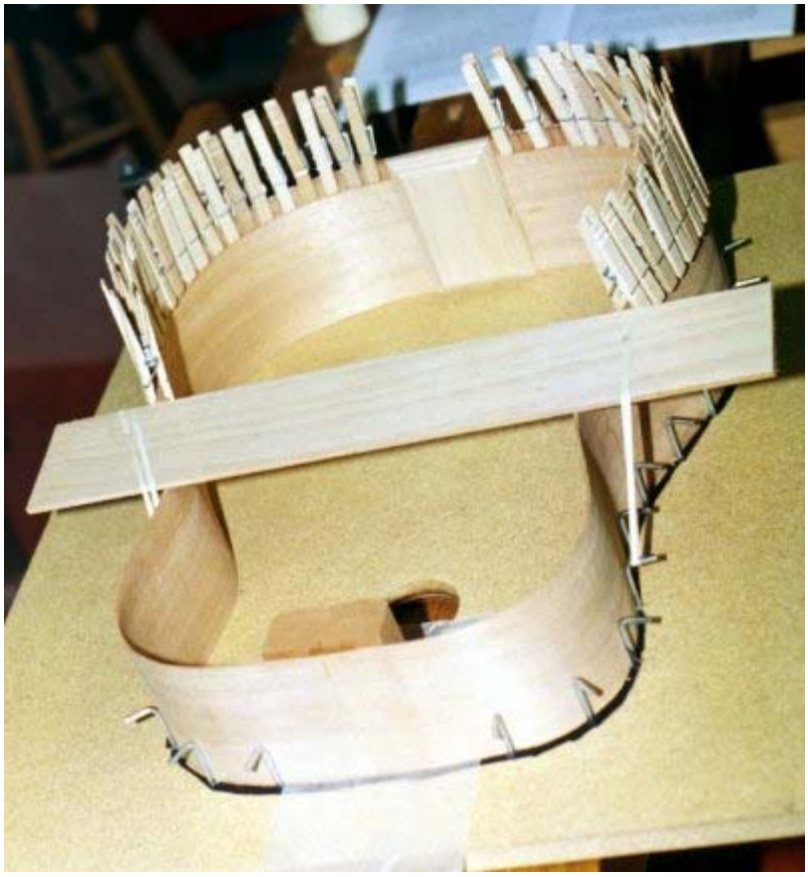
The Unpacked Kit

Here's a picture of the kit as received from Martin. You can see the sides are pre-bent for you, that the top is already edge-joined and has the sound hole cut. Although it doesn't show up well in the picture, the sound hole already has the grooves cut around it for inlaying the rosettes. The neck is already shaped, and the dovetail joint for joining the neck to the body is already cut into both the neck and the end block.

On to The finished rim and gluing the linings.

Gluing the Ribbon Lining onto the Rim

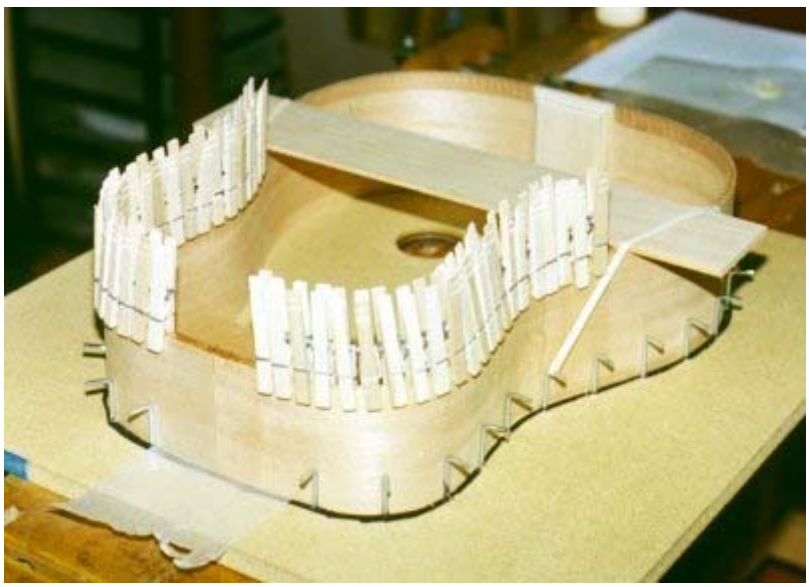
Unfortunately, I forgot about taking pictures of the process until after I assembled the rim. The rim is considered to be the sides assembled to the two end blocks. This step shows the beginning of attaching the lining to the rim. The lining is a strip of mahogany or cedar, triangular in profile, and kerfed to allow it to conform to the shape of the sides without requiring steam or heat bending. The long side of the triangular profile is glued to the side of the guitar, and the short side of the triangle is what the top and bottom of the guitar is glued to. As the sides of the guitar are no more than 1/8" thick, it does not present enough gluing surface to attach the top and bottom. The lining makes up for this.



The rim of the guitar is sitting in a mold constructed from 3/4" thick particle board and "L" hooks. The "L" hooks both force the sides to the exact contour that the finished guitar is to have, and also provide a place to attach rubber bands used for either holding down the sides (as shown in the picture), or as clamps for gluing on the top and bottom of the guitar.

On to Gluing the linings - Part 2.

This picture shows the other sides of the lining being glued into place.

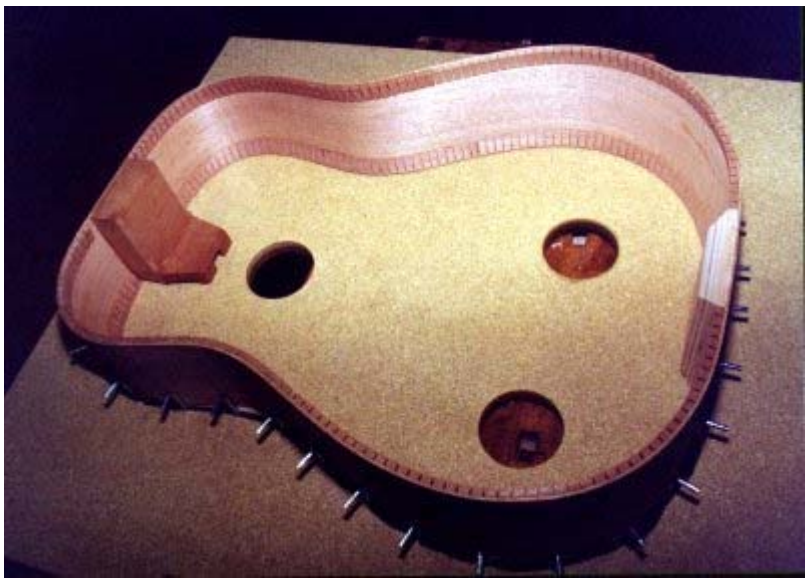


A close-up shot of the lining.

On to the completed rim.

The Completed Rim

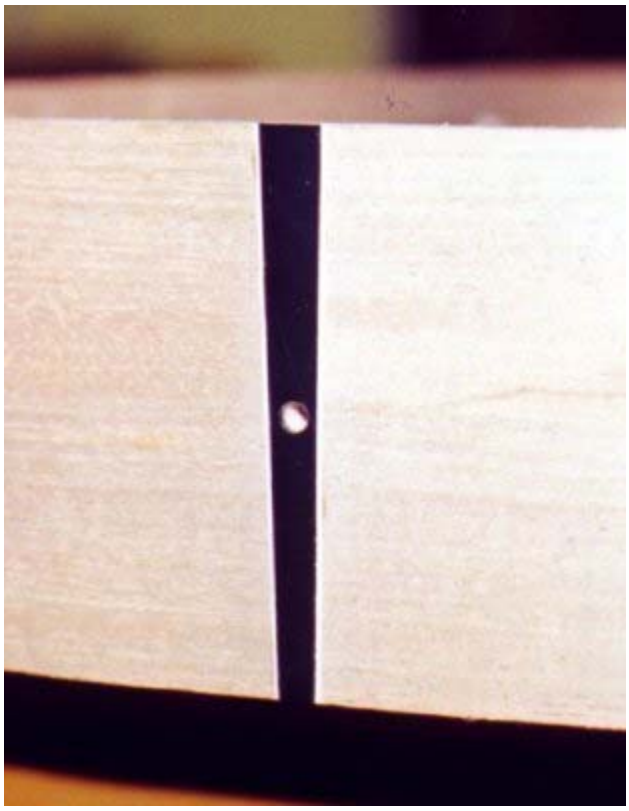
The linings get glued to both the top and bottom edges of the rim. They were quite easy to attach - the spring-type clothes pins were not only ideal clamping mechanisms, but what other clamps can you buy 50 of for only $1.50? :-)



After the linings are in place, you attach some strips of wood perpendicular to the linings, spaced about every 4 inches, around the inside of the rim to give it a little more compression strength. Once that is done, you move on to attaching the end-piece set of the guitar.

Attaching the End-Piece Set of the Guitar

This step is the first step where it really was clear that you needed to have read some literature on the art of guitar construction. The entire directions for installing the 3-piece plastic end piece are: "Cut a tapered slot through the sides to the end block and glue the end piece set in with model cement". Without prior woodworking experience, it would be difficult to get this right. At this point in the project, I chose to invest in a Dewalt Laminate trimmer, model number DW673K, as the only router I have is a very large Makita plunge router, and would be difficult to control doing delicate work on the guitar. This laminate trimmer was purchased from the local Woodworkers Warehouse store. It was also obvious (at least for me) from reading the guitar making books that a laminate trimmer is the best way to route out the grooves for the top and bottom bindings of the body of the guitar, so it seemed worth the investment. One of the bases that comes with this laminate trimmer is a tilting base, and lets you attach a ball-bearing guide that extends out underneath the router bit to keep the bit at a constant cutting depth from the edge. The tilting base enabled this trimmer to accomidate the angle of the back relative to the sides of the guitar as well.



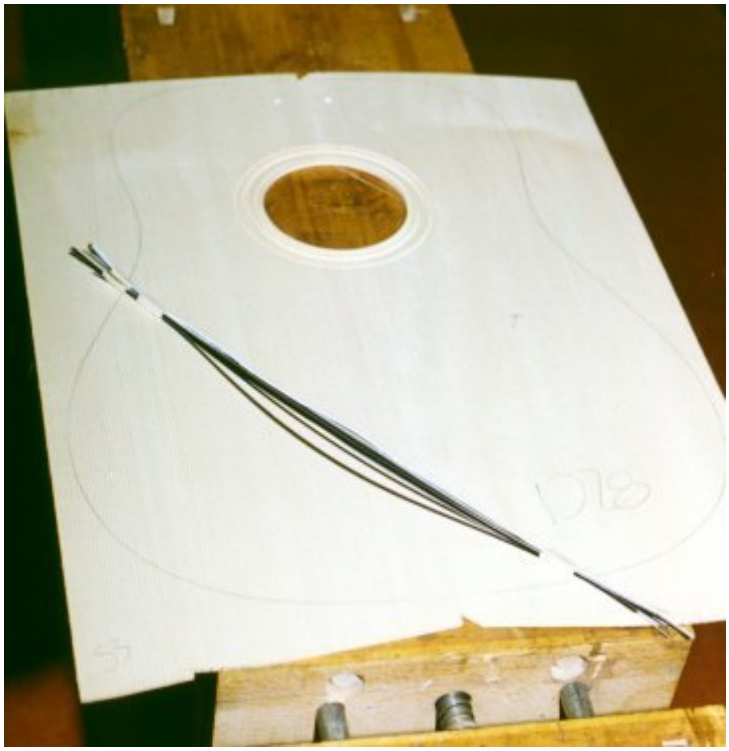
I carefully marked the boundaries of the tapered slot with a utility knife, and used the laminate trimmer with a 3/16" straight bit to clear out most of the groove. I finished it with sharp wood chisels to get the groove to the exact size. The hole in the middle was drilled after the pieces were glued into place. At some point, I will use a reamer to taper the hole to the proper angle to accept the end pin.

Another place where the directions of the kit fell short was in the description of the glue to be used for this type of work. They state that you should use model cement. This didn't sound right to me, as the only model cement I knew about was airplane glue, and I really didn't think that airplane glue would properly adhere to wood. I called Martin Guitar, and they told me to use Duco cement, which seems to have the same properties as epoxy, but does not require mixing. Overall, it worked quite well. However, it does set quickly, not allowing a lot of working time.

Once the end piece set was done, it was time to move on to preparing the top and bottom of the guitar.

Preparing the Top of the Guitar

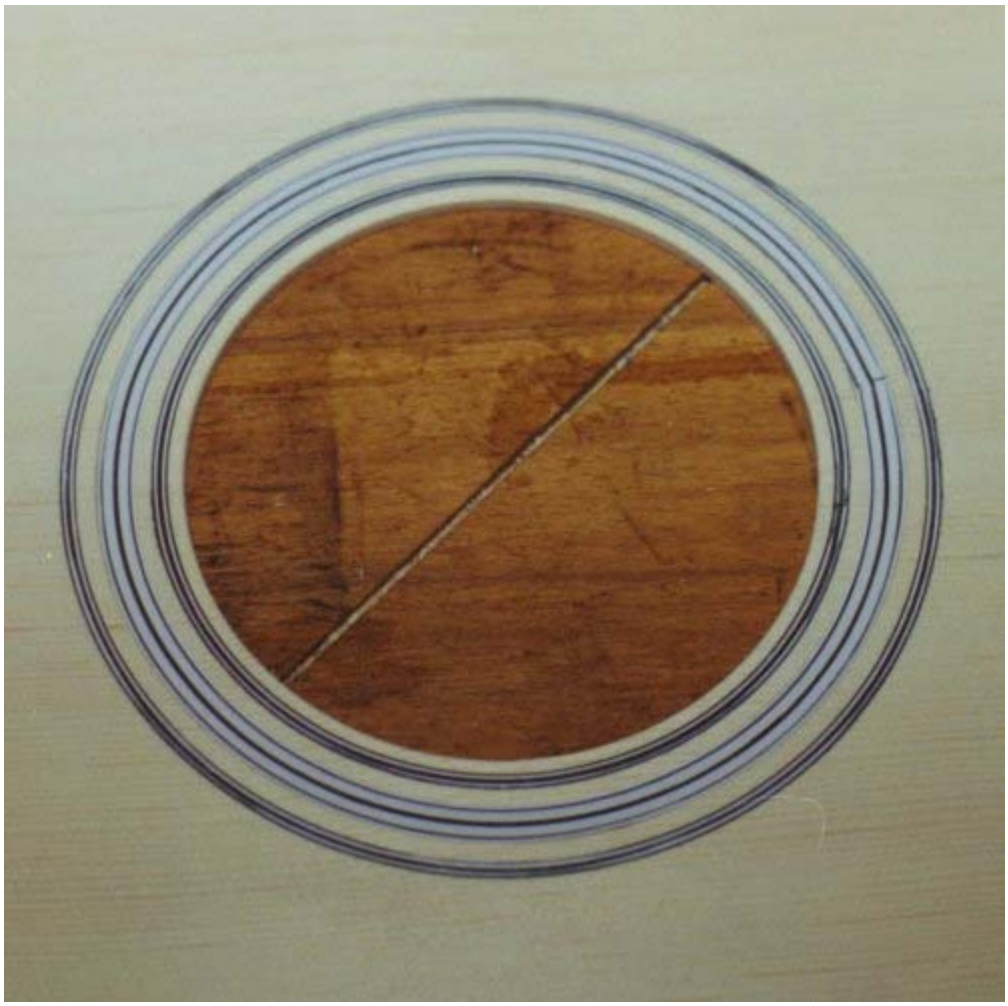
The two book-matched pieces of the Sitka spruce top already come edge-joined together. The first step is to glue in the strips of black and white plastic that form the rosette around the sound hole. Not only do these add a visual accent to the top of the guitar, they also re-enforce the exposed end-grain of the spruce at the top and bottom of the sound hole and helps keep it from splitting due to swelling and shrinking from humidity changes.



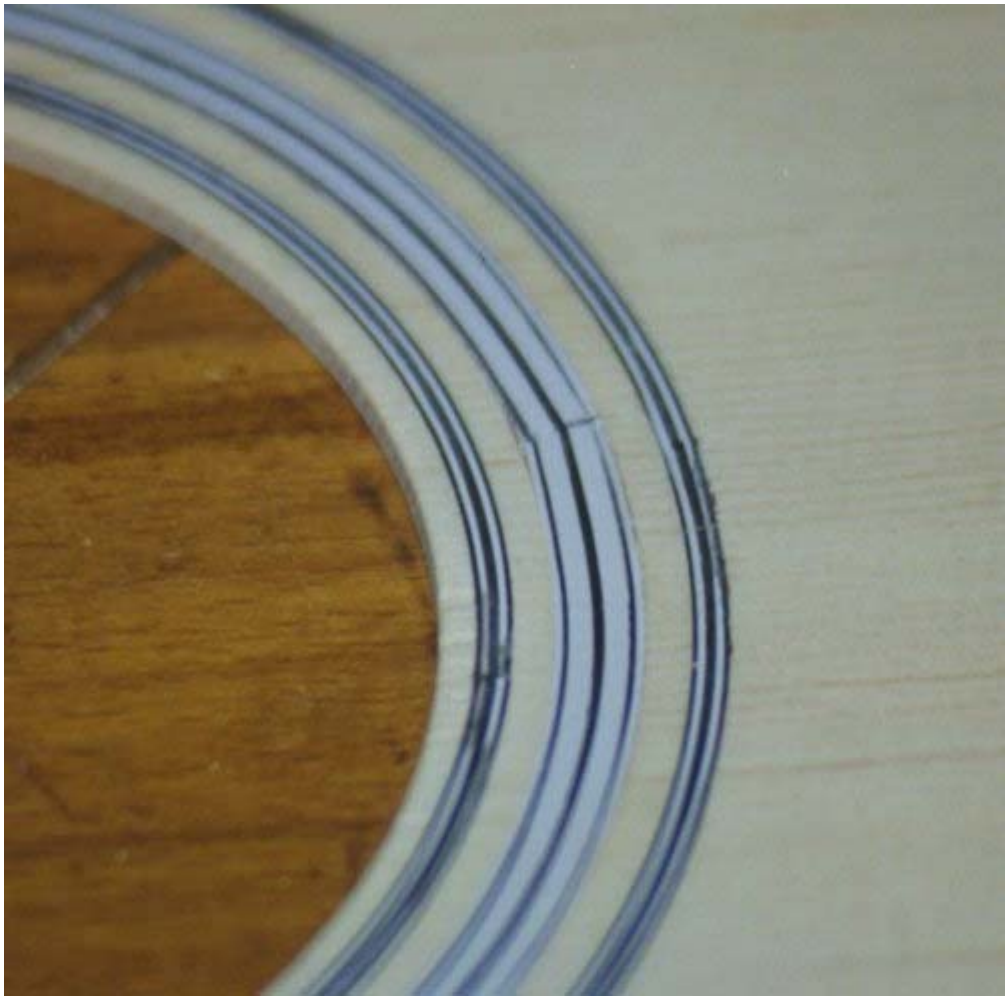
Gluing in the pieces was easier than I thought it would be. The trickiest part was getting the Duco cement smeared all over each individual strip and in the groove, and then installed before the cement started setting up. Once most of the strip is in place, you trim off the excess before pressing the last bit into the groove. Only the inner circle needed to be precise, as the tops of the other two circles will be covered by the fingerboard. The finished rosettes are shown on the next page.

Finished Rosettes

The finished rosettes:



The top seams of the rosettes:



Once the rosettes are glued in place, the area around the sound hole (including the plastic rosettes strips) are scraped with a cabinet scraper to remove the excess glue. Scraping also helps to clean up the individual lines in the rosettes, as the Duco cement can cause the surface colors to bleed into each other (as you can see in the above picture).

The next step is to brace the top.

Bracing the Top

After the rosettes were complete, the top was trimmed to about 1/4" from the outline of the finished top, and I flipped it over on its back to start attaching the bracing.

This picture shows the X-braces already attached, and the clamps are holding down the top brace.

The next picture shows the completed bracing of the top of the guitar.

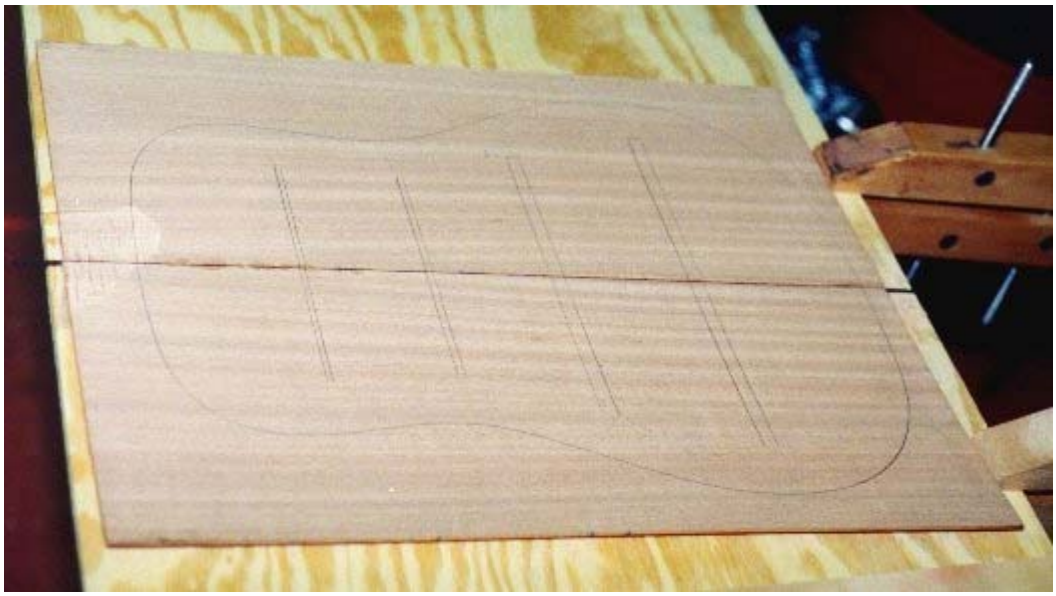
Top Bracing

This picture shows the completed bracing system for the top of the guitar. The braces are necessary to provide strength to the thin top, without stiffening the top so much that it looses all its resonance. The strings of the guitar will exert about 250 pounds of pressure on the top of the guitar. Too little bracing, or braces that aren't strong enough, and the top will be ripped apart by the strings. Too much bracing and the top won't vibrate enough, dulling and decreasing the volume of the sound of the guitar.

With all the braces attached, the top of the guitar is done for now. Next, the bottom of the guitar will be glued up and braced..

Edge-Joining the Guitar

The first step in assembling the back is to edge-join the two pieces of mahogany that make up the back together, with a strip of black plastic running down the center as an accent stripe. This picture shows the back after it was glued together.



After gluing the back, both sides were scraped with a cabinet scraper to clean off excess glue, and to level the plastic strip with the surface of the wood. Once the scraping is complete, the back was trimmed to within a 1/2 inch of it's final shape.

The next step was to glue on the center re-enforcing strip.

Center Re-enforcing Strip

This re-enforcing strip makes the joint that runs down the center of the back more stabile and gives it a great deal more strength. Once this strip is attached, the lateral bracing that provides the back's rigidity can be glued on.

Back Bracing

This photo shows the last two back braces being attached. The bracing system on the back of the guitar isn't nearly as extensive or complicated as the bracing of the top. Note that the braces actually have an arch to them, so a ring of cardboard is placed under the lip of the back to allow the back to flex as the braces are clamped on. The top braces were also glued in this fashion.

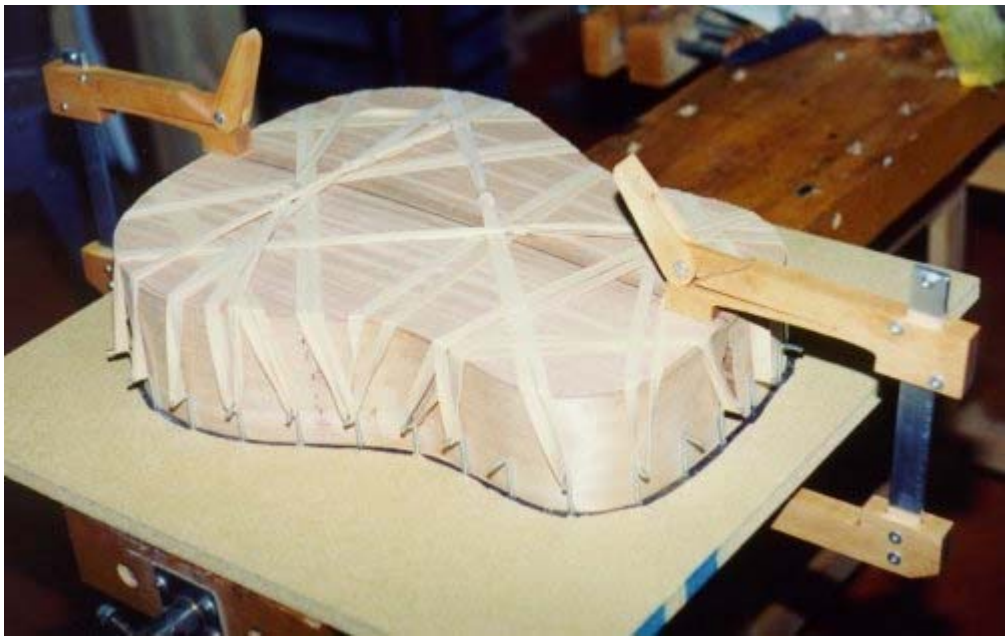
The completed back is shown below.

Once the back bracing is complete, you start fitting the top and back to the sides in preparation for gluing

Gluing the Back onto the Sides

Both the top and the bottom need to be properly fitted into the sides of the guitar. This involves trimming back the major braces until they extend past the lining and just touch the sides, and trimming back the rest of the braces so that they will fall just inside of the lining of the sides. Where the major braces touch the lining, the lining pieces are cut and removed to allow the top and back to fall snugly into place. You'll be able to see this on the next page.

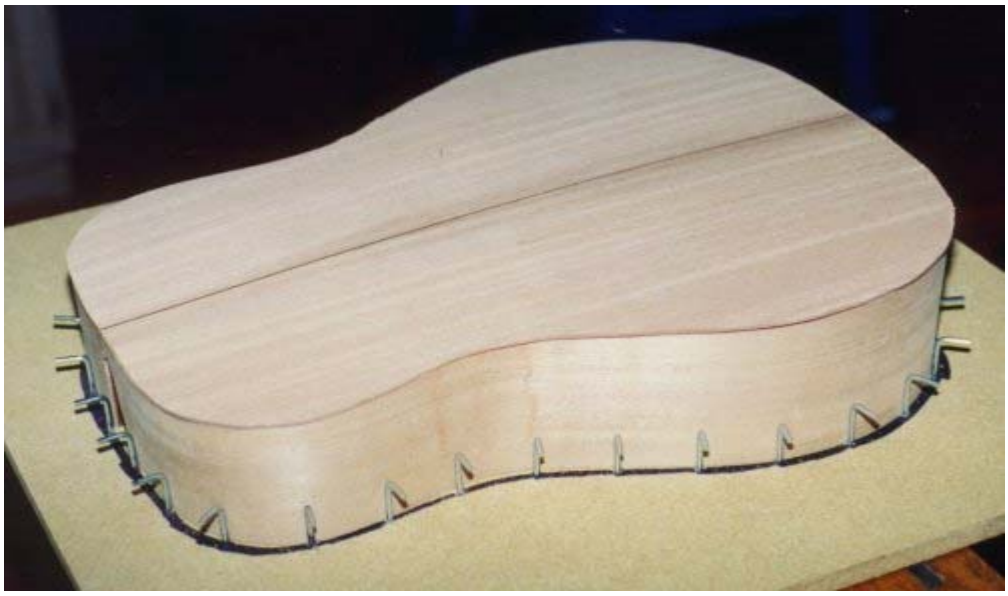
Gluing the top and bottom onto the sides involves fitting the sides back into the form, spreading glue along the linings and edges of the sides, and clamping the bottom or top to the sides until the glue is dry. Initial clamping was done with a cam clamp holding down each end of the back, and then stretching 5" and 7" rubber bands between the L hooks that make up the form to provide the bulk of the clamping pressure. Enough rubber bands were added until all edges of the bottom were held firmly against the sides of the guitar.



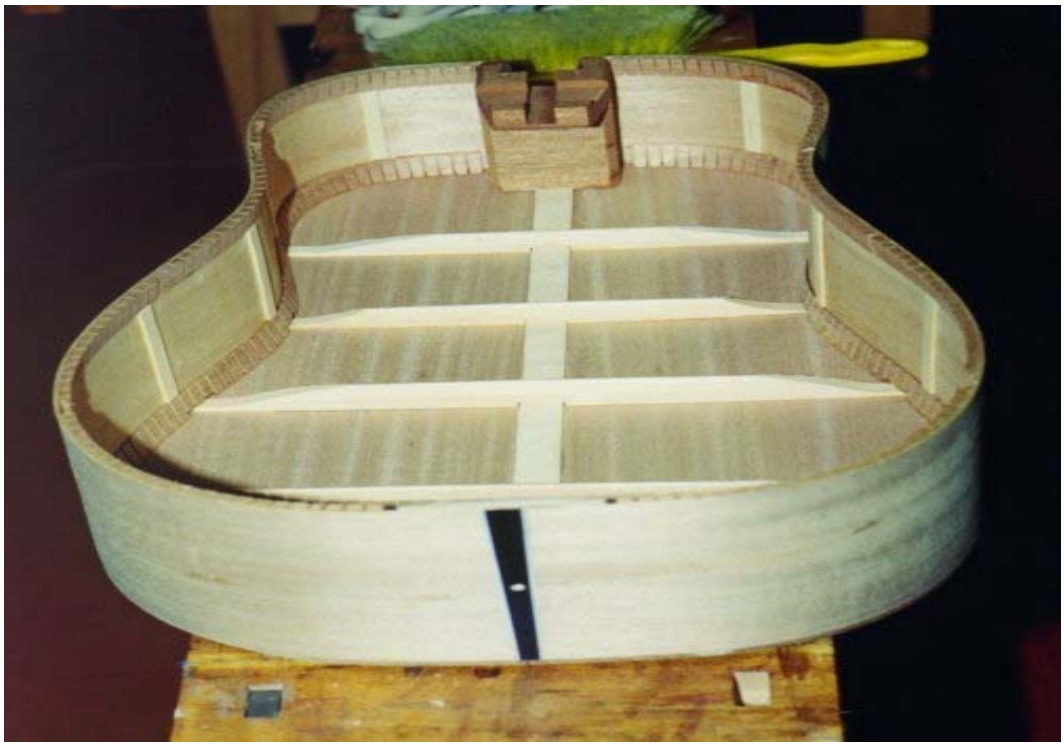
The next page shows the bottom attached to the sides.

Bottom Attached

This shows the bottom after the clamps and rubber bands have been removed.



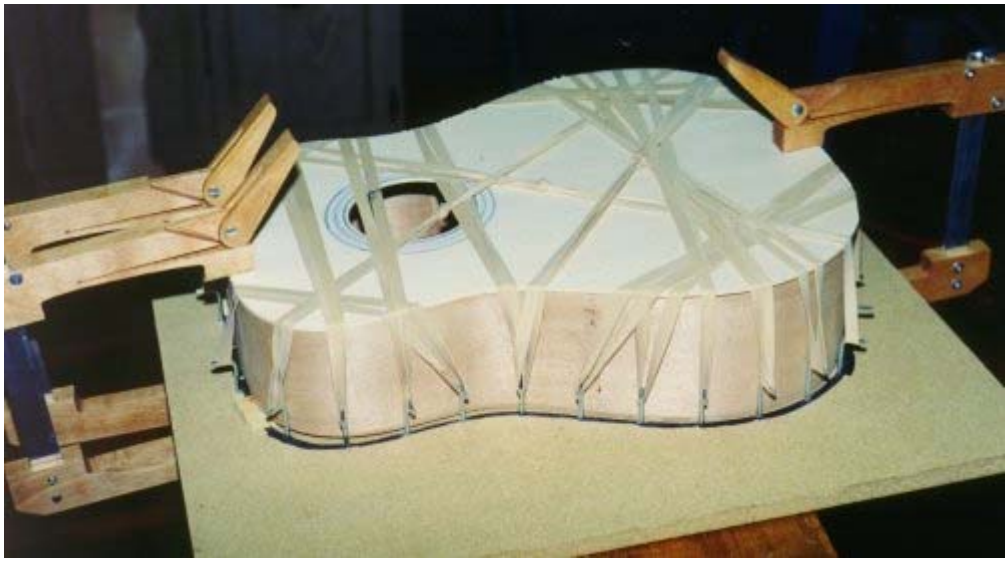
The excess overhang of the bottom was then trimmed off with the laminate trimmer, and the body removed from the form. Here's a shot of the fit of the back in the sides. You can see on the first fully visible brace how the lining was trimmed to allow the brace to come in contact with the sides of the guitar.



Once this was done, the body was re-inserted into the form with the back facing down, in preparation to have the top glued on.

Attaching the Top

Gluing on the top followed the exact same procedure as gluing on the bottom. Because the back of the guitar is curved, I shimmed the neck end of the bottom to provide a solid clamping area without putting stress on the sides.



Once the top is glued, the top is trimmed to its exact size with the laminate trimmer. After that is accomplished, I performed some of the finish sanding to smooth out the body of the guitar, up to 180 grit sandpaper. After that, you start the binding process.

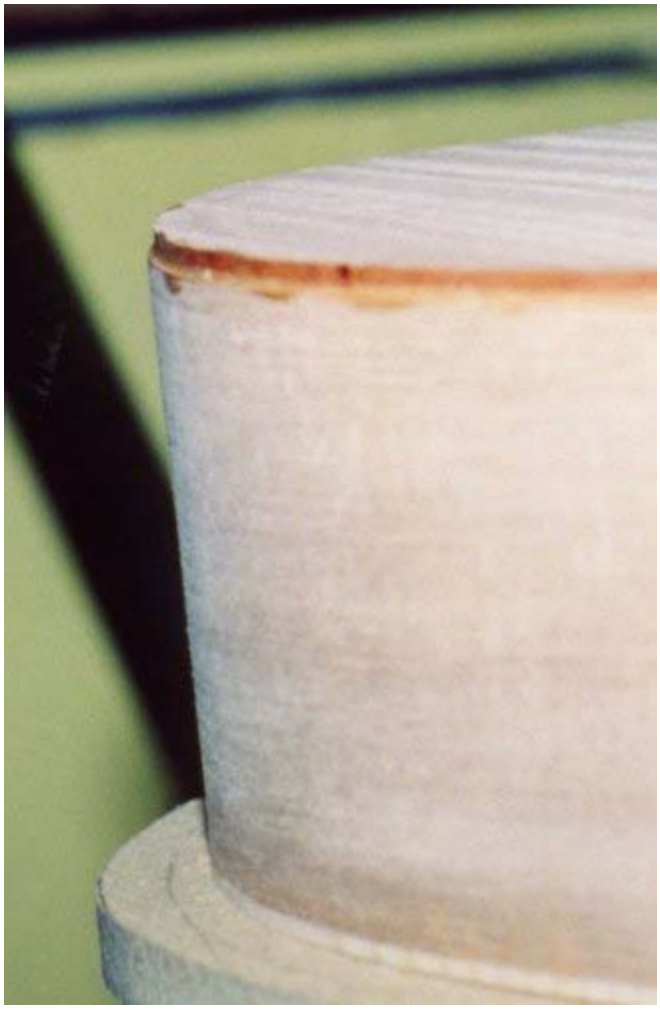
Binding Process

Binding a guitar is the process of cutting a channel along the edge of the body, and gluing in a (typically) plastic strip. The purpose of this is primarily to hide all the end grain of the top and bottom of the guitar. It also adds a decorative touch. I started with the bottom, figuring that if I screwed up, the bottom isn't as visible as the top. Plus, the top has two strips that are glued into place, instead of just one like the back has. The second, innermost strip on the top is actually called purfling, and is there just to add more decoration to the top of the guitar.

This is where choosing the more expensive Dewalt laminate trimmer really paid off. I needed to cut a groove along the edge of the back that was 1/16" wide, and 3/16" deep. I went to both Home Depot and Woodworkers Warehouse looking for a rabetting router bit that either had a set of multiple sized ball-bearing guides, one of which would let me remove only a 1/16" width of wood, or a bit that would do just a 1/16" wide cut. Well, there doesn't appear to be any such beast! Fortunately, the Dewalt laminate trimmer comes with a variety of bases, one of which accepts a guide that extends down the side of the router, and out underneath the router bit, and has a ball-bearing guide at the end.

This allowed me to use a simple (and relatively cheap) 1/2" straight bit, and because the guide on the laminate trimmer is infinitely adjustable, I could get exactly the size cuts that I needed for both the top and back binding. If I had bought one of the cheaper trimmers, I'm not sure what I would have done to accurately cut the groove for the bindings.

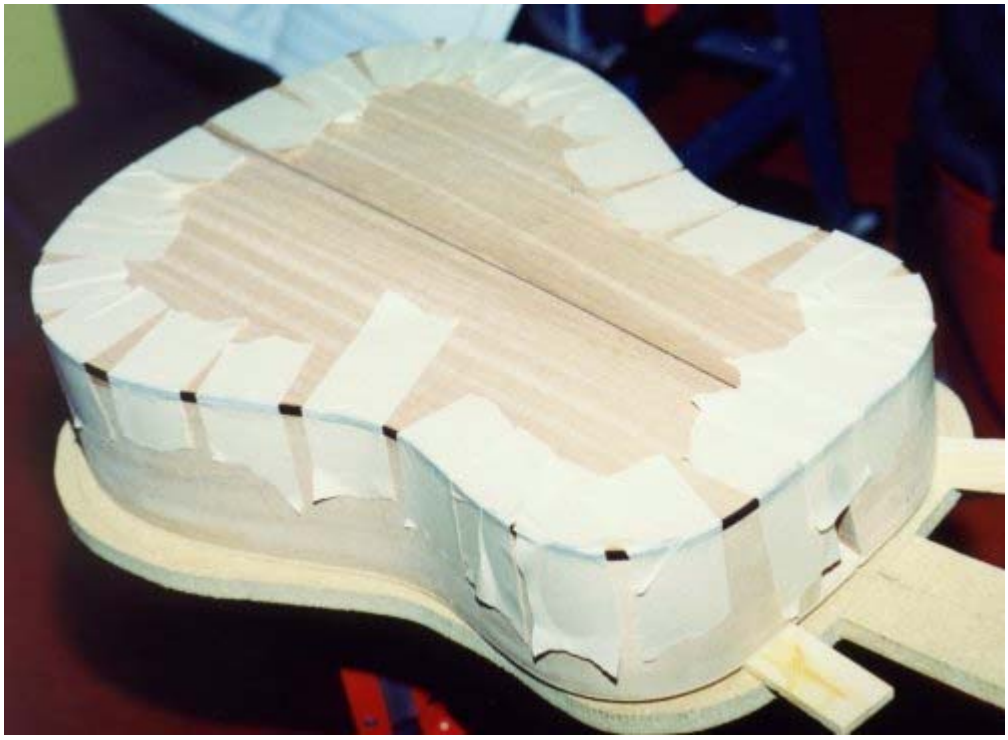
This picture shows the groove routed into the back of the guitar to accept the back binding strip. It has already received the first primer coat of adhesive.



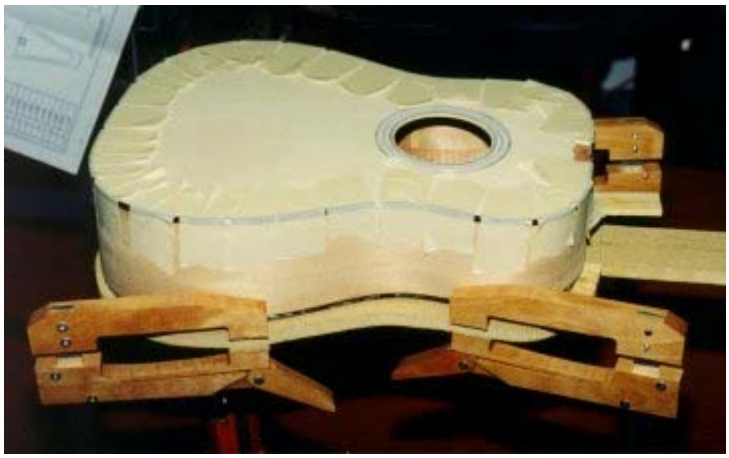
The next page shows the binding strip clamped into place.

Clamping the Back Binding Strip

The simplest way to clamp on the strips while the glue dries is to use masking tape. Basically, I'd rip off many strips of tape in advance, coat about an 8" section of the channel with glue, and then press the binding strip into place and tape it down. Once I made it all around, I needed to cut the strip to just the right length so that the seam would be as invisible as possible.



Once the glue is dry, the masking tape is removed. The top is done in the same way, except that the top binding is done with two strips of plastic.



The completed bindings

The Completed Bindings

Once the bindings are attached, a cabinet scraper is used to level the bindings to the surrounding wood, and to clean up any glue squeeze-out. The completed bindings are shown below.

Once the bindings are complete, the body is sanded to 150 grit paper. It's now time to begin work on the neck.

Fitting the Neck

The neck is provided from Martin pre-shaped, and with the traditional Martin tapered dovetail joint already machined. As shown in the pictures below, The dovetail joint is designed such that the neck will sit high on the body initially.

Onward to fitting the neck!

The first step in working on the neck is to carefully remove stock from the sides of the dovetail until the neck just drops down flush with the surface of the body. This is probably the hardest part of making the kit. You want to maintain the precise angle of the dovetail to ensure a tight fit of the neck against the body of the guitar.

Unfortunately, it appears that I did a poor job of this. I believe I changed the angle of the dovetail such that the fit between the neck and the body is a bit loose, and rocks back and forth a little. I remedied this with shims when I was preparing to glue the neck on the body, but I never got it perfect. The neck rose up a little too high on one side, and I was afraid I'd just make it worse by monkeying with it too much.

After the neck has been fitted to the body, the adjustable truss rod is installed in the slot in the neck.

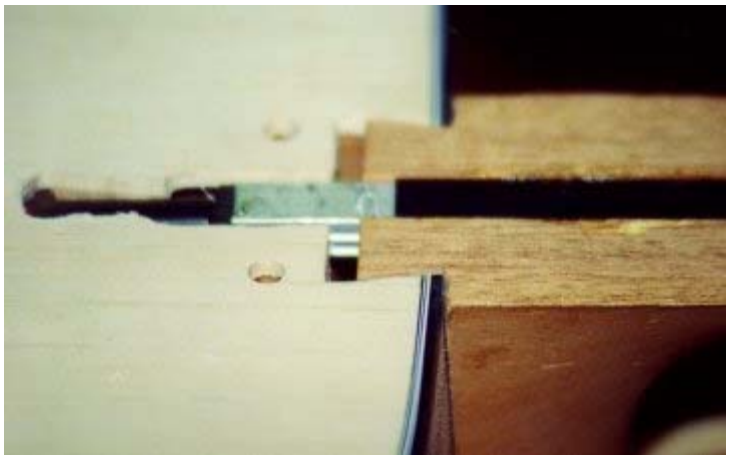
Installing the Adjustable Truss Rod

All the Martin kits come with adjustable truss rods. The neck is pre-machined with a groove to accept this truss rod. The truss rod is epoxied into the slot to ensure as strong a bond as possible between the metal jacket of the truss rod assembly and the wood of the neck.

After the truss rod has been glued into place, the top of the guitar must have a slot routed in it to clear the truss rod.

Finishing the Truss Rod

After the glue has dried, the neck is placed back on the guitar, and a line is drawn on the top of the guitar to outline where the truss rod hits the top. The top is then routed away to allow clearance for the truss rod.

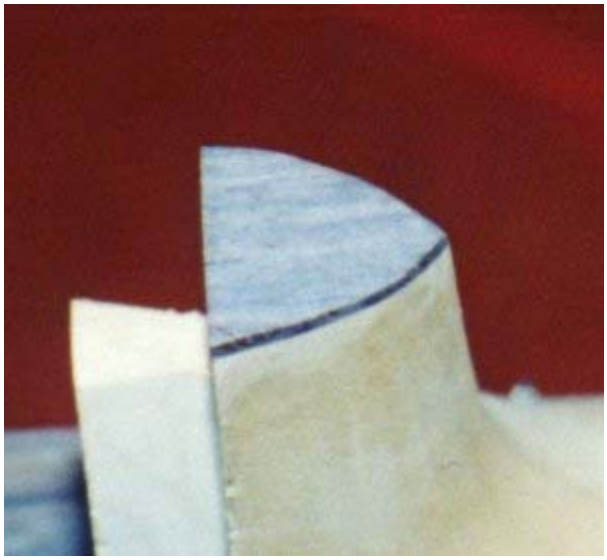


After this step is complete, a thin strip of wood or plastic is glued over the metal of the truss rod assembly, and then scraped down to be level with the top of the neck. This provides an even gluing surface for the fingerboard. Attaching the fingerboard is the next step.

Attaching the Fingerboard

Gluing the fingerboard is the next step, which is done with ordinary yellow glue. This is another step where I didn't do as good a job as I should have. When I glued the fingerboard on and clamped it to the workbench, I didn't notice that, although I had plenty of clamping pressure on the top, the edges were not being held tight together. So, I have a slight gap on either side of the neck between the neck and the fingerboard. I've since found some neck clamps in the Stewart-MacDonald guitar shop supply catalog that would solve this problem, and allow you to get a more even clamping pressure on the fingerboard. It could also be the case that either the neck or the fingerboard needed some fitting work, which I failed to check for.

After gluing on the fingerboard, the neck is placed back on the body, and the neck is marked where it hits the edge of the binding on the back of the guitar. The excess wood is trimmed off (I used a razor saw and then sandpaper), and the heel cap is glued on. After the glue dries, I shaped it with a chisel, and then sandpaper.

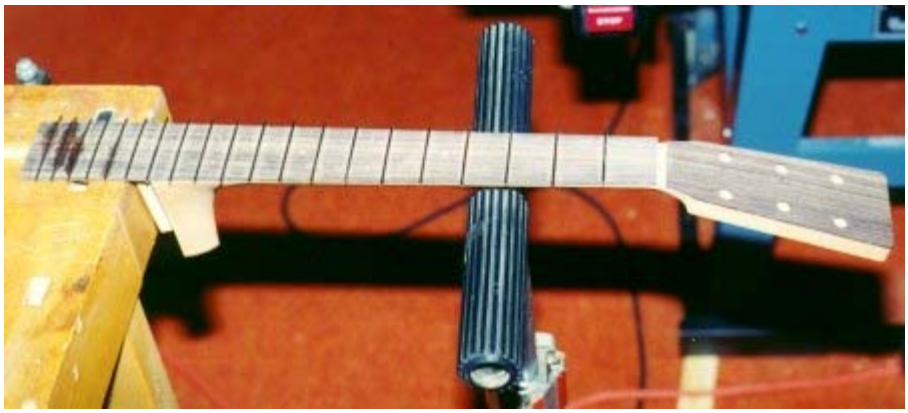


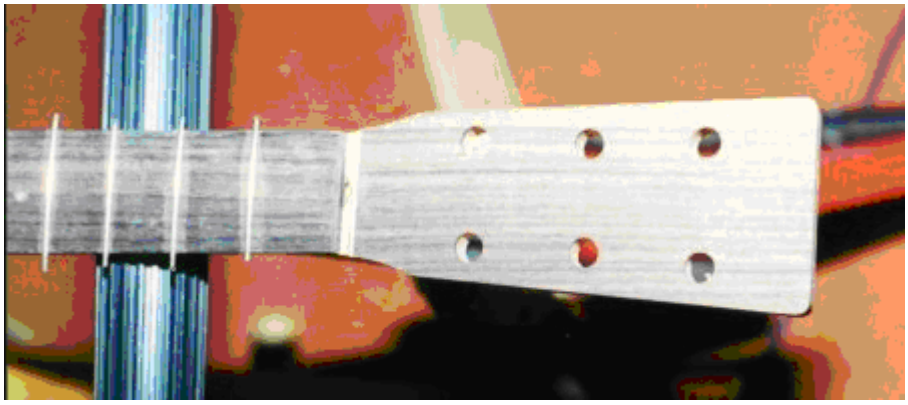
Then, holes are drilled to accept the tuning machines, and the frets are installed.

Fretting the Fingerboard

Drilling the holes for the tuning machines was done on a drill press to ensure that the holes would be straight and properly aligned. Marking the holes based on the blueprint took a little time, but was not hard to do.

Once the holes were drilled, the frets were installed. This was easier than I expected. Basically, you use some wire cutters to clip a slightly oversized piece of fretting wire off the roll that is provided, wet the pre-sawn groove in the fingerboard to make the wood swell around the "barb" on the wire once it's installed, and then gently hammer the fret into the groove.





Once the fret are hammered into place, they are trimmed as close as possible to the fingerboard with the wire cutters, and then filed down flush with the fret board, and angled slightly. After that, a whetstone, like one you'd use for sharpening chisels, was oiled and run back and forth over the frets to make sure that any high spots (relative to the other frets) would be evened off.

After the fretting is complete, the nut is shaped and installed.

Shaping and Installing the Nut

Shaping the nut was interesting, mostly from the viewpoint that the Martin kit directions never mentions it! Basically, in a small part of one sentence, the instructions tell you to install the nut. However, the nut is simply an oversized block of either plastic or bone (I assume plastic, but am not sure). I fell back on the two guitar books that I mentioned on the first page, and used mostly sandpaper and a round mill file to shape the nut to the proper angles and curves. It is glued on with the same Duco cement that was used for gluing the bindings and rosettes.

Most of the guitar is assembled at this point. The next steps are sanding the guitar up to 180 grit paper and sealing the grain with a grain filler, finish sanding and lacquering.

Filling The Grain

After the guitar is sanded smooth with 150 - 180 grit sand paper, if the guitar is made from an open pore wood such as mahogany, the grain should be filled with a grain filling compound so that the lacquer can obtain a smoother finish. The spruce top does **not** get filled; only the sides, back and neck. Here's a couple photographs from after the grain filler was applied. I had never used grain filler before; I probably could have done a better job in smoothing out the filler and removing more of the excess instead of leaving it up to the final sanding stage - it would have saved my arm muscles a little!

This is the body after some of the finish sanding is complete - it still has a ways to go.

After the guitar is finished-sanded up to 400 grit paper, it's time to apply the finish.

Lacquering the Guitar

Lacquering was an interesting experience. I chose to use spray cans of guitar lacquer, available from the Stewart-MacDonald guitar supply catalog to avoid the expense of buying spraying equipment. Besides, I'm really bad at cleaning things like brushes, so chances are I'd ruin a sprayer after the first coat!

Lacquer itself is interesting, because the fumes are not only toxic but highly explosive. Wearing a good quality mask with organic vapor filters is important, and making sure that there are no flames or sparks nearby is equally important. Because I started the finishing process in January, and I live in New Hampshire, our gas-fired boiler and gas-fired hot water heater both run frequently, and are located (of course) in the basement where I needed to do my spraying! So, for over a week I had a routine of turning the heat up very high when getting up in the morning, and then before leaving for work, shutting down the furnace and hot water heater, and extinguishing the pilot lights. I'd spray a coat of lacquer on, and then head to work. I'd come back two hours later to re-light the hot water heater and furnace, and warm the house back up. Then, I'd do it all over again after another 2-3 hours had passed.

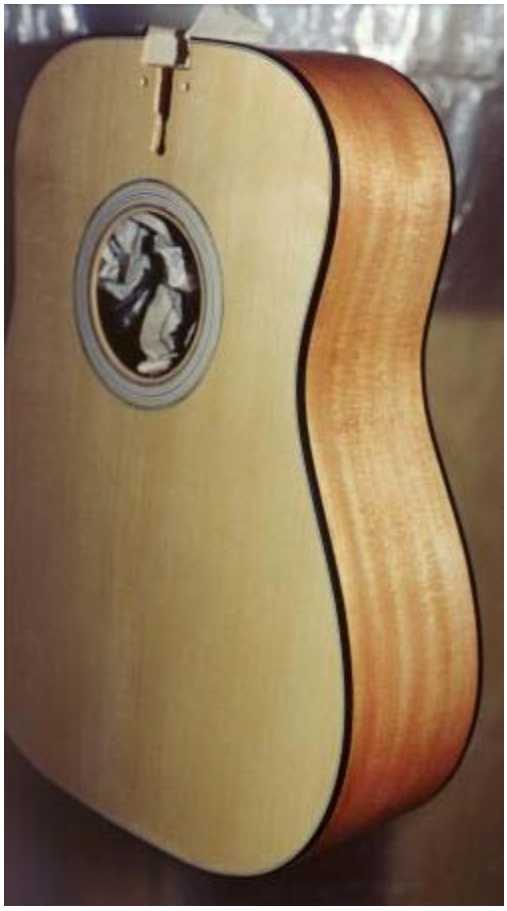
After every two to three coats, I'd sand with 600 grit paper to try and even out the finish. The finish did not come out as smooth as I had hoped, but I attribute that to spraying the lacquer in a 55 degree basement instead of the recommended 70 degrees.

In this picture, you see a make-shift "spraying booth". Basically, I bought a cheap plastic tarp, and made a three-sided area out of the plastic to catch the overspray. I put a screw eye in the neck-joint area of both the body and neck to use for suspending the part while spraying.

The next page shows close-ups of the neck and body after most of the finish had been applied.

Close-Ups of the Neck and Body

Here's a couple closer views of the lacquered neck and body. I stuffed some crumpled newspaper into the sound hole of the body, to avoid getting lacquer on the inside of the back.



After applying the finish, it's time to join the neck to the body.

Join the Neck to the Body

Joining the neck to the body consists of marking where the fingerboard comes in contact with the top of the body, carefully scraping away the lacquer from that area, and then gluing the neck joint and fingerboard to the body with white glue. White glue is used because it can be steamed apart easier than other glues, in the event that the neck needs to be remove for resetting.

I used one cam clamp for applying pressure vertically on the dovetail joint, and two deep-throated C clamps to apply clamping pressure on the area where the fingerboard attached to the body.Missy, the lilac-point Siamese, provided consulting on proper clamping pressure. The bag of flour is acting as a counter-weight to keep the neck from resting on the table.

After the neck is glued on, the bridge gets positioned and attached.

Attaching the Bridge

Locating the bridge in the proper place is one of the more critical placement procedures in building the kit. If you screw up the bridge location, you've pretty mush destroyed any possibility of playing the guitar without having to somehow remove the bridge without destroying the guitar top, repairing the damage to the lacquer, and relocating the bridge correctly.

The instructions that came with the guitar kit were pretty good, and I augmented them with the directions in the guitar making books. Basically, you position the bridge such that the middle of the slot for the saddle on the low-E string end will be located at twice the distance from the nut as the 12th fret, and the middle of the slot for the saddle will be located at slightly less than that distance. The saddle is angled so that when you press the higher tensioned strings, by the time your finger hits the fret board the tension on the string is increased enough to raise the pitch of the string to the correct pitch for that fret. The high strings pitch increases more when pressed than the low strings, so the distance to the saddle needs to be a little shorter. This is all explained quite well in the directions and the books. I had no problem correctly placing the bridge using the directions and a standard aluminum yardstick.

Once you've gotten the bridge located in the correct spot, you carefully scribe a line in the lacquer using a sharp pin, and then scrape away all the lacquer from the top at that location. Glue is applied, and the bridge is clamped in place with a few deep-throated C clamps. A 3/4" thick clamping block is placed underneath the top of the guitar to help spread the clamping pressure more evenly.

Once the bridge is located, you move on to shaping the saddle and slotting the nut.

The Saddle and the Nut

Once the bridge was located, it became apparent that the saddle needed to be in position for the next steps. However, I could find no mention of the saddle at all in the kit instructions, which was a little disturbing, as like the nut, the saddle was just a blank rectangle of bone. So, I reverted to the guitar making books again, and used a file and various sandpapers to rough shape the saddle to fit snugly into the provided slot in the bridge. I left the bridge ridiculously tall to start, knowing that once the nut was slotted for all the strings, the next step would be to shape the saddle to the correct height.

After the rough shaping of the saddle was complete, I installed the 6 tuning machines. One thing that I found odd, and I've yet to call Martin about, is that I was provided 6 identical tuning machines, which means that when looking at the guitar from the front, the 3 tuning machines on the right have the tuning knobs extending out from the top of the tuning machine, and the three on the left have the knobs extending out from the bottom of the tuning machine. It looks very unbalanced. I called Martin about it, and they agreed that was an error, and a few days later I received 6 new machines in the mail. They've been ***very*** responsive when I've called with questions or issues, for which I'm grateful. It's not very often you find good customer service these days!

After installing the tuning machines, I installed the saddle in the bridge, and mounted the first (low E) string. This was rather exciting - it made it quite clear that I was almost done, and I'd soon know if the instrument was going to be playable!

With the low "E" string in place, the nut is marked where the two sides of the low "E" string are located relative to the nut. The nut is then notched just enough to prevent the string from sliding around. The nut is then marked where the high "E" string hits, and is notched there as well. The space between these two notches is then divided between the rest of the strings, and small notches are made at those locations as well. The rest of the strings are attached, and tightened just enough to prevent them from moving around. The spacing of the strings is checked (primarily visually), and the notches for the thicker, low-end strings are gently widened in the direction that gives the best visual appeal. This is because the spacing will not be equal between each string, as the low strings are thicker and will appear to be closer together as the centers of the strings are left equidistant.

All in all, this was a great experience and I'd do it again in a heartbeat. The guitar sounds pretty good - I'd like a richer low end, but it still sounds quite acceptable, and the action came out quite nice.

I do intend on making another guitar. After I take a break from it for a little while and get some other projects done, I'll decide on whether to do another kit, or to go for broke and try making a guitar completely from scratch. I've picked up a bending iron to practice bending sides; I may just buy some quarter sawn cherry and practice making necks and sides, and when I get a set of sides and a neck that seems pretty good, I'll stop practicing and build the rest of it! :-) Until then, I'm just going to enjoying playing an instrument that I actually assembled myself!

Αντώνης Χριστάκη