PIERCING ON THE CHEAP

By Glynn Cox

Piercing is the action of removing unwanted material to obtain a desirable artistic effect. I don't mean body piercing, although that can certainly happen if you are not careful. Whether using super high speed air powered handpieces or slow speed electric motor devices it is possible to produce dramatic effects in thin wall (1/16" - 3/32") turnings.

This demo is about procuring and building the necessary components (tools) to make a pierced turning, and doing it for about $100 excluding an air compressor. I will concentrate on the ultra high speed air driven handpieces, as I find these are the fastest and most efficient tools for piercing. There are certainly other, more advanced, ways of building a system but this is a good entry level route.

I find that electric motor driven Dremmel, micro motor, or Foredom type flex shaft tools are not optimal for fine small piercing details. They do work well with thick wall, large cutout size piercings which the small air powered handpieces cannot accommodate effectively. Their large bulky size and their slow rotational speed rapidly tire the hands. These electric tools max out at 45,000 rpm where the air powered units turn 250,000 to 400,000 RPM.

The high speed air powered piercing system consists of:

- Dental Handpiece
- Air pressure regulator/filter/valve/hose assembly
- Burs
- Air compressor

Most everyone has spent time in a dentist's chair and despise the sound and vibrations of the dentist drill. Get over it! It really is not that bad when you are holding the tool.

A quick "dental handpiece" search on eBay finds a myriad of units and prices. For woodturning piercing we need to concentrate on a few features:

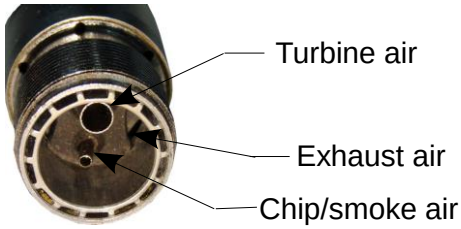
- Bend angle of handpiece (contra angle)
  My preference is a handpiece with a 45 degree angle between the center line of the handle and the center line of the cutter. This to me provides the most comfortable grip (except possibly the straight handpiece discussed later). Handpieces with head angles from 60 to 90 degrees are difficult to use.
- Ceramic bearings
  Ceramic bearings do not require lubrication which is a nuisance and the oil could get on your turning.
- Chuck release
  The chuck wrench version arguably holds the bur tighter than the push-button but is slightly more expensive.
- LED lighting
  LED lighting is a great new addition and is worth every extra cent.

- Air port configuration

  Two or four air supply ports is not a big deal but I prefer the 2 hole system as it is simpler to provide chip/smoke air. More on that later.

An eBay search for “dental handpiece 45” will find several units in the $20 price range. Add LED to the search and the price goes up and selection comes down. The LED light is powered by a miniature air powered electric generator inside the handpiece. These with ceramic bearings start about $60 from a “reputable” Chinese seller. Be sure and check the specifications for ceramic bearings. The relatively low dollar handpieces you find here are all Chinese products, even many that say made in Japan. You do get what you pay for, but you are piercing wood, not operating in someone's mouth or body.

45° HANDPIECE WITH LED

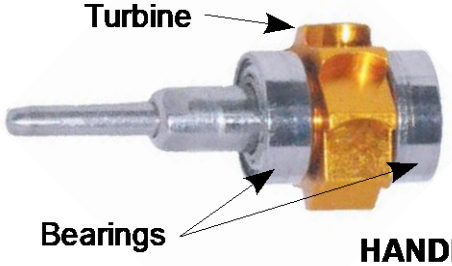


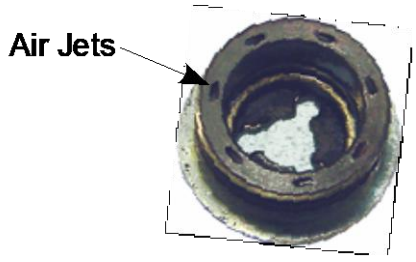
HANDPIECE END

Other hobby handpieces are available but rarely on the used market. Where the dental tools have a bend between the handle and the head these units are generally straight, like a pencil. These are great tools, very powerful, and very expensive. Hobby handpieces like the Power Carver and the NSK Presto are priced $350+. To replace a turbine in one of these will cost considerably more than the whole “cheap” system I am describing. I have not found any Chinese reproductions of these pencil type units. Do not confuse the low speed straight dental lab handpieces with the high speed ones I am describing here. They will not produce the results you want.

The shape of the handpiece is a personal preference. I have a problem holding the low angle units in a proper position to make a vertical cut. The straight units are good but again you have to watch carefully to approach the work at a 90 degree angle. The 45 degree angle I prefer is, for me, a natural angle to hold a pencil and presents the bur perpendicular to the work.

All of the handpieces have one thing in common, the air turbine. These are like a miniature hydroelectric turbine (see photo below). The regulated and filtered air is directed onto the turbine blades through extremely small slots in a disc similar to the scroll plenum of the hydro turbine. Again, these slots are extremely small and the smallest piece of contamination can clog them and reduce the turbine's speed and torque.





HANDPIECE TURBINE AND SCROLL

A compressed air source is required. The handpieces only require about 2 CFM of air volume at 45 PSI. A compressor rated at 3 CFM at 60 PSI will work, but larger is better. The higher the volume the less cycling will occur. If you don't already have an air compressor, an inexpensive "pancake" unit will work fine. A moisture separator on the compressor is very desirable.

In order to provide proper filtered and regulated air several companies offer assemblies that are priced from $120 up. You can build one for less than $50. Here's how.

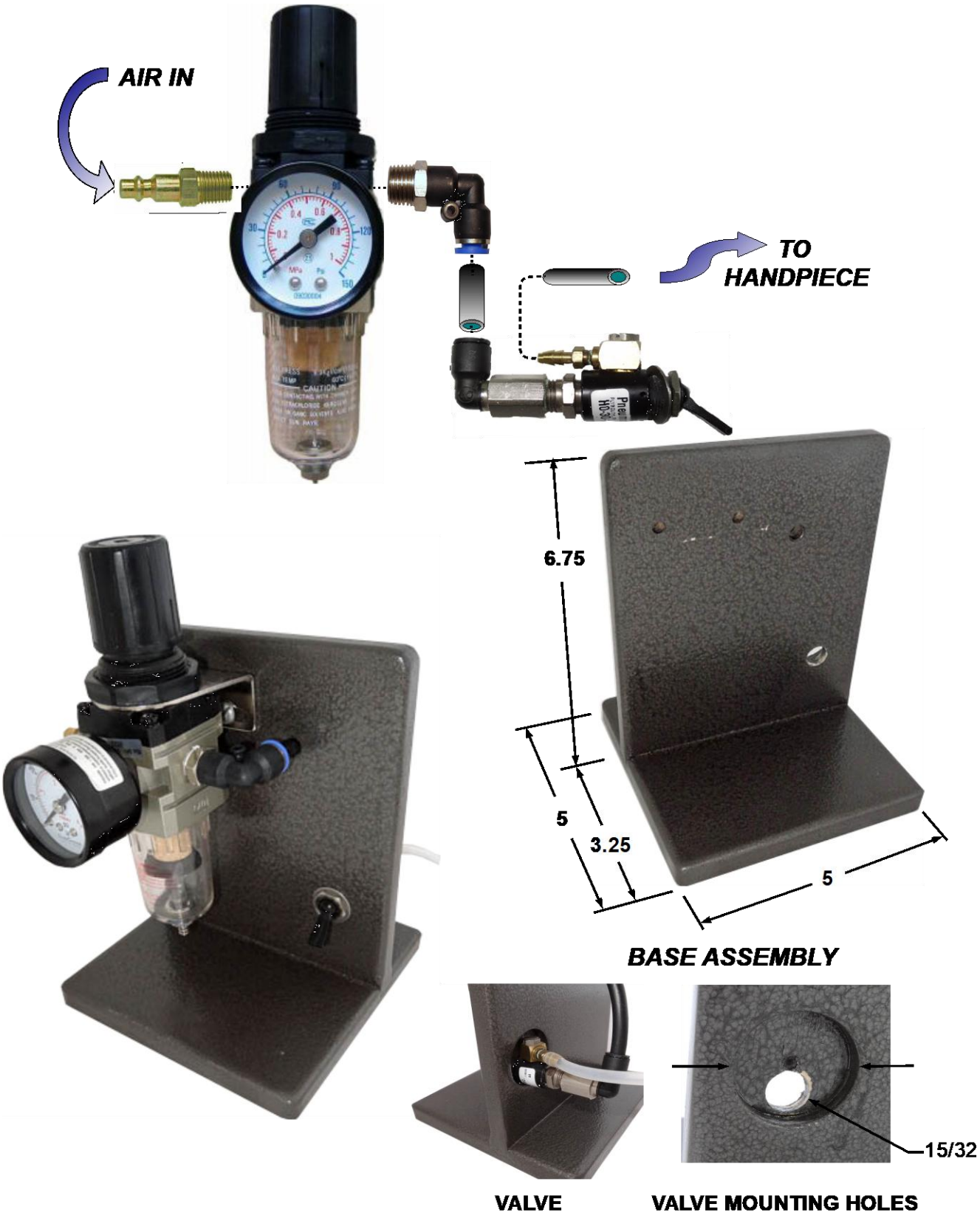
Before the air is provided to the handpiece it ***MUST*** be filtered and regulated again. Most small compressor systems have a regulator on them but few have proper filtering adequate for the turbine in the handpiece. You do not want to have any water or oil in the air stream, particularly with ceramic bearings. Other brands of filters and regulators, than the one specified here, are available either as combined or separate units. The filter needs to have a 25 micron or better filter element and be installed before the regulator. Most of the filters with a white poly element are 25 micron or better. The filter should be a coalescing type to remove excess water and oil from the air stream. The regulator ***MUST*** be a true "pressure regulator", not a "flow regulator". I see a lot of small flow valves designed for spray guns advertised as pressure regulators. A pressure regulator utilizes a spring loaded diaphragm to control a pilot valve and thus the pressure. A flow valve is only a variable orifice that controls the amount of air flowing, not the pressure and will destroy your handpiece . You can blow with your mouth through a flow regulator, not a pressure regulator. The handpiece requires 25 to 30 PSI pressure at the handpiece. Depending on the air line and fitting losses this would be about 35 PSI with the toggle valve turned off or 32 PSI with the valve turned on. This provides the desired maximum 30 PSI at the handpiece. This pressure is critical and should not be exceeded. Exceeding this pressure will burn out the LED and destroy the bearings.

It is a good idea to fabricate a onetime test gauge to measure the pressure at the handpiece. This can be accomplished by mounting a pressure gauge to a tee fitting and placing it between the end of the air tube and the handpiece connector. This will allow you to determine the exact pressure loss in your system and select the proper regulator pressure.

Acquire through purchase, trade, build, or scrounge the following components:

Regulator and filter assembly	Harbor Freight	43242 or equivalent
Air line disconnect	Harbor Freight	to match your air line
Toggle valve (2 way)	Various	search eBay
1/8 NPT or 10-32 to 1/4" tube fitting	Various (see below)	search eBay
1/8 NPT or 10-32 to 1/8" barb fitting	Various (see below)	search eBay
1/4 NPT to 1/4 tube elbow	Various	search eBay
1/4" OD nylon or PVC tubing	multiple	hardware store
1/2" Teflon tape	Harbor Freight	1/2" x 250"
Support assembly	Fabricate	1/2" thick wood
Two hole hose assembly	eBay	search '2H handpiece hose'
0-60 PSI pressure gauge (optional)	eBay	search '60 pressure gauge'

Fabricate a support assembly from ½ inch thick wood of your choice (see detail below). I used some Baltic Birch plywood I had laying around. Paint it if you like. I personally like to have all my tools look nice so I painted the support with Rustoleum Bronze Hammertone paint. Mount and assemble the components as shown in the illustration below.



Use Teflon plumbing tape on all of the pipe threads. Be extra careful not to get any of the tape onto the face of the fittings as it can come loose and get into the turbine slots. Two clockwise wraps of tape around the threads is proper. The rigid tubing fittings are push type which only require you push the tube into the fitting and pull it back to engage the lock. If you need to remove the tube just compress the locking ring and pull the tube out.

The toggle valve is a great way to easily turn the air supply on and off but you can also use a ball valve. There are a lot of toggle valves on eBay. You will need a 2 way valve and also fittings to match the valve's port size. These toggle valves come with either a 1/8" NPT or 10-32 threaded ports. The style of toggle valve selected will determine its mounting configuration and type of fittings on your assembly.

Most regulator/filter assemblies come with a 0 to 160 PSI or a 0 to 1 kPa pressure gauge. I highly recommend changing this to a 0 to 60 PSI gauge. You will be working in the mid 30 PSI range and the resolution on the 60 PSI gauge is much better than on the 160 PSI gauge. They are inexpensive at under $10 each.

As a bonus, this regulator assembly works great with air brushes since there is no in-line oiler.

You may also add a quick disconnect coupler to easily change from your piercing tool to an air brush. Search eBay for "paint ball quick disconnect". Some pipe thread to tube adapter fittings will be required for this.

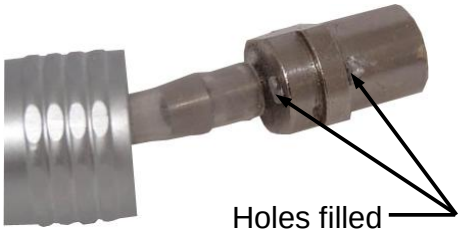
One other piece of equipment is required to provide compressed air to the handpiece. A dentist would use hose assemblies made of multiple tubes with a vinyl cover that provides air and water to the handpiece (see photo below). For our purpose only air to power the turbine is required, and optionally some air to blow away smoke and chips. Two hole connectors, with or without hoses are available on eBay for around $8 to $12. With the 2 hole system I have found that it is best to discard the large hose and use one 3mm ID x 5mm OD or 1/8” ID x 3/16” OD tube to provide air to the handpiece. This tube may be stripped from the hose or procured separately. Silicone tubing is very flexible but more readily available vinyl (Tygon), though stiffer, is also okay. This configuration puts much less stress on your hand because of the light weight and flexibility of the tubing.

If desired, a modification to the 2 hole hose connector will provide a small amount of air for chip and smoke removal. The air is expelled through a small hole adjacent to the bur chuck. This modification requires drilling a very small hole between the two air ports. Determine the depth of the two holes (ports) and the length of the mating tubes on the handpice to find an area between the end of the tubes and the bottom of the holes. It may be necessary to deepen the holes to allow clearance for the cross drill. Drill a number 76 hole thru the side of the fitting adjacent to the small port and in line with the centers of both ports. Using this hole as a guide drill a number 80 hole thru the web between the two ports. I drill a number 76 guide hole thru the outside because it is very difficult to drill a number 80 hole that deep. Remove the small hose barb by heating it with a soldering iron and pulling it out of the connector.

Once this is done it is necessary to close the number 76 hole and the small barb fitting. This can be carefully done with epoxy or solder. See photos below. A hole larger than the number 80 will produce too much air bleed. There are other methods of providing this chip removal air but I have found that this is the easiest.

HOSE AND CONNECTOR

CONNECTOR BEFORE MODIFICATIONS



CONNECTOR AFTER MODIFICATIONS

The cutters used in any small rotary tools are called burs and come in a variety of sizes and styles. There are flat, round, pointed, and egg shapes in carbide or diamond depending on the application. The ones I generally use for piercing are number FG699L and FG169L. The "FG" stands for Friction Grip to differentiate them from the slow speed burs that have a locking tab on the end of the shank. This designation is usually shortened to 699L or 169L. The "L" denotes Long, meaning the cutting length of the bur is longer than the standard bur length. The slightly larger diameter FG700L, FG701L or FG170L are also used. All of the burs have 1.6mm (1/16") diameter shanks. I prefer the 699L bur for faster stock removal with less pressure. It is called a fissure crosscut as it has chip breaking grooves radially around the cutter. The 169L does not have these grooves and makes a smoother cut which is good for cleanup. These burs are available on eBay for around $1.59 each or $1.20 each for 100. You will break them occasionally but they last a long time as they are carbide. See bur photos below. Talk to your dentist, or the nurse, they will most likely save their slightly used burs for you. They will probably not be the 699L but will be some to play with for engraving, texturing, or cleanup of pierced holes.

The wrench style handpiece comes with a special tool to tighten and release the chuck. The wrench fits around the square nut at the face of the chuck and the spring loaded pen inserts into the back of the chuck. Insert the bur until the end of the cylindrical shaft just protrudes from the chuck and then tighten the knurled nut securely. The push button style handpiece only requires the push of a button to insert and remove the bur.

CHUCK WRENCH

FG699L BUR

FG169L BUR

Now that you have the whole thing assembled it is almost time to start piercing. Turn the toggle valve ***OFF*** and set the pressure regulator for 35 PSI. Before you connect the handpiece you need to turn on the valve and blow out any foreign particles from the system.

Finally, connect the hose, insert your desired bur, adjust the regulator for 35 PSI, turn on the valve and start piercing.

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If you have any questions or comments regarding this demo please feel free to contact me at thumb9@verizon.net

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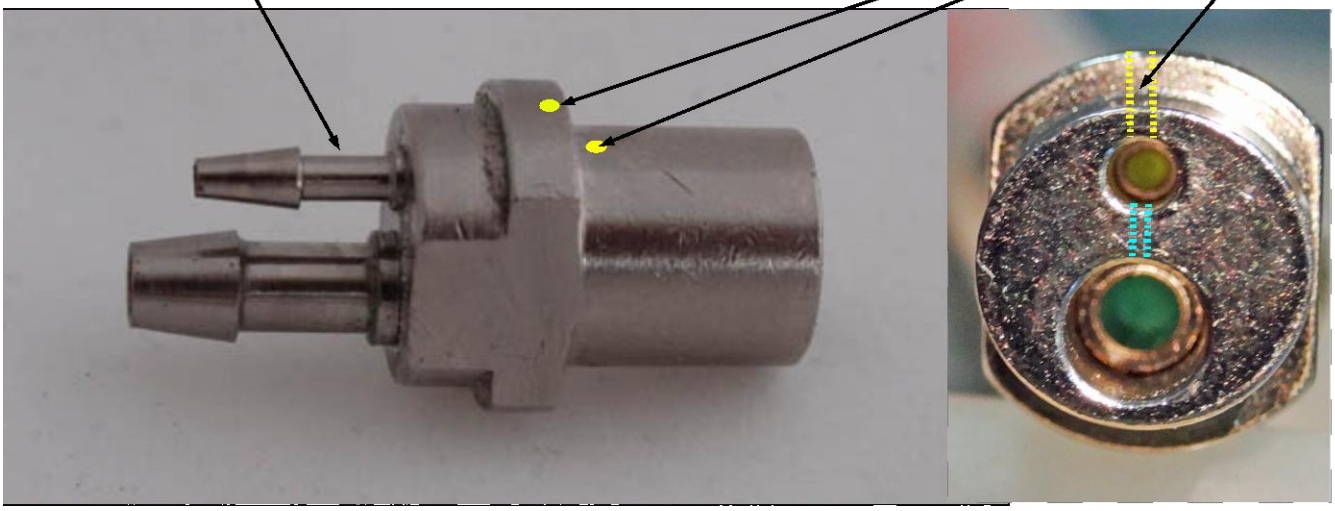
CONNECTOR MODIFICATION ADDENDUM

To modify 2 hole connector for particle/smoke removal:

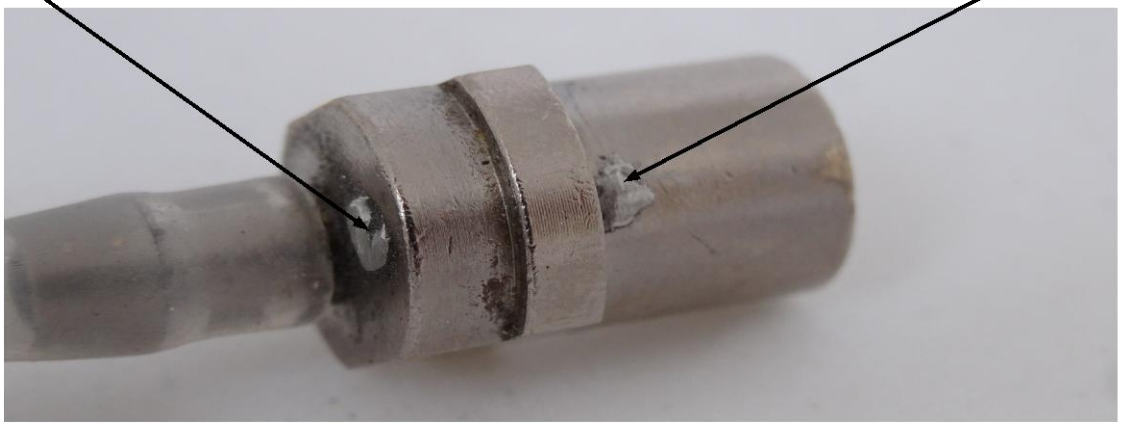
Using a soldering iron heat and remove small barbed fitting. Solder hole closed.

Using a #75 bit, drill a hole thru the outside and into the small chamber at one of these places.
Then using a #80 bit continue the hole to connect the small and large chambers.



Solder #75 hole closed

Solder barbed fitting hole closed



This modification is optional but it does help a little particularly if you do not use a fan to blow away the smoke.

The #75 hole is used as a guide for the smaller #80 drill. The #75 could be slightly larger or smaller depending on your skill in drilling small holes. I have found that the #80 is the largest hole you should use to connect the two chambers. Any larger and it directs too much air away from the main stream.
Do not drill the hole too close to the open end (RH end in photo) as the tubes in the handpiece will cover it when assembled.

When soldering the barbed fitting hole and the #75 drill holes closed be sure your solder is only on the surface and does not wick too far into the holes.