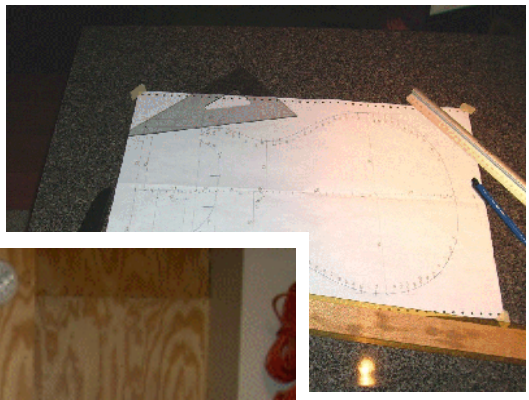
Brian's Guitar

from Conception to Birth

or How to Build a Guitar in 62 Easy Steps!

Vince Gelezunas



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Some Background on Me

Hi, I'm Vince and I met Brian when we recruited him to join our band, Idiosyncrasy. The band was a lot of fun and we played a lot of shows, but as with everything in life: all good things must come to an end. Though the band stopped playing, Brian and I (and our wives) still hung out together.

I had milked every last drop out of the band experience I could, and I guess I got out of it what I wanted from playing in bands for about fourteen years. I was also getting old and basically outgrowing our target demographic. What young crowd wants to go and see old people on stage? Someone please tell Mick Jagger that. So I sold off all my band equipment and bought woodworking equipment. We had recently built a house and were looking to do a few upgrades ourselves so it made sense. I always had an interest in woodworking and I took it to the next level by enrolling in classes at a local vocational school, Ranken Technical College. After a year of school and a bunch of small projects, I finally got up the courage to attempt one of the most demanding projects requiring rigid precision, tight joinery, and a combination of just about every woodworking skill imaginable: building an electric guitar from scratch.

Since I wasn't playing much guitar anymore, I needed someone to make it for. Brian had asked me a couple of times to go for it, so I eventually called his bluff and accepted his challenge. The deal was that he would buy the materials and I would donate my time and cover the cost of any tools needed. Game on!

The following text will probably sound like an instruction manual. While researching this project, I found others' stories of their build experiences invaluable. It is my intention to post my experience on the internet as well so someone else can muster the courage to build their own guitar and avoid as many mistakes as possible along the way. I'll cover all of the steps I used in making Brian's guitar, some of the thoughts and considerations involved, and some things to watch out for. You can bounce back and forth between some of these steps, but there are times when you will need one thing done before moving on to the next.

Please be advised that I am not a professional luthier. I have some experience in woodworking, but this is my first guitar project. I may advise something at which a seasoned guitar maker might scoff. But hey, it worked for me. Use this as only one resource from which to gather information. There are many web sites showing different techniques and processes. Stewart MacDonald (www.StewMac.com) has many articles of enlightenment as well as all the specialized tools you'll need. You Tube (www.YouTube.com) has many videos stepping you through various tasks. Project Guitar (www.ProjectGuitar.com) has a host of information from tutorials to design ideas and links to various boutique component suppliers.

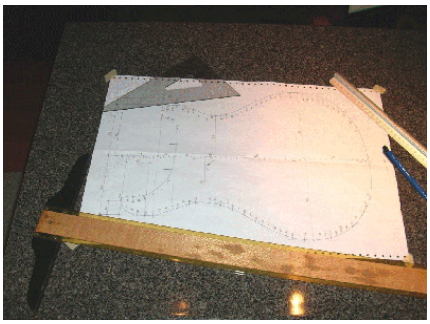
There are many steps which lie ahead of you. Don't try to finish the whole guitar off in one night. Take your time and think things through before you commit to something. And above all, have fun.

Preparation

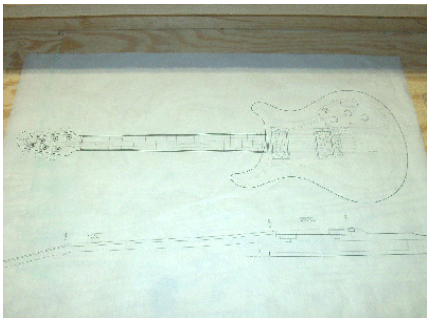
You won't want to attempt to do your own build unless you have some knowledge of how to use woodworking tools. This project will require a high level of skill, patience, and experience in woodworking. If you're missing any of those traits, your build will probably not come out as professional looking as you might expect. I don't want to discourage anyone, but this will cost a good sum of money and a large investment of time. If this is your first guitar build, you obviously won't know what you're doing. This dialogue will recount my experience on this particular guitar. Your experience may vary and difficult situations might arise so you will have to fall back on your woodworking experience to fill in the gaps. I can't teach you woodworking here or show you how to use every tool, but I can outline the steps in making a guitar and throw in a few tips here and there.

If you're planning on building a guitar to save some money, you'd be in it for the wrong reason. The tab for this build was over $1,000 in materials alone (see the Specifications listing in Appendix A). This does not count the cost of the tools used. Building your own guitar is a mark of pride in your craftsmanship and a sense of accomplishment. You can create your own designs and include the components and details you want. You don't have to settle for what's hanging up in the store.

Before you start whacking away at a pile of wood, you'll want to get yourself a little prepared and build up a some confidence. I started off by reading books and scouring the internet to gain as much background knowledge as I could. Through that research, I developed a checklist of everything Brian would have to consider when writing the specs for his new instrument, and I put him to work (see the Design Considerations checklist in Appendix B). While Brian was busy researching and buying parts for his dream machine, I got to work on sorting out the details of the design. You need to make **ALL** of your choices up front (notice the bold and all caps). You have to be **VERY** thoroughly prepared because once you start cutting and gluing up wood, there's no going back. It is also imperative that you purchase everything before you start. You need to have all the parts in your hand so you can measure all the components and prepare an accurate design based on precise and actual dimensions. Little things like the height of your bridge or the width of your nut will dramatically effect the way the guitar is put together. Avoid the temptation to just start cutting wood until you've developed a full scale drawing of the guitar.



Brian loves the Paul Reed Smith body style, so we went to Guitar Center and traced one. Please ask permission first and don't use indelible ink which might end up on the guitar or you'll end up buying that guitar instead of making one. I took the tracing to the drawing board, laid out a centerline, and plotted all the points around the body. Fortunately I have AutoCAD at work so I could transfer everything into the computer and work with more precision than doing everything with a pencil and a ruler. I input the dimensions into the computer and refined things up a bit. Though complete plagiarization is alright here, you should tweak some of the details to make the design your own (otherwise just buy the PRS). I tweaked the proportions a little and played around with the headstock design and inlay patterns. Brian wanted to personalize the electronics package.



While I was busy on the design and layout, Brian was buying stuff like a kid in a candy store. There are a few local sources for things, but the internet proved to be the best resource for opening up the most options for all the products. As Brian received the goods he passed them along to me. I in turn got out my (metric) ruler and digital calipers to document all the components and draw them up on the computer. The details of the design will start to come together as you let the individual components steer you.

To lay out the neck, you need the nut width on one end and the bridge width on the other. You need to know your scale length and fret spacing (there are plenty of charts for this on the internet). The bridge height will dictate how much your neck tilts back from the body. The dimensions of the tuning machines will place some restrictions on how you lay them out on the headstock. The depth of your electronics will let you know how thick to make the body and how large the control cavity has to be. You definitely don't want to find out that you don't have enough

room inside after you've got the guitar completely finished. You get the drift. You want to avoid being surprised after mis-cutting that $100 piece of quilted maple. The photo shows a full scale drawing of Brain's guitar and a section through it. Both are critical to have worked out before you start (see the Design Diagrams in Appendix C).

We got excited to jump into things so we satisfied that urge by buying some wood (December 14, 2007). I took a few rough dimensions off my old guitar so I was sure we would get enough. Wood choice is mostly dictated by personal preference, but there is one major rule to follow: select hard woods which resist warping. Brian decided on the following (from top to bottom in the photo):

- **Headstock Veneer**: Lacewood. While in the wood store, Brian just thought this looked cool so we found a use for it. It's only about 3mm thick and it will simply be used to dress up the headstock and a few other areas. Oh, get used to the millimeter thing. It is far easier to work in metric for this precise work than in imperial units. Where do you mark 1.693"? Or what is half of 3 19/64"? If you always use millimeters, you will always know where to mark 43mm or what half of 84mm is. Don't worry, you'll get used to it and appreciate it after a while. But most importantly, you will make less measuring and calculating errors.
- **Body Back**: Mahogany. A stable and lighter wood that cuts like butter.
- **Neck**: Hard Maple. Look for straight grain which is less likely to warp.
- **Fretboard**: Macassar Ebony. This is a very hard wood which is also very dark so you won't see your finger grunge as much. This comes in jet black, but we selected a piece with some attractive grain pattern in it for a little visual interest.
- **Body Front**: Quilted maple. This is where Brian splurged, but this is also the part everyone sees first. We got a piece thick enough where we could cut it in half and bookmatch the leaves. This piece was purchased on Ebay while all the other wood was purchased at The Wood & Shop, a local wood supply store.

We had to buy a little more wood than we actually would use since the wood stores usually won't slice things down for you. Use the leftover pieces to practice cutting or finishing on or save them for your next guitar!

A note on safety. You'll see that all of the photos of me operating a table saw show that I've removed the blade guard and splitter. Some folks will tell you it's for clarity of the photograph. I won't tell you that; I never use them since they get in the way more often than not. But I am also fully aware that my finger might get in the way, too. I won't preach to you on your own safety; that's your own responsibility. One simple rule in woodworking is that if you don't feel comfortable doing it, don't do it. But you might not be experienced enough (or smart enough) to know when something is unsafe. If that's the case, again, don't do it. Find someone who can help you through the tough bits. It would really kind of suck to build this great guitar and not have any fingers left to play it.

Even though this will be a one-off guitar, making some jigs and templates will greatly increase the accuracy of your build, and you will be able to use some of them on your future builds if you aim on doing another. A template is always better and safer to use than free-hand routing. A router bit spins at over 20,000 rpm's. If it grabs the wood unexpectedly, it will take you for a ride in the best case; it will easily take a finger off in the worst case. With a table saw you might have something to sew back on. Planting a router into your hand is akin to sticking your digits in a blender. Templates will help you keep control of the tool and are essential for making precise, straight, and repeatable cuts.

You will notice that I made many jigs and templates to help me with this build. You can make them as basic or as complete and full-featured as you see fit. Make them as you need them and design a few of your own. I don't include a lot of dimensions here as many of them will be tailored to this particular build. Use the concepts and make the designs your own with available materials. The goal for any jig and template is precision, repeatability, and safety.

The Body

Once you feel you've prepared enough, it's time to dive in. Here is where some of the "real man" tools come in handy. As I mentioned, I took woodworking classes at a technical college. One of the benefits of being an alumni is that I can go back and use their big and expensive tools. So I just planned and prepared a few trips to take care of the things I couldn't accomplish at home.

1 Rough-out the Body Panels

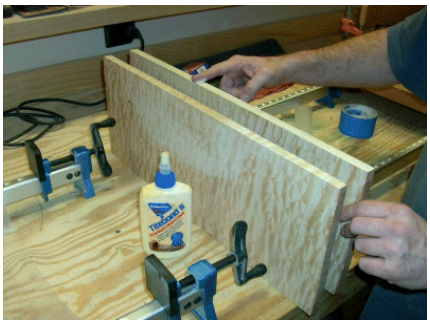

The guitar's body design has a pretty front face of quilted maple on top of the less expensive mahogany (although that's not that cheap either). I used the jointer to clean up and flatten one edge of the maple. A few light passes through the machine is all you'll need. Then take the board over to the table saw and cut just a little off the opposite edge. This will make both edges perfectly parallel. Keep the board oversized at this point. Remember, you can always trim a little more off, but you can't add more back on (just make a sign of that statement and tape it to your forehead). Take the board back to the jointer for a single, light pass on this freshly cut edge to clean up any saw marks and get it glass smooth.

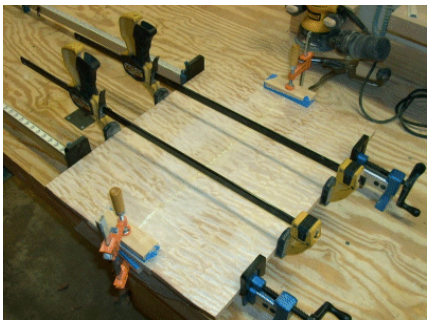

Since the top will be a book-matched set (kind of like a mirror image), you have to cut the board and open it up like a book. This is accomplished on the bandsaw. Mark your board on the edge before cutting so you can match the pieces up again later in sequence. Set the fence up to cut the board a little thicker than you need. Run both sides of both leaves through the drum sander to clean off the saw marks. The jointer is a little too aggressive for this type of wood and it will chip out on you. Get them to the same thickness, but at least 4mm over your final thickness. You'll plane them down to final thickness after they're glued up. Set the front panels aside for now and get the back panels going.


The back side of the body for this guitar is mahogany, but the board we found was not quite wide enough to book-match. It's on the back of the guitar so it really wasn't that critical to us. Mahogany doesn't have that distinctive of a grain pattern so it will not be that noticeable anyway. Just like the front panels, run one edge through the jointer and then trim the opposite edge parallel on the table saw. Make one more light pass back through the jointer on the freshly cut edge. Since I'm not book-matching this board, I can skip the bandsaw. Instead, use the miter saw to chop two panels about 50mm over the final length. Run them through the drum sander to remove any imperfections and to insure consistent depth keeping them at least 4mm over the final thickness.

2 Glue-up the Body Panels

Now it's time to glue up the halves. The front of the guitar is book-matched so you'll want to choose which book-match looks the best; it can go either of two ways. Use the edge marks you made earlier to put the boards back into the original alignment. Imagine that the binding of this "book" can be hinged on the top or the bottom. Open them up each way and pick the side you like best. Once you've selected your best face, place a mark across the faces at the abutment of the two boards so they can easily be aligned when gluing.





Once you spread the glue you only have a few minutes to work. So prepare the clamps and do a dry run to make sure everything is set up right. I cover the tops of the clamps and my workbench with wax paper to keep the glue from sticking where it shouldn't. Once you're ready, smear a little wood glue on one edge of one board. Just like picking your nose or checking your prostate, nothing works better than your finger. I also put a very small amount of glue on the opposite edge just enough to saturate the grain. If you get too much glue in there you'll have a big slippery, sliding mess (which might be good for sex, but not for this glue-up). Place the boards in your clamps and apply slight side pressure keeping your book-matched halves in alignment. Add a clamp on each end of the joint to keep the two surfaces flush with each other. Use a clamping block with wax paper wrapped around the edges of the boards. Tighten all the clamps a little at a time working your way around. Moderate pressure is all that's needed. You'll get some glue squeeze out, but that's a good thing; it shows that you've used enough glue. Avoid the temptation to wipe up the glue ooze. All you'll do is force glue into the grain of the wood and stain will not be able to penetrate those areas (meaning that would be ugly). Repeat the glue up procedure for the back panels of the guitar, and let everything dry over night.

The next day, take off all of the clamps. Use a scraper to remove the (now dry) glue ooze. As you probably noticed, when you glue something up, it tends to want to slide all over the place. My boards traveled some over the length and they crept out of flush a tad. That's why you always leave everything bigger until the last possible moment. I trimmed a fraction off each end to square things up. Then I ripped some off of each side of the panel to get it a little closer to actual size. This will help in making it easier to handle on some of the upcoming steps (as well as getting it to fit through my planer). Remember to keep the centerline of your glued-up panels in the center; trim a little off of both sides.

Clean up both sides of the panel on the planer with light passes until you reach final thickness checking after each pass with a caliper. If your planer isn't wide enough to handle the panel or you simply don't own a power planer, try kicking it old school with a trusty No. 5 bench plane and a straightedge (notice that pile of shavings). It's not quite as fast, but you'd be surprised at how well the old tools work.

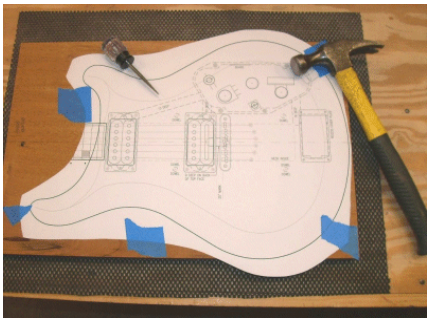
Now repeat all those steps with the top panel: square up the ends, rip to width, plane to exact thickness. Remember to keep the centerline of your glued-up panels in the center; trim a little off of both sides. Always take your time and triple-check all of your measurements. You don't want to make a wrong cut on expensive wood and have to start all over again. Your patience will reward you. Let's take some time now for a preview and to get excited about the build. Notice the mirror effect the book-matching gives you. The wood in this photo was wetted down with mineral spirits so you can see what the grain will look like after finishing. This effect will be even more spectacular once the color and top coats go on and it's rubbed out.

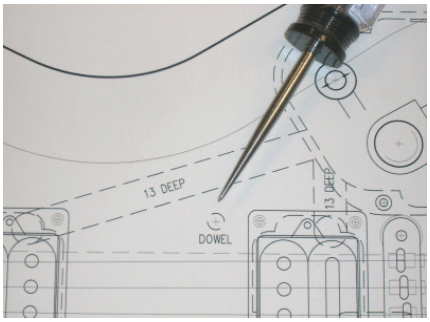
3 Install Alignment Dowels

The first thing most people want to do is get directly into cutting out the shape of the guitar. Resist that urge. Keeping your work surface square will allow you to transfer measurements from one side of a panel to the other, it will allow you to use edge routing guides, and it will provide a broader surface to support your router. Save the body magic for later.

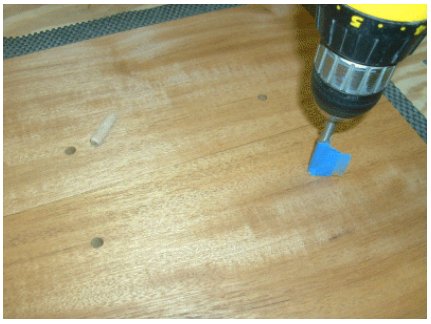
There are many cavities inside an electric guitar. They all have different depths and some of them overlap. I thought there should be an easy way to organize the various routing setups and precisely control the placement of all the cuts. I came up with a system which uses dowels to which you can accurately register a multitude of templates. It allows easy placement of your templates repeatedly in exactly the same position. You'll never have an alignment problem nor a faulty measurement issue when you start carving up your expensive wood.

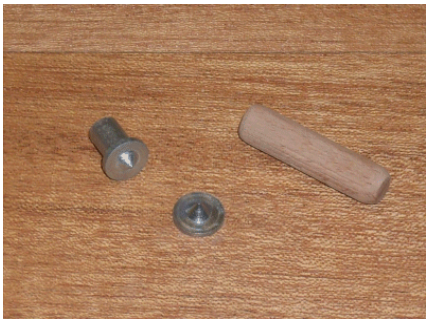
First, print up a few copies of your guitar body complete with all of your cavity layouts. Tape it to the body back panel and carefully line up your center lines. Using an awl, mark the locations of the alignment dowels. I used four dowels. Remove your pattern and drill holes to match your dowel diameter. Drill into the body about 12mm. Be careful not to drill all the way through or you'll mess up the back of your guitar.





The best way to avoid drilling too deep is to set your depth stop on your drill press. If you don't own a drill press, you can use masking tape to mark your drill bit. Just be very careful as masking tape is not the sturdiest thing and it won't stop you if you get heavy-handed. They also make stop collars which attach directly to drill bits. These will be more forgiving if you push too hard, but they, too, can still slip. Be very conscious if you're hand drilling to keep your drill perfectly level and plumb so you drill straight down. If you angle your drill, it may make for some alignment problems later on down the line.



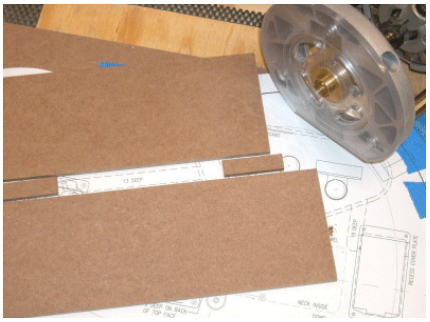
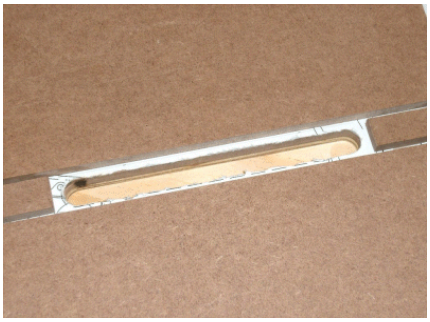
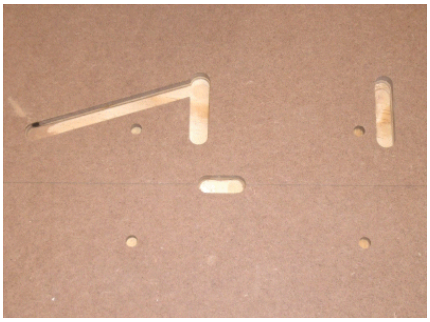


Now you'll need to transfer your dowel locations to the top panel and some 1/4" thick MDF for some template blanks. Dowel centers are commonly available and do the trick well. Insert the dowel center into the holes you just drilled, place your body top panel over them keeping your center lines aligned (keep your "show-side" out), then gently push down or rap the top with your fist to leave a slight indentation. Drill the backside of your top panel about 8mm deep. Repeat the procedure for the template blanks and transfer your center lines to these blanks. Now all of these panels can be repeatedly installed and removed in exactly the same position every time without measuring, marking, or taping down.

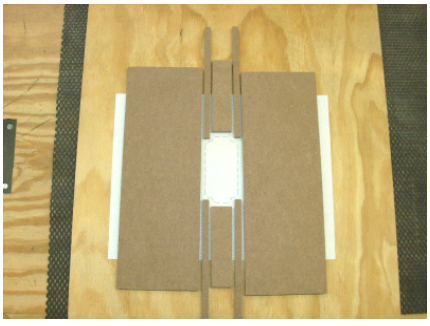
4 Make Up the Templates

Now that you have some template blanks, you can start to organize your plan of attack. Each cavity will have it's own router setup. This will include bit diameter, bushing outside diameter, bearing guided bits, depth of cut, which router bits you actually have available, etc. In some cases, you will make a template to make a template. I won't get into the entire puzzle, but I will show you a few examples.

The first example is for some simple wiring channels. Since my guitar will have a pretty top panel over a mahogany back panel, I can easily rout a channel for the wires rather than trying to drill a carefully placed and angled hole between the pickups and the control cavity. My ultimate goal is to rout the channel with a 1/2" diameter router bit with a 3/4" OD (outside diameter) guide bushing. The guide bushing will allow you to align the router first before plunging it into the surface of the wood. The template blank (with the dowel alignment holes) needs to have a 3/4" wide groove in it.

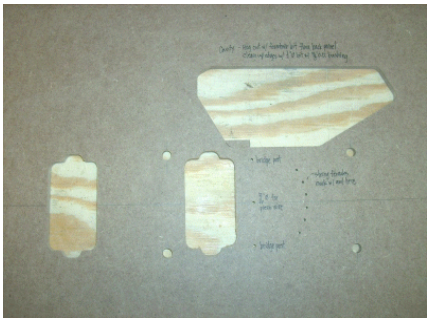




To make this groove, first tape a copy of your guitar body pattern onto one of the templates. I cut half of each dowel hole out of the pattern and used the center lines to carefully place the pattern. Draw some offsets onto your pattern 1/8" of an inch outside each of the limits of your final routed channel. Remember, using this bit/ bushing setup will leave a 1/8" offset from your guide to your router bit. Since we'll essentially be making a template to make our template, you will have two 1/8" offsets; a 1/4" (metric is so much easier, but I don't have metric router bits). Place some scrap 1/4" thick MDF at these offset lines using double-sided (carpet) tape. Since you will be routing all the way through, place your work over some scrap plywood. Set your plunge depth to just go through the MDF template blank. Place your router bushing inside your limits, flip it on, plunge it in, and rout away. I like to make two light passes blowing the dust out frequently to leave a crisp line. Remove your temporary scrap guides. Repeat the procedure for the channels.



Other cavities will have different setups. For instance, the pickup cavities on my guitar will completely pierce the top panel, but will not have to go into the back panel. Again, I will make a template to make a template. This way I can use the pickup template on the next guitar whose configuration might vary. This template scheme will work out differently. My pickup template will have only a 1/16" offset (1/2" bit with a 5/8" bushing). I will use this template to transfer the pattern to the large template blank leaving a pattern exactly the same size as that which will be used on the guitar. Then I will use a 1/2" bearing guided bit to clean up the edges. After you see some of this in action, you'll start to be able to understand how each cavity setup will vary and how to plan your methodology. For the pickup cavity template, cut up thin strips of 1/4" thick MDF to the appropriate widths and glue them all up securing them with masking tape to hold them while they dry.

Label your templates with your setup notes so you'll remember each bit and bushing arrangement. This template locates the two humbuckers, the control cavity, and the center points for the bridge mounting location and string ferrules. It took a few nights of (unrewarding) template construction, but this effort is time well spent. If you screw up a template, you're only out a couple dollars. Pretty guitar wood can be quite expensive. Remember that old "ounce of prevention" proverb.



5 Rout the Back Body Panel

Now that you're thoroughly prepared with your templates, it's time to start on the real thing. The neck on our design is sandwiched in between the top and bottom body panels. So we have to make some room for it by routing out a cavity in the back body panel. Index the template onto the dowels for perfect alignment, set up the router (in this case I used a 1/2" bit with a 5/8" bushing), and let the chips fly. Remember to set your final depth carefully on your router so you don't cut too deep. In the photo you'll notice another small scrap of MDF in the control cavity space on the template. That's just to give the router base some support so it doesn't tilt when riding over the thin strip between the template openings.

Next up is the wire channels. Using the same router setup (only adjusting the final depth), cut the wire channels. The control cavity is cut all the way through the back body panel. It's easiest to hog out the majority of the material by drilling through with a large forstner bit. To avoid blowing out and splintering the bottom, place masking tape at that area and drill onto a solid surface like a scrap piece of plywood. Now index the control cavity template onto the dowels and clean up the edges.

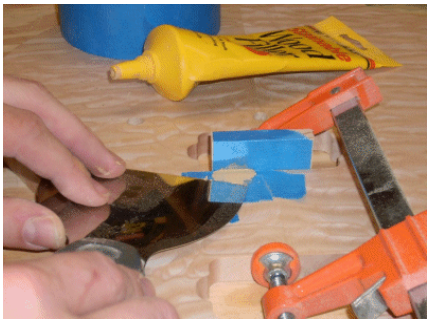
Flip the back body panel over so you can cut a recess for the control cavity cover plate. Visually align the template over your cavity. Check yourself with a ruler to make sure you're aligned properly (sorry, no dowels on the back). Using double-sided tape, adhere the template to the wood and rout to the required depth. For this setup I used a very short hinge-mortising bit (1/2" bearing guided) and my template was made to the exact final size.

The battery compartment was next. I transferred the center lines of the body to the back and took my measurements from the side of the block of wood. Setup the router and go. You should be starting to see that with the right preparation, this portion of the process goes quickly. The flange of the battery compartment will be recessed, but I had to use a different method than that used for the control cavity cover. The corners of the battery compartment have a tight, 1/8" radius. So I used a 1/4" diameter bit with a 3/8" OD bushing. As I mentioned, you have to put some forethought into each of these router setups so you can create your templates accurately. You should also take into consideration the tools you have. You'll notice that my control cavity has tighter radii on the corners. I do not own a large forstner bit nor a spindle sander. I made due with the 3/4" router bit I did own. It's alright to plan in some of these efficiencies.

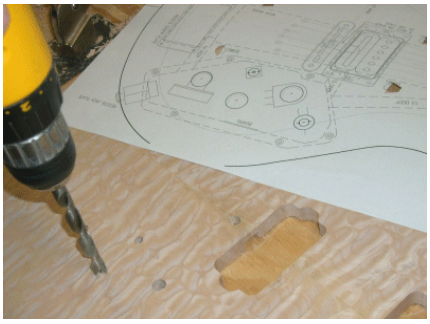
6

Rout the Front Body Panel

Now that you've gained some confidence, it's time to start whittling away on the show side. First off, the pickup cavities. My design allowed me to only have to rout cavities in the top body panel; the pickups won't go deep enough to intersect the back body panel. Be aware that you are working on the backside of the top half. Make sure to flip your template upside down as well. I definitely suggest placing masking tape on the front of the body panel and backing it up with scrap plywood to avoid any splintering when your tools break through. Hog the meat of the holes out with a forstner bit. Follow up by cleaning the edges up to your template with a 1/2" bearing guided bit.

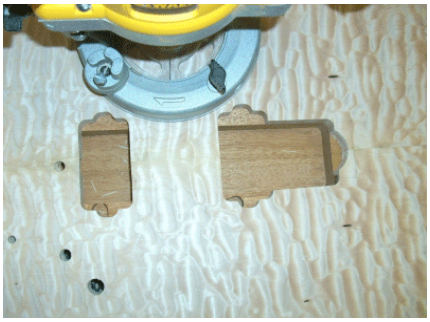


I love reading the books on making guitars where the author always gets it right the first time and the guitar comes out beautifully. As careful as you'll be, you will likely take out a chunk of wood somewhere you shouldn't have (like I did). The best thing to do is to retrieve the actual chunk and glue it back in. If you can't find the chunk, tape off the surrounding area and patch with stainable wood filler. Don't skip the taping off step since stainable wood filler will take stain, but it may not take it the way you wish. Even a little smudge outside the area will clog the wood pores and affect the way the stain penetrates leaving a nice thumb print in the middle of your quilted maple top. Immediately remove the tape, but let the patch dry overnight. Then sand the area flush. A third option is to use the opportunity to create a special inlay over the damaged area: creative camouflage. You'll see an example of this technique later on.



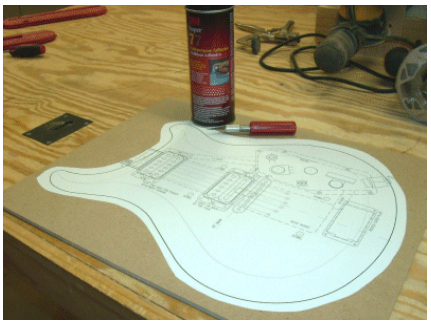
Remove the template, and with the top body panel still upside down, layout the hole locations for your knobs and switches. Remember to flip your paper pattern over and carefully align it. I cut half the dowel holes out of the pattern and used those and the center lines to position the paper pattern accurately. Mark the hole locations with an awl and hammer. Drill through with a 1/16" drill bit making an effort to stay straight up and down. Use a drill press if you own one. Now flip the body panel over and drill your holes to size from the front using brad point bits. Do not use regular twist drill bits that you buy at Home Depot. These will shred the wood. Brad point bits have a center brad and two sharp tines which score the wood first before drilling it out. For fine woodworking (like a guitar) they're worth the investment. Check the diameter of each of the knob/ switch posts and select a drill bit about 1/64" larger. Don't worry if the switch posts don't go all the way through the top panel. This guitar will have a carved top and it hasn't been carved yet. Later we'll hollow out the back of the top body panel at the control cavity to thin it out some after the carving has been done.

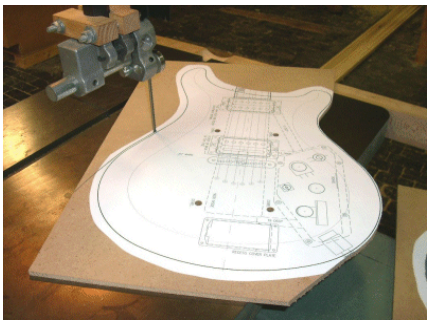
The last item of business is to rout out the area where the neck intersects the top body panel. Again, this is easily accomplished by using the alignment dowels. Index the top body panel onto the back body panel. Using a 1/2" bottom bearing bit, you can simply transfer the exact shape cut earlier in the bottom panel onto the top body panel. If you're scratching your head looking at the picture, keep in mind that the body shape has not been cut out yet. When cutting out the body shape later on, it will open up the area where the neck will lock in. Also note in the photo where the wire channels can be seen in the bottoms of the pickup cavities. Careful planning has its rewards.



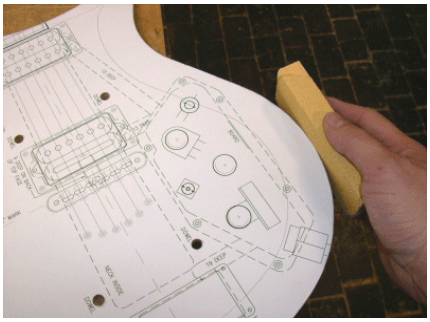
7 Cut Out the Body Shape

This is the point you've been waiting for. You will finally see what the final product will look like. Cut out your paper pattern about 12mm outside the final shape. Use spray adhesive to mount this to some 1/4" thick MDF. Drill your dowel locations through the template. On the bandsaw, cut about 2mm outside your pattern line.

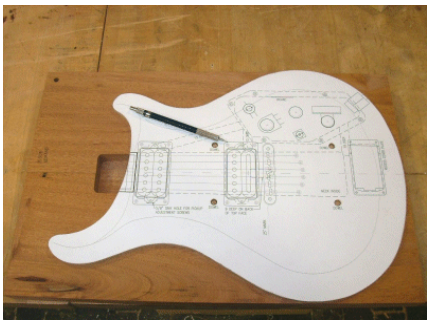




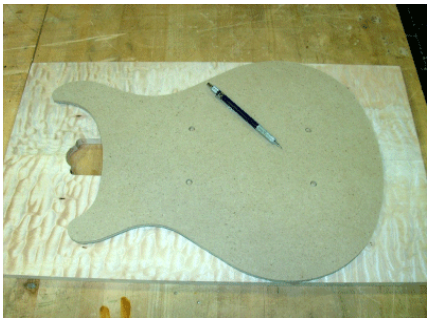
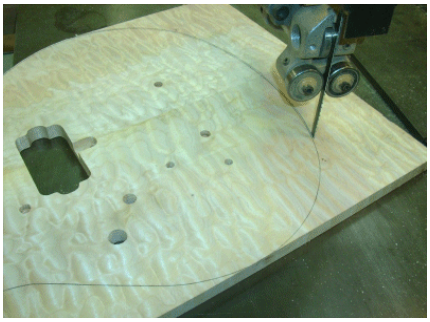
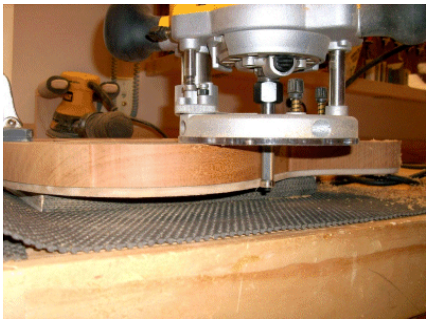
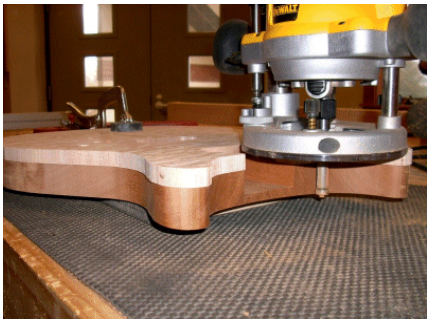
Now sand right up to your line with an oscillating spindle sander. You can also you a sanding drum mounted in your drill press. Or you can use some good old-fashioned elbow grease and a sanding block. Sand just enough to remove your line. The curves should feel smooth to the touch. This will be your final template for the body, so take some time to get it just right.



Place the template onto the back body panel using the locating dowels. Trace around the template. On the band saw, cut about 2mm outside your line.



Repeat the procedure for the top body panel. Remember your dowels are on the “inside” face so flip your template upside-down and trace. Again, use the band saw and cut about 2mm outside your line.


Place your template onto the back body panel using the locating dowels. Place the panel template-side-down on an elevated, padded piece of plywood and clamp it to your workbench. Use a long flush cut router bit with a bearing on the bottom which will follow your template. Cut halfway around, turn the piece and re-clamp so you can finish the full perimeter. Now un-clamp, flip the unit over, and remove the template. Place the front body panel over the back body panel onto the locating dowels and re-clamp. Our body design has the neck penetrating into the body cavity. So I had to set the bearing-guided bit low enough to ride the body shape without slipping into the cavity. Rout all the way around just like the last time. Now you will have two perfectly mated panels at their final shape.

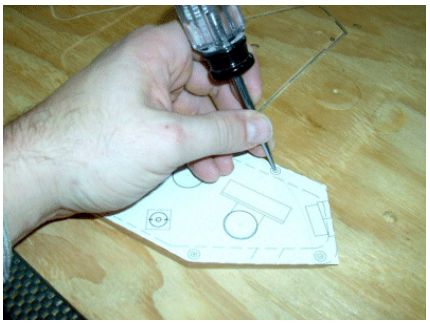
8 Make the Control Cavity Cover

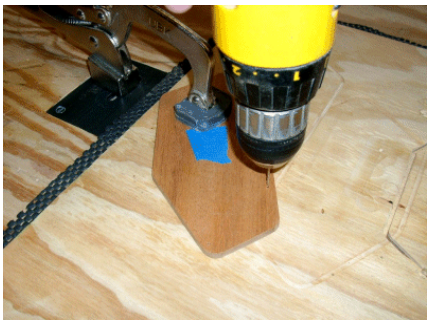
The easiest way to do this is to use the same template you used to cut the control cavity cover ledge earlier on the back of the guitar. The template was made to the exact size and shape of the final product. So using a little math (remember that class) you can come up with a way to use guide bushings to repeat the exact shape. Our cover will be made from mahogany to match the body panel, but this process will work with whatever material you choose; the concept is the same.


Plane the wood down to just barely over the exact thickness your ledge is on the body. This will leave a little to sand off flush later. You’ll be making a template using your original control cavity cover template. Secure a piece of 1/4" MDF onto a scrap sheet of plywood with double-sided tape as you will be cutting all the way through. Remember to stick a piece of tape directly under your cutout so it doesn’t catch the bit and go flying when it is released. Mount your original template over the MDF with double-sided tape. Setup your router with an 1/8" bit

with a 3/8" OD bushing. This will cut the same shape, but it will be 1/4" smaller all the way. Now rout around the perimeter being careful not stray inside fouling the template you're making. Make a couple of light passes to release the new template. Mount this new template onto your final material using double-stick tape. Remember to stick a piece of tape directly under your cutout so it doesn't catch the bit and go flying when it is released. Install a 5/8" OD guide bushing in the router, This will produce a 1/4" offset, which happens to be exactly the size your template was cut shy in the previous step resulting in an exact replica of the original shape.

You will need to sand a hair off the edges to fine tune the fit. It shouldn't be so tight you can't get it out. Sand and test the fit repeatedly so you sneak up on a fit which allows you to remove the cover plate easily. With a little patience you will get it perfect. You can't even see a seam in the photo.



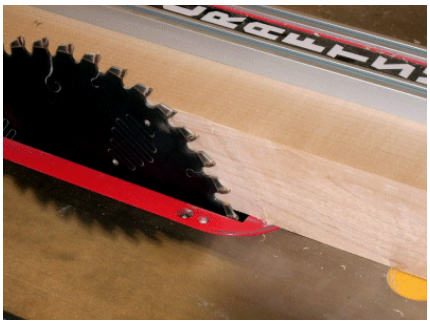


Cut the cavity cover from your paper pattern and position it onto the actual cover to transfer the mounting screw locations with an awl. Use a 1/16" drill bit to make pilot holes all the way through the cover. Now place your cover onto the guitar. Use these holes to locate and drill the holes into the guitar body. Only drill a very shallow hole into the body (about 1/16" deep). We're just locating the holes at this point.

Remove the cover plate and you will see exactly where to drill deeper and wider for the mounting screw pilot holes. I'm using threaded inserts which will never strip out, but the process is the same if you'll be screwing yours directly into the body. Gauge the depth of the threaded inserts and add 1mm to the depth so you don't bottom out the inserts. Mark your drill bit with masking tape and drill as straight in as you can. A drill press would make this easier. Brass inserts are very soft, so thread them into the holes very carefully with a hand screwdriver. Drill the holes in your cover plate slightly larger than the screw's shank and countersink for the screw heads. This is easy if you have a drill/ countersink bit. Mount your cover plate and lightly tighten the screws. Notice I said, "lightly". You don't need to torque these screws down. Sand the cover plate perfectly flush to the body.

9 Cut the Neck

You really need to have accurate and precise drawings made for your neck. I had the luxury of computer software to help, but you can still accomplish this accuracy with a T-square and a pencil. Making the neck wrong will render your guitar unplayable. Since the neck on our guitar actually penetrates into the body, it will have a few more cuts and angles to worry about.

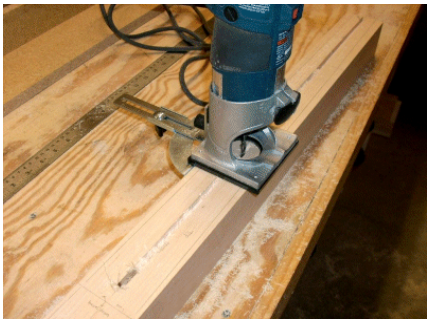

Joint, plane, and saw your rough neck stock to the exact width and height. There's no room for cutting wide this time, you have to hit it right the first time. However, I do like to make the first cut about 1mm wider than I need. Then I readjust the saw to the exact dimension and swipe off that last millimeter. Since there's less resistance on the saw blade, you can get through the hard wood more quickly and take off any burn marks made on the first pass. My drawings accounted for cutting a little extra length for the neck. But with the neck taper cuts coming up, I still have to hit the width dimensions exactly to my layout drawings.

Transfer the important layout lines to the top face of the neck. Locate the headstock bend line, the nut, the truss rod extent, and the end of the fretboard. Don't worry about the sides of the neck now since the sides (and any layout lines drawn there) will be cut off when tapering the neck later on. Locate your lines very carefully and double-check your layout. Please take heed when I say "carefully". You don't want to invest a dozen or so hours working on the neck to find out it's 10mm too short. There's just no fixing some mistakes without going all the way back to the start.

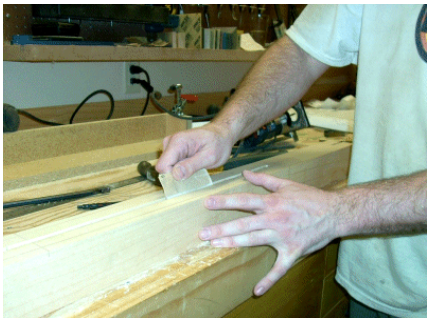
10

Rout for the Truss Rod

It's easiest to rout for the truss rod before tapering the neck while you still have an edge parallel to your center line on which your router fence may ride. Measure your truss rod's thickness and height and setup your router with an edge guide to those dimensions. Plan on making two light passes for the cleanest cut. Square off the end with a sharp chisel.



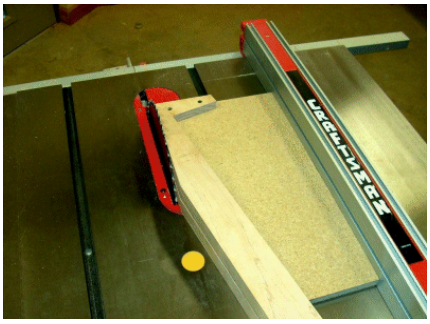
Clean up the groove with a few swipes of 150 grit sandpaper. Test fit the truss rod and do a little more chiseling and sanding where needed for a snug fit which is flush with the top face of the neck. You might notice that the truss rod does not extend all the way to the end of the neck in the photo on the right. We will cut the tilt-back on the headstock in the next step which will expose the end of the truss rod. But you should still rout your groove all the way off the headstock end of the neck blank.



11

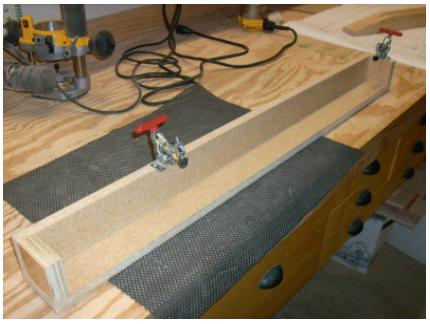
Cut the Headstock Angle

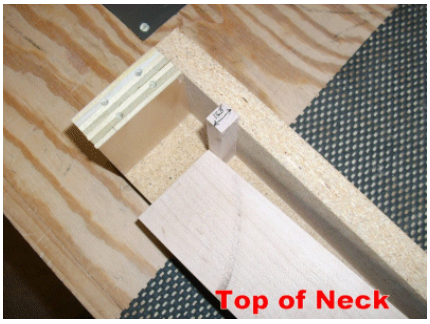
No one said that your jigs had to be pretty. To cut the headstock angle, I just needed something to hold the chunk of wood at a thirteen degree angle. So I took a piece of particle board and screwed a scrap wood stop to it and I was in business. I made the first cut wide then slowly made light passes until the edge of the cut just met the line for the backside of the nut as that is where my headstock starts to tilt back. Honestly, I made about a dozen passes. You don't want to take too much off or it's back to the start. Remember, you can always trim a little more off, but you can't add more back on.



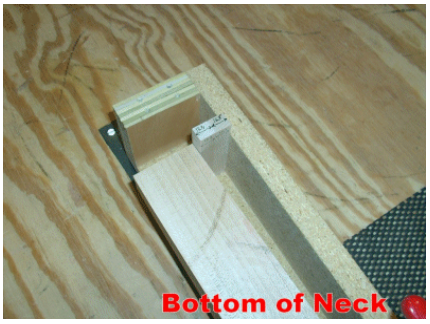
12

Taper the Neck





To taper the neck, you first need to make a sled which will hold the neck firmly at an angle. A simple jig with a few hold-downs is all you need. Using the jig is easy. First make sure your neck is cut exactly to the length your layout dictates. The neck on my guitar runs continuous from the headstock all the way into the body and almost out the other end of the body. Yours may be different, but this concept will still apply. From your drawings, note the width of the neck at the end of the headstock and the width at the body end. Divide the difference by two, which indicates the amount to taper off each side. Rip a small piece of wood to that exact dimension and cut two short pieces about 5mm longer than the height of your neck block. These will act as spacers. Place one of these spacers on the headstock end of the neck between the neck and the sled's side rail (see the middle photo above). Clamp the neck block down. Now set your table saw fence to the exact dimension of the thickest end of the neck making sure to add the width of the sled's side which will be riding against the fence. Crank up your saw blade as high as it will go and make the cut. It will be slow with some burning; just take your time and use a steady pace which won't bogging down your saw.

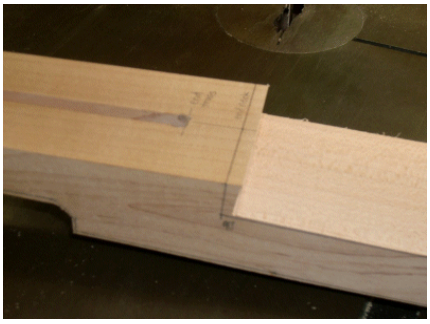


Now roll the neck over 180 degrees like a log. Add in the second spacer so BOTH are in position and clamp it down (see the left photo above). Run it through the table saw again without adjusting your fence. Clean off some of the blade and burn marks with an orbital sander loaded up with some 60 grit. Don't go crazy sanding right now since you'll be cutting a lot of wood off of the block yet. Just clean it up so you have a nice flat surface on which to draw your layout lines.

13

Rough Cut the Neck's Shape





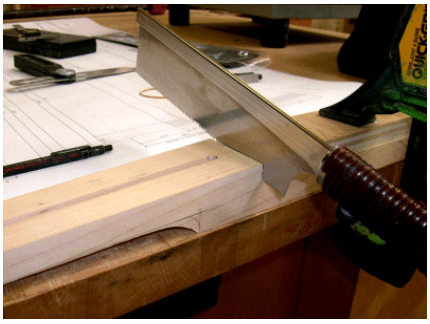
All of your layout lines should still be on the top of the neck. Some of those can be transferred to the side of the neck. A few other dimensions you'll have to "carefully" mark (there's that word again). The neck on our guitar actually penetrates about a foot into the body. This takes a little more layout and a few more cuts. After double-checking your marks, cut out the shape on the bandsaw about 2mm outside your lines. I gave about a 5mm margin where the end of our fretboard jogs to penetrate the body. I want to double (and triple) check that the end of the fretboard will be exactly where I want it. I won't cut this until after the neck is dry-fit to the body.

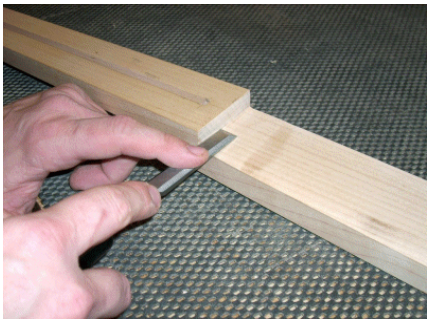

Now you just have a lot of clean up to do to get your cuts to be precisely up to your layout lines. The first photo to the right shows a horizontal/ vertical edge sander. This is a great tool if you have access to one. This will take care of leveling most of your straight edges. Just slowly work up to your layout lines with light pressure. For tighter areas and curves, use an oscillating drum sander (second photo). You can also use this on straight edges you couldn't reach with the previous sander. Just pay more attention to creeping up on your layout in a straight line avoiding any scalloping by pressing too hard in one spot. If you don't have access to these tools, you're shit out of luck. It will take a lot longer using hand planes, belt sanders, and orbital sanders.



Now it's time for a test fit. Don't worry, no matter what you've done or how careful you measured, it will not fit right the first time. If your neck is a little wide, use a sanding block on the sides of the cavity to creep up to a snug, but not too tight a fit. Don't sand the edges of the neck as it will screw up your fretboard width or make for some other weird transition. Remember to take a little off of each side to keep the neck centered. If you need a hammer to set the neck, it's still too tight (and you'll likely wedge both halves of the back body panel apart). If your fit is a little loose, some strategically placed shims glued into place will take up the slack (and no one will know). If you're off by more than 2mm, you messed up somewhere. That large a gap (yeah, even 2mm) is telling you that something

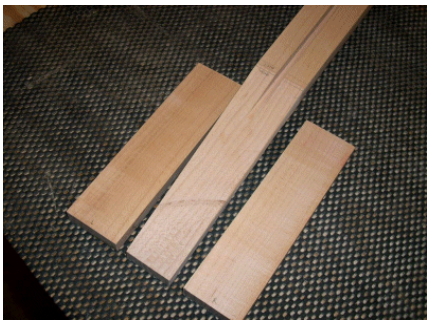
wasn't laid out correctly (it's really telling you that you're a hack and shouldn't be building a guitar in the first place!). Go back and check all of your measurements. You might have to go back to the start if you screwed up too badly. Once your neck slides smoothly into position with only minor friction, sand the portion where the neck penetrates the back body panel perfectly flush.



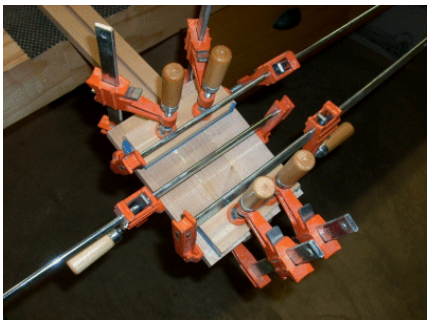


Now it's time to cut the end of the fretboard to it's exact position. Check your distance from nut to bridge. Hopefully you'll be right on or very close. The end of our fretboard abuts the neck pickup's cover plate. I marked the exact location on the neck and made the cut with my trusty Japanese pull-saw. I cleaned up the corner with chisels and sandpaper. Be sure to spend plenty of time getting the neck accurate and true. This is the most important part of the instrument and will directly affect the playability and intonation of the guitar.

14 Add the Headstock Ears



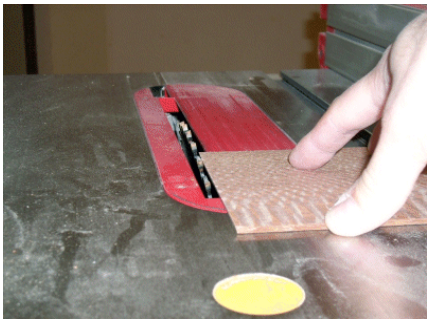
Due to the manner which the neck was cut and tapered, I will now add on a couple of ears to give me some meat from which to cut the final headstock's shape. Plane your ears to exact thickness (err on being a hair thicker). Layout where your ears need to start near the nut and cut the ears to length. Give yourself about a 25mm margin around the extent of the headstock so it won't matter if you're a bit long.



Spread a light layer of glue on one surface and position the ears exactly to your layout line near the nut. I use Titebond II glue for almost all my glue ups. Use plenty of clamps remembering to clamp the seams to keep things from slipping out of plane. I also recommend wax paper between the wood and your clamps to eliminate the chance that your clamps will become a permanent part of the guitar. Wait at least an hour before removing the clamps, preferably two. Sand the front and back seams perfectly flush with some 60 grit.

15

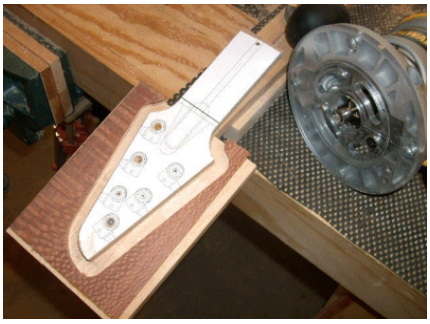
Apply the Headstock Veneer



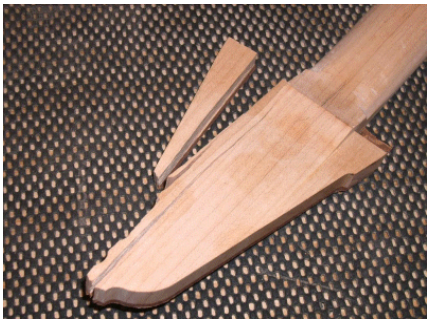
Our guitar will have some fancy wood veneer on the front of the headstock. Plane the wood to thickness and cut it plenty oversize. Since this will abut the back of the nut, the veneer should be angled to account for the thirteen degree tilt of the headstock. You don't want an unsightly gap here. Spread a thin layer of glue on the veneer and carefully position the veneer right up to the nut layout line. Use a clamping block to spread out the pressure on the thin veneer and use plenty of clamps. Wait at least an hour before removing the clamps, preferably two.

16

Cut Out the Headstock



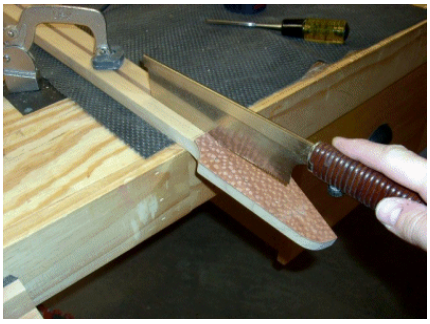
Carefully position your headstock template and double-check that it is perfectly aligned with the neck and that the nut layout line is in the right spot. I secured the template to the headstock with a couple of small, recessed screws located where the tuners will be drilled through later. Load up the router with an 1/8" high, bearing guided bit. Make a shallow, 1/8" deep pass, lower the bit, then make another pass. Repeat this about a dozen times until you're almost through. Cut through the thin piece of wood left with a utility knife. Don't make the final pass with the router as the bit could catch the falling scrap and throw it somewhere (it's just about crotch high here). Before you remove the headstock template, drill small, shallow pilot holes at all the tuner locations. You'll use these later, but you might as well establish the locations while the template is secured. Clean up the edges of the headstock with some 60 grit sand paper.



You're probably thinking that this would go a lot quicker if you roughed out the shape on the band saw then cleaned it all up with one pass using a 1" long bearing guided bit. You might get lucky, or your bit might catch the grain in the wrong direction and tear your headstock in two; lesson learned. If you recall, that was the concept used on the body panels and it worked just fine. But the mahogany used on the back panel is a softer wood with a less prominent grain structure. The quilted maple used on the front body panel has such screwed up grain that it just didn't matter. However, the maple used on the neck is very hard and has a strong, linear grain pattern. You can see in the photo that the router cut the first stretch at the bottom just fine. The bit's rotation was combing the grain as it went. But as I turned the corner, the rotation of the bit was peeling back the grain. It quickly found a weak spot and grabbed it. Then it was back to the start (with a lot of cursing along the way). When in doubt, be patient. A dozen shallow passes takes a while, but nowhere near the time it takes to start over again.

17

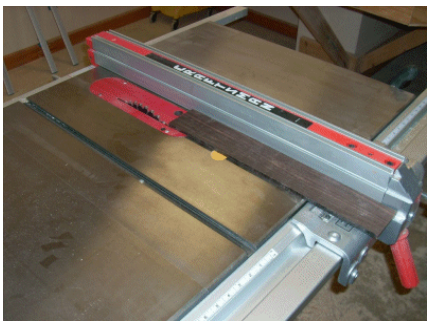
Clean Up the Truss Rod Access Cavity



The pretty veneer I put on the headstock covered up the access to the truss rod. If you're veneer is very thin (less than 1mm), you can probably cut it out with a utility knife. The veneer I used was 2mm thick and I had to use my Japanese pull-saw to cut through. I then cleaned it up and made it pretty with some small chisels and 60 grit sandpaper. To get into the tight spots, I used some self-adhesive sandpaper mounted to a thin scrap of aluminum.

18

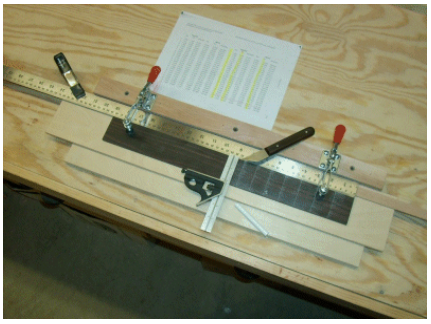
Rough-Cut the Fretboard



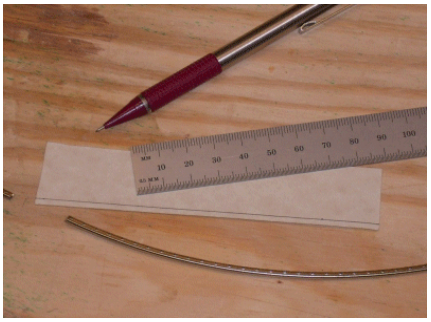
As with a lot of things in woodworking, always cut it a little big to start with. Remember, you can always trim a little more off, but you can't add more back on. Crosscut about 5mm off the end of the board to square it up and to get rid of the wax they put on there to keep the moisture out. Then crosscut the fretboard about 20mm over length. Rip it to about 5mm over width. Rip some off of each side to make sure the final piece has perfectly parallel sides. Check your ends for square and shave off a bit more if needed. Do not taper the fretboard yet. You want to keep both sides parallel so you can more easily cut your fret slots perpendicular. Now use the planer and take light passes off each face until you hit your exact final thickness at the top of the crown (err on being a hair thicker). Line it up with your nut to make sure it's where you want it. A digital caliper makes gauging things easy and accurate. A little sanding on both sides with some 100 grit will get rid of any planer snipe.

19

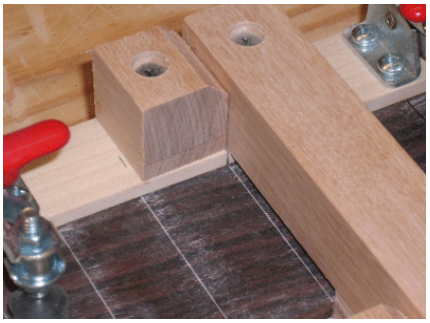
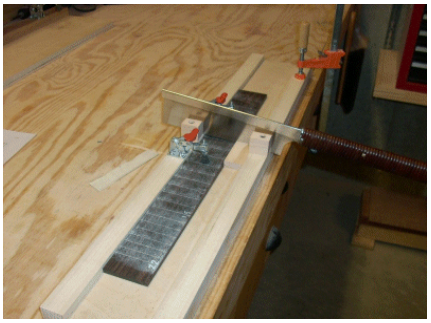
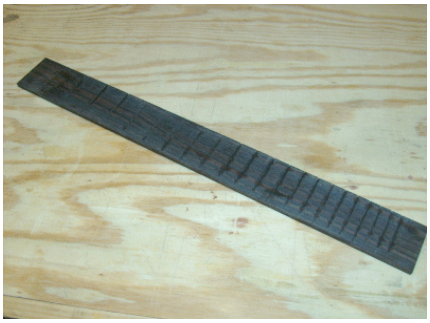
Cut the Fret Slots


Before you start sawing away on the fret slots, you want to be damn sure the saw is going to stay perfectly straight and perpendicular to the fretboard and that it won't wander and cut where you don't want it to cut. You're going to be cutting many fret slots and you don't want to get halfway through and screw one up. I built a jig to hold the fretboard solid and to enable me to saw perpendicularly without the saw wandering off. Now lay out your fret positions. You can easily find a fret distance chart on the internet for your chosen scale length. All of the charts will give you the location of each fret from the nut (not the distance between the frets). This is so that you don't compound an error all the way down the fretboard. It also allows you to clamp a ruler next to your fretboard without having to move it. Now you just need to make some marks using a combination square and a knife which will give you a very thin, crisp, and precise line. Fill in the lines with chalk so you can see them better.



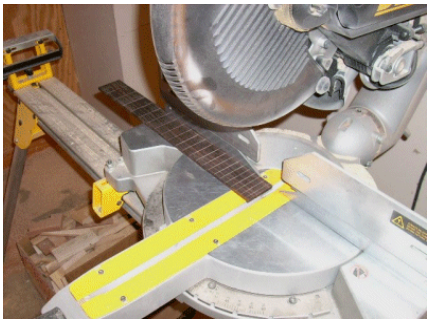

Once all the frets are marked, don't just start hacking away until you've run a few trial cuts. If you haven't done this before, you'll want to get a feel for the technique before you start messing up the real thing. I also made an ingenious template to gauge the depth of my cuts: a piece of cardstock with a line drawn on it (wow, high tech!). You can also simply draw the line on the side of your saw. I used my Japanese pull-saw which has the appropriate kerf width for the frets I'll be using. Make a cut, check the depth, and tweak the cut until it's the right depth.

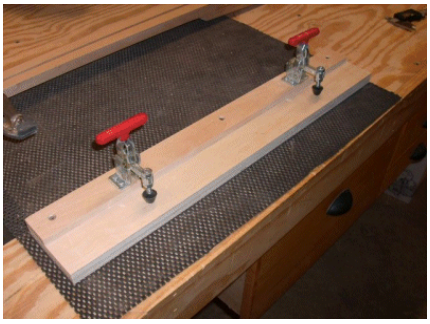




Once you've built up a little confidence, you can start making some cuts on the real fretboard. Carefully line up your marks centering them on the saw kerf in your miter box. I also used a small block to fill the gap between my fretboard and my miter box so the fretboard is supported at both edges to avoid blowing out the side of the board with the saw. Saw with a smooth and steady rhythm. Don't try to rush things as you don't want to foul the board and have to start all over. Check your depth frequently. Repeat the procedure for all of your frets. Once you've made it through all the frets, clean the chalk off the board with some mineral spirits.

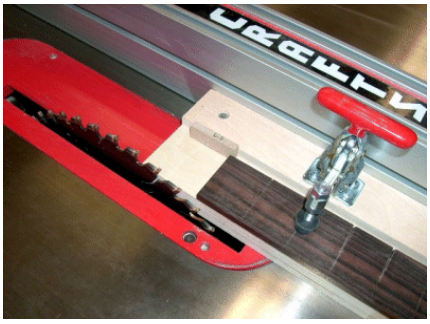
20

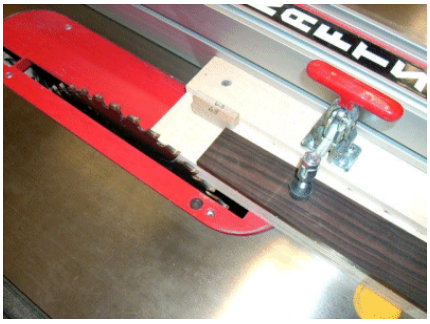
Taper the Fretboard





The process of tapering the fretboard is exactly like that used when tapering the neck. Now that your neck is rough cut, you will be able to determine exactly how long your fretboard has to be. Set the fretboard on the neck, mark the location, then make the cut. To do the tapering, you'll need another jig to hold things steady at an angle. I reused the hold-down clamps from the neck tapering jig (they're about $12 each!).

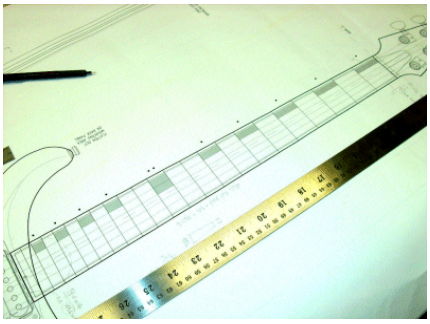




Just like before, determine how much you need to taper off of each side and make a couple of spacer blocks to that width. Set your table saw fence to the exact width of the fretboard at its thickest (plus the width of your jig's fence). Clamp your fretboard in with one spacer block making double-sure you're tapering the correct (nut) end. Make the cut. Roll the fretboard over 180 degrees like a log, add the second spacer, clamp it down, and make the second cut. It's a perfect cut every time.

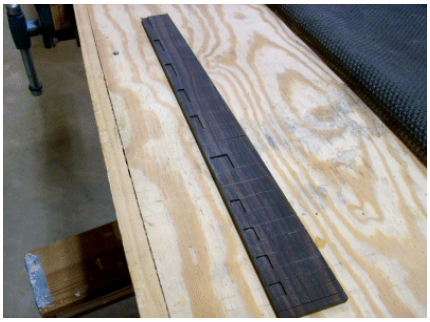
21

Add Some Inlays



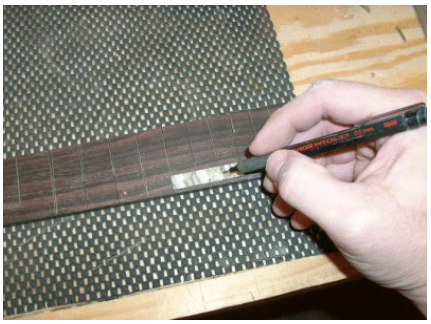
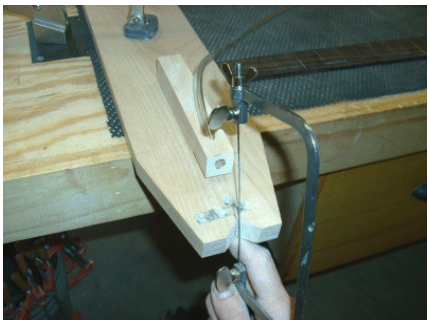
Inlays on a guitar add that little extra touch letting everyone know that you know what you're doing. But I've never done an inlay before in my life, so I really don't know what I'm doing. We picked out a simple and sleek design (plagiarized from a McNaught Guitar) that let us add some inlay, but wasn't some crazy "tree of life" complexity that had a thousand intertwining pieces. Transfer the design to the fretboard and score the edges. Typically you would cut the pieces first and score around your pieces. Since everything in our pattern is square with straight lines, I scored first and fit the pieces to it later.



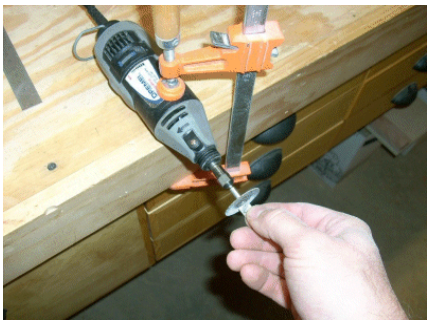


If you can't see your scored lines very well, you can fill them in with some chalk. I picked up the nifty Dremel router base from StewMac along with a few very small router bits which helped out tremendously. Set the depth on your router to leave the inlay exactly flush with the surface. Plunge your router into the field by wiggling it slightly as you penetrate the wood. Take small passes until you're very close to your scored lines. Since my lines were straight, I registered a chisel into the score and lightly tapped the last bit out. If you're design has flowing lines, you'll have to complete the cavity with your router or some very small chisels. Clean up the bottom and corners of the cavity with a small chisel. Repeat the process until your whole neck is completed.

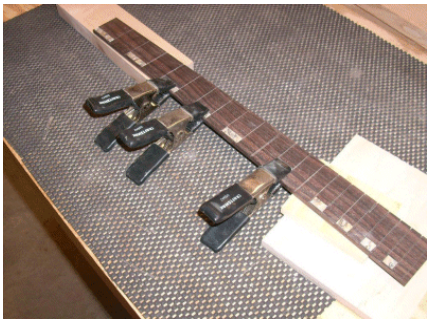
Mark dimensions onto your inlay material, in our case it was Abalam (an abalone-laminate product). I made up a cutting jig which fully supported the inlay material. It even had a small fish tank pump and hose to gently blow the dust away as I cut. Make your cuts very close to the line, but still with a little room to clean up the edges. I used a jeweler's saw with a #2 blade in it.

You can grind up to your line more aggressively with a Dremel tool equipped with an abrasive disk clamped to your workbench. For fine tuning, clamp a sanding block into your vise with some 150 grit. Sand a little then test your fit. You want the piece to just squeeze into the hole. If a piece doesn't fit right, cut another one; it doesn't take that long.



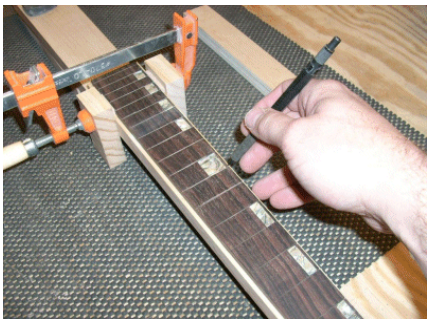

Cut and fit all of your pieces first, then glue them in. Cyanoacrylate glue (also called "CA glue" or "super glue") works great. But, dude, fork up the $5 for the debonder while you're at the store looking at it. Your hands will be close to the work, and you don't want to stick you fingers together on a Saturday night and have to wait until Monday to get back to the store. Put a drop or two of glue into the bottom of the cavity and spread it around with a toothpick. Don't use too much glue; a thin layer will do. You don't want the glue oozing out all over the place. Press the piece into the cavity. If you cut your pieces right, the side tension will hold the piece in place until the glue dries. If you have a loose piece or two, use some spring clamps to hold them down. Let the glue dry for at least an hour, preferably two.



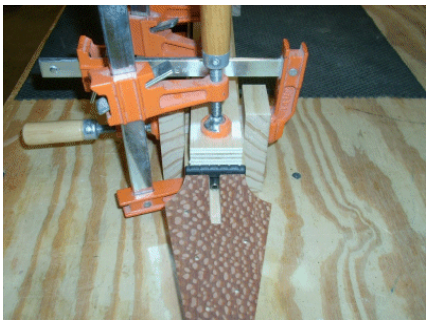
22

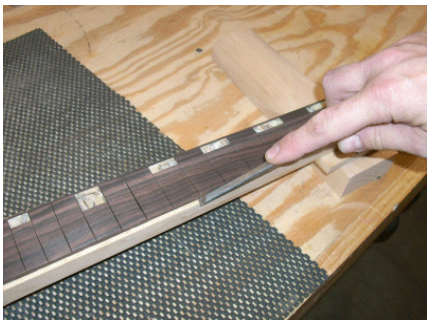
Glue the Fretboard onto the Neck

I pondered the order of the next few steps for some time until I decided what would be the best route for our guitar. This order posed a few difficulties for our build, but I weighed them against the other difficulties I'd have doing them in a different order. Any way you decide to go, make sure you're prepared and you do it carefully since any major mistake will require you to go back to the start.



It's easier to glue and clamp things while they are still flat. So I did this before adding the radius to the fretboard and before carving the back of the neck. The fretboard will be receiving edge banding, so it was necessary to pencil in the edge of the fretboard on the neck so that the glue could be spread only where it was needed. You'll also want to be prepared and do a dry run of the glue up to make sure you have all the clamps at the ready and clamping blocks cut to size. This dry run is a good idea because once you spread the glue, you only have a given amount of time to perform the assembly. If you wait too long, things won't stick well or you won't be able to reposition if necessary.



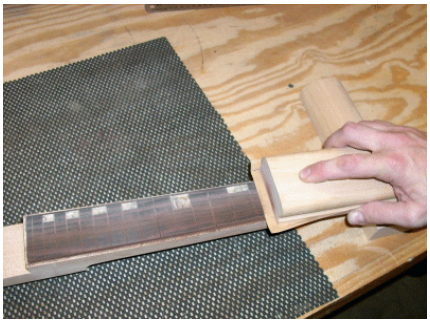


Do not forget to install the truss rod; you won't be able to slide it in later. Do not brush glue onto the truss rod and try not to get glue onto the area where the neck banding will go later. Spread a thin layer of wood glue onto the neck with a brush staying about 2mm away from your truss rod and your banding line you drew earlier. Place your nut on the end to act as a spacer, but do not glue it in yet. You can also see in the first photo above that I used side blocks with thin spacers the width of my edge banding to perfectly center the fretboard on the neck. I used a clamping block on top of the fretboard to evenly spread out the pressure. Initially apply slight pressure to all the clamps which will still allow you to reposition if necessary; make sure you're tight to the nut and centered. Then slowly work your way through all the clamps increasing the pressure in several passes. Since the edge banding area will not be receiving a finish (it will be receiving the banding), wait about fifteen minutes for the glue to get tacky, then clean up the edge banding area; I used a old small screwdriver to get into the corner. This is a critical glue-up, so let this dry overnight. The next day, remove the clamps and clean up any remaining glue ooze with a chisel.

23

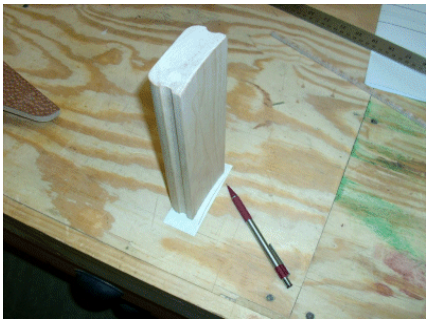
Rough-Sand the Fretboard Radius

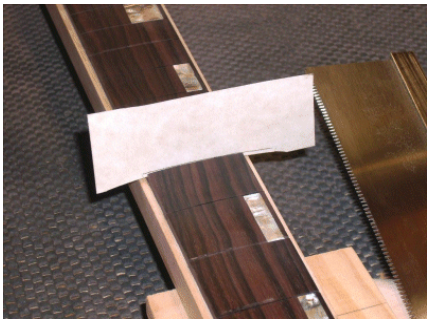
You need to get the radius onto the top of the fretboard before the fret slots can be fine tuned to their final depth, and you can't cut the fret slot with edge banding in the way. So now is the time to sand away. You could make a sanding block with the crown's radius, but that would take some time. For $15 I bought one from StewMac. Clamp and support the neck. Start sanding with 60 grit to establish the crown, then follow that up with 100 grit to smooth things out a bit. You don't need to go crazy sanding now since you will be sanding the edge banding after it's been fitted. You just need to establish the final radius so the fret slots can be accurately cut.

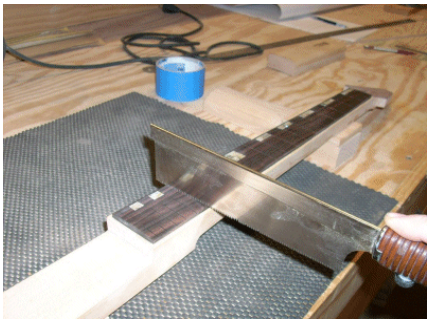


24

Fine Tune the Fret Slot Depth







Trace the radius from the sanding block onto some card stock and cut to the line with an exacto blade. Draw a second line above that radius to signify the thickness of the fret's tang you'll be using. Now you have a simple, but effective, tool to gauge your cuts. Place your saw in the original kerf and slowly refine the cut. Check your progress frequently against your gauge. Work through all of the fret slots.

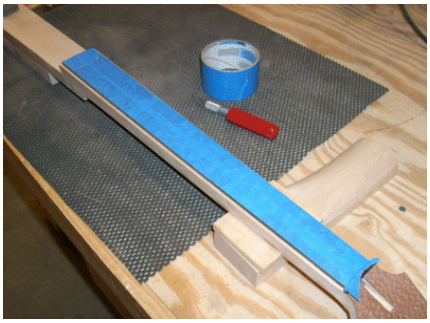
25

Add the Neck Edge Banding

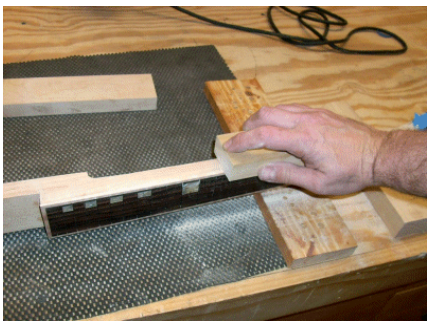
We had some quilted maple leftover from the front body panel. It's an attractive hard wood so it seemed appropriate to use that for the banding. Plane and rip a small piece of wood to about 1mm over width and height. These are thin strips (ours were only about 3mm wide), so be careful when making the cuts. Cut a couple of extras so you can pick the best ones to use.

Plane and sand the sticks to clean off any saw marks. Cut the sticks to length with a fine-tooth blade and a miter box. Don't try this on the big chop saw; it will shred the edge.

Tape off the fretboard to avoid any glue squeezing out where you don't want it to. Tape off just the top, obviously, since you will be applying glue to the sides of the fretboard. Apply a thin layer of glue to the sides of the banding and set them. Use a about a thousand clamps and clamping blocks to apply even pressure. Let this dry for at least an hour, preferably two. Remove the clamps and clean up any glue ooze.



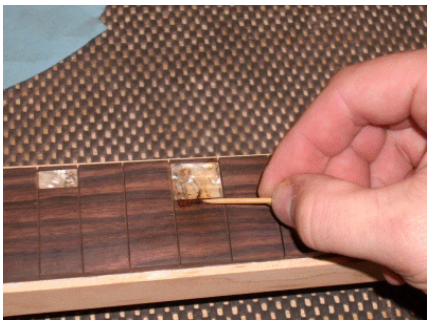
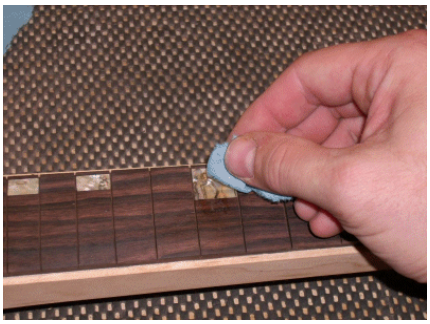
Using the contoured sanding block again loaded up with some 60 grit, sand the top of the banding down to the level of the fretboard. Sand both sides and the end of the neck with a flat sanding block with 60 grit.



26

Fill Any Gaps Around the Inlays



If you performed all of your inlay work perfectly and everything fits completely airtight, you can skip to the next step. But my guess is that you will have a few indiscretions to deal with, especially if this was your first inlay job. Don't attempt to do this before the rough sanding since the sanding might uncover some other indiscretions. Just wait until now and deal with them all at the same time.

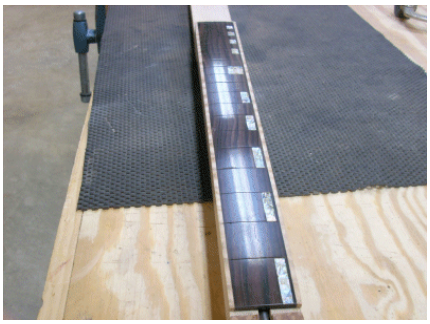
You just sanded the crap out of the fretboard, so collect a few pinches of sawdust and mix it with a drop of CA glue to make a thick paste. Force some of this paste into any gaps around your inlays. Immediately wipe any excess off with a paper towel in a diagonal motion forcing more of the paste into the gap without pulling any paste out. Don't worry if you can't get all the glue up since we're not done sanding yet.

27

Finish-Sand the Fretboard

You need to sand the fretboard before the frets go in; they would obviously be in the way. Proper sanding requires a lot of forearm stamina. This is what all those years of vigorous masturbation have prepared you for. You will not be applying any stain or lacquer to the fretboard; the strings would scrape it all off. You'll need to get that smooth, sleak shine without it. The idea of sanding is to make scratches in the wood, move to a little smaller sand, then scratch out those scratches progressively working toward the smallest possible scratch. Skipping a grit will not completely remove the previous scratches, so don't be tempted; there's no easy way out here. If you want a great looking guitar, you need to apply some elbow grease.

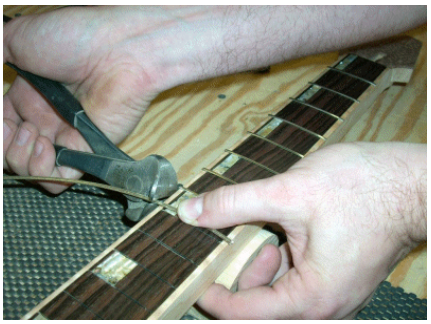




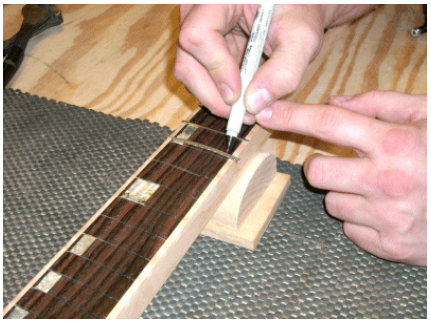
Use your radiused sanding block and work through these grits of sandpaper: 60, 100, 150, 220, 320, 400, and 600. Don't skimp on the sanding or you will not achieve the fine finish you're after. With each grit, apply about 25 heavy strokes to your wood and about 25 more strokes with a lighter touch (still working that masturbation analogy). After each grit, blow off the sanding dust, massage your arm a little, then grab the next smaller grit.

Once through the sandpaper, switch to the Micro-Mesh abrasives. They're not cheap at about $20 for 9 sheets of paper, but the payoff is worth the expense. Use the included foam backing block and work through the whole Micro-Mesh series: 1500, 1800, 2400, 3200, 3600, 4000, 6000, 8000, and 12000. The Micro-Mesh series does not correspond to sanding grits, but I guess the 12000 series correlates to about 2000 grit. As before: 25 heavy and 25 light. Blow off the sanding dust between grits like before, but this time wipe off the top with mineral spirits. Start sanding again before the mineral spirits dries out; the spirits will provide a little lubrication. After about 30 minutes of sanding, you will get immediate gratification. The right photo above shows the fretboard after sanding. The fretboard is dry with no finish and you can clearly see the fluorescent lights above.

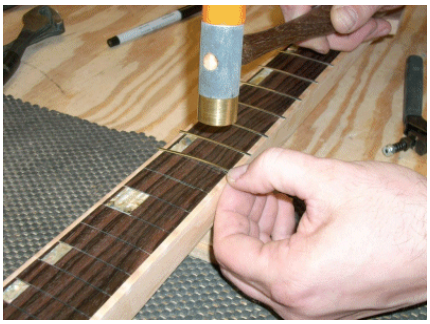
28 Set the Frets




If you haven't hammered in frets before, I would strongly recommend a few practice runs on some scrap wood to get the feel for it. Just make sure you leave yourself enough fret wire to complete the job. Our fret wire came coiled in the box. Don't try to straighten it; the coil will work to your benefit later on. You'll need a good set of nippers to get through it. Hold the wire on top of the fretboard and rough cut it so that about 2mm overhangs each side. Since our fretboard has banding on it, we need to cut the fret's tang off leaving the top crown intact. StewMac sells a special tang cutter tool that does this which was worth the investment. It cut cleanly and precisely. Without it, you would have to attempt it with a dyke (the plier type, not the bull variety), and file everything smooth. That can be very time consuming considering that there's 44 fret ends to de-tang.

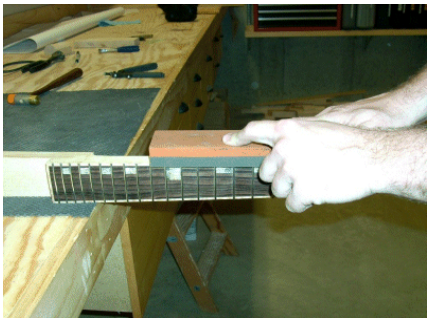



Take the tang off one side of the fret, line it up on top of the fretboard, then mark the amount to remove off the other side of the fret. After a while, you won't have to mark it since you will be able to judge the amount to remove by looking at the barbs on the side of the tang. I used some needlenose pliers and put a very slight downward angle on the ends of the frets. You do not want these sticking up in the air when you hammer them in which would be very difficult to correct. It's easier to hammer down the hump you'll create than it is the end of the fret.

Support the neck directly below the fret slot you'll be filling with a wood block. The back of the neck's not carved yet so you don't have to worry about marring it. Tap in each end of the fret leaving the middle bowed up slightly. That's the advantage of leaving it coiled as mentioned above. Again, it much easier to flatten the hump in the middle. Now tap your way across the fret taking care to strike the fret and not your pretty fretboard. After a few frets you'll learn how much force to apply. Check that the fret is fully seated by trying to jamb your fingernail under the fret. If you can, hammer some more. Don't whack on the fret ends too hard because there's no tang there and you can smash the fret or your edge banding.

Hammer all the frets in then go back and trim off all of the ends flush to the side of the fretboard. Your nippers should be ground flush on the end so that your cut is right up against the neck (I bought these cheap $5 nippers and took an angle grinder to them). If there's a bevel on the tip of the nippers, it will leave more to file off and it will want to pull on the fret when you're cutting it.

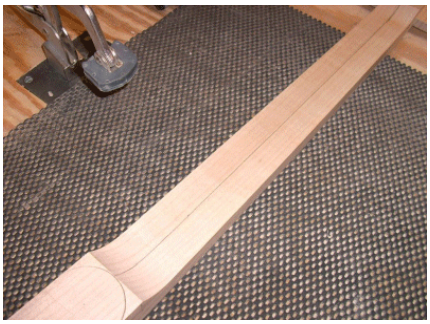


Sand the ends of the frets flush with the side of the neck; a sharpening stone works great for this. You can work on many frets at a time and you can feel when you get down to the wood. The side of the neck is not carved yet so you don't have to worry too much about marring it. Turn the stone at about a 45 degree angle and bevel the edges of the frets down to the fretboard. Don't try to level the tops of the frets yet. Leave the final fret dressing until after the neck is carved, mounted in the guitar, and strung up. That will give you a much better reference of where you'll need to level and how much.

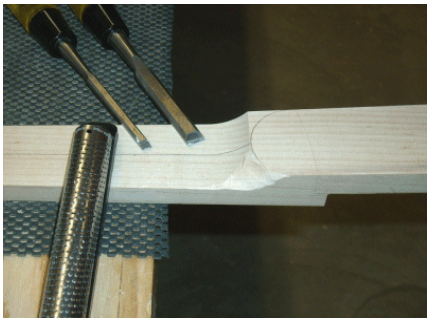
29

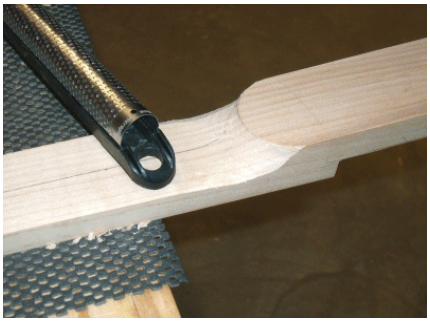
Carve the Neck

Don't worry, carving the neck isn't as bad as you might think. If you haven't done it before, do a trial run on some scrap to get the feel for the tools. Start by drawing a line down the center of the neck. Your neck should already be at its exact thickness at each end. Just remember not to carve off this line so you don't expose the truss rod. Mark out your heel and headstock transitions. Lightly tap a chisel over your heel line to establish the edge.

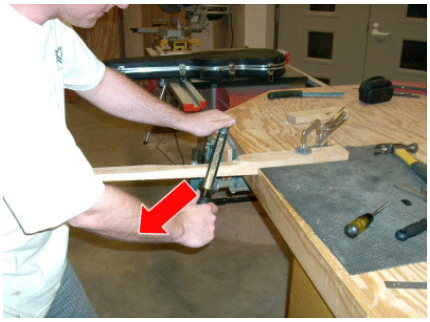


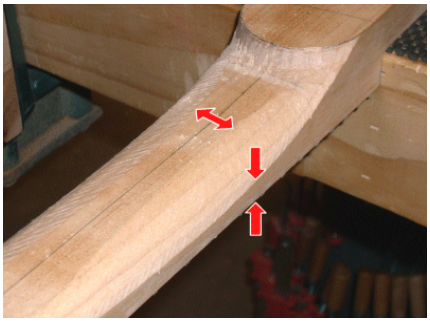
Continue using your chisels to rough out the heel transition. Don't use your hammer here. Your chisels should be sharp enough to pare away tiny amounts of wood in a controlled manner. Then use a round Microplane (the cheese grater type of surform) to remove more of the waste. Just "zen out" for a while removing a small amount of wood at a time. Visualize what it should look like (have another guitar handy if you didn't inherit the visualization gene) and slowly work your way towards it. Don't try to get the heel perfectly finished out at this point. Get it roughed out, work on carving the neck for a while, then come back to the heel to smooth out the transition.



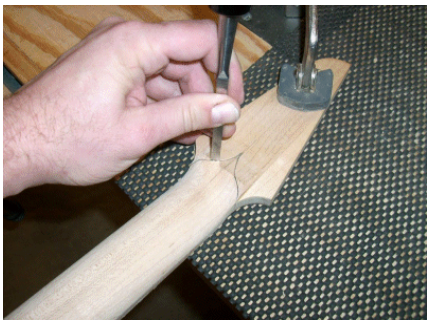


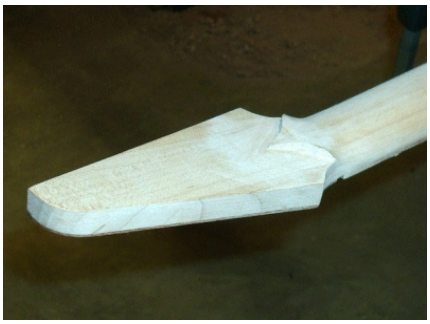
Once you get the heel roughed out, use a flat Microplane to work your way towards the headstock. Use long strokes (I prefer to set up the Microplane to cut on the pull stroke) and move the Microplane at an angle to your work. Don't file straight up and down in one spot or you'll gouge it. Work on each side starting at the corner where you'll be removing the most waste. Notice in the far right photo that the centerline remains untouched. You can also gauge your progress by the smooth areas where no wood has been removed. Try to keep these lines straight down the neck so your profile remains consistent. Also, notice the flowing line up to the heel. That's the concept: smooth, long, and flowing. Concentrate on creating many long and straight facets down the length of the neck, which you'll take care of with sandpaper later. Don't try to finish the whole neck now. Get the shape roughed in then get the headstock transition defined. There will be a lot of back and forth between the neck, heel, and headstock transitions. Work back and forth to get smooth transitions.



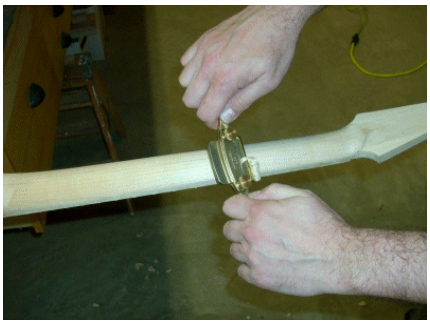


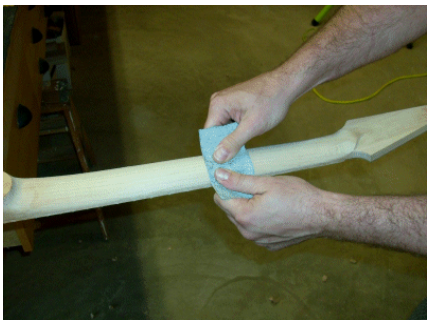
The process of making the headstock transition is similar to that at the heel. We wanted a little extra beef under the area where the truss rod exits, and we wanted something unique as well. Draw your layout onto the guitar and define the area to carve with gentle taps of the hammer on the chisel. Then start paring away the waste. Always try to keep the lines flowing from the neck to the transition. As long as your design is reasonable, it will start telling you where it wants to go; just follow your heart.





Next you'll want to refine all these rough cuts. Use a spoke shave to start smoothing out those facets. Work the tool evenly across the whole neck radius so you don't get lopsided. Also, pick the neck up and test the feel of it. Shave away some more, and proceed slowly. Remember, you can always trim a little more off, but you can't add more back on. Don't forget that there's a truss rod in there either. Once you get it close to where you want it, switch to some 60 grit sandpaper and continue smoothing. Use long, smooth strokes with both hands. Further refine the transitions. Follow this with 100 and 150 grits. You can hold off on the higher grits of sandpaper until later.





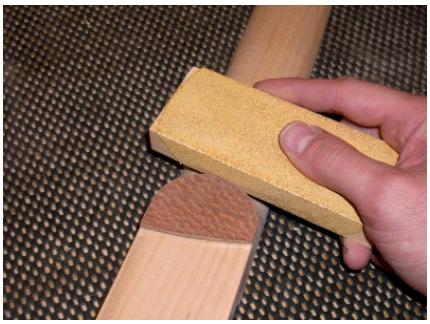
30

Add the Heel Veneer



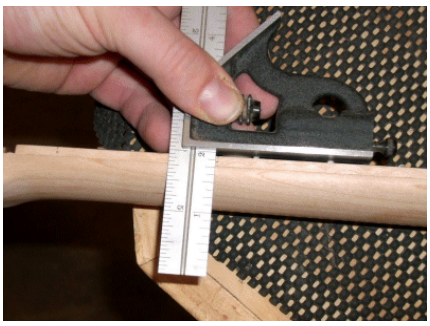
This is a fancy finishing touch that's totally optional. After looking at the heel, we thought it needed some more love. We added some veneer to match that which we used on the headstock. Dry fit the neck into the back body panel. Using your paper pattern, trace the outline of the heel onto the veneer wood. Sand to about 1mm of your line. At the abutment to the body panel, carefully hand sand the edge to your line frequently checking for an airtight fit. Apply a thin layer of glue and clamp the veneer in place. Use a clamping block on the heel and a folded rag to soften the pressure on your beautiful fretboard. Light pressure is all that's needed; don't torque the clamps down as hard as you can. Make sure the glued piece does not slip away from the body panel. Let it dry for at least an hour, preferably two.

Use a sanding block with 60 grit to flush out the veneer piece to the heel. And like before, sand the area smooth with 100 and 150 grits.

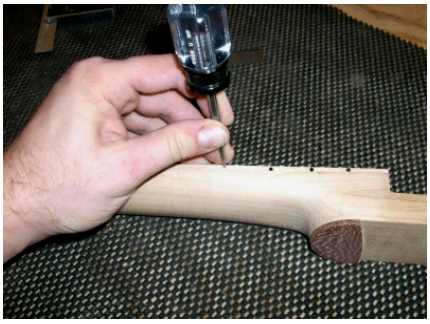


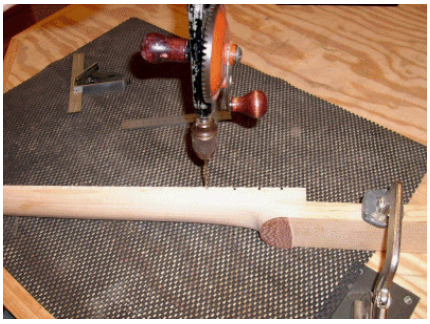

31

Add the Side Dots

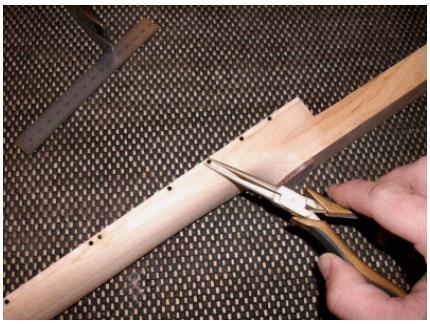


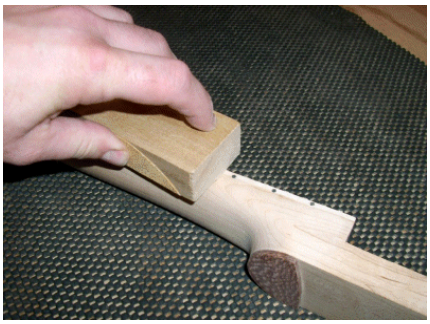
We bought pre-manufactured acrylic dots, but you could certainly make your own and in any variety of shapes. Take very careful measurements between the insides of the frets and mark the halfway point. Any errant measurement will be immediately noticed due to the tight scale and proximity to the top of the fretboard. Take your time. Transfer the mark down the desired distance with a combination square. Make all your marks up the whole neck before moving on.





Using an awl, indent your mark so that your drill will register exactly where you want it. I preferred to use the old school, hand-powered drill for this task since you can feel the progress and judge the depth better. Drill slowly and with light pressure to avoid tear out. Do not drill too deep or you'll have to fill the bottom of the hole before installing the dots. You want to drill so that the dot, once installed, protrudes only about 1/2mm above the surface of the wood. Drill a little then check frequently by dry fitting a dot. Drill all your holes all the way up the neck before moving on.



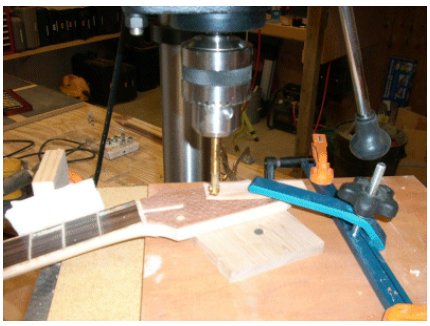


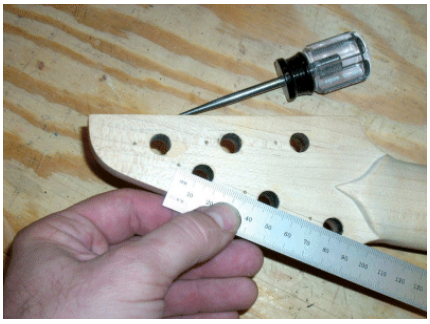
Splash a glob of glue on a piece of scrap wood and use a toothpick to transfer a small drop into the hole. Grab a dot with a needle-nose pliers and insert the dot into the hole. Use the side of the pliers to push on and seat the dot all the way in. Let it dry for at least an hour, preferably two. Sand the dots flush with a block equipped with some 60 grit. Infill any tear out with some appropriately colored wood filler. Sand some more with 100 and 150 grits without the block. You can hold off on the higher grits of sandpaper until later.

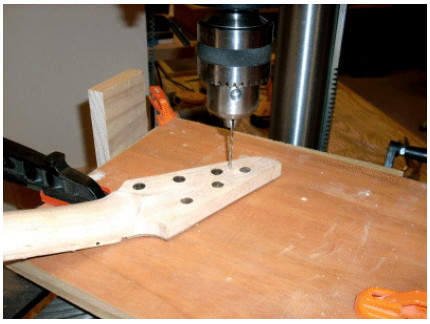
32

Drill for the Tuners

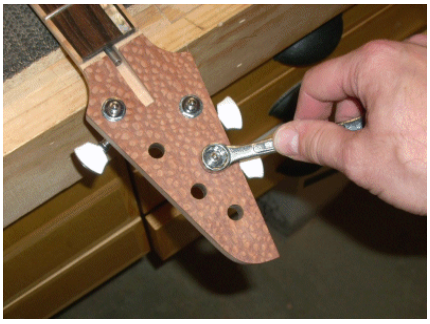
Earlier you drilled some small, shallow pilot holes to establish the tuner locations. If you didn't do it then, overlay your headstock template and do it now. Chuck up your drill press with a bit sized for the turners. I prefer the cleaner cut of a forstner bit. Test the setup on some scrap first to make sure everything will fit correctly. Tape off the back of the headstock and clamp it down over a piece of scrap to avoid tear out when the big bit breaks through the back. Tuners which are out of line are very noticeable, so take your time to line up the locations dead on.

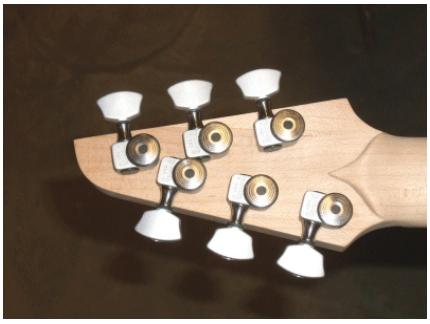






Our tuners had little alignment pegs you had to drill for as well. These keep the tuner housing from spinning around when you install the tuners. Make some layout lines through the centers of the holes you just made. Carefully measure the distance from the edge of the hole (not the center) to the center of the peg. Carefully (I used that word again) transfer your measurements to the back of the headstock and indent the location with an awl. Chuck up the drill press with a bit sized for the alignment pegs. Set your depth stop for the appropriate depth. Test the setup on some scrap first to make sure your measurements and layout were precise. Drill for the alignment pegs.





Now install all of the tuners. If the hole is a little snug, ream it out a little with a round file. Tighten them by hand; it's not necessary to torque them down too hard. On a tight headstock like ours, careful preparation and design work ensured that the tuners wouldn't interfere with each other. Now stand back and admire your work, then take all the tuners back out. You need to install and check all of the hardware before you apply your finish since it would be impossible to tweak something successfully afterwards.

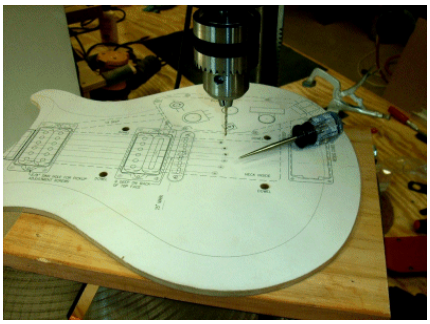
Store the tuners back in their original packaging (or in small plastic containers, or in baby food jars, or in whatever) to protect them and to keep all the nuts and washers together in one spot while not mixing them in with all the other hardware. If you think you'll get confused you can also add some labels in the containers to identify what screws go to what.

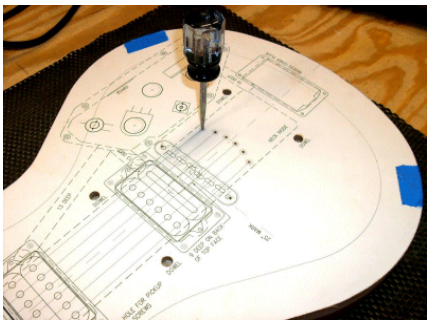
33

Drill for the Body Hardware

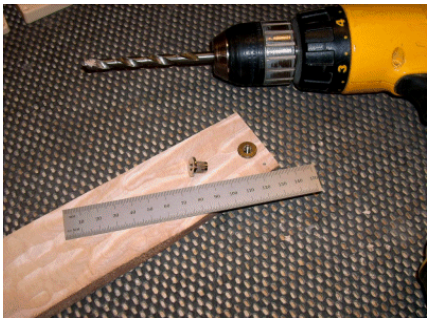
It is very important to double-check all of your hardware hole spacings on your body template. There is no way to neatly fix a misplaced hole. I noticed that my bridge hole spacing was a few millimeters off, enough so that it would not fit. It is easy to make any adjustments before you start drilling.

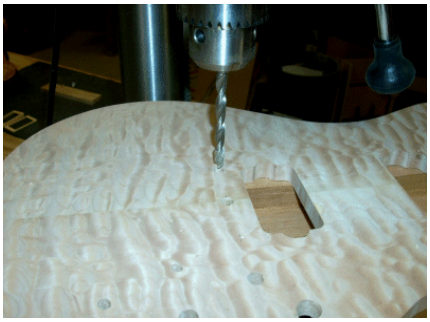
Carefully mark the centers of the bridge posts and string ferrules on the body template. Drill small pilot holes through the template making sure you hit the centers dead on. Brad point bits are ideal for hitting the marks since they have a brad on the point. Tape the template to the front body panel and transfer the marks with an awl and a gentle tap with a hammer.

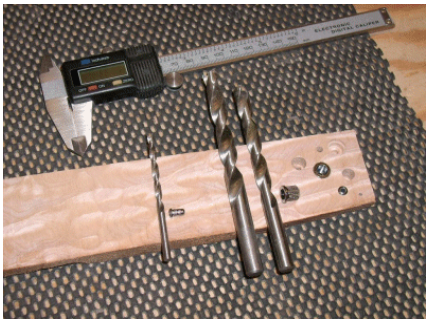


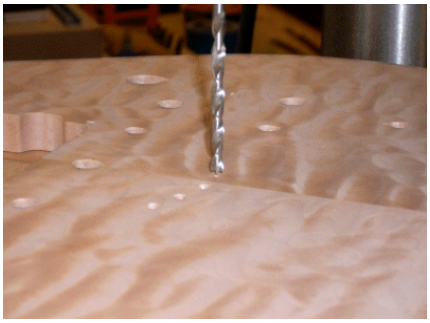


Verify the hole size for the bridge posts. Drill a test hole in a piece of scrap of the same wood as the top. You want a tight fit without having to force the posts in with a hammer. They should slide in with finger pressure. Set the depth on a drill press for a hole about 2mm deeper than what the posts measure. This will make sure you don't bottom out. Carefully line up the drill bit to the mark and drill the hole.





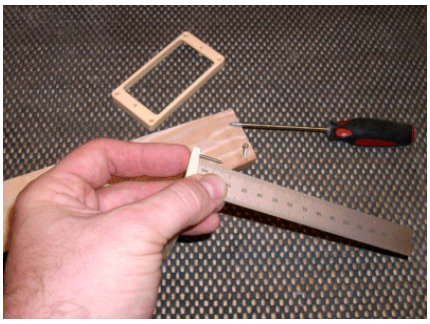




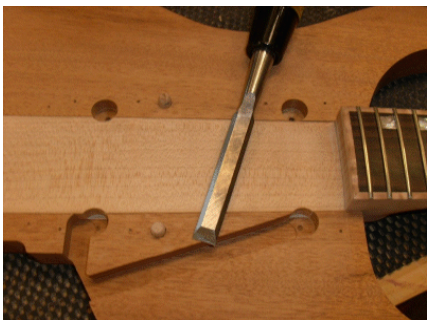
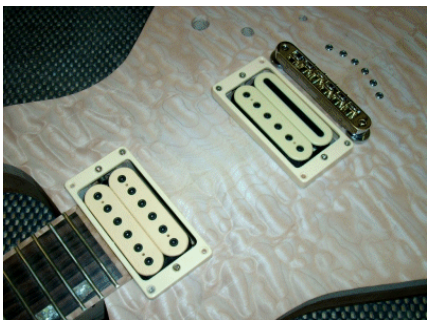
Verify the hole sizes for the front and back string ferrule hardware. There's two drill bits shown for the back hardware. We chose to take it one step further and recess the outer flange so that the back was completely smooth and flush. You know those things are sharp and you could lacerate your pecker if you're not careful. Put a piece of masking tape on the back to control any blowout. Since our neck penetrates the guitar past the point where the strings will go through the body, we made sure to dry fit the neck in place while drilling these holes. We'll probably get a little glue ooze inside the holes when we get to the assembly stage, but that will be easy to clean up. We plan on carving and contouring the top of the guitar later on, so it will be easier to drill on the back of the guitar while the front is still flat. Carefully line up the drill bit to the mark and drill the hole all the way through.

Drill for the flange recess first. Don't simply line up the center of the drill bit with the hole you just drilled. The thinner drill bit used previously may have deflected slightly when you drilled. Check the hole locations and make any necessary adjustments to the centering. Set the depth stop on the drill press to be a little less than what the flange is and drill for the recess. Check the depth by flipping the string ferrule hardware upside down and test fitting it. Adjust the depth stop and redrill until the flange is recessed just below the surface. Now that the depth is set, continue drilling the other five recesses remembering to make adjustments to the hole centers. Chuck up the bit for the body of the back string ferrule hardware and repeat the steps to seat them properly.

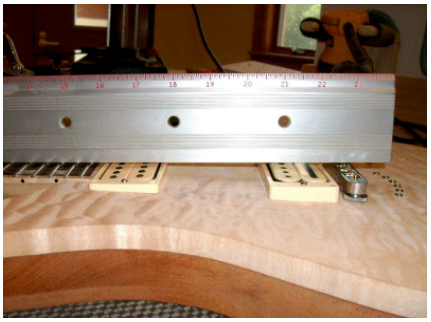





For the pickup bezel mounting screws, find the right size drill bit by drilling in some scrap of the same wood as the top and test it. The screws should go in easily by hand and not pull out. Carefully locate the pickup bezels over their respective cavities. Our bezels were angled and had different thicknesses so we made sure to get them oriented properly. Mark the hole centers with an awl. Check the depth of the mounting screws and set the drill press stop about 2mm deeper than the worst case hole. In our case it was the thinnest bezel. Line up your bit and drill all the holes.

Even though our pickups would fit nicely into the routed area of the carved top, we still needed to add a little depth for the adjustment screws on each side of the pickup so everything would fit. A 5/8" diameter recess would work for our pickups. When the pickup assembly is dropped in, see how much sticks out above the top. This will tell you how deep to make the recesses, so set the depth stop on the drill press about 2mm deeper to make sure you don't bottom out. Due to our neck design, the guitar had to be dry fit with the neck and rear body panels in place. Line up and drill the holes. We cleaned up the edges of the new holes with a chisel and some 60 grit sandpaper to ease any sharp edges; wires will be going through a couple of these holes. Now test fit all the hardware including feeding the wiring into the control cavity. Don't skip this step as it is much easier to make any adjustments to things now rather than waiting until the finish is on.

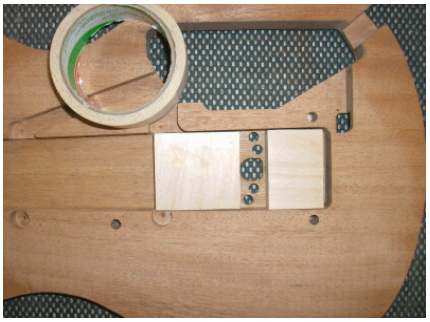
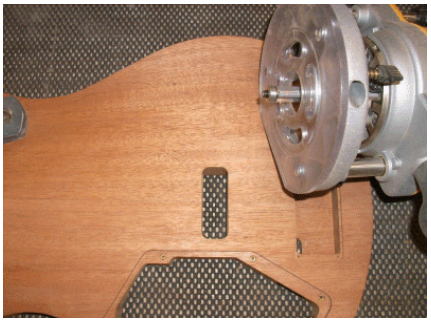

While the bezels are mounted, lightly pencil in the outside edges so you will have a reference of the locations when carving the top. You don't want to contour the area where the bezels are resting so that they will sit flush without any gaps (unless the bezels you bought are designed with a contour to them). Also, double-check your neck and string clearances. Again, it is much easier to make any adjustments to things now rather than waiting until the finish is on. We discovered that the neck pickup bezel sat a little high. Our drawings located the bezel slightly below the fretboard at its thickest part, but we forgot to take into consideration that the fingerboard had a crown making the corners lower than the center. We could either sand down the back of the bezel a millimeter or two, or we could sand the top of the guitar down at this location to make the accommodation. As you can see in the right photo above (taken after the top was carved), we chose the latter option. A belt sander is an aggressive tool; take it slow and easy and check your progress often.

34

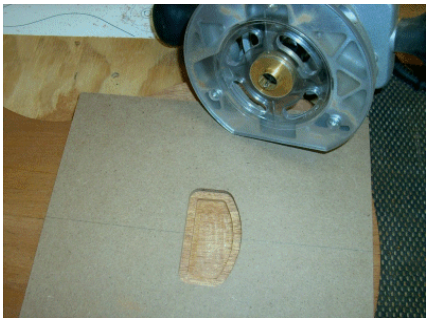
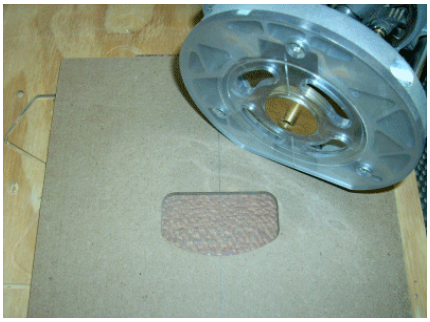
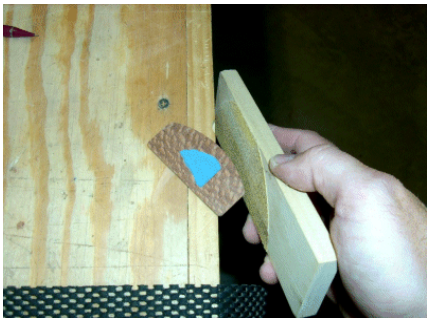
Oops!

Shit happens! With woodworking, as with playing in a band, it's not how bad you fuck up, but how well you cover up your mistake. The idea is to take your mistake and use the opportunity to make something from it. Most guitar instruction books show you that everything works great the first time, but that is rarely the case. So here is how I dealt with one of my unfortunate moments.

When drilling a couple of the holes for the through-body string ferrules, the thin bit deflected and did not come out on the backside of the guitar exactly where it should have. The holes weren't lined up and it looked bad enough where I wasn't happy with my work. So you sometimes have to say, "Gee, that would be a nice spot for an inlay."

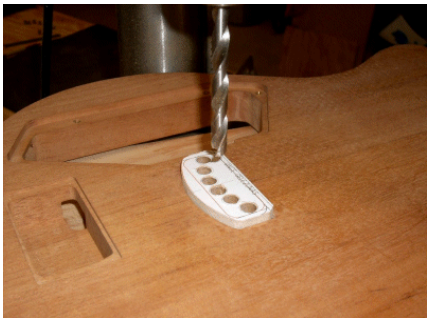
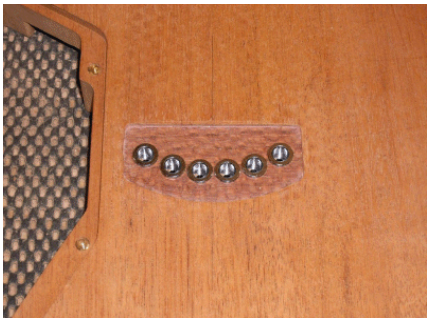




First, plug the hole. We chose to cut out the entire area of the string ferrules on the back body panel. Use double-sided tape to secure a couple of stop blocks at the limit you want to cut out. Drill a larger pilot hole in the middle of the area which will allow your bearing guided router bit to get through. Flip the body panel over and rout out the offending area. Using the same species of wood, cut a patch and fit it into the hole you just routed. Take your time with some 60 grit sandpaper to achieve a tight fit. Glue the patch in place and sand both sides flush with the adjacent surfaces. You could stop here, but the patch is still noticeable and not what someone would expect from a custom made guitar. An inlay will hide the seam with some complementary colored wood (or you could use pearl).

Make a template for your inlay. We'll use the same concept as when we made the control cavity cover. We'll make one template which is a 1/4" wider all the way around which can be used to cut both the cavity and the inlay. To cut the cavity, secure your template to the back of the body panel with double-sided tape. Double-check your measurements so you don't fuck up the fuck up you're trying to fix. Chuck up an 1/8" diameter router bit with a 5/8" OD guide bushing and set the plunge depth. Clean out the whole cavity. To make the inlay, secure the same template to your inlay material with double-sided tape. Secure the inlay material with the template to a piece of scrap would with double-sided tape. Make sure you get a piece of tape directly under the piece you'll be cutting out so it doesn't go flying across the room when it's set free. Using the same 1/8" diameter router bit, install a 3/8" OD guide bushing. Set the plunge depth to just below the thickness of the inlay material. Position the guide bushing against the side of your template, plunge through the material, and rout your way around the perimeter. Test fit the piece into the cavity, but don't push your test fit too hard or you won't be able to pull it back out again to glue it. You will have to do some fine tuning with some 60 grit sandpaper to get a tight fit. Since my inlay is symmetrical, the blue tape shown on top of the inlay (right photo above) reminds me which side is up.


Now glue it up and make it pretty. Apply a thin layer of glue to your inlay and press it into place. Use a clamp with clamping block to evenly distribute the pressure. Let it dry for at least an hour, preferably two. Clean up any glue squeeze out with a small chisel or screwdriver. the inlay may not fit perfectly, so tape off the seam and apply some appropriately colored wood filler with a small screwdriver. Wood filler does exactly what it's name describes, fills wood. Though the manufacturer will tell you the filler is stainable, it will not take stain the same as the surrounding wood. The tape protects the surrounding wood from getting clogged with stray filler. It might not be obvious now, but it will be when you stain your guitar. Then it's too late to fix it. Take the time to tape things off.

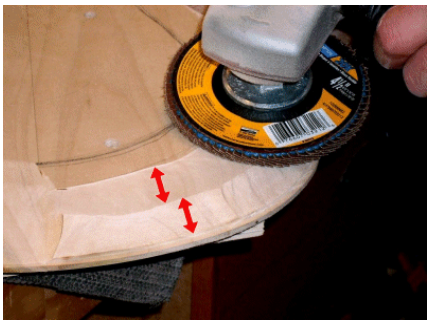



Lastly, fix the original mistake. Make a template of your string hole pattern from some 1/4" MDF. Mark and drill the holes in the template using a drill press. Carefully locate and secure the template on the back body panel. Now take your back body panel to the drill press, set the depth if you need to (our holes were drilled all the way through the back body panel), align the drill bit with your template, and drill the holes. The template helps keep the drill bit from deflecting. In hindsight, we probably should have used this approach the first time through. Double-check that the holes are continuous through the guitar and clean up any transitions between the new holes and the old holes with a file. The result should be perfection, and your client will get a nicely coordinated bonus inlay. Your mistake might be in a different area, but the concept will probably be the same: find a way to make something special from your mistake.

35

Carve the Top

Flat-fronted guitars are absolutely acceptable (ask any Stratocaster player). But carved tops are much more visually exciting (ask any Les Paul player). Honestly, would you rather play with an A-cup or a Double-D? There are various methods in achieving the final product, and after some internet research, we chose to use the angle grinder technique. It's pretty aggressive, but if you have a steady hand and an eye for visualizing things, you should fare well. If you're not that confident, you can use a violin maker's finger-plane. It's much slower going, but it will lend more control.



If you haven't done this before, like me, practice first. Our quilted maple top cost about $100 for the one piece of wood. This (less than beautiful) practice mock-up was made from a $6 piece of poplar. Get familiar with the technique before you go butchering up the real thing. Since we still had all of our templates, it only took a couple of hours to put together the inexpensive replica. Install a 40 grit flap sanding disk into an angle grinder. The idea is to use steady pressure and long flowing strokes. In the second photo above, you can see the somewhat uniform paths the grinder takes. This is the steady hand and visualization part. An angle grinder spins at about 10,000 rpm's; there will be sawdust flying everywhere. Protective eyewear is a must and a dust mask is highly recommended. The grinder takes off a lot of material quickly, so concentrate on your work, take frequent breaks, and don't sneeze while grinding. Complete the entire mock-up so you get a feel for the differing angles of the guitar front and how to hold and move the tool.

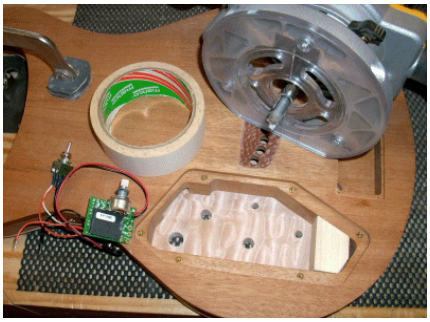
Once you think you're ready for the real deal, lay out the limits of your carving using a pencil and a ruler. This is not an exact science, a rough sketch is all you need to keep you on track. Our guitar has placement dowels located in the underside of the top. If yours has the same, be mindful you don't carve that area exposing the dowels. During our trial run, we found that it was difficult to keep the side edge a consistent height. To address that issue, we rabbeted the edge with a 1/2" diameter bit with a 3/8" diameter bearing. This gave us a 1/16" ledge of a consistent height around the guitar. While grinding, you just have to concentrate on coming right up to and just short of that ridge, and then stop. Our trial run also told us not to wrap the rabbet around the horns of the guitar. It is very difficult to grind inside the horn. The sanding disk is almost perpendicular to the wood so you can't mind the ledge very well. We drew the offset on the horn in pencil and will tidy it up later by hand.



Firmly clamp the top body panel to your workbench. I found a scrap of 1x material underneath would keep me from grinding my workbench accidentally. The edges of the guitar are somewhat concave. Start on the edge with your long, flowing strokes. Don't work too much in one area; reposition your work frequently to slowly creep up on the overall final shape. Remember to stop just short of your routed ridge. The center of the guitar is convex. Use a random orbit sander load up with some 60 grit to make that transition. Don't carve the center area where your pickup bezels were drawn on; that area should remain flat. Take off the last little bit of wood around the edge by hand with 60 grit sandpaper. Finish things up by going over the whole top with the orbital sander and some 60 grit to remove any burn marks, then with some 100 grit to smooth things out. We'll save the final sanding for later. Be patient and you will be rewarded with a curvaceous top that will send your flat-chested girlfriend home weeping with jealousy.

36

Deepen the Control Cavity



Now that the top body panel has been contoured, you have to accommodate the myriad of knobs and switches you plan on stuffing into the control cavity. You might be tempted to scoop out the knob areas on the face of the guitar first, but that's not wise. It is more important that the controls have enough depth to fit inside the cavity. Then you can worry about the fancies in the next step. Our worst case (tallest) control was the circuit board for the piezo bridge pickup, which was physically attached to the pot. The control cavity had to be at least as deep as this control. Keep in mind that the top is carved; there is less room to remove material near the edges. Use double-stick tape to temporarily place some carefully cut stop-blocks. You need to keep the extra depth at the edges so you won't route through the front and you will only increase the depth in the middle of the cavity. Chuck up a bearing guided bit and use the sides of the back body panel and your stop-blocks as your guides. Remove material from the back face of the front body panel in small (3mm or so) increments and recheck the fit of your controls. Be aware of what you are doing and don't route through the face of the guitar!

37

Scoop Out for the Knobs

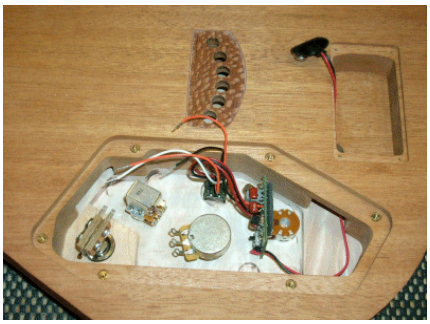
Once you are confident that all of your knobs will fit, you need to scoop out the areas at the knobs on the face of the guitar. This does two things. First, the face of the guitar at the knobs needs to be flat so that the knobs will install and seat properly. And second, it looks pretty damn cool. Chuck up a 1/2" cove bit (with the bearing removed) in your drill press. Bring the non-spinning bit down to the face of the guitar so that the nipple on the end (where the bearing was removed) is just at the face. Fine tune and center the nipple in the middle of the hole. Look at it from several angles to make sure you're dead center. Since the areas you'll be scooping out are on the side slope, it is imperative that you clamp the body panel down tightly so it doesn't shift when you start cutting. Set the depth stop on the drill press to remove about 2mm. Fire up the drill press and slowly plunge in. After making the cut, don't unclamp yet. Check to see how much meat you still have at the hole. Some controls only have about 3mm of threads on the post; some have more. You want your scoops to generate some visual impact, but you don't want the knobs sitting too low either. It's a little bit of a balancing act, but we fine tuned our depth stop so that we were left with about a 1" wide scoop at each knob.

Using some 60 grit sandpaper, gently shape and rollover the edge of each dish so they blend and flow with the face of the guitar. Follow that up with some 100 grit to smooth things out. Then place the guitar in some low-angled, grazing light and fondle yourself.

38

Preinstall the Controls

You will still have to fine tune the control cavity depth at some of your knobs. You can route down a little more at the entire area, or you can countersink a single hole with a forstner bit. Fit and install all of the controls so that you know they will all fit. Then take them all back out store them in a place where they won't get dusty.



39

Carve the Back

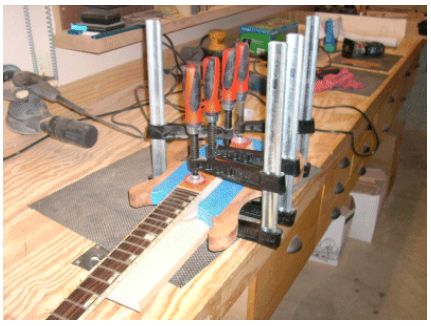

Start off by easing the sharp edge around the back of the body panel with an 1/8" radius, bearing guided, round-over bit. You don't have to carve out the boob pocket on the back, but it does make the guitar a little more comfortable to play while sitting down, and it doesn't take that long. Carving the back is much like carving the top, there's just less carving to do. Freehand sketch the limits of your carving on the back and side of the body panel. Use an angle grinder with a 40 grit flap sanding disk installed. The mahogany back is a much softer wood than the maple front, so take smooth, gentle, and flowing passes with the grinder. Make sure everything blends together nicely.


Further smooth and round things out with your orbital sander loaded with some 60 grit. Then fine tune the blending by hand and remove any router marks around the edges with some 60 grit. Follow that up with some 100 grit by hand to smooth it all out.

40

Glue in the Neck

Keeping all the pieces separated up to this point has proven to be a very good approach. It allowed tool access to certain areas which couldn't have been reached otherwise. It protected the neck and the expensive top while other aggressive maneuvers were being carried out. It allowed replacement of a single piece if someone (me) broke something (the neck).

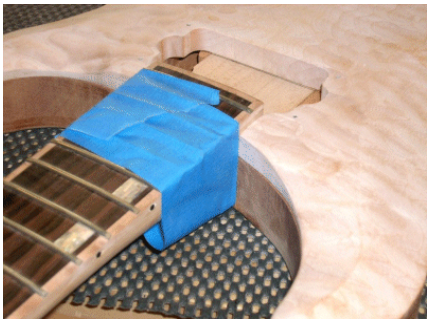



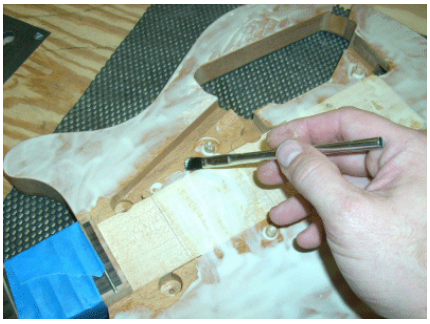

Tape off the area around the neck cavity. This will make clean up much easier. I know this is the middle of the sandwich which no one will see anyway, but I have OCD and everything has to be kept neat and clean. Use a finger to spread around the glue and a brush to get into the tight spots. A thin layer of glue is all you need. Don't go overboard or you'll have a ton of squeeze out to deal with. Experience will let you know how much glue is good. Use your deep throated clamps and clamping blocks on top and bottom to evenly disperse the pressure. You could probably remove the clamps after an hour or so, but this is a very important connection. Just let it sit overnight. The next day, remove the clamps and if needed, sand the joint perfectly flush.

41

Glue on the Top Body Panel

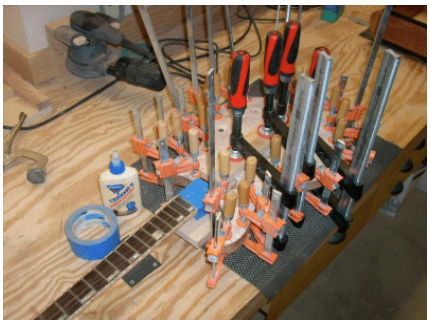
Dry fit the top and trace around the pickup cavities and anywhere else you don't want glue to be. It is also a good precaution to tape off the neck to make glue ooze clean up easier.

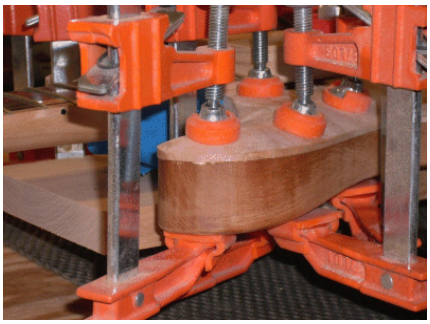




Dribble in some glue into the dowel holes and push in the dowels. Drizzle on some glue over the whole face of the panel and use a finger to spread out an even layer (we used Titebond II glue for just about everything). Don't put glue in the pickup cavity locations you penciled in earlier. Make sure you go right up to the edges of the guitar. Get into any narrow spots with a brush. You need to work quickly. There's a lot of area to cover and you don't want the glue to start drying out before the top goes on. Again, only experience will tell you how much glue to use. Obviously you want enough to stick it, but not too much where you're left with a sticky mess. Compare the photo above (the one where I'm brushing) with the amount of ooze in the final clamp up shown below.

Locate the top body panel over the dowels and push it into its final resting place. Then screw on every clamp you own (literally). Use clamping blocks down the middle (top and bottom) with deep throated clamps to apply strong pressure over the neck. Use light duty clamps (with pads, no blocks) about every 2" around the entire perimeter. Do not clamp over the control cavity since there is nothing there to back it up and you don't want to crack the wood. Carefully inspect that there are no gaps around the edge where the front and back body panels join. If you see a gap, add another clamp. Don't try to clean up any glue ooze, just let it dry where it oozed (see previous ooze discussion). Leave everything sit overnight to insure that the glue is totally cured.





42

Clean Up and Fill Up

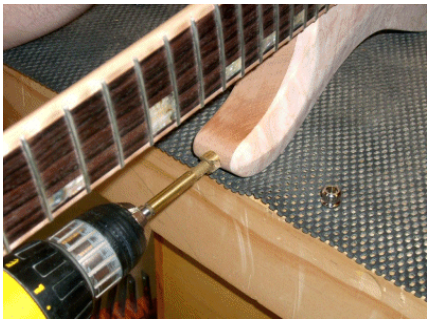
Take off all the clamps. The edges may not be perfectly aligned, so hit the abutment with some 60 grit sandpaper to flush things up. Follow that up with some 100 grit to smooth things out. You can sand with or without a sanding block depending on the situation. Sanding without the block gives you a little more feel and access to the tough curves. Use the block on broader areas which makes it easier on the hands. I prefer a foam block which conforms around the curves.

You want your dream machine to be perfect, so inspect the entire glue up for any small gaps. If you find any, tape off the area, select some appropriately colored wood filler, and fill the voids. Remove the tape immediately and just let the filler sit until it's completely dry, about an hour. Don't go fussing with it until it's dry; you'll just mess it up. Once it's dry, hit it with some 100 grit sandpaper to take down the high spots.

Some glue may have oozed into some of your pre-drilled holes. Inspect your string holes and the pickup bezel holes and gently re-drill them where needed to open them back up again. Check for any ooze into the control cavity and clean that up with a chisel.

43

Preinstall the Strap Locks



It's a personal pet peeve, but I think it just looks bad to screw a flat thing to a round thing. I'm talking about a strap lock on the horn of a guitar. It only takes a few extra minutes to recess the mounting area to create a nice flat on flat connection. Mark the center of the horn. Measure the diameter of the base of the strap lock and select an appropriately sized forstner bit. Drill the horn so that you create a flat spot. Don't drill too deep or you won't be able to slide on your strap.

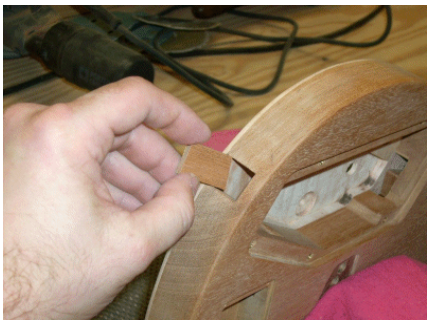
Now predrill for the mounting screw. Mark the desired depth on your drill bit with some tape. Try to drill so that you're perpendicular and straight in. Test fit the strap lock.

The other strap lock sits flat on the butt end of the guitar, so you won't have to recess the mounting area there, but still predrill for the screw and test fit it. With both strap locks installed, try the guitar on for the first time. After you air-guitar for a while, remove the hardware and store it in a safe place.

44

Recess the Output Jack Plate

Another nice (optional) finishing touch is to recess the output jack plate. Hey, it's a custom guitar; why not? The routing method which we used to make the guitar created a jack slot which was just a little too deep. I suppose we could have drilled a hole to avoid this patch, but we would have needed to drill a 1" diameter hole accurately into the end of the guitar, which would not have been that easy either.



Test fit the output jack and size a small patch of the same species and grain direction as the back body panel. Take your time to get a tight fit. Leave the exposed end a little proud of the surface, then you can sand it perfectly flush later. Glue and clamp it up. Leave it to set up for an hour, preferably two. Then remove the clamp and sand it flush.

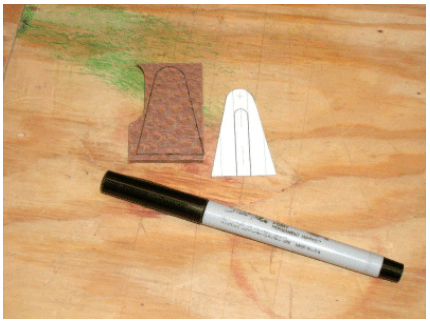
The next step is just like inlaying the fretboard; we're just inlaying a plate instead. I bought the neat Dremel routing base, I might as well get some mileage out of it. Mount the jack plate to the jack and test fit the assembly. Center it up and scribe around the plate with a sharp Exacto knife. Chuck up a 1/16" diameter router bit in your Dremel and set the depth to match that of the jack plate. Carefully rout out the area being mindful to keep the base as flat as you can on the curved surface.

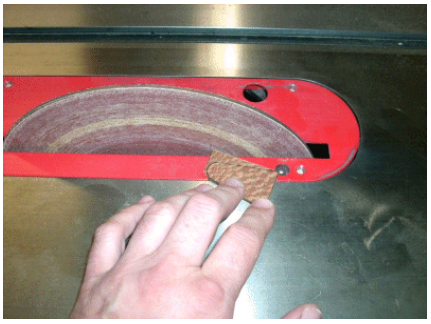
I like to get very close to the scribed line with the router, then I can finish it off with a small chisel which I can register into that scribed line. Clean up the bottom of the recess perfectly flat with your chisel. Test fit the plate periodically to make sure you have a nice, tight fit. Once you're satisfied, predrill for the mounting screws and fit the assembly. Then remove the hardware and store it in a safe place.

45

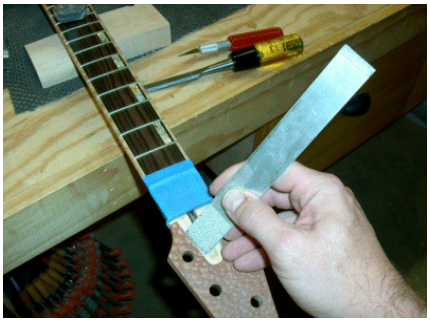
Make the Truss Rod Cover

As long as we're going crazy with recessing all of the hardware, why stop now; my time is cheap? For a clean look, we're going to make our truss rod cover out of the same material as the headstock, we'll inlay it flush, and we'll even hide the mounting screw for an almost invisible installation.

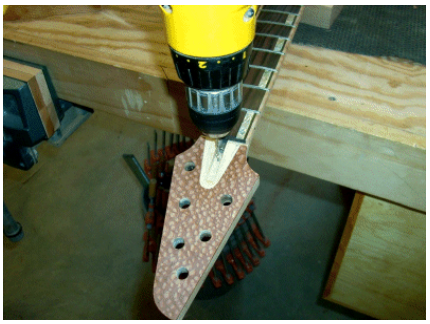




Trace the outline of the cover plate onto some scrap wood of the same species as the headstock. Try to select a piece with similar color and grain pattern. Using a sanding disk in the table saw (my newest favorite tool), sand the piece right up to your line. Finish the sanding by hand with some 100 grit in a sanding block.


Dry fit the nut, locate your truss rod cover, and scribe around it with a sharp Exacto knife. Just like inlaying the jack plate, use a Dremel tool in a router base to remove material. Set the depth to just less than the depth of the cover and work very close to your scribed line. Then finish it off with a small chisel registering it into your scribed line. Clean up the bottom and sides with a chisel. Get into the tight corners with some sandpaper stuck to a stick. Since we'll be screwing our cover on from the back of the neck, we'll need to add some meat in which to seat the screw. Make a small wedge from some scrap maple. Take your time to get a tight fit. Place the wedge into the slot, add a couple drops of super glue, and press the cover plate into place. Don't go overboard on the glue or your cover will be permanently stuck in place. Clamp it up for an hour, preferably two. Then remove your cover plate with wedge affixed to the back of it.



Choose a drill bit which will allow a small, #2 screw to slide through without the threads catching. Put some masking tape on the back of the neck to avoid any blowout. Drill through the bottom of the truss rod channel and out the back of the neck paying attention to keep the drill perpendicular and straight. Fit the cover into place. Chuck up a drill bit sized to catch the threads of the screw. From the back of the guitar, predrill through your hole and into the back of the wedge for the mounting screw being careful not to drill through the front of the cover plate. Gently drive in the mounting screw; don't over-tighten it. Flip the guitar over and sand the cover plate perfectly flush with some 60 grit, then hit it with some 100 grit to smooth things out. With the busy pattern of our lacewood headstock, the cover blends in and is almost completely invisible.

46 Make Finish Samples

You don't have to wait until the guitar is done before you start testing your finish. This can run concurrently with many of the previous steps. It only takes a minute to wipe on some stain. Plus it gets you a little excited while you're performing some of the more mundane tasks.

No matter what recipe you use for you color and clear coats, take the time to test your finish on some scraps from the actual guitar. Don't stop your testing with just your color coat, carry it through to about three coats of your clear finish. Each coat will slightly alter the color and bring a different sheen to the finish. You definitely do not want any surprises at this point. Our first sample (on top) was too light on the left and too red on the right. Our second sample (on the bottom) was a shade darker, but still not where we wanted it. Our third sample (in the middle) was right on with our color coat, but when we continued through our subsequent coats, the appearance darkened up quite up bit more than we expected. Our fourth sample (not shown; it's on the back of the bottom sample) came out just right. Keep track of your recipes so you can duplicate them on the actual guitar. It might be hard to see in the photo, but you can make out some scribbles on the edges of the boards noting the color and number of coats used.

From the work on our finish test pieces, here is the big picture on where we're going. I'll break down the discussion on each step as it's covered.

- Finish sand
- 1 coat of Golden Brown Dye
- 1 coat of Boiled Linseed Oil
- 4 coats of Orange Shellac
- 30 coats of High Gloss Lacquer
- Rub out with Micro-Mesh abrasives

47 Sand, Sand, Sand

After months of watching from the sidelines, Brian finally got sent into the game. He found something with which he was comfortable doing, and I was all too happy to let him take over. Now repeat this to yourself over and over again: "Do not skimp on the sanding." Some scratches are not evident until you smear on the stain. Then the stain concentrates a bunch of color into that scratch and makes it stand out proudly. At that point, it's impossible to spot sand and re-stain. It's too late to do anything about it except to start sanding the whole guitar all over again back down to bare wood.

Now for a few comments on sanding technique:

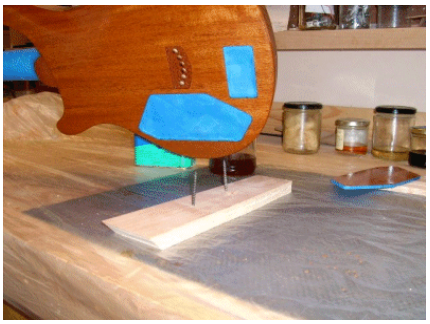
- The idea of sanding is to make scratches in the wood, move to a little smaller sand, then scratch out those scratches progressively working toward the smallest possible scratch. Skipping a grit will not completely remove the previous scratch, so don't be tempted; there's no easy way out here.

- Work on a padded surface so you don't create more scratches.
- Use a brand new piece of sandpaper for each grit. Now is not the time to try to save forty cents on paper. If there's no sand on the paper, it won't do what it's supposed to do.
- Use a foam, cork, or felt sanding block where possible. This will alleviate a lot of hand fatigue and help keep things level. Use your fingers to work on the tight spots.
- Cross-grain sanding is very noticeable, so sand with the grain or at no more than about a 30 degree angle to the grain. Your final pass with each grit should run with the grain.
- Sand enough to make sure you remove all the scratches from the previous grit. Then sand with that grit a little more just to be sure. Take your time and work through each grit slowly and methodically. Achieve that disembodied level of Zen or sand in time to some music, whatever works for you. This will take about 20 minutes per grit (about 2 1/2 hours total). Split it up over a couple-three days if you want.
- Start with 60 grit and concentrate on leveling out any deep scratches that may have come up during the build. These first grits are the most important as they take out the largest scratches. Some scratches may not be immediately evident. Wiping on some naptha or mineral spirits will darken the wood a little without raising the grain like water will. I like to use naptha as it evaporates more quickly than mineral spirits, but either will work. Put on a bright light and get close to the surface to investigate where more sanding is needed.

- Work through all these grits: 60, 100, 150, 220, 320, 400, and 600. Spend extra care on the first couple of grits as those will level out the big scratches. You can't do any serious leveling with the higher grits.
- When changing grits, blow off the surface of the guitar and wipe off any residual dust. If you move up to 220 grit while 150 grit sand is still on the surface, you'll do nothing but continue pushing that 150 grit sand around.
- This takes some time, but be very picky and don't get lazy as this will directly effect the final appearance of your guitar. People will not see the hundred-plus hours of your wonderful woodworking skills through a fucked up paint job.

48

The Color Coat



It's a good idea to do your finishing in a separate room from your woodworking and all the associated sawdust. If you don't have a spare space, don't apply finish on the same day you're cutting wood. You also need to make something to hold your guitar off the table so you're not laying it down on the newly applied finish. This doesn't have to be anything exotic. We used two screws driven through a piece of scrap wood. The screws are spaced so that the points support the inside ledge of the battery compartment where they won't gouge or scratch the finish. Now tape off everything you don't want colored. Our neck will remain natural, so we taped it off. You also want to tape off the insides of the pickups cavities (the bottoms and sides) and all the other penetrations and holes. Tape off the control cavity and the battery compartment if you have one. You will not want a build up of finish getting into all those nooks or your knobs and other hardware may not fit right later.

down with naptha or mineral spirits on a clean rag and follow that up with a vacuum to suck out the remaining dust. Avoid blowing out the dust as that will just kick the dust up into the air where it may decide to fall back down onto your newly applied (and sticky) finish. Follow that up with a thorough rub down with a tack cloth to remove any remaining dust.

Now that you're ready, it's time to throw on some color. I believe dyes are a better finish over stains. Dyes have smaller color particles which can better get into tighter grains like maple resulting in a more even coat. They are available in a whole rainbow or colors (including reds, blues, greens, etc.). They offer better control over concentrations and dilutions since you mix it yourself. We used TransTint dye in Golden Brown mixed with denatured alcohol as the solvent (Bekhol is the brand name). From our test pieces we chose to use a very diluted blend to achieve a very light brown overall tone. Sorry, we did not keep the exact dye to solvent ratio as we got there through a some trial and error. We would not be able to duplicate it exactly, but we made sure we had enough to color the whole guitar. About 4 ounces of the mixture would be enough, but make a little more just in case.

Get a smooth, clean rag and fold it over a few times to give the dye something to soak in to. Turn the guitar face down to work on the back first. Load up the rag and coat the surface. Since the alcohol dries fairly quickly, you'll want to work fast. Try not to leave any puddles which will soak in at a different rate. Use a small brush to get into the tight areas and follow up that up with wiping those areas with a rag.

Flip the guitar over without touching the new finish and rest the guitar on your "screw jacks" with the neck supported by a block of wood. Coat the sides first, then move to the front surface the same way. As long you work quickly, the dye is a little forgiving since you can wipe over an area several times without puddling and getting dark spots. Double-check everything so that you wipe up any runs. Don't forget to color your headstock, control cavity cover, and truss rod cover (if you made any of those from wood like we did). One coat is all it takes. Let it dry overnight. When you first apply the dye, the guitar will look spectacular, but it will dry down to a more muted tone. It would be nice to keep that spectacular "wet look" you see in the first photo above. That's what the following coat will get you; the oil coat.

49 The Oil Coat

To keep that awesome "wet look," apply some boiled linseed oil. It's a little old-school, but sometimes it's best to stick with the tried and true. It's foolproof to use and will pop the grain out tremendously. It will also bring a bit of an amber tone to the party, but if you made your test pieces, there won't be any surprises.

The technique of application is to generously coat the surface (go ahead a puddle this one on), let it sit for about 5 minutes to soak in, then wipe off the excess. It's impossible to over-apply; the grain will only soak up what it can. The oil will penetrate the grain and make our quilted maple three dimensional.

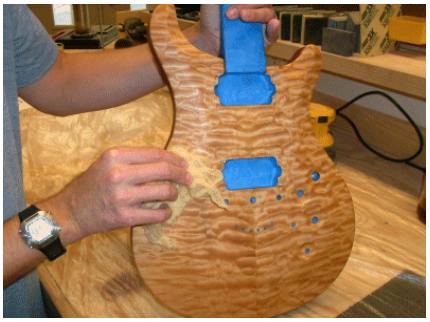
Let the guitar sit for about 20 minutes, then come back and wipe down the whole guitar again with a new, clean rag. This will remove any oil which may have leached out of the pores. Check it again after another hour and give it another wipe. The result in the rightmost photo is spectacular. Believe it or not, the finish here is fully dried; the visual texture is impressive. One coat is all it takes. Let it dry for two nights.

50 The Seal Coats

The purposes of applying sealing coats are twofold. First, you want to fill in any open pours in the grain so that the lacquer which we'll be applying next will lay down perfect and smooth. Second, lacquer thinner is more or less toxic and it will eat through just about anything, except shellac. The shellac will seal our previous work and protect it from any funky chemical reactions we might get from applying the lacquer directly over the dye and oil.

You can buy premixed shellac, but I prefer to make my own by dissolving shellac flakes in denatured alcohol. This way I can control the color and concentration. Shellac flakes come in several colors: blonde, orange, and garnet. Blonde is very pale and garnet is pretty dark. We chose the middle tone, orange, to layer on more of the amber tones. The layering of colors will reflect light differently emphasizing the three dimensional figure of the wood. The surface of the guitar will appear to move as you walk past, kind of like a hologram.

I will make what is called a two pound cut mixture which is basically just an average concentration of flakes to solvent. When it's applied, the solvent will evaporate off leaving the little dissolved shellac bits behind. The directions on the can of shellac flakes said for a two pound cut, mix 2 ounces of flakes with 8 ounces of denatured alcohol. Dump them both into an old jar (in our case, a Frontera Chipotle Salsa vessel, excellent flavor) and shake them up. Let it sit overnight and shake it some more. It should completely dissolve in about 24 hours. This should make enough shellac for the four coats we'll be applying.



Prepare the surface of the wood by throughly wiping it with a tack cloth to remove any dust. Make sure all of your little holes and penetrations are filled so they're not clogged by the following coats which will be built up. For holes too small for wadded up tape, try some small screws. To get an even coat, you will have to spray-apply everything from here on out. There is no way you can brush or wipe it on and have it look good. To remove any undissolved shellac flakes, strain your mixture through a disposable paper filter-funnel or an old T-shirt into your spray gun's reservoir.

Now for a few comments on spraying technique:

- Please spray in a well ventilated area, your garage, or outside in the shade somewhere. I wrapped a corner of the basement off with plastic sheeting. If possible, spray in an area other than your woodworking shop to cut down on any stray dust getting on your finish.
- Please wear a good respirator; a cloth dust mask will not do. Just think about it, shellac and lacquer are specifically designed to stick to anything and dry hard. That includes your nose, throat, and lungs. The first time a sprayed something, I did not use a respirator. The next day I was sick and blowing chunks of stain filled mucus out my nose. Don't learn the hard way.
- The solvents used (alcohol and lacquer thinner) are not only flammable, but in a sprayed state, they are combustible and explosive. Don't spray near an open flame (like a cigarette or a pilot light).
- Test your setup on a piece of scrap wood. Make any adjustments to your gun before you start messing up your guitar. Get a feel for the amount of spray and the speed you will need to be moving.
- Be patient! Runs, drips, and sags are bad. If you make any, you will have to completely sand them out and start over. Don't try to rush things or all of your hard woodwork will look like crap.
- Start the gun moving before you pull the trigger. Start spraying outside your piece and continue past your piece before releasing the trigger. This constitutes one spray "stroke".
- I prefer to hold the guitar while spraying. This lets me keep the gun relatively level the whole time so that my finish doesn't leak or drip on the surface. Do whatever works best for you.
- Try to keep the spray perpendicular to the piece and the same distance from your piece throughout your spray. This will provide an even distribution of material. Move quickly to avoid throwing too much finish in one spot.
- Each stroke should overlap the previous one going back and forth. It should take about five "strokes" to cover one face of the guitar. These five or so "strokes" constitutes one "pass".
- On the same side of the guitar, make another "pass" at 90 degrees to the first. I'll call these two "passes" one "coat". The surface should just be wet and thoroughly covered. Any more would start to drip, run, and sag, which would be bad.
- Repeat the procedure on the other side of the guitar. Don't forget the sides of the guitar, the headstock, the control cavity cover, and the truss rod cover.
- Hang the guitar to dry. Nothing fancy here; I used a wire coat hanger hooked through a tuning peg hole secured to a floor joist above with an eye-hook.
- Clean your gun at the end of each day's spraying.


Schedule for applying the shellac coats:

- Spray on one coat and let the guitar dry for at least one hour.
- Spray on a second coat and let it dry overnight.
- Repeat the process the next day for two more coats (making a total of four coats).
- Depending on your personal schedule, you can always wait longer. Just don't spray any sooner or the previous coat may not be fully cured.
- The next day, lightly sand the surface as explained in the next step.

51 Sand Some More

Now that you've got a solid blanket of shellac, and it looks all pretty and shiny, it's time to scuff it all up. Using a brand new piece of 320 grit sandpaper, lightly sand all of the surfaces. I said, "lightly." You do not want to sand all the way through your shellac and color coat back down to bare wood. The idea is to simply knock down any little nubs that are sticking up and to give the following coats some tooth to grab on to. You're looking for a fine coat of dust to appear on the surface of the guitar as in the photos. Flick off any build up on the sandpaper frequently.

When you've finished sanding, vacuum off the dust, wipe the entire guitar down with naptha or mineral spirits on a clean rag, then follow that up with a thorough wiping with a tack cloth. The surface will appear dull; that's alright, you just scratched it all up. We'll be adding on the shiny stuff next.

52 The Shiny Coats

The purposes of applying these shiny top coats are twofold. First, they will protect the guitar from the day to day abuse you will unto it render. Second, it will give you a thick, built-up surface which you can rub out to that kick-ass glossy shine.

Buy the high gloss "spray" lacquer, not the "brushing" lacquer as we will obviously be spraying and not brushing. I mixed up small batches as I needed them. You can always make more quickly since there is no wait time to dissolve like there was with the shellac. Following the directions on the can of spray lacquer, I mixed 200ml of spray lacquer (about 7 ounces) with 200ml of the spray lacquer thinner (about 7 ounces) with 5% lacquer retarder (10ml or about 3/8 of an ounce). This should make enough for about 6 coats on the guitar. A quart each of lacquer and thinner should be enough to coat the guitar with all the coats you'll desire. Refer back to the discussion on spraying techniques as they're the same for lacquer as it was for shellac.

Schedule for applying the lacquer coats:

- As mentioned earlier, lacquer thinner is toxic and explosive. Please take the necessary precautions.
- Spray on one coat and let the guitar dry for at least one hour.
- Spray on a second coat and let it dry for at least one hour.
- Spray on a third coat and let it dry for two days.
- Very lightly sand with 400 grit, vacuum the surface, and wipe it with a tack cloth.
- Repeat the process for a total of 10, 2-day processes (making a total of 30 coats). You'll start to see the build up and leveling of the finish after about 9 coats. Any open grain in porous wood (like mahogany) will start to plane out.
- After your last coat, let the lacquer cure for at least one week. That's right, one full week. The lacquer has to have time to fully cure or you will not be able to rub it out to that glossy finish.

Depending on your personal schedule, you can always wait longer between coats. Just don't spray or sand any sooner or the previous coat may not be fully dry. If your sanding does not produce dust, stop immediately and let it sit another day. Lacquer is unique in that it works by "melting" into or "reactivating" the previous coat. If you become impatient on coat number 11 and you lay on one extra thick coat, it will take considerably longer to dry. The longer it stays wet, the longer it continues to reactivate the 10 previously applied coats. If you're not careful you'll end up with one thick coat of jelly drooping, sagging, and running off your guitar. Then it's back to stripping the whole thing and starting over again. The risk is too great. Be patient!

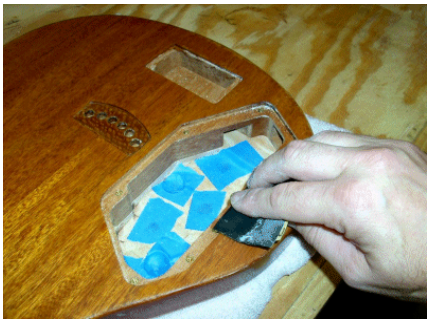
53 Rub Out the Finish

Remember to wait a week after spraying the last coat before you touch the guitar. If you did all of your preparation, sanding, and spraying carefully, you should see a pretty smooth surface. But it's not smooth enough! As they stay in all of the books I've read (and it's clever enough to repeat here), it's time to finish the finish.

From now on, always rest your guitar on a clean, soft towel when working on it so it doesn't get scratched. Start off by removing the screws protecting the mounting holes and take all of the tape off the guitar. The lacquer will have built up over the top of the tape and you want to be sure the sanding you'll be doing will ease the edges of the lacquer to bare wood abutments. Also, even though you used the easy-release painter's tape, after being on for about a month, it will have begun to stick and leave some residual goo behind. Use an Exacto blade, but do NOT cut with it which might gouge the wood. Instead, scrape backwards with the blade at the corners of the cavities. This will shave the edge of the lacquer off so when you peel off the tape, you don't peel the lacquer off with it. Use the point of the knife or a dental pick to thoroughly clean off all of the tape which might be hiding in the corners. Inspect for any sticky glue stuff remaining on the bare wood and clean it off with some mineral spirits.

They call it rubbing even though it is actually sanding. The high grit sandpapers don't produce much visible dust, so I guess they thought rubbing was a better term. When rubbing out the finish with these fine grit sandpapers, you need some kind of lubricant. It makes the rubbing a bit easier, it extends the life of your sand papers, and it helps carry off the fine dust. In an old spray bottle, mix up one part mineral spirits with one part paraffin oil (about 8 ounces of each should be enough for the whole job).

Use a foam or felt sanding block as much as possible and for all grits which helps keep the surface level and eases hand fatigue. I like to start with 600 grit wet/dry sandpaper before moving into the MicroMesh abrasives. Now don't go hosing down the piece with the lubricant; you'll end up with oil all over the place. Just spray once in the middle of the guitar and a little here and there, or when rubbing a smaller area or and edge, spray a small amount directly on the paper. Sand with firm pressure. Start by rubbing the whole surface in small circles, then rub 45 degrees to the grain direction, then rub with the grain direction. Now repeat this to yourself over and over again: "Do not skimp on the sanding." If you get lazy on only one grit, it won't become evident until you get to the last grit and it's not as glossy as it should be. This is why I recommend rubbing in three different fashions, so you're sure to rub everything thoroughly. With these finer grits, it's impossible to sand too much. Don't worry, there is no danger of sanding through 30 coats of lacquer.



The 600 grit is the most important since this will perform the leveling; you will not be able to level the surface with the MicroMesh abrasives. Start with the back of the guitar, spray on some lubricant, and rub thoroughly as noted above. When you're done with the back, wipe it down with mineral spirits to remove any dust. Now inspect the surface very carefully in a low-angle, grazing light. You'll first notice that your beautiful shiny guitar is suddenly dull. Everything's alright, that's what's supposed to happen. You'll get it brilliant looking again after working through all of the grits. What you're looking for are any shiny spots or any unevenness in the surface. The shiny spots will show the low areas which did not get sanded with the block. If the surface is not dead flat, sand more with the 600 grit until it is. If the surface is really off, you may have to take a step back to 400 grit for a more aggressive attack, then back up to 600 grit again to start smoothing. Take extra time on the first grit until the surface is perfectly level with no dimples. Only then can you continue to the finer MicroMesh abrasives.

There are 9 grits of MicroMesh abrasives, and at about 20 minutes per grit, this will take you a while. Find your rhythm and rub all surfaces in the same order so you don't forget an area. I did the body back first, then the headstock, cavity cover, truss rod cover, body front, then finally the body sides. Add a spritz of lubricant as needed. When you finish an area, wipe it off with mineral spirits and inspect. When you finish a grit, take a short break, then repeat the procedure with the next grit. You can split the rub out over a couple-three days so you don't get too tired or bored with it.

54 Wax On, Whack Off

I like to give my glossy wood projects a double-hit of wax. The first coat I like to apply is automotive scratch and swirl remover. This is a fluid product which helps fill in any small scratches which made it through the rubout. Follow the directions on the bottle. Generally, you rub a coating onto the surface (one area at a time

and in small, overlapping circles), you wait a couple of minutes for it to haze, then you rub that off with a clean, soft rag. After that, I like to go one more step with a finishing paste wax. This provides a thicker protective barrier and will really bring out the shine. The directions for the paste wax are similar to the swirl remover. However, the can says to leave the wax on for 15 minutes before rubbing it off. I would caution you about leaving the wax on that long. The wax dries fairly hard and you will have a lot of trouble rubbing it back off. What I found works best is to wipe it on (one area at a time and in small, overlapping circles), then immediately start buffing it back off at the point where I started. Even this will require some elbow grease.

Keep buffing the entire area frequently refolding the rag to expose a fresh surface. You will be rewarded with that high gloss reflectivity you're after and everyone will envy. Wow, it's starting to look like a real guitar!

55

Tung the Neck

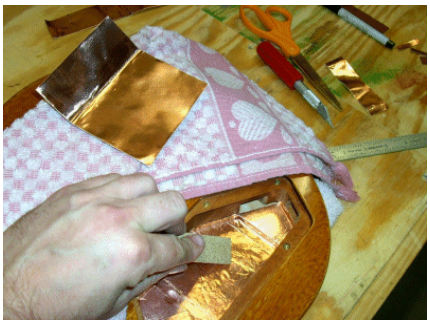
Since Brian prefers the natural feel of a wood neck, he obviously doesn't know the first thing about playing a guitar! But if that's what the man wants, that's what he gets. We already sanded the back of the neck to 150 grit when we made it, just check it carefully to see if any new scratches appeared which would need to be worked out. Continue sanding with 220, 320, and 400 grits. Be as thorough as you can since you will feel every bump as your playing.

We chose to use a tung oil finish on the neck which lends a very light, almost colorless finish, but offers some protection. It's easy and foolproof to apply. Don't worry about taping anything off, the lacquer will repel any over-wipe. Pour a little in a cup, wet a soft, clean rag, and smear it on. Go over the entire back of the neck two or three times quickly. Then use a dry rag to wipe off any excess. Flip the guitar over and do the same to the front. Use your dry rag and wipe up any oil that might have strayed onto other surfaces. Let the oil dry overnight.

56

Shield the Cavity

Guitar electronics are very sensitive. Think about it, that vibrating guitar string is all that's powering your sound. To keep out any unwanted noise or radio signals from getting into the mix, you must shield the control cavity. You can do this with a special type of paint or with copper foil. Either method works; we chose the foil.

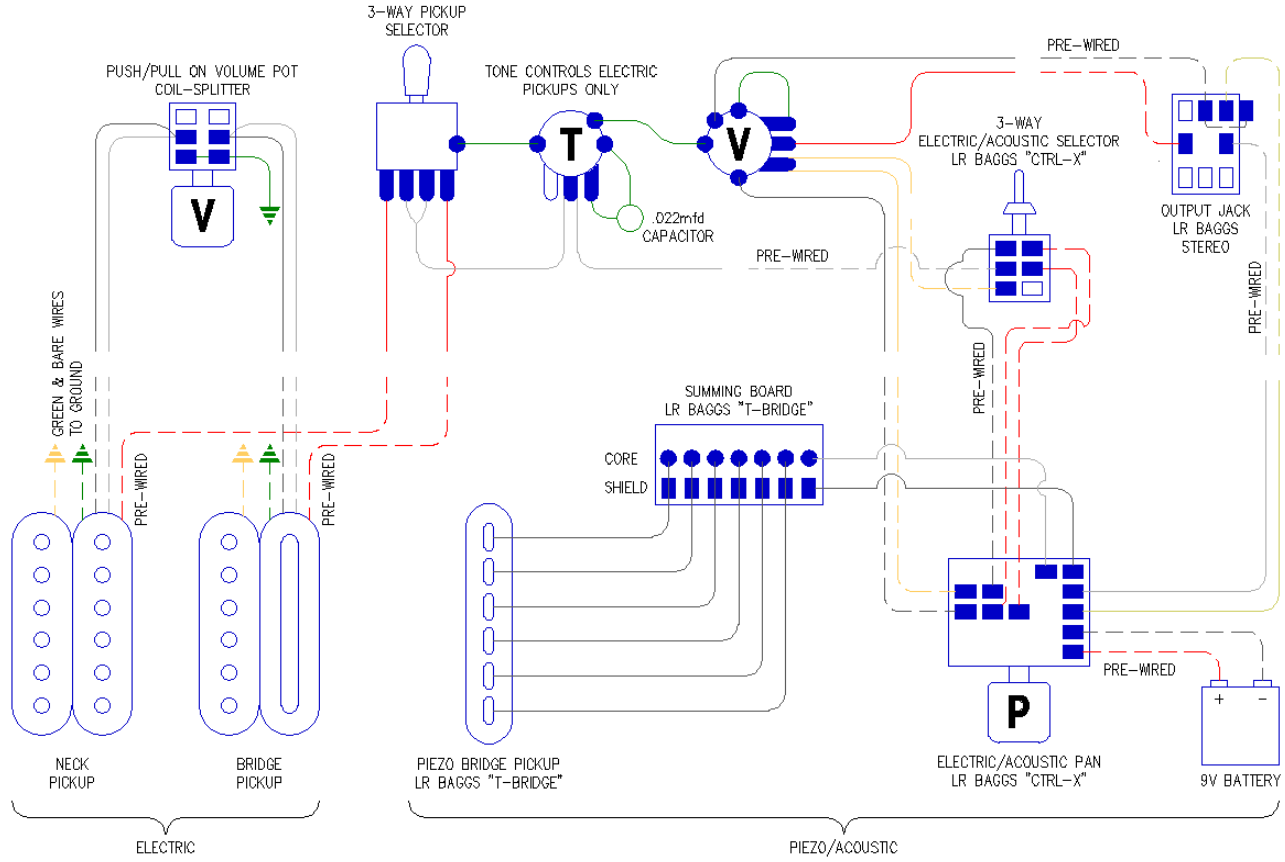


Lay the guitar face down on a soft, clean towel. Pick out any glue ooze from the inside of the cavity so you have nice clean corners. The copper foil has an adhesive back which makes things a little easier. Start with the bottom of the cavity. Cut off a small strip a little over the size you need. You want the foil to fold up the sides a little. This will provide a continuous, connected barrier. Peel off the backing and stick it in. To make sure the foil is fully seated and well stuck, burnish it by rubbing it with a small piece of wood or MDF getting into all the tight areas. Cut out the next strip and overlap the first by a few millimeters. Once the bottom is done, start on the sides. Make sure you foil over the top lip where your cavity cover will nest. If there are any areas where the adhesive doesn't take, help it out with a drop of CA glue. This is a tedious job for big fingers in a small space; just take your time. When you're done, cut out your knob and switch holes and your cavity cover mounting holes with an Exacto knife.

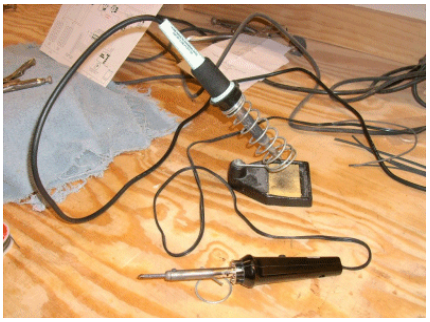
The cavity cover is much easier. Cut a piece of foil a little oversize, burnish it on, flip the cover over, and trim off the excess. The edges of the cover will rest on the foiled lip providing a continuous, connected barrier.

Solder Away

I'm not going to try to explain all of the basics of guitar electronics here. If you've never wired up a guitar before, read up on it first. There are plenty of resources on the web that will get you going. You'll also want to draw up your schematics first so that you know what gets soldered where. The schematic does not show the exact layout of all the knobs and switches; it more shows the flow of sound in the order the signal travels. There will be many wires crammed into the small cavity, and correcting a mistake might mean unsoldering several other connections to get to the problem spot. You'll definitely want to try to get it right the first time.



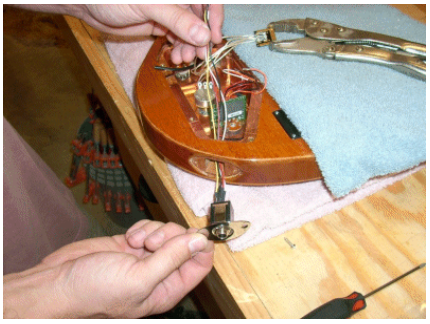
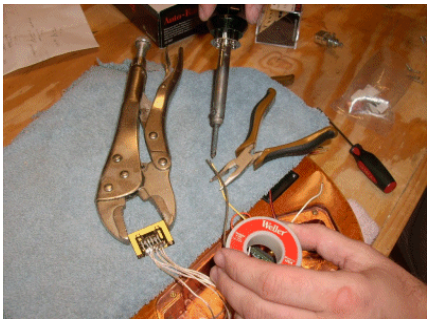
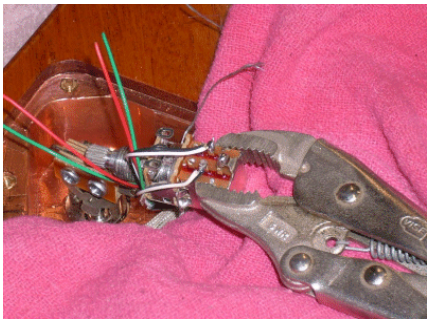
As you can see, our piezo acoustic bridge added a lot of extra wires, a couple of circuit boards, an extra switch, a 9 volt battery, and a proprietary output jack. However, a lot of the components came pre-wired which made it a little easier, and the additional tone options were worth the extra effort.



Plug in your soldering irons. I used a 30 watt unit for most of the work, but the 100 watt "flame thrower" came in handy when grounding to the backs of the potentiometers (pots) which require more heat. Install as many pots and switches as you can, and do not overtighten any screws or nuts. Keeping in mind that you will need to get a hot soldering iron to the connection points, orient the pots so that the connection points face a convenient direction. We were able to install everything except the volume pot since ours had a double-pole, double-throw (DPDT), push-pull switch on it with many wires to attach to it. It will be easier to solder the wires to that one before it is installed. If you have a battery associated with your scheme, install the housing and route the wires for that now.



Flip the guitar over and install your pickups. Our guitar had a piezo pickup in the bridge whose wiring had to be routed through the bridge pickup cavity, so it had to go in first. When installing your pickups, loop the wire around in the bottom of the cavity before setting the pickup (as in the center photo above). This will leave you a little safety slack if you cut too much off the other end. Screw down the bezels without over tightening.

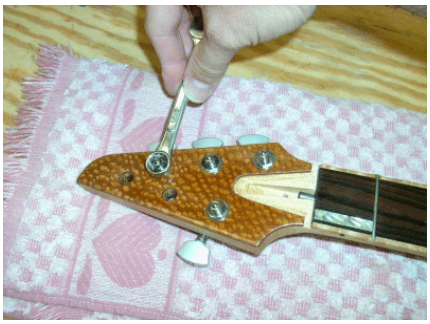




Notice the soft towels above and below our work area. Don't risk a scratch at this point. Our output jack already had wire leaders soldered to it. If yours does not, solder some on now since it will not be easy getting to those points once it is installed. Mount the jack to the cover plate and screw it in. Again, do not overtighten anything; snug is enough; strip it out and your screwed. The middle photo above shows our piezo circuit board wired up which will be installed with double-stick tape to the sidewall of the cavity. It also shows me tinning the wires before they are soldered to the pots and switches. Twist your wires together first, then apply a small amount of solder to "glue" the wires together (this is called "tinning"). Insert the wire into the tab's hole, apply your heat, and it will pull some of that solder onto the tab and make a good connection. Test all of your connections by giving them a light tug. Our volume/push-pull switch can be seen in the right photo above. A vise-grip helps hold it in place; these things do get hot. We made all the connections first, then installed the switch.

Now that you've got all of your hot wires soldered up, it's time to make sure everything is grounded properly. The three-way pickup selector switch will have a grounding lug on it; connect it to the back of one of the pots. Your pickups will have one or two ground wires which should be twisted together and soldered to the back of a pot. Be very careful as to how you route your wires. If a bare ground touches a hot wire, your signal will take the path of least resistance and go to ground. That will result in a weak sound or no sound at all. The center photo above shows our neat and organized wiring job. Our piezo pickup added some components and complexity to the schematic, but their literature was easy to follow and we were able to integrate it into our system successfully. We can't do too much troubleshooting now without strings, but you can plug in the guitar and tap on the pickups with a screwdriver. You can check for a signal, test your pickup selector switch, and test your coil-splitter switch if you have one. You'll give your electronics a full test drive later.

58 Install the Hardware

There's only a few more things to take care of before stringing her up. Install the tuners; again, don't go torqueing things down. Then install the strap locks with a felt washer. Please spend the extra two dollars on strap locks. It's not worth dropping your guitar that you've spent so much time on.



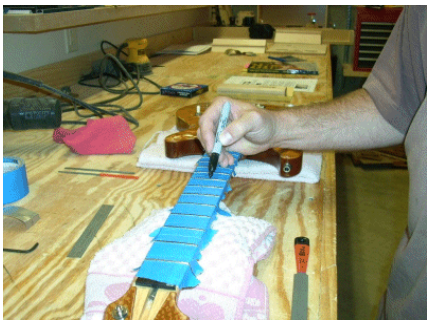
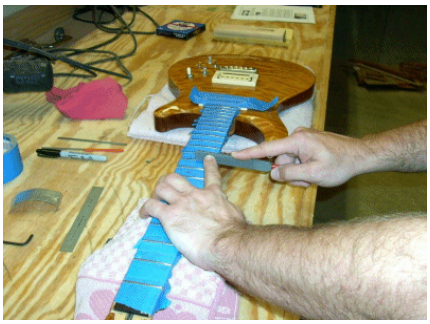
If you have string ferrules, put them in next. Start with the back ones. If your fit is a little loose, just add a drop of CA glue. Please, do not put the glue on the ferrule and slide it or it will all rub off on the edge of the hole and mess up your finish. Instead, place a drop or two of glue directly on the side of the hole, then push in the ferrule. When in doubt, tape it off. The same applies to the front ferrules. If you have any other hardware, put it on now.

59

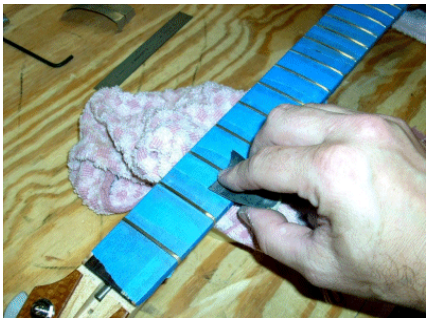
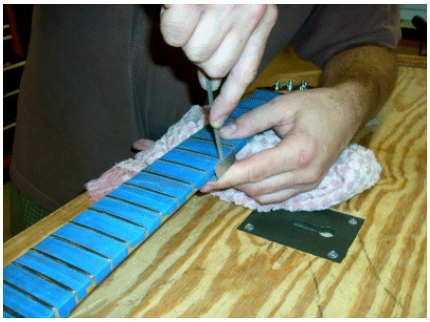
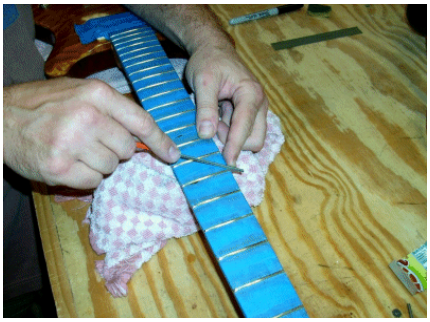
Dress the Frets



We've already worked on the neck, but we never really finished leveling out the frets. You can't really do much until this point since it isn't until now that you can string it up. Place a straight edge on top of the neck down the center of the fretboard. Adjust the truss rod so that it is as level as you can get it. Using a fat, black, permanent marker, draw a line on top of each fret being carefully not to mark on the wood. Grab your radiused sanding block you used to crown your neck, put on a fresh piece of 400 grit sandpaper, and lightly sand the frets in long, smooth strokes until you just sand off the marker lines. Don't concentrate sanding in one spot; work the whole fretboard evenly. This will level the frets so they're all in the same plane.

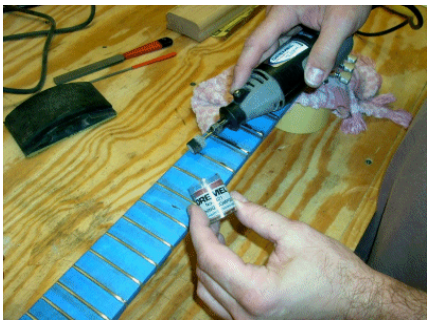




Once level, it's time to re-crown the tops of the frets. Wipe off the sanding dust from the neck and tape off the wood leaving only the frets exposed. Understand that this will only provide a minor degree of protection; you will still need to be careful. Darken the frets with the permanent marker again. A fret crowning file specifically designed for this task makes the work quick and is only a small investment. File perfectly in line with the frets; I use my left finger to keep things on track. Work in long, smooth strokes and let the file do the work. Don't go crazy filing on one fret or you will make that one lower than the rest; not good. File just until the marker line disappears. A few passes on each side with the file tilted at about a 45 degree angle will help make a smooth radius on top.

Once all the frets are crowned, it's time to make them pretty with a few finishing touches. With a small piece of 600 grit sandpaper, remove any remaining file marks and finish rounding off the tops. This will provide a beautiful satin sheen to the frets. Using a flat needle file, remove any portion of the fret which hangs off the edge which might cause you to sever a finger. I used a thin piece of metal (cut from a soda can) to protect the side of the fretboard in case I filed too much. Switch to a fret dressing file which only has burrs on the sides and none on the bottom which could mar the wood. Gently file away any remaining sharp edges. We beveled the fret ends earlier, but recheck them to see if they need any additional touch up using a sanding block loaded up with 600 grit sandpaper.

If your frets are happy with a satin sheen, stop here. But if you like the shiny gloss, install a buffing wheel on your Dremel tool and give it some polish. Just a few strokes will give you an amazing shine. Remove the tape and clean the fretboard with mineral spirits. Don't worry, it won't eat through the tung oil you put on earlier.

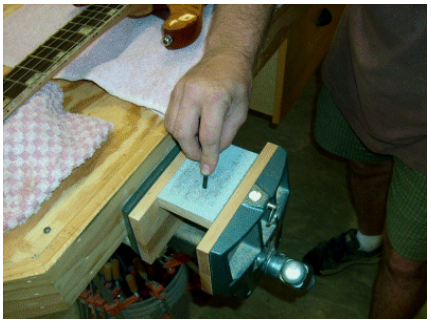



60

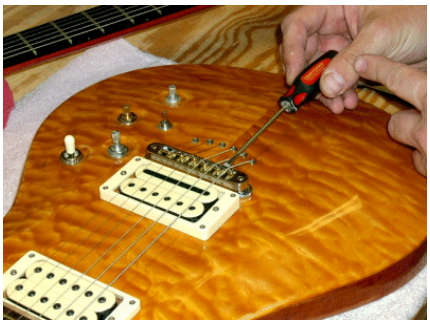
Setup the Neck



String the bitch up already! Set your nut in place, but do **NOT** glue it in yet. Install the strings, but leave a lot of slack to wind around the tuners so you can easily loosen and move the strings out of the way, which you will be doing frequently. Adjust the truss rod to lift the headstock up slightly, which will help prevent buzzing. Now give it a test drive with some Skynyrd. Don't be disappointed; it will certainly have bad action at this point. That's what you'll fix next.


With the strings tuned up, check for a 0.76mm (or 0.03") clearance between the top of the first fret and the bottom of the string. You can buy some fancy feeler gauges, but a credit card happens to be the precise dimension. You'll likely be a little high, so move the strings out of the way and remove the nut. Load a sanding block with 60 grit sandpaper and secure it in your vise. Sand off the bottom of the nut evenly. Use some 150 grit to clean it up. Reinstall the nut back onto the neck. and tighten up the strings again. Remove only a little at a time and check the clearance at the first and sixth strings to make sure you're not sanding too much off one side. Remember, you can always remove a little more material, but you can't add any back on.

When you start to get close, adjust the bridge height down a little at a time. The object is to get the lowest action possible without getting buzz or without choking the note when you bend the strings. You will have to loosen the strings a lot and make frequent adjustments, just be patient. The last thing to do is to check the intonation (the string length from nut to bridge). Hopefully, your careful layout and woodworking skills will not require a lot of adjustments here. Hook up an accurate, electronic tuner. Tune the string to the proper pitch using the tuner, then play a 12th fret harmonic. The needle should split the uprights on both notes. If they don't, adjust the individual bridge saddles until the two notes match.

61

Troubleshoot the Electronics

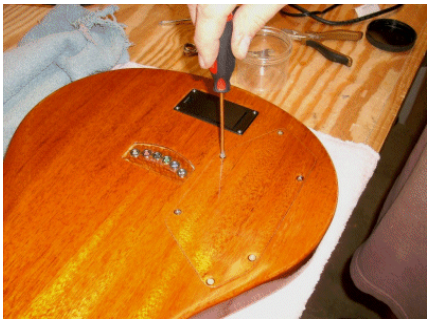
Tune up all the strings and adjust the height of the pickups to be close, but not too close. The magnets can pull on the strings and effect the tone and sustain. Pickup height also affects signal output. Adjust the neck and bridge pickup heights so that they have close to the same volumes.

Now run through all of your knobs and switches to make sure everything works as intended. Fortunately, we only had one switch wired up backwards, so it wasn't too difficult to remedy. Make any repairs and test drive it some more until all the bugs are worked out.

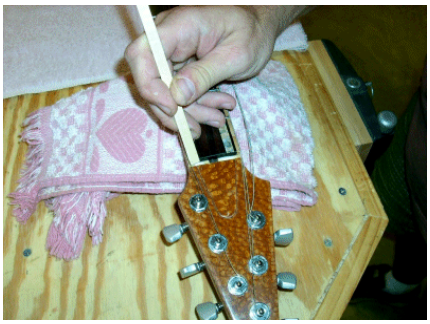
62

The Finishing Touches

When you're satisfied that your electronics are in order, screw the cavity cover in place without overtightening the screws. Flip the guitar over and push on the knobs.



Loosen the strings and install the truss rod cover. With just a small drop of wood glue on each side of the truss rod, install the nut. Wind the strings back up, but only just tight enough to hold the nut in place. Check for accurate side to side placement of your nut. Let the glue dry for an hour, preferably two, before tuning up the strings to pitch and playing.



Final Words

After doing a lot of research on guitar construction, I discovered that there are a lot of different means to get to the end. I tried to take the best segments of each approach and meld them together into one with which I felt confident and which worked for me. I never claimed to be a seasoned guitar maker; this was my first build. I made some mistakes along the way, but I tried to explain how to avoid them and how to fix them if they occur.

Vince, amateur luthier

Brian, amateur shredder

It took 164 hours over 268 calendar days to get there (see the Time Sheet in Appendix D). Granted, it was a leisurely pace, but this was supposed to be fun, not work, and I had a lot to learn along the way. Most importantly, it was quality time spent with a good friend. Honestly, when I started this project, I didn't think it would come out as well as it did (see The Portfolio in Appendix E). It pushed my woodworking skills to the limit and opened up my eyes to many new techniques I hadn't tried before. If you have a well developed background working with tools (and a friend to fund the experiment), this project could be within your grasp, too. And if you happen to have a wife who might not be too keen on your expenditure of time and money, be sure to make her a jewelry box from the guitar's scraps to ease any tensions.

Tasha, professional jewelry collector

Appendix A - Specifications

Item	Type / Make / Model	Detail / Finish	Cost
General			
Dimensions	Overall length	38 1/2" [978mm]	
	Width	13" [330mm]	
	Body thickness	1 3/4" [45mm]	
Weight		7 lbs 13 oz [3.5kg]	
Wood	Body front panel	Quilted maple	90.00
	Body back panel	Mahogany	64.80
	Neck	Maple	82.36
	Fretboard	Macassar Ebony	37.95
	Headstock and other trim veneer	Lacewood	19.80
Body style	Solid body with carved top		
Neck			
Neck style	Set-in		
Tilt-back angle		3°	
Dimensions	Scale length, compensated	25" [635mm]	
	Width at nut	1 11/16" [43mm]	
	Width at body	2 1/4" [57mm]	
Truss rod	Double-acting	18" [457.2mm]	24.35
Fretboard radius		12" [304.8mm]	
Frets	22 total		
	CH=1.17mm; CW=2.49mm; TW=.58mm	12% nickel/ silver	5.35
Fretboard banding	Quilted maple		
Nut	Graphite, 6-string, pre-manufactured	1 11/16" [43mm]	3.99
Fretboard inlay	Abalam, green		54.85
Side dots	Black acrylic	3/32" [2.5mm]	2.35
Headstock			
Headstock style	Tilted back	13°	
Tuners	Sperzel locking tuners, 3+3	Satin chrome	59.99
Truss rod cover	Lacewood with hidden attachment		
Headstock inlay	None		
Finish			
Color coat	TransTint “Golden Brown” dye in denatured alcohol	1 coat	24.78
Oil coat	Boiled linseed oil	1 coat	12.99
Seal coat	Orange shellac in denatured alcohol	4 coats	18.99
Clear coat	High gloss nitrocellulose lacquer/ thinner/ retarder	30 coats	40.97
Hardware			
Output jack	LR Baggs “Ctrl-X”, stereo		
Output jack cover	Oval, recessed mounting	Chrome	3.99
Bridge	LR Baggs “T-Bridge”, fixed, piezo	Chrome	84.55
String ferrules	Front and back ferrules	Chrome	9.46
Strap locks	Schaller “Security Lock”	Nickel	14.98
Strap lock washers	Felt	Black	3.20

Item	Type / Make / Model	Detail / Finish	Cost
Electronics			
Neck pickup	DiMarzio “PAF Pro” #DP151FCR	Cream	75.00
Bridge pickup	DiMarzio “D Sonic” #DP207FSP	Cream	75.00
Pickup bezels	Height tapered for tilt-back neck	Cream	4.98
	Bezel mounting screws	Zinc	4.00
	Pickup height adjustment screws/ springs	Zinc	4.00
Cavity style	Controls through the back		
	Wood cover with threaded inserts		3.09
	Copper foil shielding		13.75
Battery compartment	Battery required for LR Baggs electronics	Black	10.95
Schematics	Volume pot, push-pull for coil-splitter	500k	13.95
	Tone pot	500k	7.95
	Capacitor for tone	.022mfd	1.25
	LR Baggs “Ctrl-X” piezo fade pot		132.05
	LR Baggs “Ctrl-X” 3-way selector, elec./ piezo 3-way pickup selector	Cream	13.95
Knobs	Dome type with knurled sides, press fit	Satin chrome	11.96
Total Cost of Materials (Cost of tools not included)			**1,031.58**

Appendix B - Design Considerations

Choices	Discussion	Purchase
Body		
One piece or faced with veneer	Pretty or exotic wood costs a mint. That's why you won't see the whole body made of flamed maple; you just waste too much "pretty" on the backside of the guitar which no one sees. If you prefer the simple grain patterns of mahogany, (plain) maple, or ash you can go with a single chunk of wood from which to carve your body. If you go with a neck-through design, some like to see the neck on the face of the guitar where it can be embellished with multiple bands of different colored woods.	Body wood Front panel Back panel Side panels
Solid body, semi-hollow, or hollow	• Solid bodies are typical for modern electric guitars. It's basically one chunk of wood with space for your electronics scooped out. • Semi-hollow bodies add resonance chambers which involve more routing. This adds a different character to the tone. You will often see a penetration on the face of the guitar like an "F" hole. • Hollow bodies are akin to acoustic guitars and involve a whole different method of construction. The inside of the guitar is one big resonance chamber and is made from thin pieces of wood bent around to form the shape instead of starting with a single mass of wood and carving out the profiles.	
Edge-banded or not	This is personal preference. Edge-banding the body of the guitar frames the top. For this look, it simply adds another step to the process. You often see banding made up from several thin layers of plastic, wood, or shell material (mother of pearl or abalone).	Edge-banding material
Body style: sculpted or flat	Sculpted or carved tops look great, but this will add another whole technique you will need to master. Flat tops can sometimes be embellished with a routed edge or an arm rest relief to give it some flair if you want to keep it simple.	
Cavity cover: plastic or wood	You don't have to buy the expensive plastics sold in the guitar catalogs, you can just cut up a cheap plastic trash can! Or you can make one from some scrap wood.	Plastic or wood
Cavity cover: wood screws or threaded inserts	Threaded inserts will never strip out. It's probably worth the extra 3 dollars to go with the inserts.	Screws, inserts
Cavity, copper foil shield or paint	You need to control any outside electrical interference from getting to your electronics. You can purchase adhesive-backed copper shielding or use a special impregnated paint. Insulating all your wire runs should help as well.	Foil or paint Wire insulation

Choices	Discussion	Purchase
Neck		
Bolt-on, glue-in, neck-through, or set-in	Most of this is personal preference. A bolt-on neck is easier to replace, but how many necks do you break. I find that the other three glue-in neck options look better and offer better sustain. • You know what a bolt-on neck is. That was what your first guitar had. I find them very cheap looking. • A glue-in is like a bolt-on with a neck tenon glued into a mortise on the body instead of bolted on. This option will allow you to gracefully shape the neck to body transition. • Neck-through is where the neck continues through the body all the way to the end of the guitar. You can see the neck wood intersecting the body on the back and sometimes on the front of the guitar. • A set-in neck is kind of like a neck sandwich where the body has a top and bottom panel with the neck nested in between. The neck stops short of the end of the guitar and is not visible on the back of the body.	Neck wood Neck plate (if bolt-on)
Tilt-back neck or flat	This will somewhat depend on the bridge you buy. If the bridge sticks up pretty high off the body, keeping the neck parallel with the body will result in an awkward looking arrangement. Tilting the entire neck back will make neck construction a little more involved, but will give you a cleaner appearance. Drawing a section of your guitar with your actual components will start to reveal what will look best. You will usually see the neck tilted back from the body from 2 to 4 degrees.	
Scale length	Scale length is the distance from the nut to the bridge. For a standard guitar, this is usually between 24" and 25 1/2". I've heard of players who use dropped tunings opt for up to 27" scales to keep a reasonable tension on the strings when they loosen them up. You will also want to employ a "compensated" scale length. This will compensate for the amount the strings are stretched when you press them to the fretboard changing the pitch slightly. Also, your saddles will be staggered to compensate for wound versus unwound strings. I found that your scale length plus 2mm from the inside edge of the nut to the center of the frontmost saddle works.	
Truss rod	Including a truss rod will give you an adjustment option if the neck starts to do things. It also helps keep the neck from twisting. There are several types available from a traditional threaded rod with a nut to double-acting units.	Truss rod
Integral fretboard or applied	Fenders have a one piece neck with the frets laid directly onto the wood with the truss rod cut into the back of the neck. Other guitars have a separate fretboard applied onto the neck covering the truss rod cavity.	Fingerboard wood
Radius on fretboard	Try to stick with something standard. Most electric guitars have a 12" or 14" radius to crown the top of the fretboard. If you go with something different you'll have difficulty matching up a pre-made nut or bridge.	

Choices	Discussion	Purchase
Radius on back of neck	How chunky do you like it? Some prefer a very slender feel while others like to hold a log (probably a masculinity compensation). The thicker the neck, the more stable it will be, but don't try to make it too thin or you might weaken it. Remember, routing a channel for the truss rod removes a lot of structural wood.	
Frets	There are a few sizes out there. I found one with a tang which matched up with a saw I already had. Width and height of the crown are personal preference.	Fret material
Edge banded fretboard or not	Edge-banding the fretboard covers the sides of the saw kerfs of the frets. It's a little more professional to cover these up and will help keep moisture from intruding there, but it is another step to add to your production schedule. Lapping the frets over the banding is also another issue to consider.	Edge banding Wood or plastic
Neck width at nut	How far apart do you like your strings? We found a nut with a similar dimension to a guitar which felt right and bought it. This is critical to know when designing your neck. Even a couple of millimeters can throw things off. You can also buy blank nut material to make your own custom spacing.	Nut or nut material
Passive nut or locking	A locking nut helps keep your guitar in tune better. It basically clamps the strings directly behind the nut. You see these on guitars with tremolos. If you're getting locking tuners, you don't need a locking nut.	String clamp
Fingerboard inlays or dots	Dots are easier to put in, but inlays look cooler and let you personalize things a bit. It depends on what you're up to. You can also purchase pre-manufactured shapes, but they still have to be routed and inlayed. You only need a drill bit to add dots.	Inlay material
Neck side dots	Reference dots are the norm on the side of the neck.	Inlay material

Choices	Discussion	Purchase
Headstock		
Flat headstock or tilted back	Fenders have flat headstocks which are parallel with the fretboard. They usually need those ugly string trees to hold the strings down on the nut. You'll use a little less wood, but I think the flat headstock style just looks bad. Tilting the headstock back (usually 10 to 15 degrees) will pull the strings over the nut and help with sustain. Another option is to add a veneer of pretty wood over the headstock, usually something to match the body of the guitar.	Face veneer wood
6, 7, or 8 string	Stick with the standard 6 or go for the exotic. When you make it yourself, you can do as you choose. But straying from the standard 6 will reduce your options on tuners, nuts, and bridges.	
Tuners: 3 a side 2+4 1+5 6 in a row	3+3 or 6 in a row are the combinations in which you'll find tuners packaged. Going to a 2+4 or a 1+5 will require you to buy two sets of tuners and have leftovers (presumably for the next guitar). 3+3 sets have larger blades and the straight 6 tuners are smaller so they fit.	Tuners (left/right)
Locking tuners or non-locking	I prefer locking tuners since you do not have to wind the string around the post numerous times. You just pull the string though tight and clamp it. Locking tuners also hold your tuning better. You'll narrow your options some with the locking tuners, so just browse the catalogs and see what you like.	
Truss rod adjustment cover	A very minute choice to make, but it will still require you to buy something so I'll list it. You can find many pre-made covers, but for a one-off guitar, you might as well just make one from some scrap wood.	Plastic or wood
Headstock inlay	A great spot for some personalization. You can also print out your logo on clear film and lacquer it into place.	Inlay material
Finish		
Stained or natural	Your choice; the possibilities are endless. Stain your wood or paint it. Add glossy top coats or keep it a natural satin finish. Some prefer the natural feel of a neck that's only been oiled.	Stain, paint, lacquer

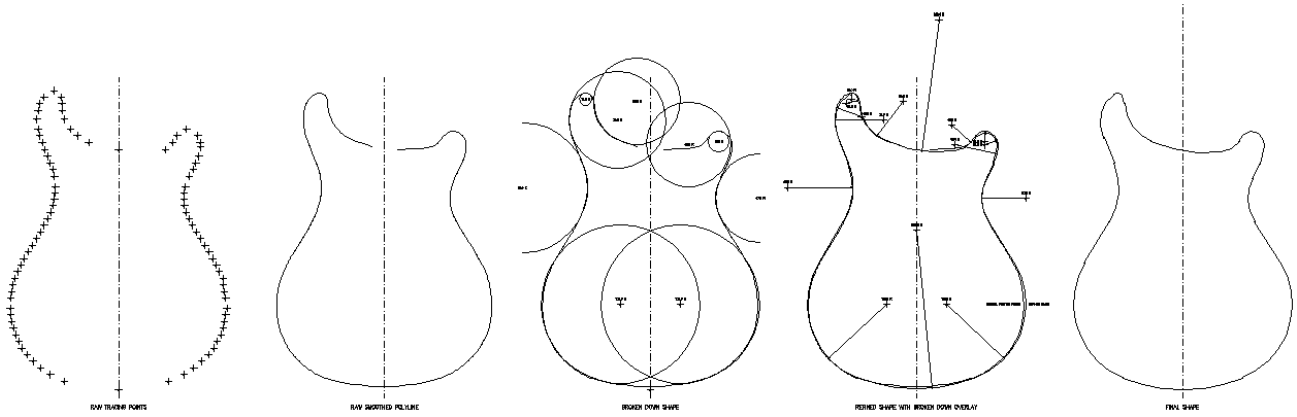
Choices	Discussion	Purchase
Hardware		
Single or electric/ acoustic output jack	You can go crazy with electronics. It is possible to have six outputs to control each string individually. You can also find guitars with computer circuit boards and MIDI outputs. I like to keep the guitar simple and use pedal effects to embellish my tone. Or you can go the BC Rich route with 48 or so on-board switches. I own a Carvin with separate electric/ acoustic outputs which does come in handy for separately amping them. Pick something that you think you are capable of tackling. You will have to read schematics and do some soldering.	Output jack(s) Output jack cover plate
Fixed or tremolo bridge	Fixed bridges are easier since tremolos require more routing. But go with whatever you like on your dream guitar.	Bridge
String ferrules or tailpiece	Some bridges hold the string balls; some require a separate tailpiece. You can also run the strings all the way through the body which will require something to trim out the holes on the front and back of the body (string ferrules).	String ferrules or tailpiece
Strap locks	There's no choice here; buy them. You won't want to be dropping your beautiful new guitar.	Pair strap locks
Electronics		
Controls through the front or from back	Fenders have the wiring from the front; Gibson's from the back. Either route is viable; however, when going through the front, you will need a large pick guard to cover up your wiring channels.	Pick guard
Active or passive electronics	Active electronics offer a few more tone choices and a little extra punch to the volume. Active electronics require room for a 9 volt battery.	Battery compartment
Potentiometers	Volumes and tone use the same kind of potentiometer. You will also need some capacitors for the tone pot(s).	Volume pot(s) Tone pot(s) Capacitors
Knobs	Pick what you like or make your own out of wood.	Knobs
Switches	Pick what you like. The only thing to consider here is not to pick a bulky switch that won't fit in your control cavity. Whenever they offer a lower profile model, buy that one.	Switches
Single-coil pickups or humbuckers	This is the age-old debate that's been going on since electric guitars first came out. Fenders use single-coil pickups and lend a thinner, twangier tone. You'll find humbuckers on Gibson's which give a fuller tone and less noise. Humbuckers can be wired with a coil-splitter option which will emulate a Fender sound. Again, this is personal preferences.	Neck pickup Bridge pickup
Acoustic pickup	There are some nice peizo pickups out that give great acoustic tone from tiny pickups mounted in the bridge saddles. You'll have to do more wiring, but it might be something you'd be interested in.	Acoustic pickup and associated switches and knobs

Appendix C - Design Diagrams

You simply can't go out, buy some wood, and start glueing it all together. You have to have a detailed plan. This includes accurate drawings of the front of the guitar as well as a section through the center of it. I enjoy doodling my ideas on scraps of paper as thoughts come to me. As I refine those ideas, I'll input them into my AutoCAD program to work out the details and exact measurements. It's a good exercise in using both halves of your brain; sketch and refine.

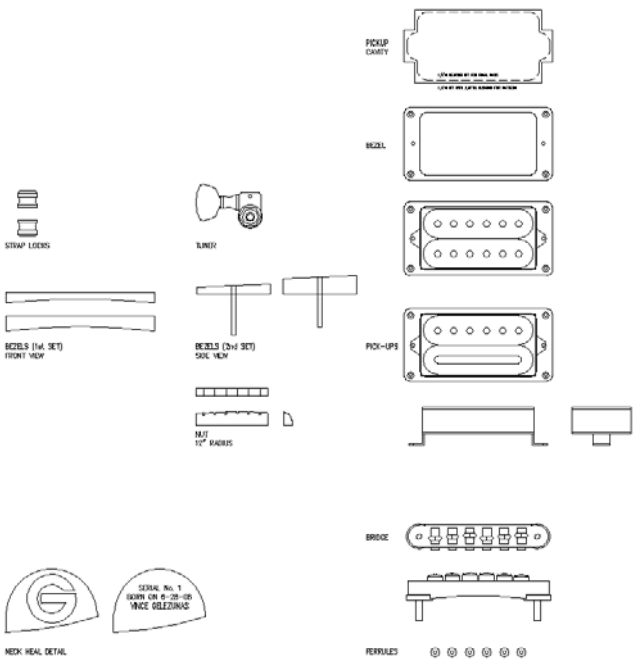
On the following pages are numerous design exercises which I went through on this build. Many times I went through many versions of a particular component only to come back to my first idea. That's ok; it just reaffirmed my initial choice and let me know that I've explored all of my options.

These diagrams have been reduced in size to fit in this book. Also, AutoCAD does not talk to my word processor very well. Thus, some diagrams will be a little difficult to read. This is mostly to show you that you need to do a lot of sketching and ciphering to get your design to work. There's a lot that goes on behind the scenes which no one will ever really see. All of your drawings should be done in minute detail and to full scale.

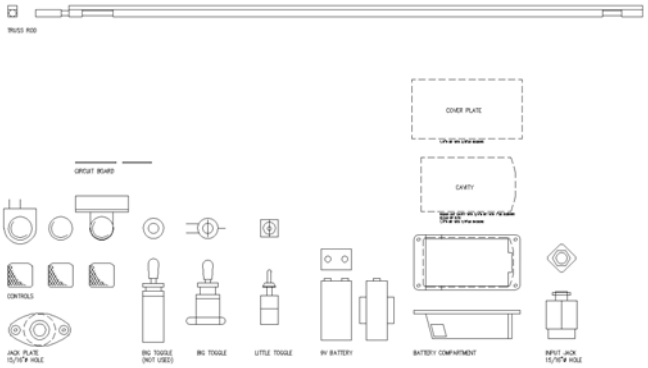


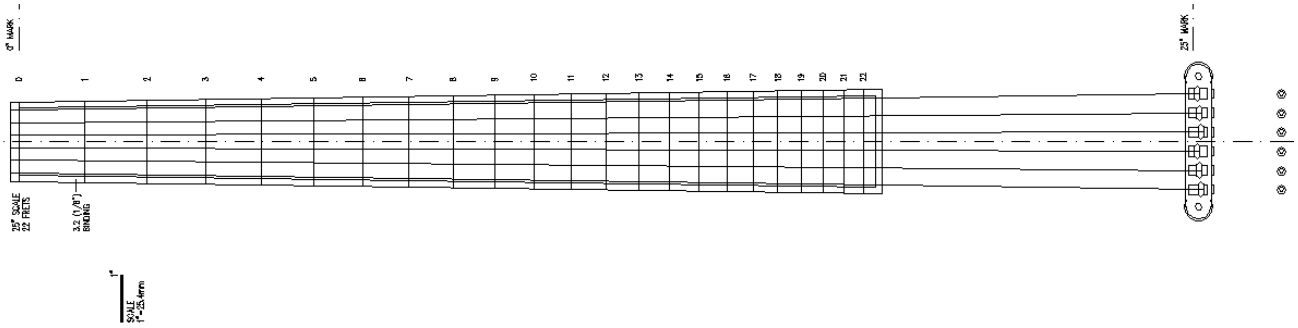
Even though we traced a Paul Reed Smith body, we still needed to plot out the points so it could be input into AutoCAD accurately (sketch 1 above). After connecting all the dots (sketch 2), I found that the pen I traced the guitar with probably wandered around a bit. I refined the layout by breaking down the design into it's individual arcs and lines (sketch 3). I then polished up the geometry, got the body perfectly symmetrical, and tweaked a few arcs (sketch 4). Ultimately, this led to the ultimate body shape which we could work with (sketch 5).

You need to have all of your hardware in hand before you can complete your design. Obviously, you want to make sure everything will fit. After receiving the hardware, I got out my calipers and transfered all of the dimensions into AutoCAD. With all of these individual parts in the computer, I began to arrange them on the guitar body I drew up previously. Preparation and accuracy are paramount when dealing with the fine level of detail involved in guitar building. Take your time and get it right the first time. Fixing a screw up later on down the line is at best difficult, and it can be impossible. These sketches depict both top and side views of many of the pieces of hardware.



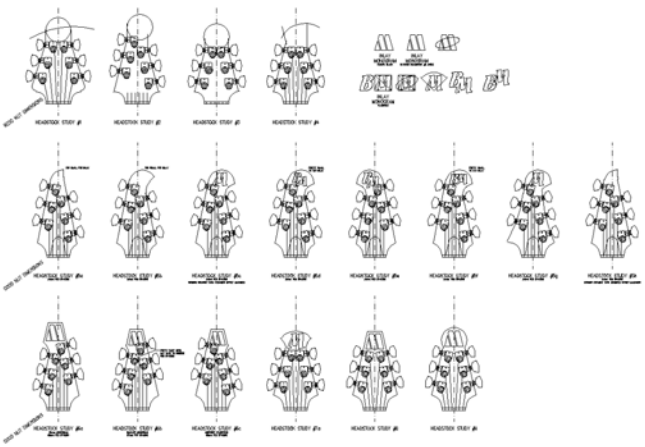
You might think that the knobs and switches are trivial, that is until they won't fit into your control cavity. This exercise informed me that the 3-way switch was too tall and would end up poking Brian in the pecker while he was playing. That may have lent some added inspiration to Brian's improvisations; however, it wouldn't have looked very good. I also had a large battery compartment which needed to be accommodated within the body of the guitar. These diagrams helped layout the routing templates used to cut the cavity and wiring channels. It's important to document and verify everything before you start cutting any wood.

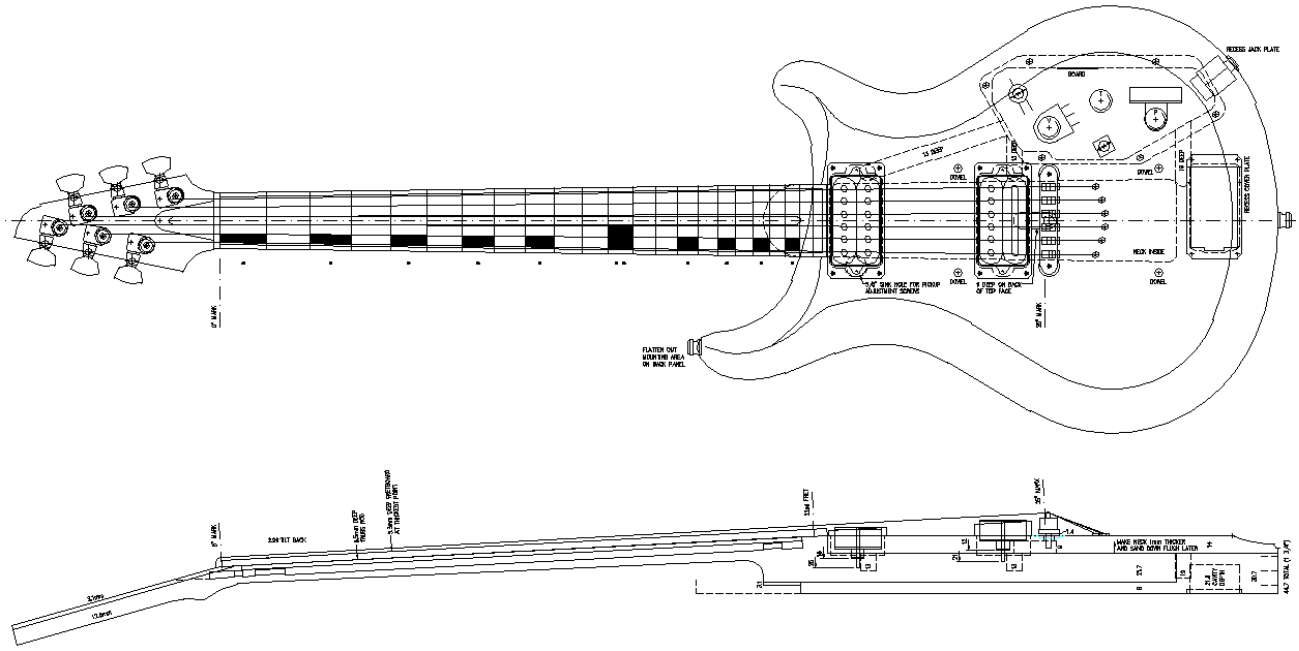




The dimensions of the nut and bridge are required to properly layout the neck. They define the width at each end of the scale. The desired scale length defines the distance between the nut and the bridge. Combining all of this data will dictate the taper of the fretboard. Use a fret spacing chart (which can be found on the internet) to help layout your fret locations.

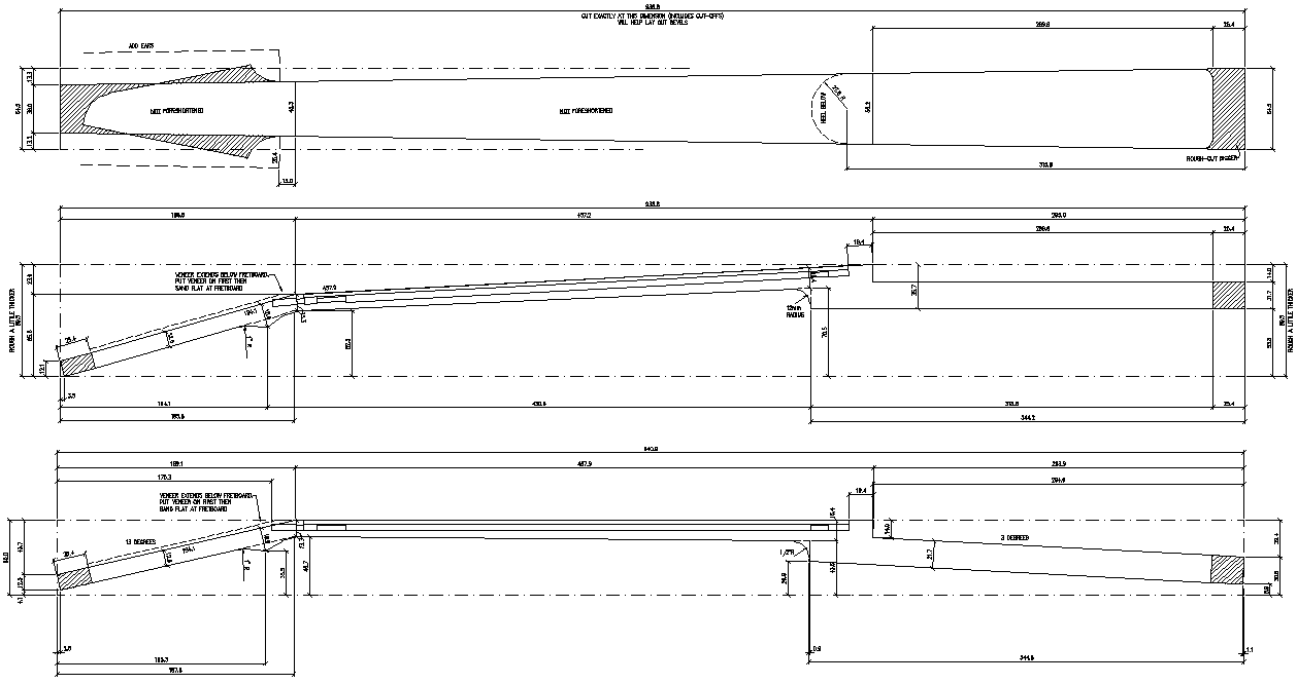
The headstock is the signature area on many guitars. You can tell whether a guitar is a Stratocaster or a Les Paul simply by looking at the headstock. It also lends a convenient spot to sign your own artistry via an inlay. We went through many different design schemes on the headstock and ended up with one of a very simple design.





Once you have all the bits a pieces documented and input into the computer, I started laying out everything on the guitar and putting the big picture together. A plan and section of the guitar was drawn accurately to scale. These drawings were printed out and directly used to make all of the templates. Wiring channels were layed out making sure they didn't interfere with the bridge mounting posts or dowel locations. Knobs and switches were located and the control cavity was designed to accommodate them while avoiding cutting into the neck pocket.

The height of the bridge will define the amount the neck will tilt back from the body of the guitar. This is evident in the section through the guitar. Make as many notes to yourself on these drawings as needed; these are your blueprints and patterns. This is the time you really get your guitar figured out in minute detail. Don't leave anything left to figure out later as by then it might be too late.



The single most important layout you'll need to devise is for the neck. If you get the neck wrong, it might render your new guitar useless. Since our neck was set into the body, we had a few more angles and cuts to make. The top sketch is a top view of the neck. The bottom two sketches are sections of the same neck, but showing how it could be cut from the block of wood in two different fashions. I chose to go with the bottommost layout since I could keep the fretboard surface (the most critical surface) untouched and dead flat. This layout is fully dimensioned since I would not be using a template to cut out the neck. I had to transfer all of the dimensions to the block of wood with a pencil, ruler, and square. This opens up an area for inaccuracies or transcribing errors, so double-check everything ... and then check it again.

Appendix D - Time Sheet

Date	Activity	Prep. & Design	Jigs / Templates	Body	Neck	Finish	Hardware	Electronics
Before Starting	There was a lot of research into design, construction, inlaying techniques, available hardware, electronics							
12-14-07	Selected and bought wood, traced guitar	1.5						
12-27-07	Measured machine heads, strap lock, pickups, neck	1.5						
12-31-07	Drew machine heads, strap lock, pickups, neck	1.5						
1-1-08	Measured the traced guitar body	1.0						
1-3-08	Drew the guitar body	1.0						
1-14-08	Refined the guitar body	1.5						
1-15-08	Explored alternate body designs, sketched headstocks	1.3						
1-17-08	Headstock sketches	0.5						
1-18-08	Headstock sketches	0.5						
1-30-08	Measured and drew bridge, nut, ferrules, neck	1.2						
2-3-08	Practiced some fret board cuts and fret installations	0.7						
2-4-08	Measured and drew truss rod, knobs, bezels	1.0						
2-5-08	Alternate body design, head stock sketches	0.8						
2-7-08	Headstock sketches, inlay design	0.7						
2-8-08	Headstock sketches, inlay design	0.7						
2-11-08	Headstock sketches, knob layout, fret cutting miter box	0.8	2.2					
2-12-08	Cavity and wire channel layout	0.7						
2-13-08	Neck, fret, bridge, nut analysis	1.0						
2-14-08	Drew section through guitar, determined neck angle, made fretboard taper jig, cut fretboard to size	1.3	1.3		0.7			
2-15-08	Laid out fret locations, cut frets				2.2			
2-22-08	Worked on section through guitar	0.7						
2-25-08	Measured and drew battery compartment, rough cut quilted maple and mahogany for body, glued up maple and mahogany for front and back panels	0.6		2.7				
2-26-08	Cleaned up fronts and backs of body panels			0.6				
2-27-08	Measured and drew toggle switch, tweaked the cavity	0.4						
3-1-08	Cut body panels to width, planed to thickness			0.8				
3-4-08	Refined control cavity, wire routing, neck angle, inlays	3.5						
3-6-08	Started body cavity templates, drilled dowels on body		0.4	0.4				
3-8-08	Started templates for wire routing, pickups, battery		2.7					
3-9-08	Continued work on templates		2.5					
3-12-08	Reworked body cavity templates	0.6	1.5					
3-13-08	Templates, templates, templates		0.7					
3-15-08	Routed body panels, cavity, neck, wire channels			2.2				
3-16-08	Routed body panels, battery, pickups, control holes			3.5				
3-17-08	Drew neck section	0.8						
3-18-08	Control cavity cover			1.0				
3-19-08	Body template, rough cut body shape, rough cut neck		0.7	0.7	0.7			
3-22-08	Finish cut body shape, cavity cover threaded inserts			0.8			0.8	
3-24-08	Made neck tapering jig		0.7					
3-25-08	Truss rod channel, tapered neck				0.9			
3-26-08	Laid out neck shape on neck block				0.7			
3-28-08	Rough cut neck, sanded neck surfaces flat				2.0			

Date	Activity	Prep. & Design	Jigs / Templates	Body	Neck	Finish	Hardware	Electronics
3-29-08	Shimmed neck to body, added headstock ears, practiced neck carving				2.5			
3-30-08	Carved neck, added headstock and neck heel veneers, made inlay cutting jig		0.7		3.3			
4-1-08	Headstock template, broke neck!				1.5			
4-12-08	Rough cut second neck, truss rod channel, headstock		0.6		2.0			
4-15-08	Tweaked neck taper jig, tapered neck		0.3		0.3			
4-16-08	Laid out neck shape on neck block				0.6			
4-17-08	Rough cut neck, sanded neck surfaces flat				2.0			
4-19-08	Headstock ears and veneer, made fretboard banding				2.2			
4-21-08	Practiced some inlaying	2.0						
4-22-08	Cut out headstock shape				1.2			
4-23-08	Cleaned up truss rod access cavity, practiced inlaying	0.5			1.5			
4-24-08	Routed inlay cavities				1.5			
4-26-08	Cut and set inlays, glued fretboard to neck				3.2			
4-27-08	Sanded fretboard, re-sawed fretslots, neck banding				2.4			
4-28-08	Sanded neck banding, polished fretboard				1.6			
4-29-08	Installed frets				1.0			
4-30-08	Installed frets, filed fret ends, carved neck heel				3.0			
5-2-08	Carved neck				0.5			
5-3-08	Carved neck headstock				0.8			
5-5-08	Carved neck, added heal veneer				1.8			
5-7-08	Sanded neck, installed side dots				1.6			
5-14-08	Drilled for tuners				1.2			
5-15-08	Installed tuners				0.7			
5-22-08	Glued up wood for carving practice	0.7						
5-25-08	Cut out shape for carving practice	1.2						
5-26-08	Practiced carving the top	2.4						
5-28-08	Verified dimensions of bezels, bridge, string ferrules	0.7						
5-30-08	Drilled for bezels and bridge						1.0	
6-1-08	Drilled for pickups and (fucked up) string ferrule holes						2.5	
6-4-08	Patched back at string ferrules						1.2	
6-5-08	Routed back for string ferrules						1.2	
6-6-08	Cut and fit veneer for string ferrule recess						2.0	
6-8-08	Drilled for string ferrules						1.2	
6-9-08	Carved top body panel			2.0				
6-12-08	Practiced recessing knobs in top body panel	0.8						
6-15-08	Increased depth of control cavity			1.7				
6-16-08	Recessed areas at knobs			1.0				
6-17-08	Recessed areas at knobs, preinstalled electronics			0.9				0.6
6-19-08	Sanded top body panel at neck pickup			0.7				
6-21-08	Sanded top body panel at neck pickup			1.0				
6-22-08	Carved back body panel, glued neck, finish test pieces	0.5		1.8				
6-24-08	Glued on top body panel, finish test pieces	0.2		0.7				
6-25-08	Patched gaps, started finish sanded, finish test pieces	0.2		0.3		0.5		
6-28-08	Preinstalled strap locks, finish sanded					2.0	0.3	
6-29-08	Preinstalled jack plate						1.2	
7-2-08	Truss rod cover plate				1.5			
7-3-08	Truss rod cover plate				0.7			
7-4-08	Truss rod cover plate				0.7			

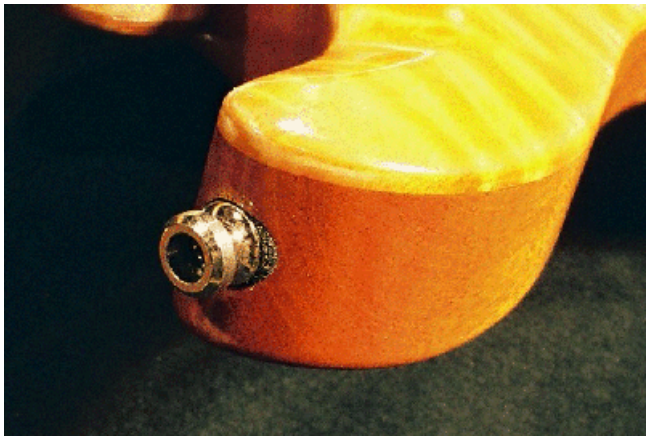
Date	Activity	Prep. & Design	Jigs / Templates	Body	Neck	Finish	Hardware	Electronics
7-7-08	Finish sanded, taped off, dye coat					2.0		
7-8-08	Linseed oil coat					0.6		
7-14-08	Additional taping off					0.6		
7-17-08	Two shellac coats					0.8		
7-18-08	Two shellac coats					0.8		
7-19-08	Sanded					0.4		
7-20-08	Three lacquer coats (1-3)					0.6		
7-23-08	Sanded, three lacquer coats (4-6)					1.0		
7-27-08	Sanded, three lacquer coats (7-9)					1.0		
7-29-08	Sanded, three lacquer coats (10-12)					1.0		
7-31-08	Sanded, three lacquer coats (13-15)					1.0		
8-4-08	Sanded, three lacquer coats (16-18)					1.0		
8-6-08	Sanded, three lacquer coats (19-21)					1.0		
8-8-08	Sanded, three lacquer coats (22-24)					1.0		
8-10-08	Sanded, three lacquer coats (25-27)					1.0		
8-14-08	Sanded, three lacquer coats (28-30)					1.0		
8-23-08	Removed tape, rubbed out finish					2.3		
8-24-08	Rubbed out finish, swirl remover, paste wax					2.3		
8-27-08	Foiled control cavity							2.3
8-29-08	Installed pickups, switches, wiring							2.0
9-1-08	Wiring							1.5
9-3-08	Sanded neck and tung oiled it, installed hardware					0.8	0.6	
9-4-08	Installed tuners, leveled and crowned frets				2.0		0.3	
9-7-08	Adjusted truss rod, set nut, adjusted bridge and saddles, set pickup height, troubleshot electronics, installed truss rod cover, cavity cover, and knob caps. Plugged it in and turned it up!				0.9		0.4	0.7
268	Days elapsed start to finish Subtotals	35.0	14.3	22.8	49.4	22.7	12.7	7.1
	Percentage of Total Time	21	9	14	30	14	8	4
	Total Hours							**164.0**

Appendix E - The Portfolio

On the next few pages are the pretty photographs of Brian's guitar with a few brief descriptions hitting the highlights. You don't need anything too fancy to get some good photos of your guitar. All of these photos were taken with an old-school 35mm film camera and they were developed straight to a CD in digital format. They were taken without a flash (avoiding unpredictable hot spots), with a high F-stop (for a greater field of focus), and at slow shutter speeds (requiring a tripod). My makeshift spray booth doubled as the photo studio since it already had four 300 watt light fixtures which I amended with two more 500 watt shop lights. Needless to say it was a bit warm in there. The backdrop was a piece of 6'x12' black felt stapled to a wood 1x2 for support.

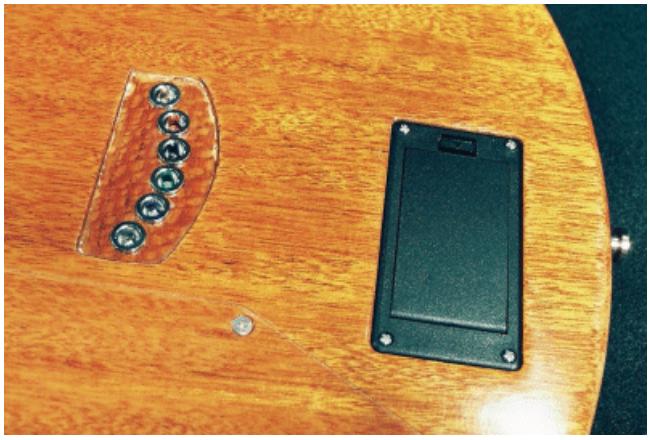
The shot to the right is the standard catalog shot: straight on. It reveals our blatant plagiarism of the Paul Reed Smith body style and McNaught neck inlays. I find the angled, perspective shots below a bit more dynamic. You can see a little detail of the carved top, but it shows up a little better in some of the photos coming up later.


The detailed shots above show the cool scooped out areas at the knobs. They really look nicely nestled in there. The carved top is a bit more evident here. The right photo above starts to show how the neck is tilted back from the face of the body, which can be noticed by the different pickup bezel heights.

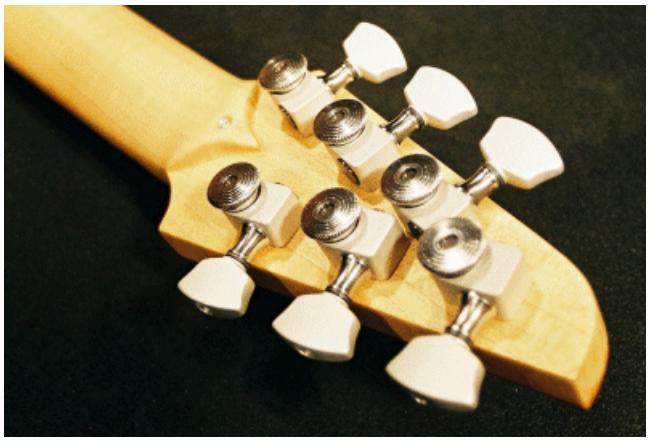



A couple of custom touches can be found in the details. The jack plate is recessed into the side of the guitar, and the strap lock is seated on a flattened area or the horn.


Rolling the guitar over, you'll find the luxurious, silky mahogany. The control cavity cover plate is almost seamless since it was made from matching wood. The neck heal is adorned with lacewood which matches the headstock veneer.



The rear string ferrules are recessed in a bed of lacewood. And perhaps being overly anal, I recessed the cover plate for the battery compartment. The abalam neck inlays are simple, but lend a contemporary flair. They really pop out on the ebony fretboard. The fretboard is bound with quilted maple and the neck is finished with tung oil.



Of note on the lacewood-veneered headstock is the lack of truss rod cover mounting screws providing an almost invisible installation. On the rear is the unique carved transition from the neck to the headstock. Brian sees it as a bird's eyes and beak. You can see the truss rod cover mounting screw on top of this area. Everything is topped off with locking tuners in a satin chrome finish.