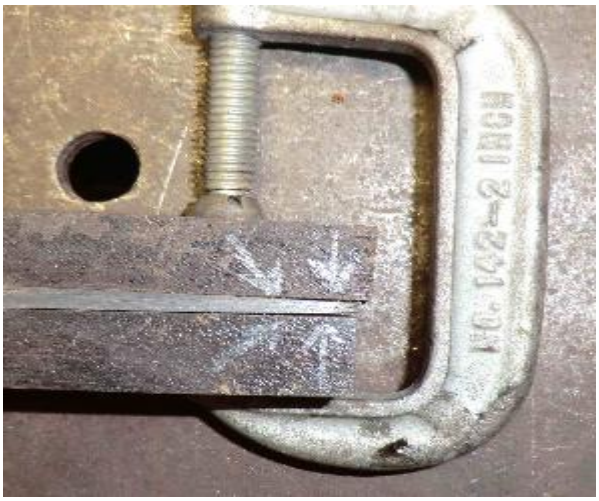
Full Tang Fit & Finish the Ironflower Way

Preparation

Forge the blade, anneal it, rough grind it and drill it for the pins. Typically, I like to use 4 pins to hold the handle together and a mosaic pin as a visual accent point, hence there will be five holes to locate and drill. I eyeball the 1st and 5th locations (not too near the ends - maybe 3/4" or so), and divide the distance between them to put #2 to #4 at equal intervals. The pin size dictates the hole size. I use 1/8" pins (0.125") and drill the holes with a #30 bit (0.128") - to leave a margin for error. The blade is heat treated, finish ground, and the interfaces of the tang and the slabs forming the handle have to be checked and adjusted if needed.

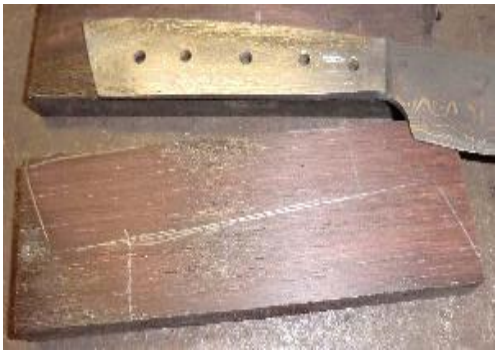
In the image to the right, the tang is being held on a "Mighty Mag" magnet (UseEnco.com - TM625-0440 $12 - highly recommended!) and a piece of machined steel (a flatness gauge) is being held to the other side of the tang. The whole assembly is being held up to a bright light (full sunlight, in this case). If light can be seen in the interface, then grind on the high points until you can't see light. Any gaps left will come back to haunt you later...



like this. Note the gaps at the end of the tang and both slabs. It is VERY easy to grind this type of error in -- just hold the tang to the belt vertically with the magnet at the end of the tang and the blade in your fingers above the belt and flat platen. Too much pressure on the magnet will tend to rock the tang out at the top and in at the bottom, thus creating a slight but noticeable curved taper in the tang. A fresh belt, light pressure and care usually works to make a flat interface. NOTE: the overall tang can taper from the blade/tang point back to the end of the tang. The tang just needs to be FLAT on both sides.

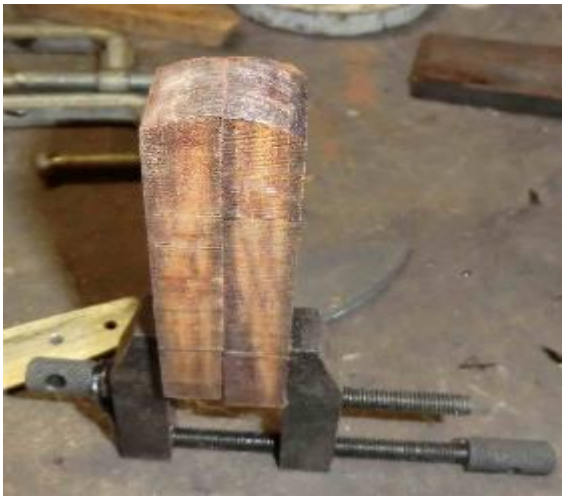
Once the sides are flat, the holes are chamfered (why - see the discussion on pins below).

Once you are happy with the steel, it's time to turn to wood. Whatever you use, it should be stabilized and the surface to be placed against the tang must be flat and clean. A 6x48 sander is great for this. When making a full-tang blade without bolsters or pommel plates, all that is needed is to lay out the outline of the tang on the pieces of wood as shown. Depending on the color of the wood, the lighting, and your eyes, you may find that a silver pencil is useful. Trace around the tang and then sketch in the line connecting the top and bottom lines where the handle will stop and the blade proper begins. Be sure to trace BOTH sides of the tang. Typically, tangs are asymmetrical and unless the wood pieces are flattened on both their sides, it's helpful to make sure that one flat piece corresponds to the right side of the tang and another flat piece corresponds to the other side.



Saw the pieces out -- and saw outside of the lines. It's easy to grind away excess wood and a pain if you have to grind away part of the steel and/or start over because you cut into the tang's outline. I find that having a desk lamp positioned at the band saw makes this operation a lot nicer.

You will have the opportunity to grind the top, bottom, tail and sides of the handle after you fasten the slabs to the tang but that is not possible for the front - the part of the slab that touches the blade proper. So, the next step is to prepare that area and to make it a mirror-image left to right. Clamp the two pieces of wood together (flats inward). I find a C-clamp works well here. Go to the grinder and grind away at the front to remove any saw marks and to make the two pieces match (as shown to the right). This is where you can angle the front top to bottom if that is what is needed to make a pleasing interface of blade to handle. Grind the surfaces down to whatever you will use as the finest finishing grit. Typically, you will protect the blade with masking tape, so only 3/8" to 1/2" of the slabs need to be ground at this stage.



Epoxy is slippery stuff. It is NOT pleasant to smear the epoxy on a slab, position it carefully on the tang, and - as you apply pressure on the assembly - watch the slab slide off to wherever it wants to go. So, first, dry position the 1st slab on the tang and clamp it in position. You can use whatever clamps you like. All that is required is that the slab cannot move and the clamps don't get in your way at the drill press. Drill a hole from the tang side through the slab using a drill matching the pins. The best location for this hole is the location of the mosaic pin. Since tangs often taper and slabs don't, you have to be careful to drill perpendicular to the center line of the tang, NOT to the surface of the tang or the surface of the wood. When you are done, you want the pins to run perpendicular to the handle and not at an angle. After some experience, your hands will know how much "lift" is needed but at first, you can put a piece of scrap wood in the drill press vise and place the slab/tang on it. Place your eye on level with assembly and adjust the slant of the scrap in the vise until the center line of the tang is perpendicular to the drill bit. Even if there is no taper, using a piece of scrap wood is a good idea to minimize splintering when the bit breaks out the far side of the slab. If the hole in the tang is larger than the drill bit, there is little danger of the bit binding and taking the blade away from you but it is safer to clamp the tang/slab in the vise.

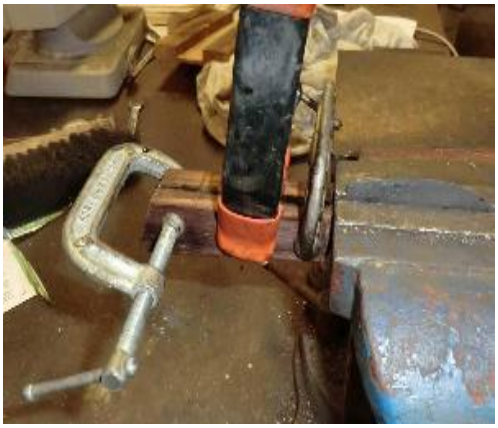
It is now time to glue the 1st slab to the tang. Run an alignment pin through the slab such that it sticks through the tang and adjust a couple of clamps to the necessary sizes (one at the front, one at the rear) needed for the tang/slab assembly (see image). Take the assembly apart and position the components in a known order (something like end clamp to the left, front clamp to the right, blade near you with interface to be glued up, and the slab away from you, interface up). Have available: (1) 5-minute epoxy; (2) a scrap of paper or an old business card; (3) a popsicle stick or tongue depressor; (4) black toner from a laser printer cartridge (or the equivalent - Brownell "Epoxy Black" as an example - which is no longer available); (5) acetone; (6) paper towels; and (7) a pair of examination gloves (optional). In the image, the pin is inserted through the tang - either way works but doing it as described above means less to do while the glue is setting up.

Mix up some epoxy with the colorant on the card. For the usual tang, a blob about dime to quarter diameter for each component of the epoxy is about right. Remember, epoxy is fairly cheap and the time needed to make more up in the middle of smearing the glue may be limited. Butter the appropriate side of the slab, taking care to place excess glue at the front and back of the slab (where gaps are most likely) and place it against the tang -- the alignment pin should make getting it located fairly easy. Place one of the clamps on the slab and check that the slab is aligned to the outline of the tang. When it is okay, apply the other clamp and tighten the clamps securely. Remove the alignment pin and with an acetone-wetted towel, clean up the interface of slab and blade. It never hurts to wipe off the blade just in case some epoxy got out of control. If you are wearing the gloves, you can take them off. If not, wipe your hands on your pants.

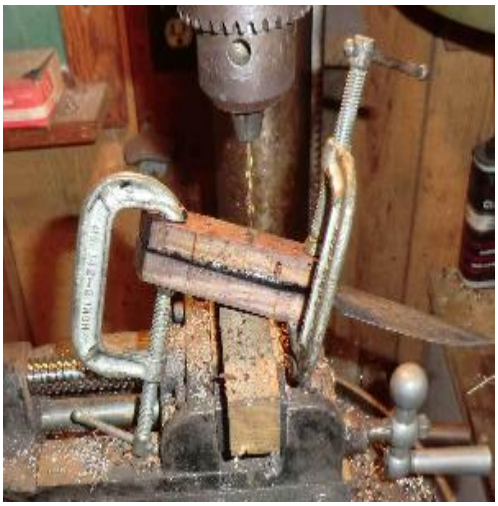
After the glue has set (it takes 24 hours to reach max strength but 10 to 15 minutes to stop sticking to you when you touch it), you can go back to the drill press and drill the remaining pin holes (tang side up, of course). If you are excessively anal about tight clearances for the pins, use a slightly smaller drill bit to drill the holes. Remember what was said about the center line of the tang being the reference plane.

It is now time to position the 2nd slab. You can simply eyeball the alignment of the two slabs or you can use a vise as shown. Lightly clamp the blade in the vise with the 1st slab square to the jaw. Slide the 2nd slab along the tang until it hits the other jaw. Apply a spring clamp for a temporary lock and then two C-clamps to hold it securely in place.

In this image, there is one clamp positioned at the tail and another at the head of the handle. Once they are in place, the spring clamp can be removed, the knife removed from the vise, and it's time to go to the drill press again.



This is why you need to keep in mind the clamps used and the configuration of the drill press and vise. Machinist's vises (like the one shown in the image showing the scale front surface grind) can make this type of screw-up less likely.

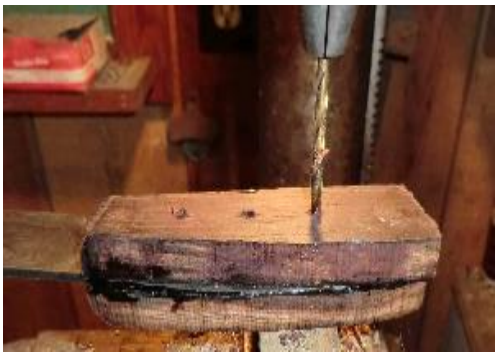


Assuming that you get the clamps positioned correct way up, you can now drill through the hole that once held the alignment pin, through the tang and through the 2nd slab. Note that if you are using C-clamps and the length of the handle is a bit short, there may be issues with the drill press chuck hitting the clamps.

Just as for the 1st slab, it helps to assemble the clamps, alignment pin, and components that are to be glued before mixing the epoxy. As with the first slab, it really doesn't matter which side the alignment pin is inserted from, just so long as it extends far enough to "catch" the other side.

Follow the procedure outline above and epoxy the remaining slab to the knife. Make sure to match the outline, to secure the clamps and to clean the interface and blade of any excess epoxy.

You can now drill through the existing holes to complete the holes in the handle. If you have used an undersized drill bit, this is when you drill using the bit matching the pins and/or use a reamer.



It is now time to shape the profile of handle. Use a coarse (fresh) belt and a flat platen on the grinder and wrap some masking tape around the blade at the start of the handle (protects the first inch or so of the blade from belt "kisses"). Grind the top so that the top surface of the tang is flush with the wood slabs. BE AWARE of heat. Epoxy loses its strength at temperatures that are just a bit warmer than the usual human can stand. If you happily grind away heating the tang to 150 F or so, the slabs may just slide off. Bummer!

Once you are happy with the top, move onto the bottom and tail surfaces. There is no real problem dipping the knife into the water to cool it but it is a good idea to move the quench bucket to one side so that sawdust doesn't end up floating on the top of the water. If you have a mask and/or dust removal system, it's not a bad idea to use them.

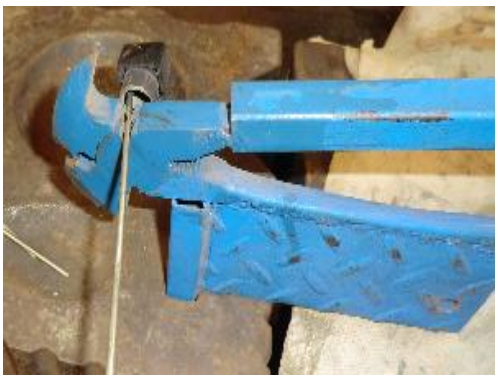
Once the profile is delineated, move onto the sides. Typically, I taper the sides to create a bulge about half way back or a bit more. This is a matter of taste - how narrow do you want the handle? Do you like bulges or not? Do what feels right to you and to your hand.

At this point the cross-section of the handle is basically a rectangle. The planes of the sides, top and bottom surfaces meet at approximate 90 degree angles. You can now knock the corners off and begin to approximate the finished shape. Do remember that it is easy to remove and a bitch to replace material, so go carefully.

It's now time to handle the pins. Epoxy does a fine job keeping the slabs from lifting off the tang but a relatively poor job preventing shear - that's what the pins do. IF the pins fit snuggly and are glued in place, they do not need to be riveted. Riveting the pins is somewhat more secure but is far more likely to result in splitting the slabs - so riveting is a judgment call. Pins are cheap, so making them too short saves little in money and costs much in overall quality.

Grind a point on both ends of the pin stock. Place the stock under the handle aligned with the hole to be filled. Looking down on the handle, make sure you can see the point extending outside the edge on one side and make a mark on the stock on the other side as shown in the image.

Most pin stock (brass, nickel-silver, copper) can be cut with a set of pliers. Stainless rod is more problematic. Typically, when you finally cut through the stock, the pin-to-be flies off across the shop and hides under the heaviest piece of equipment. My solution to the problem was to press an old set of fencing pliers into a pin shear. The lower handle was welded to a plate (for vise use) and to a piece of square tubing (which fits a hole in my swage block). The upper handle was extended for additional leverage. The pin is laid in the shear with the mark at the shear point and is sheared...



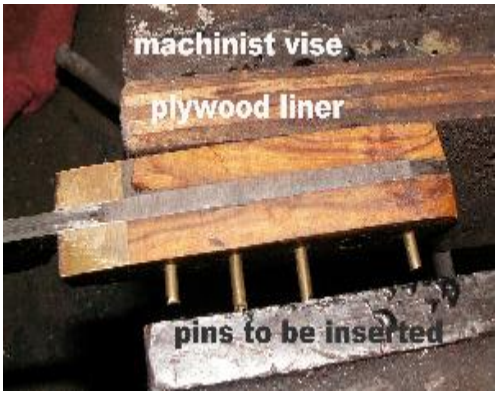
and then flies across the shop. To prevent that, a magnet from a hard disk is positioned on the far-side of the shear and a capped section of light steel pipe is placed on the magnet. When the material is sheared, the pin now ends up in the cup. I figure the time spend chasing down flying pins is far greater than the fabrication time for this tool.

The pins have a pointy end and are of varying lengths. Match the pins to the width of the handles at the various hole locations and tap (NOT drive - TAP) them in pointy end first. It is easy to split slabs by driving a pin at an angle to the hole. It is easy to pop a slab free if the pin hits the tang rather than passing through it. This is why the tang holes are oversized and chamfered and the pins are pointed.

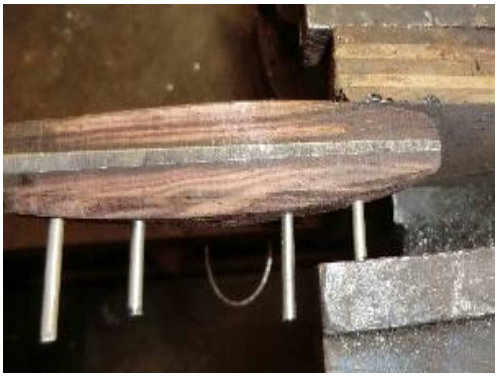
Mix up a bit of epoxy and smear it over the ends of the pins (no need to worry about the length, the ends will do).

To be on the safe side, smear some epoxy into and around the holes on the backside of the handle. What we now need to do is to somehow press those pins through the handle in such a manner as not to bend, distort, or upset the pins and not to splinter out the holes through which the pins emerge. Driving them with a hammer is possible but don't be surprised if the pins bend or upset enough to split the slab when the ends finally reach the upper slab.

To accomplish what we need, positioned a piece of scrap plywood in a machinist vise (the type of vise with a flat housing over the vise screw). The plywood ought to sit on the screw housing and extend up to the top of the rear jaw on the vise. After you have applied the epoxy, the handle is placed in the vise with the pins forward. Hold the knife as square as you can to the jaws and close the vise. The jaws will smoothly press the pins home. What you want is to actually push the pins into the plywood.

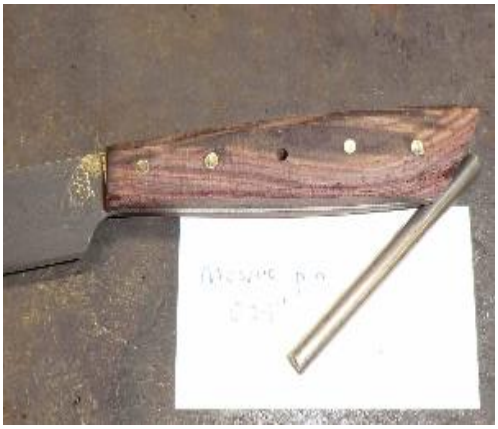


Depending on the amount of bulge in the handle (if any), you might have to individually press the first and last pin as shown. Another way to avoid this problem is insert the pins before shaping the handle. The advantages are all pins are the same length and the probability of watching the slabs fall off is lower (but if you overheat the epoxy, it will be compromised). The downside is more pin stock used.

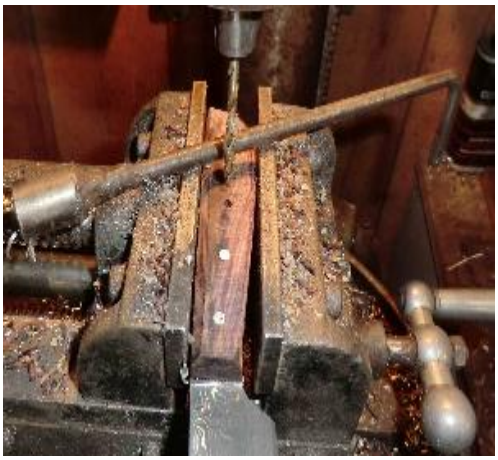


Once the pressing is over, you ought to see pins on both sides of the handle. You can now go back to grinder and grind the pins down to the wood surface. What you ought to see is nice circles looking back at you.

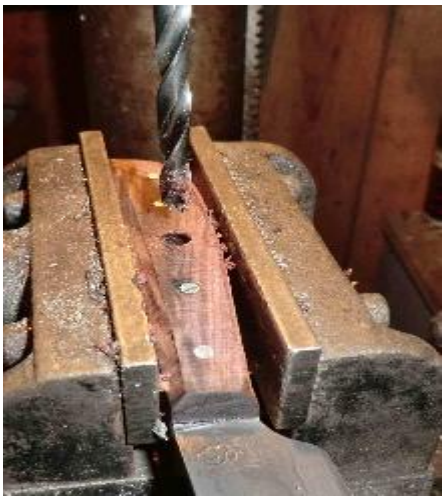
If you are going to be using mosaic pins, now is the time to play with the material. Regardless of whether you make or purchase material, it will have a known diameter. Make sure you have a drill of that diameter or, in the best of all possible worlds, an undersized drill and a reamer of the correct diameter. What you need to do is to drill a hole on both sides of the handle to accommodate the mosaic pin stock.



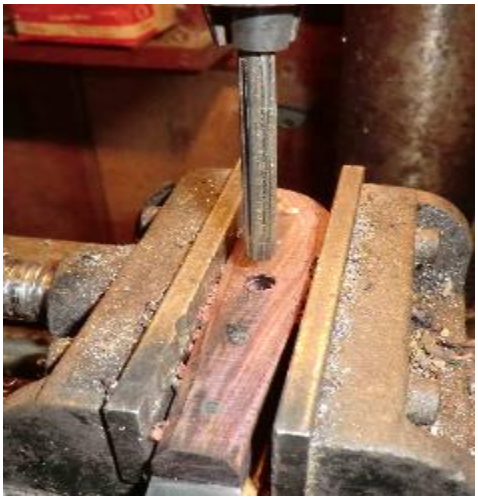
So go to the drill press and lock the blade in the cross-vise (perpendicular to the tang center as before). Use the drill bit used to make the hole as a "feeler" and position the vise so that the drill bit will slide into the hole. Lock the vise.



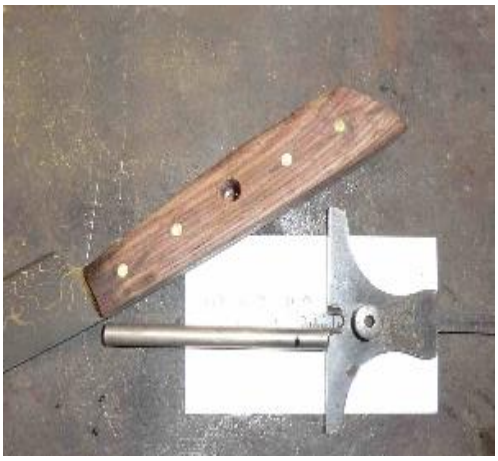
You can now switch out the small drill bit for the one to be used with the mosaic pins. Drill the hole. DO NOT attempt to drill through the tang. Go in at least 0.25" but stop when you feel or hear the tip hitting the tang. The tang is probably hard and all you will do by attempting to drill through it is to compromise the epoxy and potentially destroy the handle.



If you have a reamer, this is when you use it. Once done, flip the blade over and repeat the process (position, drill, and ream) on the other side.

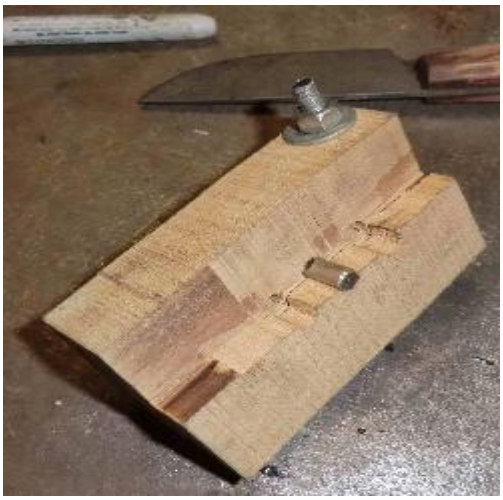


Commercial 0.25" diameter pins run something like $13 for 3.75" of stock. If your holes are about 3/8" deep, that's enough for 5 blades. Given kerf losses, it's more like 3 knives, so the damage is something like $4+ per blade (guess why I make my own). So, the first step is to determine the depth of the hole. Enco sells a pocket rule with depth indicator slide (326-1402; 1/4" wide) or you might find something like that shown in the image at a tool sale (where I got mine). Of course, you could just use a bit of scrap. In any event, estimate the depth of the hole and mark it off on the pin stock.



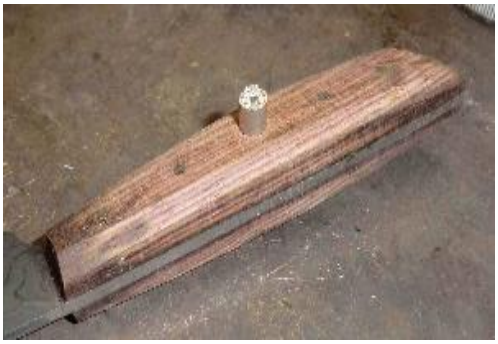
You can cut the stock with a tubing cutter or a tiny jewelry saw - neither of which work that well - or....

make one of these. It's a block of wood with a set of holes corresponding to the pin diameters to be used (here - three sizes) running left to right and in the front 1/2 of the block. A band saw slit runs along the plane of those holes (through the centers) front-to-back for about 3/4 the length of the block. Another cut runs top-to-bottom for about the same length. Finally the top-right quarter of the block is removed. A bolt is inset into the front left corner. The pin is inserted into the right hole until the mark lies in the top-to-bottom slit. The bolt is tightened to clamp the pin. Then...

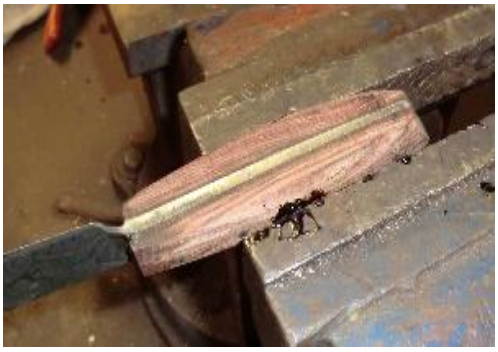


the block is placed on a vertical metal cutting band saw (the cheap one from Harbor Freight works). The blade positioned in the top-to-bottom slit, the stock extending to the right is in your right hand, and (with both hands) the block is slid forward to cut the pin stock. Once the cut is made, the bolt is slackened, the pin section pushed out of the hole, and the one end if the section is beveled on the grinder.

Just as for the pins, the mosaic pin sections are carefully placed in the holes - light taps and a scrap of wood with a hole big enough to accommodate the pin sticking out the down side makes this easier.

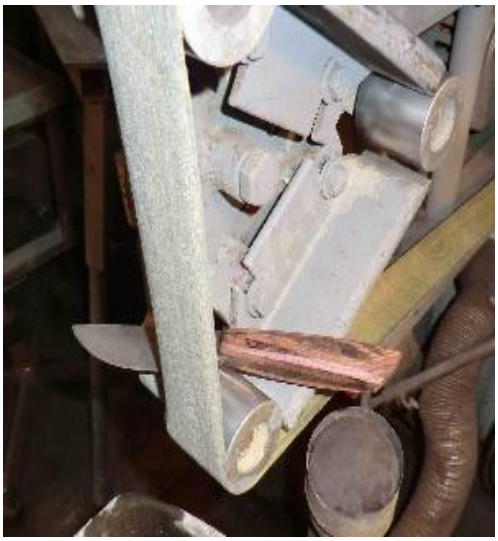


Apply epoxy as before and use the vise to press the pins home. DO NOT try too hard. The hole will have a bevel at the bottom due to the shape of the drill, so the pins may be 1/16 to 1/8" long. Once the majority is in the handle, you're done. Trying to push the pins through what remains of the wood in line with the hole and the hardened tang is NOT a good idea.



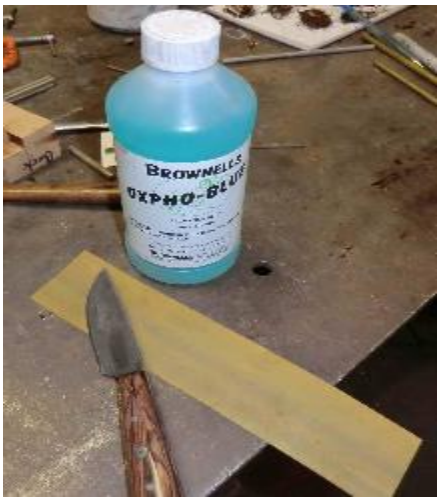
You now have something like the condition of the pins after epoxying. Back to the grinder and grind the pins flush to the surface of the handle. If you haven't already shaped the handle, do that now.

There are a number of ways to finish a handle. What I have found (over the years) that works well for me is a combination of J-Flex belts (Hermes - JF (flex) belts 120 & 320 grit) and a slack-belt set up on the grinder. By rotating the handle in plane with the belt and at angles to it, you can achieve a smoothly flowing handle of whatever shape is required. I usually finish with a Norax 30 & 16 belt (~400 and ~1500 grit).



Once the grinding is done, it's over to the buffer. I usually hit the handle with white rouge on a muslin buff. It's a good idea to go lightly on the mosaic pins. After that, the tape is removed and the knife is hit with a degreaser/cleaner (like 409) and a scrub down with an old tooth brush. This ought to remove any polish and adhesive left on the knife.

If we are talking Damascus, the knife is hit with gun bluing - not just the blade but the exposed metal of the tang. It is then wet sanded using 2000 grit paper.



The last step is to heat the blade and handle with a heat gun sufficient to melt beeswax. I make sure that all surfaces have wax flowing over them and then wipe off the excess. What results from all of this is....

Something like this.