



ENGINEERING THE GUITAR

ENGR 1600

LAB BOOK
Fall 2018

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ENGINEERING THE GUITAR LAB BOOK

ENGR 1600

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Introduction

From a young age I can vividly remember going to the local library and finding a book about electric guitar building, and in a sense, it blew my mind. Ever since I dreamt of having the opportunity of fulfilling that goal. In the spring of 2012 I was able to enroll in a guitar building class at Salt Lake Community College. At the time I think it was either the second or third time the class was offered. I was very excited to be part of it but the class did not have the structure it now enjoys (it was more about just showing up and working on the guitar with no book work or reading assignments).

This semester (Fall 2018) was the second opportunity of building an electric guitar. This time around the requirement of having a lab book was a welcome addition to the process. In the past I only documented the process through pictures, so having written down the steps, progress and mishaps will prove to be valuable in the future. I am excited to have worked on this project again and there is a satisfaction that comes with the ability to share the knowledge acquired from this last few months.

Design wise, due to the amount of school credits I enrolled for, I decided to go with simplicity. Given the first guitar I built was an *Explorer* type guitar with very different hardware than the kit provided and with a more elaborate solid paint finish, it was interesting to do the opposite this time. It was hard not being able to do more complicated things to the guitar or the finish (especially as I saw my classmates do some really cool and elaborate designs, carvings and finishes), but in the other hand it gives me something to look forward to in the future as I wish to build more instruments.



David Augusto Herrera Azcarate.

December 3rd, 2018

Machine Tool Safety Checklist

General Shop Safety Rules

- ❑ SAFETY GLASSES: to be worn when using ANY power equipment!
- ❑ HEARING PROTECTION: you are the only one who can protect your hearing.
- ❑ 12-INCH RULE: all material should be at least 12" to be able to run through any power equipment!
- ❑ NO USED MATERIAL: any wood that was not purchased by you as a new piece of material should not be used on any power equipment!
- ❑ NO FRAMING OR NON-CABINET GRADE LUMBER: Lumber that is not cabinet grade may not be used in certain machines and should be avoided unless tools designed to cut this lumber are used.
- ❑ CHECK MATERIALS FOR QUALITY & CLEANNESS: All materials that are used must be checked for knots defects etc. and clear of any metal, dirt or debris prior to using in any equipment. PLEASE CHECK FOR STAPLES!!!
- ❑ KEEP WORK AREAS CLEAN!!!
- ❑ KNOW WHAT THE MACHINE IS DOING, what its intended purpose is, and how to operate it or DON'T USE IT!
- ❑ TREAT EVERY MACHINE AS IF IT IS RUNNING.

Stationary Power Equipment

- ❑ Disk Sander
 - Only use the side of the disk that is rotating downward toward the table. Using the other side will cause the board to be lifted from the table and thrown at your face.
 - See "sanding machines."
- ❑ Sanding Machines
 - Use only light pressure, just enough to hold the work against the abrasive.
 - Wear goggles when disk sanding.
 - Remove sawdust from around the machine to prevent a fire hazard.
 - Sand parallel with the grain whenever possible to obtain a smooth finish.
 - Sand only dry wood.
 - Use a fixture, jig or wooden hand-screw clamp to hold small pieces of wood when machine sanding.
- ❑ Band Saw
 - Check the stock to make sure it is free of nails before cutting.
 - Adjust the sliding bar or post so that the upper guide is about ¼" above the work. If the guide is too high, the blade will not have the proper support.
 - Never allow anyone to stand on the right side of the saw. If the blade broke, it could fly out in that direction.
 - Make sure the saw blade has proper tension and that the teeth are pointing down.

- Avoid backing out of a cut as this could pull the blade off the wheels.
 - Never attempt to cut round stock without a holding jig. It will roll out of your hands as the saw starts the cut.
 - Hold the stock firmly on the table to do the cutting.
 - Never cut a curve of small radius with a wide blade unless you first make relief cuts.
 - If you hear a rhythmic click as the wood is being cut, this usually indicates a cracked blade. Stop the machine and inspect.
 - If the blade breaks, shut off the power and stay away from the machine until it comes to a complete stop. Never try to free the blade while the wheels are still turning.
 - Never have your fingers or arms in line with the blade.
 - Use a helper to handle long stock. Remember the operator should do all the pushing.
 - Keep a well-balanced stance as you do the cutting.
 - Never try to pick pieces of wood out of the table slot while the saw is operating.
- Drilling and Boring Machines
- Pay special attention to secure loose clothing and long hair before using any drilling and boring machines.
 - Make sure the stock is clamped properly before drilling or boring.
 - Never attempt to use a hand auger bit. Use only drills and bits designed for machine use.
 - Always position the hole in the center of the table beneath the drill and place a piece of wood beneath the work to keep from drilling holes in the table.
 - Use compressed air to keep the table free of sawdust.
 - Never try to stop the machine by taking hold of the chuck after the power is off.
 - On deep cuts, back out often to clean out the hole.
- Scroll Saw
- Install the blade with the teeth pointing down.
 - Adjust for tension by raising the tension sleeve the correct amount
 - Make sure the blade guide and the hold-down are adjusted properly.
- Router
- Make sure the router is properly grounded. Most come equipped with a 3-wire cord that will fit directly into corresponding grounding receptacles. An adaptor for grounding a 2-wire receptacle is usually furnished with the tool.
 - Turn off the motor when not in use.
 - Disconnect the plug from the power circuit when changing bits.
 - Hold the power tool firmly but lightly in your hands.
 - Never turn on the power until you are in a working position.
 - Make sure the bit is properly installed before turning on the power.
 - Never put anything in the ventilating holes of the router.

□ Belt Sander

- Make sure you hold the machine away from you until it comes to a complete stop before setting it down on the workbench. Never rest the sander against your leg, as it will draw your clothing and skin into the machine.
- Be prepared to hold the machine back from its tendency to drive itself forward when it contacts the board to be sanded.
- See “sanding machines.”

□ Finishing Spray Room

- Always wear an approved respirator when working in the finishing room.
- Safety glasses should be worn to protect eyes from overspray, splashes, etc.
- Always make sure that the ventilation fan is operating when chemicals are in use.
- Read all safety precautions and MSDS sheets prior to using each finishing product.
- Dispose of all solvent soaked rags in proper waste containers that are marked for the disposal of such waste. Solvent soaked rags if disposed of improperly can spontaneously combust causing a fire when there is no one around to stop it.
- If the filters for the spray room get clogged, notify the instructor so they can be serviced. Good air flow in this room is very important.
- When using the wall mounted airless spray gun take extra precaution to be sure that you do not accidentally spray in contact with your skin. It can inject the finishing material into your skin and cause serious medical problems.
- Gloves should be worn when there may be a chance of solvents or stains coming in contact with your skin.
- Wear appropriate clothing for the type of finishing you will be doing. Stain will not be able to be washed out of clothing that it comes in contact with. Shoes can also be damaged.
- No electrical equipment should be used inside the spray booth unless it has been approved by the instructor.
- Be careful not to cause any sparks or open flame in or around the spray booth or finishing materials. Most finishing materials are extremely flammable. **NO SMOKING!!**
- The door to the spray booth must remain closed at all times. Do not prop it open except for moving a project in or out.
- Once a project has been sprayed, it must remain in the booth for at least 30 minutes to allow for it to dry.

*Safety Shop rules were copied from the power point provided for ENGR 1600 class.

August 29th, 2018

Guitar Sculpting Preparation:

Have a plan and think of the features you would like to have on the body (belly cuts, arm rest, curves etc.), headstock or neck As with any sculpting, apply low pressure and start with removing small amounts of material (remember you cannot add material back). It is recommended to draw the features with pencil before doing any cuts or shaping. Quick sketches will also help visualize the end product. For body usually you sand, route, sculpt, sand again.



Tools: Band saw, scroll saw, push stick, router, router bits, rasp, files, clamps, belt sander, hand sander, spindle sander, belt sander, sand paper, sanding blocks.

Relief cuts: Find areas with substantial amounts of wood, tight curves or where it would be difficult to back out of a cut and make short perpendicular cuts to the design you want to have. It keeps the band saw from bogging down.

Sanding: After cutting or sculpting features, the surfaces are rough. Then using various sanding tools those features can be smoothed out. When using spindle sanders find sanding cylinders that match the curve or radius you want to sand as best as possible.

Flat sander are great for large features or straight edges that need to be sculpted. With sanding you will go from coarse sand paper for shaping up to fine grit for smoothing (i.e. from 120 up to 2000).

To do more substantial shaping use rasps or metal files to remove material quickly. The angle you hold the tool will determine how much material will be removed.



Clamping: clean bench or work areas free of wood chips, glue etc. before placing your guitar parts on the bench to avoid damaging them. When using power tools, you want to have a stable surface to work on (prevents damage and injuries). Do not over clamp to avoid denting the wood. Also use clamps with soft plastic coverings or add something to avoid denting the wood you are working on.



Routing: Before doing any routing, make sure the body is well sanded and even. Router bits have a bearing that follows any feature including not sanded or rough bumps. Never start the router with the bit hitting the working surface. If possible, do a test cut on a sacrificial board every time you make an adjustment, no matter how slight it is. It is ideal to do routing in passes, especially if it is a substantial amount of material to be removed by adjusting the height of the bit. Make sure to move fast to avoid burning wood (some wood burn quicker than others). Do your router work before sculpting belly cuts etc.

Next time: Continue sanding intricate parts of the body. Design headstock by tracing headstock blank. Decide and route design for edges of guitar. Shape the heel of guitar (probably will not use neck plate provided but other method to account for different length screws). Bring dust mask and wear earplugs. Pre-drill and sand electronic cavity cover.

September 5th, 2018

Pre-Drilling: everything is held with screws. We need to allow room for screw to go in before we insert screw. Example with back plate use 3 drill bits: one for screw body, one for screw shaft and one for counter sink

Today's Progress: I worked on the body and did more sanding on the sides of the body to make it smooth for routing. I selected a router bit with a small radius to do the front and back edges all the way around (even around the neck heel so it would be very smooth; the neck plate is still going to fit just fine). A little mistake I made today was when routing I forgot to do a test pass after adjusting the bit for a deeper cut. I ended up putting tiny sharp edge which I fixed by sanding and blending with the rest of the body. Any burnt wood from routing was easily removed with some sanding (using 220 grit). I also sanded the edges of the electronics cavity and the pickups to make it look nicer and avoid sharp edges. Most importantly I wore a dust mask, because the sanding dust was giving me allergies.

At some point I noticed there was a piece of wood in the neck pocket that was starting to crack, so I taped the areas adjacent to it and then superglued the crack to avoid further movement.

Headstock Design: Using a clean piece of paper I traced the headstock blank shape. Then I started drawing inside of the blank edges the desired shaped with pencil. I came up with about three designs and I will then use one of them as a template before cutting the shape. Finally using engineering paper and a French curve I finalized 2 designs.

Next Time: Cut and shape and sand the headstock. Sand top and back of guitar body.



Headstock Design 1

ENGR 1600
Fall 2018

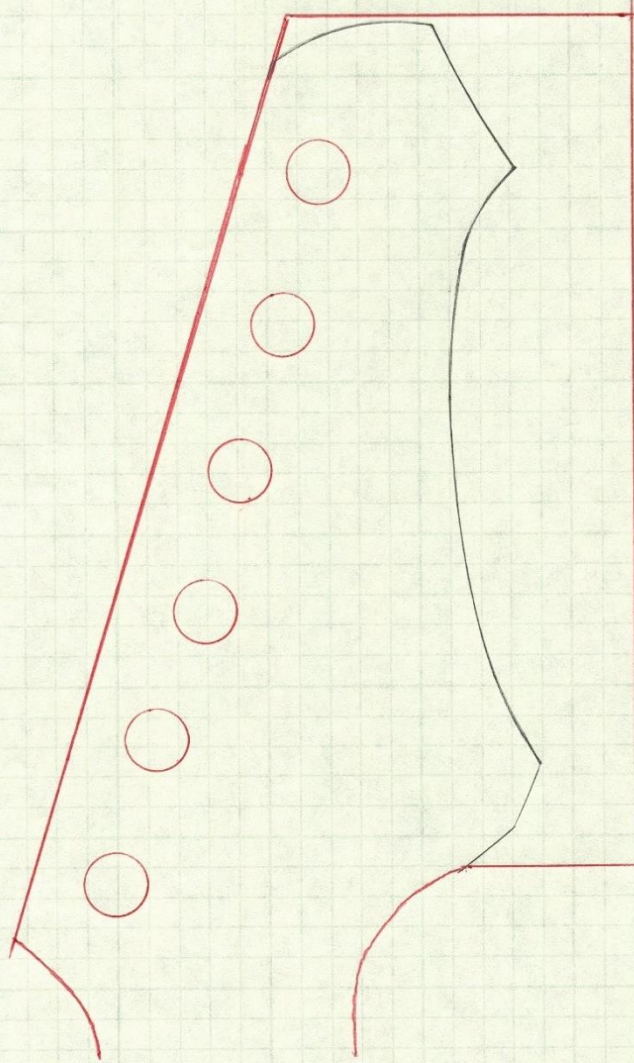
Headstock Design 1
1:1 Scale.

David Herrera

9/5/18

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET



Headstock Design 2

ENGR 1600
Fall 2018

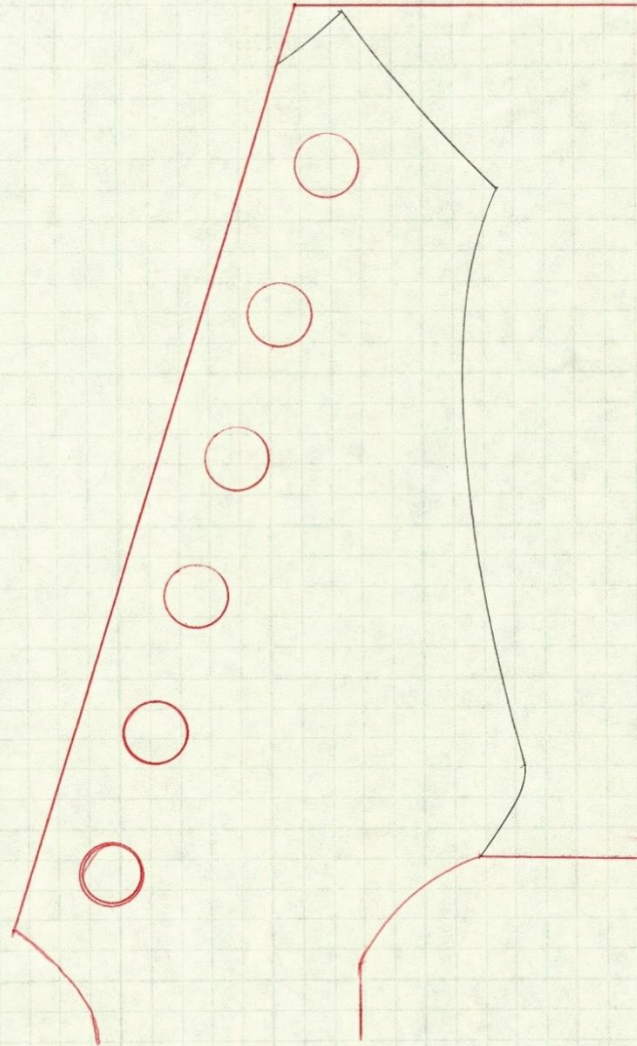
Headstock design 2
1:1 scale

David Herrera

9/5/18

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

COMET



September 12th, 2018

Headstock Shape: After some considerations, I chose design 2 since it would fit nicely with the roundness and bottom heaviness inherent to telecaster guitars. I cut and taped the template to the headstock blank. Afterwards I carefully cut the rough shape with the band saw; then used the large spindle sander to shape the final curves. It is important to cut outside the template line, so you can have material to sand to the final desired shape.



Electronics cover plate: The plate is already pre-shaped, but manually using 120 sand paper you reduce the side of the curved parts of the cover plate, leaving the flat edge untouched. Drill holes Sequence: 5/64, 9/64, counter sink.

Next Time: Prepare finger board and neck for gluing. Continue shaping and sanding the guitar body.



September 19th, 2018

Prepping the Fretboard and neck: use chalk to mark lines on the flat part of the neck and back of the fretboard, then using a flat board with sandpaper clamped to the work bench, start sanding to level these surfaces until the chalk comes off. This is used to remove high spots. We want the neck to be as flat as possible. Take your time during this process and check constantly. You can also round of the top of the fret board so when strings angle down they won't hit this part.

In my guitar my neck pocket was off, so I had to sand the left inside edge until my neck sat straight. Originally if I fitted the neck it would tilt towards the right and it wasn't flush with the outside edge of the pocket.



Aligning the fretboard: we will do this after installing the neck and working on the fit of the neck pocket to get a more accurate measurement. We will measure from the saddle of the high E string



to the inside part of the nut slot. Pre-drill the neck pocket screws using the drill press to ensure straight holes using 3/16" bit. Then drill the neck using about 1/8" bit. Before screwing the screws, lubricate them with paraffin wax. Afterward align the fretboard then using a 1/16" bit, drill alignment holes in the two opposing fret slots (one on top right and another at the bottom left of the fretboard) where registration pins will be inserted. This will help us during the gluing process later.



Drilling Fret Dots: mark the location of the dots, typically in the center of the fretboard by drawing an X at the 3,5,7,9, 12, 15, 17, 19, 21 fret locations. We will drill 1/4" hole at about 1/8" deep for the standard dots.



Gluing the fretboard: insert truss rod into the neck and check for it to be flush below the surface of the neck, we don't want it to protrude. We will apply a thin layer of glue on the neck of the guitar, then we will align the fretboard using the alignment pins and finally use a flat board specifically made for this step and 5 clamps (3 on the board and 2 at the end using smaller boards) to hold everything together and make sure to alternate direction of clamps as you go around the neck. Check frequently the alignment as you clamp, as fretboard might slide a bit. After clamping, remove truss rod multiple times until glue is not coming out on the truss rod. Curing time is about 30 minutes.

Next Time: Measure and install fret markers (on left side of fretboard). Round over the nut side of the fretboard before gluing. Glue neck and fret board. Sand and shape neck.



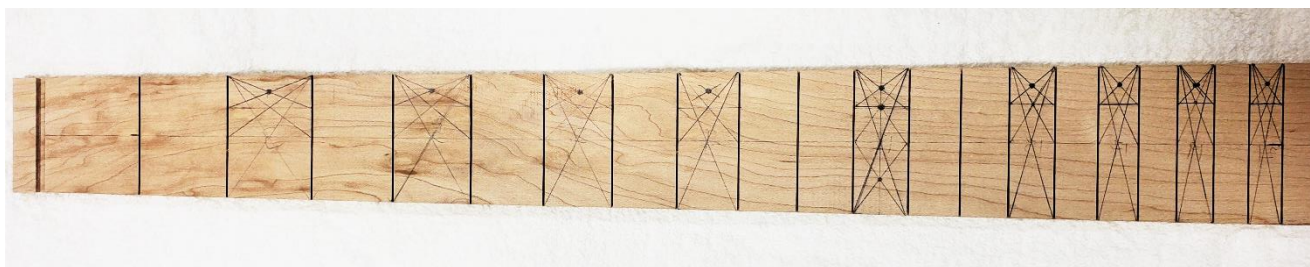
September 26th, 2018



Today's Progress: I continued the preparation work on the neck. Mainly I had to chisel away a small amount of wood in the truss rod channel, as the truss rod was still slightly above the flat part of the neck at the very end. It took trial and error, but it fit very nicely at the end. Later, I went ahead and predrilled the neck only since the body of my guitar already had the bigger holes drilled on the neck pocket. Then I installed the bridge with no problem using only the two outer screws (since it's only for measuring). When



I went to screw the neck on to the body, the screws did not lined up, they were actually bellow the pilot holes, so I sanded very carefully the bottom of the neck until they aligned properly (taking the time to do it right paid off at the end, since the alignment turned out great). After I moved on to working on the fret markers, and I decided to do the dots on the side. I went ahead and did the method of drawing crosses to find the center of the frets, and using that new center kept I kept dividing until divided in 4ths. I decided to use the small fret marker material instead of the large one since I wanted a cleaner look this time around. For drilling the fret markers, I used a 5/64" drill which is the same diameter as the small fret dot material. I drilled about halfway through the thickness of the fretboard.



The las thing I did was measure the scale length, and since I spent time doing all of the neck work for proper alignment, the top of the fretboard match the end of the neck perfectly at the 25.5" mark, so no need to do anything extra.

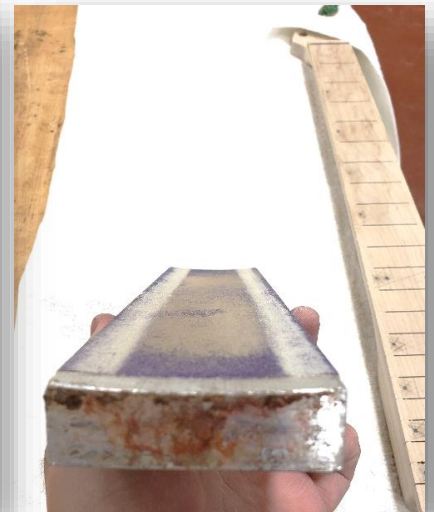
Next time: I need to drill the pilot holes for the alignment pins on the fretboard and neck. I will need to glue the neck and fretboard and probably do some shaping of the neck back after gluing is done.

October 3rd, 2018

Cleaning the neck: use metal scrapper to remove glue and wood from the side of the neck and fretboard. Hold scrapper about 30 degrees towards you with a slight skew as not to hit the fret slots. Try to get some nice shavings to make a nice transition between the neck and the fretboard. You want to do 80 or 90 percent of the work this way. Use 120 and then 220 to sand the back of the neck by hand. Remember to sand around the headstock and clean up some of the sharp edges which will help prevent the finish from chipping later.



Sanding radius of fretboard: Level the fretboard with the truss rod in. Set a metal straight edge on the fretboard and see how straight it is; then with the Allen wrench adjust truss rod until the fretboard is leveled. Once you complete the truss rod adjustment clamp the neck by the headstock and using a 12" radius sanding block you will first use coarse sandpaper then when you are about 80% done then you can switch to the finer paper. Use your legs to drive your body as you sand and use your fingers to guide and align the radius sanding block. About every 25 strokes, turn around the neck 180 degrees and sand again as to balance the sanding since one body of our body tends to push harder.



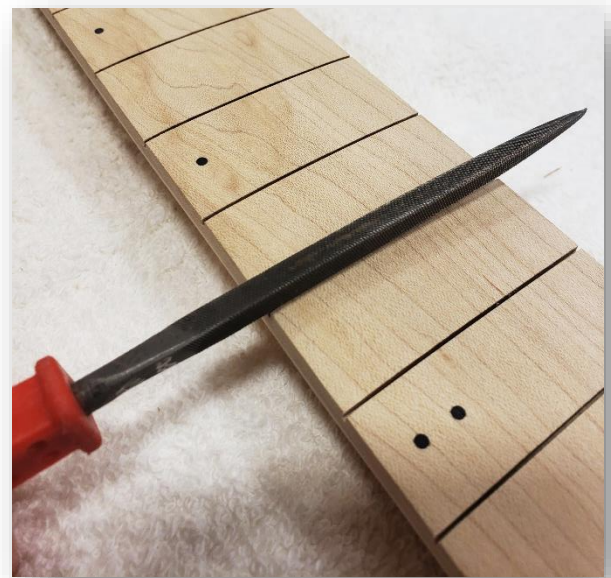
Today's Progress: I aligned and taped the fretboard, then drilled the register pin holes and glued the neck and fretboard. After 30 min. drying time, I started cleaning the glue and leveling the sides of the neck. I did some more predrilling for the bridge screws and sanded the body cavities a bit more.

Next Time: I will need to continue sanding and shaping the neck, shape and sand the top joint. I will need to install the fret dots, so I can then start sanding the radius of the fretboard.

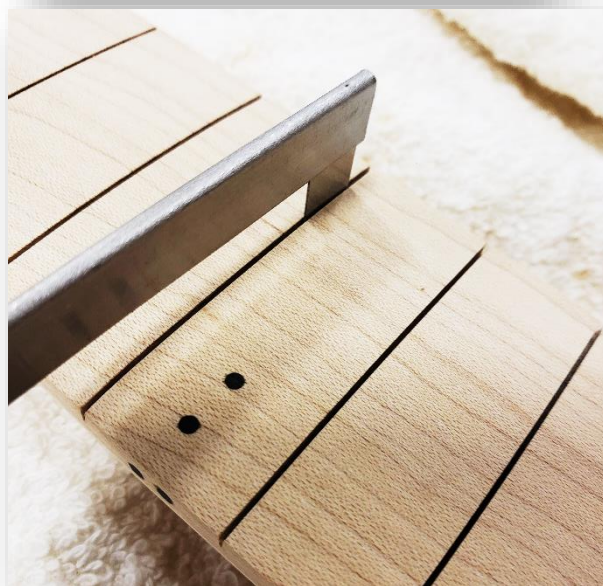
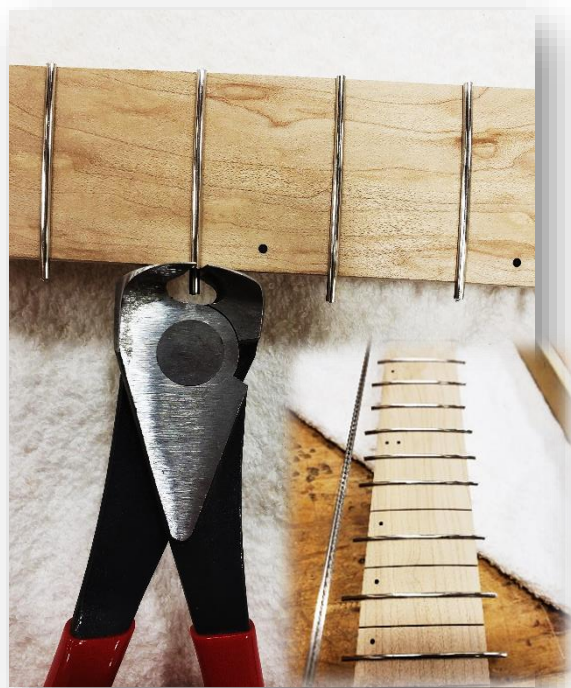


October 10th, 2018

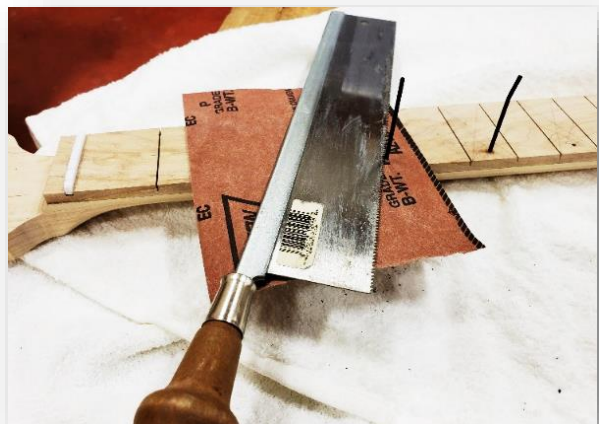
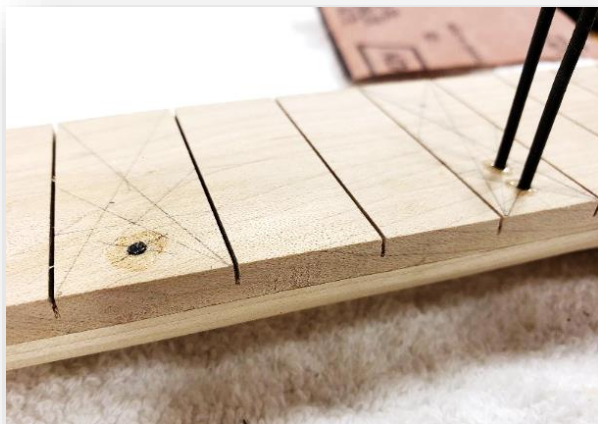
Fretting: Once you have neck radius ready, we can start working on the frets. Leave fret board sharp so frets will sit better. You will need 2 3/4 lengths of fret wire for the whole neck. First clean the fret wire with acetone to remove oil and dirt from the manufacturing process. We then will use a fret bender to put a radius on the fret wire making sure the tang of the wire goes in the groove of the tool (do a forward and backwards pass to keep it consistent). Then clip of about 3/4" from either end of the newly radiused fret wire). The using a triangular file, we will put a V groove on the fret slot to barely break the sharp edges, so the fret can rest flat on the fretboard since the tang has a slight round over.



Then cut a piece for each fret by cutting it slightly larger than the fret slot it will be going into. Remember that after putting the radius on the fretboards, the fret slots might not be deep enough so use a depth gage (double black line should not be visible) to check them, and if they are too shallow we will then use a fret slot saw (.015") to deepen the slot making sure the blade is going against the edge of the board. When all the prepping is done, insert the cut fret on the slot and use a small plastic mallet and tap each side in and then tap the center. Using a nipper, clip the ends of the newly installed fret. An alternate method is to use a fret press, first tapping an end then place the neck under the fret press which has a groove that sits on top of the fret. You don't need to press very much to get the fret inserted. For the bottom frets, put fret wire every other fret so we can have room to nip the ends.



Gluing Dots: will use super glue. Insert the fret do stick and check fit. Then put a drop of super glue in the hole and reinsert the fret marker stick, then tap it with a hammer to insure tight fit. Then using a duck tale saw parallel to the fret board cut the left-over stick (make sure to protect the fretboard with cardstock to avoid cutting it).



Next time: Finish sanding the fretboard radius. Start prepping the fret slots and fret wire to begin installing frets onto fretboard.

October 24th, 2018

Fret Level: Using a fret rocker we will work 3 frets at the time and see if there is any play (also check at different spots of the same fret, some sides might be higher than others). If there is rocking use the plastic mallet and hammer the middle fret and check again. Remember to support the neck specially when working at the middle of the neck. You will do the process up and down the neck. If there is still some high spot, we will use a special file to crown that fret. Follow the shape and radius of the fret, then sand it with 600 grit sand paper to clean up the fret.

Fret Dressing: using an edge fret file, file the ends holding the file at 90 degrees to the fret board side. File until you hear change of sound (metal to wood). After cleaning the side, we can use the same file and angle it about 35 degrees and chamfer the edges of the fret. To smooth it out use 400 grit sand paper. The last thing you will use a fret end file to smooth out the last burr out.

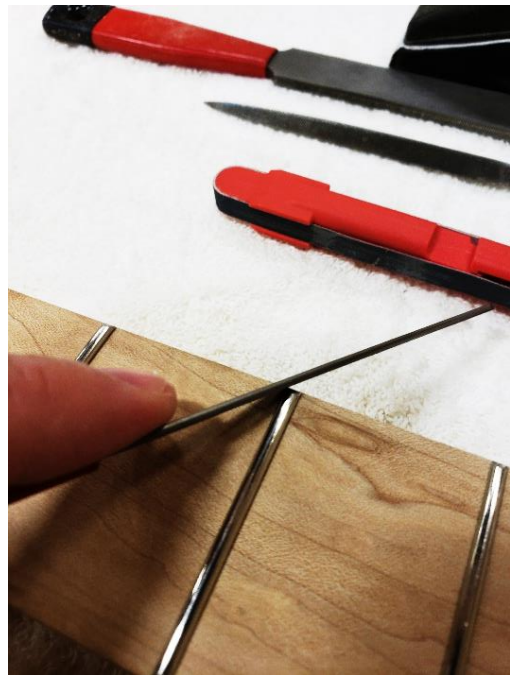
Today's Progress: I was able to install the side dot markers, but I did have a little mishap where the 12th fret dots weren't quite lined up, those two are always the hardest. I also took fair amount of time installing the frets since I had to deepen the fret slots towards the edges since the radius takes material away from that area. I cleaned and radiused the fret wire, put the v-groove in the fret slot and I also was able to press the frets into the fretboard and clip the ends.



October 31st, 2018

Today's Progress: Most of the time spend today was working on the frets since it is a critical and time consuming task that defines the playability of the instrument. I leveled the sides and added the 30-degree angle to the fret ends. I also used the small file and the strips of sand paper and rounded and smoothed the fret ends. At the end of the class I drilled the hole that goes trough the body in between the pickups to run the wire.

Next Time: drill the ground wire hole to the bridge. Drill the hole from the electronics cavity to the bridge pocket to run wiring. Final sand down of neck.

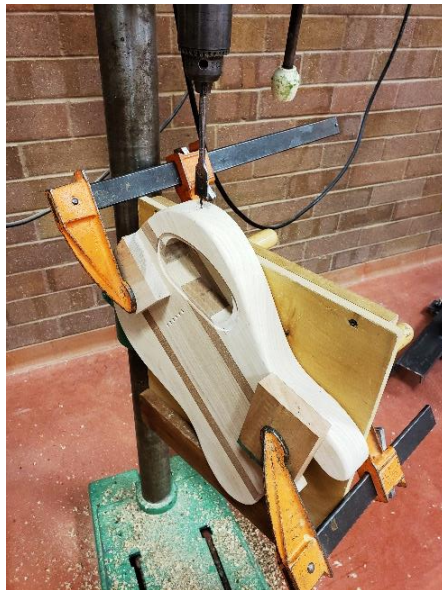


November 7th, 2018

Wiring: Follow schematic. Neck pickup will have the longer wire. The pickups we use have a hot and a ground wire. It is easier to make a pattern/plate where you can mount the components outside the guitar and work on the soldering. Remember to clean the tip of the iron and tin all the surfaces and wire ends ahead of time. When prepping the potentiometers, use some sandpaper to rough the surface, then clean it with a solvent and make sure to warm up the area as much as possible to form a nice puddle of solder. Let solder cool on its own. Ideally all the wires that go to ground on the back of the pot should be twisted together and tinned to make installation easier. For the ground wire that goes to the bridge it is recommended to use braided wire instead of solid core.

Today's Progress: Drilled the rest of the harder holes, which include the grounding wire, and the jack hole and the bridge-to-electronics cavity hole. Also did some fret rocking and hammering to set the higher frets better.

Next Time: Do final 400 grit sand down of body. Start oiling the body for finishing. Start mounting tuners.



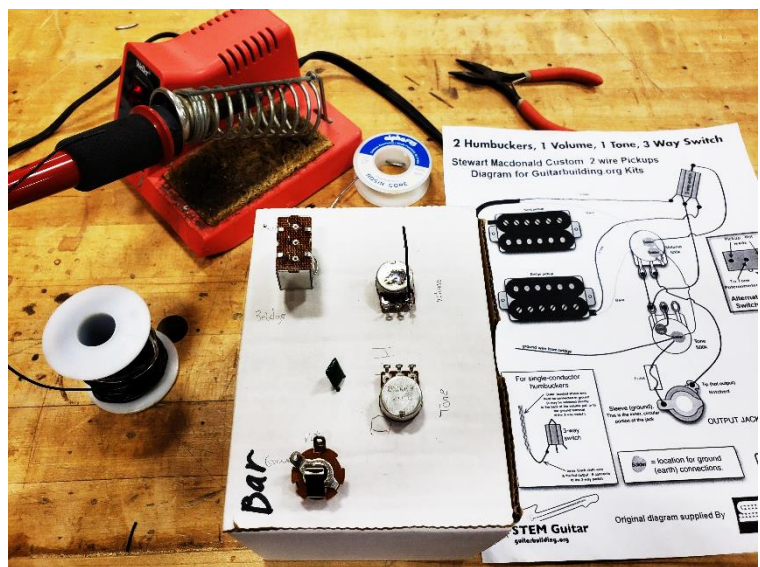
November 14th, 2018

Today's Progress: I did final sanding on the neck and body using 400 grit sand paper to prep the body. I decided to use the Danish oil as the finish for the guitar. I opted out of staining or spraying for a few reasons: first, I do not own any guitars with an oil finish yet; second it is a far easier type of finish. I am using the Danish oil called "Tried and True", since it is environmentally safe and even food safe (in case you do cutting boards or wooden utensils); third, it provides a satin finish. I taped off the fretboard since I will be using a different type of oil to finish the neck (at least for now, I might change my mind later). The application of the oil happened inside of the paint room since it is free of dust. The oil is simply applied with a lint free rag all over the body, making sure to cover every nook and cranny, then wipe off any excess with a clean rag. It requires at least 8 hours to cure before more coats can be applied (I will let it cure for 1 week for this first coat).



Then I moved on to the wiring harness and soldering. I was able to complete everything except the pick-ups since that will be done at the final assembly. I followed the schematic provided for 2 humbuckers with 1 three-way toggle, 1 volume and 1 tone knobs.

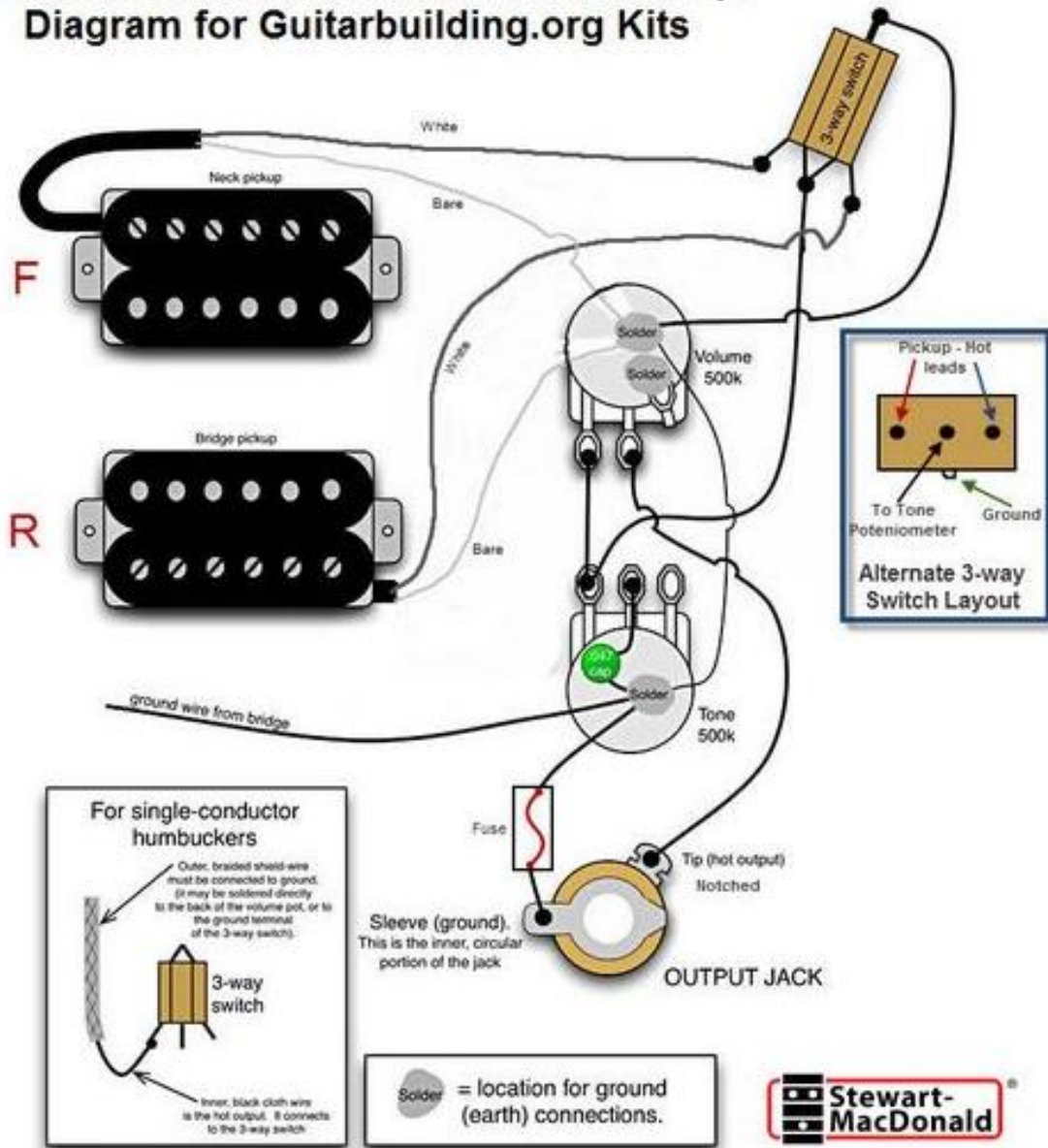
Next Time: Apply another coat of Danish oil. Continue working on the wiring harness.



Wiring Diagram:

2 Humbuckers, 1 Volume, 1 Tone, 3 Way Switch

Stewart Macdonald Custom 2 wire Pickups
Diagram for Guitarbuilding.org Kits



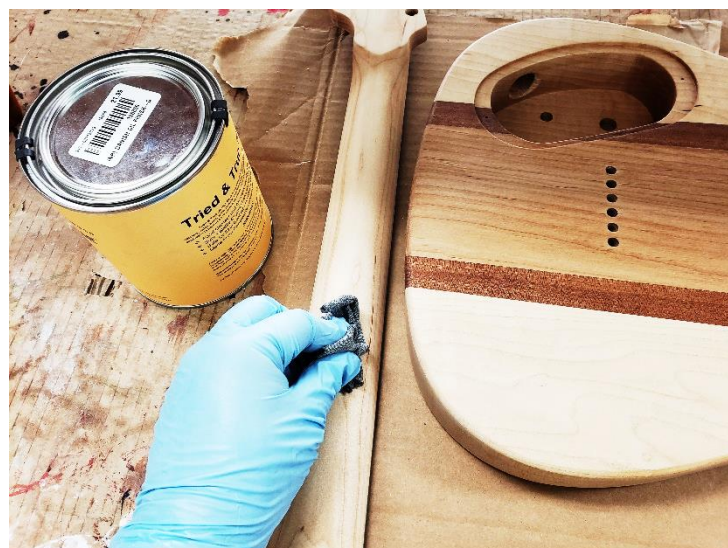
Original diagram supplied By



November 21st, 2018

Today's Progress: The first coat of oil was dry from the previous week, so using some 400 grit sandpaper the whole body and neck was sanded down, and using some 200 grit sandpaper, the horn of the guitar was sanded down to bare wood since there was something in the wood that didn't let the oil penetrate the first time around. After, more predrilling was done to take care of the strap buttons and the jack plate. The tuning head holes were prepped using a reamer to allow easier insertion and to avoid splitting the wood. Finally, a second coat of Danish oil was applied to the whole guitar body and neck.

Next Time: I will burnish the body and neck with 0000 steel wool and apply a 3rd, 4th coat at home during the week and a 5th during class. A 1st and 2nd coat of oil will be applied to the fretboard. New smaller tuning machines were ordered, also metal pickup covers will be added to the existing pickups for cosmetic purposes.



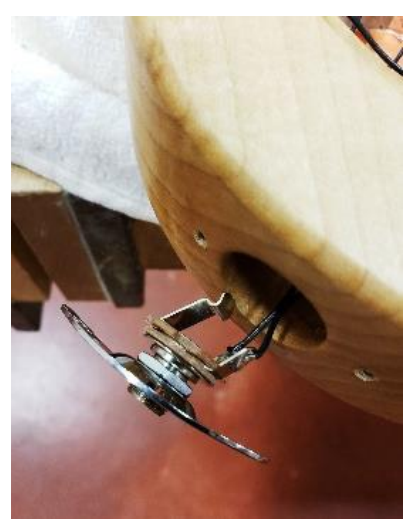
November 28st, 2018

Assembling The Guitar:

Today's Progress: The las few weeks I applied 4 coats of oil onto the body and neck and 2 coats of oil onto the fretboard. Most of the day was spent doing assembly and final predrilling. I will be adding metal covers to the humbuckers (important to note the spacing on bridge pickup is 52mm and neck pickup is 50mm). I shielded the whole electronics cavity and the cover plate with copper. Then I moved on to aligning and installing the tuners using a 5/64" bit. The Nut was inserted into the fretboard, but I had to do slight sanding to get the proper fit. Next, I inserted and carefully tapped in the string ferrules using a nylon mallet. All screws were waxed before insertion to avoid breakage. Then the strap buttons were assembled ensuring the felt spacers are used. Neck was mounted using the metal cover plate and the 4 longer screws. The prewired harness was inserted into the cavity and the jack plate was installed so the output jack of the wiring harness could be mounted (that included mounting the 2 potentiometers and the 3-way selector using the provided nuts and washers). The las step was mounting the fixed bridge onto the guitar, but before that the ground wire was run from the top making sure the wire was striped and spread out in a fan shape to contact the metal bridge.

Next Time: Pickups will be mounted and wired to the rest of the harness. The body will be waxed to protect it. Strings will be installed, and basic intonation will be performed.





December 5th, 2018

Today's Progress: Final assembly day.

Pickup Assembly: I was able to get the pickup covers that match the correct spacing of the humbuckers; they fit so snugly there is enough metal contact to avoid soldering them. Afterwards I mounted the pickup to the plastic mounting rings. I used the taller one at the bridge location, and the shorter one for the neck pick up. (I think I will change the bridge one to a shorter one as well since the one provided in the kit makes the pick-up angle towards the strings. Then it was just a matter of mounting the pickup assembly unto the body with the four screws provided for each. To adjust the height of the pick up use the two screws at either side. Slowly do one side at the time until you are about ¼" from the polepiece to the bottom of the string. Typically the bass string side will be lower compared to the treble strings.

Pick up Soldering: Remember before mounting the pickups to run the wires through the holes made before connecting to the electronics cavity; make sure to mark with tape or some sort of visible mark the neck pickup cable for easy identification when ready to solder. Once all the cables were routed to the same spot, I stripped the main cables of the pickup to separate the ground lead from the hot lead. Because these two cables need to be spread apart, I joined the two ground wires of the pickups to a third extension wire (then soldered and shielded it with electrical tape) to facilitate putting everything to the tone pot for proper grounding. Then the two hot wires we soldered to the pickup selector. After the electronics cover was screwed in with the two screws provided.

Waxing: I waxing the body using some past wax and 0000 wool to add an extra layer of protection. Move in the direction of the grain as you apply it. After letting the wax sit for a few minutes I buffed it with a soft cloth to remove the excess.

Nut installation: To fit the nut in the fretboard it required some sanding on a flat surface to lower the height of it to make it playable. Make sure if you do adjustments to the nut to lightly sand and check for fit before proceeding to remove more material. I installed the High and Low E strings to hold the nut in place and check for clearance between the string and the first fret.

Stringing: Once I was happy with the adjustments, it was a matter of passing the rest of the strings through the ferrules in the back of the guitar out to the bridge and then to the tuning pegs. After that the strings were tune from low to High standard E tuning (E A D G B E) using an electronic tuner plugged to the guitar directly. The new strings need a few minutes and some manual stretching before they hold their tuning properly. After 2-3 cycles of stretching and retuning they should be stable enough to move onto intonation.

Intonation: it is preferable to have a tuner plugged directly to the guitar for this step as to avoid sympathetic vibrations from other strings to mess with this step. First play the open string and make sure it is fully in tune. Then fret the same string an octave higher (12th fret) and see if the same note is flat or sharp. The saddle of the bridge used is adjusted using the Philips screws at the bottom. Using the nut as a datum point: If the note is flat at the octave move saddle toward the nut. If the octave is sharp move saddle away from the nut. You will then retune the open string and repeat the process until both notes are in tune.

Action: To set the action you will use the provided Allen wrench and adjust them until the string are not touching the higher register frets. A string height gage is useful for this step. Typically, the saddles will follow an arch shape with the end strings being lower to the middle strings as to match the radius of the fretboard. The action might change intonation, so it is a good idea to do this step along with the intonation procedure.

Final Touches: The last things to add are the metal knobs for the volume and tone pots by pushing them onto the shaft. Then it is optional to add a string tree or string bar to change the angle of the strings. I will add the roller bearing string tree later as I want to re do the nut with wider spacing for the strings which will change the location of the string tree (I don't want to have multiple holes at the headstock).

Enjoy: After all of that hard work it was exciting and gratifying to plug the guitar into the amp and hear it play for the first time.

