

An introduction to

VACUUM VENEERING

Your shop compressor can be used to no-fuss veneer elegant curves, stunning table inserts, and beautiful box lids!

Story & Pics by Geoff Birtles

Furniture craftsmen have used veneers extensively for many centuries. They provide an exciting palette of exotic and beautiful woods such as burls and forks, many of which would otherwise be difficult and prohibitively expensive to use.

Unfortunately, veneering has long had an image problem. Recreational woodworkers have seen the process as too difficult and consumers have considered it inferior to solid wood. Both points of view are simply untrue.

Professional woodworkers are now using advanced vacuum veneering techniques to build structural integrity into fine pieces and to extend limited wood stocks. Recreational woodworkers on the other hand are using simple clamps and commonly available veneers and glues to build beautiful box lids and stunning inserts for coffee table tops and door panels. Even the consumer public, as they become more informed, are demanding that woodworkers adopt sustainable forest practises in which veneering can play a prominent role.

It is timely for those who have dabbled, and for those who have not yet started, to explore the rewards of veneering and the full range of affordable process options now available to all.

Veneering Options

(i) Mechanical

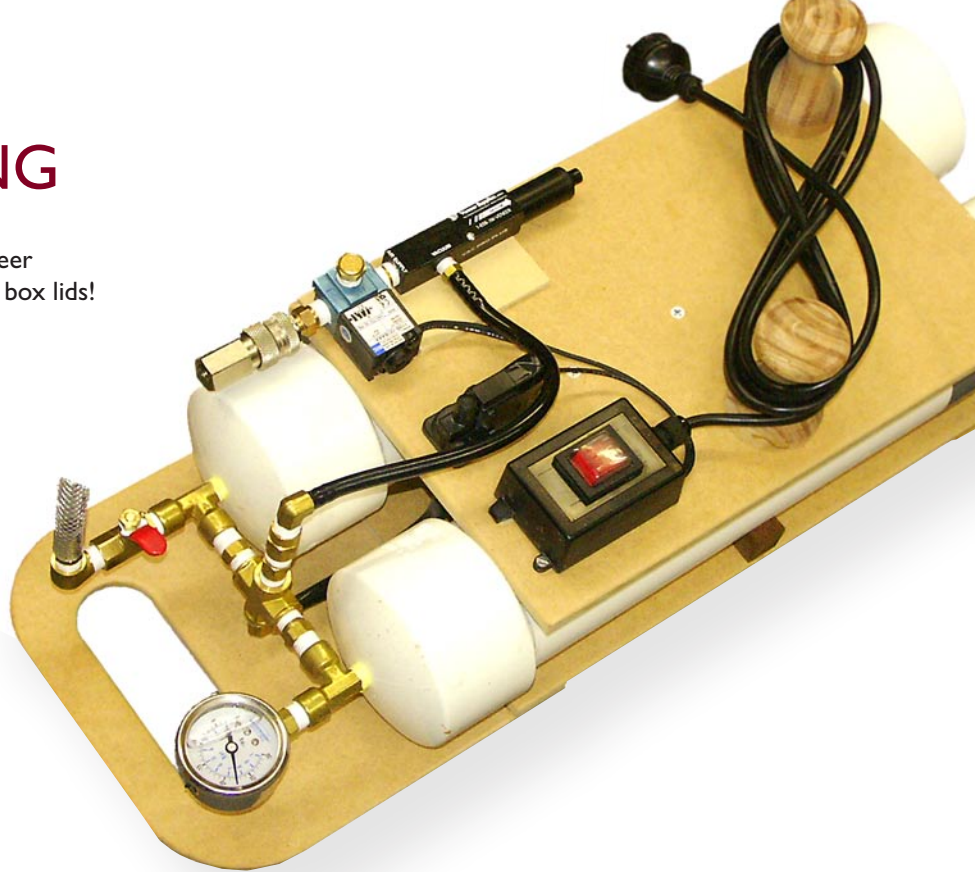
For simple projects (such as a box lid) this is where novices should get started - indeed, you may never move on because it works well.

A veneer "sandwich" of (from bottom upwards) a 16mm melamine caul, veneer, yellow PVA glue, substrate (ply or MDF), yellow PVA glue, show/face veneer and top melamine caul is clamped (with many clamps!) overnight. (*Side bar #1*).

Reams of material on cutting, flattening, joining veneer and appropriate glues are freely available on informative Web sites (see *Sources* side bar). Do not be intimidated. Small jobs, such as the Bubinga veneer topped box in *Side Bar #1*, require no special tools, glues, or tapes.

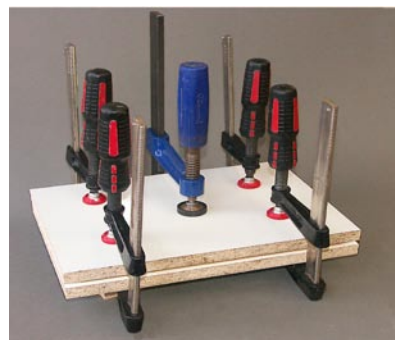
(ii) Vacuum Pressing

Essentially we insert our veneer sandwich (see above) into a sealed plastic bag and evacuate the air. (*Side bar #2*). Note we do not need a top caul for vacuum pressing as this would be counter productive to the *form hugging* nature of the vacuum bag.



Side Bar #1

Mechanical Veneering



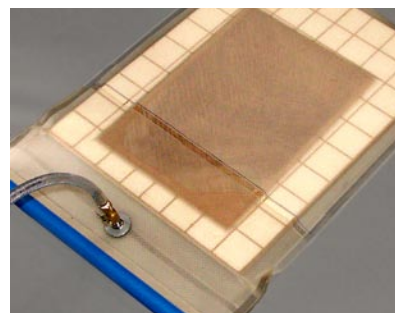
The Veneer sandwich. From bottom up - Melamine clamping caul, veneer, substrate, veneer, clamping caul.

A simple Huon Pine box (by the author) is stunningly transformed with a veneered Bubinga lid insert.



Side Bar #2

Vacuum Veneering



Vacuum veneering a small box lid. Note that top caul is replaced by breather mesh and bottom platen/caul has saw kerfs to optimise vacuum flow.

Evacuation of air within the bag allows the air around us at an ambient pressure of 15psi, or one Bar, to press down upon the sandwich with much greater pressure than possible using hand clamps. Do not under estimate the incredible force of a vacuum press. It is capable of producing over 1800 pounds per square foot of pressure at full capacity (For example, A 144 square inch panel X 15 psi ambient air pressure X .85 vacuum efficiency). Not only does this press the veneer onto the substrate, it compresses the veneer fibres partially displacing air with glue to provide an even stronger bond. The whole process is over within an hour!

Mechanical v Vacuum? And the winner is.....

Mechanical veneering of anything larger than a small box top requires a lot of clamps and cauls. (Effective pressure spread of a clamp is less than 100mm). Curved pieces require matching curved cauls. The package becomes heavy and awkward. The process becomes a race against the glue clock! Curing time is many hours. It is little wonder that most recreational wood workers do not bother.

On the other hand you might well have only one vacuum bag, with one MDF platen (acting as a bottom caul) which you can use for large or small tasks. Your platen/caul lives inside the bag. Place your vacuum bag onto your table saw (blade down!), slip your veneer/substrate/veneer sandwich into the bag on top of the melamine platen, place a piece of breather mesh on top of the sandwich (optional if you use a grooved platen as shown in following pictures), seal the bag with a PVC tube clip, connect the Venturi Press hose and turn it on. Typically it will cycle for a minute or two, stop for a minute, recycle for 15 seconds and you may not hear it again, if your seals are good. Leave it for an hour and you are set to go.

Vacuum Press Options. Muscle v Air v Electricity.

(i) Hand Pump

A wine bottle air extractor pump, usually sold in kits with a small bag actually works! However, we will not dwell on this given its limitations.

(ii) Dedicated Electric vacuum Pumps

Many of these units are commercially built for professional use and are available in different capacities to suit various bag sizes and applications. Reasonably expensive (in the order of AU\$2000 for auto-cycling pumps) they are quiet, compact and efficient. The more mechanical amongst us could make their own utilising a recycled refrigerator pump - but it's just not worth the effort. Getting parts that mix and match, and pump longevity, are all issues and the savings over a fully reliable Venturi system are marginal at best.

iii) Compressed Air Venturi Pump

It was Daniel Bernoulli, an 18th century Dutch/Swiss mathematician with a talent for fluid mechanics, who discovered that compressed air exiting a constrictive orifice within a tube accelerates, and on expansion leaves a negative pressure or vacuum in front of the restrictive nozzle (*Figure #3*). He based his theory on the work of a contemporary Italian scientist, Giovanni Venturi, a priest and physicist who created a choked flow tube (Venturi Tube) for speeding the flow of fluids and introducing gasses into liquids.

Giovanni Battista Venturi is the discoverer and eponym of the well known *Venturi Effect*. Practical day to day applications of this

effect include - bunsen burners, carburettors, SCUBA regulators, atomisers, automated pool cleaners - the list is goes on!

There is little difference in practical performance or in the use of an electric or venturi vacuum pump. The commercial electric pumps are a little quieter, slightly more compact and much more expensive. The availability of a simple Venturi powered vacuum veneering press, and in particular the simple build process, has bought the cost of a fully professional unit within the reach of all recreational woodworkers.

Veneering processes compared			
Operation	Clamps	Venturi vacuums	Electric vacuums
Lowest Cost	✓	2	3
Set up speed		✓	✓
Bonding speed		✓	✓
Bonding Strength		✓	✓
Curved work		✓	✓
Work piece size & flexibility		✓	✓

(InDesign doc grouped)



This document box (by the author) features highly figured Tasmanian Burl veneered onto both sides of MDF substrate sitting on a lip inside the solid Blackwood carcass.

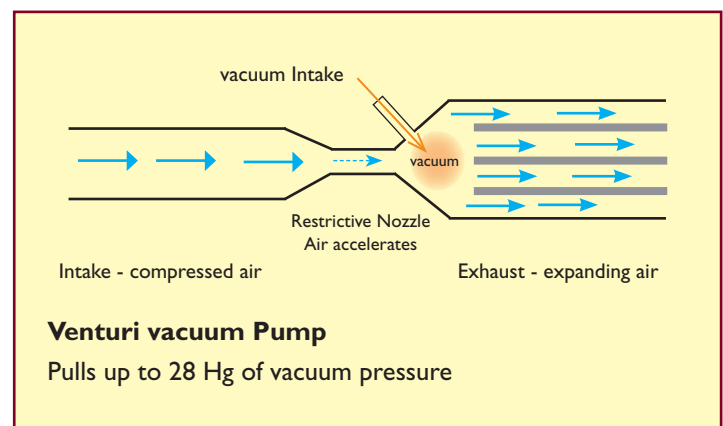


Figure #3

(InDesign doc grouped)

Build your own Venturi Vacuum Press

How it all works

Essentially compressed air (4.8 cfm @ 80 psi, from your shop compressor) passes through a switchable flow valve into and through a Venturi vacuum generator (Figure 4). The Venturi draws a vacuum from the vacuum bag and reservoirs. A sensor monitors vacuum pressure both inside the bag and within the vacuum reservoirs and switches the compressed air intake valve on or off, as determined by your vacuum preset (usually 21 Hg ie 21 inches of mercury). The reservoirs minimise cycling that could occur from small pressure losses - although even frequent cycling is harmless.

Major Components (Figures 4 & 5)

- Venturi vacuum pump (rated for 28 Hg)
- Electromechanical 3 way air intake valve (240V)
- Vacuum pressure sensor / control switch
- Vacuum gauge
- Vacuum reservoirs (High Pressure PVC water pipe and end caps)
- Shut - off valve

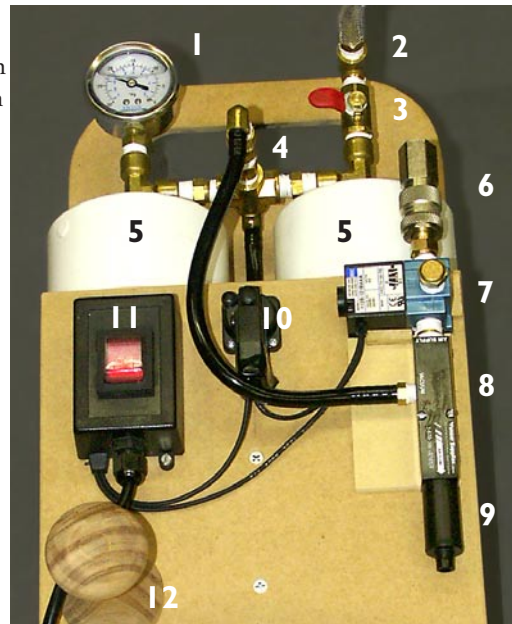
Additionally, you will require fittings for manifold construction, airflow and hose connection, plus some electrical items - all of which can be obtained from your local trade tool shop and hardware store.

I will not pretend that putting together a parts list with sourcing and matching of major components is easy. However, during my frustrating research, initially for a cheap locally available complete press, then, when this all got too hard, a plan and specifications to build my own, I came across a USA veneer supplier web site (JoeWoodworker.com) that provides plans, parts list and specifications for many different vacuum presses (both Venturi and electric), all down loadable and entirely free of charge! Plus, surprise surprise, they supplied kits of major matched components allowing the builder / purchaser to get the miscellaneous items locally.

I prevaricated about purchasing on the web from an overseas source, but really, the alternatives were all too hard and the landing costs very reasonable. After “toe- dipping” by sorting out the 110V / 240V issue (their communication was prompt) I bit the bullet. The unit pictured is from their “Project V2 Plus Auto-Cycling Kit” which they describe as “best value for your bucks”. It handles a 1200 x 2400mm vacuum bag pulling a vacuum at 3.2 cfm with a vacuum pressure set to 21 hg.

Construction

Kit delivery was less than 14 days from purchase, build time about 3 hours with only one glitch. The unit did not work! After tracing back the wiring diagram I realised I had the air flow valve wired back to front. I have done hundreds of vacuum tasks since without a problem - this included pressing 12 box lids at one time during a club demo, all perfect. The Venturi V2 works at least as well as any commercially built professional electric units that I have used, and at substantially less cost.

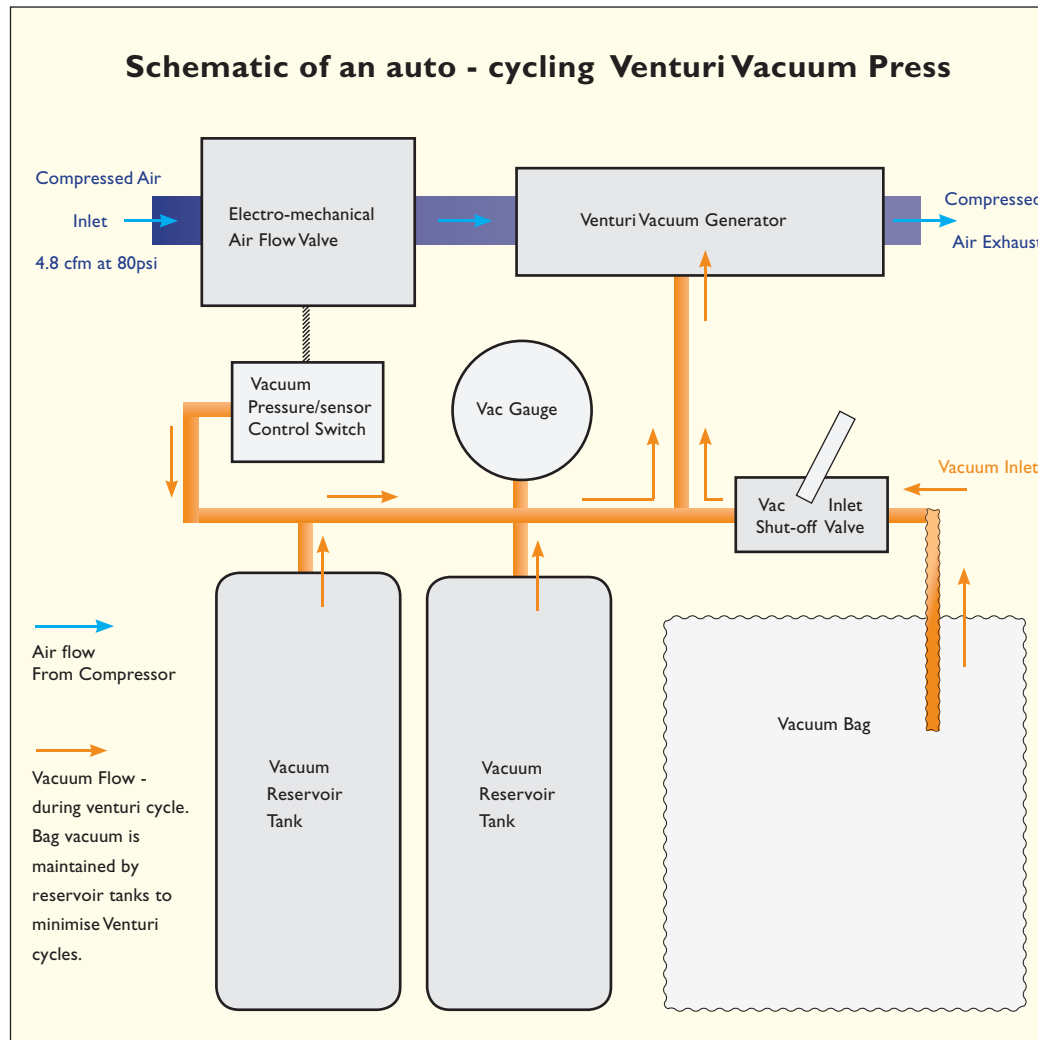


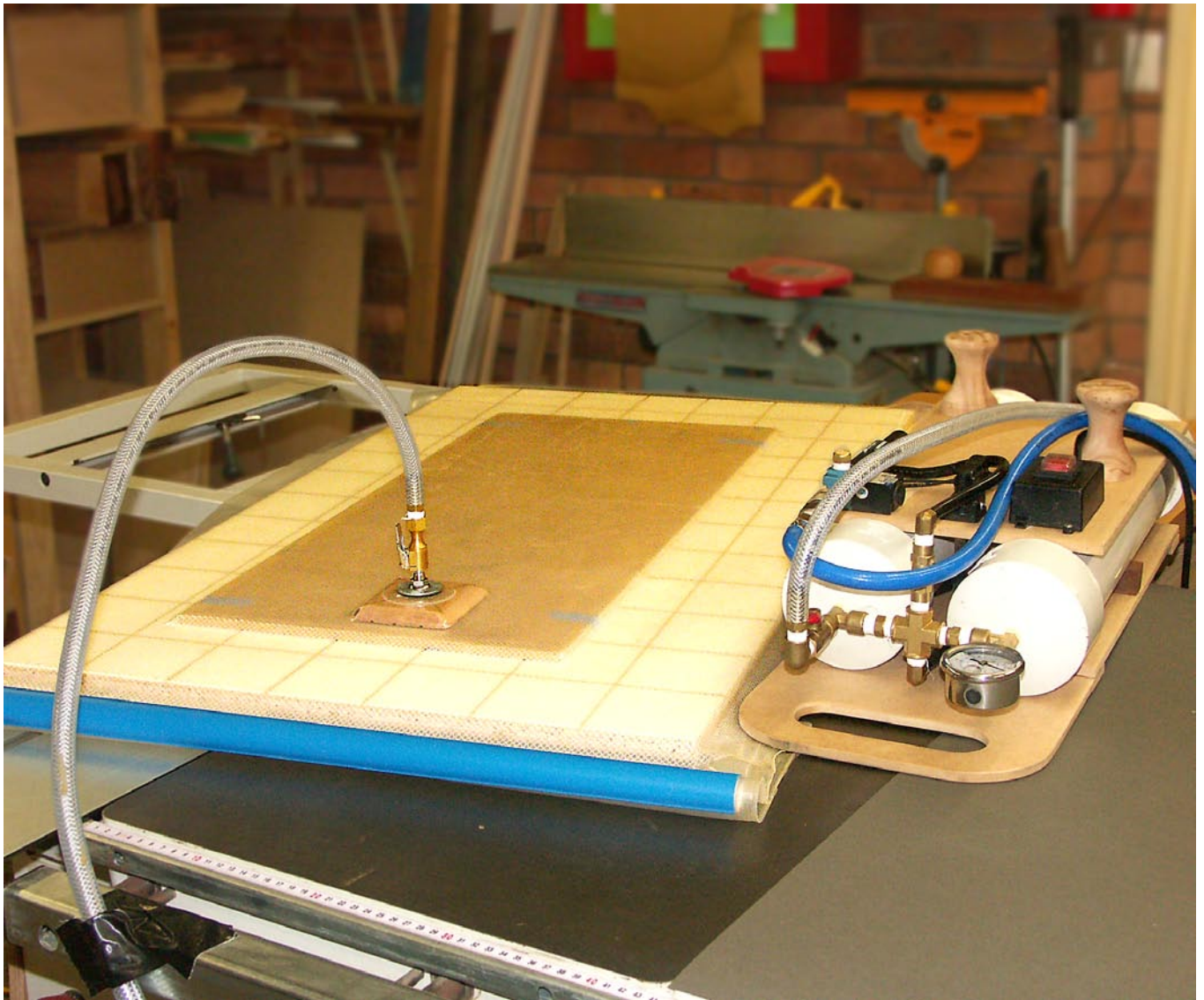
Venturi vacuum Press

1. Vacuum Gauge
2. Vacuum Hose
3. Shut-Off Valve
4. Manifold
5. Vacuum Reservoirs
6. Compressed Air Intake
7. Air Intake Valve
8. Venturi
9. Air Silencer
10. Vacuum Pressure Sensor / Controller
11. Power switch
12. Hose Storage Bollards

Figure #5 Linked eps Objects Grouped (Ungroup)

Figure #4 Linked eps





Venturi Vacuum Press at work. Normally the press hangs under my saw outfeed table during storage and use. To start veneer pressing I drop the saw blade(!), place the polyurethane bag on the table top (the platen/caul and breather mesh live inside the bag in between jobs), insert the veneer/substrate sandwich between the mesh and platen, seal the bag with a PVC tube clip, clip the vacuum hose, plug in the Press and switch it on. It took 30 seconds to pull a vacuum for this task (I leave the Press reservoirs charged in between jobs), a further 5 second burst 20 seconds later and one 3 second burst after one hour.

My best advice to a prospective builder is to access the JoeWoodworker.com site, download the detailed plans and parts list, then see how you go sourcing locally.

Construction is exacting but simple. The main challenges were finding high pressure PVC water pipe (you can't get Joe's spec in Australia, locate an irrigation specialist who will supply pipe cut to size with end caps) and tapping the reservoir end caps (use a dedicated NTP tap, see *Sources Sidebar*). It is important to pay attention to air fitting connections, leaks are counter productive to a good vacuum. Electrical is so simple I got over confident and got it wrong! If you have a half decent work shop you will have the tools to do the job (apart from maybe the 1/4" NPT Tap).

Vacuum Bags

Successful and stress free vacuum veneering begins with a strong flexible and durable bag using an effective air-tight closure, valve stem and hose connector. It is analogous to jointing and squaring the first two faces of any work piece.

(i) The Bag. Polyurethane works better than PVC. It is much more durable and resilient. Its higher elasticity conforms better to shapes, makes it more puncture resistant and returns to the bag's original shape after use. It's a real pleasure to use.

Bags can be sourced locally (See *Sources Sidebar*). The main hassle is that minimum sizes are very large for many recreational users and they are fearfully expensive. A 1220 mm x1220 mm 30 gauge polyurethane commercial bag sourced locally is about AU\$650. This can soon turn your modest project into something else again! I have had smaller bags made locally by a pool cover fabricator who refused to charge me because they were from scraps!

Note. It is OK to use a large bag for a small job (bring the closure closer to the work piece) so if you buy your first bag, go large (probably still the smallest available size).

(ii) Closures. A PVC tube around which you fold the bag end and a C channel closure works really well and this is what you see in the photos. These are usually supplied with the bag but I am not sure you can get them as a separate item locally. You can easily make good closures from dowel, cauls and clamps.

(iii) Valve Stem. These pretty much duplicate tyre tube stems and indeed this is an option for the DIY enthusiast prepared to tackle sealing issues. However, the proprietary product you see in the various pics is a worthwhile investment being easily interchangeable to different bags. I got mine with the closure and my first bag, together with the vacuum kit. JoeWoodworker.com has reams of downloadable material on making your own bags, closures and valve stems. I have done so with limited success but found it not worth the effort.

(iv) Breather Mesh. Breather Mesh is an extruded flexible plastic mesh used in place of a top platen/caul. It eliminates pockets of air between the veneer and bag allowing the vacuum pressure to distribute evenly throughout the bag - the key to successful vacuum veneering.

Mesh is something of an option if you use a grooved platen/caul and the work piece is flat - however it should be used for curved work pieces. I always use it because I see no harm in having the best possible vacuum distribution across the show face of the veneer

sandwich. Additionally it traps small glue bleeds in the form of micro beads that sand or scrape off more easily.

You can make your own from many propriety products (even plastic mesh shopping bags) or purchase it from your bag supplier.

(v) Glue. This is outside the scope of this article but, in spite of what others will say, Yellow PVA works well! Speciality Cold-Set glues work better with less bleed through. Apply either glue only to the substrate.

If this article helps provoke you into veneering, make sure you enjoy the journey. Mine was initially frustrating because I lacked direction. When I became "informed" (see Sources Side Bar) it all came together very easily. The rewards in terms of personal satisfaction, creativity and flexibility to do new projects differently, continue to outweigh the initial uncertainty and expense. Enjoy!

About the author.



Geoff Birtles is a semi-retired integrated marketing & communications professional who until recently, headed his own business. He has worked with wood since his early school days and his workshop is an all abiding passion. He splits his woodworking time into furniture, jigs, box making and built-ins. His latest projects include Shoji Screens, a Coffee Table and a Buffet, each with veneered inserts. Writing about woodworking, photography, graphic design and both mountain and road cycling keep him pretty busy between the odd corporate marketing assignment.

Geoff can be reached at gbirtles@bigpond.net.au

Sidebar

Sources

Commercial Vacuum Presses, Bags & Accessories.

- Australia Yareus PL www.yareus.com.au
- U.S.A. Vacuum Pressing Systems Inc
<https://secure.burgessinc.com/vacuumpress/products.htm>

Both of the above supply similar products and instructional videos

DIY Vacuum Press Plans & Veneering Information

- U. S.A. www.JoeWoodworker.com
This is the single best site for recreational woodworkers to get useful information on all aspects of veneering. Downloads are free.

DIY Vacuum Press Kits, Parts, Bags & Accessories

- U. S.A. www.veneersupplies.com
This is the business site of JoeWoodworker, and point of purchase

NTP Tapping Tool

- Australia McJing Tools www.mcjing.com.au
-

Sidebar

How much does it all cost?

Local Sourcing

- Commercially built, professional Electric Vacuum Pump AU \$1995
- Industrial Poly Bag 1220 x 1220 mm (min. size), with closure AU \$656

Off Shore Sourcing

This lists all required parts for a complete system other than miscellaneous local items at about AU\$100.

- Venturi V2 Plus Autocycle vacuum Kit US\$155.50
- Polyurethane industrial standard Bag 600 x 1200 mm US \$99.00
- Valve Stem Assembly US \$7.50
- Lock on Vacuum Connector US \$14.50
- Vacuum Breather Mesh (1000 x 1500mm) US \$13.50
- Air Freight - all of the above, 10.6kg US \$172.55

Total Cost US \$462.55

At our current lousy rate of exchange I reckon that this works out at less than the cost of a short bed 6" jointer! Prices are from supplier Web sites January '09.
