A Guide to Advanced Cigar Box Guitar Making

By Joshua Gayou

Introduction

In the middle of 2008 I hadn't the slightest desire to build or play the guitar. The last time I had even touched one was when I was a teenager in high school – I had a cheapish steal string acoustic that I rattled a few tunes off of here and then but I never got very serious about playing. The guitar (especially electric) had always been my favorite instrument but as far as really understanding it went, I never really encountered anything that truly inspired me.

As far as music was concerned, there was inspiration to be had all around. Both of my parents saw to my musical education from a very young age, exposing me to a broad range of genres and artists spanning hundreds of years, from the classical masters all the way up to modern Rock N Roll. The technology gradually changed over the years, first with my dad's old records and 8 tracks, followed by tapes, and then on to CDs. Through it all, one style always stuck with me the most: The Blues. Nothing ever affected me like that incredibly deep and soulful music. So I guess you could say that the seed for "all of this" had been planted early on.

So there I was in 2008. One day on my lunch hour at work I was checking out some videos on YouTube when I came across a particular video posted by a guy named Brother Yusef. He was playing the most simple and primitive looking guitar I had ever seen in my life. As far as I could tell it was a cigar box with a tree branch stuck through it and some wire run over it for strings. It completed refuted everything I thought I knew about music.

My son was just one year old when I saw this video and I thought of him immediately. I was already looking forward to introducing him to music in the way my parents had done with me but this opened up a whole new realm of possibilities. I knew I could easily make a guitar similar to the one shown in this video (it would never even have occurred to me to attempt making

a high end electric guitar) and, best of all, I wouldn't have to worry about my son damaging it due to how cheap it would be to construct. I ran down to the local hardware store and bought a few tools and some wood. I grabbed a coping saw, some files, and some chisels and got a 1x2 piece of poplar for the neck. It took me maybe a couple of nights of effort but when I was done I had a strung instrument and my son went nuts on it. Even better; he was always very careful with it from the first day I gave it to him and he still has it today. I will most certainly make him a nicer one when he is older but it is good to know that my boy owns the first guitar I ever made.

The first time I heard that guitar make a sound I was a changed man. What started as a fun little side project for my kid became a personal obsession. I can't really explain it very well but my guess is that if you are reading these words right now you probably already know the feeling, so I'll just leave it at that.

My wife thought I was nuts at first when I told her that I wanted to make guitars out of cigar boxes. The first one I made was humble to say the least and she had a hard time seeing the appeal. Then came the day when someone paid me a couple of hundred bucks to make three for him. I could see that she still didn't quite understand the whole thing but at least she was having second thoughts about my sanity. She suggested that I make a web site to see if there was any interest out there. Things were very slow at first and I even sold my earliest creations at a loss on eBay. Over time, I improved my skills and built up my reputation. I kept my head down and kept chugging away in my shop. Eventually people started seeking me out. Today, people from all over the world come to me to make them high end custom instruments.

Comparing my early efforts with the guitars that I make now should hopefully make something very obvious. A short time ago in 2008 I hadn't even a clue how a pickup worked. Now at the end of 2010 my work is light years ahead of what I used to do. The point to all this (the point that I want you to take away, at least) is that if I can do this, you certainly can as well.

A Cautionary Note

The information contained herein represents some of the most helpful lessons I have learned in my time as a custom cigar box guitar maker. The techniques I describe show the best ways I have found to accomplish their associated tasks. This does not mean that my way is the only way or that I know all.

My wish is that you learn from what I have to share with you but that you adapt it in the ways that seem most beneficial to you. Do not become so obsessed with perfection that you shy away from attempting new and potentially bad ideas. You will always learn ten times more from your failures than you will your successes. Trust me on this; I have a long line of failures to my name.

Above all, do not take the word of so-called experts at face value (including my own). There is a great deal of misinformation floating around out there that is spread by people who claim to be in the know. Be able to prove the assertions of yourself and others in the shop through test and experimentation before you repeat some “truism” to an initiate. In the end, the best policy is to be humble and assume that you know nothing.

Tools

I have accumulated a number of tools in my shop over the years, most of which were purchased specifically for guitar making. Here is a list of what I have and why.

Hand Tools

Files

No matter what you're doing, every good wood worker has a set of files. I commonly use the following: a flat file, a half round (fine), a half round (rasp), and at least one rat tail. I like two rat tails, one thin and one fat. I find them especially useful for shaping the shoulders of the neck right at the headstock and also the heel.

Chisels

Chisels are good for rough shaping such as neck carving as well as fine detail work such as making minor adjustments to the neck pocket.

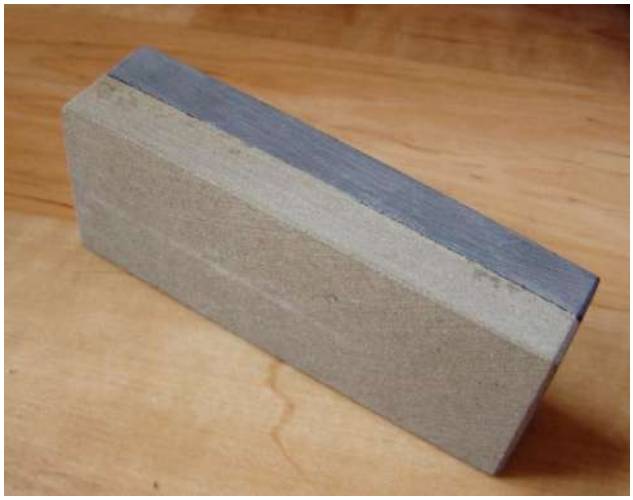
Planes

Planes are useful for flattening uneven surfaces and for shooting straight edges. I own a regular block plane for general rough work, a low angle block plane for fine work and for dealing with stubborn grains, and a trim plane for edge work.

Shaves

I use my spoke shave for carving out the round back of the guitar neck.

Whet Stone



It is critical that you be able to sharpen all of your bladed tools. It not only keeps them in good working order, it also makes them safer to work with. Properly sharpened tools cut easily through wood. Dull tools must be forced, creating the potential for the tool to break out of the wood and gouge yourself or others.

Keep in mind that you can also forgo the whet stone and sharpen your tools using advancing grades of sand paper; however you will need to do so over a sheet of glass in order to ensure that the work surface is perfectly flat. I have found that the underside of a glass cutting board is ideal for this.

A cheaper, coarse grade of whet stone may also be used for fret leveling operations.

Bridge Pin/End Pin Reamer

Aside from its originally intended purpose, this tool is also useful for widening out tuner holes in guitar headstocks for modern 10 mm tuning machine shafts.

Scratch Awl

I use this to punch out all of my drill bit entry points. The pilot point of the bit centers on the punched hole and greatly improves accuracy.

Handsaws

I use a back saw and miter box often, especially when trimming fret boards to length.

I use a standard cross cut handsaw for cutting scarf joints in my neck. A rip saw is also useful for ripping large stock if you don't have a table saw.

Finally, I use a specially made fret saw for cutting fret slots.

Squares and Straight Edges

An engineer's square is necessary for laying out square lines. Get one precision made from metal (avoid the wooden ones).

The bevel gauge is necessary for laying out frets.

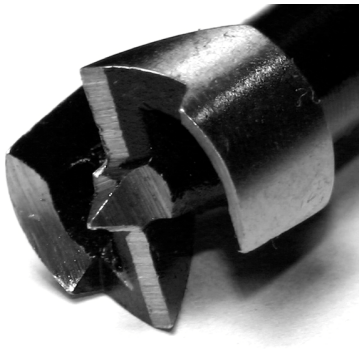
Straight edge rulers and meters sticks should be made of metal or acrylic and not wood. Wood dents far too easily and will ruin your precision. You will need a full length meter stick for laying out frets but shorter versions using the standard scale (6 and 12 inch) are also useful.

Vernier Caliper

A vernier caliper is the best and most accurate way to measure depth and thickness of irregular shaped objects, such as a carved guitar neck. Spend a little extra for a digital version.

Drill Bits, Forstner Bits, and Spade Bits

I have a large number of these for use in my hand drill and drill press. A standard set of pilot point bits are required. Brad point (lip and spur) bits cut near perfect holes with no chip out, which is necessary for fret board inlay.



Forstner bits are designed to cut holes with flat bottoms. I like using these for a number of operations. They work well for removing bulk material from pockets that need to be routed, which prolongs the life of my router bits.

The spade bit is great for drilling large bore holes in situations where you aren't so concerned about the cleanliness of the edges. I use a 13/16" spade bit to drill the hole for the guitar's jack input.

Drum/Spindle Sander Bits

Purchasing a drum sander bit for your drill press will turn it into quite a versatile machine.

Clamps

No matter how many clamps you have you will always find yourself running out. Buy several of assorted sizes. The Irwin Quick-Grip is my favorite.

Knives

You may find a set of instrument maker's knives useful. I do well using only an Exacto knife.

Mallets

I have never had a need for a metal hammer but soft mallets are very useful for tapping certain hardware into place (such as bridge posts).

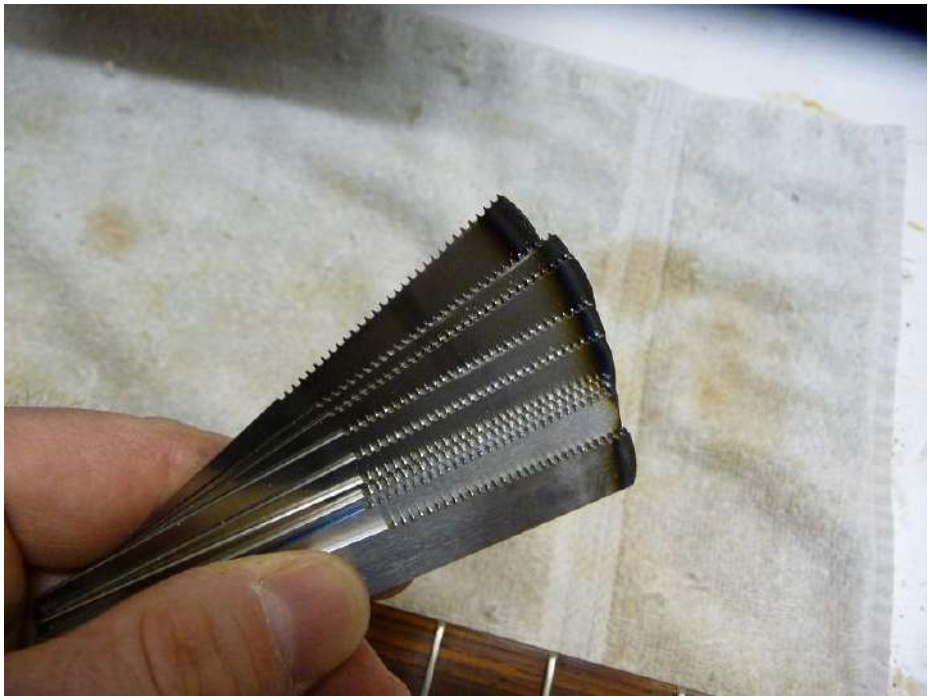
Fret Tools

A specialized set of tools for cutting and dressing frets will ease your work considerably. An end dressing file, crowning file, flush ground cutters, and tang nipper are required in my shop.

Radius Sanding Block

Buy a radius sanding block for sanding a radius into your fret board. There are various sizes that you can purchase. I find a 9.5" radius (Fender) nigh unplayable but you certainly don't want to go too shallow either. A 16" radius is optimum for my taste but you should personally test out fret boards of different radii to see which is best suited to your playing technique.

Nut Files



A gauged set of files or cutters for cutting accurate strings slots in the nut.

Soldering Supplies

A standard soldering kit (such as those sold at Radio Shack) is a good start to get you going. You'll also want wire cutters, needle nose pliers, a good wire stripper and a soldering stand to help you hold your work in place.

Power Tools

Scroll Saw/Jig Saw

The scroll saw is useful for cutting curves and small work pieces safely.

Bandsaw

The bandsaw is useful but dangerous. Take care in its use as it will claim a finger easily. Try to find a model with as deep a throat as possible as this will yield the most flexibility.

Bench Sander

A combination belt and disc sander is used for a number of operations in my shop.

Drill Press

This is the best way to drill a straight hole at an accurate angle. This machine can also be set up with a drum sander bit for use as a versatile power sander.

Bench Plane

You will need a way to accurately thickness wood.

Plunge Router

A plunge router is needed for cutting the truss rod trench in a guitar neck. It is also useful for cutting out the neck profile.

Handheld Drill Motor

You will need a handheld drill for any operations where the drill press is impractical (input jack channels, strap button holes, tuning machine screw holes, truss rod cover holes, etc).

Supplies

There are a number of materials that will be consumed rather quickly in your shop. If you intend to sell your creations, you will need to account for the cost of these supplies in your overhead.

Economy Woods

If you're building traditional cigar box guitars or if you're just getting ready to build your first guitar, look no further then Lowes or Home Depot. In the lumber section, Poplar and Red Oak will be your entire supply. They have boards of varying lengths, widths, and thicknesses; all of which will easily fulfill your needs. This wood is extremely affordable, thereby minimizing the pain of any mistakes you make when starting out.

When selecting your wood, you have to be careful. On one hand, don't expect to find any quarter sawn pieces but do make sure that you're buying boards that are straight (no crowns, bows, or twists). Always select the straightest piece you can find. You may be looking for a while as this is not instrument grade wood, strictly speaking.

High End Woods

At some point poplar and oak just aren't going to cut it for you any more. This is when you need to start sourcing real lumber suppliers. I do not recommend purchasing wood from Stewart MacDonald or Luthier's Mercantile. While it's true that they offer some of the finest quality woods, they also offer some of the highest prices. You will always be able to find material of equal quality at better prices if you take the time to search for suppliers. Another thing to keep in mind is that the big guys like Stewart MacDonald don't offer a lot of exotics. Spend some quality time on your PC looking for good lumber suppliers and build up your supply chain.

Fret Wire

The best use of your dollar is to buy a large coil of fret wire (50 feet or so). I have been happy with Luthier's Mercantile in this regard. It comes pre-bent so you will not need to purchase a fret bending Jenny.

Sand Paper

Hardware store sand paper will be good for rough sanding but you will need finer grades than they typically carry. Even so, don't buy sand paper from luthier suppliers. You'll get soaked. You can find grits 60 to 600 at a Lowe's or Home Depot. You can find grits from 600 to 2000 (wet or dry) at any automotive supply store with a paint section (Chief Autoparts, Autozone, Pep Boys, etc).

Glue

You'll be using a lot of glue in your guitars. For any load bearing joints, you'll want to use Titebond III (yellow glue) or gel type super glue (I use the super glue to attach acoustic bridges and nuts). Any joints that don't have to carry a heavy load can be done with white glue (Elmer's).

For gluing metals to wood (such as sound hole screens) get some 2 part clear epoxy. Clear epoxy is also easily mixed with wood dust to create a filler compound.

Electrical Supplies

You'll want electronics grade (rosin core) solder, electrical tape, wire (22 gauge if you can find it), shielded wire (coax) for long runs, shrink tubing, and possibly adhesive shielding tape or paint. Most of this can be found at Radio Shack except for shielding tape/paint.

If you go the shielding tape route, you need to be sure that the adhesive is conducting.

Double Sided Tape

This stuff is extremely useful for temporarily securing work pieces as well as for securing wires inside cigar boxes. The kind that you get should be of a very aggressive adhesive.

Finishes and Sprays

This all depends on how you want to finish your guitar. In my shop I have denatured alcohol, shellac, Tung oil, spray lacquer (gloss), varnish, Dr. Duck's Axe Wax, olive oil, and Danish oil.

For application, I also have bags of linen rags, rubber bands, cheese cloth, various paint brushes, plastic dishes, container jars (for mixed shellac), and gloves. For gloves, make sure they're the kind that you can buy in automotive supply stores. These will stand up to gasoline, whereas the standard surgical latex variety will start to break down very quickly when exposed to a lot of the solvents you'll use.

Screws

Sure you can get wood screws and such at Lowe's, but you won't find specialized screws (mounting ring screws, pickup height adjustment screws, pick guard screws, etc) there. If you're serious about squeezing out every last dollar you can figure out the screw types (size, thread, etc) and then source them out. For me, it's worth my time to buy them from Stewart MacDonald.

Parts

You will need to buy an assortment of parts and hardware for each guitar you make. Try to select materials and finishes that will compliment each other. The standard hardware finishes for a guitar are chrome, gold, and black. You should do your best to avoid mixing these finishes as combining them will give the guitar a haphazard, thrown together appearance.

Tuning Machines

Tuning machines come in varying shapes and sizes. Buying higher end tuners will increase precision and tuning stability.

Bridges

The type of bridge you select will greatly affect the design of your guitar. A flat fixed bridge will allow you to set the neck flat into the guitar such that it runs parallel to the body. A raised Gibson style bridge is set rather high off the body and will require you to set the neck at an angle to achieve the correct action.

Pickups


The type of pickups you use and how you wire them will have a tremendous impact on the voice of your guitar. Spend a good deal of time researching the options available to you and try to engineer the tone that you want.

Assorted Hardware and Small Parts






There are a number of other small parts and hardware you can install to further set your instrument apart. Some will enhance its look while others will improve playability and convenience. Spend some quality time examining what's available.

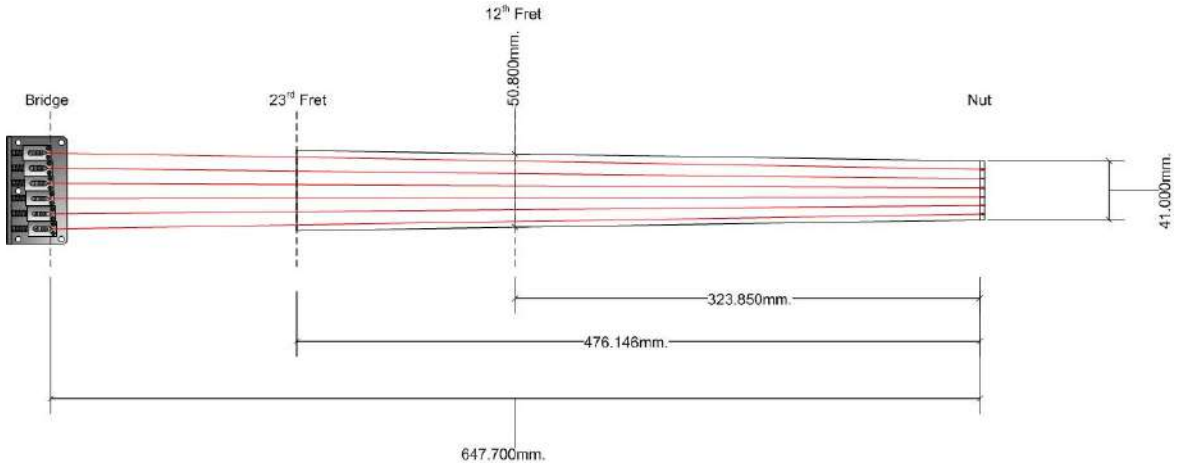
Design

If you're going to build a simple stick-through-a-box guitar, you don't need to invest a lot of time in design. You're not exactly making a precision instrument, so it's pretty safe to figure things out as you go.

Once you start adding details like scale, frets, standard bridges, and 100 other features, you'll want to start planning things out on paper first before you take a saw blade to any wood. Especially when you get to a point that you're using more expensive woods, you'll want to plan everything out on paper first as mistakes become costly.

One of the challenges we face when we make what I would describe as a precision cigar box guitar (accurate scale length, frets, string spacing, etc) is that we are constrained by the size of the box we are using. Conventional guitar makers have a lot more freedom than we do because they get to design the shape and size of their guitar body around the features that they want the guitar to have. Cigar box guitar makers have to design their guitar around the box to ensure that everything will fit correctly.

One way you can ensure that your design will work before you even start to spend money on parts is to make a scale drawing of the guitar. It isn't necessary to compose a work of art. Really, what you want to do is use the drawing as a tool to define the key design criteria or constraints of the instrument. These constraints always focus on scale and neck dimensions. Take a look at the following picture. This is an example of a typical layout that I'll do whenever I'm getting ready to build a serious guitar.



This drawing tells me everything I need to know concerning how the different parts of the guitar will go together. In fact, the only thing this drawing doesn't tell me is headstock angle and neck pocket depth. Strictly speaking, it also doesn't show me pickup layout or pots but that is less important when you're making a cigar box guitar. If you're making a solid body guitar, it is important to layout the position of these components as well.

The drawing above shows me a layout for a standard 25.5" scale. The guitar will have 22 frets; therefore the fingerboard in this drawing ends at the 23rd fret. The nut is a standard 41mm wide and the 12th fret is 2" wide (common neck dimensions).

Because we know the scale length we can place a scale drawing of a bridge at the correct position. Now, given the size of our box, we'll know if this scale will work with the box or not because we can tell if there is enough room to mount the bridge and we can also tell if there is enough room to sink the heel of the neck into the box (neck pocket).

Another thing this drawing will tell you is if the bridge you're thinking about buying will work with the guitar. Since I've drawn in the strings in this picture, I can see that the high and low E strings don't run perfectly parallel to the edges of the neck. This is because the bridge that I've put in (which is a scale drawing I did with accurate string spacing) does not match the neck dimensions.

There are a few things I can do to compensate for this. One option is to seek out a bridge with string spacing that accommodates my neck design. The other option is to decrease the width of the nut, increase the width at the 12 fret, or a combination of both. This will adjust the run of my neck to accommodate the bridge that I have selected for the drawing.

You can start to see how this practice pays off in the long run. We have already defined several potential errors that I could have made, some disastrous (a scale length that might have been way too big for the box) and some mildly annoying (strings that don't run correctly in relation to the neck). We have also identified these problems without spending a dime on parts and without wasting any wood out in the shop.

Incidentally, I have found that cigar boxes with a minimum length of 11.5" work well for standard scale length guitars.

Making the Guitar Neck

The neck is the most important part of the guitar - period. Every bit of skill, patience, and concentration you posses must be invested in ensuring that you get this part correct. If you do your job well, the player will be delighted and amazed at how well the instrument plays and swear that the guitar feels as though it was made especially for him or her. If you get even the slightest thing wrong, it will be this one thing that is remembered first despite all of your efforts. Everything else on the guitar might be flawless and yet the player's foremost thought concerning the instrument will always be that three frets ends are sharp and snag or that the 22nd fret has the unfortunate habit of sounding a dead note on the A string (or some such other detail).

It sounds counterintuitive (and perhaps depressing) but it remains true: if you do well then the owner of the guitar should not be able to pick out any one detail. Everything should just gel together and play the way it's supposed to. The purpose of all your effort is to free the musician to create music and not draw his attention to how hard you worked.

The key to a good neck is smoothness. Your hands have to slip over it like it is greased. There should be no sharp edges anywhere – you want everything to be fluid.

The process of making a guitar neck is really a process of removing all the rough and jagged pieces of raw stock until only what you need remains.

Wood Selection

Each specie of wood that you work with comes along with its own set of behaviors and characteristics. Consideration for tone and how it will be affected by the wood you use is only where you'll start. Weight, grain, color, and stability are just a few of the very important aspects that you'll want to consider when selecting wood. Certain woods will work very well with bladed tools (planes and shaves) where others will tend to chip and tear under even the sharpest blade, requiring the use of sanders, files, and rasps instead. Some woods will be comparatively stable in a wide array of climates while others will be temperamental and require closer care.

When considering new and unfamiliar woods for your project, be sure to research them thoroughly so that you are not met with unfortunate surprises later on.

Be sure you purchase your wood from someone who specializes in supplying luthiers unless you are fortunate enough to have access to mill equipment. This will ensure that you are buying instrument grade wood that has been milled and treated properly. Most of us don't have the facilities to re-saw raw lumber or to dry it; purchasing from a luthier supplier will guarantee that your stock will be as close to ready to cut as possible when it arrives.

Dimensions

Measurements are approximate based on your need, but the neck blank should generally be 30" long, at least 3 ½" wide, and at least ¾" thick. If you can get blanks at 1" thick then do so by all means. This will give you more wiggle room if you have to plane the blank down for straightness.

The fingerboard blank should be around 24" long, 2 ½" wide, and ¼" thick.

Head plate veneers (top plates) should be about 8" long, 3 ½" wide, and around 1/16" thick.

Decorative sheet veneer should be slightly larger in length and width than your head plate and will be rather thin (thin enough to cut with scissors).

Storage and Acclimation

You shouldn't start cutting into the wood as soon as it arrives, especially if you have ordered foreign or exotic material originating in a completely different climate from which you live and work. Wood will always warp according to its climate. If you have purchased from a luthier supplier then the wood will have already had a chance to settle initially and any further change when it gets to your shop should be minimized. Regardless, the wood still needs to settle when it arrives. Wood will loose or absorb moisture to match its surroundings. If you live in a humid area the wood will take on water. If you live in a dry climate then the wood will dry out. This business of taking on

or loosing moisture will cause the wood to warp and bend over time. Heat and cold will also have an effect on your stock as well.

There isn't really anything you can do about this outside of taking steps to help ensure that the water loss or gain is even over the entire piece of wood. You do this by storing the wood in such a way as to provide that as much of its surface area as possible is exposed to open air. If you lay the wood on a flat surface (a table for example) then the bottom will lose or gain moisture at a slower rate than the exposed portion, causing some nasty bowing.

The following picture shows the correct way to store wood stock. Note that each piece is stacked on small spacers, providing maximum air exposure.

The temperature of the environment should not be subject to excessive change. I'm lucky enough that, living in California, I can keep my wood in my garage year round. Folks living in other parts of the country or world will not be so lucky and should store their stock in a controlled, insulated environment. Store your wood in this manner for a period of four to six weeks. After that time, the piece can be planed flat again if needed.

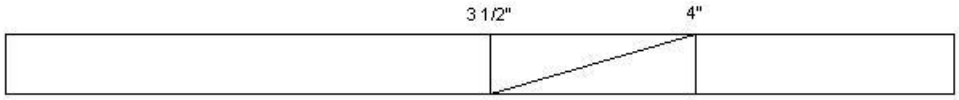
Constructing a Scarf Joint

There have been numerous studies on the topic but the simple fact is that for an angled headstock, a scarf joint is always stronger then a solid piece of wood. I have seen several load tests conducted on necks with scarf joints and in all cases, the neck never broke along the glue line. When executed properly, the glued joint of the scarf joint is actually stronger than if you had never cut the wood.

To begin, ensure that your blank is of the proper thickness. One inch thick is doable but excessive. 5/8" thick is at the extreme minimum. Unless I want a thicker than usual heel, I always plane the neck blank down to ¾".

Layout

Start by laying the neck blank on its side and measure in 4 inches. Scribe a line at this point with your square. Measure in another 3 1/2" and scribe another line. Finally, connect these two lines with a diagonal running between them, as shown:



Execution

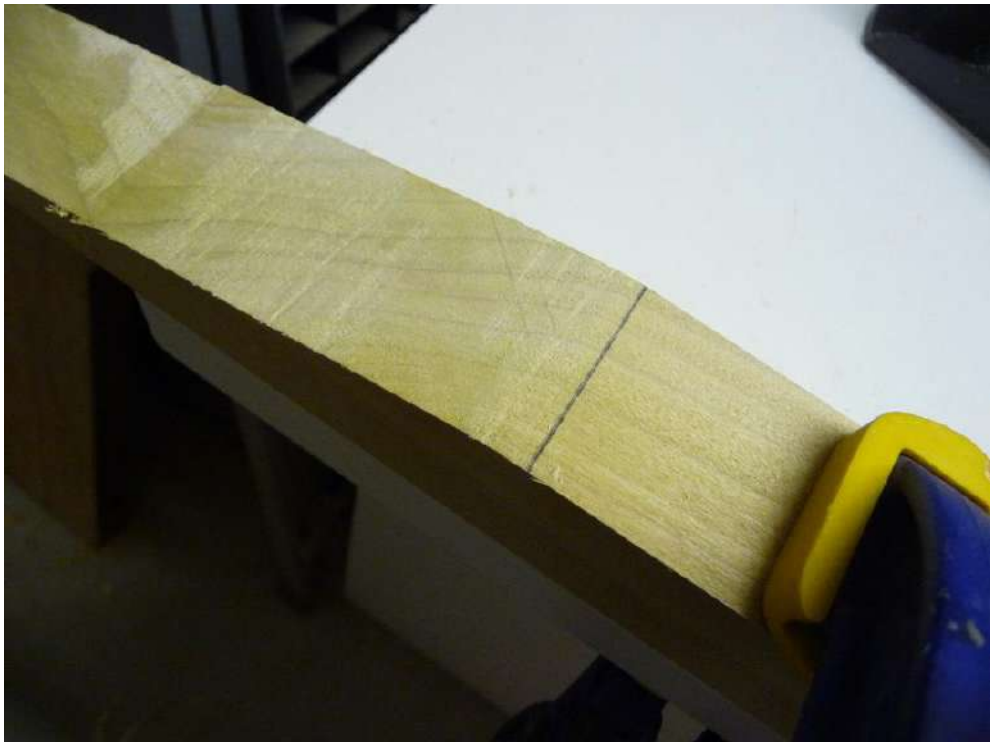
You will be cutting along the angled line to create the scarf joint. This cut can be made with a band saw or cut by hand with a simple handsaw. It takes some skill to cut the joint by hand but even gross mistakes in straightness of cut can be repaired with a block plane later on.

When done, you should have two pieces of wood similar to the following.

The cut will naturally be jagged. Use a block plane to clean it up.

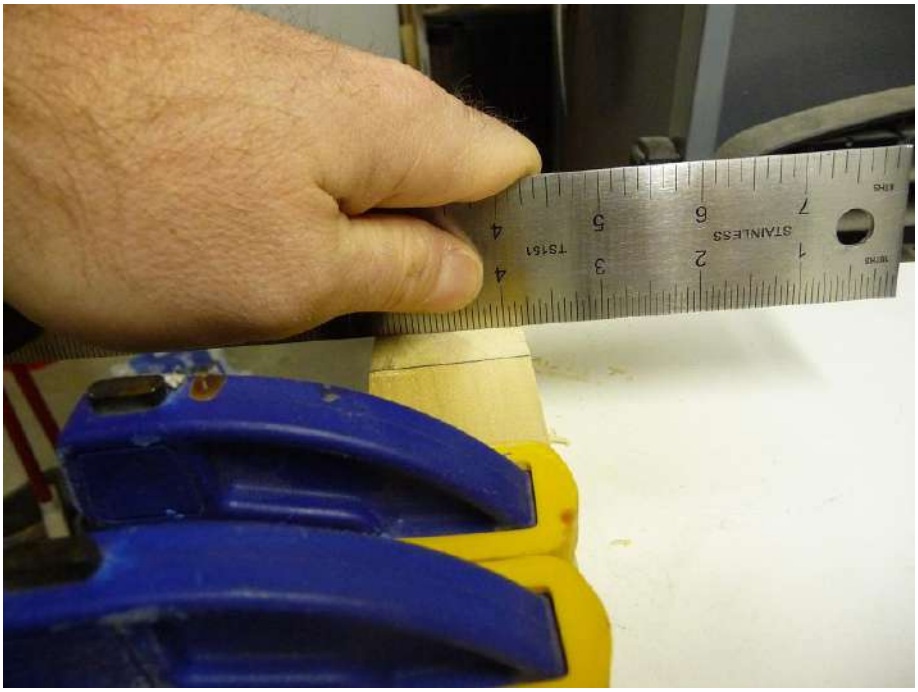
You will first start by clamping the small piece on top of the larger piece, such that they form one long, continuous plane, as shown in the bottom picture.

Note the pencil line that has been drawn across the top. This is drawn in with a square such that the line is at 90 degrees to the run of the neck. It acts as a visual reference that you can use to ensure that the surface remains perfectly even.

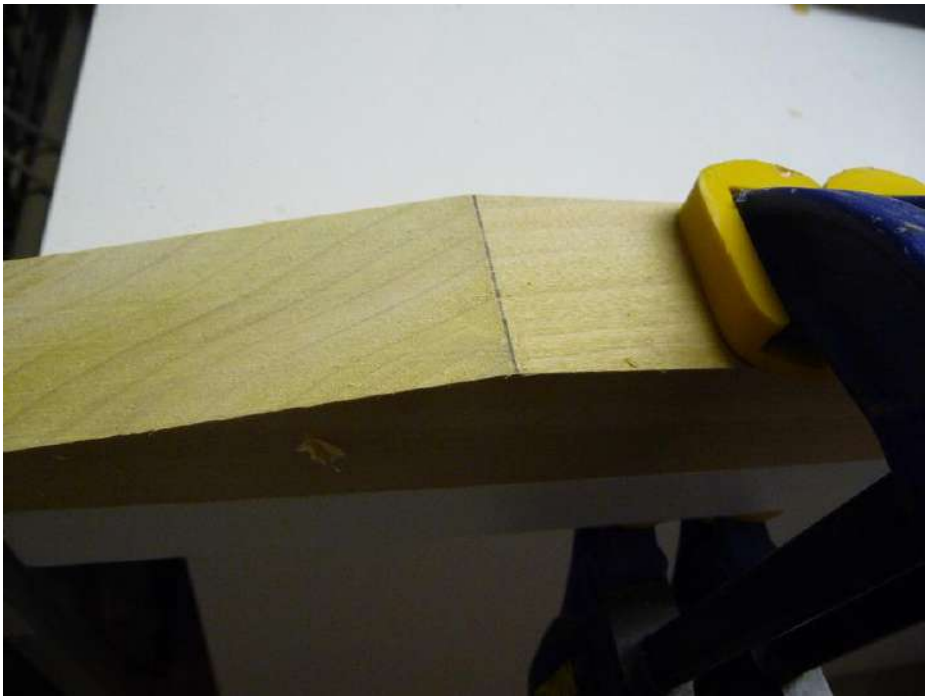


Now get out the block plane and begin to clean up the cut.

You must constantly check your work as you go using the square. When you are finished, the planed surface must be perfectly flat. If you can see any light coming through, you need to carefully clean it up some more until you have it right. If you do not do this you'll have a thick glue line in the best case and a joint that will fail in the worst case.



Note that I never plane away my pencil line reference. I get the cut right up to it and ensure that the cut is parallel without destroying the line.



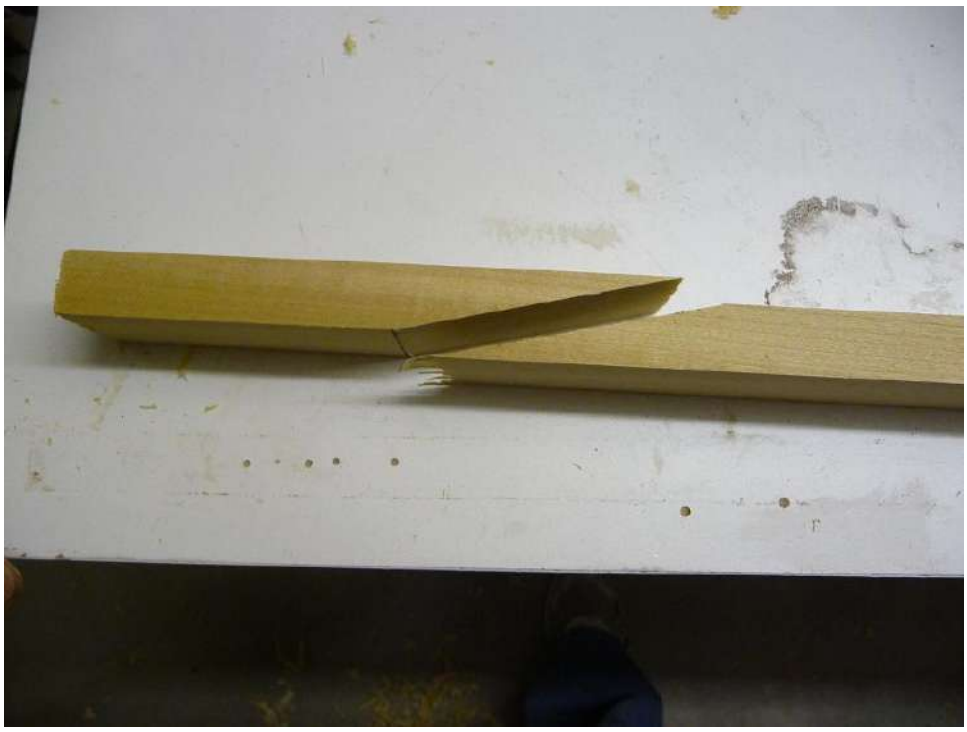
Now that the surfaces are perfectly flat, flip the piece over and make the joint.

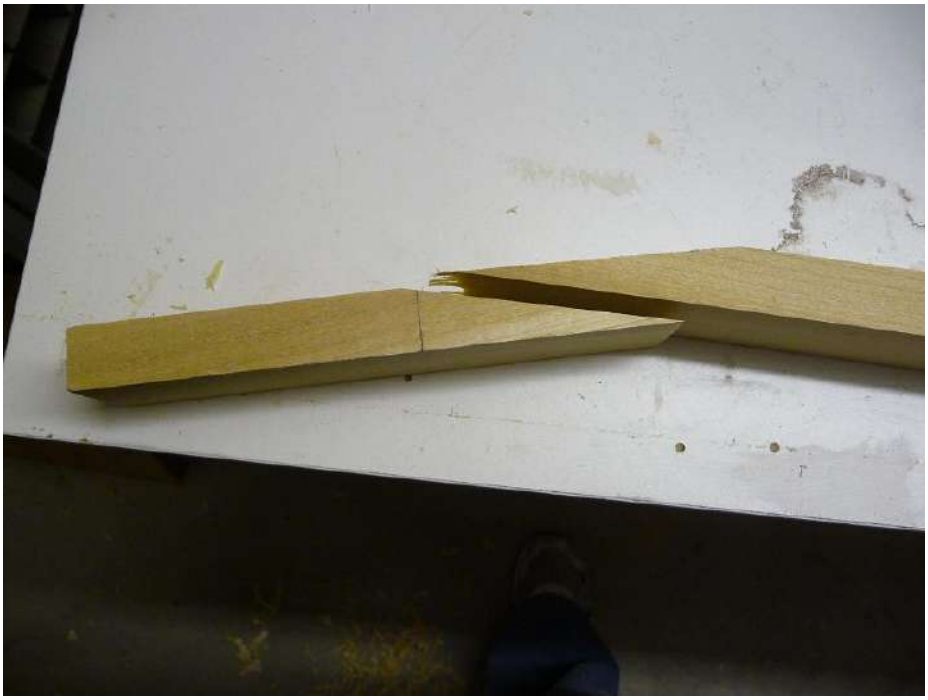
Alternatives to the Block Plane

In some situations you may find that a block plane is simply unmanageable. I have personally dealt with some particularly stubborn pieces of dry, old growth mahogany that refused to plane well and constantly broke off in chunks at the edges, even with my low angle block plane sharpened razor fine. If you find yourself in this situation it's best to give up on the block plane altogether as you will only make the problem worse as you go. In this case your best alternative is likely to flatten the cut out on a belt sander.

I do not recommend going to the belt sander as a matter of course. A belt sander requires a balanced hand and a light touch; it removes material very quickly and it is very easy to round over your surface if you're not paying attention. A block plane is far preferable in my opinion because you can always control the speed at which it removes wood and will self level if tuned appropriately.

Gluing Up the Joint

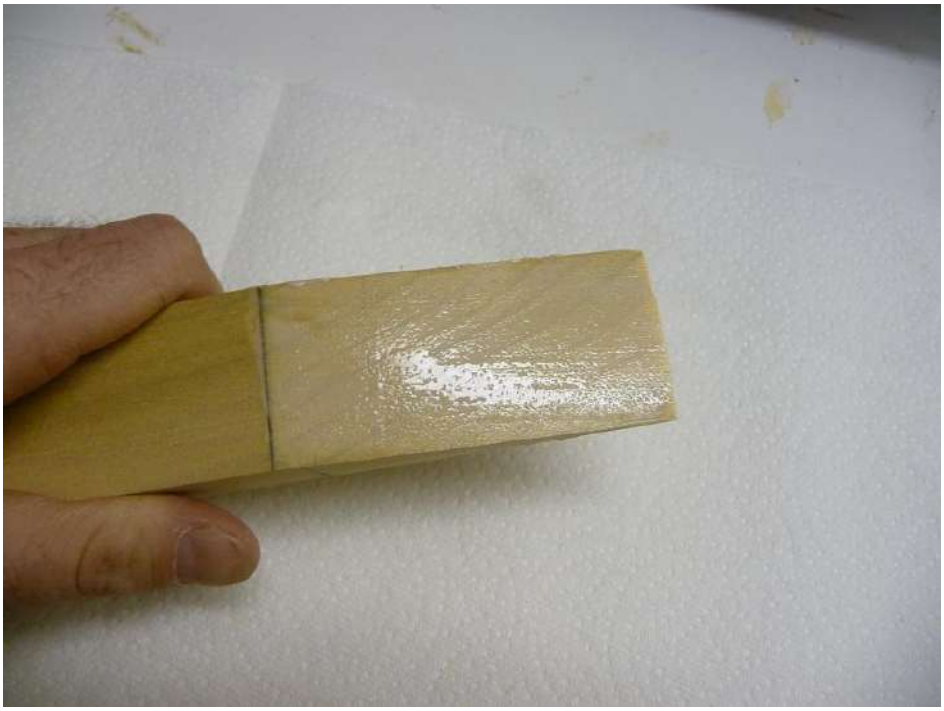




Clamp some scrap stock to your bench as a stop, to keep the piece from sliding around when you try to glue it up.

Note in above image that the front face of the headstock does not match up flush with the joining surface of the neck. This is intentional. You can control the final thickness of the headstock by moving the piece forward away from the neck (thinner) or by moving it backward towards the neck (thicker). The uneven portion can be planed or sanded away later.

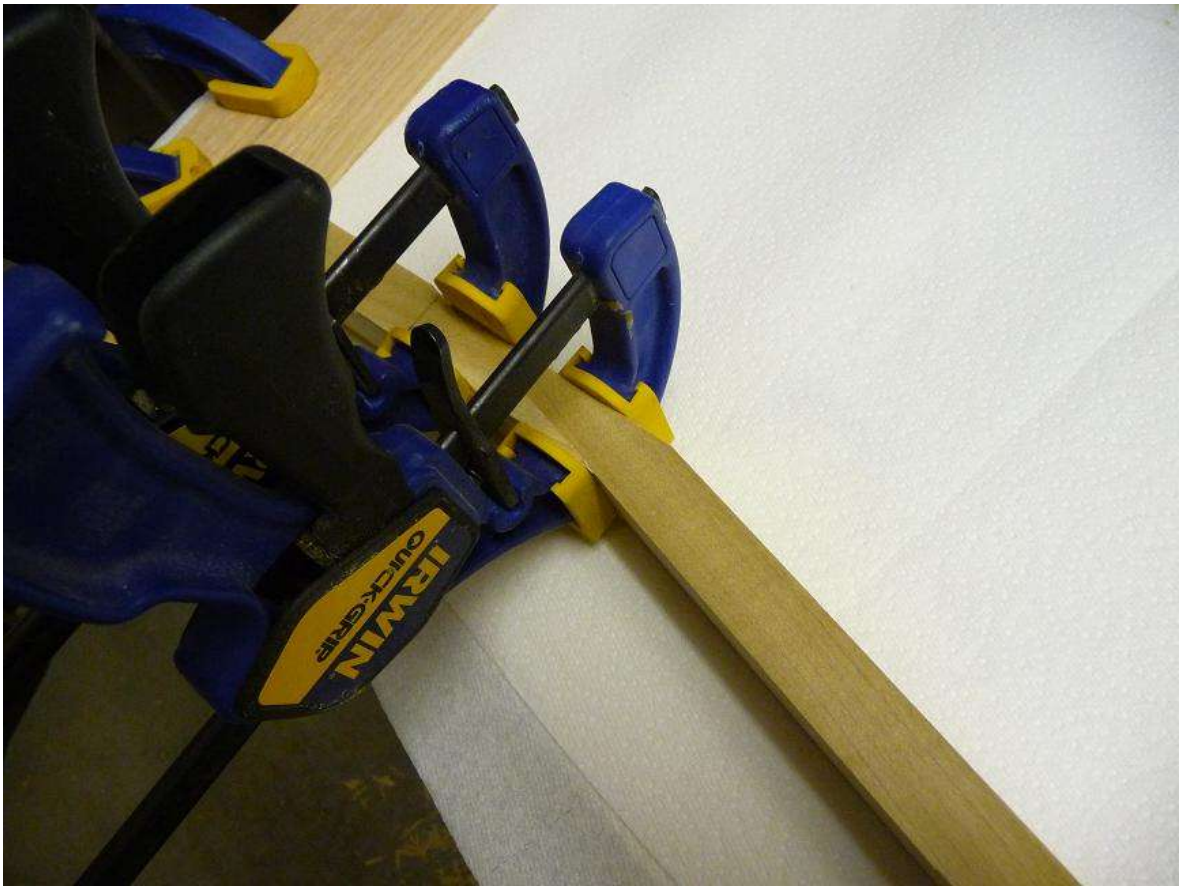
Apply yellow glue and spread it thin with a credit card.



Now mate it up to the neck and apply clamps. I have found that four clamps are sufficient to completely clamp up a scarf joint (one at each of the joint's four corners). When clamping down, make sure that you apply enough pressure to get some squeeze out along each side of the joint. Apply no more pressure than this or you run the risk of the joint becoming glue starved.

As shown below, clamping a block behind the headstock and clamping the lower portion of the neck to the bench will ensure that the pieces don't slide as you clamp them.

Start the joint out with two clamps on one side of the neck. After the glue has had a chance to grab, you can remove the neck from the bench and put two more clamps on the other side.



The following image shows a fully clamped neck (one clamp at each corner of the joint).

Set the piece aside and let it set for 24 hours. After 24 hours is up, you will need to plane down the face of the headstock to ensure 1), that this surface is perfectly flat and 2) that the headstock thickness is about 5/8" to 1/2" thick.

If the headstock will include a veneer and/or head plate, plane the surface undersize to account for the added thickness of the head plate (9/16” for just a head plate or 5/8” – 1/16”).

The following picture shows two scarf joints ready to be planed.

The giant hunk of wood on the top piece can be taken down rather quickly with a sharp standard block plane. This will actually go much faster than you would think. When you get it level with the rest of the face, draw a line across the neck at the nut position with a square (similar to what you did when you cleaned up the saw cut) and use it as a reference point to level out the surface of the headstock. If you do your job correctly, the glue line will also run at 90 degrees to the side of the neck.

Head Plates and Decorative Veneer

A good veneer and head plate serves several functions. For one, it covers the unsightly glue line that runs along the face of the headstock scarf joint. Second, it adds considerable strength to the joint, creating a mild form of plywood. Finally, when matched up with contrasting wood colors, it can create a striking visual effect.

Preparation

You want to have everything laid out and ready to go in front of you as this operation is time sensitive. You need to make sure that all layers are glued and clamped in place before the glue has a chance to become tacky or you run the risk of layers separating later. One of the ways to prolong the setting time of the glue is to swipe each surface with a damp sponge before applying glue.

Cute each thin veneer sheet to size using the headstock as a guide.

Before you do anything else, ensure that the headstock face is free of any saw dust. Lightly wet a folded paper towel with denatured alcohol and swipe it down the surface of the headstock face. It should dry immediately.

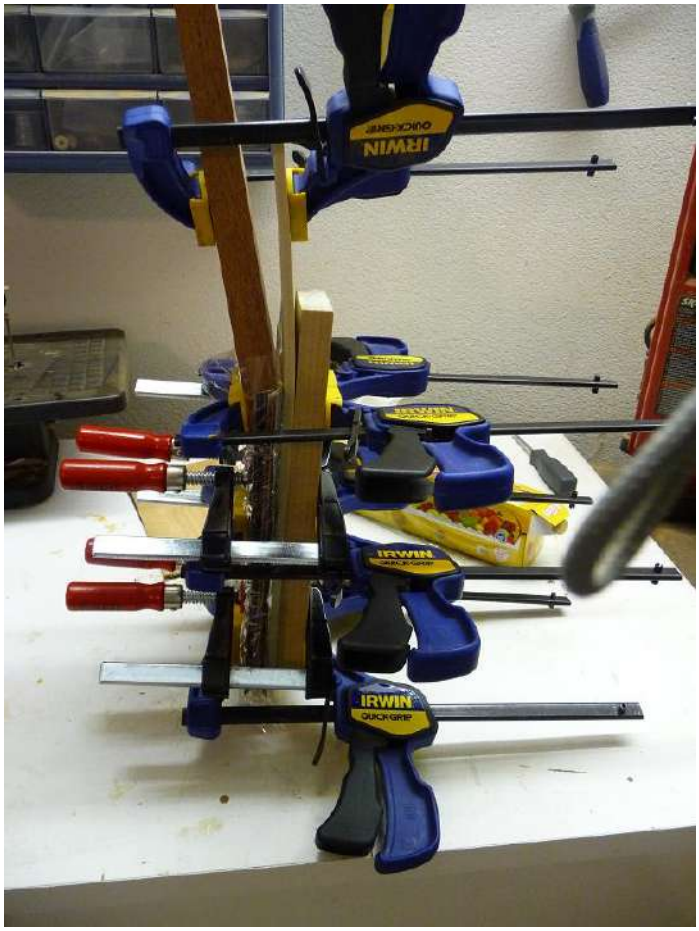
Gluing Up

If you wish to prolong the set time of the glue, be sure to wipe the surface down with a damp sponge. Apply a thin layer of white glue to the headstock face and spread it with an old credit card. Immediately put down the first veneer sheet and press it firmly into place. Take care that the leading edge of the veneer is flush in line with the back edge of the nut (where the nut will eventually be in the future, anyway).

Immediately repeat this process for any additional veneer sheets, finishing with the thicker head plate. Make sure that each successive piece lines up evenly with the back edge of the nut.

With everything in place, put a piece of plastic cling wrap around the headstock. This will prevent any squeeze out from gluing your caul to the face of the headstock.

I have found that a ¼" thick caul sandwiched between a ½" thick caul is ideal for ensuring that the veneers are firmly clamped down throughout their entire length. The reason is that the ¼" thick caul will bend over the nut area, clamping down the leading edge of the veneers, while the ½" thick caul will apply even pressure to the rest of the area.



Set the piece aside and allow it to dry for 24 hours. After it is dry, remove the clamps, cauls, and cling wrap. Be careful when removing the cling wrap that you do not break the overhanging veneer. Bandsaw off any overhanging veneer before it has the chance to break off unevenly.

As a final operation, true up the leading edge of the veneer using a flat file.

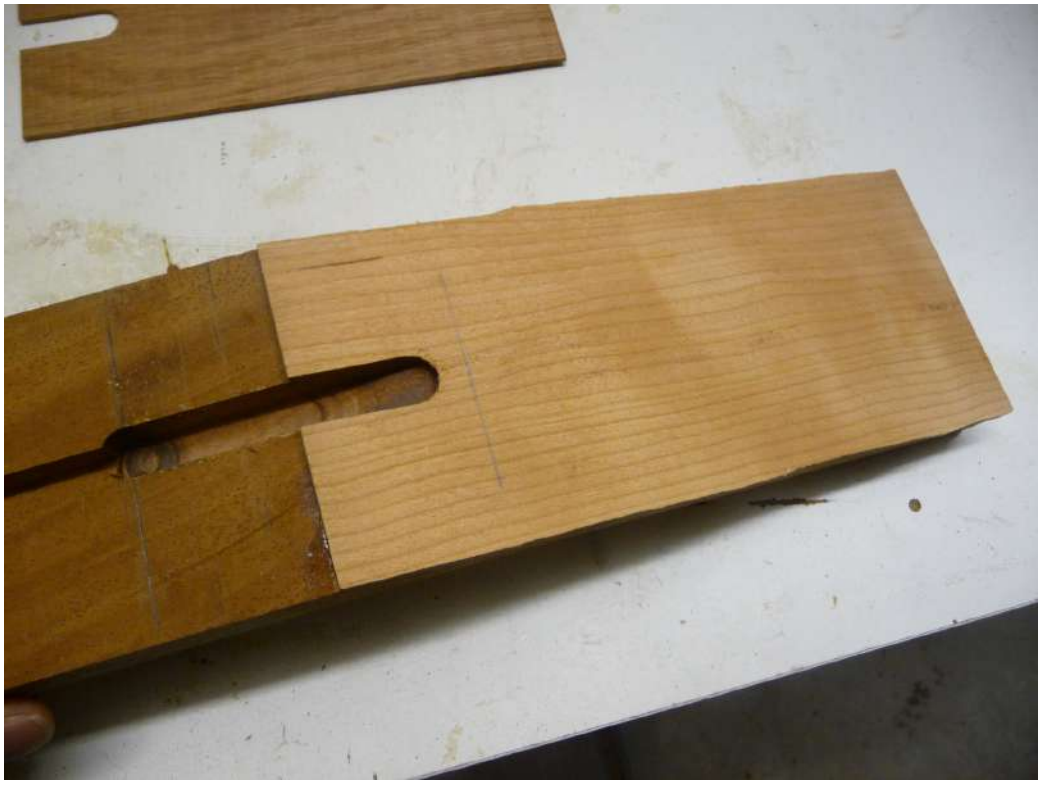
Installing a Truss Rod

Installing a truss rod is a simple operation that remains intimidating due to the nature of a router; a perfectly serviceable guitar neck can be converted to kindling in seconds with one careless mistake. Thankfully, this danger is easily avoided with careful planning and forethought.

Preparation

If your neck has veneers on the headstock, you will need to raise the router such that the edge of its base will clear them. This is easily accomplished with a ¼" piece of stock (cut to the same width and length as the neck blank) clamped on top of the neck. The router bit will cut through this piece and into the neck to make the truss rod channel, while the base of the router will be raised over the neck far enough that it will easily clear the raised edge of the veneer and head plate.

Place a truss rod cover on the face of the headstock flush with the leading edge and pencil in where the screws will go. Remove the truss rod cover and draw a line across the headstock just ½" south of the top center screw hole that you just drew. This line represents the limit of the truss rod cavity; you do not want to route any further than this. This will help to ensure that the truss rod cover will completely cover the truss rod hole.



Clamp the neck and ¼" stand-off to your work bench, such that both of their edges align perfectly with the edge of the bench top. Set up the edge guide for your plunge router such that the cutter runs down the very center of your neck. With an appropriate sized straight bit loaded in the collet, set the depth stop so that the rod will sit just shy of the neck surface when placed in its trench.

Lay the truss rod down on the neck and mark its start position down by the heel of the neck. This is where you'll begin your cut.

Routing the Channel

The type of truss rod you use will determine the nature of the channel. I like to use 18 ½" long rods that are ¼" wide and 3/8" deep. The rods that I buy are shrink-wrapped down their entire length. This allows me to install the rod without having to run silicon down the channel; the shrink wrap will prevent rattle on its own.

Up at the adjustment nut you will need to go to a larger bit. For my channels, I step up from a ¼" bit to a ½" bit. The nature of my truss rods also requires that I make the channel slightly deeper at the adjustment nut by about 1/16".

When you are sure that everything is lined up properly, route your channel. Be sure to wear safety **goggles** for this operation. Safety glasses are absolutely useless. A router is quite a messy tool and sends fine saw dust literally everywhere. If you don't have a good set of goggles that make a seal against your face, you will get sawdust in your eyes and you won't be able to see what you are doing.

With the channel routed, dig out the trench to remove any lingering saw dust and then drop in the truss rod. Press it in firmly and make sure that no part of it stands proud of the neck surface. If any part does, you may need to adjust the depth stop on your router and take another pass.

Finally, a piece of tape needs to be placed over the truss rod. The truss rod must be able to bend freely in its channel so you can't allow any glue in there when you attach the finger board. Use masking tape and trim off any excess around the edges. Aim for the tape to overlap the sides of the nut trench by no more than 1/8" on all sides.

Making the Fret Board

To begin, the leading nut edge on the fret board blank must be perfectly square to the center line. If it is not, mark off a line near the leading edge that is square to the center line and then square it up using the bench disc sander. This is a delicate operation that requires a light touch.

Once you have ensured a square leading edge, measure out the total length of the fret board. If your blank is of equal width from top to bottom, a miter box may be used. If the blank has already been tapered to some degree, you must ensure that the bottom line of the board is also square (the cut can be made with the band saw and again cleaned up with the disc sander).

To determine the length of the fret board you must first know the scale of the guitar and the number of frets it will have (which should have been determined in the design phase). The length of the fret board should be the distance of the nut (0 fret) to the last

fret plus one more fret. For example, if the fret board will have 22 frets, the total length of the fret board should end at the position of an imaginary 23rd fret.

Be sure to save the scrap when your fret board is trimmed to length. This left over piece can be used for many things. I like to thin my pieces down and make truss rod covers out of them. Another thing that this scrap is good for is in making wood dust to be used as a filler compound for sealing up the fret ends (discussed later).

Find the Center Line

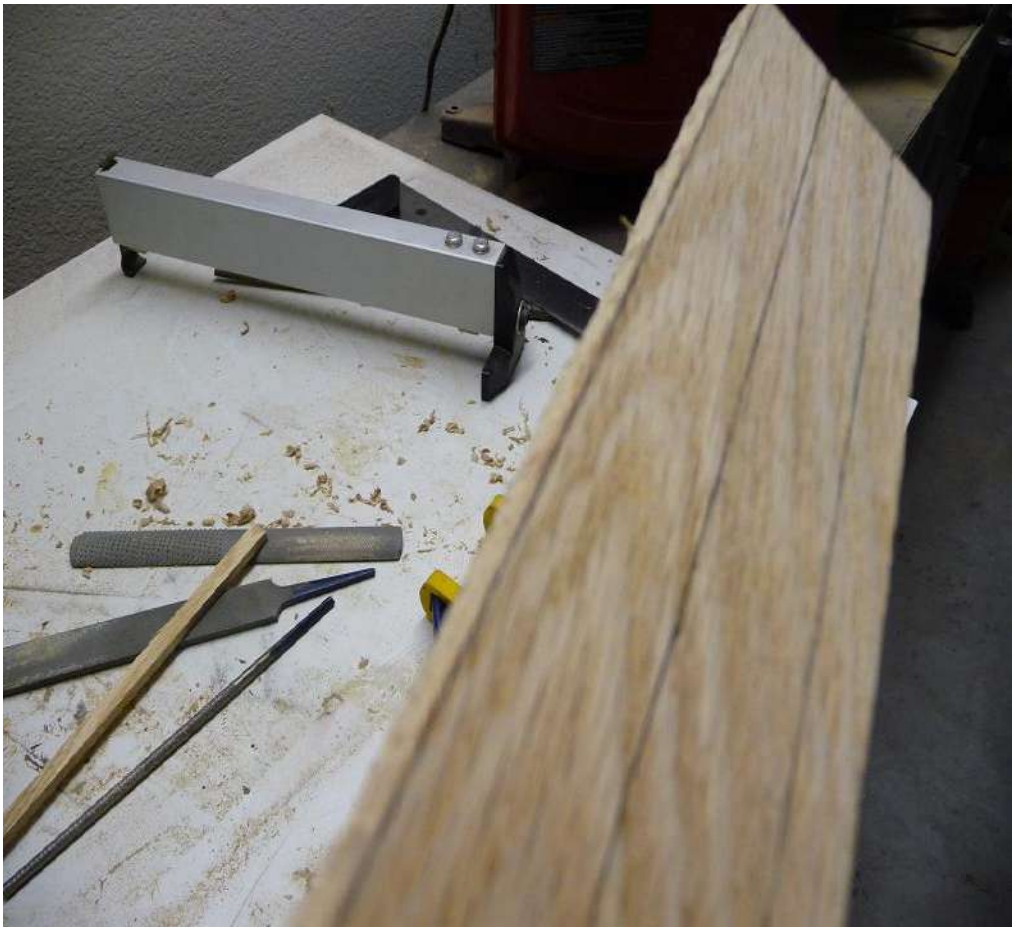
Using a metric rule or vernier caliper, determine the center point at both ends of the blank and draw a line down the entire length (connecting these two positions). This will be the principle datum of the entire guitar. The position of everything else will be made in relation to this line. In other words: be sure you get it right.

Now mark off the edges of the fingerboard on both sides of the neck, towards the nut and the bridge. Again, the width at these points should have been determined in the design phase.

Using a straight edge, connect the marks at either end and draw a line between them. In the picture below, I have the straight edge clamped in place to make sure that it doesn't slide when I drag a pencil down it.

Cutting the Fret Board

With your fret board fully marked out, take it to the band saw and cut off the excess. As always, do not cut on the line. Aim to cut about 1/8" away from the line. The excess material will be carefully removed later, ensuring that the dimensions of the fret board match the intended design.



Cleaning up the Edges

Clamp the fret board down to a work surface and shoot the edges with a trim plane or low angle block plane. Be sure keep the plane square to the board as it is easy to bevel the edge. Your plane should be set to just whisper over the wood, taking very fine cuts. Too deep of a cut and the wood may tear, especially if it's an open grained specie. Tearing produces the likelihood that the piece is cut undersize.

Once again, plane just up to the line, but do not plane the line away. You want your pencil line to still be visible when you're done.

Check your work continually as you go. Use a vernier caliper to ensure that the width at the nut and the 12th fret is still correct and use a meter stick to check that the edges of the piece are perfectly straight.

Now you need a good, long, straight sanding block. I use a 16" length of oak that has been flattened on a bench plane. Apply double sided tape to both sides of the block and then wrap a full sheet of 80 grit sand paper around it.

In the process of sanding, you want to go until the line has just disappeared but no further than that. This will be a very slow and repetitive process. Each pass should run the full length of the board with even pressure applied throughout the pass. You must put a meter stick up against the edge of the board very often, preferably with a light behind it, so that you can see any high or low spots (indicated by light shining through between the work piece and meter stick). Devote a little extra attention to any areas that are a little high. You should continue until the edge is perfectly straight but, whatever you do, do not sand the board narrower than the width dictated by your design. Be sure also to constantly check the width of the board at the nut and bridge ends with your vernier caliper to ensure that the overall width of the fret board is correct.

When you are finished, sight the board down the center to verify that the center line is still correct. If you sanded one side of the board down too far, there is still an opportunity here to correct your error by adjusting the center line (but only if your error was minor).

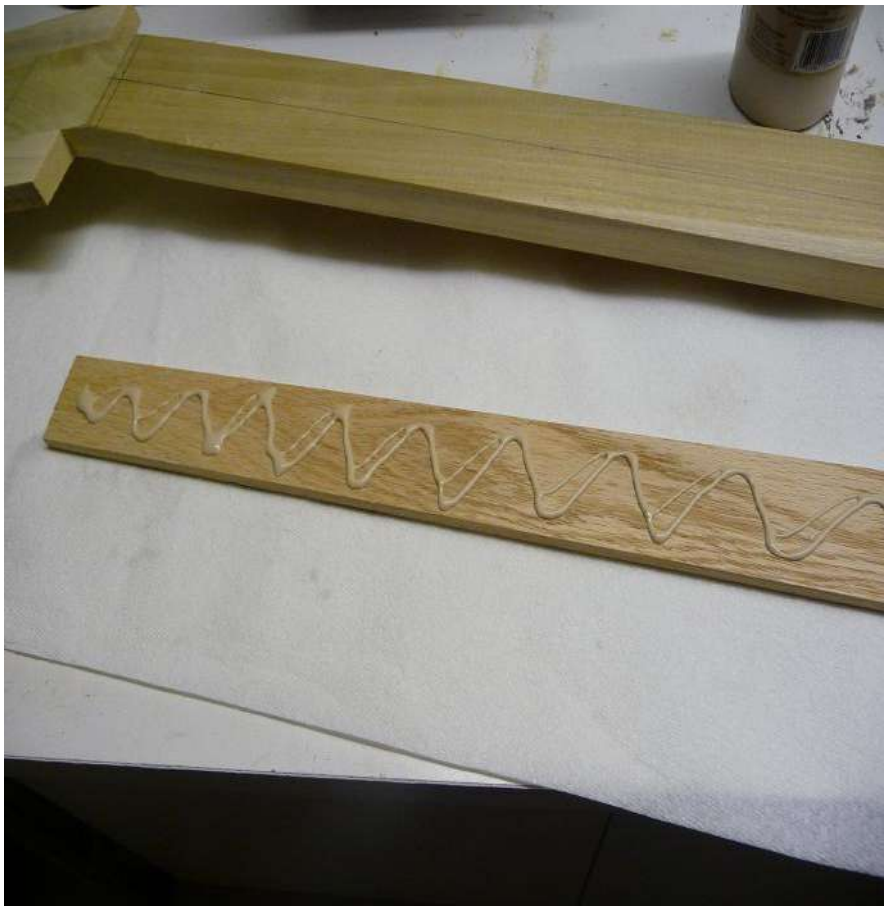
Gluing the Fret Board to the Neck

Get your neck and fret board together on a comfortable work surface and put some paper towels or newspapers under them. Ensure that the neck has its center line marked along its entire length (should flow naturally from the truss rod channel if a truss rod was used). On the fret board, transfer the center line to the edges, as shown.

This will be mated up to the center line that you drew down the neck earlier:

Up at the headstock, determine the thickness of the nut and draw this line out using a square. The line is offset from the edge of the scarf joint angle and defines the leading edge of the nut (zero fret). I personally set this thickness at 3/16".

Apply yellow glue to the fret board in preparation to gluing it to the neck and spread it out evenly over the entire surface. Note that if you are using a dense or oily wood for your fret board (e.g. Ebony or anything in the Rosewood family), you should score the mating surface of the fret board with an awl in a cross hatch pattern so that the glue will have some extra surface area to which it can key.



After spreading the glue, lay the fret board down on the neck, taking care to line up the center lines of both pieces. A small amount of very fine sand sprinkled over the glue will help to prevent unwanted sliding. Slowly and carefully slide the fret board back and forth by small amounts while applying moderate downward pressure to help rub the glue into the pores of the mating surfaces until it grabs. Ensure that the fret board lines up with the mark that you drew for the nut leading edge and with the center line of the neck. Apply as many clamps as possible when you are sure the position is correct. The following images depict the clamps being applied directly to the fret board but it is really best to use a caul for this task as it will provide much more even pressure throughout the surface of the work piece.

Put the work piece aside to dry for a minimum of 12 hours if the neck doesn't have a truss rod, minimum 24 if it does have a truss rod.

Headstock Layout and Neck Trimming

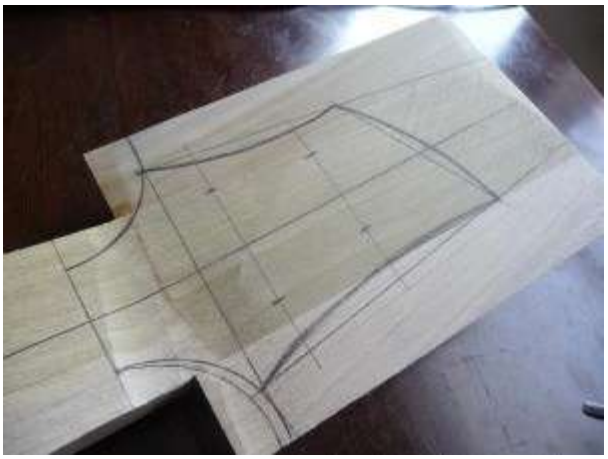
With the fret board applied, it is now time to layout the headstock and trim down the sides of the neck.

This is now a good time to layout the headstock design. Most serious luthiers have a signature headstock design that they use to readily identify their guitars. If you are interested in making a name for yourself as a guitar maker, you will need to develop your own if you wish to be taken seriously by the rest of the community. In the world of custom guitar making, luthiers often copy guitar body shapes (see the numerous Stratocaster, Telecaster, Les Paul, and PRS duplicate bodies currently available by independent guitar makers). It is a matter of professional courtesy and honor, however, that headstocks are never copied.

Eventually, the best practice is to create a template to easily transfer your headstock design to the neck. It is also possible to draw out an original design directly on the headstock.

It is easiest to draw the design on the back of the headstock and cut it out face down on the bandsaw. Keep in mind that when you draw your design in this fashion, the image will be mirrored (reversed).

Start by finding the center line down the back length of the neck and then use a square to transfer the leading edge of the nut around from the front to the back. You can then mark out the sides of where the fret board would be on the back of the neck and draw in the headstock accordingly.



Some general dimensions:

1. The center of the tuner hole is usually positioned ½" in from the edge of the head stock.
2. Tuners can be placed anywhere from 1 ¼" to 1 ½" apart from each other. Any shorter and you have to start worrying about the tuning keys interfering with each other. Any further and the overall appearance of the headstock will be clumsy.

Cut the headstock out on a bandsaw, leaving at least 1/8" relief between the cut and the line that you drew in. The rough edges are cleaned up later on a drum sander.

Before cleaning up these edges, however, trim the extra side material of the neck on the bandsaw as well again leaving about 1/8" of relief all around.

The sides of the neck can now be trimmed down flush with the edge of the fret board. If you are working on a budget, this can be carefully done with a block plane. This will constitute quite a bit of effort and care must be taken to ensure that the planed edge is square.

The fastest and most accurate way to trim down the sides of the neck is with a router and pattern trimming bit. If you have access to a router table this is by far the safest and easiest way to go. The neck can be easily moved over the table surface and errors are unlikely. If you don't have a router table then you'll have to set up your plunge router to rest on top of the fret board as you move it around the neck. This is an extremely delicate operation in which it is very easy to ruin a neck within a split second (especially if the base of the router rocks on the overly small surface of the fret board). In fact, if you have little to no experience with a router this probably shouldn't be attempted at all and you should just stick with the block plane method.

If you will use a router, set up a pattern trimming bit in your router with a depth such that it will trace the fret board as a template (this is why it is so critical to get the fret board precisely sized and positioned). Run the router around the perimeter of the neck, ensuring that you do not roll it around the nut edge and inadvertently cut off the headstock. After the first pass you can adjust the depth of the cutter until the whole neck has been trimmed.

With the edges of the neck trimmed down, you can now clean up the edges of your headstock on a drum sander.

With the edges of the headstock finalized, re-measure the marked position of the tuning machines on the back of the headstock and verify that they are still positioned ½" in from the edge. If they are not (i.e. you have sanded the headstock slightly undersize), adjust the marked position so that it is again ½" in from the side. Punch the center position of each tuner with an awl and drill out the tuning machine holes on the drill press. Make sure to put a piece of scrap wood on the underside of the headstock (where the drill bit will exit) to prevent blowouts (which would be catastrophic at this phase).

Simple Inlay

Inlay work can be as simple or complex as you wish it to be. There are various extravagant examples that require master levels of craftsmanship to execute (some of which can take as long as six months or more to complete due to the complexity involved).

Pictured Above: Lunacy

Thankfully, the simplest form of inlay (the dot) can be well executed by the beginner.

Layout

There should still be a center line running down the middle of your fret board as well as a visible mark for the 12th fret position. If the line has faded (especially likely in the case of oilier woods such as Rosewood) take the time to trace it in again to help them stand out.

Inlay dots are placed in between frets. For this reason it is helpful to layout the fret positions on the neck first. Do so by clamping a meter stick to the fret board along the center line such that the 0 millimeter mark lines up with the 0 fret position.

Now go down the length of the neck and mark in the positions of each fret according to the fret position print out.

It is necessary to fully draw in each fret along the fret board, especially for the double dots at the 12th fret position. You can't use a standard 90 degree square for this because the neck is tapered. To ensure that each fret runs parallel to the center line of the neck, you must use a bevel gauge specifically calibrated to the run of the fret board. This is easily accomplished by offering the blade up to the nut or heel edges of the neck and tightening the thumb screw when the blade is flush. Once tightened, you can confirm that the blade position is correct by placing it on either side of the neck and verifying that it is still flush with the nut or heel edge.

Move down the length of the neck with the bevel gauge and fully mark in the position of each fret. Note that the masking tape shown in the picture is not required. This picture is actually from an example on fretting (you can actually see completed inlay under the tape in the picture) but it applies here just as well.

With the position of each fret drawn in, you can now accurately mark in the position of each dot marker down the length of the neck. Standard placement for position markers are at the 3rd, 5th, 7th, 9th, 12th, 15th, 17th, 19th, and 21st fret positions, with two dots placed at the 12th fret to indicate the octave.

With each position marked, use an awl to punch a slight hole at the exact center position of each inlay. This will help ensure that the drill bit is perfectly placed as it enters the wood.

Execution

Use a brad point drill bit (also called a lip and spur drill bit) on a drill press to drill the recess for each dot marker. Make sure that the drill bit is of the exact diameter as that of the dot (I stick to ¼" or 6.23 mm dots). Set the depth gauge on your drill press such that the top of the dot sits just proud of the surface of the fret board.

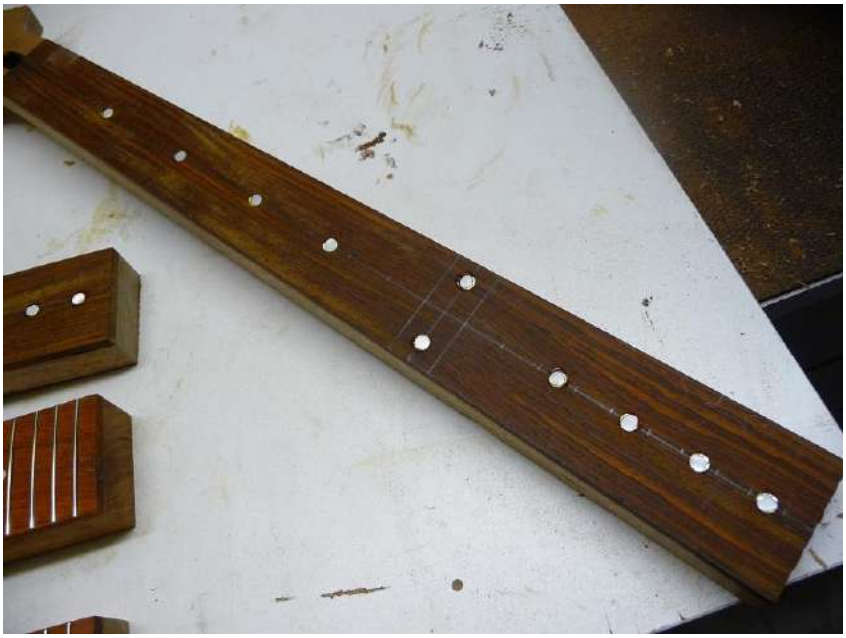
Drill out each inlay position and be sure to take your time.

Setting in the dots is simple and fast. Put a small dab of gel type super glue in the position marker recess and carefully lay the dot into position using tweezers. Lightly press the dot into place but do not push down with excessive force as you risk cracking the dot. Just press down firmly enough so that it is evenly seated along the bottom.

If you get some glue squeeze out around the dots as you press them in just leave it alone. By all means, do not wipe it away as it will be pushed into the fibers of the surrounding wood and discolor it.

When all position markers are in place set the neck aside for 20 to 30 minutes to ensure that the glue has set, including any squeeze out.

When the glue dries, lightly file down the position markers with a medium file using gentle pressure until each dot is completely level with the surface of the fret board.



Rough Carving the Neck

This is arguably the most satisfying part of making the guitar neck. This is the point when you get to see the neck gradually emerge from an unsightly hunk of wood into a graceful work of art.

The trick to getting a neck carved just right is that you want to get the back of the neck to appear as straight as possible without forcing it to be so. Unlike a CNC machined neck, which is straight to a fault, and hand carved neck has the opportunity to curve smoothly in line with the player's hand, providing a much more fluid playing experience. The vast majority of the neck's back should undoubtedly be straight from the heel to about the 2nd or 1st fret position. After that, however, you want it to thicken just

imperceptibly as it arches back again to meet the headstock. If done correctly you almost shouldn't be able to detect it unless you sight directly down the back of the neck. When you run your hand over it you will see that this one minor detail makes all the difference.

Blending the Headstock in to the Neck

You will note that there is a sharp angle where the headstock meets the neck at the scarf joint.

Roll the flat of this joint gently over the rounded drum of a belt sander to blend the two joining surfaces together gracefully. Do not linger in any one position for too long or you could sand the thickness of the headstock undersize.

From here you can begin the process of carving out the back of your neck. You will do this by carving down the heel and shoulders of the neck (just below the headstock) to the desired depth and radius and then joining those two points together in a straight line along the back of the neck. From this point the sides of the neck are rounded over to meet the fret board.

Carving the Heel

Start by determining how long the heel of your neck needs to be by mocking it up on the intended guitar body.

When you have the depth of the neck pocket determined (according to your scale length and bridge position), you can mark out the approximate position of the heel arc on the back of your neck. The point here is to have as little of the heel as possible protruding from the body. No guitar player likes to wrestle around with a gigantic heel.

With the depth determined, turn the neck over and trace out the arc with a pencil. I typically do this freehanded but a small paint can or soup can makes a ready template.

Clamp the neck into a bench vise and begin to scoop out material using a chisel, working from the outsides of the neck into the center.

Be sure not to take the depth too low at the center of the neck. If you started with a ¾" thick blank, don't take this cut deeper than 1/8" less the original thickness (5/8" thickness not counting the fret board).

For each cut that you take with the chisel, start with the blade right on the line and cut down steadily into the wood at a slight angle. Smoothly scoop the blade out of the wood and away from you, bracing the back of the blade against the top of the heel.

As your blade gets deeper into the wood (and further from its starting position), you will find that the wood begins to splinter off of the neck. Stop immediately and attack the cut from the other direction taking care that the blade does not break loose from the wood and gouge the heel.

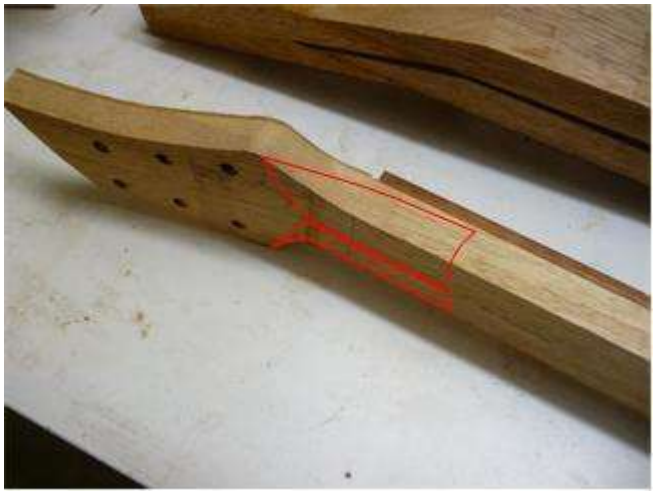
Take your time and keep your cuts small and precise and soon you will have a nicely carved out heel. Don't be concerned if it looks very jagged at this point. The picture shown above is just about as clean as you'll be able to get things with just a chisel. Your work will be refined later with files and sandpaper.

Carving the Shoulders

The term "shoulders" is something I came up with to describe the interface between the neck and the headstock, just where it flares into wings. I have no idea if this term is generally used but it makes sense to me.

In order to have a neck that is rounded comfortably in this area, it is necessary to remove a good amount of wood such that the neck is able to transition smoothly from the rounded back to the more angular headstock.

The following picture indicates this shoulder area and the wood that must be removed (in red).



To remove this material you must again use your chisel to pair it away in successively larger “bites”, starting from the top of the shoulder and cutting down smoothly to the base of the neck, as shown.

Each pass of the chisel takes the rounded over portion of the neck closer and closer towards the center of the neck until they almost touch.

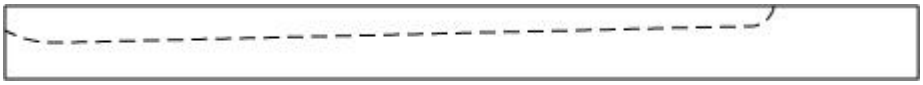
As you go, you must also take down the back of the neck in this area in thickness with a spokeshave until you approach your final radius. For a truss rod that sits 3/8” deep into the neck, I find that a total thickness of 22 mm (including fret board) is a good number. This will leave just over 1/8” thickness of wood under the truss rod nut.

Finding the Highest Point of the Neck

Before you get too busy trying to make the heel and the shoulders perfect and beautiful, you need to create a straight line running from the heel to just up to the back of the headstock, which will constitute the highest point of the neck’s back when laid face

down. Once this area is perfectly straight, you will use it as the starting point to round over the sides of the neck and blend them into the fret board.

Attack the back of the neck with a low angle block plane. Work only the center of the neck and take only a few swipes at a time before checking the straightness of the neck with a straightedge. When you have a straight line running from the heel to the headstock (as shown below in side profile) you are ready to start rounding over the sides.



Note in the picture below how the flat on the back of the neck appears to flair out in width towards the middle. This is due to the fact that the front and back of the neck have been partially radiused while the center has been left relatively square. We will take these sides down in subsequent steps with a spokeshave.

Rounding Over the Sides of the Neck

Run a spoke shave down the sharp corners of the neck's sides. Take equal passes from each side. You want to see the flat on the back of the neck become thinner and thinner until it almost disappears. Take care that it does not disappear fully. If it does, you will have lost your perfectly straight reference point and you will not be able to easily recreate it without the danger of cutting through to the truss rod.

Note that your shave will work better from different directions depending on what part of the neck you are cutting. This has everything to do with grain direction of the neck. This will require you to get inventive with how you approach the neck. In many cases, you will find that the left side of the neck wants to be planed from one direction while the other side wants to be planed from the opposing direction.

The following link demonstrates the process of carving out a neck using a drawknife. The process shown is very similar to that of a spokeshave.

http://www.youtube.com/watch?v=eqBdT8JB0G0

Rough Clean-up With Files

Go over the entire neck using round and bastard files to ensure that the entire neck presents a smooth and even radius. You will find that this is a frustratingly iterative process, where each area that you perfect exposes another area that is high (or low). The best you can do is to be patient and keep working at it slowly and carefully until you are done, checking constantly with a straight edge.

When you are finished your neck should resemble the following.

You'll note that while it looks far from perfect, it looks much better than it did when you took those first swipes with the chisel.

Rough Sanding and Fret Board Radius

Like many other tasks in guitar making, sanding is another sequential and iterative process. Each phase of this activity takes you to the next step and each step must be fully completed for the following step to be successful.

This phase includes sanding the radius into the fret board. For sanding the neck itself, you will transition from 60 grit sand paper to between 100 to 150 and finish at 220. The fret board will be sanded starting at 60 grit and transition through 100 (or 150) to 220, to 400, to 800, to 1000, to 2000.

For each grit, you must make sure that all of the scratch marks left behind are uniform and even (indicating that all of the scratch marks from the previous grit (or from your files) have been completely removed. Work until you see no more sign of any such scratch marks and then wipe the entire neck down with a paper towel dabbed in denatured alcohol. This will remove the saw dust and expose areas that are not quite done (the rougher cuts will stand out in relief as the alcohol soaks into and evaporates from the inner grain).

The thing to remember (and motivate yourself with) is if you invest a greater amount of time in the lower grits, less of your time and effort will be required at the higher grits. By the time you've hit 400 grit, you should really only be required to make a few spirited passes, whereas you'll find your self spending a larger hand-cramping amount of time down at 60. The good news is that 60 grit sandpaper eats away at wood rather quickly. Just keep at it and I promise that you will get there.

Fret Board Radius

You'll make your first pass around the neck with 60 grit sandpaper. As noted before, this is the most critical part to get right. This step will level out any lingering irregularities in the neck and get you ready for the successive finer phases.

Start by clamping the neck in one or more vises such that the fret board is completely exposed.

Wrap a sheet of 60 grit sandpaper around your radius sanding block and begin to run it up and down the fret board in long continuous passes, keeping the downward pressure even along the whole run.

As you go, you will notice the outsides of the neck becoming cloudy as the sandpaper scuffs progressively larger portions of the wood surface. You will also see your pencil

lines left over from the inlay work slowly disappear from the outsides of the neck in. You must continue until the scuff marks on the outside of the neck grow to a point where they meet in the middle of the neck, indicating that the entire surface of the sanding block is now making contact. Continue to sand only until any remaining pencil lines are completely removed. Finish by holding a straight edge to the neck and ensuring that the fret board is straight from nut to heel.

From this point, higher grits of sandpaper need only be worked over the fret board until the scratch marks are uniform. By the time you reach 800 grit, the neck will be smooth enough to play. With 1000 and 2000 grit, the surface will take on a polished, mirror-like appearance.

For the sequence in which you sand, I recommend sanding in the fret board radius at 60 grit first and then moving on to the rest of the neck with 60 grit paper. Following that, refine the radius with 100 (150) grid and then do the rest of the neck with 100 (150). Repeat this with 220 grit sandpaper. From this point on you are finished rough sanding the back of the neck and can work the fret board up to 2000.

Rough Sanding the Back of the Neck

Again, the first pass with 60 grit sandpaper is the most critical.

Lay a towel down on the work bench (to protect the radius of the fret board) and clamp the neck such that the headstock is floating out in space.

Now, clamp successive scraps of wood down around and to the neck to lock it into place.

Cut a ¼" thick strip of 60 grit sandpaper roughly 8" to 10" long and roll it over the neck and shoulders in a manner similar to a shoe shiner's rag (cross grain). Repeat this process at the heel of the neck. Work both sides evenly until your radii are perfectly blended with well defined edges.

Work the rest of the neck over with your hand. For flat portions such as the front and back of the headstock or the flat portions of the heel, use a flat sanding block to avoid rounding over the edges.

Grades higher than 60 will not require this cross grain “shoe shiner” approach. Sand with the grain at all of these higher grits.

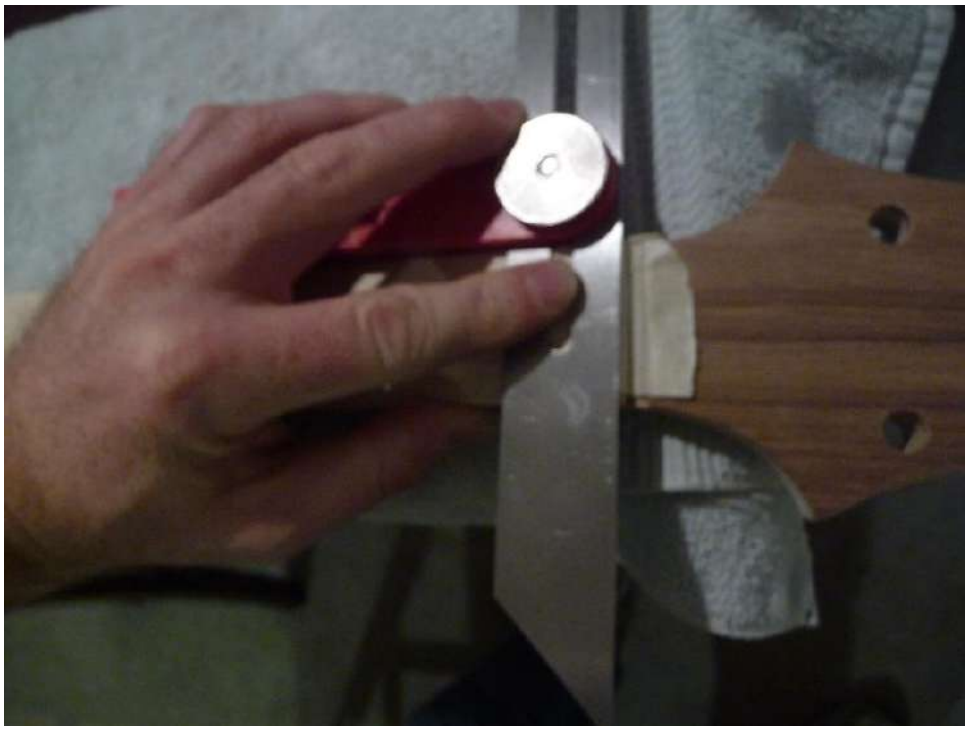
Fret Work

Slotting the Fret Board

Protect the fret board with some masking tape. A good fret saw has a plastic depth stop, which will mark the wood during sawing if left exposed.

Once the neck is fully masked off, clamp a meter stick to it with the 0 mark lined up to the 0 fret. Ensure that the meter stick runs down the center line of the neck.

As discussed in the section on inlay work, set up a bevel gauge to match the run of the neck.



Now that the gauge is properly set for the run of the neck, draw in your lines. When you get close to the other side of the neck, you'll find that you run out of room (you won't have anything to rest the gauge against). At this point you'll have to reset the angle of your bevel gauge for the other side of the neck and continue from the other direction.

When you get to this point, hold your neck up to the light and look at the position of the dot markers in relation to the lines you drew in (if you used the right color masking tape, you'll be able to see the inlay through it). Make sure that everything is lined up correctly and that you will not be cutting through one of the markers.

Use the bevel gauge to guide the fret saw as you cut the slots. Place the gauge on the neck so that it just touches the line that you drew in earlier. Lay the saw down on the neck so that the blade is resting up against the gauge and very carefully cut the slot.

During the cut, you will need to rock the saw first forward and then backward to account for the fret board radius (ensuring that the cut is a uniform depth across the neck). Be sure that the depth stop evenly scuffs the tape along the full width of the neck. This will let you know that you have cut to the full depth. If you fail to do this you could have high or not fully seated frets.

As before when drawing in the lines, you will have to turn the neck around at some point and reset your bevel gauge as you will run out of room.

When the slots are cut, remove the masking tape from the wood. Some of the glue from the tape will be left behind. Get your radius sanding block, load it with some 2000 grit paper, and give the fingerboard enough passes to smooth it back down.

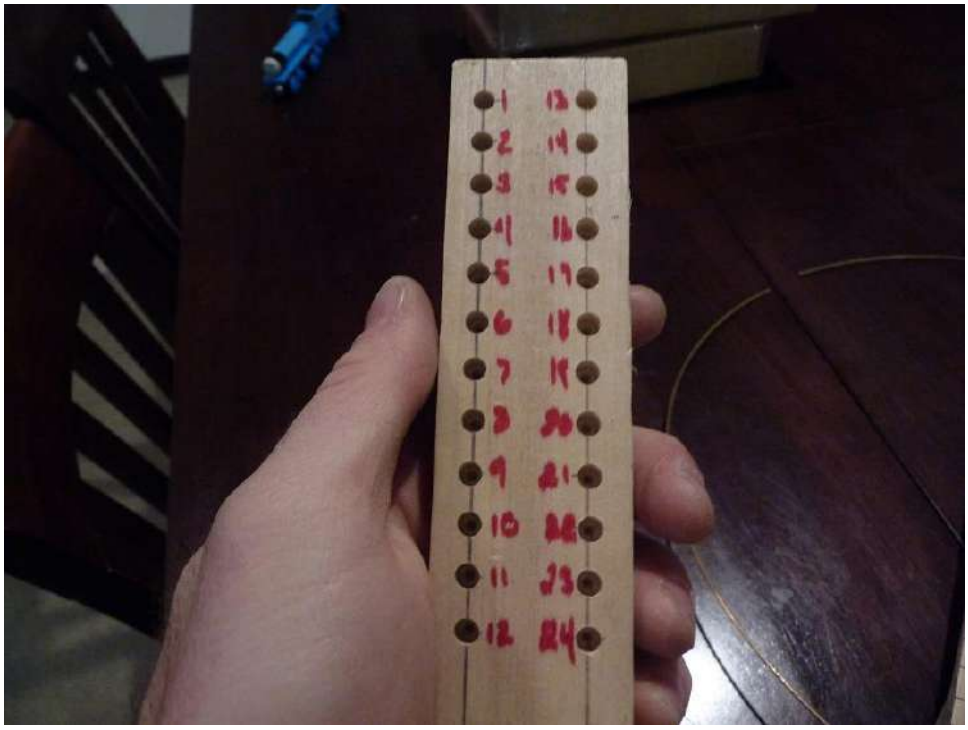
Wipe the surface down with some denatured alcohol. This will remove all of the sawdust from the board. I much prefer this method to tack cloth, as tack cloth will leave a waxy residue and gum up the wood. Alcohol is also great because it will not raise the grain of the wood like water will.

Setting in the Frets

NOTE: Before carrying out this process, you may wish to put a light chamfer on each fret slot with a small triangle file. The chamfer should be very, very small. This chamfer will make it much easier to remove the frets from the neck in the future without tearing up the fret board in the event that the frets need to be replaced due to wear.

When putting frets on a tapered neck, you need to keep track of which fret goes in which slot, since the frets at the bottom of the neck will be wider than the frets towards the nut.

Creating a block similar to that shown below will allow you to keep track of each fret's position.

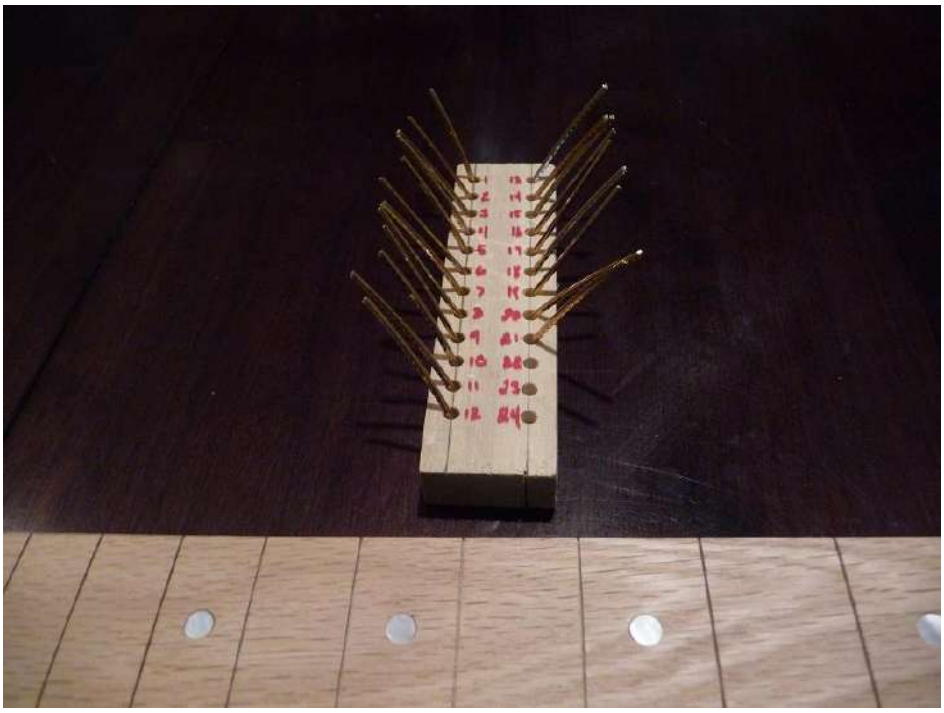


When cutting frets for a tapered neck, always start down at the heel of the neck first and work your way back towards the nut. If you cut a fret too short, you still have the chance to use it further up the neck where it's narrower, rather than having a wasted fret that you can't use at all.

For each slot, lay the fret wire across the board and put your thumb nail up against the point where you want to cut it. Make sure that there's about 1/16" worth of overhang to either end of the neck when you mark it in this way.

Clip the wire with your end nippers and place it in its appropriate slot in your fret caddy.

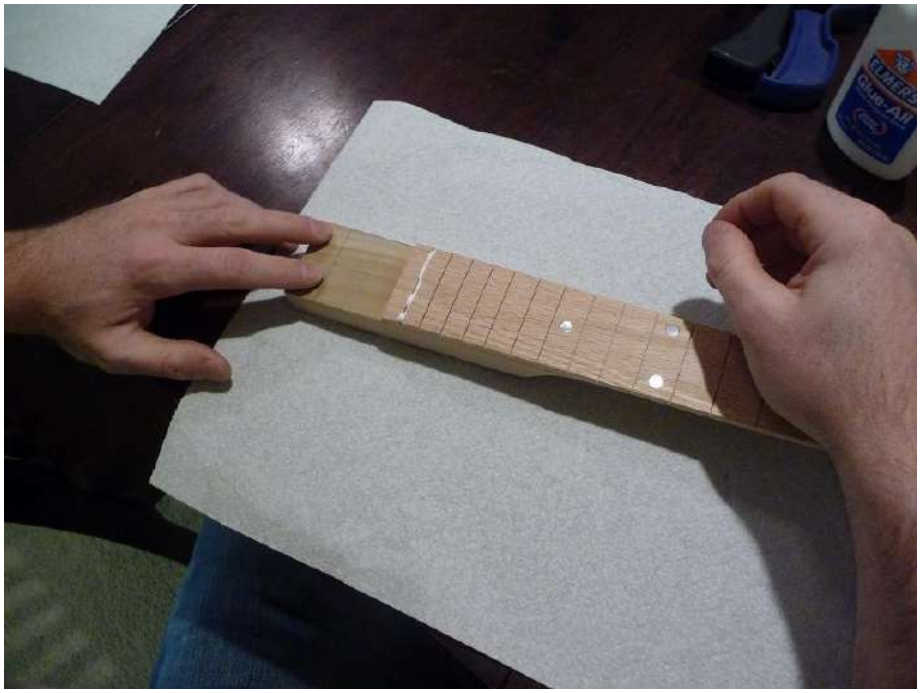
Now when you're ready to set your frets in, you know quickly where each one goes without having to keep them all lined up on the table, etc, etc.



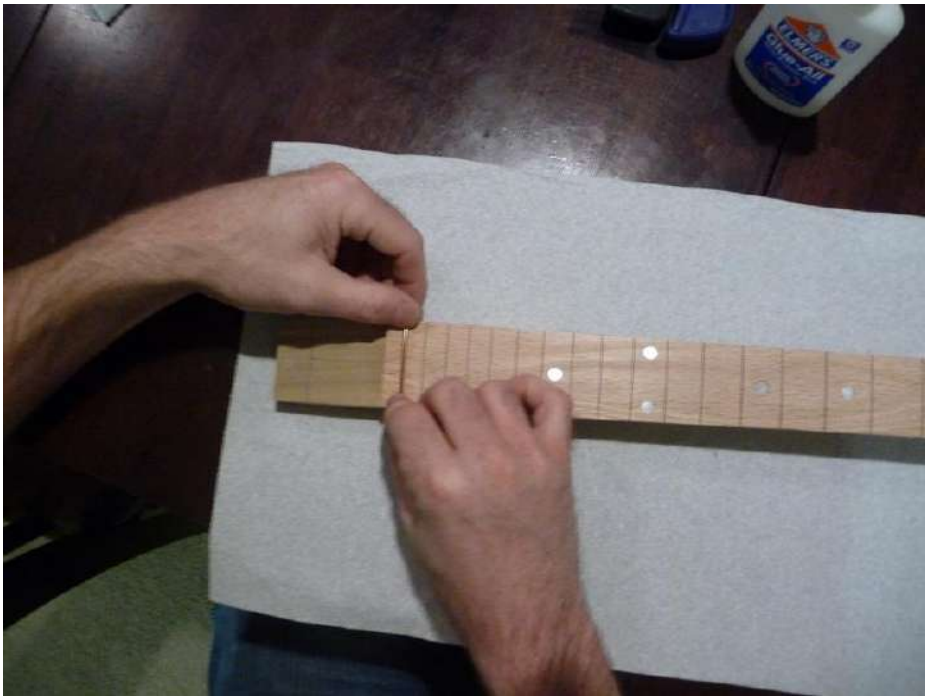
Certain woods require different treatments at this point. Lighter or more open grained woods (oak, bloodwood, padauk) will benefit from a bit of white glue worked into the fret slot, which will help to firmly lock the fret in place and prevent rattle. Denser woods (rosewoods, ebony, etc) don't necessarily require this extra step although it hurts

nothing if you choose to do it anyway. As a guitar maker, the choice is yours. The following steps include working glue into the fret slot for the sake of completeness.

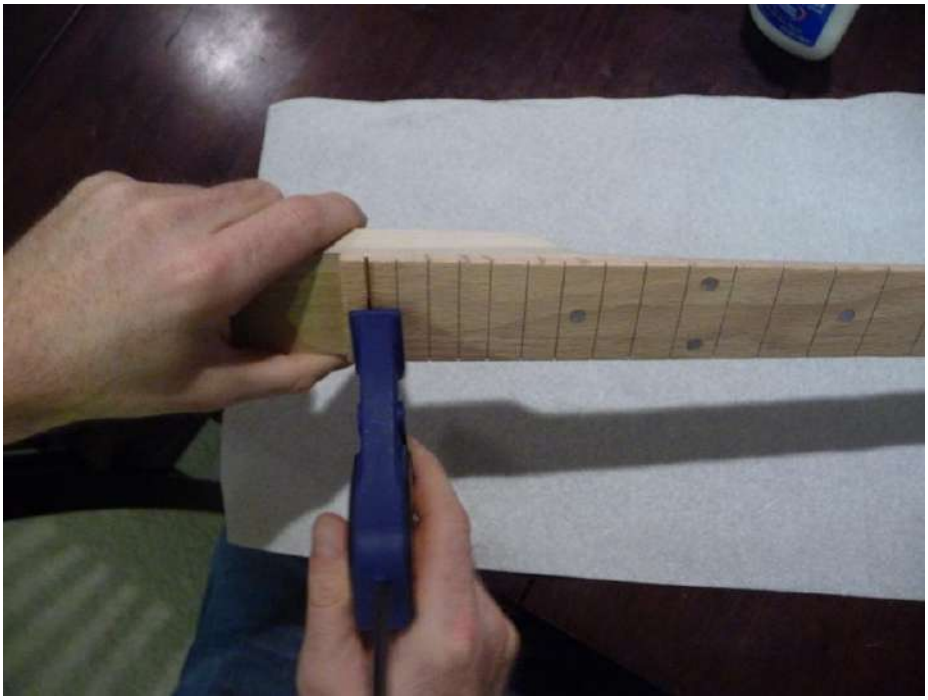
Start by running a thin bead of glue down the fret slot. Wipe down the slot with your finger, such that the glue is worked into it.



Now grab the appropriate fret and set the tang into the slot. Push it in steadily, making sure that it is lined up with the slot correctly (or you could chip the edges of the slot, translating into a loose grip on the fret when set). Be sure that the tang is accurately placed in the slot before pushing down. It is amazingly easy to scuff or mar the face of the wood with the fret tang, especially darker woods.



Now get one of your Irwin Quick Clamps. Pull the rubber pad off one of the arms of the clamp. Position the clamp over the fret such that the padded arm rests on the back of the neck and the unpadded arm rests across the fret wire. Crush the fret into the neck, starting at the center and then working your way out to each side.



Wipe away the excess glue with a damp sponge or paper towel.

Fret Dressing

You'll note here that I'm showing a lot of this process on a straight neck as well. This is just because these are the pictures that I happened to have ready at this time. The process for dressing frets is the same no matter what kind of neck you are constructing.

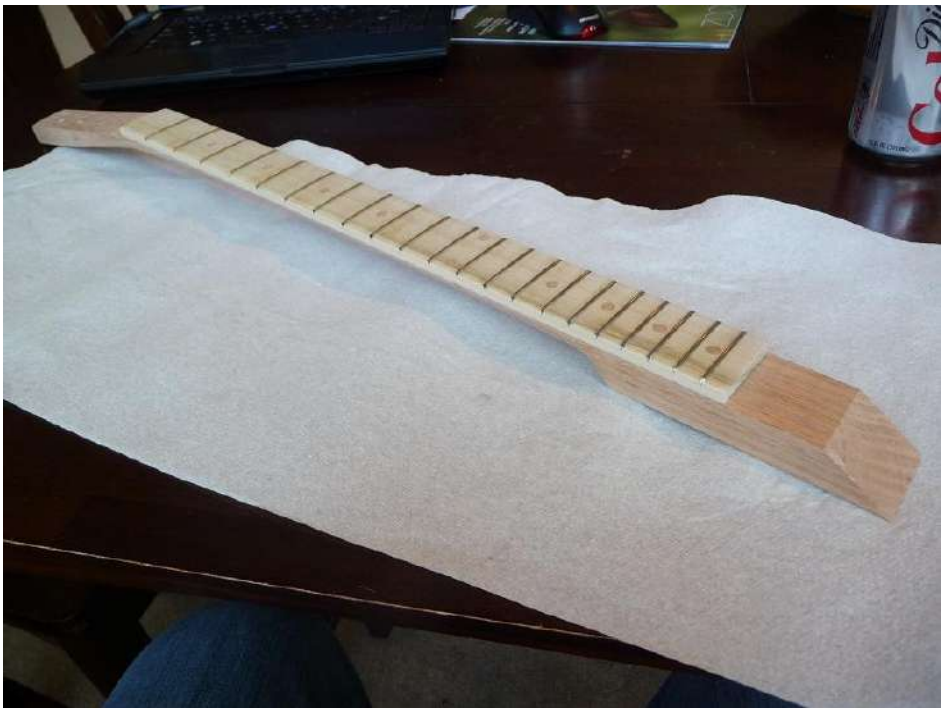
If available, trim the ends of the frets down flush to the sides of the fret board using a set of flush ground cutters. If you don't have a set or are set against spending the money to buy some I urge you to reconsider. This simple tool significantly reduces your time spent with a file.

I start first by getting the biggest flat file I have and filing the ends of the frets down flush to the side of the fingerboard, holding the file straight up and down at 90 degrees. You'll know when they are all the way down as you wont hear your file grinding over metal anymore, you'll hear the smoother sound of contact with wood.

Once the frets are down flush, I'll roll the file 45 degrees and file a bevel on the ends of the frets. I do this on both sides of the neck, obviously.

Go slowly and carefully during this step. You do not want to gouge the wood.

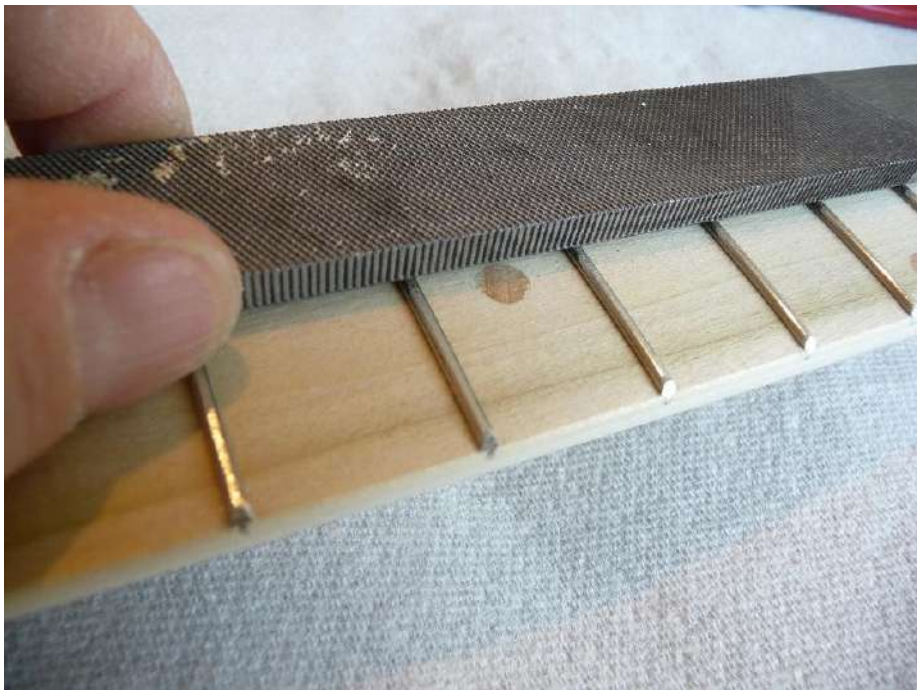
With the ends of the frets taken down and beveled, you can now level the frets.



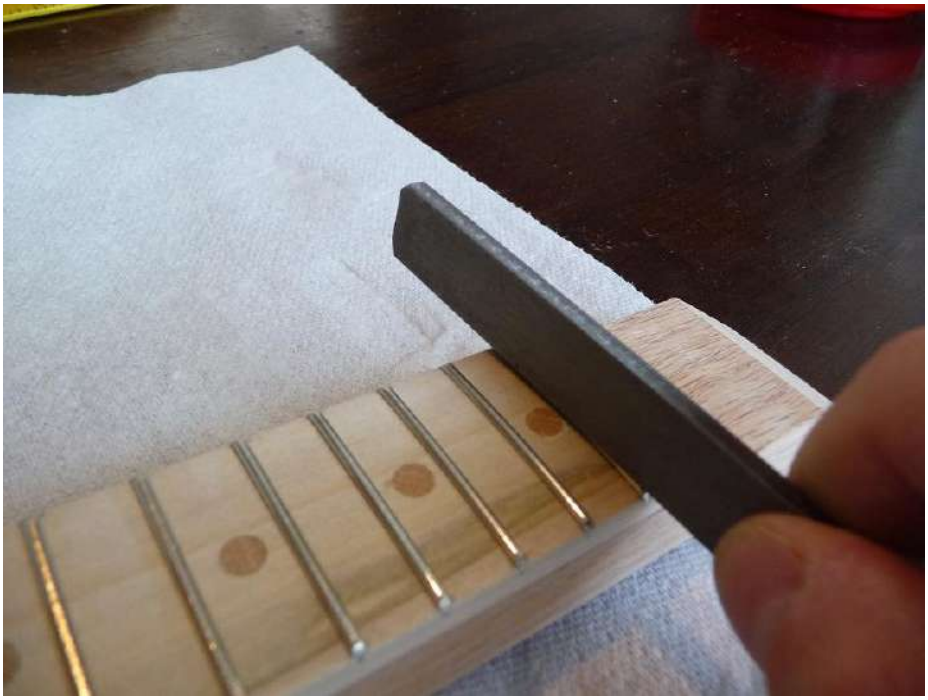
Depending on how straight your neck is and other small conditions, your frets will likely not be perfectly level after you set them in. To level them, use a coarse sharpening stone or a file. Run it lightly over the tops of the frets, taking full passes down the length of the neck and evenly across the surface of the frets (side to side). Be sure to keep the downward pressure as constant as possible. Also, keep the downward pressure light.

The weight of the stone or file alone is almost enough to do the job. You certainly don't want to take any more material off the frets than you have to. Stop as soon as you see that a flat has been worn on to the top of all of the frets, across their entire surface.

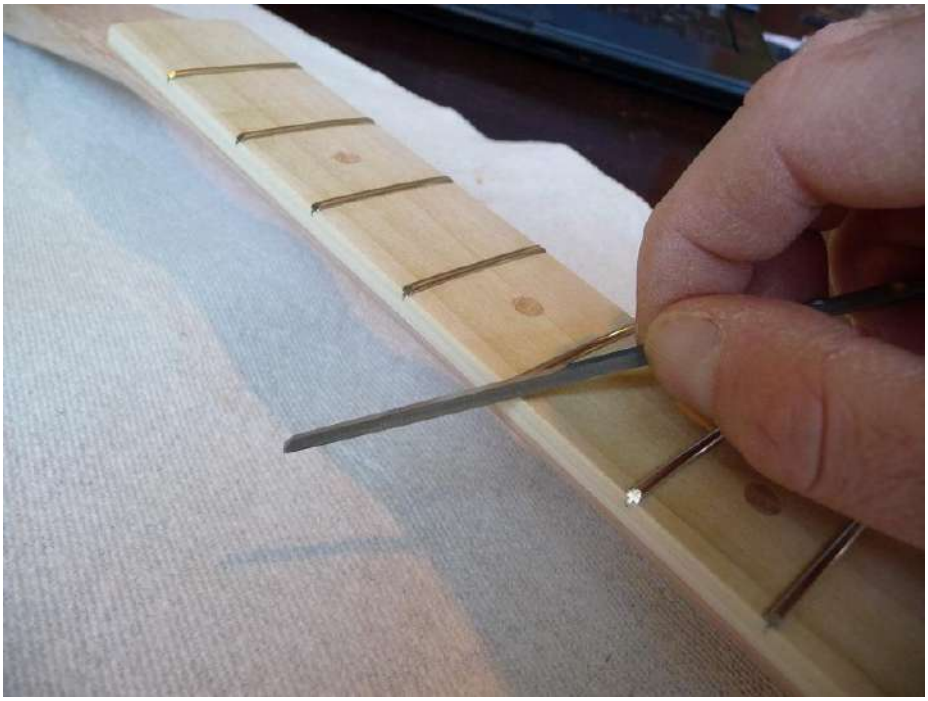
Get a straight edge and lay it across the tops of the frets. Ensure that there are no low or high spots. If there are, work them down just a little bit more. Spot leveling is permissible with a light touch but do not overdo it.



At this point the frets are all perfectly level. Now you just have to clean them up. Start by re-crowning each fret using your re-crowning file. When doing this, be sure to give each fret the same number of passes with this file. This will help prevent from taking one of the frets down too low and therefore nullifying the whole operation.



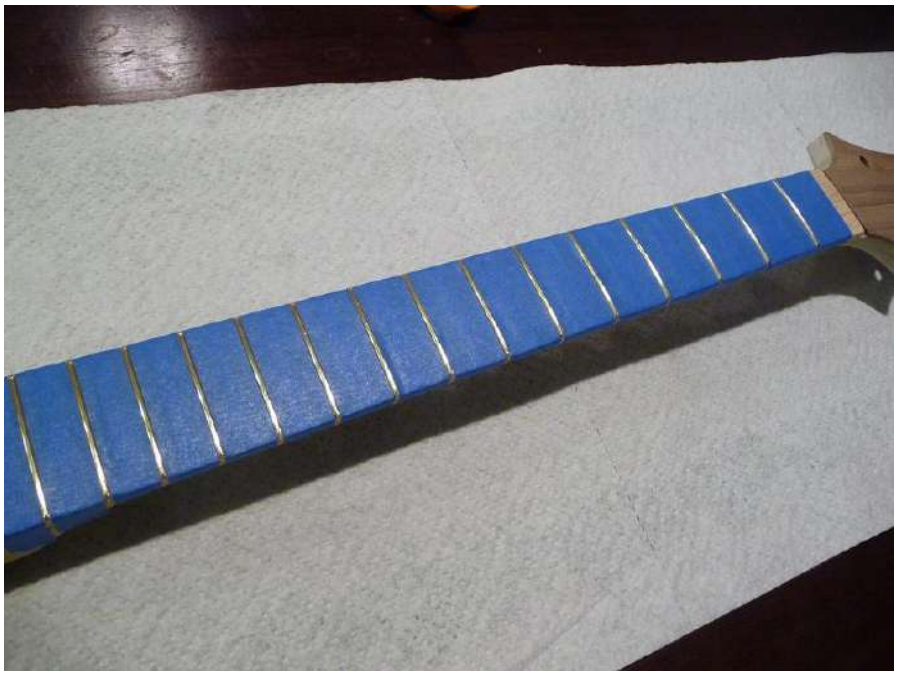
Now you want to file the sharp edges off the ends of the frets. Get your end dressing file and smooth down the edge of each from both sides. You want to roll the cutting surface of this file over the fret such that it follows the edge of the bevel that you filed in. Also, be sure to give the very edge of the fret where it meets with the fret board a couple of passes so that this area will not snag the player's fingertips.



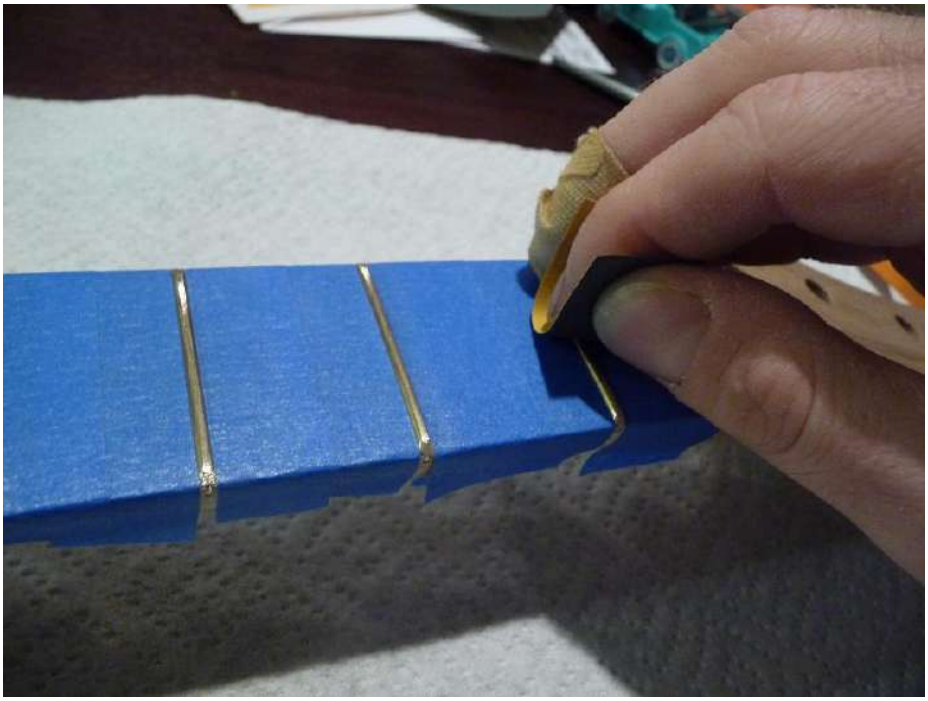
Now run a piece of 400 grit sand paper up and down the edges of the frets on both sides of the neck to smooth them down further. Run your fingers over the edges of the frets. If you feel any sharp edges, give them more time with the end dressing file.

As a final operation you need to polish the frets. This will remove any file marks in the frets and will also make them good and slippery for string bending techniques.

Begin by masking off the entire fret board to protect the wood. This operation will make a lot of metal dust (as well as grit from the sand paper) that will work into the wood and discolor it. The edge of the tape needs to go right up to the fret wire.



Now get a piece of 800 grit sand paper and buff out each fret with it until all of the file marks are gone.



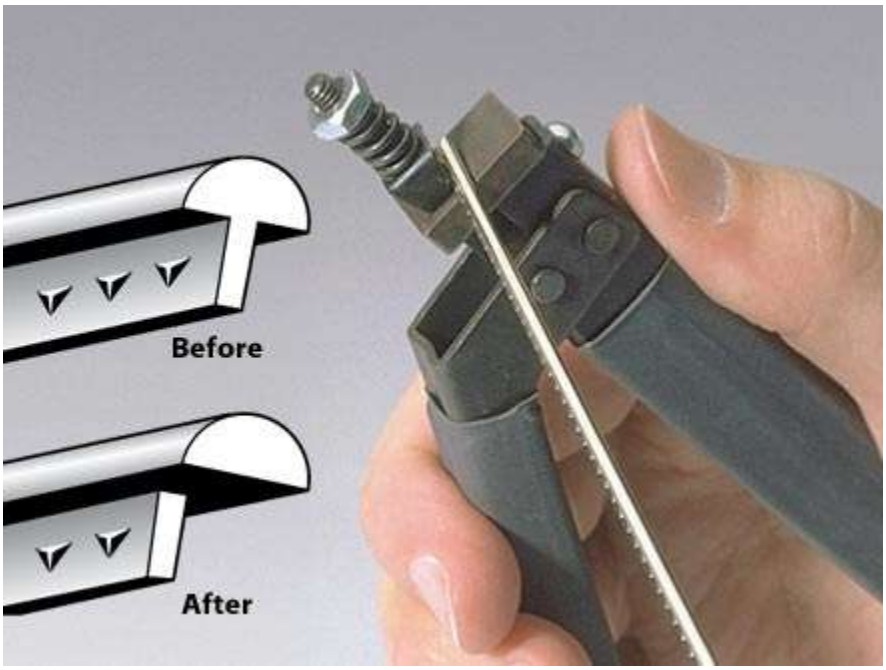
As a sanity check, put the straight edge down on the frets again just to confirm that they are still level. If you have any low spots you will have to start the process over again from the leveling step. Again, do so very lightly and carefully as you don't want to take too much material off.

Finish Sanding

The neck itself can now be finish sanded preparatory to applying finish. Sand the neck starting at 400 grit and advance all the way up to 1000.

Special Tricks for Frets

A fret tang nipper like the one pictured below is an excellent time saver when making a bound fret board but you can also use it to enhance the look and feel of a standard unbound neck.



Cutting the tangs off the ends of your frets before setting them into the neck will leave a tiny hole on the side of the neck that you can backfill later with a mixture of wood dust and epoxy. This isn't a necessary step and might not even be noticed by the guitar's eventual owner, however for someone who is looking (especially with his or her fingertips) the difference is noticeable both visually and to the touch.

The following is a picture of a guitar neck with untrimmed fret ends. You can very obviously see the tang of each fret along the side of the neck.

Compare this against a few necks that had their fret slots filled.

These pictures were taken before finish was applied. After the neck is finished, the overall color of the wood is brought to a more uniform dark color, further obscuring the slots.

The process to fill these gaps is rather simple. First, you will need wood dust matching the color of your fret board. If you saved the scrap that you cut from it earlier when you cut it to length, then you have more than enough to make the required dust with enough left over to make a truss rod cover. Take the scrap of wood over to the drill press with a drum sander bit. Adjust the drill press table such that it is just under the sanding drum and put a sheet of clean paper on the table under the drum (this will catch all the dust). Now just turn the drill press on and sand down your scrap of wood against the drum until you have roughly a tablespoon worth of dust. Be sure to rotate the scrap as you sand it down. Continued sanding in one area will increase the temperature and darken the resulting dust.

Mix up some clear 10 or 15 minute two part epoxy right on the same sheet of paper and work some of the wood dust into the blob until it is the desired color. Dip a toothpick into the result and use it to spread small amounts of the mixture over each hole. Make sure that the mixture is worked into the hole and not just spread across the top. If you get any on the base wood of the neck (the back) get it wiped off quickly.

Keep in mind that you'll probably have to mix up separate a batch for each side of the neck.

When finished, set the neck aside to dry for maybe an hour or so to ensure that the epoxy cures fully. When it has, you can lightly file down the worst of the excess with a flat file and clean off the rest with 400 grit sand paper rather easily.

Obviously you'll need to trim the fret tangs before you set the frets into the neck but the filling step should be performed after the frets have been fully dressed and just before you finish sand the neck.

Finishing the Neck

The French Polish is my favorite finishing technique. The chief benefits and drawbacks of this technique are usually cited thus:

Benefits:

- No specialist equipment or spray gear is required
- You don't need to be in a clean or dust free environment
- The shellac mixture is rather benign (no worry about inhaling spray and having it harden in your lungs)
- It will not bog down the wood and deaden the tone like a heavy duty factory plastic finish
- It brings out the natural beauty of the wood
- Achieving a silky, glass-like finish is possible without a buffing wheel.
- The French Polish has a rich history, dating all the way back to the 1700's
- Damaged spots are easy to repair
- The finish will dry almost as fast as you can rub it on (very little down time)

Drawbacks:

- The shellac will require a few weeks (as many as six depending on temperature and climate) to fully cure
- Though it provides a lovely finish and will protect the wood against liquids, it is still easy to gouge through to the wood (this is the tradeoff for unhindered tone)
- A French Polish could possibly be used on dyed wood (I haven't tried personally) but certainly not painted wood. Nitrocellulose, varnish, or lacquer are still your best choices in this case
- The application of this finish is a long, laborious process.

Canadian Luthier Steve Dickie provides an exceptional series of videos on French Polish technique for free over at YouTube. Although his videos are aimed at classical acoustic guitar making, his instruction is easily applicable to solid body and cigar box guitar making. The following links will direct you to his segments on finishing.

Part 1: http://www.youtube.com/watch?v=a159BCBwZX4&feature=player_embedded

Part 2: http://www.youtube.com/watch?v=svNoEGbDIHo&feature=player_embedded

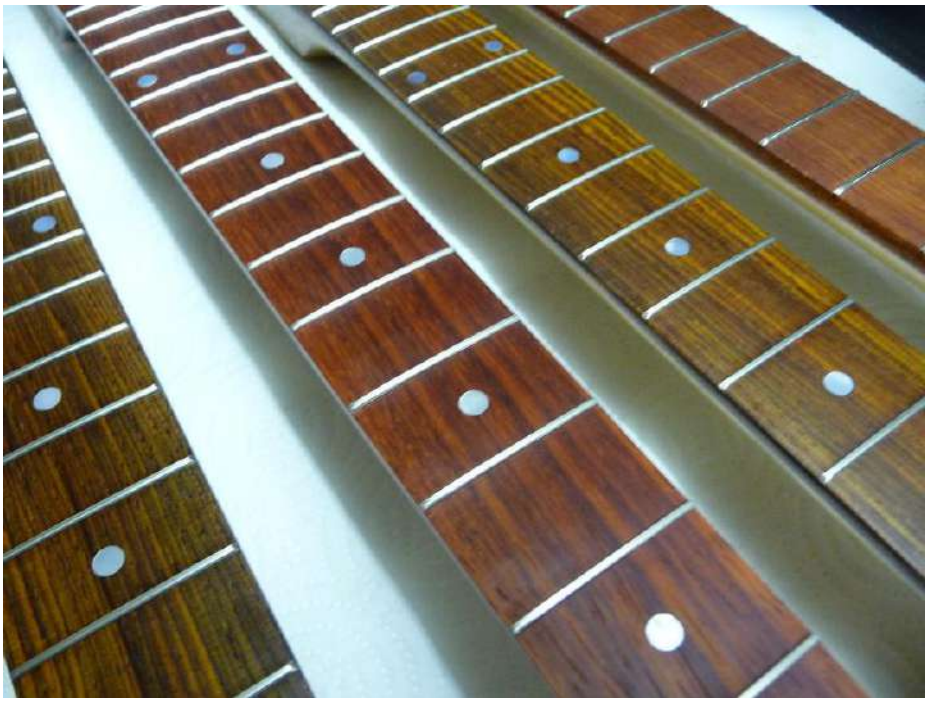
Part 3: http://www.youtube.com/watch?v=jLt3hwLTQqo&feature=player_embedded

Finishing the Fret Board

There will be some shellac build up on the edges of the fret board when you are done that will need to be cleaned up. You can take this opportunity to remove this build up as well as treat the fret board timber.

Rub some olive oil over the face of the fret board for the first 7 or 9 frets (you will do the neck in thirds or fourths). With a thin strip of 2000 grit sand paper, sand in between each fret, right up to the edge of the fret. Make sure that the shellac build up around the edges is completely removed and that the wood between the frets is fully sanded. Wipe off the excess olive oil with a dry paper towel. Perform this process over the entire fret board. Take care that you do not accidentally sand the frets. This will create dust from discarded grit that will mix with the oil and discolor the wood.

You will note as you go that the color of the fret board will darken as the oil absorbs into it. By the time you are done, you'll have a beautiful piece of work ready to set into a guitar body.



Making the Body

Initial Layout

With the neck completed it is now time to precisely lay out where all of the components and hardware will be installed in the guitar body. There should be no real surprises here as you would have checked that everything would work together sufficiently when you were initially designing the guitar. This is now just the formality of finalizing where everything will go and ensuring that it will all work together properly.

Finding the Center Line

The two most critical data points in the design of your guitar are the instrument's center line and its string action. Both of these values are easy to determine on paper but the act of translating them into physical reality is a delicate operation. Being off by even a millimeter or so could mean the difference between a well made, playable instrument and an expensive hunk of firewood.

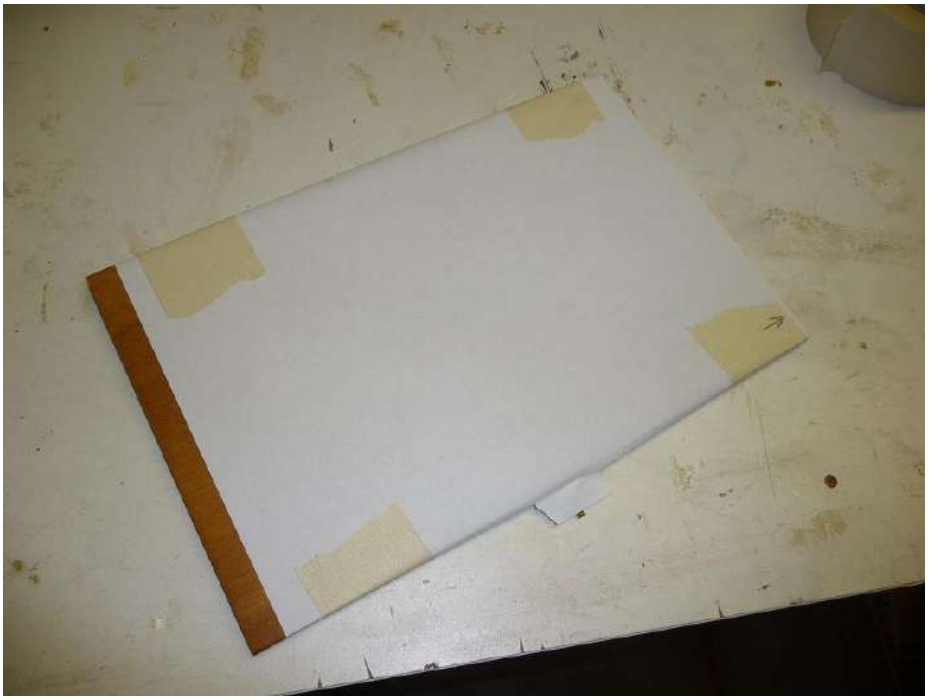
In a traditional solid body guitar where all of your pockets would have to be routed directly into the body, you would need to take the center line and action into account at the same time since your length, width, and depth dimensions are all being cut simultaneously. In the case of a cigar box body, things are made a little more manageable because (due to the nature of the box) you can work in 2D. This basically means that you have the ability to remove the lid from the box and work in the length and width dimensions, thereby completely disregarding the depth dimension. In other words, you can put all your focus into achieving an accurate center line first and then worry about the action (depth) later.

To begin, remove the lid from the box. Various boxes have different means of attaching the lid. Some use simple hinges with tines sunk into the box and lid (such as the box used in this example). Some boxes have a similar hinge that is affixed to the body and lid with small wood screws. Other boxes may have an entirely different method employed. It is up to you to study your box and determine the best way to remove the lid or, in some cases, if the lid can even be removed at all.

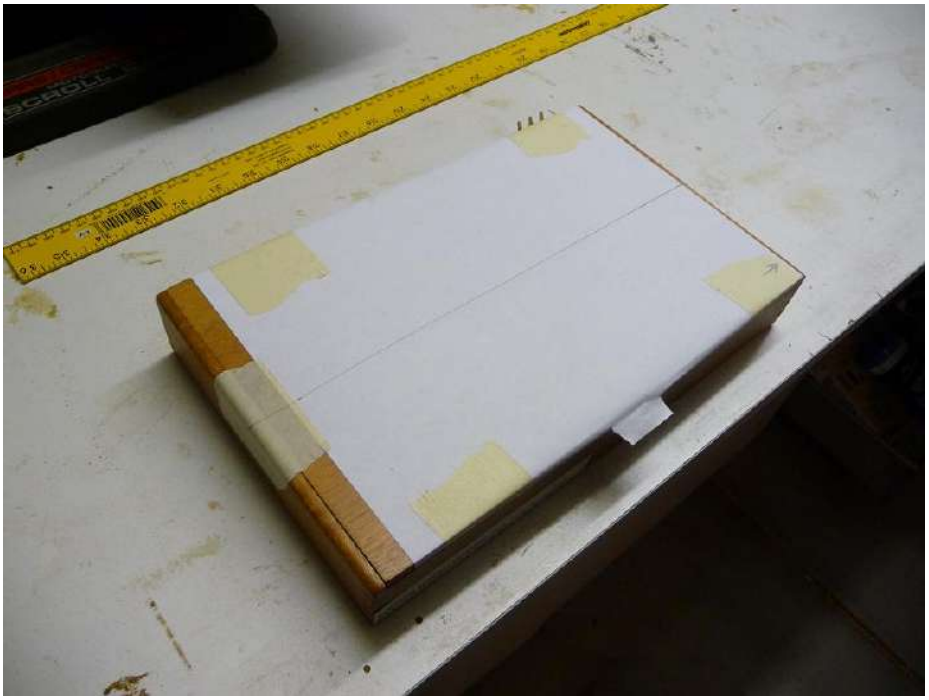
The Cohiba Red Dot style boxes have a very simple hinge that the lid can be removed from by firmly grasping the lid with the base of your thumb and pushing against the base of the box with the tip of your thumb and forefinger, as shown.

If you move slowly enough, you should be able to separate the lid without damaging the hinge, which means that you can reattach the lid to the hinges later to preserve the original look of the box as much as possible. If this is not a concern for you then you can easily just remove the hinges from the box using pliers.

Put the box aside in a safe place. Tape a piece of clean white paper to the top of the lid (you don't want to mark up the wood of the box) and draw in a small arrow to indicate the direction of the neck. It would be a shame to cut a neck pocket on the wrong end of the lid!



Now determine the center line of the lid and draw it in with a straight edge.



Note in the picture that the lid has been placed back on the box. This is going to make it easier to line the neck up with the box later. Also, a piece of tape has been wrapped over the tail of the box so that the center line could be extended all the way to the end of the box without marring the wood with a pencil line (you want to preserve the original finish of the cigar box if at all possible).

You now need to find the center line of the neck so that it can be mated up to the body. You need to do this at the nut (0 fret) and at the last fret at the heel (21, 22, 24, etc). The best tool to determine the total width of the neck (and therefore the center point) is a vernier caliper. Put two pieces of masking tape over the neck at the nut and heel so that the center line can be drawn in.

Mark the center position of the neck at both points with just a small line.

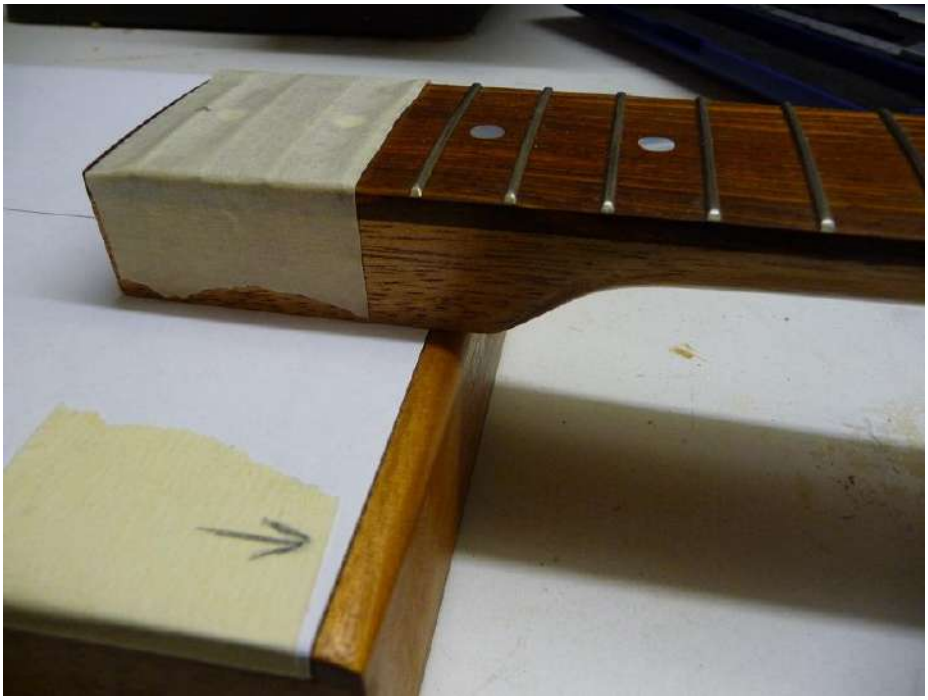
Aligning the Neck to the Body

With the center of the body and neck determined, you can now determine the position of the neck on the body and draw it in. Start by placing the neck on the body at an approximate position. Put some scrap under the headstock such that the heel rests perfectly flat (or as close as you can get to flat) on the surface of the body. You may have to experiment with pieces of varying thickness until you get it right.

Now determine how deep the heel should be sunk into the body. This doesn't need to be overly precise. In other words, there isn't some surefire principle or formula that you're supposed to be following here. The box itself doesn't have a cutaway and you haven't made any cuts for pickup or control cavities nor have you drilled out for the bridge. Really, just make sure that there will be enough room on the box for the bridge plus a little more.

Try to minimize the heel as much as possible (taking the position of the bridge into consideration as mentioned earlier). The last thing a guitarist wants is to have their hand interrupted by a heel as it is being slid down the neck.

Even though you want to minimize the heel protrusion as much as possible, you must not put the neck so deep that the heel begins to round over before it has left the body (creating giant, unsightly gaps). Look at your setup from all possible angles to make sure you will have a tight joint all around.



It is now time to align the center line of the neck with that of the body. Due to all of the preceding careful preparation, this is now easily accomplished with a square and a length of fishing line.

Place the square at the tail of the body such that the edge of the blade lines up precisely with the center line of the body. If your square has a wide base it will stay there on its own. You will have to tape some blocks to it if it is just a thin piece of stamped metal.

Take a length of fishing line and pull it tight across the neck and body. Hold one end of the line exactly over the center mark you drew at the nut of the neck. Hold the other end of the string such that it rests up against the blade of the square and just touches the body (ensure that the fishing line is resting exactly on the body's center line).

Now look at the center mark that you drew in at the heel of the neck. If the fishing line is resting on that mark then your neck is aligned perfectly to the body. If it is slightly to the left or the right, you need to adjust the position of the neck in small increments until everything lines up properly.

When you're satisfied that everything is positioned properly, gently but firmly press down on the heel of the neck to ensure it is flat and trace its outline on the body (or rather the paper covering it).

Aligning Pickups to the Body

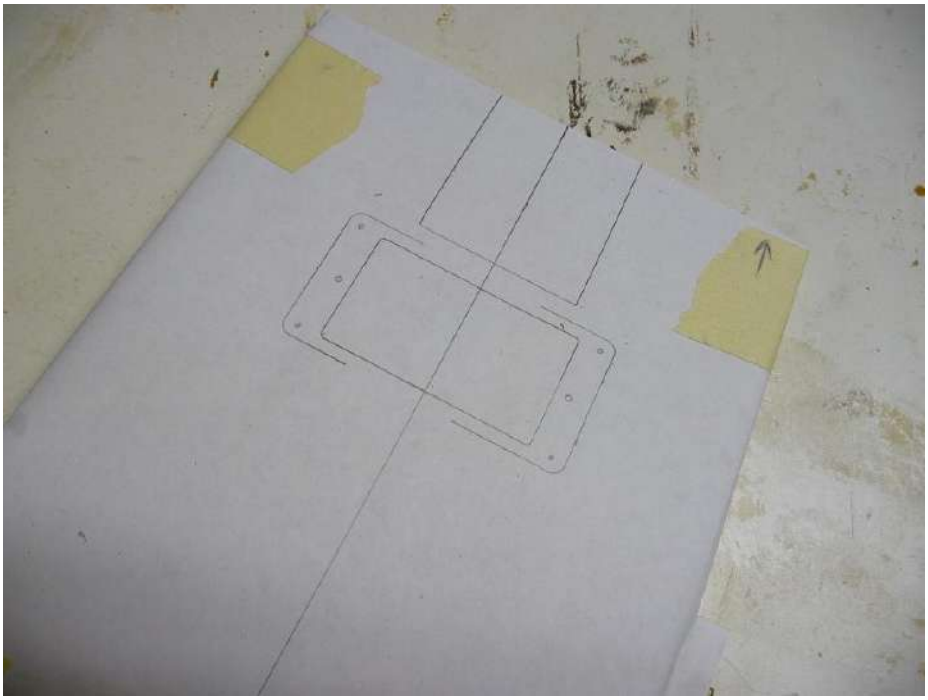
You can now draw in the position of the pickups in relation to the neck. The guitar in this example will have only one pickup at the neck, but this applies to any position that you'd like to install on your guitar.

The easiest thing to do is to use the mounting ring of the pickup as a template to trace out the position on the body. Most of the time when you buy a new pickup it will come already attached to the mounting ring.

Remove the mounting ring from the pickup by loosening the height adjustment screws on either side with a small screwdriver until they release the pickup height adjustment tabs. Take care and go slowly. The height adjustment springs are under tension and can easily fly across the room and be lost if you are not holding on to them when things come apart.

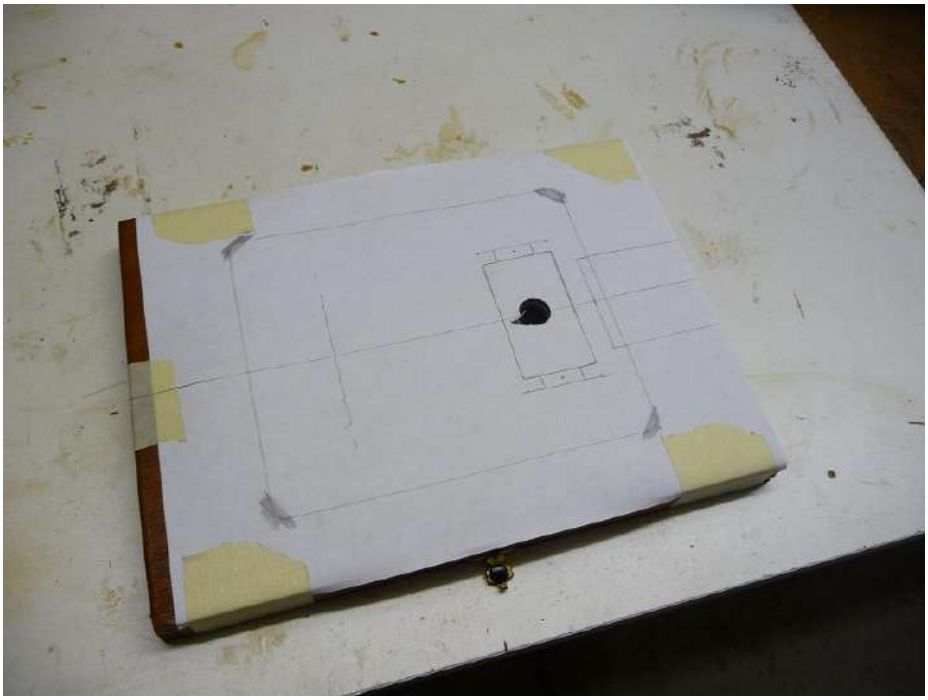
As before with the neck, wrap some masking tape around the top and bottom of the mounting ring and draw in the center line. Line the ring up with the body's center line and position the pickup appropriate to its designated position (based on the scale length and the neck, middle, or bridge position).

Draw in the hole as well as the position of each screw.

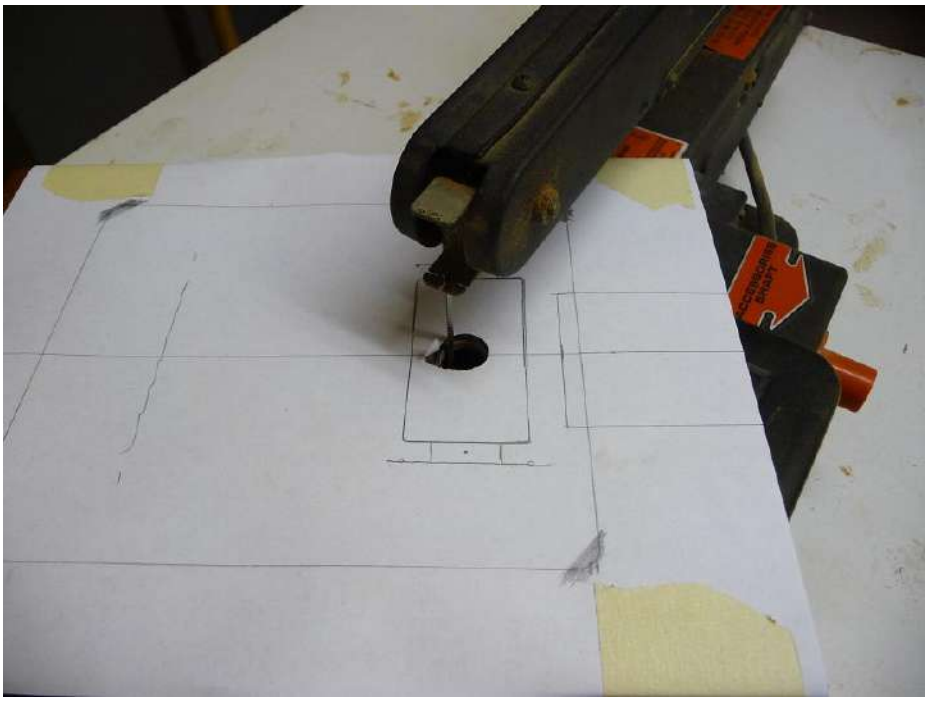


Cutting Pockets in the Lid

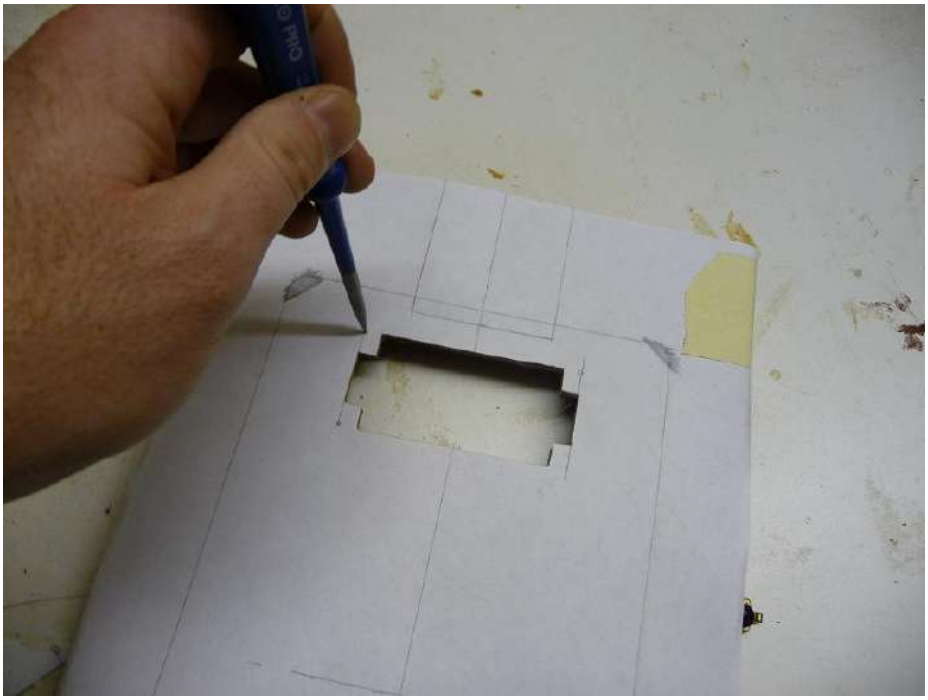
To cut the hole for the pickup, first drill a good sized hole in the center of it using a forstner bit.



You can thread the blade of your jig saw through this hole.



With the hole cut out, lightly punch the position of the mounting ring screw holes and drill them out on a drill press using a 1/16th" bit.



Finally, carefully cut out the hole for the neck pocket on the jig saw. Cut slightly undersize such that the neck doesn't fit into the pocket (but only barely), as shown.

Tuning the Neck Pocket

The neck should fit tightly in the pocket. In traditional guitar making, you would create a routing template for the neck and ensure that it fit tightly in the template. Then, trusting that your template was correct, you would route that pocket directly into your body blank

with a pattern bit. For our purposes, the lid of the cigar box *is the template*. You will use it as a template to guide your router in later steps.

Mount the lid to a work surface and slowly tune the edges of the neck pocket with a file until the heel of the neck just fits in place.

Hold the heel of your neck up to the hole often to determine where material needs to be removed. When you are done, the pocket should be snug enough to hold the weight of the neck even though you are only dealing with a box lid.

Making the Body Insert

The guitar shown here is destined to be a true solid body guitar. This means that the cigar box used for the body will essentially be wrapped around a solid block of wood.

This guitar uses a magnetic pickup and therefore does not rely on the vibration of a soundboard for volume. To maximize sustain and tone, the body to neck interface must be as rigid as possible. Sinking the neck into a solid block of wood is the best way to achieve this short of making a true through-neck guitar. This is actually the simplest way to go as it doesn't require you to engineer a complex system of reinforcing braces.

The material I like to use for making a body insert is poplar. It is extremely cheap stuff and is readily available (you can find it at any local home improvement store). Most importantly, poplar is recognized as an unnaturally resonant tone wood. Many Luthiers today use it as the core wood for their guitar body and either paint it or cap it with decorative top plates (the appearance of poplar is rather unremarkable and is often shot through with unappealing patches of green). Really, for our purposes as cigar box guitar makers, poplar is a dream come true. It is cheap, easily found, and yields fantastic tone.

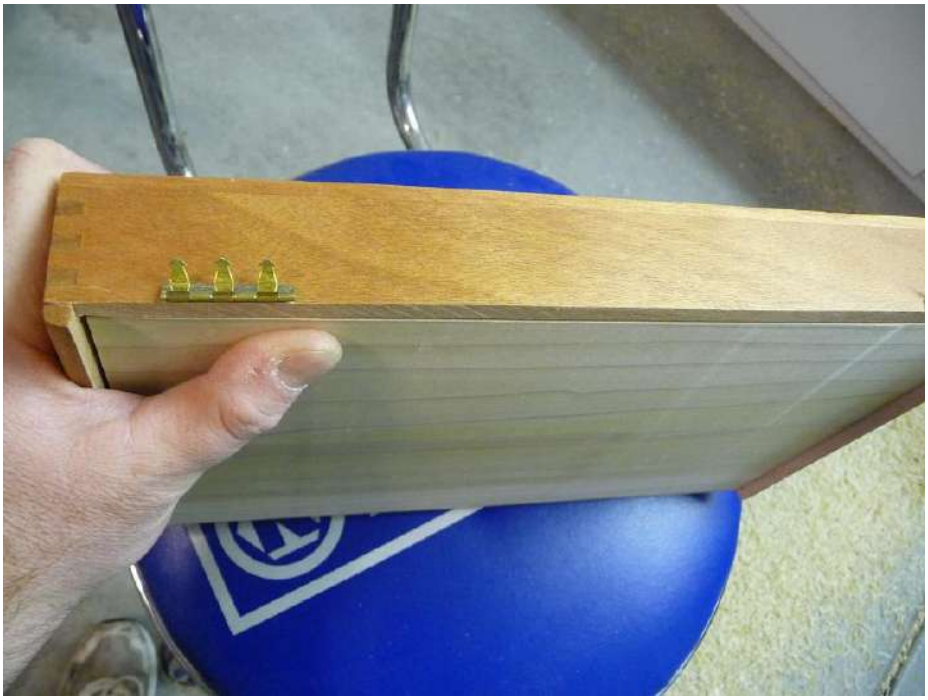
When I get wood to make a body insert, I purchase a ¾" plank from 4 to 6 foot long (which, off the top of my head, I think amounts to something like $12). I then cut squares off of it to the appropriate size with a hand saw and then glue them together overnight with yellow glue. I use as many layers as necessary to fully fill the depth of the box.

After drying over night, I trim down the sides of the insert on the bandsaw and clean the edges up on my bench sander until the insert fits comfortably in the box.

The insert is then run through the bench plane until it is the correct thickness to perfectly fill the box.

It is very important to get this thickness correct. If the insert is too thick, there will be a gap between the lid and the top of the box, ruining the appearance. If the insert is too thin, there will be a gap between it and the lid. At best this will create a decrease in sustain as the lid won't be as solid as it could have been and at worst the instrument could buzz if the gap is small enough that the lid rattles against the insert when the strings are plucked. There are also the dangers of the lid ripping off the box with the

strings under tension or the lid itself being cracked and split when clamped into place or when the bridge is finally screwed on. Just take your time and make sure you get this part right.



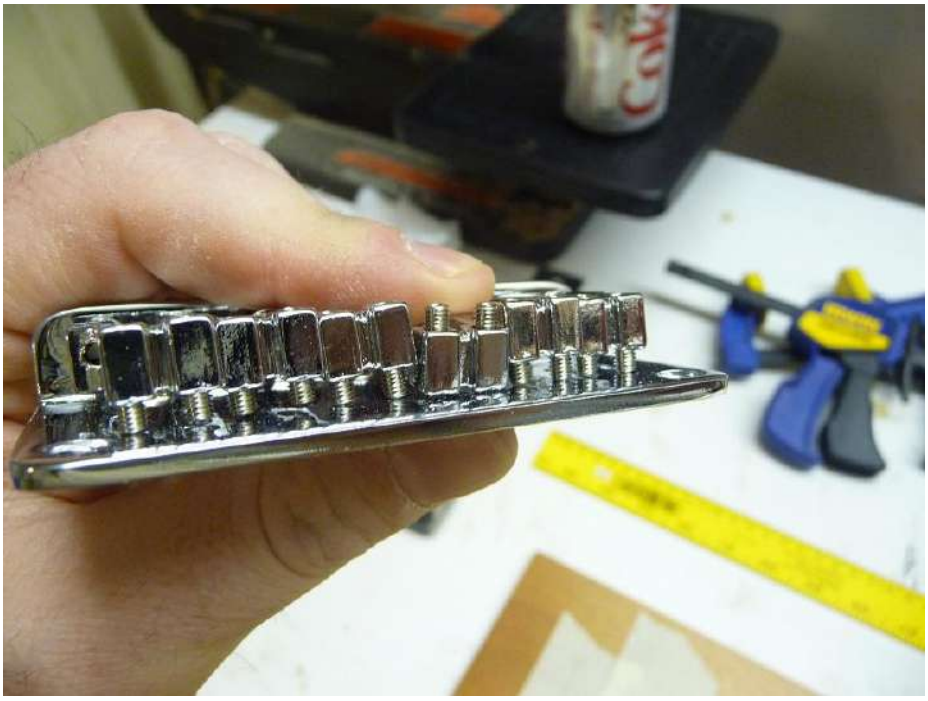
Run your thumb over the transition from box side to insert. Your thumb will tell you far better than your eyes if the surface is flat. Set the insert aside for now.

Determining Neck Pocket Depth

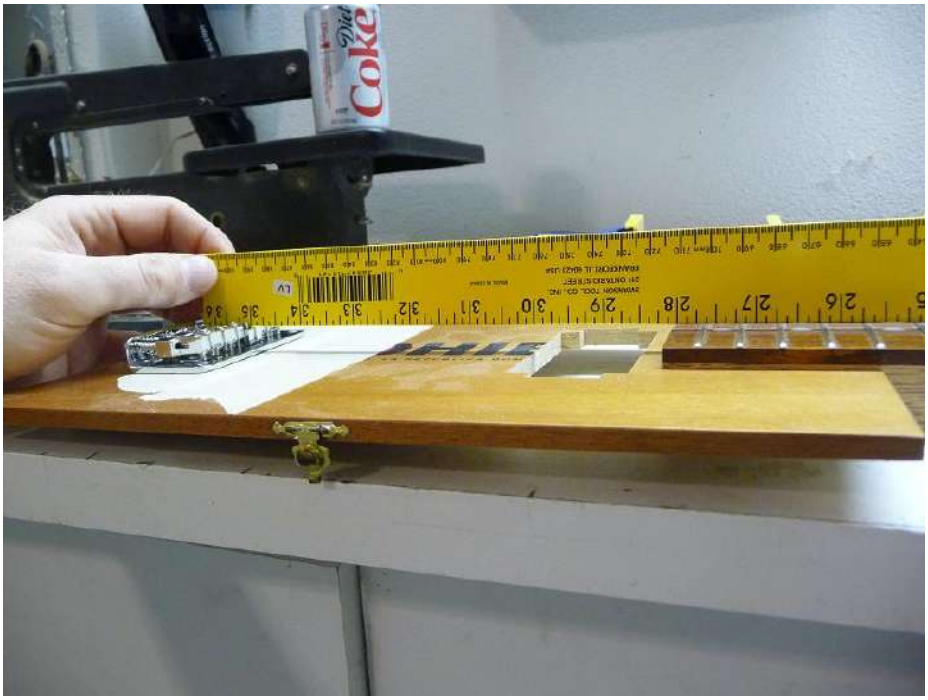
There is a formula you can employ to determine the necessary depth of the neck pocket. Essentially this is the height of the heel plus the height of the fret wire less the height of the bridge saddles at their lowest position off the guitar top. As I mentioned before, it is necessary to understand and use this formula if you are dealing with a solid slab of wood but since you have a lid in this case (which will double nicely as a router template), you can really consider this all a lot of unnecessary math if you prefer.

Start by putting the neck in the box lid at what looks like a good starting depth using your calibrated eyeballs. From there you can lay a meter stick over the neck starting at the nut and mark out the bridge position. Be sure to lay some masking tape over the lid (or tape a piece of paper over the lid if you have a paper label that you're trying to preserve).

Now adjust one of the center saddles on the bridge such that it is at the lowest playable position.



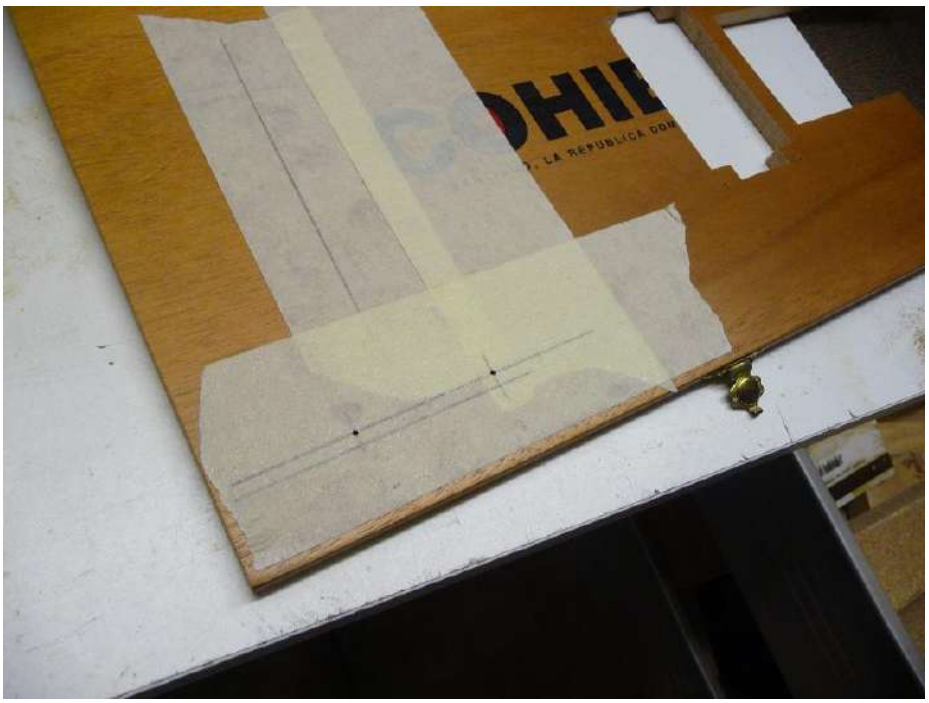
Place the bridge on the lid (ensuring that the lid is parallel to the fret board) and run a straight edge from the saddle out to the nut.



If you have the depth of the neck correctly set, the straight edge should just barely brush the frets. This establishes the perfect action; you know that you'll be able to adjust the saddles so low that the guitar becomes unplayable and that adjusting them to their maximum height will also make it unplayable (unless you wish to do some lap steel playing). This neck depth will afford you the fullest possible range of adjustment in string action. Determine the distance from the top of the lid to the bottom of the neck heel. This is your neck pocket depth. Mark it off on the side of the box where the lid meets it, rough cut it with a coping saw, and finally clean the cut up with a file.

Creating the Control Cavity

You are almost ready to glue in the body insert but you must cut out the control cavity first. I like to lay my control knobs right on the box to figure out where the most comfortable position for them would be (ensuring that there will be enough room for the underlying pots) and mark that position on the lid.



Punch the center points with an awl and drill out the holes with an appropriate size bit.

Using these holes, you can determine the best location for the control cavity cover on the back of the box. There isn't really a set shape that you should be using for the hole. I tend to trace mine out using a credit card as a template and I round the corners such that I have a handy place to put the screws of my cover.

As with the pickup, cut a hole using a forstner bit so you can cut the cavity out on a jig saw.

Gluing the Body Insert

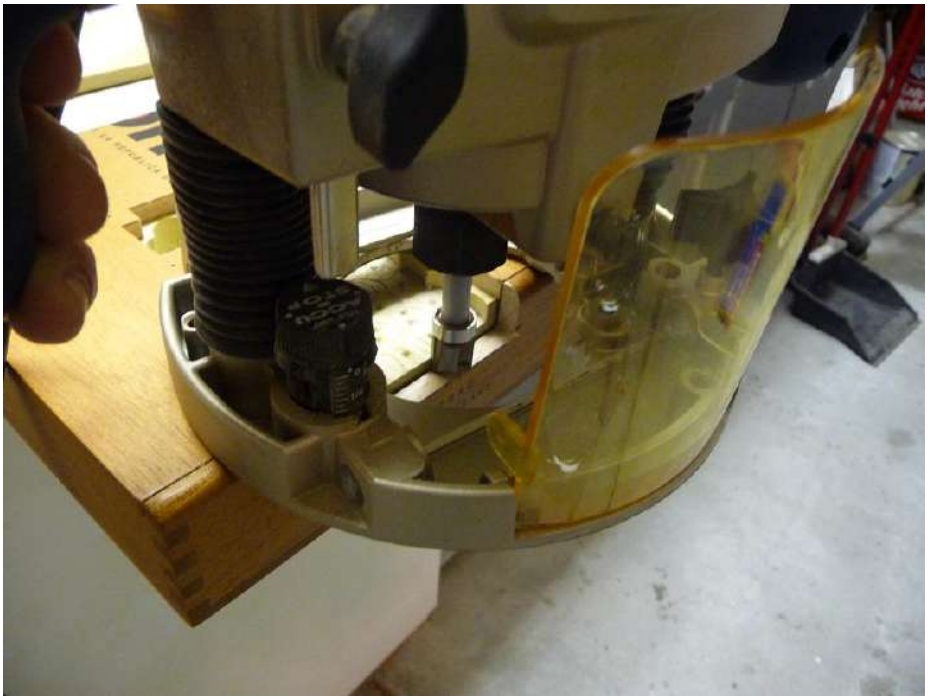
After the control cavity is cut, you can glue in the body insert. Completely coat one side using yellow glue and drop it into the box (be sure to wipe up excess from the exposed control cavity so that you're not dripping all over your bench). With the insert dropped into the box, put a layer of glue over the top of it and press the lid into place. Apply an abundance of clamps and allow it to dry over night.

Routing out the Body Pockets

There are two standard size pattern cutting router bits that you can purchase from Stewart MacDonald (where I got mine). One is ½" diameter and the other is 3/16". The ½" diameter bit is designed for all of the heavy work and can take much more abuse. The 3/16" bit is there to help you cut tighter corners in your cavities. Given the price of these bits (they are very high quality), you should only use them for the tasks for which they were designed.

To prolong the life of your router bits, you should always start by removing bulk waste with a forstner bit. When so doing, make sure that you set the depth stop of your drill press to account for the pilot point of the forstner bit. It protrudes quite a bit farther than the flat cutter and will leave your work piece full of small pips if you drill to final depth (an example of these pips is shown below).

Set your router up with the ½" bit and adjust its depth such that the template bearing will trace the neck pocket that you cut into the box lid.



Route the neck, pickup, and control cavity pockets using this bit to final depth. When finished, take another pass at the neck pocket with the 3/16" router bit to tighten up the corners. The pickup and control cavity pockets do not require this extra fine adjustment.

Even with the 3/16" bit, the corners of the neck pocket will still have a slight round, which will prevent the neck from seating properly. Finish off these corners with a chisel.

Take your time. Do not panic if you cut slightly over size. Remember that the lid of the box is cut to match the neck heel perfectly and will therefore hide any minor mistakes that you might make in squaring up the corners.

When finished, you should have a nice, square pocket.

Insert your neck into the pocket (dry fit) to test the fit.

As a sanity check, you can also place the bridge back on the body and double check your action. If you need to adjust the depth of your neck pocket, this is certainly the time to do it.

Inspect the fit of the neck from all angles to ensure that the heel of the neck mates well with the bottom of the pocket.

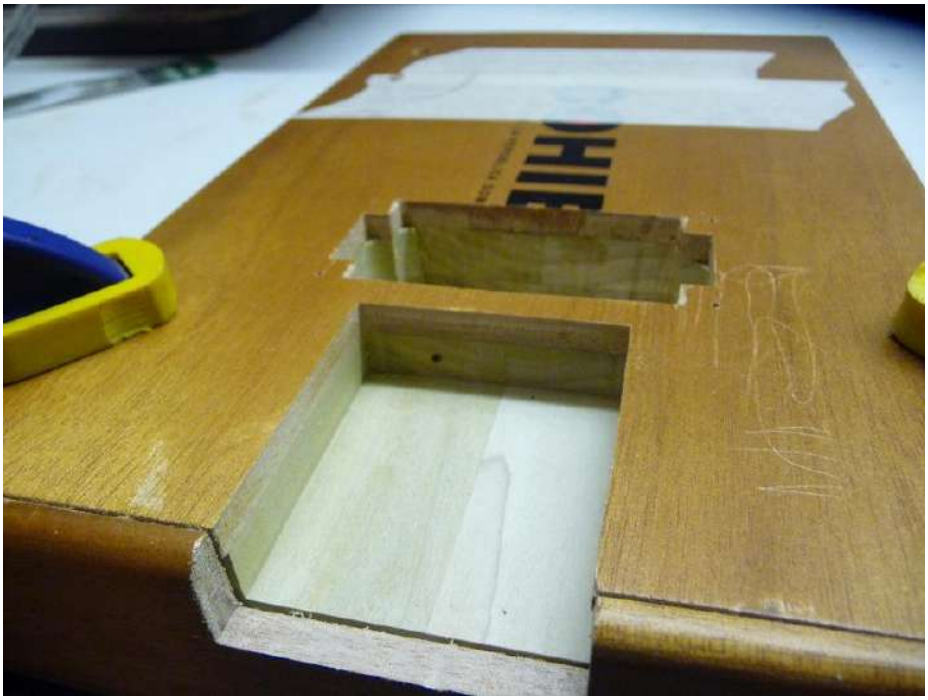
When you are satisfied that the neck fits well, remove it from the box and set it aside. It is now time to drill channels for all the wiring.

Drilling out the Body for Wiring

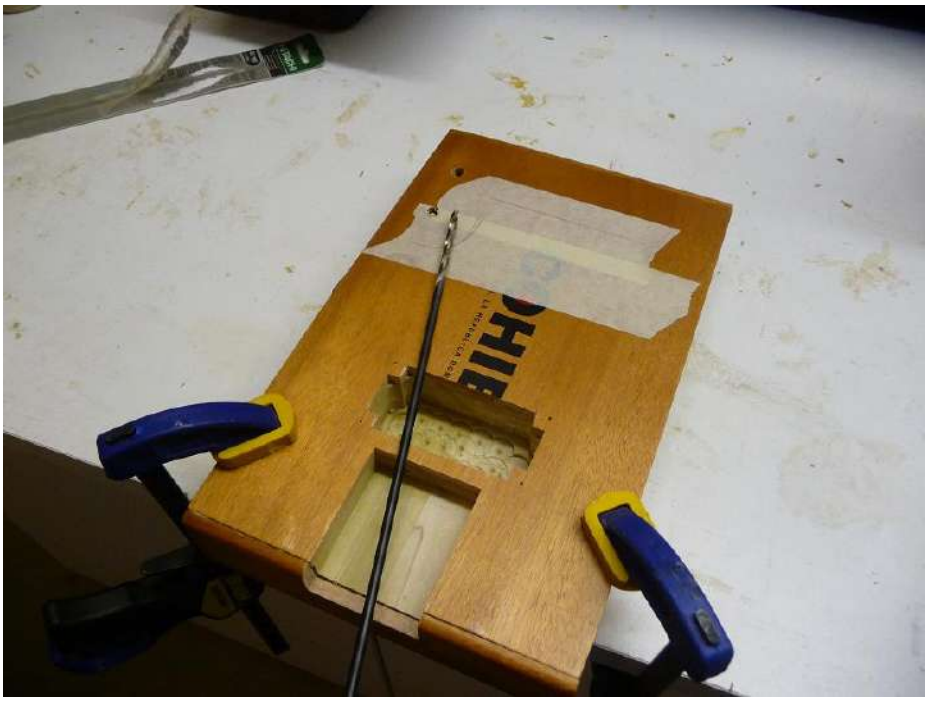
Pickup Channel

Start by drilling the channel from the pickup to the control cavity. This is most easily accomplished by drilling straight through the back of the neck pocket, which will help you keep the bit parallel to the body.

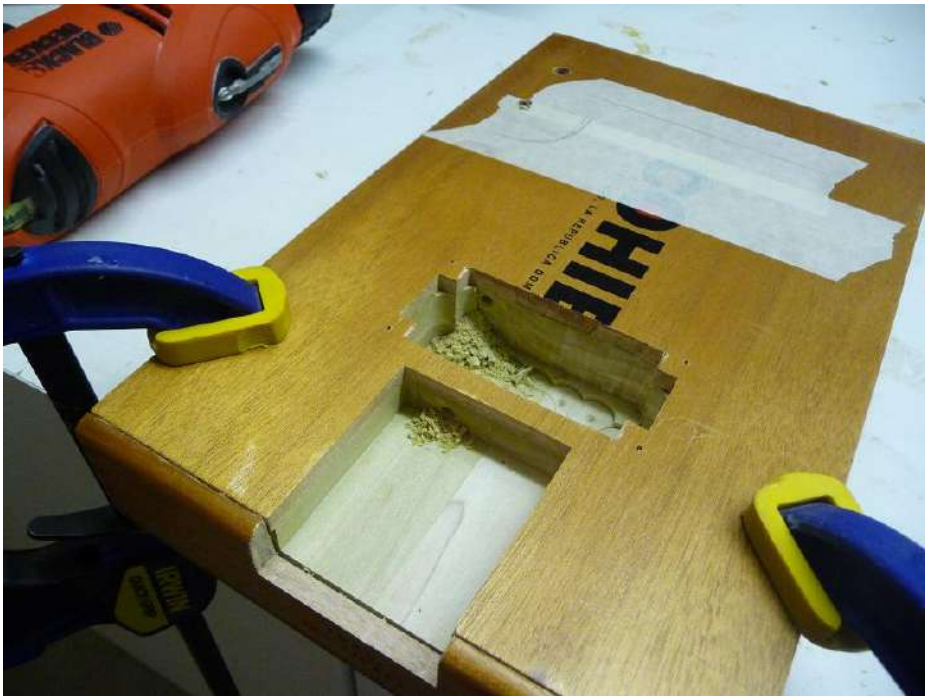
Punch an entry point with an awl to prevent the drill bit from travelling.



Load up an extended 3/16” drill bit in a hand drill motor and drill from the neck pocket all the way through the pickup cavity to the back control cavity. If you line it up such that you’re aiming right at the foremost pot hole you should be in good shape.



Back the bit off several times while drilling to extract excess material from the hole and to help cool the bit.

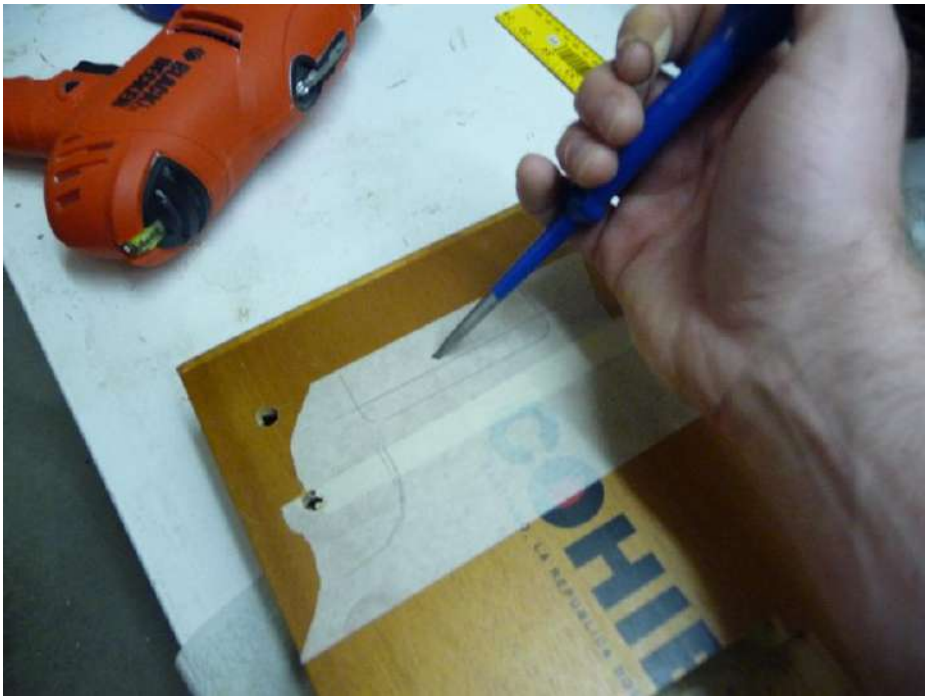


If your aim is good, you should be able to see where the bit broke through into the control cavity.

Bridge Ground Channel

The bridge ground runs from the base plate of the bridge to the back of the star ground point (typically the volume pot back shell). It is possible to wire up a guitar without a bridge ground, however you may note a slight hum when playing due to the strings not being grounded.

Place the bridge on the guitar body at its correct position according to the scale length and center line and outline it using a pencil. Punch an entry point for the drill bit using an awl at an angle directed towards the control cavity.

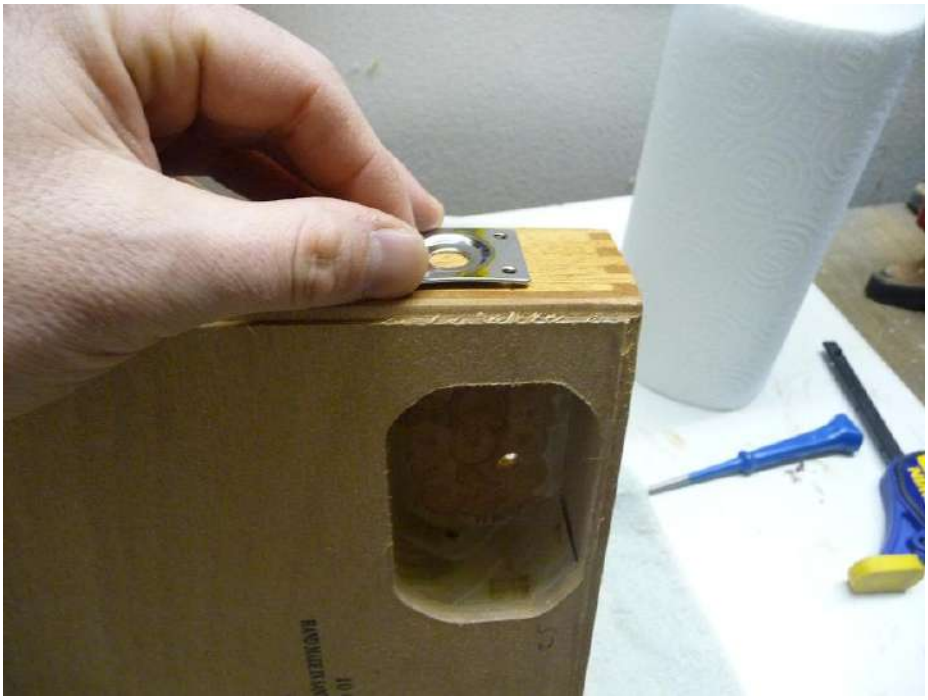


Drill this channel using the long 3/16" bit. You may have to apply counter pressure to the shaft of the bit using your hand to keep the tip from travelling across the lid. Just make sure that you place your hand on the smooth portion of the shaft rather than the sharp, threaded part.

Make sure that the channel emerges properly into the cavity.

Jack Input

Use the jack plate to trace in the position of the screw holes on the bottom of the body. Position the jack such that it is offset from the path of the tone and volume pots (you don't want the jack to interfere with them when everything is installed).



Punch the center of each hole with an awl.

Drill out the center hole with a 13/16” spade bit, all the way into the cavity. Drill the four corner holes with a 1/16” bit.

If your guitar includes strap buttons, this is the best time to drill their pilot holes.

Final Assembly

It is important at this time to take a bit of a breath and relax. It is very easy to become excited and try to rush things as soon as the neck is attached. Believe it or not, the final assembly of the guitar is probably the point where some of the most ruinous and frustrating mistakes are made. Considering all the care you have taken thus far, you owe it to yourself to be just as careful in the final stages. Slow and steady wins the race, as the saying goes.

Attaching the Neck

To glue in the neck, you first need to sand off the finish from the heel.

Firmly seat the neck back in its pocket. It should easily stay in position on its own assuming you cut the pocket tight enough. If it is a little loose just clamp it in place.

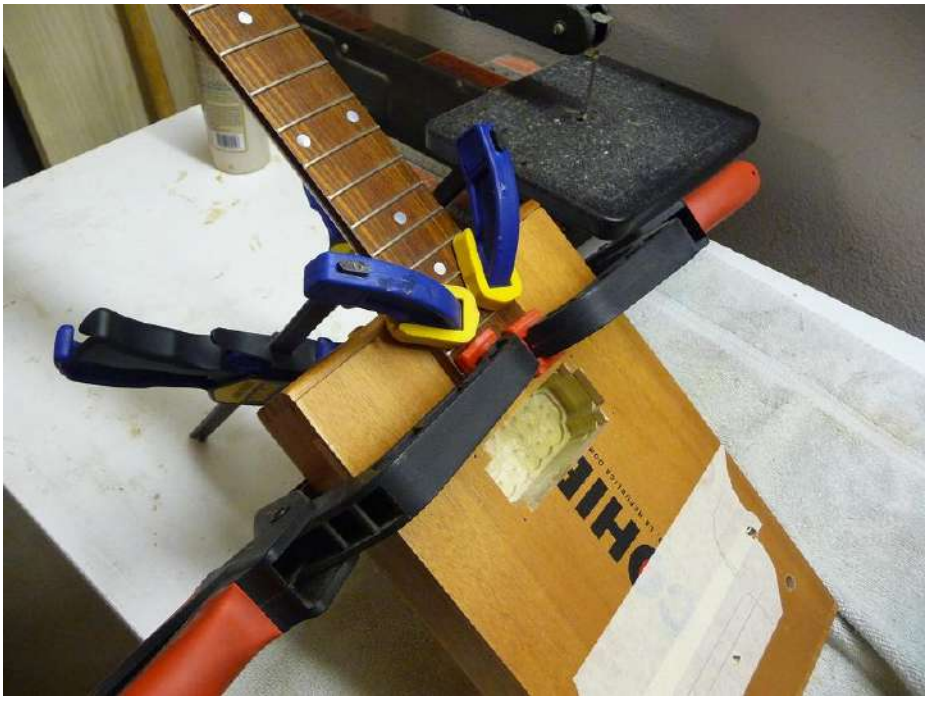
Put a piece of masking tape on the heel at the exact point where it meets the body. This will serve as a guide when sanding.

Wrap a piece of 60 grit sand paper around a flat piece of scrap wood and carefully sand off the finish, taking great care not to round over the edges and not to sand past the masking tape. When finished, wipe off the exposed wood with a paper towel dipped in denatured alcohol to remove excess saw dust.

Feel free to remove the masking tape at this point.

Lay the body out on a work surface and spread some yellow glue in the neck pocket.

Press the neck into the cavity and clamp it firmly in place. Be sure to get four clamps at each corner of the heel to ensure the neck is squarely set.



Be sure to wipe away any squeeze out. A damp cloth or paper towel works fine for this.

Set the guitar aside to dry for 24 hours.

Making the Nut

It is wise to make and install the nut at this point due to its utility in finalizing the position of the bridge (the reasons for this will soon become clear as you read on).

The type of headstock you have used will dictate the size of the nut blank that you start with. My guitars use traditional angled headstocks (scarf joints) so I order nut blanks custom sized from buffalo bone to match a standard Gibson guitar.

Initial Rough Thickness

The thickness of this blank is ¼". To ensure a snug fit, I layout the headstock veneer and finger board on my necks such that the nut trench will be 3/16" wide. This requires that I remove roughly 1/16" worth of thickness from the nut.

It is possible to remove all of this excess material by hand using a file or sand paper but doing so would take a miserably long time and it would be difficult to maintain a uniform thickness across the length of the nut (no matter how hard you try you simply cannot produce perfectly even pressure with your fingers).

A fast and accurate alternative is to attach the nut blank to a square piece of scrap wood using double sided tape and take the sides down on a disc sander.

The piece of scrap and the table on the sander will both ensure that the nut is held square to the disc. Make sure that you use a long piece of scrap so that your hands are well away from the disc. The larger piece of scrap also makes it easier to make small, controlled adjustments to the position of the nut blank during sanding.

Take roughly 1/32" off one side, then remove the blank and flip it over and take 1/32" off the other side. This will get both sides of the nut good and square.

Do not sand the nut down on the disc sander enough so that it actually fits in the trench. If you do, the nut will be well undersized after you sand it to a polish through advancing grades of sandpaper. By the time you take it off the disc sander, you want it just on the edge of being able to fit without actually doing so. From there, rub the nut on some 60 grit sandpaper (always in the same direction along its length to remove the circular

marks from the disc sander) until you can just wedge one end between the fret board and the headstock top plate (but still not be able to fully seat the nut in the trench).

From there, give the nut only enough passes over some 120 grit sandpaper such that the 60 grit scratch marks are removed from both sides. Follow this up with 220 grit and continue until you can seat the nut all the way down into the trench (check often as you still want the nut to fit very tightly).

Sight the bottom of the nut where it mates with the trench bottom. If you see any gaps, remove the nut and square up the bottom with 220 grit sandpaper until it sits perfectly flat in the trench with no gaps along the bottom.

When you are satisfied, trace the outline of the fret board on the leading edge of the nut.

Remove the nut. Use your radius sanding block (which you used to sand in the fret board radius) as a template to draw another arc over the line you just traced. This line delineates the top of the nut after it is shaped and installed. Make sure that this arc is offset from the original line by a minimum of two fret heights. In fact, add a little extra just to be sure. If you go too low here the strings will end up buzzing off the 1st fret.

Trimming to Size

There are several ways to take the top down to this curved line. It can be filed by hand (again, another long and painful process), or sanded, or trimmed on a jig saw. I have seen at least one luthier trim this down on a bandsaw. My personal opinion on this matter is if you're reckless enough to attempt cutting such a small work piece on something as dangerous as a bandsaw, you deserve the missing fingers you're about to not have.

My favorite method to take this material away is to hold the nut firmly with a set of pliers (it will get very hot) and roll it down slowly and gently over a belt sander. This picture shows only one set of pliers here but I actually hold the nut with two sets (one at each end) using both hands for the greatest possible control.

If you go lightly, you will find it easy to get right down to the line accurately with no mistakes.

Trim the sides of the nut down on a jig saw.

Place the nut into the trench on the neck to see how far the sides stick out after trimming and sand them down flush to the fret board accordingly (removing the nut from the neck to sand it, of course). When the size is correct, polish the nut using advancing grits of sandpaper, through 400, 800, and 1000.

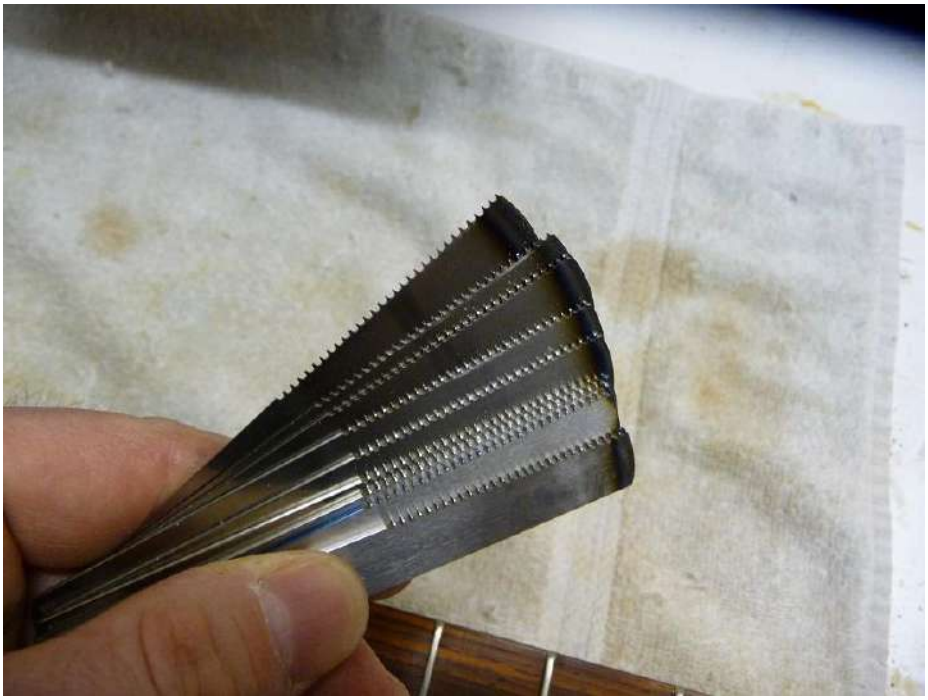
Gluing

To secure the nut in place, run a thin bead of gel super glue down the bottom of the nut trench on either side of the truss rod and another bead down the leading edge of the fret board where the nut will rest against it. Press the nut into place so that it is lined up correctly and apply moderate clamping pressure with your fingers for about a minute, both downward into the trench and forward towards the fret board.

You will find that many luthiers recommend using white glue for this. I recommend breaking with convention and using super glue for the following reasons. First, gel super glue sets hard and fast, making a rock solid joint (which is certainly good for sustain). The second (and probably more important reason for me) is that super glue forms a brittle bond. While this bond is clearly not so brittle that the nut can be knocked loose accidentally with ease, you can replace the nut at a later time for any reason (the nut has become cracked or damaged or the string slots have worn down enough to produce buzz) by administering a sharp tap from a hammer and chisel or other sufficiently hard probe (a nail set would do in a pinch). The super glue bond should fracture cleanly with no damage to the surrounding wood. Two taps are generally enough; one against the leading edge and going away from the fret board and another coming in from either side in a slight upward direction. It is okay if the nut is cracked and comes out in fragments; any excess can be cleaned away with a fine file.

Cutting Starter Slots for the Strings

There are a number of ways to cut string slots in the nut but for the best results you need to use gauged slot cutters or files that leave a rounded trough to cradle the strings, similar to the following.

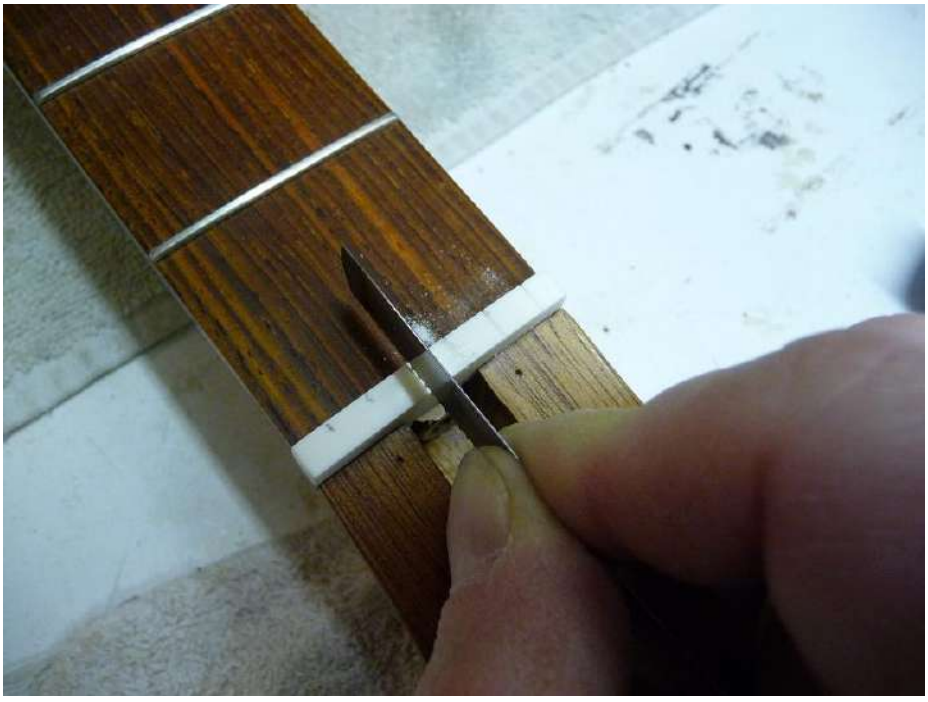


There are, of course, other ways to accomplish this (some of them rather low budget such as using torch tip cleaners or just filing in a “v” shaped notch using a needle file). For the best precision, action, and performance you really need to invest a little money here and get the right tool for the job. Take your time and research the different available options as this is a rather specialist tool and prices will vary widely between suppliers (from the reasonable to the astronomical).

To determine string spacing, there is actually an elaborate formula that takes the gauge of each guitar string into account for laying out a precision nut. I won’t detail it here as it is readily found on the internet with a simple search. I can show you an exceedingly simple solution, however…

While I would not profane a custom hand made guitar neck with a preformed plastic nut, I am not above copying one's string spacing assuming it matches the width of my nut.

Using the smallest gauge cutter you have (mine is .012), lightly cut in a starter slot for each string.



Do not cut too deeply. Each slot will be cut to its final size when the guitar is actually strung up.

Bridge Installation

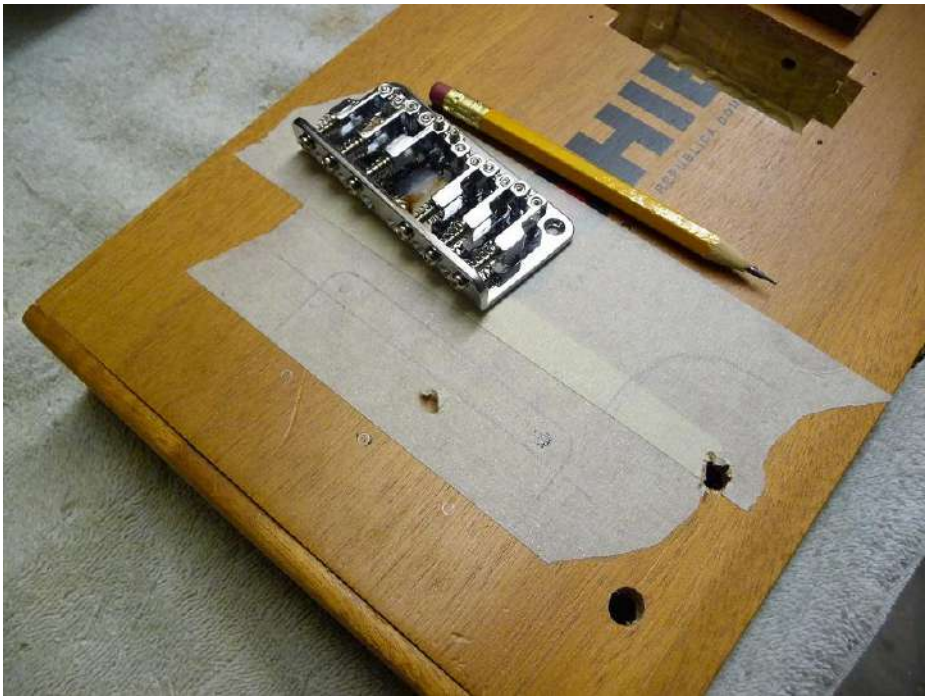
The bridge installation was left until after the nut was installed intentionally. Being able to line the bridge up with the nut using test strings (in this case fishing line) is the best way I know of to eliminate all possible chance of error during bridge placement.

Finalizing Position

The end of the scale should already be marked out on the guitar body. To determine the best position for the bridge, cut two roughly 3 foot lengths of fishing line from a spool and tie each one to the low E and high E tuner holes in the headstock. Thread these lines through the low E and high E string slots in the nut and pull them back over the guitar body. Center them over the associated saddles of the bridge and gauge their overall position over the guitar neck.

If the strings run parallel to the edges of the neck, you're in fine shape and can happily mark the position of the bridge.

To mark out the position of the bridge, just pencil in where the mounting screws go.



Drill them out on the drill press and the bridge is ready for installation.

Grounding and Mounting the Bridge

Though not required, it is a good practice to ground the bridge (and therefore the strings) as part of the guitar's electrical circuit. This doesn't require fancy work with the soldering iron; a mechanical joint will suffice.

Cut a length of 22 gauge wire, strip the end, twist it and fold it over into a ball. Place the wire into the ground channel that you drilled when making the body, such that the other insulated end terminates in the control cavity.

Place the bridge down firmly over the ground wire and screw it into place. The wire will be firmly pinned in position for later connection to the circuit's ground cluster.

Pickup Installation

Start by twisting the exposed wire bundle at the end of the pickup wire.

This will make it much easier to thread the wire through the pickup channel.

Gently press the complete pickup assembly (including mounting ring) into place in its pocket, taking care not to force it in. If the pickup wont sit flush against the guitar top, determine where it is getting hung up and pair that area down carefully with a chisel. Be sure to remove the pickup and wire completely before going in with a chisel to avoid cutting the wire accidentally.

With the pickup firmly seated, screw the mounting ring into place.

As a final step go ahead and install the pots into the body, if for no better reason than that you will have them easily to hand when you wire up the guitar.

Making a Custom Truss Rod Cover

There are numerous sources for all sorts of different truss rods available. Materials range from plastic to MOP and everything in between. One method that I have found to be quite striking (and economical) is to make a custom truss rod cover using left over scrap that was cut from the fret board.

This will create an incredibly attractive appearance as the wood is guaranteed to match the fret board and it will create a visual flow from the neck into the headstock.

The scrap material will be much too thick to make a truss rod cover with when you start (roughly ¼" thick). I plane that material down to 1/8" on my bench plane (any thinner risks pulverizing the excessively thin material). This is easy and safe to do if you tape the pieces of scrap to a larger board using double sided tape, which will give you a nice, large piece of stock to hold on to as you send it through the potentially dangerous machine.

Keep in mind that some woods are not suitable to being thinned out in this manner. Any specie of Ebony is a prime example (due to its propensity to chip and tear) and should be taken down to thickness through sanding alone.

With the piece taken down to thickness, I trace in a pattern and lightly punch the screw holes with an awl. You must be very delicate here. Too much pressure and you will split the wood along the grain and ruin your work piece.

Take the piece to a drill press and drill out the holes with an appropriately sized counter sinking bit.

Cut the cover out using a jig saw.

This sequence of drilling first and then cutting is important. If you cut it out first and then try to drill it, you again run this risk of splitting the piece along the grain.

Lay the cut piece out on the headstock to determine what the final thickness should be.

You can then take it down to its final thickness by hand with some 60 grit sandpaper or use the disc sander in a manner similar to the one I suggested for thicknessing the guitar nut.

When the correct thickness is achieved, the final affect is completed by sanding through advancing grits of paper (100's, 220, 400, 800, 1000, 2000). At 220, bevel the leading

edge of the cover such that it sits flush against the nut. At 400 grit, be sure to sand a light chamfer on the outside edges of the cover.

Wipe off the piece with some denatured alcohol to remove the saw dust and then condition it with Dr. Duck's.

To install, lay it on the headstock such that it is centrally positioned and completely covering the truss rod access hole. Lightly punch the screw holes with an awl (again, too much pressure and you could split the top plate along the grain).

Drill out these holes using a 1/16” drill bit, taking great care not to drill all the way through the head stock.

Screw the rod cover into place using appropriately sized screws. A tip for cigar box guitar makers with lots of tuning machines left over from three and four string guitars: tuning machine screws work great for this.

Wiring

Wiring a guitar is one of those voodoo topics that we all need a little explanation on from time to time. The issue here is that you're moving from the mechanics of making a guitar (straight neck, good resonance, proper scale length, etc, etc) to the physics of creating a sound electrical circuit. When you're simply making a guitar it's easy to spot problems because they become apparent immediately, such as the string rattling of the frets. When you have a problem in your wiring, the fix is maybe not so evident. This is especially true when you consider that you can make mistakes or do some things wrong when creating the circuit and still have a functioning tone circuit. You'll note problems of course (usually in the form of unwanted noise or hum) but for the most part when you plug in to an amp you'll get amplified, guitar-like sound.

The real annoyance is that the more you learn about and understand guitar tone circuits and how they work, the more they'll start to seem like black magic (at least this was the case for me when I first started). At that point, you find that you need to start learning about physics if you want to have a real low level understanding of what actually goes on between the strings and the output jack. Some of us are persistent enough to suffer through learning how it works but others of us just want to get the guitar properly wired so we can jam!

Luckily, you don't have to be an electrical engineer to put together a professional tone circuit on a guitar. You just have to follow some basic rules and guidelines and know when and if it is safe to deviate from them.

Soldering

For the beginner, the largest hurdle is to become familiar and comfortable with soldering. Soldering is one of those basic skills that need to be practiced, much like driving a nail with a hammer. You can't just read a quick little guide and then do it well. It's like learning to drive a stick shift. Even if you understand the mechanics of how it's done, you still need to develop the feel for it. Unfortunately, most of the guides covering the subject of guitar wiring seem to assume that the reader already knows the basics of soldering and focus instead on making a circuit. It doesn't matter if you are fluent in reading schematics; if you don't know how to solder then you're in trouble.

In order to solder effectively, you obviously need to practice but you also need to know the basics of how solder behaves. If you are able to predict its behavior then you'll be able to understand the reasons behind the techniques outlined here.

First, solder wants to go where the heat is. It is easy to assume that you melt solder onto the tip of the iron and then apply it to the joint that you're trying to make. It "sort of" works this way but that's really only half the story.

You "tin" the tip of the iron (that is, you melt a small bit of solder onto the tip) because it helps you transfer heat faster to the metal that you're working on. The trick is that you want to heat the surface of the metal with the iron and then apply the solder coil to the heated surface and/or the iron, not the iron alone. When solder melts, it is pulled towards the heat, or rather, it is said to wick into the material. When you become used to this behavior everything else will come together naturally.

Soldering Wires to Lugs

A quick note on soldering lugs: many Luthiers and techs recommend making a good mechanical joint on a lug before applying solder. This means to thread the wire through the hole of the lug and twist it tight such that it completes the circuit before solder is even applied. The reasoning behind this is that even if the solder joint breaks there is still a chance for the circuit to work and the overall tone circuit will continue to function.

I recommend against this practice for the simple reason that it can hide problems with the guitar. If a solder joint breaks, I want to know about it immediately and I want the problem area to be obvious. Rigging up the joint in the aforementioned way could yield miserable tone (through a circuit constantly broken by movement or vibration) and the problem will not be readily apparent through a simple visual check because everything will still be connected.

Regardless of your own position on the matter, you should not have to worry if you do your job well. A correctly soldered joint is a rather solid thing and would really only break under egregious abuse.

To solder a wire to a pot (or other) lug, follow these steps:

1. Tin the iron.
2. Heat the lug with the iron (if you look close you can see the metal change colors when it's hot enough). Once you have the right heat, apply the solder coil to the lug (not the iron) and allow it to wick onto the surface of the lug. Most lugs have

a hole in the middle. It is not necessary to fill the hole with solder but it will not hurt if you do.

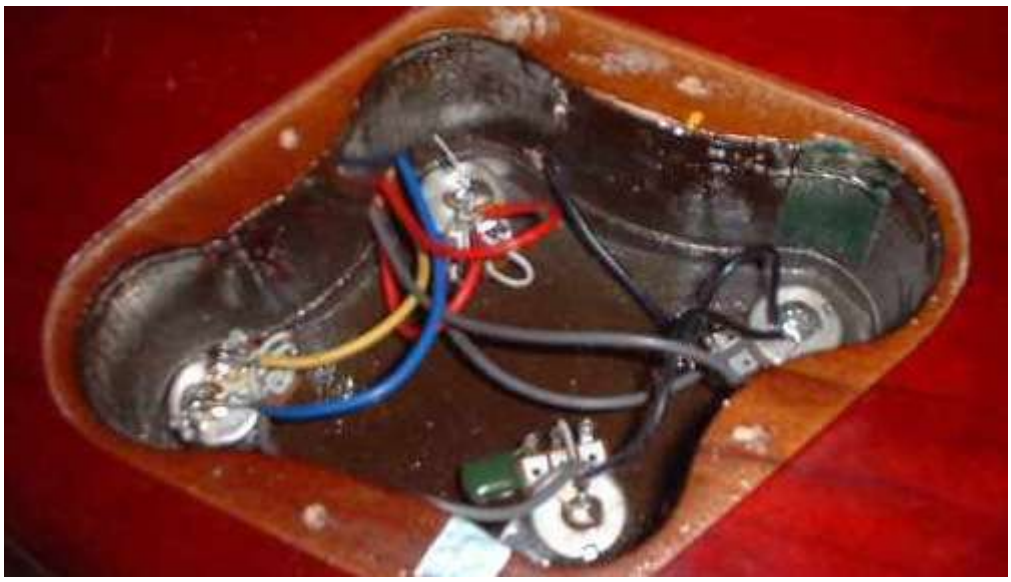
3. Twist the stripped end of the wire that you intend to solder to the lug. Heat it with the iron, and again, apply the solder coil to the twisted wire and not the iron. You'll see it wick into the braid.
4. Lay the tinned wire onto the tinned lug. Hold it VERY steady (hold it in place with a clip if at all possible or brace your hand against something so that it doesn't move). Now lay the iron on top of the tinned wire and rock it back and forth gently until you see the solder on the wire and the solder on the lug liquefy and join together. Pull the iron away but do not move the wire until you see the solder harden up again and change color (usually a good 5 seconds or so).
5. **NEVER blow on solder to cool it**. You could force air bubbles into the blob and produce a cold joint.
6. After the solder hardens up, give it an additional 5 count just to be extra sure and then give the wire a little tug. It should be rock solid.
7. If the solder looks like a really murky gray after it hardens, you may have a cold joint. Lay the iron down on it to melt it and then let it set up again. The shinier the joint, the better it is.

Soldering Wire to Wire

1. This is the easiest thing in the world to do.
2. Twist the ends of both wires together.
3. Tin the iron and apply it to the twisted wires.

4. Once heated enough, apply the solder coil to the twisted wires and it will wick into the braid.
5. Remove the iron and let the joint cool before moving it.

Soldering to a Pot Shell (Grounding)



1. This is the toughest one to do well.
2. Scratch the back of the pot in a crosshatch pattern using the jaw of your pliers, wire cutters, or whatever.
3. Melt a wad of solder onto the tip of your iron until its fat and threatening to fall off.
4. Touch the hanging ball to the pot shell (don't contact the shell with the iron). Wait for the shell to heat up such that the solder starts to wick to it.
5. Now spread it around just a bit with the iron (go ahead and contact the shell now) and then pull the iron away smoothly.
6. Give the pot some time to cool (do this so you don't overheat the pot and damage the internals). It should be comfortable to touch with your bare fingers before you continue.
7. Make sure that the ground wire that you want to hook up is tinned.
8. Lay the tinned ground wire on the blob that you just placed on the shell. Lay the iron over that wire and rock it back and forth until the solder melts down and joins up.
9. It may be necessary to melt a little bit more solder over this new joint to ensure that everything is well encased and permeated with solder. This is true if you have a pencil tip iron that can't distribute a large amount heat over large surfaces. If you have a good, fat iron tip for grounding work then this shouldn't be necessary as the pot blob should soften up quite easily.

Star Grounding

The grounding on a guitar is the single most important thing to get correct after good solder joints. You can have a well grounded guitar with no shielding whatsoever and it will still sound pretty nice (though any single coil pickups may give a slight mains hum). Conversely, you could have the most shielded guitar in the world but if it is not properly grounded it will likely sound horrible or it won't sound at all.

There are two very basic rules to adhere to when grounding your guitar:

1. Ground everything that is metal.
2. DO NOT create a ground loop.

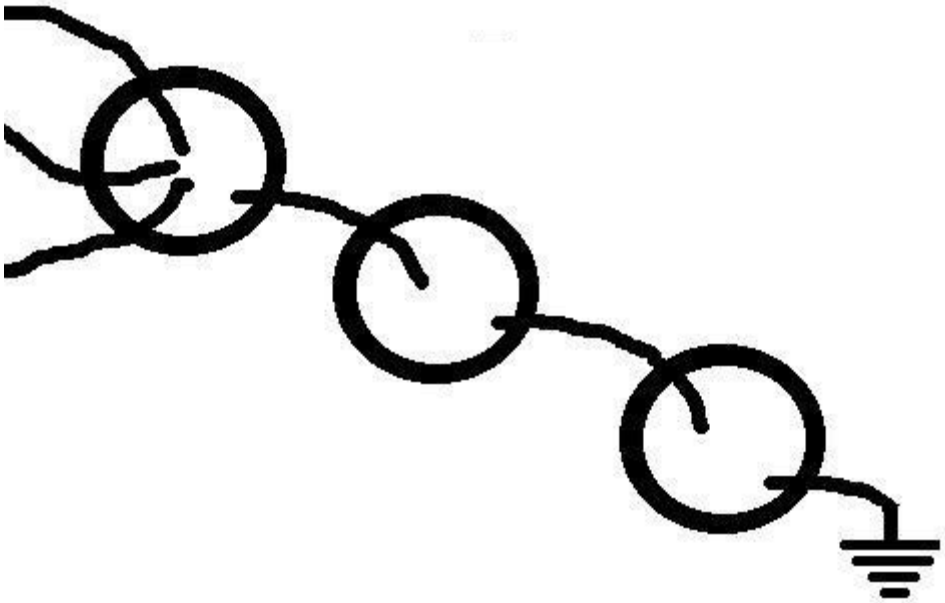
Grounding all the Metal Parts

Assuming a basic guitar (without a lot of metal accessories or other frippery), you can ground the following items to ensure that the instrument is fully covered:

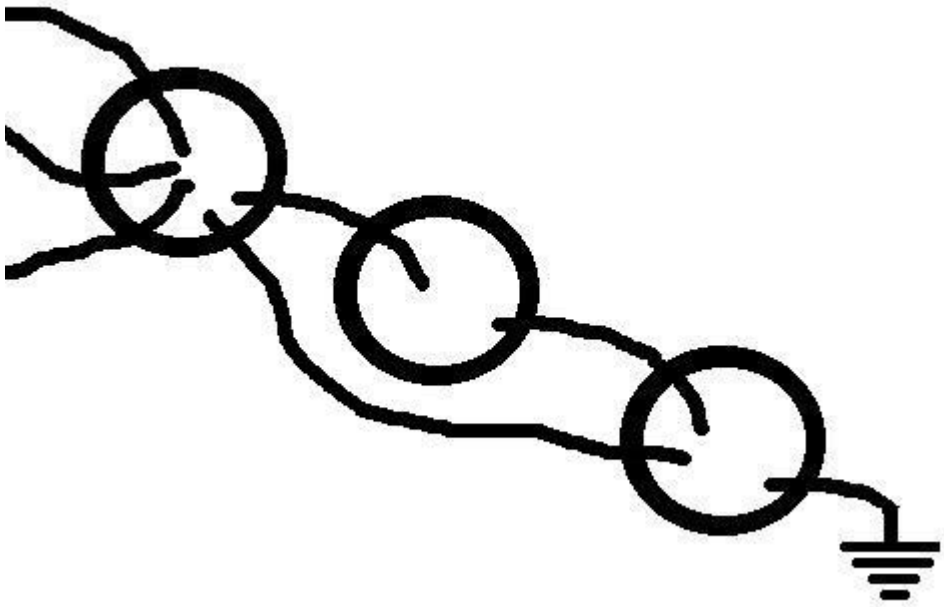
- Each Pickup
- Each Pot
- The bridge (and therefore the strings and tuners)

Avoiding a Ground Loop

Star Grounding dictates that each component can only follow one possible path to ground, as shown.



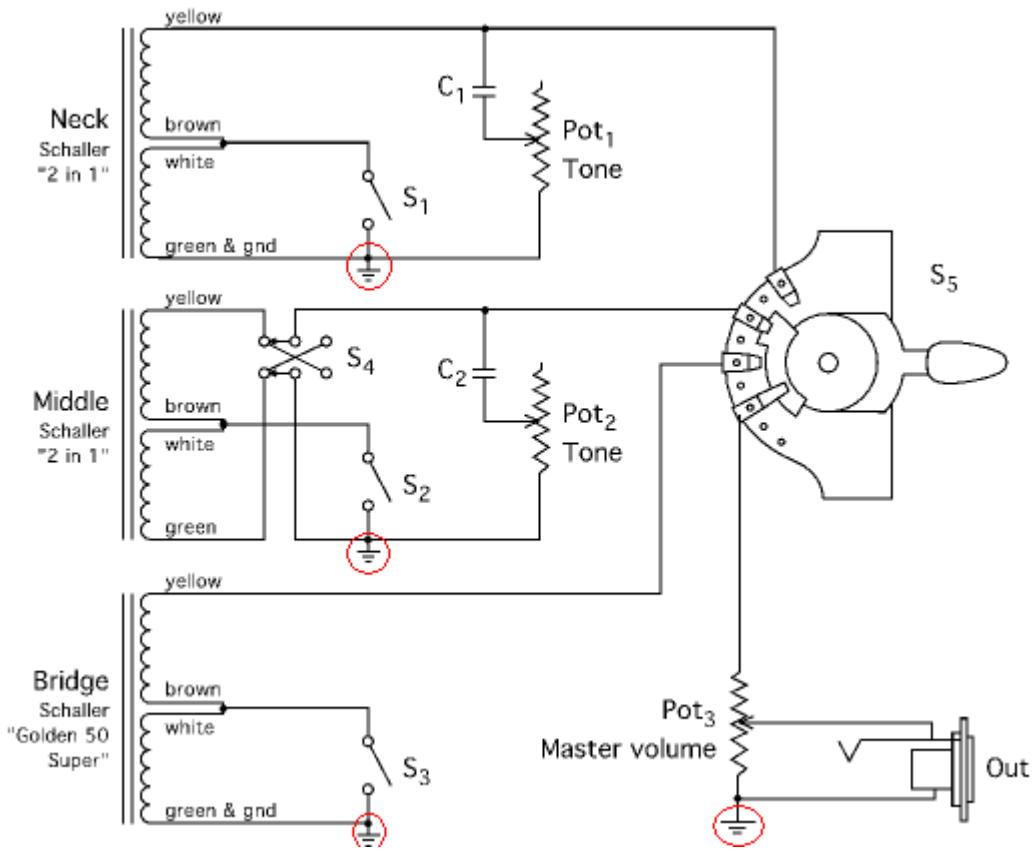
If a component can follow more than one path to ground, a ground loop exists and the tone of the guitar will be negatively impacted.



The standard practice is to run all of the grounds in the circuit to one large location (typically the volume pot's back shell) and then run one wire from there to the ground lug of the jack.

If you have two pots mounted to the same piece of shielding (tape or paint), connecting a ground wire between their two back shells will cause a ground loop (one path through the shielding and one path through the wire).

When dealing with guitar schematics, you may note several ground symbols throughout the drawing.



The reason the schematic is drawn in this fashion is to avoid confusing the image with a lot of extra lines running to the pot. It is assumed and understood that each ground symbol indicates a ground connection to a central location.

Shielding

Shielding in guitar making refers to the practice of building a Faraday cage around the electrical components to ensure that they don't pickup interference hum from outside sources such as house mains power or fluorescent lighting. There are many techniques and materials available to approach shielding; however you will likely find that using conductive paint is the easiest solution.

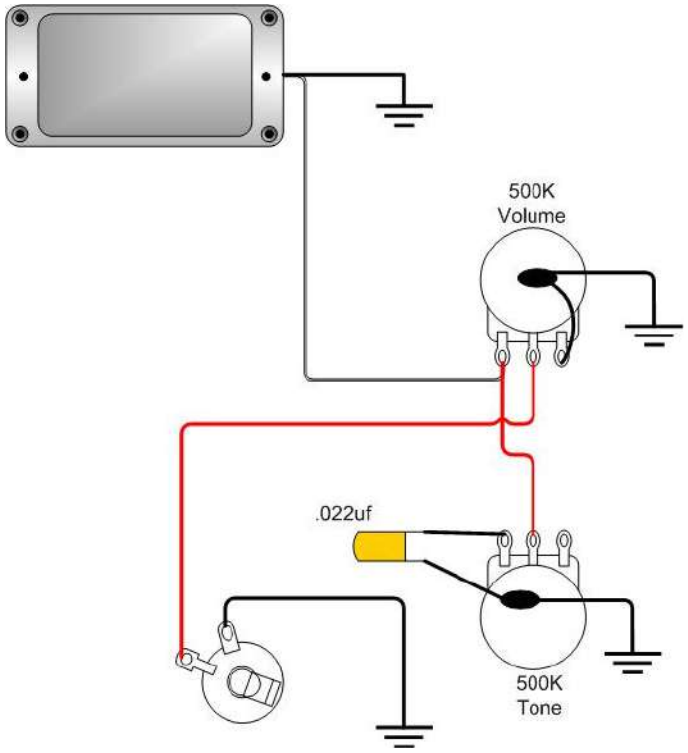
You will note in the examples I have shown you throughout this tutorial that I have not shielded the cavities on my guitar. This was because the guitar shown utilizes a humbucker pickup, which is extremely resistant to outside interference in its own right. For myself, I really only consider shielding when using single coil pickups in a guitar.

For a much more complete discussion on grounding and shielding, please see the following link, which will expose you to a world rich with nuance and detail:

http://www.guitarnuts.com/wiring/shielding/shield3.php

Circuit 1 – Simple Volume & Tone

The following diagram details a simple volume a tone circuit for a neck humbucker pickup. If you have a 4 wire humbucker, you can easily tape back the tap wires (typically red and white wires that are soldered together) to keep them out of the way.



Circuit 2 – Volume & Tone W/ Coil Tap

If you bought a 4 wire humbucker for your guitar you can add more versatility to the tone circuit by adding a coil tap.

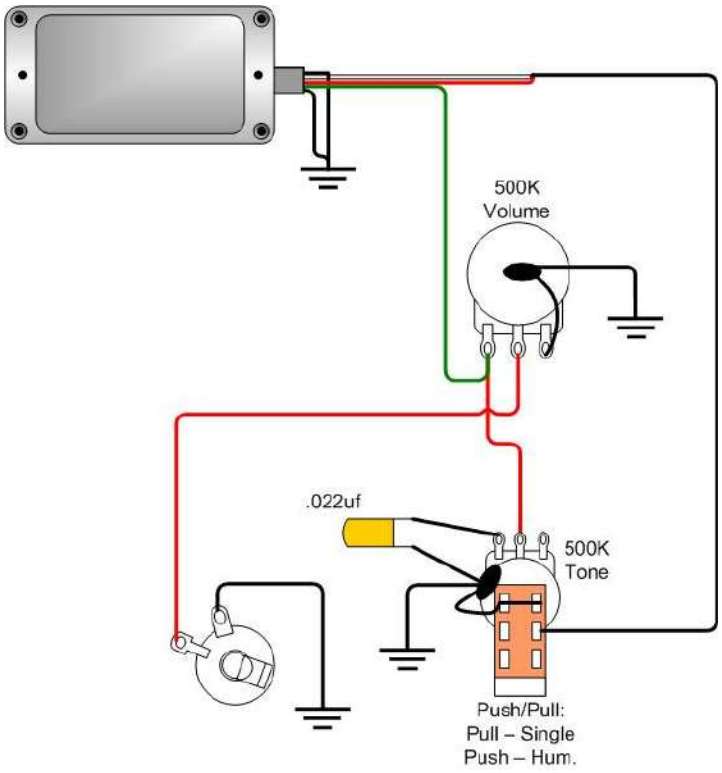
Without getting too detailed, a humbucker pickup is basically two single coil pickups smashed together and wired in such a way that any external interference (from house mains power or other sources) will be filtered out of the circuit, which provides a very clean tone. Due to the characteristics of the pickup, the tone of a humbucker is often described as deep or meaty but these are really just colorful adjectives used to explain that a humbucker has more bass response.

A 4 wire humbucker has two wires exposed that will completely deactivate one of the coils when grounded. This effectively turns the pickup into a single coil pickup. Yes, this does mean that the hum cancelling effect of the double coil is lost but it also means that the pickup itself takes on the tonal characteristics of a single coil, which means that it will sound brighter and provide more performance in the mid and high ranges (treble response).

Adding a switch to the circuit will allow you to put the pickup into single coil or humbucking mode at will. When added to the tone circuit, you have four distinct sounds that you can utilize on a simple single pickup guitar: Humbucker with and without a full

tone cut and single coil with and without a full tone cut. You will have a workhorse of a guitar that will be able to handle rhythm and lead work quite admirably (although a bridge mounted pickup is really the best choice for lead play).

Note in the drawing below that the pickup shows two wires going to ground. This indicates that you need to take the black insulated wire from the cable and twist it with the cable's braided shield before connecting to ground.



Testing the Circuit

You can test out the circuit before you ever put strings on the guitar by plugging it into an amplifier and tapping the pickup with a magnetic tip screwdriver. With the volume turned up, you will hear an audible tap over the speaker. Indeed, you will be able to detect a change in the tone of the tap by adjusting the tone knob or by setting the pickup to single coil mode (if available).

Final Setup

I like to leave installation of the tuning machines and other extraneous hardware to this step. The knobs obviously wouldn't be installed until after the instrument is wired up. I leave off the tuning machines until this point because they are simply not needed until now and they are far more protected in their box then they are installed on the neck. In addition, tuning machines add considerable weight to the headstock (though they may not look like much) and I prefer to avoid this weight gain while wiring up the guitar (due to all the shifting and maneuvering about that I must do).

Control Knob Installation

Installing control knobs is a rather simple task. Plastic knobs typically just fit tightly over the knurled shaft of the pot and should just be pressed down over it. More expensive metal knobs are fastened into place with a grub screw.

When the knobs are pressed down over the pot shaft they should sit flush against the guitar body. If they do not you will need to adjust the depth of the pot shaft with a nut and washer on the underside of the lid.

Tuner Installation

Most modern tuners require a 10 mm hole in the headstock, which unfortunately is not a standard drill bit size that you can just pick up in any store. Luthier suppliers do sell them but they come dear. If you are patient, you can drill the tuner holes with a standard size bit and widen them out with an end pin reamer or rat tail file.

Press the tuning machines into place and align them into their correct positions. When they are properly aligned, punch out the positions for the tuner screw holes.

Remove the tuning machines and drill pilot holes for the screws with a 1/16” drill bit. Take extreme care not to drill all the way through the headstock.

After the pilot holes are drilled place the tuning machines back into position and screw them into place. Tighten the screws only enough to get a snug fit as they are very easy to strip.

Flip over the guitar and install the tuning machine bushings. Look closely at the washers that come with the bushings. Many of them are beveled on their face and are meant to be installed only one way.

Use a nut driver to install the bushings as a wrench or pliers will easily scratch the finish of your hardware. In my experience, a 10 mm socket is usually required.

Stringing up the Guitar & Nut Action

At long last it is time to string up the guitar for the first time. This operation includes widening out the nut slots to their proper gauge.

Go slowly and install one string at a time. The nut slot should typically be slightly larger than the gauge of the string itself. Assuming you took my advice and procured a set of gauged nut slot cutters, determining the correct cutter should be a simple matter. Just use the next highest size that you have compared to the string you're about to set up.

Run the string through the bridge and wind it up in the tuning machine. When it is reasonably tight, begin to cut into the starter slot that you made earlier.

Take maybe only 3 to 5 swipes at a time before dropping the string back into the slot to test the height over the first fret. You don't want to go too far such that the string buzzes off the frets.

For setting the proper nut action (string height over the first fret) I have no universal advice to give. Like so many details in a guitar's setup, the nut action is subject to the

preferences of the player. The best advice I can offer here is to go slowly until things start to look right. Set your action at the bridge and tune the guitar to pitch. Experiment with several chords up by the headstock (especially bar chords). If you find yourself struggling to play a clean chord, it may benefit the instrument to lower the nut action just a little bit more. As I've said before: go slowly. You can always take material off but you cannot put it back on.

Playing Action

When the nut has been properly tuned, any action adjustments from that point on should be taking place at the bridge or with the truss rod. The type of bridge your guitar has will determine how you accomplish this. Fender style plate bridges support action adjustments on a per saddle basis via grub screws. Gibson style bridges offer less fine control, being raised or lowered as a mass with two large post screws on either side.

Begin by assessing the straightness of the neck before adjusting the bridge. The neck will have had a chance to further settle by now (especially under the load of the strings) and may have shifted positions since the last time you checked. A slight forward relief on the neck is desirable. Forward relief allows you to achieve a lower playing action because the curvature of the neck will match the natural curve of the string as it vibrates after being plucked. If you find that the neck is perfectly flat (or much worse, has a back bow), adjust the truss rod. You want the relief to be very slight. If it is too pronounced then the playing action will again be negatively impacted. In fact, it is fair to say that achieving the best playing action is a delicate balancing act of factors taking you from fret buzz to fast, aggressive playing. If you spend enough time trying to get it just right, you could find yourself devoting a whole evening to getting things exactly the way you like them.

As mentioned before, make small adjustments, retune the guitar to pitch, and play it for a while to see how much you like or dislike what you have done. In time, your preferences will become clearer to you and you will be able to set up a guitar in no time at all.

Intonation

Intonation refers to a guitar's ability to accurately sound notes over the whole scope of the fret board. Because the strings are slightly raised over the fret board to allow for vibration, they don't run a perfectly straight line from nut to bridge with respect to the frets. This means that notes are actually being pulled slightly sharp when you fret a string, although this is mostly imperceptible to the human ear. I say mostly because this effect is more pronounced as you move down the neck into the higher end of the scale and accomplished musicians are able to detect the disparity. Setting the intonation of the guitar is a process of attempting to spread out this margin of error evenly over the entire neck, minimizing the overall effect.

The easiest way to assess and adjust intonation is to chime the string at the 12^{th} fret and then pluck the string while it is fretted at the 12^{th} fret. The note should be identical (although the timbre will be different). If the note is different between the two, you must adjust the scale length either forward or backward for that string by adjusting the saddle position. Note that you will have to retune the string each time you adjust the saddle's position as it will change the pitch of the string.

The Finished Instrument

It is my deepest hope that this guide has been of use to you in building your dream guitar. If I may be allowed to ramble for a bit – it is quite clear to me that people in the cigar box guitar community are divided on my interpretation of this amazing instrument. From all of the discussions we've had together on the forums I know that there is a camp that is inspired by the guitars that I make and that there is yet another camp that is totally confused by what I'm doing. One group feels that the cigar box guitar has a place among high end, precision instruments while the other feels that it was always intended to be a primitive, low-fidelity lightning rod. Whatever your position is on the matter, I hope you have found something in these pages useful and that I have helped you (if even a little) to become the guitar maker that you wish to be.

Now tune the sucker up, plug her in, and blow the roof off!


SCROLL