Making a Vacuum Chuck

by Kurt Hertzog

The faceplate used in this example is a homemade one made by welding a 1"-8 nut (for my particular lathe) to some mild steel and then turned round. Obviously, the weld must be leak free or any leaks need to be plugged with caulking prior to use. Other than cost, a factory made steel or aluminum faceplate would have worked equally as well. I have made vacuum chucks with no faceplate by drilling and tapping the thread into a hardwood. I've used Maple and Walnut with success.

A hole is drilled in the center to couple the vacuum through as well as three holes drilled for fastening the faceplate to a wooden block. The vacuum hole need not be dead center. I drill all of the holes on a drill press. It's easier and cleaner to drill the steel there than on my lathe. Because this is for a very light duty vacuum chuck, I chose three holes for mounting. If you are planning a larger or heavy duty chuck, make sure you select enough mounting holes and the properly sized mounting hardware for safe operation.

I am using a piece of plywood that is thick enough so the mounting screws (3/4" #8s) won't protrude.

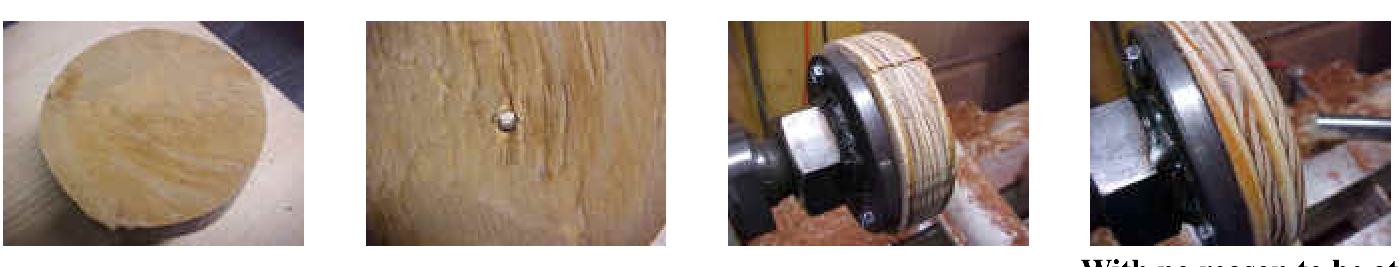
The circle is loosely cut on the bandsaw leaving extra for trimming on the lathe.

The faceplate is checked for fit and the best side of the plywood is used to seal to the faceplate.

Probably not necessary, but I use whatever caulking compound is around to seal the wood to the faceplate.

Not much is required. Just a ring that will seal around the center vacuum hole.

The faceplate is mounted to the wood block with the 3/4" #8 screws.



The worst side is out with the best side creating the seal to the faceplate with the assistance of the caulking.

The vacuum hole already in the faceplate is drilled through the wood block now while it is easy to do.

The faceplate is mounted on the lathe for truing and balancing.

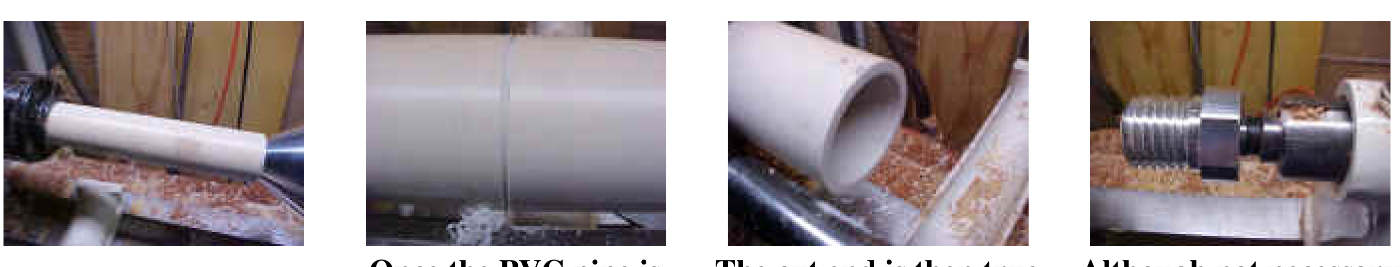
With no reason to be at exactly the same diameter as the steel on the faceplate, the wood is only turned until round and close in diameter.

Rather than leave a sharp corner on the front, I roll that edge using a sweeping radius to the approximate edge of the tube. By breaking the sharp edges on the front and back edges of the wood block, it becomes much more operator friendly if you should brush against it.

I mark the approximate id of the PVC tube to be mounted.

By trial and error, I open the od until it's close and tune the id as well.

Once it's a press fit, I open it to a slip fit and allow for a radius in the corners.



The PVC pipe I am going to use is loosely chucked and tightened after being centered with the tailstock cone.

Once the PVC pipe is running true in the chuck, a parting tool is used to cut a length the proper distance from the chuck.

The cut end is then true with a skew, the sharp edges are radiused with sandpaper, and the id, od, and end are sanded to roughen them for gluing.

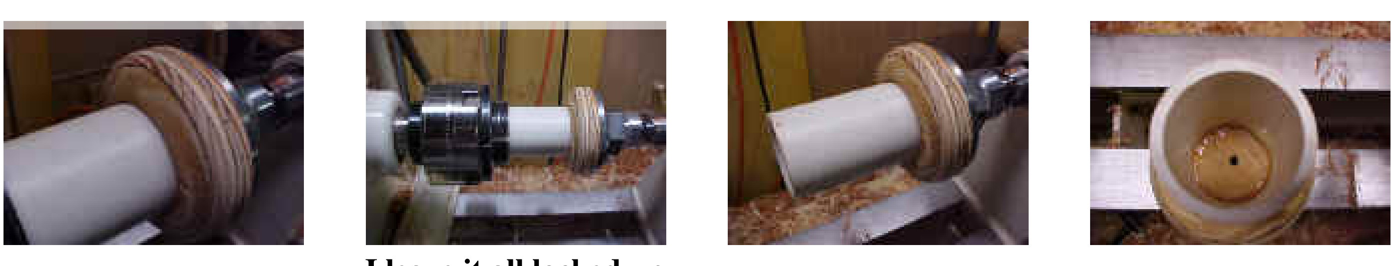
Although not necessary but helpful, I have a 1"-8 male threaded fitting that is attached to a #2MT that can be installed in the head or tail stock.

I bond the PVC to the plywood with standard hobby 5 minute epoxy.

The epoxy is mixed and put in the bottom of the groove and on the sides as well.

The faceplate ready for gluing is threaded on the tailstock fitting.

This allows for good lineup between the PVC tubing mounted in the headstock chuck and the vacuum chuck under construction in the tailstock.

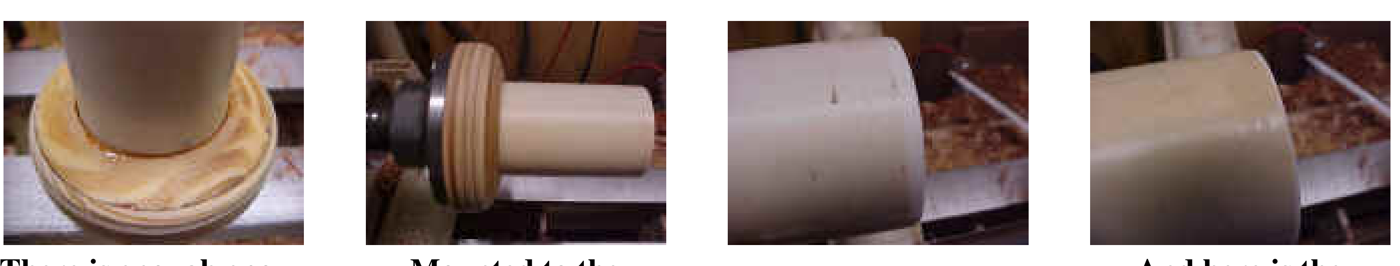


The tailstock is advanced allowing the tubing to be bottomed in the groove and clamped with sufficient force while the glue cures.

I leave it all locked up until the epoxy cures fully. Without the tailstock piece, it would be done on a bench and the PVC would just be glued into the groove vertically with a weight on top.

After the epoxy has cured, the chuck on the headstock is loosened and the tailstock is retracted.

The vacuum chuck is unthreaded from the tailstock. A look at the glue coverage inside.

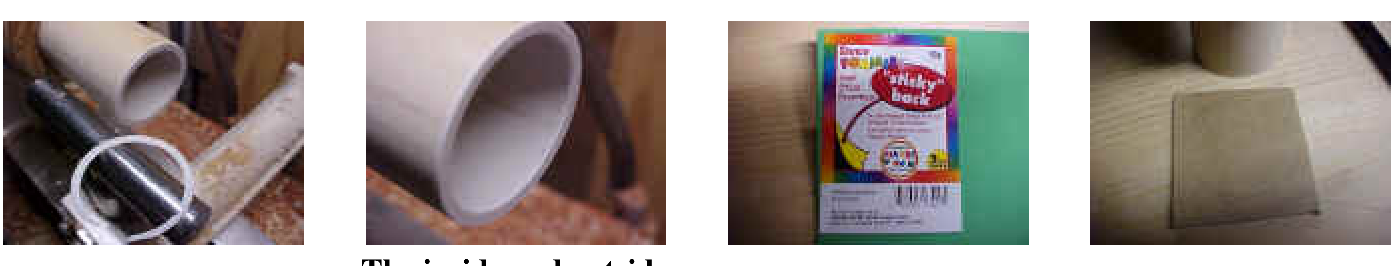


There is enough epoxy flow to bond the PVC to the wood well and provide a leak free seal.

Mounted to the headstock and running, it shows little "out of true" at the working end.

The end is scraped with the edge of a skew and here is the max scraping.

And here is the minimum. I can't say what the out of round was but its true now.



A skew is used to cut a square and flat face on the end of the PVC tube.

The inside and outside corners are broken by scraping with the edge of a skew.

Self stick, hobby foam is used for the compressive seal on the working end.

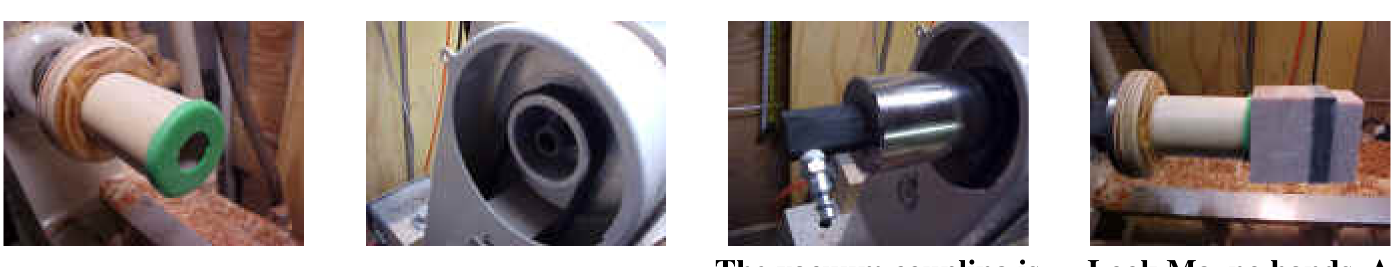
A piece of foam is cut and the diameter of the tube is traced on the backing.

The foam is trimmed with scissors leaving some excess to "roll over" the edge.

The center hole is cut. The size is unimportant so quite a bit of foam is left on the id.

The protective backing is removed.

The compressive foam is stuck to the end of the vacuum chuck.

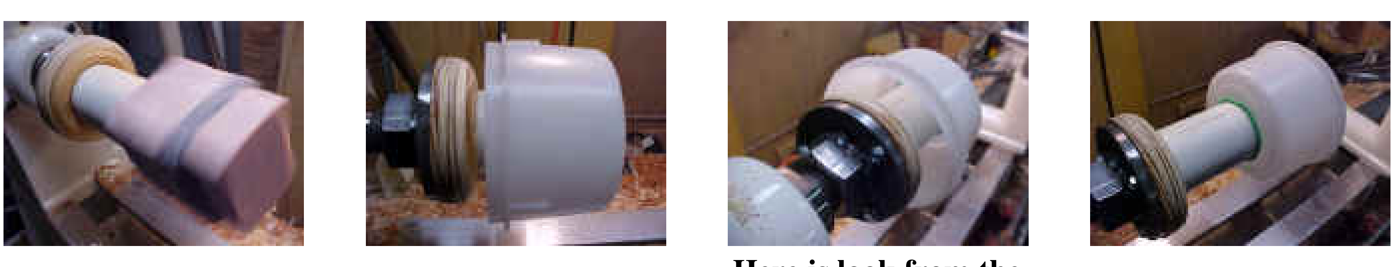


Okay so it's a real work of art... but will it hold anything?

The handwheel is removed from the lathe.

The vacuum coupling is installed and the vacuum pump hose is attached and the pump is turned on.

Look Ma, no hands. A handy piece of heavy material. Here I am holding a glue up of Corian pieces.

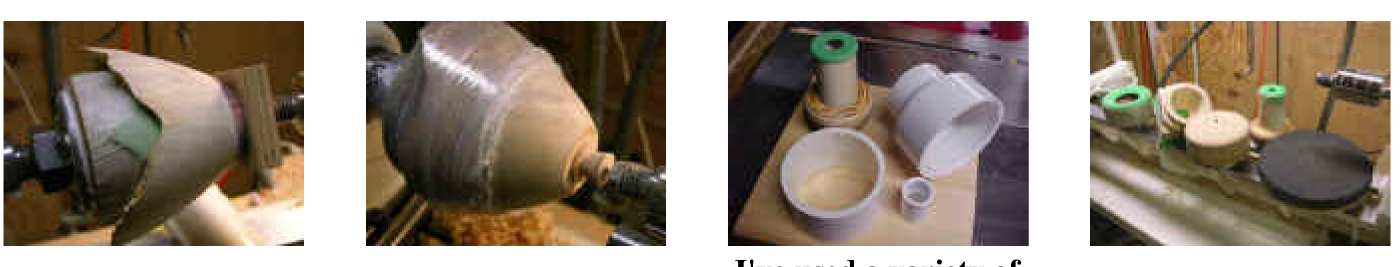


Intentionally held off center, the piece is gradually run up to a higher speed to check the holding power.

The real reason for the size and length of pipe on this particular chuck is to reach inside items to hold them, such as lidded boxes and hollow vessels. Here a Tupperware bowl is held to show the concept of reaching down into a vessel to hold it for outside and bottom work. This type of chuck allows me to locate and seal on the bottom versus the rim or inside wall. There are applications where you might want to locate on the rim or inside wall.

Here is look from the headstock end. Remember, the holding force is a function of the vacuum pulled and the area of the surface actually under vacuum. Smaller pieces are being held with less force. Do your vacuum chuck design with the application in mind. You have the capability to create chucks that won't have sufficient holding power or create chucks that will crush pieces, or anywhere in between. The old IBM motto still applies, "Think".

This concept of construction offers all kinds of flexibility in holding a variety of turned items, including just plain old flat surfaces.



I suggest using the tailstock whenever you can. It provides a measure of safety even if you have sufficient holding force and use a light touch in your cutting.

I often tape (packing stretch wrap works nicely without leaving adhesive behind) my piece to the faceplate to provide that extra hold or safety strap should the vacuum force be broken while turning. This is particularly important after the tailstock has to be removed. If the vacuum is broken, at least your piece doesn't become a projectile.

I've used a variety of sizes from small PVC pipe up to 4 inch. Combined with assorted couplings, reducers (used in either direction), or different assemblies, you should be able to make whatever size and shape you need. Don't forget to use "just wood". It can be shaped inside and outside to be form fitting. The same adhesive foam can be used. When the foam is worn out. Replace it with new. I cut and trim the wood for various projects making specialty vacuum chucks. When the wood is worn away, I replace it and start again.

Because this vacuum chuck is so inexpensive and very quickly made, there is no reason not to have a host of them for your different needs. Create them as you need them tailored to be the best solution for your task at hand.

Photos by Kurt Hertzog