Blues

RESOMASTER

Resonator Guitar Kit

Assembly Instructions

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Table of Contents

Getting started

Welcome to guitar building! You are about to build a great resonator guitar, patterned in many respects after a late-1920s wood-bodied National Triolian.

We designed this kit with the small shop builder and a modest tool budget in mind. For power tools, we used a small laminate router and an electric hand drill. With the exception of a few specialty guitarmaking tools, such as several nut-slotting files, we used standard woodshop hand tools. These included a chisel, rasp, half-round bastard file, small razor saw, a sharp knife, a couple of rulers, and a long straightedge. Of course, we used some clamps (8 cam clamps, 24 spool clamps and 50 clothespins), but that's all.

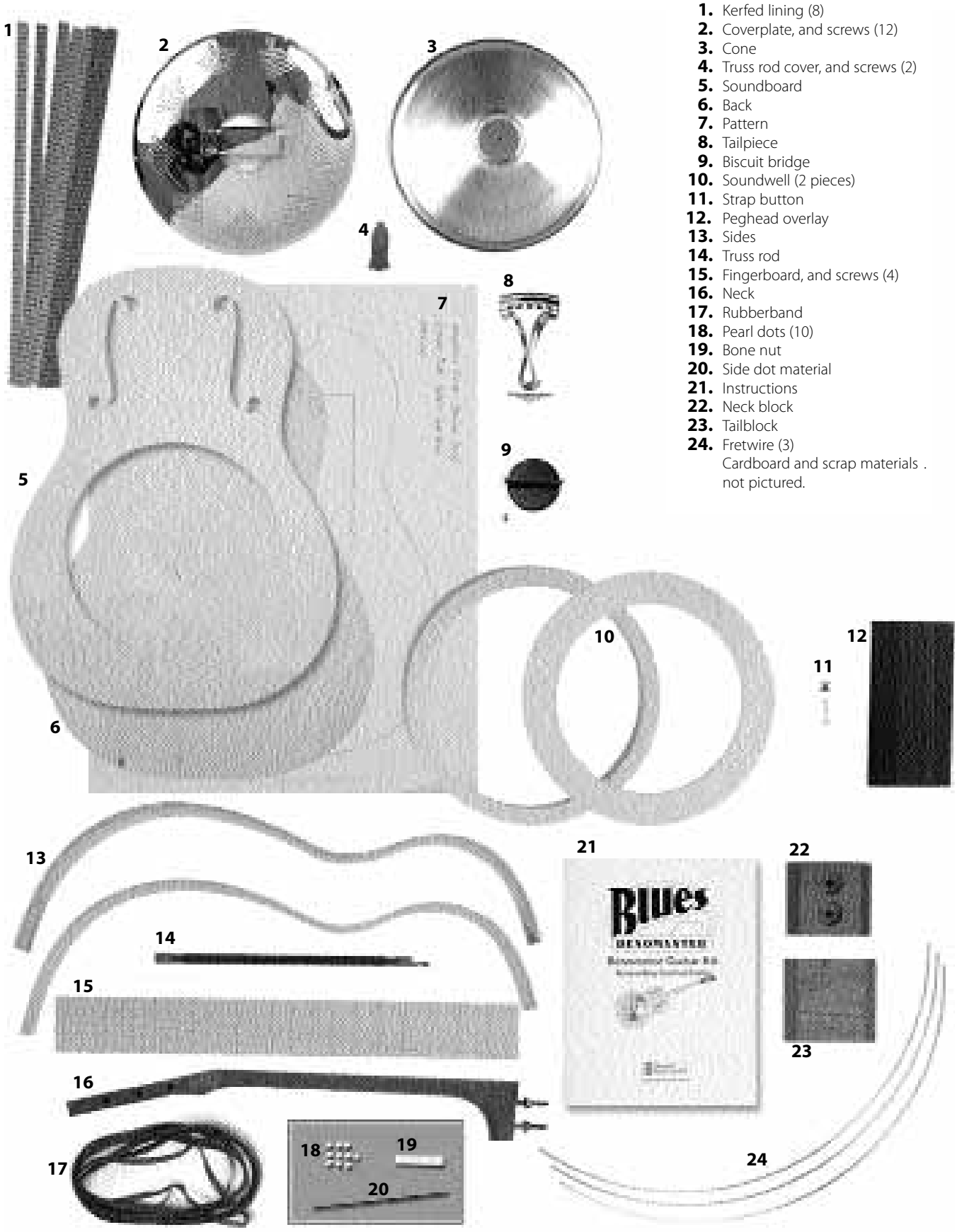
Please read these instructions before building your guitar. It's important for you to "dry run" the fitting, gluing, clamping and finishing operations before trying them for real. Also, it's very important to acclimate the wood to your building environment. The ideal temperature is 70-80° Fahrenheit, with a controlled relative humidity of 45-50%. The kit wood should be laid out and allowed to "equalize" for one week in your shop. Flip the wood daily to minimize excessive warping. Depending upon your location and the season, you may need to humidify or dehumidify your shop to maintain the desired relative humidity. It's a good idea to use a thermometer/hygrometer to monitor your shop's climate (our Digital Hygrometer is accurate and inexpensive). If you're unable to control the relative humidity in your shop, we discourage building the guitar during the transition from dry to wet seasons, or vise versa. The radical change in humidity can cause serious complications from cracks or warping.

Neck assembly and body assembly are two separate processes. So, you can work on the neck while glue is drying on the body, and vise versa. In fact, it's good to have the neck assembled before the back is glued on so that you can test fit it to the body.

Use a flat work board approximately 24" x 36" x 3/4" for keeping the body flat during assembly. Plywood is your best bet, and Baltic birch is an ideal choice. We used a flat basswood drafting board.

Be safe when using tools, glues, and chemicals. Wear eye protection and gloves when needed, and always use proper ventilation.

Kit parts list



1. Kerfed lining (8)
2. Coverplate, and screws (12)
3. Cone
4. Truss rod cover, and screws (2)
5. Soundboard
6. Back
7. Pattern
8. Tailpiece
9. Biscuit bridge
10. Soundwell (2 pieces)
11. Strap button
12. Peghead overlay
13. Sides
14. Truss rod
15. Fingerboard, and screws (4)
16. Neck
17. Rubberband
18. Pearl dots (10)
19. Bone nut
20. Side dot material
21. Instructions
22. Neck block
23. Tailblock
24. Fretwire (3)

Cardboard and scrap materials . not pictured.

Assembling the body

Gluing the sides to the neck block and tailblock

Determine the center of the neck block and tailblock and draw centerlines in pencil on their outer faces (their gluing surfaces) and on the tops and bottoms of the blocks.

The sides are machined with one flat edge (for gluing to the top), and one slightly angled edge for creating the slight taper of the back. These angled edges are not too distinguishable from the flat edges, so they are marked for you (keep track of the marks until the top is glued on).

Place the bent sides on the flat workboard to approximate the shape of your guitar. The top of your guitar will be facing down (either edge of the sides can be used as top or back). One at a time, glue the sides to the neck and tailblock. No trimming to length is necessary; simply butt the ends tightly together on the centerlines penciled on the blocks.

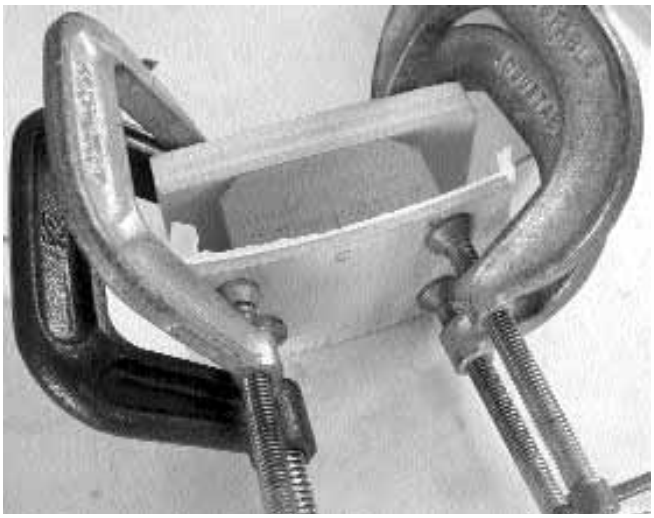
Throughout these instructions we will use clamping "cauls" to protect the wood from clamp marks, and to apply even pressure over a glue joint. The outer (gluing) surface of the neck block is flat, so use a flat caul when you clamp it. However, the tailblock is radiused. The simplest clamping caul for squeezing the sides against the radiused tailblock is a scrap of 1/4" plywood or wall paneling as the outer curved caul, and a scrap wood caul on the backside of the tailblock.

The neck block and tailblock have beveled corners on their inner sides. The inner backing caul at the tailblock should be wider than the block itself, so the clamps put pressure where it's needed to pull the sides into the curve **(1)**. The 1/4" outer caul, being longer than the block, flexes and forms the sides to the block. A layer of wax paper between the sides and the caul will keep them from being glued together accidentally. During gluing, the neck block and tailblock should rest flat on the work surface, flush with the face-down top edge of the sides. A weighted block of wood laid across the sides will help keep them flat on the table during gluing.

TIP: Use a glue brush

Applying glue with a brush eliminates most of the glue squeeze-out because the brush spreads just the right amount of glue. We use flux brushes, inexpensive hardware store items used in plumbing. You can also spread the glue with your finger.

After the neck and tailblocks are installed and the glue has dried, use a 9/32" bit to drill through the sides to open up the neck block's bolt holes. Clamp a piece of scrap wood over the sides before drilling to minimize tear-out as the bit breaks through the fragile side wood.



1. The simplest clamping caul for squeezing the sides against the radiused tailblock is a scrap of 1/4" plywood or wall paneling as the outer curved caul, and a wooden caul on the backside of the tailblock.

Making the inner-body form and waist clamp

The two pieces of heavyweight cardboard supplied with the kit are for creating a guitarmaking form to support the body during the early stages of building.

Using the paper pattern, cut two matching pieces in the shape of the guitar body. Cut carefully on the lines of the pattern, leaving no extra cardboard outside the lines.

Build the cardboard form inside the guitar body. First, place two scraps of 3/4" plywood onto the work surface inside the guitar. This will lift the cardboard form up to make room for the kerfed linings, which will be installed later. Lay the first cardboard piece onto the 3/4" plywood inside the guitar body.

Next, glue several 3/4" thick blocks of scrap wood onto the cardboard, and then glue the second piece of cardboard onto them. Now the two cardboard forms are fastened together with blocks of wood between them, creating a three-dimensional form for supporting the guitar sides **(2)**.

Use the paper pattern to make the U-shaped "waist clamp" from 3/4" plywood. The waist clamp holds the guitar's waist tight to the inner cardboard mold, maintaining a constant shape until the back is glued on.

Use a file to smoothly round the two inner edges of the waist clamp. Square edges wouldn't slide over the tight curve of the guitar sides at the waist, and they could crack the wood.

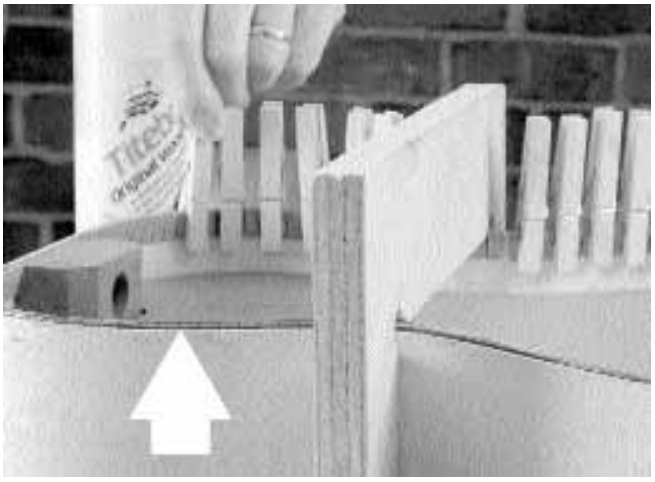
Install the waist clamp from the back side of the guitar. (Later, after the top's installed, you'll switch the waist clamp to the top side.) When sliding the waist clamp on, hold the guitar sides tight against the cardboard form to avoid cracking the sides. If the fit is too tight, remove small amounts from each side of the U-shape until the waist clamp slides snugly onto the waist, but not so tightly that it's hard to remove.

2. The two cardboard forms are fastened together with blocks of wood between them, creating a three-dimensional form for supporting the guitar sides.

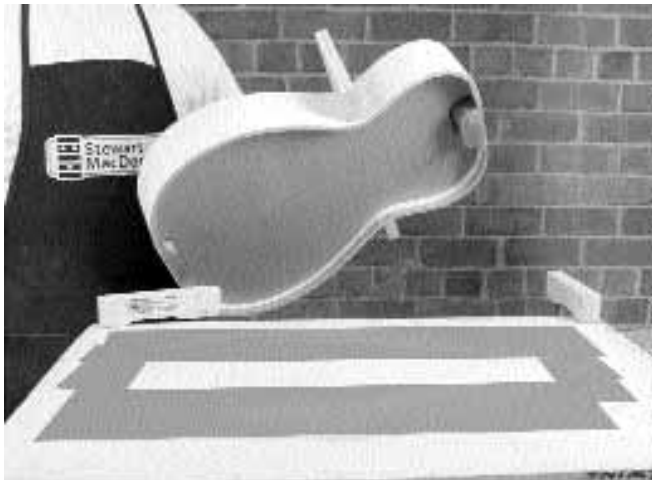
Installing the kerfed lining ("kerfing")

With Titebond glue, and clothespins as clamps, install the kerfing on the top and back. The kerfing should start at the inner edge of the neck block and run to the inner edge of the tailblock. Leave the kerfing raised slightly, approximately 1/64", above the side's edges, both top and back **(3)**. This guarantees that the kerfing will be flush with the top edge of the sides after sanding (as described next), and makes up for any possible misalignment during gluing. In guitar building it's safest to err slightly on the high side — you can always remove wood, but it's hard to put it back! Let the glue dry at least 4 hours.

Apply adhesive-backed 80-grit sandpaper (or non-stick sandpaper and double-stick tape) to an area of the workboard as shown in the picture **(4)**. Don't cover the entire board, just a large enough area so that the kerfing and sides contact the



3. The kerfing is installed with 1/64" exposure above the side's edges.



4. Apply adhesive-backed 80-grit sandpaper (or non-stick sandpaper and double-stick tape) to an area of the workboard.

sandpaper as you move the side assembly, face down, in small circles to level the kerfed lining. Mark the gluing surfaces of the sides, kerfing, neck block, and tailblock all the way around with a pencil. Check your sanding progress often; when the sandpaper begins to remove the pencil marks around the entire top, the kerfed lining will be level with the sides.

TIP: Weighting the rim

Try using a weighted board placed across the top side of the rim for uniform downward pressure **(5)**.

5. Try using a weighted board placed across the top side of the rim for uniform downward pressure.

Installing the top

Choose the best-looking surface of the guitar top as the outside surface. There are two small centering holes at each end of the guitar top. Center a long straightedge on these holes, and lightly pencil an erasable centerline on the top.

Next, glue on the top. THE most important thing you must do is to line up the front (machined) edge of the top with the sides at the neck block. The top and sides must be flush there. This alignment locates the soundwell and determines accurate intonation. There should not be ANY top overhang in this area!

With the waist clamp still installed from the rear, line up the top's centerline with the centerlines you drew on the neck and tailblocks. Start clamping in the waist area, within several inches of either side of the waist clamp, using spool clamps to gently hold the top in place **(6)**. Clamp the tailblock, using two cam clamps or bar clamps and a caul to spread the clamp pressure. Next, clamp the neck block. Use an accurate square to be sure that the neck block is square to the top as you clamp. Use the same type of clamps and caul that you used on the tailblock. Follow with spool clamps spaced evenly around the sides. With spool clamps close on either side of the waist clamp, you should have good glue squeeze-out at the waist. Leave the waist clamp in place, and let the glue dry at least 5 hours.

Remove the waist clamp temporarily to make room for a router. With the top glued on, notice that the sides have gained great stability, even with the waist clamp removed.

6. Start clamping in the waist area, for several inches to either side of the waist clamp, using spool clamps to gently hold the top in place.

Use a flush-cutting ball-bearing router bit to remove the top overhang in the waist clamp area (any slight burnish marks left by the ball-bearing will sand off easily). Later, after the back is glued on, you'll remove the rest of the top overhang. For now, the top overhang will match the back overhang, making it easier to align the spool clamps.

TIP: Spool clamps

Spool clamps can be made using 8" all thread rods, wing nuts, drilled wooden spools and cork or leather lining pads. They're also available in our catalog.

Sanding the back kerfing

Since you need to remove the cardboard inner form before you can install the soundwell, sand the back kerfing now while the body is still relatively rigid.

Re-install the waist clamp from the top side. Place the guitar on the sandpaper workboard with the back side down. Sand the back kerfing flush just as you did the top, until the sandpaper just "kisses" the penciled edge of the sides.

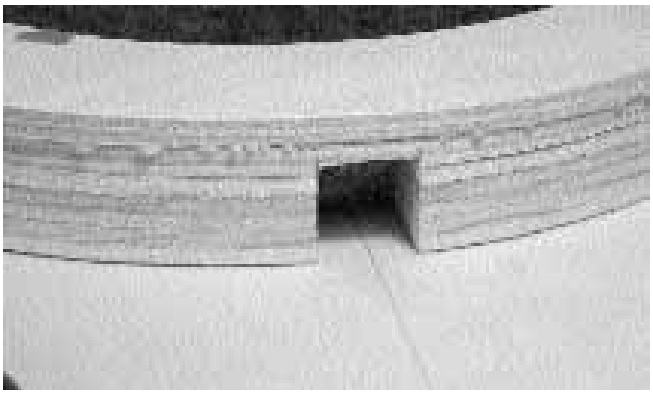
Installing the soundwell

Remove the waist clamp and cut the cardboard inner mold into quarters and remove it.

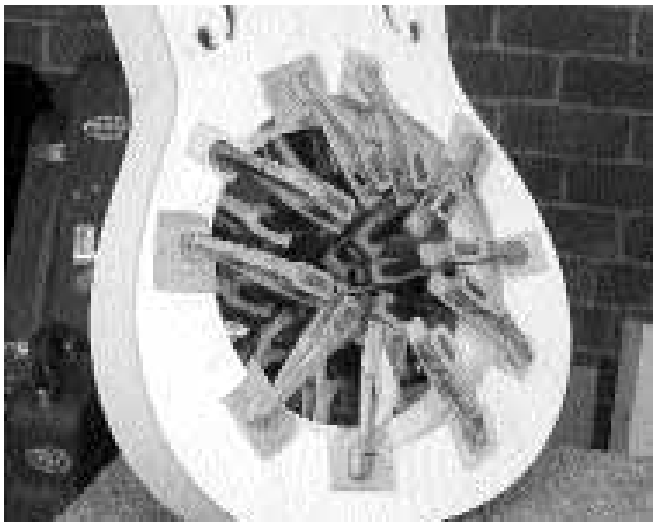
To assemble the soundwell spacer ring, glue the 3/16" ring to the 3/4" ring to create one thick ring. After spreading glue on one surface, align the two rings concentrically, and tap in several small finishing nails to keep the rings aligned as you clamp them. Pull the nails out when the glue is dry. Next glue this thick spacer ring concentrically to the larger soundwell bottom ring (again, the nails help with alignment).

Saw and chisel a 3/4" wide by 3/4" deep notch in the spacer to allow access later for bolting on the neck. Don't cut entirely through the spacer to the soundwell bottom ring. **(7)**

Align the soundwell concentrically with the 9-1/2" hole in the top, and with the sawed notch facing the neck block. With Titebond glue and plenty of clamps, glue it to the top. Use scrap wood cauls to protect the top from the clamps **(8)**. Make a "dry run" of this clamping setup, inspect it carefully, and pencil around the spacer on the underside of the top — refer to the pencil line as you do the actual gluing.



7. Don't cut entirely through the spacer to the soundwell bottom ring.

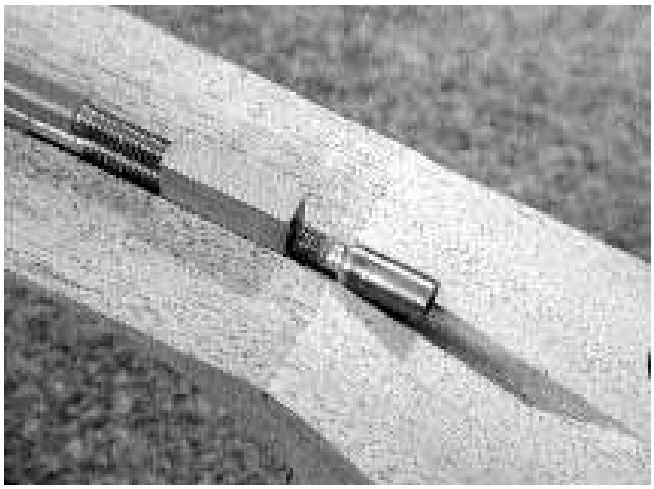


8. With Titebond glue and plenty of clamps, glue the soundwell to the top..

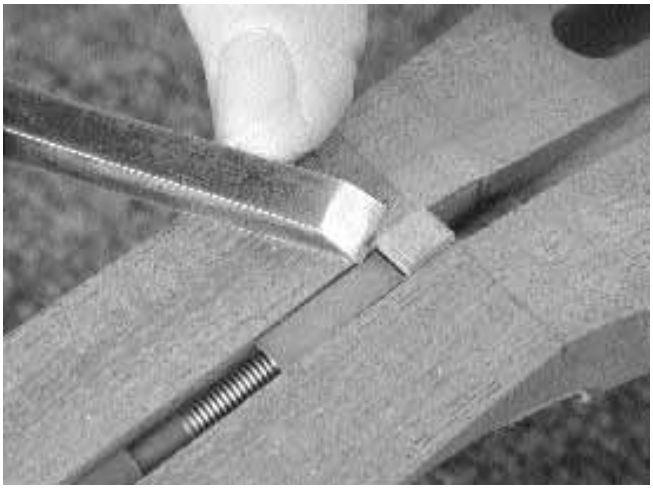
Installing the truss rod

The truss rod is installed so that it adjusts at the peghead end of the neck. This makes it easy to adjust the truss rod under string tension.

Roll the rods simultaneously between your thumb and fingers to adjust them, until the thread in the upper half of the brass lug (the rod without the adjusting nut welded to it) is flush with the face of the lug, and not protruding excessively.



9. Align the back edge of the adjusting nut with the break line of the peghead angle.

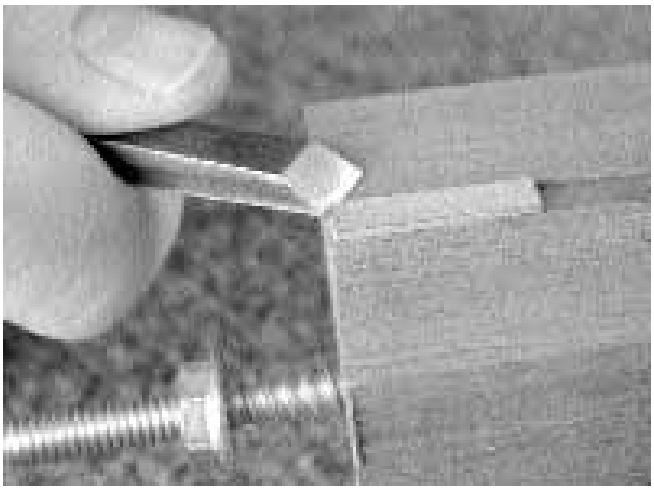


10. The filler strip will support the bone string nut, which will be installed later.

Align the back edge of the adjusting nut with the break line of the peghead angle. **(9)**. This locates the front edge of the truss rod's brass lug just under the end of the fretboard. A flat area of approximately 7/32" will remain between the end of the fretboard and the break angle of the peghead — this is where the bone string nut will be installed.

The adjusting nut is slightly wider than the slot machined into the neck. Chisel a slight clearance in the slot walls until the adjusting nut fits to the bottom of the channel.

Install the rod with the adjusting nut facing down. Glue in a piece of the supplied filler strip over the adjusting nut **(10)** and the exposed truss rod threads, between the brass lug and the rear of the adjusting nut. The filler strip will support the bone string nut, which will be installed later. Of course, keep glue off the truss rod threads. When the glue is dry, chisel the filler strip flush with the surface of the neck. Glue a filler strip at the opposite end of the rod too, to fill the remaining empty channel, and trim it flush **(11)**.



11. Glue a filler strip at the opposite end of the rod too, to fill the remaining empty channel. Trim it flush.

Shaping the fingerboard

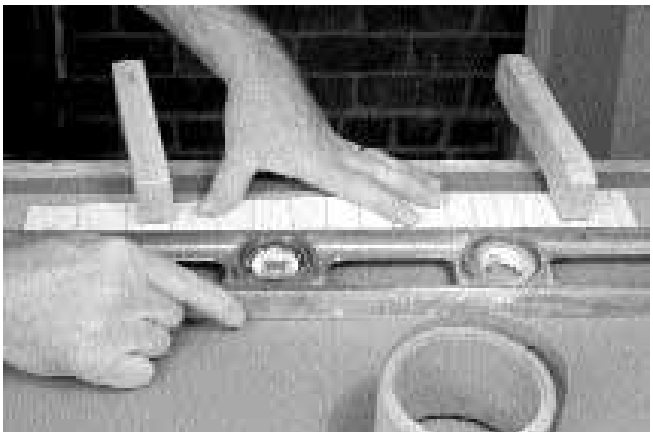
The fingerboard has 24 fret slots, more than are needed for a resonator guitar. Trim off the fingerboard at the 20th fret slot.

Draw a pencil line across the back of the fingerboard to mark the location of the 12th fret slot. The end of the neck's fingerboard gluing surface, at the top of the heel, will line up with this mark when the fingerboard is glued on. Align the heel with the mark, center the neck on the fingerboard, and draw the profile of the neck onto the fingerboard **(12)**. Extend the lines using a straightedge and white or yellow-lead pencil.

Trim the fingerboard profile close to the pencil lines using a band saw, coping saw, or a hand plane.

The edges of the fingerboard must be smoothed after they're trimmed. On your flat work surface, rest the fingerboard, backside down, on a spacer block approximately 1/4" thick and as long and wide as the fingerboard. Slide the fingerboard slightly off the edge of the spacer block so that one long edge overhangs.

12. Draw the profile of the neck's taper onto the fingerboard using a white pencil.



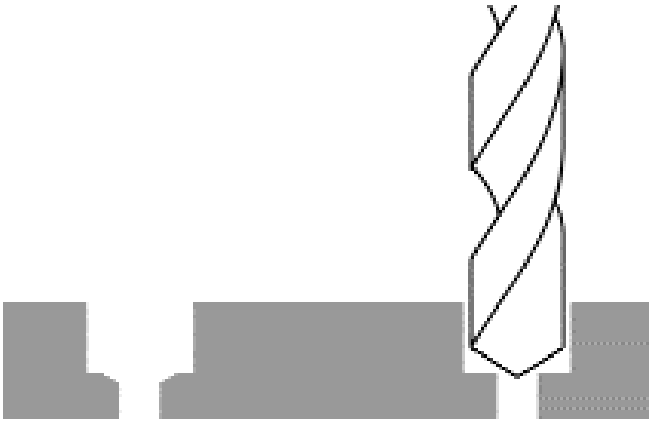
13. Clamped and sanded in this fashion, the fretboard will not only be straight end-to-end, but the edge will be sanded at 90°.

With a long flat sanding block, sand the overhanging fretboard edge lengthwise to remove any trimming marks. We used a carpenter's level with 100-grit sandpaper double-stick taped to its thin edge. Clamped and sanded in this fashion, the fretboard will not only be straight end-to-end, but the edge will be sanded at 90° to the work surface. **(13)**. Reverse the procedure for the other edge of the fingerboard.

Clamped and sanded in this fashion, the fretboard will not only be straight end-to-end, but the edge will be sanded at 90°.

Inlaying the fingerboard

Traditionally, single dot inlays are installed behind frets 5, 7, 9, 12, 15, 17, and 19. Frets 15 and 19 get two inlays each. These will cover the four mounting screws that hold the fingerboard to the top. You won't inlay frets 15 and 19 until later, after the guitar is finished.



14. Create chamfers within the four 1/4" holes using a 7/32" twist drill.

Lightly draw a centerline down the fingerboard in pencil. Use an awl to mark for drilling along this centerline, measuring halfway between the appropriate frets.

Drill 1/4" holes for each inlay, using a brad-point drill bit. Go *slightly* deeper than the thickness of the dots. Be extremely careful to keep the drill bit from "hogging" into the wood and accidentally drilling completely through the fingerboard (practice on scrap)!

As mentioned, frets 15 and 19 are drilled for double inlays. They're spaced 1-3/8" apart (11/16" to each side of the centerline), and should be centered between the frets.

Within the four 1/4" holes, just barely start a secondary hole with a 7/32" twist drill (not a brad-point). These secondary holes bevel the bottom of the 1/4" holes to form the right shape for the fingerboard mounting screws. These holes are difficult to drill without overdoing it, so practice on scrap! This chamfering is very delicate; the slightest turn of the drill bit will produce the desired shape.

Next, drill 1/8" holes through these chamfered holes at frets 15 and 19, for the four mounting screws to pass through the fingerboard during final assembly after finishing.

Put on your protective safety glasses! Then, one at a time, place a drop of medium-viscosity superglue in each drilled hole and set the dot inlay in place. By using a piece of clear acrylic as a caul (lightly waxed with paste-wax), you can apply pressure without sticking to the superglue, and still be able to see when the inlay is flush. Remember not to inlay at frets 15 and 19! You may need to tap gently on the caul with a hammer to seat the dot inlays. Don't overdo the superglue, and you won't have a messy fretboard to clean up. Flush the inlays to the fingerboard using a smooth mill file and a sanding block. Sand equally from end to end so you don't change the flat surface of the fretboard.

Installing side dots

A 1/16"-diameter plastic dowel is included with your kit for making side dot fret position markers along the bass edge of the fingerboard (for right-handed players, that is). Install them now at frets 5, 7, 9, 12, 15, 17, and 19. The 12th fret often gets two dots, spaced evenly between the 11th and 12th frets, but some makers use only one. Often, side dots are not used past the 12th fret — the choice is yours.

Clamp the fretboard on edge, mark the centers of each hole with an awl, and carefully drill the holes with a sharp 1/16" drill bit. Drill square to the fingerboard edge at all times. Nip short lengths from the plastic inlay dowel and superglue them into the drilled holes — they should extend slightly above the surface. When dry, file and sand the dots smooth.

TIP: Re-sand the fingerboard edges

Clamp the fingerboard back on the spacer block used earlier for truing the edge of the fingerboard, and re-sand the edges lightly with the carpenter's level and 220-grit sandpaper.

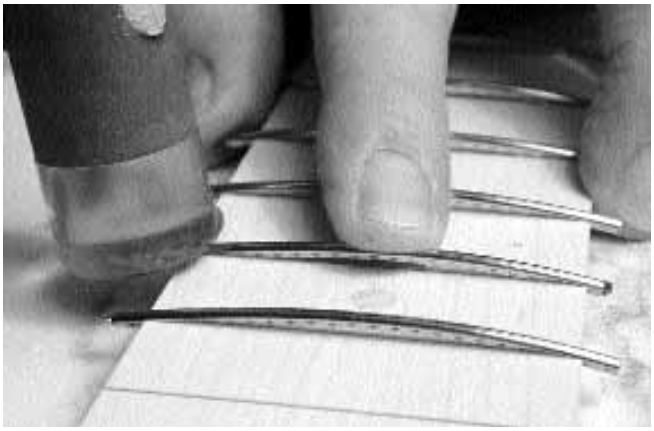
Fretting the fingerboard

A scrap piece of slotted fretboard has been included with your kit, as well as enough fretwire to practice fretting on this piece. Measure out the frets you will actually use on your fretboard, and use the leftover fretwire to test your skills on scrap.

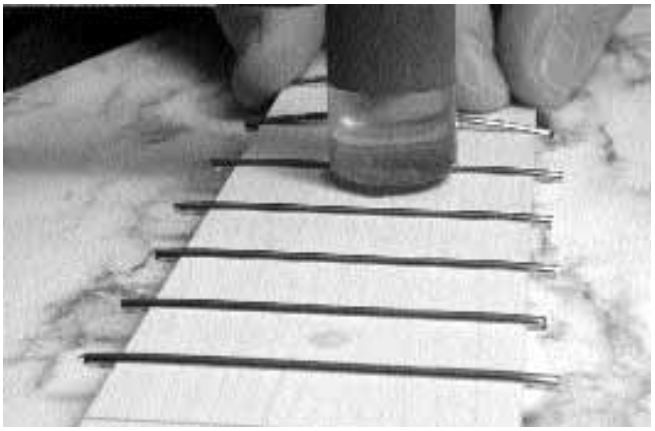
Drill 19 holes in a block of scrap wood to keep the frets in order as you cut them to length. Using flush-cutting fret nippers, cut the pre-radiused fretwire to length, allowing an overhang of 1/8" on each side of the fingerboard.

Clamp the fretboard flat to a solid surface. We fretted on a flat, 1-1/4" thick chunk of marble. A piece of plywood resting on a cement floor would work well, too. Set the fretwire on the slot; since it's curved, only the ends will enter the slot. With your finger, balance the wire to keep it from tipping and prying up a chunk of wood as you tap the two ends into the fret slot with a hammer **(15)**. When the two fret ends are embedded in the fret slot, the fret is unlikely to tip as you hammer it home.

Keep the wire from tipping and prying up a chunk of wood as you tap the two ends into the fret slot with a hammer.

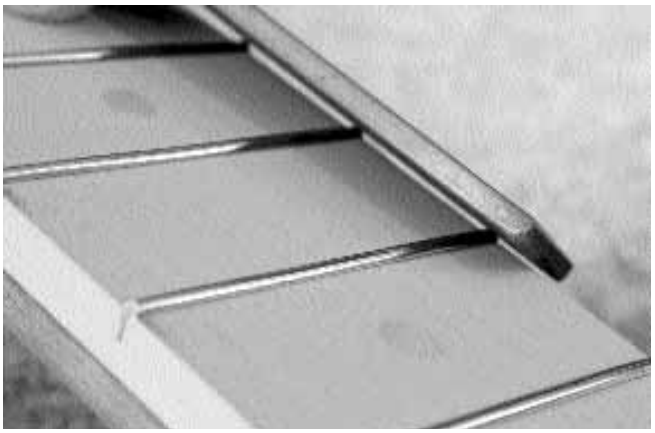


15. Keep the wire from tipping and prying up a chunk of wood as you tap the two ends into the fret slot with a hammer.



16. The fret tang, with its diamond-shaped barbs, embeds itself into the fingerboard as the fret straightens.

17. Just like Leo Fender did for 50 years, we opted to tap the frets over sideways slightly.



18. Use a smooth mill file, held at an angle, to bevel the fret ends.

Hammer back and forth across the fretboard in short, sharp blows. Use the face of the hammer, not an edge, and try not to hit the fretboard on either side of a fret. The fret tang, with its diamond-shaped barbs, embeds itself into the fingerboard as the fret straightens end-to-end from the hammer blows. **(16)**

See that the frets are seated by prying on an overhanging end with your fingernail. Loose frets can be firmed up with superglue run into one end of the fret slot. Keep the fretboard tilted at an angle to keep the glue from getting onto the fretboard. Or, you can tape off the fretboard on each side of a slot and run a bead of Titebond into the slot before hammering in the fret. If you use Titebond, let the frets dry overnight before nipping and filing their ends.

Just like Leo Fender did for 50 years, we opted to tap the frets over sideways slightly (perhaps 1/32") — this *really* seats the frets since the barbs move sideways and seat into the wood. Clamp the fretboard tight to a solid surface, and tap with a punch and hammer. **(17)**

When the frets are firm and the glue is dry, nip them almost flush with the fingerboard edge. Do not nip right up to the edge, or the nippers will pull into the fingerboard and possibly unseat a fret end.

Use a smooth mill file to flush the fret ends to the edge of the fingerboard. Then use the same file, held at an angle, to file the fret end bevels **(18)**. Choose a bevel that suits you — perhaps between 45° and 60°. Stop when the file hits the wood.

Blunt the top edges of the fingerboard on the bass and treble sides with a single-edge razor blade. Later, when you glue on the fingerboard using a rubber band clamp, there will be no sharp edge to break the rubber band.

The fingerboard is now ready to be glued to the neck. First, however, check the fit of the neck to the body before gluing on the fingerboard.

Fitting the neck to the body

Before gluing on the fingerboard, you must slightly undercut the "cheeks" (the backside of the neck heel), where they meet the sides. This is because the sides and neck block area have approximately a 12" radius that is more curved than the neck heel. Viewed from the side, the neck's heel is machined to the correct angle for a good neck set-to-saddle angle, but viewed from above, it is not machined to the 12" radius. The final neck fit must be made by hand, using a sharp chisel. It is not hard to do. Chisel carefully near the two neck bolts — don't push your chisel toward the bolts! Remove the last bit of wood around the bolts using a throw away item such as an X-acto blade (or sharpen an old screw driver blade, and hack away).

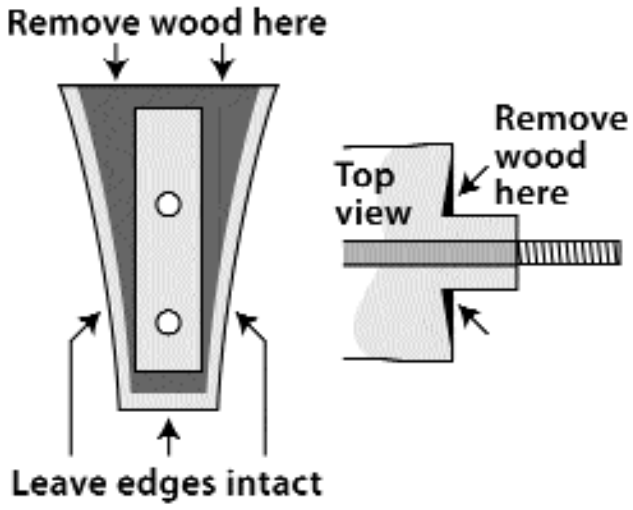
Pencil a 12" radius on the neck from tip to tip of the cheeks, and also a line 1/8" wide down each cheek and across the bottom of the heel **(19)**. This "land" — from the pencil line outward to the edge if the cheeks — should remain untouched. However the area in between the pencil lines must be chiseled away **(20)**. Your goal is a snug fit between the land of the cheeks, and the sides.

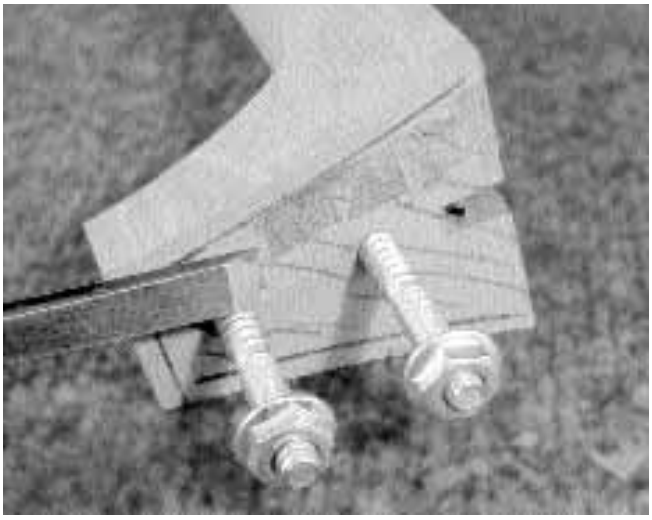
If you keep the body square during assembly, and never touch the outer edges of the cheeks, then the neck-fit — and proper angle of the neck to the body — should be correct. You can check to see if the neck angle is correct even before installing the fretboard. If you need to chisel or file to make an adjustment of the cheeks, it's easier to do without the fingerboard extension in the way. (Also, as described on page 15, if more than a tiny bit of wood is removed during neck fitting, the intonation could be changed. If the fingerboard is not installed yet, you can adjust for that before gluing it on).

Bolt the neck onto the body for a trial run. First "dry clamp" the fingerboard into position on the neck (we used two rubber-tipped spring clamps), and clamp the fretboard flush to the top as you tighten the two hex nuts from inside.

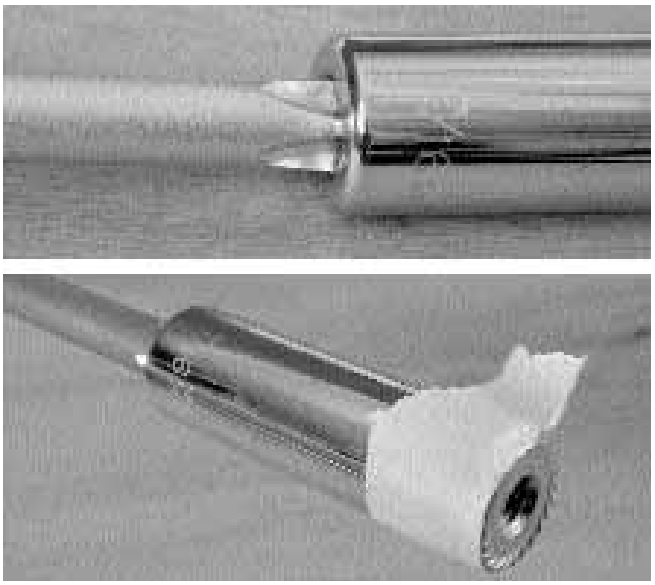
It's good to practice bolting on the neck like this while you can see the bolts, so the job will be easier when the back is on. You'll need a long-handled 7/16" socket driver.

19.





20. The area in between the pencil lines must be chiseled away.



21. We made a long-handled nut driver from a deep-well, square-drive 7/16" socket, and a #3 Phillips screwdriver that fit the 1/4" drive perfectly.

Don't use a socket wrench with a right angle drive to tighten the nuts onto the neck bolts — you could get too much torque and possibly crack the heel, or pull a bolt out of the heel!

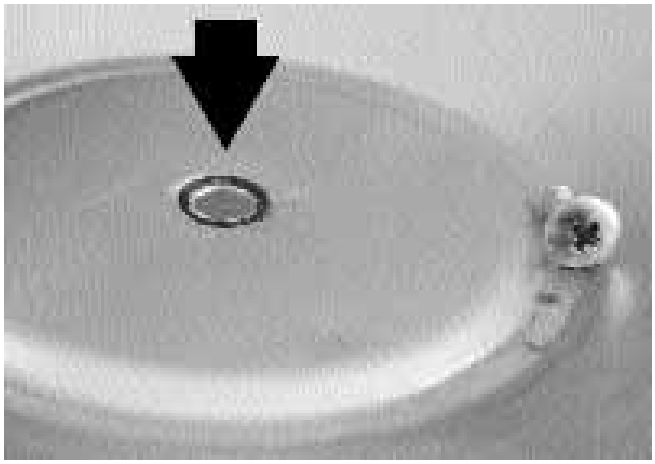
Instead, make your own nut driver as we did. We made a long-handled nut driver from a deep-well, square-drive 7/16" socket, and a #3 Phillips screwdriver that fit the 1/4" drive perfectly **(21)**. Use tape to hold the socket onto the screwdriver shaft. The amount of pressure you can apply with your thumb and fingers is probably plenty.

Fasten the biscuit saddle to the cone

To check that the neck angle is correct you'll need to have the cone and biscuit/saddle in the soundwell. Use the supplied small screw and washer to fasten the biscuit to the cone. First, be sure to thread the hole in the biscuit with the screw before actually connecting the cone to the biscuit.

Mark a small circle around the screw hole in the underside of the cone; this will help you be certain that the screw and washer are centered on the hole as you tighten the cone to the biscuit **(22)**.

Gently tighten the biscuit until snug. (You should still be able to turn the biscuit on the cone at this point.)



22. Mark a small circle around the screw hole on the underside of the cone.

The straightedge test

With the neck bolted to the body, and the cone resting in the soundwell, rest a long straightedge on the frets and project the straightedge to the saddle. If the bottom of the straightedge meets the saddle approximately 7/32" to 1/8" up from the biscuit your neck angle is correct.

Understanding the neck joint

The following information is excerpted from the instructions included with our Acoustic Guitar Kit. We revised the text for use in our Blues Resomaster kit. This may be more information than you're likely to need, but if you happen to get into neck alignment problems, the principles outlined here will come in handy. Use this information to adjust the angle of the neck in any direction.

The neck heel sets the neck angle

Ideally, the top and sides of your guitar are square to each other: meeting at a 90°angle, especially at the neck block. When they are square, a minimum of hand fitting is needed to get the proper neck set (the angle of the neck/body joint). However, it's not uncommon to find that some adjustment is needed in setting the neck. The neck angle is controlled by the shape of the neck heel as it contacts the sides of the body. Removing wood from the top or bottom of the neck heel tips the neck forward or back. Removing wood from either the bass or treble side changes the neck's angle in relation to the center of the bridge.

Shaping the neck "cheeks"

The two roughly triangular surfaces on either side of the neck mounting bolts are called the "cheeks" of the neck heel. The top edge of the cheeks is the pivot point between the neck and body. This controls the neck angle as viewed from the side. These cheeks are flat, but the guitar sides they contact are curved: the guitar has a 12" radius at the neck block. Most of the handwork in fitting a neck is cutting away the inner part of these cheeks to fit this radius. Only the outer edges of the heel make contact with the body, and these edges set the neck angle.

The contact area of the heel is an area about 1/8" to 3/16" wide around the outer edges of the bass side, treble side, and bottom of the cheeks. Mark this area on the heel with a pencil. Using a sharp chisel, remove wood from the remaining inner area up to the tenon.

After undercutting the cheeks this way, you should have a neck fit that is very close. Still, you may need to remove a little wood from the outer contact edges to adjust the neck alignment. Removing wood from the upper part of the neck cheek edges will raise the neck; removing wood from the bottom will lower it. Taking wood from either side will move the neck in that direction.

It's important to note that removing wood from the upper part of the neck cheek edges will not only raise the neck, but will also move the neck toward the bridge slightly. If the 12th fret moves toward the bridge the intonation will be sharp: this is the reason for checking the neck's fit before installing the fingerboard.

Neck adjustment: side-to-side

The first area that may need to have a small amount of wood removed is the treble or bass cheek. Wood removed here controls the side-to-side alignment of the neck to the centerline. If the neck is misaligned side-to-side, one of the two outside strings will be too close to the edge of the fretboard. The removal of a tiny amount of wood is all it takes to make an adjustment here. Remove this bit of wood uniformly across the contact area on one cheek to tip the neck in the proper direction (this won't change the neck angle when viewed from the side of the body). To check the alignment, use a long straightedge laid against both the treble and bass sides of the fretboard and extending to the centerline of the top at the tailblock end: the straightedge should measure the same distance from the centerline on either side.

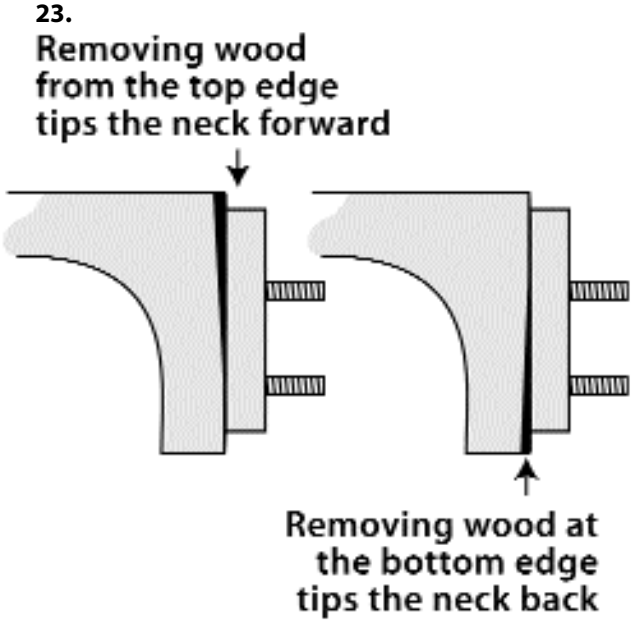
You may not need to make an adjustment at this stage. If the neck is off-center by only 1/32" or less, don't try to correct it. Remember that a tiny bit of wood removal makes a big difference in the neck 's relationship to the centerline!

Neck adjustment: tilting the neck back

Removing wood from the bottom of the heel on both the treble and bass sides equally will tip the neck back **(23)**. This is the most common adjustment. Remove the wood in a wedge shape, which tapers to zero at the top edge of the cheeks.

Use the formula in "Understanding neck angle geometry" to determine how much wood to remove. With a sharp pencil and a straightedge, mark the area to be chiseled away in a straight line from the bottom of the heel to the zero point at the top. Continue this line across the heel cap and up the opposite side. These lines may be tricky to draw, because they must taper away to nothing — to the zero point at the top of the heel.

23.



With a sharp chisel, remove about half of the measured amount of wood. Don't overdo it: set the neck into the body and check the fit. You'll finish the shaping with sandpaper — preferably 100-grit emery cloth (cloth-backed sandpaper). Loosen the neck joint and slide a strip of this sandpaper or emery cloth between the heel cheek and the body, with the abrasive side facing the cheek. Slide the strip almost — but not quite — to the top edge of the heel (this top edge should be left intact). Hold the heel against the guitar body and pull the strip out toward you. This removes a little bit of wood while conforming to the shape of the guitar body. Shake the sawdust off the sanding strip and repeat the procedure on the opposite cheek. Sand equally from side to side. If you need to remove a lot of wood, make two or three passes before changing to the other cheek. The fit will change rapidly, so check your progress frequently.

A small ledge of unsanded wood will remain on the bottom of the heel between the sanded cheeks. Either "pull-sand" it with the strip, or use a sharp chisel to remove it.

Neck adjustment: tilting the neck up

Wood is seldom removed from the top of the heel, but if the neck block was mistakenly tipped forward when glued in place, the neck may be "overset" too far away from the body. In this case, the straightedge laid on the fretboard will extend above the bridge. Removing wood from the top of the heel on both the treble and bass sides equally will bring the neck up so the straightedge comes down to the top of the bridge (pictured).

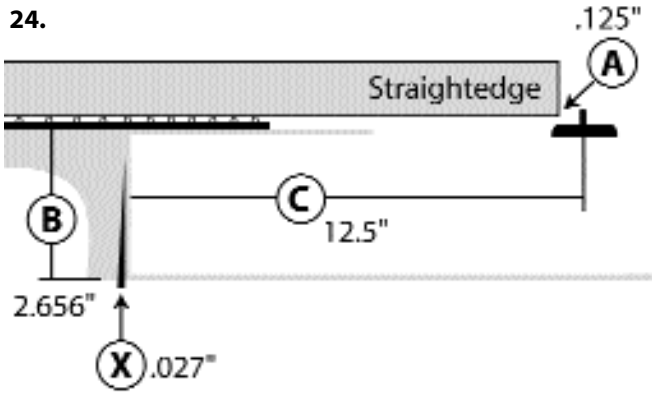
Use the formula in "Understanding neck angle geometry" to determine how much wood to remove. With a sharp pencil and a straightedge, mark the area to be chiseled or sanded away in a straight line from the top of the heel to the zero point at the bottom. Repeat this line on the opposite side.

Understanding neck angle geometry

Here's the way to determine how much wood must be removed from the heel for the correct neck angle at the bridge. Always remove wood gradually and check your progress frequently. A little adjustment goes a long way! Our example measurements below are based on the scale length of this guitar: 25 inches.

The measurement we want is — the amount of wood to remove from the heel to change the neck angle so that a straightedge laid on the frets will be flush with the top of the bridge. **(24)** Must install the cone and biscuit bridge here first.

24.



A = How far the straightedge falls below the top of the bridge. In this example: 1/8" (.125").

B = The height from the bottom of the fretboard to the bottom of the heel. In this example: 2-21/32" (2.656").

C = The distance from the neck/body joint to the saddle. In this example, that's at the 12th fret, and **C** = 12-1/2" (12.5").

X = **A** x **B** (÷) **C**

In this case, those numbers are .125" x 2.656" ÷ 11.375" = .029". So in our example **X** = .027" which is almost 1/32". This is the amount to remove at the bottom of the heel.

Intonation check

When you build a standard acoustic guitar the bridge is glued on last, so you can move it to position the saddle for good intonation. Resonator guitars are different because the saddle position is determined by the fixed location of the cone resting in the soundwell. The cone, and saddle with it, can be moved forward or back about 1/16" within the soundwell, but that's it. You can guarantee good intonation, however, by careful placement of the fingerboard.

If you removed wood from the top of the cheeks when you fit the neck, you altered the intonation to some degree. In this case, when the neck fit passes inspection, leave the neck bolted into the body to check the lengthwise placement of the fingerboard, specifically the location of the 12th (octave) fret in relation to the saddle. This relationship makes for good or bad intonation.

Since you haven't glued the fingerboard on yet, you can slide it forward or backward a little, to control the distance between the 12th fret and the saddle. You also have a little adjustment at the saddle, since the cone will slide forward or back about 1/16".

If you slide the fingerboard, the flat area where the string nut is located will become wider or narrower, and you'll need to fit the nut accordingly. Also, the fingerboard edges may no longer be perfectly flush with the sides of the neck. Simply shape the edges of the fingerboard and neck to match, using a file and sandpaper.

If minimal wood was removed at the cheeks, locate the fingerboard so that the 12th fret lines up with the point where the neck cheeks join the body. At the peghead end there should be approximately 3/16" of flat area left between the end of the fingerboard and the break angle of the peghead. This is where the bone nut will rest, and it may be as large as 1/4" or as small as 1/8" if the fingerboard is moved forward or backward for intonation adjustment.

To get accurate intonation, the distance from the 12th fret to the saddle should be approximately 1/8" longer than the distance from the 12th fret to the nut. Since your guitar's scale length is 25", the distance from the 12th fret and the nut is 12-1/2". Add 1/8" to get the desired distance from the 12th fret to the saddle: 12-5/8".

This extra 1/8" is called "compensation," and makes up for the slightly longer string length caused by the strings as they rise to the saddle, and for the fact that strings tend to go sharp when they are pressed down to the fret. If you located the saddle at the uncompensated distance from the 12th fret, the intonation would be sharp.

Center the cone in the soundwell. Locate the 12th fret by loosening the spring clamps and sliding the fingerboard forward or backward until the 12th fret measures the compensated 12-5/8" distance from the center of the saddle. When the 12th fret is where you want it, and with the spring clamps holding the fingerboard on, place a piece of masking tape on the neck surface at the nut end of the fingerboard. Use this tape as an index to butt the fingerboard against when you glue it on.

When all the neck-fitting and fingerboard-locating tasks are complete, unbolt the neck from the body and glue on the fingerboard.

Final assembly

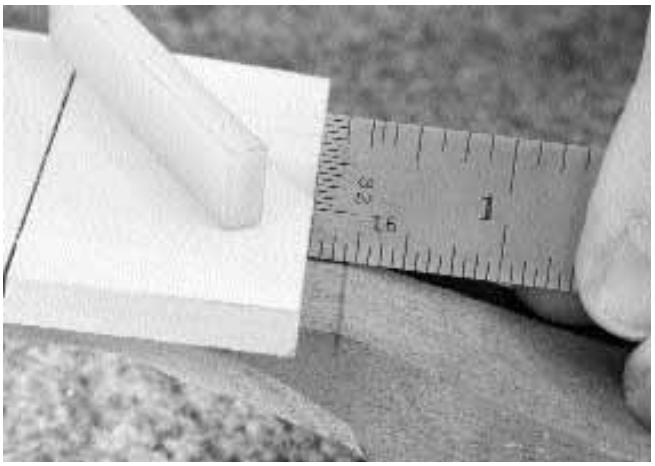
Installing the fingerboard

Clamp the peghead to your workbench with the neck hanging out over the floor. Butt the nut end of the fingerboard up to the tape that you placed on the neck's gluing surface earlier as an index.

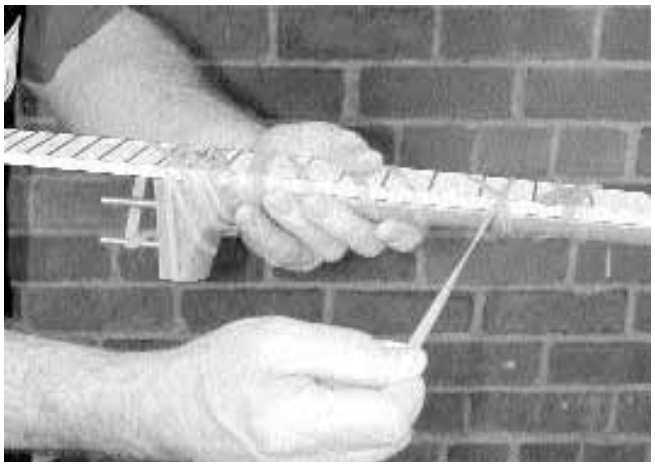
There should be a flat area approximately 3/16" to 7/32" wide left between the end of the fingerboard and the break angle of the peghead. This is where the bone nut will rest **(25)**.

Install the fingerboard with Titebond glue. To get just the right glue coverage, spread it with a flux brush. Work the glue up to the edge of the truss rod channel, and then draw it away from the edge with the brush to keep glue squeeze-out away from the channel.

Place the fingerboard onto the neck surface and center the 12th fret slot directly over the edge of the neck heel. Hold the fingerboard in place temporarily with a spring clamp **(26)** as you start to wrap with the rubber bands supplied with your kit. Tie the rubber band at the peghead and wrap from end-to-end and back again. Get plenty of wraps on the heel. You may find that one rubber band is all that's needed for the job. You can a shift the fingerboard slightly from side-to-side as you wrap, but usually the board will center itself nicely.



25. The bone nut will rest on the flat area approximately 3/16" to 7/32" wide left between the end of the fingerboard and the break angle of the peghead.



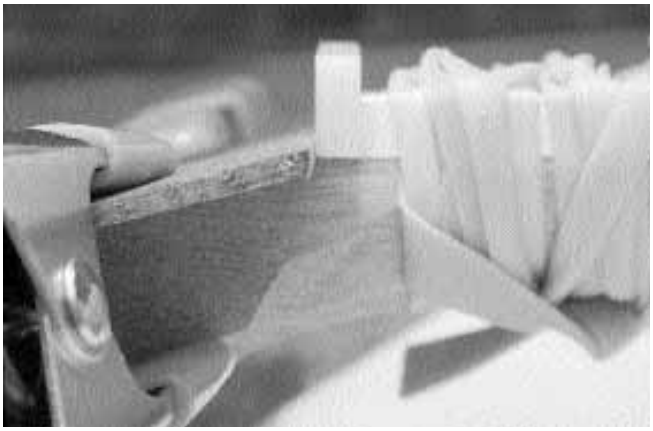
26. Hold the fingerboard in place temporarily with a spring clamp as you start to wrap with the rubber bands supplied with your kit.

Installing the peghead overlay

When the fingerboard's dry, remove the rubber band clamp.

The bone nut blank should be smooth-surfaced, square-bottomed, and of uniform thickness. If it needs smoothing or thicknessing, sand it with 100- and 220-grit sandpaper, double-stick taped to a flat surface.

Place the nut blank on the flat ledge which remains between the end of the fingerboard and the break angle of the peghead. File or sand a 14° angle on one end of the peghead overlay so that it butts flush to the back edge of the nut **(27)**. Once the overlay is glued on, the space between the overlay and the fingerboard will be a perfectly-sized channel for the nut.



27. File or sand a 14° angle on one end of the overlay so that it fits flush to the nut.

Dry-clamp the overlay in place. With a pencil, mark a point 1-9/16" from the back edge of the nut, centered on the peghead's width. Drill a 1/4" hole at that point. This is the access hole for the truss rod.

Remove the clamps from the overlay. Hold the overlay in one hand and elongate the hole by slowly tilting the overlay against a running drill bit **(28)**. You may want to practice this on a piece of scrap (plenty of excess overlay will be trimmed away, so practice on that). You'll end up with an elongated access hole for the 1/8" Allen wrench that adjusts the peghead.

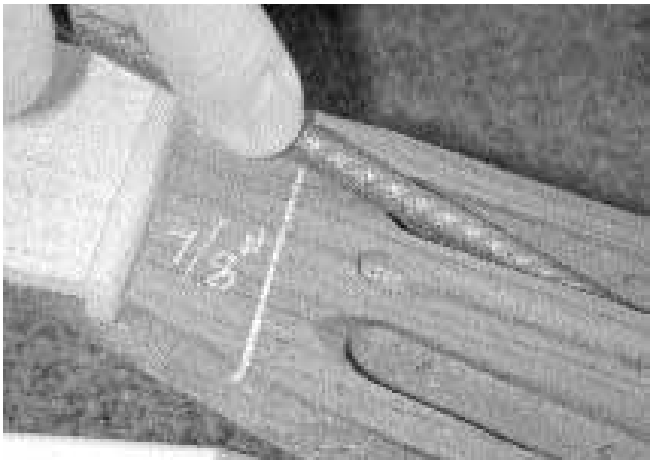
Mark the peghead shape on the overlay. Trim away most of the excess, to within 1/8" all around the peghead. Use cauls on the face and rear of the peghead, and glue on the overlay (you may want to cut a "V" shape into the caul for the rear of the peghead, to clear the diamond shape on the neck). Keep the overlay pressed tightly against the nut during alignment.

When the glue's dry, clamp the peghead firmly, face down, on a scrap of plywood. Use a 7/16" bit to drill holes against each end of the tuning machine channels (the channel will keep the drill bit lined up), and then drill several holes in between these holes in the remainder of each channel to eliminate as much of the wood as possible.

Saw, chisel, and file away the chaff left by drilling, until the channel walls are smooth. Then carve and file ramps at the nut end of each channel, so the strings don't rub the wood on their way to the tuning posts. The shape of the ramps is up to you, but they extend approximately 1" to 1-1/8" from the back side of the nut **(29)**.

Carve and file away the overhanging peghead overlay, and then sand the peghead face and sides smooth with 150-grit Fre-Cut® sandpaper.

28. Hold the overlay in one hand and elongate the hole by slowly tilting the overlay against the running drill bit.



29. Carve and file ramps at the nut end of each channel so the strings don't rub wood on their way to the tuning posts.

Fitting the tuning machines

The tuner holes are pre-drilled with a distance between the tuning post centers of 1-3/8". This is a common measurement, and a variety of tuners will fit this hole spacing.

Set your tuners in the peghead, and use an awl or other sharp tool to mark the mounting screw holes. Remove the tuners, and drill the holes with a 1/16" bit. Mark the drill bit with a piece of masking tape as a depth stop.

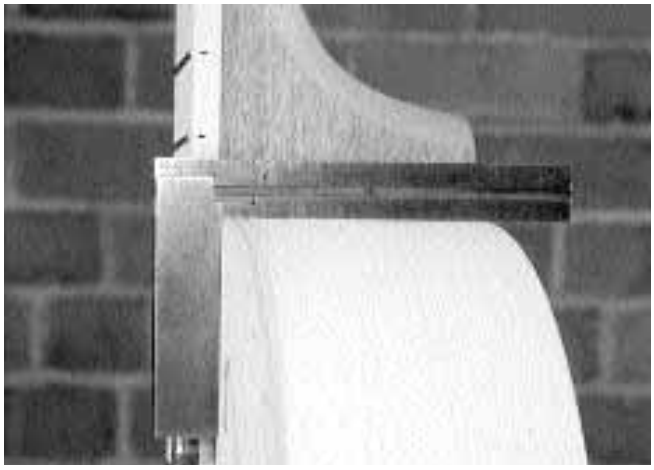
You may need to cut off the end of the tuner mounting screws if they're too long for the thin outer walls of the slotted peghead. First use the untrimmed screws to "tap" the thread for each hole, and then cut their ends off and install the tuners temporarily, so you can fit the neck to the body.

Installing the back

At this point you should have retained squareness between the top and sides, especially at the neck block. Squareness at the top and sides there, and the slight angle of the neck's heel, will give you the right action later **(30)**. If you are out of square now, it can't be by much, but make a note of it, and adjust for that when you glue on the back by pushing or pulling the neck block and sides into square.

With the waist clamp installed from the top side, install the back as you did the top (holding it in place at the waist and sides, gluing the tailblock first, and gluing the neck block last). This is your final opportunity to square the neck block to the top, if it needs it, as mentioned above.

When the glue has dried, use the flush-cutting router bit to trim the back overhang as you did the top.



30. Squareness at the top and sides there, and the slight angle of the neck's heel, will give you the right action later.

Shaping the neck

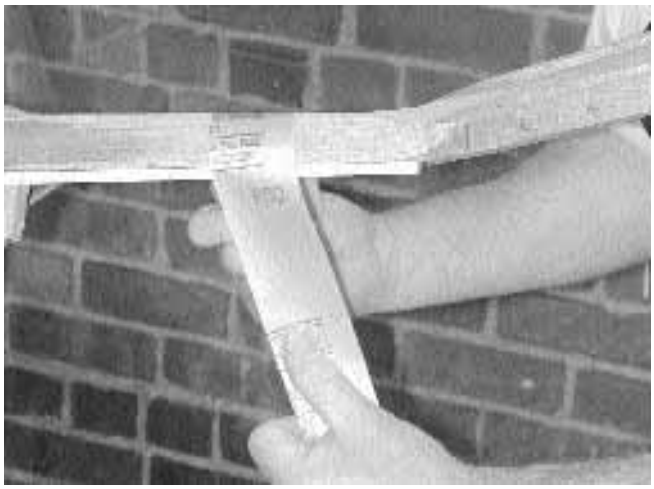
The round shape of the neck blends into the flat sides of the peghead very simply. This photo **(31)** shows a much-used 1929 National Triolian (at the rear in the photo). Notice the the plain yet elegant design of the transition from neck to peghead. The flat side of the peghead rounds simply into the neck shape without sharp edges. Note that the top edges of the peghead are quite rounded also.

Pencil-in the area of wood that needs to be removed and use a rasp for the rough-shaping. Follow that with a smoother file and sandpaper to blend into the back of the neck.

The neck has been machined to the basic shape, but left oversize for custom shaping. Any sharp edges left by the machining process will be removed as you shape the neck to suit your tastes. We chose to eliminate the "diamond" on the rear of the peghead, and did so with a chisel, a half-round bastard file, and sandpaper until the rear of the peghead looked as if the diamond had never been there.

A great way to bring the neck to shape quickly and accurately is to "strap sand" — like shining shoes — using a length of 2" wide 80- to 100-grit sandpaper with a strong backing. Use emery cloth, Mylar-backed sandpaper, or even regular sandpaper with a reinforcing backing double-stick taped to it. This sanding technique **(32)** follows the machined shape of the neck, and if you work smoothly from end-to-end, you

31. A much-used 1929 National Triolian (at the back in this photo) shows the smooth neck-to-peghead transition.



32. Mylar-backed sandpaper "strap sands" the round shape into the neck.

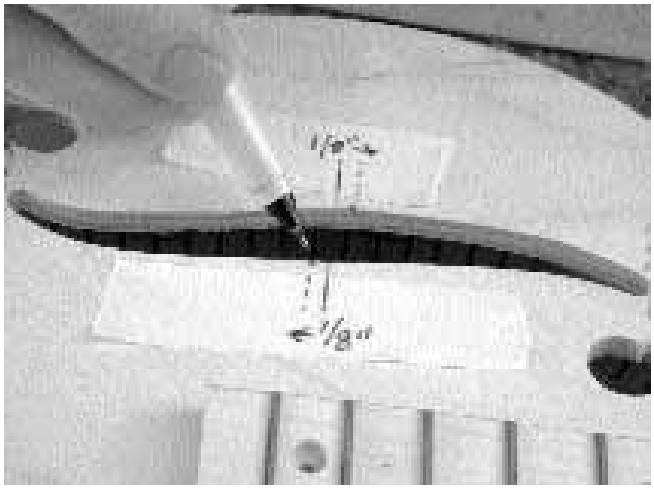
can round the neck perfectly. Don't stop in any one place, and check your progress often.

Use a half-round bastard file to shape the heel, and then cut your "strap sander" to a narrower width and "shoe shine" the heel to shape. When the neck has taken a round shape, hand-sand with a flexible rubber sanding pad and finer grit sandpapers to remove the harsher 80-grit marks. Be sure that when you shape or sand the heel you don't alter the 1/8" "land" that controls the neck angle!

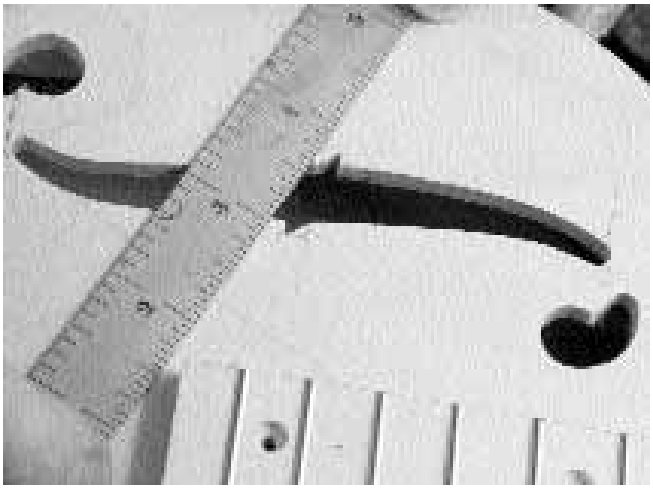
Use the same half-round bastard file and sandpaper to shape the rear of the peghead and smooth the area near the nut where the neck contour meets the peghead.

Shape the F-holes

Before the final sanding, notch the F-holes in the traditional style. Find the center of the long part of the 'F' (2-5/16"), and mark it. Then, mark 1/8" fore and aft of the center mark **(33)**. Lay a straightedge across these marks, and pencil an angled line. Use a thin triangle file and a knife to cut angled notches **(34)**. Before and during the notch shaping operation, swab some superglue on the edges of the plywood to harden it and keep it from chipping.



33. Mark 1/8" fore and aft of the center mark to layout the F-hole notches.



34. Use a thin triangle file and knife to cut angled notches.

Shape and sand the body

Use a rubber backing pad, or a padded block with open-coat Fre-Cut® sandpaper. The sides, which are solid wood, should be sanded first with 150-grit sandpaper, to remove any marks left by the flush-cut ball-bearing router bit. Also use 150-grit paper to blunt the hard corners and slightly round them. Then sand the entire body with 220-grit Fre-Cut®. Don't use a sandpaper coarser than 220-grit on the top and back. The plywood is smooth, and needs only a light sanding.

Double-check that any portion of the top or back overhanging the sides at the neck block has been sanded flush with the sides, so the neck heel will make full contact when you bolt it on. This will guarantee correct neck-to-body angle, which results in the proper bridge saddle height under the coverplate. Also, use a flat block and sandpaper to be sure the sides are as flat as possible at the neck joint.

Assembling the guitar

You should assemble the guitar, set it up completely before applying a finish, and then dismantle it for finishing.

Install the tuners in the peghead, and attach the neck to the body. This time, since the back is on and you can't see or touch anything, use a small piece of masking tape to hold the neck bolt hex nuts into the 7/16" socket to keep them from falling out. Remember *not* to over tighten the neck mounting bolts! Also, don't install the four screws that hold the fretboard extension to the body until later!

Install the tailpiece on the centerline of the sides at the tail-block. A screw and strap button hold it on.

Find the cone's "sweet spot"

Place the cone in the soundwell and tap on the outer bottom edges where the cone seats. Rotate the cone in the well and tap until you find the sweet spot, or area where the cone rocks the least and seems to seat firmly all around. Then put a little downward pressure on the cone by pressing on the biscuit, and double-check the fit. Rocking is not preferred, but you'll always have a little; the slight pressure will tell you if the cone is seating well. With a dark marker, mark an arrow on the cone that points to the peghead/ then you can relocate the cone in this sweet spot in the future. Rotate the biscuit until the saddle is perpendicular to the arrow on the cone, and then remove the cone and tighten the biscuit snugly to it. Tighten the biscuit only until it stops moving on the cone, to avoid dimpling the cone. The biscuit should be tight and perpendicular to the strings when the cone is facing forward on center.

Rough-shape the nut height

Round the backside (the peghead side) of the nut with a file, and shape it to a roughed-in height that's tall enough to accommodate filing and fitting later. Set the nut in the nut slot with a little overhang on each side. The top of the nut blank should measure a bit more than 1/8" above the fingerboard.

Double-check the neck alignment

At this stage, install the two outside strings to check that the neck is well aligned to the tailpiece and to determine the approximate string height at the nut and saddle.

Use medium gauge bronze strings. Install the two outside bass and treble strings in the tailpiece, run them over the saddle, and to their respective tuning keys. Tighten them enough so that they aren't slack (but not to pitch) and will hold their position when spread apart at the nut and saddle.

Center the two strings 2-3/16" apart on the saddle **(35)** and cut slight temporary notches for them.

Space the E-strings approximately 1-17/64" apart at the nut, put pencil marks on each side of the strings, and cut starter nut slots **(36)**. The two outside strings will now hold in place at both the nut and saddle when the strings are brought to a higher tension.

The cone has a little more than 1/16" of movement for adjustment within the well, both side-to-side and front-to-back. The front-to-back adjustment is important for intonation, and the side-to-side movement allows for slight alignment of the saddle to the neck and tailpiece.

The cone should be centered in the soundwell when the two outside strings are spaced correctly at the nut and the saddle. If the cone sits slightly more toward one side than another, 1/32" or less, that isn't a great problem.

With the two outside strings lightly tensioned, if the saddle is slightly off center with the neck and tailpiece — pulling too far toward the bass or treble side — you have several options for minor alignment:

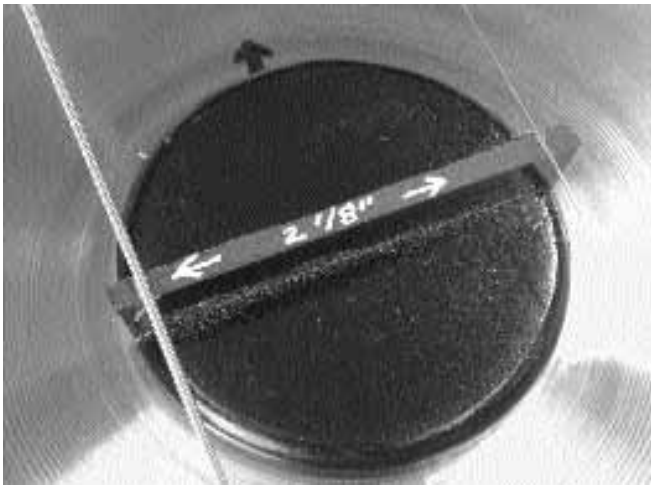
• Loosen the neck mounting bolts and force the neck in the proper direction to bring the strings in line when the cone is centered.

• Further enlarge the two holes in the neck block to move the neck a bit further. The neck block holes have been drilled 1/32" oversize to allow for slight adjustment, but can be enlarged a little if necessary.

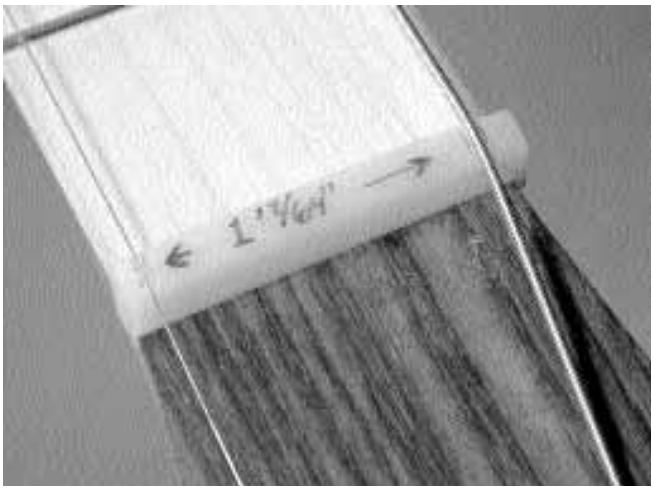
• Move the tailpiece slightly to either side if that will bring the cone, strings, and tailpiece into alignment.

To move the tailpiece, first pencil a locating mark on the top or side outlining the shape of the tailpiece. Remove the screw and endpin from the tailpiece (the slight string pressure will keep it snug, but you will need to hold the tailpiece against the body), and slide the tailpiece to one side or another. It's doubtful that you would ever need to move the tailpiece more than 1/16", which is almost undetectable. Plug the tailpiece screw hole with a small glued dowel, and then drill a new hole.

None of the above minor adjustments should be necessary if all the neck-fitting procedures described earlier are performed accurately.



35. Center the two strings 2-3/16" apart on center at the saddle and cut slight starter notches for them.

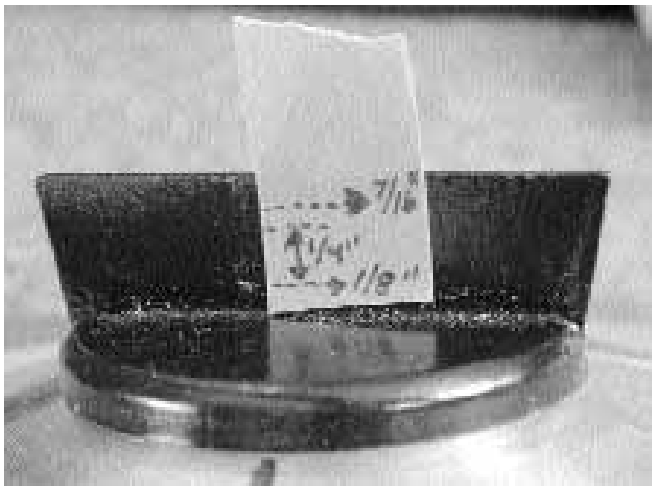


36. Space the E-strings approximately 1-17/64" apart at the nut, make pencil marks, and cut starter nut slots.

Rough in the saddle height

With the two outside strings still in place at low tension, repeat the process you did earlier during the initial neck alignment. Rest a long accurate straightedge on the frets, starting near the nut and extending to the bottom edge of the saddle. If the loose fretboard extension over the body gets in the way of the straightedge, tape it to the top. The bottom of the straightedge should meet the face of the saddle somewhere between .100" and .176" (7/64" to 11/64") above the top of the biscuit, and will often measure around 1/8". With a sharp tool, mark this point on the saddle. Place a piece of tape next to the mark so that you can use a pen or pencil to make several more marks.

Make a second mark 1/4" above the first mark. This will be the approximate height of the strings in the bottom of the notches that they rest in, and is approximately 3/8" from the top of the biscuit **(37)**. Make a third mark 1/16" above the second mark. This is the approximate top of the final saddle, and allows for a string notch that's deep enough to keep the string from popping off the saddle when plucked.



37. The 1/4" mark is the approximate location of the bottom of the strings when the action is correct.

Remove the biscuit and saw off the top of the saddle down to the top mark. Then recut your starter notches.

A quick action check

With starter notches cut at both the nut and saddle, you can now lower the strings at each end, by degree, until you reach the correct action height.

First, eliminate the string height at the nut as a factor so you can deal only with the saddle height. Install a capo at the first fret and tighten it just enough to pull the strings down to a virtually correct string clearance at the first fret. Clearance between the bottom of the strings and the top of the first fret should be 1/32" at the treble E-string, and 3/64" at the bass E-string. This is a relatively stiff action at the nut, but it will be lowered after the saddle is close to the correct height.

With the capo still on, measure the clearance between the bottom of the two outside strings and the top of the 12th fret. Our clearance measured almost 3/16", which was approximately 1/16" more than we wanted. We were looking for 1/8", or even a little less — but not until all the strings were on, tuned to pitch, and the guitar had settled in for at least a week. For this reason we settled on a slightly higher 12th fret measurement of 5/32" at this stage. To reach that mark, the strings needed to be lowered 1/32".

To lower the strings 1/32" at the 12th fret, you must remove twice that amount, or 1/16" in our case, at the saddle. Our saddle measured 7/16". We needed to lower the bottom of the strings 1/16" into the saddle. We didn't lower the top of the saddle. It must remain approximately 1/16" higher than the string bottom to provide a deep notch to hold the strings in place.

We can't repeat enough that the reason for not lowering the strings the full distance at this stage is because all the strings are not installed and tuned to pitch, and the cone will compress after a week or so. Err on the high side, and reach your final depth in several stages: a rough-in stage now with two strings installed, then two more stages with all the strings installed.

At the nut end, remove the capo and lower the outside strings to a proper action after measuring the clearance between the bottom of the strings and the top of the first fret. We ended up with a clearance of .014" under the high treble string, and .025" under the low bass string.

Install strings and cut nut slots

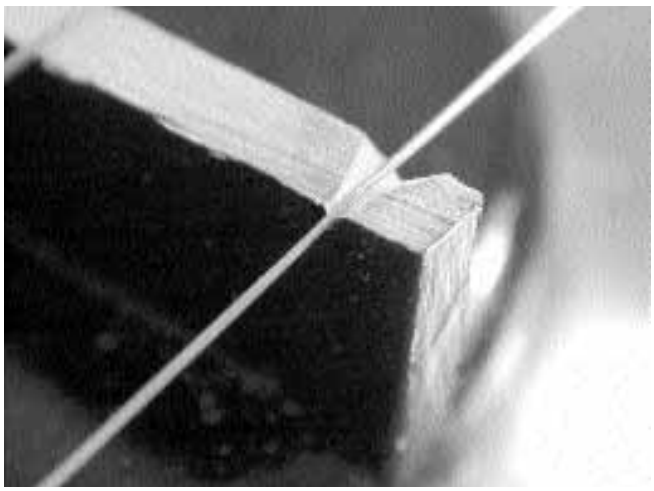
Install the remaining strings and repeat the above nut/capo/saddle operation. Rough-in the strings at the nut so that they hold their place under tension. A good starting point for string spacing at the nut and saddle is to divide the space between the centers of the two outside strings by 5, and pencil that measurement four times across the top of the nut. These four lines are the rough locations of the four middle strings.

Make slight starter cuts on these marks, to hold the strings in place temporarily. From this point you can move the string slots from side to side, as you move them downward, by using razor saws and nut files held at an angle or on their sides, until you get a spacing that looks right to you. We prefer to spread the wound strings a little further from each other to make up for their thicker diameter, and to move the unwound strings a little closer together. The end product is a proportional spacing that takes into account the diameters of the strings, and has a uniform look. Don't lower the strings to their final depths yet.

Cut the saddle notches

Tune the guitar to pitch, and put the capo back on to simulate a realistic action at the first fret. Go to the saddle and space the strings as you did at the nut. Lower all the strings at the saddle to match the depth of the two outside strings. Since the guitar is tuned to pitch, you'll need to de-tune each string to lift it free while you work.

A small sharp triangle file is good for cutting the correct notch in the saddle. We prefer to finish the job with a sharp knife.



38. Notice that the string contacts the saddle at the rear edge, leaving a distinct V-groove dropping away from the string in front of the contact point.

Lower the strings at the saddle until they all measure 5/32" over the 12th fret, and shape the saddle slots as shown in the photos. (You can lower the strings more, or leave them higher, if you choose.) Notice that the string contacts the saddle at the rear edge, leaving a distinct V-groove dropping away from the string in front of the contact point **(38)**. This moves the intonation point toward the back edge, unimpeded by more saddle than is necessary to hold the string in place. This is a trademark setup for this style of guitar.

TIP: Removing paint from the saddle

The black paint on the biscuit and saddle seemed to rob some brightness from our guitar, so we used paint stripper to remove the paint from the saddle and biscuit. The tone seemed to improve afterwards, and we didn't mind the vintage look. With the paint removed, it was also easier to cut clean notches in the saddle. When the guitar was complete, we colored the bare wood with black marker pen and sprayed one thin coat of aerosol lacquer on the biscuit.

Finish the nut slots

When the saddle slots are cut, with 5/32" clearance at the 12th fret under all the strings, remove the capo and lower the nut slots to a comfortable action. File the slot depths for a clearance of .025" under the 6th (low) string, and .014" under the 1st (treble) string. The rest of the string clearances should graduate between these two across the width of the nut. You may want to lower the strings a bit more than this after a settling-in period.

With the strings holding the nut centered in its slot, use a sharp pencil to mark the overhang on each end of the nut for trimming. Remove the strings, remove the nut, and file off the excess. Round the top ends of the nut, and then sand the nut smooth to remove file marks. The ends of the nut should be flush with the fingerboard and neck on the bass and treble sides. Replace the nut, but don't glue it in yet (you'll need to remove it during fret leveling). Replace the strings, tune the guitar to pitch, and double-check the nut slot depths.

Don't bury the strings in the nut slots

When approximately 1/2 to 2/3 of each string's diameter rests in the slot, the depths are correct.

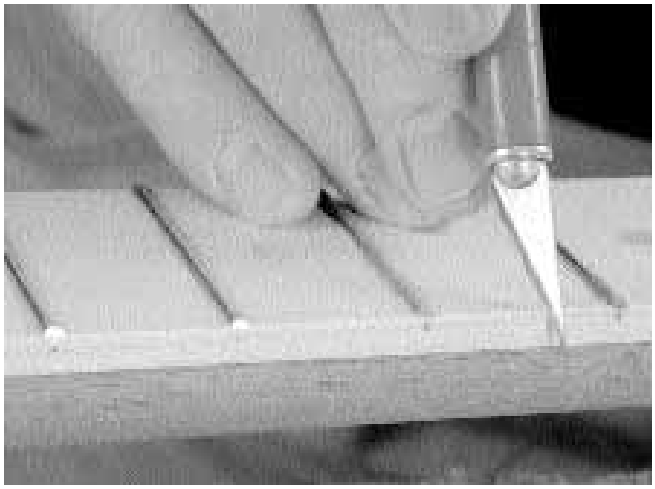
Fasten the fingerboard to the top

With the guitar settled in and tuned to pitch, drill holes for the four screws that fasten the fingerboard to the top. Use a 5/64" drill bit for these screws — it will center easily on the four 1/8" clearance holes that you drilled through the fingerboard earlier. Install the four fingerboard mounting screws, but don't install the dot inlays over the screws. You'll disassemble the guitar for finishing soon.

Level and crown the frets

Remove the strings and give the frets a slight leveling and crowning. With masking tape and heavy paper, tape off the top around the fretboard to protect it from your fret leveling tools. With the peghead resting on the tabletop for gentle support, adjust the neck perfectly straight, until a straightedge rests on all the frets. The straightedge won't rest on the fingerboard extension over the body, which will fall away slightly.

Use masking tape at each side of the frets to protect the fretboard from sanding. Before taping off the fretboard, however, use a razor knife to blunt the sharp edge of the fretboard that wasn't hit earlier when you beveled the fret ends **(39)**.



39. Use a razor knife to knock off the sharp edge of the fretboard that wasn't hit earlier when you beveled the fret ends.

TIP: Protecting the maple fingerboard

We wiped two thin coats of shellac on the fretboard as a sealer for protection during fret leveling, and to protect it during handling before the final finish is sprayed. Masking tape along each edge of the fretboard keeps the shellac off the mahogany neck (shellac would seal the mahogany and prevent it from "taking" the stain). Let the shellac dry two hours between coats, and allow it to dry overnight before taping off the fretboard. You can get away without this sealing step, but just be clean and careful if you do!

Next, use draftsman's masking tape to mask off the maple between the frets. Cut the tape to fit when you reach the upper frets, which are closer together. Be thorough with your taping, because metal filings can discolor maple!

Use 320-grit sandpaper, double-stick taped to the narrow edge of a long flat surface (we used a carpenter's level). Hold the neck at the center to support it as you sand **(40)**. You'll need to lightly sand the fingerboard extension separately with a smaller sanding block, since it falls away from the level plane of the main fingerboard.

When the sandpaper has dulled all the fret tops, use a fret crowning file to round the fret tops. Or, if the fret leveling is minor (since you did such a good fret job), simply round the frets with 320-grit sandpaper wrapped around a piece of stiff foam rubber. Round a gentle edge on the foam rubber with a coarse file. Wrap successive grits of sandpaper over the rounded edge of the rubber and sweep the sandpaper evenly, back and forth, the length of the neck. Use uniform pressure. The rubber will round the fret tops from both sides as you sweep across them **(41)**. Use Fre-Cut® sandpapers in 400, 600, and 800-grits. Then switch to micro finishing paper and use 1000-grit. This will give a great look and feel to the frets. You will end up with round fret tops that are nicely polished. Vacuum off any fret dust, then glue in the nut blank.

40. We used a carpenter's level and 320-grit sandpaper to level the frets.

41. Work the sandpaper lengthwise along the fingerboard with uniform pressure.

Hold the sander on edge to shape the fret ends and smooth the edges of the fretboard.

Glue in the nut

Place a few tiny drops of Titebond glue on the bottom and fingerboard side of the nut, and set the nut in its slot. Center it so the ends are flush with the fingerboard. Put on the two outside strings and tune them up a little. String pressure will hold the nut in place. Let the glue dry one half hour or more.

When the glue is dry, tape off around the nut to protect the fingerboard and peghead face. Use a file and sandpaper to remove excess material from the top of the nut, if there is any, and to give it a final smoothing and shaping.

The neck is ready to be removed, final sanded, and finished.

Installing the coverplate

Install the coverplate. There isn't a lot of extra wood for the coverplate mounting screws (often the original Triolians had holes drilled right on the edge of the soundwell — into thin air!). Take time to locate the coverplate carefully and concentrically. Measure 5/16" out from the edge of the soundwell rim on the centerline, and at right angles to it, and place a piece of masking tape at each point **(42)**.

Locate the coverplate with the "single diamond" mounting screw hole on the centerline and toward the neck **(43)**, and with the "double diamonds" toward the tailblock. Pick up the centerline between the double diamonds to center the coverplate at the tailblock.

The 5/16" measurement is larger than the coverplate diameter, and will leave a gap of 1/16" between the coverplate and the 4 pieces of tape. Center the coverplate over the soundwell until the gaps are equal at all four points, and mark the location of the mounting screw holes.

Drill the coverplate mounting screw holes with a 1/16" bit, and install the coverplate and screws.

42. Measure 5/16" out from the edge of the soundwell rim on the centerline, and at right angles to it, and place a piece of masking tape at each point.

43. Locate the coverplate with the "single diamond" mounting screw hole on the centerline and toward the neck.

Final action height

Re-install the strings and tune the guitar to pitch. The coverplate should clear the strings and the top of the saddle, with no chance for contact or buzzing, and the saddle should be centered in the coverplate's width.

When we reached our final action of 1/8" at the 12th fret, the top of the saddle was a little over 11/32" tall, and the bottom of the string slots were approximately 9/32" from the top of the biscuit. This is a normal final string height at the saddle for a biscuit-style resonator guitar. These measurements left room for going even lower in the months to come as the guitar settled in.

You're ready for finishing!

It's time to disassemble the guitar and apply the finish. This section describes how to create a traditional sunburst, although you might want to consider the "Polychrome" finish described in the tip on this page. Whichever finish you choose, be sure to put some type of protective finish on the maple fingerboard. You can simply wipe on Master-gel finish, or you can spray the fingerboard with several coats of aerosol lacquer (clear gloss). Spray right over the frets, and file the lacquer off them once the finish has cured.

TIP: 1920s polychrome finish

Late-1920s Triolians had a "polychrome" finish, which was a popular look used on many items of the era. The effect is a mix of colors sprayed in soft-edged spots over a solid background color. If you've seen a polychrome finish and want to create one, use solid pigmented colors. Start with a white primer then spray an overall yellowish (ochre) color coat. Add a glossy clear lacquer topcoat.

Create the shading, sunbursting, and spot spraying with blue, purple, red, and pink pigmented lacquer to highlight areas. On the 1920s originals, the highlights were random, sprayed almost as if the finisher was teasing the guitar with the paint. Swatches of alternating color were sprayed like fret markers at the appropriate frets, and then the black "inlay dots" were sprayed on using a stencil.

As you get ready for finishing, it's a good time to final-shape the nut, too: file off the overhang, round the corners and the back side, and use at least 400-grit Fre-Cut® to smooth it. Place a couple drops of glue in the nut slot and glue the nut in place. The neck finish will cover the ends of the nut for a professional look.

If you finish the neck and body separately, you'll do a better job of sanding and buffing. When the neck's attached, it's more difficult to fill the grain, sand, and buff around the neck/body joint. Also, lacquer tends to build up in that area, and unsightly air bubbles may become trapped there.

The quality of your finish work is certainly important to the appearance of your guitar. A thin "non-professional" finish won't necessarily harm the sound of your guitar, however. If the following instructions seem beyond your skills (they're probably not), or if they seem to be more work than you'd like, you can simply apply a low-gloss wipe-on finish by hand, consisting of a couple of coats of waterbase lacquer or freshly-mixed shellac. This will seal the wood and protect it from the elements, and you'll be playing your new guitar a lot sooner.

TIP: Quick way to remove strings

You may find yourself removing and re-installing the coverplate and strings often during setup. To save time, you can slacken the strings until just taut, hold the tailpiece against the body, and remove the tailpiece mounting screw. Then lift the tailpiece free and thread it — with strings intact — through the coverplate hand rest.

The following instructions, for spraying an aerosol nitrocellulose lacquer finish, are pretty close to foolproof and don't involve an investment in shop spraying equipment.

There's a lot of finishing information in our book, Guitar Finishing Step-By-Step, and many customers are glad they studied the book before finishing their first guitar. In brief though, here are some pointers and a finishing schedule to follow.

Dos and don'ts

Do practice on scrap wood until your finishing technique has been perfected. If you'd like your guitar to look as good as it sounds, don't rush!

Do use a backing block or pad when sanding the guitar body. It helps maintain a level surface. On round surfaces, use a flexible rubber backing pad, a thick piece of felt or leather, or fold the sandpaper three or four times to give it firmness with flexibility.

Don't apply more than three coats of lacquer per day. Spray an initial light misting or "tack" coat, followed several minutes later by a heavier wet coat. The tack coat gives the wet coat better adherence and lessens the chance of a run or sag in the finish.

Do let the finish cure for 10-14 days or longer prior to final sanding and buffing.

Do have thinner around for cleanup. Aerosol lacquers require no thinner, of course, but it's nice to have thinner on hand. If you decide to use spray equipment, always thin nitrocellulose lacquers with nitrocellulose thinner only.

Do wipe the aerosol tip often. Aerosol lacquers have a tendency to spit if the tip gets clogged. Also, you can clean the tip by turning the can upside down and spraying until the spray stream stops. It's recommended that you do this each time you are done spraying in order to keep the tip clean.

Do buy a can of aerosol blush eraser for lifting the bluish haze that can occur when moisture is trapped in the lacquer finish. Blushing can result from humid conditions, or if the coat is sprayed too heavily.

Do let the surface dry for 24 hours if you get a run in the finish. Then level-sand the problem area. If you touch wet lacquer, you'll leave a deep impression which will be much more difficult to fix.

Sanding the body

All the wood surfaces should be fine sanded up to 220-grit. Use Fre-Cut® paper on a wooden block lined with thin leather or felt (or use a rubber sanding block). Start by sanding the body. For the solid wood sides, as mentioned earlier, the sandpaper should be no coarser than 150-grit, and you should switch quickly to 220-grit. (For the plywood top and back, use 220-grit sandpaper only). Sand in the direction of the grain, not across it. After the first 220-grit sanding, dampen the entire surface lightly with a water-dampened (not soaked!) cloth to raise the grain. Let it dry, and sand again with 220-grit. Blow off and vacuum the wood dust.

Filling fret ends and sanding the neck

Before sanding the neck, "drop-fill" the small slot spaces under the fret ends. Use fine rosewood sawdust in either Titebond or superglue. We used a toothpick to apply the glue/sawdust mixture. After drying, the small mounds of glue were sanded flush. If you don't fill the ends of the fret slots, holes will remain which the lacquer finish won't fill.

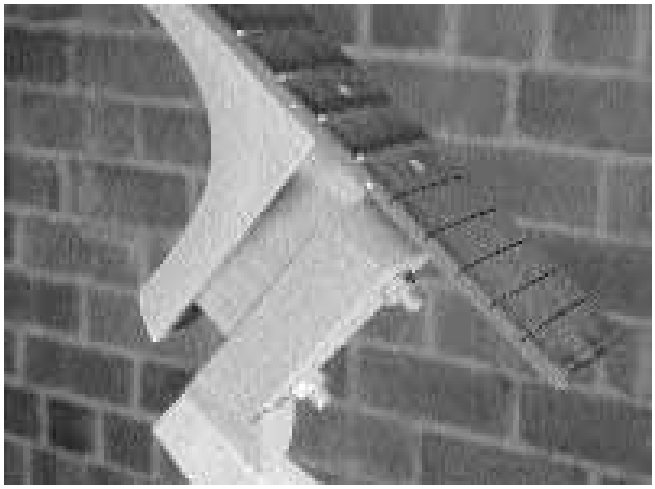
The neck needs extra sanding and grain-raising in the end grain areas of the heel, and the "ears" and the end of the peghead. Sand up to 320-grit, dampening to raise the grain. Do this several times, so the end grain pores will absorb stain more uniformly for a better appearance.

Finish the wood preparation by wiping the neck and body with a rag, dampened (not soaked) with naphtha, to degrease all the surfaces to be finished. Handle the unfinished wood parts with clean gloves from now on.

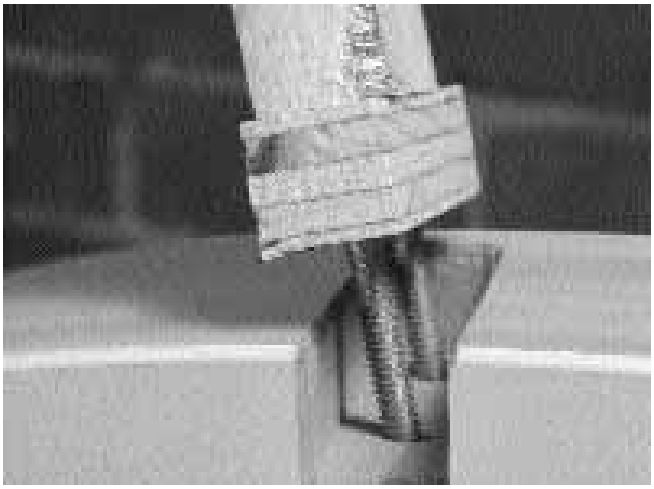
Making hangers and masking the neck and body

To fasten a spraying handle to a bolt-on neck, drill two holes in a scrap wood handle to match the bolt spacing **(44)**. Tape over the exposed nuts to protect them from lacquer. Or, as an alternative, simply hold the neck at the center, spray the peghead, the heel, and a good portion of the neck up to where you are holding it. Loop an S-shaped wire hanger through a tuner hole and hang the neck for spraying the center area. You can also rest the neck fretboard-down on a riser block and spray it in the horizontal position. Use the two holes in the neck block to bolt a handle onto the guitar body **(45)**.

Apply masking tape to cover the areas that won't be stained or finished: the fretboard playing surface, the sides of the fretboard (to be unmasked after staining), the nut, the neck joint surfaces on the neck and body, the underside of the fretboard extension, and the interior of the body. To seal the body interior, stuff paper into the two small sound holes until it closes these openings. Make a cardboard disc the same diameter as the soundwell opening (approximately 10-5/8") and press it into the opening. The cardboard should be large enough to stay in place by itself.



44. A scrap wood spraying handle for a bolt-on neck.



45. Use the two holes in the neck block to bolt a handle onto the guitar body.

Staining

Wear plastic gloves when handling stains. The mahogany neck (and the rosewood peghead overlay, if you wish) should be stained. We recommend our ColorTone liquid stains in an equal mix of tobacco brown and red mahogany. Add 25 drops of each color to each ounce of water to produce a warm dark stain. For a lighter, redder color, you can use just the red mahogany at 50 drops per ounce of water. Test these stains on sanded scrap mahogany first.

TIP: Filler instead of stain

You can also use waterbase paste filler to color the bare mahogany while filling the pores, and skip the stain entirely. Test this on scrap mahogany and see if you like the somewhat lighter appearance.

One or two ounces of mixed stain is plenty for a neck. Pour the stain into a shallow bowl. Wet a soft clean cloth with stain and apply it in long uniform strokes in the direction of the wood grain. It shouldn't take more than a minute to stain the neck. Stain the peghead veneer, too: it's easier than trying to mask it.

Let the stain dry for half a day. Then unmask the sides of the fretboard. The fretboard's playing surface, neck joint areas, the nut, and the underside of the fretboard extension should remain masked.

Applying a wash coat sealer

Remember to wear clean cotton gloves whenever you touch the wood. Lacquer is highly flammable, so always work in a dry, well-ventilated area, away from open flames or sparks. Be sure to wear an appropriate respirator while spraying.

Spray one uniform "wash coat" of clear lacquer on the neck. A wash coat is a very light coat, so it won't cause runs. The wash coat seals the stain or the natural color in the wood, and keeps the upcoming coat of paste filler from producing a smudged look. Sealed in this fashion, only the open pores of the wood accept the filler. Let the wash coat dry overnight.

Filling the wood grain

We recommend our ColorTone waterbase brown paste filler for filling and leveling the open grain pores of the rosewood peghead overlay and the mahogany neck. Because it dries fast, you won't be able to fill all the neck's surfaces at once, so work in stages. Practice on scrap pieces before starting on the guitar. The wet filler should be packed into the pores with a rubber squeegee held at a 45° angle across the grain (an old credit card makes a great squeegee). Within minutes the filler will start to harden and look hazy. Wipe off the excess, working across the grain, with a clean lint-free cloth. At any time during the grain-filling process, you can use a rag lightly dampened with water to soften any filler that's hardening too quickly. When the wood pores have been filled and wiped level, a bit of blotchy, hazy residue will probably remain on the surface. Let the wood dry overnight. Light sanding with 320-grit Fre-Cut® may be required to remove any remaining buildup of filler on the wood surface. Try to avoid sanding through the wash coat into the stained mahogany. If you do sand through an area, wipe a little stain on it and wipe off the excess.

Sunbursting the body

On this style of instrument, it's traditional to sunburst or stain the light wood body to a dark brown color. To accomplish this, first spray a base coat of lacquer for the color to lie on. The body has been damp-sanded but still has an irregular surface due to the wood grain and its hard and soft nature, and grain pores. The maple sides, and the birch top and back of the body are "closed grain" woods. They require no filler, but they still need leveling to get that glossy guitar look. Spray three coats of aerosol lacquer on the entire masked body, allowing 45 minutes between coats, and let it dry overnight.

When dry, sand with 320-grit Fre-Cut® sandpaper to achieve a level, uniformly dull look over the entire body. With only three coats you may not be able to do this. Watch your sanding, and if you are sanding through to bare wood, stop and spray another three coats just like above. Try to level sand again when dry. At this point you should be able to sand most of the shiny spots dull. If there are just a few deep ones that won't cooperate, use a brush to drop-fill them with some lacquer rather than spraying the whole body again. Now is when the quality of your wood preparation will really start to show.

Level those spots you drop-filled, and get ready to mix colors. You can use the same ColorTone liquid stains to mix into clear lacquer for coloring the body. For the light center of the sunburst, use Vintage Amber. Make up two ounces of vintage amber shading lacquer by adding 50 to 100 drops of concentrated stain to two ounces of thinned clear gloss lacquer (a little thinner might be needed here to get a sprayable mixture). Test the strength of the mixture on scrap to determine if you have reached the color intensity you want. You have the option of spraying a couple of coats of the shader to build the color coat in several passes, rather than mixing a stain that might be too dark.

Put the shader into a Preval sprayer. Spray the amber color in the center of the top and back, and on the sides where the upper and lower shoulders reach their maximum width. Based on your color, and on how much you spray, a second or third coat might be necessary. It's not necessary, or even recommended, to spray the entire body with the yellow. Just spray the center of the burst, and fade out as you reach the point where the color changes. Next, mix the Tobacco Brown as you did the Vintage Amber. You'll probably need 3 or 4 ounces of this color, since there is more area to cover with the dark brown. Put this mix into your Preval sprayer, and spray the outer edges of the sunburst. You can leave a nar-

row band for Red Mahogany, or skip it and blend the Tobacco Brown right into the Amber. We recommend the red mahogany for its pleasing look. If you choose to do it, mix two ounces of this color as above, and blend or shade it between the dark brown and the amber. Practice on scrap, and your first attempt will be more successful.

After overnight drying, carefully scrape off the color to reveal the plastic binding beneath (the sunburst has covered the binding as well as the wood). Use an X-acto blade, single-edge razor blade, or utility knife blade as a scraper. Hold the scraper between your thumb and fingers with a short section of the blade exposed. With your thumb, finger, or knuckle controlling the depth, you can keep from scraping deeper than the binding and into the colored wood. Too much scraping will create a deep ledge that the following finish will not be able to fill.

Now go on to the lacquer spraying schedule below.

Lacquer spraying schedule

Day One: Spray three wet (not runny) clear coats on the neck and body, an hour between coats, and let them dry overnight.

Day Two: Lightly "scuff-sand" the neck with 320-grit Fre-Cut® paper to knock off the high spots in the finish (on flat areas, be sure to use a backing pad on the sandpaper). Sand just enough to "open" the finish; don't try to sand out every shiny spot or sunken area in the lacquer. Clean off the sanding residue. Now spray the neck with three uniform coats of clear lacquer, one hour between coats. You now have six coats on the neck and three coats on the body. Let the guitar dry overnight.

Day Three: Lightly scuff-sand the finish with 320-grit paper again, and clean off the residue. You can be slightly more aggressive in flattening the sprayed surface now, but be careful on the curves of the neck, and on any of the edges of the neck and body (it's easy to sand through the edges). Don't try to sand out all the shiny spots yet. This sanding will release solvent from the finish and help it to cure. Let the finish dry for two more days.

Day Six: Once again, spray three wet clear coats, one hour apart, on the neck. Spray two wet clear coats, one hour apart, on the body. Let the finish dry overnight.

Day Seven: Scuff-sand the finish with 320-grit again. This time most of the shiny spots will disappear, leaving a uniformly dull look. Spray three more clear coats on the neck, one hour apart. Spray two more coats, one hour apart, on the body. Allow overnight drying.

Day Eight: Lightly scuff-sand the finish with 600-grit Fre-Cut® sandpaper, to help the solvent escape. The neck and body should now be left in a warm dry location for two weeks to let the finish harden and shrink.

Wet-sanding and rubbing out the finish

Dry-sand the neck and body to a flat, dull sheen with 800-grit Fre-Cut® sandpaper. Clean the residue off the sandpaper often by rubbing it against a scrap of carpet. Any "orange-peel" texture (caused by lacquer shrinkage as the solvents cure out of the finish) should be removed, but don't over-sand. When all the little shiny low spots in the lacquer have been removed, you're ready to go to the next step.

Wet-sand with 1200-grit micro-finishing paper and water to bring the finish to a smooth satin surface that's ready for final polishing. Excess water and residue should be wiped off the finish often with a clean dry soft cloth as you work. Rinse the sandpaper in soapy water often, to remove hard specks that can scratch the finish. (Note: Soak the micro-finishing paper in water overnight before use. It will scratch less and last longer.)

Using soft cloths, or an electric hand drill with foam polishing pads (a separate pad for each compound), rub out the fine wet-sanding scratches to a final gloss with medium and fine polishing compounds. You can follow this with swirl remover if desired. Clean off the residue left by the polishes, remove the remaining masking tape from the neck, and remove the soundhole masking materials.

When your guitar is finished, well-cured, and rubbed-out, reassemble it, string it up, tune it up and play it. Good job!