



# PIERCING ON THE CHEAP II



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. You will hear some of the more "artsy" turners say piercing is creating "negative space". To me, an engineer, it is the space left when you remove some material. In my thinking, space is the absence of something, thus negative space must be the presence of something... well you get the idea. Left brain vs. right brain.

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. A personal note here... I have seen piercing accomplished on relatively thick walled pieces with large cutouts but I much prefer the thin walled application. To me it is a more elegant expression.

I find that electric motor driven Dremmel, micro motor, or Foredom type flex shaft tools do not work well with fine small piercing details. They do work well with thick wall, large cutout size piercing which the small air powered handpieces can not 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.

This demo is about procuring and building the necessary components (tools) to make a pierced turning, not on the piercing itself. 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.

The piercing system consists of:

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

Since the first version of this document, in 2009, several new components have come on the market and my recommendations have changed drastically.

Most everyone has spent time in a dentist's chair and despise the sound and vibrations of the dentist drill. Get over it! In 2009 the least expensive air tool for piercing was a used Midwest Quiet Air dental handpiece. These handpieces require lubrication every 30 minutes or so and you stand the chance of getting oil on your turning. I have modified my Midwest unit with ceramic bearings, at extra expense, so I no longer have to lubricate it. I still use it occasionally when I need to get to a confined area.

Today there are other handpieces available that greatly surpass the functionality of the Midwest handpiece. 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).
- ◆ Ceramic bearings  
Ceramic bearings do not require lubrication.

- ◆ Chuck release  
I use the chuck tool version as I was told it holds the bur tighter than the push-button.
- ◆ LED lighting  
LED lighting is a great new addition and is worth every extra cent.
- ◆ Two or four air supply port configuration  
Two or four air supply ports is not a big deal but I prefer the 2 hole system as it simpler and uses lighter weight air supply tubing. More on that later.

A search on ebay for “handpiece ceramic” will find several units in the \$18 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. Add 45 to the search to find the 45 degree angle units that I prefer. These are about \$70 from a “reputable” Chinese seller. 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 someones mouth or body.



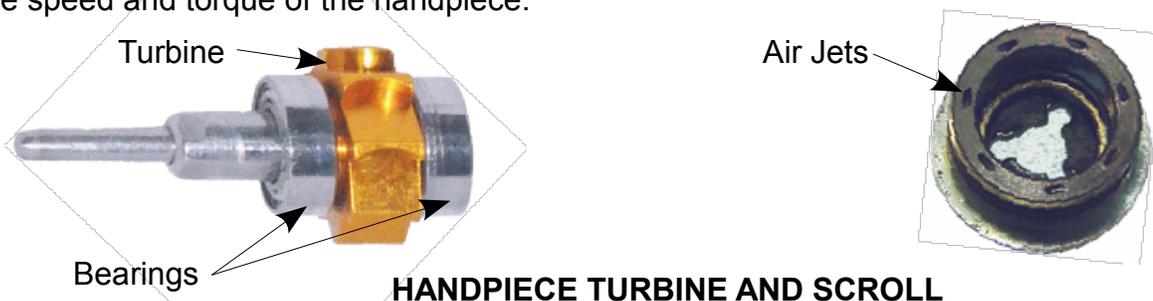
**45° HANDPIECE WITH LED**

**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 be 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 speed and torque of the handpiece.



**HANDPIECE TURBINE AND SCROLL**

I am assuming that an air supply is available. 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.

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 5 micron or better filter element and be installed before the regulator. 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. You can blow with your mouth through a flow regulator, not a pressure regulator. The handpieces require 40PSI pressure at the regulator with the toggle valve turned off or 35 PSI with the valve turned on. This provides the desired 32 PSI at the handpiece after regulator and air line losses. This pressure is critical and should not be exceeded.

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

✓ Regulator and filter assembly	Harbor Freight	43242
✓ Airline disconnect	Harbor Freight	to match your air line
✓ Toggle valve	Pneumadine	MJTV-3 or equivalent
✓ ¼ NPT to ¼ tube elbow	Pneumadine	
✓ ¼ 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 page 4). 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 on page 4. 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.

Most regulator/filter assemblies come with a 0 to 160 PSI 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 about \$7 each.

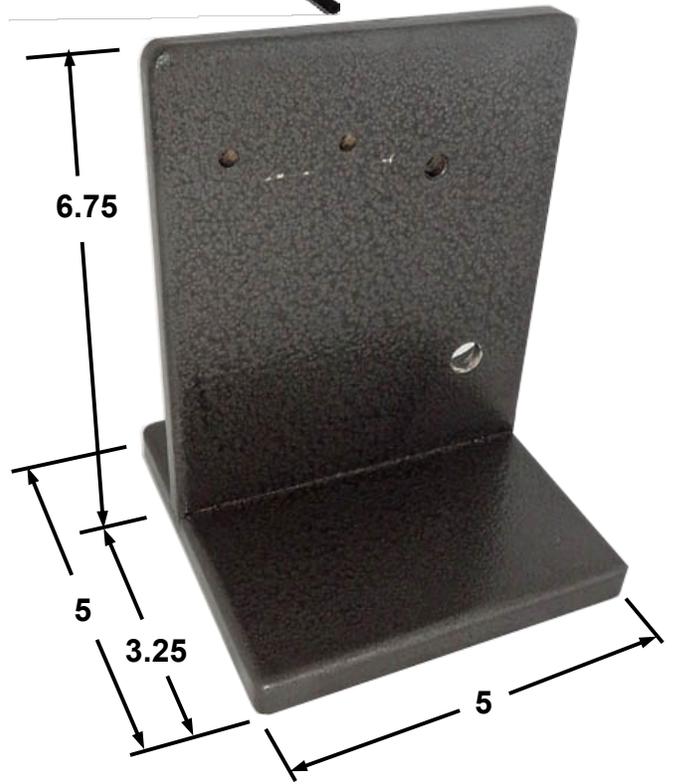
As a bonus this regulator assembly works great with air brushes since there is no in-line oiler.

You may also add a quick disconnect 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.

The illustration below shows the assembly of the filter-regulator-valve.



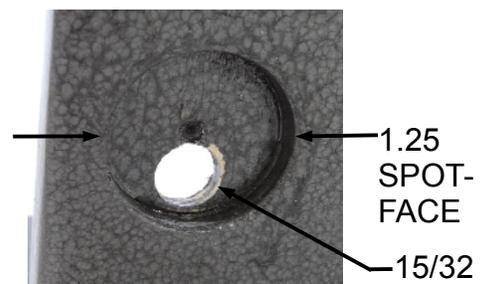
**COMPLETED  
REGULATOR-FILTER  
ASSEMBLY**



**BASE ASSEMBLY**



**VALVE**



**VALVE MOUNTING HOLES**

Another piece of equipment is required to provide compressed air to the handpiece. A dentist would use hose assemblies made of multiple tubes and 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 vinyl (Tygon) is okay also. 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 handpiece 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 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 \$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 on next page. 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.



**CHUCK WRENCH**



**BUR AND DIME**



**FG169L BUR**



**FG699L BUR**

The handpiece comes with a special wrench 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.

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 40 PSI. Before you connect the handpiece you need to turn on the valve and blow out any foreign particles from the system. **DO NOT LUBRICATE CERAMIC BEARING UNITS.**

***Finally, connect the hose, insert your desired bur, turn on the valve and start piercing.***

## **SOME USEFULL LINKS**

<http://www.harborfreight.com/14-air-line-filter-regulator-with-gauge-68228.html>

<http://www.ebay.com/>

[http://www.poweraire.com/pdfs/fittings\\_catalog.pdf](http://www.poweraire.com/pdfs/fittings_catalog.pdf)

<http://www.pneuaire.com/fittings.html>

[http://stores.ebay.com/DirectMaterial?\\_trksid=p2047675.l2563](http://stores.ebay.com/DirectMaterial?_trksid=p2047675.l2563)

<http://www.clippard.com/store/search.asp?sku=&description1=toggle&andOr=and>

<http://www.angelfire.com/il2/binhpho/toolsupply.html>

<Http://www.onegoodturn.ca/>



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