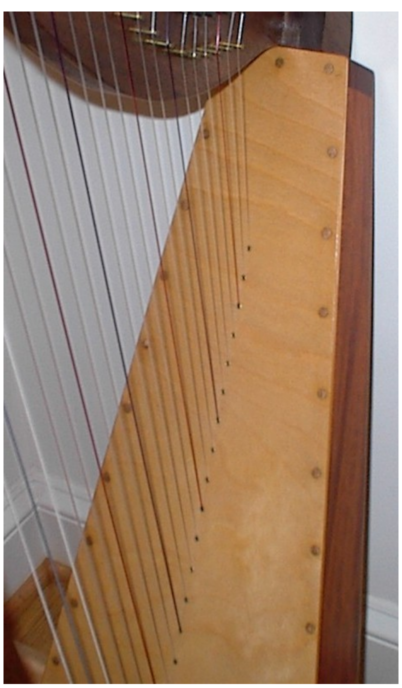
Chapter Five

Plain and Fancy Soundboards

Along with the string set, the material and construction of the soundboard and string ribs are the primary determinants of a harp's sound. I have used a variety of materials for soundboards including aircraft birch plywood, redwood, sassafras, cherry (for a wire strung harp), and pine. Debates have raged among builders on the relative merits of solid boards vs. plywood and on the merits of various species of wood.

Above – The back side of a Redwood soundboard. Below - A soundboard veneered with a striking curly cherry veneer.

With some experimentation and adjustments, each of these materials can be used to make a good sounding harp. Most of my clients specify a traditional Sitka spruce board, so I have developed the most experience with this material, and must admit it is well suited to structural and acoustic demands of the soundboard.



Plywood boards

Many first time builders start using thin birch (3-5mm aircraft) plywood for sound boards. There are nice sounding 4 octave harps that use a plywood board, but the design demands low tension or a carefully sized string rib that can take a fair amount of the tension from the bass strings.

When I tried plywood on one of my early harps, I eventually had to replace the board because the grain was not oriented correctly. I have also replaced soundboards on two other harps (different makers) for the same reason.

Proper grain orientation for a ply board - the outer plies should run across the width of the sound box

If you are going to use three-ply 3mm birch plywood for your soundboards, orient the grain across the width of the sound box.   If you run the grain down the length of the harp, that thin, 1mm center ply ends up having to bear practically all of the string tension and will eventually fail, usually by separating from the bottom ply where it is glued down to the side of the sound box.

Making a Solid Sound Board

When I started to build harps, I worried too much about the time/effort and specialized equipment a solid board would require. After I made my first few solid boards, I was surprised at how easy it was. I am convinced that making a soundboard from solid wood is something every harp builder should try early on.

If you have trouble finding suitable wood for soundboards, see *Sourcing woods for soundboards* in the appendix.

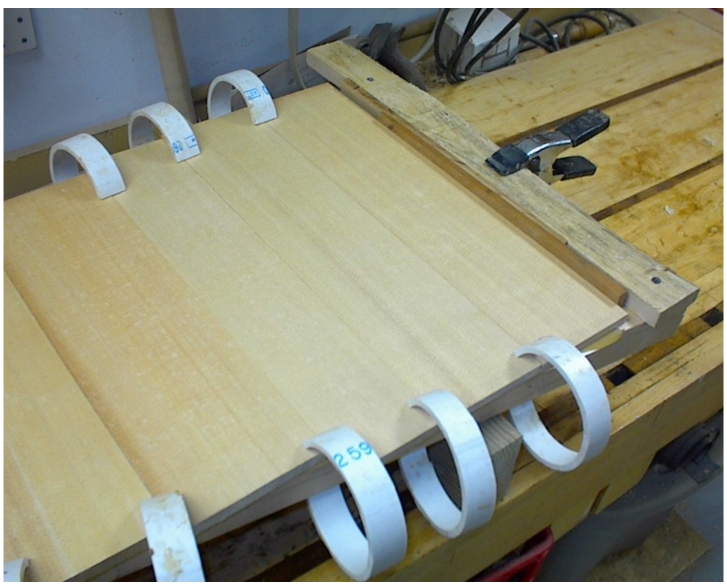
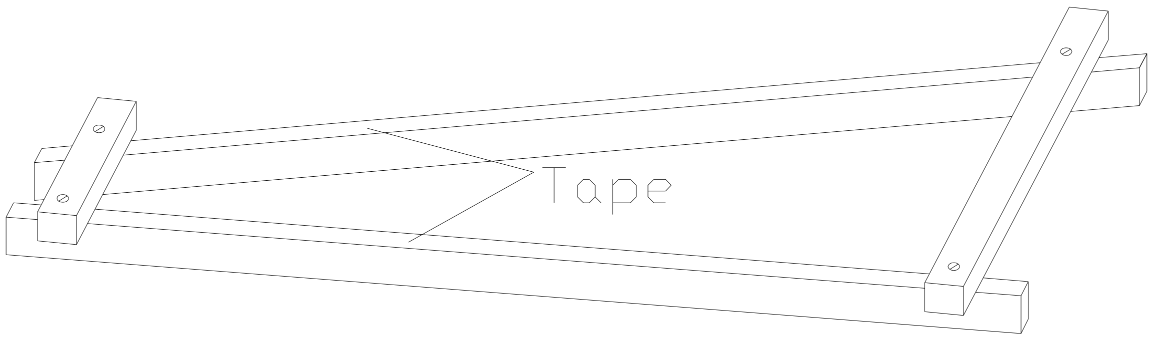


Photo – The bass end of a soundboard with the planks glued up and wedged in compression. You can see the frame, ring clamps and wedges. The frame is propped above the workbench with 2/4's. The hand spring clamp on the end of the frame board holds a small piece of scrap wood to keep the wedges from falling through the frame

Build the Frame

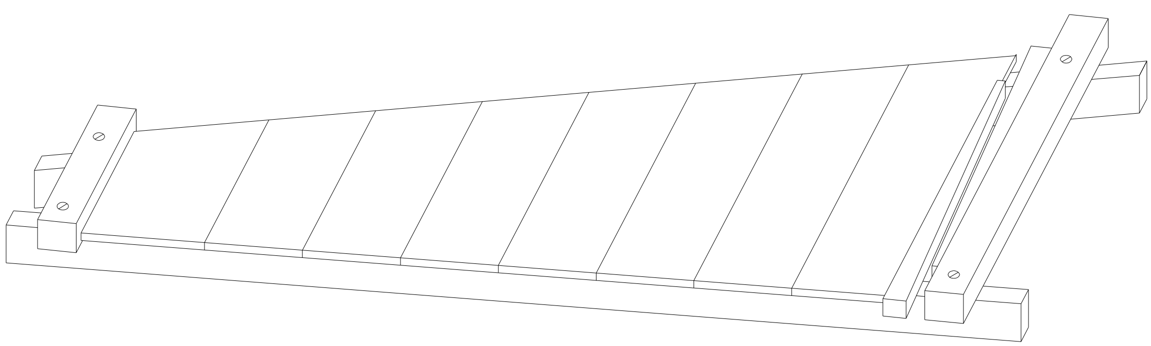
I glue and shape the soundboard on a simple trapezoidal frame. The runners of the frame are built of two long pine 2x2's. The cross pieces are made of 1x2 and they are secured with four drywall screws. The frame needs to be 2-3" longer than the finished sound board, and about an inch wider.



Packing tape on the two long sticks of the frame to will keep the soundboards from being glued on to the frame. I make two long wedges from ¾″ stock - 12″ long that taper from ¼″ to ¾″.

Cut the boards to length

Next cut the planks for the sound board to length, starting from the bottom. I arrange the boards on top of the sound box and cut them so they are at least an inch longer than they need to be:



I place the planks on the frame, and move the cross brace at the top up or down so that the two wedges can be slid into place. Check the seams between the planks and make sure they are tight. Fix any gaps with a jointer. At this point I place the sound box on top of the planks to make sure I have allowance all around. I also strike a light pencil line from the treble to the bass end and use it to align the planks during the glue up.

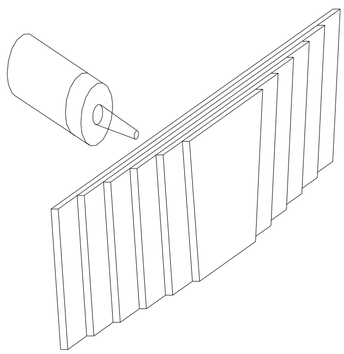
Time saving trick – if you have a thickness planer

You can do a lot of the longitudinal tapering with a thickness planer. Just leave the top three or four boards (that boards near the treble end) in a longer plank, 12-20" long. Most thickness planers will eat short thin boards, so I don't cut them to length till I'm ready to glue.

Stack the boards in order and take them to the thickness planer. The soundboard should taper from ¼ " thick at the bottom, to 1/8 " thick at the top, so plane all the boards down to 5/16″ inch, and take out the bottom (bass board) and set it aside. Crank the planer cutting head down 1/64" and plane all the remaining boards, setting aside the next to the bottom board. Crank down; plane all the boards, setting the lowest board aside on each pass. The last board or two should be ~5/16" thick. Then, cut the last board into the pieces that will go at the treble end of the harp.

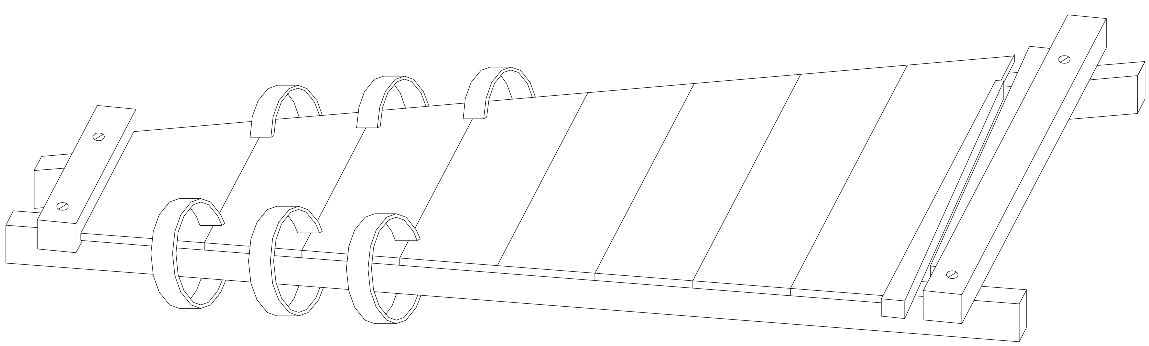
This way you can do the bulk of the longitudinal (treble to bass) tapering with a power tool before the boards are even glued together.

Once I'm happy with the fit of the frame, wedges and boards, I'll get ready to glue.



I use yellow carpenter's glue. To spread the glue quickly and efficiently, I "collate" the boards together in an even stack. I use a spring clamp to hold them while I spread the glue on eight or nine edges all at once. After taking off the top and bottom boards (they only need glue on one edge) I flip the stack over, re-clamp and spread glue on the opposite edges.

The top board is only five inches long, so it only needs a pound or two of clamping pressure. Place all the boards on the frame and push the wedges gently in by hand. Next place two slit PVC pipe ring clamps on each seam, one at each end. The ring clamps hold the boards to the frame and even with each other. They also keep the boards from "buckling up" as pressure is applied.



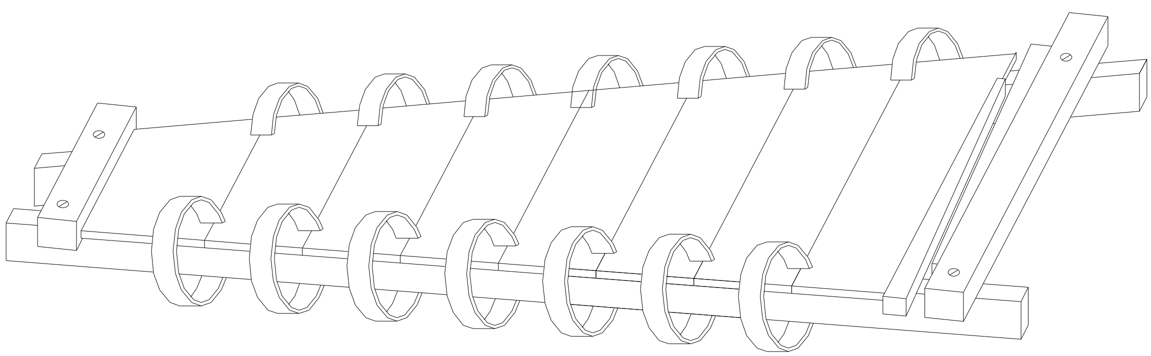
I *start placing the ring clamps at the top* (treble) end of the sound board. After I have put on the first six clamps or so, I stop and tap the wedges lightly to generate a little more pressure. When I've placed about 2/3 of the ring clamps I'll tap the wedges a second time to increase the pressure between boards. Too much pressure will starve the glue joint. The glue seam at the bottom is 16" long and has a lot more surface area than the joint at the top, so the third function of the ring clamps is to maintain a pressure gradient - light pressure at the top, more at the bottom.

PVC Ring Clamps

Ring clamps can be made by sawing a 4" PVC pipe into one to two inch wide rings and then slitting the rings. Cheap and effective. They look like a box full of white C's. Actually the internal stress on the plastic makes them always want to close so they are more like white plastic O's. With blue lettering on the side. Four inch PVC pipe. Just one more thing to look for on those late night dumpster dives at local construction sites.

I make it easier to put the ring clamps on the soundboard by raising the frame up off the work bench with scrap pieces of 2x4 placed underneath the frame.

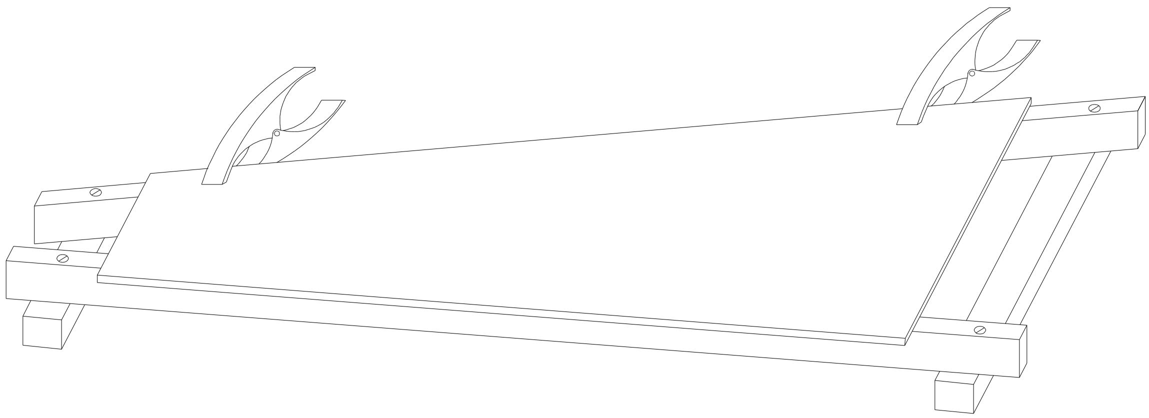
The PVC ring clamps ensure the boards are even on the edges, but boards may bow up or down in the middle. Run your fingers across the center of the seams to ensure they are aligned fairly well. If one of the boards is high, you can usually push it up (and the other down) in the first 2-3 minutes before the glue has begun to grab.



After the glue dries, you should have a soundboard that is dead flat on one side. Take the clamps off and lift the soundboard off of the frame. At this point the soundboard will be alarmingly floppy, so handle it gingerly until the string rib has been glued on.

<u>Tapering the Soundboard</u>

Turn the frame over and screw it to the work bench. I use hand spring clamps to hold the soundboard down so that I can use a random orbital sander to take the glue off and level one side of the sound board.



If you will be doing most of the tapering with a hand plane, I suggest gluing the string rib to the first side of the board after you have sanded it smooth. Even with a newly sharpened plane, I have to apply enough pressure that the board needs to be reinforced to keep it from buckling and breaking, especially at the thin end.

Flip the board over and taper the other side. I do the rough tapering with a hand held power planer. These power planers can eat a lot of material quickly, so you may want to use a fairly shallow blade set (<0.4mm), practice on scrap and stop short of your final dimensions. I plane the longitudinal taper first then thin the edges to give it the second (double taper). After planing, the board may look rough and have some ledges where the edge of the plane blade dug in. I sand these out with 60 grit disc mounted on a random orbital sander. By the time I built my third board, I could taper the board to its final dimensions with the power planer and sander in less than an hour.

<u>If you used a thickness planer to pre-taper the board:</u>
I use a slightly different process for tapering. The top side of the board will have a series of 1/64 steps as the board gets progressively thinner. The other side should be pretty close to flat.

The first few times I used a power thickness planer to pre-taper the blanks before the glue up, I flipped the board over and tried to sand the flat side smooth. When I pressed down too hard with the sander one board cracked along one of the stepped ledges.

When I used the hand power planer, I found the sound board was pretty thin (5/64") at the treble end. The power planer aggressively eats stock. At 5/64" I had to be *<u>reallllly</u>* careful trimming the board at the narrow end.

Through trial and error, I developed a process that allowed me to taper the board more efficiently and with less risk. First, leave the stepped side of the sound board up, and use a belt sander (80 grit) to smooth out the 1/64" steps. I keep the sander pointed to the treble end (it puts the board in compression), use very little down pressure, keep the sander moving around and stop frequently to checking thickness. After I have removed 90% of the step corners, I start making the cross taper with the random orbital sander (by thinning the edges of the board. I usually leave the board a bit thick, as a certain amount of material will be sanded off when I flip the board to smooth the "flat" side and remove the glue.

If I use a light touch with the belt and random orbital sander, I can usually do all of the shaping before gluing on the string rib.

Dimensions:

The optimal thickness of the soundboard is going to depend on

-String tension,
-the width of the board, and
-how thick the ribs will be
-the quality of the wood,
-how long the builder wants it to last.
-How stiff the sound box sides are

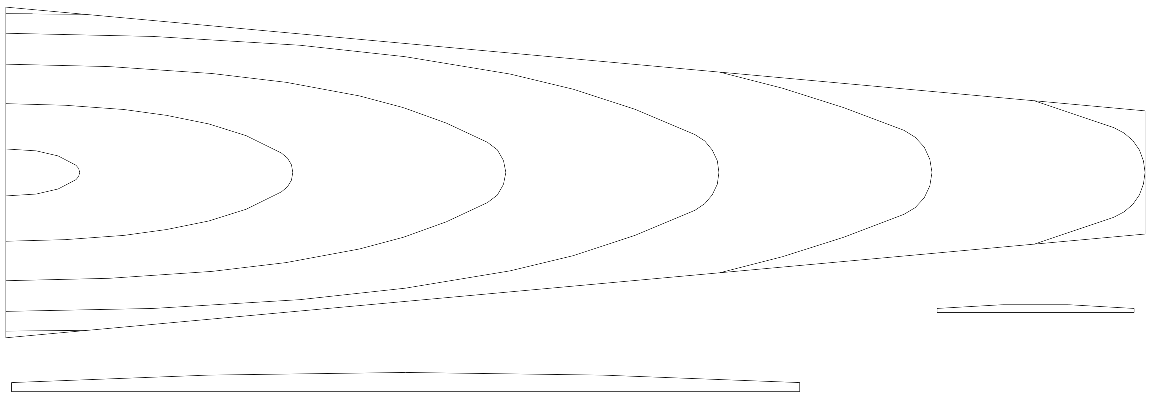
A thinner board will generally be more responsive, but is more fragile.

Here are the scantlings and specifications for my standard 36 string harp:

-16" wide at the base end
-Clear Sitka Spruce board
-Tension is 1300 lbs.
-Inner and outer String ribs

Sound Board:		String Ribs:	
Treble end center	5/32	Width Treble End	1/2
Treble end edge	3/32	Thickness Treble End	1/8
Bass end center	5/16	Width Bass End	1-1/2
Bass end edge	3/16	Thickness Bass End	1/4

Like a topographic map, these contour lines portray the shape of a double tapered soundboard with a linear longitudinal taper.



The flat plates below the contour drawing are enlarged cross sections of the board at the bass and treble end. I use a linear taper along the length of the board – midway up the board - the center thickness should be 15/64”. The string ribs have straight line tapers too. The side to side taper on the soundboard is a gentle arc.

Guitar and Violin makers seem to be much more scientific about the profile of their soundboards than most of the harp makers I have met. If you want to go in that direction, you will need a deep throat caliper to monitor your tapering as you shape it to a specific sound board profile. You may also want to measure and record sound board scantlings so that you can figure out how it relates to the sound of each instrument.

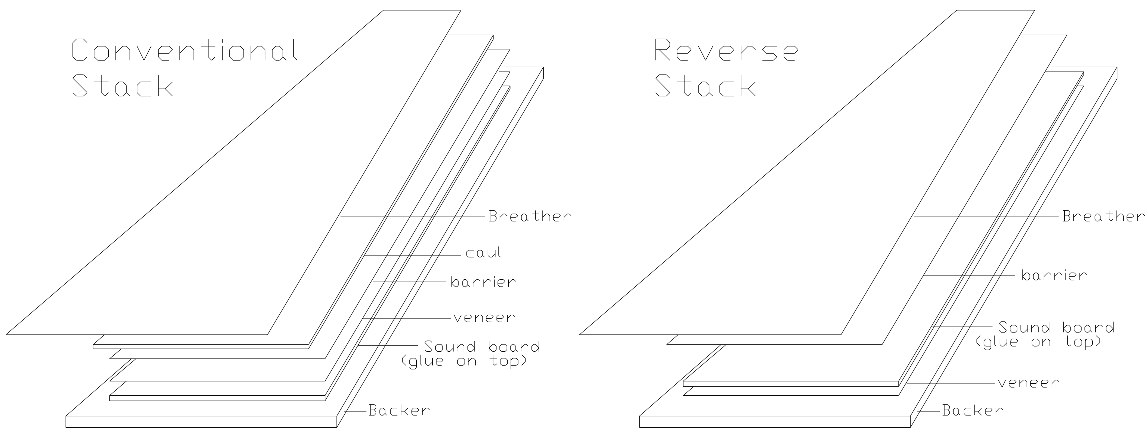
Left – A simple caliper made from plywood scraps and a $10 dial indicator. Even with a domed anvil, the reading will be thrown off if the sound board is canted one way or the other. To find a true reading, I rock the board back and forth to where the needle registers the thinnest measurement.

Vacuum Veneering a Sound Board

Many of most expensive harps cover the soundboards with a fancy veneer. This has several advantages:
-The hardwood is easier to finish than Sitka Spruce or pine
-Fancy veneers are very striking (a good selling point)
-The soundboard harder and more ding resistant
-It forestalls the formation of cracks in the soundboard core, and covers them up when they eventually form.

Orthodox traditionalists argue that adding a veneer can muffle the sound of good board. I think it depends a lot on the string tension of the harp. Getting good volume and a lively response from a lightly strung harp requires a thin, carefully profiled board, and adding a veneer seems to detract from that. A veneered board does not seem to adversely affect harps with medium to high tension.

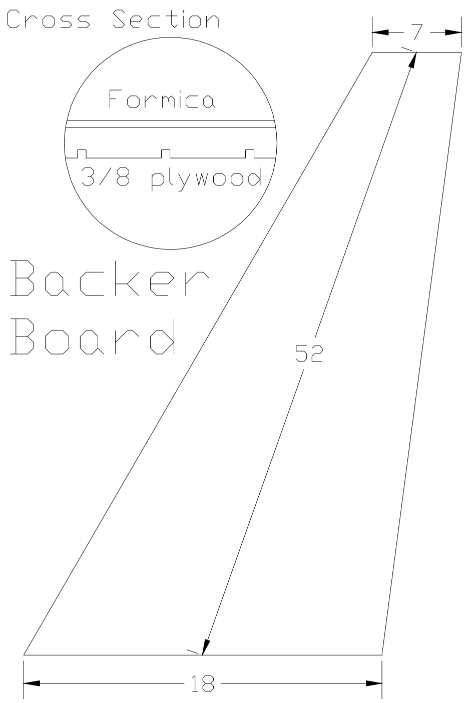
The technique I use for veneering a soundboard is identical to the one I use for veneering a plywood back panel for square back sound box.



In conventional vacuum veneering, a caul is used on top of the veneer to ensure it comes out flat. In this stack the veneer is usually a bit smaller than the substrate and the caul is a bit smaller than the veneer to prevent it from driving all of the glue out from under the edges of the veneer as the bag is evacuated.

A barrier layer, used to keep from gluing the veneer and substrate to vacuum bag, is typically plastic sheeting or wax paper. The breather layer provides vacuum channels to the bag port, and can be made from bubble wrap, carpet padding felt, or (my favorite) nylon window screening.

The vacuum bag needs to be about 4” wider and longer than the backer board. If you plan to do vacuum formed round backs too, you will want an even larger bag. My all-purpose bag is 44” wide at the mouth, tapering 84 inches to the other end which is 22 inches wide.



By reversing the conventional stack and placing the veneer between the backer and the substrate, the need for a carefully sized caul is eliminated and the board comes out of the press with a top that is as flat as the Formica it was molded on. I use the flattest, shiniest Formica I can get and cover it with a coat of car wax (that is then thoroughly buffed) to prevent any glue that seeps though the veneer from sticking, gluing the sound board to backer board.

I use a backer board made from plywood that is at least 3/8″ thick and is an inch or two wider than the soundboard. One side is covered with Formica, and the back is scored with a hatch work of saw kerf every 2-3 inches. These kerf s help ensure vacuum pressure is distributed across the entire board. I preserve the longevity of my bag by rounding the corners of the backer board to a ¼″ radius.

Here are the basic steps:

1. Prepare the veneer and place it on a waxed backer board. Tape two opposing corners so it stays in place (the tape only needs to overlap the veneer by ¼ inch or so).
2. Gather the breather, barrier sheets; make sure you have the closure for the bag ready.
3. Mix about 90 ml of DAP Weldwood Powdered Resin to cover a 16 x 48 x 4″ sound board. Dump the glue onto the sound board, and distribute it evenly with a 4″ foam roller.
4. Let the mixed resin set for about 5 minutes so the adhesive begins to gel a bit
5. Place the soundboard glue side down on the veneer and tape the soundboard in place so it does not shift around
6. Add the barrier layer (I slit a long strips of wax paper in half and tape them over the edges of the sound board where it is likely to seep out)
7. Add the breather layer and tape itsleading edge to the backer board so it stays in place as it is loaded into the vacuum bag.
8. Slide the stack into the bag, seal the closure
9. Apply a vacuum and wait for the adhesive to cure (6-8 hours)

When the glue has cured, I remove the stack and re-wax the Formica on the backing board so it will be ready the next time I need to use it.

Three Tips for working on veneer

I usually cut two pieces of veneers from adjacent flitches and book match them along the center line. I cut each half so they will be about ¼" larger than the soundboard blank. I join them with veneer tape.

Many veneer vendors ship their veneers rolled into a roll that is 18" in diameter or so. For two years I wrestled with veneer that persistently tried to roll itself up. After my second or third shipment, I unrolled the veneer, cut it to the lengths I would need and stored it flat. When the veneer is stored flat, it stays flat which makes it much easier to cut to size and join with veneer tape. A big flat box under the sofa in the living room makes a great storage spot.

For several years I cut veneers with a utility knife (with a new blade), then dressed the edges square by clamping the veneers between two pieces of freshly joined plywood and sanding them with a sanding board. A veneer saw can be quicker and more accurate. It also does not veer off or follow the grain the way a utility knife does. Make sure the saw is sharp. It only takes a few minutes to learn how to use it.

When I veneer with epoxy, I place the tape on the inside (in between the veneer and the substrate). This is because the epoxy bleeds through and surrounds the tape. It can be very difficult to scrape the tape off once it is encapsulated in hardened epoxy resin.

When I veneer with DAP Weldwood Powdered Resin, I place the tape on top. The resin will not penetrate through the paper veneer tape, so the veneer is only weakly bonded to the substrate along the center seam. The tape is easily removed be dampening it with water then scraping it with a newly burnished scraper.