Deterrence Dispensed presents:

9x19mm 50-10 Progressive Twist

Easy, Accurate, Safe, Cheap

DIY ECM v2.0 Barrelmaking

For FGC-9 MKI and MKII, and other applications

Preface

This project will walk you through the process of making your own rifled barrels at home using electrochemical machining. The accompanying files, documentation, and information found in the same download package as this document will detail and provide the help you need.

You can watch a high-level overview of the process here:
https://lbry.tv/@Ivan's_CAD_Streams:c/ECM-DIY-Barrels:a

I recommend you use the video to become familiar with the process, then rely on this document for the actual information you need - having text-based steps helps keep things organized.

Do not be intimidated by the length of this documentation – it is lengthy because it covers all cases and goes into great detail, such that your issues and questions will be answered without you needing to ask them.

If you have found this tutorial useful, consider sending me Bitcoin to further development of this sort of thing – there is much more to explore in 3D printed guns, DIY guns, DIY ammo, etc.

BTC: bc1qm9q5lu5skq8e50yqz8hps69r44lmue6sfq5y2y

For stability through rotational motion.

Remember that it is our shared responsibility to be safe and smart with firearms and show the world there is a peaceful way to own guns – take the time to get training, to learn basic (and advanced) safety rules, and to share the hobby with everyone interested – those most scared of guns in the hands of the people are often the ones who have no experience with guns in the first place.

Contents

Introduction

Crafting a barrel using the ECM process is easy, affordable, and can offer excellent results when done properly. This tutorial will help the end user understand how to set up, run, and check their progress as they cut a barrel via ECM. There are five main sections (Tooling Creation, Tooling Setup, ECM Process, Non-Destructive Inspection, Troubleshooting) and a preface (which is mainly words of wisdom regarding the process) to this tutorial – I recommend you read all of it before you start with any actual work on the ECM setup. The size of this tutorial may seem daunting, but don't let that scare you – the tutorial is thorough and aims to help you avoid as many errors as possible.

Note that there is a video showing some (but not all) of the information presented in this document here: **https://lbry.tv/@Ivan's_CAD_Streams:c/ECM-DIY-Barrels:a**

The video can be a good quick reference, but you should rely on this document for the level of detailed instructions you need.

Thanks to Jeffrod for the inspiration/advice that helped get me started with ECM rifling.

Key words/Definitions

Reservoir: container for holding liquid.

Electrolyte: fluid that can conduct electricity.

Suction Side: the side of the pump that sucks in fluid from the reservoir.

Pressure Side: the side of the pump that pumps out fluid to the barrel/ECM head.

Sludge: a nasty mixture of metal ions, trapped oxygen/hydrogen gas, and electrolyte. AKA barrel coffee.

Boring – increasing the bore (inner diameter) of the barrel.

Rifling – adding rifling grooves to the barrel.

Throat Cutting (aka throating) – cutting a throat in the barrel to allow rounds to seat fully in the chamber without the bullet engaging in the rifling.

Chambering – adding a chamber to the barrel.

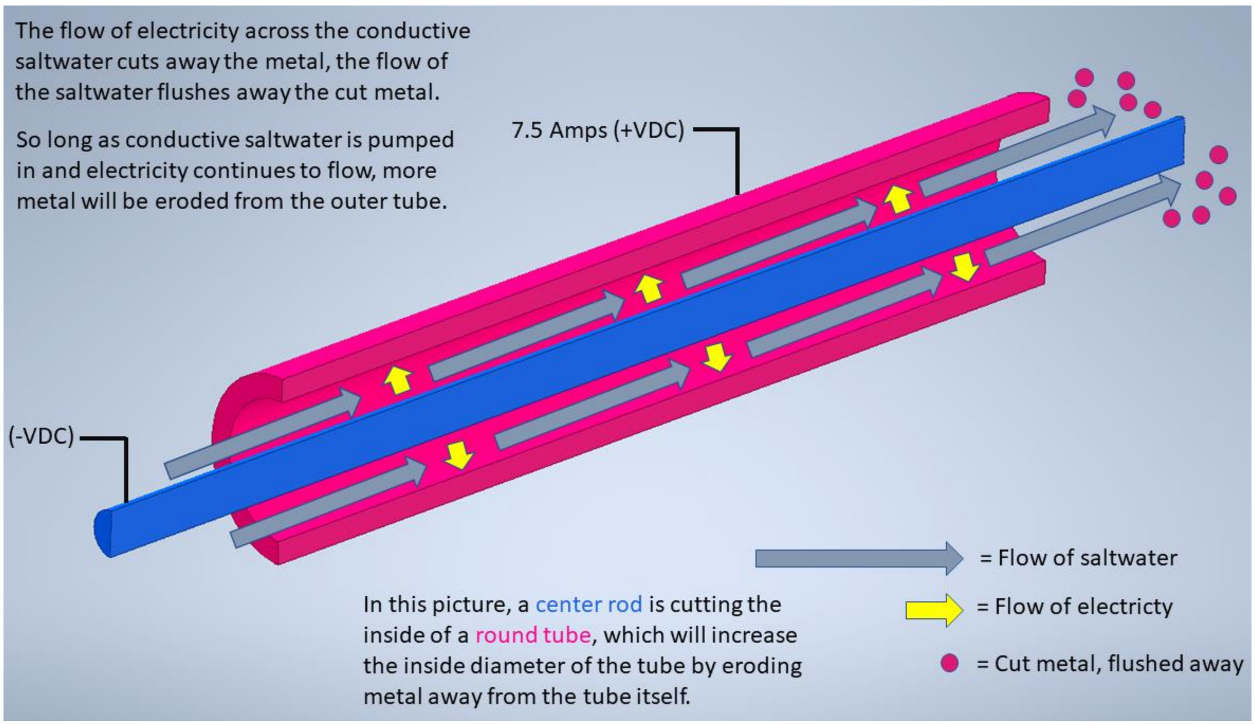
Hill – In polygonal rifling, lands are referred to as hills. Hill to hill measurement should be the same as bore diameter (8.82mm).

Valley – In polygonal rifling, grooves are referred to as valleys. Valley to valley measurement should be around 9.30mm.

101:

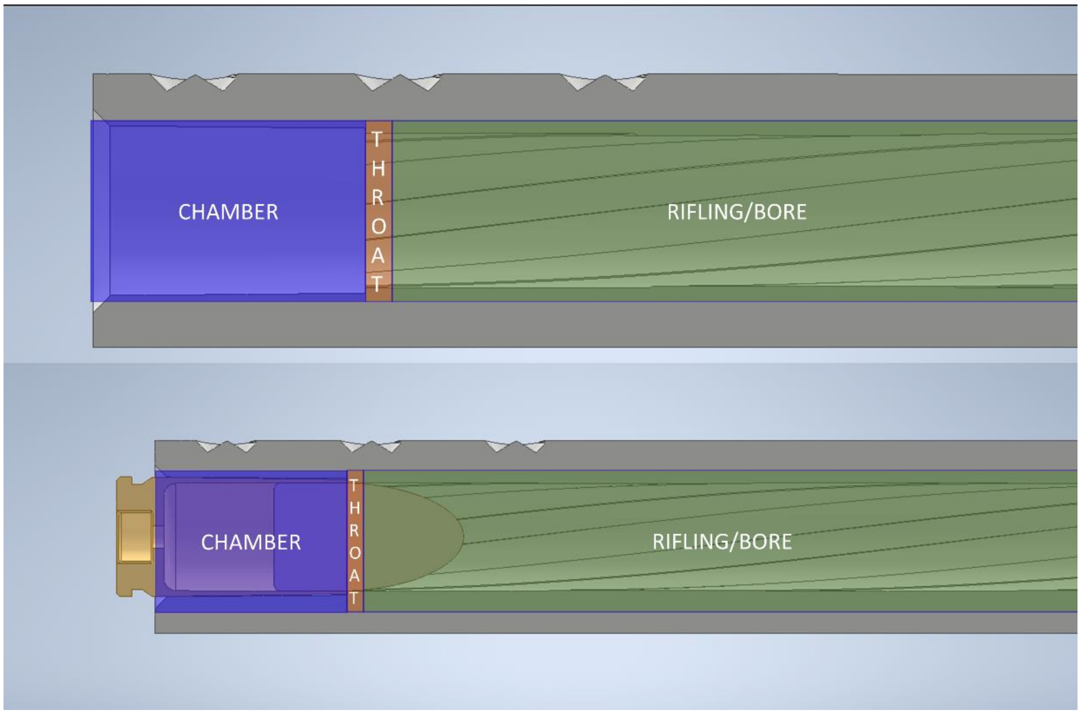
What Is Electrochemical Machining?

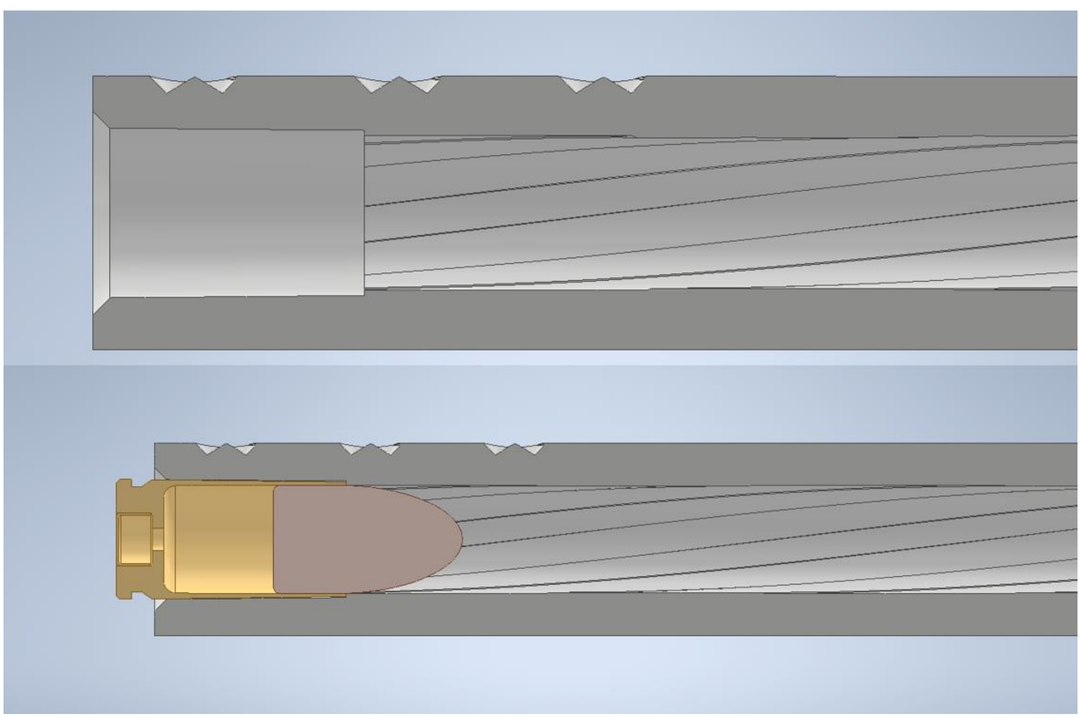
Electrochemical machining is a process that uses controlled electrolysis to erode metal in a pattern that we can control. From a very high level, you use electricity to eat away metal in a specific pattern, for an amount of time we can control, and it leaves us with a way to cut through hardened steel without breaking a sweat. This image gives a very basic representation of how ECM works – it might help some people to understand the concepts of ECM in order to feel more comfortable doing it. But rest assured – if all the fancy science words scare you, that's totally fine. You don't need to understand the concepts in order to use ECM and follow this tutorial – much like you don't have to understand how electric motors work in order to use a battery drill.



Parts of a Barrel

The type of barrel that this tutorial will have you create will have three major sections – the chamber, the throat, and the rifling/bore. The chamber is the part of the barrel that the cartridge (ammo) will sit inside. The rifling/bore is the pathway that a fired bullet will travel along as the bullet spins and picks up speed. The throat is the transition between the chamber and rifling/bore. These pictures show where these sections lie inside of a barrel:





Most barrels have to have throats because the bullet (which is located at the front of the cartridge) sticks out of the cartridge. In a barrel that has no throat, the bullet would have to be jammed into the rifling of the barrel in order to chamber the cartridge fully – the rifling/bore itself is a smaller diameter than the bullet itself is, so the bullet has to be deformed and forced into the rifling when using a barrel without a throat. The throat is simply a section that has a wider diameter than the rifling/bore, but a smaller diameter than the chamber. This lets the bullet stick out past the chamber without having to deform against the rifling. The throat is a very short section, usually not more than a few millimeters long, but it makes a huge difference in terms of how easy to use and reliable a finished barrel is. This tutorial will walk you through forming all of these sections. And if the sections seem confusing, don't worry – you don't need to understand all the mechanics going on behind the scenes, you just have to follow the tutorial in order to make a working barrel. This section is provided as a reference, for those who are curious or want to know more about what they are doing.

Preface

There are a few tips I've picked up from ECM rifling that I think everyone will benefit from knowing – I want to include them at the start so that people don't miss them.

1.) It's easier to stop cutting and measure than it is to cut too much and must restart a barrel.
2.) Off-spec barrels should never be intentionally hand-fired – it's easier to make a new barrel than explain an injury.
3.) The ECM process may take you a couple tries to master – but it is straightforward and cheap enough that anyone can learn to do it just by trying.
4.) ECM sludge (the solid waste left behind after cutting) has been reported to be toxic, though after close experimentation we've been unable to actually verify this. While you should never drink it/ingest it, we've found no evidence of Chromium VI in the sludge – as a result, it might be safe to dispose of the waste in the trash (depending on local laws and such). Personally, I've just been collecting the scrap metal in a spare bucket. I've cut over 30 inches of barrels and there's maybe only two inches of sludge in the bottom of the bucket. I plan on just letting it sit. If you have a local auto store that takes used motor oil, you can mix your sludge in with used oil and make it their problem to deal with. Another idea is to take the solid waste and melt it down (if you have a furnace/kiln) and use it for casting, making ingots, etc.

   Now – another note about the waste products – if left alone, your sludge will settle. The solid waste (which will settle to the bottom of your ECM fluid container) is the only harmful part of the waste. If you're planning on making another barrel, let the sludge settle, then pour or pump out the water from the top of the container. You can reuse the saltwater mix at least 10 times – though your cutting rates may vary slightly if you reuse the fluid over 10 times. The solid waste is much easier to manage if it isn't under several gallons of saltwater.

   As another addendum, be sure to cover your sludge after you are done cutting your barrel – animals may find the smell of the saltwater enticing and either fall into the sludge container and drown, or they may spill the container. Just a simple sheet of plywood or whatever else to cover the top of the container would work.

5.) The ECM process can be a little messy – especially if a hose manages to blow loose or leak. You can do this process in a house or apartment, but I'd stick to places with tile floors that are easy to clean. Unfinished basements would be great, bathrooms would be great, you could potentially even use your bathtub, but be careful to make sure that the ECM sludge won't stain your bathtub. If it does, or if you are worried, use a plastic drop cloth underneath the ECM setup. In addition, the process releases hydrogen and oxygen gas (which can be flammable in the right situations) as well as trace amounts of chlorine gas. So long as your pump is running while you are cutting, there shouldn't ever be enough chlorine gas to cause any issues – but if you feel a painful itching in your eyes and throat and it isn't just the saltwater – turn the power supply off. Now, as far as the flammability goes, I've cut many barrels and only ever had a tiny little pop. It occurred when I connected the power supply leads AFTER I had turned the power supply on. This created a spark which caused a tiny poof of hydrogen gas to burn. Avoid connecting a live lead and you should be fine. If you can use a well-ventilated area (a back porch, room with a window), that would be a good idea. I cut my barrels in a dingy shed full of wasps and mice – it doesn't need to be fancy.

Tooling Creation

This section covers how to create the various tools you will need for the ECM process. While most of these tools are very straightforward to assemble, I'll include full documentation just in case it helps someone. Note that all the tooling images shown here are of used tooling, but the instructions should still guide you through assembling your own tooling.

A simple point about metalworking: when cutting the rods or tubes for this process, be sure to deburr after cutting. This means grinding/filing off any sharp burrs or peaks left behind after cutting a rod or tube. Break the sharp edges on the ends of rods or tubes you cut using a file or Dremel tool.

Note that either zip ties or hose clamps can be used to hold the parts of these tools together. I used to prefer zip ties, but now prefer/recommend hose clamps. It wouldn't hurt to get both, and you can decide which you prefer on your own. I've found both to work fine.

It is recommended to use brake cleaner/degreaser to remove any oil/fingerprints/dirt from the inside of the barrel and from the cutting tools (metal parts). Try to avoid getting degreaser on the plastic.

Some of the parts you will buy via the "ECM Barrelmaking v2.0 Shopping List.pdf". While that pdf is included in the documentation folder, you should use this pdf link since it will be updated as needed or if links go dead: **https://lbry.tv/@Ivan's_CAD_Streams:c/ECM-Barrelmaking-v2.0-Shopping-List:4**

The other parts you will need to print – the link to the CAD/print files are in this download package.

I recommend you print all the printed parts in eSun PLA+. You can, of course, use whatever you'd like, but the low warp and easy print-ability of PLA+ makes it a very dimensionally consistent filament (which is important for stuff like ECM rifling). When printing, ensure you print hot (230C nozzle) and have your cooling settings match those that are described in the README.

The printed parts include:

1x Fixture

1x Rifling Mandrel

1x Chambering Insulator

1x Chambering Offset

1x Throating Offset

1x End Pilot

I recommend printing at least 1 extra end pilot for the event you drop one into the reservoir. The various tools should be able to be reused to cut at least 5 barrels, assuming you wash them off (get all the salt off them) after using them.

A note on the printed tools: when using the tools that have vertical "fingers" on them, you should take care not to bend the fingers excessively. They can break if you abuse them. They are only present to allow the clamps/zip ties to fasten things together – meaning that they should not be tightened, bent, dropped, etc when there isn't something inside them to tighten down on.

Barrel Stock Creation

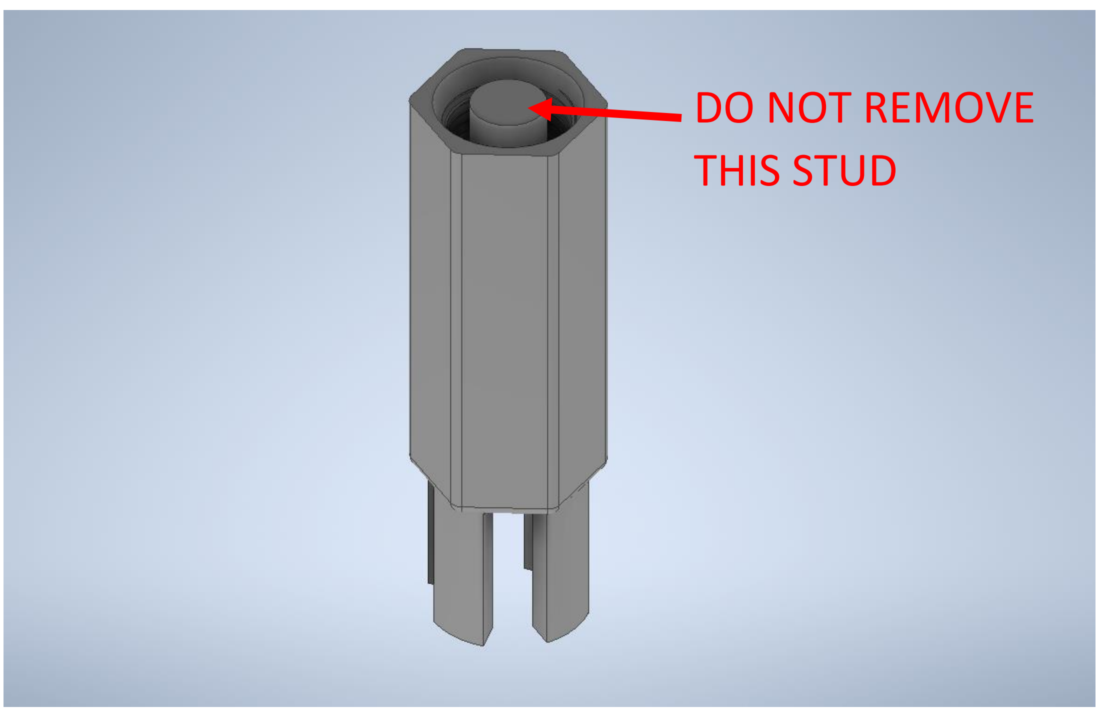
Cut your barrel stock from your hydraulic tubing by using a hacksaw to cut a 4.5” (114mm) section from the hydraulic tubing. Note that the ‘114mm progressive rifling mandrels’ MUST be used with 114mm long barrels. Your barrel’s length can be ±2mm but try to be exactly at 114mm.

IMPORTANT NOTE: Some of the tubing coming from China has rust buildups inside of them. If your tube isn’t smooth and clear on the inside, I recommend you contact the seller and return it. This corrosion that is present in some pipes is resistant to ECM and won’t erode away – as a result, it will prevent the tube from being used for ECM. There’s a chance you could use a drill bit to clean out the corrosion, but this hasn’t been tested. Just return the tube if the inside doesn’t look smooth.

Fitting/Fixture Creation

First off, we have the fixture. Refer to the README for print info.

Note: The update version of this part has a center support stud. You do not need to remove this center support stud, you can leave it how it is after the print is done. Do not attempt to use pliers to rip it out, just leave it in place.



Screw the fitting into the threaded end of the fixture. The parts should screw together without much resistance – if you feel a lot of resistance, you might be screwing the parts together crooked – ensure that you are screwing the fitting straight into the fixture. The two parts might get tight before it looks like you have fully screwed them together – this is fine, move to the next step once the two parts are tight.

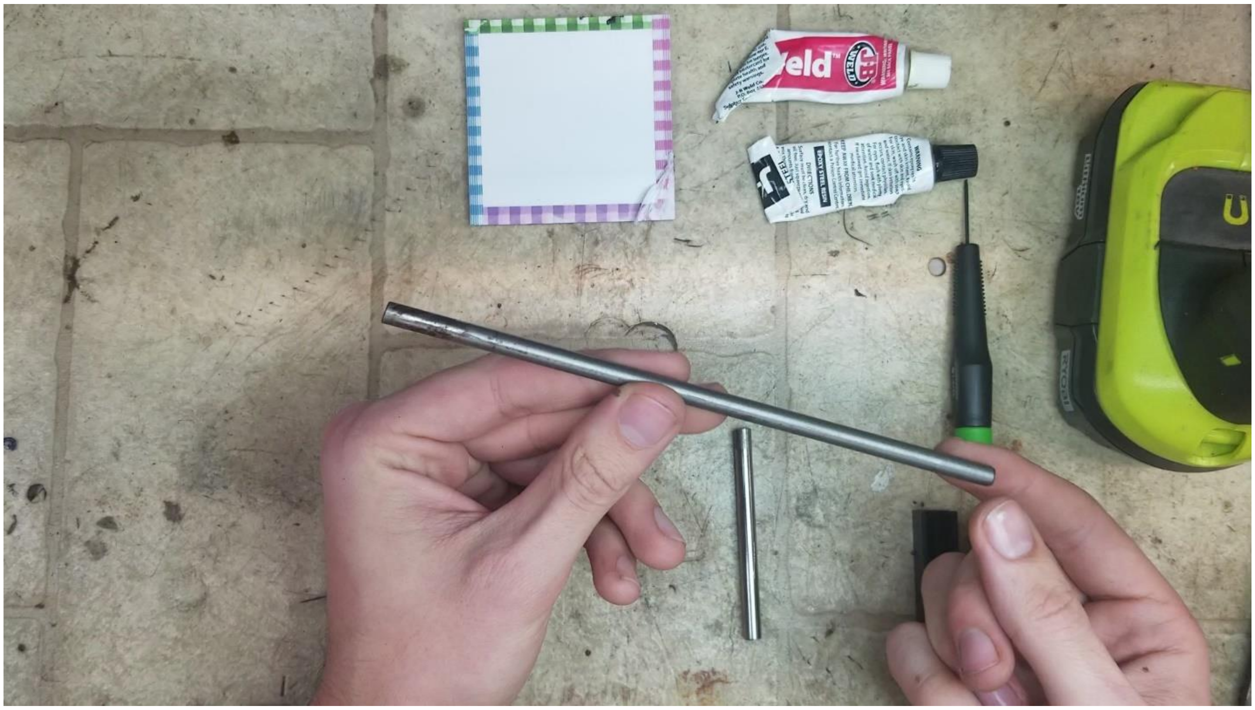
Note that it is possible to print the hose fitting (the file is contained in the “Alternate Parts” folder). This printed fitting will assemble the same way as the metal fitting.

Screw the fitting down until it starts to get tight. It doesn’t have to be fully screwed in to be tight, just install it until it gets tight. Because the fitting has tapered threads, it seals on the threads and not on the abutting face, so once you feel resistance, that’s a sign that the threads are sealing.

This is what happens when you are a gorilla and didn’t read the instructions. Don’t overtighten.

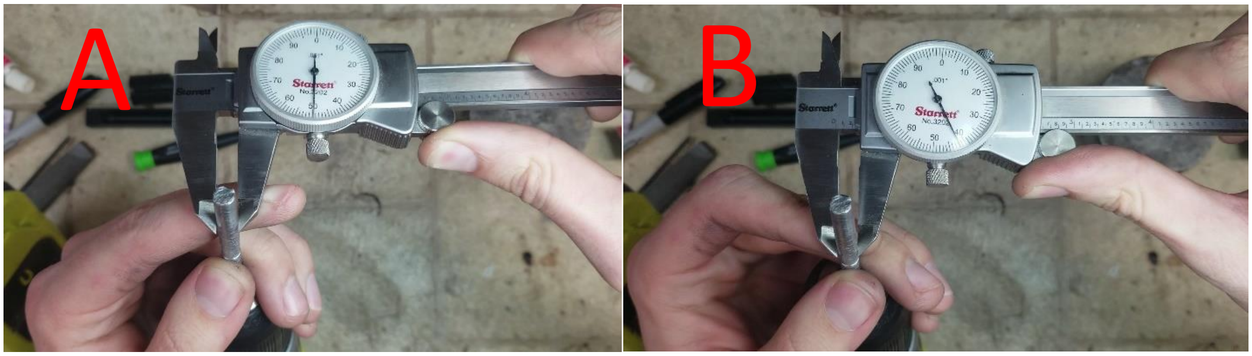
Optionally at this point, you can spray-seal the fitting/fixture combo to keep it from leaking – during the higher-pressure operations, some fluid will spray out from between layer lines in the fixture. Any spray paint/sealant/coating should work fine to fix this – just give it 24 hours to dry after applying, and let it dry in the orientation shown in the above picture. It doesn't need to be a thick coat (avoid runs in the coating), just enough to thinly cover the part.

Boring/Chambering Rod Creation



The boring rod is simply a ~**7.25”** (**18.4cm**) long rod cut from your 0.250” or 6mm bar stock. If your bar stock came coated, use sandpaper to remove the coating – you want bare metal exposed.

The chambering rod is a **3.00”** (**7.62cm**) long rod cut from your 0.250” or 6mm bar stock. If your bar stock came coated, use sandpaper to remove the coating – you want bare metal exposed.



It is strongly recommended that you taper the chambering tool in order to add a taper to your chamber. Note that in picture A, the rod is a **0.249”** (**6.32mm**), and in picture B, the rod tapers down to **0.242”** (**6.15mm**). When using a 6mm rod stock, this would be proportional to a taper from **6mm** (the max width of your rod stock) down to **5.73mm**. This taper does not have to be accurate but having even just a slight taper shape to the chamber will significantly reduce extraction friction for a casing in the chamber.

This taper, when used in an ECM setup, approximates the taper found on 9x19mm chambers. In order to apply this taper to the rod, you will first need to mark **1.2”** (**30.48mm**) from whichever end of your rod is the squarest/flattest. This mark will be the point where you will need to have the small diameter of the taper originate from. Next, mark a spot **0.57”** (**14.48mm**) from the same end of the rod. This will be the location of the large diameter of your rod. Between these two marks are where you will need to apply the taper. If you have a hard time keeping track of the marks, use some tape to mask off the sections you don’t need to taper.

Rod chucked up in a drill. Note the two marks placed on the rod, one at 0.57” from the end, another 1.2” from the end.

I recommend using a flat file and a drill to apply the taper – while you are free to be creative and apply it however you'd like, I've found this method to work well. Chuck up the rod in the drill. Starting at the small diameter (**1.2"**)/(**30.48mm**) mark, spin the drill and push the file against the mark. If using a flat file, you can dig in some with a corner. Spin this area down until you have a little shoulder start to develop – this will provide an endstop when you are shaping the rod. Make sure that you form this shoulder exactly at or a little past the small diameter (**1.2"**)/(**30.48mm**) mark – if your shoulder forms at **1.3"** (**33.02mm**), that is fine. If it forms at **1.1"** (**27.94mm**), you will need to start over.

Note the shoulder formed on this rod at the 1.2" mark

After grinding a shoulder, you can take your time and gradually remove more metal to create a taper shape. I usually just wiggle the rod a little away from the shoulder, then back about 20 times, then wiggle it about ¼ of the way to the large diameter (**0.57"**)/(**14.48mm**) mark 15 times, then ½ of the way 10 times, then ¾ of the way 5 times, then back and forth along the length 10 times to smooth things out. Repeat this process until your measurements of the rod are close to pictures A and B above.

Tapered rod (bottom), tapered rod inside it's insulator (top).

After shaping the rod with a taper, it's time to mate it with the chamber insulator. To do this, take the "chambering tool spacing jig", your chambering tool insulator, your tapered rod, a flat surface, and a little JB weld. Begin by taking a drill bit the same size as your chambering tool rod (should be ¼" or 6mm) and use a drill to drill out the small hole in the chambering tool jig – ensure that that rod can pass freely through this hole. Prepare the chambering tool insulator by ensuring that the bottom of the insulator isn't smushed out where it was touching the print bed (especially if you printed with a brim). Remove anything that is shaped like a brim. Next, prepare by mixing the JB weld and applying it to the mouth of the chambering tool insulator.

Apply a little JB weld to the inside of the mouth of the chambering tool insulator

Next, you need to place your chambering insulator inside the jig, with the open end of the insulator facing up towards the hole in the chambering jig. Take your tapered rod PAYING CLOSE ATTENTION TO WHICH END HAS THE TAPER. You will want to stick the end that DOES NOT have any taper down into the hole first.

Push the rod down from the top and into the insulator (which is sitting inside the jig)

Once the rod is pushing inside the insulator, stand the jig and tool upright. With the bottom of the jig and bottom of the insulator on a flat surface, push down on the top of the rod using a flat surface/tool (I used one of the flat sides of the printed ECM fixture). After pushing the rod flush with the jig, let the rod/insulator sit inside the jig for 12-24 hours while the JB weld sets up. After this time, you should be able to push the rod down and out of the jig using a screwdriver. Use a file or scape with a screwdriver to clean off any JB weld that got on the outside (or top/mouth) of the insulator.

Rod fully pushed inside of jig. Note that this should be done with the jig upright on a flat surface.

The assembly upright on a flat surface. Note that the rod Is pushed flush with the top of the jig, the assembly is on a flat surface.

Rifling Mandrel Creation

For setting up the rifling mandrel, you will need to print a mandrel then dress it with wires. Pay close attention to these steps, as they will answer issues that you may run into while making your mandrel.

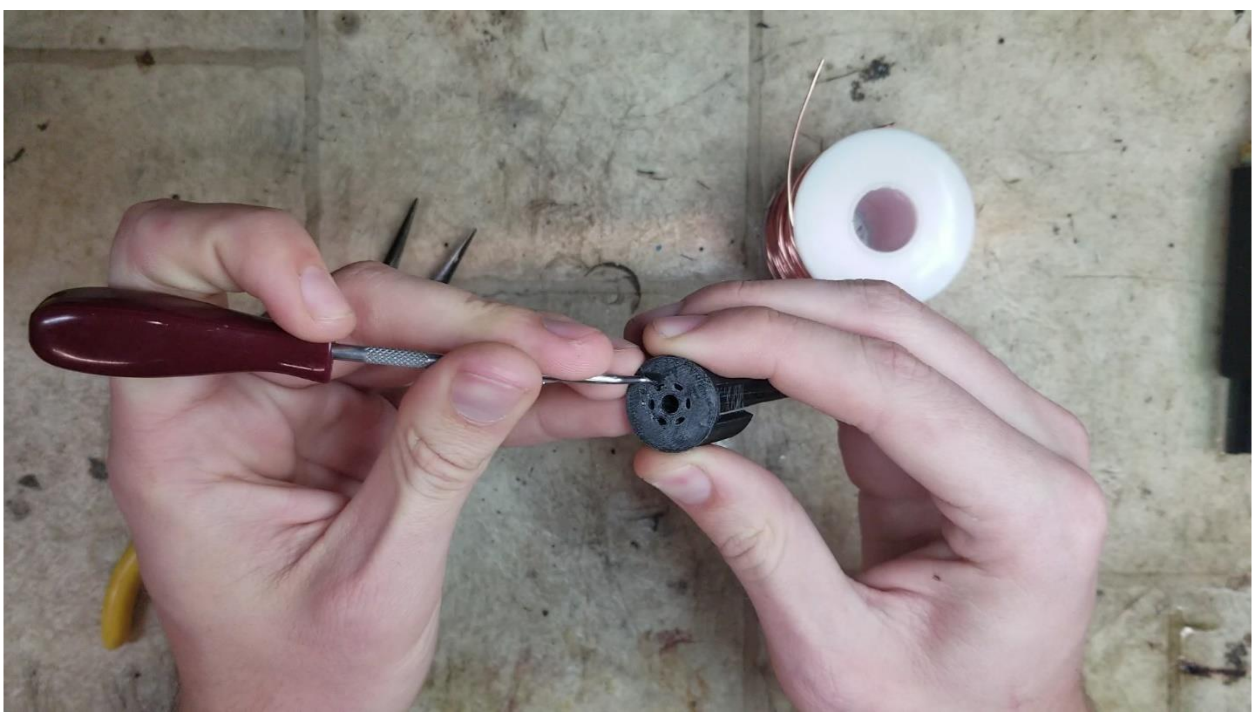
Wire-Based Mandrel Setup

You will need to cut 6 lengths of your **20ga** wiring, about **8"** (**20.3cm**) long. It is worth taking the time to get the wire straightened out now – you can do this by yanking on one end of the wire while the other is held in a vise, or by pulling the two ends apart with two pair of pliers. Alternatively, you can straighten the bends in a wire by hand.

A note on wire-based mandrels: if you can't get the wires to tuck into the mandrel easily, you can reprint the mandrel with a smaller layer height – try 0.12mm layers at first, then 0.08mm layers if you still have issues. Some printers that aren't quite perfectly dialed in will print the channels a little cleaner with smaller layer height settings. If your 0.08mm mandrel doesn't turn out right, then you should look into making sure your printer is properly set up.

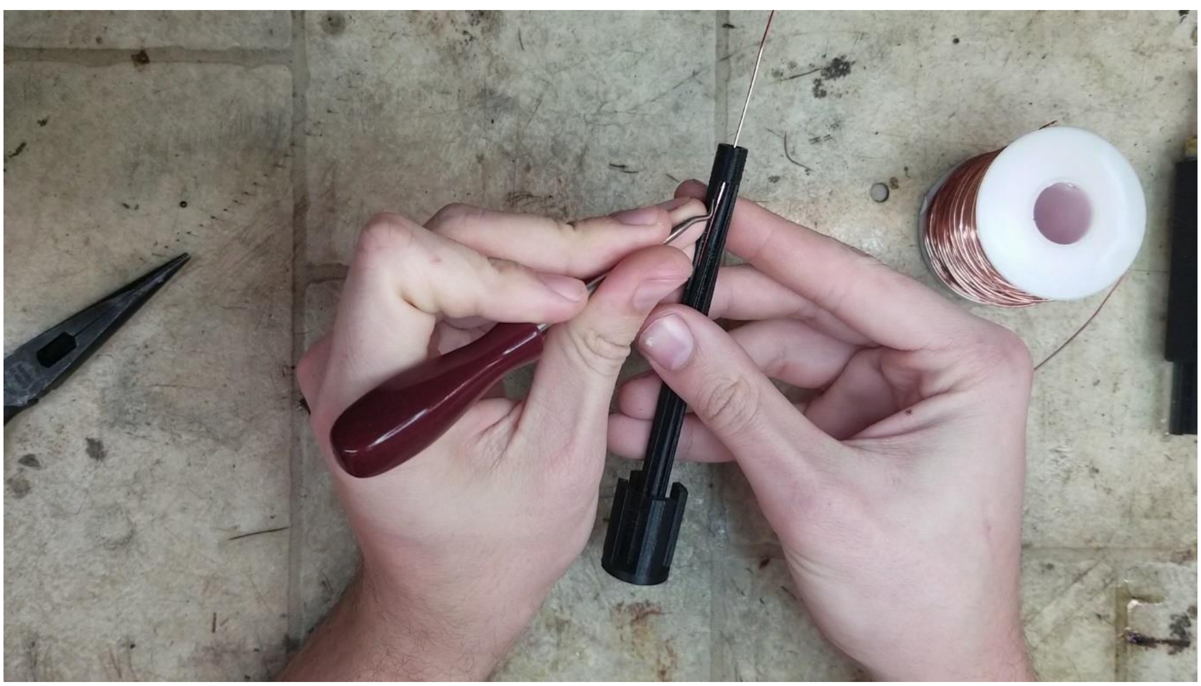
Next, take your mandrel and a dental pick/needle/small pointed tool. I've had some mandrels of this type need the holes in the top poked clear with a tool. Just take whatever tool you choose and ensure the holes that lead from the top of the mandrel to each of the grooves/slots is free of print debris.

Ensure the holes at the bottom of the mandrel are free of print debris – again, use a small, pointed tool to clear out any obstruction left by the print process.



Next up, take your straightened wire and poke it down through the opening at the top of the mandrel and into one of the slots. Ensure that the end of your wire wasn't smushed when you cut it off (the end of the wire shouldn't be wider than the main diameter of the wire as a result of being flattened). Depending on your print settings, your wire may try and stick up out of the slot – that's ok, just use a screwdriver or other tool to push it back into the slot. If your wire simply won't push through, ensure that you removed any obstructions from the hole with a needle as described in the previous step.

Poking the wire in from the top.



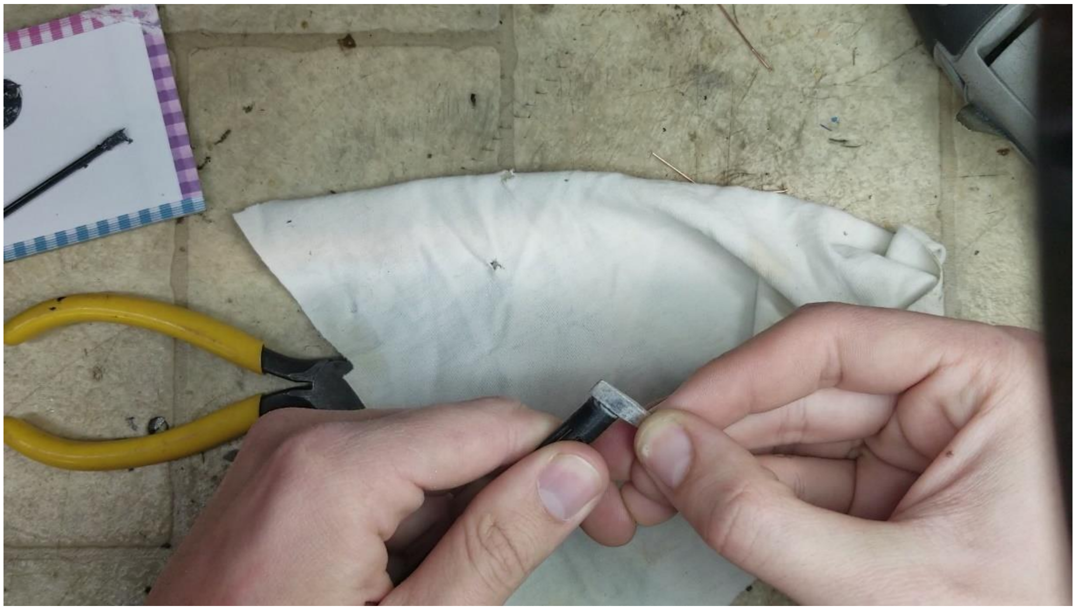
Pushing the wire down into the slot might be required when starting the wire. It should push in easily.

Once the wire is started into the slot, you can use a pair of needle-nosed pliers (or other tool) to feed the wire through. If you start feeling the wire becoming harder to push through, check and ensure the wire isn't trying to push out of the slot anywhere – if it is, push it back down like the previous image shows. Don't push more than **½"** (**12.7mm**) at a time with the pliers to avoid bending the wire when feeding it in. Avoid pinching hard with the pliers, you do not want to crush the wire. Feed the wire through until it pokes out the bottom of the mandrel. You should be left with an inch or so sticking out each side. Repeat these steps for all six slots, so that each slot has a wire.

Once all six wires are inserted, use pliers or your hands to twist all the wires at the bottom of the mandrel (the end with the four fingers and base) together. You don't need to twist them together tight, but just enough that they stick together.

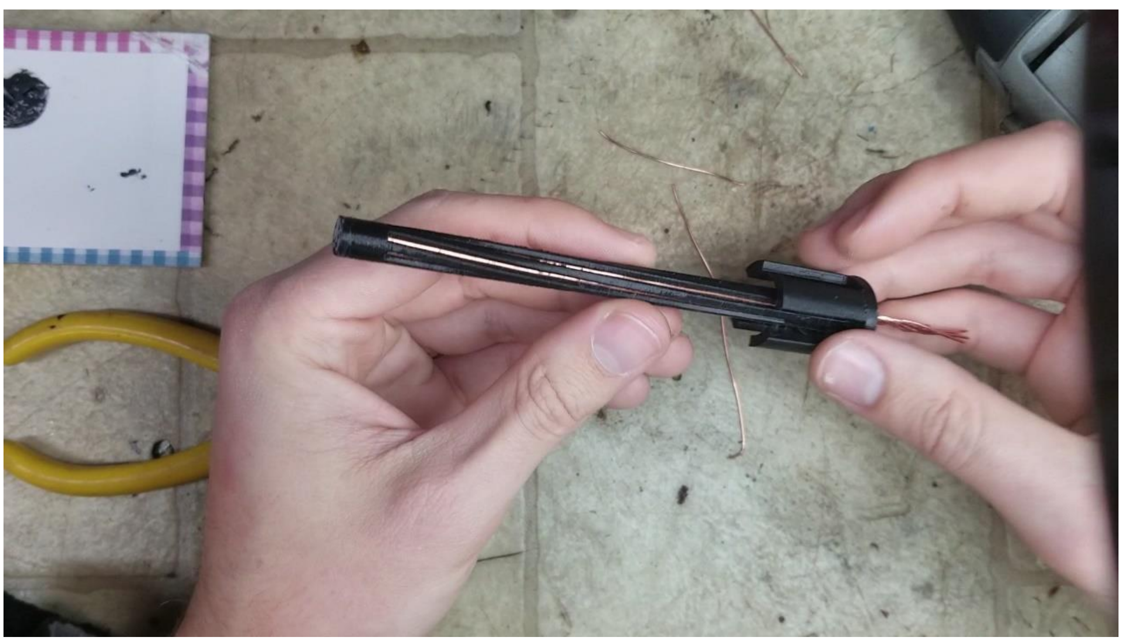
Next, you will need to trim off all the wires at the top of the mandrel. I used a Dremel tool to do this, but you can use a file, side-cutter pliers, or any other tool you want. Try and cut the wires off flush with the end of the mandrel, without tearing up the end of the mandrel too much. After cutting the wires, clean up the end of the mandrel (if you damaged it at all when cutting the wires, try and get the end to be flat again).

After cutting the wires off, take a little JB weld and place it inside the hole at the TOP of the mandrel. This will prevent the wires from being pulled out on accident. You don't have to place very much JB weld, just get a dab in the hole and wipe it off flush with the end of the mandrel.



Wipe off the end of the mandrel after applying JB weld to the hole at the top.

After finishing the application of JB weld, let the mandrel sit for 12-24 hours for the JB weld to set up. One of these mandrels will last you at least 10 barrels if you properly clean them (flush/rinse with warm water) after using them.

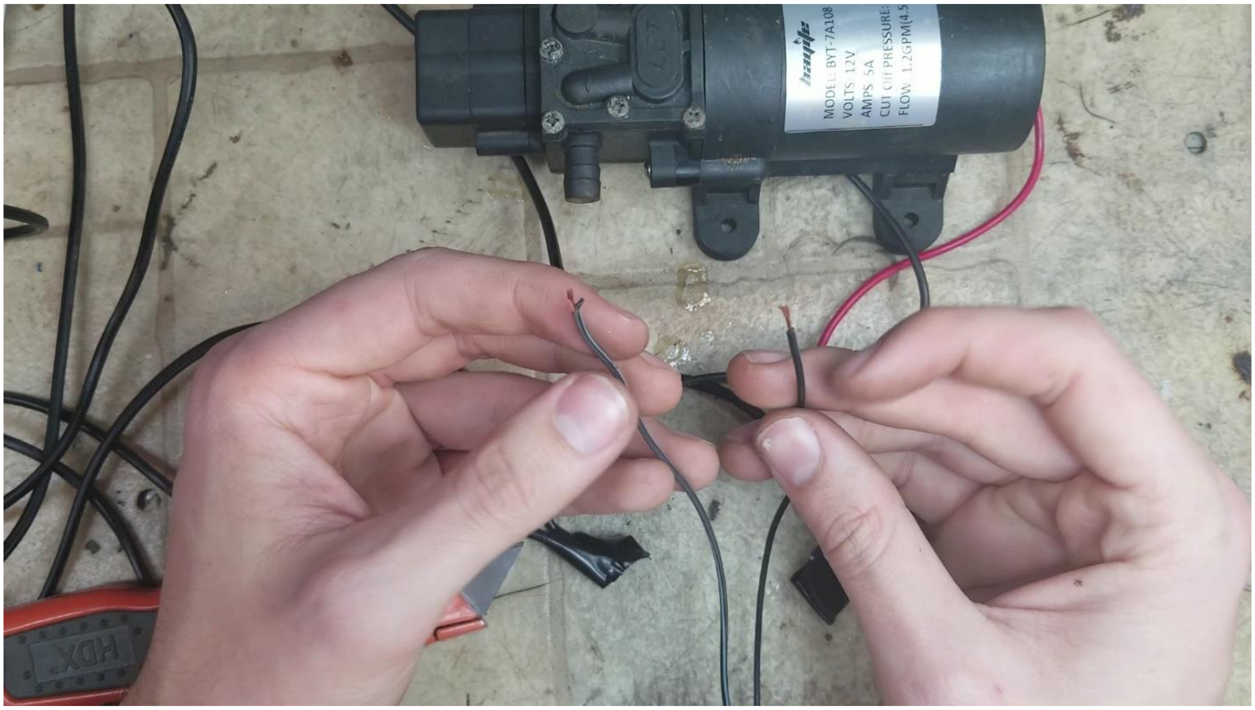


Pump Setup

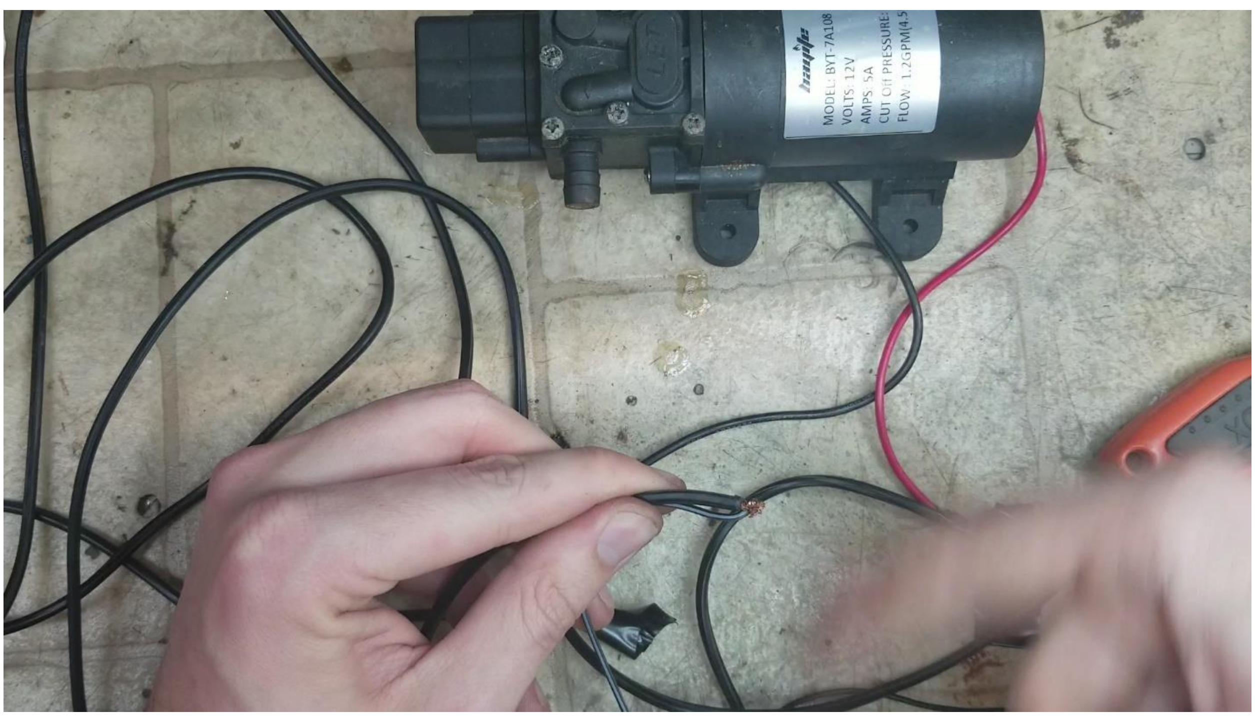
If your pump didn’t come with a plug for a wall socket (most don’t), you will need to splice the wires from the power brick listed in the shopping list to power the pump. Alternatively, if you have drone/RC car batteries, I have used a 2200mAh 11.1V battery to power the same pump that is quoted in the shopping list. Note that if you use a drone/RC car battery you will need to recharge it after about 45 minutes.

Start by stripping the wire leads coming from the pump. On this pump, I spliced in extra leads for longer wires, but you’ll just need exposed wires on the end of the leads coming from the pump.

Strip both wires leading from the wall plug power supply that the shopping list recommends (or other comparable power supply). Determine which wire is the positive and the negative lead.



Twist the exposed copper from the corresponding leads from the pump and power supply together (red/positive pump to red/positive power supply, black/negative pump to black/negative power supply). Wrap the twisted wires in electrical tape to hold them together. If you have a soldering setup/know how to solder, you can tin these connections. If you don't know how to solder, it isn't a required step.



If you have 11.1V RC/Drone batteries, you can use them to power the pump – just match up the corresponding wires and you won't need to use a wall mount power supply. Note that this 2200mAh battery drained after about 40 minutes of running the pump, so if you only have one such battery, plan on having to recharge it. If you have two, just keep the second one handy and swap it out when the pump starts to run slower (you will hear the pump start to slow down once the battery starts running out of charge).

Tooling Setup

This section covers detailed steps on how to assemble each tooling setup – become familiar with this section, as it will be important to getting the ECM process correct. Note that these steps are presented to you here as a reference – in the "**ECM Process**" section, you will be instructed to set up the tooling as these following instructions describe.

Boring Setup

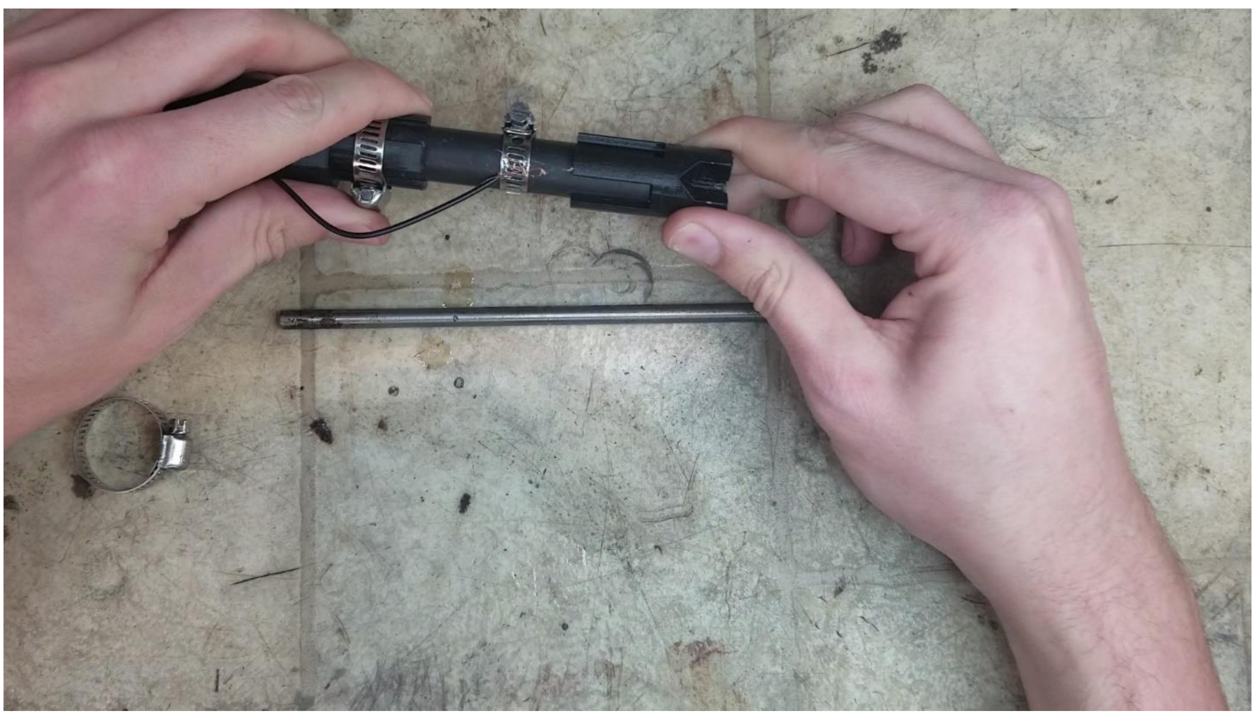
The boring setup – this setup consists of your barrel, boring rod, end pilot, and fitting/fixture combo. You can use zip ties or hose clamps (I recommend hose clamps, but both work fine). You will need three hose clamps/zip ties big enough to wrap around the fingers found on the fixture/end pilot, and one hose clamp/zip tie big enough to wrap around the barrel itself.

Begin by installing the barrel into the fixture. If you have lots of resistance, ensure that your barrel doesn't have any burrs/flared edges as a result of being cut to size. If it does, take a file and clean up the burrs/edges. If your barrel still doesn't want to fit, your printer may be far out of spec – check some calibration cubes and ensure your barrel's outside diameter is 16mm.

Install a zip tie or hose clamp to the fingers on the fixture. Ensure the barrel is fully inserted when you do this.

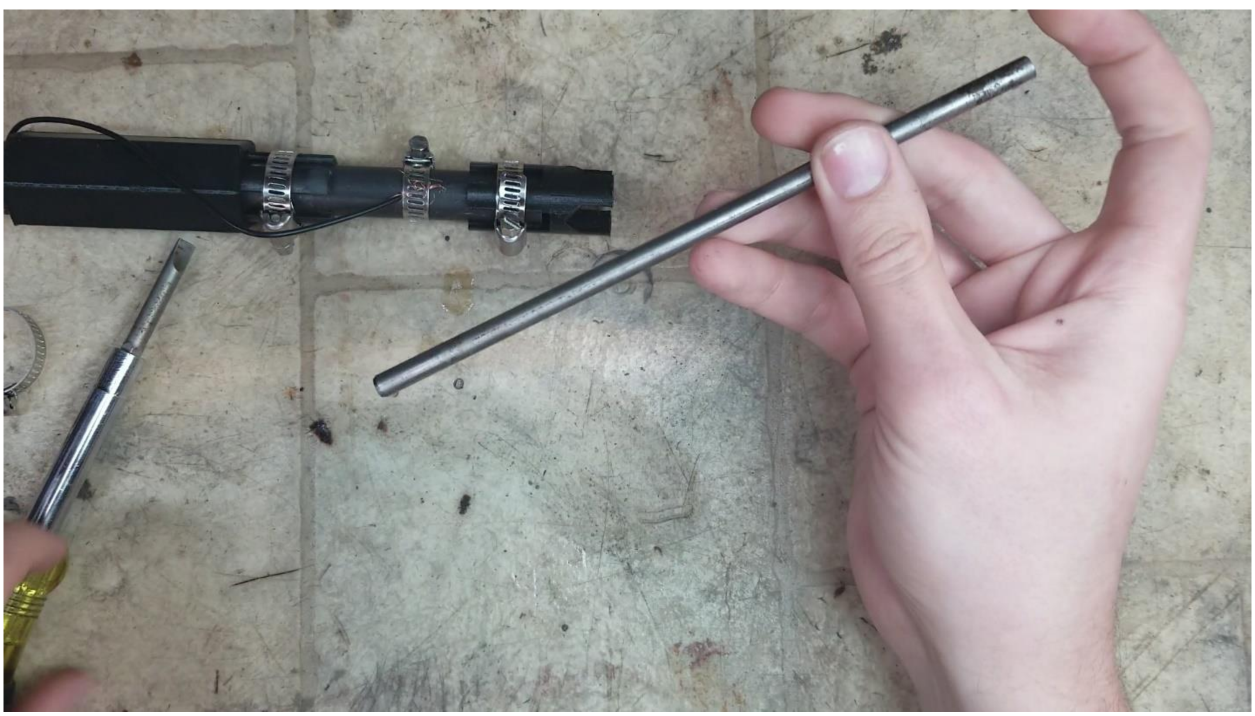
If you haven't already secured your barrel grounding wire (this is covered in the "**Boring Operation**" section), you can use a hose clamp or zip tie to secure the exposed (bare) wire from your wiring lead to the body of the barrel. The bare copper of the wire should be touching the barrel.

Next, install the end pilot. Push the end pilot onto the barrel as far as it will go – it has integrated standoffs that will automatically set the proper distance away from the barrel.



Install another hose clamp/zip tie onto the top (the side with four fingers) of the end pilot. Ensure that the end pilot is pushed all the way onto the barrel when you install the zip tie/clamp.

Take your cutting/boring rod and shove it up through the bottom of the end pilot. You should be able to push it all the way up inside the fixture. If your rod doesn’t fit inside your end pilot, you will need to take a drill bit that is the same size as your rod (6mm or ¼”) and drill out the inside channel on the end pilot



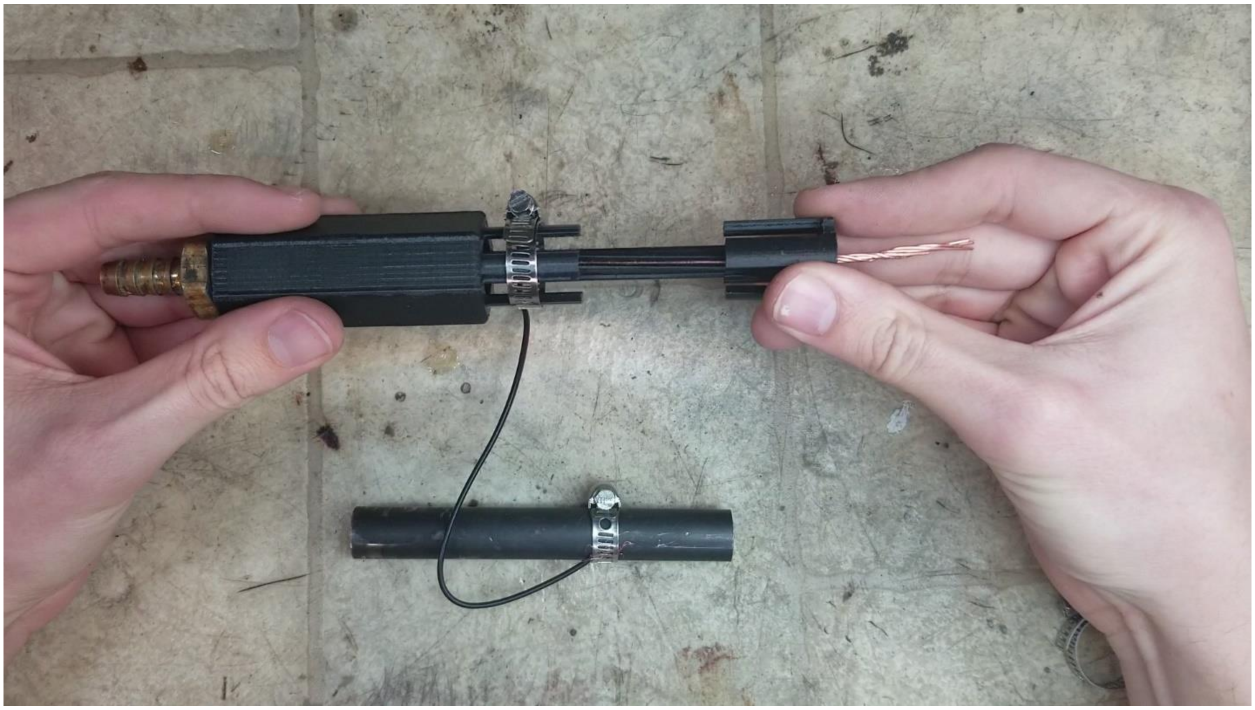
With the rod fully inserted, install a final hose clamp/zip tie around the bottom (the side with three fingers) of the end pilot. Ensure the rod is fully inserted when you install this clamp/tie.

Your tooling is now set up for the boring operation. The “**Boring Operation**” section has the information on how to use this tooling setup.

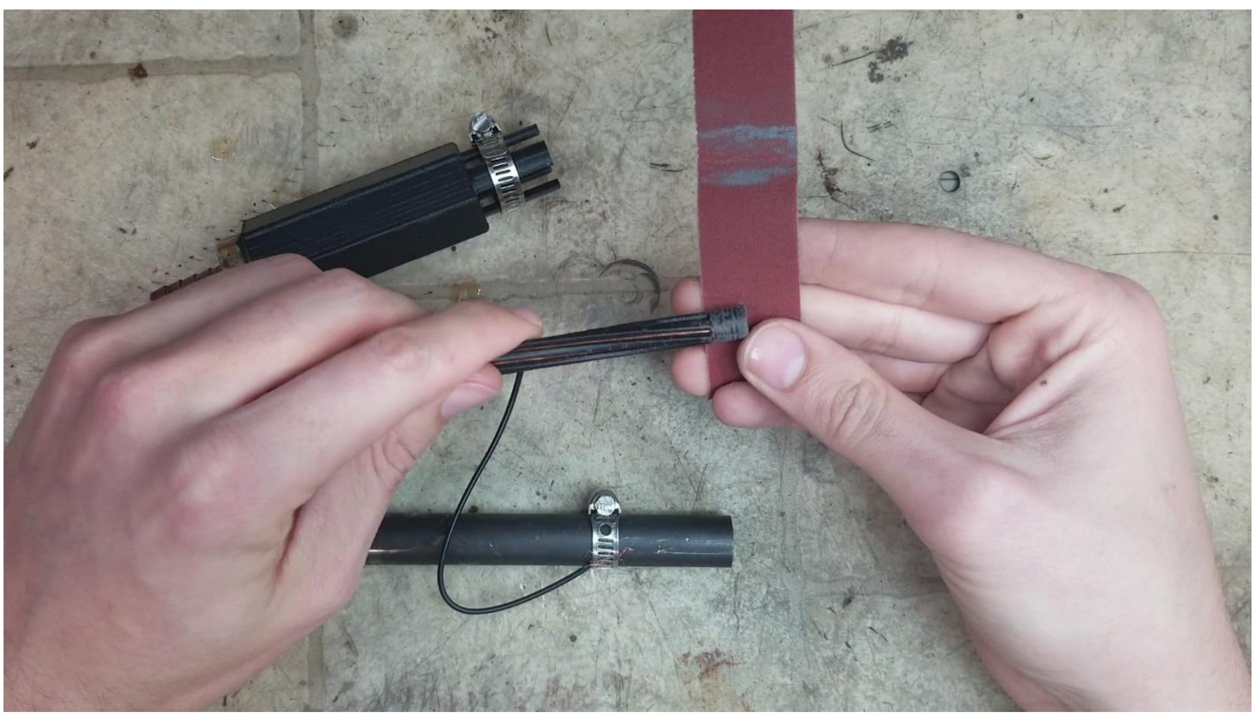
Rifling Setup

The rifling setup – this setup involves a bored barrel, a rifling mandrel, a fitting/fixture combo, and a hose clamp/zip tie. Your wiring lead from the boring operation should still be attached – see **this** section for a reminder on how to install it.

First, take your rifling mandrel and fixture. Push the rifling mandrel into the fixture (there is a recess in the fixture to accept the end of the rifling mandrel). These two parts should have a snug fit – it shouldn't be loose, but shouldn't be tight at all. If your parts fit tight, take your rifling mandrel and sand the end of it just a little.

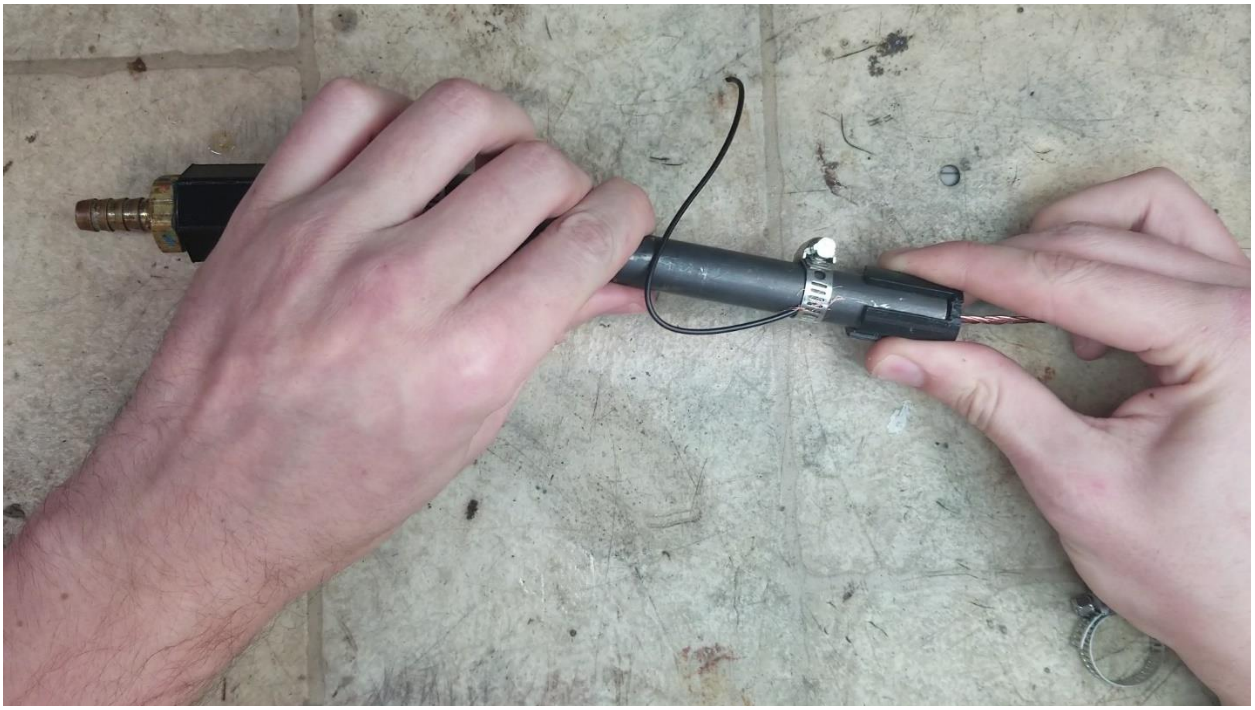


Checking the fit between mandrel and fixture

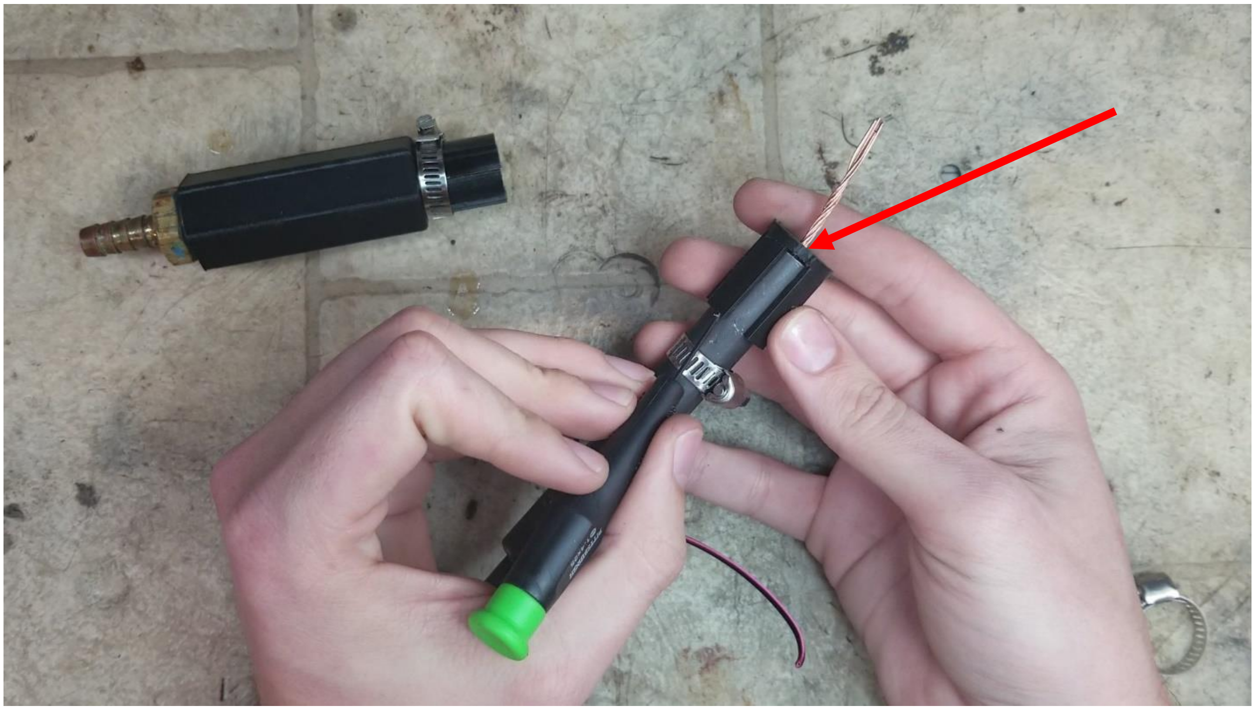


Sanding the end of the mandrel to ensure a smooth fit

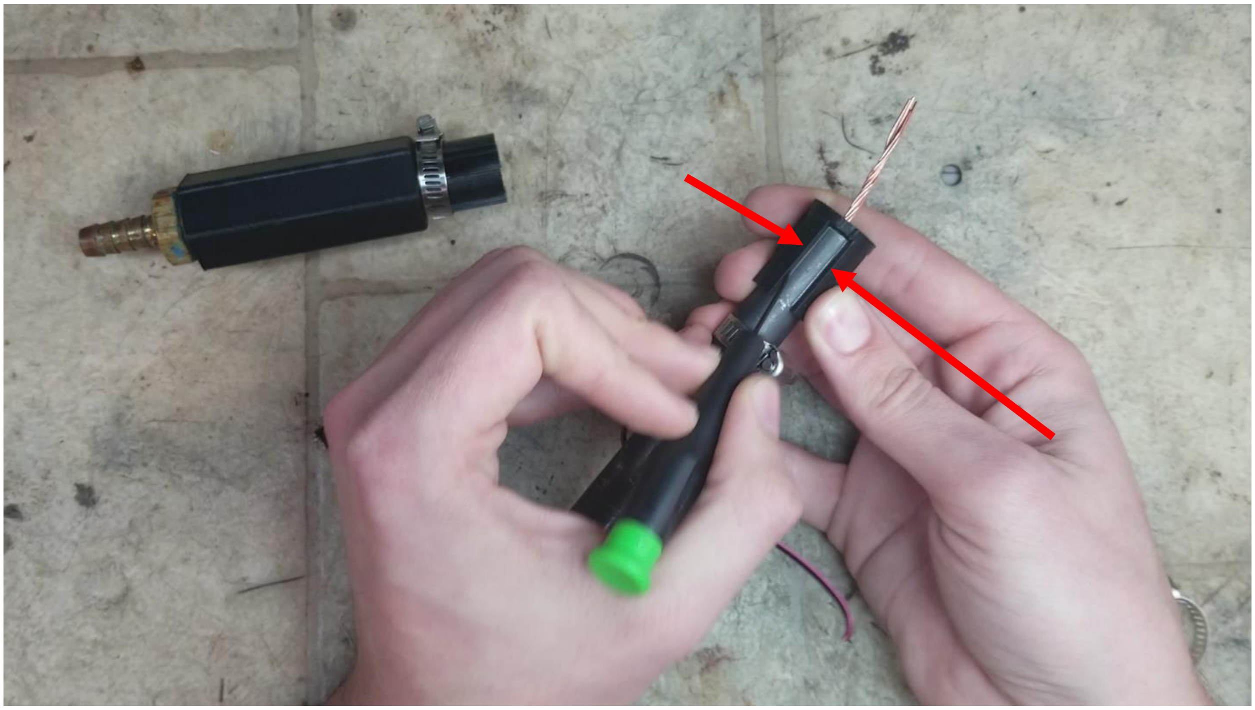
Next, take your barrel and push it all the way onto your mandrel. It is important to note that EVERY time you assemble these tools, you do so by first pushing the barrel all the way onto the mandrel. This will *always* be step one for installing the rifling mandrel into the barrel.



With the barrel pushed all the way onto the mandrel, you will need to make indexing marks (if you haven't done so already). You do this by finding the gap that has a square cutout between two fingers on the mandrel (shown by the arrow in the picture)

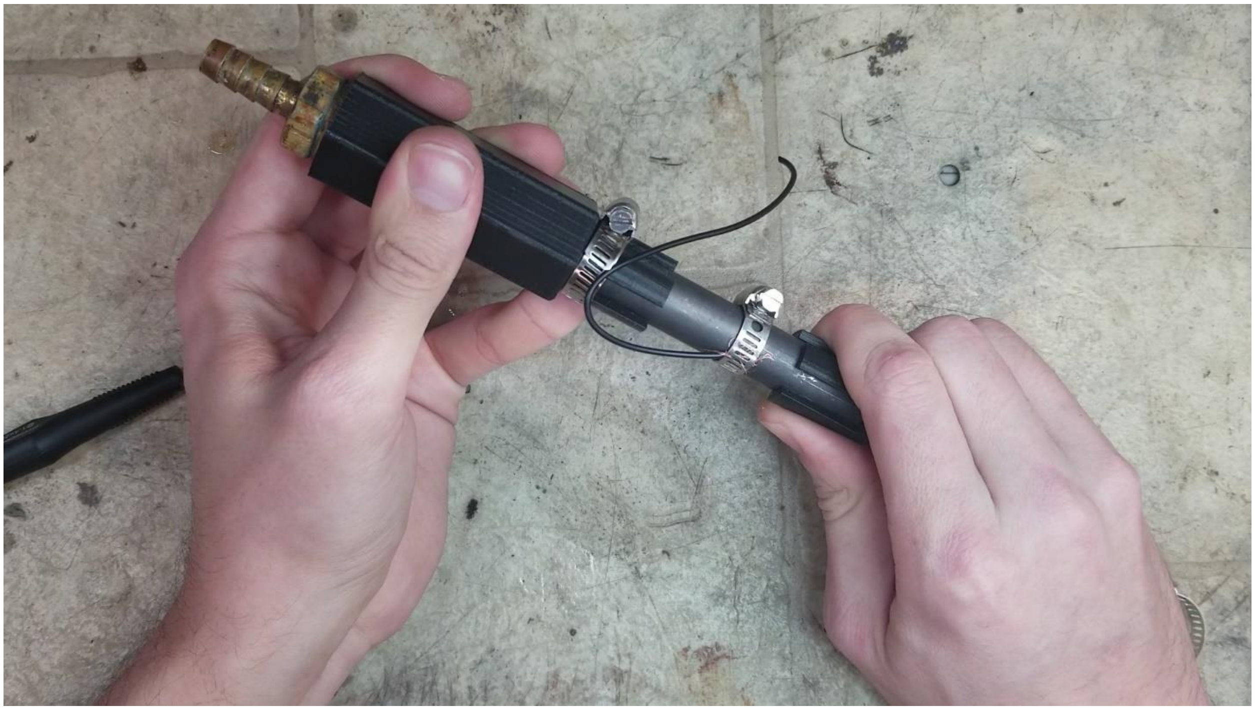


Take a screwdriver, knife, boxcutter, or other similar metal tool and make light scratches in the finish of the barrel using the fingers of the mandrel as a guide. Note the shiny marks in this picture:



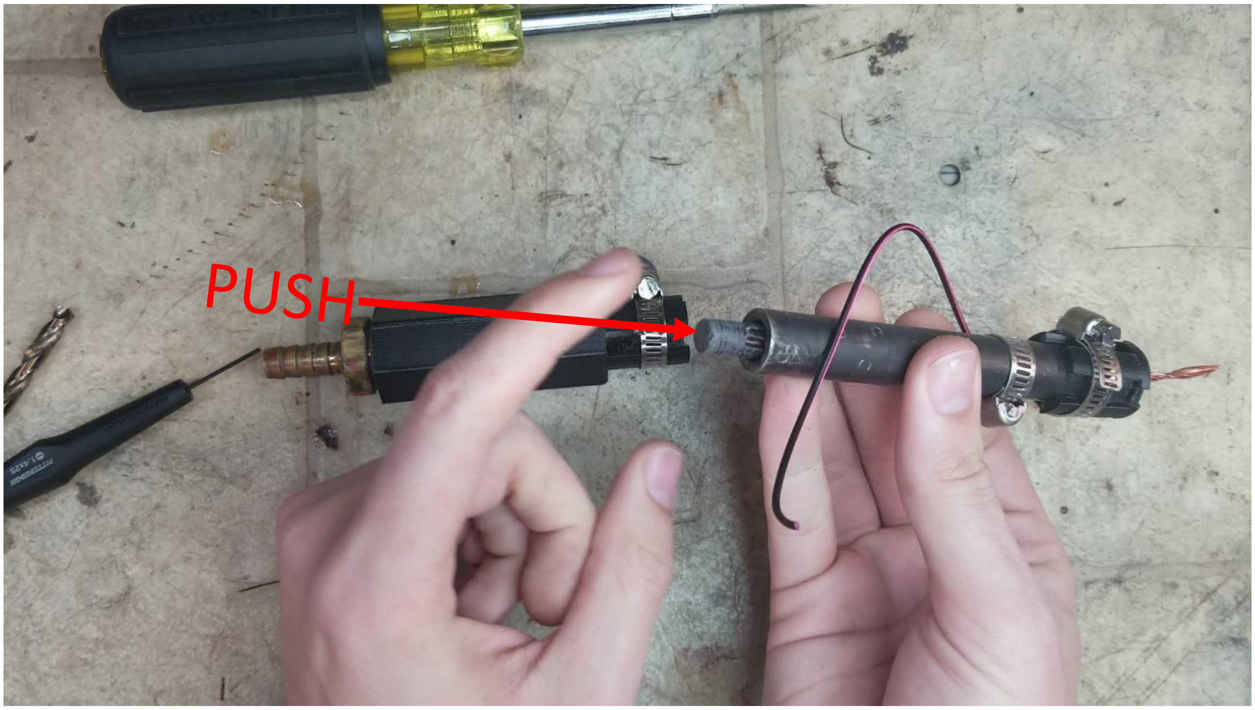
EVERY time you mate the rifling mandrel and barrel together, you must make sure that the scratches you made line up with the fingers that are adjacent to the square cutout on the mandrel. So long as you ensure that the mandrel and barrel line up in this manner, you won't have any alignment/index issues.

Push the mandrel assembly into the fixture as far as it will go. Ensure that the barrel stays fully seated against the mandrel, and that you don’t push the barrel off of the mandrel while pushing the mandrel into the fixture. Try to ensure that you don’t spin the barrel or mandrel while inserting them (as this will mess up the alignment/index). If you do twist them, you should be able to twist them back after inserting them. If you’re having trouble, you can install a hose clamp/zip tie to the mandrel/barrel while they are aligned before inserting them into the fixture.



Install a zip tie/hose clamp on both the fixture and the rifling mandrel. Ensure that the mandrel is fully inserted into the fixture before tightening the clamp/tie on the fixture, and that the barrel and mandrel are aligned (using the marks that you made earlier in this section) before tightening the clamp/tie on the mandrel.

In order to take these tools apart, remove the clamps and pull the mandrel/barrel from the fixture. To remove the mandrel from the barrel, make sure the clamp/tie is removed and push on the end of the mandrel (you can push it against a table if you need or want to).



Chambering Setup

The chambering setup – this setup involves a rifled barrel, a chambering tool (with insulator), a chambering and throating end pilot, and a fitting/fixture combo. These steps will tell you how to set up the various tools for the throating and chambering setups. **THIS** section will tell you when/how to use these tools. Your wiring lead from the boring operation should still be attached – see **this** section for a reminder on how to install it.

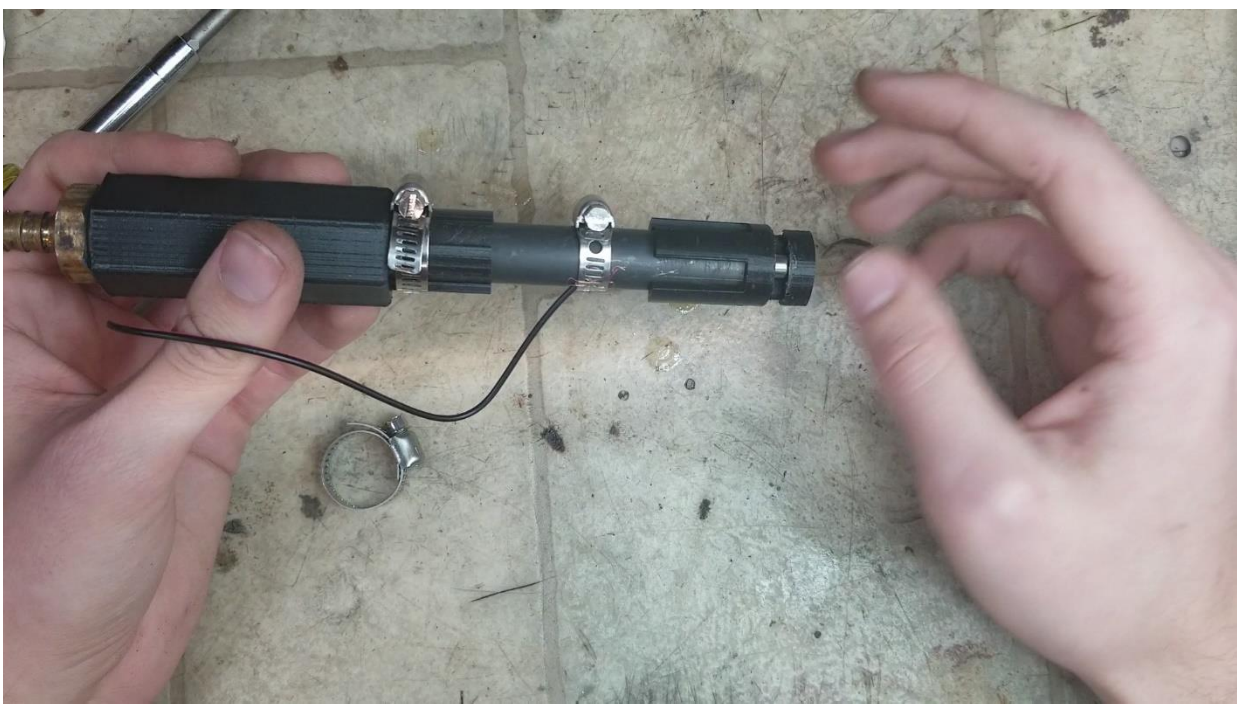
Throating Setup

Start by installing the barrel fully into the fixture. Install a zip tie/hose clamp to retain the barrel. **YOU MUST ENSURE THE MUZZLE END OF THE BARREL IS PUSHED INTO THE FIXTURE.** You want the CHAMBER end of the barrel to be pointing out of the fixture. The muzzle end should have rifling, the chamber end should not have rifling (it was insulated during the rifling operation).

Next, identify your throating end pilot. It will be the one with a "T" embossed on it.

Take your insulated chambering tool and install it into the throating end pilot. If the hole in your throating end pilot is too tight, you can take a drill bit the same size as your cutting tool (6mm or ¼") and carefully drill out the hole in the middle of the end pilot. You should push the chambering tool until it rests on the bottom ledge of the end pilot.

With the chambering tool still pushed all the way against the bottom of the throating end pilot, push the throating end pilot inside the barrel. The throating end pilot has integrated offsets that automatically set the proper distance to the barrel, so just push it on all the way.



Install a zip tie or hose clamp to secure the throating end pilot to the barrel. Ensure that the end pilot is pushed onto the barrel completely, and that the chambering tool is still sitting all the way at the bottom of the end pilot. If your chambering tool slips or pushes upward, you can remove the end pilot to push it back down, or just tap the whole assembly (with the end pilot on the bottom) on a table to use momentum to put the chambering tool back at the bottom. Note that when you are cutting, fluid pressure should help keep this tool pressed down.

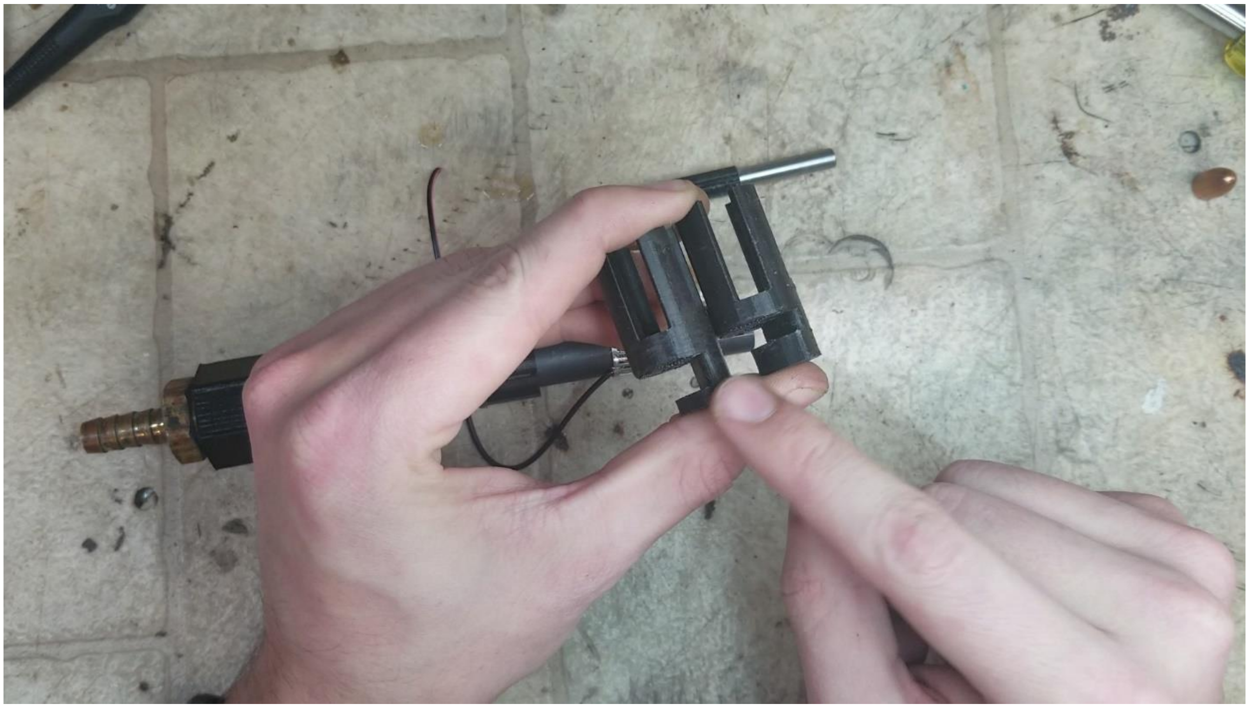
You can remove these tools by reversing the order you installed them in. Refer to "**Chambering Operation**" section for instructions on using this setup.

Note: When connecting the electrical lead to the chambering tool, be very careful to ensure that the clip on the wire doesn't push the tool upwards at all – the end of the tool must be flat against the seat on the throating end pilot. You may have to guide your wires in such a way that the clip will not be trying to push the tool upwards – pay close attention to this before cutting anything.

Chambering Setup

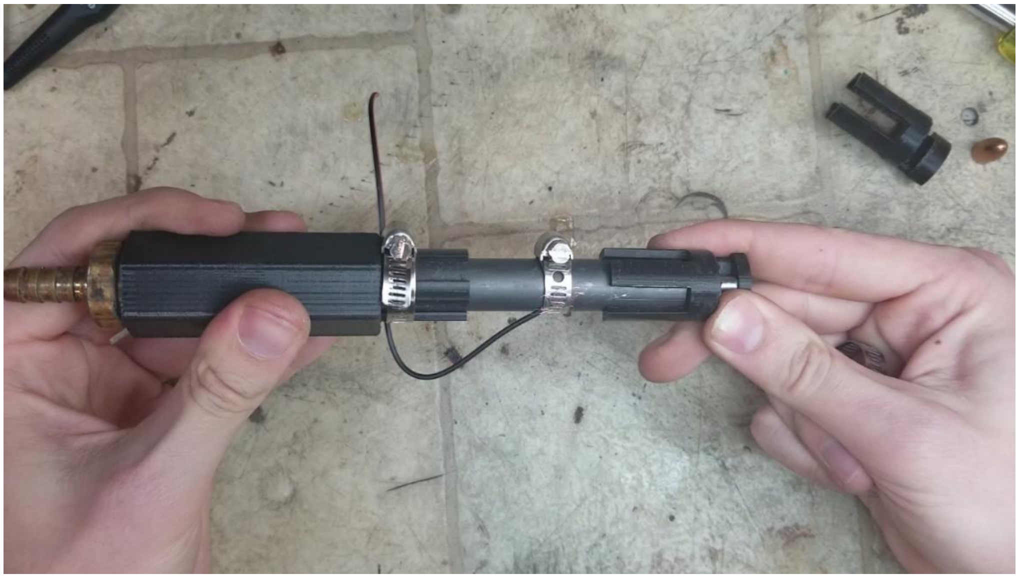
Start by installing the barrel fully into the fixture. Install a zip tie/hose clamp to retain the barrel. **YOU MUST ENSURE THE MUZZLE END OF THE BARREL IS PUSHED INTO THE FIXTURE.** You want the CHAMBER end of the barrel to be pointing out of the fixture. The muzzle end should have rifling, the chamber end should not have rifling (it was insulated during the rifling operation).

Next, identify your chambering end pilot. It will be the tool with a "C" embossed on it.



Take your insulated chambering tool and install it into the chambering end pilot. If the hole in your chambering end pilot is too tight, you can take a drill bit the same size as your cutting tool (6mm or ¼”) and carefully drill out the hole in the middle of the end pilot. You should push the chambering tool until it rests on the bottom ledge of the end pilot.

With the chambering tool still pushed all the way against the bottom of the chambering end pilot, push the chambering end pilot inside the barrel. The chambering end pilot has integrated offsets that automatically set the proper distance to the barrel, so just push it on all the way.



Install a zip tie or hose clamp to secure the chambering end pilot to the barrel. Ensure that the end pilot is pushed onto the barrel completely, and that the chambering tool is still sitting all the way at the bottom of the end pilot. If your chambering tool slips or pushes upward, you can remove the end pilot to push it back down, or just tap the whole assembly (with the end pilot on the bottom) on a table to use momentum to put the chambering tool back at the bottom. Note that when you are cutting, fluid pressure should help keep this tool pressed down.

You can remove these tools by reversing the order you installed them in. Refer to "**Chambering Operation**" section for instructions on using this setup.

Note: When connecting the electrical lead to the chambering tool, be very careful to ensure that the clip on the wire doesn't push the tool upwards at all – the end of the tool must be flat against the seat on the chambering end pilot. You may have to guide your wires in such a way that the clip will not be trying to push the tool upwards – pay close attention to this before cutting anything.

ECM Process

Please note that some of these pictures reflect an older version of the tools used in this process. You should refer to the "**Tooling Setup**" section if you have any questions about how the tools should look. The process itself is still technically identical, in that you'll still be hooking everything up the same (thus why old pictures are used).

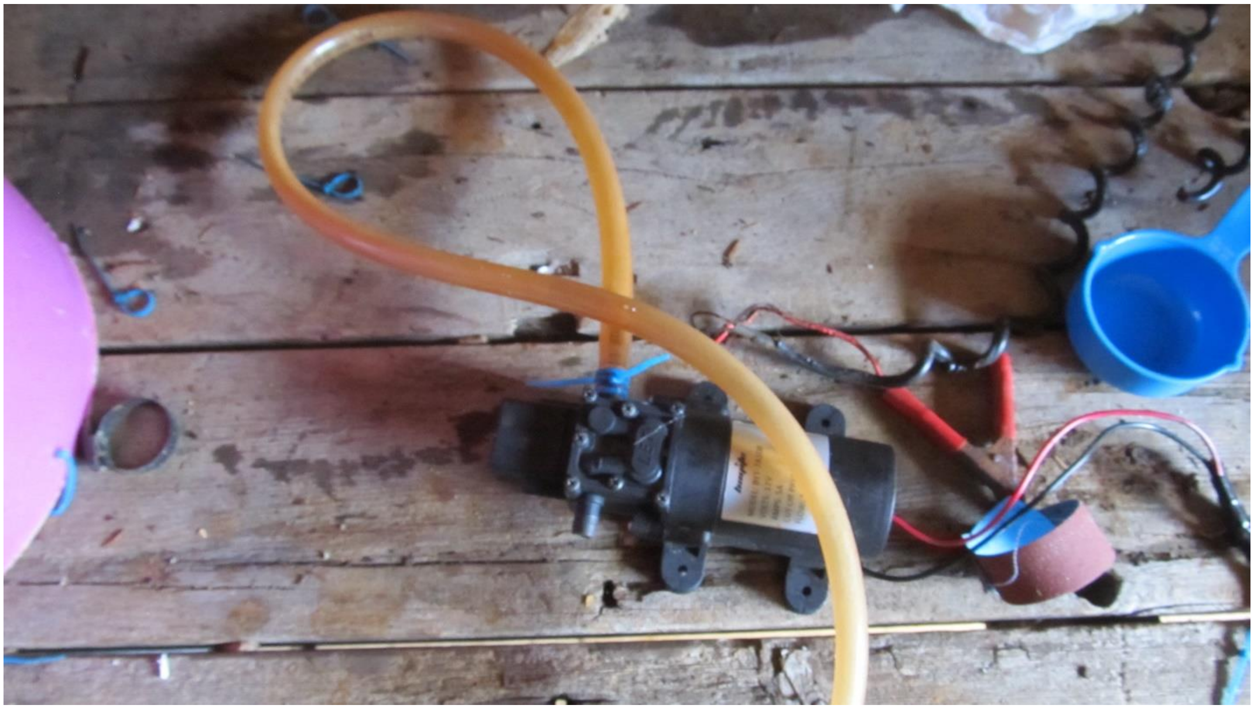
Preparation Work

Step 1: PREPARING RESERVEOIR - First, pour 11.3L (3 Gallons) of tap water into your bucket/reservoir.

Step 2: MEASURING SALT - Measure out 304g of salt. There are tools online to convert mass of salt to volume of salt. I used one cup of salt. It isn't imperative to nail the amount of salt, but if you put too little salt in, the electrolyte will have too high resistance. Putting too much salt in can cause variances in cutting rates and will make your barrel rust faster when exposed to open air.

Step 3: PREPARING ELECTROLYTE - Pour your salt into the reservoir. Mix it in.

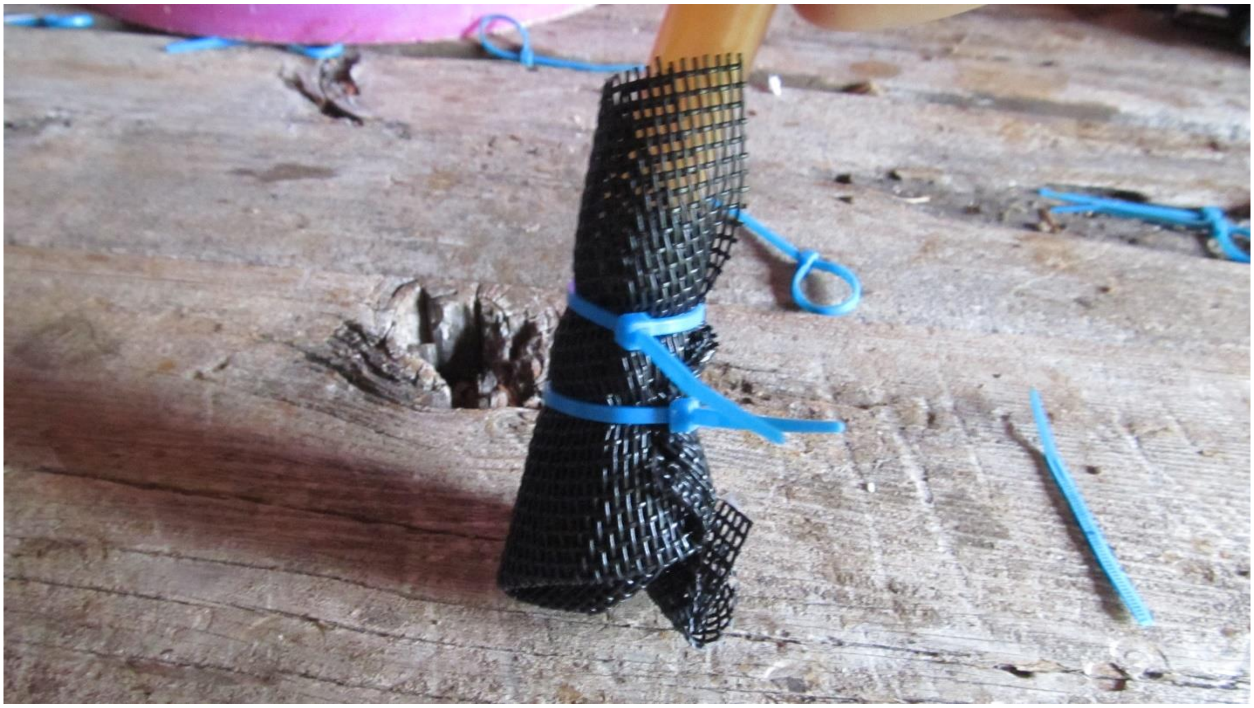
Step 3 continued: MIXING ELECTROLYTE - I just used my hand to mix the salt in. Mix until you cannot feel any rough salt on the bottom of the reservoir. This may take a while depending on the size of your salt grains and the hardness of your tap water.



Step 4: PREPARING SUCTION TUBING - Take your pump and connect a ~5ft (150cm) section of tubing to the SUCTION side. You can cut the tubing from the stock using scissors, a knife, boxcutter, etc. Length does not need to be precise. I recommend adding a couple zip ties or hose clamps over the tubing around the barb on the pump – this prevents leaks when the pump runs at high pressure.

Step 5 (optional but recommended): PREPARING SLUDGE FILTER - Cut two 3in x 3in squares from screen door material (also known as insect mesh). You can also use a single ply of coffee filter paper, either on it’s own or in conjunction with the screen door material. There’s lots of solutions for filters (you can do simply gravity/flow filters, mesh filters, or even buy a home water filter) – while filters do help the quality of the barrel produced some, they are not required and as long as you make sure your suction hose doesn’t sit at the bottom of the bucket while you are pumping water, it should be fine.

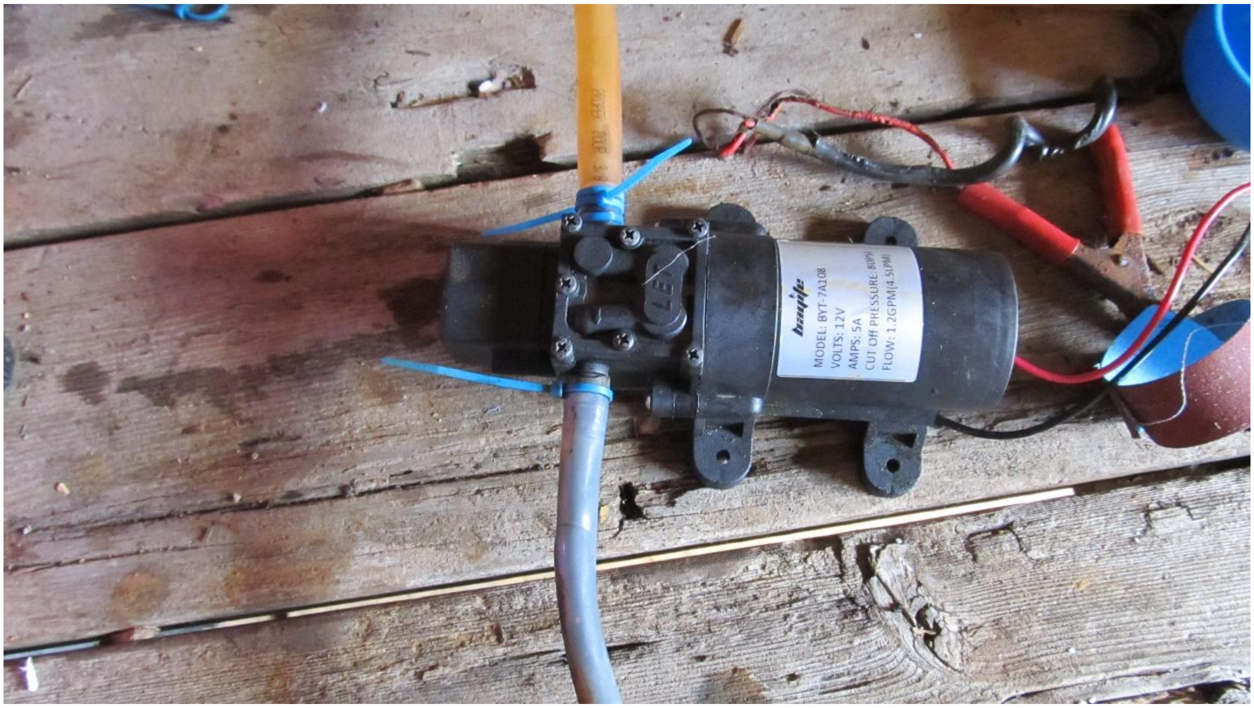
Step 5 continued: PREPARING SLUDGE FILTER - Take the end of the tubing from the previous step that isn't attached to the pump and lay it on top of the two squares of screen. Lay the screens on top of each other at a 45-degree offset as shown in the image.



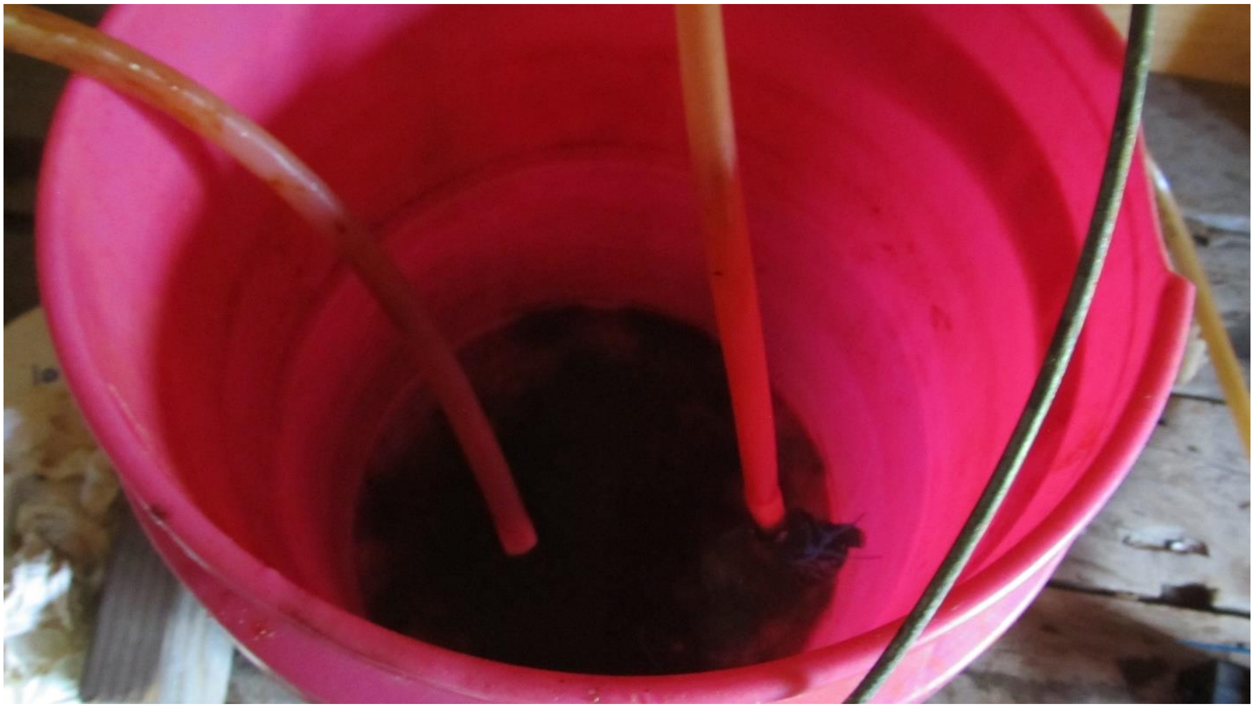
Step 5 continued: PREPARING SLUDGE FILTER - Wrap the screen material up and around the tubing. Zip tie it in place. This will serve as a filter that keeps sludge from being sucked through the tubing. It won't filter out fine particulate, but it will keep the head of sludge that this process creates from being recirculated.

Step 6: INSTALLING SUCTION TUBE - Insert the end up the suction tube into the reservoir. Ensure the tubing is long enough to allow you room to position the pump on your table while not pinching the tubing.

Step 7: INSTALLING SUCTION TUBE - secure your suction tubing to your reservoir. I used a zip tie around the tube, securing it to the handle on the reservoir. Any setup that can hold the tip of the suction tube roughly halfway between the bottom of the reservoir and the level of the electrolyte should be good. DO NOT PLACE THE END OF THE SUCTION TUBE AT THE BOTTOM OF THE RESERVOIR! The solid waste will settle to the bottom, you want to be sucking up fluid about halfway up inside the bucket. Doing this ensures you have a gravity filter of sorts.



Step 8: PREPARING PRESSURE TUBING - Take your pump and connect a ~5ft section of tubing to the PRESSURE side. You can cut the tubing from the stock using scissors, a knife, boxcutter, etc. Length does not need to be precise. I recommend adding a couple zip ties or hose clamps over the tubing around the barb on the pump – this prevents leaks when the pump runs at high pressure.



Step 9: INSTALLING PRESSURE TUBE - Insert the end up the pressure tube into the reservoir. Ensure the tubing is long enough to allow you room to position the pump on your table while not pinching the tubing.

Step 10: CHECKING THE PLUMBING SETUP – At this point, you have completed the plumbing setup. Ensure that the lines are not kinked/too short, and that your basic setup matches this image.

Step 11: TESTING THE PLUMBING – Plug in your pump in order to start it. If you have an extension strip with an on/off switch you can use that as a start for your pump. I just unplugged it to turn it off.

Step 11 continued: TESTING THE PLUMBING - check the system for leaks. Ensure that electrolyte leaving the PRESSURE tube isn't full of air bubbles. If it is, you probably have a leak in your SUCTION tube. Once you are satisfied that the system is free of leaks, you can shut off the pump.

Step 12: INSTALLING PRESSURE TUBE - secure your pressure tubing to your reservoir. I used a zip tie around the tube to secure it to the handle on the reservoir. Any setup that can hold the tip of the pressure tube roughly above the middle of the reservoir will work.

Boring Operation

Refer to **HERE** for instructions on setting up the tool.

It is strongly recommended to use brake cleaner/degreaser to remove any oil/fingerprints/dirt from the inside of the barrel and from the cutting tools (metal parts). Try to avoid getting degreaser on the plastic.

Step 13: BORING SETUP – Lay out your supplies for this setup. You will need your dressed fitting, boring rod, barrel blank, and end pilot.

Step 14: POWER SUPPLY SETUP – Lay out your power supply. You will be using the alligator clips that it comes with.

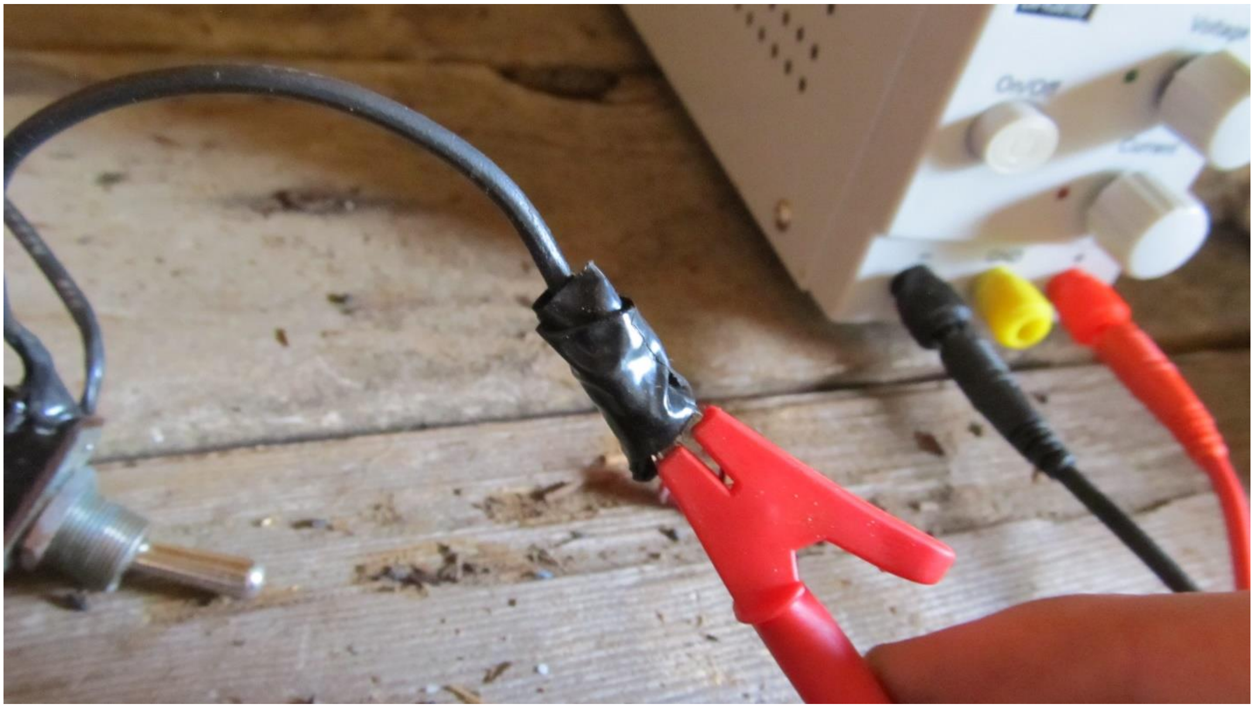
Note: If you are using a different power supply, (or if you order this power supply and they change the internals on it), you will have to read the manual for your power supply in order to learn how to set it up. You will want to set the constant current output to 7.5A and set the voltage to maximum (as the power supply will auto-adjust the voltage to maintain the targeted amperage).

Generally speaking the steps that follow are how you set these power supplies up – but if your supply is different, follow the instructions that came with it.

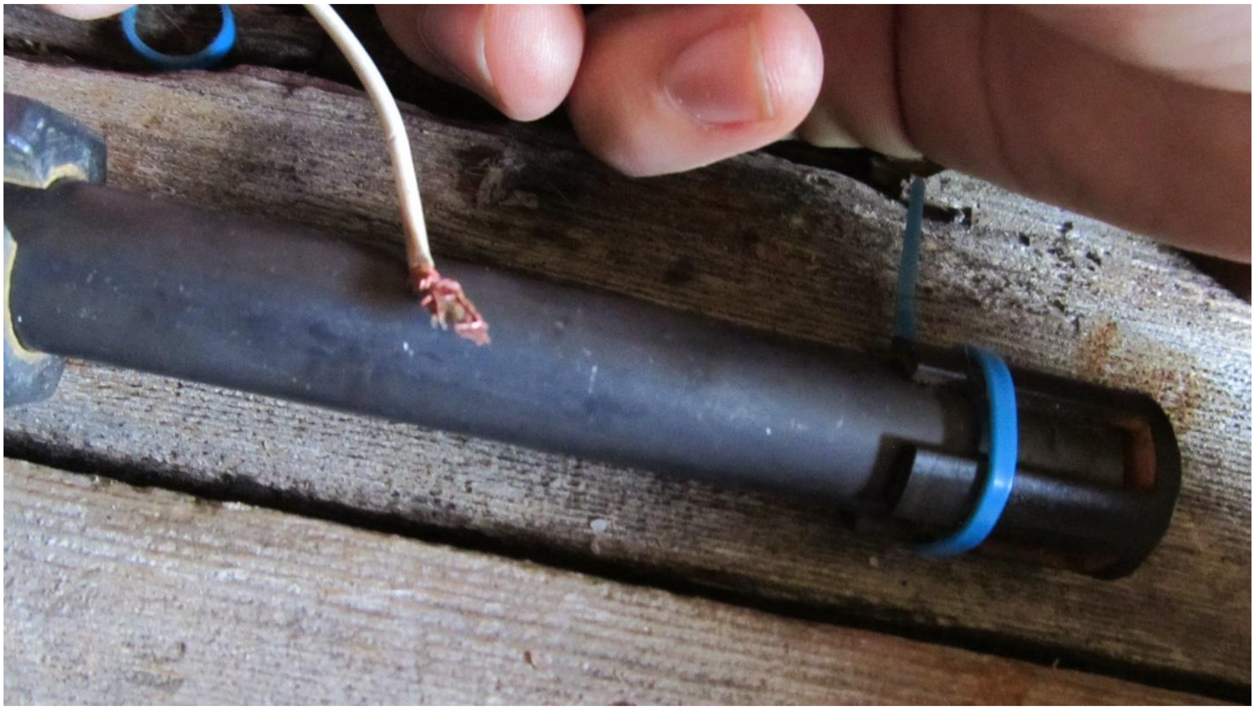
Step 14 continued: POWER SUPPLY SETUP – Switch your power supply on. Ensure that the alligator clips are not in contact with one another. The display should read some number of volts and zero amps. Spin both knobs on the power supply counterclockwise multiple times (some power supplies don't have stops on their dials, so just spin the dial until it stops or until you pass five full turns), then spin the voltage knob just a little (1/4 turn is plenty) clockwise.

Step 14 continued: POWER SUPPLY SETUP – Touch the two ends of the clips together. They will quickly begin to heat up, so do this step quickly. Turn your CURRENT knob until the display reads around 7.5A. You don't have to nail this value at this time, just get it close. When you are close, remove the two clips from each other. After disconnecting the clips, turn the voltage knob clockwise until it reads 20 volts (because we don't care about what voltage we cut with, you can just max out the voltage knob – the power supply will automatically adjust voltage to keep the current constant as long as you set the voltage high enough).

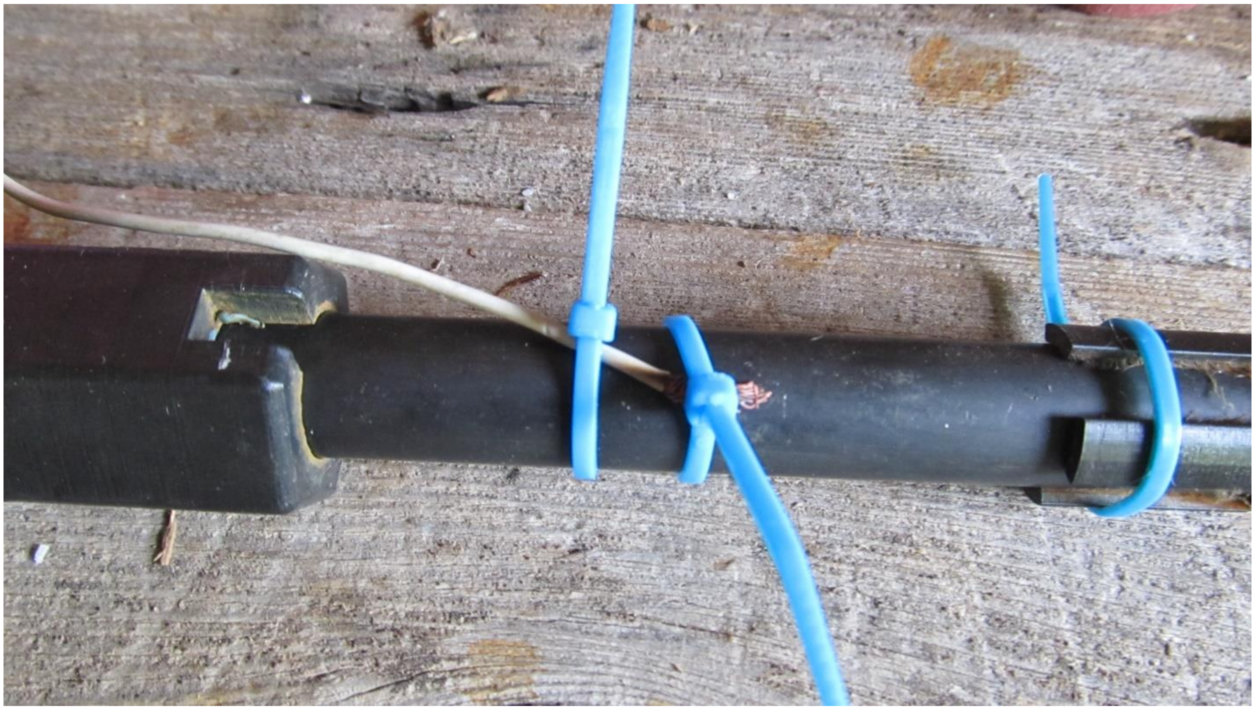
Step 14 continued: Turn the power supply off. It is now set to be close to the values you will need while cutting the barrel. Do not touch the knobs until instructed to later in this tutorial.



Step 15: POSITIVE LEAD WIRING SETUP – Using a ~5ft (150cm) length of your spare wire, strip one end, exposing the bare copper underneath the insulation. You can do this with wire strippers, scissors, a box cutter, etc. Clamp the exposed copper in the clamp for your positive lead (red wire). Wrap the clamp in electrical tape (or other tape) as shown in the image above.



Step 15 continued: POSITIVE LEAD WIRING SETUP – Strip the other end of your spare wire. You will be using zip ties or hose clamps to secure this wire to the barrel itself, with the exposed copper of the wire touching the barrel.



Step 15 continued: POSITIVE LEAD WIRING SETUP – Example of how to secure the positive lead to the barrel. Note using two zip ties, one to hold the insulated section of the wire and another to hold the bare wire against the barrel. This can also be done with a single hose clamp.

Step 16: NEGATIVE LEAD WIRING SETUP – Using a ~5ft length of your spare wire, strip one end, exposing the bare copper underneath the insulation. You can do this with wire strippers, scissors, a box cutter, etc. Clamp the exposed copper in the clamp for your negative lead (black wire). Wrap the clamp in electrical tape (or other tape) as shown in the image in the first part of step 15.

Step 16 continued: NEGATIVE LEAD WIRING SETUP – Strip the other end of your negative lead wire. Splice on your extra clamp. Your clamp won't be as big as the one pictured, that is fine. I recommend soldering and taping the splice, but a pigtail twist and tape should work. If your clamp cannot grab on to the end of the steel rod shown above, you may have to hammer the jaws of your clamp flat.

Step 16 continued: NEGATIVE LEAD WIRING SETUP – Clamp the clamp on to the end of the boring rod. It doesn't need to clamp tight but shouldn't fall off on its own.

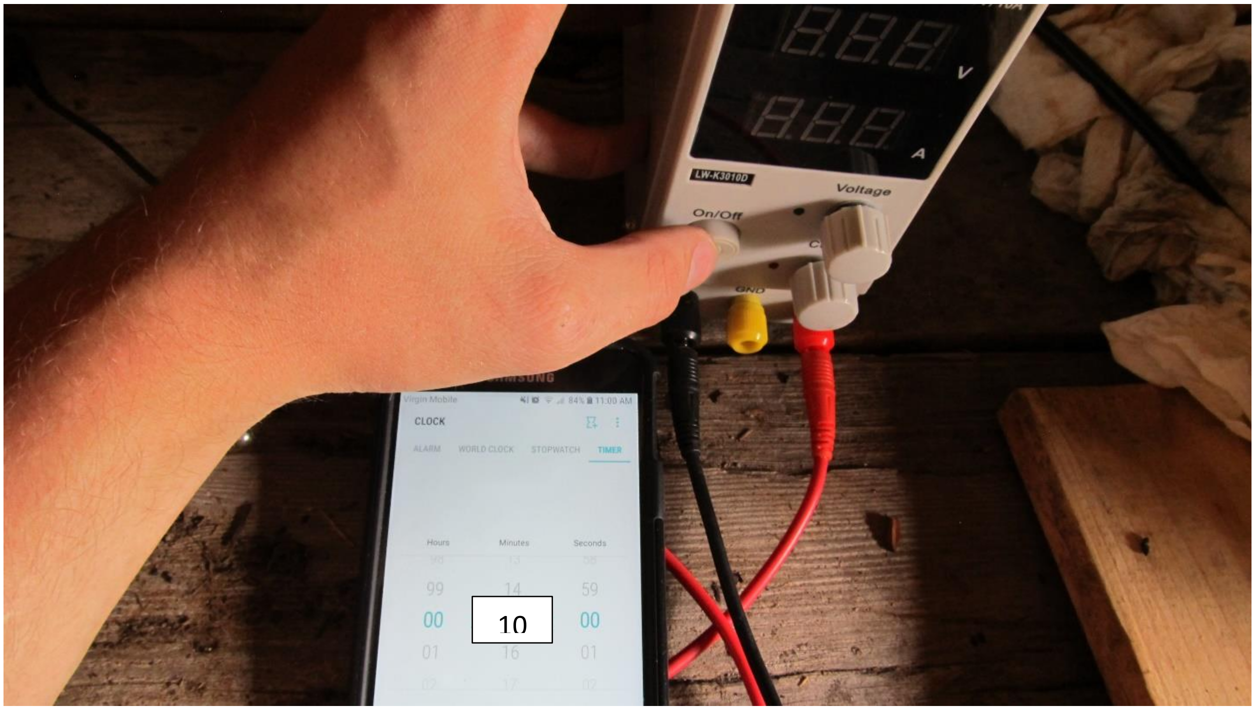
Step 17: MOUNTING THE TOOLHEAD – slide the PRESSURE side outlet tubing over the barb on the toolhead. Use a zip tie or hose clamp to ensure the toolhead stays connected to the tubing. If using a bucket similar to the one in this tutorial, you can zip tie the pressure side to the top of the handle and have the toolhead hang above the bucket.

Step 17 continued: MOUNTING THE TOOLHEAD – example picture showing the toolhead hanging above the bucket. Note position of zip ties – these zip ties can all be used interchangeably with hose clamps.

Step 17 continued: MOUNTING THE TOOLHEAD – Example picture showing using a block of wood (2x4) to prop up the handle of the bucket to hang the toolhead above the bucket.

Step 18: BEGINNING BORING OPERATION – Connect the clamp to the bottom of the boring rod. Double check your plumbing and wiring, ensure it matches what these instructions have said.

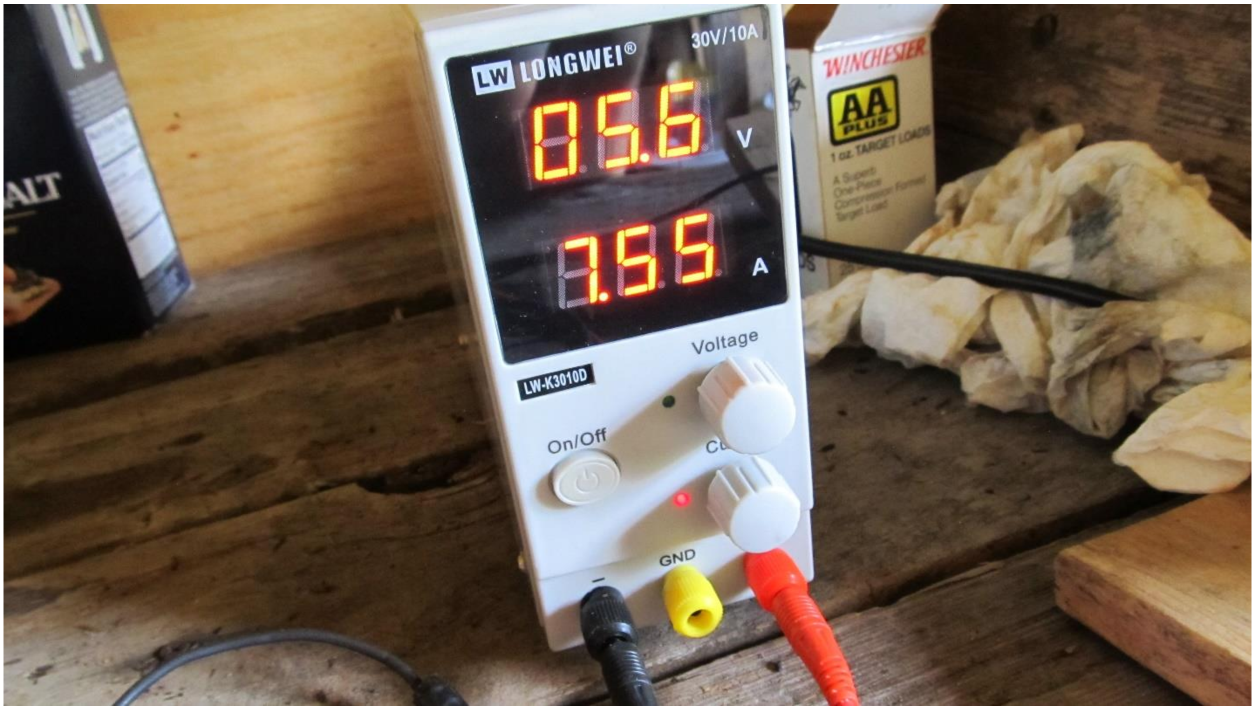
Step 18 continued: BEGINNING BORING OPERATION – Turn on your pump. The fluid should flow consistently and without too many air bubbles. Take this time to ensure the SUCTION side of the tubing is about halfway down into the bucket's fluid.



Step 19: BORING OPERATION – **READ THIS STEP BEFORE STARTING.** Turn your power supply on. ENSURE THE PUMP IS RUNNING STILL. Running the power supply without the pump running can pit your barrel, burn up your power supply, or cause other issues. Once you turn the power supply on, you will need to do three things. First – check that the fluid pumping out of the toolhead changes color. It should become a lighter color and you should notice a hissing sound. This is good. Second – start a timer for 10 minutes. I recommend cutting in intervals of 10 minutes until you get close to the correct barrel bore, then cutting in smaller time increments. NOTE: If the tubing you are using is 8.6mm ID (as opposed to the standard/normal 8mm ID tubing), start by cutting in 5 minute increments – some of these '8.6mm' ID tubes are actually 8.7mm ID, and if you cut for 10 minutes you will cut too much away. Obviously, the longer time interval you cut for; the more material will be removed. Third – check the AMPERAGE read on the power supply. You set this to 7.5 before, but it may shift once you are using the actual setup. Adjust it to 7.5A again if it isn't still 7.5A. NOTE: the boring operation can take up to 1 hour and 15 minutes. Don't waste a barrel by cutting without measuring periodically. Step 20 will detail how to measure/check that you are done. If you bought/are using a barrel tube that started at 8.6mm inside diameter, you will have less material to remove. I used 8.0mm inside diameter tubing, so the times I give in this section will reflect that.

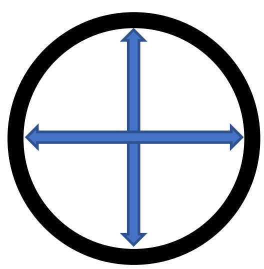
I recommend these cutting increments for an 8mm ID, 4.5in long tube: 10, 10, 20, 15, 5, 7.5 minutes, then 5 more minutes if needed, then 1-minute increments past that point. Note that cutting these cutting recommendations might not perfectly reflect the cutting times your barrel requires, and are provided for reference. When cutting a 8.6mm ID tube, cut in shorter increments – 5, 3, 2, 1 minutes.

Step 19 continued: BORING OPERATION – Example of the lighter color of the fluid once the power supply is turned on. A hissing sound may also be heard.



Step 19 continued: BORING OPERATION – Example of amperage changing slightly once the cutting starts. Adjust this to 7.5A and leave it be for the rest of the operations. If your power supply's internal fans turn on, the amperage may shift slightly – don't worry about readjusting, just let it be.

Step 20: MEASURING THE BORE – After each cutting increment, demount the barrel, rinse it in clean water, spray brake cleaner down the barrel, then push a cloth patch through the barrel 1-3 times to clean out the inside of the barrel. You can use your boring rod to push the cloth patches down the barrel. After running patches through the barrel, the inside should be clean and dry. At this point, you should measure the bore. You can use calipers to do this. In order to most accurately measure the bore with calipers, twist them around in the bore as you measure. Ensure that the caliper jaws are parallel to the bore. Whatever number you see as your peak number is the size of the bore. Confirm your bore measurement by measuring the bore in two places 90 degrees away from each other:

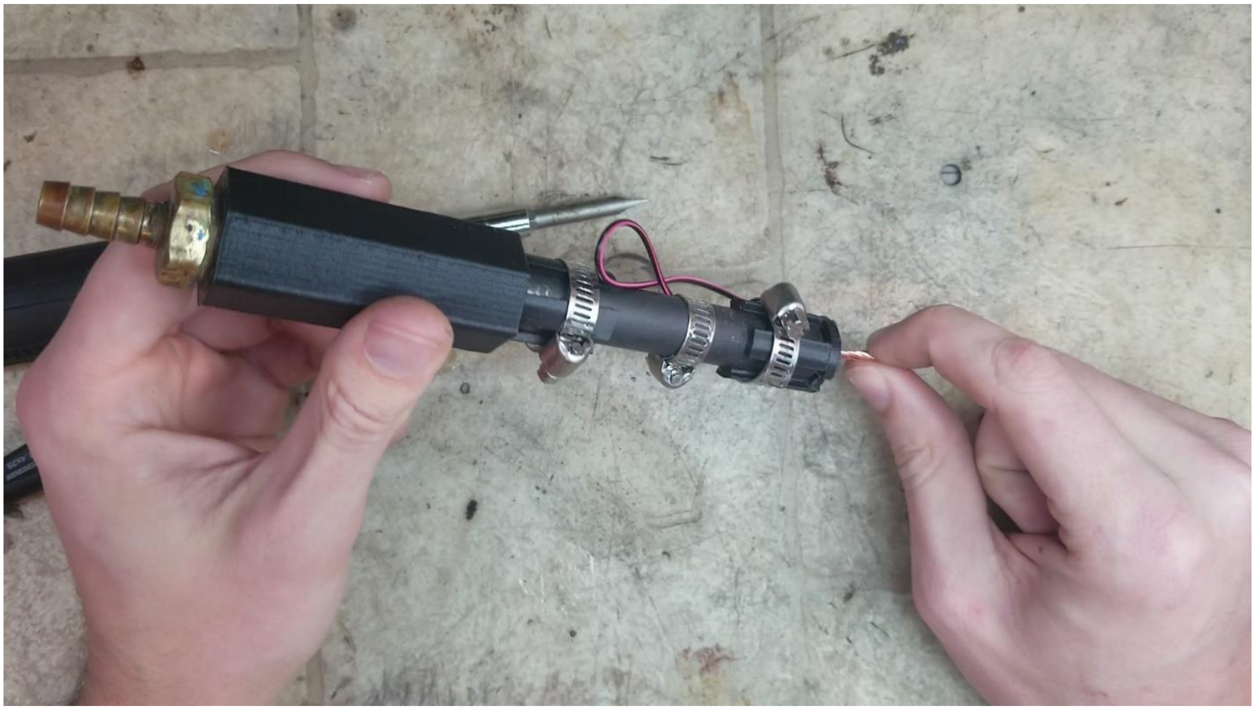


Your final bore size should be 8.82mm. You can overshoot this by a little (8.85mm is still acceptable), but don't undershoot it.

You will likely have to cut for over an hour. Your first 10 minutes may not cut very much if the barrel stock has a coating, as that takes a long time to wear away. Once it is gone the cutting will go a little quicker. Keep a notepad where you track how long you have cut and what the size of the bore was after the most recent cut. This notepad can help you guess how much cutting will need to be done when you get close.

It is strongly recommended that you use 1-3 cloth patches (pushed through the tube) and a little brake cleaner (sprayed down the tube) between cutting increments. This will greatly improve surface finish. Skipping this step will result in a much worse finish on the inside of the barrel.

Rifling Operation



Refer to **HERE** for instructions on setting up the tool.

It is a good idea to use brake cleaner/degreaser to remove any oil/fingerprints/dirt from the inside of the barrel and from the cutting tools (metal parts). Try to avoid getting degreaser on the plastic.

Step 21: BEGINNING RIFLING OPERATION – After the bore reaches 8.82mm in the boring operation, the rifling tool should be able to fit snug in the barrel. If your barrel is 8.82mm on the money, the tool might be a little tight. If it is, use sandpaper to gently sand down the outside of the mandrel until it fits snug in the bore of the barrel.

Your connections will be the same as in the boring operation, only your clamp will attach to the bottom of the rifling mandrel.

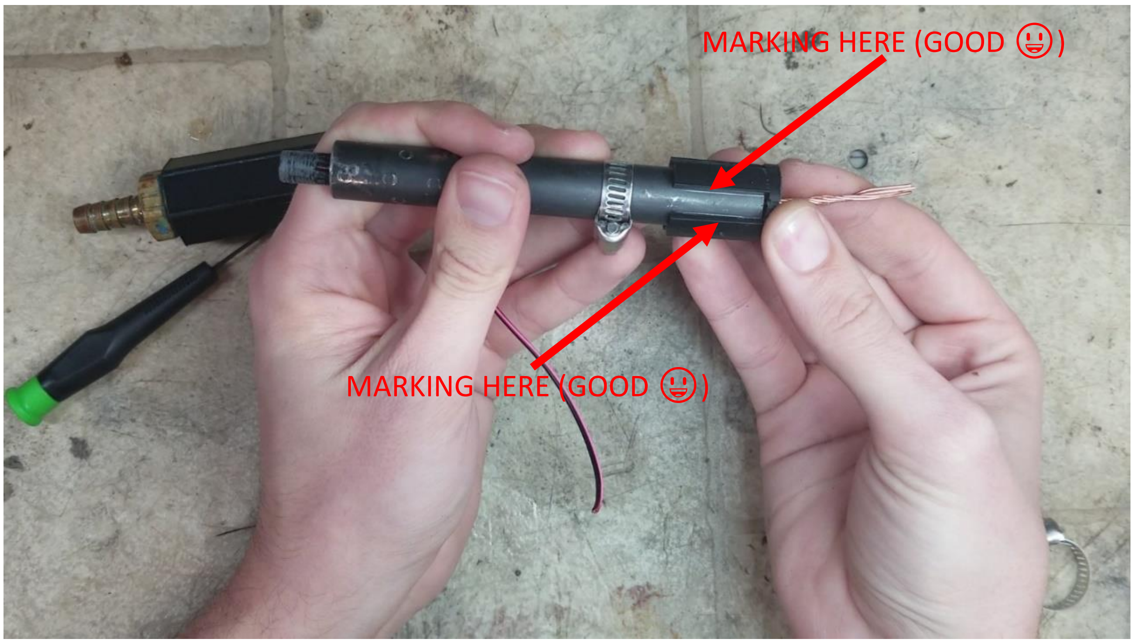
To begin cutting, ensure the pump is on, the electrical connections are correct, then turn the power supply on. It should still be set to ~7.5A, though the voltage will be different than it was on the boring operation. This is acceptable.

I recommend these cutting increments for an 8mm ID, 4.5in long tube: 5, 5, 2 minutes, then 1 more minute if needed, then 30 second increments past that point. Note that cutting these cutting recommendations might not perfectly reflect the cutting times your barrel requires, and are provided for reference.

Step 22: RIFLING OPERATION – **THIS IS IMPORTANT – READ THIS BEFORE STARTING**: The rifling operation requires the operator to pay some attention to what they are doing. You will need to maintain INDEX of the barrel to the toolhead between demounting the barrel. If you fail to do this, your rifling will overlap and your barrel will be ruined. Read **THESE** instructions in order to know how to maintain index of the barrel.

As a quick reference:

When re-mounting the barrel during the rifling operation, be sure to mount the barrel with the two markings aligned with the fingers – in person you can very easily see your markings and notice when they are and are not lined up. MAKE SURE YOU ALIGN WITH THE FINGERS THAT ARE NEXT TO THE SQUARE CUTOUT ON THE MANDREL!



An example of an out of index barrel – the marking line isn't aligned with the fingers.

Step 23 continued: MEASURING THE RIFLING – After cutting and measuring in increments, a valley to valley distance of 9.30mm -.2mm + .1mm should be achieved. After demounting the barrel after a cutting increment, clean the barrel as you did in step 20 (rinse with water, spray with brake cleaner, run 1-3 patches through the barrel).

As in step 20, measure in more than one place (more than one valley to valley) and rock the caliper around to find the largest measurement while the caliper jaws are parallel to the bore. If your valley to valley distance isn't big enough yet, cut for another 5 minutes (unless you're very close to an acceptable distance, then cut for 1 minute or 30 seconds if you're extremely close). ***BE SURE TO INDEX THE BARREL WHEN REMOUNTING.***

It is strongly recommended that you use 1-3 cloth patches (pushed through the tube) and a little brake cleaner (sprayed down the tube) between cutting increments. This will greatly improve surface finish.

Chambering Operation

Refer to **HERE** for instructions on setting up the tool.

It is a good idea to use brake cleaner/degreaser to remove any oil/fingerprints/dirt from the inside of the barrel and from the cutting tools (metal parts). Try to avoid getting degreaser on the plastic.

Step 24: CUTTING THE THROAT – After the rifling is cut to spec, you are ready to cut the chamber – the first step of cutting the chamber is cutting the throat of the chamber. The throat is the section of the chamber where the round itself will sit. If you don't cut the throat, rounds (and potentially casings) will interfere with the rifling, causing extraction issues.

Your connections will be the same as in the boring operation, only your clamp will attach to the bottom of the chambering tool, which will be sticking out of the bottom of the throating end pilot.

To begin cutting, ensure the pump is on, the electrical connections are correct, then turn the power supply on. It should still be set to ~7.5A, though the voltage will be different than it was on the boring operation. This is acceptable.

Reminder: You will use the chambering tool (the metal rod that you stuck into the chambering insulator) when cutting the throat – the same metal rod is used for cutting both the chamber and the throat.

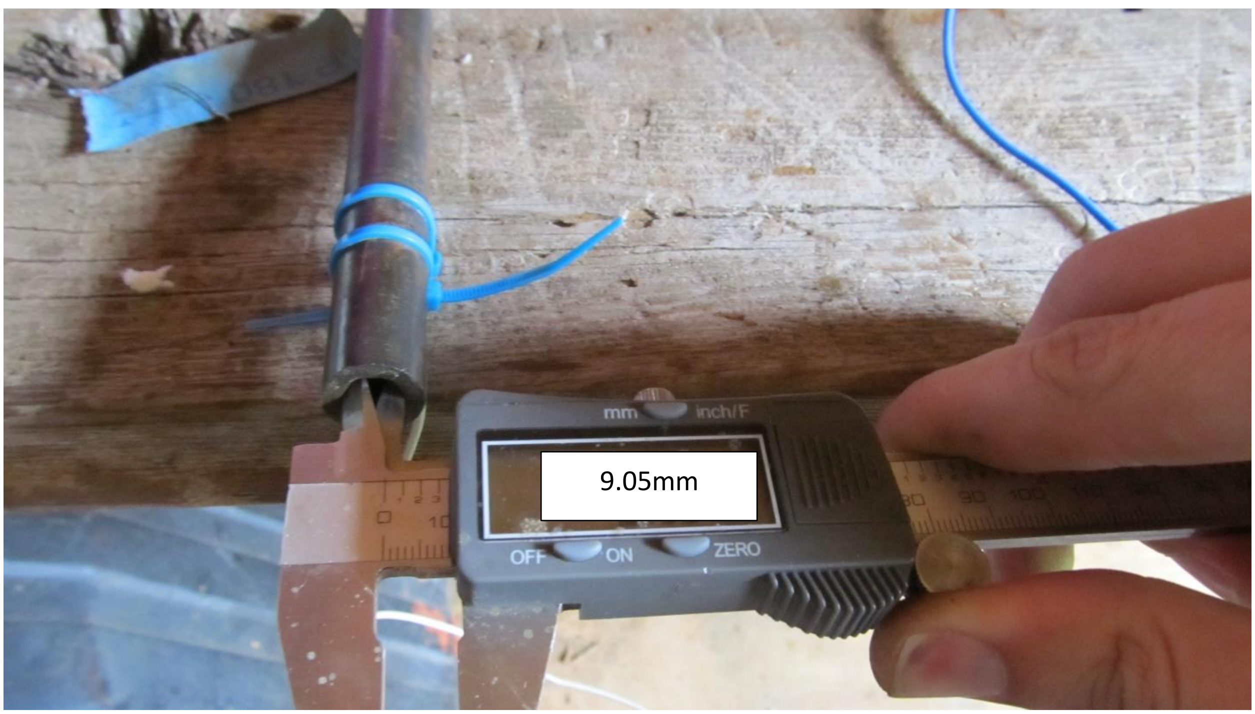
REMEMBER: When connecting the electrical lead to the chambering tool, be very careful to ensure that the clip on the wire doesn't push the tool upwards at all – the end of the tool must be flat against the seat on the throating end pilot.

Step 24 continued: MEASURING THE THROAT – After cutting and measuring in increments, the breech (rear) end of the chamber should measure 9.05mm -0.00mm + 0.03mm. As in step 20, measure in more than one place and rock the caliper around to find the largest measurement while the caliper jaws are parallel to the bore. If your breech end distance isn't big enough yet, cut for another minute (unless you're very close to an acceptable distance, then cut for 15 seconds if you're extremely close).

I recommend these cutting increments for an 8mm ID, 4.5in long tube: 1, 1, 1 minute, then 20 second increments past that point. Note that cutting these cutting recommendations might not perfectly reflect the cutting times your barrel requires, and are provided for reference.

It is strongly recommended that you use 1-3 cloth patches (pushed through the tube) and a little brake cleaner (sprayed down the tube) between cutting increments. This will greatly improve surface finish.

You can confirm you have done this step correctly by taking a 9x19mm bullet (just the projectile) and dropping it into the chamber. It should be a close fit, but the projectile should be able to fall all the way to the rifling in the barrel.



Step 25: CUTTING THE CHAMBER – After the throat is cut to spec, you are ready to cut the chamber itself – the actual area where the cartridge will go.

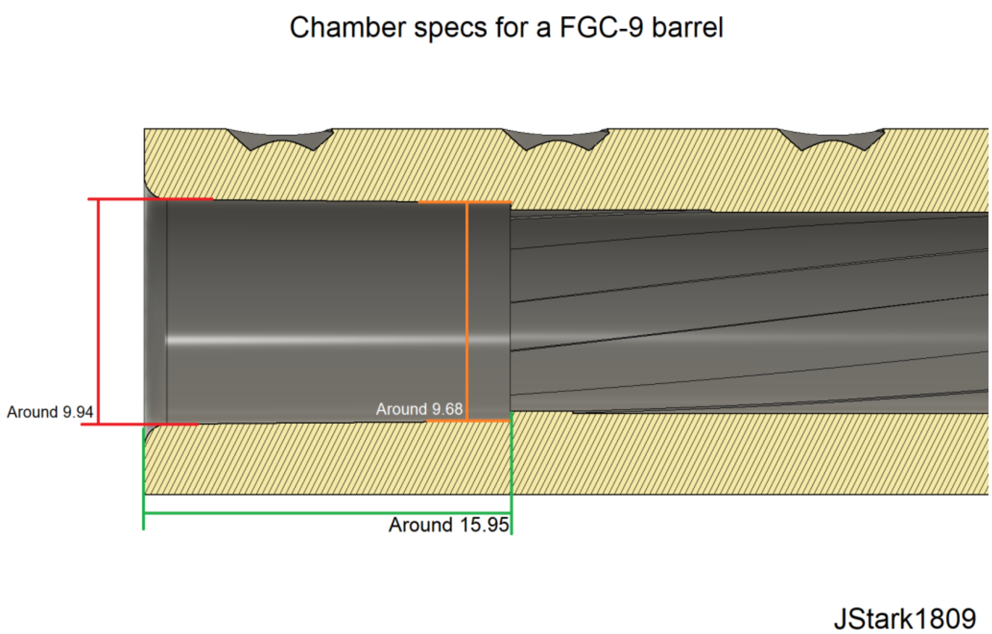
Refer to **HERE** for instructions on setting up the tool. Note that you are now setting up the CHAMBER cutting setup.

Your connections will be the same as in the boring operation, only your clamp will attach to the bottom of the chambering tool, which will be sticking out of the bottom of the chambering end pilot.

To begin cutting, ensure the pump is on, the electrical connections are correct, then turn the power supply on. It should still be set to ~7.5A, though the voltage will be different than it was on the boring operation. This is acceptable.

REMEMBER: When connecting the electrical lead to the chambering tool, be very careful to ensure that the clip on the wire doesn't push the tool upwards at all – the end of the tool must be flat against the seat on the chambering end pilot.

For reference, this image shows what the final shape of the chamber should be like. Your measurements might not exactly match what is shown in this image, and you won't be able to easily measure the orange dimension.



Step 26: MEASURING THE CHAMBER – After cutting and *checking* in increments, the chamber should be able to accept both a complete 9x19mm cartridge (case assembled with a bullet), as well as just a case. The chamber should be loose enough that after you push the round all the way into the barrel, it will fall out when you tilt the barrel upside down, but it shouldn't be so loose the cartridge has a lot of wiggle when fully inserted in the chamber. If your chamber won't allow the cartridge to seat all the way yet, cut for another 2 minutes (unless you're close to being able to chamber a round, then cut for 1 minute, or 15 seconds if you're extremely close).

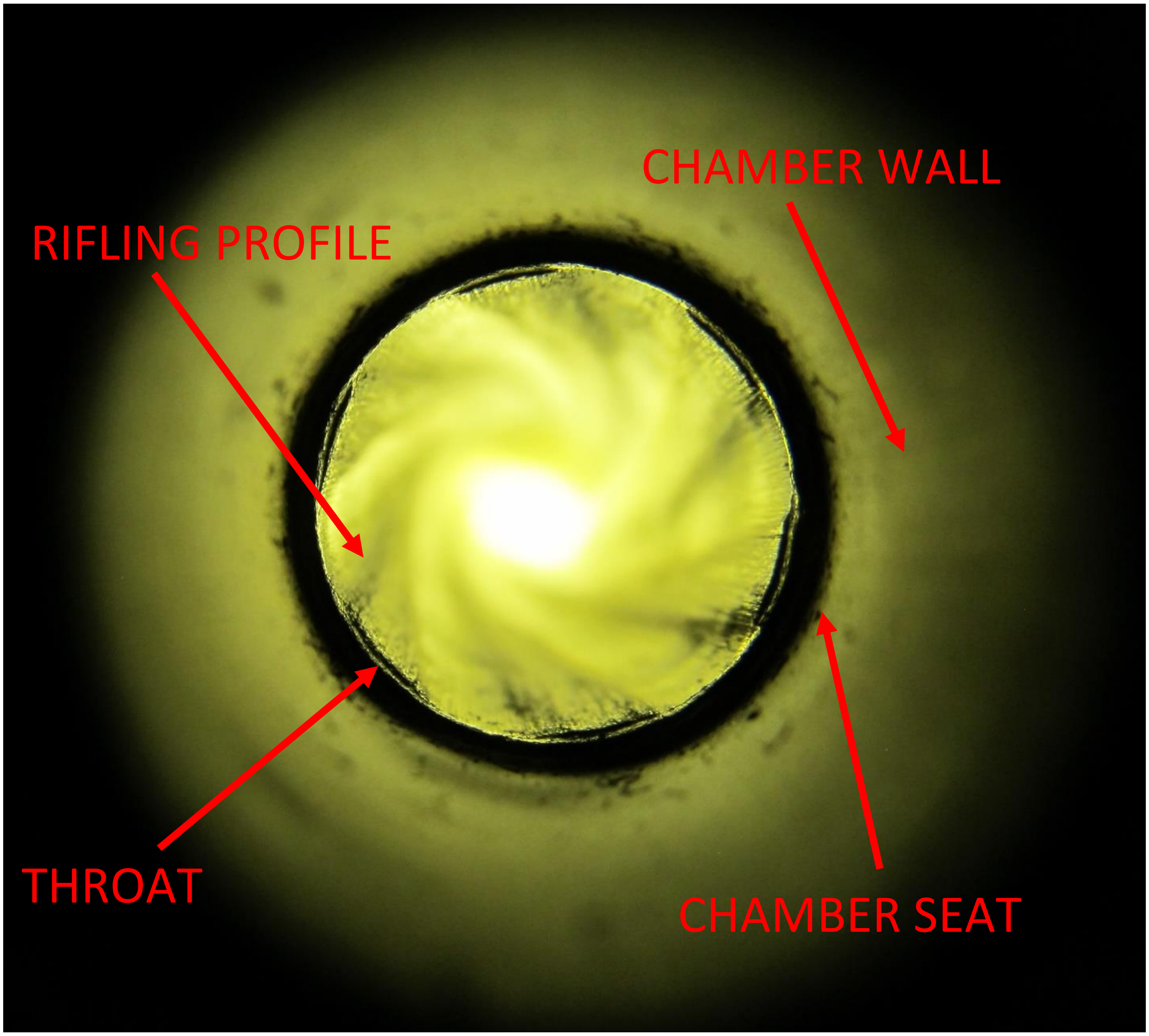
I recommend cutting until an unfired or resized case (no bullet installed) can be pushed hard into the chamber without sticking. If you can't get an unfired case, use a fired case or a whole cartridge – but an unfired or resized case is ideal. An unfired or resized case should have a very slight wiggle and be very easy to pull out after pushing fully into the chamber. A fired case should be tight and have little to no wiggle, but still be able to be fully chambered. A whole cartridge should be able to be easily inserted, but it might have a little trouble falling out of the chamber on its own. I cut in 2-minute increments until the case was close to chambering, then did 1-minute increments until the case could chamber fully. I am not going to give the total time it took me, as it will depend on the taper on your chambering rod/exact fitment of your chambering setup, but some of the beta testers reported cutting increments of 4, 4, 4, 1.5 minutes worked for them – but remember, you aren't cutting for a particular time, you're cutting until a round can fully chamber.

If your case is tight against the chamber walls (when inserting, pulling out, or when spinning inside the chamber), you will need to cut a little further on the chamber. If your case wiggles so much that you can see it wiggle (and especially if you can really hear it wiggle), you have probably cut your chamber too much – loose chambers can still be safe and work properly, but accuracy won't be very good. If you suspect your chamber is too wide, I recommend firing your barrel remotely for the first five rounds and checking the fired cases to ensure they aren't cracked or bulged.

A note on ‘fully chambered’ – in the case of these barrels, fully chambered means that a cartridge will insert into the chamber such that only a little of the cartridge is still sticking out of the barrel. The image above shows a fully chambered round – only a little bit of the case wall should be sticking out of the barrel.

It is strongly recommended that you use 1-3 cloth patches (pushed through the tube) and a little brake cleaner (sprayed down the tube) between cutting increments. This will greatly improve surface finish.

A finished barrel just after the chamber was cut. Note the rough finish on the breech face – this can be stoned or filed flat if you desire to make it pretty. The ECM process will leave a nice radius at the mouth of the chamber, which aids in feeding – thus no work should be needed to remove sharp edges on the barrel.



This is a picture of a freshly cut barrel that you can use for reference. You can see the primary parts of the barrel – the rifling profile, the throat, the chamber seat, and the chamber itself. The bore quality is a little rough, but what you're seeing is embrittled metal (metal that has been mostly ECM-ed away and is a weak, sponge-like structure) that can either be polished out, or shot out – after using the barrel the roughness will smooth out.

Non-Destructive Inspection

Non-Destructive Inspection (NDI) is a process where you can gauge the effectiveness (and proper craftsmanship) of your barrel without actually firing it – doing NDI first can save you from blowing a barrel up when doing “destructive inspection” (which really just means firing it).

I recommend “slugging” the barrel as your NDI – there are other ways to do this, but slugging is a cheap and effective way to do this. In order to slug your barrel, you will need:

1.) A finished barrel (or barrel that you think is close to finished and you want to check)
2.) A 9mm *bullet* (or whatever size bullet your barrel is meant to fire)
3.) A pushrod of some sort – you can use a flat punch, or your 0.250/6mm rod you used for the boring operation. It’s best if you can use a pushrod that is about 8.5mm in diameter, so that you minimize deformation of the bullet due to hammering on.

Take your bullet and set it down into the chamber. Using your pushrod and a hammer, tap the bullet through the barrel.

Bullet set down into chamber

Example punch used to hammer the bullet down the barrel.

Bullet after being tapped a few times with the hammer.

Once you get the bullet close to the end of the barrel, take a 17mm socket (or other comparable size/tool) and place the barrel inside of it. This will allow you to drive the bullet out of the barrel and into the socket, where it will fall out and can be inspected.

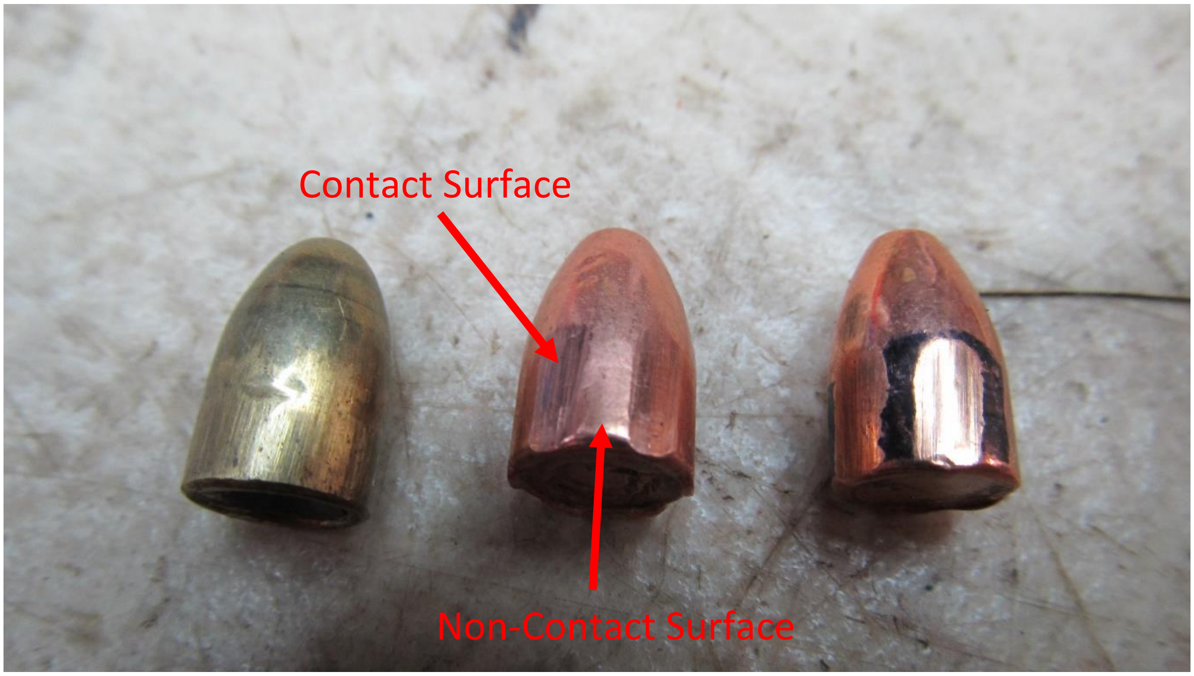
Inspect the marks that the rifling left on the bullet. The marks should be about equal in width to the areas where rifling was not left on the bullet.

If the marks the rifling left are very thin and the gaps between marks are thick, then you likely bored the barrel too wide in the boring operation or didn’t properly index your rifling mandrel during the rifling operation.

If the marks on the bullet are very thick (or the whole bullet is covered in marks) you bore may be too tight (though if you managed to fit the rifling mandrel in the bore, this probably isn’t the case) or you may not have cut your rifling deep enough. Ensure that the valley-to-valley distance is 9.30mm. If you’ve already cut your chamber and have this issue, don’t worry – you can still cut the rifling deeper after the chamber is formed (though you should try and avoid doing this if possible).

The next thing to check is a little harder to quantify. When you are hammering the bullet down the barrel, it should take a fair amount of force. The bullet shouldn’t ever feel like it is stuck, however – it should move with every hard hit. The bullet shouldn’t feel like it’s easy to move one hit, then hard the next – it should take a consistent amount of force to move the bullet a consistent distance down the barrel. If you have sections of the barrel where the bullet is very hard to hammer through and it comes out with wear marks all the way around the bullet, your barrel might not be safe to fire (though you should ensure that your wear marks aren’t a result of deforming the bullet badly as a result of hammering it down). If your bullet feels like it slides easily though part of the barrel but takes more force in other places, you either bored your barrel too wide or messed up the indexing on the rifling mandrel. Such a barrel would likely still be safe to shoot, but wouldn’t be very accurate at all.

The above issues can also happen if you accidentally bent your boring rod – if any of your cutting tools are damaged, rusty, or not in good working order, you must replace or repair them. Rust can be taken off of the cutting tools using sandpaper, but a bent rod should be replaced.



Here are examples of three different bullets all slugged through the same barrel at different points in the barrel's rifling procedure. Contact surfaces are where the rifling engages the bullet, non-contact surfaces are where the rifling doesn't engage the bullet.

On the left, you have a bullet slugged with only 5 minutes of rifling cut – you cannot see any pronounced separation between the contact and non-contact surfaces on the bullet.

On the right, you have a bullet slugged with 10 minutes of rifling cut – you can see some difference between the contact and non-contact areas because the bullet was marked with a Sharpie market prior to being slugged (a useful technique for seeing the difference between contact and non-contact surfaces). However, this bullet shows much more contact surface width than we want – you can see the contact surfaces are about twice as wide as the non-contact areas.

In the middle, you have a bullet slugged with 15 minutes* of rifling cut – you can see the difference between contact and non-contact areas, and you can see that the width of the contact area is roughly the same as the non-contact area. This is ideal in my experience – it will prevent the bullet from even impacting the non-contact surfaces when fired (fired rounds deform a little more than slugged rounds will). There's also some minor benefits to the even sized width of contact vs non-contact surfaces – the one most worth mentioning is that the rifling will engage the bullet in a manner that should reduce stress on the barrel – something that the rounded nature of ECM rifling lends itself to.

*This does not mean 15 minutes of cutting rifling is always the perfect amount. Follow the ECM guide for cutting your rifling and use this NDI section to double-check that your rifling looks good. Don't think of NDI as a way to measure your barrel until you get the cutting right, think of NDI as a way to tell you "this barrel isn't going to work in a safe manner". If your slugging ends up looking like the bullet on the left or right, you might just need to cut your rifling more – you can retool/set up the rifling setup again and cut the rifling further, even after the chamber is cut (though you should avoid doing this if at all possible).

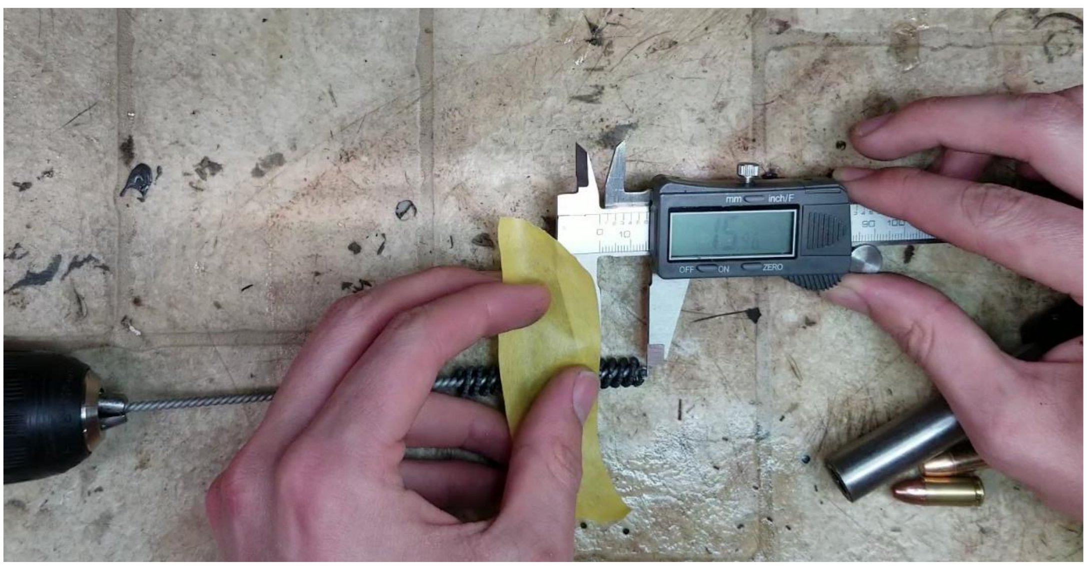
Post Processing

As an optional finishing step, buying and using a chamber honing brush (like the one called out in the ECM Shopping List) is a simple, cheap way to polish the inside of the chamber on your barrel. While this isn't required, doing this has been shown to help barrels with tight or poorly cut chambers extract much more reliably.

In order to use these brushes, you will need your calipers, some tape, the brush, a drill, a couple cartridges (for testing how rounds seat in the chamber) and your barrel.

Make sure that your brush is around 9-10mm outside diameter – using a brush too big can damage your chamber. The brushes listed in the shopping list have all been tested, but it's always good to double check their quality control before ruining your barrel.

Chuck up your brush in your drill. Set your calipers to a measurement of 15.95mm (the depth of the chamber on your barrel). Wrap a piece of tape around the barrel such that the bottom edge of the tape lies 15.95mm from the first orb on your brush. It is important that you measure from the first orb on the brush, and not the end of the brush itself.



This strip of tape will act as your depth gauge – you only want to brush the chamber of the barrel and should not use this brush in the throat or bore of the barrel – these brushes can destroy your chamber seat if inserted too far, so be careful. After installing the strip of tape, set your drill to its highest speed. Use brake cleaner to clean out the inside of the barrel.

Read these steps in their entirety before starting: Start spinning the drill before inserting it into the barrel. Insert the brush quickly to the depth indicated by the strip of tape. Hold the barrel and drill still while the drill spins for 2-3 seconds. Quickly remove the brush while the drill is still spinning.

After performing these steps, the chamber will be smoothed out. Avoid brushing for more than 2-3 seconds, as brushing for longer than this can remove the taper from the chamber or cause your chamber to become too wide.

Following your brushing, take your brake cleaner and clean out your barrel. Take a cartridge and chamber it – if you had excess drag or a rough chamber before, chambering your round should be much easier now, and if your round stuck a little and didn't want to drop free before, it should drop out of the chamber a little easier too.

Cleanup

A note on cleanup – all tools that were exposed to saltwater (including the barrel) should be flushed/rinsed with freshwater (non-saltwater) once you are done. Run about a gallon of freshwater through the pump (move the intake hose to a pot/jug of freshwater and suck it out) after cutting to reduce the chance of salt deposits being left in the pump itself.

The tools should all be rinsed with warm (but not hot) water thoroughly. Dry them and apply light oil (WD40, machine oil, etc) to the metal parts of the tools (it's ok if a little oil gets on the plastic, but the plastic doesn't need protected) to keep the tools from rusting. *Remember to clean the tools off using brake cleaner/degreaser before using them again!*

For the mess that is left in the bucket, I let it sit for 24 hours, after which time the solid waste will settle to the bottom of the bucket. You can pour out the water and reuse it, or you can just let it evaporate. The solid waste can be dealt with as described in the "**Preface**". I have just been keeping mine in a spare bucket – you could easily hold 100 barrels worth of cut steel in a single bucket.

Troubleshooting

- My tubing is leaking, or the hoses are blowing off
  - Using zip ties or hose clamps over the hoses on the barbs will help fix leaks and prevent hoses blowing off
- My pump sounds like it is running, but it isn't moving any water
  - Your pump could be locked up or might not be self-priming correctly. You can manually suck water into the suction hose so that the pump can prime itself easily.
  - If you've used the pump with saltwater before, there's a good chance it has salt buildups preventing it from priming. Trying to blow water through it can help, but what works best is popping off the top cover (just a few screws) and soaking the rubber plate under the top cover with water. Once this is done, reinstall the top cover and the pump should suck (in a good way) again.
- I have all the connections right, but when I turn the power supply on, current doesn't flow/the barrel doesn't get cut
  - It could be that the barrel is getting cut and you don't notice it. Look for the bubbles showing up in the water leaving the barrel assembly – you won't be able to see sludge in the water that flows out.
  - It could be that you didn't add enough salt or didn't add any salt at all – you need to add salt so that the water is conductive to electricity.
  - It could be that your electrical connections aren't correct – ensure that the wiring lead on the barrel has a good connection, and that the clamp on the electrode is actually in contact with the electrode.

The Hardware

- My rod/tools won't fit together!
  - Ensure that the ends of your rod/barrel don't have burrs/damaged edges. Fix with a file if they do.
  - Ensure that your printer is dialed in, and that you followed the print settings in the README.
  - In some cases, you can use a drill bit the same size as the rod/tool that won't fit to drill a hole to the proper size. Be careful and think about what you are doing before going crazy with a drill.

Feedback

Have more questions? Thoughts? Found a cool new way to make the process go easier? Design a new mandrel/caliber conversion setup and want to get it added to the package? DM me on rocketchat or pop into the ECM Rifling channel! (The link to the rocketchat sever can be found on this site: deterrencedispensed.com)