Bulb Filler Fountain Pen

By

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The Finished Pen

Introduction

When I decided to make a bulb filler fountain pen, I found very little information on how to do it, so here is a tutorial documenting by process so others can find some information.

I do several things differently than what I have seen others do. With kit-less pens there are endless possibilities, and I encourage you to experiment and adapt these steps into your own unique way of building a pen. My hope is that this tutorial will open up possibilities so you can use these concepts to make your own unique creations.

I'd like to thank George Butcher (A.K.A. Texatdurango) for his help with breather tubes. He shared his knowledge which helped me tremendously. My method of doing a breather tube is different from George's, but I learned the concept from him. Thanks George.

There are also other ways to do a breather tube that does not require the feed modifications I do here, but I found the alternative does not work as well, so I have settled on this approach. I also like this approach because when I pull out the feed, the tube comes out with it, which makes cleaning easier.

In the step by step part of this tutorial, I don't include preview pictures of the final part, so I recommend reading through this tutorial twice, as some parts may make more sense the second time through.

You will notice that the tutorial creates a section using black acrylic. The green section used on the final pen was made the same way.

This pen requires 2 full blanks to make.

This entire pen was done on a wood lathe. A metal lathe is not required.

How Does a Bulb Filler Work?

A bulb filler works by having 2 paths from the ink chamber to the outside, with the two paths having a different amount of flow resistance.

The path with the higher resistance is the normal path that ink flows into the end of the feed and through the feel slots via capillary action to the nib.

The lower resistance path is through the breather tube. This path starts at the end of the breather tube, and then into a hole in the center of the feed which exits under the nib.

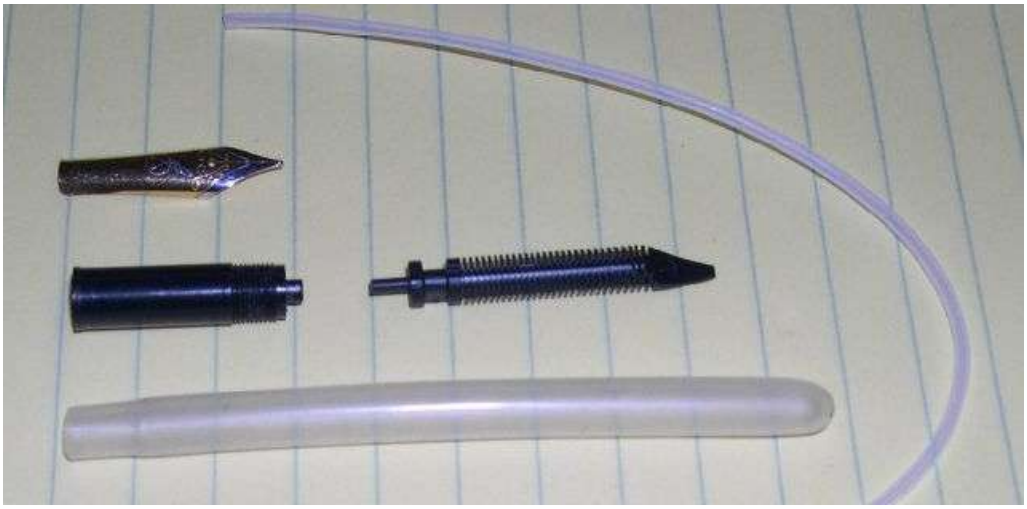
When the bulb is quickly squeezed, more of the contents of the ink chamber will leave via the breather tube (the low resistance path than the high resistance path. When the pen is held upright, this means that more air from in the bulb will be expelled than ink which is lower in the chamber. Then the nib is fully inserted into ink, releasing the bulb will pull ink in through both high and low resistance paths. Each squeeze expels some air from the bulb and draws in ink until the ink level is above the breather tube.

To empty the pen, squeeze the bulb slowly. A slow squeeze allows pressure to equalize between the two paths so the ink will drip out of the pen through the feed path.

Some things you will need

A collet chuck and collets.
Sac Cement or Shellac (I'm using Orange Shellac)
"Kit-less" mandrels – shop made from 1/2" brass rod using taps and dies.
Threaded bushing – shop made using taps and dies.
Lube for cutting threads. I use PAM cooking spray.
Calipers.
A magnifying loop.
A Sharpie.
Die Holder.
Taps & Dies (I use M10 x .75 and M12 x .8 Triple Start)
Drill Chuck.
Centering Bits (60 degree).
Live Center.
Various other drill bits that will be mentioned later in the text.

You will need a nib/feed/feed-holder assembly, as well as a sac and breather tube. I use a silicone sac. The breather tube has approximately 1/16: OD. I used a #16 sac. The sac and breather tube I purchase from richardgreenwald.com. Nibs and feeds are available from a number of vendors. Schmidt nibs and feeds from richardgreenwald.com, Bock nibs and feeds from www.indy-pen-dance.com or www.classicnib.com. Heritance nibs and feeds are from www.indy-pen-dance.com. Nibs and feeds are also available from meisternibs.com. www.indy-pen-dance.com also carries black latex sacs.



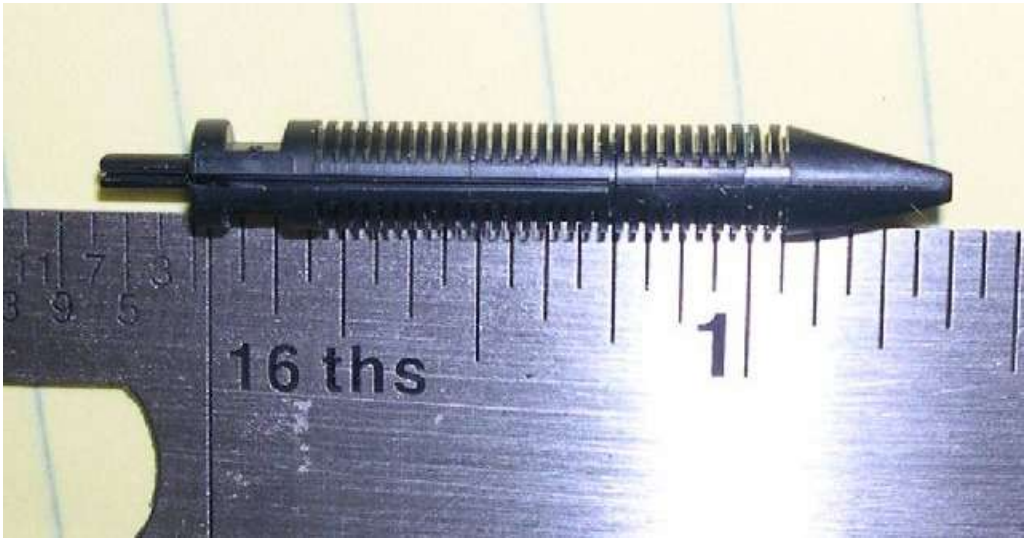
Feed Selection

For this pen I used the feed pictured below. This feed takes the modification well because there is enough material that when the feed is drilled, a larger bit can be used. . (We'll see this in more detail later.). This feed is either a Heritance feed, or one from a kit. I mixed up my supply and the feeds from the two sources are very similar.

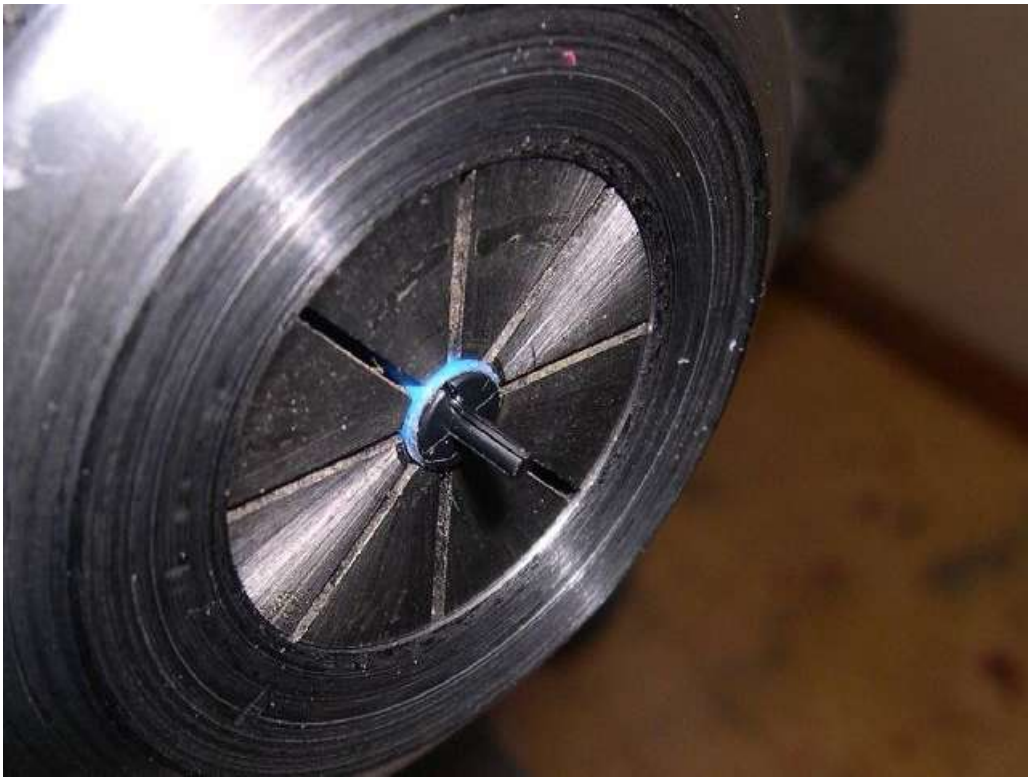
The next picture is a feed from Bock. Note the "cut-outs" in the feed. These will make it more challenging to drill a hole down the center of the feed. These feeds can be modified, but they are trickier to do, requiring more precision and a smaller bit. I modified one of these feeds using a #60 bit, whereas with the above feed I used a #53 bit. The other feed is easier to modify. The Bock feeds can be used, they are just more difficult to modify. I have not modified a Schmidt feed, but they appear to be modifiable too.

Let's Begin! – We Need a Breather Tube

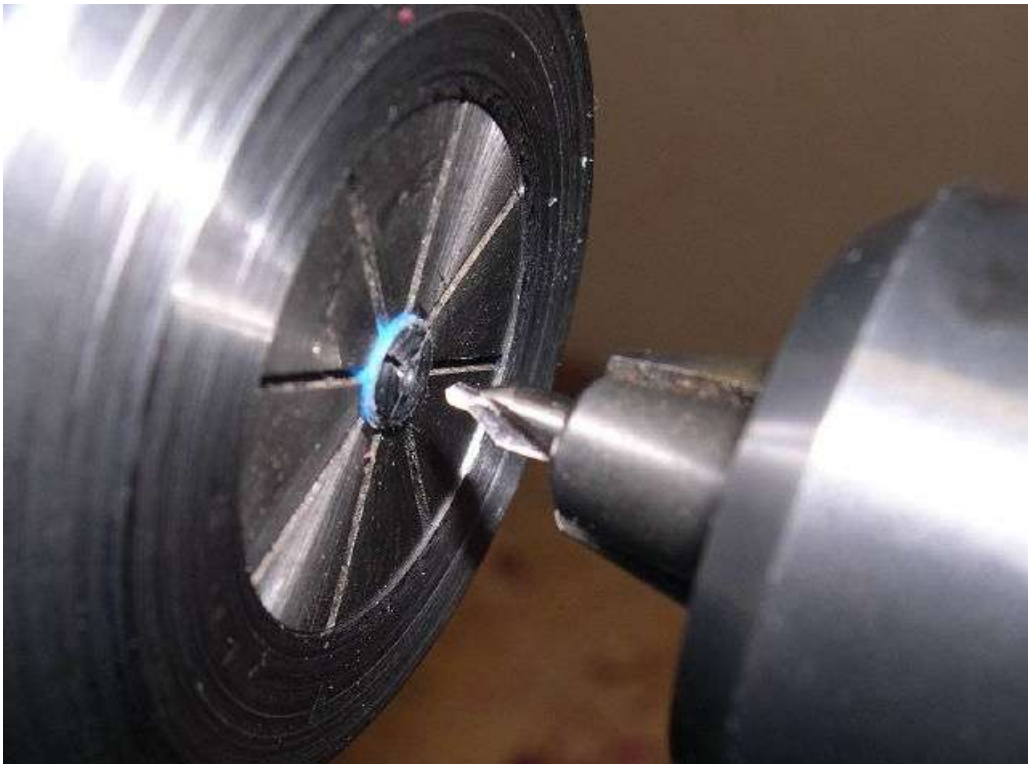
I'll be using the following feed. Examine it closely. Note where the fat channel ends at about the ¾" mark where there is a cross-slit in the feed. When drilling the hole in the feed, stop before this point. Measure carefully and mark the desired depth on your bit.



Chuck the feed in a collet chuck. My smallest collet is ¼", which is too big for a #5 feed, so I carefully wrapped the feed in blue masking tape to make up the difference.



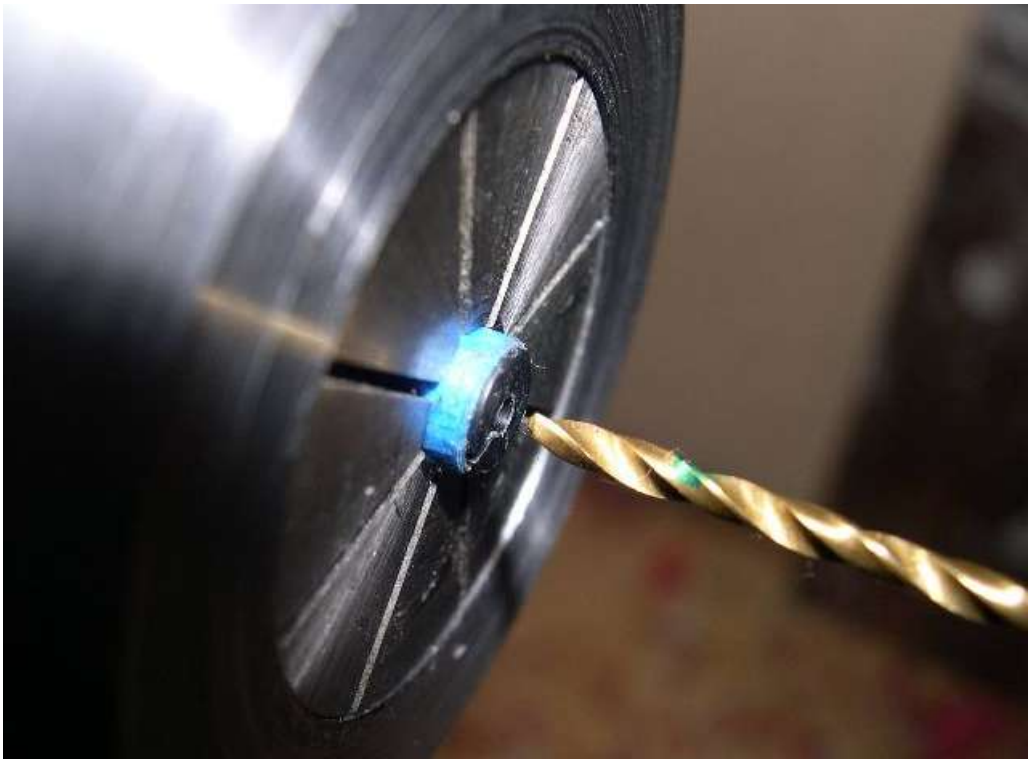
I cut the little “nipple” off using a sharp skew. Then, using just the tip of my smallest centering bit, I start a hole.



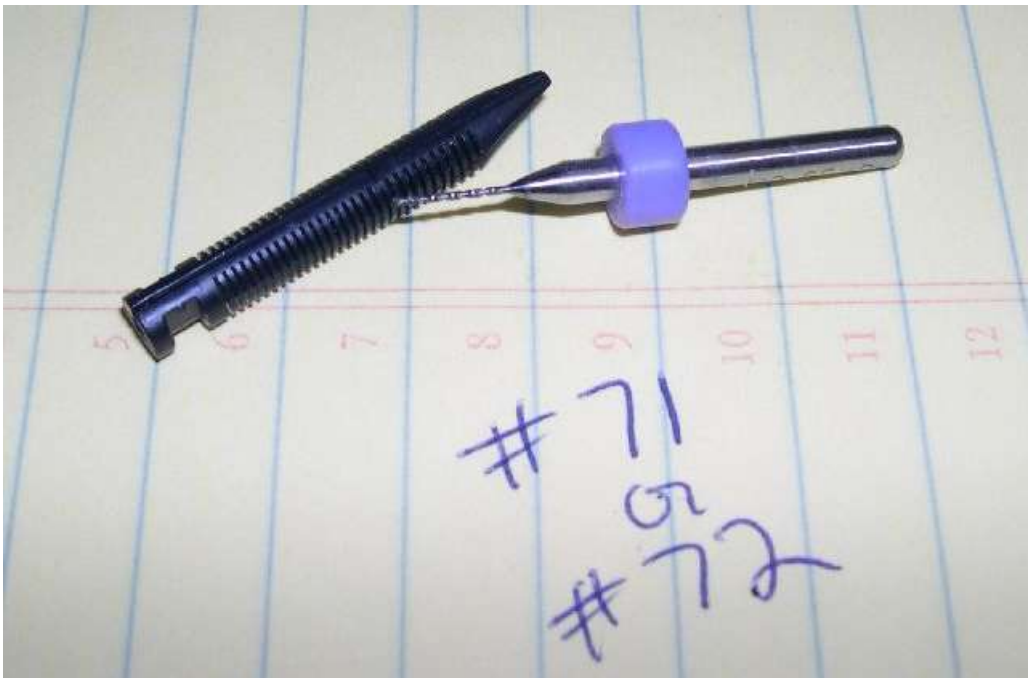
Drill a hole into the feed. Be sure to stop before going too far! The drill size is not critical. I used a #53 bit because it is the smallest bit my drill chuck will hold without an adapter. I drilled about 11/16”

Next we will need to widen a portion of the hole so the breather tube can be inserted. My tube has O.D .067, which matches a #51 bit.

I marked the bit at about ¼” and drilled in.

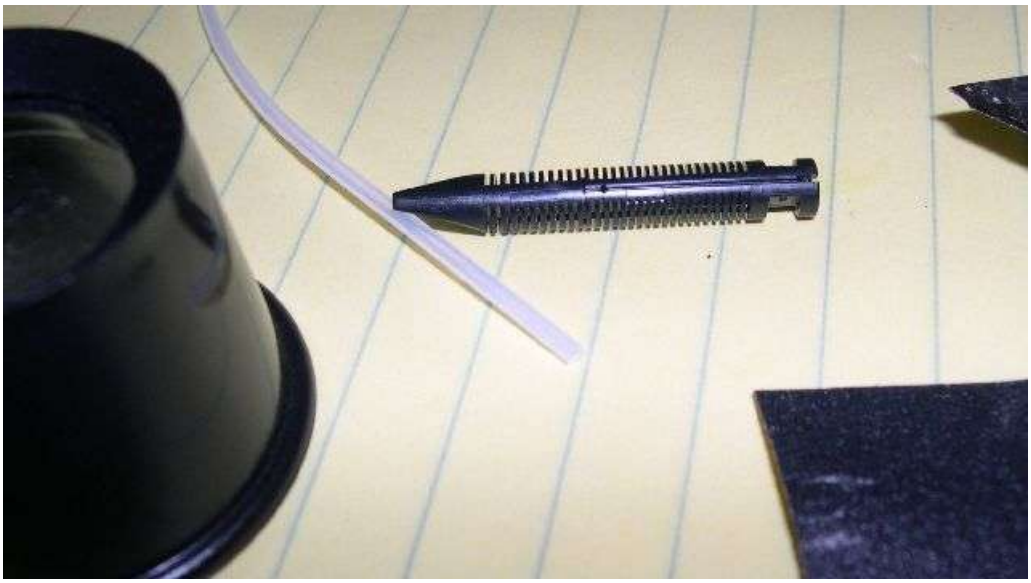


We now have a hole drilled down the longitudinal axis of the feed. Next we need to drill a small hole in the top of the feed that joins up with the longitudinal hole we just drilled. Any bit numbered in the low 70's should work fine.



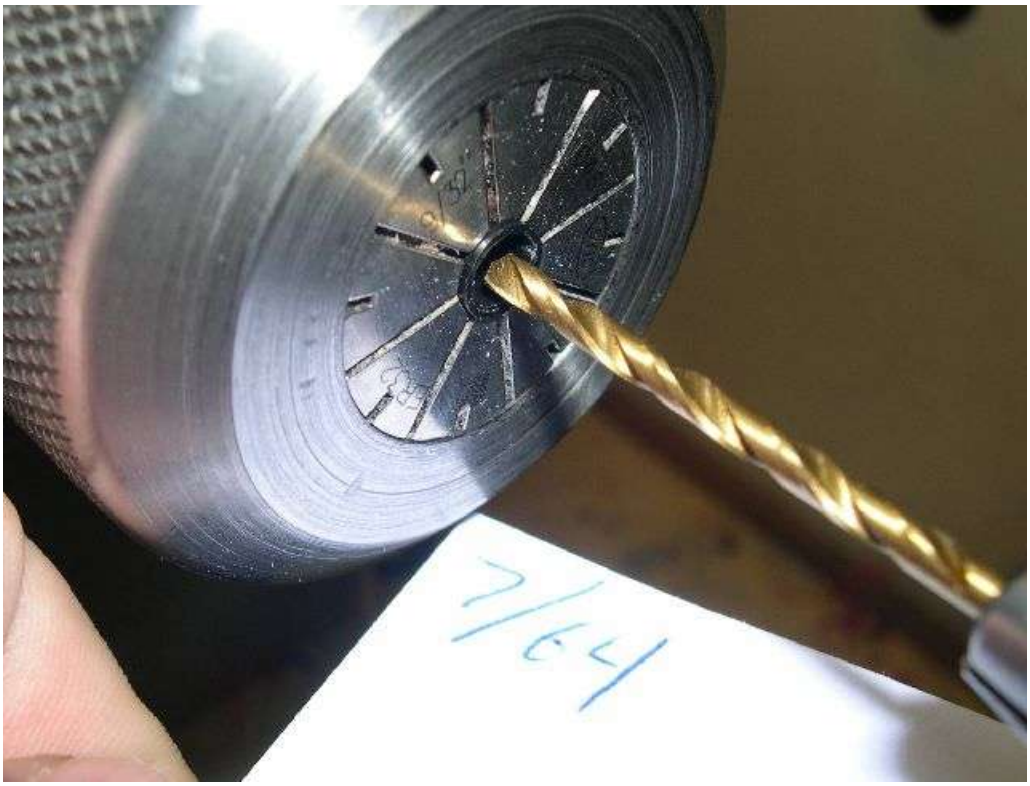
The next picture shows the hole drilled in the top of the feed. I drilled by hand. A magnifying loupe helps get the hole positioned. Don't go any deeper than you need to meet the longitudinal hole. Do not drill through to the bottom of the feed. To confirm I have linked up the holes, and to clear debris from the hole, I use a squirt bottle with denatured alcohol into the end of the feed, and watch it jet out of the top hole.

I cut the breather tuber using a utility knife. Using scissors or wire cutters will deform the end making it difficult to get it inserted into the feed. Since the tubing is slick, I roughen the end with some 400 grit sandpaper.



“Glue” in the breather tube using sac cement or shellac. Be very careful not to plug the hole with “glue”, and don’t let any shellac wick up into the feed slots or else it will block ink flow. I put the shellac on the roughened part of the tube, and then wait until it is partially dry before inserting it into the feed. The shellac should still be sticky, but thick enough so it doesn’t wick into the feed slits. I’ll clean up the excess with alcohol once the shellac sets a bit. Allow to dry overnight. Epoxy could also be used instead of shellac.

Next, the feed holder needs to be modified. I simply drill out the center with a 7/64” bit.



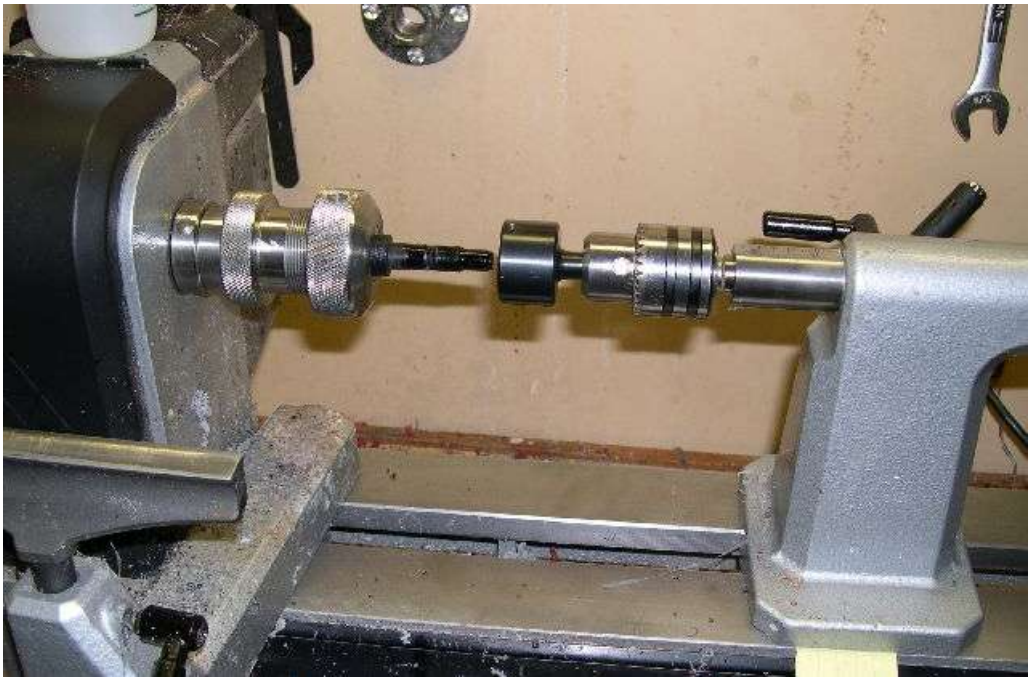
The drilling removed the nipple and makes a hole a little larger than the tube. Ink will be able to flow around the tube into the feed. This completes the feed modification.

Making the Section

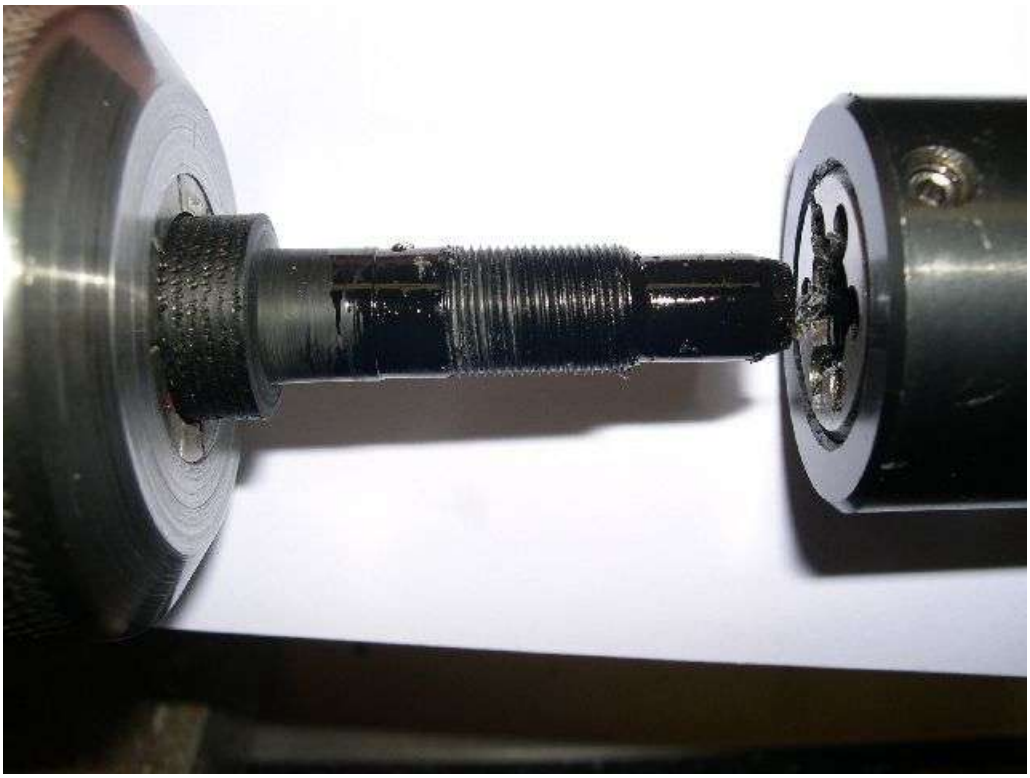
Chuck a rounded blank in the collet chuck. Use a 60 degree centering bit to create a place for the live center. If there was already a hole in the end of the blank before using the centering bit, cut the blank down to remove the hole before using the centering bit. This will ensure that your new hole is perfectly centered after chucking the blank. Make sure the face of the blank is square to the hole so that the bit engages evenly. True the end if needed before drilling. The photo depicts the blank after drilling.

I make my sections a bit differently others I have observed. I incorporate the cap threads into the section instead of the body. You may want to read through and come back to this point to understand why I turn to this shape. This shape as a big and a little tenon for the 2 sizes of threads, and “on-ramps” to help align the die as the thread cutting starts. Your taps may vary, but for mine I turn to diameters 11.8mm and 9.85mm, which yields good results with my dies.

This is my setup for threading with a die. My die holder goes into the drill chuck. I lube the tenon and die with Pam cooking spray and push the tail-stock in while I turn the spindle by hand.



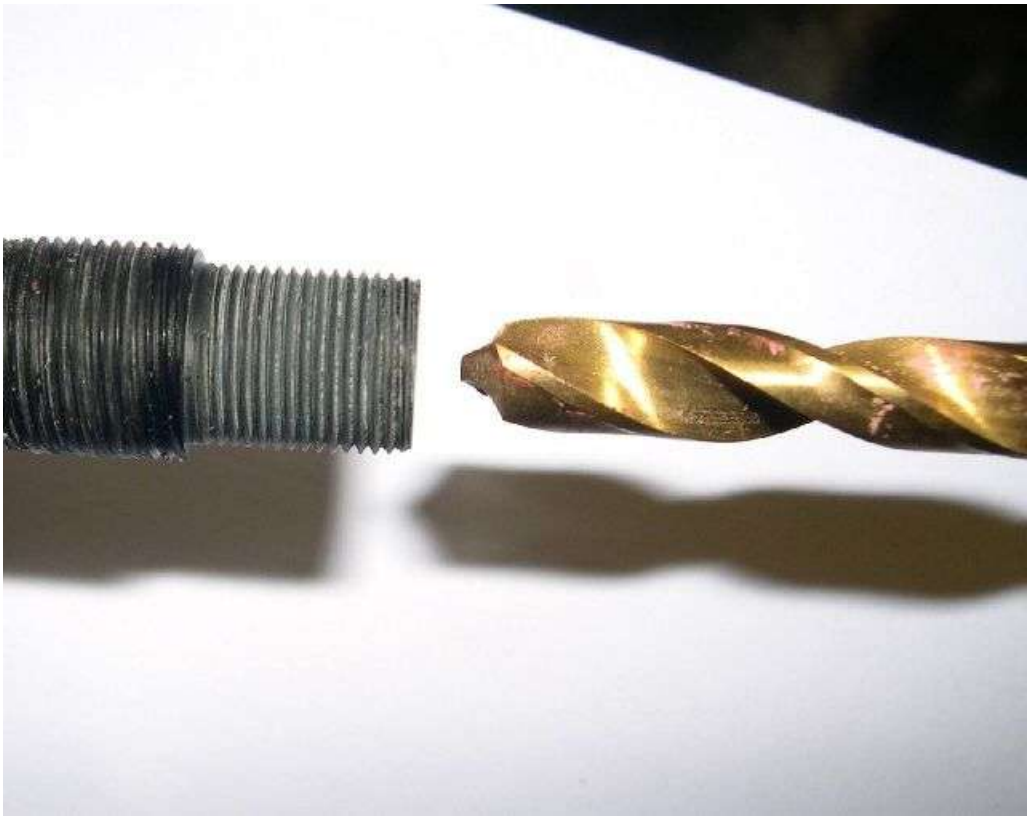
First cut the large threads (M12 x .8 triple start).



Before cutting the small threads (M10 x .75), remove the M12 “on-ramp” to create a square shoulder.

After initially cutting the small threads using the die holder, I like to reverse the die and use it by hand. This enables me to get the threads cut a little bit closer to the shoulder because the back of the die dies not taper.

Drill a 17/64” hole into the end. For depth, go just past the shoulder by approx. 3/16”. Make sure the face of the blank is square to the hole so that the bit engages evenly. True the end if needed before drilling.

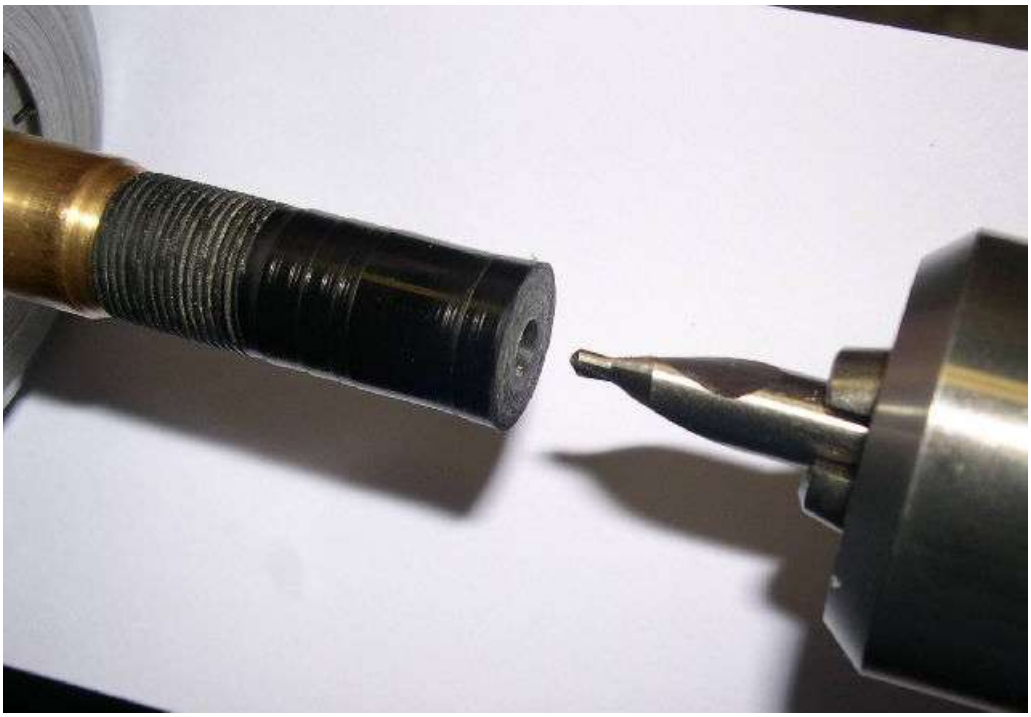


I put a slight chamfer on the inside and outside of the hole using the corner of my carbide tool. This gives it a nice finished look.

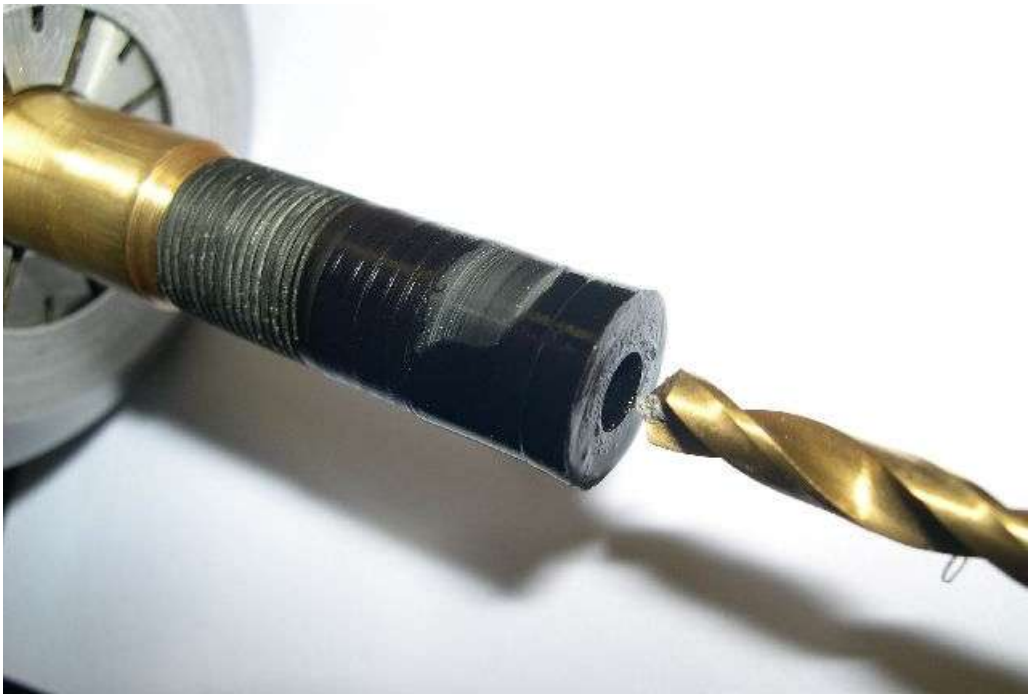
Test fit the M10 x .75 threaded tenon into the “Kit-less” mandrel. If I have done everything well, there is just a bare hint of run-out when spun. If everything looks good I’ll part-off my threaded section blank.

Chuck the female side of the M10 x .75 kit-less mandrel.

Attach the threaded section blank. Using a centering bit, create a starter hole for drilling. If there is a little nub or unevenness on the face of the blank, I'll clean it up with my carbide tool before using the center bit.



Drill into the blank. Meet the hole drilled from the other side, but stop short of the shoulder. The reason for drilling like this is that some feed holders will be fatter than the hole drilled from the other side, and this approach leaves a little more material for strength in the M10 threaded tenon. . Make sure the face of the blank is square to the hole so that the bit engages evenly. True the end if needed before drilling.



If you try to drill full diameter, there is a good chance that the M10 tenon will break off from the stress. I start small, drilling 3 times to work up to the proper size hole to accept the feed holder. Use calipers on your feed holder to determine the proper final bit. The ideal size is a slip fit with no play.

Once the hole is drilled, I use a centering bit to create a place for the live center to ride in.

Turn your section to whatever shape you desire. The number of threads you leave will determine how many rotations the cap will need to screw on. Note that excess near the live center will be parted-off. The bead at the end of the section helps align the cap to help prevent cross threading the cap threads. If the bead is too small, the cap can cock to one side, which makes the user need to take greater care when capping the pen. An 11mm bead diameter (before sanding) works pretty well for me.

The feed holder I am using has a rim, so there needs to be a recess in the hole to enable the feed holder to insert all the way. I modified an old lathe tool into tiny scraper that so I can get inside small holes like this. I find this gives me more control that trying to drill a small recess.

Test fitting the feed holder before sanding and polishing the section.

Once the section is finished, the feed holder is glued into the section using shellac. You may have noticed that I did not tap the inside of the section for the feed holder. The feed holder must be sealed to the section so that ink does not seep out of the pen. Since I am "gluing" the feed holder in with shellac for a seal, I decided to forgo the internal threads. Alternately you could use epoxy, but shellac releases at about 140 degrees F, making future disassembly possible.

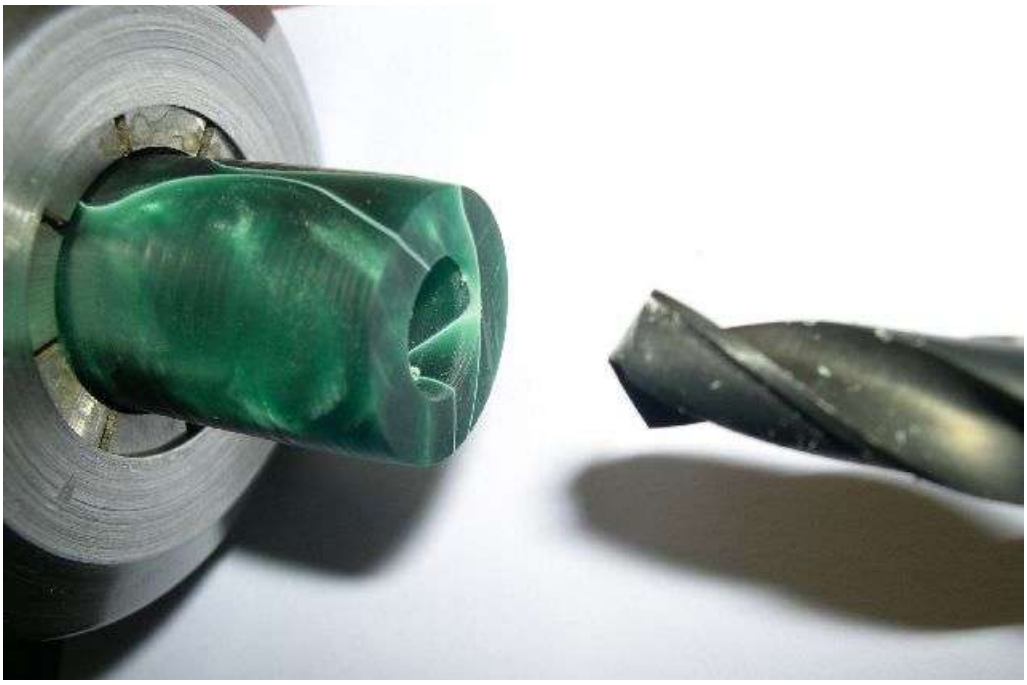
The fully assembled section.

Creating the body

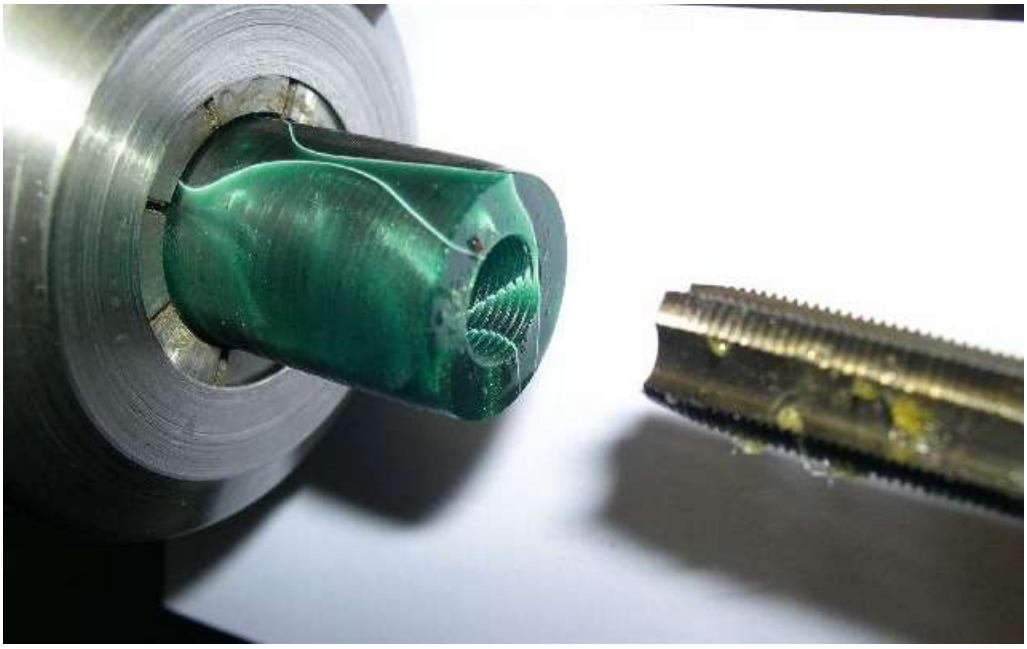
I decided to make the body 1 & 7/8” long.

Chuck a rounded blank in the collet chuck. Use a centering bit to start a hole. If there was already a hole in the end of the blank before using the centering bit, cut the blank down to remove the hole before using the centering bit. This will ensure that your new hole is centered after chucking the blank. Square the face before drilling.

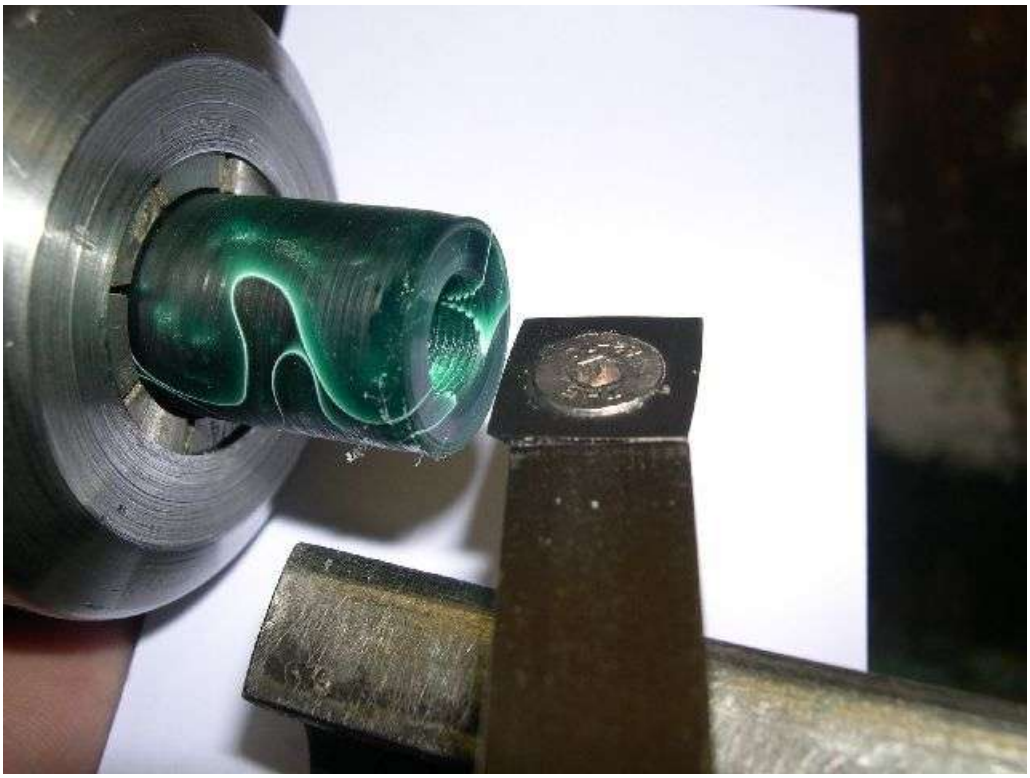
Drill 1” deep for the M10 x .75 threads. I use a 9.25mm bit, but the closest fractional bit will work fine. Make sure the face of the blank is square to the hole so that the bit engages evenly. True the end if needed before drilling.



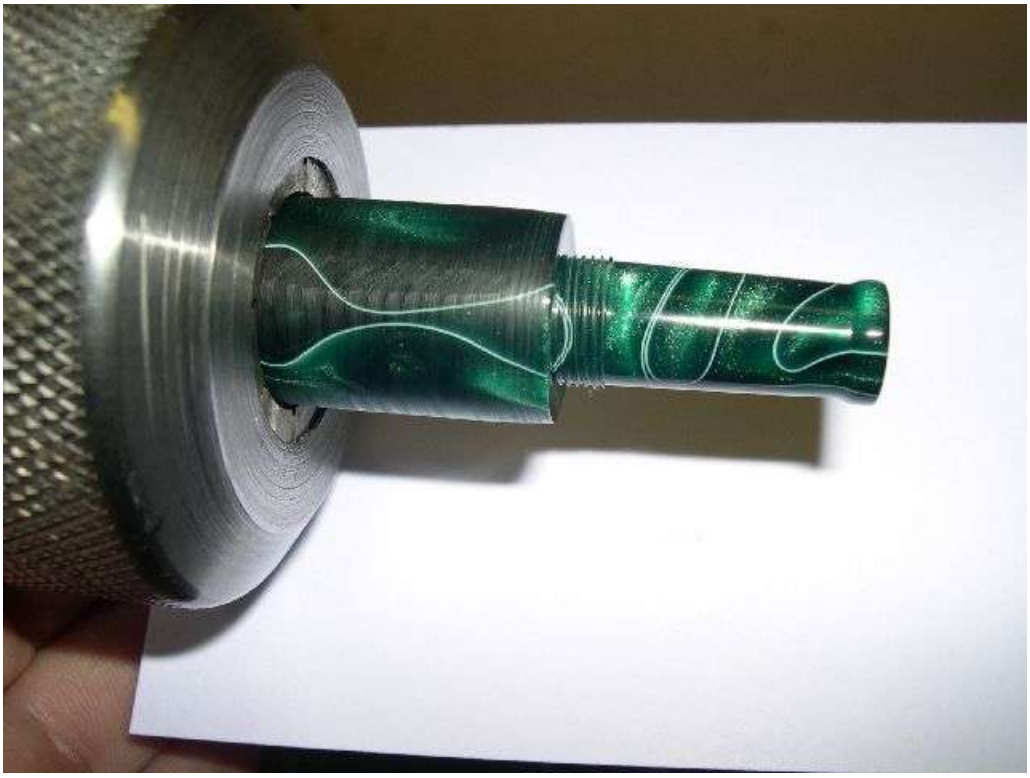
Tap the threads. I use Pam cooking spray to lubricate. I do the same procedure as I did with the die, except, of course, I use a tap here.



Re-square the face of the blank and put a small chamfer on the inside. I also wet sand and polish the face at this time while it is easily accessible.



Test fit the section.



Chuck the M10 x .75 male kit-less mandrel.

Attach the blank to the mandrel and use a centering bit to start a hole. If there was already a hole in the end of the blank before using the centering bit, cut the blank down to remove the hole before using the centering bit. This will ensure a new, accurate center after attaching the blank to the mandrel.

Drill until you meet the hole from the other side, then tap with M10 x .75. Make sure the face of the blank is square to the hole so that the bit engages evenly. True the end if needed before drilling.

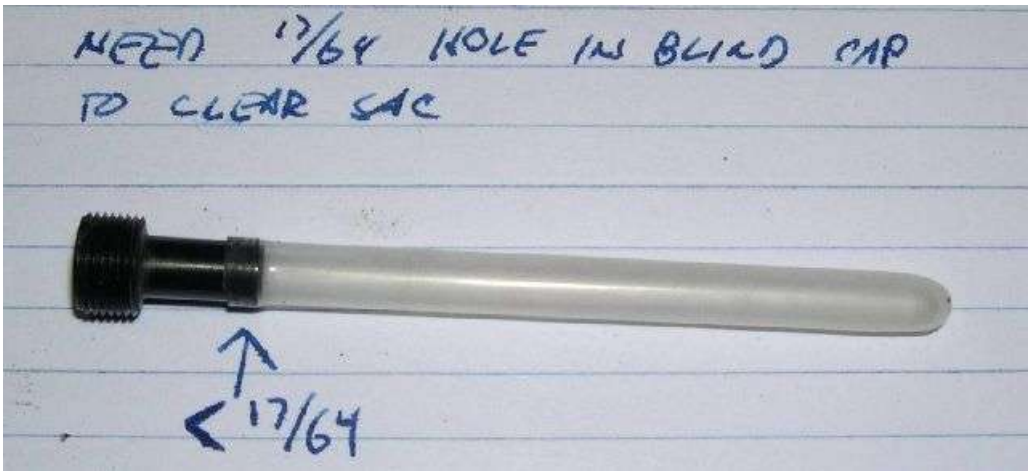
This is a threaded bushing that I made to engage the live center. Threads are M10 x .75 and there is a 60 degree counter sink to accept the live center. It can be made from brass, aluminum, Delrin, Corian, etc. You turn a tenon with a nice, square shoulder, and then thread it. Part off and attach it to the female kit-less mandrel to make the 60 degree counter sink with a centering bit.

The body is mounted and ready to turn to the desired shape.

We need to create a plug for one end of the body that has a nipple for the sac. Using techniques similar to creating the section, create a threaded plug with a nipple sized appropriately for the sac. Drill a hole through the center. The picture below shows what it should look like just before parting off.

The completed plug/nipple. I chucked the part by the nipple end to clean up the back side after parting off.

Test fit the sac. The hole in the blind cap will need to be 17/64" to fit over the sac. This is a #16 silicone sac.



The plug is epoxied into the body (be sure to put it into the correct end!). Use a tooth pick to get the epoxy down inside the body. You want to screw the plug in enough that there are threads available to accept the blind cap, so be careful to get the epoxy down inside the body while leaving the closer threads clean. The plug must be sealed to prevent ink from seeping out, so use an appropriate amount of epoxy to ensure a seal.

The sac is attached using Sac Cement or shellac (sac cement is basically shellac.) Cut the sac to the desired length. There are tools make attaching a sac easier, but I do not own them. I start by turning down a small part of the sac.

Put shellac on the nipple and the part of the sac that is turned down. Slide the sac on the nipple a little bit, then un-fold the turned down part. It's a bit tricky, but you can always clean everything with alcohol and try again until you get the hang of it. I use toothpicks to help me fold down the flap. Once attached, you can adjust the sac so it is straight. Clean up any excess with alcohol. Allow to dry overnight.

Making the Blind Cap

Making the blind cap is very much like making the section. The threading steps are identical. Drill into the end with the bit required to clear the sac (17/64" for this pen) and drill deep enough to accommodate the sac.

Test fit the body (with sac already attached). When everything fits OK, part-off the blind cap blank. When you part-off, make it long enough that you can drill a counter sink for the live center to provide support while shaping the cap.

Complete the blind cap in a closed-end fashion using the female kit-less mandrel. You want to remove the excess cap threads, but leave it as thick as possible and only taper slightly. Leaving the post as thick as possibly helps align the cap when posting, which helps prevent cross threading the cap onto the post.

Making the Cap

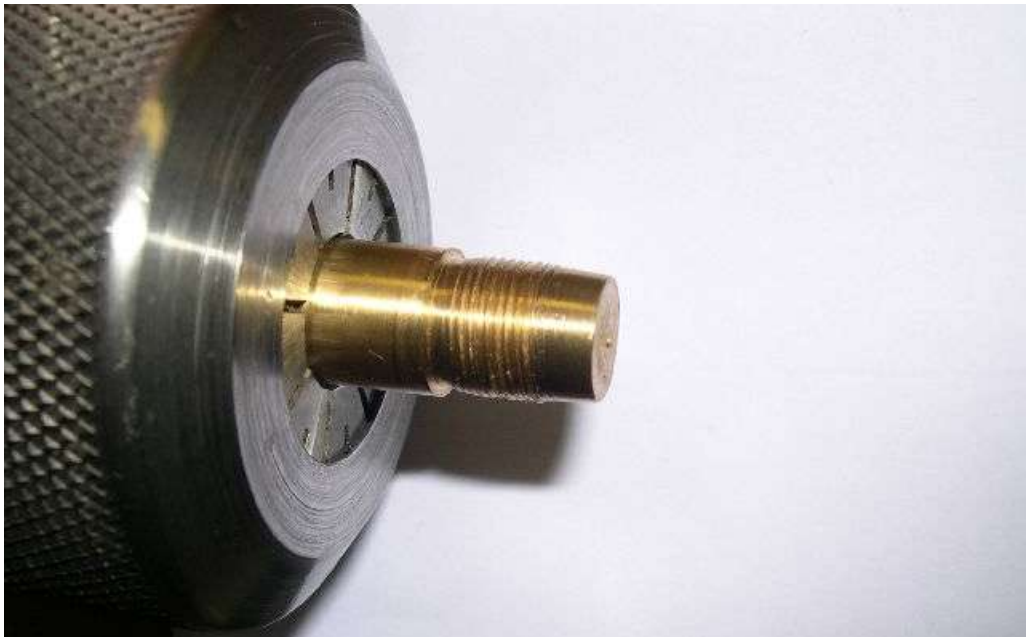
The cap will be closed end with a bent wire clip. Measure your section with the nib installed to determine the total drill depth needed for the cap.

Chuck the cap blank. Drill and tap in the same manner as we did for the body, except in this case we will drill with a 7/16” bit and tap with the M12 x .8 triple start tap. I like to step drill the cap so I can taper the end of the cap more aggressively. Drill with the 7/16” bit deep enough to accommodate the section and blind cap length (whichever is longer), and then finish drilling with a smaller bit that accommodates the width of the nib.

Test fit the pen into the cap. This picture shows testing the “Capped” position.

This picture shows testing the “Posted” position.

Remove the cap blank and chuck the M12 male kit-less mandrel.



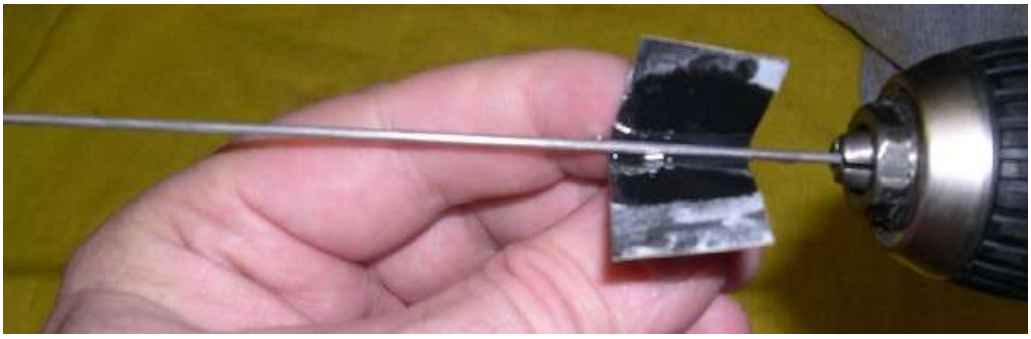
Mount the cap blank. Use a centering bit to create a counter sink for the live center. I marked the blank with the depth of the hole then transferred the mark to the tool rest. As long as I don't move the tool rest, I can use this mark to determine where to part off the end of the cap. The small tenon on the live center side is left over material from parting off the blind cap – it will be parted off once the shape is complete.

Turn to desired shape then part off the excess. By taking very light cuts, you can shape the end of the cap after parting off the end. For now I will defer sanding and polishing. After I fit the clip, I will re-mount the cap to sand and polish.

Bent Wire Clip

I'd like to start with a comment on difficulty. I find these clips very time consuming to do. The fitting of the clip so it is straight and even can be tedious and time consuming. Have patience.

I use 1/16" stainless steel rod made by K&S Engineering. The rod comes in 12" lengths and is un-polished. I chuck a rod in a hand drill and sand with oil from 340 to 2000 grit.



Cut a 6" length for one clip.

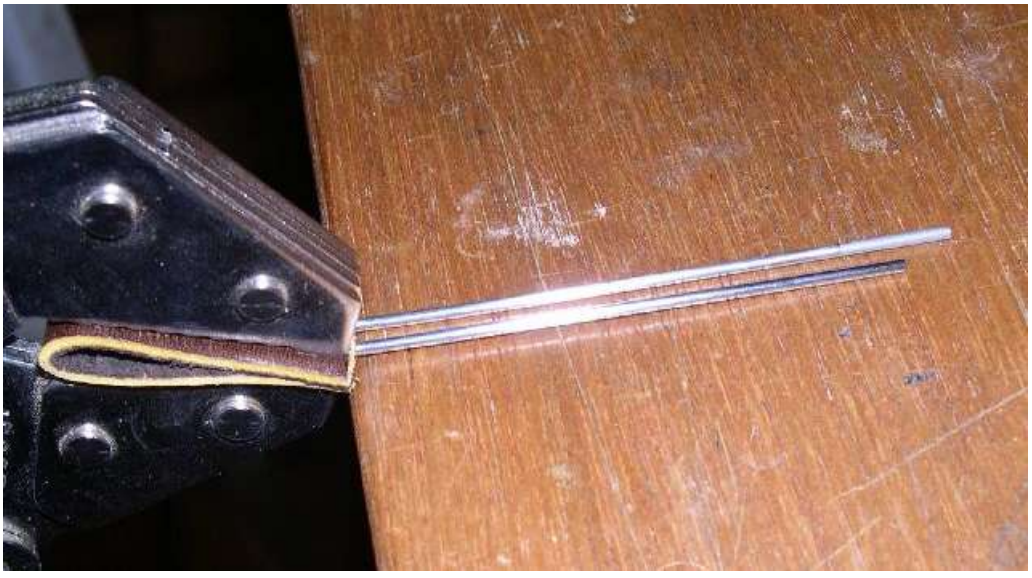
Bend the rod in half. I use scrap wood with a slot in it to start the bend. Nothing fancy – this came straight out of my scrap bin.

Continue to bend by hand until you can get pliers across the bend

Continue the bend with pliers. I use leather to keep from marring the metal.

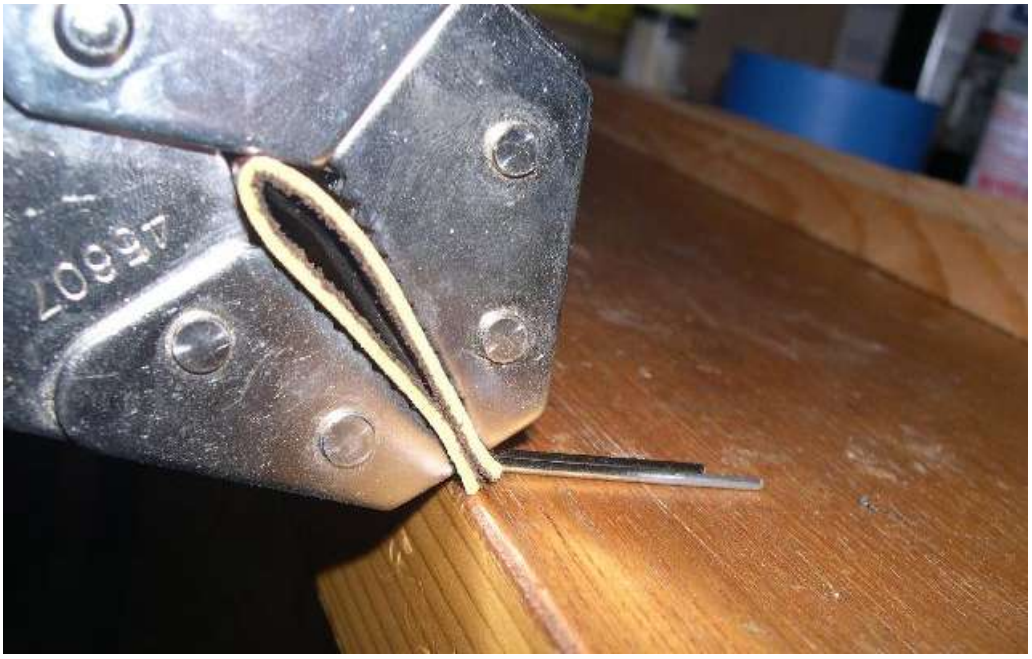
Bend until both sides come together. The tighter the better.

Grip the tip of the clip in vise grips (using leather) and bend up the tip

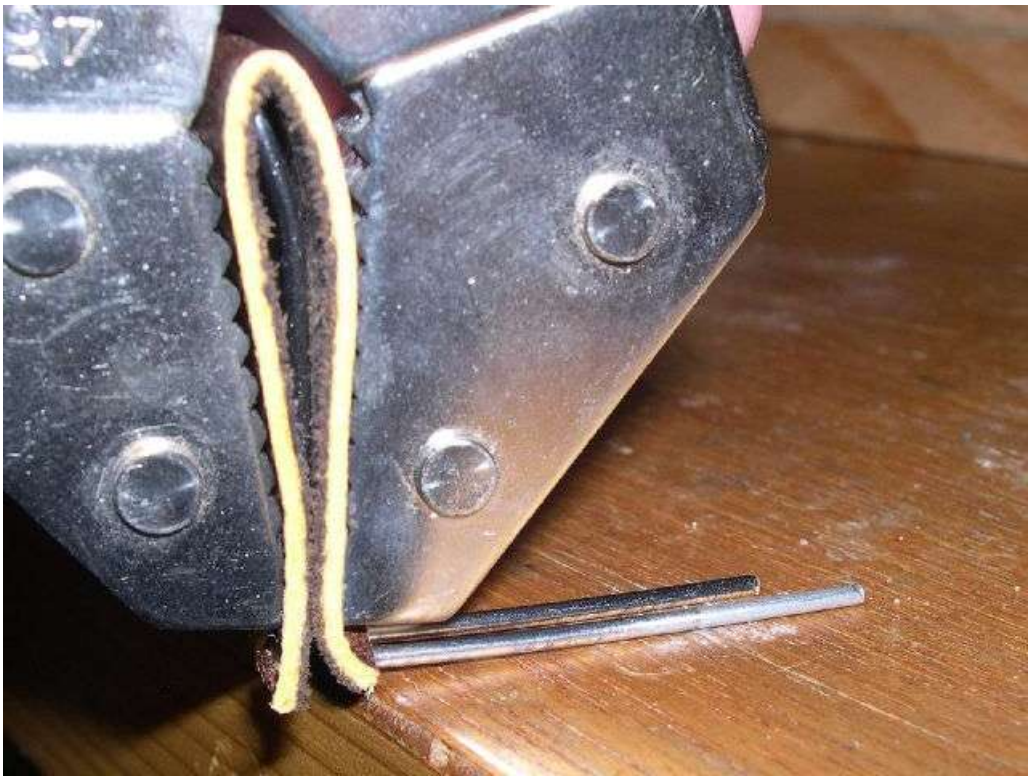


Note the length of the leather. The clip length will be approximately ½ the length of the leather. In this case about 1 ¾.

Use vise grips and leather to start the bend in the prongs. Take great care to ensure the clip is absolutely straight in the vise grips to ensure both sides of the clip end up the same length. Make sure you bend the prongs in the proper direction relative to the previous bend.

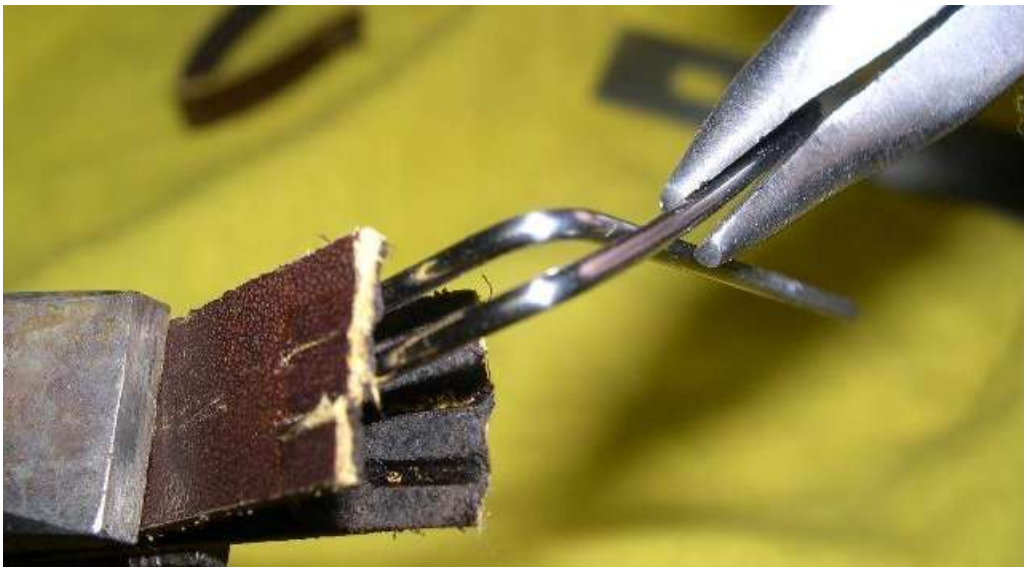


Move the vise grips back a little to make room to complete the bend

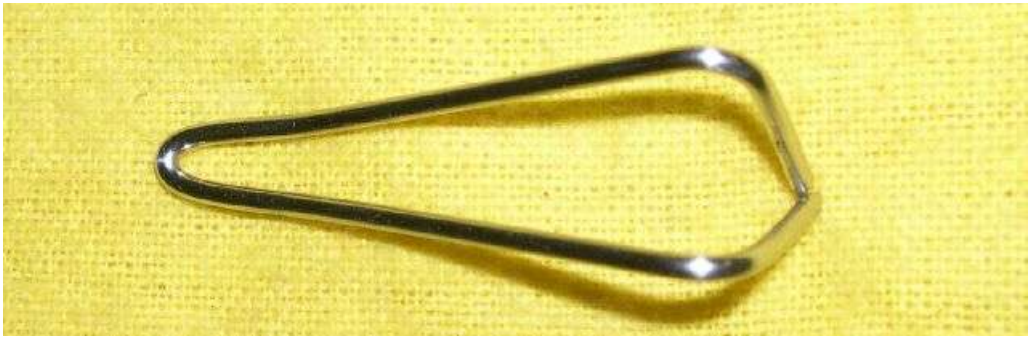


The completed bend. The slight unevenness of the prongs will get tweaked later.

Grip the tip of the clip with pliers and twist each prong inward.



Use wire cutters to shorten the prongs.



I use a grinder to get the prongs to the right length, chamfering the ends as best I can to make it easier to insert into the holes I will drill into the cap.

Post the cap on the pen and mark the clip position with a sharpie.

Use a cradle to hold the cap in a drill press. The blue tape built up under the cap compensates for the taper in the cap and helps keep the cap from rocking in the cradle. I first use a very small bit to make a starter hole so the bigger bit does not wander when I start drilling. The bit should be centered on the cap. Rotate the cap to drill the second hole (the cradle never moves). You can experiment to determine the spacing you prefer for the holes. I recommend at least 45 degrees as I find it makes fitting the clip easier than a narrow stance.

The small starter holes.

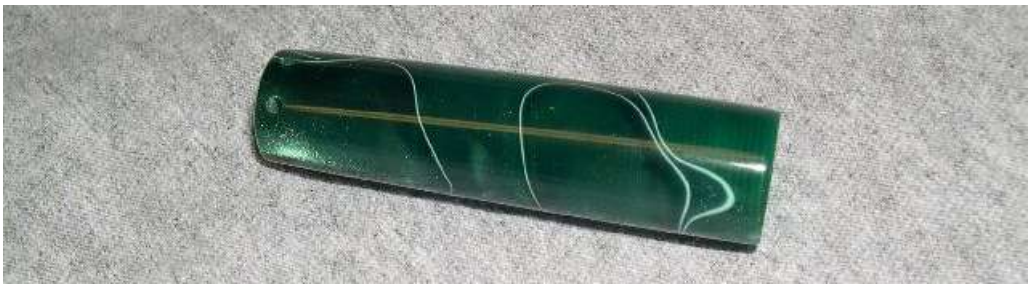
Use a bit that matches the diameter of the rod you used (confirm with calipers). For me it is a #51 bit. Set the drill depth to just past half way through the cap. Carefully drill using the starter holes, rotating the cap for the second hole. Hold the cap in place firmly so it doesn't move (especially when extracting the bit)

The final holes

Test fit the clip. It is very unlikely that the clip will fit perfectly at this time. I can't give instruction at this point. You will need to make small adjustments to the bends to get the clip to fit properly. You want the clip straight, and both sides in contact with the cap. This is the part of this process that can be very time consuming and frustrating. If your holes are not even, or both sides of the clip are not the same length, fitting may be impossible. If the clip is flawed, make a new one and try again. If the holes in the cap are not even, you can either re-make the cap, or bend a new clip, intentionally making one side longer than the other. If the clip seems to be at fault, save it – one day it may fit another cap.

Once the clip fits the cap, polish with buffing compound (I use Tripoli) on a rotary tool. If you marred the clip with pliers while bending and fitting (as I usually do) you will need to first re-sand the clip by hand through the grits before polishing. . I'll do one last test fit after sanding/polishing the clip.

Put the cap back on the lathe to sand and polish it. I wait until the end to sand and polish because I invariably scratch the cap during the fitting process.



Use a toothpick to put epoxy down into each hole, and then insert the clip. Be very careful not to scratch your freshly polished cap. (It helps to practice attaching the clip a few times before sanding/polishing the cap.) If you get one side pressed in too far, a toothpick can help gently pry it out. Epoxy will squeeze out (if not, you likely did not use enough). I use small pieces of paper towel and denatured alcohol to clean up the squeeze-out. Be careful of epoxy on used portions of paper towel (this is why I use many small pieces) and on your fingers. You don't want to spread around the epoxy and have it harden on the outside of the cap. Inspect the cap carefully for epoxy and clean it up. I use 5 minute epoxy and have plenty of time, but you can use a longer set epoxy if desired.

The Completed Parts

Assembly and Testing

I trim the breather tube so that it ends just before the end of the sac nipple. The feed holder and sac have already been sealed with shellac. The section will also need to be sealed to the body when they are screwed together.

For testing, I use Teflon plumbing tape to seal the section to the body. This way I can easily disassemble the pen. However, I do not know if there will be an undesired interaction between the tape and ink, so for final assembly, I use shellac as a "thread locker" to seal the section to the body – just to be safe.

I test the pen using water with a little dishwashing soap to lower the surface tension. I ensure the pen fills, and I will leave it filled for a day so I can check for leaks or seepage. You can even check that the flow is not blocked by writing with the water, or touching the tip to a paper towel and watching the water flow out the end of the nib through capillary action. By writing with the soapy water, you can make at least an initial assessment that the nib is reasonably tuned.

Once I am satisfied, I will disassemble the pen (except shellacked parts), rinse everything well and allow all parts to dry. For final assembly I use shellac on the section threads. The shellac in the confined space dries very slow. I'll let the shellac partially dry before screwing in the section, and then wait several days before installing the feed & nib.

Do not ink the pen unless it is for your own personal use. The ink will slightly discolor the sac, so of your sell/gift the pen, it will look like a used pen.

Shellac will release at about 140 degrees F. If you use a material that is not sensitive to hot water, you can disassemble shellacked parts by heating with hot tap water. Some materials are sensitive to heat and/or water, so know your materials before heating the pen for disassembly.