

Vacuum Chucking

MDAE Woodturning Center Course Number 95537001

Purpose of vacuum chucking

- Completing the foot of a vessel
- Re-chucking a “completed” object
- Quick securing for additional steps (sanding)

How it works

Vacuum chucks function by decreasing the air pressure inside the vacuum chuck and its attached vessel. The outside atmospheric pressure holds the vessel by attempting to equalize the internal and external pressure to atmospheric pressure (at sea level One atmosphere = 14.7 PSI).

Lower internal air pressure is generated by means of mechanical or venturi effect devices ranging from vacuum cleaners to specialized vacuum pumps. Vacuum pumps are not 100% efficient and cannot generate a “perfect” vacuum. The atmospheric pressure at the location and the pump’s efficiency limit the potential of the system.

Example:

- a 10-inch diameter bowl held at the rim would have a surface area of (πr^2) 78.5 square inches
- One atmosphere of pressure and a perfect vacuum creates a pressure of 1,153.9 pounds of surface pressure!

What is required

- A means of generating lower atmospheric pressure (generally a pump)
- A lossless connection to the lathe headstock threads
- A means of varying the amount of pressure reduction
- An appropriate chuck to hold the vessel
- Filters to protect the components for damage by woodturning debris

Generating Vacuum

- Venturi pumps generate vacuum passing a stream of air or water past a small orifice cause a pressure drop and suction. This type of vacuum “pump” allows you to use your compressor with this device to create the vacuum required. The V812 Hold Fast Vac Generator, \$130.00., It requires 2 CFM flow and will generate up to 24 ”/Hg vacuum at 80 PSI.



- Rotary Vane pumps produce high CFM, are motor operated and have a moderate life expectancy. Gast is the most recognized name in this field. Their pumps can be found used on line or new through the woodworking dealers. The one used with the Oneway system is ¼ HP, produces 4.5 CFM and pulls 26 “and costs \$445.00.



- Diaphragm (oil) driven pumps are quieter to use, have a long-life expectancy when maintained. The consumer pumps have lower CFM and quite operations. The 2.5 CFM pump from Harbor Freight is on sale at \$104.00:



- Other vacuum producing techniques are:
 - Using the shop vacuum cleaner
 - Hooking up a compressor backwards
 - Converting a refrigeration compressor to work on air

Vacuum Adapters for the Lathe

- Commercial rotary adapters such as the Oneway adapter fit on the hand wheel side of the headstock, a thread insert will match to your lathe. The adapter will need to be removed for knockout bar access. Price is \$111.00 US. Other manufactures such as Technatools also provide similar adapters for their lathes.



- Through the headstock adapters fit tightly at the threaded MT #2 end of the headstock, pass through the opening and attach to a rotary adapter on the outboard side. These are more easily removed and less expensive. The length of the adapter rod is cut to length is cut to fit your lathe. The Hold Fast adapter sells for \$60.00.



- A third style of adapter fits *inside* the headstock bore and can easily be installed and removed without mechanical attachments. Due to the differenced in headstock bores, the fitting must be purchased to fit your specific lathe model perfectly. (<https://jtturningtools.com/vacuum-adapters>)



- Custom built rotary adapters can be constructed by fitting a double seal rotary bearing into the hand wheel and attaching the vacuum hose to it. This may require some custom machining. In custom constructions it is important to assure that the full system (adapter to chuck) is leak free. Many lathes have “holes” drilled into the headstock bore which must be sealed.

Vacuum chucks

Both commercial and home build chucks may both have a place in your shop. Home build chucks can be adapted to fit any project size and cost little to construct. Currently there are two manufacturers of quality commercial chucks to consider

- Oneway Manufacturing produce a machined aluminum chuck in three sizes. A separate thread insert is required to fit to your lathe the prices range from \$75.00 - \$284.00.



- Hold Fast chucks also come in various sizes and are thread-fitted to your lathe. Prices range from \$62.00 - \$97.00.



Home built chucks can be constructed in any size needed for your projects. They can be threaded to screw onto the headstock or attached to a quality faceplate. Here are a few considerations in selecting materials for the homebuilt chuck:

- Do not use plywood or MDF for construction as they are porous and will leak – MDF will eventually break down and disintegrate.
- If using a hardwood for the chuck base or body, be sure to seal all faces with a topcoat finish to seal the wood pores. Cross grain construction for the base is preferable.
- When mounting to a faceplate, attach the base component and then re-true the assembly to the lathe axis before adding the next component.
- After mounting the chuck body, re-true the top rim before adding the seal material.
- In selecting a seal, closed-cell foam is preferred for the top vacuum seal. Do not choose material too thick such as a wet suit material as it will not provide a firm seating for the vessel being mounted.
- PVC or ABS pipes work very well if the wall thickness is kept thick.



Setting Up the Vacuum Chucking Hardware

At the right is a picture of a hardware assembly including the inexpensive rotary adapter.

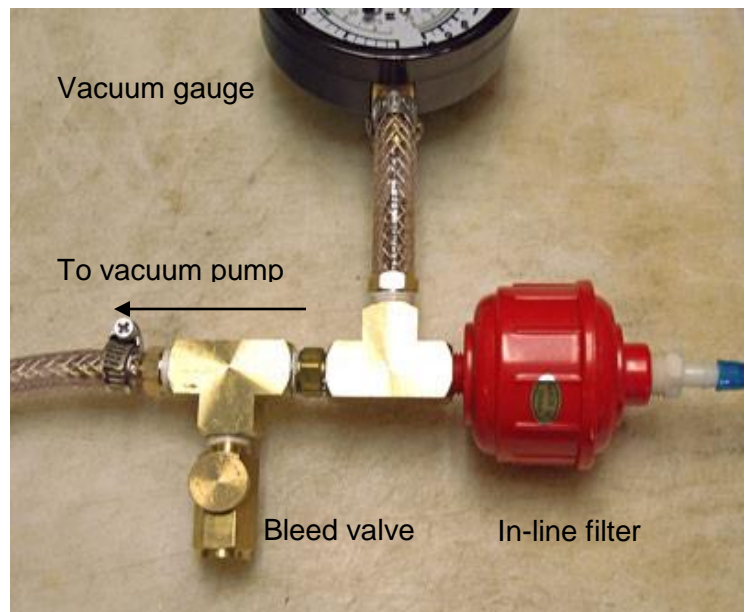
This adapter is fitted through the headstock, the black Morris Taper adapter (shown at the top of the photo) is screwed down to the inboard side of the headstock and the brass tubing is passed through the headstock and the excess is cut off to length. The opposite end fits snugly to the outboard side of the headstock and contains a vacuum tight rotary fitting.

The red in-line filter is required to protect the vacuum pump from debris and sawdust.



All brass parts have been wrapped with Teflon tape before being screwed together. Hose barbs to hose assemblies should be strengthened with the addition of a hose clamp.

The following is a complete list of all parts I purchased to build this assembly



Hardware for setting up a vacuum chucking

- Harbor Freight
 - 68197 (2 each) ¼ inch brass “T” 4.78
 - 68254 (1 each) Brass ball value (inline bleed valve) 3.99
 - 68211(3 each) ¼” to hose bard w/ clamp (1.89 each) 5.67
 - 68299 ¼’ female/female coupler 1.99
 - 94501 (1 each) hose repair kit -7 pieces 3.99
 - 68224 (1 each) Disposable in-line air filters 1.99
 - 68198 ¼” male/male coupler 1.29
 - 1 each PTFE (Teflon) tape .89
- Hardware store
 - 3 feet vacuum hose w/nylon impregnation 2.37
- Vacuum gauge
 - O’Reilly Vacuum gauge, Holly 26-501 44.99
 - Amazon Actron vacuum/pressure gauge kit CP7802 14.95
- Pass through vacuum adapters
 - Craft Supplies, Hold fast 280-2650 58.95
 - Packard Woodworks, E-Z Adapter 111210 82.95

TOTAL **\$100.86 – \$154.90**

Additional requirements

Vacuum pump

- Harbor Freight 2.5 CFM 98076 \$89.99
- Harbor Freight 4.0 CFM 66466 \$154.99

Other options

- Oneway hand wheel replacement adapters \$110.00
- Commercial vacuum chucks
 - Oneway 5 ½” \$94.95
 - Holdfast, 6” \$72.90

Construction a vacuum chuck

While commercial chucks are available and not too expensive, they may not meet your specific needs as to size or dimensions. Construction of your own chucks is another option that is easily accomplished.

Home-built vacuum chucks require the commitment of a faceplate, an attached non-porous chuck base and a chucks body and edge seal.

I recommend the use of acrylic materials for the chuck base as it is non-porous, accepts cut threads easily and will be completely stable in use.

Chuck bodies can vary in diameter and length by selection the most appropriate size of ABS plumbing or sprinkler pipe and cutting it to length.

Seal material should be a closed cell foam material that is not too thick as to cause the project to shift under vacuum. I recommend the Michael's colored foam sheets 8 x 10 inches and their foam cement located in the same department.

Construction steps

1. Drill and tap the acrylic to match the screw holes of your face plate.
2. Cut the acrylic roughly round before attaching it to the faceplate.
3. Mount the acrylic to the faceplate and turn it round on your lathe.
4. Measure the OD of your selected ABS chuck body and transfer to the face of the rounded chuck base.
5. With a parting tool cut a groove into the acrylic that will snugly fit the ABS.
6. Mix up 2-part epoxy and attach the ABS chuck body into the groove.
7. (You may also want to seal the acrylic to the faceplate at the same time with the epoxy).
8. Reattached the chuck assembly to the lathe and true up the ABS to turn concentrically to the lathe. True up the face and both inner and outer walls – all must be true.
9. Place a bead of the Michael's foam adhesive on the chuck's top edge and set the chuck upside down on a sheet of the closed cell foam – allow it to dry for several hours.
10. With scissors, roughly trim the sheet around the chuck leaving at least ½" overhang.
11. Remount the chuck and using the point of your skew chisel lightly trim the outer edge to round.
12. Repeat the skew chisel action on the inner edge leaving at least a ¼" overhang.