PHOTOGRAPHS BY KURT HERTZOG

Workholding aids & chucking – part 4

Kurt Hertzog continues his series on workholding aids and chucking by taking a closer look at the subject of vacuum chucking and its many uses to the woodturner

Since most workmounting can be accomplished in more than one way, there really isn't any indispensible method in the host of techniques available. Having said that, if there was one, it would quite possibly be vacuum chucking. You can spend your entire woodturning career without having a vacuum system, but once you've enjoyed the pleasures of having one, you won't want to give it up. Depending on your implementation vacuum chucking can be expensive, but there are many ways to bring the costs into line with most budgets. I'm going to take you through how it works, some things you can do with it, and ways to moderate the cost of implementation.

As with most woodturning items, there are things that are easily made and others requiring certain equipment. Those with good workshop skills and a well-equipped workshop can venture into making most of the major pieces of a vacuum system except the pump itself. With safety being the key, even the Spartan workshop can make the plumbing apparatus and a host of vacuum chucks, skipping the rotary union. Again, safety being paramount, venture into the homebuilt arena only if you are confident of your skills.

KURT HERTZOG

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VACUUM CHUCKING BASICS

Vacuum chucking is simply allowing air pressure to hold your work on a chuck. Rather than adding pressure to the outside, evacuating the inside accomplishes the same thing. A vacuum pump pulls a vacuum on the headstock side of the vacuum chuck, allowing the air pressure we live in to hold your work in place. Without belaboring the maths, accept that a full vacuum at sea level will allow the ambient 14.7psi air pressure to 'push' your work onto the vacuum mounting. There are two important points here. A full vacuum, and 14.7psi. If you have less than full vacuum available, you will have less than 14.7psi force. For proportionally less, plan accordingly. Regardless of the amount of vacuum, the force in pounds is a function of the cross sectional area under vacuum. If you have thin or fragile turnings and/or a large cross sectional area under vacuum, you can crush things before you realise the forces involved. Likewise, a small vacuum area, regardless of the size of the turning, provides little clamping force.

Most modern lathes have a headstock that can accommodate a standard vacuum system. Some can't, and there are systems available to deal with those. They are usually less desirable with threaded rods and seals or headstock side only apparatus moving the work even farther away from the headstock with the corresponding problems. The four major pieces of a vacuum system for a typical headstock that has a sealed spindle shaft are: a vacuum pump; vacuum control mechanism; rotary union; and vacuum chuck. There are plumbing connections along with these..

ABOVE: Vacuum chucking is as simple as evacuating the air on one side of the work and letting our atmospheric pressure push to hold the work in place on the chuck

ABOVE: Full vacuum – 100kPa or 29inHg – will produce a clamp force of 14.7psi. Proportionally less vacuum yields proportionally less clamping force from the atmospheric pressure

MAIN: The larger the area under vacuum, the larger the clamp force. All of these chucks could mount this bowl but the size of the chuck will impact the force holding the work

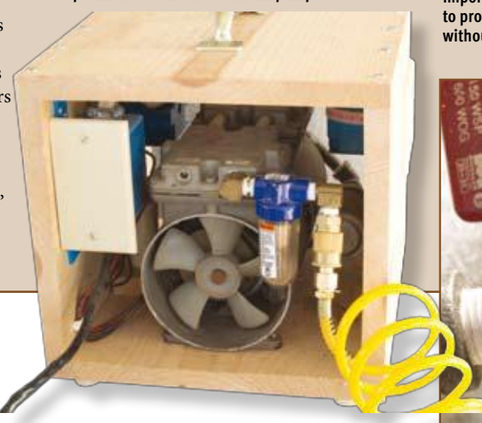
RIGHT: For lathes without a sealed headstock shaft, there are add-on products that will run through the shaft and seal both ends, enabling use of a vacuum system

RIGHT: The four major parts of any vacuum system are the pump, rotary union, control valving and a chuck

PUMPS & CONTROL MECHANISMS

There are many high quality vacuum pumps available. To reduce expense, some people try to use venturi vacuum systems or vacuum cleaner motors which are not recommended as reliable systems. There are modestly priced surplus vacuum pumps available as are compressors that can be plumbed to provide vacuum. Once the seal has been made, the pump flow requirement is almost nonexistent. Regardless of your selected vacuum source, be sure it is reliable since your safety and work security depends on it working continuously and reliably.

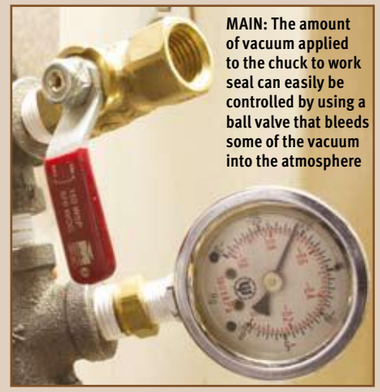
BELOW: My travelling vacuum system pump is a retired hospital equipment compressor that is plumbed to work as a vacuum pump



BELOW: Knowing the numbers isn't as important as regulating the vacuum applied to provide as much clamping force as possible without damaging the work

PUMPS & CONTROL MECHANISMS (CONT.)

The vacuum control mechanism is a simple plumbing arrangement that allows you to control and apply zero to full pump vacuum to your vacuum chuck, based on your need. Having a vacuum gauge is nice but not critical. You'll quickly learn from the sounds of the pump and the workholding forces desired what portion of full vacuum is appropriate. Regulating the amount of vacuum applied as you are positioning your work up to full available vacuum can be done via a simple ball valve in the vacuum circuit. Regardless of the force available to hold your work in place, it is always good practice to keep the tailstock in play until you are forced to remove it.



MAIN: The amount of vacuum applied to the chuck to work seal can easily be controlled by using a ball valve that bleeds some of the vacuum into the atmosphere

MAIN: Good practice when turning – vacuum or other methods of workmounting – is to use the tailstock until it must be removed

THE ROTARY UNION UNIT

The rotary union passes the vacuum through, allowing your lathe shaft to rotate and the vacuum hose from the pump to remain still. You'll need the rotary union unit that fits your lathe with the proper threading for the outboard side of your headstock shaft, or the proper diameter fitting with its 'o' ring seal. Although a rotary union can be made by someone who is shop handy, I've been a fan of the commercial units. A bit pricey, but in my opinion well worth it. A good unit will last a lifetime and fetch a fair return should you decide to sell it. While the home built rotary unions can work, I've been more inclined to buy the rotary union and home build other parts of my vacuum systems.

BELOW: The rotary union provides a leak-free seal allowing the lathe shaft to rotate while letting the vacuum line remain stationary

THE VACUUM CHUCK

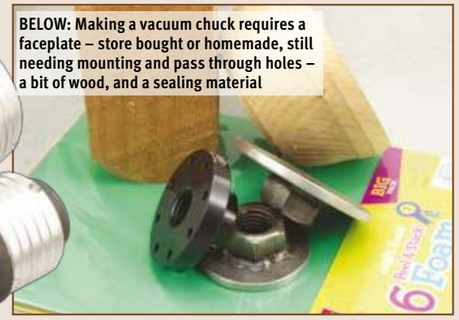
While these system components are critical, the vacuum chuck is where it all comes together. The size, shape, and fit of the vacuum chuck will determine the effectiveness of the mount. The beauty of vacuum chucking is the huge array of mounting potential it has. Inside grips, outside grips, nesting grips, extended grips, forceful grips, light assisting grips and more are all available. Commercially available vacuum chucks range from large aluminum chucks – machined from solid block – to various injection molded chucks with insert molded aluminum threading. You can usually find something that will work quite nicely for your projects. Because of the flexibility of vacuum chucking, you can use these general-purpose chucks for a wide range of applications, so you don't require many.

Essentially, anything that can thread and seal on the headstock threads that is airtight at the interface with the work is a vacuum chuck. If the vacuum couples through the faceplate to the work side and you can seal things, you can control the force holding the work by adjusting the applied vacuum.

The real fun for the handy person is making your own vacuum chucks. Very easily done and created specifically to your needs; vacuum chucks can be made in a few minutes in the workshop. If you need something different, a few cuts and you can have what you need. Your repertoire of home built chucks is limited by your imagination.

The incredible versatility of vacuum chucking is its virtue. You can hold turnings from raw stock to finished turnings with a good grip to the lightest of touch. It is a valuable addition to the array of workholding methods. If you haven't tried it, I recommend you do so. I am pretty sure that once you've had an opportunity to use vacuum chucking, you'll never want to give it up.. ●

ABOVE: Commercial vacuum chucks are available in a variety of sizes and materials ranging from machined aluminum to moulded plastics



BELOW: Making a vacuum chuck requires a faceplate – store bought or homemade, still needing mounting and pass through holes – a bit of wood, and a sealing material

MAIN: Quick to make and tailored to your specific need, shop built vacuum chucks provide you with flexibility and cost savings

BELOW: Even work that is partially out of true and with some wobble can be vacuum mounted. Prior to refinishing, this goblet gets a bit of sanding even after the wood has moved considerably