Reverse Chucking of Bowls

A Catalog of Options

By Bill Juhl

Presumption: Reverse chucking comes into play as close to the last stage of work on the lathe. It assumes the interior of the bowl is entirely shaped, the exterior nearly entirely shaped.

The benefit? If you are the master of all of these methods, then you can proudly march into Starbucks and with three one dollar bills you can have an Espresso!
But if you have these as potential tools for use, you are then ready to tackle challenges that you may have previously shied away from. So here we go……

Why Reverse Chucking?

- It's the last step to remove the tenon or recess that was used to hold the piece while turning the interior of the bowl
- otherwise "finish" the bowl bottom removing any marks, shapes, or evidence of how it was held in the lathe
- Remount a previously finished bowl to repair, or to create a new tenon
- Create a tenon on a section created as an interior core

Key issues of Reverse Chucking

- Typically the work is nearly finished, and the goal is to not damage the finish
- Usually the hold or grip is more fragile that earlier
- Two parts of the puzzle to consider
  - Holding the piece against the headstock safely
  - Transferring the rotation of the lathe to the piece without slippage
- Padding is often used either as a seal or to prevent marring
  - Using the minimum amount of padding possible will keep the work from flexing
  - Any flexing in the chuck can provide the opportunity for a catch, potentially tearing the piece out of the chuck
- Different shapes and forms of bowls need different approaches –
- Generally, the most secure and safest hold will come from providing contact at the widest radii possible.
- Some of the methods do not require the tailstock to stay in place. Those methods allow for finishing the bottom of the bowl entirely while on the lathe and eliminate the need to complete the work by hand off of the lathe.
- HOWEVER, if the tailstock is removable ultimately, a best practice is to keep it in place as long as possible for safety reasons.
- In making the cuts to remove a tenon:
  - apply the force of your cut *parallel to the lathe bed*, *toward the headstock* (not perpendicular to the lathe bed)
  - make small gentle cuts … ¼" spindle or bowl gouge use here is a good practice
- Speed of turning needs to be considered … as the grip on the piece being turned is more fragile it is far easier for it to come loose from the lathe. Slow down the rotation.

Types and Methods of Chucks

Pressure Jam Chuck – probably the most commonly used method of reverse chucking. The hold in the lathe is achieved by the sustained application of force provided by the tailstock

- Pressure application points – any of the
  - Bowl Bottom
  - Rim edge connection
  - Bowl Side connection
- Chuck composition and manufacture
  - Shop turned or commercial manufactured male plug
  - Turned or manufactured cup form
  - Flat plate on a face plate
  - Wood plug mounted on a steel rod – gripped within a scroll chuck or Jacobs chuck
  - Scroll chuck – usually with padding
  - Usually requires a semi flexible padding (sheet foam, fabric, paper towel, etc. to provide
    - adequate friction so the work doesn't spin or slip on the chuck, and
    - prevent scratching or marring of the finished work

Friction Jam Chuck – a jam chuck made to achieve a fit tight and secure enough that continuing pressure from the tailstock is not required

- Rim connection – MDF plate, either interior or exterior friction with a recess carved within
- Side connection
  - usually a tight fit to the *interior* of the turning
  - typical for straight sided pieces (boxes, peppermills, etc.) where a jam plug can be made that is a tight fit

Mechanical Grab Chuck – a chucking method by which the chuck itself is adjusted to either contract around or expand within the piece to achieve a secure grip

- **4 Jaw scroll chuck itself**
  - Contract on the rim
  - Contract on the body of the piece (extended jaw chuck)
  - Expand within the interior cavity of the piece
- **Cole Jaws or Jumbo Jaws**
  - Grab the rim either in contraction or in expansion in the case of inward flowing rims
  - Commercial or shop made
- **Sliding Slot Jaws** – shop built –
  - Wood plate with slots radiating out of the center
  - Rubber buttons with bolts and wingnuts in the slots
  - Work is manually centered on the plate
  - Buttons are slid in and tightened to compress or expand within the rim.
  - Useful
- **Longworth Chuck** –
  - history: in 1988 a turner in New Zealand, Leslie Longworth brought to a club meeting a prototype of a chuck he designed that was a self-centering chuck that used two rings to collapse buttons around the rim of a reversed bowl. Very shortly after that he died. Others used his prototype to produced plans and home-built versions have been around ever since.
  - Commercial Longworth Chuck – 3-4 years ago, a commercial version was introduced and is available now from the usual sources.

Capturing Chucks – all provide some means of enveloping or capturing the bowl

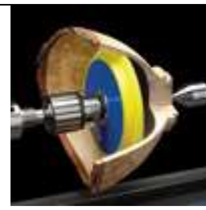
- **Donut chuck** – either with
    - rim pressure or
    - bottom pressure from pedestal within the chuck base
    - Uses rings of plywood with long bolts, to compress the
- **Tape or Strapping** – typically strong tape holding the piece against the head piece

Vacuum Chuck – evacuates the air from within the cavity area of the piece by use of a vacuum pump

- Chuck contact points
    - Bowl bottom
    - Bowl Rim
    - Bowl or vessel sides
- Chuck composition
    - Commercial … aluminum or composite material
    - Turned from wood
    - Hybrid wood + ABS or PVC pipe
    - Seal at contact point
        - Closed cell foam… neoprene, shelf liner, o-rings, mouse pads, etc.
    - Usually a cup form
    - Also can be a flat plate with foam

Reverse Chucking examples

Pressure Jam Chuck … bottom pressure	
Rim flat jam chuck – friction grab to either exterior or interior edge of bowl -- MDF	
Jumbo/Cole Jaws All use the ***mechanical movement*** of a four jaw scroll chuck to either • ***compress*** on the exterior bowl rim or • ***expand*** against the interior of the bowl rim Can be Commercial or shop made. Best made very stable material such as Baltic birch ply, Delrin, or aluminum.	  
Slot Slide Rim Chuck *(courtesy John Lucas)* Bowl is centered manually, then slide button brackets are adjusted to provide inward (or outward) pressure on the rim. *Can potentially be used to successfully grip a warped bowl.*	
Scroll chuck solo as interior bottom or side jam chuck (with or without padding)	
Scroll chuck as rim chuck	
Scroll chuck with shark jaws grabbing interior bead or shelf	

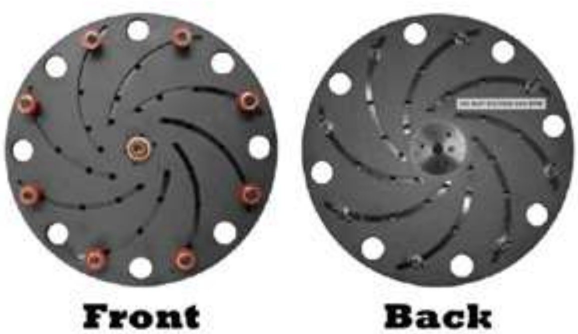
Drill pad as bottom jam chuck	
Donut chuck If flat rim bowl, pressure against the plate at the rim If a natural edge bowl then pressure against a pedestal as shown	 

The Longworth Chuck

The Longworth chuck was the inspiration in the late 1980′s of Leslie Douglas Longworth of the Hunter Valley Woodturners in Australia. It features a self-centering mechanism that easily and quickly adjusts to the size of your turning.

The concept is quite simple – a pair of disks rotate against each other drawing in, or out, eight or more rubber ‘jaws’ on a series of opposing arcs.

A point to understand--- the force on the rim from the sliding of the rubber plugs is modest. The strong grip comes from the expansion of the rubber plugs by compression of their bolt AFTER they are snug on the rim of the bowl. As in all reverse turning chucking system, it is wise to engage the tailstock for added pressure up until removing it at the last moment.



How to make your own

http://www.woodworkersguide.com/2010/10/17/how-to-make-a-longworth-chuck/

The world of Vacuum Chucks

A Vacuum Chuck Systems is any system that creates force by creating pressure against the exterior surface of a bowl by evacuating air from the interior of the bowl, or creating a partial vacuum within the bowl. That force holds the bowl against the chuck or surface that is attached to the headstock of the lathe. That force is generated by our normal atmospheric pressure, i.e. the force of the weight of the air that is above us on this planet.

<u>System components</u>

- Vacuum pump itself
- Connector hose, fittings, swivel and piping through the headstock
- Bleed valve
- Vacuum gauge
- Vacuum chuck with seal
- Filter (option)
- Reversing Morse Taper (option)

Most lathes require inserting a plumbing fixture *through* the headstock (usually lamp tube) or other device to carry the vacuum from the pump through to the chuck. A swivel is needed at the hose connection to the headstock, as **most turners** prefer that their vacuum pump remain stationary when the lathe is turned on and not swing about the room revolving at the end of the hose.

A few lathes (Stubby S-750 and Powermatic 4224B, maybe others) have a built in connector for vacuum. OneWay offers a Rotary Adapter that attaches. Craft Supply has a good section on all the parts in their catalog.

Chuck seal. A material that is somewhat soft and closed cell (no air goes through) is needed at the boundary between the hard wood, plastic, or metal of the chuck body and the wood of the bowl. Numerous materials have been used: Neoprene foam (wetsuit stuff), O-rings, shelf liner, custom molded shapes (Rubber Chucky), soft leather, vacuum seal cord, closed cell packing foam, and closed cell shelf liner have been used. As a broad statement, the seal needs to be flexible enough to compress and flex sufficiently to fill in the irregularities between the chuck and the bowl. That said, a seal softer than is necessary can flex and let the bowl move slightly enough so the turner gets a catch and the bowl rips off the chuck with rather spectacular effect.

Force generated. The force on a bowl generated by a vacuum system depends on the capacity of the pump, on the leakage that occurs between the pump and the turning, the current atmospheric pressure at your location, and the *surface area (representing the volume)* of the item within which the partial vacuum is being created. As a rough approximation, it is sufficient to understand that the area of a circle is a function of the diameter of the circle, the formula being $\boldsymbol{A = \pi r^2}$ The important part to notice is that the area (ultimately the volume) increases with the SQUARE of the radius. Essentially then the force against the chuck is also squared as the diameter of the chuck is increased.

The maximum vacuum possible if you could achieve perfect 100% evacuation of all air molecules would be the current atmospheric pressure at your location, as affected by your elevation and the current movement of weather systems (highs, fronts, troughs, lows, etc.) Vacuum is measured in inches of Mercury. The "Standard Atmosphere" at sea level is defined as 29.96 inches of Mercury. That is the equivalent of 14.696 pounds per square inch.

What does all this mean?

- ✓ **Vacuum Power has a Limit** – The most powerful vacuum chucks can create 13-14 pounds of downward holding force *per square inch*. You could harness a Chevy V-8 to a vacuum pump and still that's the limit. This is because the air pressure around us is what actually squeezes the part down onto the chuck. A vacuum would have no effect in outer space since there is no air pressure.
- ✓ The maximum possible vacuum power your vacuum pump can generate
  - At sea level is 29.96 in/Hg (14.71 pounds per square inch)
  - At 2,500 feet above sea level at "standard atmospheric pressure" the max would be 27.31 in/Hg (13.42 psi)
  - At 5,000 feet above sea level your standard atmosphere max vacuum would be 27.32 in/Hg (12.21psi)

What do you do to make this work?

- ✓ **Make your system as air tight as possible**. Any leakage of your system will decrease the effective vacuum created – 27 to 28 in/Hg would be outstanding. Less may often be ok.
- ✓ **Use as <u>large a diameter</u> chuck as will fit.** The diameter of your vacuum chuck has a HUGE effect. For example

  If your vacuum gauge measures 25 inches of Mercury,
  - A 3" diameter vacuum chuck seated against the bottom of the bowl will generate 87 pounds of force against the chuck.
  - Same setup except the diameter of the chuck is 6", the force generated will be 347 lbs.
- ✓ **Use as thin and rigid a seal as will maintain vacuum**.
- ✓ **Chucks should be as <u>rigid</u> as possible** … minimal flex, as short as feasible, secure mount against the headstock.
- ✓ **Preserve the tailstock center mark on the bottom tenon**. Use the tailstock to center the bowl in the vacuum chuck (or a jam chuck as well).
- ✓ **Keep the tailstock in contact as long as possible**. Remove it only at the very end in order to finish off the bottom.
- ✓ **Cuts – tool and direction.** Small cuts are good at the end. I use a ¼" gouge with the tool rest as close as possible. Make your cutting force along the lathe in the direction <u>*toward*</u> the headstock (<u>not</u> perpendicular to the lathe bed).

Vacuum Chucks:

- **Flat plate Rim Chuck**. Round disk, with hole through the center and Seal material (shelf liner) on the entire surface
  - Threaded onto headstock
    - faceplate mount or
    - Beall threaded wood connector
- **Cup Chucks**
  - Commercial
    - OneWay Aluminum Vacuum Cylinders are the Cadillacs – quality and price up to $214
    - Holdfast Vacuum Chuck Head .. no personal experience – limited third hand feedback wasn't favorable
  - DIY
    - Ellsworth wooden cup, with threading using Beall Spindle Tap'
    - Wooden blank with inserted and glued in ABS/PVC pipe.
      - faceplate mount to the wood blank or
      - Beall Spindle tap threaded
        If you are making your own, you want very stable wood that is sealed. Very dry walnut is dimensionally stable, also Baltic Birch plywood.

Vacuum chuck system

Essential elements:

- Vacuum pump
- Connector hoses
- A vacuum gauge
- A bleeder valve to release vacuum so slight adjustments can be made
- A variety of vacuum chucks either commercial or shop made

Note: an endless variety of vacuum chucks can be shop made easily by using the David Ellsworth model.

- Select a stable wood – very dry walnut is good, Baltic Birch Plywood should be fine.
- Using a Beall spindle tap, drill and tap threads to match your lathe spindle.
- Mount the blank and turn the shape you need. Seal it with CA

glue or other finish so there is no air bleed through the cells.

- Use closed cell shelf liner (from your local hardware) as the edge seal

<u>Total cost?</u>

- First one is $20 for the tap plust $5 for a roll of shelf liner plus some scrap wood.
- Second one is essentially zip.

Added bonus: These vacuum chucks are also great pressure jam chucks.