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HANDMADE GUITAR, PART 1: INTRODUCTION AND WOOD SELECTION

From "Handmade Music"
episode DHMM-101 -- More Projects »

In this episode of DIY's *Handmade Music*, host Jeff Wilson introduces viewers to the world of vintage luthurie. We see how stringed-instrument builders (luthiers) mix contemporary materials and "old school" know-how to create guitars that resemble -- and sound like -- beloved vintage guitars. Over the course of the guitar-building series, we see an elegantly built vintage-replica guitar built from the ground up -- literally.

In this first of four episodes focusing on guitar-building, we learn that the "gold standard" for bluegrass pickers is the famous Martin D-28 guitar built in the 1930s and the early 1940s. Viewers find out how master guitar-builder Lynn Dudenbostel crafts new guitars that meet the high standards set by the great luthiers of yesteryear. Also in this first episode, viewers also are introduced to two luthiers -- John Arnold and Ted Davis -- whose passion for replicating vintage guitars borders on obsession. Arnold and Ted know that reproduction of vintage requires a specific type of wood: red spruce. Martin Guitars used this particular type of wood to build tops for the famous D-28 during the golden era, but during World War II the aircraft industry depleted the supply of spruce wood so guitar manufacturers switched to alternative wood. Today after sixty years of growth, the red spruce tree is once again available for selective harvesting. For John and Ted, it's been a long time to wait for the revival of great sounding guitars.

This episode follows the men on a quest to harvest one red spruce tree. When it's located and cut Lynn Dudenbostel begins creating a guitar using the wood supplied by John and Ted. If Lynn does his job well, viewers will be treated to a sweet sound not usually produced by a new guitar. This show follows the construction of the guitar's top and back including the precision carving of brace wood.

The Martin D-28 -- the "gold standard" of acoustic guitars.

Luthier John Arnold could be called passionate when it comes to the quest for the perfect guitar sound. For this series, he located and harvested a red spruce tree for the creation of guitars like those used on the classic Martins.

The Legacy of Red Spruce

The vintage guitars of the 1930s and early '40s had a material advantage over the manufactured guitars of today. They were made from a type of wood unavailable to builders for more than 50 years. "The most desirable instruments made by Martin," says Lynn Dudenbostel, "had tops made of Eastern red spruce. Until the past twenty years or so, that has been to builders. During the war, spruce was in high demand for building aircraft, and instrument builders had to seek other alternatives."

Now that red spruce is available again in limited quantities, the distinctive sound of the vintage guitars can be recaptured. Luthier John Arnold took DIY along on his quest to find a red spruce tree for use in building guitars. That quest took John to the mountaintops of West Virginia where this unique type of timber can be found (**figure A**).

Figure A

Locating a tree for harvest on private land is the biggest challenge. John was able to locate a mammoth 300-year-old spruce (**figure B**), and was able to negotiate with the land owner on which it resided for harvesting the tree.

Given the large diameter of this tree (**figure C**), there is raw material in this spruce for hundreds of guitar tops.


Figure B


Figure C

Once he gets the raw lumber back to his workshop, he uses an ax to remove the bark from quartered sections of each piece. A template is then used to ensure that each piece is large enough to make half of a guitar top (**figure D**).

Using a band saw, John shaves away a thin section from the log to create half of a guitar top. The next thin section will form the other half, so that the two halves will come from book-matched slices of wood (**figure E**). The practice ensures that the grain patterns will match when they are joined together to form the top of the guitar.


Figure D


Figure E

Building the Guitar Top

Materials:

Red spruce stock
Template
Band saw
Block plane
Clamps

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.


Master luthier Lynn Dudenbostel crafts new guitars that meet the high standards set by the great luthiers of the original golden era of instrument making.

With the wood procured, the work of the luthier begins in the process that will ultimately produce a visually and acoustically accurate replica of the Martin D-28 guitar (**figure F**).

Steps:

- Using book-matched slices of spruce like these, luthier Lynn Dudenbostel takes the first step in the process of building a guitar. He creates one top from two mirror-image pieces of wood. After planing the edges of each piece smooth using a hand-plane, he applies glue to the two edges that will be joined together (**figure G**).


Figure F


Figure G

- After glue has been appied, the spruce pieces are joined using a fixture made from rails and clamps (**figure H**). The distance between the rails is slightly less than the width of both pieces. This method applies constant and equal pressure to both sides to join them together precisely.

Once the glue has dried, Lynn uses a template from a vintage guitar to outline the body's shape onto the edge-glued spruce. At the band saw, he then cuts along the outlined pattern -- slightly outside the line -- to reveal the guitar's top (**figure I**).


Figure H


Figure I

In the segment that follows, Lynn Dudenbostel continues work on the guitar's top, back and inlays.


Host Jeff Wilson, standing on the stage at the famous Ryman auditorium in Nashville, holds the legendary Martin D-28 guitar -- considered special because of techniques and materials used in the golden era of guitar making before World War II.

RESOURCES:

Kentucky Thunder
For more information on the band that appeared in DIY's *Handmade Music*, Kentucky Thunder -- and to hear streaming audio and download samples of their music -- visit the website for Skaggs Family Records, www.skaggsfamilyrecords.com.

GUESTS:

Lynn Dudenbostel, Luthier
Dudenbostel Stringed Instruments
Knoxville, TN

John Arnold, Luthier
Newport, TN

Ted Davis, Luthier
Loudon, TN

ALSO IN THIS EPISODE:

- Handmade Guitar, Part 1: Introduction and Wood Selection
- Handmade Guitar, Part 2: Top, Back and Inlays
- Handmade Guitar, Part 3: Top Bracing and Tone Bars
- Handmade Guitar, Part 4: Back Bracing
- WEB EXTRA: *Handmade Music* Song Downloads

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HANDMADE GUITAR, PART 2: TOP, BACK AND INLAYS

From "Handmade Music"
episode DHMM-101 -- More Projects »

Master luthier Lynn Dudenbostel builds guitars by hand, and he only builds one at a time. In this four-episode series, we see the step-by-step process by which Lynn builds a guitar in the style of the classic Martin D-28.

In his workshop, Lynn emulates the techniques of craftsmen who came before him to recapture that hard-to-describe magic found in classic vintage guitars. In this segment, he continues work on the guitar's top, back and inlays.

Materials:

Rosewood stock
Template
Band saw
Drum sander
Plunge router
Hand-held drill
Circle cutter
Block plane
Cabinet scraper
Hammer
Clamps
Wood glue
Sandpaper, 100-grit
Acetone-based glue

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

Guitars have been known to be made from unconventional materials. Host Jeff Wilson holds a rare "Ryman Guitar" made using wood from some of the wooden pews that were removed from the original Ryman Auditorium in Nashville.

Marquetry inlays are one of the distinctive visual features of our handmade vintage-guitar replica. The name for the inlay around the guitar's sound-hole is *purfling*.

Guitar Back

"Wood selection," says Dudenbostel, "is one of the single most important things that's going to influence the sound of your instrument." So far we've seen Lynn's work on the thin sheets of red spruce -- the wood that forms the top of the guitar and does much to provide the instrument's unique sound. But guitars are made from a number of materials. The process for making the back of our Martin D-28 replica is essentially the same as that used to make the top. The main difference is in wood selection. For this section of the instrument, Lynn selected East-Indian rosewood. As with the top, the slices of wood used to make the back of the guitar are a book-matched pair (**figure A**).

Figure A

- Using the template from his guitar plans, Lynn marks the outline of the guitar's back onto the rosewood (**figure B**). He then planes the joining edges perfectly smooth using a block plane, and joins the mirror-image pieces together using glue, clamps and straight rails.

Figure B

- The joined pieces are passed through the thickness-sander. In it's raw form, the guitar back is about 200/1000-inch thick, but once sanding is finished it will be down to about 90/1000-inch. A caliper is used to ensure proper and exact thickness (**figure C**).

Figure C

- Lynn then cuts out the guitar's back the band saw (**figure D**), saving the scraps to make brace pieces later on.

Marquetry Inlays: Back and Top

Figure F

With the back cut out, work can begin on some of the many decorative touches that will be added to this beautiful hand-made instrument. The traditional look for this vintage guitar includes a marquetry strip down the center of the guitar's back (**figure E**). Pre-made strips like this can be purchased from a luthier-supply shop.

A channel must be cut down the center of the back -- along the joint -- to hold the strip. Lynn cuts the channel using a plunge router. After two precise passes with the router, there is room to insert the inlay. Lynn fills the channel with glue and inserts the strip. The strip should fit snugly and, because it's slightly taller than the depth of the channel, rise just above the back's surface (**figure F**).

After the strip has been clamped down, and the glue has dried fully, the inlay is planed flush with the surface of the back using a block plane (**figure G**) followed by a cabinet scraper. Once finished, the inlay is perfectly even with the back's rosewood surface.

Figure G

With the back-strip inlay done, work can begin on the ornate inlay for the top. The technical name for the inlay around the guitar's sound-hole is **purfling**. The first step is to locate the position for the exact center of the sound-hole. Lynn then uses a hand-drill to drill a small hole at that exact location. He then uses a circle-cutting fixture attached to a rotary tool to cut three channels around the sound hole (**figures H and I**). The purfling, made from a laminated fiber, will be embedded into these channels.

Figure H

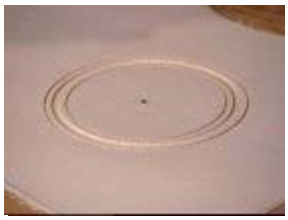

Figure I

Acetone-based glue is placed in the channels to hold the purfling, but it's critical to achieve and maintain a snug fit even without the glue. To get the look he wants, Lynn groups several pieces together inside the center channel, and gently eases them into place using a tap-hammer (**figure J**).

Figure J

When the top was originally run through a thickness sander, it was intentionally left just a little thick so that it can now be scraped and sanded with the purfling in place. In that way, the purfling can be made perfectly flush with the surface of the red-spruce top.

The center of the sound hole is removed using the circle-cutter and rotary tool (**figure K**).

Relevant information about each guitar Lynn makes is recorded on this piece of rosewood (**figure L**) that's been removed to make the sound hole. The circle of wood, complete with notes, is kept on file in case Lynn needs to reference a past work.

Figure K

Lynn radiuses the sound hole's edge using 100-grit sandpaper (**figure M**) to soften and eliminate the square corners.

With the inlays in place, and the top's sound hole cut out, the top (**figure N**) and back have begun to take shape. Both, however, still have some work that needs to be done.

In the segments that follow, bracing and tone bars are added to the reverse sides of these pieces. These additions impact the sound of a guitar more than any other steps in the process of guitar-making.

Figure L

Figure M

RESOURCES:

Kentucky Thunder
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HANDMADE GUITAR, PART 3: TOP BRACING AND TONE BARS

From "Handmade Music"
episode DHMM-101 -- More Projects »

In this segment, bracing and tone bars are added to the guitar's top and back. These additions, located ultimately inside the guitar, impact the sound of the instrument more than any other step in the process of guitar-making. Luthier's refer to this most critical step in the guitar-making process as "giving voice" to the guitar. It provides much of the beautiful and nuanced tone of an expertly crafted guitar.

Lynn Dudenbostel places the bracing and tone bars on underside of the guitar top. Luthier's refer to this critical step in the guitar-making process as "giving voice" to the guitar.

Materials:

Spruce stock
Plans for guitar-top bracing
Sharp chisels
Finger planes
Sandpaper
Caliper
Straight-edge
Carpenter's pencil
Wood glue
Hot hide-glue
Clamps

Top Bracing and Tone Bars

Tone bars and bracing provide both acoustic and structural support. Without them, a flat-topped guitar like the one built in this series could never transmit the beautiful sounds for which they've become known. Since the steel strings of the guitar create tension between the neck and body, the bracing provides very necessary structural reinforcement. When it comes to location for these critical elements, nothing is left to chance. After years of research and experimentation, master luthier Lynn Dudenbostel has developed exacting standards for placement.

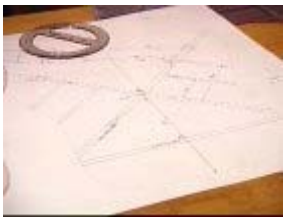

Figure A

- Following a plan diagram (**figure A**), he lays out a pattern on the underside of the guitar top. Then he cuts spruce into braces that will fit on the outline he has drawn.
- First, Lynn cuts four finger braces -- quarter-inch strips that primarily provide structural support for the top. He attaches these braces using ordinary wood glue and clamps (**figure B**).

Figure B

- For the braces that serve acoustic purposes, he uses specialized **hide glue**. "Hot hide-glue, " says Dudenbostel, "is a traditional glue and offers very good strength and very high resistance to heat, unlike some of the modern glues. I use it in almost all applications where sound is very important. In gluing the braces to the top of the instrument (**figure C**) and the center-seam of the top, I use hide glue. The trouble with working with hide glue is working with it in a normal room temperature. It's cooked at about 140 degrees. Once it drops below about 90 degrees, it begins to gel. So when you have a large area that you need to glue, you have to work very fast.
- Before adding the rest of the bracing, Lynn carves the finger braces and tone bars using a very sharp chisel. The finger braces are carved down and tapered extremely thin as they reach their ends (**figure D**), but have a high peak in their middle. The structure of these braces is somewhat analogous to a suspension bridge, with wood removed where the stress is lower, and left intact where the stress is higher.

Figure C

- With the finger braces shaped to a perfect dimension, Lynn moves on to the tone bars. The profile of these elements is meticulously trimmed and scalloped to exact shapes and dimensions (**figure E**). To do this, he uses finger planes, chisels, calipers and sandpaper. Lynn suggests studying the tone bars on an old, authentic Martin guitar to determine the shapes, or going by the dimensions of plans that can be purchased from luthier-supply shops.

- Once the tone bars are done, Lynn adds the X-bracing to the guitar. The X-braces (**figures F and G**) are key to the sound of the guitar. They are placed in keeping with the positioning on vintage Martins, attached using hide glue and held securely with clamps as the glue dries.


Figure D


Figure F


Figure G


Figure E

- Using hide-glue, Lynn attaches the traverse brace just above sound hole (**figure H**), clamps it in position and allows the glue to dry.
- Lynn also adds a plate to support the bridge that will later be glued on top. The plate is cut to fit just beneath the X-bracing, below the sound hole.
- Once the glue has dried, the clamps are removed. Lynn then tapers the ends of the X-braces using a block plane and chisel, essentially creating a "ramp" from the top down to the edge on each leg of the brace. The braces are trimmed and tapered to specific dimensions required for vintage guitars. Using a chisel, Lynn also sculpts a diamond shape into the intersection of the X-braces. He also shapes the traverse brace with a block plane, this time removing much less wood.
- Finally, a few smaller structural supports are added around the sound hole.


Figure H

Keep in mind that the end product all of this precision work -- placement and carving of tone bars and braces (**figure I**) -- will never be seen once the guitar is built. They are solely to reinforce the guitar's structure and define its distinctive sound. It's an example of work that's heard and not seen.


Figure I

RESOURCES:

Kentucky Thunder
For more information on the band that appeared in DIY's *Handmade Music*, Kentucky Thunder -- and to hear streaming audio and download samples of their music -- visit the website for Skaggs Family Records, www.skaggsfamilyrecords.com.

GUESTS:

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- Handmade Guitar, Part 2: Top, Back and Inlays
- Handmade Guitar, Part 3: Top Bracing and Tone Bars
- Handmade Guitar, Part 4: Back Bracing

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HANDMADE GUITAR, PART 4: BACK BRACING

From "Handmade Music"
episode DHMM-101 -- More Projects »

In this segment of DIY's *Handmade Music*, bracing and tone bars are added to the rosewood back of the guitar.

There are several reasons why a guitar's back requires a substantial amount of bracing. For one, recall that the marquetry strip along the back of the guitar (**figure A**) was added by first cutting a channel along the joint where the two book-matched halves of the guitar-back come together. Routing the channel for the strip compromised the joint somewhat. Bracing on the opposite side will help offset this compromise and strengthen the back. Additionally the back of a guitar is not flat but, in fact, bends on a slight curve from the neck to tail-piece. Bracing also counters the stress inherent in the curve.

The bracing on the inside of the guitar's rosewood back provides structural support to compensate for the channel cut for the marquetry inlay and for the curve of the guitar's back surface.

Materials:

Rosewood and spruce stock
Band saw
Belt sander
Plans for bracing
Sharp chisels
Finger planes
Sandpaper
Caliper
Straight-edge
Carpenter's pencil
Wood glue
Hot hide-glue
Clamps

Figure A

Back Bracing

- As he did with the top, Lynn Dudenbostel sketches a brace pattern onto the rosewood back-piece (**figure B**). His pattern mimics the vintage guitars he has studied over the years.
- With the pattern drawn out, Lynn then cuts the brace pieces from the spruce stock left over from making the top, carefully cutting across the grain. "You want the grain to run the length of the brace," says Dudenbostel, "You don't want it running diagonally through it. It's like splitting firewood."
- Once the strips of bracing are cut, Lynn processes them into rectangular cross-pieces. He glues those brace strips into position to strengthen the bond where the two rosewood pieces were joined earlier (**figure C**). The gaps between the adjacent strips will be used to form an intersection with more spruce bracing later. Using a block plane and sandpaper, Lynn creates a gentle radius on the brace.
- The rest of the bracing is actually curved. "Braces on the back of the guitar have an arch to them," says Dudenbostel, "They're not just straight. They have a curvature to them that helps allow the wood on the back of the instrument to expand or contract with changes in temperature and humidity." Without the curved braces, the back piece could come apart under the resulting stress. Lynn forms the curved braces using a block plane and belt sander (**figure D**). He then uses a sharp chisel to cut paths through the back-center brace to allow intersections with the curved braces.
- The curved brace is attached to the back with wood glue. The fit at the intersections must be snug, so Lynn carefully trims in small slices and checks the fit frequently as he joins the braces together (**figure E**).

Figure B

Figure C

- Some carving is required on the back braces but, unlike the top's brace wood, scalloped design is not required. A radius shape is carved into most of these using chisels, planes and sandpaper (**figure F**).
- Using the chisel, Lynn tapers the brace wood along the back's perimeter to where it meets the rosewood (**figure G**). This is where the back will eventually join the sides, so this tapering will help allow that fit.

Figure F

Figure G

Figure D

Figure E

Once these braces are done, the work on the back and top of the guitar is complete. In the episode that follows, Lynn begins work on the sides and assembly of the guitar body.

The hands of an artist and a work of art: Cody Kilby of bluegrass band Kentucky Thunder strums the strings of a vintage-style guitar.

RESOURCES:

Kentucky Thunder
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Stewart MacDonald's Luthier Supply Shop
Website: www.stewmac.com

Luthier's Mercantile International, Inc.
Website: www.lmii.com

Pioneer Valley Luthier Supply Company
Website: www.pioneervalleyluthier.com

GUESTS:

Lynn Dudenbostel, Luthier
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Knoxville, TN

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HANDMADE GUITAR, PART 5: MAKING THE CURVED SIDES

From "Handmade Music"
episode DHMM-102 -- More Projects »

In this episode of DIY's *Handmade Music*, master luthier Lynn Dudenbostel continues work in the creation of a custom hand-made acoustic guitar -- built in the tradition of the great guitars from the 1930s and early '40s. Viewers discover how to bend rosewood to form the sides of a D-28 style guitar. Points of emphasis include creating a head block, tail block and kerfed lining. Viewers also hear from two luthiers -- John Arnold and Ted Davis -- who remind us of the importance of red-spruce wood in the crafting of great guitars. Along the way, bluegrass band Kentucky Thunder entertains viewers with some traditional tunes and Andy Leftwich of Kentucky Thunder treats viewer to a DIY lesson in songwriting.

The mark of excellence from the golden age of guitar-making: the Martin & Company logo.

Red Spruce and "Holy Grail" of Acoustic Guitars

The vintage guitars of the 1930s and early '40s were made from a type of wood unavailable to builders for more than 50 years, the Eastern red spruce. During the war, spruce was in high demand for building aircraft, and instrument builders had to seek other alternatives. Now that red spruce is available again in limited quantities, the distinctive sound of the vintage guitars can be recaptured. Luthier John Arnold harvested the 300-year-old spruce tree that provided the wood used to make the top of the guitar built in this series -- as well as many other guitars.

Host Jeff Wilson, at the famous Ryman auditorium in Nashville, holds a handmade guitar built in the tradition of the golden era of guitar-making.

It's that kind of wood that was used the guitars made in the golden era of stringed-instrument making. Perhaps the most famous guitar from that era is the legendary Martin D-28. "It's got the best sound of any of the vintage guitars," says Arnold, "It's the one that everybody tries to replicate, and a lot of the reason is the red-spruce top. It also has Brazilian rosewood back and sides, mahogany neck, ebony fingerboard and bridge, and red-spruce bracing inside." The result is a warm, resonant and clear tone that musicians revere.

John's quest for red-spruce wood led to his meeting to Ted Davis, regarded by many as the "godfather of the red-spruce revival." Ted points out that, even in it's raw form, the cut trunk of a red spruce makes a distinctive "ringing" sound when struck by a hammer, rather than a dull "thud" typical of ordinary woods. "This dates all the way back to the 1400s and 1500s," says Davis, "when it was discovered in Europe that spruce had the properties that made best instruments. For the instrument maker, it's *the* wood."

According to luthier John Arnold the red spruce tree harvested to create the guitar shown in this series (as well as many others) is one of the finest specimens he has ever seen.

John and Ted have spent a great deal of time in the Appalachian mountains -- and ion woodlands from North Carolina to Maine -- in search of the red spruce wood that luthiers crave. Though red-spruce trees are actually quite abundant, most are on protected land. The challenge for John and Ted is to locate spruce trees that can be harvested from private land. "Had it not been for the work of Ted and John," says master luthier Lynn Dudenbostel, "we wouldn't have a lot of this really fine wood that we now have."

John Arnold holds the

extraordinary Martin D-28 guitar.

Making the Curved Sides

Dudenbostel guitars have a reputation for a "big" sound, but they also look like works of art. In earlier segments, Lynn created the spruce top, rosewood back, internal bracing and tone bars for a guitar. In this segment, he continues work on the guitar by making the curved sides.

Materials:

Rosewood stock
Template
Band saw
Drum sander
Plunge router
Block plane
Cabinet scraper
Water bath
Bending iron
Propane torch
Bending form
Clamps

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

- Once the book-matched pieces of rosewood are cut, work begins on the side pieces by hand-planing the edges. The pieces are then passed through a thickness sander (**figure A**) to bring the width of the sides to about 80/1000-inch.

Figure A

- Using a template as a guide, Lynn traces an accurate shape of a side onto the rosewood stock (**figure B**), and cuts away excess wood at the band saw. Plans and templates are available from luthier-supply shops, but Lynn uses a template that came from measurements from an actual vintage guitar.

- The Indian rosewood used to build the guitars sides makes for an attractive look, but is used mainly because it is durable and pliable -- both characteristics needed for bending guitar sides. The first step in bending is to soak the rosewood in water (**figure C**).

Figure B

Figure C

After the wood is thoroughly soaked, Lynn begins working the strips from side to side over a hot bending-iron (**figures D and E**). The bending surface is simply a metal pipe heated using a propane torch. Lynn starts bending each side from the middle, and gradually works outward. Water beading up on the metal surface indicates that the iron is hot enough. Keeping the wood wet with a spray-mister during this process keeps the wood from scorching. As Lynn works, he periodically checks his progress against the curved template.


Figure D


Figure E

Once the sides match the shape of the bending form, they are clamped into the form and allowed to cool (**figure F**). With both sides bent and clamped in place, they are kept in the form overnight.


Figure F

Note: See the links below for luthier-supply companies who sell plans to make bending forms, as well as templates, plans and other materials needed in the creation of musical instruments.

In the segment that follows, Lynn continues work on the sides, and creates the guitar's head block and tail block.

RESOURCES:

Stewart MacDonald's Luthier Supply Shop
Website: www.stewmac.com

Luthier's Mercantile International, Inc.
Website: www.lmii.com

Pioneer Valley Luthier Supply Company
Website: www.pioneervalleyluthier.com

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ALSO IN THIS EPISODE:

- Handmade Guitar, Part 5: Making the Curved Sides
- Handmade Guitar, Part 6: Head Block and Tail Block
- Handmade Guitar, Part 7: Kerfed Lining and Attaching the Back
- Handmade Guitar, Part 8: Gluing on the Top
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HANDMADE GUITAR, PART 6: HEAD BLOCK AND TAIL BLOCK

From "Handmade Music"
episode DHMM-102 -- More Projects »

In this segment of DIY's *Handmade Music*, luthier Lynn Dudenbostel completes the side pieces and creates the head block and tail block for the custom-built guitar.

Andy Leftwich (L) and Cody Kilby (R) of Kentucky Thunder.

Mandolin player Andy Leftwich.

Materials:

Rosewood stock
Template
Band saw
Drum sander
Block plane
Cabinet scraper
Chisels, gouges
Mallet
Bending form and spreader
Wood glue
Clamps

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

Though the inner surface of the guitar's sides will never be seen or felt once the guitar is assembled, Lynn scrapes and sands the rough spots created during the bending process (**figures A and B**). The rosewood puckers when it encounters the hot bending iron. The scraper and sanding block are used to counter that process.

Figure A

Figure B

Once the excess wood has been trimmed away from the sides using the band saw, the sides are placed back into the bending form (**figure C**).

Figure C

The "waist" of the guitar is spread using a wooden spreader to ensure a snug fit (**figures D and E**).


Figure D


Figure E

Head Block and Tail Block

With the sides placed in the form and set aside, work can begin on the guitar's head block and tail block. Those pieces will be glued to the inside of the guitar and will span the seams created at the top and bottom of the body where the two sides contact. The blocks are made from solid mahogany, the same wood used for these pieces in vintage guitars. Although these pieces can be bought pre-made from luthier-supply shop, Lynn prefers to make his by hand.

- To make the blocks, Lynn makes a series of cuts using the band saw.
- Each piece is then shaped further using a belt sander (**figures F and G**).


Figure F


Figure G

- Once sanding is complete, Lynn carves out a dovetail joint in the head block using a sharp chisel, some gouges and a mallet (**figure H**). This joint will connect the guitar's neck to the body.
- Lynn applies wood glue to the head block (**figure I**), an spreads it evenly.
- With glue applied, the head-block is positioned at the seam at the guitar's top (**figure J**), clamped in position and allowed to dry.
- The tail block is glued in the same way to the bottom seam.


Figure H


Figure I

In the segment that follows, Lynn glues the guitar's back and sides together.


Figure J

RESOURCES:

Kentucky Thunder
For more information on the band that appeared in DIY's *Handmade Music*, Kentucky Thunder -- and to hear streaming audio and download samples of their music -- visit the website for Skaggs Family Records, www.skaggsfamilyrecords.com.

Stewart MacDonald's Luthier Supply Shop
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Luthier's Mercantile International, Inc.
Website: www.lmii.com

Pioneer Valley Luthier Supply Company
Website: www.pioneervalleyluthier.com

GUESTS:

Lynn Dudenbostel, Luthier
Dudenbostel Stringed Instruments
Knoxville, TN

John Arnold, Luthier
Newport, TN

Ted Davis, Luthier
Loudon, TN

- **ALSO IN THIS EPISODE:**
- Handmade Guitar, Part 5: Making the Curved Sides
- Handmade Guitar, Part 6: Head Block and Tail Block
- Handmade Guitar, Part 7: Kerfed Lining and Attaching the Back
- Handmade Guitar, Part 8: Gluing on the Top
- WEB EXTRA: *Handmade Music* Song Downloads

Members of Kentucky Thunder create their own brand of handmade music.

Mandolin player Andy Leftwich likens the process of songwriting to painting a picture, with each instrument being analogous to a different color.

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HANDMADE GUITAR, PART 7: KERFED LINING AND ATTACHING THE BACK

From "Handmade Music"
episode DHMM-102 -- More Projects »

In this segment of DIY's *Handmade Music*, luthier Lynn Dudenbostel continues work on the custom-built guitar, gluing the back and side pieces together.

John Arnold holds an authentic and original Martin D-28 guitar.

Materials:

Rosewood stock
Mahogany kerfed-lining
Bending form
Saw
Chisel
Mallet
Clamps
Clothespins
Wood glue
Superglue
Straight-edge
Carpenter's pencil
Safety glasses or goggles

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

Kerfed Lining and Gluing on the Back

In earlier segments, the guitar's rosewood back was built using book-matched pieces of Indian rosewood, and the back's internal bracing (made of red spruce) was added (**figure A**). Now work can begin in bringing the body of the guitar together by joining the rosewood back to the sides.

- To achieve this next step in the creation of the guitar, Lynn will uses kerfed lining (**figure B**). Luthiers use kerfed lining to create a wider surface area for gluing. The contact points for the kerfed lining is where the guitar's back top and back meet the sides. "This gives a little bit more glue joint," says Dudenbostel, "Once you put the purfling on the guitar and the binding, you've routed away most of the glue joint. So you need more surface area for the top and the back to be glued. That's the purpose of the kerfed lining." Kerfed lining can be ordered pre-cut from a luthier-supply company but, as with other steps in the process, Lynn prefers to make his own using mahogany.


Figure A

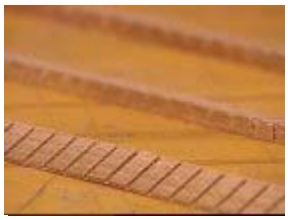
Figure B

- Lynn applies wood glue to the lining, positions it along the edge of each side and holds it in place using a large number of clothespins (**figures C and D**).


Figure C


Figure D

Once in position, it's alright for the lining to rise slightly above the sides (**figure E**) since it will be sanded level later in the process. The important thing is to keep the lining from dipping below the top edge of the sides. The lining creates a sort of ledge for the top to rest against. Once glued, the bond between the top and sides is extremely strong and durable.

After the top lining has dried for several hours, the clamps are removed, the body is flipped over, and kerfed lining is added to the opposing side (**figure F**).

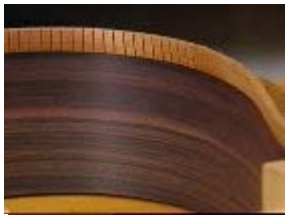
Figure E


Figure F

Once both sides are glued, and the glue has dried thoroughly, the clamps can be removed and the guitar is set on its side. Lynn measures the exact width of the side (**figure G and H**), and begins cutting reinforcement strips to that dimension.


Figure G


Figure H

The reinforcement strips will help stabilize the guitar and help prevent cracks from forming or spreading through the sides if the guitar is ever dropped or hit. The strips are 1/4-inch wide and are cut from rosewood stock (**figure I**). They are glued using superglue to five points spread along the guitar's inside surface.


Figure I

Once the reinforcement strips are in place, the next step is to level or contour the sides to accept the top and back. In the case of the top, Lynn uses coarse (100-grit or 80-grit) sandpaper attached to a wide board to create a flat surface -- while the sides, with kerfed lining in place, are still in the form (**figure J**). This creates a flat surface for gluing the top.

"For the back," says Dudenbostel, "there's a compound curve going on -- a longitudinal and a latitudinal arch. The contour is changing. So the body is not as deep at the neck block as it is at the tail block." Lynn accommodates that curvature by planing a ramp into the head block (**figure K**) to allow the rosewood block to contact the sides, then slope upward and outward to create the compound curve. The curvature must also be accommodated when the kerfed lining is sanded so that it's no higher than the rosewood sides. For this, Lynn uses the sanding board for what he calls freehand sanding. "I'll take the board with sandpaper on it," he says, "and work those contours, changing the angle of the board depending on where I am on the guitar body."


Figure J

Once the sanding is done, the back is dry-fit against the sides (**figure L**) to check the contact points along the inside of the guitar.

Lynn then marks the areas that will need to be cut away where brace wood and kerfed lining intersect. This ensures a firm fit without obstruction. He marks the contact points (**figure M**) then cuts away lining as needed using a hand-saw and a sharp chisel.

Figure K

Figure L

Figure M

Using a saw and chisel, he also cuts away portions of the back's bracing that extend too far into the guitars sides (**figure N**). Once he has the chisel positioned exactly, Lynn trims away just enough of the spruce wood to complete the fitting process.

Tip: One of Lynn's tips for this step is to use the reflection of the brace in the chisel as a reference for achieving a perfectly straight cut with the chisel. When the reflection of the wood lines up perfectly so that the brace and the reflection looks like a continuous, straight piece (**figure O**) the blade will be at the perfect 90-degree angle to the wood for a perpendicular cut.

Figure N

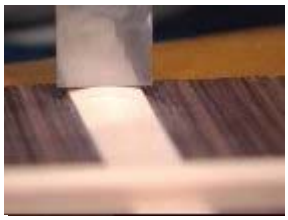

Figure O

After a final dry-fit to check the fit of the back with the sides, glue-up can begin. Wood glue is applied generously atop the kerfed lining (**figure P**) and positions the back (**figure Q**).

Figure P

Figure Q

Finally, multiple clamps are used to hold the back secure against the sides within the form (**figure R**), forming a perfect joint as the glue dries.

In the segment that follows, the top is added to the guitar body.

RESOURCES:

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Newport, TN

Ted Davis, Luthier
Loudon, TN

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- Handmade Guitar, Part 6: Head Block and Tail Block
- Handmade Guitar, Part 7: Kerfed Lining and Attaching the Back
- Handmade Guitar, Part 8: Gluing on the Top
- WEB EXTRA: *Handmade Music* Song Downloads

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HANDMADE GUITAR, PART 8: GLUING ON THE TOP

From "Handmade Music"
episode DHMM-102 -- More Projects »

In this segment of DIY's *Handmade Music*, luthier Lynn Dudenbostel continues work on the body of the guitar, gluing the top to the side pieces.

The most revered of guitars -- an authentic Martin D-28.

Materials:

Red-spruce guitar top
Bending form
Block plane
Chisel
Mallet
Orbital sander
Clamps and cauls
Clothespins
Wood glue
Straight-edge
Carpenter's pencil

Attaching the Spruce Top

Once the glue has dried, forming a solid bond between the guitar's rosewood back and sides, the clamps can be removed in preparation for adding the red-spruce top. With the clamps removed, the precise intersections between bracing and kerfed lining can be seen clearly (**figures A and B**). It's this kind of fine craftsmanship inside the guitar's body that offers substantial advantages over that of manufactured guitars.

Figure A

Figure B

With the kerfed lining trimmed flush with the top edge of the guitar's sides, as was done at the back, Lynn is now ready to attach the red-spruce top (**figure C**) which was fitted with bracing and tone bars in an earlier segment.

Wood glue is applied along the kerfed lining and the top is carefully positioned (**figure D**).

Figure C

Figure D

Once in position, the top is clamped securely in place (**figure E**).

Using multiple clamps ensures a solid joint at the top, all the way around the guitar's body (**figure F**). Wood cauls are used to prevent damage to the spruce wood by the clamps.


Figure E


Figure F

Once the glue has had a full day to dry, the clamps can be removed and the body of the guitar can be removed from the form (**figure G**). Finally, the parts have come together and, for the first time, are beginning to resemble a guitar. But the body is still not complete.


Figure G

At this stage, excess spruce is removed from the top's edges around the guitar body (**figure H**). He continues shaving away wood until the top and back are even with the sides. In this trimming process, great care is taken to follow the grain of the wood, particularly around the curves and corners where the grain pattern shifts.

Once the top is shaved level with the sides, the process is repeated with the rosewood back (**figure I**).


Figure H


Figure I

At some of the curved points on the guitar, using a block plane is awkward. For these locations, Lynn uses a sharp chisel to remove small amounts of wood to achieve a perfect edge (**figures J and K**), working from one direction and then the other, and using care not to cut into the end-grain of the wood.

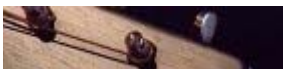

Figure J


Figure K

Finally, an orbital sander fitted with 150-grit sandpaper is used to finish smoothing the edges of the guitar body. He also uses the sander to smooth over the rosewood body (**figure L**) to smooth out the undulations and imperfections that are the result of the bending process.


Figure L

In the episode that follows, host Jeff Wilson drops-in on George Gruhn of the world



famous Gruhn Guitars in Nashville to learn more about the quality of vintage guitars. Lynn Dudenbostel continues work on his guitar, turning his attention to the guitar neck.

RESOURCES:

Kentucky Thunder
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HANDMADE GUITAR, PART 9: COMPLETING THE BODY

From "Handmade Music"
episode DHMM-103 -- More Projects »

In this third episode of DIY's *Handmade Music* Lynn Dudenbostel demonstrates how he adds this decorative element to his guitars. Vintage guitars were bound with distinctive herringbone strips that framed a guitar's perimeter, and Lynn uses the same technique on his guitars. With binding in place, the Dudenbostel guitar body is complete, and after a quick sound test Lynn turns his attention to the guitar neck. Lynn shows viewers how to slowly carve away wood from a block of mahogany until a perfectly shaped neck remains. He then attaches an inlayed fingerboard and prepares the guitar for finish.

In addtion, host Jeff Wilson drops in on George Gruhn of the world-famous Gruhn Guitars in Nashville to learn more about the quality of vintage guitars. The show closes with more music from Kentucky Thunder. It's a session that delivers a "sneak peak" at the completed Dudenbostel Guitar.

In this first segment, Lynn Dudenbostel finishes up work on the body of the guitar by adding the decorative herringbone binding.

Lynn Dudenbostel is a nationally known luthier, and builds guitars by hand in the tradition of the classic Martin guitars made in the 1930s.

Lynn hand-shapes the guitar's neck from a block of solid mahogany.

Materials:

Guitar binding
Table router
Sharp chisel and mallet
Acetone-based glue
Masking tape
Cabinet scraper
Sandpaper
Safety glasses or goggles

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

Guitar Body and Binding

In earlier segments, Lynn Dudenbostel created the guitar's top from prized red-spruce wood and crafted the back and curved sides from Indian rosewood. He also added the internal support structures and tone bars that help give the guitar its trademark resonating sound. He added decorative marquetry inlays and purfling around the sound hole -- in keeping with the details on the vintage guitars which this one is based upon. Once kerfed lining is added and the parts are all glued while held securely in a custom form, the result is a fully formed guitar body (**figure A**). But there's still work to do before the guitar takes its final form (**figure B**).

Figure A

Figure B

Binding is the material that frames the guitar's body. Lynn uses a traditional herring-bone style reminiscent of classic Martin guitars (**figures C and D**). This visual accent enhances the look, but not the sound, of the instrument.


Figure C


Figure D

To complete this finishing touch on the guitar body, Lynn uses the table router to make a precision cut along the guitar's edges, making a channel for the binding (**figure E**). He uses a 1/4-inch spiral router-bit and depth gauge to cut a narrow rabbet, or ledge, around the edge of the guitar's body (**figure F**) on both the top and back. The ledge will be used to accept the binding.


Figure E


Figure F

As he works, Lynn checks the accuracy of the cut using the binding as his guide.

Before adding the binding, he then trims a "v" in the rosewood and spruce at the guitar body's upper end (**figure G**) to clear the way for the dovetail joint that will connect the guitar's body to the neck. In an earlier segment he carved and glued a mahogany head-block inside the body with a v-shaped notch that now matches the one carved out section in the body.


Figure G

With the dovetail notch cut, work can begin on binding the guitar. He begins by applying a bead of acetone-based glue into the channel he's cut around the guitar. He then begins taping the binding in place, starting at one end of the guitar body and working his way around the perimeter (**figures H and I**).


Figure H


Figure I

The glue-up is tedious and detailed work, and actually requires gluing of two strips of binding along the rabbet -- the herring-bone patterned strip and a plain white strip that is glued on the outside and runs parallel to the guitar's sides. Plenty of tape is used to hold the two strips in place as the glue dries. Some of the excess glue is wiped away before it begins to dry. Any that can't be removed in that way will be cleaned away later using sandpaper. Once the binding has been applied completely around the top of the guitar, the gluing process is repeated on the guitar back (**figure J**). Like the herring-bone binding used on the front, the strip used on the back is historically accurate -- an ivory-like strip that completes the vintage look.


Figure J

Once all of the strips have been glued in place, the guitar body is set aside to dry. After the glue has dried overnight, the masking tape can be removed. This step requires considerable caution since removing the tape could tear the fibers of the spruce surface. Lynn carefully pulls each strip back over itself, rather than pulling straight up, to remove the tape without damage. Finally, a cabinet scraper is used (**figure K**), in combination with sandpaper, to soften the sharp edge of the binding and provide a smooth, radiused edge.

Once scraping and sanding is done, the guitar's body is essentially complete. At this point, Lynn uses a traditional luthier's trick -- which he learned from luthier Wayne Henderson of Virginia -- to "test" the quality of the guitar body. A lit match is held directly in front of the guitar's sound hole. A solid tap to the guitar's top will cause the

body to resonate. If the air currents coming from the hole blow the match out (**figure L**), the body of the guitar is deemed to be "a winner."

Figure K

Figure L

In the segment that follows, Lynn Dudenbostel begins work creating the guitar's fingerboard and frets.

John Arnold, who harvested and supplied the red spruce for the guitar's top, gives a sheet of the spruce lumber the "tap test." The tightly grained red spruce has unique resonating qualities, and produces a sustained "ring" -- rather than a "thud" -- when tapped.

RESOURCES:

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- Handmade Guitar, Part 10: The Fingerboard
- Handmade Guitar, Part 11: Building the Neck
- Handmade Guitar, Part 12: Hand-Shaping the Neck
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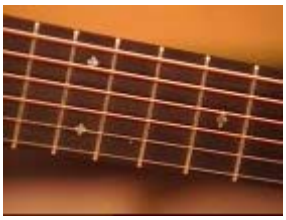
HANDMADE GUITAR, PART 10: THE FINGERBOARD

From "Handmade Music"
episode DHMM-103 -- More Projects »

In this segment of DIY's *Handmade Music*, luthier Lynn Dudenbostel begins work creating the guitar's fingerboard and frets.



The fingerboard is the part of the guitar used to create notes or chord when the instrument is played.

Materials:

Ebony stock
Sanding block
Template for frets
Table saw
Band saw
Double-stick tape
Abalone shell
Rotary tool
Epoxy glue
Straight-edge
Carpenter's pencil
Safety glasses or goggles

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

Fingerboard and Frets

The **fingerboard** is the part of the guitar used to create notes or chords when the instrument is played. Metal **frets** are space along the length of the ebony fingerboard.

Figure A

- To shape the ebony wood for the fingerboard, Lynn uses a sanding block with a 16-inch radius to convert the raw ebony stock to a rounded to a rounded fingerboard blank (**figure A**).
- Once the ebony has been prepared, a table saw fitted with a special 22/1000-inch blade is used to cut kerfs for the frets. A custom template ensures the precise placement of the kerfs in the fingerboard. The template is cut from plexiglass, and is attached to the back of the fingerboard using double-stick tape (**figure B**).
- Once the template is secured to the ebony, the kerfs for the frests are cut on the table saw using a fence and miter-gauge. An indexing pin assists with making the precision cuts, with the fingerboard oriented face-down on the saw (**figure C**).

Figure B

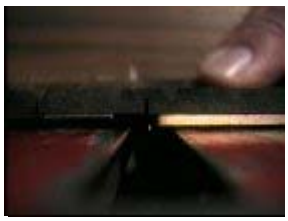


Figure C

- Fingerboards are tapered so that they're thin at the nut, and wider at the bridge. Once the kerfs have been cut, a band saw is used to make the cuts necessary to create the taper (**figure D**).

Figure D

- Another traditional detail originating from vintage guitars is the inlay found on the fingerboards. The carved ornamental pieces (**figure E**) are made from abalone shells (**figure F**). Although these pieces can be purchased from luthier-supply shops, Lynn prefers to make his own.


Figure E


Figure F

- After cutting the diamond shapes by hand with a tiny saw, Lynn outlines the shape of each diamond on the fingerboard (**figure G**).
- He then uses a rotary tool to rout out the tiny diamond outlines on the fingerboard (**figure H**). Each cut is just deep enough to hold the abalone inlay.


Figure G


Figure H

- Using a mixture of epoxy glue and black dye, Lynn dabs a small amount of the special mixture into each cavity using a toothpick, then submerges the inlays into the mix (**figure I**). Once it's dry, the epoxy mixture resembles ebony surrounding the inlay.
- A thorough sanding job brings the abalone and epoxy filler flush with the surrounding ebony (**figure J**).


Figure I


Figure J

Finally, Lynn uses a sanding block to sand a slight radius at the bottom edge of the ebony (**figure K**). That final touch completes the building of the fingerboard

In the segment that follows, host Jeff Wilson visits George Gruhn at the world-famous Gruhn Guitars in Nashville to learn more about the quality of vintage guitars. Then, Lynn Dudenbostel begins work fashioning the guitar's neck out of mahogany.


Figure K

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HANDMADE GUITAR, PART 11: BUILDING THE NECK

From "Handmade Music"
episode DHMM-103 -- More Projects »

In this segment of DIY's *Handmade Music*, host Jeff Wilson visits George Gruhn at the world-famous Gruhn Guitars in Nashville to learn more about the quality of vintage guitars. Then, Lynn Dudenbostel begins work fashioning the guitar's neck out of mahogany.

Host Jeff Wilson visits the guitar showroom at the world-famous Gruhn Guitars in Nashville, Tennessee.

Gruhn Guitars

George Gruhn, of the internationally famous Gruhn Guitars, has spent much of his life investigating the vintage guitars made by master luthiers in the 1930s and early 1940s -- and discerning what factors made those guitars so great.

"If you look at, for example, a 1937 D-28 Martin, aside from the fact that it's an aesthetically pleasing instrument," Gruhn says, "with beautiful wood and attractive lines, it *is* a really superb-sounding guitar. It plays physically well, and there are three basic factors that go into that: design, workmanship and materials."

George Gruhn holds an authentic Martin D-28 built in 1937.

Building the Neck

When it comes to workmanship and materials, luthier Lynn Dudenbostel doesn't take chances or leave much room for mistakes. With the body and fingerboard of the guitar both complete, he now begins work on the guitar's neck made from a block of solid mahogany (**figure A**).

Lynn Dudenbostel measures and marks the precise placement of the fingerboard on the neck of the guitar.

Materials:

Mahogany stock
Router
Band saw
Table saw
Woodworker's glue
Straight-edge
Carpenter's pencil
Safety glasses or goggles

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

Figure A

Steps:

- Lynn begins with a 4x4 piece of mahogany that's 24 inches in length. On that block of wood, using an established template, he lays out the design for two guitar necks.
- With the neck-blanks laid out on the stock, he then uses a band-saw to rough-cut the shapes.
  Once the rough shapes have been cut out, Lynn cuts a channel down the center of the neck piece using the table saw (**figure B**).
- The channel is cut on the face where the fingerboard will later be mounted. The purpose of the channel is to accommodate the placement of a truss rod

(**figure C**). "The **truss rod** counters the tension of the strings," says Dudenbostel, "you can either loosen or tighten it to move the neck in either direction." The truss rod will be installed, beneath the fingerboard, later in the process.


Figure B


Figure C

Lynn then begins work on the neck's dovetail. With the neck piece attached to a custom fixture, and outfitted with a custom template, Lynn uses a dovetail router to rout the dovetail that will hold the neck to the body (**figures D and E**).


Figure D


Figure E

Once the dovetail has been cut, Lynn cheks the fit of the dovetail where the neck will join the body (**figure F**).

With the neck-piece dry-fit to the body, he also uses a fret-scale to take measurements to determine the precise location of the nut on the guitar's neck (**figure G**).


Figure F


Figure G

The guitar's **nut** is a piece of ivory resting at the top of the fingerboard (**figures H and I**). It is used to keep the strings properly spaced on the span between the peg head and bridge.


Figure H


Figure I

A peg head also slopes away from the fingerboard and the nut's position signals the start of this transition. Lynn determines the position he planes the peg head to meet the mark. Also the angle of the peg head exposes the truss rod's channel. Lynn covers the open end with an ebony plug (**figure J**). The peg-head veneer will cover the open end completely.


Figure J

Now Lynn marks the full width of the nut onto the neck. After spreading wood glue on the peg head he unites a rosewood veneer with the mahogany surface. This rosewood is leftover from the cutout of the back. The position of the nut dictates the placement of the veneer. When it's dry Lynn outlines a peg head design on the veneer. The template he uses (**figure K**) was copied from a vintage guitar.

Before the neck is ready to meet the body Lynn must cut away part of the spruce top and mahogany head-block to accommodate the truss rod. He also uses a sharp chisel to do some final shaping on the dovetail to ensure a perfect union with the body (**figure L**).

Next, the fingerboard -- which has already been cut and shaped to its final dimension -- is laid out and aligned precisely on the guitar's neck (**figure M**). Tiny marks are made on the fingerboard and neck to ensure proper alignment.

At the lower end of the neck, Lynn checks to ensure that the center of the fingerboard intersects perfectly at the center of the purfling ring that surrounds the sound hole (**figure N**). A symmetrical intersection with the circle indicates perfect alignment.

After a final dry-fit to ensure precise alignment, the fingerboard can finally be glued to the neck using wood glue (**figure O**). "Once you spread the glue," says Dudenbostel, "you need to work fast. It's one of the few times a luthier gets in a hurry!"

Figure K

Figure L

Figure M

Figure N

Figure O

Once the pieces are glued, they are allowed to dry overnight.

RESOURCES:

Kentucky Thunder
For more information on the band that appeared in DIY's *Handmade Music*, Kentucky Thunder -- and to hear streaming audio and download samples of their music -- visit the website for Skaggs Family Records, www.skaggsfamilyrecords.com.

Stewart MacDonald's Luthier Supply Shop
Website: www.stewmac.com

Luthier's Mercantile International, Inc.
Website: www.lmii.com

Pioneer Valley Luthier Supply Company
Website: www.pioneervalleyluthier.com

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Knoxville, TN

John Arnold, Luthier
Newport, TN

Ted Davis, Luthier
Loudon, TN

- **ALSO IN THIS EPISODE:**
- Handmade Guitar, Part 9: Completing the Body
- Handmade Guitar, Part 10: The Fingerboard
- Handmade Guitar, Part 11: Building the Neck
- Handmade Guitar, Part 12: Hand-Shaping the Neck
- WEB EXTRA: *Handmade Music* Song Downloads

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HANDMADE GUITAR, PART 12: HAND-SHAPING THE NECK

From "Handmade Music"
episode DHMM-103 -- More Projects »

In this segment of DIY's *Handmade Music*, the guitar's neck gets refined to its final form through hand-shaping. Luthier Lynn Dudenbostel spends lots of time getting guitar necks to fit like a glove.

Cody Kilby is one of the finest guitar players in America, and he has enjoyed the vintage sound of Dudenbostel guitars for years. He

Cody particularly likes the way the neck of this Dudenbostel guitar feels in his hand.

Materials:

Band saw
Straight-edge ruler
Carpenter's pencil
Sandpaper
Safety glasses or goggles
Luthier's hand tools including:
Hand scrapers
Chisels
Draw-knife
Hand-planes
Rasps

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

- Lynn prepares for the shaping process starts by cutting excess mahogany from the neck with a band saw (**figures A and B**).

Figure A

Figure B

- Then he trims away the excess rosewood-veneer from the peg head (**figure C**).
- Next, Lynn sketches a distinctive detail to the back of the peg head. This is for creating a feature that's characteristic of the vintage guitars Lynn strives to emulate to the finest detail.

Figure C

- "In the 1800s and early 1900s," says Dudenbostel, "the neck and the peg head were not one piece of wood. They were two separate pieces, and the peg head was joined to the neck with a scarf joint (**figure D**). When Martin [Guitars] went to a one-piece neck, they carved a diamond on the back of the peg head to mimic the scarf joint -- just to pay homage and be historically correct."

Paying homage is not easy. This is a tough assignment. Lynn shaves away the excess width of the peg head but leaves a triangular area to mimic a scarf joint (**figure E**). He'll carve it later to dress it up.


Figure D


Figure E

With a neck free of excess wood Lynn puts it in a vice and begins carving, using a variety of hand tools including rasps, draw-knives, chisels, hand scrapers, hand-planes, etc. (**figure F and G**). He begins shaping at the heel of the neck, then moves on to the shaft. The process of carving the neck may take Lynn four to five hours.

Building a guitar by hand never reaps the same result. Each one made is uniquely and pleasingly *imperfect*. "There's a certain level of 'imperfection' that just can't be duplicated with a machine," says Dudenbostel, "but I hesitate to call it imperfection. It's really more of a character that you get in the final product that really shows when it's done by hand."


Figure F


Figure G

Essentially, Lynn took a 4"x4" block of wood and, in just a few hours, crafted this perfectly shaped guitar neck begging to be united with its body (**figures H and I**).

"Carving the neck is really satisfying," Lynn continues. "You start out with a piece of mahogany 4 inches by 4 inches square and two feet long. There's a neck in there somewhere. It's a matter of carving away everything that doesn't look like a neck."


Figure H


Figure I

Before that can happen, however, and before a wood finish is applied to both the neck and body, some sanding must be done to prepare them (**figure J**). Lynn begins by raising the grain of the wood using distilled or de-mineralized water. Then he begins sanding with 150-grit sandpaper. After allowing the wood to dry, he goes back and sands using 220-grit paper. He may repeat this process three or four time until the grain doesn't raise any more. Lynn also sands the binding. It doesn't take much sanding however, because scraping made the surface fairly even. At this point, he only needs to round out the edges a bit.

After sanding, Lynn measures and marks the area for the ebony bridge (**figure K**). By doing this now he can mask the area with tape to prevent finish from getting under the bridge.


Figure J


Figure K

In the episode that follows, a wood finish is applied, the guitar is "set up" (i.e., strung) and given a test run in a Nashville studio by bluegrass virtuoso Cody Kilby.

RESOURCES:

Stewart MacDonald's Luthier Supply Shop
Website: www.stewmac.com

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Website: www.lmii.com

Pioneer Valley Luthier Supply Company
Website: www.pioneervalleyluthier.com

GUESTS:

Lynn Dudenbostel, Luthier
Dudenbostel Stringed Instruments
Knoxville, TN

Johnny Ray, Custom Auto Sound
Fullerton, CA
www.custom-autosound.com
Automotive sound systems, including those designed with the look of original systems for classic and collector cars.

- **ALSO IN THIS EPISODE:**
- Handmade Guitar, Part 9: Completing the Body
- Handmade Guitar, Part 10: The Fingerboard
- Handmade Guitar, Part 11: Building the Neck
- Handmade Guitar, Part 12: Hand-Shaping the Neck
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HANDMADE GUITAR, PART 13: WOOD FINISH

From "Handmade Music"
episode DHMM-104 -- More Projects »

This episode of DIY's *Handmade Music* brings to a conclusion the four-episode guitar-building series. Featured in this episode is the precise application of a sophisticated wood finish to the instrument. It's an alchemy of applied elements, but luthier Lynn Dudenbostel shares a secret. A good finish is the result of what he *removes* not what he applies. As he says, it's not how much varnish you put on a guitar, it's how much varnish you *leave* on a guitar.

The show then goes back to the Nashville recording studio where Cody Kilby, guitarist for bluegrass band Kentucky Thunder, gets to take the newly completed Dudenbostel guitar for a trial run. And just to insure a passing grade, host Jeff Wilson asks *the* expert on vintage guitars, George Gruhn, to evaluate the finished product.

In this segment, Lynn Dudenbostel reveals the various techniques he employs to finish this guitar, following in the traditions of master guitar builders.

Host Jeff Wilson with luthier Lynn Dudenbostel, the creator of the guitar featured in our series.

"It's not how much varnish you put on a guitar," says Dudenbostel, "it's how much you *leave on."*

The timber from this giant red spruce tree provided the top for the guitar Lynn has built.

Materials

Drill press
Paint sprayer
Water-based stain
Varnish
Lacquer
Tuners
Spray booth
Protective gloves
Safety glasses or goggles
Respirator

Safety Alert: *Always* wear safety goggles or safety glasses when working with stains, varnishes, solvents and other toxic chemicals. When working with chemicals that give off toxic fumes, wear a respirator.

The process thus far has consisted of first building the guitar body (top, back and curved sides) from red spruce and rosewood, and then carving the neck from solid mahogany. With those two main elements built, it's now time to apply a finish. "You have a neck that's pretty much complete, and a body that's complete," says Dudenbostel, "and it's time to finish those. And in the case of a guitar, unlike a mandolin, I finish these separately and join them together later -- mainly because this is the way it's done traditionally. Tradition has a lot to do with why we do certain things and when we do certain things."

Finish for the Guitar Neck

- The first step is to stain the neck. Mahogany responds beautifully to Lynn's mixture of walnut and dark brown dye so one even coat is all that's needed. Dye is a good choice for necks because the water-based type Lynn uses here doesn't fade with age. Lynn applies dye with a cotton rag (**figure A**).
- With an even coat applied Lynn uses the spray booth and sprayer to add a sealer-coat of lacquer to the neck (**figure B**). Again, one coat will do the trick. Lynn has learned over the years to be thorough with finish, but he's careful not to apply too much of anything.


Figure A


Figure B

Once the lacquer is dry, Lynn he adds a personal touch to the instrument -- the "Dudenbostel" logo (**figure C**). The name on his guitars (**figure D**) reveals the maker, but that name also stands for craftsmanship unmatched since the "golden age of guitar-making" before World War II.


Figure C


Figure D

Once the finish has been applied to the neck, there's a bit more work to be done to prepare the neck for the installation of the tuners. Once installed, the tuners (**figures E and F**) will be used by the musician to adjust the tension on the strings, thereby altering the pitch of the notes that each string makes.


Figure E


Figure F

Using a template from a vintage guitar Lynn marks the location for the tuners onto the face of the peg head (**figure G**). The tuners connect the strings to the peg head.

Using the drill press, Lynn then drills quarter inch holes at each of the six marked locations (**figure H**). "It's a good idea to [add the tuners] before you join the neck to the body," says Dudenbostel, "because it's a lot harder to handle once the body is attached."


Figure G


Figure H

A set of bushings is inserted into each newly drilled hole (**figure I**) and, after masking tape is removed from the fingerboard, Lynn reveals an exquisite neck for his fiftieth custom guitar (**figure J**). The frets will be installed later. For now, Lynn sets the neck aside as he begins work on finishing the guitar body.


Figure I


Figure J

Finish for the Guitar Body


Figure K

The body is finished using varnish. Another choice could have been lacquer. But whichever he chooses, Lynn has a golden rule for finishing. "In the case of an instrument," he says, "typically the less finish, the better. The more finish you build up on the surface of the wood, the more you hamper the sound of the instrument; the more trouble it has vibrating. So you want to get by with a minimal finish, but still have a nice-looking finish."

Lynn begins the finishing at the spray booth. First he lightly coats the spruce and rosewood with a sealer-coat of shellac. He carefully and evenly coats the guitar starting first with the sides (**figure K**). Experience is helpful here. No one using a sprayer for the first time should expect a perfect coat. It can take years to develop a spraying style that delivers perfect coats of shellac. When finished with the rosewood sides and back, Lynn sprays an even coat across the spruce top.


Figure L

Once that coat dries he usually applies one more coat of shellac to the body (**figure L**), then sets the body aside to let it dry overnight.

After sanding the shellac, Lynn begins brushing on the first coat of varnish (**figure M**).

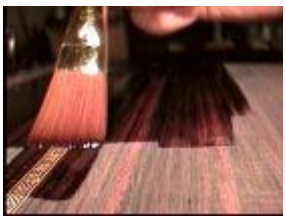
Figure M

Once that coat is dry, he sands again with 320-grit sandpaper (**figure N**).

A second coat of varnish is applied, and Lynn repeats the process again and again. All those coats of varnish could hurt the guitar's sound. That's why many of his customers ask Lynn to keep the coats to a minimum. "They're afraid of getting too much finish on it," he says, "but I always tell them 'No, it's not how many coats you put on it, it's how many you leave on it.'


Figure N

Ultimately Lynn will brush two or three coats of varnish on the spruce, and four or five coats on the rosewood. Each coat added gets sanded with a finer grit of paper. "Varnish is an acoustically superior finish to lacquer, in my opinion," says Dudenbostel, "It's more work, and it costs more to do it this way, but you end up with a better sounding instrument."

Clogging can occur with finer grits of sandpaper, so another sanding technique is introduced after the first couple of coats. **Wet sanding** isn't exactly a requirement. Lynn could sand with dry paper, but he would end up using about five times more than necessary. The wet-sanding phase is over when the guitar's finish is smooth and uniform (**figures O and P**).


Figure O


Figure P

In the segment that follows, Lynn finalizes the finish with a French polish, then joins the neck to the body and installs the bridge.

RESOURCES:

Stewart MacDonald's Luthier Supply Shop
Website: www.stewmac.com

Luthier's Mercantile International, Inc.
Website: www.lmii.com

Pioneer Valley Luthier Supply Company
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GUESTS:

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Dudenbostel Stringed Instruments
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John Arnold, Luthier
Newport, TN

Ted Davis, Luthier
Loudon, TN

- **ALSO IN THIS EPISODE:**
- Handmade Guitar, Part 13: Wood Finish
- Handmade Guitar, Part 14: French-Polish, Neck and Bridge
- Handmade Guitar, Part 15: Tuners, Saddle, Nut and Strings
- Handmade Guitar, Part 16: Christening the Dudenbostel #050
- WEB EXTRA: *Handmade Music* Song Downloads

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HANDMADE GUITAR, PART 14: FRENCH-POLISH, NECK AND BRIDGE

From "Handmade Music"
episode DHMM-104 -- More Projects »

In this segment of DIY's *Handmade Music*, Lynn Dudenbostel finalizes the guitar's wood finish with a French polish, then joins the neck to the body and installs the bridge.

Dudenbostel #050, the fiftieth in a series of modern handcrafted guitars built in the tradition of the classic Martin guitars from the 1930s and early '40s.

Materials:

Cotton pads
Shellac
Walnut oil
Grain alcohol
Safety glasses or goggles

French Polish

The final phase of finishing the guitar is the creation of a smooth surface through a technique known as **French polish**. French polishing is just a method of applying a thin coat of shellac, using alcohol as a thinning medium, to create a final luster. The technique delivers a gloss to the instrument, and it's the only way to create the desired richness when using varnish. But there is a dilemma. Any amount of finish on a guitar hampers the sound in some way, but some form of finish is necessary. Applying shellac in the spray booth now would add too much finish. French polishing solves the problem.

Figure A

The polish is achieved using a mixture of pure-grain alcohol, shellac, and walnut-oil (**figure A**), and the ratio of ingredients is learned through experience. Lynn's main objective is to find a balance between dry and saturated. Both extremes will hamper the effectiveness of French polishing.

The mixture is applied meticulously by hand to the guitar's surfaces using a cotton pad (**figures B and C**). "You start out with lighter pressure on the pad," Lynn describes, "and as it dries out you apply more and more pressure. As you progress through the process of French polishing, you add less shellac and more alcohol. That helps smooth everything out and you get to the point where you're not building up any more, but just 'finishing the finish.'"

Figure B

Figure C

With each pass of the cotton pad, Lynn leaves a micro-thin film of shellac (**figures D and E**). As the alcohol dries, the strokes leave what Lynn calls a "comet trail" resulting from the alcohol quickly evaporating as the mixture is applied. This cloudy appearance upon application is indicative that the finish is being applied properly. "Outside of selecting the wood, and knowing what to listen and feel for," says Dudenbostel, "if there's any other part of this process that seems magical, it's French polishing. When everything's going just right, it's a wonderful process."


Figure D


Figure E

Joining the Neck and Body

With both the neck and body finished and buffed out, the two can now be joined together.

- Glue is applied to the faces of the dovetail and the bottom of the fingerboard extension, and to the surface on the body where the extension will join it (**figure F**).
- The neck is then placed in the body (**figure G**), and the two main elements of the guitar are finally joined.


Figure F


Figure G

- With the neck on the body, the guitar is ready for **setup**. Setting up a guitar includes adding frets, strings, and tuning pegs, but first the bridge must be glued to the top.
- Masking tape, which was added earlier, is now removed from the guitar top to reveal unfinished spruce wood at the bridge location. Hot hide-glue is applied to the raw spruce wood (**figure H**) and to the bottom of the bridge, and the bridge is quickly set in position. The glue is allowed to dry overnight.
- Once the glue has dried thoroughly, Lynn drills the holes for the six bridge pins through the bridge and spruce top (**figure I**). Once the guitar has been strung, bridge pins will hold the strings to the bridge once the guitar has been strung.


Figure H


Figure I

In the segment that follows, the tuners, saddle, nut and strings are added to complete Lynn Dudenbostel's fiftieth guitar creation.

RESOURCES:

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HANDMADE GUITAR, PART 15: TUNERS, SADDLE, NUT AND STRINGS

From "Handmade Music"
episode DHMM-104 -- More Projects »

In this segment of DIY's *Handmade Music*, the tuners, saddle, nut and strings are added to complete Lynn Dudenbostel's fiftieth guitar creation.

Ebony and ivory: the guitar's bridge, saddle and bridge-pins.

Materials:

Guitar tuners
Fret wire
Guitar strings
Ivory blanks for guitar nut and saddle
Guitar pick-guard
Belt sander
Screwdriver
Tap-hammer
Sanding block
File

Safety Alert: *Always* wear safety goggles or safety glasses when working with wood, power-tools, saws, drills, routers, etc.

Handmade Guitar: Finishing Touches

Before stringing the guitar, Lynn installs **tuners**. Earlier he slipped bushings into the peg head. Now he pushes the tuners through each of the six holes, secures them with screws (**figure A**) and checks them to ensure they operate properly (**figure B**).

Figure A

Figure B

Next, Lynn adds fret wire to the ebony fingerboard. Earlier he notched the fret slots using a template for spacing. He cuts just enough wire to match the neck's width at each position (**figures C and D**). The frets are hammered into place for a snug fit using a tap-hammer. There's no glue used, and these should never come out unless a qualified repairman wants them out.

Figure C

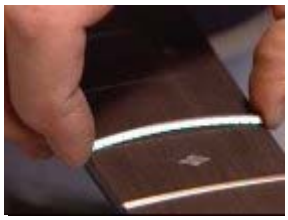

Figure D

As you can imagine, playing a guitar with sharp metal protruding from the edge would be less than enjoyable for a musician. To facilitate ease in playing, Lynn files, shapes and profiles the frets on each end of the fingerboard (**figure E**). He also gives the face of each fret a radius.

A pick guard is added below the sound hole (**figure F**) to protect the finish from the constant strumming and picking this guitar will endure for many

years.


Figure E


Figure F

With ivory blanks, Lynn creates the guitar's **saddle** and **nut**. Both serve as guides for the guitar strings. A belt sander is used to shape the ivory.

First the saddle is shaved to fit the groove in the bridge (**figure G**). When the blank fits Lynn marks with a pencil the bridge profile. After cutting away excess ivory and shaping the ends Lynn has a rough approximation of a saddle (**figure H**). This element will be tweaked to produce perfect tone and to create a user-friendly action.

***Handmade Music* factoid**: A guitar's **action** refers to the height of the strings over the fingerboard. Some pickers like the strings high, and some low. The musician's personal preference dictates the setting.)


Figure G


Figure H

With the saddle in place, Lynn moves on to the nut. The nut blank is fit into the slot left earlier in the guitar's neck and marked to indicate the final height of the nut (**figure I**). The blank is then ground to its final dimension on the belt sander.

Once it's ground down to the proper height, so that it will rise just above the surface of the neck, Lynn glues the nut in place using super-glue (**figure J**).


Figure I


Figure J

Using a hand-saw, Lynn begins cutting carefully spaced slots in the nut (**figure K**). The six slots will be the guideposts for the strings.

Now, for the first time, the guitar will be strung (**figure L**). The exact positioning and depth of cuts in the nut also affects the action, so getting the slots just right is really a process of trial and error. "I'll string it up for the first time," says Dudenbostel, "but still I don't bring it up to full tension because there's an hour or two of going back and forth, getting these just a little closer each time."


Figure K


Figure L

Finally, the guitar is strung and the strings are adjusted. Dudenbostel #050 can now be strummed to produce its first sound as a guitar. In the segment that follows, the newly made guitar gets "christened" as it's taken for a trial run by Kentucky Thunder guitar virtuoso Cody Kilby.

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HANDMADE GUITAR, PART 16: CHRISTENING THE DUDENBOSTEL #050

From "Handmade Music"
episode DHMM-104 -- More Projects »

With the guitar strung for the first time, and the strings are adjusted, the instrument can now be strummed to produce its first sound as a guitar. In this final segment in the guitar series, the newly made guitar gets "christened" as it's taken for a trial run by Kentucky Thunder guitar virtuoso Cody Kilby.

And for its final exam, Dudenbostel #050 is taken for inspection by guitar expert George Gruhn of Nashville's Gruhn guitars.

The hand of a craftsman: Lynn Dudenbostel plays some of the first notes made by the guitar he has built by hand.

The handmade guitar, crafted by master luthier Lynn Dudenbostel, is finally complete. The guitar-maker can now check the guitar's tone, and sample the sounds that the instrument is capable of making by adjusting the tuners (**figures A and B**). Lynn is pleased with the guitar's tone, which he describes as that "old sound."

Figure A

Figure C

A handmade guitar like this may be viewed visually as a work of art, but in order for it to "live," it must be played. In a Nashville recording studio, guitarist Cody Kilby -- along with mandolin player Andy Leftwich and other members of the bluegrass band Kentucky Thunder (**figures B and C**) -- gets the honor of taking this guitar for its maiden voyage.

And he likes what he hears. "This is a great guitar," says Kilby, "Most of the time you give a guitar a year or two to age and settle in, but every one of Lynn Dudenbostel's guitars -- right off the bat, and new -- are just killer guitars."

Figure C

Figure D

If you'd like to hear some of the music featured in *Handmande Music*, click **here** to link to a page featuring downloads of music heard in the series.

This concludes this guitar-building series of handmade music. Subsequent episodes feature the building of a mandolin and dulcimer.

Andy Leftwich, Cody Kilby and other members of Kentucky Thunder.

RESOURCES:

Kentucky Thunder
For more information on the band that appeared in DIY's *Handmade Music*, Kentucky Thunder -- and to hear streaming audio and download samples of their music -- visit the website for Skaggs Family Records, www.skaggsfamilyrecords.com.

Stewart MacDonald's Luthier Supply Shop
Website: www.stewmac.com

Luthier's Mercantile International, Inc.
Website: www.lmii.com

Pioneer Valley Luthier Supply Company
Website: www.pioneervalleyluthier.com

GUESTS:

Lynn Dudenbostel, Luthier
Dudenbostel Stringed Instruments
Knoxville, TN

John Arnold, Luthier
Newport, TN

Ted Davis, Luthier
Loudon, TN

- **ALSO IN THIS EPISODE:**
- Handmade Guitar, Part 13: Wood Finish
- Handmade Guitar, Part 14: French-Polish, Neck and Bridge
- Handmade Guitar, Part 15: Tuners, Saddle, Nut and Strings
- Handmade Guitar, Part 16: Christening the Dudenbostel #050
- WEB EXTRA: *Handmade Music* Song Downloads