/wiki/Cyanoacrylate
http://en.wikipedia.org/wiki/Epoxy

This document by also be viewed at:

http://www.kcwoodworkersguild.org/Articles/Myot%20Epoxy&Superglue.htm

Your comments are invited and welcome and may be addressed to:

William Johnston
johnston@everestkc.net
913-492-6942